# Building sustainability: definitions, process and case

by

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I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

# Abstract

This thesis is an exploration of how to do sustainable development for buildings, especially during the earliest stages of such development.

The thesis starts by considering clear definitions of *sustainability*, *development* and *sustainable development* as these concepts apply to organizations in general and as they apply specifically to the charity All Our Relations (AOR) and their community of the Region of Waterloo in Ontario, Canada. Three critical challenges to the process of development are also discussed in these early chapters, namely *assessment, vision* and *feedback*. In the third chapter, these same challenges are put under the lens of sustainable development and three new, but related, challenges of *connection complexity*, *shared futures* and *resilience* are examined to better understand the problems and solutions that surround them. At the end of this broad introductory section, AOR's relationships with the community are explored as part of their efforts to draft an organization-wide sustainability plan.

The second part of the thesis is an attempt to apply and expand on the general ideas from the first half through a focus on buildings and specifically the building of AOR's planned Hospice and Retreat Centre in Bloomingdale, Ontario.

As part of the focus on *sustainable buildings*, the Leadership in Energy and Environmental Design (LEED™) system of assessing building impacts is presented and critiqued. As part of a focus on *building developments* the earlier challenges of assessment, vision and feedback are revisited as they apply to the concept design phase of the typical building design.

The final three chapters of the thesis are a synthesis of all the previous chapters and the formal presentation of the case study concept development for the AOR building. A full summary of all previous definitions are presented and the final definition of sustainable building development is expressed as a culmination and extension of its parts:

*Sustainable building development is a process of creating space-for-use which recognizes both the importance of space in our lives and the impact that developing that space has on our greater goal to pursue sustainability.*

Potential critiques of this definition are discussed and two methods of engaging in the difficult challenges of sustainable building development are presented: *the decider's dilemma* and the *life-cycle-service-network* model of connection complexity. Finally, the case study use of LEED as a guide for doing sustainable development in buildings is contrasted against the author's proposed approaches. Through a series of qualitative and quantitative observations based on the results from the case study design, LEED is revealed as being effective mostly as an early guide, but lacking in the rigor and complexity needed to address properly the challenges of building sustainability.

# Acknowledgements

I'd like to begin by thanking NSERC and Enermodal Engineering Ltd. for their monetary support and their trust in me to be an industrious post-graduate. Likewise, I would like to thank my faculty advisor Stephen Birkett and my industry advisor Stephen Carpenter for their guidance, their patience and their willingness to let me explore the ideas that I am most passionate about. I'm also very grateful for my extended circle of advisors – Keith Hipel, David Mather, Robert Gibson and Martin Jewitt – for their thoughtful criticism of my ideas and the seeds of wisdom they've sown throughout the following pages.

I am similarly indebted to all those involved in the All Our Relations (AOR) Hospice and Retreat Centre design process. Our excellent consultant team included Richard Lay, Tim Dietrich and Martin Jewitt of Enermodal; Carol Bacon of GSP Group; Robert Dyck of R J Dyck Architects and Associates Inc.; and Dave Kittel, Dave Wolff and Richard Stevanus of Van Del Contracting. Of course the entire case study would not have come about without the passion and commitment of the director's of the AOR board, especially Shari Foster, Gary Norris, Judy Walder and Marjorie Paleshi.

Finally, I'd like to thank my family, my friends and especially my wife Natalie for their shockingly tireless support of my work over the past five years. Without them I would not have the strength or the motivation to be so passionate about helping others to care about the future.

Dedicated to Natalie, with whom I
work every day to share a future.

# Table of Contents

# List of Tables

# List of Figures

# 1

# Introduction

*"Everything should be made as simple as possible, but not one bit simpler."*

- Albert Einstein (attr.)

Have you ever seen Figure 1 when a text or presenter is talking about the idea of sustainability or sustainable development? I certainly have. This diagram is the most common one I have see used to explain these concepts to people.

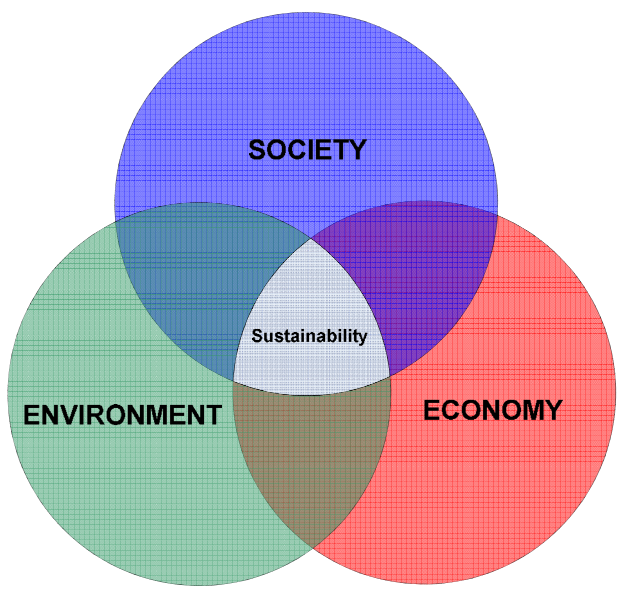


**Figure 1 – The Venn diagram of sustainability[1]**

The diagram is often accompanied by the explanation that there are three pillars in our lives – the environment, society and the economy – which must come together to make our developments sustainable. I hope it's not too harsh of me to say that I think Venn is

[1] For example, see how Wikipedia uses the diagram at http://en.wikipedia.org/wiki/Sustainability.

rolling over in his grave. What is it that this diagram is actually showing us? If we follow the common rules for a Venn diagram, we should conclude that each circle represents a set of things that are mutually exclusive from each other. This thought leads to my first confusion about the diagram: what situation in your life can be thought of as exclusively in any one of these domains?

Are there purely social situations? At first blush you may be inclined to say that anything that's got to do with people interacting is a social situation. Reading this thesis, for example, is a social act. Of course it would not have been possible for this thesis to exist without funding from the government for my scholarship. You may have even paid a tiny portion of that funding from your own salary. Thanks. Also, whether you are reading these words electronically, or whether you are reading a paper copy, a not so small amount of energy was expended to brighten the screen or print the bound book that you see before you. A large portion of this energy was, without a doubt, extracted from the natural environment and labeled as a "resource". It may have even been extracted from an open pit coal mine in Alberta. Sorry about that. Of course my point is that nothing we do as members of society, as human animals, or as economic entities can truly be separated into the pillars or circles you see above. I'm not trying to suggest that these concepts can't exist as *ideas* in isolation, but I don't think it makes sense to pretend as though we could ever be in a real life situation that exists anywhere outside the "sustainability" centre of the diagram.

This point highlights my second confusion with the diagram: it entertains the possibility that decisions are currently being made whose outcomes are thought to exist only in one of the pillars. This is like saying that when a stock broker makes a trade on the market, the only thing that trade impacts is the market value of the stock. Recent events in our global economic lives have shown that this assumption is patently false[2]. Of course people do frequently believe their decisions are free of unexpected outcomes in domains outside of their focus. Some might even say this "omission of the unseen" is part of human nature. But if the only purpose of the diagram is to show that sustainability

[2] I am referring to the global market collapse that occurred starting in late 2007 which still has significant ramification in the present. The nefarious trading of derivatives of American housing debt led to a chain of global financial institution failures and to instability in people's livelihoods worldwide. The social impacts were certainly as numerous and as significant as the economic ones.

requires recognizing that your choices will have a complex set of impacts that you may not currently foresee, then I'm skeptical of how useful this diagram is going to be to people who want to engage in sustainable development.

Maybe it's my desire to follow the recommendation of Albert Einstein above, but I think this diagram may be too simple to be useful. Of course, the reason it's simple is because sustainability is difficult to explain. Why do we seek to simplify our explanations of complex things? In my experience – at least in the situations I've seen this diagram used – the presenter doesn't really want to spend a lot of time sharing an intricate definition of sustainability with his audience. He wants to get to his recommended solutions or process for tackling sustainability as quickly as possible. But how can we solve a problem when we don't really understand the complexity inherent in the that problem's definition?

## 1.1 Embracing complexity

Let's look at another diagram that is, at least at first blush, a little harder to understand. In Figure 2, we see the figure eight or mobius loop that Holling first used to describe the functions of ecosystems as they change [1].

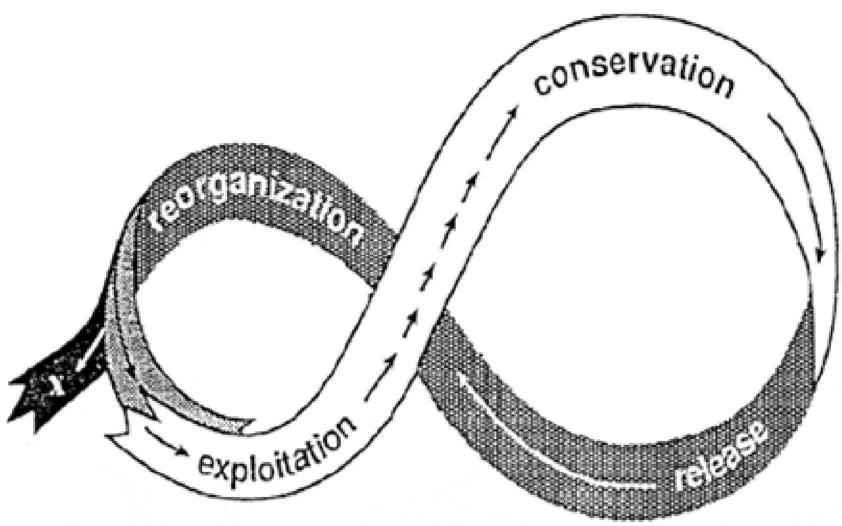


**Figure 2 – Holling's mobius loop of ecological resilience**[3]

[3] This diagram is in fact a simplification of the original version presented by Holling. I got it from the internet at http://www.albaeco.com/english/htm/webbart/ecosystem.htm.

As the system (let's say a forest ecosystem) begins to exploit its environment and grow, it stores energy and biomass in its structures and it also grows in terms of the number of species that it can support (its diversity). A pinnacle or climax state of conservation is reached where the species are very intricately connected to each other and rely intimately upon each other for success. That tight pattern of reliance will eventually be broken by some catastrophic event – maybe a fire or an invasive pest – and the system breaks down suddenly and a portion of its energy is released. At the ebb of release, the system begins to reorganize itself slowly and it either begins the cycle again, enters a new state of existence or it might even die off completely.

This description of the life-process of a system as complex as a forest is very illustrative and useful for understanding how a real forest will react to shock. Holling, among others in the literature of the theory of complex systems[4], makes a point of arguing that we cannot take a simple approach to understanding and managing the world around us, especially when that management is of living things. Holling's diagram, however, because it is an effective description of a complex system, may also be a valuable metaphor for other types of systems with a similar dynamics. Can you think of other systems which have shown this process of exploitation – growth – collapse – reorganization? By observing and describing the fascinating dynamics of the forest, Holling has potentially given us a useful starting point for understanding ourselves.

There are two very important words in the last paragraph which I'd like to highlight before we get too far. *Process* is a word I will use almost insatiably in the pages that follow. I apologize in advance to anyone who grows tired of me describing things using this word. The reason I am so inclined to use it is because it gets us away from thinking about the important problems in our lives as being static. Nothing that's alive, or part of a *living process*, is ever static or "in balance". We should be careful, therefore, not to think that our goal when making changes in our lives is about finding some magical balance point of perfection.

The second word that I will use a lot is "system". I hope you can understand that the only real way to describe something with a complex pattern of interconnected

[4] I have regularly used [18, 19, and 38] as a source of ideas in my research.

structures engaged in the process of life is to call it a "system"[5]. Of course the discussion about sustainability that follows is focused entirely on such things, so you will see the word a lot.

I've shown you Holling's diagram and I've brought up the ideas of complex systems theory because I want to make one very important point about why I decided to write this thesis in the first place. *I want to start a real conversation about the complexity of our choices and figure out how to make those choices well while respecting that complexity.*

There is no single, perfect metaphor for life, nor for the developments we engage in throughout our lives. This thesis is written with this premise in mind. If we want to talk about how to make life better for ourselves and for others, we need our stories to be as complex and as unique as we are.

## 1.2 Why this thesis is the way it is

As you no doubt discerned from the title, there are three important parts of this thesis: definitions, process and case. Figure 3 illustrates the flow of the discussion of these three things between the different chapters.

The next two chapters are intended to provide a broad set of definitions for the ideas of sustainability and development as much as they can be seen separately from each other. The definitions provided in these chapters are perhaps not what you would expect if you have read a great deal of the literature that surrounds these two ideas. My intention throughout the entire thesis is to provide definitions which are as free of presumptions and bias as possible. This means, in some cases, that I have reshaped a word that is normally meant to mean something virtuous into a word that has no inherent motivation. I hope this approach does not offend anyone too much, but if it does, please let me know why. I am more than willing to discuss my reasons in more detail.

The fourth chapter includes a synergy of the previous definitions and process-related challenges and the first set of case specifics for the case study project that I have undertaken with the charity All Our Relations (AOR). This chapter is a summary of the

[5] I take this description of systems, especially living systems, from Capra [39] and Maturana and Varela[5].

full set of ideas in Chapters 2 and 3 applied to the case of AOR, but it is not as detailed or as thorough as the remainder of the thesis. My original goal when undertaking this topic was to focus equally on the broad, organization-level and the case of buildings. I soon realized that to include both of these perspectives fully would be much more than I could handle in the scope of a master's thesis. As a result, the first three chapters are really meant more as an introduction and as guidance to the ideas more fully addressed in the following four chapters.

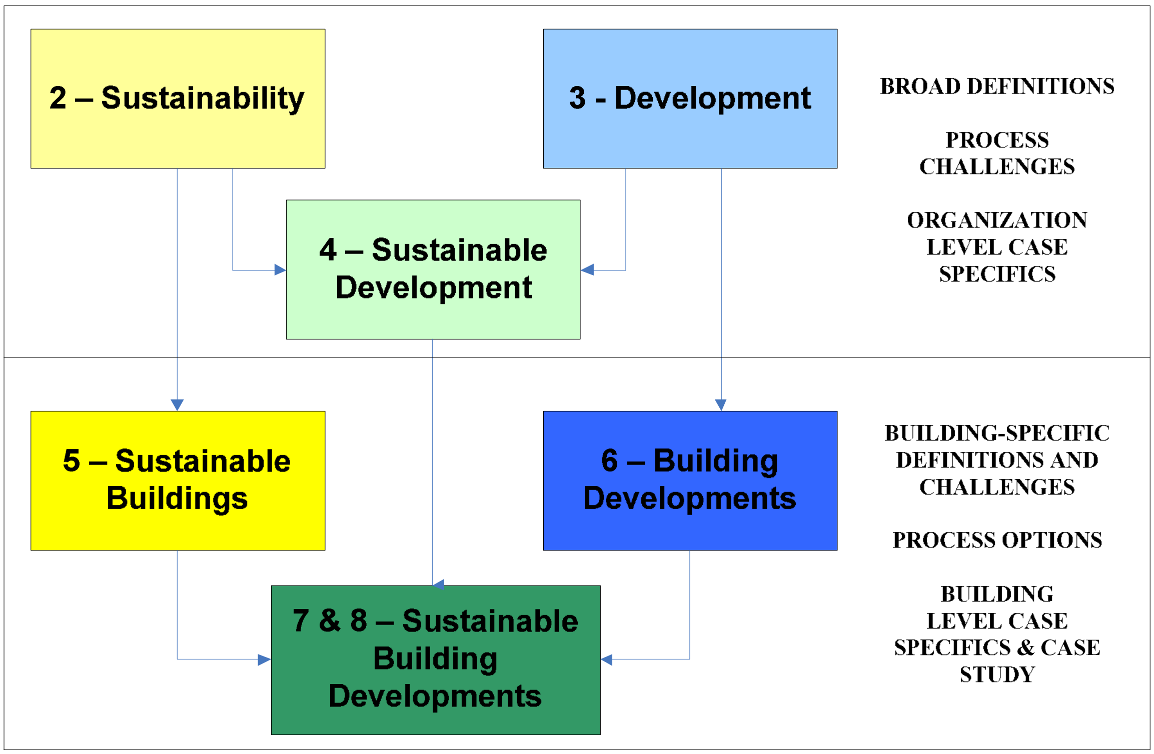


**Figure 3 – Process flow for this thesis**

In Chapters 5 and 6 I provide refinements of the definitions from the corresponding Chapters 2 and 3. These chapters also provide a good introduction to the general reader about the Leaderships in Energy and Environmental Design (LEED™) assessment tool and about the typical building development process that LEED is applied to.

Chapters 7 and 8 are the culmination of all the previous definitions and process ideas as they apply to building sustainable development and especially to the early concept development of buildings and the specific building development of AOR's hospice and retreat centre. Chapter 7 harmonizes the ideas present in all the previous chapters into a model process of building concept development, while Chapter 8 uses AOR's building project to apply and contrast this new process with LEED.

Structure aside, this thesis is the way that it is mostly because of who I am. My every day job is in building energy performance analysis, so my desire to contribute to the industry in which I have found a niche is strong. My undergraduate training was in systems design engineering at the University of Waterloo, so my theoretical focus on systems and process thinking is hard to shake. And I have always, even as a young boy, been enthralled with the beautiful complexity of the world around me, so please don't be too surprised if my tone is much more personal and maybe a bit too idealistic for an engineering thesis. I wouldn't have been able to write it any other way.

## 1.3 Contributions of this thesis

This thesis does not have a single, all-encompassing focus. It's mostly an attempt to start a conversation about *building sustainability*, in both meanings that such a phrase could have. The contributions to the field of building development that come from this work are also multiple.

First, I have tried to provide, throughout the following five chapters, a set of definitions and their associated challenges which explore building developments and their potential to pursue sustainability from the perspective of the decision-maker. These definitions are meant to dig down to the core motivations for the ideas of sustainability, development and sustainable development in order to see how these concepts are important parts of our daily lives.

Second, I have transformed my experiences as part of this thesis into an approach to the early concept development for buildings which is discussed in Chapter 7. This approach is rooted in a respect for complexity, in the need to recognize the diversity of desired outcomes and in the importance of dialogue as the key technology for success.

Third, and most immediately relevant to my colleagues at Enermodal Engineering, is the case-specific critique of LEED as a tool to guide the early development of buildings in Chapter 8. This critique is designed to challenge LEED both as a tool for assessment, but also as a decision-making tool for deciding how best to design a building to maximize sustainability-related performance.

Finally, this thesis represents the formal documentation of both the organizational and building-related sustainability goals of All Our Relations. As such, this document is available on-line at http://sites.google.com/site/keepbuildingsustainability. This site will be used to promote discussion and make transparent AOR's past, present and future efforts. Please review this on-line project and provide any comments and questions that you would like. My hope is that through a greater dialogue with the building development community, this simple case study can grow into something more valuable.

# 2

# Sustainability

I've been a student of the word "sustainability" for a few years now and one thing I've learned is that sustainability is a lot like love – as words, both can be very misleading. If you want to use either word, you'd better understand the situation you're going to use it in. If you're lucky, or have worked at it, the people you're talking with know you well enough to understand your meaning without too much clarification. For me, for either word, there aren't many people who know me that well.

Much of my study of this word has been through the design and construction of what are often called *sustainable buildings*. As discussed in the introduction, I plan to address this concept in more detail soon enough. For now, what matters about sustainable buildings is that people have a hard time answering the question "what makes them sustainable?" Usually when people give their answer to this question, what they're really answering is "what aspects of a building's performance do you think define sustainability?" Common answers to this new question are energy and water conservation, recycling or reuse of building materials, improved occupant comfort, and increased development density and access to public transit.

If I probe the people I ask about sustainability further (which I often do) I like to ask one or all of the following questions:

- Is a building sustainable if it uses less energy and water but does not include any recycled materials?
- Is a building sustainable if it uses any energy at all?
- What does people's comfort have to do with sustainability?
- If a building affords access to public transit, but the transit system is dysfunctional, is that building still sustainable?

All of the common responses – energy and water use, materials selection, space qualities and site characteristics – are examples of possible aspects of sustainability for buildings, or more precisely, *possible ways that sustainability can be measured*. What is missed by almost everyone who I have this conversation with is that without us first agreeing on what is truly meant by the word "sustainable", it will be very difficult to explain how their building has succeeded in being so.

If I asked the same people "what makes your building pink?" they would very quickly answer that they don't understand what I'm saying. It is not pink (unless of course it is). Pink has a very distinct definition when you're talking about buildings (unlike "green"). And though I do not think sustainability can ever have the same clarity as "pink" in people's minds, what I hope to do in this chapter and Chapter 4, is make sustainability a little pinker.

## 2.1 What it was

The most pervasive, long-lasting definition of sustainability is the one provided in 1987 by the World Commission on Environment and Development (commonly referred to as the Brundtland Commission). I'll quote the summary version of this definition here for your benefit, and because it seems to be a tradition to include the definition when you write anything having to do with the subject.

> "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
>
> 1) the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and
> 2) the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs." [2]

When this definition was established, the world was just beginning to wake up from a long post-war period of perceived growth and prosperity. Certainly in many parts of the world – North America and Europe in particular – people were better off in some ways. But what many people were beginning to realize was that a much larger part of the world's population was not doing nearly as well. At the same time, we were beginning to bump up against many limits to the consumption of natural resources and to the carrying capacity of the biosphere for our wastes. This massive, global tension of needs and wants is what Brundtland was trying to characterize – and suggest a solution to – with the idea of sustainable development[6].

## 2.2 What it is

Brundtland's commission placed these words at the beginning of their report and in so doing, established a clear definition for sustainable development that guided their work and the work of many others who followed. Unfortunately, I have come to realize that when some of those many others reference this definition, they tend to change it in two dangerous ways. First, they will cut the first five words off the leading paragraph ("sustainable development is development that") and replace them with a single word: "sustainability". Second, they rarely provide the quote with both of the key concepts included. I find that these cuts over-simplify the definition while at the same time making it more all-encompassing. There are, as one might expect, several problems with over-simplified, all-encompassing definitions.

It's easier to apply a concept called "sustainability" to our actions as opposed to trying to apply a concept called "sustainable development" to the same actions. To have sustainable development we probably need to be engaging in the act of developing in some way. Development requires its own careful definition (which I'll reserve for the next chapter) but I feel it's enough for now to describe development as a *process of change for the better*. The word sustainable, separated from development, could be used to describe anything – even something as vast and nebulous as "our society" or "the economy". Of crucial importance is how this split of sustainable and development makes the concept of sustainability into an adjective and not a noun. What seems, in its full form, as something we should *do*, is changed into a quality of what we are doing, or worse, what we were planning to do anyway.

Also, if what we're trying to do when pursuing sustainability is meet the needs of the present without compromising the ability of future generations to meet their own

[6] This is the extent of the history I have time to go into as part of this thesis. I strongly encourage the eager readers to review the full Brundtland report [2] and Brundtland's speech that summarizes the intent so well [40]. I've also found the summary in Gibson et. al. very valuable [4].

needs, then we can really be talking about any need as long as we can argue that it is needed both now and in the future. We could just as easily be speaking of the need for sustained economic growth or ice cream as the need for human rights or clean water. However, the needs specifically associated with the World Commission definition are quite clear. They are the *essential needs of the world's poor*. These needs are surely meant to be the most basic needs of humanity. Though we could haggle over the specifics, I think the following list captures the most important of these needs:

- healthy food, clean water, adequate shelter and the energy to provide them;
- basic medical care and protection from easily-curable disease;
- a livelihood that enriches ones community and oneself;
- access to basic education and the opportunity to teach others;
- people to love and be loved by and time to spend with those people;
- protection from slavery, torture or other forms of cruelty;
- the right to life, liberty and the security of person;
- and the freedoms of self-determination, movement, expression and organization.

These essential needs have been discussed openly by many, especially the UN, for nearly two generations[7]. Sustainability of any kind that follows from the definition outlined by the World Commission must stay true to providing these needs first and foremost.

Finally, the tension inherent in the second key concept – the tension of limits – is a tough one for many people, which means it can sometimes be left out of the discussion. The limits that exist in the earth's ability to sustain humanity's bulging population and consumption growth are real and no longer easy to dispute. In fact, some calculations of humanity's net ecological footprint already show that we have exceeded the carrying capacity of the planet by 50%[8]. Whether we have surpassed these limits is a very important question and forms the starting point for how much consumption growth can continue to occur worldwide. Any definition of sustainability that ignores such limits is dangerous.

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[7] To learn more about poverty alleviation, I strongly recommend a review of the UN Millennium development project. Visit http://www.un.org/millenniumgoals/ for more info.
[8] Visit http://www.myfootprint.org/ for more info on ecological footprint calculations.

What's left when you cut the process, the poverty and the limits from sustainability is a vague, but much more optimistic statement about everyone getting what we need and making sure our children can do the same. Unfortunately, this definition has been applied to many ideas that may not truly embrace the complexity and clarity that Brundtland and the rest of her team were trying for.

## 2.3 What it isn't

This is the part of the discussion where I will be most negative. I wanted to give that admission now, so that you can expect future sections to be more optimistic. There are three somewhat common stances on the meaning of sustainability that I really have difficulties agreeing with. I'd like to review these perspectives, briefly, as a way of revealing more about the definition of the word as I would like to use it.

First, I do not think that sustainability has anything to do with anyone maintaining the status quo and bringing everyone else "up" to that status. This is especially true if the status quo means the current "western lifestyle". Our wealth is already excessive, even on average[9]. We have so much stuff, and are over-worked to pay for it; we eat excessively, and are unhealthy; we live such fast-paced, jam-packed lives, and we are often unhappy. Sustainable development, in many respects, asks us to rethink our life and be critical of what we really want[10].

A brief aside about the word "lifestyle". Like the late, great George Carlin I find this word to be almost meaningless, if not absolutely ridiculous. If I have an active lifestyle, what do I do? Run every morning? Isn't it just as reasonable to say that I live an active life? Carlin joked that, if you think about it, Genghis Kahn lived an active, outdoor lifestyle. Now that's ridiculous. I bring this definition up because, there are some words that we use a lot that really take away from what we truly mean. Since everyone uses these words, we start to think that the word has valuable meaning without really stopping to understand whether we share an understanding of that meaning with anyone. This is the same fate I would like to avoid for the word sustainability.

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[9] Alan Durning's essay "Asking How Much is Enough" is a great review of our excessive consumption. Though it's a bit old now, it's still very convincing [41].

[10] I particularly like the take on our consumer culture portrayed by "The Story of Stuff". You can see this film on the web at http://www.storyofstuff.com/.

I am also strongly opposed to seeing sustainability as the solution to a host of global problems: climate change, global poverty and economic stability to name a few. The recent COP15 results[11], this year's Monk Debates[12], even the Brundtland Commission to a certain extent are hoping, even expecting, sustainable development to be the solution to all these massive, seemingly conflicting challenges. And though the concept admits the tensions between basic needs and global limits and between stakeholders of varied perspectives, sustainability isn't the solution to anything. It's a process we might follow to discover the best solutions for the long-term. The solutions are the discussions we have, the technologies we create, the actions we take and, ultimately, the stories we tell to our grandchildren.

Finally, sustainability is not just a global concept. In fact, the global level is a very hard venue to pursue sustainability. The interests, the tumultuous history, the deep-seated views, and the sheer grandeur of global decision-making make it the most complex (albeit worthwhile) example of development we can attempt. It's fair to say that the best examples of successful sustainable development exist in smaller communities – like cities, villages and households – all across the world. This community-focused approach has great merit and is worthy of further study [3].

## 2.4 What it could be

There are three additional definitions I would like to introduce into our discussion before providing you with my own definition for the word "sustainability". A lot of life is shared with others. You might call this sharing our community relationships or, if you want to be really big about it, our *society*. I've found it very useful, when talking about these relationships, to distinguish three important types of them, namely: *governance*, *service* and *civility*.

Instead of trying to define the objects or actors of our community – government, business, and civil society – I think it's more valuable and instructive to talk about the

[11] The fifteenth Conference of Parties (COP) took place in Coppenhagen, Denmark in April, 2009. It was generally considered to be a failure at achieving a lasting, meaningful resolution on global carbon reductions.
[12] The resolution this year was that "Climate change is mankind's defining crisis and demands a commensurate response". Visit http://www.munkdebates.com/The-Debates/Climate-Change for more info.

relationships they engage in. These processes are more useful than the objects because of their generality. Even if an organization can be officially labeled as a business, a government, or a non-for-profit NGO, that organization will probably have a desire (and opportunity) to govern, to serve and to civilize at some point.

This first relationship – ***governance*** – is about making decisions. Governance guides society through an on-going history of choices. It is about determining, maintaining and changing rights and freedoms. It is about the power of choice, the distribution of that power and the use of it.

This second relationship – ***service*** – is about meaningful action. Service provides for the desires of society and the fulfillment of the service provider. It is about applying knowledge and experience, often through the use of technological systems, to solving problems. It is the act of providing needed and wanted sustenance for people within the constraints of an environment.

This last relationship – ***civility*** – is about being aware and respectful. Civility fosters understanding of place, power and self. It is about critical observation of the decisions and actions going on around us. It is also about understanding the significance of those decisions and actions on our own lives, on our families and communities, on our culture, on humanity at large, on all living things and on the earth in its entirety. And it is also, most importantly, about communicating our observations and perspectives to each other.

I would also like you to see *development* as the act of changing our governance, our service and our civility *for the better*. How we quantify "better" and with whom we share that definition matters a great deal.

Which brings us to *sustainability*. If development is the "change towards", perhaps sustainability could be "the better". ***Sustainability is a better approach to human governance, service and civility that puts caring for each other and caring for those who have yet to come first and foremost in our minds.*** I've learned to appreciate sustainability as a process that can help us find the core values, inspiration and rigor we need to thrive in our relationships with other people and with the planet.

For the set of values or *criteria for sustainability* I have no reservations in directing you to the work of Robert Gibson and his colleagues [4]. Their criteria are meant to cover the core requirements for progress towards sustainability. In the interest of getting these criteria up front in your thoughts, I will reproduce a list of them here along with a few clarifying statements of my own:

1. *Socio-ecological system integrity.* Natural and cultural systems that are thriving, not declining.
2. *Livelihood Sufficiency & Opportunity*. A day's work you want for the day's pay you need.
3. *Inter-generational Equity*. Care about the future of your actions.
4. *Intra-generational Equity*. Care about others as you act.
5. *Resource Conservation & Efficiency*. Doing {more, the same, less} with less.
6. *Precaution & Adaptation.* Be careful of what you don't yet understand and be ready for change you can't control.
7. *Socio-ecological Civility & Democratic Governance*. Listen, learn and decide together and with respect for the complexity of your environment.
8. *Immediate & long-term integration.* We must never forget that everything is connected and all the criteria above must be applied and sought after together.

Within their proposed framework, how to address trade-offs is as important as the values that are put forward as being traded. These trade-off rules are also worthy of summary here:

A. *Maximum net gains.* Success should be broad and positive in all criteria.
B. *Burden of argument on trade-off proponent*. If you want to sacrifice something, it's your job to argue how this choice still satisfies rule A.
C. *Avoiding significant adverse effects*. Preventing significant failure to meet any one criterion is more important than significant success at meeting another.
D. *Protection of the future*. Avoid burdening the future more than the present.
E. *Explicit justification*. Any trade-off must be argued in the context of the criteria, not through arguments outside the decision-making process.
F. *Open process*. Arguments and decisions for trade-offs must be transparent and open to criticism by all those at stake.

You will notice throughout the rest of this thesis that I have used the words and ideas from these criteria and trade-off rules repeatedly to talk about my own ideas for sustainability.

I also feel that the idea of sustainability inspires us towards continuous, positive improvement. The simultaneously challenging and fascinating part about the criteria above is how broadly they are defined and how interconnected they are. The inherent tensions identified by Brundtland and others since are also very challenging. This thought is especially true of poverty from an absolute perspective, not a relative one. All of this challenge means that we need to be truly careful, caring and creative in our approach to solutions. It also means that we'll have to work together. Developing a way to effectively apply the values of sustainability to the case of buildings and specifically the All Our Relations building project has been a large part of my work these past five years. I know I would not have been so inspired to continue if the possibility of pursuing sustainability wasn't central to my goals and the goals of the others involved in the project.

Sustainability also requires, perhaps demands, a way of ensuring we don't forget the core values and needed inspiration discussed above, even when things are changing around us. *Resilience* comes when such a process is pursued[13]. I think resilience is a lot like the cognitive process described by Maturana and Varela in their challenging book The Tree of Knowledge [5]. Resillience mirrors the drive for life itself – each action preceded by a history of choices and each choice a new step towards the continued integrity of life as a whole. There is no certainty of the next step, only a desire to continue living and perhaps a recognition that the diversity and strength of our interconnections matters. In the same way, by pursuing sustainability, people become intentionally connected, awareness and respect for the magnitude of our desires and their impacts grows and we realize that acting for the betterment of all in the long term is essential to our own betterment now. Maturana and Verela call this interconnection *love*, of a kind [5, p.246]. I'm not sure how confident I am yet to connect sustainability and love so directly, but maybe there's a kind of poetry to that possibility that fascinates me most of all.

[13] For another well-summarized presentation of a process for resilience, I recommend The Natural Step's on-line material available at http://www.thenaturalstep.org/en/toolkits-around-world.

## 2.5 No general without specific

One of the unfortunate things about sustainability writ large is how overwhelming it can be. Sustainability was born out of the global scale of issues and that scale of action is hard for many of us to grasp. One way to break down the seeming intractability of such massive tensions is to look at smaller, local cases where success has been possible, or hasn't been. In the case study, both the successful and the failed are valuable, since they help us to learn either way. Moreover, the local cases are the ones that have been most successful and worthy of praise.

The case also has its own character. The values described above should never be blindly applied, ever. In fact, bringing context – the specifics of the everyday – to the broader perspectives and values is where the most work needs to be done in convincing people to do sustainable development. It's in figuring out how the overall process applies to the unique situations we are facing in our daily lives that we will make sustainability a pervasive approach[14].

In connection and contrast to this previous point, the case is also immensely valuable as a model. Though there are differences in every building, for example, the approach to development one takes from building to building can be very much the same, or at least share some of the same qualities. This "science of the case" approach – making every project a miniature pursuit of knowledge – is something very exciting to me. It's with this mindset that I have approached the case of the development of the All Our Relations Hospice and Retreat Centre. Though the project is very unique, the approach to thinking about building sustainability might be valuable for other projects as well. We shall see if you agree as this case is presented in the following pages.

[14] Gibson et. al. [4] discuss this need for both broad criteria and case-specifics very effectively. I owe most of my thinking along these lines to their guidance.

# 3

# Development

I have already said something very specific about development – it is a process of change for the better. Since things are always changing, one could simplify the definition of development too much by associating it with all change. I would argue that we must keep the "for the better" part of development as essential to its definition. If we do not start from a place of desire to do better, then a development simply becomes change for the sake of change. Of course, what "for the better" means depends a great deal on what those doing, those being done for and those being done to all think. There are also those, as we've briefly discussed, who cannot judge our developments through their own voice, but may do so through the voices of others, or in generations to come.

Continuing with our formal list of definitions, we can now add the following.

**Development:** ***A process of change for the better.*** This process is an intentional effort to *control* a given system to achieve a *desire*.

**Control:** ***A separation of understanding, responsibility and influence***. Those things that we control we need to understand, take responsibility for and influence the outcome of. Those things we do not control are placed external to these separations – they become an environment. The act of taking control is, inherently, the act of creating an environment.

**Impact:** ***An outcome of our new system's process and ultimately of our choices in the development of that system***. Impacts are the result of our efforts to control the system. They can be seen within the system or in an adjacent or distant environment of the system.

**Desire:** ***Both the purpose of our development and special impacts of that development, depending on your point of view.*** Desires are the anticipated impacts which have specific value to those who control the development, the stakeholders. Desires may or may not overlap between stakeholders and they may be in tension.

Though I've tried to be clear and concise in my meanings for these four words, I respect that these may not be the definitions that you expected and perhaps not the ones that you agree with. Allow me to clarify things a little further.

Seeing control, not as act of taking something, but one in which we're pushing something away is perhaps a novel perspective, but I think these things are really the same. I also think this definition of control is a lot more appropriate to the way we make choices during development, especially the development of complex things. We need to create an environment, otherwise we quickly become overwhelmed by how much there is for us to be aware of and affect. If we can just focus on our little piece of the problem, we can manage it much more successfully than trying to see the big picture the whole time.

Also, my definition of control has three requisite parts (or acts): understanding (or knowing), responsibility (or owning) and influence (or interacting). When any one of these aspects is missing from something we report to control, we are probably not going to be controlling it for very much longer.

I've also said that impacts are the outcomes of efforts to control a system. In this light, impacts are a neutral concept. Of course impacts can be both positive and negative, but only if they are valued that way by someone. I've also said that desires can be seen as anticipated impacts, from a certain point of view. This statement is akin to the old adage: "one man's junk is another man's treasure". In a development, therefore, *desires are valued impacts*.

When we use the word *desire* we sometimes use it to refer to something we want for emotionally-charged reasons, or for "irrational" reasons. In my definition of the word, I am not making any assumptions about where the desire comes from. In my experiences with developments of various kinds, emotion and rationality are thoroughly intertwined in the explanation behind the wants and needs of those involved.

I'd also like to make a special point about seeing money as an object of desire, or as a measure of impact. I don't think people really want money. Money is just a piece of paper, or a hunk of metal, or a few properly positioned digits in your bank's mainframe. The desire for money is really the desire for the opportunity that money brings. This opportunity exists because money is the most important way that we collectively value the things that we share with each other. When someone values something with money they make that value comparable to other things that are also valued using money and that makes those things easy to exchange or trade. Of course there are some things that we've realized are very difficult to value in this way. Human life, for example, and our most important freedoms cannot be valued using money, at least not in many places anymore. Many people would also argue that the lives of their pets and those of endangered species of wild animals also can't be valued with money. But what is it about these things that makes them so hard to put a cost to? Wouldn't it just be easier to make decisions and get on with the changes that are needed in the world if we could make everything comparable? I hope my tone is clear. *There are some things we should never make equal to the things we are willing to value with money.* The hard part about deciding not to value things with money, besides agreeing on what those things are, is figuring out how to value them in other ways that still allow us to make good decisions about them. If it's any consolation, it is my intention throughout this thesis to propose how we can do this kind of valuation whether it's hard or not.

You may also be reluctant to agree with my definition of development. The word "development" is used, both colloquially and in scholarly work, in a number of contexts that are very different from each other. For example, there are large companies which refer to themselves as *property developers*. These companies purchase land and build speculative buildings on it, such as office spaces and condominiums, for fairly wealthy corporate and private city dwellers to occupy and conduct their own business. The actions of these property developers can be seen as development. There is also an equally large group of committed folks who spend their time working with people in the communities of poor countries all over the world. These *development workers* spend their days engaged in the process of development too and they may even be helping to build homes and offices for the people they work with. There are some who would argue that I should not use the same word to refer to both of these types of development. My desire, as I have already briefly mentioned in the introduction, is to provide definitions of these important acts of relationship that are as free of presumptions as possible. If we recognize that development can occur along a spectrum of intent – ranging from "purely for personal profit" to "altruistically motivated" – then we can more effectively compare one development to another along this perspective. It's by reflecting on a development and comparing it to other similar acts that we decide its value.

I've also argued that development is one of the essential processes of our lives. It is the application of one of our greatest virtues as a species – creativity. This virtue, which is seen as so valuable by so many, is therefore applied in equal measure to developments of all kinds. By exploring the full spectrum of the word, we may find solutions in one type of development that we can apply to others at different scopes and scales or undertaken for completely different reasons.

## 3.1 Process stages and actors

I would also like to provide a few brief definitions for the major stages of development. I want to highlight these separations of the process because I think considering each stage on its own allows us to see the challenges and perspectives that are needed to do development well. The stages are:

**Envision.** Articulating our desires for the development now and in the future.

**Design.** Conceiving of systems which are most likely to satisfy our desires.

**Decide.** Choosing a specific vision, design, or plan from a set of options.

**Plan.** Creating a method (i.e. course of action) to bring a designed system into physical existence.

**Construct.** Acting on a specific plan to realize some physical system.

**Use.** Interacting with the developed system.

**Assess.** Evaluating our designs, decisions, plans, constructions and uses and reflecting on:

(1) how they satisfy our initial desires (our vision),

(2) how the potential and real impacts of the system alter our desires, and

(3) how we can change the current development, future developments, and our development process to better satisfy our initial desires or any new/altered desires.

This list of stages is not a chronological or linear description of how developments should occur, but simply a summary of the structures of any development process. These stages can occur in a variety of different orders. Sometimes they are iterated cyclically and other times whole stages are skipped entirely. Some developments are often governed, intentionally or unintentionally, by very rigid process requirements not the least of which are temporal requirements often called *timelines*. This point will become clearer, I hope, in Chapter 6 where we will discuss the specifics for building developments.

The key actors of a development are as varied as the stages above, but typically there are five key groups of people.

**The designers.** These are the people who typically guide the visioning, take responsibility for preparing the designs and draft the first set of plans for the development. Some typical synonyms for designer are architect, planner and author.

**The builders.** Taking plans from the designers, or developing plans of their own, the builders bring a clear plan into reality through the act of construction. Typical synonyms for builder are contractor and labourer.

**The users.** This group of people will be directly connected to the system when the development is complete. They are often invited to contribute to setting the vision for the development too, but not always. Some typical synonyms for user are customer, occupant, tenant, client and constituent.

**The deciders.** This definition has a small joke in it, but I am taking from George W. Bush[15] his likely intended meaning for this group of people. These are the people who get to make the final decision for the development's direction or whether it is to occur at all. They also, often, have the power to choose who the designers, builders and users of the developed system are. There is one group of people the deciders typically do not control, however – the impacted. Common synonyms for the decider are owner, leader, executive officer, principal and parent.

**The impacted.** Technically, everyone involved with the project is among the impacted. Often, however, there is a potentially large group of people who have not been directly involved in any way with the designing, building, deciding or using of the developed system, but they are still connected to its impacts.

Let's consider a simple example of a development project to demonstrate the six aspects and five actors and how they can differ depending on the case. The example I

[15] Consider, if you want more context for this joke, watching the video the president where he makes clear his role at http://www.youtube.com/watch?v=E2Zv1T4Qdv4.

would like to propose is the development of a new home for my wife and me. This is a very common example of development for recently married young people like us. We have already begun to *envision* a home for ourselves and our potential family to be. My wife has her specific *desires* for how she sees the home and I have my own. For example, my wife would like the home to be in the countryside similar to how she grew up, with a big back yard and a forest nearby for the kids to play in. I, on other hand, want a location that will minimize our carbon footprint – something close to both our places of work and to transit so we can access the rest of the city without driving if we don't want to. Clearly our desires about the ideal location do not overlap very well.

Call in the *designer*, or in this case, the real estate agent. She will take our more or less clearly described *vision*, including the conflict of location, and try to find us a suitable spot that meets as many of our requirements as possible. She will proceed to present us with a few appropriate options and we will *make our choice*. Hopefully that choice was in time and at the right price. If we succeed in winning the house, *plans* for arranging legal and other essential services will immediately ensue, not to mention how we're going to get all the junk out of our basement with less than an eighteen wheeler.

Of course, the house we choose may not be exactly what we want. My wife, even as we are walking through the home for the first time, may develop intricate *designs* for how we should change the layout to suit our vision. Before we move in, I may succeed (hopefully with the support of my more experienced colleagues at work) in *planning* and *constructing* some of the desired renovations. My wife's *assessment* of the work will certainly be thorough and it may lead to *new desires* which she is likely to share with me right away. As we finally begin *using* the house for our daily activities it will slowly become our home. Our cat, our new neighbours and our children yet unborn will all be *impacted* in various ways by this new home development, and these impacts will be almost completely outside their *control* since my wife and I will have made most of the decisions on our own.

I've used this simple example of home buying and renovation because I want to be clear that development is neither limited in scope to large, complex projects nor simple even at what might typically be seen as the smallest scale. There are always a myriad of perspectives, recommendations and opinions to weigh into the process at each stage. The importance of recognizing the role of each actor and clearly articulating each stage is also no less instructive at this smaller scale of development. For example, it's important to realize that my wife is the ultimate decider, regardless of my desire to share that role. This is something important for both myself and the real estate agent to understand and accept. Also, I may be asked to take on multiple roles throughout the development and I need to be prepared and plan accordingly.

All joking aside, moving into a new house is an immensely important part of North American culture. I will deal more with this importance of place in Chapter 5. What matters here, as we explore these definitions, is that a lot is at stake in any development and success is always in the eye of the beholder. I would like to argue that the challenges that come with ensuring success from many perspectives have more to do with how we describe our vision, how we assess it and how often we do both of these things thoroughly.

## 3.2 The challenges of assessment, vision and feedback

I've always been surprised how often I don't understand people right away when they tell me something they want me to do. I may be somewhat hard of hearing, but I think the problem goes beyond that physical limitation. It's not easy sometimes telling people what you want. Harder still can be explaining how you will know when you've gotten what you want. I'm sure this observation isn't a revelation to you, but the most surprising part about failing to communicate vision and assessment is how often people don't recognize the failure as being in the medium, not in the message.

### Assessment

Assessment is done to one extent or another throughout almost every development process. My wife and I will spend time assessing the housing options that are presented to us by the real estate agent. We will visit the houses to get a feel for their aesthetic, I will be sure to note the nearest bus line and we will certainly compare the prices to our budget. We may not have that long to make a decision though. In the end, we might just "go for it" because a certain house "feels right". Assessment during many types of development can be prone, especially in the midst of tough new information and a tight timeline, to be pushed aside or simplified.

Because of the potentially disastrous effects of failing to do proper assessment, many rules or schemes of assessment have been developed to guide our efforts. Some such schemes are important enough that every development must follow them by law. Building codes are great examples of this type of mandatory scheme. They have developed over the years as a direct response to significant accidents or errors in judgment throughout the building industry. Some systems of assessment similar to codes are also useful as guides for design. The Leadership in Energy and Environmental Design (LEED)[6] system of assessment has been seen as such a scheme and we will explore its effectiveness as a design tool in Chapter 8. Especially for big organizations, assessment can be difficult because of the scale of operations and because we work with many other organizations we do not control as tightly as we control ourselves. Walmart is one such fascinating massive (or perhaps fascinatingly massive) organization. They are the largest retailer in North America and among the world's largest economic entities [7]. Recently, Walmart began to create what they call a "sustainability index"[16] which will eventually develop into an assessment scheme for all their products. In its final version, the scheme will provide "product information in a simple, convenient, easy to understand manner so [their customers] can make choices and consume in a more sustainable way" [8].The first step along the path to developing their index was to prepare a 15-question survey for all of their U.S. suppliers about a variety of important impacts. I was initially surprised by the simplicity of this survey, but after closer review I feel the more quantitative questions will be difficult to answer for many businesses that have never looked at their operations through what Walmart calls the "lens of sustainability". Walmart will also be scoring each of its suppliers based on their answers to the survey which provides a strong motivation to respond. The scoring is very subjective, but it will allow Walmart to prepare a basic ranking for all their products by category.

Much of the work for this first phase will remain internal to Walmart and their suppliers for an indeterminate amount of time. Walmart has not offered any timeline for the completion of this first phase or for the start of the second phase (life-cycle database)

[16] Visit http://walmartstores.com/Sustainability/9292.aspx for more information.

and final phase of the project. The simplicity of the early survey and the uncertain timelines aside, I find it hard to criticize Walmart's early efforts to improve the assessment of impacts for the products they sell. They are slowly but effectively introducing a completely new set of decision-making criteria to their suppliers which certainly number in the thousands. The literature they've prepared does make it clear that the assessment is genuine. And the results seem to be important to Walmart at the highest level of the company. We will have to wait and see if this early effort at effective assessment continues into the next phase.

## Vision

The challenge of assessment is made easier when the people demanding the assessment are the most powerful in the relationship. This is the case for Walmart relative to its suppliers, but what about for Walmart's customers? Will they be willing to pay more for products that score high on the sustainability index? Or what if the truly more sustainable products that Walmart sells don't need to be purchased as often and are ultimately cheaper? Will Walmart be willing to transparently provide the results of their finalized sustainability index if it means losing money?

There is a tight coupling between the transparency and quality of our assessments and the importance of that assessment to all those involved. Establishing the rules of engagement for effective, transparent assessment is part of setting the vision for a project. How we measure success is driven entirely by knowing what we want and what others want.

Unfortunately, for this very reason, the visioning process for many developments can be prone to vagueness. People think that if they set the vision too clearly that they will be stuck with what they've said. They may soon realize that their vision is insufficient, unrealistic, too narrow or just plain wrong. No one likes being wrong, especially in the eyes of others. There is also an insidious motivation to intentionally weaken a vision because you don't want to admit your fear of being wrong, or admit some other selfish desire.

One of the most impressive organizational visions that I've had the pleasure of learning about is that of Engineers Without Borders (EWB) Canada[17]. Over the past ten years of their short existence, they have transformed from a small, innocent group of engineering students with a passion for change, into one of Canada's most vibrant and innovative international development organizations. That said, their own process of development has been far from smooth. During the time since I was first a member of the University of Waterloo chapter of EWB, I witnessed many shifts, ebbs and near-restarts of the organizational vision. EWB's central group of program designers and decision-makers is strongly connected to all of the nation-wide chapters of students who make up the core group of volunteers. This central yet distributed structure means that engaging the entire membership takes a lot of work, but can lead to an amazing breadth of vision and creativity. In all of its transformations EWB has managed to grow very quickly into a genuinely reputable and knowledgeable player in the international development community. The reason for this success has to do with many things, not the least of which is hard work, but the fact that the leaders of EWB were willing to be humble and admit when their vision was wrong played an important role. Setting a clear vision can often feel like it requires a crystal ball. I would argue that this thought is a fallacy. Vision sets the direction and core goals of a project, not its actual outcomes or its endpoint. Essential aspects of an effectively articulated vision are the inclusion of the views of others, being true to your core values and transparency in the visioning process.

## Feedback

It was through effective feedback from their members and advisors that EWB's national vision was reshaped. They learned to regularly solicit feedback from their members about the vision to the benefit of the entire organization. I would like to clearly define feedback as the act of integrating assessment and (re)vision regularly during the development process to explore the success so far and re-evaluate one's position. Feedback is virtually synonymous with regular self-reflection. It can also be used to inform future developments and the developments of others making a similar change. This definition

[17] Much of the discussion here about EWB is from my own memory as a member of the organization. For a more official version of the story, I'd recommend visiting their website, http://www.ewb.ca/en/index.html.

should sound very close to the definitions I gave earlier for both “envisioning” and “assessing” a development. Feedback is the process by which these two stages are interlinked and simultaneously made much more useful. Feedback can be:

- Structural (i.e. imbedded in the normal flow of the process)
- Spontaneous (i.e. arise through a recognized need or through surprise)
- Internal (i.e. inspired by someone who is part of the development team) and
- External (i.e. solicited from someone outside the development team)

An excellent example of the use of feedback I have encountered is the Agile Development of software[18]. Agile has feedback as its core mechanism. The daily, focused review of progress and challenges amongst the team of developers is one important type of feedback. Also, time and attention typically paid to meeting specifications is instead spent reviewing and discussing the latest working version of the software with the client/user. Ideally, the more the client sees their desires realized one feature at a time, the more they want to be involved in the development process. This positive act of feedback – helping the client see the current success and shape future changes – can also be very rewarding for the software developers.

I can understand why some software developers might see so much feedback as tedious and time-consuming. Such reluctance might also stem from the fact that programmers can be a bit reclusive and anti-social. I know that if I tried to engage in so much feedback during a building development the design team would think that I was crazy too. I’ll speak a lot more about the sanity/insanity of building developments in Chapter 6, but suffice it to say that the idea of meeting with the client more than once a week is not really very common. Of course buildings and software are not necessarily that similar. Or are they? They are certainly both very complex systems to develop. Also, a great deal of their success is in how the user (or occupant) is made more successful at some other activity. Both buildings and software are platforms for other endeavors of the mind. I think it’s this commonality – this user-at-the-centre-of-it-all idea – that makes the development of both things so challenging and so rewarding. This idea is also what makes a clear definition of desires and regular assessment so important.

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[18] My interest in agile development is more of a philosophical one. For a more in-depth review then what I am providing here, I would visit http://agilemanifesto.org/

## 3.3 All Our Relations: living well, dying well

All Our Relations (AOR) is a charitable organization operating in the Waterloo Region since 1998. The direction of the organization has changed somewhat over that time, but the organization's current mission is to: "create a model of service and compassion for the community in living and dying"[19] The president, Marjorie Paleshi, will be quick to tell you that living well and dying well are two sides of the same coin – fostering one means respecting the other and vice-versa. The organization currently has two main activities: (1) promoting their mission in the community through workshops, guest speakers and conferences and (2) fundraising and planning for the construction of a residential hospice and retreat centre.

There is a fascinating tension between the two sides of the coin, one that connects the great fears and great joys in our lives. It's exposing and softening this tension that is the main mission for AOR. Perhaps, by coming face-to-face with our own mortality as we help our loved ones to die with dignity, we can learn to experience life more vibrantly and more at peace. This tension is also a challenge. Who will come to a retreat where people are dying next door? How is it possible to break people free of their fears of death at the same time as challenging them to live more fully?

AOR's development has been undertaken over the past decade by a small number of very committed volunteers and social entrepreneurs. The characteristics of the development project as I've just described them are all part of AOR's history.

**Development Desires.** Their desire is to promote their mission through on-going workshops and conferences. They have also always wanted to build a centre to deliver their mission more coherently and fully. Of course, building a centre is more than just putting up a building. The operations, funding, and many other aspects of the centre are also crucial to its development.

**Boundaries of Control.** Currently AOR has one planned construction site within the Region of Waterloo and their service as a hospice and retreat provider would be to that community. The focus of their activities is on providing "space", on offering and

[19] See the first few pages of Appendix #2 – Outcome #1 for more on AOR's purpose.

facilitating educational programs, and (to a lesser extent) on advocacy for hospice care and environmental stewardship.

**Development Impacts.** I will more fully explore the development impacts of AOR in the next chapter and in Chapter 8, since this exploration is the purpose of *my* project. Another part of the purpose of this project is to continue the building development process that was begun by AOR in 2003 by revisiting the visioning that was done at that time and further developing preliminary plans for the building. I will discuss this early planning process more in the last section of Chapter 6.

There is also one additional point about my involvement with AOR that I should bring up now. It’s important for me to let you know that the AOR president, Marjorie Paleshi, is my mother. Because of our relationship it has been much easier for me to establish a good rapport with the board of directors and to gain their trust throughout the entire exercise that is documented throughout these pages. Of course it is also true that this relationship may have contributed to a bias on my part that I have not fully noticed. I appreciate your respect of this potentially hidden bias as you read these pages, but if you notice anything glaringly biased or flatly false, please let me know.

# 4

# Sustainable development

Now that I've dealt separately with the concepts of sustainability and development, I can share my definition for the combination of the two words. ***Sustainable development*** is a unifying process which asks us to:

1) ***Understand our impact outside our direct control***. This means connecting our purpose to the impacts that pursuing such purpose will have on communities and ecosystems from local to global. This is the act of effective assessment.
2) ***Extend our desires into the future and outside our immediate environment.*** This means seeing the longevity of our developments and their interconnections with their environment as an essential part of the purpose of those developments. In this way we allow effective assessment to inform a fuller vision.
3) ***Share and expand our desires with others.*** We must consider the possible tensions between our desires, the desires of those at stake and the future desires of those who are not yet born. This is the act of sharing a vision.
4) ***Respect uncertainty.*** Prepare for the possibility of unexpected change, ignorance and error. This means making feedback and assessment systemic to development.
5) ***With this holistic view of a development established, transparently and democratically pursue a positive net gain towards sustainability (as discussed above).***

Based on this definition, sustainability and sustainable development are subtly different. I recognize that this idea is a bit confusing. You're probably thinking: "Didn't he already say that sustainability and sustainable development are basically the same thing?" In a way they are and in a way they are not. As we've discussed, development is a change for the better, while sustainability describes an on-going process. So, sustainable development is achieving net gains towards the criteria, trade-off rules, cooperation and resiliency that come with real sustainability[20]. A couple of examples would probably help to clarify this point.

In nature, something like sustainable development is present in the succession of many ecosystems. The first, early species that take hold on a bare piece of Canadian Shield are a great example. These fungi and mosses slowly whittle from the rock a thriving, but fragile co-existence. Eventually, as they provide for a richer bed of soil and a means of trapping water, other larger plants and insects can begin to integrate themselves into the ecosystem. After a long time under the right conditions – perhaps hundreds of years – the rock is transformed into a mature forest ecosystem. This ecosystem, unlike the system that started it, is in a pattern of sustainability – a kind of steady state where diversity, interconnection of species and the give-and-take of the cycle of life are fully realized. The exact state of the ecosystem could change at any moment, requiring the forest to alter some of its structure to adapt, but the pattern and process of sustainability is still in place. The forest still has the resilience and core integrity to avoid losing its sustainable pattern. If the forest were to be decimated by logging, or fire, it may then return to a state where the sustainable development of the pioneering life is needed again.

As discussed in Chapter 3, human developments are not very much like natural ones, especially these days. The pace and scale of many modern-day developments have lead to a strong, linear view of the process and to the definition of "better" being very narrowly defined. That said, there are a few good examples of organizations that are pursuing sustainable development quite honestly, or have begun to do so. A Canadian example which immediately comes to mind is Mountain Equipment Coop (MEC). MEC is a cooperative, which means their governance structure is quite a bit more democratic than many other clothing manufacturers and retailers. This structure of decision-making has allowed them to follow a mission which is also quite atypical. Their three long-term goals of activity, conservation and marketplace show a clear sense of their desire to change their organization towards sustainability, particularly the sustainability of the wild

[20] In addition to the comparison I've provided here, I also recommend Robinson's essay "Squaring the circle?" which contrasts and compares sustainability and sustainable development, while simultaneously reviewing the relevant literature as well as any other paper I've read [24].

spaces that matter most to their members[21]. MEC also takes a broad, organization-wide approach to their reporting and assessment activities. Included in their assessment are quantitative metric for the sustainability of their product sourcing, manufacturing, transportation of goods, building operations, employee engagement, community interactions, economic performance and internal governance. In fact, when I was preparing the All Our Relations survey of important community relationships discussed in the next section, MEC's efforts were an important reference, despite the fact that the two organizations are engaged in significantly different daily activities. MEC recognizes that they are not currently (nor may ever be) a truly sustainable organization, but they are working very hard to think towards that goal nonetheless.

Any organization like MEC that is pursuing sustainable development will certainly meet with significant challenge as they explore their impacts and connections and realize that they are quite a bit further from their goal than they'd like to admit. The challenges of sustainable development are what I'd like to discuss next.

## 3.4 The challenges of connection complexity, shared futures and resilience

Sustainable development transforms the previous challenges discussed in Chapter 3 – assessment, vision and feedback – in interesting ways. What start out as challenges to the way we act become challenges to our presumptions, meaning that we may have to change how we care about what we know at the same time as we change our ways of knowing. Sustainability challenges our ethics about our choices as well as our understanding of what we're doing.

This section is only an introduction to the three challenges of sustainable development. As such, I have focused on providing the core definitions of each challenge and brief descriptions of the problems and potential solutions that surround each challenge. I will be elaborating more on each challenge in the second part of the thesis when we turn to the case of buildings and the AOR Hospice and Retreat Centre development.

[21] I recommend reading their 2007 accountability report available at http://images.mec.ca/media/Images/pdf/accountability/MEC_2007_Accountability_Report_v1_m56577569830738027.pdf

## Challenge #1 – Connection Complexity

Connecting our desires to the impacts of those desires is a complex problem. Without this connection complexity, however, we could never satisfy the first need of sustainable development. If we can't assess our impacts outside our immediate control, we can't understand our responsibility nor can we change our desires for the better. A brief example of how hard it can be to connect desires to impacts will hopefully clarify the complexity that is involved and allow us to characterize the problem more effectively.

Imagine you are sick in bed, it's late afternoon, and you want to read a good book you got for Christmas to make you feel better. Your desire is for comfort – you want to read to take your mind off of being sick. But for that you need light. You reach over to the bedside lamp, turn it on and begin to read your book. Away from your focus, however, the following events occur:

- the electricity demand for your house goes up ever so slightly,
- switching at a central station adjusts to compensate for the slight increase
- the load on the circuitry of the electrical grid causes a small additional amount of power to be generated at the power plant, or set of power plants, currently providing power.
- A very tiny amount of additional carbon dioxide, nitrous oxide and particulate are released from all the coal-fired and natural gas-fired plants. Since it's summer, these plants make up a significant part of the Ontario power mix during peak times.
- Again since it's summer, the additional light in the room adds more heat, causing the air conditioner to cycle on earlier than expected. This energy use contributes even more significantly to the electrical demand for your house.
- Also, switching on the light causes it to wear out just that little bit faster than if you had just walked over to the curtain and opened it up instead.

You might be inclined to think that digging so deeply into such a simple example is a bit of stretch. Who really cares about the emissions from a single light bulb used by a sick person to read a book? The point, however, has more to do with the complexity of the connections which contribute to linking your desire for light to those emissions through the fascinating system known as the electrical grid and the thermodynamic wonder that is your household heating and cooling system. It's also important to recognize how many of the impacts have to do with aggregation effects (i.e. peak demand occurs when everyone turns on their A/C) and with operating conditions potentially outside your control (i.e. you don't control the source of power for your electricity).

**Problems that Arise:**

**Qualitative desires and quantified decisions.** Desires are in our heads, they are inherently qualitative and communicated (with time) using language. "I'm hot," or "I want light" are desires which can be easily communicated. "I want to run a green company" may not be as easy to express with rigour.

Even more vexing, however, is the fact that our most proficient schemes of assessment are very quantitative, especially when the scale of an organization is large. Our unit of measure for success is almost always monetary value. Reconciling the "quantities" of assessment and the "qualities" of desire can be very difficult.

**Traversing the system of impacts.** Impacts exist within a very complex system of interconnections and relationships. Organizations buy, sell and trade amongst each other. They have multiple and distributed processes within their own operations, they have people, places and processes that they control and when you buy from them you are assuming a fraction of the responsibility. Also, an organization's interconnections to the environments of culture and ecology are at the "ends" of the system. These environments contain the raw materials, the sinks for pollutants, the labour force, the profit takers and the buyers of products and services. The complex process of our technology links culture to ecosystem and back again.

**Making impacts relevant and meaningful.** Not all emissions lead to cancer. Not all new jobs lead to a better livelihood in the long term. Not all lights turned on lead to emissions. There is a need to know the relevance of a given impact and to normalize impacts from one endeavour relative to another, especially when they are meant to satisfy the same desires. Relevance also helps to determine "cut-off" criteria for the depth and scope of an assessment [9].

**The uncertainty of data and process.** A model of the system is only as good as the knowledge of the modeler and the data available as inputs. If we put garbage data in we will get garbage out. Also, those who want to make good decisions using these models expect reliability, reference and reproducibility. These things are not always available, but can a decision still be made without them?

**Potential Solutions:**

**A service-and-flow approach** [10, 11]. Hawkin, Lovins and Lovins define the service-and-flow economy as one that is "based on a flow of economic services [so it] can better protect the ecosystem services upon which it depends"[10]. By seeing all the processes in our economic system as part of the delivery of services to people, we have a good reason to understand all the complex connections of that system because we want to know how we contribute to the end game of effective service delivery. By exposing the network of flows that make up our organization's delivered services to those who use those services (often called a cradle-to-gate analysis of impacts) we can eventually build up the total impact of a service through its component flows. We can also, using this same perspective, imagine how what we dispose of as part of delivering the service may be re-circulated back into an earlier process or on to some other more valuable cradle. This is McDonough's brilliant vision of the cradle-to-cradle design paradigm.

**Process Network Models** [12, 13]**.** In the engineering field of system modeling, Herman Koenig, Rammamohan Tummala and Bruce Koenig have developed a very powerful graph-theoretic representation of the service and flow economy. Bruce's more recent work on the subject allows for an effective formulation of systems of equations that paint a thermodynamically and economically rigorous picture of the cradle-to-gate for any technological process. Visit sites.google.com/sites/keepbuildingsustainability for a paper I wrote which attempts to introduce Koenig's process networks as an effective tool for doing design with connection complexity in mind.

**Life-cycle Impact Assessment** [14, 15, 16, 17]. A science now entering its early stages of maturity, life-cycle assessment (LCA) and its "relevance-deciding" component life-cycle impact assessment (LCIA), have become effective tools for identifying the flows to ecosystems that are relevant during our study of connections. I will explore life-cycle thinking and assessment methods more in Chapter 5 and as part of the case study project in Chapter 8, but the eager reader should take a look at the references above for a good summary of the current practice and examples of the various LCIA methods that are the state of the art. Connections to the social side of the environment are less well described by this same literature. I don't blame eco-toxicologists for being wary of focusing on poverty and equity while they are focusing on climate change and cancer. The complexity of the connection between these things can be quite overwhelming at times, but they nonetheless exist. To respect them, we should attempt to understand them somehow.

**A respect for complexity** [1, 18, 19]. In the introduction I discussed the notion that simplicity is not always an elegant solution to understanding complex problems. An important corollary to this idea is that these same kinds of problems often require us to respect the fact that we won't fully understand the problem due to its inherent complexity. I believe that the ecosystem perspective and system complexity theory put forward by Kay, Lister, Holling and others in the works cited here apply to more than just ecosystem management. These ideas can also apply to a broader process of decision-making. Models of service and flow and impact assessments can only describe small pieces of the web of connections that needs to be traversed to do sustainable development.

## Challenge #2- Sharing a Future.

If possible, all participants in the diverse group of impacted people in a sustainable development need to come together to share a future of that development. Of utmost importance to this challenge is the willingness of the designers and deciders of the development to include all those at stake in an effective and equitable manner. Sometimes (often) this is the hardest challenge.

### Problems that arise

The problems that arise with inclusion of others are easy to list, but difficult to address. People can be excluded because:

1) **It's hard to include people you don't know…**
    a. …because they are far away.
    b. …because they are in a different cultural group.
2) **It's hard to include people you don't agree with…**
    a. …because your values differ.
    b. …because you want different things.
3) **It's hard to include people who aren't yet born…**

a. …because you can't guess at their world.

b. …because they can't speak for themselves yet.

**4) It's hard to include non-people…**

a. …because non-people are not as important.

b. …because non-people don't have a voice.

**5) It's hard to include people in time for the deadline…**

a. …because sometimes (1), (2), (3) and (4).

b. …because others aren't concerned with the deadline.

### Potential solutions

**Deliberative dialogue** [20]**.** I have been thoroughly drawn-in by Ann Dale's description of a process for slowly working with a group of people towards the successful state of *deliberative dialogue*. She describes the necessary dialogue as follows:

> Dialogue has the ability to bridge asymmetries within and between communities by building collective norms, values, and governance among diverse sectors (or "stakeholders," in the modern parlance of government). In this way, dialogue differs from consensus building or consultation, since it provides a more permanent, open-ended, and inclusive modality of shared decision making with the public[…]. These dialogues will not happen spontaneously; they need to be deliberatively designed, and the importance of emergent properties of reflection and contradiction valued [20].

In Figure 4 I've reproduced the diagram which Ms. Dale uses to show how a group of interacting people can evolve – from early engagement on to the powerful notion of shared futures – through the process of deliberative dialogue. This figure, alongside her full description of the process, illustrates how diverse groups can work together to build deliberative dialogue. It's easy to be cynical and describe this graph as too idealistic – the real world is a lot messier than a linear graph that fits onto a third of a page. But what inspires me about Ms. Dale's process is the gradual transformation of it. I don't think it's too idealistic to think that if we can really engage with each other where everyone has a voice we will eventually be able to trust and commit to each other. If you appreciate that each step along the time access will take as much time as it needs to, then I think progress can be made. The perpetual problem, as I will discuss further, is how much time is allowed for real dialogue. I will also return to Ms. Dale's ideas in Chapter 7 when I discuss my own process for fostering effective dialogue during a building development.

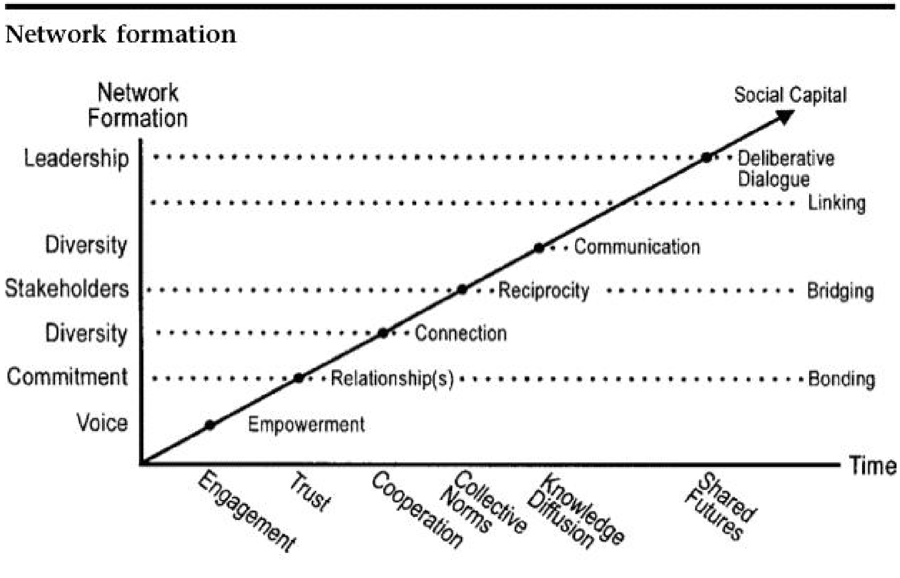


**Figure 4 – Network formation, reproduced from** [20]

**A shared ethics** [21]**.** In her recent Massey lectures, Margaret Somerville tackles the challenge of shared futures at a global scale and specifically the shared future of what she calls "the new techno-science". Though I am less interested in this specific topic, Ms. Somerville begins her lectures by proposing the fascinating idea of how to begin developing a shared ethics amongst a diverse group of people. She is clear that a shared ethics is different than a common ethics, since the goal is to seek out the broad areas of overlap between the ethics of a diverse group of people as opposed to trying to have everyone agree on a specific ethics. It's this process of exploring our ethical space together and seeking out these overlaps that intrigues me the most and it's this spirit of exploration that I feel can help to address the challenge of sharing a future with others. Ms. Somerville also proposes several examples of beliefs that might be worthy starting points for a globally shared ethics: a respect for nature and the natural, a respect for all life and especially human life and a shared concept of sacredness (which she calls the "secular sacred"). All three of these ideas are valuable places to begin an exploration of a shared ethics.

**Socio-ecological civility** [4, 22]**.** As I discussed in Chapter 2, I feel that civility is an essential human act of relationship. It only makes sense then for civility about our socio-ecological connections to be essential to sustainable development and especially essential to establishing a shared sense of what is important. It's always been fascinating to me how learning the intricacies of our connection with nature inspires people to care about those connections. This transformation from experience to values is especially strong in children[22]. That said, it is not only among the young that such exploration needs to take place. Perhaps it's my own history of civility that biases me, but I have always valued the native world view as discussed by Gardner and Roseland as a way to begin thinking about our relationship with nature, about how to respect our community and about how to make decisions without forgetting where we've come from or where we want to be [22]. I have been lucky to receive teachings from several native elders in my life and their lessons of respect and reflection are among the most powerful in my memory.

**Exploring the system to find the stakeholders.** One way to help decide who to include in the dialogue is to use a description of the system in question. A well-drawn system description will show, at least qualitatively, the connections between the process that is of concern (e.g. making widgets) and those who are part of that process (e.g. designers, builders, buyers, supply chain contributors, community members near the widget plant, community members downstream of the widget plant, etc.). By exploring the system and its life-cycle impacts, we can find those who care about changes to that system.

I will address this idea of using the model as more of a qualitative decision-making tool in section 7.1 and especially in 7.2 where I propose a potential modeling process for building developments.

## Challenge #3 – Resilience

Accurate connections and effective shared futures are certain to change with time and with the chaotic dynamics and general messiness that comes when people are working on tough problems. To pursue sustainable development means respecting change and creating a system that is resilient. Resilience is the key feature of the process of sustainability that is required even at the earliest stage of development.

### Problems that arise

[22] Fritjof Capra addresses this need for ecological literacy in the young quite effectively in the epilogue of "The Web of Life" [39].

It helps to look at the problems that give rise to the challenge of resilience from the systems perspective discussed in the first chapter[23]. The complex systems perspective helps us to realize that assumptions about the linearity, stability and limited dimensionality of real world problems are tenuous at best. We must recognize that:

1. **The system is multi-stable and not necessarily evolving towards a single end.** There are a lot of possible solutions that lead to an acceptable state for our system. This is both good and bad. Good because we can reach the same goal from a myriad of perspectives, but bad because it can be hard to admit when a completely different approach is sufficient, or perhaps preferred.
2. **The system is cyclic, yet recursively striving for life.** The twisted loop diagram from the introduction showed us that natural systems have a tension between preserving some connections, yet continually pursuing some tendency towards further complexity. Sometimes this means change through tighter coupling, sometimes this means change through near-destruction and rebirth. In the words of Maturana and Varela, this continual act of fostering connections is part of how we "bring forth our world" [5]. They argue that this is the ultimate goal of life.
3. **The system is multi-scaled and multi-dimensional.** Influences and perturbations will not come from one sub-system, group, or perspective. Trying to put different parts in separate silos may make the high level (i.e. most important) communication difficult.
4. **The system has non-linear dynamics.** There are slow-changing and fast-changing variables and sometimes the slow ones are the most important to the integrity of the system. This means that variables that we previously were not concerned with may have significant influence over the future direction of the system as it changes. For example, when we are constructing a building we may care more about getting funding from any source possible, not worrying about where it comes from. In fact, the fewer the number of sources, the easier it is to get the building going from an administrative perspective. Once the building is operating, however, what will happen if that funder goes bankrupt?

[23] My insight into these ideas has come mostly from reading the work of James J. Kay [17, 18] and C.S. Holling [1].

***Possible Solutions:***

**Citizen science** [19].Out of respect for complexity comes a desire to do science in a new way. The idea of citizen science is described well by Lister & Kay in their article on celebrating diversity. They describe a very fascinating kind of ecological management project:

> "We should consider demonstration projects that emphasise "learning by doing". Such projects should be small enough that if they are not successful, they can fail safely, without endangering an entire ecosystem, watershed or habitat. "Failures" or mistakes may provide experience that can be used in the future. In this way, the "surprising" nature of ecosystems can be turned into a learning opportunity rather than a liability."[19]

I agree strongly with the idea of experimentation through action. I think there is great merit in exploring this idea further in the context of organizational development and building development. Can we envision our development projects both as actions towards our organization's purposes, but also as small-scale efforts in sustainability research? The spirit of exploration, willingness to be open and acceptance of failure that comes with such an approach are all valuable to maintaining resilience.

**Assessments are cautious, adaptive, diverse and regular** [4, 23]. As I discussed in section 3.2, regular feedback of assessment is a requirement of any successful development. To promote sustainability through resilience, however, we must ensure that regularity is coupled with: (1) the ability to adapt our assessment process to significant changes in the system, (2) an assessment regime which is diverse in scope and scale, and (3) a willingness to be cautious when it's clear that assessment isn't enough to provide the necessary understanding of our impacts. This last aspect is often referred to as the *precautionary principal* and has become an important concept in many venues of system management and law-making[24].

Much of the literature I've read which relates to the idea of cautious, adaptive assessment applies to ecosystem management and large-scale development projects. There is, however, no reason to believe that the same principles can't be applied to the

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[24] I recommend the Wikipedia summary of this concept at http://en.wikipedia.org/wiki/Precautionary_principle.

activities of a local charity and their 20,000 square foot hospice and retreat centre. In fact, I would argue that the smaller the scale of the case, the easier it will be to see the most important connections and to include the important stakeholders in establishing a shared vision. As organizations get bigger, their ability to undertake a broad assessment of their actions becomes harder and harder. Of course the bigger they get without engaging in good assessment, the greater the potential for significant, negative impact[25].

Whenever I've thought about the seriousness of all three of these challenges of sustainable development, I try to remind myself regularly that they exist entirely in our heads. Complexity, stakeholder diversity and the need for resilience are not physical limitations, except perhaps when it comes to the time required to address them. This is not to say that they are any less challenging. In fact the opposite is true – cognitive challenges are often the hardest of all to overcome because they ask us to confront the thoughts, beliefs and emotions that govern our most basic, everyday actions. And we're often not very good at such confrontations [24]. Still, I try to remain hopeful – inspired by the successes of others and by the opportunity to address the challenges myself through my support of All Our Relations and their efforts. It's to this effort that I'd now like to return your attention.

## 3.5 All Our Relations: Envisioning from 2032 until now

With a fuller definition of sustainable development to work with and the relevant new challenges considered, you might feel somewhat more prepared to apply this knowledge to the case of All Our Relations. I certainly do. Of course, the AOR board and I were not nearly as up to speed when we actually began to think about sustainability and the sustainable development of their centre. This isn't an admission of guilt as much as an observation of experience. I've learned the most about the process of sustainable development in the fits and starts of the past five years.

So in the spirit of the case, this section and its extension in Chapter 8 are written both to express the details of a process that could be followed and to tell the story of the process that was followed. The focus in this section is exclusively on the very broad

[25] I am immediately reminded of the BP oil spill disaster in the Gulf of Mexico in 2010. As I write these words, at least tens of millions of barrels of oil are filling one of the world's richest ocean ecosystems.

assessment and (re)visioning of the organization as a whole while Chapter 8 deals directly with the case of using LEED as a design tool to support sustainable building development.

As discussed in Chapter 3, AOR has a mission "to create a model of service and compassion for the community in living and dying". This is a very challenging goal, as we've addressed briefly, but it is one that has the thought of sustainable development already within it – especially the idea of creating a model of service for the community. It was also a very early goal of AOR to pursue what the president called "stewardship of the land". I have come to understand that this desire applies very broadly to the activities of the organization, but also very specifically to the land they already own and hope to built their centre on.

***Step #1 – Explore the service, civility and governance of AOR from the viewpoint of the set of sustainability values.***

**IDEAL**

The first challenge of connection complexity is immediately apparent. How do a broad, tension-filled mandate, a piece of land and a business plan describe the relationship between desire and impact? Well, perhaps it can with the right approach. Figure 5 below shows a process of thinking that allows us to go from purpose to developed system and back again. The logic goes something like this:

- You clearly describe your purpose. This description exists in the context of a specific environment which you've created by stating a boundary of control.
- Your purpose dictates a certain set of relationships between what you want to do and the people, places and sub-services in your community. Though you do not directly control both sides of these relationships, you do have a strong connection.
- Based on the relationships that are needed, you can then envision the system you'd like to develop. What acts of service, governance and civility will you engage in to make the system function sustainably and promote sustainability within the community as well?
- As you assess the impacts of your hopefully sustainable system, you will undoubtedly realize that some impacts affect not only the more distant socio-ecological environment, but also the more immediate (and tightly connected) community

relationships. This may inspire you to change the system you've developed, change your purpose entirely, or perhaps change the relationships you've established within the community.

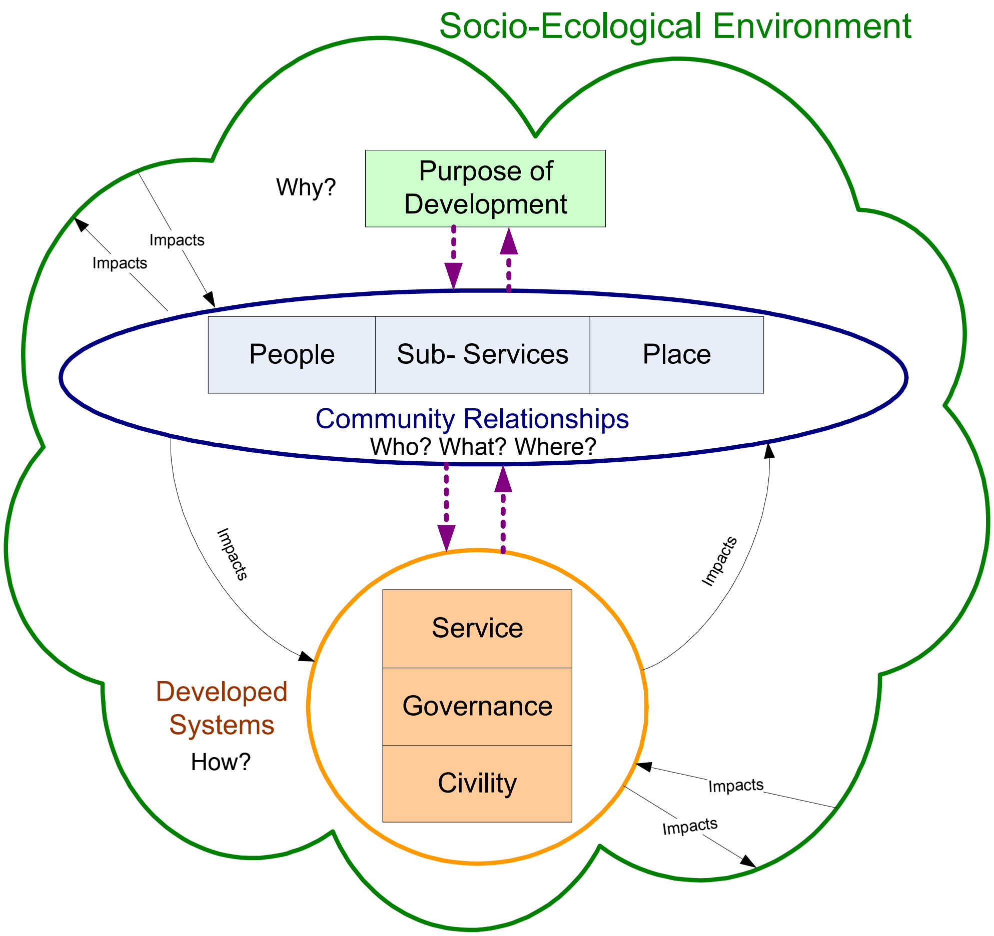


**Figure 5 – Organizational development system diagram**

Important ideas that flow from this first process of vision and assessment include:

1) Purpose can be broad at the start. What is important is that the stated purpose allows you to explore the relationships that will need to exist and covers the full range of organizational desires.
2) Impacts are numerous – they exist fully between the designed systems, the immediate community and the socio-ecological environment. To understand the sustainability of your development you should explore all significant impacts, at least qualitatively.
3) The community sits between the purpose of a development and the system that is developed to satisfy that purpose. This placement is intended to force those pursuing

sustainable development to think through their actions and continually check in with the community for necessary corrections to either system or purpose or both.

4) Once identified, the community relationships can inform us of who should be contacted to represent the interests at stake.

Based on our discussion from my first meeting with AOR and based on the ideal approach described above, I prepared a summary of AOR's purpose and the proposed sustainability values and then outlined the important relationships that require exploration. These relationships are discussed in full in Appendix #2 – Outcome #1: "Draft Sustainability Plan", but a summary is included here and in Table 1.

***Relationships of Place:***

**The Grand River.** Adjacency to the river heightens its historic and contemporary impact on the development.

**Local farming.** Connection with the adjacent organic farm and regional farming culture, including the community of Bloomingdale.

**On the edge of the city.** The tension and mutual benefit of urban and rural cultures in the region. Also, the tension that comes from offering an urban-focused service in a rural setting.

***Relationships with People:***

**Compassion and service in palliative care.** Addressing the best model of end-of-life care for all who are dying, but especially the growing elderly population.

**Learning both to live and die well.** Balancing both palliative care learning and broader sustainability-focused education for retreat-centre visitors.

**The volunteer service experience.** Ensuring enrichment opportunities, training and effective compensation is available for all volunteers and staff.

**Open and democratic governance.** Establishing effective internal and external systems for membership, decision-making and fundraising.

***Relationships through Sub-systems:***

**One building for many reasons.** The space to house and service the basic needs for hospice and on-site retreat.

**Being part of the healing network.** Connecting to the network of other healthcare services and to the network of other hospice care providers.

**Table 1 – Important community relationships for All Our Relations**

| Community Relationships | Relevant Sustainability Criteria | Appropriate Actor / Organization for Dialogue |
|---|---|---|
| **Relationships of Place** | | |
| The Grand River | SEI, LSO, InterE, RME, SEC | Grand River Conservation Authority |
| Local Farming | SEI, InterE, PA, LSO, RME, SEC | The adjacent organic farmer and other Bloomingdale farmers. |
| On the edge of the city | SEI, InterE, RME, IntraE, LSO, SEC | Regional Planning Authority |
| **Relationships with People** | | |
| Compassion and service in palliative care | InterE, IntraE, PA, RME, LSO, SEI, SEC | Palliative Care Nurse and/or Doctor |
| Learning both to live well and die well | SEC | Existing community palliative care and "healthy living" service and education providers |
| The volunteer service experience | LSO | Existing AOR volunteers and palliative care volunteers |
| Open and democratic governance | DG | Organizers from other similar NGO service providers |
| **Relationships through Sub-systems** | | |
| One building for many reasons | SEI, RME, PA, LSO, InterE, intraE, SEC, INT | Building developer, architect and MEP designers as well as expected building occupants |
| Being part of the healing network | LSO, InterE, SEC, INT | Reps. from hospital, long-term care and other residential hospice organizations |
| A system of giving | PA, IntraE, SEI, INT | Donor organizations such as the United Way |

***Sustainability Criteria Abbreviations:***

Socio-ecological integrity (SEI)
Livelihood sufficiency and opportunity (LSO)
Intragenerational equity (IntraE)
Intergenerational equity (InterE)
Resource maintenance and efficiency (RME)
Socio-ecological civility (SEC)
Democratic governance (DG)
Precaution and adaptation (PA)
Immediate and long-term integration (INT)

**A system of giving.** Money, for a not-for-profit organization, is secondary to the purpose, but essential to the continued viability and operation of that organization. What is a sustainable distribution of funding sources for the proposed activities?

Each of the ten areas identified was described using a series of questions about how AOR's proposed actions would impact that relationship. The questions were also related back to the core sustainability criteria so their importance could be better qualified during discussion. Each of the ten relationships also lends itself quite directly to who would be most at stake, and who could represent the relationship best in a deliberative dialogue.

**REALITY**

The first meeting was between the members of the board (3 in attendance), myself and Dr. Robert Gibson. The purpose was to review Dr. Gibson's general sustainability criteria and trade-off rules and begin to discuss the core purposes of AOR from the perspective of these criteria. Also, an important outcome of the meeting was to consider the stakeholders that should come to the next, more detailed, discussion about the vision of the organization.

The written material that was prepared (i.e. the summary and ten relationships above) was useful for facilitating the subsequent discussion, at least as described in step #2 below. The board accepted the ten areas of focus outlined above with little debate. Because there was a limited amount of time (only two full-day sessions were available) I did not conduct a thorough discussion of whether any relationships were missing or whether the proposed relationships were sufficiently well-described.

Also, in part due to time constraints, contacting and including the identified stakeholders was not very thorough. Though, in my ideal situation above, we were hoping to create a deliberative dialogue with all stakeholders present and contributing, I've realized that this was a very unlikely and perhaps foolish expectation at this early stage of development. Before we could include such a large group of people in our detailed discussions, the board needed to come together a few times first to understand and learn more about the challenges of sustainable development from their own perspectives. Thankfully, a good amount of discussion centered on this challenge – both of attendance at meetings by the current board and of the proper steps to take before involving too many others in the bigger picture. We came to a number of key conclusions about involvement:

- We would need to prepare the proper written and verbal material for review during a dialogue with a larger group of stakeholders.
- Until that time, people on the board and others who attend would need to "wear a variety of hats" to represent different perspectives. This role-playing approach would be important to thinking from a variety of perspectives.
- There would need to be a few additional people involved, even in the earliest discussions, because the board did not currently have those skills and perspectives.

Prior to the second meeting, we did manage to confirm the attendance of a hospice care provider, the current volunteer coordinator for the organization and an additional board member with extensive business development experience.

**Step #2 – Look into the future at least a generation and see how the actions of AOR will satisfy a vision of sustainability for the organization.**

**IDEAL**

With the sustainability values, decision-making strategies, relationships and impacts described (at least in rough) and the right group of people assembled to have a lively discussion, you can begin the first of two steps in what I've learned to call "backcasting" [25]. This first step is looking far enough into the future and asking the question: "What do we want things to be like?"

In the case of AOR, it made sense to make that time in the future a single generation – 25 to 30 years (2032-2037). The Region of Waterloo has a growth management strategy document that also looks a similar amount of time into the future (to 2040) to envision the people, land use and services that will be and that will need to be available in the region and discusses how to plan for this future. Aligning the AOR visioning horizon with the regional one makes a great deal of sense and allows us to (1) make use of many relevant statistics, (2) understand the region's perspective on related issues and (3) to communicate our plan more effectively to regional government.

Though the challenges and goals for sustainability apply to the organization as a whole, there is a natural separation of the discussion into three important categories of action.

**Regular operation and maintenance of services.** This category includes the daily operations of the Hospice and Retreat services AOR plans to provide. This category reflects day-to-day activities and actions that AOR can take to meet its sustainability vision. This category also (for now) includes actions which relate to the design, siting, construction and dismantling of facilities and operations.

**Programming and education.** This category focuses on educational and on-going learning and experiential opportunities that AOR wishes to be engaged in or help to facilitate at the centre. Actions in this category can often be broken down into three different levels of involvement: open facilitation (making space/facilities available but not running/administering), active facilitation (openly and actively pursuing others to regularly run/administer events) and in-house programs (running, administering and facilitating).

**Advocacy.** AOR, as a mostly service & educational organization, may need to become involved with government, advocacy and civil action to inspire the community and decision-makers to pursue mandates which it feels are important to a sustainable future. This category discusses efforts to pursue such aims.

These three categories were simply meant to focus the types of actions considered by the group along case-specific lines of service, civility and governance. The categories were mainly meant to ensure that we didn't forget that action can occur at least in these three directions as opposed to just as a service-focused organization.

## REALITY

The second day was full of lively debate and challenging ideas for the entire group. The additional participants – the palliative nurse, the volunteer coordinator and the businessman – added the necessary breadth and depth to the discussion, especially for the "compassion and service in palliative care" relationship. This particular issue consumed much of the afternoon and led to several very valuable insights into the future service goals of AOR as a palliative care provider[26]. I feel we focused so much on this issue because of three very important reasons: (1) on average, the people in the room were most informed about this issue, (2) I had spent the most time preparing material for this

[26] For the full conversations, see Appendix #1 – Meeting #3 and Appendix #2 – Outcome #1: "Draft Sustainability Plan".

issue, and (3) palliative care is the most complex (and therefore interesting) part of the planned purpose of AOR.

Since we were working through the ten relationships in the order presented above, our extended debate over palliative care made it hard to address the remaining relationships adequately. It was decided at the end of the day that we would eventually return (after the design of the building had begun) to this discussion, perhaps with a rotating set of appropriate attendees to suit the specific relationship in question.

One, perhaps serious, issue with stopping the backcasting exercise prematurely was that we did not directly focus on the "one building for many reasons" issue in these earliest conversations. Since the discussion in Chapter 8 addresses how LEED was used to design the concept for the building, some of the sustainability-related issues highlighted were addressed. In fact, much of the discussion in the second half of this report deals with the difference between a LEED-focused approach to concept design and what might have come out of a back-casting exercise. Though it is too late to have this conversation without the design team knowing about LEED, I do hope to revisit the "one building" sub-service discussion along with the other relationships which were not fully addressed.

***Step #3 – Work back from that vision to today – to our next steps.***

**IDEAL**

The backcasting exercise was originally applied to discover what Brooks called a "soft path" [25] to the use of a resource. For this reason, backcasting likely works much better for resource planning and management than it does for organizational development. This later type of development is much broader in its required community relationships – especially in the case of All Our Relations. That said, the Natural Step has had success in generalizing the concept of backcasting, at least based on the literature and testimonials that I have reviewed[27]. The appeal of trying to work from an ideal case back to a current reality is in the excitement of seeing the ideal as possible first. The hope that comes from such a vision makes the hard work of getting there easier. This approach is especially useful for organizations who wish to undergo substantial change, or who are really just

[27] Visit the Natural Step website for more information at http://www.naturalstep.org/.

starting out on their development path. This later situation is the case for All Our Relations.

This process of backcasting, however, must make imperative the set to sustainability trade-off rules as discussed by Gibson [4] and must address the three challenges of sustainable development at each step backwards. It can be easy to forget these concerns – especially through the error of omission. This is why an iterative process and an open dialogue during steps #1 and #2 are crucial.

**REALITY**

Since step #2 was not completed for AOR it was difficult to move on to the second phase of the backcasting exercise. I am certain that after completing the first stage of the backcasting exercise for the remaining relationships, we will return to each issue to complete the second, more-challenging stage. Also, I hope a great deal of the work already done for the concept building design will make that issue and several others much easier to address.

Given that my focus for this project was on the concept phase development of AOR's building, I did not expect to be able to complete the full exercise in the time available. As you will see in the discussion in Chapter 8, however, several issues that would likely have been addressed during this exercise were needed and partially developed as part of the concept building design. Some other aspects, such as the interconnection between the building and other important relationships, could have served to be more thoroughly developed in advance of the building work.

## 3.6 Organizational sustainability

As discussed in the introduction, my original intention with this thesis was to focus equally on the pursuit of organizational sustainability and on the specifics for buildings. I realize now that this goal was overly ambitious, but before we move on to buildings I would like to briefly summarize the conclusions that have come from my experiences with AOR and their earliest work to consider their organizational sustainability.

The process (and learning that came from following that process) can be summarized in three key points:

1. **Explore the system of relationships**
    a. Establish the complexity of relationships – from purposes to community relationships to actions to impacts and back again.
    b. Determine a starting list of the necessary stakeholders
    c. Establish a relationship between your actions and the criteria for sustainability.
2. **Engage in a deliberative dialogue about a vision for the future**
    a. Ask for the necessary stakeholders to be represented in some way, even through role-play
    b. Use backcasting as a tool to both inspire people about what the future could be and begin to understand how that future can come about.
    c. Ensure that when trade-offs are considered, they follow the rules outlined by Gibson et. al.
3. **Don't expect perfection**
    a. Prepare for things to take longer than you initially think.
    b. Prepare to learn more about the process by doing then through preparation.
    c. Setting both easy and hard goals for success will ensure that the process doesn't seem like a failure, but still seems like it can go further.

As we move into the next section of this thesis, I will return to these ideas again in the context of developing buildings in their conceptual phase and for the specific development of the case study of AOR's Hospice and Retreat Centre.

# 5

# Sustainable Buildings

A quick search for "sustainable buildings" on Google reveals over 16,000,000 results, but a similar search for "green buildings" reveals over 100,000,000. What makes a building green? What makes it sustainable? Can a building be both green and sustainable? Clearly there's a lot of buzz about both concepts. There's also, potentially, a lot of confusion about these two ways of describing buildings.

What is it that makes the word "green" easier to use? For one, it's simpler. A colour is more directly attributed to our senses and experiences without needing a tangible definition. Green is also representative of a movement that existed before the idea was directly applied to buildings, so there is some history [26]. Perhaps more importantly, green is very vague, which lets us get away with a lot. Just as a vague definition of sustainable development has allowed some people to pursue their own agenda, so has the green building movement.

As much as I like to avoid the idea of green buildings because of its vagueness, the idea of sustainable buildings, given all that I've said about sustainability so far, is a little harder to agree with. In fact, I'd like to make what might be considered an outrageous claim. ***Buildings cannot be sustainable. Only living systems can pursue sustainability.***

"But aren't buildings alive?" you may be inclined to retort. And you would be right to do so. As we can see from studying Figure 6, buildings are a lot like people. They have a very similar life-cycle and they have many of the same systems essential to their functioning. When we try to look inside a building's metaphorical head, however, it's the collective consciousness of the people who occupy the building that we see and it is that consciousness that has the capability to pursue sustainability or not. I guess what I'm trying to say is: ***What we do with our buildings, we do to ourselves.***

| | People | Buildings |
|---|---|---|
| **Life-cycle Phases** | | |
| Inception: | Not long (minutes?) | Design: 2-20 weeks |
| Initial Construction: | ~ nine months | Construction: 6-36 mnths |
| Birth-Death (i.e. lifetime): | ~80 years (in North America) | Occupancy: 30-100 years |
| Decomposition: | 1-2 years | Disposal: a few weeks. |
| **Systems** | | |
| Strucutre: | Bones | Foundation & structure |
| Protection: | Skin | Building enclosure |
| Heat/Cool/Ventilation: | Circulation, evaporation | HVAC systems |
| Senses: | Nervous system | Sensors & controls |
| Consciousness: | Mind | ***People in the space.*** |

**Figure 6 – People and buildings, a comparison**

Buildings have a very strong interconnection with the rest of our lives. They are the place where a great deal of the service, governance and civility in our lives is undertaken – especially in our cities. They are also the connection point for many of the community relationships – technological, psychological and ecological – that I described in Chapter 4. They're the place we drive from and to, they are the place we use energy to convert materials from one form to another, they are the place we sleep, eat, work, laugh, play and dance. They are our home, our office, our gym, our market and our cottage. From the earliest days of agricultural human culture, buildings have been ***our place***.

Buildings also have a very significant impact on the socio-ecological environment. A concise list of the most important classes of these impacts includes[28]:

- *Equity*, *socio-ecological integrity* and *livelihood* impacts associated with the consequences of site selection, construction of a building for new purposes and delivery of site services such as utilities and transportation.

[28] A full coverage of all the relevant impacts of buildings is outside the scope of this report. That said, I have provided a basic coverage in Appendix #1 – Meeting #5. Also, I refer the interested reader to [28], [42], [43] and [44].

- *Socio-ecological integrity*, *resource maintenance and efficiency* and *equity* impacts through the consumption of water, materials and energy during the full life-cycle of the building.
- *Socio-ecological integrity* impacts within the space based on indoor environmental quality and the general health of the space.
- *Socio-ecological integrity* impacts on the immediate site and on adjacent, near-by and far-away ecological habitat and cultural space through emissions to air, water and soil during the full life-cycle of the building[29].

Also, because of the power of place that buildings have, they are a significant source of livelihood and sufficiency through their construction, sale, operation and ownership. This fact is more evident now than ever before, as building development has become one of the most significant methods of stimulating economic activity during government reactions to the recent financial market collapse[30]. Not coincidentally, this collapse was caused by mishandled and arguably greedy investments *in the building industry*[31]. The connection between these observations is that property and building ownership are among the most powerful ways in which the rich maintain their wealth and we all make our living. Who controls a space and the space services available has a direct impact on many of the various aspects of sustainability outlined in Chapter 1. Of particular importance are issues of sufficiency *(what buildings are essential for our lives?)* and equity *(does everyone deserve adequate shelter that they control, at least in part?)*. There is a special kind of wealth that comes from building ownership and permanent occupancy. ***It is the wealth of space – space to do what you want to, on your own terms, under your own control***. Space, and especially the space created in buildings, has associated with it a very clear and legally-defined act of control. This need for our space and the services that are delivered to that space for our use is a pervasive cultural desire.

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[29] I've attempted to relate the activities associated with buildings back to the sustainability criteria outlined by Gibson in [4].

[30] I'm specifically referring to the "Infrastructure Stimulus Fund" provided by the Canadian Federal Government. For info visit http://www.buildingcanada-chantierscanada.gc.ca/creating-creation/isf-fsi-eng.html.

[31] For a quick summary of how the financial crisis of 2007/2008 relates to the overvaluation of housing assets, visit http://en.wikipedia.org/wiki/Financial_crisis_of_2007%E2%80%932010.

For this reason, a great deal of governance and service centres around buildings and their development. We will investigate the importance of building developments further in Chapters 6, 7 and 8. First, we should explore the relationship between the growing desire to understand the sustainability-related impacts of buildings and the subsequent development of building rating systems as tools for understanding those impacts.

## 5.1 LEED buildings

Because of the study of LEED as a concept development tool presented in Chapter 8 , my focus here will be on the LEED rating system and in particular on the Canadian version of LEED that is developed and enforced by the Canada Green Building Council (CaGBC)[32]. This is not to say that there are not other (in fact, numerous other) building rating systems that are designed to provide the same education and service[33]. I feel this is an important point to bring up right away. All “green” or “sustainable” building rating systems and their providers seem to have in mind three key purposes:

1) Education of building development stakeholders about the impacts that buildings have on the socio-ecological environment. They also seek to create a building development community to share ideas and to reward those who have done well in the eyes of the rating system. These acts could be seen as ones of civility.
2) Defining a set of rules regarding which building impacts are most important to consider and which actions taken by building developers succeed in achieving a reduced negative, or even net-positive, impact. This act could be seen as one of governance.
3) A third-party review and critique of the actions taken and resultant building impacts. This act could be seen as one of service.

Unlike the other tools, however, LEED has become the most prominent tool in North America trying to satisfy these purposes. In fact, because it is the most pervasive of

[32] The current version of the standard that is most relevant to my discussion is “LEED Canada for New Construction version 1.0”[44]and all applicable addenda. The full set of current LEED standards can be found at http://www.cagbc.org/leed/systems/index.htm.

[33] A few other good examples of certification systems include BREEAM (http://www.breeam.org/), Green Globes (http://www.greenglobes.com/) and BOMA BESt (http://www.bomabest.com/).

all the rating systems, LEED has undergone a great deal of scrutiny. In the interest of time and focus, I'm going to work under the assumption that you are informed, at least a little bit, about LEED and its purpose. Instead, I would like to address, in this section, two important questions regarding LEED as an assessment tool:

1) How has LEED become so successful?
2) Does LEED as delivered by the CAGBC satisfy the three purposes outlined above with sustainability in mind?

Even though LEED itself is a tool, the CAGBC is the organization that delivers it. They are ultimately responsible for its value to the process of sustainable development. By reviewing praise for and challenges of LEED – both from within the building industry and from without – I think answers to both of these questions can be revealed.

### 5.1.1 Praise for LEED

Unfortunately praise is typically anecdotal, while critique is more often well documented. In my years of experience working with LEED I have had several lively conversations with owners, architects, engineers and my colleagues at Enermodal about the most valued aspects of LEED to the typical building owner and occupant. These conversations are where most of my evidence of praise exists, bolstered by the work of Jerry Yudelson. Some of the benefits listed here are mirrored in his more thorough discussion of LEED's success to date [27].

**Point #1** – *The point system is easy to understand and dynamic.* All you have to do is add up your points to determine your success. Also, there are really only four levels of success – certified, silver, gold and platinum. If you want to push into the next level of success, you'll have to add more points. It's as simple as that.

There is a straight-forwardness to the point system as well: "If I do this and document it, I get a point." This is what I call the "best-practice" approach to success. LEED describes the actions required and as long as you are in compliance with the description, you succeed at achieving the point. As a result of this approach there is also no real delay between the successful documentation of all the points and the submission of the certification.

There is also a valued trade-off benefit to the system: “If I don’t do this, I can do that and still succeed.” When one point isn’t achievable according to the required approach there will probably be other credits that make more sense to pursue, though there are pre-requites in all categories of impact. As an extension of the idea of customizability, there are also different versions of the standard. Both the USGBC and the CaGBC have created several LEED systems for different phases of development and types of construction, resulting in different systems of assessment for:

- new construction and major renovations of commercial, institutional and industrial buildings
- new construction of homes
- new construction of speculative space (core & shell)
- new construction or major renovation of commercial interiors
- existing building operations and maintenance
- neighbourhood and community developments

These different versions have been in response to the uptake of LEED. Each version helps to: (1) clarify the system by excluding or modifying points that don’t apply to a given situation and (2) make concessions for some developments that have difficulty pursuing specific requirements owing mostly to the complexity of the coordination process (e.g. core and shell builders don’t always know who their tenants are before they move in).

**Point #2** – *Council structure is trustworthy.* The green building councils are designed to include players from the entire industry. They follow notably democratic governance within the council using a committee-based consensus approach. The broad and extensive expertise of those on the various committees also provides a sense of confidence in the decisions that are made.

There are a number of aspects of using the rating system which are also fairly open and give the building owners access to the decision-making process:

1) You can submit a request for clarification on the ruling about a point. This clarification can influence the adjudication of the point and sets a precedent for changes to the rating system.

2) There are a small number of innovation points which are at your discretion to use to advance the field of building design and development in some way. These points are intended to capture innovative actions on the part of the design team and the building developer and are very open to interpretation.

**Point #3 –** *The mission is inspiring.* The stated mission of leadership in design applies both to the person applying and to the industry as a whole. The Green Building Councils want those who pursue LEED to foster change in the industry by individually being leaders in each building they build.

Also, just like the system of Olympic medals, LEED's levels of success make people feel as though they are achieving something valuable, especially relative to others who have not achieved the same level as them. The level system also inspires a mechanism for competition among peers.

**Point #4 –** *The intents are sound, the metrics are adapting.* The foci on energy, water, materials, site and space encapsulate many of the major impact areas relevant for buildings. And the system is changing based on criticism. Some of the criticisms discussed in the next section have been addressed in the latest version of the rating system and there is always a healthy, though perhaps less democratic, dialogue of how to change LEED for the better.

### 5.1.2 Challenges of LEED

#### The Pragmatist's Challenge[34]

**Point #1 –** *Points don't lead to sustainability, good work does.* The simple point that we should focus on performance through good design and clear assessment of our design is, unfortunately, a worthwhile critique of LEED. There are prerequisites in LEED for some common sense design strategies such as sufficient indoor air quality and HVAC system commissioning, but points are also offered up for other examples of good design such as meeting basic thermal comfort requirements and avoiding and controlling air pollutants at their source. This first pragmatist's point really just asks that the most basic, practical

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[34] Though I have read many pragmatic critiques of LEED over the years, I am most indebted to Joseph Lstiburek for his recent direct and biting critique [45].

concepts of good design should not be credited, they should be assumed as part of the minimum requirement for leadership in green buildings.

**Point #2 –** *If you aren't really any better than other buildings that aren't LEED certified, what good is LEED?* This point is especially true for energy-relate impacts which can be (and have been) more directly measured and compared. An excellent report in the U.S. prepared by the New Buildings Institute showed that the average LEED-certified building is only marginally better in terms of energy performance than its counterpart non-LEED building built to code requirements[35]. The report also showed that there are numerous certified buildings which perform somewhat or even significantly worse than the average building. The central argument in this challenge is that if LEED is trying to define what makes a building "sustainable" or "green" or even just *better* then all buildings certified by LEED should actually be *significantly better* than the average. The response from the green building council to this challenge, at least in the U.S., has been to require those who submit for certification to commit to sharing their energy and water use statistics. We shall see if this requirement, along with a significant increase in the importance of energy points, results in a shift towards real performance that the pragmatist is looking for.

### The "Living Building Challenge" Challenge[36]

The Living Building Challenge (LBC) is the brain child of Jason McLellan and continues to be developed by him and other members of the Cascadia Region Green Building Council. The folks at Cascadia have all been involved with LEED projects on the west coast of Canada and the U.S. for many years and they have done an excellent job in taking the intents of LEED and extending them to what could arguably be described as their holistically sustainable ends.

**Point #1 –** *Evaluation of success should be fully performance-based: best practice should lead to best performance.* This is a simple point, but one that LEED has continued to avoid even in the 2009 version of the standard. As much as possible, the evaluation of all building impacts should be through measurement of actual consumption and emissions.

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[35] The report [46] and Listuburk's discussion of it [45] are both excellent reads.

[36] The Living Building Challenge is now in version 2.0. I used version 1.2 when I did my review of this critique to LEED, but the spirit of this earlier version is in version 1.3 which is still available on-line at http://ilbi.org/the-standard/version-1-3.

Instead of doing an energy model to prove a building is energy-efficient, simply show that the building is net-zero on its energy bills. A good example of where LEED's approach can fall down in this regard is with building fresh air requirements. Currently, LEED permits energy savings credit for using carbon-dioxide ($CO_2$) detection as a proxy for occupancy to control outdoor air amounts. This rather complex mechanism of control is acceptable because it is assumed to be an energy-efficient technological improvement. If, however, the same building that employs $CO_2$ control has accidentally over-estimated the baseline ventilation requirement, the amount of outdoor air brought into the building may be no different than if the $CO_2$ sensors had not been installed in an otherwise properly-ventilated space. Assessment of the real energy usage is where this mistake would be realized.

My assumption has always been that LEED has avoided this kind of direct assessment in its new construction certification programs because of the time delay involved in waiting for results and because of the need for a suitable reference standard for new construction. It's curious, however, that the LEED standard for existing building operations and maintenance (LEED EB:OM) is based on real performance of the building and that EnergyStar® requirements have been deemed a suitable reference for this standard[37].

**Point #2 –** *Go further, in all directions, now!* All the LBC criteria are prerequisites or "imperatives" to success. This fact greatly simplifies the assessment scheme but also makes it very challenging. This point is not as much a critique of LEED as a critique of the entire building industry. The proponents of the LBC feel that the proverbial bar needs to be substantially raised when it comes to building impact improvement. The implication for LEED is that it does not go far enough. I would argue that this critique is probably acceptable to LEED's proponents. They want to transform a much larger segment of the building market than the very small number of projects that are likely to pursue the Living Building Challenge.

**Point #3 –** *A building is a building is a building – there are no separations between different building types and processes*. The LBC's structure of prerequisites encompasses

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[37] Visit http://www.energystar.gov/index.cfm?c=business.bus_index for information about the requirements of this standard.

all building types and ages. Also, in the newest version of the standard, any scale of building project – from community developments to renovations – is assessed using essentially the same system of prerequisites.

This "one standard fits all" mentality is contrary to the multiplicity of LEED systems discussed above. I think the reason the building councils have created the various certification types is to make it easier for the actors who control the various phases and parts of the industry to achieve certification without the involvement of the rest of the industry. This allows representatives from the housing construction community to set the rules and requirements for that industry separately from those who have a similar interest and expertise in the commercial market. Market-specific systems of assessment potentially allow LEED to penetrate those markets more effectively, which is a central part of the mission. I agree with the LBC, however, that the more important goal should be impact reductions, not market penetration. If LEED is watering-down or otherwise simplifying requirements in order to increase certifications then debate and change is needed.

**Point #4 –** *Consideration for beauty and socio-ecological civility should be part of our building assessments.* The sixth category of the LBC version 1.2 was named "beauty & inspiration" and required buildings to include features which satisfied desires for human delight and cultural celebration. In my anecdotal conversations with architects, this imperative for beauty is something they often feel is missing from LEED. There is also a requirement in this section of the LBC for building owners to provide education material and regular tours for the general public to "facilitate direct contact with a truly sustainable building" [28]. This call for socio-ecological civility is something I support a great deal and I agree that it should be an imperative for all buildings that make improvements towards sustainable development. LEED accommodates those who want to focus on occupant and guest education in their buildings through the innovation credits, but having a few education-focused prerequisites would be a good way to foster the kind of best-practice recommendations that are important for all buildings. If a building's occupants don't know the motivations and choices made by the owner to improve the impacts of the building, then an important part of the leadership spirit of LEED is lost.

## The "Life-Cycle Assessment" Challenge[38]

**Point #1 –** *Look at the full life-cycle of your choices.* The studies that have been done to critique LEED from this perspective have all come to the same first conclusion: when we trace the choices made to achieve similar LEED results through their material and energy transformation processes, we may find vastly different net impacts. For example, instead of looking at site energy use, the focus should be on primary energy which is the "delivered energy including production and delivery losses" [29]. In a place where electricity is generated mostly by coal, as opposed to being generated mostly by hydro dams, the emission impacts of electricity are vastly different.

The potency of this argument is that if you take the intents of the LEED credits as describing their purpose, then those intents do demand a life-cycle approach to assessment if it is possible to know the full impact of the building through such an approach. But can the best practice approach get it right most of the time? For the energy and atmosphere credits the answer to this question is possibly "yes", since the correlation between energy conserved on site and energy-related emissions and consumption throughout the life-cycle of the building is quite strong. It's in the material and resource credits where the best practice options are less connected to the life-cycle results. For example, a bamboo counter-top shipped all the way from China may actually contribute much less to carbon emissions than its locally sourced granite cousin. The argument here is that the devil is in the details of how the material was grown, harvested, processed, transported, re-processed and delivered. All of these factors should be considered when deciding the success of one material choice over another.

**Point #2 –** *Impact assessment should be based on an established set of impact metrics, not on cost.* The cost part of this important critique is made well in the NIST report [30]. The calculations in LEED – for both energy and materials – are based on costs, not on mass flow or on a more relevant indicator metric such as carbon emission. The use of cost as an implicit weighting of importance for both energy and materials is one of the major simplifications that was introduced into LEED to allow designers and builders to

[38] There are three excellent sources that make up the bulk of the reference material for this challenge: the National Institute of Standards and Technology in the U.S.[30, 47], a recent evaluation by Humbert et. al. in the Journal of LCA [37], and the ever-present voice of Wayne Trusty and his colleagues at the Athena Institute[29, 32].

perform the calculations more easily and to avoid the political ramifications of choosing one metric of impact over another. Cost is the easy choice, but if there is a significant disparity between cost and actual emissions-related impacts, does it make sense to continue using costs?

The other important part of this point is the recommendation of a standard set of reference impact metrics. These recommendations are the best part of the life-cycle challenge, but they are also the easiest to critique. Life-cycle assessment (LCA) practitioners argue for the use of a scientifically-based set of quantitative metrics of building impact (i.e. one consistent with the ISO 14040 standard) which would provide definite rigor to a LEED assessment. The practitioners of building LCA that I have read, however, differ quite a bit in the impact assessment and interpretation parts of their efforts. Humbert et. al. are probably the most thorough by using the full set of IMPACT2002+ metrics and their associated normalization factors [15]. But there is still significant dispute in the life-cycle assessment research community about which metrics should or shouldn't be considered as part of the core set [14].

Focus in all these critiques also seems to be mostly on the materials credits and the energy and atmosphere credits, since these are the areas where consensus about life-cycle inventory methods are reliable. Repetition and the associated reliability of life-cycle impact assessment results is still improving, since the discipline is still new and growing. This newness, coupled with the complexity of LCA work, is probably why LEED has only begun to introduce LCA thinking into its structure recently [31]. The addition of more life-cycle thinking is likely, however, as more and more efforts to think from the life-cycle perspective add to the weight of these arguments[39].

### The "Sustainability Assessment" Challenge[40]

**Point #1 –** *LEED doesn't take a building's purpose into account when deciding if it merits a leadership designation.* This choice is understandable, given the desired scope of the tool. However, we should be careful to reward those attempting to wash their sins away with the watershed of "LEED means green".

[39] For example, the PHAROS project is attempting to provide standardization to the life-cycle assessment of materials selection. Visit http://www.pharosproject.net/ for more info.
[40] This section is labeled "Sustainability Assessment" owing to the ideas developed by Gibson et. al.[4] which the three points discussed here reflect.

For example, how would LEED judge the following hypothetical (but plausible) example of a LEED-candidate industrial facility?

- The building's HVAC systems are connected via co-generation or heat recovery to the waste heat from the process.
- Much of the large roof surface features a 100 kW solar photovoltaic system which could account for at least 20% of the remaining regulated (i.e. non-process) energy use.
- All water lost during the process and used by the modest staff for typical non-potable purposes is recharged from rain water captured on the large roof surface and stored in a large underground cistern that also serves as an innovative source of cooling water for part of the process.
- The space provided for regular occupancies features excellent daylighting, controllability of heating and cooling, natural ventilation through operable windows and full monitoring of indoor environmental conditions.
- The materials for the building envelope, the structure, and the interior finishes are made either from local, recycled, rapidly-renewable, or reclaimed materials and all have very low volatile organic compound (VOC) content. An attractive Forestry Stewardship Council (FSC) certified and Urea-formaldehyde (UF) free wood panel floor and wall finish is used throughout the office areas.
- This finish, though mostly symbolic (since not a lot of wood is used throughout the building) is intended to show respect for the adjacent 250 hectare hardwood forest which was protected as part of the purchase of the property.
- In fact, the plant is sited on top of an older, derelict industrial site. Much of the old structure has been rehabilitate for the modest office and plant staff areas. The soil damage from the previous industrial process has also been remediated. The large space surrounding the plant on three sides has been naturalized with native and adaptive species. A path has been provided for employees and the local community to enjoy the woods and naturalized areas. All storm water is effectively managed on site.
- Finally, the extension of a near-by transit line has been arranged through the well-established relationship between the building owner and the municipality where the building is situated.

I hope it's clear that such a facility could apply for and likely receive the platinum level of LEED certification or even qualify for the living building challenge if additional PV were to be installed. Several other public and private industrial facility projects have pursued LEED, though they do not tend to pursue LEED as often as commercial and institutional organizations[41].

Now, imagine that this facility is a new coal-fired power plant planned for construction in Alberta. There is an almost immediate reaction to describe such a building's LEED certification as green washing no matter how great a project it is. The challenge I'm trying to pose here is that there are a few space uses that make a building inherently unsustainable and labeling such a building as green or a leader in the field is far from the intended purpose of such a label.

We could ask ourselves the question: "Why shouldn't a coal-fired power plant be a LEED building?" I think this is the wrong question, however. We probably should ask: "What is it about a coal-fired power plant that makes it not a contributor to sustainaiblity?" One of the key environmental goals of LEED buildings is to reduce their energy-related emissions to air. If a building's inherent purpose is in direct contrast to this central goal, does it not make sense to deny that building a certification?

Those who are strong supporters of LEED maintaining a neutral stance on the purpose of the space in LEED-certified buildings have a point. There is a very slippery slope to climb when deciding what the "wrong" kind of space is. Is it ok to certify the head office of a company who is known to have committed international environmental atrocities? What about the converse problem? If a new facility has a clear social benefit through the use of its space (a social housing project, for example), should it be allowed to achieve certification with less stringent requirements?

Ultimately, this is a debate about how the purposes of space matter. I hope such a debate serves to show the CaBGC that they, as the living-breathing organization responsible for LEED in Canada, must consider these exceptional cases when judging the value of their certification system to the building industry.

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[41] In fact, a quick review of the CaGBC certified projects list (at http://www.cagbc.org/leed/leed_projects/index.php) shows that less than 10% of certified LEED projects are Industrial / Manufacturing facilities.

**Point #2 –** *The CaGBC does not engage in fully open, democratic dialogue about the structure of the LEED rating system.* As discussed in the LCA challenge above, how we weight the different impacts of a building can be very subjective especially on a building-by-building basis. But the broadest process of weighting impacts – the one that sets priority for 10 energy conservation points vs. 5 water conservation points, for example – is not within the power of each design team, nor are the weightings openly debated by the practitioners of building development. The CaGBC (and, even more so now, the USGBC) have control of how we weight the different impacts and, indeed, which impacts are included in the rating system. What if a design team doesn't agree with the weightings?

One response to this challenge is: "I assume the experts who are members of the CaGBC know what's best when it comes to building impacts." They certainly know a lot about the issue and there is a diversity and strength of expertise amongst members of the CaGBC. As we discussed in section 4.1, however, the challenge of sharing a future demands the inclusion of as many stakeholders as possible in the most important decision-making activities of an organization. Those who succeed in becoming members of the council have a proven measure of expertise, but many also have a vested interest in setting the direction of the building industry. Vested interest and expertise are the first two steps down Ann Dale's path of the destruction of social capital [20]. It can be a reliance on "experts" when making complex decisions that eventually leads to the full exclusion of those for whom the decision has the biggest impact – the occupants of the space itself.

Another retort would be: "You can't expect to involve everyone in the building industry in setting the over-arching criteria for LEED." To which the response is: "Yes, that's true." But the CaGBC could also change its structure to offer membership to anyone who desires it. Or, they could easily involve everyone who is currently considering submitting, has submitted and has certified a LEED building in the country by including a free membership with each registration for the entire design team. The problem is not involving everyone, the problem is being sure to involve at least the most important people and avoiding excluding those who want a voice.

A final response to this challenge is: “LEED is only one rating system and if people don’t like it they can go elsewhere. There is always the democracy of the dollar.” I agree with this statement, but I’m not sure the CaGBC does. They want LEED to be Canada’s most used and most reputable building rating system. In fact, this goal is the one that trumps all others when it comes to the sustainability of a rating-system-providing organization. If you aren’t a trusted authority, you probably won’t have anyone use your system and your mission of leadership will fail. It’s arguable, but I think that the path to developing such an organization sustainably will require a more democratic and broadly-held structure of power where members from throughout the green building community have a voice when the most important decisions are being made.

**Point #3 –** *LEED recommends best practice in design, construction and operation, but why doesn’t it explicitly advocate the best practices of integrated design and owner education of building impacts?* People want a LEED building because they see it as representing something better. The problem is they are not required to understand what better really means (or even what the core issues of building impact are) for themselves and for the shared future of their organization and community. I will not elaborate as much on this challenge here, as it is one of the central discussion points in Chapter 7. It’s important to include this challenge now, however, because it illustrates one of the key reasons for the success of LEED to date: not rocking the boat too much. In an effort to make a rating system that was accepted by the industry, LEED had to be simple, fairly quick to implement by designers and builders, and allow the building owners and occupiers (who are often the deciders) to pass off the responsibility of understanding the significance of their choices to the bigger picture. But as I stated above, this explanation of significance – this building of socio-ecological civility – should be a core mission of any organization who wants to promote the sustainable development of buildings. As we move through the next three chapters, we will see the structure of the boat (perhaps “massive oil tanker” is a better metaphor) that is the building industry and why the challenges of dialogue and education are so hard for an organization like the CaGBC to promote.

# 6

# Building Developments

Building developments are one of the most significant acts of development that any organization – family, business, community, government – can engage in. And we certainly do engage in building developments regularly. A quick search on the Statistics Canada website will reveal that in 2009, construction accounted for more than $69 billion (2002 dollars) or roughly 6% of the Canadian economy[42]. Real estate accounted for a much larger sum – $149 billion or more than 12%. All told, the money that changes hands for the purpose of space construction and occupancy is the most significant in the country. Also, as we've just discussed, it's not just the monetary value and legal relationships established around property that make space so important to us. *Our* space also gives us a sense of success, pride, community and control over our future that matters much more than money. I think it's important, therefore, to be very clear on what we mean when we talk about building development.

What follows is a series of definitions and related discussion that attempts to dig down into the process of building development, at least as it is commonly followed in the Canadian context. I've attempted to mirror these definitions directly with those from Chapter 3 to provide a connection between buildings and the broader idea of development discussed there.

**Building development.** *A significant process of change of space for the betterment of an organization or person.* I say "significant process" because I want to exclude regular maintenance activities from the perspective of this discussion. Restoring a building from a derelict or even less desirable state is a clear act of development, but doing regular maintenance of a building that is otherwise operating as desired is not really development in the way that I would like to address it. The level of effort required for the former is

[42] See http://www40.statcan.gc.ca/l01/cst01/econ41-eng.htm for the industry-wide GDP for 2009 and http://www40.statcan.gc.ca/l01/cst01/fin06-eng.htm for the real-estate specific numbers.

usually much more significant than for the later. That said, there isn't really an obvious line between repair and development; it's more of a spectrum. Sometimes the smallest changes at one level can produce significant changes throughout the system.

In general I'd like this idea of change-of-space to apply to almost every meaning of the word space. Changes to the basic services (e.g. lighting) to the aesthetics (e.g. colour of walls) to the space use (e.g. parking vs. parkland) and to operating procedures (e.g. training for employees on waste management practices). The scale of these types of activities may vary hugely from international, to company-wide, to the renovation of a bathroom.

**The boundary of building control.** There is a very strong legal boundary drawn around our building developments – the site boundary. This boundary represents one of the most important separations in human culture. Almost everything inside your site boundary is your responsibility, but you are also afforded many freedoms within your own site. As soon as you (or any services you desire) cross that boundary, a great deal more responsibility is implied. The site boundary is the legal unit of assigning responsibility by government and by other service providers such as energy utilities. In Canada almost every square meter of land is controlled, through the mechanism of site boundaries, by someone. There are, however, many properties held in the common trust of government, or through public and private partnership. These shared spaces, especially those with impressive ecological or cultural diversity and uniqueness, are highly valued by Canadians.

**The desires of building development.** Building developments are about creating space-for-use. In Figure 7, we see a very similar structure to the one presented in section 4.2. The earlier image was used to describe the relationships between the purposes, community and actions of an organization. This new diagram explores a very similar relationship of components.

At the top, in green we see the ***target functions of the building (i.e. the building's purpose)***. These functions are directly tied to the earlier discussion about the sub-services that are required by an organization to fulfill its purpose. In the case of AOR, having a building to engage in all of the varied activities of the organization was one of the chief development relationships that needed to be explored.

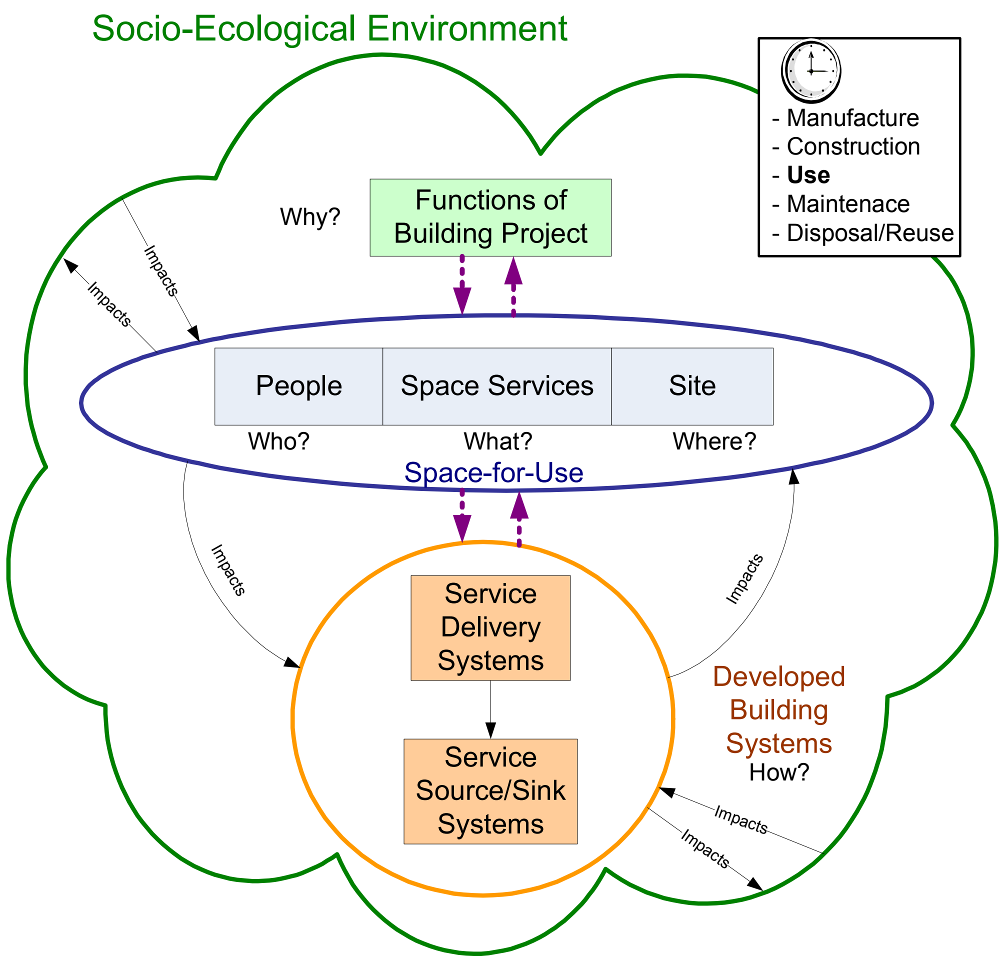


**Figure 7 – Building development system diagram**

As I've discussed, this need for physical space is pervasive, so almost every organization has spent some time describing and changing the space of their daily actions.

Just as the broader purposes of the organization help describe the community relationships that are required, the broad functional requirements of the building define the ***space-for-use*** that is required. The space-for-use of a building development characterizes the relationship between the people, the site, and the space services that are expected to be delivered to those people at that site. Space services can include a variety of different things, but very often include:

- separation (e.g. from the outdoors),
- interconnection (e.g. a view to the outdoors),
- heating and cooling,
- fresh air,

- light,
- connection to electricity and communications channels,
- disposal of wastes (liquid, solid and gaseous),
- drinking, washing and cleaning using water (of varied temperatures),
- storage (including temperature-controlled storage) and
- work surfaces (in various planes)

These ten essential space services are needed for almost every building development to one degree or another[43]. There are also many other special space services that apply to different building functions, especially those that are thought to be industrial in nature.

The reasons the space services are required, for whom they are required and the specific location of their requirement is what is often described in the ***functional program*** of a building. These three issues (who, what, where) clearly define the qualities of the spaces that are required – they describe the space-for-use.

Interacting with the space-for-use and environment are ***the developed building systems*** (e.g. structure, envelope, HVAC, lighting, etc.). These systems are intended to provide the desired space-for-use. It is the proper design, planning, construction and use of these systems that is the central focus of the building development process.

You can see that I've also (somewhat artificially) separated the developed systems into two pieces – ***delivery systems*** and ***source-sink systems***. Delivery systems link the space-for-use to the source or sink for the service in question and the sources/sinks link the delivery system to the environment. For example, a faucet and pumped piping network (delivery) link the service of drinking water to the on-site treatment system and well (source). It often helps to see a distinction between the piping and the well because two different people may have control of the two systems. This possibility is especially common for energy-delivery systems whose sources (e.g. natural gas, electricity) are often controlled far from the specific building in question.

The final important part of the diagram is the ***boundary of control*** that separates the development from its socio-ecological environment. As discussed, this boundary is often a very real (at least in our social lives) and legal boundary between one property

[43] For an excellent summary of building form and essential function, I recommend Edward Allen's "How Buildings Work" [48].

and another. It also represents the minimum scope of responsibility of the building development team. Anything that crosses or is adjacent to this boundary has, in some way, a relationship with the development.

Recognizing that the site boundary is usually the significant boundary of control brings to light the fact that the space-for-use developed must include consideration for the entire site area, not just those spaces which are constructed within a building envelope. We often call the “building” just these interior spaces and everything else the “site”. I am fine with these distinctions, but will sometimes use the words interchangeably because I don’t really see a reason to separate the two throughout the majority of this discussion. Because there are certain legal requirements which apply to “buildings” and others which apply to “sites” doesn’t change the fact that a development is happening over the entire space within the site boundary.

**The Impacts of Building Development.** As part of their interconnection with the socio-ecological environment the developed systems will have numerous impacts on that environment as we have already discussed in the previous chapter. Likewise, the environment will impact the developed systems in a variety of ways.

Also, as the space-for-use “comes to life” through the developed building systems, it too will have impacts on the environment as it shapes the people, the site and ultimately the organizations that occupy the building and their community. These impacts result, quite simply, from the actual use of the space. Is the space being used for the purposes that were expected and intended, or has it been used for other dynamic and un-expected reasons? Who is benefiting most from the space that has been developed and does that group overlap with the intended benefactors?

The relationship of impacts between space-for-use and building systems must be respected too. The quality of space brought about by the systems will change through the changing desires and forces within the space. A light switched on and off too often will burn out a bulb, requiring its replacement by someone. A bird will nest for the winter in an uncovered drain pipe. A new manager will prefer privacy and install a blind. Space affects systems which affect space and so on. The ever-important concepts of occupant health, comfort and usability of the space fit into this set of impacts. As do measures of system durability and reliability.

Also, all of these impacts will occur in a variety of ways throughout the life-cycle of the building, not just during the use phase of the building. In fact that is why I have used the term space-for-use because it is the use phase of the building life-cycle that is the targeted phase (i.e. the one everyone's always working towards). The impacts of manufacturing, constructing, maintaining and disposing of the building systems developed for this purpose must be deliberately brought into our field of vision, otherwise they may be neglected or at least marginalized. I will deal more directly again with all these different classes of impacts in Chapter 7.

Related to the life cycle impacts, but worth mentioning separately, are the significant impacts on the team of people who are developing the building. Their experiences throughout the major phases of the development will affect not only the building project in question, but perhaps many other projects in the future. These particular impacts, especially the ones that occur during the earliest conceptual work of a project, are what I would like to address next and from the perspective of sustainability in Chapters 7 and 8.

## 6.1 Process in context

The building developments I have worked on and studied most closely are those of multi-unit residential, commercial, institutional and light industrial organizations. As a result, most of the discussion here and in the next chapter will focus on these types of buildings and is based on my personal experience of involvement with building projects. I would also like to thank Martin Jewitt formally from Enermodal Engineering for his perspective and lessons about the contractual aspects of building developments, much of which is included in these definitions.

### 6.1.1 The people

Let's first review the major actors involved in the building development process. For ease of discussion, I will attempt to label them by the role discussed in Chapter 3 that best suits them[44].

[44] There are many different kind of contractual relationships in building developments. The discussion here is focused more-so on a typical "bid-spec." style contract, but the actors and process described can easily be generalized to any situation where construction is separate from design which is separate from ownership.

## DESIGNERS

**The architect (i.e. the consultant of record).** The architect is the principal designer for a building project. She will often be the one to sign a formal contract with the owner to become the consultant of record. This person is legally bound to provide a set of documents which are used to describe the requirements for the developed building systems.

**The service designers.** The architect will often hire a team of sub-consultants with specialized expertise in the areas of interior, landscape, structural, civil, mechanical and electrical design. These designers will share in the responsibility of preparing the contract documents and will also share in the value of the architect's consultancy contract with the owner.

## DECIDERS

**The owner.** The owner is the person or organization who will legally possess the developed systems when they are completed. He is also often the person who possesses the legal property on which the building site sits. The owner is the ultimate decider of the highest-level actions to be taken during the development process, specifically which consultant of record to hire and which contractor to hire to build the building. For some organizations, ownership of a building project is passed from one group to another at the end of the construction phase of the project (which we'll discuss briefly). The most common case of this transfer of ownership is in the case of speculative residential developments such as high-rise condominium projects.

**The owner's representative.** Often, and especially for large and costly projects, the owner will hire a representative to manage the development project for them. This representative will be given specific contractual power to make some decisions on behalf of the owner, especially decisions of scheduling and minor adjustments to contract requirements. Their more important role, however, is the effective management of the owner's expectations and desired outcomes for the full design, plan and build phases of a development.

## BUILDERS

**The general contractor (i.e. the contractor of record).** The general contractor is the person or organization hired to construct the building systems in their entirety according to a very detailed contract with the owner. Like the consultant of record, the contractor of record will be paid a specific amount of money for a building project delivered in accordance with this contract. It's important to note that the contract established between the owner and the contractor is not only for a specific set of building systems, but also for a specific timeline. Changes to either the agreed-up systems or the timeline results in a conflict of contract between the owner and the contractor which can often lead to changes in the net monetary value of the contract.

**The sub-contractors.** Since the general contractor cannot often complete all the specialized building on their own, they will hire a possibly large number of sub-contractors with specialized experience in a given trade. These sub-trades often align quite closely with the division of work for the sub consultants (e.g. a mechanical sub-contractor for the mechanical design).

**The product manufacturer or supplier.** Buildings, like most complex systems, are an assembly of pieces. More so than for most complex systems, however, buildings contain thousands of components that are not constructed by the contractor or the sub-contractors. Many of these components, or products, are sourced through a myriad of suppliers who work exclusively with contractors and sub-contractors in the building industry. Because of their complexity, buildings are one of the only developments that touch virtually the entire supply chain including raw materials such as sand and aggregate, simply-refined products such as lumber, finish materials such as drywall, simple machinery such as a light switch, complex machinery such as an air handling unit, electronics such as an occupancy-controlled lighting system, living organisms such as bedding flowers, and the list goes on and on.

## USERS

**The tenants or occupants.** The tenant is the person who will occupy and use the space-for-use when it is completed. In a variety of situations the tenant is also the owner and will therefore have a seat at the decision-making table. If the tenant is not the owner, they may still have a strong influence over the owner, especially when there is a great deal of speculative space and not as many potential tenants.

**The building operator.** In almost every situation of commercial, institutional and industrial buildings, there is a specific group of users who are charged with the regular maintenance and detailed operation of building sub-systems. The operator is a special kind of user, but a user nonetheless. The operator will often be employed directly by the owner and may be charged with the operation of many different buildings for that owner.

## IMPACTED

As discussed in Chapter 3, anyone who is touched in some way by the impacts of a development – including the nine groups above – is counted among the impacted. That said, I would like to highlight three important groups of people who are often involved directly or indirectly in building developments.

**The neighbours.** Probably the most obvious group of people who are impacted by the development of a building site are the geographical neighbours of that site. This group of people often share property boundaries with the developing organization and can be the most vocal if they have concerns about the potential impacts of a development directly or in-directly on their own property and also (though less often) about the impact on the local community[45].

**The local community.** Virtually every building development has an associated community, even those in the most remote locations. This is so because the inhabitants of every site will, at some point, desire to interact with other people or they will at least need resources. For most buildings there is a local government that places specific community requirements on developments. This is especially true if the building is connecting to local sub-services managed by that community such as fresh water and sewage conveyance, electricity, waste collection and most importantly – people. These people often become employees, customers, guests, clients and partners with the organization developing the building. Both in the official legal capacity (through building code authorities) and in a variety of unofficial but equally important ways the local community will share and/or impose their desires on every building development.

[45] I particularly like John Jackson's description of how NIMBYs (not in my back yard) become NIABYs (not in anyone's back yard) in [49].

**The building development community.** There are many others developing buildings, many to serve similar purposes, across the country and across the world. As discussed above, part of the purpose of rating systems like LEED is to bring together and share the experience of these different projects and create a community of best practice. Deciders of building developments, especially of green building developments, are always keen to follow a path that is proven as successful. The idea of “quick assessment through the experience of others” is usually how the building community can have the greatest influence on an on-going development. The best test of whether a proposed choice is a good one is if someone else who made the same choice is still happy with her decision.

### 6.1.2 The process

Buildings often follow quite closely the major semantic stages of development outlined in Chapter 3. These developments follow a series of stages/cycles of ever-increasing length as depicted in Figure 8.

**Operation & Maintenance**

Though the diagram implies a “left-to-right” approach to describing the process, I would like to start from the longest stage of development – the operation & maintenance stage. In the diagram I have assumed this main stage will last what could be considered a reasonable amount of time for a building to remain in use in more or less the same state – 30 years (or 1560 weeks). This expected amount of time, under good maintenance practices, is commonly called the “predicted service life” of a building [32]. It’s a prediction because no one really knows what the actual service life of any development will be. It’s important to predict and plan for this service life, however, because of how long the operating period is relative to the rest of the development cycle. Many of the significant impacts of a building occur during this phase of the development.

It’s during this relatively long use period that an organization focuses on its operations – on the processes for which the space was developed. The ideal condition during this period is to reduce the focus on, effort towards and monetary cost of the building systems so that these things can be directed towards the activities of use.

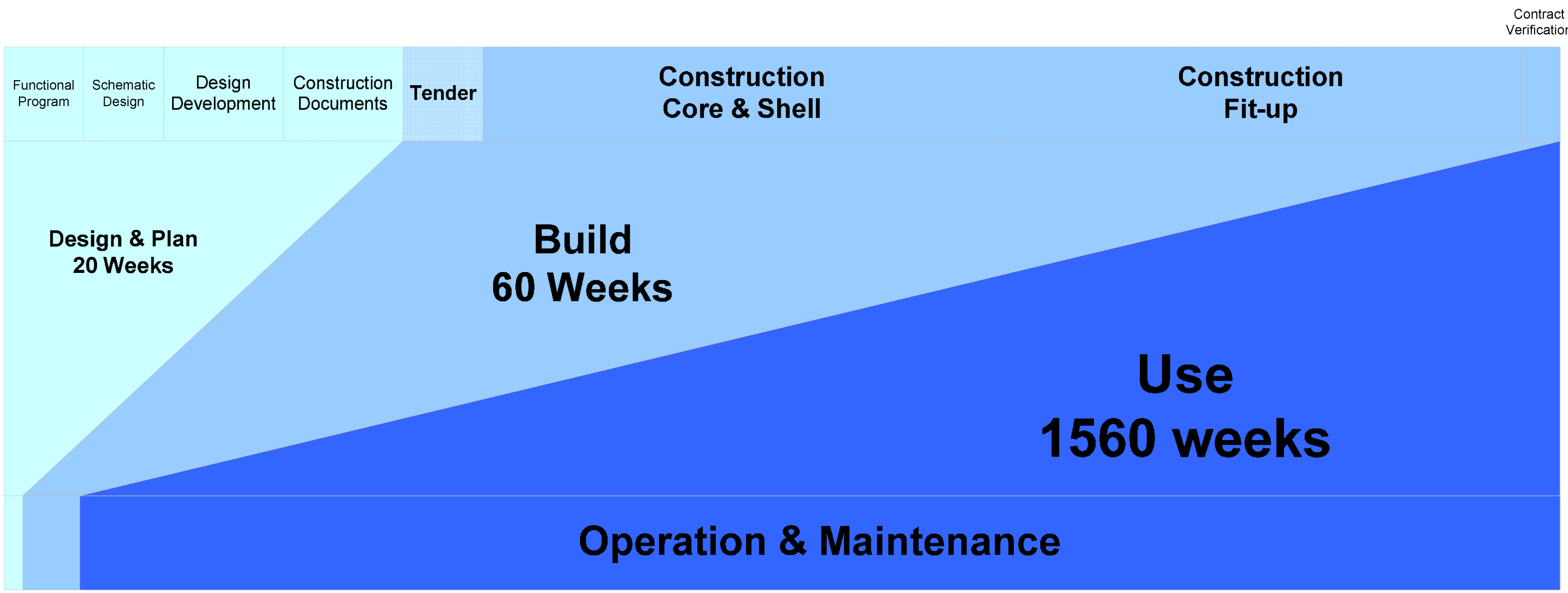


**Figure 8 – Building development timeline**

Design, planning, decision-making and construction during the use phase are, therefore, minimized. When these acts are required, it is often the preference of owners and occupants that they occur simultaneously across many systems to reduce the "down time" that is suffered by the operations of the organization as a result. This is why service life planning is so crucial – to ensure that renovations are efficient and timely [32]. There is a tension between the vague and challenging work of predicting and planning for the service life of a building project and the importance of such prediction and planning to maximize operational effectiveness.

When design, planning and decision-making occur during the use phase they are often conducted by the building operator where such a person is different from the owner. Motivations for mid-use development (often called renovation or redevelopment) need to be strong and usually coincide with organizational change in other ways. For example, if a company were to begin pursuing an organization-wide carbon reduction strategy, they may consider auditing and renovating their existing facilities to reduce emissions from building energy use.

**Construction**

Construction is when the physical structures of the development are brought to the site, assembled or crafted into systems, tested for compliance with functional requirements and then signed off as being in conformance with the requirements of the development contract. This last act must occur before the building is officially passed to the owner, operator and occupant for the use phase.

I have put 60 weeks as an approximate length of this phase for illustrative purposes only. The actual construction phase length will depend a great deal on (i) the functional program (especially on the sheer size of developed space) (ii) the complexity and uniqueness of the development plans as described in the construction documents and (iii) on the decision-making process leading up to and coinciding with construction. As mentioned above, the price set for a building development between the contractor and the owner is contingent on both a building's plans being effectively realized and on the amount of time required for this realization.

There are often two semantically useful parts to the construction phase – the core & shell construction and the fit-up construction. The former involves the assembly of the most basic, central components and often includes the construction of the source/sink systems such as energy plants, structural members, the building enclosure and the major water and waste conveyance systems. The later involves a “fitting up” of these core systems with the delivery and aesthetic systems such as finishes, lighting devices, work surfaces, electrical devices and data communications equipment. Contractually, the fit up may also be the responsibility of the tenant to negotiate, while the owner is almost always responsible for the core & shell.

Design & planning that occur during construction (often called *re-design*) centre around a very rigorous set of procedures for altering the requirements set out in the tendered documents. If the change is minor (e.g. slightly longer delivery time or different colour of paint) no additional charge or credit is usually imposed. However, for more significant changes, both owner and contractor are entitled to credits on their accounts and they will almost always seek such credit. Especially when a change order is issued by the owner to the contractor, large additional costs are often imposed because: (i) the price of such a change is at the whim of the contractor; (ii) there is an inconvenience to returning or disposing of incorrect parts and (iii) there is additional labour to change-mid-course or (in some cases) demolish and rebuild a piece of work and (iv) there may be cascading delay effects on other work.

In the case of new building development, construction is often the single most costly (in terms of $ and person-hours) period of any building’s life-cycle. This statement is especially true if you assume that the actions of people within the completed space-for-use are not directly associated with the building’s development which is often the assumption of the owner and always his assumption when the owner is not the occupant[46]. Because of the large relative cost of construction and because of the strong legal implications of construction contracts, much of the design, discussion and decision-making for a building development is done prior to contract tender.

The tender phase of any large building development is arguably the most complex of all the phases. It’s at this transition point that plans which are perhaps not quite ready

[46] The exceptions to this typical case are developments which contaminate their site or a neighbouring site during the occupancy period. In these cases, the disposal or end-of-life phase can be the most costly. Nuclear reactor buildings are such developments. The end-of-life remediation for these (arguably failed) developments can often coincide with the start of a new development project on the same physical site.

are rushed to completion. It's at this point that those who have not been directly responsible for planning pass a fine-toothed comb over the prepared documents, since those documents will form the basis of a legal contract. The tender phase also represents, for most developments, a most critical decision-making step – the selection of an appropriate contractor. Selection is often done on the basis of the lowest-price bid under the assumption that all potential bidders are equally capable of performing the work to the level of quality and speed outlined in the tender documents. The urgency of this decision is softened for projects which pursue bid processes such as *Design Build* or *Construction Management* but the transition from plans to contract must occur for all buildings whether sequentially or in a single stipulated sum. What is curious is how little time is spent in discussion between the owner, the consultant of record and the potential contractors regarding the clarity and usefulness of the tender documents in the act of preparing a bid.

**Design & Planning**

This part of the development is often just called "the design phase" because design is the word most people use to describe the act of going from desire to action. In my discussion I have separated out the steps of envisioning, designing, deciding, and planning because of the complexity of the visioning and decision-making processes. I don't want designers to get too much of the responsibility and, correspondingly, too much of the authority. They are experts at design, but they may not be experts at vision or decision or, for that matter, assessment (which we will address shortly). This phase of the project is the only one which exists entirely inside the heads and woven into the discussions of those who take part in it. Significantly fewer trees are harmed in the visioning, design and planning phases of a building than elsewhere (despite the reams of specifications and drawings prepared at the end of this phase for tender).

Because the success of a building project can be seen to depend heavily on the quality of the contract documents, considerable authority is placed in the hands of the consultant of record and her team to guide the owner through the process of preparing those documents as expeditiously as possible. Because there is money at stake during design as well (though not nearly as much) the more revisions that are required later in the process (especially during the rush to prepare plans for tender) the more frustrating and costly things can become. And the timelines imposed on the design & planning team are often much shorter (as shown in the diagram) than for construction. As we will see, tight timelines and a complex set of legally-binding documents are two of the most challenging aspects of the design process to deal with when attempting to pursue sustainable development.

The main (and sometimes only) acts of visioning done during the development process of a typical building are done in the earliest two phases of the diagram above – functional programming and schematic design. Before anyone spends time preparing documents, there is often a small push on the part of the consultant of record and the owner to spend a little time thinking very broadly about the kind of building that is desired. How big should it be? What are the qualities of the space-for-use? What types of people will occupy the space and in what numbers?

Two questions that are often answered even earlier than the beginning point of this typical process are: (1) “How much are we willing to spend?” and (2) “Where will the physical site be located?” It’s not so strange to think that the two most culturally-engrained notions of wealth – money and land ownership – are the decisions that are not up for much (if any) discussion during the key discussion period of most building developments.

In the remainder of this thesis I’d like to address directly the concept phase and pre-concept phase which constitute the earliest and (in my opinion) most important visions, designs, decisions and plans of any building project. There is one thing that is quite certain – the better the concept is, the better the building is likely to be overall [33, 34].

### 6.1.3 The concept development process

There are three essential parts to the concept development process that I would like to describe in more detail before we revisit the challenges of Chapter 3 – assessment, visioning and feedback.

**Site selection**

Site selection is not commonly thought to be part of a building's development process, since it is usually done by the owner without the support of the traditional development team and prior to the other stages of the concept phase.

Many important desires play into the selection of an appropriate site. The most important of all of these desires is the distance from current or anticipated users (customers, employees, etc.) as that distance affects who can come to the building from a reasonable distance away which ultimately impacts operational costs or the potential benefit of the organization. Other logistical constraints such as connection to special other sites and processes or distance to transportation hubs may also play a role in deciding the best area to look for sites. Of course, for most organizations that are well-established, the best place is often on the same site that they already have or one very close by.

Once a specific community or area for the development is clarified, the site selection process might be seen to follow a decision-making structure as follows:

1) We need to change space use, but we don't need to add any new space.
    - i) Can we just move people around once within existing available spaces?
    - ii) Can we retrofit an existing space without adverse impact on our current operations?
    - iii) Can we move minimal activities away, creating an open space to be retrofitted, then move back?
2) We need new space, but already have sufficient site area.
    - i) Can we build a second structure on existing land without disturbing operations?
    - ii) Can we add new space in addition to renovating existing space as per 1-iii?
3) We need new space, but don't currently have sufficient site area.
    - i) Can we lease a new space with a building that is already sufficient for our desires?
    - ii) Can we purchase a new green field site to build new space quickly?
    - iii) Can we purchase a brown field to build on after it is remediated?

iv) Can we purchase an existing site and buildings that we can easily demolish and remediate and then build on?

v) Can we purchase a new site that requires reuse of the existing site and building features?

This set of questions illustrates the implicit set of additional short-term construction and loss-of-operations costs. As we move from changing without disturbance to buying a new space with existing building that must be demolished or reused we add the following costs:

- Loss of operating time for move (all stages)
- Costs of fit-up permitting for changes and fit-up construction costs (1.ii, 1.iii)
- Additional loss of operating time due to multiple moves (1.iii, 2.ii)
- Cost of additional permitting and related costs for new construction (2.i, 2.ii, 3.ii through 3.v)
- Operations losses for longer move to new site (3.i through 3.v)
- New lease (3.i)
- New site (3.ii through 3.v)
- Brown field remediation costs (3.iii, possibly 3.iv)
- Demolition costs (3.iv, some for 3.v)
- Existing systems remediation and additional design fees (3.v)

Often, the exercise of site selection is a decision-making process which attempts to minimize these various costs, within a preferred boundary for the place of operation, for a variety of properly-designated sites (i.e. sites that have been designated as suitable for development by the municipality) . Help in finding new sites within the preferred boundary is often provided to the owner by a real-estate agent. Real estate agents act, in this context, as the owner's representative in the contractual negotiation of land purchase.

**Functional Programming**

As discussed briefly above, the functional program for a building is a description of the space-for-use that is desired by the owner and/or occupant. Several crucial visioning details are developed as part of a functional program:

1) An overall description of the facility's general purpose

2) The expected schedule of occupancy for the building and the peak and typical occupancies of the various spaces
3) The total amount of space and number of spaces desired for different purposes
4) Details regarding the relationships between spaces (e.g. adjacent-to, far-from, isolated-from, etc.)
5) A description of the qualities, quantities and controls of the services that are required in each space and for the building overall (e.g. light, temperature, water-access, etc.)

Programs can vary widely in detail, but they will often include at least some information about these five items and they will always include the first three, since without this information, no design can be done. When it comes to developing space-for-use, the purpose, the size, and the occupancy of the desired spaces is essential. These crucial pieces of information are also essential for site selection, so the development of a functional program will often start before, or during, site selection. Often, however, items (4) and (5) are not done prior to selecting a site. My impression based on projects that I have been involved with is that it is the designer of record who often leads the owner through the process of developing items (3), (4) and (5) while the owner will have already developed items (1) and (2) on his own.

You're probably wondering why I'm spending so much time worrying about the order that things happen in these early stages of development. I hope this scrutiny will become clearer in the next section when we address the features of the typical concept phase process that bring about the challenges discussed in Chapter 3.

**Schematic Design**

Once a site is selected and a draft vision of the space-for-use is available, the designer of record and her team can more clearly begin to guide the owner in the design of his building development. Design, as we've discussed, is considered the most creative part of a development process because of the ingenuity and expertise required to transform the owner's vision into a physically-realizable thing. Schematic design, therefore, is the most creative part of that creative process, since it is when the prototype ideas for that realization are formed.

In fact, the schematic design for some buildings is so important to the design process that owners will occasionally engage several qualified design teams in a competition for the privilege of designing their space. In this way the owner can review many different possible ways for realizing the building and pick his favorite. The owners who pursue this more costly schematic design process are often trying to build high-profile, culturally important, or long-lived buildings.

For these schematic design competitions and for many development projects that can afford a longer design timeline, schematic designs can include unique consideration and detail for all of the major systems – architectural, structural, civil, landscaping, interior design, mechanical, electrical, plumbing and communications. In most cases, however, focus during schematic design is on the specific space layout of the programmed spaces and on the aesthetic appearance (massing, orientation, site positioning, finishes and landscaping). The more hidden systems realized through the disciplines of civil, structural, mechanical and electrical designers are less well detailed because those systems are often thought to be of secondary concern to the overall impact that the space has on its occupants.

Also, and this point is purely based on my own experience, but my impression of architectural design is that effective form, well-connected space function and aesthetic beauty are the first goals of design in buildings. Occupant comfort, controllability of space services and building durability are secondary goals. Though these are important, the key (especially during a design competition) is to sell the aesthetic.

Of course there are many examples of building developments that do not involve a unique schematic design at all. Such developments often have a much lower budget assigned to them (per square meter) and the main goal of the development is getting the building built as quickly as possible in the selected location. Functional programming for these types of buildings is often at extremes – it is either very well known before a specific development begins (e.g. Walmart) or the space is to be speculative (i.e. the usage is, for the most part, unknown). In these situations either a very detailed or very vague template schematic design can be created and used over and over again at a variety of sites. In either case, this template approach creates a situation where the unique place and people who will be connected to the development are independent of the design.

Whether skipped or thoroughly investigated, the most confusing part about schematic design is determining when it ends. Schematic designs often turn directly into detailed designs and sometimes directly into tender documents. Often (and especially when timelines are short) the design team doesn't pause and review their work before the crucial milestone of site plan approval or they may even wait until tender. More often, any assessment of schematic designs and the resultant decisions to modify those designs are made on the fly, as the ideas are presented. This rapid-fire approach allows the changes to that idea to be carried away by the design development process and on towards tender without interfering with the pace of the project.

## 6.2 Challenges revisited

The previous summary of the actors and process of a typical building development project was focused on decisions – when are they made, by whom and based on which criteria and information. Of course every building development is unique so the answers to these questions can never really be generic. That said, I think I have covered a lot of the most common ground, especially for the concept phase.

The challenges of assessment, vision and feedback exist in most building developments. There are several key factors which affect all three from being effectively addressed:

1) The sudden need for space.

   *"We really need this building to develop our organization right now."*

2) The driving timelines of the contractual process.

   *"To stay on schedule, these documents need to be ready very soon."*

3) The limit of the initial capital budget.

   *"If we want that change, it'll have to be within budget."*

4) The convenience of the expert's opinion.

   *"Trust me, I've been doing it this way for the past 30 years."*

5) The disconnection from impacts, but desire for certainty.

   *"I know it's too early to be certain, but we need to make a decision."*

These five factors affect the quality of assessments, the clarity of vision and the frequency of feedback at all major stages of development, but most noticeably during the concept phase.

### 6.2.1 Assessment

**In Site Selection**. The discussion in section 6.1.3 identifies the three most important decision-making criteria used for site selection: proximity to important people and sub-services, disturbance of current operations and initial monetary cost. Assessment of these three aspects often occurs for each potential site that an owner is considering. However, the five factors play into this assessment:

The urgency of need fuels the most significant avoidance of assessment during site selection. It also explains why site selection is seen as separate from the rest of the concept development process. If we want to get started building a building which we need right away, the first most obvious thing to decide is where the building's going to be. Within a given territory, and with little time to assess other impacts, most sites look roughly the same. Also, properties selected for consideration are usually limited by the expert opinion of a real estate agent. This is seen as a prudent choice, since giving responsibility for high-level selection to a professional simplifies and expedites the work of decision-making.

New greenfield sites are easier and more convenient to build on. The cost and time delays of assessing an existing or brownfield site and undertaking remediation, if necessary, weighs heavily on the budget and the timelines. Also, green field sites are often not more expensive than brownfields or existing sites because municipalities have made their own decisions to designate certain greenfield areas for economic development. This designation sends a signal to potential developers that the land is an ideal location for new projects and development on the land is desired by the citizens of the community. Relying on this designation to decide what is an appropriate site (i.e. using the designation and low price as an indicator of value to the community) is like relying on an expert's opinion (the city planner) to gauge the desires of the community. There are two important, interrelated cases of this expert's opinion problem: speculative development (where developers buy up designated land) and commercial tenancy (where occupants/users who don't want to buy their own land have only the space developed by the speculative owners to choose from).

As discussed in Chapter 5, the impacts associated with a site are mostly consequential. It's not until after you've begun using the site – building on it, operating that building and having people and services come to and from the building – that the factors of proximity and place begin to show their effects. The amount of assessment required to consider these impacts for each potential site while you are trying to decide could be costly and the uncertainty of this temporal disconnection from impact would make decision-making difficult.

**In Functional Programming.** The process of programming a building often straddles the selection of a site and the development of schematic designs. The functional program, therefore, is used for assessing potential sites and schematic designs. In fact, this program can sometimes represent the only set of metrics for assessment during the concept phase. The amount of detail the owner includes in the program (e.g. of the five aspects discussed above) prior to site selection and design can significantly affect both of those processes.

The detail of a program is limited most by the urgency to build. Because there is a need for a building now and because people often assume they already know what the space-for-use is (since, in most cases, they already inhabit a similar space) there is a tendency to draft low-resolution functional programs and hope that the details can be discussed or worked out during schematic design

Owners and occupants often leave certain desires out of their space service requirements because they do not understand the importance of describing those requirements in terms of desires. For example, the amount of light needed for a specific purpose could be a very important functional requirement. However, if owners have never measured or determined the level of light best suited for an activity, they may not be aware of which level to specify or that such a specification is even needed to satisfy their desires in the design. The owners rely, instead, on the expertise of the rest of the design team (i.e. on the designer of record) to understand and specify such requirements for them. It is rarer to have the designer assist the owner in understanding and taking responsibility for specifying such technical requirements themselves.

**In Schematic Design.** Assessment occurs in schematic design more than any other phase of the design process. As overarching ideas and optional designs are presented to the owner for consideration, these designs are assessed in terms of the criteria laid out in the functional program and in the collective minds of the design team, especially the owner. Also more than any other phase of design, schematic design is affected by the five factors.

The desire to get things done is strong when you've come up with an acceptable way to do it. Once the owner sees a design he likes, if he is strongly motivated to see the space done, he will begin to push the process onward. Assessment that was in progress to answer seemingly minor issues will then be dropped, or put on a backburner.

The owner's need for space is helped along by a well-defined timeline. The project schedule can be used in two different ways to dampen assessment: (1) as a push to those doing assessment to accelerate their work and potentially weaken its quality, or (2) as a way to pass off assessment to later stages, since it is not relevant in order to make the transition to the "next step" along the timeline.

Designers are not always paid to include sufficient assessment in their scope of work during the concept phase (or at all). Because they are hired as expert consultants, however, they are expected to provide insight into the impact of their design. Now, with a limited budget and the implication of broad expertise in both design and assessment, most designers tend to give their past experience as proof of their ability to know what will happen for the current project. Not wanting to admit that you don't know the answer to questions of assessment and aware that the client does not want to pay you more to investigate that information, the designer is pushed to ask "for them to trust you"; which they are willing to do to save time and money.

Specifically, despite the relative inaccuracy of cost estimates during concept (when compared to the actual incurred construction or operating costs) these estimates are used for most decision-making. Confidence in the designers to provide these estimates, without independent confirmation or explanation, is common in building developments. This confidence in an expert's opinion is taken for granted because of the assumption that experience with previous building projects implies experience with new projects of a similar type in a new location. This can often be a good assumption, but as soon as the designer is asked to consider an approach she has not previously followed (e.g. to consider an unfamiliar HVAC system) she may be inspired to overinflate or otherwise discredit this option, because of reluctance to go outside her realm of comfort or do work outside her own contract budget.

Many concept phase decisions are made with first cost estimates based on previous experience, not on case-specific data. This is the case because estimates on first cost take time and involve a type of coordination and trust between design teams and builders that is not common: the builder must put aside the potential for a contract and the owner and designer must trust that this potential has been put aside. When a project has a construction manager as part of the design team (i.e. as one of the owner's representatives) this type of cost estimation discussion is more likely to occur. Also, when there is only one qualified provider of a product or service, assistance can be more easily provided without the hidden motivation of undercutting or discrediting the competitor.

The most important assessment of any design alternative is its importance to the initial budget. For example, if one design option offers improved controllability for lighting and a long-term benefit to operating costs, but the initial cost for that option is high (or even perceived to be high) its benefits may never be explored because it was deemed too large a capital expense to bother investigating further. Because a decision needed to be made and the owner's trust in estimates of long-term impact is low, further assessment was not pursued.

In general, decider trust in impact assessment not translated into "short-term return" dollar amounts is low. Even long-term dollar estimates are looked upon with distrust and often for good reason. The reliability of the assumptions that must go into long-term estimates about cost can be tenuous. Life-cycle cost calculations and even net-present-value calculations often assume a fixed escalation value for things such as the price of energy, inflation and taxation rules. Without a sensitivity analysis of these factors, it can be hard to rationalize using them for decisions, especially when a very real and significant first cost is looming so close by.

### 6.2.2 Vision

**In Functional Programming.** Functional programming sets at least part of the vision for a development – the vision of the space-for-use. What's missing from most functional programming is a clear description of the organizational purpose. What is important to the organization? What defines it? What are its most important values and goals? In order to help those who the owner will be involved with during the development process to understand his expectations and desires, he must include such a description in his functional program.

The need for space can make inclusion of purpose seem frivolous in a functional program. Why bother telling your design team who you are as an organization? They know their job is to design your space, so telling them what they need to know to get that job done is all that is important. Without an understanding of the organizational values, however, the design team may struggle to understand what aspects of the design matter most to the owner and where to focus their efforts.

The initial budget may also limit the owner's scope of vision. He may think back to the cost of past mistakes and assume that pursuing an ambitious program may result in delays or a significantly higher budget. This limiting of vision before design stifles creativity, since the designers may have new solutions to the old problems, especially if they were also part of the team who experienced the past mistakes and learned from them alongside the owner.

The owner may also assume that a simple program is all that is required, since the design team should be capable of understanding his desires based on their level of expertise with similar projects. Just as with assessment, this assumption may be accurate as long as the owner's wants are consistent with the designer's expectation of standard practice. When the owner wants something outside the norm, the designer may not know to ask for clarification leading to confusion and revision further along in the process.

**In Site Selection.** A vision of the purpose of the development and the activities of the organization, especially as they relate to the movement of people and delivery of services, are important for selecting a site. But site selection is more than just picking a place to build. It's also picking a community, picking a specific set of neighbours, picking a customer or user base, and picking a place for employees to come from and come to.

But as discussed above, the sudden need for space can override the process of visioning and focus it myopically on the immediate core functions. This may lead to a weakening of vision with respect to community connections and employee and client needs. The owner may tend to be satisfied with locations that meet all his most basic concerns for proximity to markets and cost-savings, and he may choose a site without thinking about the future of his industry or the long-term needs of his employees and users.

The rigours of the development timeline dictate that site selection must be done first, often without a detailed functional program (i.e. without a detailed space vision). This adds the more immediate risk of overlooking a space service that cannot be provided adequately or cheaply from the chosen location. For example, without a careful understanding of the internet bandwidth required for his operations, an owner may select a site that has very poor connectivity and requires a significant upgrade in infrastructure.

**In Schematic Design.** Designers are capable of taking very little communication from the owner to establish a schematic design for a building, especially when they have many years of experience working with the same general space type (e.g. office buildings).

Because of the rush to build, the owner may be willing to pass a lot of the detailed visioning for the project to the designer of record and her team by allowing them to specify the qualities of the space implicitly in their concept design. This approach may be fine when the designer is closely in tune with the owner's organizational vision, but if this connection is not present, the space may fall short of what the owner would have gotten if he had taken the time to articulate a clear vision together with the designer, before the schematic design began.

As with site selection, not knowing the full, detailed set of services to be delivered (and purposes to be served by those services) can lead to significant costs (in the form of redesign) later during the development process. Unfortunately, the development timeline can sometimes allow for the clarification of certain desires to be pushed back, or even ignored, until very late in the process. If those desires, when finally sorted out, are in conflict with the current design, it can lead to frustration on everyone's part. For example, a common afterthought in office projects I have worked on is the number and position of personal offices around the perimeter and the need for daylight in interior spaces. Knowing how many perimeter office spaces are likely to be desired by occupants is rarely factored into the design of the interior walls of such spaces to allow light to pass into the centre of the building. This omission may be unintentional, however, since those who sit in the interior are rarely involved in the decision-making, so their opinion may be excluded from the visioning process. Of course such exclusion *is* intentional.

Though it becomes increasingly more important for buildings pursuing sustainable development, the lack of understanding on the owner's part of the diversity of desires of occupants and operators can lead to a schematic design with poor attention to the controllability and serviceability of systems. Giving users a space that works well can, surprisingly, become a secondary priority to the aesthetics and cost-effectiveness of the development. This failure is often attributed to the designer, but I think it's more appropriate to see it as a failure of the owner to articulate his vision for the space properly. If the owner stipulated a level of control and serviceability that he expected each space to have, he would get it without a great deal of additional cost. Controls, if implemented elegantly, need not be expensive.

### 6.2.3 Feedback

**In Site Selection.** It would be good to allow the functional program to inform and be informed by site selection. For every site we consider, how does it change our vision of the project? Does this site add any unique new perspectives or community connections? The need and the timeline prevent such consideration in the usual way – by forcing a steady progress towards tender.

**In Functional Programming.** The development of a program can start when the owner first conceives of his new space and remain a living document perpetually during the organization's development. The program may also become, through effective feedback, a record of the collective desires of several people involved in the development (e.g. the occupant and operator as well as the owner).

The sudden need for space usually means that an on-going understanding of space has not been happening, otherwise it would not be sudden. The need for space can also lead to a reluctance to solicit feedback. If you know someone is going to complain, you may not want to ask for their opinion.

The reliance on expert advice presupposes a quick march to design. The feedback necessary is assumed to be part of the designer's experience. Spending time iterating on purpose and describing the space in large sessions with dozens of stakeholders can make the project seem bureaucratic: just "going through the motions" of inclusiveness. This is especially true if that actually is the reason for including people – because some outside rule requires you to.

**In Schematic Design.** Once a decision is made and detailed drawings (i.e. tender drawings) have begun, the designer no longer wants feedback because it would require changing the documents. This makes schematic design the most crucial time to include feedback in the process, since the design team has not committed a huge amount of effort to begin planning a certain design. Unfortunately, many factors lead away from a schematic design with iterative characteristics.

Because of the desire to push on to tender, schematic design is brief and often leads seamlessly into detailed design and planning. This means that if a variety of options are to be considered, they must be presented all at once and in a comparable manner. This method of refining a design is actually the complete opposite of feedback – it requires the assessment to happen all at once.

Because of the expertise of the designer, there is a tendency on their part to "know the right way to do it". Knowing the right way implies a certainty that doesn't require feedback (either structural or spontaneous). In fact, when not agreed upon by the designer, feedback can be taken as an insult to their credibility and ability to understand the constraints and challenges of the design.

Because of the tight timelines, large cost and complexity of the design and construction of a building, development can be seen as isolated to those steps in the process, not as a continuous process that has the potential to carry on after construction. Schematic designs, therefore, rarely include the character of being easy to iteratively redesign and reconstruct the building throughout its entire life. This approach is sometimes minimally employed during the schematic design of phased developments (i.e. developments that are funded and constructed in phases) but usually involves the future construction only and often focuses on entire additional shells (e.g. additional floors or whole new structures) not on the potential for transforming sub-systems such as HVAC, envelope, or electrical power. This point may sound a bit absurd to some: "Why would you want to redesign the envelope of a building after it's already built?" First, that idea sounds unnecessarily expensive and wasteful. Second, it seems to be completely counter to the normal ideal of "building it right the first time". That said, what if you can't afford to build it the way you want the first time? Might there be a way to prepare for future changes by designing a building that is more plastic in its nature, more adaptable? Such a design might make feedback possible in later stages of development to affect the system.

### Summary Dialogue

Before I move on to the next section, I think it's fitting to play out a small dialogue that captures a lot of the typical thought process that happens during concept design. Imagine, if you will, two building property owners sitting in the boardroom of their Toronto office discussing their next development project.

#### *Building Sustainability: Act 1, Scene 1*

*{Scene: boardroom, Bay St. Office, Toronto, Ontario}*

**Owner 1:** We need space to grow. We've got to build a new building right here, right now.

**Owner 2:** Are you sure? What kind of space do we want? What will the impacts be of this new space?

**Owner 1:** We don't have time to think about all that fluffy stuff in too much detail.

**Designer:** {magically appears out of nowhere} I have an idea. What about this?

**Owner 1:** Wow, this looks great! {to Owner 2} See, he knows what he's doing. It'll be great.

**Owner 2:** I'm a bit worried, these early decisions lock us into a lot. Do we like that future?

**Owner 1:** What do you mean? What can we know about how things will unfold?

**Owner 2:** Well, remember last time when…

**Owner 1:** This is different. Plus, we "solved" that one, remember? *{he touches his nose}*

**Owner 2:** I understand, this is a bit different, but we need to ask...

**Owner 1:** Who should we be asking?
Don't we have the right team already?

What could we possibly learn from involving more people?

**Owner 2:** *{exasperated}* I don't know! I thought we could start by calling these guys. *{shows consultant's card}*

**Owner 1:** *{Looking briefly at card}* You know, things are really busy right now. Look at how messy my desk is! We've only got a couple weeks to figure all this stuff out.

**Owner 2:** I understand, I'm just worried. Shouldn't we prepare for a future we want?

**Owner1:** *{a brief moment of reflection}* I guess you're right. Let me see that card again? You think they can help?

**Owner 2:** At least we could ask.

**Owner 1:** How much do they cost?

**Designer:** Drawings are ready!

**Owner 1:** Great! Wow, right on schedule. Let's get this thing built! *{to Owner 2}* Can we get back to this "ideal future" with the next building?

**Owner 2:** *{Sigh}* Ok. *{to self}* If there is a next building.

## 6.3 All Our Relations: hospice and retreat centre

As we already discussed in section 3.4 and 4.2 space-for-use is an essential requirement of the AOR mandate. Both sides of their mission – the living well and the dying well – seem to require space for the service model that has begun to develop.

Through my conversations with the president recently and over the past many years, I've learned that new space has been a perceived need of the board since the inception of the organization. The idea of designing a new place to bring together the novel concept of hospice care next to retreat facilitation has always been part of the vision.

### Site selection

In 2002 AOR acquired a piece of existing farm land in Bloomingdale, Ontario to be the site of their centre. The site was purchased, severed and rezoned for commercial use through a complex set of negotiations with municipal authorities, the farmer and local land-owner who owned the site, and the new farmer and friend of AOR who wanted to start a small organic farm on half of the property. As is common, no functional programming or schematic design had begun prior to the purchase of the land. Based on my conversations with the president, however, they did have some key decision-making criteria in mind:

1) The site needed to be close to, but not directly within, the cities of Kitchener and/or Waterloo. They wanted to be close to their community of operation (the Region of Waterloo) but not so close to the urban centres to take away from the idea of the retreat centre actually allowing the visitors to retreat (at least a little).
2) They wanted the site to have a "connection to the land". Features such as adjacent forests, farming operations, bodies of water and other unique ecological features were strongly desired. This was particularly important for the retreat side of the operations, since retreat visitors would be challenged to commune with nature and find a spiritual connection with the land.
3) Related to this second criterion was the desire for a site that was large enough to have a series of prominent features – walking mazes, herbal gardens, trails through the woods and the like.

A model of ideal performance was taken from the Kingview Centre near Toronto, Ontario. It is a retreat centre with a mandate and focus similar to that of AOR's (at least the retreat side of the mandate). In fact, the AOR board and founders were originally inspired to build their centre based on their own experiences at Kingview. As a result, when a site that mirrored Kingview's features came about (farm/rural setting, not far – but far enough – from the city, lots of space for connection) AOR jumped at the chance. The Bloomingdale site was the best of many that they investigated in detail and its specific features have set the stage for all future development efforts.

**Functional programming and early schematic design**

Once a site had been acquired, work began quite quickly on a functional program with the hope of preparing a schematic design and then, as soon as funding could be secured, construction could begin. AOR did not yet have sufficient funding to build the centre they had begun to envision, so their first focus was getting enough material together to begin explaining their mission and showing their vision to others.

Robert J. Dyck Architects and Associates Ltd., a firm with extensive hospice and long-term care design experience, was asked to lead the design team and be the designer of record for the building. In June 2003, with Robert Dyck's (Bob's) guidance, AOR assembled its board along with a small group of friends and advisors to engage in a series of two "Needs, Dreams and Ideas" workshops. Bob led the group through an excellent exercise of describing the space-for-use by soliciting keyword phrases, emotional responses and action words both one person at a time and also through discussion. Though these workshops focused on defining the space, a lot of discussion dealt with the broader mission, operating plan and general workings of the organization as a whole. The entire exercise was recorded by Bob and his staff in three ways: (1) through a series of minutes; (2) through a space interconnection diagram; and (3) in a schematic layout of the space, including some basic exterior features. All three of these records are included in Appendix #2 – Outcome #2: "Functional Programming".

The minutes and interaction diagram prepared by Bob from the early meetings was reviewed by the board at the end of June 2003 and the hope was, given some potential funding opportunities that had begun to reveal themselves, to begin construction in mid 2004. Unfortunately, throughout the next several months, progress was slow. Significant changes of membership on the board occurred in 2003 and 2004. Also, slow or incomplete work done by other consulting firms (mostly on a volunteer basis) caused the process to drag on. Finally, in 2005, the schematic design drawings shown in Appendix #2 were prepared by Bob Dyck and AOR had a first version of their centre to review. After review, several massing changes were made in spring 2005 which led to the final schematic floor plan shown.

**Next Steps**

It was at this point that I became more intimately involved with AOR as part of my research work. They needed to complete their schematic design, including details of civil, mechanical, electrical, and landscaping so that a suitable cost estimate could be prepared by Van Del. The prospect of building the centre in the short term had faded a bit, since good funding opportunities had not materialized in the two years since concept design had begun. The current goal was (as before) to complete a concept design that could be costed for use in a business plan and for promotional material.

My suggestion to the board was to marry their goal of a completed concept with my own goals to explore LEED as a process for sustainable building development. The details of my proposed experiment are described in Chapter 8, but it's important to know first that my suggestion came with a great incentive on the part of Enermodal Engineering Ltd. with whom I was working both as my masters partner and as an employee. Enermodal would provide consulting for mechanical and electrical design services and would guide AOR through the Enermodal approach to concept design using LEED as a framework. All of this early work would be for zero up-front cost. This offer, similar to what had been offered by Bob Dyck and Van Del, would assume that AOR would continue to work with Enermodal to complete the detailed design after funding was secured.

Thankfully, AOR, Enermodal, Bob Dyck, and Van Del all agreed to pursue the completion of the concept design as part of my research. Chapter 8 details this process and the efforts made on my part to capture the benefits and drawbacks of using LEED as a guide for sustainable building development.

**Typical and Atypical**

Before we address my case study concept work with AOR, I'd like to briefly discuss how their situation is both typical of most building projects (as discussed earlier in this chapter) and how their organization and specific project are quite unique.

Like most projects, site selection was done well in advance and separately from the functional programming exercise and schematic design. This site is now the site for the centre. To change it now would be very difficult, mostly because of how much work has gone into envisioning the operations of the centre with this specific landscape in mind. Of particular importance to the board's love of the site is Marjorie's (the president's) work to secure a partnership with Reinier (the neighbouring farmer) and his adjacent organic farming operation. Also, based on the current desires of all those involved in the project, the site is excellent. It meets the three core criteria of proximity, land connectedness and size almost perfectly. Without further work to quantify some of the long-term impacts of this site choice, it would be difficult to argue for it as being anything other than ideal.

AOR is also very keen to build. They clearly feel that space is essential to realize the full, future potential of their organization. All of their fundraising efforts to date have been focused on the construction of the centre and except for several notable community conferences and speaker presentations they have organized over the past ten years, all of their actions have been bent on developing and fundraising for the centre itself. It's clear that space is an urgent organizational need. Of course, it's very difficult to argue against this perception of need. How does one operate a residential hospice without building bedrooms? How does one offer retreat services without a place to retreat to? There may be unique answers to these questions, but the point I'm trying to make is that no one is really trying to answer them. The solution is clear to everyone involved: they must build.

The most important similarity between AOR and most commercial and institutional organizations developing space is their disconnection from impacts, but desire to make long-term decisions. AOR has never operated a centre like the one they hope to build. In fact, neither I nor any of the board members have yet to encounter such a place. They have, however, visited both residential hospices and retreat centers to explore the financial requirements to operate and the nuances of organizational success. They also know the needs of the hospice guests well, as demonstrated by their fervor to address the quality of this service during our initial organizational visioning session. What's missing from their knowledge is an understanding of the long-term impacts of their building on its occupants, on the local site and on the larger socio-ecological environment during product manufacturing, construction, operation and disposal. This inexperience in building life-cycle impacts is common for most organizations and business, no matter how long they have been in operation. AOR is no exception.

Their disconnection is also, actually, the first way AOR is a fairly unique organization to work with during concept design. They do not have any significant, current operations to help them understand their impacts before they build their new centre. This fact has posed some minor challenges with the process I have followed, as you'll see. That said, their starting with nothing has also made them keen to explore options more fully and with more detail, since they need to develop a more detailed sense of what they are doing, overall.

This keenness also extends to their willingness to involve others in decision-making. The fact that the board is made up of volunteers, as is the entire group of people doing the design, makes inclusion essential. If people are giving their time, the least AOR can do is allow them to participate in the part of development that is the most fun and inspiring, which is concept design. There is also a natural tendency to include more people when those people are volunteers, since there is a chance that one of them will become busy and others will pick up the slack. The desire to include others is not always common among financially-motivated and faster moving projects.

Therein lies the most significant difference between AOR and the more typical building development: there is currently no budget and no timeline established for completion of the project. In fact, as long as the budget does not exist the project cannot continue past the concept phase. Without a fixed budget, capital-cost driven decision making is not as strong a controlling factor as with most developments. There is a similarly strong motivation to complete the concept work in order to finish the business plan and move one step closer to soliciting good funding opportunities. Though this is not the same as the drive to meet a timeline to avoid significant lost financial opportunities, it represents the only urgent timeline that AOR currently has.

Another important difference, though one I have not addressed as directly in my discussion above, is that AOR is a not-for-profit organization. Because they are not as concerned with the bottom line as with delivering a high-quality service, they may be more willing to investigate opportunities and explore design choices and processes which lead to success that cannot be valued in dollars. They are not financially ignorant, however. Remaining financially viable over the long term is essential to their functioning, as outlined briefly in the discussion in Chapter 4. It’s this long-term focus that is more novel and hopefully valuable when reviewing financial assessments and making decisions.

Ultimately, AOR’s uniqueness or commonality with other organizations is not as important as actually engaging in a real, valuable concept design for their building. Though I would love to be able to generalize all of my experience with them to make it relevant to all building projects, some of the specifics will not be transferrable. As we move through the final chapters, I will try to draw some conclusions that make sense in the general, and others that were valuable only to AOR and their development process. My hope is that both types of conclusions are useful to the reader in their understanding of the story of AOR’s sustainable building development.

# 7

# Sustainable Building Development: definitions and process

Since this chapter is the culmination of the past five chapters (both in name and in ideas) it's only fitting that I provide a summary of the most important definitions so far.

***(1) Sustainability.*** A structure of values, a pattern of actions and a process of inspiration that allow us to continually bring about a world we all desire to share now and into the future.

***(A) Development.*** A process of change for the better. This process is an intentional effort to control a given system to achieve a set of desires.

***(1A) Sustainable Development.*** A process of change towards sustainability. Sustainable development challenges us to understand the connection between our desires and their impacts, change our desires based on that understanding, share a vision of the future with those we impact, and through that vision, pursue net gains towards sustainability.

***(2) Sustainable Buildings.*** Valuing buildings as one very important part of our lives: as *our place* to live.

***(B) Building Development.*** A process of change to create space-for-use to satisfy our organizational desires.

And so, given all of these definitions, we might consider the following definition:

***(2B) Sustainable Building Development.*** *A process of creating space-for-use which recognizes both the importance of space in our lives and the impact that developing that space has on our greater goal to pursue sustainability.*

Several imperatives fall out of this definition as a refinement of the general process of sustainable development:

1) We should understand the connection between our envisioned space-for-use and (i) our organizational vision, (ii) the impacts of the space through its use and (iii) the impacts of the space through the systems that provide it. We should also

understand the weight of building-related impacts on the broader scale of impacts caused by all the relationships of our organization (i.e. we should include the building amongst all the other relationships of people, place and sub-services).

2) We should explore the importance of space with all those who have a stake in that space and develop a shared future for the space. We should also recognize that this space has a purpose (or purposes) and ensure that the purpose is as respected by those at stake as the space itself. This really just means including the purpose when establishing our shared future for the space.
3) We must imbed resilience into the process of developing our space to ensure that as the development progresses, as the environment changes and as our broader organizational desires change, we continue to pursue a shared future. We should also have a process for changing that vision when needed.
4) Finally, we should develop our space as part of a holistic, organizational movement towards sustainability.

My definition and these imperatives obviously deserve scrutiny. There are four key actors who have the most to lose and gain through the doing of sustainable building development as I've described: the owners of buildings, the designers of buildings, the occupants of buildings and the organizations (like the CaGBC) who are developing systems of assessing sustainability for buildings. Each actor would ask several probing questions of doubt to challenge my vision.

**Owner's Questions**

***Q1: Why can't I explore the impacts of my building separately from the rest of my organizational impacts? I don't have time to do an entire revision of my overall goals just to make decisions about new space. In fact, I'm not even in charge of the larger vision. I'm just trying to build us a building.***

You don't have to rework your organizational vision, at least not at first. The only thing you have to do is recognize and make transparent the connection between the space-for-use and purpose. Why are you building new space? Is it to grow your business into a new territory? Is it to offer services that don't already exist in a given area? Is it to renovate a space that employees are finding hard to use? Is it to consolidate remote operating locations to save on operating cost?

Consider a hypothetical example. You are the facilities manager for an oil company wishing to expand its operations at Fort McMurray, so you have been asked to build a new operations centre for the maintenance, storage and refueling of fleet vehicles and for the offices of field inspection staff. What is the purpose of such a facility? How does it relate to the planned space-for-use? Its purpose is to satisfy a growing market in a place with a potentially large future source of oil – a place for potentially large medium-term revenues for your company. Your direct manager wants the space to be up-and-running quickly so that the Fort Mac division can "stay competitive in this growing market". Overall, the desires behind the development of the space are as discussed in Chapter 6 – space is needed to grow now and the faster it can be developed the better.

Making such a purpose transparent to those involved in the development is essential. Those not as directly associated with satisfying the need for space may ask: "How can we say we're doing sustainable development when the purpose of our building is in contrast with the long term socio-ecological integrity of the planet?" Such a question may start a discussion about the core purpose of the organization – to extract fossil fuels to meet the demands of a culture addicted to fossil fuel use. How can we build a fleet centre that respects the need to shed this addiction? Use it as a demonstration and repair centre for a zero-emissions fleet? Provide space for researchers to study fuel efficiency in northern climates? Not build it at all? This example may seem hyperbolic, but I would argue that it is not. The most important dialogue that must occur for companies like BP or Suncor when building new space is the relationship their core business actions have on the long-term impacts of the service they are instrumental in providing – transportation. If even a few of their employees and local stakeholders in Fort Mac are challenged to think about these larger impacts, and the conflict of purposes that arises, they may be inspired to start a change towards sustainability for their organization as a whole.

The retort to my retort, especially in this situation, is predictable: "Sure, talking about these conflicts of purpose is good for furthering the debate, but you know they're going to build the fleet centre anyway. Why would you promote a discussion that leads nowhere? They're a massive oil company: they're not going to change." This is a pragmatic view of the situation which I respect. It is very likely that the discussion surrounding one building's development will not radically change an entire company. But that's not the most important point, really. The reason for the dialogue to extend to the company's core purpose is to recognize and open up the conflict between building one's building sustainably on the one hand and the reason for that building having very little to do with the notion of sustainability on the other. As with the coal-fired plant in Chapter 5, with the fleet centre, or with most buildings for that matter, the reason for the space and its relationship with the larger operations and actions of the organization is far more important to sustainability than the building itself. Recognition of this fact keeps the actors in the development honest about their reasons to pursue sustainability and may inspire them to think in new directions. That said, I realize that such honest and inspired thinking may also threaten to dishearten them when their suggestions for change are ignored by a management structure that is not willing to admit the same level of honesty because of what it says about the organization's overall mission. One can only hope that honestly is likely, in the long run, to be recognized as the best approach.

***Q2: How can I possibly take the time to "envision a shared future for the space"? This sounds like a long, drawn-out process of conflicting views and trying to guess at a future we'll never really know. The whole process also sounds a little wishy-washy. What are we really going to do?***

The exact process to follow to envision a shared future for the space is something I'd like to address more later on in this chapter. I do admit that "envisioning a shared future" is not as concrete a description of something to do as "drafting a functional program," but the concepts may not be far from each other in terms of how you get there. I'll address this idea more in section 7.2.

The more important point in this doubting perspective is that the process of visioning is seen as potentially drawn-out, conflicting and uncertain. To be honest, I can't offer any assurance that this will not be the case. It will very likely be the case if the overall view of the process is a negative one. There is going to be conflict since the point is to facilitate a discussion that is open. Conflict, tension and descent, when honoured as important to the discussion, are essential to establishing shared futures.

There is also going to be uncertainty, but as I discussed in Chapter 4, effective visioning permits uncertainty. In fact, a clear vision will include the need for resilience (as recommended by point three above). It's important to remember that a shared future is a description of our collective future desires. It's what we want, not how we're going to get there or even where we'll go. It's a hope, not a dream.

Time is the hardest critique to rebut. It will take time and likely some creative approaches to dialogue to get people who may normally not interact on a daily basis to get together, to describe their own visions and to build a shared vision. And I respect the fact that this talk, unlike the adage, isn't cheap. Usually the people who have to get together are busy keeping the organization moving on a daily basis. They may also be important members of the community who are busy with other projects of their own. Their time is valuable elsewhere and we don't want to waste it on fruitless dialogue. The challenge of time (and how to save it while still doing what we need to do) will be addressed throughout the rest of this chapter and also in Chapter 9. Time remains one of the most difficult challenges to making sustainable development practical in the current culture of the building industry that I am part of.

**Designer's Questions**

***Q3: How can I understand such a complex set of impacts – both those "of the space" and those "of the system"? I'm worried about the problem of garbage-in-garbage-out. I'm also worried about giving the owner bad advice about impacts because I don't know what the future will be like.***

I definitely understand the concerns of bad assumptions and uncertain futures. These are the challenges of connection complexity from the designer's perspective. I will go much further into the details of a recommended approach to this problem in section 7.2. Before deciding on an approach though, I think it's best to consider the following corollaries to the act of sustainable building development.

First, designers should not have to be experts in understanding impacts outside of their current abilities. They are required to participate in the discussion and support the necessary assessment of impacts, but they are not expected to take full responsibility for them. Responsibility for decisions should be shared by all those on the design team equitably.

The problem with this perspective is that it is contrary to the current mindset of building developments. The designer of record is professionally responsible for some of the impacts of the building (e.g. safety). What I am arguing is that extending this professional responsibility to encompass all impacts is inappropriate, even detrimental, to the process of sustainable development. For example, if the designer is afraid of litigation by the owner because the building, as operated, failed to reach a carbon emissions reduction target then she will be much less inclined to offer support to properly set such a target. Fear of extending professional responsibility too far is significant in the building industry.

Second, decisions that require certainty where assumptions and futures are inherently uncertain are flawed. No one can expect certainty in such a situation. What can be expected, however, is that those involved are at least exploring the impacts qualitatively and making recommendations that respect the uncertainty of the situation. There is a stark difference between an investigation that addresses key uncertainties openly and one that gives up because an answer is futile "given how much is unknown".

Finally, one of the greatest (and most rewarding) challenges of the process that I've described is being creative in the face of uncertainty. How can systems be designed to use feedback to adapt to future changes? If one of your goals is resilience, then uncertain variables are powerful decision-making tools – they are the factors that should be included in a sensitivity analysis of any proposed system.

To reiterate the discussion of functional programs in section 6.1.3, the impacts of the space are always considered as part of a development, at least to a certain extent. How many loafs of bread can our new facility bake in a day? How many people can use a washroom during half-time? How many employees can simultaneously access the internet? Discussing the impacts of the space, at least before the building has been built, is identical to discussing the desired outcomes of the space-for-use when in action. Being clear on these desires is essential to making the connection to other impacts.

The impacts between the space and the system that are important to understand are very closely aligned with those that the designer is usually already considering when she is developing the space: beauty, usability, maintainability, health. These are all the impacts between the developed systems and the space-for-use discussed in Chapter 6. What the designer needs to do beyond her normal routine is recognize how these impacts are affected by and affect the systems that she is designing to provide the space-for-use. How does a 700 lux requirement for luminance affect the size of the lighting system? Correspondingly, how does the brightness of a light affect the comfort of the occupants?

It's these reciprocal relationships between quality needed and quality provided – between system action and system effect – that require further study.

The connection to impacts of the designed systems outside the site boundary is more of an exercise in uncertainty, especially when trying to understand those impacts over time. How will changing the site's landscape affect the local ecology? What resources will be required and how will their associated life-cycle use affect the local community and the broader environment? The myriad of impacts and considerations can be very overwhelming. This is why systems have been devised to limit the number of issues and to narrow the scope of focus to make assessment manageable. In section 7.2 I hope to describe another way to consider this challenge of narrowing scope – using an iterative network model of space, systems and impacts to decide what is most important to focus on.

***Q4: How can I facilitate an effective discussion with even more people at the table? I am worried about the blur of voices that can come from such a situation. It's hard to make good decisions when that happens.***

I have a few suggestions on the best approach to facilitating a discussion among many stakeholders, but I realize that it will depend a lot on the specific team of folks who are assembled and on the owner's patience. One simple strategy is to preempt group meetings with survey or discussion of the issues with each individual who will be involved. Collecting and summarizing many individual responses can save time as it helps to prepare people for a larger discussion and to identify common ground more easily.

My experiences with AOR's higher-level sustainability discussion helped me to realize that having a framework of approach to keep discussion organized and on track is useful, but will not always mean less time is required for discussion. My opinion is that there needs to be a willingness on everyone's part to meet often, with purpose and process in mind, but with a willingness to really engage. If you don't get as far as you want the first time, you may need to take longer.

***Q5: How do I coordinate such a grand approach? It seems like a lot of ground to cover for just one building, especially if the owner has not previously contemplated a larger, organizational vision for sustainable development.***

Hopefully my own suggestions throughout this entire thesis are a good starting point to begin the dialogue. Taking time to help sketch out at least a preliminary broader vision for the organization you're working with can make the building-related work easier or at least more relevant to the bigger picture. The coordination of the broader approach is also not necessarily the designer's responsibility. The owner or owner's representative, especially if he works for a large organization like a corporation or branch of government, is likely to have a colleague who is responsible for these broader goals and this person should be involved in any discussions about purpose and vision that are part of the building design.

### Occupant's Questions

#### *Q6: I like the idea of being included in the discussion, but how can I expect the owner to listen to my opinions? This is also true of the other stakeholders who don't have even as much sway with the owner as I do.*

Facilitating the necessary dialogue will not be easy, especially if everyone involved isn't motivated to be inclusive and open. There's also the touchy subject of whose perspective matters more. There needs to be equality in how the process solicits and respects opinion and equity in how those opinions are weighted or combined. This kind of equity is not common in the typical building development process as the owner's opinion is often taken as the final word, except where the expertise of the designer is deferred to. My suggestion, as you will see, is one of open discussion of anonymous visions. If it can be hard to get into a room with those who have higher authority, simply bring everyone's ideas into the room without revealing their originators and see what comes of it.

There must be time for everyone at stake to share his or her desires with the group. In the end, however, those who control the development process are likely to still apply a final judgment on the vision of the project. My hope is that by listening to the stakeholders' visions and exploring the impacts that matter most to those stakeholders, the owner may be inspired to share much of that vision to the long-term benefit of the occupants and their community. If the owner chooses another path – one that is contrary to the desires of the occupant or other stakeholders – they will at least be required to explain, fully their motivations for doing so to the entire group of stakeholders.

***Q7: Isn't this process a little too focused on the owner's point of view? My organization's vision is just as important to the space as that of the owner; in fact we're the ones who will actually make use of the space, not the owner.***

In the case where the owner is not the occupant, I completely respect this point of view. In many of these situations the owner is a *property developer*. This person (or corporation) has an even stronger motivation to include the desires of his tenant in the decisions he makes about space. As a result, the occupant's vision should be realizable in the space that is developed, even when occupancy changes over time. The challenge to this type of owner is to be even more forward-looking and inclusive when making the early development decisions about space. If he does not do so, he is likely to lose out on tenancy opportunities as the desires of the market shift towards a better fit with tenant sustainable development goals.

There is the opposite possibility, however, that the occupant is even less inclined to pursue sustainability than the owner. In this case it may seem like the owner is not servicing the occupant effectively, especially when the occupant is the one who is in desperate need of space now. In these situations I sympathize with the owner who, in the end, is not going to use the space. Who are they to decide that such space should be part of a path towards sustainability? This perspective is unfortunate in two ways. First, it is unfortunate that the owner, assumed to have his own agenda for sustainable development, wouldn't want to share that perspective with the tenants. Such a direct opportunity to engage a future business partner may not come up too often. Second, if the owner is pursuing their own sustainable development, passing off the responsibility of failure along that path to their tenant is still a failure. Pursuing sustainable development may sometimes mean that others who you are in business with don't agree with such a mission. This is your opportunity to help them share a future of sustainability with you, at least when you want to work together in development[47].

## CaGBC's Questions

***Q8: How can pursuit of this process be shown to lead towards real sustainability through building development?***

[47] For an example of how property developers have tackled this challenge, see REALPac's "Green Office Lease" at http://www.realpac.ca/green-office-leases/.

This question is probably the best criticism of my suggested approach. The fictitious pragmatist who criticized the CaGBC in Chapter 5 has returned to ask: “How is this process you describe actually going to promote sustainability?” I know it’s not enough for me to say that since I’m requiring buildings to be included in a larger pursuit of sustainability that everything will be ok. I think the real point behind this question is that organizations cannot be assumed to know, outright, what sustainability is in the larger context. That’s why they need someone to dictate the terms. They are also expected, perhaps, to act in their own interest and potentially circumvent or ignore issues that are unpleasant to deal with and then weaken the idea of sustainability as a result. Such a weakening, as I argued in Chapter 2, is what has already happened to the definition of the word sustainability itself. I think it is enough, for now, to suggest that the requirements of (1) stakeholder inclusion and (2) a full review of the connections between desires and impacts with those stakeholders, is a good place to start to impose further requirements. Who must be included in your set of stakeholders? Which specific impacts must be investigated? Setting requirements in these areas and then describing required outcomes in the final, operating facility based on the early visions of the project may close the loop on effective assessment and actually lead to a more sustainable building. I will discuss a more exact strategy for closing this loop in the section 7.1.

I think it’s also important to give some respect to the people engaging in the development. There is no higher authority governing what makes an organization more sustainable. There are only those, like myself, who are trying to suggest some of the more important process and values requirements and challenge organizations to follow in the footsteps of the early adopters. There are also those, like the CaGBC, who are carving out aspects of organizational sustainability and making clear suggestions as to the requirements thereof. If the owner is pursuing a legitimate effort towards sustainable development, he is very likely to have goals which overlap quite strongly with “real” sustainability goals for his buildings, especially when building development is instrumental to his core activities. He may even want to go beyond the LEED requirements, once he explores the impacts further. In the end, we can only compare our efforts against those of our peers, the people we serve and the people who serve us. The success of sustainability must come from a willingness to be judged against and by these others. Then, the key to legitimacy comes from being open and honest about what you've done and being willing to admit when you need to change.

***Q9: How can we possibly review and critique, for each building design, such a rigorous process of exploring and documenting their vision and early assessment? Our goal is for assessment regimes to be easy to quantify. We need to be clear on how people demonstrate leadership so that such demonstration is honest, straight-forward and comparable.***

This may not be a real CaGBC question, but it's one I'd like to ask from their perspective anyway. They may actually be perfectly willing to review such thorough documentation, but it will obviously take a lot of time. I support the opinions of the Living Building Challenge in this regard. As far as critique of success goes, why not just do a third-party review of the end result and allow the owner to interact with his peers to compare the earlier efforts in design? What should matter to the CaGBC is providing a venue for education and best-practice recommendation early on and then making sure that efforts to act sustainably have been followed through with properly. Currently, assessment of use-related impacts such as energy and water have more to do with the best-practice approach not the actual result, but (in the US at least) the owner is required to submit his actual energy and water use for comparison to other similar buildings if asked[48]. My suggestion is that the process be reversed. Help visions of success, design ideas and impact assessments done early on to be prepared in a comparable manner, but don't scrutinize them as successful or not. Then, audit the important impacts of the facility compared to the goals and to industry averages. This process would require much less documentation and put the CaGBC in a position to assist the owner in legitimizing their efforts when it counts – in the use phase.

Of course, this approach may not be desired by either owners or the CaGBC and for exactly the same reason. Waiting for actual data takes too long and can be a messy business. My only response to this criticism is that the current scheme of documentation can take as much time up front as would be spent waiting for real results and is no less messy. I will offer a few more thoughts on this matter in Chapter 9 when addressing the issues of saving time during design.

[48] For more information about this requirement, see the USGBC's "Building Performance Partnership" page at http://www.usgbc.org/DisplayPage.aspx?CMSPageID=2201.

There are certainly more questions of doubt and challenges of my approach that I have not thought of from these various perspectives and from other perspectives. Before moving on to my own application of this sustainable development process to the concept phase, I would like to make a small declaration of intent. This document, though submitted as a thesis for completion of MASc requirements, is meant to be a work in progress. My hope is that, as others read and are interested in the things that I've said, they will contact me and start a dialogue. I intend to regularly update this document with feedback from others.

## 7.1 The decider's dilemma

What we've reviewed so far in this chapter is a definition for sustainable building development as a process. How to actually engage in that process throughout the different phases of building design, construction and operation is a more interesting challenge. *How do we come to understand the necessary connections between our desires and their impacts? How do we facilitate a dialogue that is both inclusive and effective at establishing a vision? How do we respect uncertainty and make our vision resilient? And how do we ensure that we are pursuing net gains towards sustainability at large?*

These four questions mirror the structure of the definition above and the challenges of general sustainability that I developed in Chapter 4. As you may have guessed, the "possible solutions" that I discussed there are my suggested keys to addressing these challenges in the concept design of buildings. I will describe a model for exploring the connections more in section 7.2, but describing the process of visioning and re-visioning that must be shared amongst the many stakeholders of the development is certainly the harder of the four problems, from my perspective, since it requires those involved to establish a new set of values and norms together and it requires them to share their own desires honestly with others. Admitting and potentially changing our perspective on our own is never easy. Admitting and changing together, especially with others who we normally interact with in a completely different way, can be very difficult.

My approach is to help the group of stakeholders to move from recognition of the problems we face when trying to pursue sustainability to recognition of the realizable benefits of such a pursuit. I call this transformation the “decider’s dilemma”[49]. Much of the spirit of this process follows the stages towards deliberative dialogue that Ann Dale outlines, which I discussed briefly in section 4.1 [20].

The diagram in Figure 9 is meant to help clarify and navigate this dilemma. Anyone involved with decision-making about how to do sustainable development is usually in one of the five states of mind in light blue at the top of the diagram. The challenge of coordinating a group of people is that not everyone may be in the same state. Take the relatively narrow problem of water conservation. There may be someone, like a representative from the local conservation authority, who knows a great deal about the importance of water conservation, what strategies and best practices are used to conserve water and what needs to change in the current design in order to maximize water conservation. The owner of the building, however, may know nothing about water conservation or even care about it.

I think the solution is to work with the entire group under the pretence of ignorance, of a kind. For the specific project, before it begins, everyone is ignorant of many potential impacts, positive and negative. Focusing on the project and exploring the case-specific impacts means that everyone can be innocent at the start, despite their knowledge of the impacts in general. Using the model of connections between desires and impacts (between space-for-use, systems and environment) as a focal point for discussion allows the entire group to begin exploring the problem from a similar perspective.

Once everyone agrees to use this model as a basis for discussion, my suggestion is to structure that discussion in such a way that requires establishing the vision for the project in five stages: (1) understanding the problem, (2) taking responsibility for the need to act, (3) establishing what constitutes sustainability, (4) measuring success now and into the future (5) reflecting on how to change. These stages represent five necessary conversations that the group must have together, in order to set a clear vision for the project. Each conversation has its own dilemma.

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[49] Any relationship between this process and the “prisoner’s dilemma” is purely coincidental. That said, both processes are ways of understanding cooperation and how to foster it.

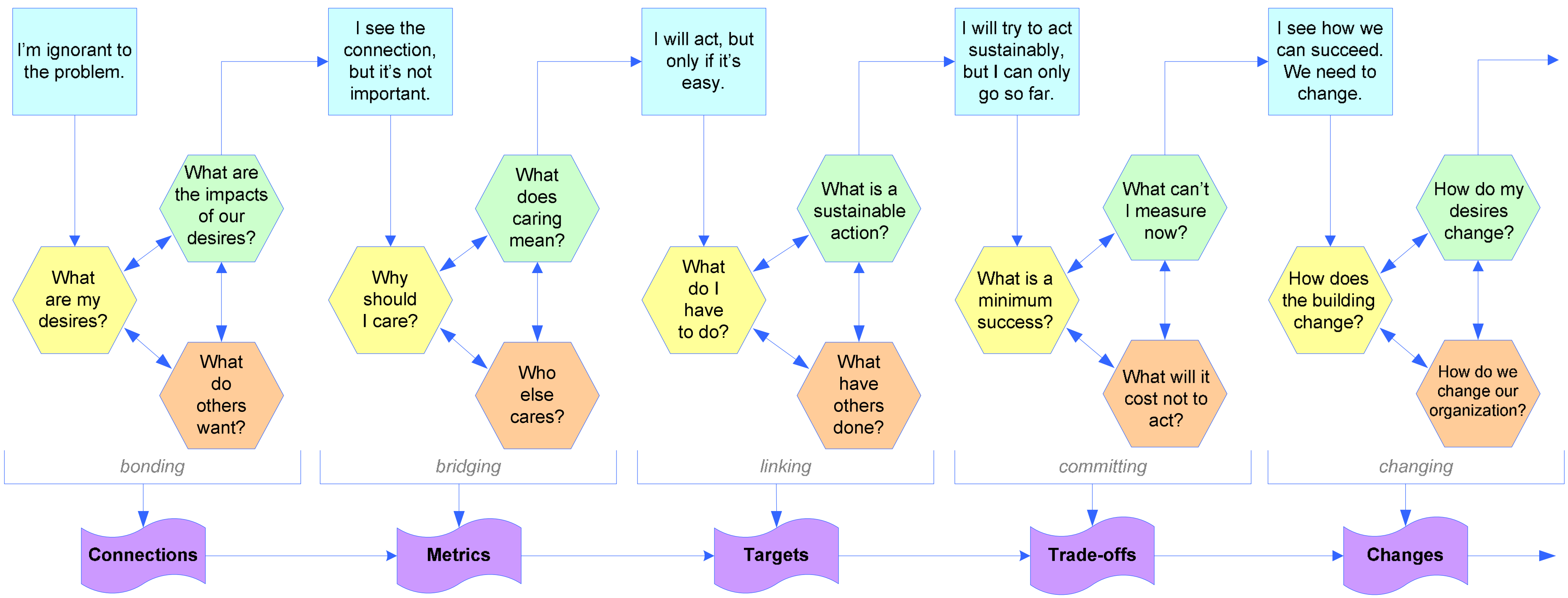


**Figure 9 – Flow chart for the Decider's Dilemma**

### Understanding the problem

To understand the problem, we must be able to describe our desires to each other and be willing to listen to the desires of others. Through exploring the impacts that our desires have, we may realize that some people who are impacted and should be involved in the conversation have not yet been included. These people should be added to the discussion at this point, at least in some way, to know how their desires affect the group's perspective. It may also be important to include people in the discussion who can represent future generations or non-people in a way that is meaningful to the group. We can "escape" this first dilemma if we all agree that we have an effective understanding of the connections between our collective desires for the project and the impacts of those desires. Continuing with the water example, when owner, occupant and conservation authority understand that the expected usage pattern to meet the desire for a variety of water uses such as watering grass, flushing liquid wastes, HVAC cooling, etc. will lead to a water consumption rate of 400 L/day/occupant which is 50 L/day/occupant more than the national average. If everyone consumed the same amount of water in their facilities, the region of Waterloo will need a pipeline from Lake Erie 5 years earlier than planned. The usage pattern (desire) is linked to a daily consumption through the current systems (irrigation system, toilets, cooling towers) and to the impacts on the local socio-ecological environment (the regional mandate to provide water for all citizens but the lack of recharged supply in local groundwater).

***Issues to resolve at this stage:*** Trust in the data of connections. Inclusion of important stakeholders. Clear statements of desires for the project.

***Documentation Outcomes:*** Development of a model of connection between our current desires and the environmental and systemic impacts.

### Taking responsibility for the need to act

Once we see the connection between our usage of water and the impacts it will have on regional sufficiency and ecological integrity in the future, we may be inclined to immediately take responsibility for our contribution to this potential future. Others may see a pipeline to Lake Erie as a natural progression of the growth of the Region and would be willing to pay higher taxes to support this vision. These same people may argue that growth of the region means economic development that will be more beneficial to our prosperity than the costs of a pipeline. Also, the pipeline is really just closing a loop that is created by the natural flow of the Grand River into lake Erie. The important question at this stage is: “why should I care?” Of course, many people around the table may have strong personal desires towards water conservation that were stated in the previous stage. Their reasons may be about the sacredness of water to humanity, or about the concept of reciprocity – if we want to use a resource for our benefit, we should use it in a way that does not negatively impact the system it was extracted from.  Still others may want to target water conservation because they know it’s a cheap way to get LEED points. Expressing these personal motivations openly can be difficult, but it must be done. Even if the collected stakeholders don’t agree with each other, they must be willing to listen to what others have to say and to share their own motivations.  When asking “why should I care?” hearing the answer to “who else cares?” makes a big difference to the dialogue. Often when discussing motivations, people will be inclined to share strategies for improvement and the ancillary benefits to making an effort. When conversation turns exclusively to these reasons for caring and those reasons are documented and agreed upon, the group can continue to the next phase.   For water conservation, it may be agreed upon by the group that because they want to remain important and respected members of the Regional business community, their responsibility is to reduce their daily consumption of water for their facility to a level which will allow the Region to push back their target date for the pipeline, or potentially avoid the pipeline altogether.

***Issues to resolve at this stage:*** Establishing which impacts are important to the group. Listening to why others care. Sharing motivations for measuring and improving those important impacts.

***Documentation Outcomes:*** Identification of the metrics of success and shared reasons for caring about those metrics.

**Establishing what constitutes sustainability**

Being motivated to reduce potable water usage and knowing that low-flow faucets will achieve a 20% reduction in usage are different aspects of a similar vision. One part is “what matters to me” and the other is “how to do it”. There is a part in between that is sometimes forgotten – “what to do”. This is not the same as “how” since how requires taking specific action and it is not the same as “what matters” because it sets a target of requirement. “What to do” is knowing the extent to which action must be taken to achieve success. The CaGBC, and many other organizations interested in providing governance for building-related impacts, provide these “what to dos” for the metrics that they care about in their systems of assessment. These targets of performance are what are subject to the most scrutiny during the development of an assessment tool like LEED because the targets are seen as defining sustainable levels of performance. If we can agree that a 50% reduction in water use is the LEED requirement, we’ve come a great distance to convincing people that a 50% reduction is a sustainable target of reduction because the LEED targets for building water use are seen by many as synonymous with sustainable targets. The reason that I’ve gone into detail in describing this observation here is that I would like to suggest an alternate method of setting targets that may help the group of deciders to understand what constitutes a sustainable target of success. We must ask ourselves: “What is needed, given our specific space-for-use and systems, to satisfy the criteria for sustainability as we understand them?” For water use in the Region of Waterloo, how much can be used (per person per year) to avoid the pipeline and maintain safely charged levels of ground water? Also, how much can be used by future generations to ensure that the same safe levels are maintained?

Many of these answers are specific to each region (perhaps even each site) and many answers will be difficult to come by. Does it not behoove a group of people concerned with the sustainable use of water in their building to spend some time understanding how much that means they need to conserve? This search for a target may mean including additional opinions from people outside the current group of deciders. It may involve asking those who are engaged in similar efforts to tell their stories to the group and provide their recommendations for targets. They may also share strategies for how to meet those targets and such strategies should be noted for future consideration. Meeting and talking to leaders in the field can go a long way to convincing a group of committed deciders to pursue leadership themselves. This stage may also be a place to employ the backcasting exercise described in section 4.2. In the end, three targets should be set by the group for each important metric: the sustainable target, a minimum target of acceptable performance and the hopeful target for this project, given the other desires and details of the development. This last target may be equal to the sustainable target, but it also may be more or less than that target, depending on how important performance is. Once these targets have been established, the third dilemma can be considered resolved.

***Issues to resolve at this stage:*** Investigating levels of performance which satisfy the criteria for sustainability. Inviting and visiting with leaders in the field to reflect on their experiences in achieving sustainable performance. Establishing a range of acceptable performance for the project.

***Documentation Outcomes***: The three performance targets: Minimum acceptable performance, sustainable performance and hopeful performance. Also, any support and recommendations from leaders in the field should be recorded.

### Measuring success now and into the future

To this point we've established a model of our space-for-use and systems, a set of metrics that we care about and targets that reflect success along those metrics. The question that immediately arises is: "How well are we doing?" For some metrics, we may be achieving all of our targets. In others we will be falling behind even the minimum level of performance that we've set out for ourselves. The next question that is likely to come up, then is: "What will it cost to achieve all of our targets?" Answering this question involves design and/or re-vision, because we require a novel change to our systems or to our space-for-use desires in order to satisfy the targets. We should also probably calculate the cost (in a variety of uses of the term) of such changes. In short, we're getting ahead of ourselves just a little. What we need to answer first is: "How do we determine the cost of success?" or, in short "How do we cost success?" In the simplest terms, answering this question may seem like answering the question "how much money are we willing to spend to succeed?"

I would like to suggest a slightly more complex set of sub-questions. Setting a fixed capital budget for achieving performance targets is only half of the problem. This budget sets a maximum amount to how much can be used to achieve success. I feel that a minimum amount must also be put in place. This minimum should be the amount of money that is required to: (1) make at least a marginal net gain in all metrics towards the sustainable level of performance and (2) achieve at least the minimum level of performance in all metrics. When I refer to minimum "net-gains" toward sustainability, I am referring to the concept as it is discussed in Chapters 2 and 3 above. The design team should estimate the cost of at least putting in place the necessary infrastructure to make future gains towards sustainability when new ideas, more funding or cheaper technology become available. This perspective is sometimes called "future-proofing". The cost of such future-proofing should be included in the minimum cost estimate.

Having a range of monetary costs instead of a single budgetary number forces the deciders to see the discrepancy between the cost of net gains towards sustainability and their (perhaps arbitrarily) chosen budget. I would also encourage deciders to consider costing calculations that respect the long-term. Life-cycle costing, net present value and simple payback calculations are examples of such calculations. Though these types of estimates are arguably less certain than a capital cost (especially one which will shortly be paid) they take into account the time-value of money and the longer-term cost saving which may be associated with the targeted success. I also strongly recommend that owners include the potential for tax and other incentives from government in their calculations for costs (even the capital ones). Though water is cheap to use in most jurisdictions of Canada, there are an increasing number of tax breaks for reducing a facility's water requirements below specific targets. Such incentives should be included when making decisions using costs. There are also consequential costs of not achieving a target which should be considered, in some situations. As I mentioned earlier in this chapter, if occupants are expecting a certain level of performance from the space to meet their own sustainable development goals, they may not be willing to stay long, or at all, if their targets are not achieved. Finally, there will certainly be some things that cannot be measured effectively at the time of decision-making and some costs that are not easily measured using dollars that should be considered separately from the cost-trade-off exercise. Special attention to these factors should be part of the discussion. Once these exceptional trade-off factors and the minimum requirements for net gains are agreed-upon and the maximum budget costs are established, the dialogue can move to the final (and zeroeth) dilemma.

***Issues to resolve at this stage***: What are the requirements for a minimum success? What is the maximum amount that deciders are willing to spend to succeed? What factors cannot be traded-off with money or cannot be evaluated right now?

***Documentation Outcomes***: A description of what constitutes minimum success. The budget improvement cost and cost trade-off rules for the project (e.g. a five year payback is acceptable for all energy conservation measures with a maximum of $250,000 in up-front costs).

**Reflecting on how to change**

The last dilemma is really the first step of design: reflection on the current standard approach with a well-defined set of design requirements. The deciders must work with the designers to describe the ways in which the building must change to satisfy the targets and they must work together to weigh the costs of such changes to see how they compare to the established trade-off rules. This dilemma can sometimes be seen as the hardest to resolve, because it can lead to a stalemate of sorts. It is possible that the minimum cost to achieve net-gains towards sustainability is higher than the maximum cost limit set by the deciders in the previous step. In simple terms: minimum sustainable development costs more than we are willing to pay. In some situations, this may mean that sustainability is sacrificed (e.g. a cut is made to the targeted level of minimum performance). Creativity matters a great deal during this stage of decision-making and the team must take full advantage of the experience of others to find ways to stretch the limits of cost, system performance and space-for-use requirements. Decision-makers may also need to stretch their point of view. They may need to consider changing the process of valuation within their organization (e.g. more money may be requested of upper management based on arguments of life-cycle cost benefit rather than capital cost benefit made by those on the development team). Or, deciders may be required to change their earlier desires (e.g. they may not get a space that is as attractive as they had originally wanted). Regardless of what decisions are made to change the building, organization, or desires for sustainability, all should be documented as changes to the model, metrics, targets and trade-offs.

***Issues to resolve at this stage***: What changes can we make to the current design to succeed at sustainable development? What changes must we make to our desires and at the organizational level to make minimum performance possible?

***Documentation Outcomes***: A description of the necessary changes to our system, space-for-use, targets and trade-off rules that come from the process of reflection.

### 7.1.1 Process flow and feedback

I think that it is important to deal with these dilemmas in a fairly linear order, owing to how much the next conversation relies on the previous. That said deliberations on each dilemma will need to follow a unique path since the goal is to escape the dilemma, not just to go through the motions of escaping. I'm not suggesting that the entire group of deciders be locked in a room until they have an answer to the given dilemma. Iteration is probably the best practice. I briefly hinted that the last stage could also be a zeroeth stage – a pre-stage to a second time through a similar process. Factors such as the accuracy of the model, changes to the space-for-use description, or new sums of money dedicated to the building development process may inspire a new exploration of the vision or some of its parts.

In fact, this kind of feedback of the visioning process throughout the development of the building may be the best way to maintain resilience and strive for continual improvement. As more and more detailed information about the building becomes available, a more detailed model can be prepared. Conversely, as the design progresses, decision-making becomes more restricted and less time is available to explore options. Thankfully, for many of the sustainability-related impacts of buildings, the most important decisions require only a very broad initial level of description. The problem of decision-making has more to do with time spent understanding and discussing the intents and desires of the deciders. This means that the earlier the process of visioning starts, the sooner a structure of decision-making can be put in place that will make changes to the design later on much easier to weigh and resolve.

The models used to make these early decisions, therefore, needn't be overly detailed – at least not aesthetically. They must, however, accurately convey the relationship between desires and impacts. There is a difference between this accuracy of connection and the typical accuracy of a model. The entire model may be quite crude in appearance, but as long as the variables which describe the links between the space-for-use desires and the metrics of performance established by the development team are sufficiently understood, decisions can be made. Even if the margin of absolute error is broad early on, decisions about relative performance can often still be made. And as more and more information about the building is made available, the model can become increasingly more accurate to the point that it may be used as an approximate prediction of actual performance.

Table 2 below summarizes the various when it makes sense to attempt feedback of the visioning process based on significant changes to the level of detail of the design. Sometimes this feedback should constitute an intensive review of all five dilemmas and other, later times should simply be as a check to ensure that targets are still being met.

Though continued, regular review of the established vision and realized performance is essential, the most crucial time for exploring the vision for the project is at the beginning and especially as part of the first three phases above – site selection, functional programming and schematic design. Most of the detail needed to determine the key sustainability performance targets for a project is available even in these early phases. The sooner the decision-makers for a project begin the process  the sooner they become aware of the importance of dialogue, the important stakeholders and advisors that are missing to make good decisions and the connections between their desires for space and their new or renewed desire to make their building project sustainable. My proposal for how to establish this ever-evolving link between purpose, space-for-use, systems and impacts is the focus of the next section in this chapter.

## 7.2 A "life-cycle-service-network" approach to building connection complexity

I'd like to describe my own approach to seeing buildings as the space where an organization can pursue sustainability. This view is really just an amalgamation of the material discussed in Chapter 4, especially the ideas of the service-and-flow economy, life-cycle assessment and Bruce Koenig's process network models. Understanding impacts, through the designed systems, to the space-for-use and back to the purpose of the building is a first step in developing a building sustainably.

## Table 2 – Feedback schedule for the review of project vision

| Phase of Development | Detail Available for Model | Assumed Details of Model | Focus of (Re)visioning |
|---|---|---|---|
| Before Site Selection | type of building, rough size, climatic and political region of expected site, expected occupancy, previous operational history of organization, costs of labour, operational resource costs (e.g. energy) and generic municipal service costs. | generic site constraints, operating performance similar to current facilities, generic massing and orientation, system performance based on code compliance or previous project targets. | Potential consequential site requirements (required changes / massing restrictions) and proximity-to-site performance issues. Used to help decide on an appropriate site. |
| Completed Functional Program | specific site info, expected occupancy schedules and detailed space-for-use descriptions, rough layout and massing concepts, possible mechanical and electrical design briefs, detailed costing for many municipal services. | space service delivery and source/sink systems based on standard practice, though appropriate for actual occupancy and site specifics. | Massing and orientation related issues, detailed off-site source/sink requirements for services, design of systems for connecting people to the specific site. Used to situate the building on the site, establish a baseline of site-specific performance, and provide guidance to designers for opportunities for innovation and areas to maintain tighter constraints. |
| Completed Schematic Design | Specific, but high-level strategies for addressing all major design decisions regarding delivery and source/sink systems, capacities and performance qualities of all systems available; class C costing possible. | performance levels of systems based on generic requirements not on actual product options; floor plans and layout of distributed systems still rough | Intensive review and revision of the entire design. Establishment of a clear direction of expected performance by the development team. The visioning exercise should be fully realized by this point. |
| Between site plan approval and tender | All sizes of equipment known, layouts finalized, recommended products selected. Class B costing possible. | Minimum rated performance of recommended products; ideal operation of system control strategies; pessimistic assumptions for construction phase performance | Confirm that current design on track to meeting performance requirements. Inclusion of additional sustainable design features if updated cost estimates permit. |
| As part of confirmation of construction contract. | As-built drawings, selected equipment, some equipment calibration and testing results and verified control sequences; Can also include actual performance of construction-phase targets including final costs of construction. | At this point, any new data from equipment testing and metered performance can be used to calibrate the model for confirming predictions and to support the commissioning of installed systems. | Establish the “as-built” performance of the project. Review successes and failures at pursuing sustainable construction practices. Confirm and adjust targets for as-operated performance. |
| At the end of the first year of operation after commissioning is completed. | Comparison to at least twelve months of actual performance data. | No significant assumptions remain. Some lingering differences between the as-built and as-operated building may still exist. | A “debriefing” on the annual performance of the facility. Comparison of as-operated targets to actual results. Used to develop a plan to continue improvements for which the essential components had been established during initial construction (e.g. adding to PV array capacity). |
| After each five years of operation or as major changes to space use and organizational goals arise | An average of many years of data including any progressive changes to the design as established during year-one plans. | | Ascertain success of entire development project at achieving medium-term targets. Consider the next five years and potential future re-development plans. Move on to the detailed, medium-term planning for challenging, generational goals. |

We can try to solve this problem of connection complexity by studying the relationships between:

1) the purpose of the building and a space-for-use that meets this purpose (Connecting Desire to Service),
2) the space-for-use and a concept for the developed systems (Connecting Service to Systems),
3) the process networks of those systems and the network of their processing environment (Creating Process Networks), and
4) these process networks and their life-cycle impacts on the socio-ecological environment and on the space-for-use(Connecting Process to Life-Cycle Impacts)

Then, like the back-propagating solution of a neural network, we can decide what the impacts are that matter to us and how caring about those impacts affects change in the corresponding systems, space-for-use, and ultimately in the purpose of our building development project. Let's explore each step of this connection process in more detail and then discuss the mechanism for adjusting systems, spaces and purposes based on the realized impacts.

### 7.2.1 Connecting Desires to Space Service

Let's imagine three different people or groups of people who desire new space for different purposes:

(a) I want a shack in the woods that I can escape to on the weekend.
(b) I want an environment for my employees to explore great ideas alone and in a collaborative manner.
(c) I want a facility that is adaptable and allows me to build and ship as many widgets as possible as cost-effectively as possible.

It's probably safe to suggest that these statements of purpose are not sufficient to know all of the space-for-use that is desired in each case. There are many important questions to ask to dig down into these statements. This asking of questions is really the functional programming exercise that most deciders will go through with their development team.

When asking questions about these purposes it's very important to decipher how the giver of the purpose will know if their purpose has been satisfied. These ways-of-knowing may be significantly harder to describe than the purpose itself, since there is often a lot of cultural intuition when assessing the quality of a space. Still, even an exploration of the words used to describe the purpose can help. For example, in each of three cases above, there are several words which hint at the ways-of-knowing:

a) "shack" – A single room? A minimally-serviced space that still meets the essential requirements of life. "escape" – From what? The daily grind of life, so a relaxing but not-too-far-away place. "in the woods" – Seclusion in nature? A minimum degree of seclusion and certain kinds of ecology are desired, like foot access to a lake. "on the weekend" – not used every day, but still year-round? Minimum maintenance required, but still four-season access and minimal comfort.
b) "environment" – A unique form? A space that goes beyond basic functions and is more useable by employees. "explore great ideas" – The core activity of the employees? What are the measurable fruits of such exploration? Employee productivity and happiness. "alone and in a collaborative manner" – A variety of places for exploration? Yes and the ability to transfer the explored ideas from one place to another and share with others is essential.
c) "facility" – A tightly controlled and monitored place? As assessed by other standards such as ISO-9001. "Adaptable" – within the core business? Yes, we want to switch between a wide variety of widgets, but we'll never build tegdiws. "As many widgets as possible as cost-effectively as possible" – Based on annual profit targets? The goal is to have a growth of widget sales of 10% in the next five years and an annual net profit target of at least 15%.

There will always be some basic desires and purposes that should be explored such as how many people will occupy the building, how often will the building be used, the approximate location and the need for the basic space services such as conditioning, lighting, electrical service, etc. that were discussed in Chapter 6. Each space service that is required should be separately discussed for all regularly occupied spaces.

There are also some important additional concerns about space services which should be explored in detail:

- The basic qualities of space services (e.g. a preference for natural light)
- The quantities of space services (e.g. at least 300 lux on the desk surface)

- The controllability of space services (e.g. at least a light switch in every room)
- The range of tolerance in each of quality, quantity and controllability (e.g. spaces needn't have more than emergency lighting at night)

These service attributes should be explored for all spaces if possible, but at least for the most major, regularly occupied spaces .

At this point in the description of requirements it is very important to see the space from the user's perspective. A description of use cases can be very valuable to help determine the functional requirements. I will demonstrate an example of this user-centered-description for the AOR case study in the next chapter. When describing these cases it also makes sense to involve the expected user to give their perspective and to comment on assumptions about use that may be incorrect or that are particularly important to them.

It's also important to know something about the site requirements as part of this programming process. For one, much of the space-for-use may be exterior spaces. Exterior space-for-use may be subject to even more performance requirements than spaces which should be inside a building enclosure and temperature-controlled. Being clear on the exterior space-for-use is just as important as the interior. Also, there may be some requirements of adjacency and venue for the site which, as discussed in Chapter 6, are linked to other goals of the organization and their relationship with the local community.

A great number of requirements for the space may be determined to one degree or another as part of this step. These requirements should be organized by space-for-use descriptions of: (i) who will occupy the space and when, (ii) where the space will be in conjunction with other spaces and on the site and (iii) what the space service qualities, quantities, controllability and tolerances are. It's also very important, wherever possible, to highlight specific connections between purpose and space performance. For our examples, these descriptions may appear as follows:

a) "I want the shack to heat up quickly when I arrive in the winter so I'm comfortable once I get everything unpacked from the car."

b) “People should be able to look outside at an attractive, natural landscape wherever they are in the building so that they are inspired by the beauty of nature around them.”
c) “Temperature tolerance needs to be within 1°C at all times to avoid widget fouling and improve our waste reduction targets.”

**Summary**

For this first step in connections the development team should prepare:

1) A well-articulated purpose or set of purposes for the building development with ways of knowing if the building satisfies those purposes.
2) A full, detailed (as much as possible) description of the space-for-use and site requirements.
3) Connection statements focusing on motivations for specific requirements and the desire that drove them.

### 7.2.2 Connecting space service to system

As discussed in 7.1, the degree to which a system that provides the space-for-use can be described changes as more information becomes available throughout the design. The question is: what level of detail is necessary to facilitate the decision-making that may occur after impacts are identified?

For the earliest explorations of connections, it is my recommendation that the design team choose from among the following conditions when establishing the concept system. Let the systems be:

- the same as current organizational best-practice,
- the most cost-effective to construct and
- in conformance with all current legal codes of practice.

These assumptions provide an excellent “baseline” design for future decision-making, since the majority of decisions are usually made based on the incremental capital and operating cost of improvements.

What matters most at this stage is describing systems well enough to know that they will provide the defined space-for-use adequately for the expected use of the space and the expected variability of that use. Some extensions of our examples here could be:

a) Electric baseboards will be installed in all spaces connected to a single, central thermostat. This will allow the space to respond to occupancy and heat the room up quickly.
b) The landscape design will focus on providing features which attract wildlife and isolate the building somewhat from the urban surroundings. Views to the outside will be provided to all regularly-occupied spaces through the use of floor-to-ceiling glass and a narrow floor plate.
c) Rooftop equipment that can maintain a 1ºC tolerance requires several large units to be more frequently placed throughout the facility with fans running continuously.

There will also be many previously un-spoken space requirements discovered as the systems are described. Usually these are things that are so obvious as to be assumed to be included in the design, or they are not important enough to have set a clear requirement for. Typically these new requirements can be documented, but provided in the most cost-effective or otherwise appropriate manner. For example, the structural systems used to provide the basic support function may be designed to use whatever material is cheapest at the time of the design, as long as it conforms to all the loading requirements usually set by the criteria for other systems such as finish, space conditioning and occupant density.

Since this model of connections is meant to evolve throughout the development, the detail of the system description need only be enough to establish the necessary connections between space-for-use, delivery systems, source / sink systems, and the boundary of the site. Basically, we want to be able to describe as simply as possible the process by which the space-for-use is provided.

Of particular importance is that the delivery and source-sink systems must link the space to the boundary of the site for all the services they connect with. For our examples, such descriptions could be:

a) "Toilet and sink sewage in the shack link to a drain pipe which carries the waste to the septic tank close to the road. This tank can be emptied by the septic cleaners through an access port near the property line."

b) "Wireless nodes throughout the building connect to a central Ethernet router which also has as fibre-optic connection to a local ISP."

c) "Wasted widgets and widget parts are placed in small inspection bins, collected nightly by QC staff and put in a single solid waste bin for the contracted waste hauler to remove."

**Summary**

For this second step in connections the development team should prepare:

1) A description of systems which provide the desired space-for-use,
2) Statements of connection that motivate why the given systems were selected and
3) Descriptions of how systems connect the space-for-use services to the site boundary and the external service providers.

### 7.2.3 Formulating the process network and processing environment network

At this point, I have not recommended a modeling process that is more extensive than what is typically followed by the development team during the concept phase for a building. It's just that they do not call these things a modeling process because it is thought of as "the concept design". But we have selected a rough site (or region for a site) which sets the modeling constraints – the socio-ecological environment. We have also described a functional program that links the purpose of the space to a detailed description of the space-for-use. In doing so, we've set targets of performance for the model and the expected modeling schedules of use. And we have a concept for the systems which will provide this space-for-use. This concept ties modeling targets to a realizable process that can connect satisfaction of those targets to impacts in the space and in the socio-ecological environment. Now we need only make clear those connections through some methodical process description. We should start first by describing the annual process of using the space (the process network) and the process of constructing the space (the processing environment network). We should look at both of these networks at least as far as they intersect with the boundary of the site.

As discussed in Chapter 4, Koenig's process network models were designed mostly for decision-making about interconnected processes within the materials economy. The hard part about using his network formulation for space is that space is not traditionally thought of as a material product. Manufacturers don't sell space, they sell stuff. That said, let's explore this notion a space as material a little further. In the case of the widget-maker, the widget, or more precisely a flow of widgets over time, is the object of transformation for his process network. But what of the space needed to make widgets in? Well that space  is an area (or perhaps volume) of technically-specific materials too. It is the right temperature conditions, the right amount of lighting on the work surface, the right amount of water and ventilation air delivered for employee benefit, and so on. You could say that the combination of systems used to deliver this space is delivering an essential material to the process network for the widgets – the *right space* to pursue widget-making.

As for our other two examples, recognition of this provided space is even more crucial. Where Koenig may have hidden the provision of space in his formulation for manufactured products, how would he hide such space when there is no material object of transformation? What are we making in an office building for a company whose mission is good ideas? What is being manufactured in a shack in the woods where we can relax? Well, Koenig would probably argue that the making of good ideas and of relaxation is measured by the number of human hours devoted to those technically-specific energy costs. This is a fairly rigorous way of saying that it is the time spent on such activities that is the purpose of the process, not a material flow. I agree strongly with this point of view. However, the formulation of the network in these two cases will reduce to zero if we don't have at least some object of transformation crossing the system boundary. Koenig's requirement is that this object be "physically conserved through transformation" [12] but the only thing that is conserved in the space-for-use is the relationship between people, place and services. The service of space is what is conserved.

This seeming end-point of the materials economy is a fascinating idea to me. It's in our homes, our offices, our cottages – our places – that the idea of economic products come to an end and service becomes what matters. This is the central idea of the service and flow economy outlined by Hawken, Lovins and Lovins [10]. And as I've discussed in Chapter 5, space-for-use is one of the central, all-pervasive services in our lives. I think it's fair to say that the object of transformation for these endpoint processes – at least some of the object – is the space that we need to live. In this way, the endpoint flow of many of the most common materials in our lives can be seen as at the core of all the services we value and all the time we want to spend.

Of course, many of the most common materials involved in the process networks of buildings are in the making of the processing environment through its separate network of transformations. It's the processing environment network that defines the relationship of rooms, the core structure of the building, the types of equipment installed, the link between the site systems and other service providers, and many other important aspects of the process network. The processing environment network is essentially analogous with the construction process for a building.

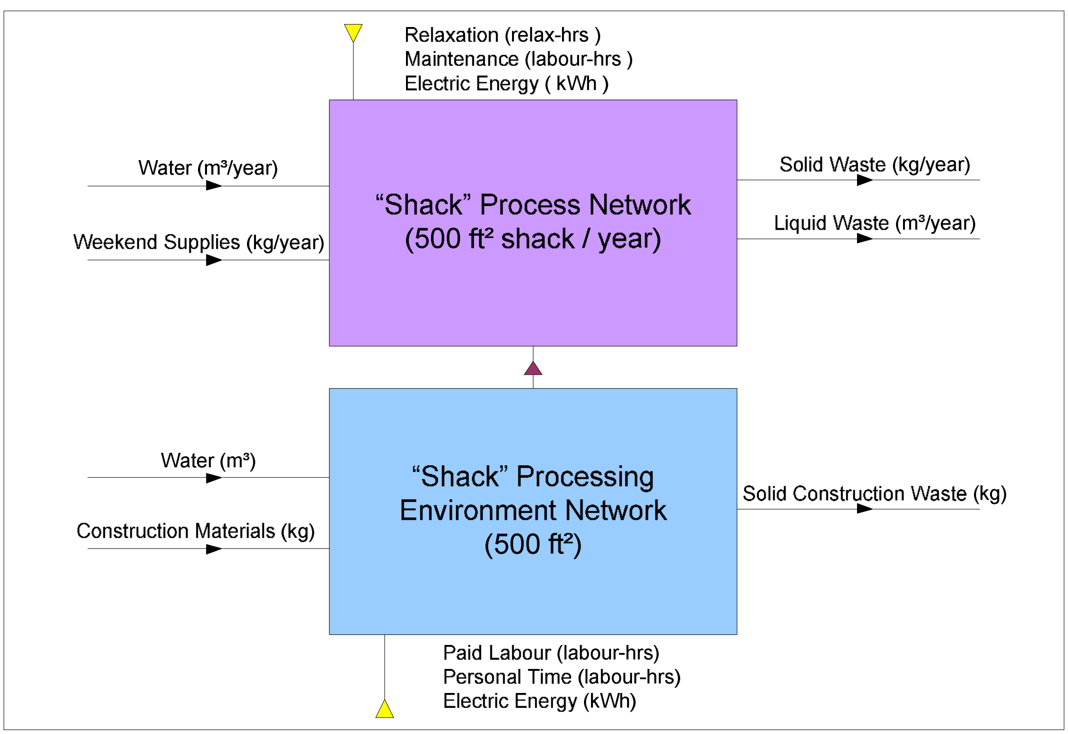


**Figure 10 – Process networks for example "shack" building**

In Figure 10 above, we can see a basic diagram of the process network and processing environment for our shack. This is the most minimal diagram I could describe that also includes all the most important, initial desires of the potential shack owner. Let's look at the processing environment network (in blue) first. The resources that flow into the site from outside the boundary are water and construction materials, while construction waste flows off of the site to be disposed of by the waste hauler. In order to build the shack, we are likely to have to expend three different types of energy: paid labour (measured in labour-hours), electrical energy (measured in kilo-Watt-hours) and the personal time of the potential owner himself or herself (measured in labour-hrs).

Of course, hidden inside the blue box is a great deal of complexity. That's why it's called a "network" of processes; there is more than just one process. For example, we'll need to lay the foundation, build the structure, insulate and weather seal the envelope (including windows and doors), put on exterior finishes, put on interior finishes, and probably move in furniture. And that's just the main fixed surfaces and space-defining parts of the service. We'll also have electrical, mechanical and other services to deal with. All of this is a lot of work, even for a small shack in the woods. And it's also a lot of different kinds of work – different technically-specific kinds of work. As well, the kinds of construction materials and construction waste – right now all grouped together – will be significantly different. In the end though, if the owner doesn't see or know about any of that, does he really care what different kinds of labour there were, or how the waste materials differed between processes? Well, maybe he does, but for now let's pretend that he doesn't. What he cares about are the major items that have an associated cost of construction. In this case I've probably included the water and electricity unnecessarily, though these will be things he does have to pay for during construction. He may not care though, because the cost is not very high. That said, they are still consumed, regardless of their cost. In fact, it's important to note that even though we've grouped a lot of different material and labour types together, we are still asking for the total amount of all these things to maintain the proper accounting of mass and energy involved in this space construction process.

The product of the processing environment network is the shack itself. Once we have gone through the process of constructing the shack, we may now use it and describe the process network for this use. As I've just discussed, the product of this process network is the operation of the 500 $ft^2$ shack, but in the case of process networks we must apply a length of time that is relevant to the decision-making involved. In this case (and in the high-level analysis of most buildings) this length of time is one year.

For our shack-for-use service there are several important flows and associated energy costs. The water we use for drinking, washing, flushing, etc. and probably also the water we used for construction comes from a well on the site. Therefore we must expend some electricity to pump water from that well for our use. This is one simple example of how the process network transforms a resource at the edge of the network into part of the space service we want by paying an energy cost. The installed heating, lighting, refrigerator/freezer and electric stove are other ways that we'll use electrical energy. Weekend supplies from the grocery store, etc. are also consumed during the shack-for-use process and converted into solid waste and (along with some of the water we use) into liquid waste.

All of these services, as we've discussed, are meant to provide for as many hours spent relaxing as possible. This hopefully negative energy cost (i.e. energy benefit) is the main measure of success for the shack. The longer people spend there having fun and not worrying about maintenance and energy use the better. Obviously some minimal maintenance will be required (with associated material flows not currently included) and a good amount of electricity is likely to be used in the winter (since the shack doesn't really have much insulation) but in the end, it will hopefully be worth it.

Of course we could consider pumping the water from the well by hand. This act would have a labour cost (which we might put into the maintenance-hrs cost) and may reduce the total number of hours we can spend relaxing (measured in relaxation-hours). This idea is hinting at an alternative structure for the processing environment. However, since currently we've established that an electric pump will be used, we don't want to get ahead of ourselves by thinking of ways to transform the processing environment without having a reason to do so. Why save on electricity if it will sacrifice relaxation?

### 7.2.4 Linking process to impacts

I'm sure you've guessed that this last question is rhetorical. The whole purpose of looking into this process network model was to see how we could connect our desire for space to the impacts of that desire in the socio-ecological environment. How do we begin this exploration of connections?

Well, we already know a great deal about our most basic interconnections with the immediate environment. For one, we know how much material, water and electricity are used for building and operating the space according to our current designs. Water and electricity consumption especially are important impacts on their own because they are often shared resources. Their arbitrary use would be fine if their supply – both instantaneously (i.e. their demand) and over the medium term (i.e. their net consumption)- was not limited. The more of any limited, shared resource that is consumed to provide for a specific purpose the less of such a resource that is available for other uses or for the same use by others. For some, consumption of water and energy should be limited out-right, even when arguments can be made for both of these resources as being renewable. The question becomes, what is a sustainable sharing of limited resources?

We may also want to expand the list of flows that matter by separating out one of the many technically-specific flows that are grouped together in "construction materials" or "solid waste", for example. It may be important for someone on the decision-making team to know how much of the wood used in the construction of the shack was from sustainable forestry practices. We can probably take the easy first step of assuming that none of the wood is from sustainable sources, since such wood is more expensive and less readily available. We could also ask a knowledgeable wood provider to determine the availability and cost of switching the various wood products used in the shack to certified wood. We need only use our existing knowledge of the current processing environment process to identify all the wood materials consumed in the construction and ask the question: "Where would we typically get this wood from and do they have certified wood?"

There may be some flows that are seen as important impacts that are not immediately obvious through the current process network. Carbon dioxide emissions are a great example of this type of flow. Someone may want to know the carbon footprint of the shack, but we have not identified any flows of carbon dioxide of significance in either the process or processing environment networks. The challenge is that carbon emissions occur anywhere throughout the network of processes where fossil fuel is converted to energy. How can we possibly determine all such emissions to develop an accurate footprint for the space-for-use? When looked at from a global scale, every material flow can be traced from its use back to the natural environment where it was extracted. Likewise, every material object of transformation can be traced ahead to its use in a service space and ultimately back to the natural environment to be take-up by the many amazing material transformation processes of the biosphere. This feature is the second thing about process networks that truly fascinates me: they can be used to describe how our entire materials economy is simply a slow transformation of living systems to serve living systems and then be absorbed by living systems, all fueled exclusively by the sun. Some may call this fascinating network the economy of human kind, but others may call the same thing humanity's participation in (and reliance on) a much more beautiful system[50].

Continuing with the example, to properly understand the full scope of our carbon impacts, we must traverse the chain of transformations within the network until we find the emissions to the environment that matter. I have not yet read of many effective stopping criteria for such traversal of the network, but an adaptation of the relative mass, energy and economics method described by Reynolds [9] may be one excellent and rigorous approach. It is not my desire, however, to explore this idea further now.

An easier, though perhaps less rigorous way to begin investigating the carbon footprint is to use existing, building-related life-cycle assessment tools. These tools (like the Athena Institute's Environmental Impact Estimator[51]) have a pre-selected set of impact categories that have been explored for a variety of common building construction techniques. Though these tools don't speak in the process network language, they have essentially investigated the interconnections of that network with the ecological environment over many layers and degrees of separation from the site itself. They also

[50] One of the most well-developed arguments of this perspective is James Lovelock's "Gaia Theory"[50].
[51] The Athena EIE is available through the Athena Institute at http://www.athenasmi.org/.

use the ISO14040 standard of accepted emissions to air, water, and soil as metrics[52]. These metrics may not necessarily all be relevant to the deciders, but they are at least a well-known and fairly well understood set of flows that contribute to major ecological impacts such as climate change and human respiratory illness.

Investigating the processing environment network for carbon emissions may be only partially fruitful. The likely biggest source of emissions is from the energy used to generate and transmit the electricity used by the shack. Well-published annual emissions factors can be easily applied to the annual energy use of electricity for the shack. This number can then be combined with data from the standardized life-cycle assessment tool to give at least a rough picture of the shack's carbon footprint.

When combining similar impacts from the process network with those of the processing environment network it's important to establish an estimated service life for the building, as discussed briefly in Chapter 6. This number of years can be used to weight the annual process-related impacts with the essentially one-time impacts of the processing environment.

There are also other, more difficult to explore flows that could be the source of significant carbon, or other important emissions. Both waste water treatment and solid waste hauling and land filling have their own associated emissions and other adverse stresses on the relevant biophysical systems. To develop a full footprint, it would be a good idea to explore these networks as they stretch away from the site as well. Time and available expertise may limit how detailed the inventory can be. This is a core challenge of life-cycle assessment in general. In many cases the data have simply not been collected and organized in a sufficient manner to be used by people for day-to-day decision-making activities.

This leads to the first caution I'd like to make about exploring impacts using process networks of the desired space. Such exploration should be rigorous enough to admit when connections are missing. When an impact is important and it's understood that a part of the network may contribute significantly to that impact, but that part cannot be explored more quantitatively, then precaution and further research may be a good idea.

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[52] For a copy of the standard, visit http://www.iso.org/ and search for 14040.

The second caution is that the process of the space services may not be as important as another aspect of the larger organizational process network that is not being explored. For example, both the transportation of shack-goers to the site and the process network of the food and other "weekend supplies" may contribute to a much greater extent to the carbon footprint of the desired shack-related relaxation. Though exploring these "unrelated" impacts may seem like extra work, they may lead to important decisions for the organization as a whole and also for the building development process.

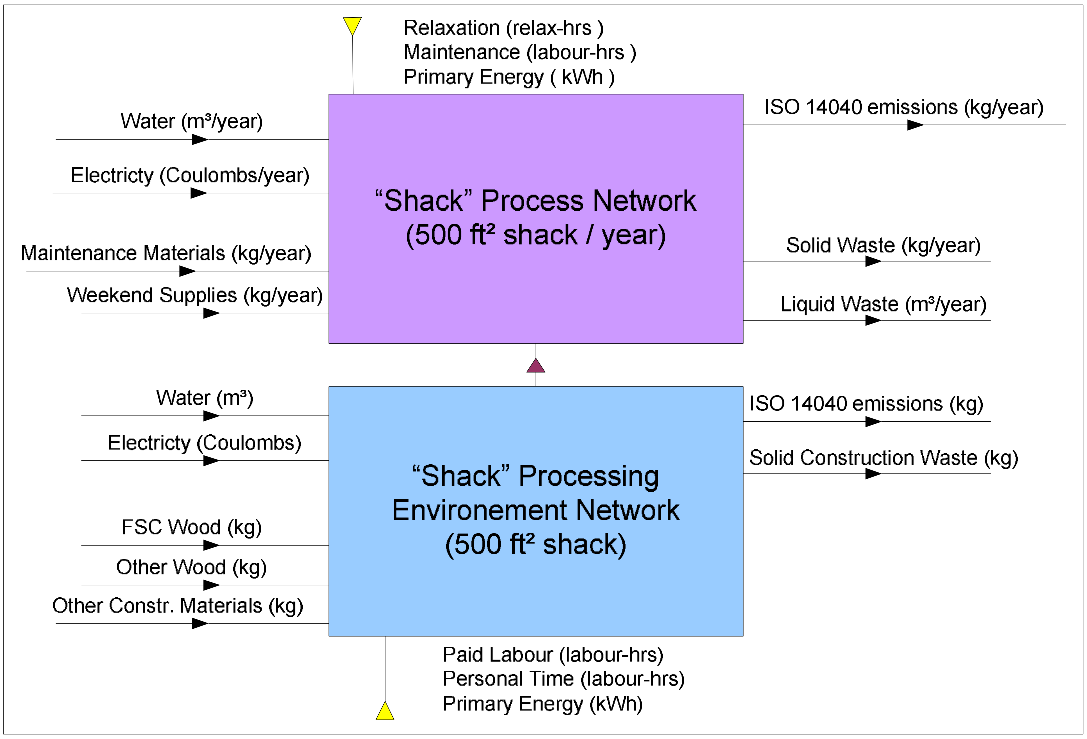


**Figure 11 – Updated process network for "shack" example building**

above is an updated version of the shack process which includes some of the important impact connections that we have just discussed.

### 7.2.5 Making impact-informed decisions and changes

I hope that it's at least a little clearer now how process networks are a good way to encapsulate the links between purpose, space, systems, process, and impacts. With the right people working together to explore these links a great deal can be understood about the complexity of connections in a short period of time. The harder task must truly be deciding what to do once we understand this complexity. I have dealt at least a little with this dilemma already, but it's important to talk about how the networks can be used to as a guide during the five phases of the decision-making process discussed in section 7.1.

**Connections and relationships.** Process networks show connections, but they can also identify important relationships. When we investigate an impact in an earlier or later process in the network we often find ourselves needing to involve the person who might be responsible for that process. They likely understand the impacts of their system much better than we do and they may already have a suggested approach to improving the important ones. For example, a flooring product manufacturer may have an alternative product that serves a similar purpose but has a reduced carbon footprint. Additionally, involving such people in our design process may actually help them to learn more about the sustainability-related goals of those who use their products and services. As I discussed in Chapter 2, WalMart is attempting to involve their supply chain in just such an exercise.

**Deciding metrics.** Process networks help to identifying metrics that are quantifiable. This feature is both good and bad. It is good because many of the important impacts that should be metrics of performance are quantities of material consumption and emission that process networks could be used very effectively to identify. Quantification of metrics is also one of the most important ways of making sustainable building development more scientifically-based. If we can collect data in later stages of development that help us confirm or refute our earlier assumptions we are much better prepared to make changes in the systems which lead to those quantified impacts. Of course, quantity and quality are not always aligned. Process networks do have the ability to "qualify" different metrics by naming them separately (i.e. by creating new technically-specific flows or energy costs) but each new metric may have a much more diverse set of qualities than this form of qualification accommodates.

This statement is especially true for energy costs that relate to people. How can we, for example, measure the quality of people's experience in a typical day at work. We may create "happy work-hrs", "normal work-hrs" and "frustrated work-hrs" energy costs, but then what is the process of putting people into these categories? We may simply use "total work-hrs" and assume that if the number is higher than our targets we have succeeded in keeping people happy. This assumption, of course, would be patently wrong since many things motivate people to work longer than their employer expects. Qualities like “happiness” are not easily put into quantitative metrics, so process networks may not be the best way to measure them. Other approaches, like employee surveys and direct dialogue may be called for.

**Understanding the contribution to sustainability.** Process networks can help us see what our current impact is in a given metric. This gives us a personal context for where we need to start for relative improvements towards a more sustainable process. We are likely to need an absolute reference as well. How much carbon does the typical building with a similar space use to ours emit in its life-cycle? Answering this question means looking at other organizations’ impacts or looking at research which attempts to encapsulate an average of processes for a given segment of the building sector.

Opportunities for comparison, especially for process-level annual impacts, are numerous[53]. As long as these data are brought properly into the context of the specific case of the current building project (e.g. updating referenced energy use data so they are relevant to the local climate) then these comparisons can be very helpful in providing an absolute context. Knowing where we are relative to others and relative to the average is important, but knowing where we need to be to pursue sustainability is the better question. Understanding process networks cannot ensure an easy answer to this question, since they really only describe one piece of the complex global system – the piece that interconnects human desire to the ecological systems that surround us. Koenig suggests that his concept can extend to a description of natural systems as well [12], but it’s really the complexity of the connections and our lack of understanding of them that belie such extension. Process networks can be used to identify the impacts, but it is up to the development team to learn how those impacts might contribute both positively and negatively to a more sustainable future. This work of understanding what constitutes a best practice contribution to sustainability is the hardest and most necessary part of the process that I am describing. Thankfully, many organizations and independent researchers have begun to suggest targets that are likely excellent starting points and the

[53] For example, Statistics Canada regularly provides excellent energy use statistics for the building sector. Visit http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/publications.cfm?attr=0#c for a full array of their excellent reports.

framework of sustainability criteria suggested by Gibson and others allows us to test each impact's contribution to these general requirements [4].

**Costing.** Process networks were originally devised to provide a more rigorous way of applying costs to the economic systems of the materials economy. A first key requirement of this rigor was that the flows and energy costs identified would be easy to price, but that they would not be represented by prices, they would be represented by the technically-specific materials and energy (i.e. by the actual things being transformed and doing the transformation). Once we understand these flows and energies, we can much more easily apply the prices that are relevant to them and use network formulation to total up those prices and calculate the "net value" of the network [12]. This cost-related rigour is an excellent feature of the process network formulation for typical cost-based decision-making and trade-offs. Owners who wish to include more than the space-related flows and energies in their network (our widget-maker, for example) can also use the costing to analyze the return on investment and other key financial performance metrics of their new developments [12].

Ease with costing can weaken the process of decision-making, however. If we only care about those things to which we can apply a monetary cost then we may be inclined to exclude from our trade-offs those things which don't have such a cost. This is why some people feel a monetary cost should be applied to everything in the process network, so such formulations of cost-benefit can properly weight all flows and all energy[54]. I strongly disagree with this approach because if we apply a monetary cost to everything, we separate ourselves one degree further from our responsibility for those impacts. By costing everything we are giving away a part of our understanding of the system to those who set the price. Such a loss of control is contradictory to the core requirements of sustainable development which ask us to use a clear understanding of our impacts to enlighten us as to how we should change our desires. Thankfully, a second requirement of rigour for process network formulation is that all flows, even those that cannot be priced, should be included in the system. My argument is that we must hold true to this approach and recognize as important even those flows which we cannot price.

[54] This is a common message of Canada's Fraser Institute, for example. They have published a number of books and position papers on the "full-cost accounting" of natural resources. Visit http://www.fraserinstitute.org for more information.

Even though this willingness to go without costs may be challenging, especially for organizations that operate for-profit businesses, it is necessary if we want to avoid cheapening our full understanding of building developments and our other organizational actions.

**Making changes.** The level of detail I have described for the process networks we've seen so far does not necessarily lend itself well to intricate changes to the operating and construction processes. Hidden in the box "space-use process" were many complex sub-services of space and their associated delivery and source-sink systems. Formulation of the simplified network does require us to understand and model these sub-services in some detail however. It's in these lower-level models that we can look for ways to improve our designs. Knowledge of how to change the system may come from many people:

- those who set the space-for-use requirements (e.g. occupant, operator),
- those who design the site systems (e.g. architects, mechanical designers, landscape architects),
- those who construct the system (e.g. contractors and product suppliers),
- those who supply the site services (e.g. power authorities, water providers)
- those who have tried to develop similar buildings before (e.g. other owners and occupants) and
- those who understand the impacts on the socio-ecological environment (e.g. conservation authorities, sociologist, geographers).

Using the process network model to help a diverse team of designers to become aware of how the systems they understand connect to the important impacts is an excellent start to making effective changes to the building, to the organizations involved in the building's development and to the knowledge and desires of all those involved.

# 8

# All Our Relations & Enermodal Engineering: an experiment in concept design

Before the decider's dilemma, life-cycle-service-networks, or my definitions of sustainable building development were in any more than a sketchy state, I began to work for Enermodal Engineering Ltd. in Kitchener, Ontario, Canada. Enermodal's stated mission was at the heart of my desire to work for them. Their goals are three-fold: (1) To save the world some energy, (2) to have fun doing it and (3) to make enough money to do (1) and (2). This kind of mission from a for-profit company – one that puts impact improvement and employee happiness as prerequisites before profit – is both refreshing and fascinating to me.

One of Enermodal's primary business activities is to support building owners, occupants and design professionals attempting to pursue leadership in energy-efficiency and environmental impact improvements in their developments[55]. Enermodal offers six major support services to the design and development team:

1) Mechanical and electrical design services,
2) Building energy modeling and energy-related decision support,
3) Project coordination and documentation for the pursuit of LEED certification,
4) Fundamental (i.e. during construction) and best-practice (i.e. during design) commissioning of building systems,
5) Measurement and verification of important impacts such as site water consumption and energy use and
6) Support for marketing the success of green building development efforts to the occupants, visitors, clients, etc.

[55] For those who are interested in learning more about Enermodal, see their website at http://www.enermodal.com.

Working at Enermodal these past six years and experiencing the growth and change of these services has informed my views on building development a great deal. Many of the ideas I have proposed in the previous sections and chapters have evolved either directly from Enermodal's approach or from my own experiences through delivering Enermodal services, especially building energy modeling and decision support.

Enermodal's approach to pursuing sustainable building development is very closely aligned with LEED. Though opinion on why this is so may differ significantly among those I work with, I think the most important reason is that LEED works to motivate our clients. As I discussed in Chapter 5, LEED is the most well-received and talked-about of all building assessment systems that have been developed in recent years, at least in North America. In the commercial building sector especially, LEED-building is virtually synonymous with green-building to many people. LEED certification is taken as a clear indication that the building's developers at least thought about the impacts of their building and targeted some best-practice choices during development. Many people at Enermodal have worked hard to build the reputation of LEED and add rigor to its application in Canada through their involvement with the CaGBC and through Enermodal's focus of working almost exclusively on LEED-candidate building projects.

When I first started working with Enermodal, their established concept-phase process for exploring impacts and changing the design was what interested me the most. A series of four phases (often four integrated design meetings) was common:

**Phase 1.** Review of the major building impact categories and associated LEED points in the context of the specific project. This review would also begin to address the obvious ways that the project might succeed at achieving LEED points as well as which points (and associated impacts) might be difficult to achieve.

**Phase 2.** An energy "shopping list" workshop. For this workshop Enermodal energy analysts would prepare a baseline model of performance for the building and a list of potential energy conservation measures to review and explore with the team. Energy cost savings (i.e. the monetary cost of energy), total energy savings (in kWh) and simple payback based on typical capital cost assumptions about equipment were used in these design workshops to decide the best choices for improving the energy performance of the design. Having all the design team at these workshops was very valuable, since it helped them to understand how their part of the design affects performance and allowed them to contribute their thoughts on how to make the building more energy-efficient in addition to Enermodal's recommendations.

**Phase 3.** A later meeting to review the concept design to date and focus on the more detailed aspects of the building design such as interior and exterior finish choices and landscaping details.

**Phase 4.** A final concept phase meeting to present a summary of LEED-related goals of the project and review the incremental costs associated with these changes that were important for the owner to capture. This summary would then be used by Enermodal during the detailed design and construction phases to compare the owner's expectation for performance to the plans tendered by the consultant of record and her team and the actual building constructed by the general contractor and his team.

During my early work with the company I had a sense that Enermodal's concept process worked well to make the concept design more energy efficient and to help the client ensure they got the building they thought they wanted. This was especially true when the process was followed thoroughly by a client that actually cared about the broader ideas of sustainability and green development. The question that lingered in my mind, however, was whether LEED – as presented by Enermodal in this typical process – was really helping the building owner to understand the relationship between the choices they made and the impact improvements of those choices. At the end of the process, did the client care only about getting LEED or did they care about how well they did at meeting the intents that LEED was supposedly assessing?

This question of "why do I care?" seemed like a good thing to explore with Enermodal and an eager design team as part of my masters work. In discussions with AOR and with Steve Carpenter at Enermodal, I developed the following question of study:

> ***How does pursuing LEED during the concept design of a building transform the purpose of the owner from building a "green or sustainable building" to building a "LEED building"?***

In practical terms, searching for a case-specific answer to this question was an opportunity to explore two different purposes:

i. To test the use of LEED as a guide to the sustainable development of an "ideal" case building (i.e. one that had relatively open timelines and a keen design team). Does pursuing LEED augment or stifle the necessary client knowledge about intents and the changes to their core desires that are needed to have positive net gains towards sustainability?

ii. To develop my own ideas for approaching the concept phase further by creating a rudimentary life-cycle service network (as discussed in 7.2) and use it to describe the decider's dilemma (as discussed in 7.1) for the schematic design. In a way, comparing these alternatibe strategies to LEED and Enermodal's process was a way of testing, in part, my suggested approach against one that works very well already and has led to great success in many building developments.

## 8.1 Building Concept Development – Ideal vs. Reality

As with the high-level concept development exercise in section 4.2, I'd like to tell the story of the case study in a comparative manner. What would have been an ideal process was not always the reality. I feel that highlighting the differences between the two is where the most constructive conclusions about the effectiveness of my case study process can be found.

***Step #1 – Envisioning Sustainability and the Space-for-Use***

**IDEAL**

Before work with Enermodal could begin, I saw a need to work with the AOR board to envision what constitutes sustainability for their building project, at least in very broad terms. I also wanted to give them some preliminary education about what impacts their building was likely to have and how such impacts are connected to the desires within the space-for-use. You could say I wanted to give them a first-pass through the decider's dilemma to familiarize them with the decision-making terrain.

To establish this first vision of sustainability I would use both the Living Building Challenge (LBC)[56] and AOR's organization-level sustainability discussion. The LBC would be a very ambitious example of what pursuing sustainability could mean, yet the

[56] Visit the on-going challenge development at http://ilbi.org/. In my work, I referred to version 1.2 of the standard. It is currently at version 2.0.

overall goals of the organization might restrict or augment the board's ambition when comparing their own desires to the LBC. The goal of this exercise in visioning would be to revise and update the functional program they had already begun with Robert Dyck to include both a refreshed description of the desired space-for-use and an effective quantification of the most important impact improvements from their perspective.

**REALITY**

The functional program was re-explored quite effectively with Robert Dyck, the members of the AOR board and several key stakeholders or stakeholder representatives such as a palliative care nurse and the construction managers at Van Del Contracting. This process also helped to reinvigorate the members of the design team such as Robert Dyck and the team at Van Del who saw that the project was continuing and that it would be pursuing LEED, something meaningful to both of them. The user-centered case studies and updated conceptual floor plan that came out of this work are all in Appendix #2 – Outcome #3: "Functional Program".

My efforts to explore impacts as a second part to updating the functional program were effective, but not quite as rigorous as I had hoped. I struggled quite a bit with how to group the important impacts within LEED, the LBC and the broader life-cycle perspective. In the end, I chose to group qualitative descriptions of a variety of different impacts into the major categories of impact common to both LEED and the LBC: energy, water, materials, site and indoor environment. I also added the sixth category of impact from the LBC – "beauty" which I dubbed "Inspiration" in the hopes that "innovation" points in LEED could partially overlap this category. I reviewed the relevant impacts within each of these categories with each member of the board individually. I answered their questions about why the various impacts were important as best I could from my own perspective, but I tried to remain agnostic on which categories were most important for their design. See Appendix #1 – meeting #6 for the presentation slides of these meetings.

After meeting with each board member, I asked them to consider the six categories and the impacts that mattered to them that fell into those categories. I then asked them to rank the categories in order of importance from 1 to 6. I told them that they could rank all categories as 1 or use whatever spread of importance they wanted to. I then normalized all rankings for each person and combined the results into a single set of priority percentages for each of the six categories. Equal priority would mean that all categories would have a percentage of 1/6 or approximately 17%. In the case of AOR it seemed that, at least in my crudely quantified manner, water and energy use were the most important impact categories, followed more distantly by materials and indoor environment, then even more distantly by inspiration and site. As you'll see, this priority breakdown is referenced several times in the results graphs below.

I also asked each board member to provide as many qualitative responses as possible that explained their ranking thought process. I grouped these responses by category and presented the entire set of responses and rankings to the board as a group. See Appendix #2 – Outcome #3: "Building Impact Rankings" for the material that was presented. I don't think they were too surprised with the result, since many had similar opinions of the relative importance of the six impact categories. There was one outlying perspective, however, which made the discussion about confirming these rankings interesting. In the end, discussion of the rankings was probably not thorough enough – at least not as thorough as I would now recommend to other design teams trying to set targets of performance.

My opinion of this ranking and response process was that it was a positive learning experience for the board. They each took a respectful amount of time to consider the ranking process and the quality of the responses they provided indicate that fact. I also think that the process of creating relative rankings for the categories of impact as opposed to isolating specific impact measures and targets helped to simplify the exercise somewhat. I will discuss this simplification more as we proceed through the other stages of the case study, but I think it was the best choice at the time to facilitate an effective comparison to LEED. Knowing what I do now about the broader spectrum of impacts that could have been discussed, it might have also been good to allow the board to highlight key metrics within the categories that mattered to them; like climate change, for example.

***Step #2 – Schematic Design with Enermodal***

**IDEAL**

Having introduced the AOR board to the broader dilemma and helped them to set minimum targets, I was then planning to move into more of a researcher role to document the concept development process with Enermodal as the project leaders. In essence, my goal was to shadow the design and decision-making process of the case study building using Enermodal's approach to applying LEED as a design tool. Key decision-making discussions and actions would be documented, paying particular attention to where choices seemed to be made to pursue AOR's early vision versus those choices which seemed to be made in an effort to achieve and target specific LEED points. I was to remain an impartial, third-party participant in all discussions. Also, based on past experience, but budgeting additional time for the fact that the project team was working on a volunteer basis, I was expecting the series of Enermodal-led concept meetings to last between five and ten weeks.

**REALITY**

LEED was certainly used as the guiding tool, but the project – because of EEL providing so many services and everyone being a volunteer – didn't exactly follow the standard process. That said, most of the essential components were included. There were a total of four LEED-related workshops which followed the expected format quite closely. The major Enermodal support tools of the energy shopping list and the LEED scorecard were also effectively explained and used as decision-making and tracking tools by Martin Jewitt, the Enermodal principal in charge of the project.

I was actively involved in a lot of the design and decision-making activities, but managed to avoid taking responsibility for any decisions in the early meetings. I filled a lot of what could be called the "non-responsible" roles for the M&E designers and for Enermodal's energy analysis services. I also acted as a project manager for AOR, scheduling meetings and contributing my thoughts to some of the ideas that were considered. These non-responsible roles did give me a great deal of control over what was considered, but I avoided as much as possible suggesting only one option when decisions were based on my work.

The biggest departure from my expectations for this process was the timeline. We began on July 24, 2007 and did not finish the fourth and final LEED wrap-up meeting until September 4, 2009. In between all this time a great deal of work was done – including the development of an excellent concept design by Robert Dyck and Enermodal and a full cost comparison of this concept to a standard practice design by Van Del. Still, two years is much longer than ten weeks and some of the momentum common to the concept development phase of a building was lost. AOR's board also changed shape somewhat in the interim, though the core group of decision-makers were still present at the final meeting. Despite the length of time, the fourth and final meeting did provide the design team with a suitable summary of the LEED-developed design and the associated capital costs[57].

**Step #3 – Compare the LEED-Designed building to a standard practice case**

**IDEAL**

The final step was to compare the LEED-designed concept to a building that meets standard practice at least cost. This comparison would be done in four different ways:

1) Using the LEED-NC1 score for the two buildings.
2) Using a detailed life-cycle environmental impact assessment of the building as well as a site and IEQ impact analysis to complement the LCA. Together, these analyses were intended to more directly quantify the impacts of the designs on the site, space and broader ecological environment. My hope was that the tools used for this assessment would be available off-the-shelf and require little to no customization to suit the AOR project.
3) Using a class C capital cost budget for both designs prepared by an independent third party organization.
4) Using these budgets and an estimate for the target building service life of 50 years, conduct a life-cycle cost calculation for the two buildings.

These comparisons would be used to judge the effectiveness of both LEED vs. LCA and Capital Cost vs. Life-cycle Costing as methods for conveying the impacts and cost trade-offs associated with all the design changes.  My intention was to present a summary of all

[57] See Appendix #1 - Meeting #12 and Appendix #2 - Outcome #5: "Concept Costing Summary" for the material that was presented to the board and design team at the fourth and final Enermodal-led meeting.

four comparisons to the whole design team and conduct a group discussion about the pros and cons of the different methods.

I would also conduct one-on-one interviews with each member of the AOR board to see if their individual goals towards the building impact had been satisfied by the LEED design and to assess their individual feeling about the usefulness of LEED vs. LCA and Capital Cost vs. Life-cycle Costing.

**REALITY**

With the help of Martin Jewitt and the rest of the design team, I prepared what I called a "Difference List" to be used by Van Del to compare the additional requirements and significant differences of the proposed or "*LEED-designed*" model and the baseline or "*least-cost*" model[58]. Though the preparation, review and costing of this difference list did add a significant amount to the project timeline, the construction cost estimate was done very well by Van Del with some valuable support from the landscape architect Carol Bacon of GSP Group and from myself (for photovoltaics (PV), measurement and verification (M&V) and consultant fee estimates). Unfortunately, time constraints prevented me from preparing a life-cycle cost (LCC) estimate of sufficient detail and rigour to use in my comparison. This is future work that I still hope to do with AOR, but I simply was not able to prepare a good enough LCC in time for the completion of this thesis.

Since the LEED NC-1 estimate could be easily prepared based on the difference list, this component was also effectively prepared by Martin with my support. However, since it was already late 2009 when the concept was wrapping up, it was decided that a scorecard which followed the new version of LEED (due to be released in Canada in June 2010) would also be prepared for review and comparison. LEED 2009 is significantly different from the current version of LEED, but since it was possible that the AOR project would use the new system, it made sense to do the comparison of both LEED 2009 and NC-1 to the life-cycle assessment results.

The tools used for LCA met most of the criteria outlined above, though a combination of four tools was required to provide a full set of quantitative impacts

[58] See Appendix #2 – Outcome #4: "Design and Construction Difference List"

relating to emissions and resource use. For the majority of the construction-related aspects of the design, the Athena Institute's Environmental Impact Estimator version 4.0 was used[59]. For the interior finishes such as carpet, paint, linoleum flooring and wood floors and for the parking area asphalt I used the BEES 4.0 tool developed by the National Institute of Standards and Technology in the U.S[60]. For detailed site energy results, I used James J. Hirsch's eQUEST version 3.6.3[61] with some minor hand-calculated tweaks for occupancy control of lighting and ventilation. I also used a custom and proprietary water use calculation spreadsheet available to me from Enermodal. That said, this spreadsheet is very straight-forward and really just facilitated the proper reference calculations for the standard practice faucet flow rates and landscape watering requirements.

I should make two very important points clear right now. Much of the work to prepare these four analyses and combine them was done exclusively by me and is by no means completely free of errors. It has been reviewed by some people, but if you are reviewing the results yourself at some point and wish to make a comment to me, please do so. I am always very inclined to improve my estimates even after they have been used to make decisions. The second point is that the work done at this point in the concept phase was never expected by anyone to be more than sufficiently accurate for decision-making and for good, early estimates of capital cost and process impact.

In order to create a common set of normalized emission and resource impact metrics, it was necessary to transform some of the factors from Athena EIE to be in common units with BEES and vice-versa. Ultimately, the eight common impact categories used for both were: global warming, ozone depletion, acidification, eutrophication, criteria air pollutants, smog, water intake and primary energy. With this list of metrics established, I was able to use the BEES normalization factors for all but the last category. For this category – primary energy – I took the average of U.S. and Canadian data from 2007 (which is the BEES reference year for the other factors)[62].

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[59] As previously mentioned, visit http://www.athenasmi.org/ for more info.
[60] BEES is available from the NIST at http://www.bfrl.nist.gov/oae/software/bees/
[61] The current version of eQUEST is available at http://www.DOE2.com.
[62] For the U.S. data, I visited http://perotcharts.com/2008/07/us-primary-energy-consumption-by-source-and-sector-2007/. For the Canadian data, I visited http://www40.statcan.gc.ca/l01/cst01/prim71-eng.htm.

Athena EIE, BEES, eQUEST, and the custom water calculator were good enough to capture the most important impacts of energy, water, and materials. The space and site-related impacts were more difficult to quantify, however. For one, it was an intentional part of the exercise (as suggested in section 7.2) that all the thermal comfort, controllability, daylight access and views desired for the space be included in both LEED and baseline designs. Review of the energy model space-level performance and a daylighting simulation conducted by Enermodal in AGI32[63] confirmed this intention, so the majority of the indoor environmental quality points between the least-cost and LEED designs were the same. That said, the fact that the life-cycle assessment does not capture these IEQ points was a matter of contention with the board, which I will discuss shortly.

Another important assumption to discuss is the landscaping water requirement factor. Though the landscaping has been roughly designed, a full landscape coefficient calculation has not been completed. Instead, I've assumed that, based on good plant placement and selection, the coefficient is reduced from a combined species and microclimate factor of 0.5 (essentially the median value according to the Landscape Coefficient method) to a factor of 0.2 (the average of the "low" species factor) [35]. This assumption seemed appropriate, given that we are still at the concept phase of development and given how thoroughly the plantings were designed with this intent in mind.

As for the site impacts associated with transportation, proximity to protected and special spaces, and the consequential impacts of transforming space use, research and analysis done in these areas was not considered to be good enough to provide an accurate picture. Further work in the area of site impacts is certainly needed, especially since AOR is transforming a significant farm landscape into their centre and other associated land use (such as parking and landscaped features).

Because of the neutrality of the space-related impacts and the lack of site impact rigour, comparison between the LCA results (read life-cycle-service-network model) and the LEED results was done based only on the Energy, Material and Water impact categories.

[63] Visit http://www.agi32.com/ for more info.

I took some minor liberties when preparing the LCA to provide for a better comparison and decision-making. Specifically, the impacts of FSC wood and green power were implemented as hand calculations or modifications to the other tools. For FSC wood, I took the liberty of assuming that the default “weighted material use” impact of wood of 2.5 could be reduced to a factor of 1.0 given the assumption that FSC wood has a significantly lower impact than its non-certified counterpart. This reduction from 2.5 to 1.0 was arbitrary and a clear oversimplification, but it is arguably still in line with the survey and decision-making logic proposed by the original study that was used to determine these factors [36]. For purchased renewable energy, I simply cut the electricity use entered into Athena from my energy model by 50% and took my lead from Sebastien Humbert by assuming this cut would last the entire 50 year period of the project [37]. I made sure to track the “*Green Power*” model separately from the other model, however, so the AOR team could compare the results with and without green power.

Finally, also due to timeline constraints and the busy schedules of the design team, only the AOR board members were available to review the results and provide personal comment on their impression of the success of LEED at assessing and guiding their design development. I conducted four “exit” interviews with the board based on a full review of the LEED and LCA results[64]. Though a few minor modifications were made to the results since then to correct a scaling error, the results that follow represent what was shown to the board and what served as the focal-point for the majority of the discussion.

## 8.2 Quantitative and qualitative results

The LEED-designed building can be compared to the least-cost design in several illustrative ways. I’ll begin by providing some results which focus on the success of the design at achieving LEED results and life-cycle impact reductions. Of more interest, perhaps, is the comparison of these two sets of results to the board priorities and the qualitative observations from the client which follow.

[64] See Appendix #1 – Meeting #13 for the final board presentation. Some of the results will differ slightly from what is shown here. I noticed some minor calculations errors since this initial presentation, but I am confident that it would not change the more-so qualitative responses of the board.

## LEED Results

In Figure 12 below, I've shown the breakdown by impact category of both the total LEED points and the points achieved in the proposed design for both LEED NC version 1.0 and LEED NC 2009.I've also provided the AOR board priority in each category for comparison.

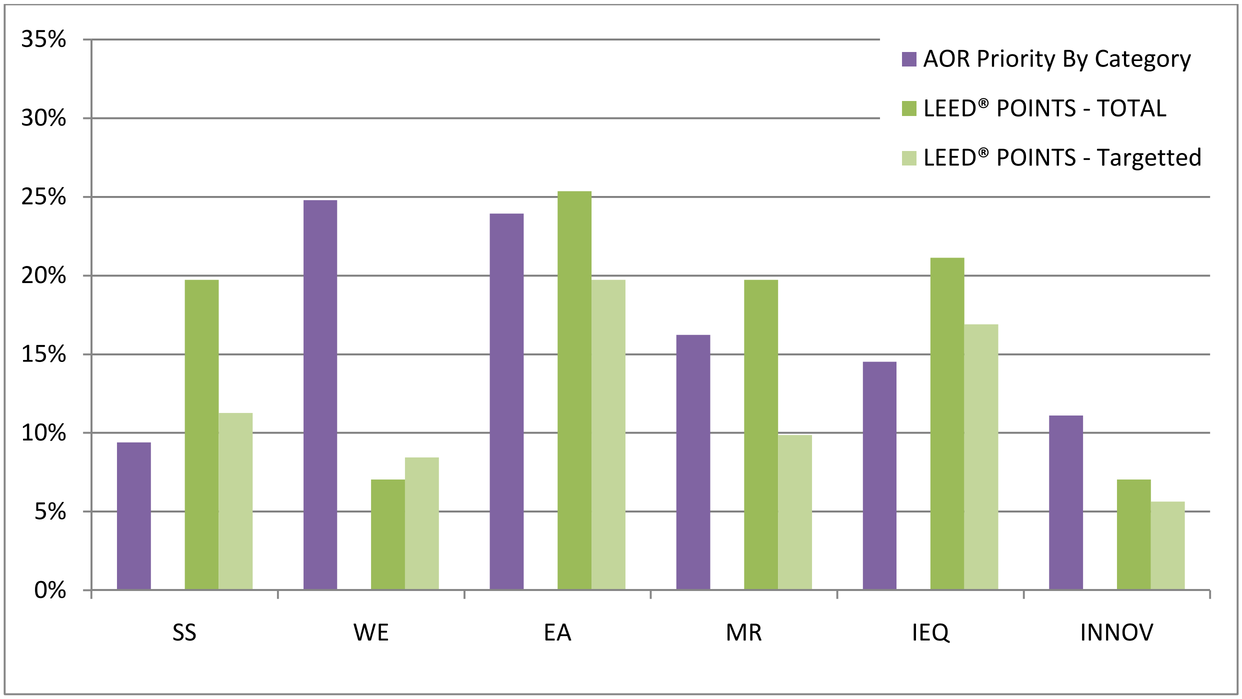
Though a more thorough explanation of each proposed design change is included in Appendix #2 as part of the design difference list, Table 3 summarizes the changes that led to the current points in each category.  I have also included the number of points that could be attributed to the least-cost design. These points are achieved for free, so to speak, since they are included in both the baseline and improved case. A total of 51 LEED NC-1 points are targeted which would safely put the project in contention for a gold LEED level. In LEED NC-2009 gold is also very likely, given the 72 targeted points under that system.

A breakdown of the first costs assigned by impact category is shown in Figure 13[65].  The total incremental cost of approximately $824,000 was divided by impact category, as shown in Table 4, with the lion's share of the capital cost increase attributed to improvements for envelope and mechanical systems and to a lesser extent for FSC wood.

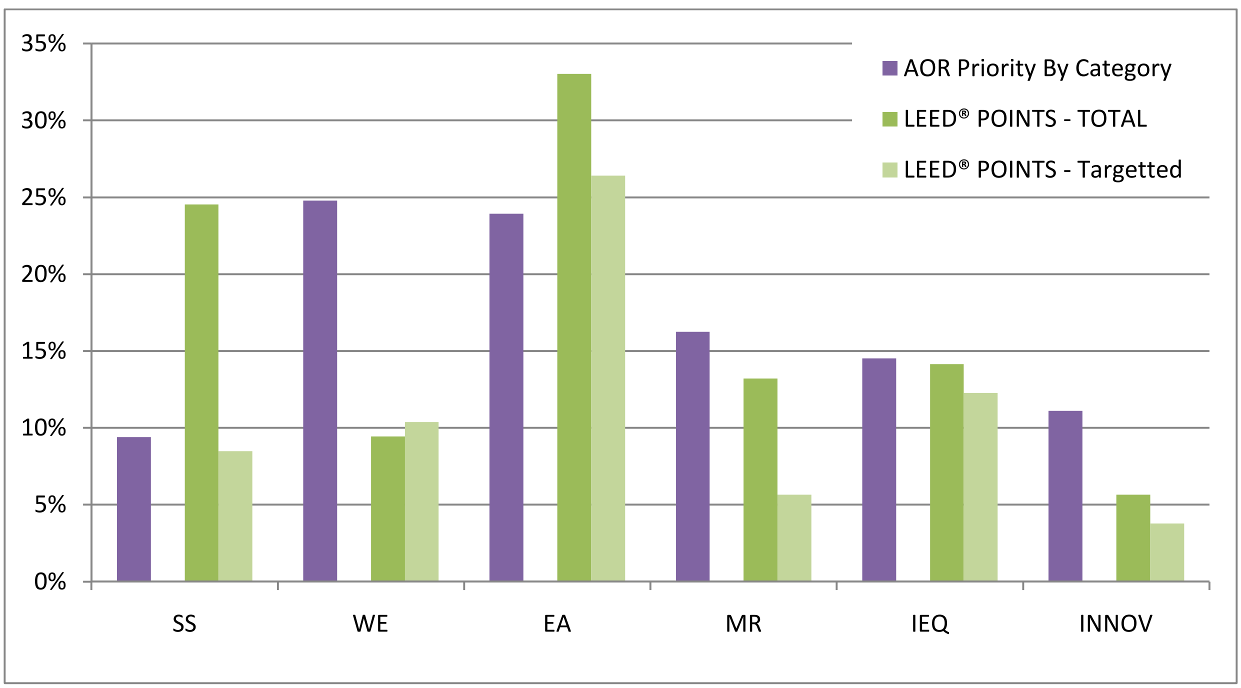
Though a full life-cycle cost analysis was not done as part of the work for this thesis, it is possible to quickly calculate the simple payback of the energy and water savings costs using current standard rates. For energy, the same electricity costs used for the LEED calculations were used: $7.2 per kilo-Watt (kW) electricity demand, ~$0.092 per kilo-Watt-hour (kWh) electricity consumed, and ~$0.40 per cubic metre ($m^3$) of natural gas. A total water rate of $1.6/$m^3$ was based on the Kitchener Utilities rate[66]. Even though the site will have a well, this price is at least useful to illustrate a payback. Using these prices, the simple payback for the energy conservation improvements is

[65] A more thorough breakdown of costs by design discipline is included in Appendix #2 – "Outcome #5 – Concept Costing Summary".

[66] Visit www.kitchenerutilities.ca for current rates. The rates I used were as of March 1, 2010




(a) – LEED Canada new construction version 1.0




(b) – LEED Canada new construction version 2009

**Figure 12 – AOR proposed design LEED point percentage breakdown for (a) LEED NC-1 and (b) LEED 2009 as compared to AOR board priorities**

## Table 3 – Summary of LEED points for the AOR proposed concept design

| Impact Category | Point Targeted | Strategies |
|---|---|---|
| **Sustainable Sites**<br>NC-1 Points: 8<br>NC-2009 Points: 9<br>"Least-Cost" Points: 5 | SSc1 – Site Selection (only NC-1) | Strictly based on site selection. |
| | SSc4.2 – bike storage & changerooms | Racks and trail access provided. Shower in staff room. |
| | SSc4.3 – hybrid or alternative fueld vehicle | Committed to transportation demand management study & efficient vehicles for staff & group transport. |
| | SSc5.1 – Protect and restore open space | Shared land for farming, restoration of land adjacent to forest. See landscaping plan. |
| | SSc5.2 – reduced development footprint | Modified massing to respect current site form. Un-touched or rehab. site areas exceed disturbed areas. |
| | SSc6.1 – storm water – rate & quantity | Bioswales and "Grasspave" for some areas. |
| | SSc6.2 – storm water – treatment | All storm water remains on site. |
| | SSc8 – light polution | Full cut-off fixtures and minimalist exterior design. |
| **Water Efficiency**<br>NC-1 Points: 6*<br>NC-2009 Points: 11*<br>"Least-Cost" Points: 0<br><br>(*includes 1 ID credit) | WEc1 – Water efficient landscaping | "Low-mow" and native/adaptive species throughout. No irrigation system, despite extensive landscaping plan. |
| | WEc2 – Innovative wastewater technology | Cistern sized to meet full annual hose bib, toilet/urinal and dish washing load. |
| | WEc3 – Water use reduction | Low-flow fixtures used throughout. |
| **Energy and Atmosphere**<br>NC-1 Points: 14<br>NC-2009 Points: 28<br>"Least-Cost" Points: 0 | EAc1 – Optimized energy performance | Significantly improved envelope over MNECB<br>Efficient lighting design with daylight/occ. controls<br>Efficient delivery and control of ventilation air<br>GSHPs for 50% of building, with condensing boilers and high-SEER split A/C for the other 50% |
| | EAc2 – Renewable electricity | A 4 kW PV starter system is planned, with room and provision for expansion. |
| | EAc4 – Elimination of HCFCs | All refrigerants to be R-410a or R-134a |
| | EAc5 – Measurement & verification | A $30,000 system is planned and Enermodal will provide M&V services. |
| | EAc6 – Green power | AOR plans to purchase green power for 100% of their electricity use. |

**Table 3 – Summary of LEED points for the AOR proposed concept design cont.**

| Impact Category | Point Targetted | Strategies |
|---|---|---|
| **Materials & Resources**<br>NC-1 Points: 7<br>NC-2009 Points: 7<br>"Least-Cost" Points: 3 | MRc2 – Construction waste diversion | Contingency in budget for 100% diversion of waste. |
| | MRc3 – Salvaged materials | Stonework finish from salvaged field stone (mostly on-site or from adjacent farm) |
| | MRc4 – recycled content | Concrete SCMs, recycled steel roofing, drywall and cellulosic insulation are major contributors. |
| | MRc5 – regional materials | Preference for locally-sourced wood, steel and aggregates is a priority with associated premium. |
| | MRc7 – Certified wood | 100% of wood is currently specified as FSC |
| **Indoor Env. Quality**<br>NC-1 Points: 12<br>NC-2009 Ponts: 12<br>"Least-Cost" Points: 5 | EQc3.1&2 – IAQ during construction & before occupancy | Included as part of construction contingency. |
| | EQc4.1to4 – Low-emitting materials | All materials specified as low-VOC and UF-free including paints, sealants, coatings, carpets, millwork, etc. |
| | EQc6.1&2 – Controllability of systems | Occupancy, daylight, temperature, and ventilation controls included for all spaces, including core offices. |
| | EQc7.1&2 – Thermal comfort | ASHRAE 55 compliance in all spaces with temperature and humidity monitored in all spaces and tied back to M&V system. |
| | EQc8.1&2 – Daylight & views | Special attention has been paid to ensure that daylight and views are provided to all spaces. |
| **Innovation in Design**<br>NC-1 Points: 4*<br>NC-2009 Points: 4*<br>"Least-Cost" Points: 0<br>(* – one ID credit moved to water efficiency) | IDc1: #1 – Green building education | AOR plans to prepare a detailed summary of the design improvements in web-based and written material. They plan to offer regular tours of the facility and offer sustainability-focused programming as part of the regular operations of the retreat centre. |
| | IDc1: #2 – Green housekeeping | With Enermodal's help, AOR will develop a housekeeping program which uses appropriate low-impact and low-emissions products (e.g. Green Seal certified cleaners). |
| | IDc1: #3 – Published LCA Research | As part of the completion of this thesis work, AOR will publicize (on the web) the full process of their concept design development using the LCA approach discussed here. |
| | IDc2: LEED accredited professional | Enermodal's support comes with the advice of many LEED APs. |

**Table 4 – Breakdown of incremental costs by impact category**

| Impact Category | Incremental Cost ($) |
|---|---|
| Sustainable Sites | 99,000 |
| Water Efficiency | 86,000 |
| Energy and Atmosphere | 400,000 |
| Materials & Resources | 169,000 |
| Indoor Env. Quality | 41,000 |
| Innovation in Design | 29,000 |
| **Total** | **824,000** |

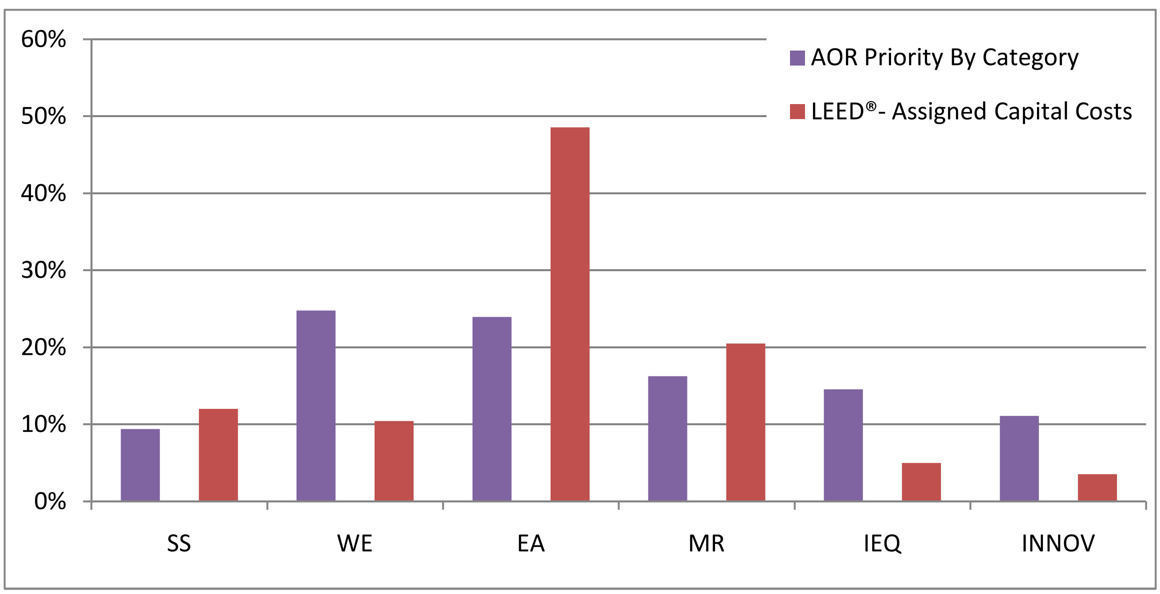



**Figure 13 – Budget capital cost assigned by LEED-related impact category**

approximately 19 years ($16,000 saved annually) which does not include the cost and associated savings of the photovoltaic system or any of the consultant fees shown in the more detailed summary. The payback for the water improvements is approximately 26 years ($3,400 saved annually). Sewage costs were not included.

**Life-cycle Assessment Results**

A full set of LCA results figures in all impact categories is included in Appendix #2 – Outcome #6: "Life-cycle Assessment Results". Below, I've reproduced the final normalization table (Table 5) and the breakdown of results into the associated energy, water and materials categories as discussed above (Figure 14 and Figure 15).

The normalized LCA results are measured in "person-years" which is not an immediately intuitive unit of measure. A person-year represents the annual amount of emission of a pollutant or consumption of a resource for an entity (e.g. country) divided by the number of people who are associated with that entity (e.g. citizens of a country). In this case, the entity is the United States of America and the people are the entire population of the U.S. in 2007. As discussed in the previous section, I have taken the majority of these normalization factors from the set used by BEES 4.0.

The total LCA-determined impact reduction of the LEED-designed building was approximately 650 person-years – essentially a 66% or two-thirds reduction from the baseline impact of 976 person-years. As Figure 15 shows, more than two-thirds of that reduction was through energy savings efforts and another 30% from water-related improvements. Virtually no savings came from the materials-related improvements. This result has mostly to do with the fact that more concrete was required to build the cistern while modest gains were made back through the use of recycled carpeting. More importantly, since there are no normalization categories that deal explicitly with materials impacts (as there are for water and energy) it is arguable that materials-related impacts are under-represented in this table. A recommendation for future improvements to the LCA process should be the inclusion of a useful normalization for weighted material use or perhaps for non-renewable material resource use.

One important observation from Table 5 is that the total number of person-years for the baseline (976) divided by the number of full-time-equivalent occupants (44) is approximately 22 years. This means that over the fifty year life-cycle of the study, the impacts of the building represent 22/50 or roughly 50% of the annual impacts of the regular occupants. In a way this observation makes sense since, for the Hospice guests and full-day retreat guests at least, a significant percentage of their daily impacts will come from being at and using the designed space.

**Table 5 – Normalized Impact LCA results – Baseline & LEED-designed**

| Impact Category (TRACI*) | Annual Impact (USA data) | Unit of Normalization | Person-Years (Baseline) | Person-Years (LEED) |
|---|---|---|---|---|
| Ozone Depletion | 0.3 | kg CFC-11 equiv. / (person * year) | 0 | 0 |
| Acidification | 7860.0 | kg H+ equiv. / (person * year) | 0 | 0 |
| Eutrophication | 19.2 | kg N equiv. / (person * year) | 18 | 11 |
| Smog | 152.0 | kg NOx eqiv. / (person * year) | 41 | 24 |
| Criteria Air Pollution | 231.0 | kg PM10 equiv. / (person * year) | 97 | 34 |
| Water Use | 530.0 | $m^3$ of water / (person * year) | 224 | 39 |
| Global Warming | 25.6 | tonnes CO2 equiv. / (person * year) | 235 | 84 |
| Primary Energy | 350.0 | GJ / (person * year) | 361 | 136 |
| Total | | | **976** | **327** |

* – in addition to the common TRACI normalization factors between BEES and Athena EIE, there is a primary energy normal I calculated from 2007 U.S. data. This normal is meant to replace the "fossil fuel depletion" normal used only by BEES.

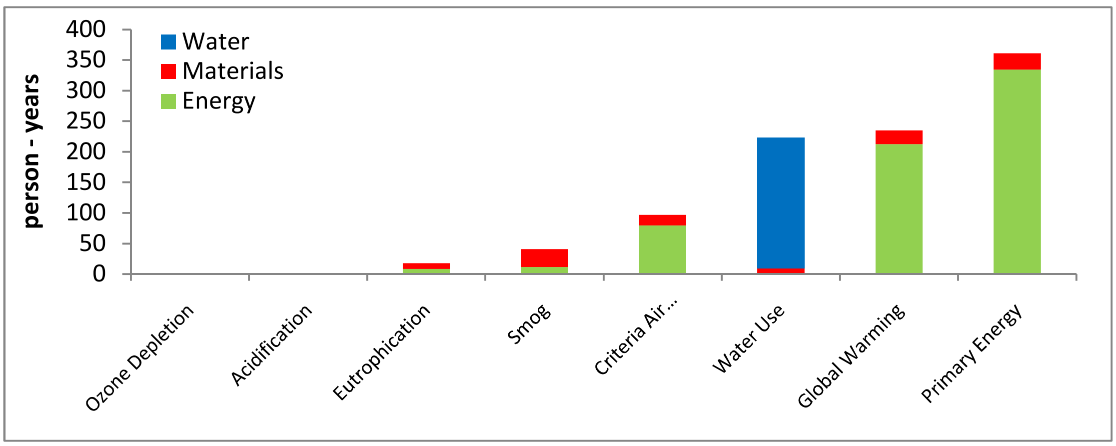



**Figure 14 – Breakdown of LCA impact by normalization category**

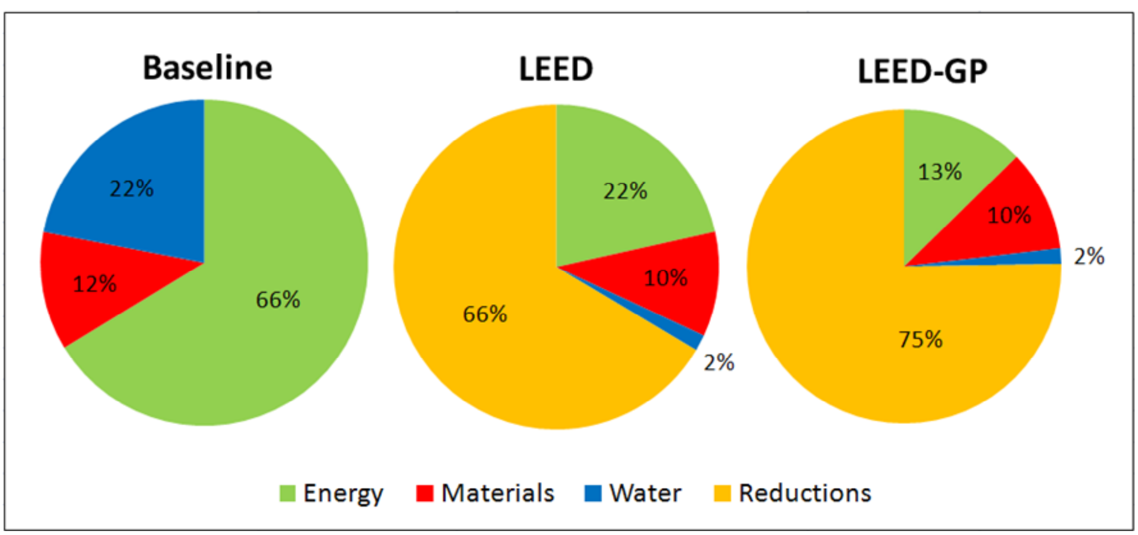



**Figure 15 – Comparison of LCA results in energy, water and materials**

## Comparative Results

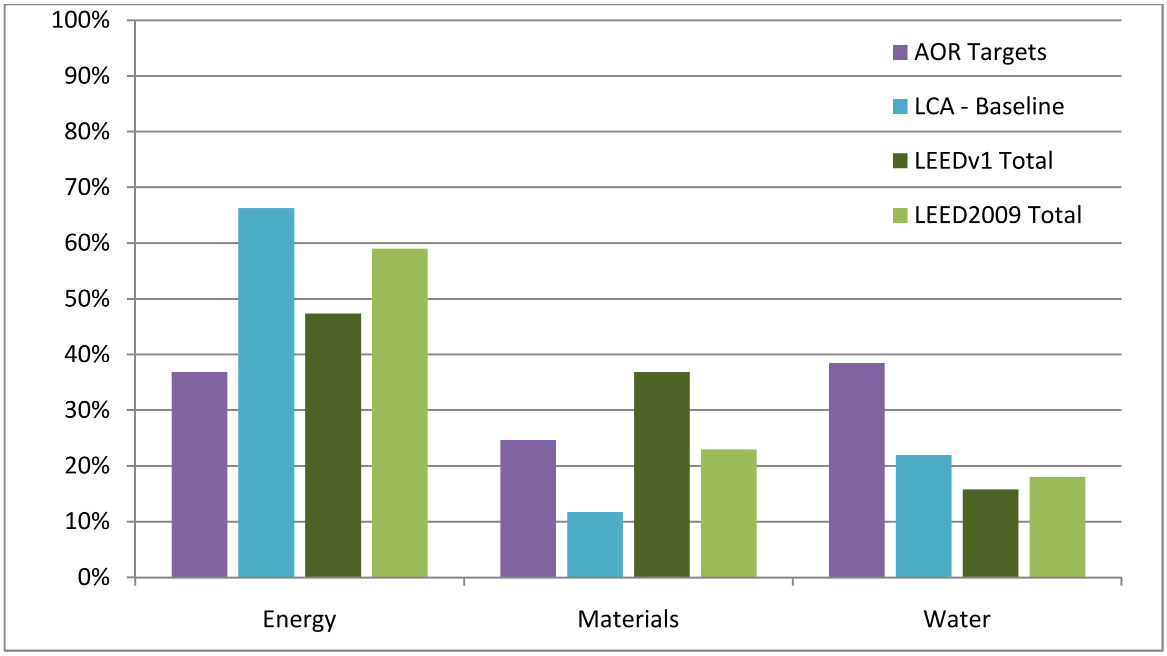
The final results of the comparative analysis of the LEED-designed building are summarized in the two-part Figure 16 – one for the absolute results which we show the totals and baseline in each system of assessment and one for the relative results which represent the success at reducing or improving the impact in each category.

I will briefly explain the way that each series has been calculated in these graphs. The purple bar is the importance assigned by the AOR board to each of the three studied categories, relative to the total importance for all three categories. This comparison to only the energy, water and materials categories was important, since my quantitative analysis did not formally include the other categories of impact. In this form, all three pieces of the impact categories for energy, water and materials add together to 100%. This removal of space, site and inspiration/innovation is the case for all of the series in these two charts.

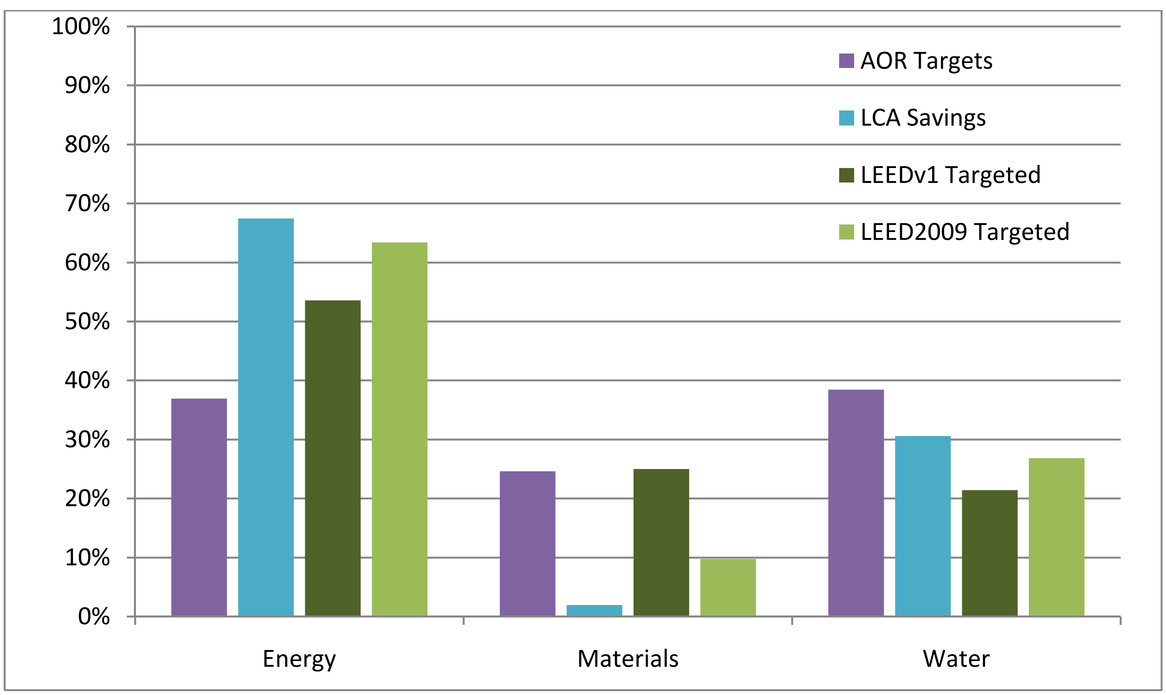
### *Absolute Comparison*

The "LCA – Baseline" (in blue) is a breakdown of the total life-cycle impact of the standard practice or least-cost design into the three categories of energy, materials and water. These data are, as discussed above, a combination of the normalized mid-point impact categories used in Athena EIE 4.0 and BEES 4.0. The LCA baseline is meant to give a sense of the absolute importance of the three categories to the total building impact over its estimated 50 year life-cycle.

The same impression of absolute importance is intended to come across from the second and third series – the "LEEDv1 Total" (in dark green) and the "LEED2009 Total" (in light green). These series show how much weight is given by LEED to each of the three impact categories when compared to the total LEED point for all three categories. Comparing the three sets of absolute results to each other reveals two important observations. First, it is clear that compared to either LEED system, the LCA puts energy as more important than LEED. It is also clear, however, that LEED 2009 puts more emphasis on energy by sacrificing materials – related points. This change from NCv1 to 2009 is consistent with the stated goal of the U.S. Green Building Council to rework the point system to be more in line with life-cycle thinking [31].




(a) –Absolute comparison




(b) – Relative comparison

**Figure 16 – LEED, LCA and AOR priorities: comparative results**

When we compare these absolute results to the client expectation we see a more pronounced difference. Both LEED and LCA place the most importance on energy, while the AOR board had decided that water was the most important category of impact. Energy is important to LEED and the life-cycle assessment because of how significant the 50 year emissions from energy use in a building are on the various impact categories included in the normalization process – especially climate-change-related emissions, primary energy use and particulate emissions which cause respiratory health effects.

Though impacts such as climate change and human respiratory illness were important to the board, the greater importance of water they saw seemed to stem from the absolute view that water is essential to life. Comments collected during the survey such as "water is associated with life...clean water is essential" exemplify this perspective. Though water is currently abundant and available in our community, the possibility of needing a pipeline from Lake Erie in less than a generation led several board members to see water as a limited resource worth protecting. On the other hand, energy and materials impacts seemed to be important due to their related implications such as long-term monetary cost, air quality impacts and carbon emissions, not for their intrinsic value as a shared resource.

Also, since the board had not seen the absolute impacts of the LCA person-years or LEED points when they were setting their priorities, they used a more context-independent perspective when deciding what was important. This ability to weight something because of its personal value independent of context is not present in the LEED certification process, since its system is based on a fixed set of quantifiable metrics and on the subjective judgments of the Green Building Councils. The transparency of the process of selecting weights and assumptions about impact importance has improved with the development of LEED 2009, but the system is still quite far from allowing individual project teams to look at their specific context and apply their own desired weighting to the assessment system [31].

From an absolute perspective, the most important observation about the three graphs is that there is a much more pronounced difference between the three categories in the LCA and LEED results (especially LEED 2009) than for the board priorities. The board priorities balanced out much more evenly across these three categories owing to the fact that several of the members ranked water, energy and materials 1,2,3 or even 1,1,1 in the general ranking process. The board's priorities were much more evenly balanced across all three categories than are the weightings for either LEED or the LCA.

***Relative Comparison***

The set of absolute results were meant to show the importance of the different categories within each system of assessment while the relative results are meant to show how each system weighs the improvements made in the LEED-designed building as compared to the standard practice. In this chart, the blue graph is a breakdown of the total life-cycle person-year savings achieved by the improved design in each category, while the green graphs represent the LEED points achieved in the three categories as a percentage of their total.

Comparing these relative results to each other, we see a similar trend to the absolute numbers with respect to the changes in LEED 2009. The effect of becoming more LCA-like is clear, perhaps even more so then with the absolute comparison. The graphs for impact reductions due to energy savings and water savings are very similar and a very pronounced reduction in importance of the materials points brings the savings there down much closer to the marginal LCA savings value. One observation of these results is that LEED is aligning itself more with the design choices made according to the measures of success important to a life-cycle assessment done using the Athena/BEES tools (i.e. TRACI-based).

Comparing the LCA and LEED results to the board priorities is quite interesting. Despite the fact that water credits were maxed out in both systems of LEED, the savings associated with water was marginally closer to the priority than with either system of LEED. This benefit was to the detriment of the materials goals, however, which were virtually zero for the LCA, while the LEED-v1 materials success was actually quite in line with the board priorities.

Energy success is the most startling difference between the board goals and the measured results in the LCA and LEED-2009. The success in energy is nearly twice the targeted value, indicating that a great deal of effort was spent to save energy above the other two categories. Given the cost associated with energy efficiency improvements shown above, it is clear that energy savings was an obvious priority. This exceeding of expectations in energy is not really a surprise, since Enermodal's expertise lie in making energy-efficiency recommendations and in designing energy-efficient buildings.

Ultimately, from a relative perspective, the system of assessment that matched the board priorities the closest was the LEED-v1 results, despite the fact that this system fell down on making water the most prominent measure of success, which was a board priority. This "success" of LEED-v1 by the numbers is not consistent with the qualitative observations of the AOR board.

**Qualitative Results**

The exit interviews revealed four important conclusions about the board's impression about LEED as compared to LCA and in general as a tool for guiding the concept development of their building.

First, it was clear that LEED was seen as a valuable design tool, especially for its ability to cover the full spectrum of impact categories. All board members were disappointed that site and space-related impacts were not as easy to quantify and include in the LCA results. For this reason, they felt that LEED did allow them to broaden their review of the related best-practice activities and consider some things they may not have if LCA was used exclusively as a decision-making tool. In contrast to this first point, all members of the board did prefer performance-based results, especially to give "clout" and show that actual savings were being made by the design. They also liked the idea that performance-based results could more easily lead to answering the question "what needs to change?"

Also, LEED was seen as a more reputable and "explainable" tool of assessment. Though all interviewees felt that the 'person-year' concept was a more concrete measure of long-term impacts and a more understandable measure of absolute impact, many felt that LEED would be easier for new people to understand and would likely serve as a more appropriate marketing tool for that reason. Two of the board members also suggested, however, that a combination of LEED as a "good start" and LCA as a "better understanding" might be the best way to talk about the results of the development and provide education to people interested in learning about the project.

Third, it was fairly consistently felt among all board members that a LEED-gold certification would be fine, even if platinum was within reach. One respondent did say she liked the idea of platinum from a marketing perspective, but went on to recognize that this would probably not matter as much for the board's internal decision-making process. This self-observation on the part of the board is fairly consistent with my in-meeting notes from the final presentation when it was determined that platinum was a possibility. All were excited, but comments such as "gold would be good enough, as long as we are focusing on our priorities" did occur immediately.

Finally, all four members interviewed were happy with the general outcome of the concept development process, despite the fact that their targets for water and materials savings were not fully realized (depending on the system of measure) and that energy savings were so much beyond the goal. This may be partly attributed to a change of perspective that I noticed occurred that made a focus on energy more important to the board. Because energy was discussed with more intensity than the other areas of impact, it was natural for the board (with less experience and a freer perspective on what exactly makes a building "better") to be swept up a bit in the Enermodal push for energy improvements. It is fair to say that I was also partly caught up in this same push, since I was partly responsible for suggesting energy efficiency improvements to the board, having prepared the energy shopping list (though not having presented it). It was also important that there wasn't a fixed budget to stick to for the concept design. If the board was as worried about hitting a specific first cost target as is common for many building projects, they may not have liked the fact that their design was 25% more expensive than a comparable "lowest-cost" baseline and that 35-40% of that cost was associated with energy efficiency improvements. Their goal of enumerating the incremental costs and then pursuing donations for these improvements as a unique marketing strategy is partly what motivated the "do as much as possible" approach. I will discuss further, below how this same mentality can be used for all projects, even those with very tight budgets.

# 9

# Conclusions & recommendations from the concept case

After the two year period that was the case study for AOR's hospice and retreat centre, I felt a little uncertain about what clear conclusions and recommendations actually came out of the entire process. For one, the case study had resulted in a quite expensive, but in all other ways satisfying concept design. I was not able to delve fully into the minds of the design team, but I did learn from the client (the AOR board) that they were happy with the work that had been done for them and they had generally enjoyed the experience of such a detailed (but perhaps disconnected) concept design for their building.

After a long and detailed review of my notes, I realized that this positive outcome is worth contrasting against a more typical building concept development process when trying to draw conclusions. What went right with the concept development for AOR can inform projects that are constrained in other ways to understand how those constraints may limit the success of using LEED to guide their concept phase. To frame my conclusions, I've made four "problem statements" about LEED that can tend to be true based on my personal experience over the past few years, but that can be resolved if the design team uses the right perspective and approach.

**Statement #1: A LEED-focused process has a tendency to transform intents into actions without confirmation of impact improvement. In other words, the points become the purpose.**

For AOR, this transformation was avoided, for the most part, because they had a principal and design team at Enermodal who lead the discussion with a focus on intents. Also, the board had thought about what they wanted, even in broad terms, before engaging in the LEED-focused exercise. This early thought process kept "point focus" in check, though sometimes the fact that points were achieved with a given action meant that further efforts were not pursued. Exploration of waste water strategies was the most prominent example of this effect. Water impacts were a clear priority for the board. But, since WEc2 and WEc3 could be effectively met by installing low-flow fixtures and a cistern, further investigation of wastewater and grey water treatment systems did not occur. Though the credits were achieved and the LCA shows a significant reduction in water use, I think waste water is an area where the board would have liked to see further design ideas and further innovation.

Point focus isn't as much of a problem in concept design if it leads to an exploration of intents. As I discussed above, using LEED to broadly explore the categories of impact was seen as a good thing by several of the board members. In other projects I have worked on, however, problems can arise more so when it becomes time to cut points rather than add them. During cuts, a design feature is seen as isolated from its impacts and is judged based on its capital cost, on how many points will be lost if it is cut and on how important the idea of the point is, qualitatively, to the deciders. This last judgment factor is the closest the decision-making comes to focusing on intents. Unfortunately, by separating points from their intents, the LEED system can become another abstraction of the real impacts, just like monetary value. Since AOR has not had to go through the cost-cutting process yet, it is difficult to know how they will react and whether they will use the points or the more quantitative performance metrics to make their decisions.

As discussed in Chapters 7.1 and 7.2, my proposal for avoiding point focus and point-based decision-making is to see the building as an interconnected system with specific impacts rather than as a set of actions that lead to a level of success. In this model, what matters is how much you improve the impacts of your building, not whether you took the right action. There are, however, three important problems with using tools such as LCA to provide a more holistic, performance-based assessment of impact in early decision-making: (1) understanding the significance of impacts, (2) trust in the ability of the model to quantify and qualify impacts and (3) being able to establish meaningful targets.

I, perhaps incorrectly, assumed that the AOR board would have some trouble understanding the significance of the impact categories proposed by LCIA systems such as TRACI and IMPACT2002+. This assumption lead me to simplify the categories of impact we explored to the broader needs-focused categories of energy, water, materials, site, space, and inspiration. Unfortunately, by using this simplification, I forced the board to group several potentially distinct concerns (like climate change, for example) into the broader category that was likely to contribute most to that concern (in the case of climate change, this would be “energy”). I also think that I did not give the board sufficient education on the connections between the broader category (e.g. materials) and the various, more specific impacts that result (e.g. human health effect during manufacturing). In the future, as proposed in 7.1, I would use a baseline model for a building “like your own” to show the link between the desired services (heating, cooling, water, control, etc.) and the mid-point impacts that result (carbon emissions, eutrophication, etc.). This process would hopefully help to establish the necessary understanding of these connections and help the client to start talking about which metrics and targets are most important and why.

Such a discussion would probably also address the client’s trust and confidence in the modeling approach. By talking through the link between services and impacts, those preparing the model would need to be clear on where assumptions were made and illustrate to the client how sensitive the model is to those assumptions. Of course there is a fine balance between preparing a model that is not too complex to allow the connections to be traced but also detailed enough to approximate reality (at least the reality necessary for the decision-making at hand). The wrap-up discussions of the LCA I conducted with the AOR board showed me that there is still some work to be done to make the model I prepared both easy to understand and useful for decision-making. Of course, the time I took to explain the modeled results may also have played into their confusions and reservations about how easy it was to understand the life-cycle approach.

Time is truly the most challenging part of any concept development process and time affects the third problem with LCA most of all – establishing targets. My ability to average the weighted scores from the board’s category rankings was a relatively simple procedure, but these “targets” were only really useful for the comparison between LEED and LCA, not as goals for absolute success. During our earlier discussions, I tried to portray the Living Building Challenge (LBC) criteria as defining the most sustainable level of performance, but I only briefly quantified what would be required to achieve the

LBC levels and without asking the board to set specific targets for the metrics established by the LBC. Though my strategy served the purpose of the case study, I feel strongly that future projects should attempt to understand what truly constitutes sustainability when setting their own targets, as I've recommended in 7.1. Establishing sustainability as the ultimate goal gives a long-term context for a given metric that far outweighs any relative measure of success recommended by authorities such as the CaGBC or even the current desires of the client. As I discussed above, establishing what constitutes sustainability is hard, time-consuming work. That said, many people are engaged in this challenge for a variety of important impacts. The hard part is usually figuring out who best to talk to and which data are the most reliable and appropriate for your organization.

**Statement #2: LEED, especially as delivered by Enermodal, has a tendency to favour designer-led discussions and decision-making.**

This statement did apply, in part, to the AOR concept phase. Many of the conversations documented during the schematic design were between the project principal (Martin Jewitt) and the architect of record (Bob Dyck) with the AOR board contributing their thoughts more infrequently. These conversations would begin with Martin moving to the next LEED point and providing a brief overview of the intent. Bob would then provide his opinion of the point and suggest whether he felt it was valuable to pursue or not and what the associated design strategy might be. Then, if someone disagreed with Bob's assessment, there would be conversation back and forth and occasionally the perspective would change. This back and forth discussion resulted in several points changing position, the most notable of which was FSC wood which was ultimately targeted, despite the recognized additional cost.

The tendency in all such discussions was to let the experts provide their perspective and advice and then either follow that advice or request other options or information. Reliance on the expert opinion to establish what is realistic and appropriate for a design certainly makes sense, especially if the designers are thinking in the best interests of the client and are providing clarification and reasoning for why they would make a choice or not. This approach is also arguably the most cost-effective one, since designers tend to be very cognizant of the cost of the design options they are familiar with. My problem with expert-led discussion is that they can stifle a client's exploration of their project's impacts and prevent them from recognizing their own responsibility as the ultimate decision-makers.

The reliance on expert opinion that happens when following the LEED approach has a tendency to limit education opportunities for the client because talk quickly turns to "how would we get that point". In this situation the client may not ask for clarification of intents, especially if a strategy is only briefly described and the point quickly becomes "targeted". The client may also become confused by the technical language that comes up during discussions of design strategies. For AOR, their early work with me and Martin's continual return to the broader subject of intents likely inspired more conversations about the "what" and "why" of various credits than is common.

Designer-led discussions and decision-making also have a tendency to make the designers responsible for both the actions that need to be taken and the impact improvements being targeted. This later responsibility is one that should never be given to the designer, since it is the owner who is ultimately responsible for the impacts of the project. Energy-efficiency, for example, became more important and received a huge amount of the incremental budget partly because Enermodal placed their own emphasis and effort on energy performance. Again, this shift of intents is not bad per se, but it was not necessarily in line with the desires of the client and the shift was not fully discussed and agreed-upon with the AOR board. It just happened.

As I've suggested in 7.1, my recommendation for ensuring a client is well-informed and has explored their own vision for sustainable development is to separate the discussion of impacts from that of actions. This approach was followed in part for the Hospice and Retreat centre, because there was a period of visioning about the project before the concept design began. When it accidentally became known to the design team that the AOR board had placed their largest emphasis on water-related impacts, the connection between this first phase and the schematic design was made. Also, the board was vocal in their desire to emphasize energy and water which resulted in maximizing (and even exceeding) the associated energy and water conservation points.

Specifically, if the board's priority for water had not been known, it's likely that either a cistern sized for 100% of irrigation or low water landscaping would have been pursued, but likely not both strategies, since only one of them is required to achieve all the necessary points for water. This was not the case, however, and both strategies were included in the design resulting in only a single additional LEED point (stolen from the innovation category) but a significant incremental cost and one with a simple payback period of almost thirty years. The need for payback wasn't as important to the board as achieving water savings and both the mechanical designer and the landscape architect followed this board-led goal with rigour and creativity.

Extending this idea a little, I have tried to imagine what would have happened if the experiment to use LEED as a design tool hadn't happened. It's likely that the full set of priorities would have been presented to the design team as general guidance for their design. How the designers would have used the priorities in developing the schematic design is currently unknown, but I think it's fair to say that it would have led to a more evenly-balanced category breakdown, especially in the energy, water and materials categories. Also, the water-related design considerations would likely have received more scrutiny. For future projects, I think it would be interesting to work with the client group to establish the desired performance targets without the "how" of the design in mind and then engage the designers with the challenge of achieving the specific performance-based targets afterwards. Giving the designers responsibility for the how, but being clear on what success looks like, is perhaps the best way to promote the spirit of creativity necessary for good design.

**Statement #3: LEED points targeted in the concept phase develop a false sense of optimism about how successful the project is likely to be.**

This statement is very likely to apply to AOR's design too, but perhaps less-so for two important reasons. First, as part of the broader schematic design, the board had a detailed capital cost assessment prepared comparing a least-cost design to their targeted design. They are also planning to review life-cycle costing calculations for the major improvements prior to moving into the detailed design and construction phases. Changes to the concept based on these calculations are likely, but these changes will happen before any further money or time is invested by the designers or the builder.

The second reason, and perhaps in contrast to the first, is the fact that the designers have spent quite a bit more time than is common developing the concept design for the building. As a result, the owner is more-or-less satisfied with the results and they have (or will shortly) provide the designers with a clear direction for future work. With such direction, unless significant complications arise in detailed design, the strategies that have been proposed now and the associated impact improvement are more likely to remain as they are.

What I'm suggesting is that by the end of the concept phase the proposed design should encapsulate the intended building project and all of its impacts. This full description of the space-for-use, designed systems, associated costs and targeted impact improvements will allow the design team to solicit the necessary response and direction from the project stakeholders and provide a reference for decision-making during the planning phase (i.e. detailed design) and construction phase of the project. The accuracy of this description will be relative to the available info, but should still provide enough detail to let the client and designers feel comfortable moving into the next phase of development knowing how the project is likely to succeed.

Of course significant complications arise quite often in detailed design, during construction, and especially at tender. To adapt to these shocks – and perhaps the key to fostering resilience in the building development process – is to employ feedback of this "encapsulating" assessment, as discussed briefly at the end of 7.1. This feedback would be especially important when there are shifts in the client's desires (e.g. funding is cut or substantially increased). To make feedback easier for the AOR project, significant effort was made to determine the incremental cost of the LEED-design improvements division by division. This kind of clarity early on will make hard cost-cutting decisions easier and avoid wasting everyone's time when designs become more intricate and changing designs more time-consuming. In essence what I'm recommending is that for even the most time-stingy projects, having a good baseline and incremental cost analysis will always save time when there are conflicts or changes.

Another recommendation I would like to put to design teams, when preparing the encapsulating assessment, is to make clear which sub-systems are easily changed or added onto later on in the development process and which sub-systems need to be in place right at the start because of how costly or otherwise challenging it would be to retrofit them. Important examples of these core sub-systems include buried systems such as in-ground piping, envelope systems and the basic structure of the building. Also, any large HVAC strategy changes (for example from variable-air-volume (VAV) to a distributed system like fan-coils) may be very costly.

A corollary to this recommendation is for designers to keep retrofit and serviceability in mind (i.e. design for change). An example of this strategy included in the AOR design is the use of distributed in-floor heating supplied by a condensing boiler system. If the price is right, or if the cost of gas skyrockets, a second ground-coupled loop could be installed to replace this boiler. Another example from the AOR project is the solar PV system design. All of the necessary wiring and switch gear for a large solar array is planned, but only a modest-sized array will be installed right away. The important part of any such strategy is to think about the ideal future for the given system and include at least the most core requirements in the baseline design.

A second important way to foster resilience comes directly from this "ideal future" idea: having a long-term vision which is not totally realizable in the short-term inspires a realistic optimism during the design process. The idea of "leaving something for later" is a visioning and design strategy akin to the backcasting exercise described in Chapter 4.2. Having such a vision and articulating it to those involved in the project will lead to a design that can be both assessed for its current successes and be prepared to adapt and change as new options become available or more money can be put to improvements. Such a vision is also likely to inspire property owners to more regularly review their developments to see if they are ready to take the next step.

For AOR, two currently installed systems that will promote this kind of adaptation include:

1) A metering system for assessing energy consumption, water use and comfort levels in the space to ensure that targets are being met and to identify areas of improvement.
2) The installation of the expandable solar array, as just mentioned. Once the current grade-level panel spaces are filled up, racking can be installed on the roof and when 40-60% of the roof is filled (depending on the selected technology) AOR will likely be able to operate at net-zero site energy.

Some additional design features could include:

3) Reserving the necessary space for the second ground loop in the adjacent field by ensuring that the initial ground loop serving half the building is installed more permanently under paved sections and parking areas.
4) Allocated space for future grey and black water treatment systems to extend AOR's water conservation targets to net-zero. The design required for this ideal future would not be as straight-forward as the other three ideas and may require a redesign of the current floor plan to put all washrooms on the main floor to allow for drainage to a future black water treatment system in the basement.

These example adaptation strategies are unique to the AOR project and are made possible by the fact that AOR has a big property for their operations. The size and relative remoteness of the site, however, lead to issues of impact that have not been successfully highlighted as part of this study, which leads to the last of my four statements about LEED.

**Statement #4: A LEED-led process absolves a design team of accounting for their "untargeted" impacts, especially when the overall LEED level hoped for is achieved.**

This statement is most valid for AOR when we consider the site-related impacts of the Hospice and Retreat Centre. LEED includes many site-related impacts which were difficult for AOR to achieve, especially those which relate to land-use transformation, development density and access to the site via public transportation. These later two impacts are even more prominently featured in LEED 2009, since density and transportation have become 17 of 26 site points (65%) as opposed to 5 of 14 points (36%) under LEED NC-1. Also, the site transformation of an existing farm field into the building site means that the credits available for brownfield redevelopment and site selection (under LEED 2009 at least) are also not targetable.

The fact that these credits are not achievable is worth noting for two reasons. First, they are entirely dependent on the site selection and were therefore virtually off-limits even before the concept development began. I have already briefly discussed (in 7.1) the idea of doing at least a cursory assessment of the project before site selection to identify such impacts. More important to the process, however, is how quickly these impacts were forgotten. In the very first meeting, once it was realized that these credits were "off limits", the design team (though disappointed) did not return to the discussion of site-related impacts for the rest of the concept development process. Only at the end, when the LCA results were reviewed, did mention of the site-related impacts come up in discussion, and only really in the disappointment of the board that the LCA could not properly capture the site impacts.

By working through the LEED points category-by-category in a linear fashion, if the end result is “gold”, we may not be inclined to say “yes, but what did we miss?” The trouble with trying to quantify and make a metric out of the various site impacts, however, is that they are both not well understood (even in the LCA community [14]) and they are also on the border of what one might considered “building-related” impacts. Issues of development density and access to transit are only partially related to the development of the building, since they are dependent on the siting of that building. But just because an organization puts their new building on a city bus line doesn’t mean that employees are going to take the bus. Transportation services are another large, essential piece of every organization’s desires and impacts. It’s admirable that LEED is recognizing this interaction between site location and transportation impacts and I am very impressed by that fact, but if the points are not achievable because the client has already chosen a site, what motivation is there to continue including those impacts in decision-making?

LEED NC-2009 is revising the site requirements slightly to allow for a completed transportation demand management study to help the building qualify for the transportation credits as is the case in LEED-EBOM (existing buildings, operations & maintenance) [6]. The point I’m trying to make, however, is one I’ve already hinted at in both Chapter 7 and Chapter 8. It is important for LEED and other systems of assessment to be taken as one part of the overall organizational assessment of sustainability. LEED should only be one part of how an organization looks at its development impacts, especially when impacts are common to two different parts of operations as climate change is to both building energy use and transportation.

In AOR’s case, it makes sense for the board to consider a transportation demand study for their planned centre to investigate the emissions and other access-to-service impacts that come from offering a service desired by city-dwellers in a semi-rural location. There may be changes to their transportation plans – and costs associated with those changes – that are comparable to the costs for building energy efficiency. Trade-offs between the two sources of impact may also need to be explored. For example, could additional, future on-site electricity generation be used to charge electric vehicles in off-peak times? We began this project by looking at the entire organization because I wanted to address the broad set of potential sustainability concerns and their interconnections first. I wanted to see if, when looking at the successes and costs of the building, the board was reminded of the other related areas of their sustainability plan. I am worried about using LEED as the exclusive tool for assessing and developing organizational sustainability because throughout the entire process, our focus was exclusively on the building and its success. LEED seems to have a tendency to draw an organization into the excitement of pursuing gold or platinum when the real purpose is mitigation or improvement of energy and environmental impacts.

However, as long as an organization takes a broader approach when considering sustainability, LEED can serve as an excellent impact review tool and as a source of best-practice strategies for improvement. This was certainly the case for AOR. A thorough review of the point system provides keen clients with an effective introductory level of education about building impacts, especially when guided by an experienced firm such as Enermodal. Bearing the four statements above in mind, I am willing to recommend using LEED as a jumping-off point for further exploration and as a means of determining the best metrics of performance for an organization-wide approach. LEED is a great first step in the life-long process of building sustainability that I have outlined over these past six chapters. Once that first step is taken, the remaining journey – though wrought with complexity and challenge – promises to reveal a future worth sharing.

## 9.1 Looking beyond the concept & case

If I look very honestly at the past 180 pages, I see a handful of thoughtful definitions, several insights into how we might develop buildings more sustainably, and a case study project that has only just begun. In short: a good start. Thankfully for myself and others interested in exploring the landscape of sustainable building development, there's a lot of undiscovered country.

A first, obvious extension of this thesis is to do more case study concept work with other organizations engaged in building development. I would love the opportunity to apply my recommended process of iterative assessment using the deciders dilemma (section 7.1) and to further flesh out my sketch of the life-cycle-service-network model of building impacts (section 7.2). Thankfully, the USGBC agrees with me. Three of the six currently offered pilot credits described on the USGBC website are essentially invitations to test out these ideas[67]. If someone is keen to try out these credits using my work as guidance in some way, I would be very interested in helping out in what modest way I can.

Of course, you don't have to be building a new building to begin taking an organizational view of sustainability and to pursue sustainable building development right now. Any organization interested in applying the ideas that I've discussed here would have my support and, for what it's worth, my guidance. A more appropriate suggestion, however, might be for the CaGBC to follow in the USGBC's footsteps and engage in a pilot program of case studies which focus on how a more thorough concept phase can lead to better buildings. This pilot could apply to either existing or new construction. Though I have not investigated the idea very far, I imagine that several universities across the country would be willing to have masters students just like myself provide analysis and documentation support (in exchange for a degree) to organizations interested in being part of such a study. Collaboration between the CaGBC, keen building owners and research institutions would simultaneously satisfy the green building industry's need for experienced graduates, provide the building owners with more than just a basic understanding of LEED and provide the CaGBC with an in-depth look at how LEED affects the design and decision-making process for a variety of building types, locations, and owner perspectives. I'm sure it would be hard work to find the right match between building owner, institution, project and researcher, but the benefits for all could be numerous.

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[67] The current pilot credit website for the USGBC is at http://www.usgbc.org/DisplayPage.aspx?CMSPageID=2104. The credits I am referring to are "Pilot Credit #1: Life-cycle Assessment of Building Assemblies and Materials" and "Pilot Credit 5 & 6: Preliminary Integrative Project Planning and Design". I have downloaded both credits and made them available as Appendix #3 of this thesis.

A second extension of the ideas in Chapter 7.2 is further development of software tools and research databases to improve the speed and accuracy of life-cycle approaches to building assessment. A crucial goal in my mind is to develop a tool or suite of tools which can:

1) be simple enough to focus quickly on the early decisions,
2) be accurate enough to articulate the connection between our desires for space services and our impacts in the environment and
3) improve in accuracy, in an iterative manner, as project details become clearer and the project moves through design into construction and on to operation.

There are currently many tools out there for analyzing different building systems and general environmental impacts. A small list of the tools that I am personally interested in seeing become more "interchangeable" are provided in Appendix #4.

What's missing from this list, in my opinion, are tools and approaches which address building water use and stormwater management, land-use transformation, and the full spectrum of life-cycle cost considerations. These exceptions aside, each category in Appendix #4 has at least one or two good tools available. The important goal is to see all of these tools as different ways of looking at the same system. Using the process network paradigm, I hope to explore an object model which might help to connect these different, but equally useful tools towards a common purpose.

Of course the hardest part of modeling in the fast-paced building industry is having enough time and expertise to do the right analysis under time constraints. An interface designed to transpose the structures and results from one tool and move them into another might make modeling at least a little faster. This vision declared, I really don't want to reinvent the wheel. I hope to make as many contributions as possible towards this common model project through existing projects such as the open gbXML schema[68] project and various on-going projects under the UNEP/SETAC life-cycle initiative[69].

This kind of interchange tool will never and should never be a substitute for a well-rounded education in buildings and their impacts. As such, my short and near-term

[68] Visit http://www.gbxml.org/ for more information.
[69] A full description of the initiative is currently available at http://lcinitiative.unep.fr/.

plan is to focus on learning the suite of tools in Appendix #4 as I learn the field of impact analysis through my day to day work at Enermodal. Doing this thesis has led me to believe that working on actual building projects is the best way to know how to make future projects better.

And so finally (and most immediately) I am anxious to continue with the development of AOR's building project past the building concept phase. As I've mentioned throughout, some of the important concept phase work still remains. The AOR board has requested that I complete my work on the life-cycle cost analysis of the building and there is the matter of the final presentation of the study results to the full design team. I would also like to formalize the process described in 7.2 by preparing a proper diagram for the life-cycle-service-network that has been developed for the current design.

As we move into the detailed design phase and on into construction, my hope is that the AOR board will be willing to use the approaches I have proposed to look again at their vision for the building and at the building's impacts. I would ensure that this review would include setting specific targets for metrics such as carbon emissions and water use and we would use those metrics to assess the tender design, the as-built building and the as-operated building after each year of operation.

Before AOR can continue with their design, however, they must first secure funding. There are two ways that I can help with this immediate challenge. First, I think the work that they have done to describe their building concept is among the most detailed and thorough of any project I have worked on. This description can easily be transformed into marketing material that I can help to prepare. Second, they have only just begun to take a long-term, high-level view of their organizational sustainability. I would like to continue to investigate the various relationships and impacts that were identified in the brief preliminary assessment described in section 4.2 and try to look at each relationship with the same or similar rigor as has been applied to the building concept. My hope is that AOR will want to open this development process up to scrutiny by publishing a working copy of the sustainability plan and starting a blog of the discussions that will continue to build on that plan. If anyone is interested in starting a similar plan, would like to contribute their thoughts about our efforts, or would like to participate directly in All Our Relations' process, please get in touch with me. Though AOR's efforts at building design and organizational development are unique to them, I hope that we can change the conversation a little by making people aware of what we've done and challenging other organizations to comment, critique, question and, ultimately, to act for themselves.

### A hopeful summary dialogue

To wrap things up, I thought it might be fun to imagine how our two owners from Chapter 6 might fare after having been confronted with the idea of pursuing LEED for their next building. Who knows, maybe a version of this dialogue is happening in a Canadian property developer's office right now. We can only hope.

### *Building Sustainability: Act 1, Scene 2*

*{Scene: the same boardroom, one year later}*

**Owner 1:** Ok, it's time to build again soon. I'm starting to get a little worried about what you were saying before about impacts. A bunch of our larger tenants keep asking about this "LEEDs" thing. What should we do?

**Owner 2:** I've been reading about it. I have a feeling we should consider certifying this next building. It might be a little more expensive, but our biggest competitors are doing it on all their buildings. They're even targeting gold on some of their projects.

**Owner 1:** But we don't have any more money for this next project than we did for the last one. How are we supposed to get gold?

**Owner 2:** In my browsing on-line I came across this tiny project near Kitchener, Ontario. They are taking a broader approach and looking at more than just LEED. They are using their building as a way to start looking at what they care about across the entire organization. It's an interesting read, although it might be a bit idealistic. They did have to spend more to get gold, but they used it for their marketing too, so we might be able to steal some of marketing's budget.

**Owner 1:** If the other guys are doing LEED, shouldn't we just focus on that? Doesn't the designer know about LEED? Hey Designer what do we have to do to get LEED Gold?

**Designer:** Uh, well, that depends on what you want it for. If it's just for marketing, then I can probably sit down with you today and figure out what we could do. It might not be cheap though. If you really want significant savings it might take more time.

**Owner2:** Hold on. We can't just do things because other people are doing them. We'll never get ahead of our competition that way. We need to think about what we care about and what our tenants care about.

**Owner 1:** Ok ok. I get what you're saying. But what do we care about?

**Owner 2:** Well, I know what I care about. I'm sure you know what you care about. But we don't have a common vision. Maybe we should sit down with everyone else and figure that out first.

**Owner 1:** We only have a little bit of time. This isn't parliament. We've got to get this building built.

**Owner 2:** We could ask that consultant I showed you last time to help us out. Designer, have you worked with these guys before?

**Designer:** Yes. They're pretty good. I can call them if you'd like.

**Owner 1:** Ok. Please set up a meeting for next week. {to Owner 2} Do you think a week is enough time for us to talk about what we want?

**Owner 2:** No, but it's a start.

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# Appendices

Please visit http://sites.google.com/site/keepbuildingsustainability/ for augmented versions of Appendix #1 and Appendix #2. The full detail of the concept design process is provided at this site.

Appendix #1 – AOR Concept Development: Meeting Presentations and Minutes

Appendix #2 – AOR Concept Development:  Design Outcomes

Appendix #3 – USGBC On-line Material: LEED 2009 motivations & Pilot Credits

Appendix #4 – Useful modeling tools

# Appendix #1 – AOR Concept Development: Meeting Presentations and Minutes

# AOR Hospice & Retreat Centre

Envisioning A Sustainable Development

# Overview

- The all-important questions
- The challenges of development
- Exploring sustainability
- Envisioning a sustainable development
- Homework

# The all-important questions

- What is your purpose?
- What is the future of that purpose?
- With whom do you share this future?

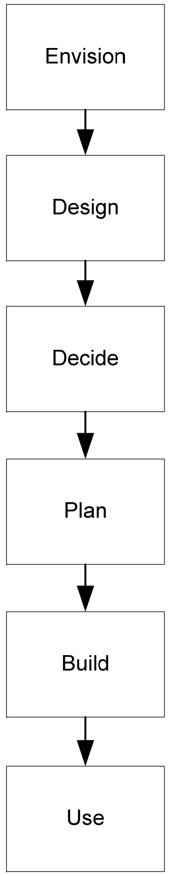
# The all-important questions

A purpose is something we all seek and realizing a purpose is what I call *human development*.

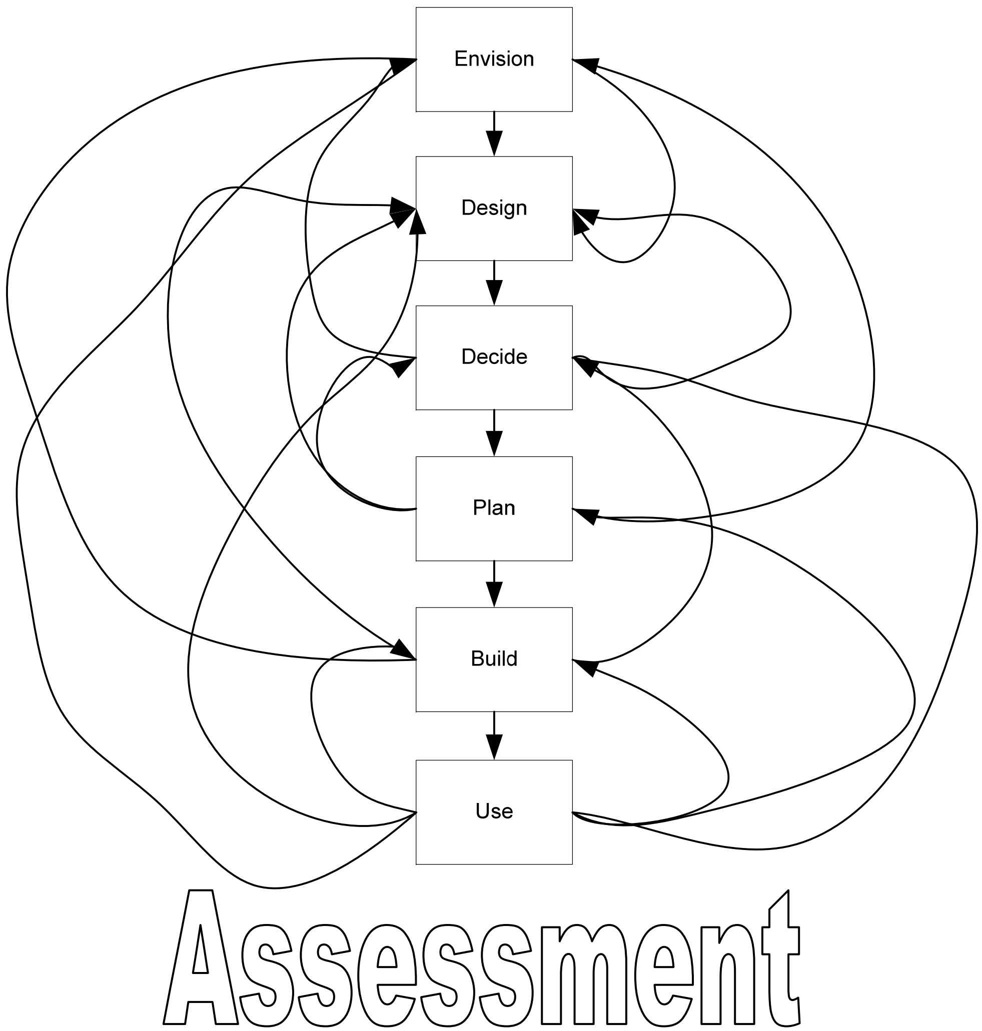
But, planning for the future of that purpose and considering those with whom we will share such a future is not always easy.

So, where do we start?

# The challenges of development



# The challenges of development



# The challenges of development

- **Planning Exercises**
  - Building Plan & Site Assessment
  - Programming Design
  - Industry/Niche Research
  - Fundraising Plan
  - Roles & Goals
  - *Business Plan*

# The challenges of development

- **Why a business plan? Are you running a business?**
  - Measures opportunity in time, energy, resources
  - People who have money ask first how you plan to use it. Need to do a business plan to show them.
  - It's the most common way to value such a diverse set of requirements

# The challenges of development

- **Other valuable things not commonly dealt with in a business plan…**
  - Quality of service to be provided
  - Equity of opportunity for all interested stakeholders
  - Sufficiency and opportunity for improved livelihoods
  - Integrity of social and ecological environment
  - Resilience and durability of systems

*All in all, how sustainable is your plan?*

# Exploring sustainability

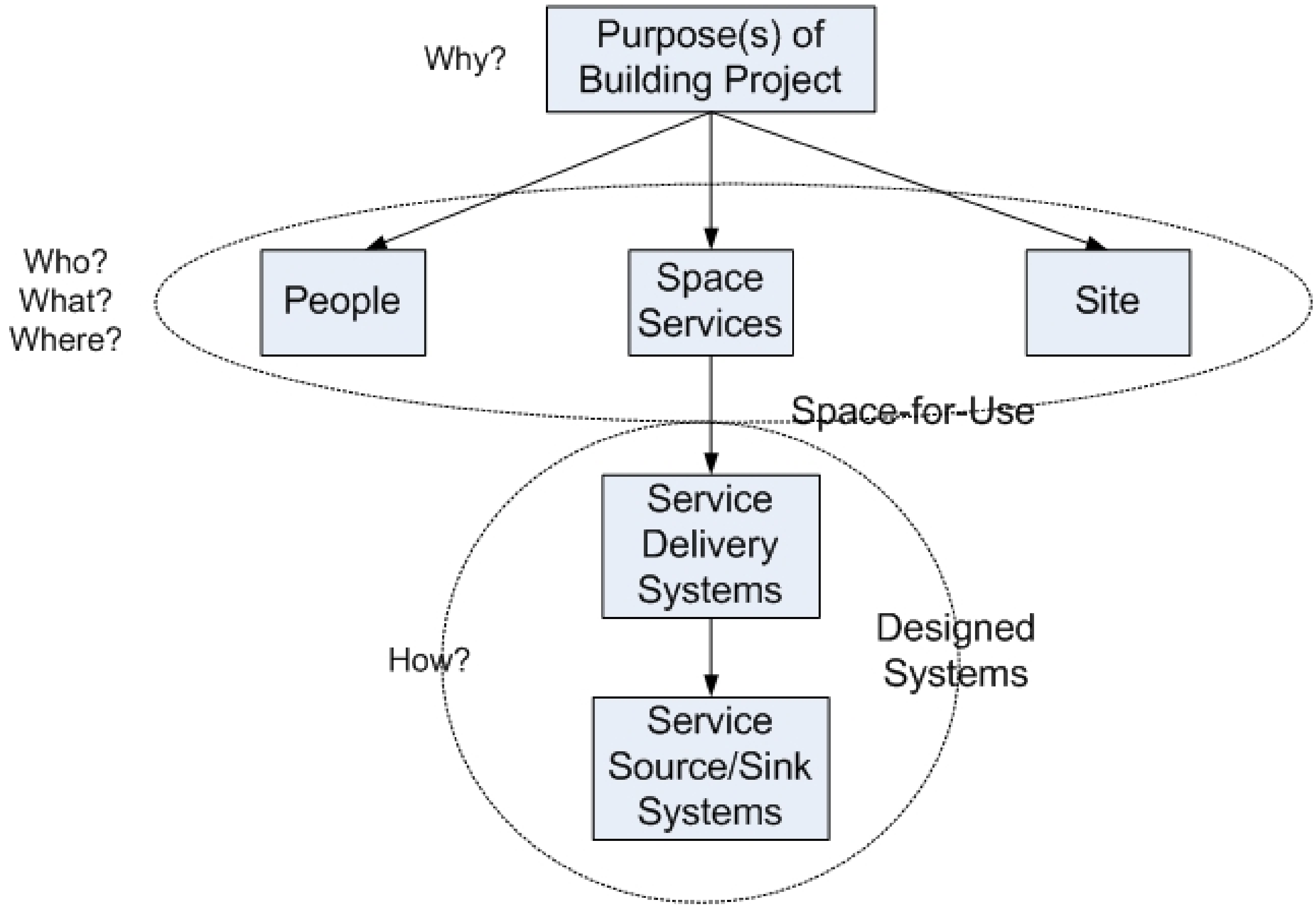
## What is sustainability?

A unifying concept which ask us to:

- See the interconnection and longevity of human developments as an essential part of their purpose
- Consider the possible tensions between our desires, the desires of those at stake, and the future desires of those who are not yet born
- Connect our purpose to the impacts that such purpose will have on communities and ecosystems from local to global

# Exploring sustainability

A sustainability assessment of AOR's purposes would provide an holistic way of achieving your desires and planning for the future while also considering those who will share that future with you.


Why?
Purpose(s) of Building Project
Who?
What?
Where?
People
Space Services
Site
Space-for-Use
Service Delivery Systems
How?
Designed Systems
Service Source/Sink Systems

# Envisioning a sustainable AOR

- First Meeting(s):
  - Explore the concept of sustainability
  - Develop criteria, trade-off rules, and decision-making schemes
  - Review business plan in context of sustainable development

Product: Rough draft of sustainability plan for all AOR Activities.

# Envisioning a sustainable AOR

- Second Meeting(s):
  - Walk through a “Living Building”
  - Detailed considerations of a building’s life-cycle
  - Review and revise “Needs, Dreams and Ideas” work developed with Bob, Richard, Enermodal, other stakeholders.

Product: Draft sustainable building program.

# Homework

- Determine necessary stakeholders to attend meetings.
  - E.g. Reinier, hospice association, hospice care nurse, potential retreat organizers, Bloomingdale residents, etc.
- Read “Sustainability Assessment Paper” and “MEC – Sustainability Report”
- Watch “The Corporation” or listen to “A Short History of Progress”
- Think about your involvement with AOR. What is your purpose? What is your future?

# Summary of Project Timeline

1. Visioning Session #1 – AOR (1+ days)
2. Visioning Session #2 – Hospice & Retreat (1+ days)
3. LEED Intro (0.5 – 1 day)
4. LEED Energy (0.5 days)
5. LEED Coordination (0.5 – 1 day)
6. LEED Costing (0.5 – 1 day)
7. LCA Review & Steps Forward (1+ days)

## AOR Visioning Meeting #1 - Sunday May 27, 2007

- **09:00 - Greetings & Introductions**
- **09:30 - Presentation by Prof. Robert Gibson: Sustainability Assessment**
    - Bob will make a brief presentation of his work and it' general application to the AOR project followed by a detailed question and answer period.
- **10:30 – Considering Dying Well**
    - We will discuss the act of providing hospice care as a service to the public. Some important questions to address will be:
        - What is hospice care? Why is it important as compared to other health services?
        - Who needs hospice care? Who needs respite care?
        - Who is best suited to care for the dying?
        - How do care givers need to be supported?
        - What is the ideal place to die? What are the differences between dying at home and dying in a residential hospice?
        - What makes residential Hospice care unique compared to other types of health-care facilities? What is the same?
        - Overall, what types of places, people, and services will be required to provide sustainable hospice care?
- **12:30 – Lunch**
- **1:30P – Considering Living Well**
    - We will discuss the act of providing retreat and learning opportunities and space to the public. Some important questions are:
        - Who will be best served by retreat services immediately adjacent to a hospice care facility?
        - What types of on-going learning and experiences should be available to the various stakeholders and clients of the centre?
        - What types of on-going learning and experiences should be provided for the community at large, irrespective of their involvement with the hospice?
        - What types of places, people, and services will be required to provide these learning opportunities and experiences?
- **3:30 – Planning for next meeting.**

## AOR Visioning Meeting #2 - Sunday June 3, 2007 AND/OR Sunday June 10, 2007

- **09:00 - Greetings & Introductions**
- **09:30 – Recap. Last meeting & Review draft Sustainability Plan**
    - We will briefly review the many concerns and opportunities for sustainability discussed at the previous meeting and from literature review. These themes will be organized broadly into three categories:
        - *People:* Compassion and Service in Palliative Care, Learning Both to Live Well and Die Well, The Volunteer Experience, Open and Democratic Governance
        - *Place:* The Grand River, Local Farming, On the Edge of the City.
        - *Sub-Services:* One Building for Many Reasons, Being Part of the Healing Network, A System of Giving
- **10:30 - Vision 2032 – AOR in a Generation**
    - The group will envision, together, the services and programs AOR will be offering a generation from now – in 2032.
        - What kinds of operations, programming, and policy will AOR be engaged in?
        - How many people will the organization employ and how many people will it serve on an annual basis?
        - What will be the system of governance for the organization?
        - Where will our services take place? How much space will be required? How will stakeholders and service-providers travel to the facility?
        - What support services will be needed in order to deliver these programs effectively? For example, what will be the primary financial costs of the organization? Where will such funding come from?
        - What impacts will the organization have on the social environment locally and at the regional, provincial, national and international levels? How will we measure these impacts?
        - What impacts will the organization have on the natural environment at these different scales? How will we measure these impacts?
- **12:30 – Lunch**
- **1:30P – Taking the Soft Path (i.e. how to get there from here the right way) [Optional, given time]**
    - Based on our earlier discussion, we will try to bring the vision for 2032 into the near-future.
        - What needs to be in place now and by the time the first centre is constructed to achieve the generational plan?
        - What significant efforts will still remain? Roughly, how will the remaining goals be achieved?
        - What measures and indicators will be most effective to determine our progress from now until 2032?
- **3:30 – Planning for next meeting.**

The resultant conversation of this two-part meetings lead to the draft sustainability plan which is Appendix #2 - Outcome #1.

# AOR Hospice & Retreat Centre

Enhanced Building Program – Part 1

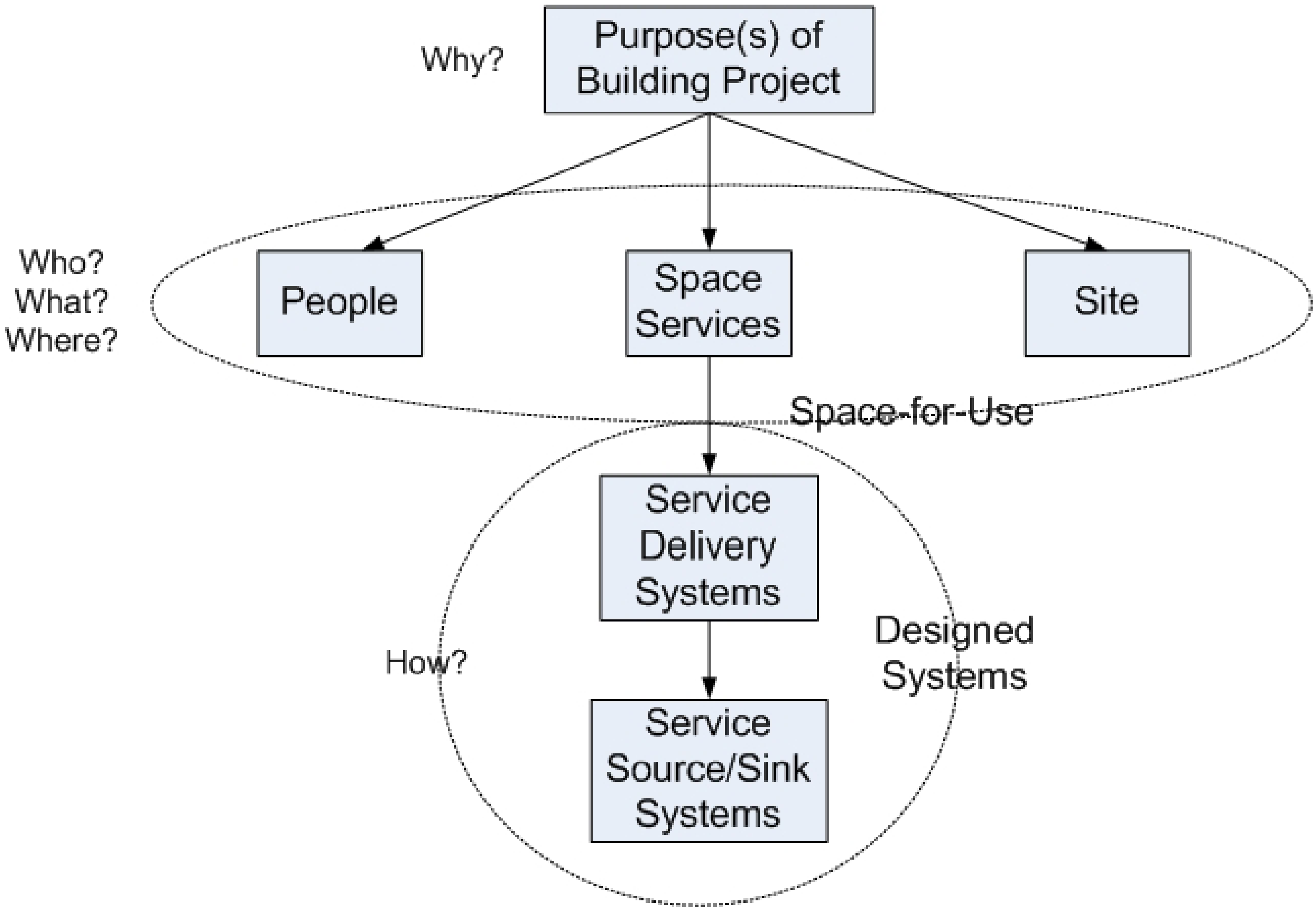
# Summary of Project Timeline

1. Visioning Session #1 – AOR (1+ days)
2. Visioning Session #2 – Hospice & Retreat (1+ days)
3. LEED Intro & Site (0.5 day)
4. LEED Energy & Indoor Env. (0.5 days)
5. LEED Materials (0.5 day)
6. LEED Costing (0.5 day)
7. LCA Review & Steps Forward (1+ days)

# Envisioning a sustainable AOR

- First Meeting(s):
  - Explore the concept of sustainability
  - Develop criteria, trade-off rules, and decision-making schemes
  - Review business plan in context of sustainable development

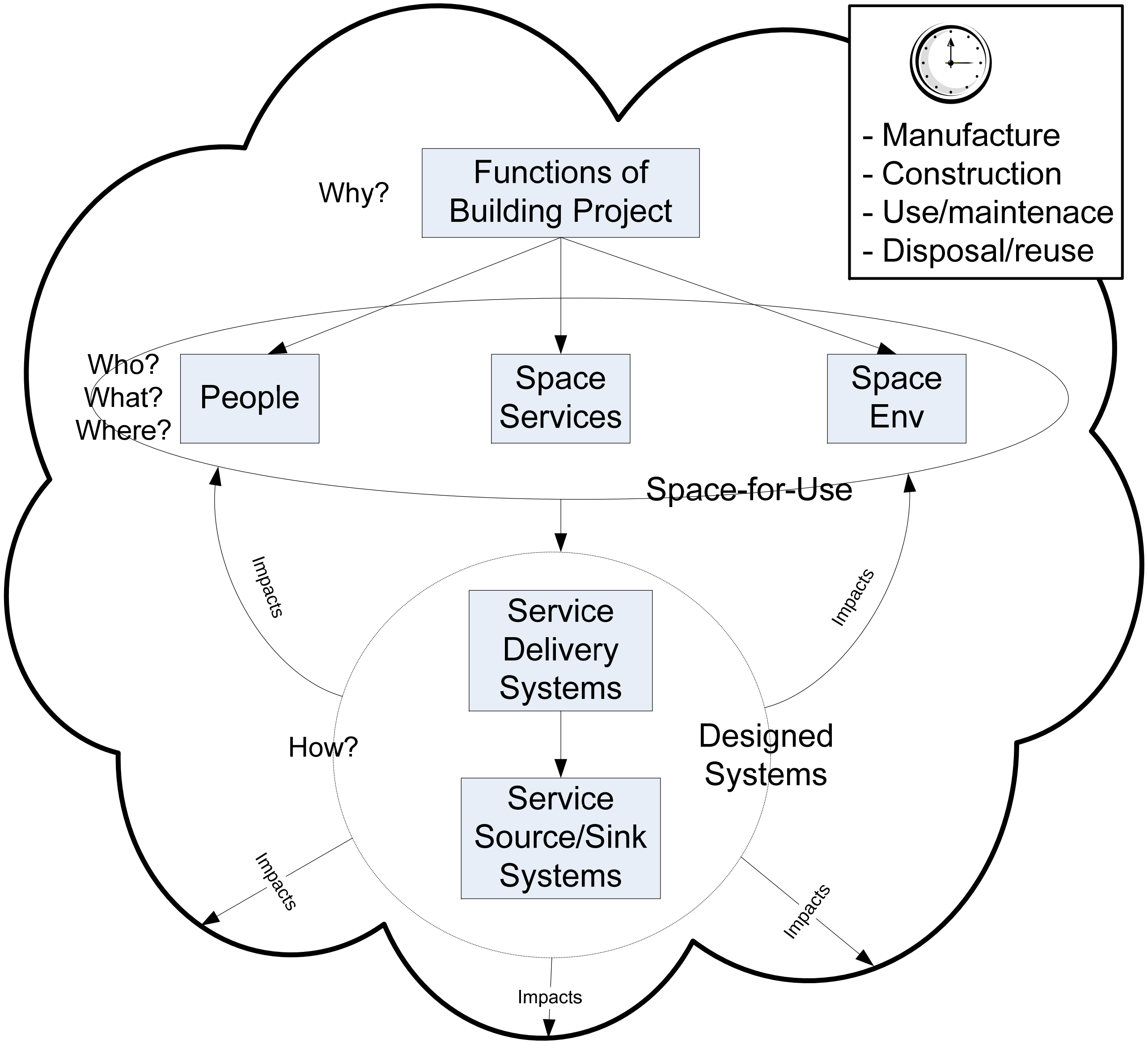
Product: Rough draft of sustainability plan for all AOR Activities.


Why?
Purpose(s) of Building Project
Who?
What?
Where?
People
Space Services
Site
Space-for-Use
Service Delivery Systems
How?
Designed Systems
Service Source/Sink Systems

# What is the “Building”?

- Collection of spaces-for-use that we decide, together, are needed to deliver the AOR mandate.
- Doesn’t necessarily need to be “Inside” spaces. Many important spaces are “outside”.
- We will describe (or continue to describe) the people, environmental qualities, and services available in that space.

## Socio-Ecological Environment



# Plan for Today:

- Visit and discuss the current site and building plan.
- Talk about how the important people use the space – what do they do during a typical day?
- Talk about the demand for and qualities of the space environments and space services.
- Organize these demands and qualities in order of importance…what aren't we wiling to sacrifice?
  - Why would we have to sacrifice anything?

The discussion from this meeting was the space requirements and list of users outlined in the functional program outcome.

# AOR Hospice & Retreat Centre

Enhanced Building Program – Part 2

# Today's Agenda

- Recap of progress so far
- Are building's alive?
- The challenges of design:
  - The boundary of control
  - Deciding what's important
- AOR's Living Building Discussion

# Summary of Project Timeline

1. Visioning Session #1 – AOR (1+ days)
2. Visioning Session #2 – Hospice & Retreat (1+ days)
3. LEED Intro & Site (0.5 day)
4. LEED Energy & Indoor Env. (0.5 days)
5. LEED Materials (0.5 day)
6. LEED Costing (0.5 day)
7. LCA Review & Steps Forward (1+ days)

# Envisioning a sustainable AOR

- First Meeting(s):
  - Explore the concept of sustainability
  - Develop criteria, trade-off rules, and decision-making schemes
  - Review business plan in context of sustainable development

Product: Rough draft of sustainability plan for all AOR Activities.

# Envisioning a sustainable AOR

- Second Meetings:
  - Discuss the important hospice users and how they will use the space we are developing.
  - Set some priorities about importance of certain space qualities.

Product: Rough draft of functional program for Hospice & Retreat.

# Desiring spaces

- Collection of spaces-for-use that we decide, together, are needed to deliver the AOR mandate.
- Doesn’t necessarily need to be “Inside” spaces. Many important spaces are “outside”.
- We have begun to describe the people, environmental qualities, and services available in that space.

# Designing systems

- Also, a building has designed systems to deliver light, heat, cool, water, power, etc. to the space-for-use.
- The effective design of these systems is the responsibility of the design professionals along with the building owners and users.
- We will describe these systems, in conceptual terms, over the next few months.

# Considering impact

- The designed systems have interconnections with their environment – social and ecological.
- And that environment is not only the one at the border of the walls, or the site, but also in the space (e.g. carpeting).
- We want to consider the impact of these interconnections today.

# Are buildings alive?

- People
  - Inception – Not Long (minutes?)
  - Initial Construction – 9 mnth
  - Birth-Death => “Life Time” – 80 Years
  - Decomposition – 1-2 years (?)
- Buildings
  - Material Fabrication (supply chain)
  - Construction
  - Occupation (maintenance & use)
  - Dismantle (disposal / re-use)

# Are buildings alive?

- People
  - Structure – Bones
  - Protection – Skin
  - Heat/Cool/Ventilation – circulation, evaporation
  - Senses – eyes, ears, nose, mouth.
  - Consciousness – mind.
- Buildings
  - Structure – Foundation
  - Protection – envelope
  - Heat/Cool/Ventilation – HVAC systems
  - Senses – sensors & controls.
  - Consciousness – ***people in the space***.

# Are buildings alive?

- Buildings are an extension of ourselves. They are a place for us to interact with each other and do the things we want to do.
- Buildings also interact with us through the space and through their impact on our mutual environments.

*What we do to our buildings, we do to ourselves.*

# Building Interconnections

- Types of Interaction:
  - Infrastructural (NOT just “Economic,” resources too)
  - Ecological (NOT “Environmental”)
  - Psychological (NOT just “Social” but individual too)
- Scales of Interaction:
  - On-site, regional, national, international
  - space, site, local landscape, bioregional, global
  - Staff/volunteer/family/guest, Bloomingdale, Region of Waterloo, National Hospice Community

**Why create such separations?**

# The Boundary of Control

- Control. The reason for separation and for segregation.
- Control = Understanding, Responsibility.
- Design Target = Controlled interaction
- Design Impact = Un-controlled interaction

  e.g. Lighting System.

# Sustainability: new boundaries

Recall the goals of sustainability…

A *unifying* concept which ask us to:

- See the interconnection and longevity of human developments as an essential part of their purpose
- Consider the possible tensions between our desires, the desires of those at stake, and the future desires of those who are not yet born
- Connect our purpose to the impacts that such purpose will have on communities and ecosystems from local to global

# Deciding What's Important

- Ok, sustainability sounds great, but how can we possibly change all impacts into targets? We don't have control over everything.
  - Including all impacts is almost impossible, but we can include the most important ones.
- Options:
  - Ask an "expert"
  - Become an expert: educate yourself about the important impacts.
  - Discuss what impacts are important to the stakeholders of your project.
  - Prepare to adapt, be cautious, and actively assess your actions.

# Building Impacts: An expert's opinion

- Experts: US/CAN Green Building Council, Jason McLennan (Cascadia GBC), SETAC, Suzuki Foundation, Sierra Club, Pembina Institute, others.
- Major components (Living Building Challenge):
  - ENERGY, WATER, MATERIALS
  - SITE, SPACE
  - INSPIRATION, INNOVATION, COMMUNITY

# ENERGY

- Energy is needed in all buildings. Much of it, however, comes for "free" from the sun.
- Factors: demand for energy, type of generation, location of generation (distance from site).

Impacts of Energy Use:

- Demand on regional/provincial infrastructure (e.g. more power plants need to be installed) [+/-; equiv-kW and equiv-kW]
- Green-house gas emissions => Global Warming [-; $CO_2$-equiv]
- NOx/SOx Emissions => Ground-level Ozone & Smog [-; NOx/SOx]
- Monetary cost of Operating Energy Service (hot water, lighting, HVAC, Power Services) [-; $]
- Monetary cost of Energy Consumption / Deliver [-; $]

# ENERGY

- Common Practice: Natural Gas for heating, grid-tied electricity for cooling, lighting, services. 30% less then MNECB is common.
- Living Building: “100 percent of the building’s energy needs supplied by on-site renewable energy on a net annual basis.”
- Challenges:
  - Reducing demand enough to make on-site renewable energy infrastructure feasible and cheap.

# WATER

- All buildings need water too, especially those where people bath frequently. Water is used for many sources and requires various degrees of quantity and quality for the given task (e.g. flushing vs. drinking).
- Factors: demand for water (quantity & quality), distance from water infrastructure.

Impacts of Water Use:

- Demand on bioregional water tables [-; L-withdrawn]
- Demand on municipal infrastructure [+/-; L-potable]
- Monetary cost of Operating Water Services (water treatment, storage, distribution) [-; $]
- Monetary cost of Water Consumption / Delivery [-; $]

# WATER

- Common Practice: much of the water in the area is withdrawn from the ground (i.e. wells) and released back into on-site septic.
- Living Building: “100 percent of occupants’ water use must come from captured precipitation or reused water that is appropriately purified without the use of chemicals.” (some exceptions)
- Challenges:
  - Reducing demand enough to make rain-only water for flushing, cleaning, watering, etc. feasible
  - Sufficient rain at the site to meet the needs of the cleanest requirements
  - Matching the quality of the water with the purpose.

# MATERIALS

- Toxic emissions to soil, air, water and extensive resource use are embodied in the materials of a building during their manufacture and assembly. Also, it is through our purchase of materials that we hold manfacturers and builders to account for the sustainability of their operations.
- Factors: Specific material choices, transport distance, and construction management practices.

Impacts of Building Materials:

- Distance materials travel (and team-members) [-; km]
- Embodied Energy Indicators and Water Use [-; see other pages]
- Precautionary exclusion of harmful materials [-; *ecological impacts*]
- Purchase of “certified sustainable” materials [+; kg-certified/kg total]
- Monetary cost of  building materials & construction costs (including energy and water systems) [-; $]
- Cost to repair and replace expired building materials [-; $]

# MATERIALS

- Common Practice: Natural restrictions exists on transport of heavy materials. Asbestos is one of few buidling materials not allowed in buildings. CFCs and HCFCs are also commonly avoided in new construciton.
- Living Building:
  - Many material exclusions.
  - The project must account for the embodied carbon footprint of its construction through a one-time carbon offset tied to the building's square footage and general construction type.
  - All wood must be FSC certified or from salvaged sources.
  - Heavy Distance Restrictions
  - Heavy recycling of construction waste requirements

# MATERIALS

- Challenges:
  - The life-cycle challenge…when to draw the line of control.
  - Inexperience and reluctance of manufacturers to accept questions regarding the material content of their products.
  - Inexperience of builders with the guidelines of construction waste and site management.
  - Conflict between available suppliers of desired products and transport distance.

# SITE

- The site is the immediate natural and cultural environment to the building. Protecting sensitive lands and important cultural spaces is vital to the preservation of local ecology and community.
- Factors: Size of building footprint, proximity to sensitive areas (e.g. wetlands), previous use of land being built-on.

Impacts of Site:

- Area of use-transformations (e.g. farm-to-commercial, or contaminated-to-naturalized) [+/-; $m^2$-transformed]
- Proximity to Sensitive Areas [-; m]
- Area of developed “interpretive spaces” [+; $m^2$]
- Area of developed “recreational spaces” [+; $m^2$]
- Cost of site transformations, protection and interpretation projects [-; $]

# SITE

- Common Practice: Cannot build in the 100-year flood plain of the Grand River. Cannot build within a minimum distance of the Grand River (20-50 m?).
- Living Building:
  - Cannot build: Within 50-feet of Wetlands, On or adjacent to Sensitive Ecological Habitats such as: Primary Dunes, Old Growth Forest, virgin prairie, and others (as defined), On prime farmland, Within the 100 year flood plain.
  - Projects may only be built on previously developed sites, either greyfield or brownfield.
  - For each acre of development, an equal amount of land must be set aside as part of a habitat exchange.

# SITE

- Challenges:
  - Conflict of site size and building space desires.
  - Not all new buildings can be built on existing grey/brown fields.
  - Monetary costs of reclamations/habitat redevelopment are very high.
  - Conflict between desire for site services and preservation.

# INDOOR QUALITY

- Providing a high-quality indoor environment free of pollutants and with ample fresh air and sunlight are vital to any hospice or retreat centre.
- Factors: Type of occupancy/space use, number/type of emission sources in spaces, adjacent access to light and fresh air.

Impacts of INDOOR QUALITY:

- Fresh air changes per hour [+; ACH]
- Indoor pollutant source emissions [-; *Source Control Analysis*]
- Floor area with access to views [+; $m^2$]
- Occupied spaces with access to the outdoors / fresh air [+; % of total]
- Incremental monetary cost of low-emitting building systems [-; $]
- Additional energy consumption [-; *see ENERGY]*

# INDOOR QUALITY

- Common Practice: ASRHAE-90.1 2004 fresh air requirements. Entry mats and Low-VOC paints are common.
- Living Building:
  - Every occupiable space must have operable windows that provide access to fresh air and daylight.
  - Entryways must have an external dirt track-in system and an internal one contained within a separate entry space.
  - All kitchens and bathrooms must be separately ventilated. All copy rooms, janitorial closets and chemical storage spaces must be separately ventilated.
  - All interior finishes, paints and adhesives must comply with SCAQMD 2007/2008 standards. All other interior materials such as flooring and case works must comply with California Standard 01350 for IAQ emissions.
  - The building must be a non-smoking facility.
  - The building must be designed to deliver air change rates in compliance with California Title 24 requirements

# INDOOR QUALITY

- Challenges:
  - Controlling sources of emissions to reduce the conflict between energy demand and additional air flow.
  - Designing operable windows not to conflict with energy systems.
  - Finding products which serve space functions effectively but have stringently low emissions levels.

# INSPIRATION & SERVICE

- Buildings should inspire their occupants as interesting and vibrant places to be. Especially when the functions of the building are for residence (even temporary) and recreation. Also, a well-made building should be demonstrated to its community.
- Factors: Interaction between space occupant and the “character” of the building – architectural features, adjacent views, sensory experiences.

Impacts of INSPIRATION:

- Testimonial from occupants of their experience in the space [+/-; *survey*]
- Number of annual open-house days to demonstrate the building and its “Green Systems” [+; count/survey]
- Monetary cost of additional architectural and demonstration time [-; $]

# INSPIRATION & SERVICE

- Common Practice: There are excellent examples of hospices and retreats which are very inspiring places to be.
- Living Building:
  - The project must contain design features intended solely for human delight and the celebration of culture, spirit and place appropriate to the function of the building.
  - Educational materials about the performance and operation of the project must be made available to the public in order to inspire and educate. Non-sensitive areas of the building must be held open to the public at least one day per year, to facilitate direct contact with a truly sustainable building.
- Challenges: Inspiring the design team to such aims.

# Additional Concerns

- Let’s not forget that the building, though an important part of AOR’s sustainability goals, is not the only part.
  - Transit, Food, Cleaning Services
  - Rural/Farming & Grand-River culture & community
  - Quality of Services offered
  - Support for Volunteers & Employees
  - Maintaining charitable operations
  - Maintaining educational and medical service interconnections
  - Democratic Governance
- The question is: What ***must*** we do to realize the building we want for our guests, for our community, and for our planet.

# AOR Hospice & Retreat Centre

Concept Design & Cost Review

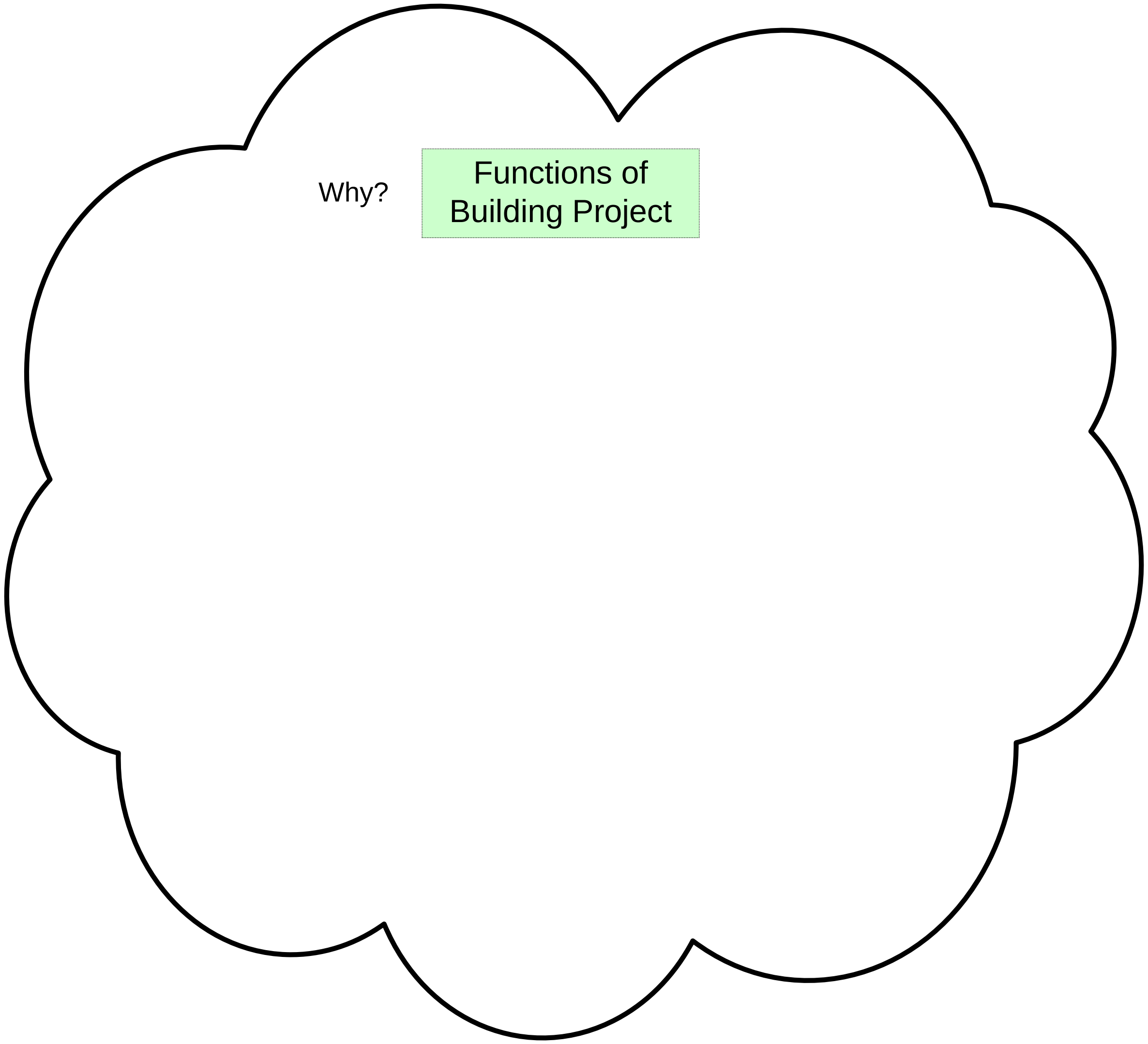
# Today's Agenda

- Recap of progress so far
- Comparison of Design & Costs

  Baseline vs. LEED-Gold
- LEED Results & Incremental Costs
- Final Meeting – pre-discussion

# Summary of Project Timeline

1. Visioning Session #1 – AOR (1+ days)
2. Visioning Session #2 – Hospice & Retreat (1+ days)
3. LEED Intro & Site (0.5 day)
4. LEED Energy & Indoor Env. (0.5 days)
5. LEED Materials (0.5 day)
6. LEED Review & Costing (0.5 day) => Today!
7. LCA Review & Steps Forward (1+ days)


Why?
Functions of Building Project

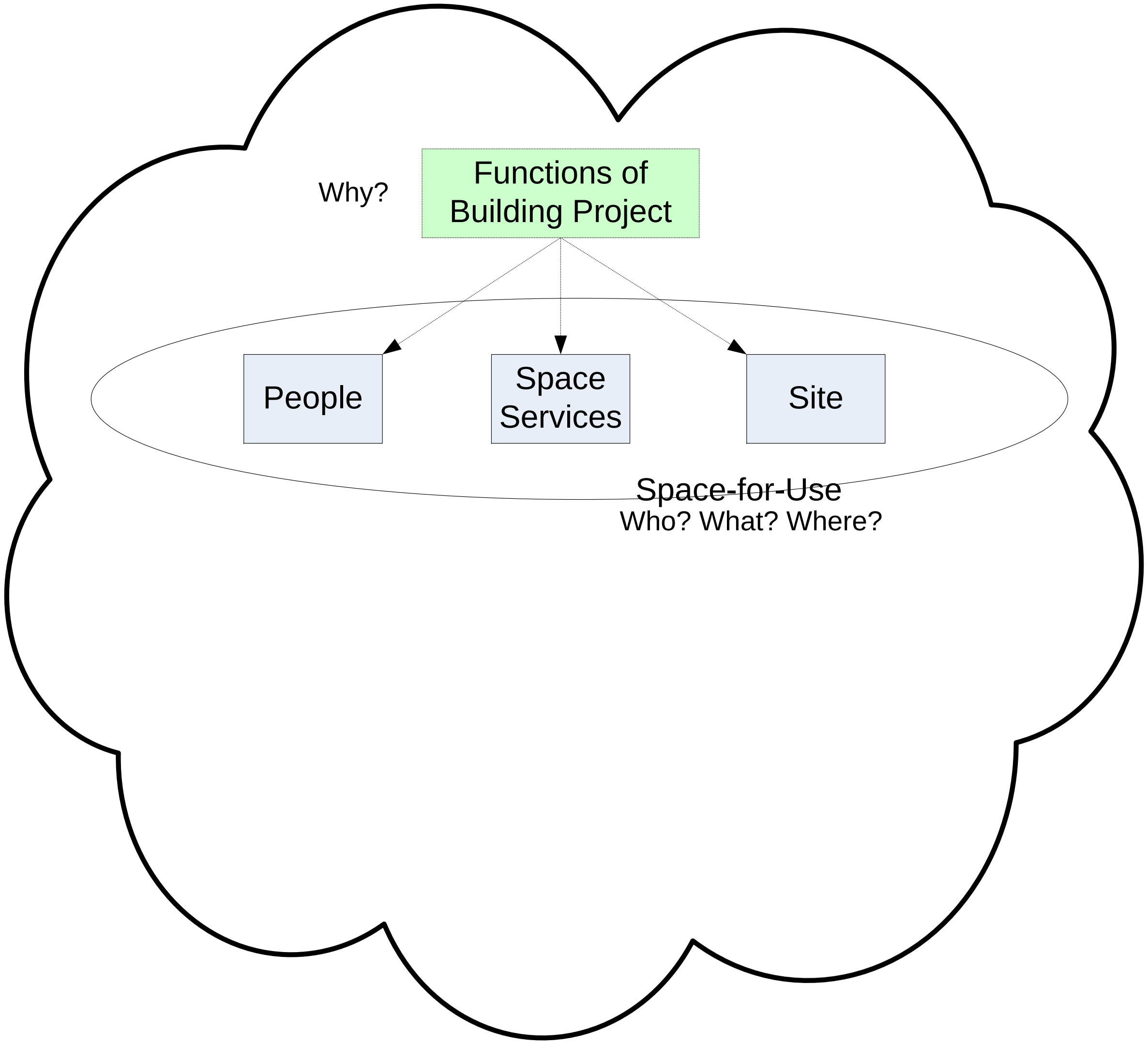
# Envisioning a sustainable AOR

- First Meeting(s):
  - Explore the concept of sustainability
  - Develop criteria, trade-off rules, and decision-making schemes
  - Review business plan in context of sustainable development

Product: Rough draft of sustainability plan for all AOR Activities.

# Sustainability Criteria

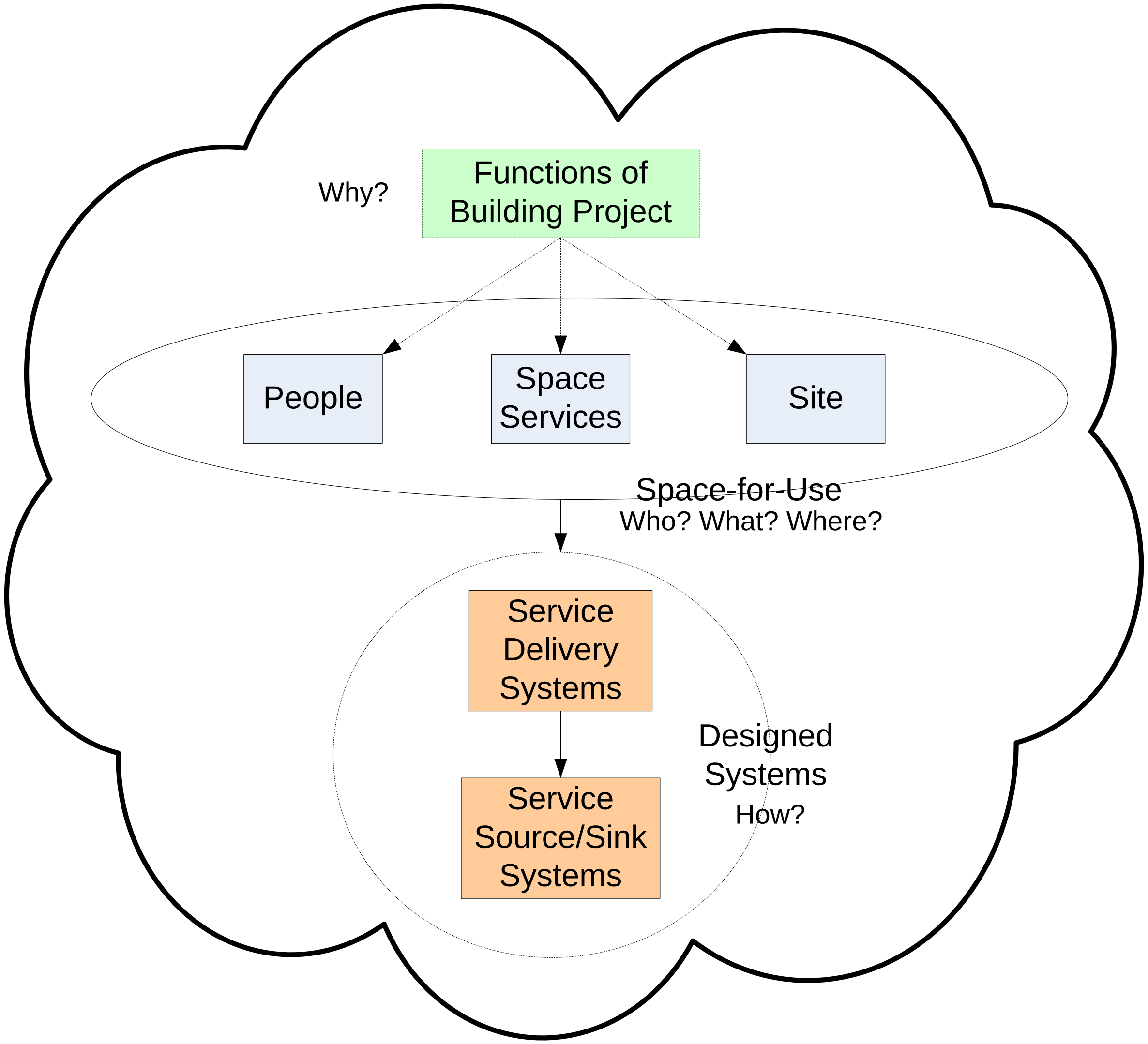
- Summary of AOR Sustainability Concerns
  - Transit, Food, Cleaning Services
  - Rural/Farming & Grand-River culture & community
  - Quality of Services offered
  - Support for Volunteers & Employees
  - Maintaining charitable operations
  - Maintaining educational and medical service interconnections
  - Democratic Governance
  - ***Building – Space for Sustainable Operations***


Why?
Functions of Building Project
People
Space Services
Site
Space-for-Use
Who? What? Where?

# Envisioning a sustainable AOR

- Second Meetings:
  - Discuss the important hospice users and how they will use the space we are developing.
  - Set some priorities about importance of certain space qualities.

Product: Rough draft of functional program for Hospice & Retreat.

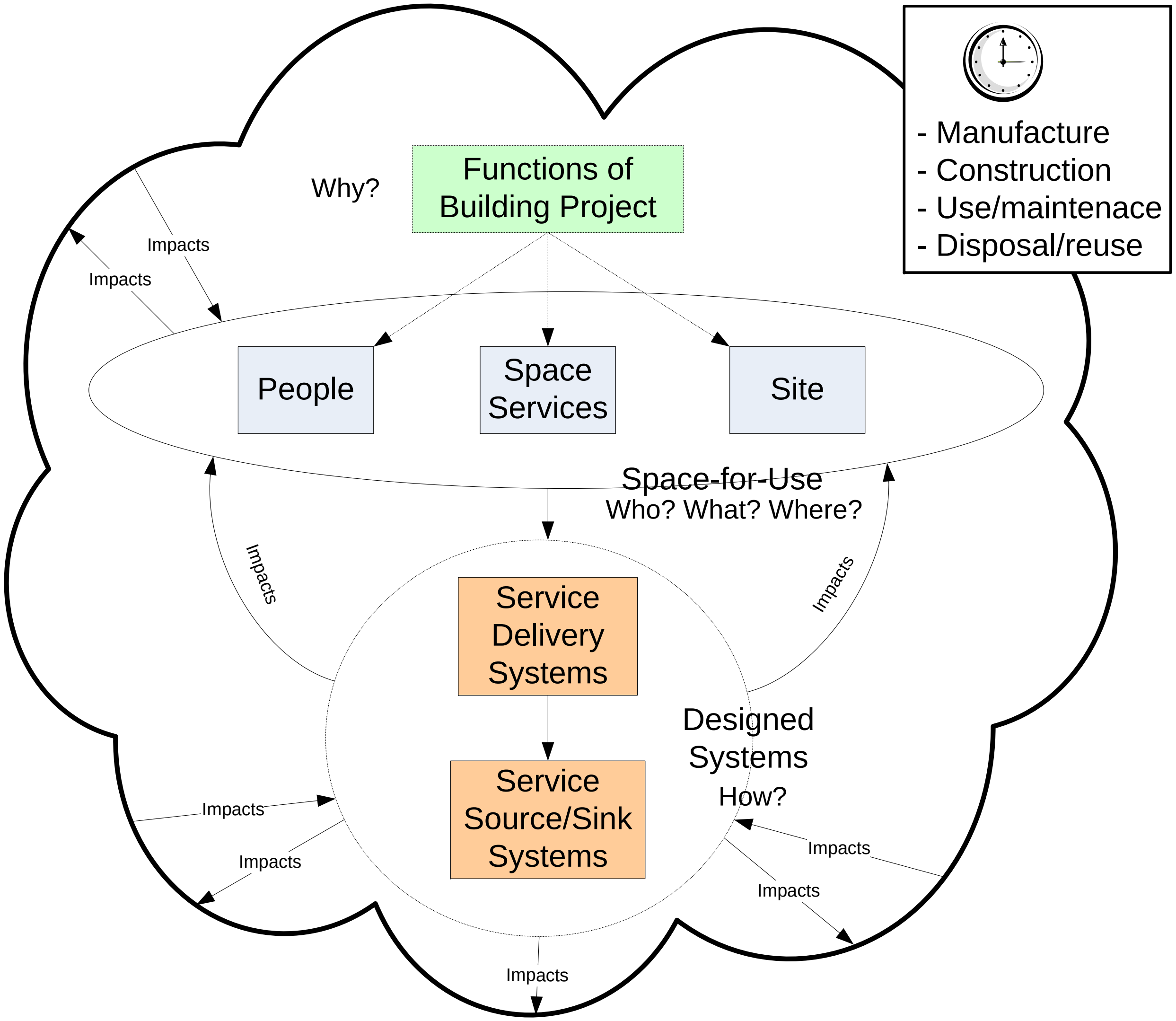


Why?
Functions of Building Project
People
Space Services
Site
Space-for-Use
Who? What? Where?
Service Delivery Systems
Service Source/Sink Systems
Designed Systems
How?

# Designing systems

- Also, a building has designed systems to deliver light, heat, cool, water, power, etc. to the space-for-use.
- The effective design of these systems is the responsibility of the design professionals along with the building owners and users.
- We will review the designed systems today, and also review the fist costs implications of the design.

## Socio-Ecological Environment



# Considering impact

- The designed systems have interconnections with their environment – social and ecological.
- And that environment is not only the one at the border of the walls, or the site, but also in the space (e.g. carpeting).
- We have set our priority for impacts as a group in terms of the major impact categories.

# Review of Design & First Costs

- Baseline
  - Least monetary cost ($) solution to achieve similar aesthetic and function.
  - Complies with Ontario Building Code energy and water requirements.
  - Meets all Functional Requirements as laid out in the functional program.
  - Includes basic consulting fees

After this slide, the "Design & First Cost Summary" document was reviewed (as per Appendix #2 - Outcome #5)

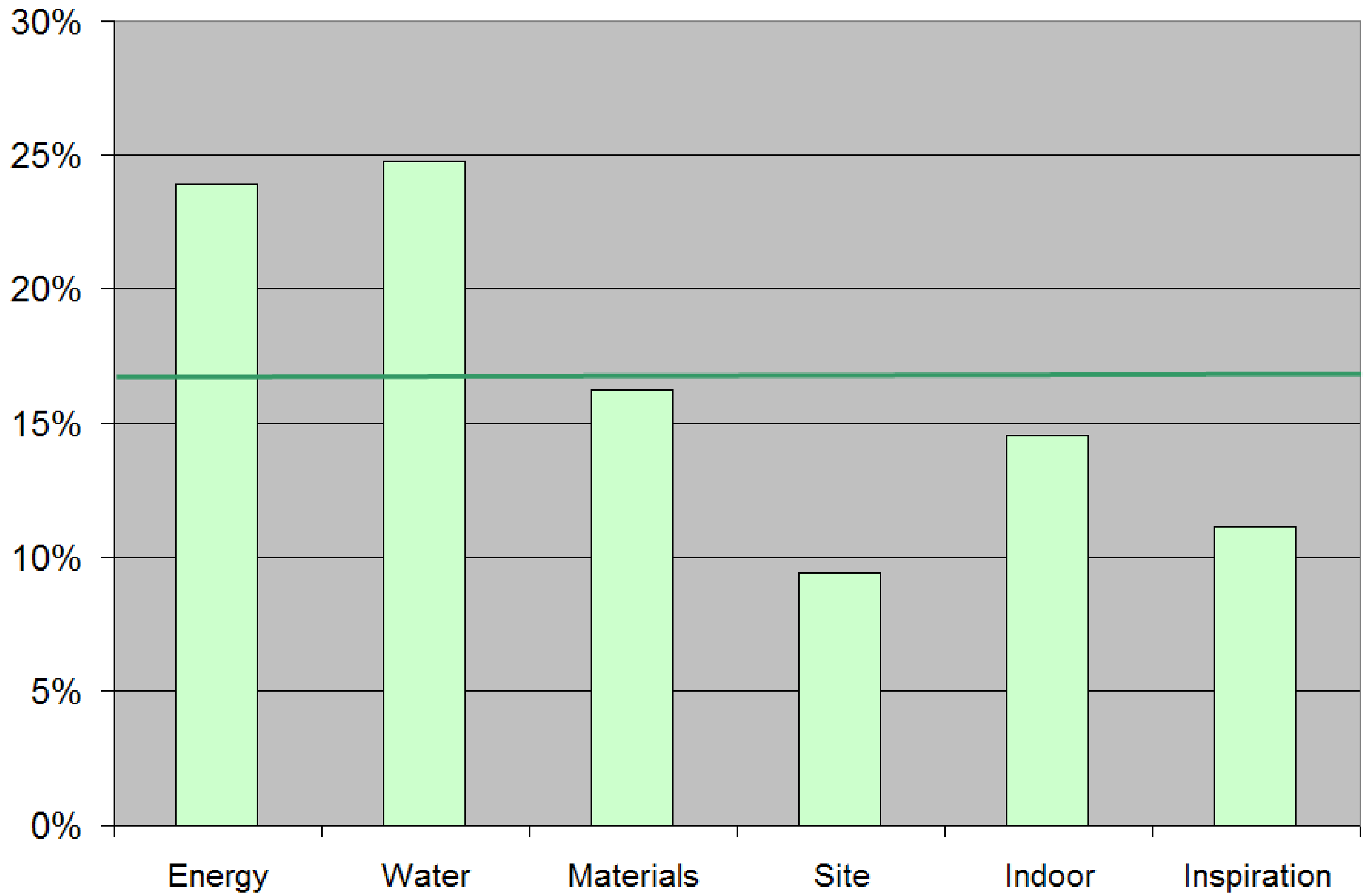
# AOR – Impact Review

What follows is the final meeting slides in the case study agenda - Review of LCA

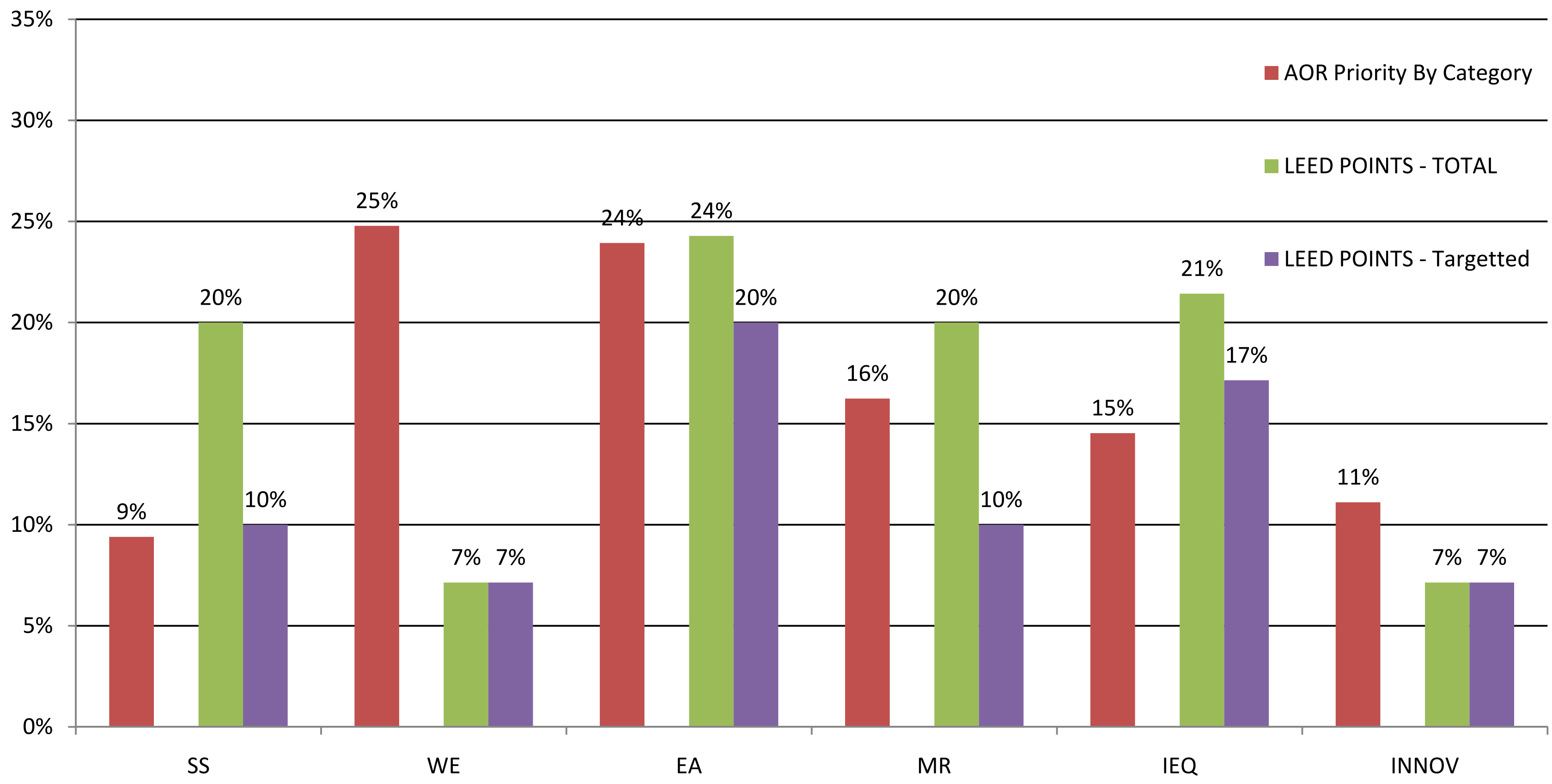
# Today's Agenda

- Review of LEED NC-1 and NC-2009 results
- LCA Impacts – Energy, Water, Materials
- Comparing LCA and LEED

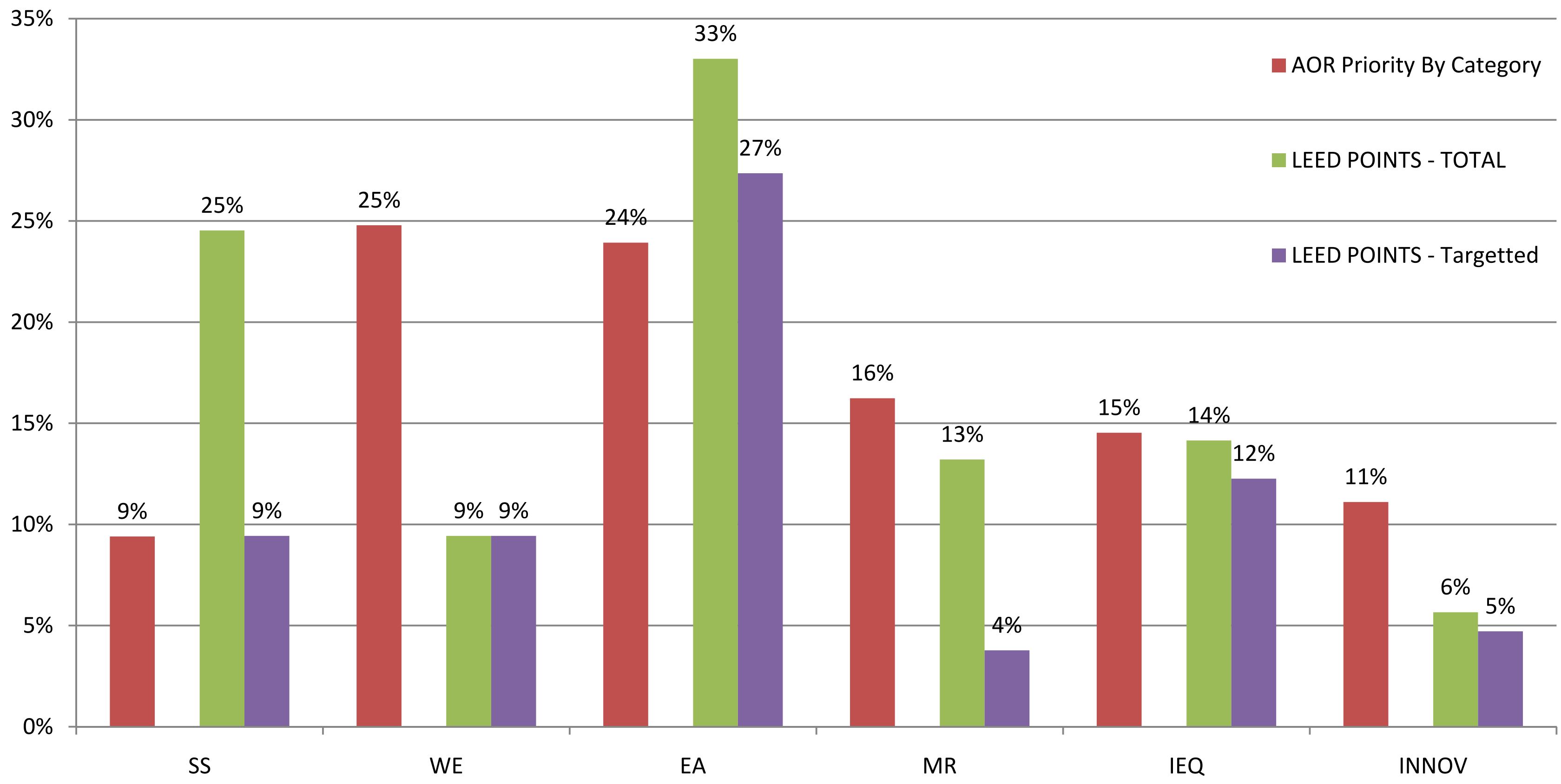
# AOR Board Impact Rankings



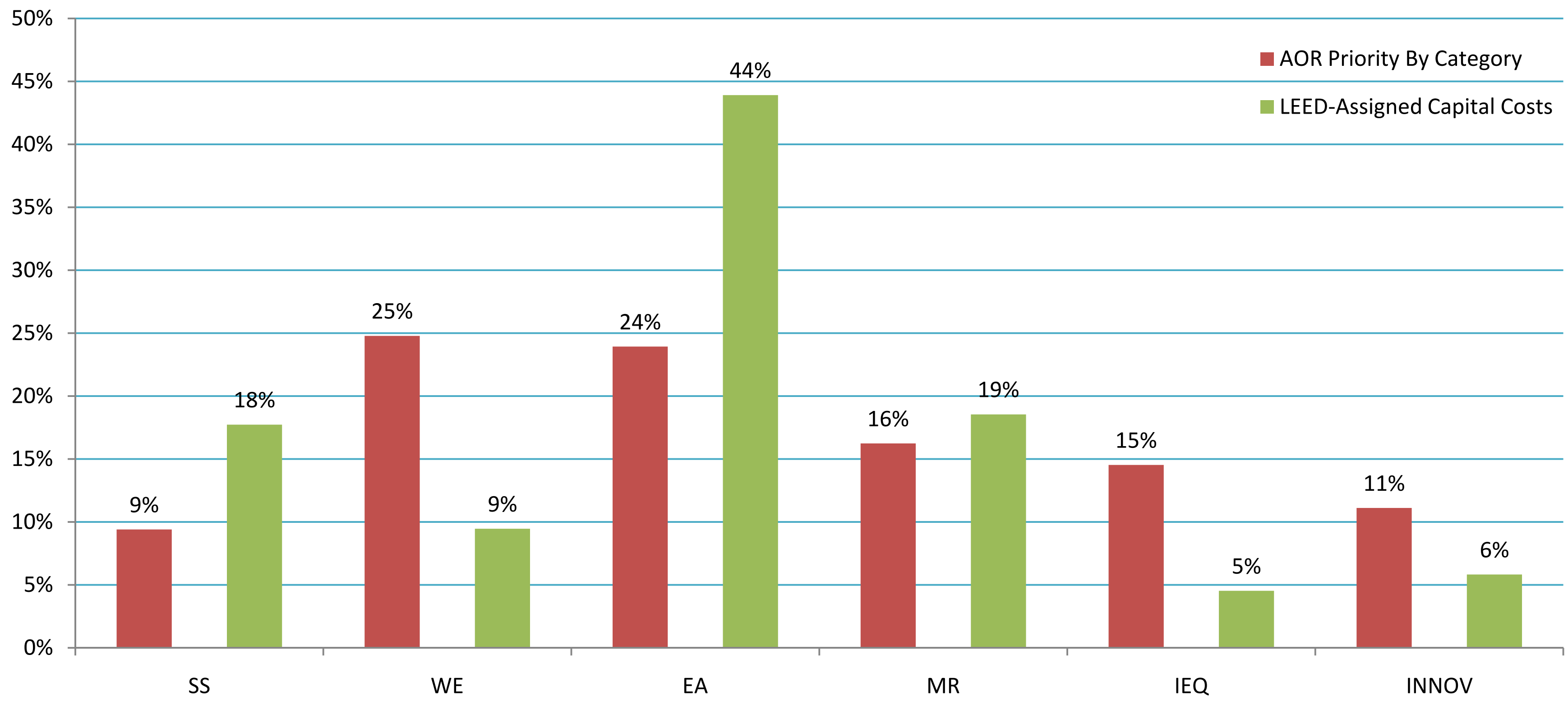
# LEED NC-1.0 Score



# LEED 2009 Score



# Review of LEED Score & Costs

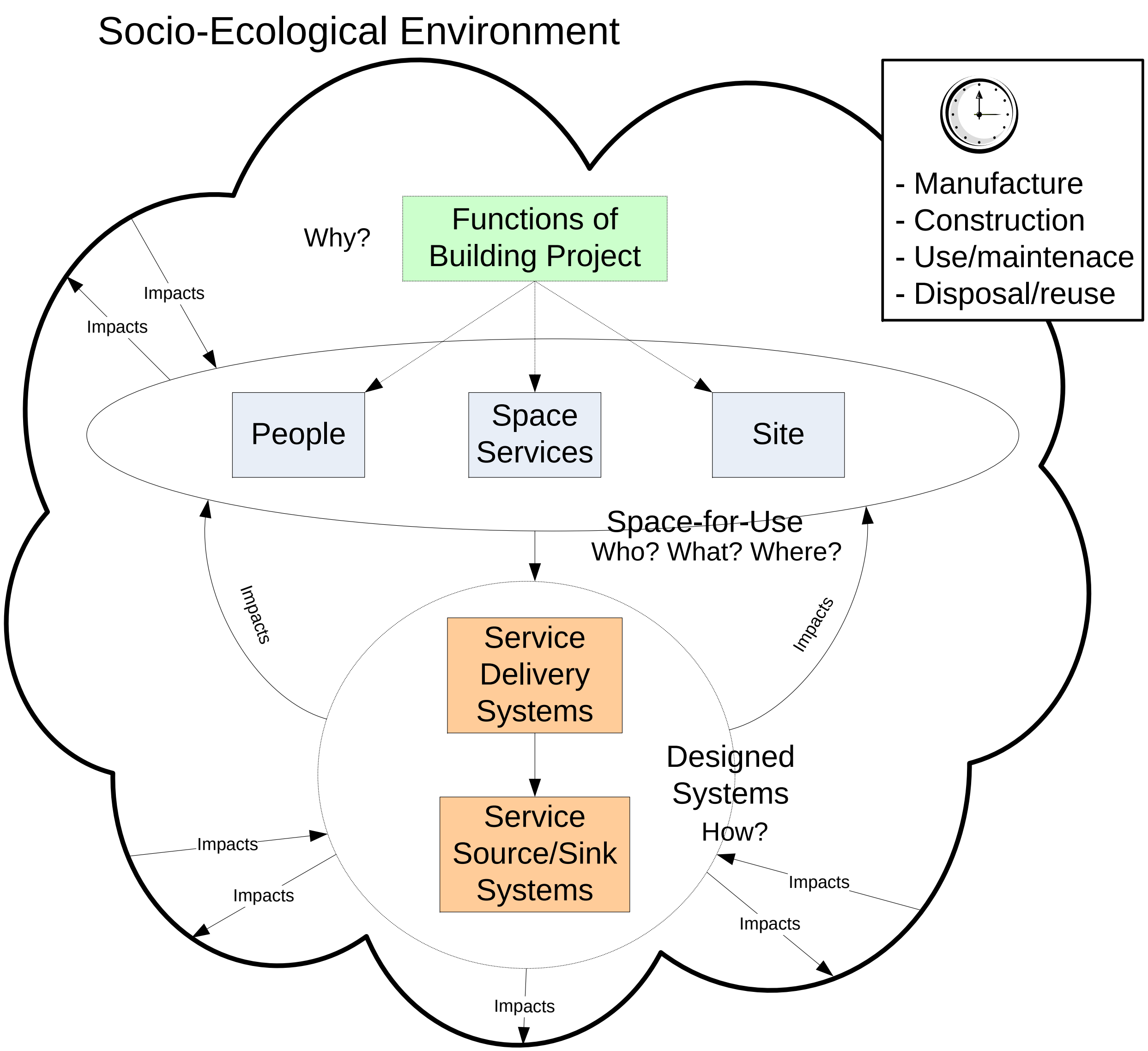


# “LEED” be GONE!?!

# Building Interconnections

- Types of Interaction:
  - Infrastructural (NOT just "Economic," resources too)
  - Ecological (NOT "Environmental")
  - Psychological (NOT just "Social" but individual too)

- Scales of Interaction:
  - On-site, regional, national, international
  - space, site, local landscape, bioregional, global
  - Staff/volunteer/family/guest, Bloomingdale, Region of Waterloo, National Hospice Community


Socio-Ecological Environment
- Manufacture
- Construction
- Use/maintenace
- Disposal/reuse
Why?
Functions of Building Project
Impacts
Impacts
People
Space Services
Site
Space-for-Use
Who? What? Where?
Impacts
Impacts
Service Delivery Systems
Service Source/Sink Systems
Designed Systems
How?
Impacts
Impacts
Impacts
Impacts
Impacts

# Energy, Water, Materials Impacts (LCA)

# Life-Cycle Assessment (LCA)

1) **Inventory**
- entire life-cycle, but how far to look?

2) **Impact Assessment**
- Tricky. What is the fate, then exposure, then damage done by emissions?

3) **Interpretation**
- Subjective, but necessary for context.

# LCA - Inventory

**Tools:**

- Athena EIE 4.0
- BEES 4.0
- eQUEST (for energy)
- Water Calculator (for water)

**Exclusions / Oddities:**

- All site hardscapes, except asphault driveways
- Furniture
- HVAC equipment
- Alignment of phases a bit off

# LCA – Impact Assessment

**Tools:**

- Athena EIE 4.0 (using TRACI, modified)
- BEES 4.0 (using TRACI, modified)
- TRACI = “Tool for the Reduction and Assessment of Chemical and other environmental Impacts”

**Exclusions / Oddities:**

- Impacts due to ozone depletion (negligible)
- Kept mostly to common categories (no damage categories from BEES included)

# LCA – Impact Assessment

**Emission-Based:**

Acidification

Eutrophication

Smog

Criteria Air Pollution

Climate Change

Indoor Air Pollution

**Consumption-Based:**

Primary Energy

Water

Weighted Materials

# LCA - Interpretation

- Normalization to the US average consumption per person, per year. Helps to give context to the observed impacts.

- Then, it's up to you. Which impacts matter? How should they be weighted?

At this point the full LCA results were reviewed. See Appendix #2 - Outcome #6.

# LEED vs. LCA

In either system of measure, are you happy with the results that have been achieved for your building? Why?

Which system makes you feel better about what you've done? How?

What does a 'LEED point' mean to you? What does a 'person-year' mean? Which one is more significant a measure of impact, in your mind?

# Questioning LEED

What sense of the absolute impact of your building do you get by reviewing the LEED score? (recall the living building challenge)

If you got 1 point less than Platinum, would you still be satisfied with Gold? Why does it matter which level of LEED you achieve?

Can you recall from our discussion which aspects of LEED are performance-based and which aspects are credits for “best-practice” choices? How important are performance-based results to you? (recall report card example)

# Questioning LCA

Is it acceptable not to include site, space and community/innovation in the accounting of impacts provided by LCA?

Would it help to see an LCA for something other than a building as a reference?

Unlike LEED, the provided LCA has not been approved by a standards organization. Is that important to you? Do you think others will appreciate a summary of the project using LCA results over LEED results?

# Further Discussion

What additional information would you like to see to help answer these questions?

What kind of cost information would you like to review about costs? Would it be useful to see a cost breakdown similar to the LCA provided?

# Appendix #2 – AOR Concept Development: Design Outcomes

OUTCOME #1

# AOR Sustainability Planning – First Cut
## 2007-06-03

**Attendees:** Melba Amos-Spinelli, Sheri Foster, Martha Jewitt, Gary Norris, Antoni Paleshi, Marjorie Paleshi, Judy Walder.

## *Purpose of Organization*

"Our mission is to create a ***model of service and compassion*** for the ***community*** in ***living and dying***."

Questioned Statements relating to Purpose:

"The hospice is the focus for both the living well and dying well programs offered by the retreat centre."

## *Core Services/Activities*

1. Residential Hospice Care ("physical, emotional and spiritual support to the dying and their families")
2. Education and Training for Hospice Volunteers
3. General Retreat Space and Facilitation open to the community
4. Structured Educational Programming ("group workshops and engagements and individual counseling on topics related to *living well* and *dying well*")
5. Community Advocacy and Public Discussion

Further description of services planned:

*Hospice Services:*
- Provide physical, emotional and spiritual end-of-life care to those who are actively dying
- Provide emotional, spiritual and counseling support to the families of those who are dying
- Open to all regardless of income, age, culture, ethnicity, religion, or illness/disease causing death
- Care provided at no cost to individuals or families
- 6 beds devoted to palliative end-of-life care
- 1 bed devoted to respite care

*Retreat Centre Programs:*
- Education and training programs for hospice volunteers, nurses, music therapists, possibly doctors and other health care support workers
- Liaison with Colleges and Universities regarding health, wellness, music therapy, dying etc.
- Group workshops and individual counseling related to death and dying, care-giver advice, and grief counseling
- Community education on topics related to body, mind, emotional and spiritual growth

- Holistic therapies (for example, therapeutic touch, reiki etc.)
- Facilities to continue community programs already offered by All Our Relations such as the Living Well Dying Well conference, presentations by renowned authors and spiritual leaders such as Dr. Bernie Siegel and Dr. Deepak Chopra
- Community rooms available for rental to local groups

## *Sustainability Discussion*

In pursuing its mandate of providing a model of service, AOR is currently discussing including core sustainability concerns into its overall mandate and decision-making processes. An example list of criteria for consideration were presented by Robert Gibson, professor and sustainability assessment researcher at the University of Waterloo. These criteria are well laid-out in the book "Sustainability Assessment" (Gibson et al, 2005).

There are two important lists of considerations: the sustainability criteria and the trade-off rules which help to define the general assessment process. For reference in this document, theses criteria and rules are duplicated here.

**Sustainability Criteria:**
Socio-ecological integrity (SEI)
Livelihood sufficiency and opportunity (LSO)
Intragenerational equity (IntraE)
Intergenerational equity (InterE)
Resource maintenance and efficiency (RME)
Socio-ecological civility (SEC)
Democratic governance (DG)
Precaution and adaptation (PA)
Immediate and long-term integration (INT)

**Trade-off Rules:**
Maximum Net Gains
Burden of Argument on Trade-off Proponent
Avoidance of Significant Adverse Affects
Protection of the Future
Explicit Justification
Open Process

A full summary of the Sustainability Assessment Approach as outlined by Prof. Gibson is included as an appendix to this document (when printed in PDF format).

**Specifics of Sustainability Concepts for AOR:**

Given the broad criteria and general trade-off rule, AOR must consider the issues of concern which are specific to the services they hope to offer in their own community.

Consider specifics for the services which include:
- place (surrounding social systems and ecology),
- people (those who are receiving and delivering the service),
- sub-services (which also include their own places and people in varied ways)

Also, there are significant interconnections between the concerns of place, people, and services. These interconnections should be described and considered.

**Vision 2032:**

In order to focus on protecting the future and making AOR a viable organization in the long term, the concept of a generational vision is also included in our assessment of the key context-specific sustainability concerns. By considering the people, places, and services the organization will be involved with in 25 years and enacting a vision of that involvement that is already as sustainable as we can imagine today, then the organization can look back (or “backcast”) to the present and plan a feasible and adaptable path to that desired future.

**Division of Activities:**

Though the challenges and goals for sustainability apply to the organization as a whole, there is a natural separation of our discussion into three important categories of planned operations:

1) *Regular Operation & Maintenance of Services*. This category includes the daily operations of the Hospice and Retreat services AOR plans to provide. This category reflects day-to-day activities and actions that AOR can take to meet its sustainability vision. This category also (for now) includes actions which relate to the design, site, construction, and dismantling of facilities and operations.

2) *Programming & Education*. This category focuses on educational and on-going learning and experiential opportunities that AOR wishes to be engaged in or help to facilitate at the centre. Actions in this category can often be broken down into three different levels of involvement: open facilitation (*making space/facilities available but not running/administering*), active facilitation (open and *actively pursuing others to regularly run/administer events*), and in-house programs (*running, administering and facilitating)*.

3) *Advocacy*. AOR, as a service organization, may need to become involved with advocacy and civil action to inspire the community and decision-makers to pursue mandates which it feels are important to a sustainable future. This category discusses efforts to pursue such aims.

**Implications of PLACE:**

Though not described specifically in the mission statement, AOR's community is the census metropolitan area of the Waterloo Region. Currently, the desire of AOR is to maintain and use the site it owns in Bloomingdale for the first and perhaps only location of its services. There are several implications for sustainability related to the selection of this site and fulfilling the AOR mandate in the Region of Waterloo in general.

***1. The Grand River***

- Source of water for the local community
- Significant biological resource – at the heart of many local ecosystems
- Part of the lake eerie watershed – a significant bio-regional system (link the bioregional landscape)
- The Grand River is central to the identity of the regional community through things such as tourism, history, and inherent business and personal association with place (e.g. think of all the businesses with the words "Grand River" in their title).

References:
*http://www.grandriver.ca/*
http://www.grandrivercountry.com/
http://www.chrs.ca/Rivers/Grand/Grand_e.htm

General Goals for 2032:

- Member of GRCA as part of decision-making and planning for the organization
- Partner with GRCA and other conservation organizations to provide programming and public discussion
- Develop access to the river and visibility of it and perhaps have a canoe launch.
- Respect for first nations claim of grand river territory

Potential Actions and Responsibilities for AOR:

…in regular operations & maintenance of services:

- Effective control of erosion, run-off and pollution of the watershed during construction of buildings and development of sub-services on site.
- Similar control during on-going farming and gardening of the site.
    - Large buffer of wooded area. Buffer needs to remain and be respected.
- Proper management and storage of waste-water on site.
    - Septic system may require a raised bed design
- Similar control during use by AOR and those who use its facilities (e.g. for recreational activities)
- First Nations endorsement/blessing for construction and operation of facility.
- GRCA involvement in decision-making for recreational facilities and land-use planning

…as part of programming offered to the public:

- Actively facilitate regular conservation activities which feature the Grand River and improve awareness of its contribution to the past, present and future of culture, ecology,

and economy in the region. This programming would be led and administered by other organizations who partner with AOR.
- Developing recreational facilities for using the Grand River (e.g. paddling, hiking, sport fishing, etc.)

…as part of advocacy AOR is engaged in:
- Partner with other organizations to promote the conservation and appropriate use of the Grand River. A similar partnership for advocacy of First Nations rights and claims is also important.
- Regularly, and in a sustainable manner, donate "in-kind" to such advocacy efforts.

## 2. *Local Farming*

- The planned site is an existing farmer's field and immediately adjacent to a planned organic farming operation and coffee importing business.
- The current site may have been used for non-organic farming in the recent past resulting in potential long-term contamination of ground-water and the Grand River by pesticides such as Round-Up (which includes Glyphosate) [SEI, InterE, PA]
- The opportunity exists to partner with the adjacent organic farming operation to improve site conditions and continue to use the majority of land for organic farming and gardening [SEI, InterE, LSO]
- There are also many other farms in the immediate area of Bloomingdale and in the northern and western part of the region which are facing decline due to factors such as big agri-business competition and cheaper food available which is not grown locally. A lack of locally-grown food available in the region not only increases the distance food needs to travel [RME] but also puts reliance on other areas for the region's food production needs, weakening our ability to adapt to problems in other regions and countries. [LSO, SEC, PA]
- For those necessarily imported snacks and treats that are often desired by the dying – sweets, coffees, teas, and tobacco products – consideration of the fairness of trade, political situation, and ecological integrity of the places where the desired products are grown and produced is also warranted [SEI, LSO, IntraE]

References:

http://en.wikipedia.org/wiki/Glyphosate
http://www.checnet.org/healthehouse/chemicals/chemicals-detail2.asp?Main_ID=248
http://www.greenontario.org/strategy/agriculture.html
http://www.cog.ca/
*http://locator.region.waterloo.on.ca/locator.htm*
http://www.foodlink-waterlooregion.ca/


General Goals for 2032:

- Locally-grown organic food is available and affordable.
- Food production is limited mostly to the region (i.e. we mainly eat what we produce).
- AOR is regularly providing locally-grown, organic food options to its retreat centre and Hospice guests.

NOTE: No discussion was had yet about the impacts of imported foods.

Potential Actions and Responsibilities for AOR:

…in regular operations & maintenance of services:

- A portion of the land will be used to farm organically. A mandate will exist for the AOR land to be farmed organically.
- Food provided by AOR for hospice guests, their families and volunteers will be locally-grown and organic, preferably by adjacent faming (or on-site).
- An important trade-off is to allow families to prepare food from anywhere (perhaps imported and non-organic).

- For retreat centre, recommendation for catering will be towards those who provide organic and home-grown foods, but within the given budget of the retreat goers.
- A garden for aesthetic purposes and produce for the centre will be developed.
- Excess produce grown at the centre could provide a job at the market
- Info for local and organic farming will be available in the information centre.

…as part of programming offered to the public:

- Focus on providing space and active facilitation for programs to learn organic farming and advocacy for local farming.
- Developed tours of the facility may include discussion of organic farming and local relationships.

…as part of advocacy AOR is engaged in:

- Partner with other organizations to promote the conservation local and organic farming efforts.
- Regularly, and in a sustainable manner, donate "in-kind" to such advocacy efforts.

### 3. *On the Edge of the City*

- The proposed centre is in Bloomingdale, a small rural town on the edge of the cities of Kitchener and Waterloo – separated from both by the Grand River.
- An important consequence of this placement is that the centre is within reasonable driving distance to the outskirts of each city, but somewhat distant from their centres. Some example distances are:
    - Grand River Hospital: 9.9 km
    - St. Mary's Hospital: 10.0 km
    - Lutherwood: 9.7 km
    - Charles St. Bus Terminal: 9.2 km
    - Conostoga Mall: 9.3 km
    - Lissard House: 16.4 km
- There is also currently not a mass transit solution through Bloomingdale and one is currently not planned by the region for the next few years. This fact means that guests of the hospice and retreat centre will likely have to get there by automobile or independent transit solution. Given the significant contribution to global warming [SEI, InterE] of automobile emissions, the lack of efficient [RME] transit options is a potentially significant concern. Also, those people who do not own a car would be unfairly prevented from visiting their loved ones staying at the centre [IntraE].
- Being on the outskirts of the city is advantageous for the retreat function of the centre. A retreat centre is a place to retreat to and should have the feeling of being separate or different in some way from the busy city life. Being close to the city that the retreat distance is not significant [RME], but far enough away that the atmosphere is preserved is an advantage of the current location. This fact is especially true if retreat goers attempt to carpool when visiting the centre.
- Being on the edge of the city also provides the interesting opportunity of promoting the sustainable integration of rural and urban life [SEI, IntraE, LSO, SEC]. Providing a place for programs which consider the tensions and interconnections of the urban with the rural could be both very challenging and very rewarding for the entire community. By providing both a commonly urban service (the hospice) and a commonly rural service (retreat centre) AOR may be uniquely positioned to address this rural/urban link.
- The rural location of the centre also means that centralized services may not be available for sewage conveyance and potable water. This lack of urban water services may be an opportunity to demonstrate novel and effective technologies for rain capture and storage and grey and black water management [RME, SEI]. There are also potential interconnections with this concern for water services and that of local farming (a potential use of grey water) and the Grand River (a potential sink of septic release).

References:
- http://transitea.region.waterloo.on.ca/

General Goals for 2032:

- Mass transit is available to the centre
- Guests and their families can access the site regardless of socio-economic concerns (i.e. they don't need to own a car).

Note: No general discussion goals were outlined addressing the URBAN/RURAL divide.

Potential Actions and Responsibilities for AOR:

…in regular operations & maintenance of services:

- Bus to Bloomingdale
- An energy-efficient multi-passenger shuttle to transport individuals and groups to the Hospice and Retreat Centre.
- For retreat centre there would be a set schedule of transit and people would be required to adopt group transit methods (carpooling, etc.)
- Allow volunteers and employees to work around bus schedule

…as part of programming offered to the public:

- Focus on providing space and active facilitation for programs to foster the urban/rural connection.

…as part of advocacy AOR is engaged in:

- Partner with other organizations to promote the effective integration of urban and rural life.
- Regularly, and in a sustainable manner, donate "in-kind" to such advocacy efforts.

*Implications for PEOPLE*

### ***4. Compassion and Service in Palliative Care***

- In 2033 there will be roughly 730,000 people living in the Waterloo Region. In a generation, however, the baby boomers will have grown old (over 70). How many people will desire palliative care at this point?
- 90% of people would prefer to die in their homes, yet 64% of families cannot afford the time required to care for their dying loved ones at home. A central question of creating an effective and sustainable model of palliative care is whether efforts should be focused on assisting those who wish to die at home or developing palliative care services in existing institutions or new residential locations. What is the equitable and efficient solution? Do these two options conflict? To allow for adaptation and precaution, how much should a diversity of options be developed? [InterE, IntraE, PA, RME]
- Inspiring a new model of health-care which includes increased respect for palliative care (especially in primary care physicians) seems of the utmost importance. What relationships and advocacy needs to be in place to prepare for the region's aging population to die with peace and dignity? [LSO, InterE]
- Effective palliative care must focus on the full spectrum of care – mental and physical, emotional and spiritual. How can such a diverse set of needs be facilitated for all the dying and their families in an increasingly diverse region? [IntraE, SEI]
- What supports and training for palliative care professionals will be essential to provide the vision of compassion in care for the dying AOR hopes to deliver? [LSO]
- How can AOR inspire in the public a respect for hospice care and for compassion in care for the dying? Should AOR take an active role in such advocacy and discussion, or should it play more of a passive role in offering service and allowing people to participate in unique learning experiences which may change perspectives more slowly. (SEC)

Additional General Discussion (During meeting):

- Immigration will likely be the source of new residents in the Region, but what will their family connections be? Will they have the skills to provide for those who are dying? Can they be easily trained?
- Is there a difference between palliative care and hospice care?
- Is Hospital not the place for people who are aging and palliative? Some people will make transition from acute to palliative at Hospital, even 25 years from now. Will these people be the majority of the dying? (e.g. Freeport services)
- Baby boomers will create a shift. A mini poll was conducted to see where everyone would prefer to die:
    - Judy - home (but not as a burden on family)
    - Shari – didn't run into a single person who would want to die at home. Residential Hopsice is a great alternative. We do not expect our children to look after us. We're planning for our future.
    - Marjorie – Residential Hospice. Care model is better. A wonderful place to leave.
    - Melba – Huge burden now. It will be difficult for boomers to change their perspective. Doesn't want to die in her home, not now.
    - Gary – Palliative care could not be provided in-house for all palliative patients. In home 1:1? In residential 1:6?

  - Martha – can’t just talk about baby boomers. Could be a child. How do the family of dying parents feel about their child dying at home? Where she dies does not matter – it’s how she dies: without pain, with family. There may be need for all three options…fluid.
- Aside: Definition of length of stay at residential hospice: 3 months.
- Martha: Edmonton palliative care is at the forefront of information available.

General Goals for 2032:

- Huge influx of nursing and similar “truly” trained practitioners available 24/7 if families are necessary.
- Instead of research and money for cancer treatment, the care of those who are dying is also considered.
- When additional home care is available, also increased numbers of residential and LTC centre support with the “right model”. The available services need to be dynamic to support a fluid demand for hospice care.
- Choices are important. In 25 years, regardless of where you’re dying, you have support and level of care that you need.
- Advocating at local, provincial, federal, delivering at local level.
- Educating at local such that others from further away are interested in participating
  - Example of representative from Ian Anderson House who advocates about what we’re doing in hospice.
- People are given the option of palliative care earlier in the treatment process. We value autonomy – we need to be given the choices. “I can’t offer you any more treatment, but I can promise you a comfortable transition to death.”
- Support for a “dula of death” program and training (i.e. chaplaincy without a religious agenda, necessarily). Questions – would this be a paid position? By whom? How would the demand become manifest in the community?
  - There is perception of increased value of a service when it is paid-for.
  - However, would you attract the right-minded people into such a role when you pay them to do so?
  - How would you regulate and develop the standards and requirements which govern their learning and actions?
  - Would this prevent the other roles from connecting and considering the interconnection of care of the patient/guest?
- Also foster a team approach for the program of care (ref: Ira Byock’s “Dying Well”). Example given of CAPC program (@ Ryerson?)
- Provision and model for complimentary healthcare as part of palliative care when it is desired and effective. Need for policy and experience of knowing which techniques are valuable and when.
  - Benefits have been repeatedly observed (Marjorie)

Potential Actions and Responsibilities for AOR in a Generation:

…in regular operations & maintenance of services:

- Be the “one-stop-shop” for palliative care information in the region. Have regional information centre to allow people to access the resources. CCAC’s role is similar, but they struggle with that.

- Have interns from medical and nursing schools rotate into hospice operations and receive exposure to the transition from treatment to palliation to death.

…as part of programming offered to the public:

- Programming specifically focused on doctors and other palliative care practitioners designed to address the western medical model's flaws in considering the palliative care process. Not just considering – looking at death in a different way.
    - Use pain management as a hook to get the medical community to participate
    - Ira Buckman's idea of just listening – allow patients just to be, not failing.
    - Changing from offering only treatment to offering, as well, the possibility of compassionate end-of-life transition.
- Similar "mindset" programming for the community at large, but not to diminish the current experience of death and the desire for life.
- Provide training for spiritual advisors and leaders to better understand their role and involvement in the hospice process.
- Training for how to provide care for personal support workers in the palliative context. Additional education will be required.

…as part of advocacy AOR is engaged in:

- There is a need for advocacy for hospice care at the government level. The problem is that there's not enough money geared towards the aging population.
- Actively become involved in Hospice Association of Ontario to advocate for such provision of service and increased funding. Independent advocacy will not be necessary.
- Advocate for doctors to learn more about palliative care as part of their education. And for nurses. Question: "Is dying an elective?"

5. ***Learning both to live and die well***
    - AOR wishes to focus on both sides of the coin – both living well and dying well. The question of how (and in what proportions) to provide space, programming, advocacy to service the community in both types of learning (and in their relationship) is a central question of the organization. (SEC)
    - When space and resources are limited, for example, what mission should take precedence? Should palliative care learning be the focus with occasional use of the centre by other local groups, or should a 50/50 split of living well and dying well programming be offered?

General Goals for 2032:

Potential Actions and Responsibilities for AOR:

…in regular operations & maintenance of services:

…as part of programming offered to the public:

…as part of advocacy AOR is engaged in:

### 6. *The Volunteer Experience*

- Volunteers are expected to play a central role in the provision of hospice care and the general maintenance and support of the AOR programs and the centre. The fact that they offer these services in their spare time, for no charge, is what makes them volunteers.
- To what extent should volunteers receive recognition, services-in-kind, or VIP access to learning opportunities? Overall, what should be given to volunteers to respect their necessary role? Would it be better, given sufficient funds, to have some commonly "volunteer" roles be filled by members of the community looking for living-wage jobs? [LSO]
- What training will be required for volunteers to be active and compassionate members of the hospice care team? Will volunteers be required to participate in training, or will it be optional?

General Goals for 2032:

Potential Actions and Responsibilities for AOR:

…in regular operations & maintenance of services:

…as part of programming offered to public:

…as part of advocacy AOR is engaged in:

***7. Open and Democratic Governance***

- What structure of governance will best serve the current and future mandate of AOR? How will things change as the organization transitions through capital fundraising to full-time operation?
    - Optional models include corporate-style boards with oversight over several executive positions who manage centre employees, more inclusive systems with representation on the board from each stakeholder group (e.g. volunteers, employees, families, health-care providers, community members, etc.), or hybrids of both options.
- How will AOR acquire and engage its membership? How will members become part of the organization? What will inspire them to stay part of the organization?
- How will stakeholders have involvement at the strategic and decision-making level of the organization regardless of the governance structure?

General Goals for 2032:

Potential Actions and Responsibilities for AOR:

…in regular operations & maintenance of services:

…as part of programming offered to public under the "Living Well" mandate:

…as part of advocacy AOR is engaged in:

**Implications for SUB-SERVICES:**

8. ***One Building for Many Reasons***
   - AOR's current vision includes both hospice and retreat centre contained within a single building. Is this the ideal model for meeting the mission of AOR?
   - Will the space requirements of the organization change significantly throughout the next generation of use? If so, in what way will they change and/or grow? For example, will a place for overnight guests be constructed in the near or distant future?
   - Many important building services could be maintained on-site or interconnected with regional infrastructure. The degree to which the centre is self-reliant for electricity, heating and cooling energy, potable water and sewage conveyance will affect the ability of the centre to adapt to potential short-term and long-term fluctuations in the cost and reliability of such services as well as dictate the type of service that is provided. [SEI, RME, PA]
   - The manufacture, transport, construction, use, maintenance, reconstruction and final disposal of buildings and their service systems lead to significant social and ecological impacts. These issues will be further discussed when the enhanced building program is developed, but a rough list includes:
     - Source and transport of construction materials and regularly used building resources (e.g. wood for heating) [SEI, LSO]
     - Type and quantity of energy used [SEI, InterE, IntraE]
     - Water use, treatment and disposal (including sanitation) [SEI, InterE, IntraE]
     - Impact of structure and services on surrounding ecology (SEI)
     - Impact of indoor environmental quality on occupants (SEI, LSO)

General Goals for 2032:

Potential Actions and Responsibilities for AOR:

…in regular operations & maintenance of services:

…as part of programming offered to public under the "Living Well" mandate:

…as part of advocacy AOR is engaged in:

### 9. *Being Part of the Healing Network*

- As discussed as well under the category of people (compassion and service in palliative care) a residential hospice does not stand alone in it provision of health-care services. Human resource and physical (e.g. transit) links will need to be developed between the centre and Hospitals, Long-term care centres, regional palliative care associations, complimentary care practitioners, volunteer sources, and other community organizations. Carefully considering which organizations are important and then discovering the best way to foster and maintain these links is essential to the future of AOR.
- Similarly, the retreat centre and its programming will be reliant not only on this network of health-care services, but also on the community at large for ideas and leadership in on-going activities. The wider the mandate of programming at the centre the wider the breadth of community interconnection that will be required.
- This need for community interconnection provides AOR with a massive challenge and opportunity. Providing a place for so many people to come together – for both living and dying – will allow AOR to bring people from all walks of life into contact with one of humanity's most complex questions – when we die, what do we leave behind? [LSO, InterE]

References:

Potential Actions and Responsibilities for AOR:

…in regular operations & maintenance of services:

…as part of programming offered to public under the "Living Well" mandate:

…as part of advocacy AOR is engaged in:

***10. A System of Giving***

- One of the most important mechanisms of opportunity for AOR is its charitable status. Allowing people to give both monetary and in-kind gifts to the organization in return for a charitable receipt is a powerful tool for accomplishing the goals of the organization.
- With this thought in mind, what models of donation, volunteer time, and in-kind services are the most sustainable ones to pursue?
- Should the organization be open to donations from any sector, business, or individual, or should some scrutiny and oversight over the source of funds and gifts be held? What criteria would apply to such scrutiny?
- It is the mandate of the charity not to charge for hospice services given to the dying and their families. As such, this will impose a clear financial deficit on the organization.
- How can AOR establish a sustainable system of paid-for services offered through its retreat side to balance its hospice expenses? What are good model organizations for determining appropriate fees for service?
- Roughly, what balance of large-scale fundraising, paid-for services, larger private donations, and public funding should be pursued to make AOR viable and resilient in the long-term? [RME, PA]
- Will acquiring stable public funds required advocacy on the part of the organization? If so, what capacity should AOR have to advocate at the various levels of government for public funding of hospice and/or retreat services?
- If the goal of “service and compassion” requires a more centralized model of funding, is AOR willing to push its fundraising dollars to a higher level to help support other residential hospices and home-care programs? [IntraE, SEI, PA]

Potential Actions and Responsibilities for AOR:

…in regular operations & maintenance of services:

…as part of programming offered to public under the “Living Well” mandate:

…as part of advocacy AOR is engaged in:

Appendices:

Gibson, Robert B. “Sustainability Assessment: basic components of a practical approach,” Impact Assessment and Project Appraisal, volume 24, number 3, September 2006, pages 170–182.

OUTCOME #2

**AOR Hospice & Retreat - Functional Programming - User-centered Review of Spaces**

**User List:**
Guest
Guest's Family/Friends
Nurses
Doctors
Hospice Care Workers
Service People
Complimentary Care Practitioners
Administrative Staff
Spiritual Advisors
Social Workers
Retreat Attendees
Caterors

**Guest**

- No distinction between night and day
- When they are awake:

Option - Access to the outside: feel the outdoors, be outside.
- They go outside with wheelchair, walker, roll the bed out.
- Doors are wide enough for the bed to get through (or beds are small enough)

Option - OR, they are photosensitive - need to darken out the space
- They need to be able to control the brightness themselves?
- Not necessarily, people are moving in and out often - they need only ask the staff or family to change the brightness.
- Room needs to be flexible (or bed does)

Option - Interact with their family, others
- Flexibility - enough room all around for their visitors
- playing games, looking at pictures
- Different number of people in family means a different room size requirement
- How can spaces be modified / transformed to fit the family size needs
- Comfort with nobody, but also with up to 5-10 people in the room at the same time.

example - Brantford Hospice (same in area as boardroom - more square) 12'x21'

Option - Bed large enough to allow two people to sleep?
- conflicts with desire to go outside the room
- Need bed solution which can be modular…can we butt or T beds together?

Point - Die the way you live…make the space their own space.
- Never be perfect…average person?

Option - Eat in the room with family
- What about the adjacent room?
- Staff will talk with them about food too.
- What about isolation of smell?
-Nausea may be an issue
- e.g. MRSA - need to have the pressurized room option?
- Likely not…smell control is the likely extent.
- Separate air-handling in each room. Don't mix the air between the suites.

Option - Wanting quiet
- Noise suppression will be important => already an assumption.

IDEA - With the door closed - they are isolated (sound and smell)
- With the door open, they are connected.

Option - Wanting warmth/cool
- All sensitivies are magnified
- Maybe with sheets
- The need to remain covered, to avoid embarrassement
- Elderly people are always cold…but dying people need a variety of requirements
- Patients can sweat with morphine - they need moving air all the time
- Requirement: Ability to change temperature quickly.

Option - Need light to:
- Watch T.V. (provides a sense of security)
- Healing aspect of indirect (i.e. non-glare) natural light
- Reading, looking at pictures.
- Flexible in different locations
- quality of light - direction for shadows => Indrect is best.
- Control light through window => low-enough to sleep in day-time (but like in a home)
- Perhaps just with a simple curtain
- Generally, people like dim light…things are all so jarring.
- The sun coming in is important…warmth & outside.

- Conflict with ceiling height…may not be desired.

Option - Listen to their own music (radio, or CDs)
- Allow them to bring a high-quality system (or provide that system)
- Provide music options to the client (more likely, allow them to bring in their own)

Option - Visit the washroom
- Large enough to access from walker/wheelchair and have family help
- Sitting showers will be required for all units
- A single bathtub for guests in a commonly-accessible area
- space for bed pan for non-ambulatory guests
- Visits can be frequent, but can be once every eight hours
- Towel warmer in bathroom…touch of comfort
- Shower use is not frequent. W/Cs are used until the end.
- Height of toilets must be sufficient for elderly

Option - Access their articles
- example of McMaster => articles all over the corridor.
- picture hanging - a shelf…easy.
- clothing…space to store your own comfortable clothes.
- sometimes the gown will be necessary…especiallly towards the end.
- personal items…freedom of choice and respect for what you wear and what you store.
- built-in wardrobe…hospital-grade for cleanliness, durability
- bed sheet storage and blankets
- hamper for laundry in bathroom

- Go for a cigarette
- only one or two puffs…just to know that they are capable
- may want to do it with the family member

**Guest Family**

- Family member may sleep at the Hospice
  - With the guest?
  - Could it be a recliner? What about a hide-a-bed?
  - Requirement: Be near/next to guest
  - They can be cuddling…a single bed may be sufficient for some

- Read while guest is sleeping
  - Transportable reading lamp for family member

- Storing their effects
  '- Small storage space…enough to fit a suitcase

- Wander in contemplation…relax
  - to recharge.
  - preference to be outside, near to nature
  - a change from the experience they've been in
  - comfortable place to sit
  - home-like experience as well: flooring of wood
  - pray or meditate…in a separate room, away from the Hospice
  - place for contemplation separate from the common space

- Interact with others who are experiencing the death…a central common space
  - comfortable seats, around a fireplace or a central area
  - place for children to play…video games, dolls, etc.
  - for children - their own place to be.
  - sit together, adjust the space/seating to be closer together.
  - outdoor place to play for the kids
  - access to the internet

- Go for a  cigarette
  - more and more people going outside for a cigarette
  - would need to go outside, unless they were accompanying the guest
  - minimum distance would be required…(10 m?)

- Eat something
  - snacks for kids
  - kitchen tables to eat at…immediately adjacent to the kitchen
  - kitchen to prepare the food
  - kitchen, family room (common spaces) interconnected

- Cook for their family members

- Standard kitchen requirements
  - effective ventilation for that type of space
  - family fridge to store their own food
  - Usually preparation occurs at home. Family members only need a little.
  - Storage of ice cream

- Receive complimentary care treatment
  - qualities of the space already well-defined

- Talk with a social worker / spiritual advisor
- Talk with the doctor
  - In a quiet place
  - Access to records not necessary
  - A short period of discussion.
  - a space to review documents
  - But it could be like a livingroom, couches and a coffee table
  - Indirect type of lighting

**Nurse**

- Relax, and be separate from work
  - A staff room is necessary…for a break
  - Needs to be different, in appreence.
  - It's own kitchenet to put food and other articles
  - Window with a view (operable)
  - Comfortable place to lie down
  - Desire: A place to write…a desk (with a computer?)
  - Music and Television
  - Read and relax
  - Access to the outdoors, especially during the summer (may not need to be directly out from the staff room space)

- Bath the guest
  - 3 types: personal, sponge, and elevated/live-in
  - Basin, towel, soap, over-bed table.
  - Special space requried for the third type of bath (and size requirement)

- Cleaning up messes of bodily fluids
  - some type of device for quickly and sanitarily clean up a mess, then return the item from storage
  - Soon after, this cleaning tool would be sanitized.
  - There could be issues of cross-contamination.
  - Would it be better to have a separate cleaning tool for each room?

- Pronouncement
  - Phone doctor and family

**Care Worker**

- Doing laundry for the whole hospice, including the guests
  - larger central system
  - heavy-duty domestic machines
  - machine is elevated so that older people (bent) can access it easily
  - hang clothes to dry, circular, brought down.
  - Collection => dirty hamper in each room, collected by the person doing the laundry
  - Room-specific hamper to identify laundry while washed
  - All clothing needs to be labelled (labels may be needed)

- Cooking food for the guests and their families
  - They would do the bulk of the real cooking in the kitchen
  - Pantry for keeping baked goods and prep stuff
  - An island for perp and range
  - Storage for all the standard kitchen items (enough to make a Christmas dinner?)
  - Designed principally for cooking, with the additional storage.
  - Large family dish-washer (heavy duty)
  - For special functions, may need additional seating, plates, cutlery

- Cleaning physical environment
  - cleaning all types of surfaces

- any common spaces and guest rooms need to be cleaned thoroughly (for contamination issues)
- Hand sanitization may be needed, but hand washing is the best option
- Flooring needs to be easily cleaned

**Service Staff** (Antoni P. - 2007-11)

- May be either a volunteer or paid staff

- Maintain grounds of centre
    - Need a place to store grounds maintenance equipment
    - This place may be outside. Does it need to be heated?
    - Will want access to water for grounds care
    - Will need various tools for gardening and grounds care
    - If gardening is serious, there may be a need for a greenhouse with some heat to start seedlings early in the season.

- Repair physical structure of centre (e.g. regular building maintenance and repairs)
    - Would a workshop to store tools and equipment and perform standard repairs be required? Could it be in the currently-planned space?
    - If painting, sawing, and gluing were going on there would need to be special ventilation for this space
    - Would it be possible to construct a single structure for gardening/grounds care and for repairs and maintenance?
        - This workshop could incorporate a similar gas-fired heater as planned for the smoking porch.
    - Depending on the extend of regular mechanical maintenance requirements, a storage space adjacent to the mechanical room may the easiest

**Complimentary Care**

- Provide complimentary care to guests
    - A bed that goes up and down easily
    - Place to keep/set lotions and other articles
    - A firmer table will not be required for guests
    - Access to the patient sink

**Doctors & Social Workers**

- Social workers and doctors need to document the process
    - same space requirements as the nurses

**Centre Staff**

- Volunteer coordinator for hospice
    - Meet with families prior to someone coming into hospice
    - Train the volunteers to work at the hospice
    - Spend most of their time within the hospice office - the two offices.

- Receptionist / Centre Administration Assistant
    - Greet people as they arrive.
    - Assistant to the administrator: write letters, prepare receipts, scheduling, brochues, mailings, donor info, etc.
    - Spend most of their time at the reception area

- Administrator
    - Organize on-going retreat activities - soliciting users and planning programs.
    - Responsible to the board.
    - Spend their time in the other office (next to the volunteer coordinator)

**Retreat Attendees / Users:**

- A weekend event may be going on
    - Workshops would last all day: 9 am - 5 pm
    - 1.5 or 2 days of this would be common.
    - Spend time primarily in the bottom meeting rooms.

Example Rubenfeld Workshop:
- spend most of the time in the basement
- during "alone time" go the water, walk the land, or have sessions in the session rooms.
- also may use the meditation room.

Example Half-day "Sustainability"
- spend most of the time in the walk-out meeting rooms

- start 9 am (coffee/tea). A speaker/seminar. A Lunch.

Example Kiwanis, Optimists, Yoga teacher, Business Having sessions.
- 0.5 to 2 days in length. Similar usage.

Example Hospice Training / Palliative Care Sessions
- Spend most of their time downstairs but also using the hospice as the "second-half"
- Or, inviting other hospices and associations.
- Hopefully, down the road, doctors and nurses.

Library Visitor:
- Mostly a resource room.
- Some usage for small sessions and lessons.

- Regular sessions: Training, sustainability, hospice workshops, community use - 8-15 people
- Monthly sessions: invited organizations, weekend events - 30-50 people
- Annuals: Festivals, Fundraisers - 50-150 people (both inside and outside)

OUTCOME #3

**2008-04-13**

**Impact Category Ranking Results from AOR Board**
**for their Hospice and Retreat Centre**

The six impact categories: Energy, Water, Materials, Site, Indoor, and Service/Inspiration were ranked by each board member. Rankings did not have to be in numerical order (i.e. different categories could be given the same rank).

When averaged-out, the categories ranked as follows:

WATER – 1.7
ENERGY – 1.8
MATERIALS - 3.3
INDOOR - 3.7
SERVICE/INSPRIATION - 4.3
SITE - 4.7

Here, in no particular order, are some of the comments of motivation that were given by people about the different categories.

**FIRST (by 0.1): Water**

- Tension between wanting to be good stewards of water and needing abundant water for bathing and drinking will be an important consideration.
- I value the need for human consumption above the need to water lawns and flowers.
- Lack/limited availability of this resource would greatly hamper the ongiong functionality of the centre.
- limited resource: Region considering pipeline to Great Lakes
- Water quality taken for granted until something like Walkerton happens
- Focus now, because it might be expensive to retrofit in the future
- Water is associated with life and in the struggle to maintain a healthy living until the end of life, clean water is essential.
- Without access to an adequate/sustainable source of clean water then we can't function, can't happen, can't be.
- Fortunately, our temperate climate provides plenty for our use, a collection system needs to be desigend for smart use.
- Being a public building we'll have to install a treatment system for potable water.

**SECOND (by 1.5): Energy**

- It will be one of our biggest ongoing costs to run the building, so we must reduce use and cost as much as possible.
- When I look at my life, I realize that I am dependent upon energy for all of my daily activities. This is sobering when we consider the impact of green-house gas emissions on the environment.
- Buying 'green' energy is something that I would value and support.

- Thinking about energy use is something that needs to be incorporated into our thought processes
- The most important objective here is to reduce demand. With less demand the smaller amount of energy required, the smaller the energy footprint both locally and globally.
- The budget will let us do small things like plant lots of trees but maybe we can look into some generation also.
- Like buildings to be self-sustaining energy-wise that would make a great deal of sense to me.
- And the more self-sustaining it can be energy-wise there won't be as much of a future concern to maintain and keep it going as it would be.
- How can we cut back on energy, use different forms that are open to all of us? This is not necessarily money-related, it's environmentally-related and sustainable.
- Most commonly used energy sources are non-renewable and the manufacturing, transportation, use of and disposal of byproducts contribute to green house emissions or other potentially harmful environmental impacts (consider disposal of nuclear waste byproducts)
- we need to design/utilize energy systems that are environmentally friendly, conserve and make use of renewable resources to the greatest extent possible
- Our design needs to get this right - could be costly to retrofit or fix after the fact

**THIRD (by 0.3): Materials**

- To enhance the indoor quality [Not an uncommon reason.]
- This I feel is the least important regarding sustainability.
- The materials will have to meet building code, and the requirement of low maintenance and the desire for certain materials to increase inspiration and comfort may increase distance materials will travel.
- construction materials need to be such that they support the environmentally sustainable design and operation that is our goal
- we'll look to those with the expertise to guide us in the appropriate choices of materials to achieve the goal
- exterior materials including windows may be costly to replace - so again we need to get it right in the design and choice of materials
- interior materials may be more easily replaced if they prove to be inadequate - however with guidance we should be able to make the right choices from the start
- Energy Water and Materials rank the same in importance.
- However, the cost of 100% of the building's energy needs, water and construction materials for a living building may be beyond our budget.  But since they are so important for the future of the whole project, I think we should budget a large amount for theses components if we want a living building.
- However, if cost is a factor, I would not sacrifice energy and water for material restrictions.
- Durability and functionality are important for care givers who care for the terminally ill.

- Materials that wear well are preferable and if they can be purchased reasonably and are also environmentally friendly, that is great.

**FOURTH (by 0.6): IEQ**

- Sensory stimulants for the terminally ill can have harmfull effects -eg. nausea. Therefore, I believe that air quality and sunlight are important.
- Access to fresh air, natural light and subdued noise levels should be considered.
- I am still opposed to the smoking room due to increased costs and the fact that residents can access the outdoors for smoking.
- Air quality, heating/cooling, managing light/darkening are important elements
- Fresh air will be required for everybody's comfort but providing that has to be balanced with energy use
- Low emitting materials will be another requirement.
- For me it's important to have air exchange. I don't want a closed-in building.
- It's important to have light and as much natural light as possible. Keeping it light in the areas it needs to be and dark where desired as well. I want to be able to see outside.
- This most directly affects our guests/staff/volunteers and hospice users. We must have a hospice that is as healthy as possible and is as user friendly as possible for all these groups.
- Building design already incorporates excellent uses/views of outdoor spaces
- Vitally important to have the best indoor quality (air exchange and controls for pollutants) for the comfort of our guests and working environment of our staff, volunteers and visitors to the building.
- Room comfort for the guests is a top priority.
- Reflecting pool, meditation room are spiritual, tranquil indoor spaces

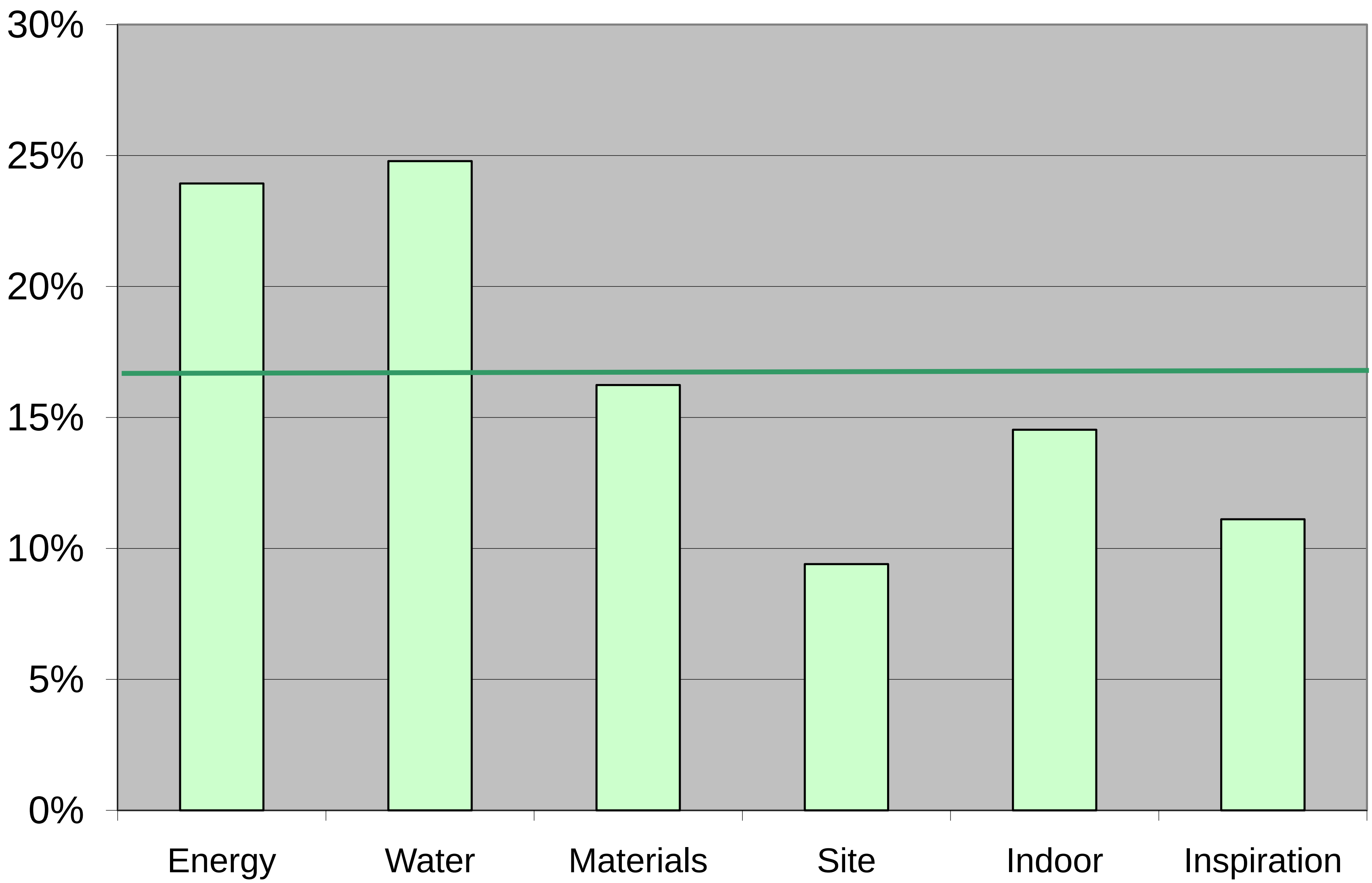
**FIFTH (by 0.4): Inspiration & Service**

- I would like people who are visiting to feel a deep "ahhhh" inside as their fears and apprehensions are lessen and they feel they are in a safe, comfortable place of understanding and compassion that would meet their personal needs.
- Inspiration and service most important because this is the feeling and comfort that the hospice and retreat centre is trying to convey
- The first step into the building has tomake the participant at home, comfortable and willing and wanting to go forward. It needs to satisfy and nurture him / her.
- building design already incorporates the elements from needs, dreams and desires meetings - reflecting pool and meditation room are examples
- I know that AOR has committed itself to service and I support this. If intelligent, informed attention is paid to the other categories, inspiration will be implicit
- There are more than enough features to delight the senses and feed the soul of the terminally ill and their families.
- people must want to return to use the retreat center over & over so must have a positive feeling about the facility.
- The hospice must be as comfortable and peaceful as possible for both the living and the dying there.

- It's the inspiration and the service that runs the whole thing. This is the reason for doing it - all of us.
- You can't separate the sharing from the doing. We want to pass on the knowledge/information that we develop to others.
- I envision the Hospice and the Retreat as being spiritual, peaceful, and healing environments. These components are vitally important to the success of the project and in many ways are the “roots” of our mission.
- inspiration and service will be supported by the building and the land but for the most part will be defined by the people who work and volunteer at the hospice/retreat centre and the guests who spend time at the facility
- programming will be designed and delivered to support the dreams
- outdoor amphitheatre and labyrinth, gardens and walking paths all support the inspiration
- these elements can transform as new inspirations and dreams for what can be evolve
- The impacts would be educating the staff, volunteers, families who are considering the hospice/retreat and community educational programming so they understand our mission and the benefits of such a building that would help create such an enviroment.

**SIXTH: Site**

- The site is important but we can improve and have it evolve by being aware of the environmental concerns and needs of the site to keep it as natural as possible.
- We must make the most of the use of our site, keeping in mind our fit in the neighbourhood and community.
- Preserving environmentally sensitive land is an important consideration but there is much farm land that has been developed for housing without much outcry.
- Site seems to be important only to those who take the time to consider 'footprint'. I support keeping the hospice to as small a structure as functionally possible.
- We already have the location and we know we will not have public transit to this spot but we have the opportunity to use this site to the optimum.
- We can lower our environmental footprint, we can utilize the natural habitat, including the river and natural woodlands along its bank.
- We have the space to do gardening, possibly an orchard and still develop a habitat exchange area.
- We also have a local community to work with and feed off of each other.
- I think we are considering the various impacts that the building will have on the site and will have to work with the GRCA, the farmer and his orchard.
- Since the site is already determined it is at the bottom of my list
- Except for the distance from public transit and the need for people to use personal vehicles to access the location, it does fulfill the tranquil elements we desired in the location
- care must be taken to minimize the footprint
- gardens, natural pathways, trails, trees and organic farming support the natural qualities of the land - these can evolve and change


30%
25%
20%
15%
10%
5%
0%
Energy
Water
Materials
Site
Indoor
Inspiration

OUTCOME #4

# AOR Hospice & Retreat – Design & Construction Difference List (v2010-01-16)

The intent of this document (and its accompanying drawings and scorecard) is to provide a comparison of two designs – "standard practice" vs. "LEED concept" – for the All Our Relations Hospice and Retreat Centre planned for construction in Bloomingdale, Ontario.

By reviewing this list of differences, it is the hope of the design team that a fairly detailed *costing document* will be created by Van Del Contracting Ltd. which provides a full budget for the project *and* highlights the differences in cost between the standard practice design and the LEED design.

***Design Comparison:***

*Standard Practice Design*. These options are intended to reflect what would be designed and built for the project if the team was not specifically pursuing any of the Leadership in Energy and Environmental Design (LEED) targets. Instead the performance goals for the project are to minimize initial and operational cost while meeting all functional requirements.

*LEED Concept Design*. This column reflects the current concept design for the building. Added to the goals of function and low cost is the goal of achieving "LEED-Gold" as outlined by the attached scorecard of LEED points targeted by the design team.

Line items appear in this document in three ways:

i) *As general requirements for both cases*. This means that both the standard practice and LEED designs are assumed to follow the same set of requirements. A single cost should be prepared for these items which will apply to both budgets.

ii) *As a LEED-only requirement*. This means that the standard practice would not include the detailed item. An "added cost" should be prepared for these items and included in the LEED Design budget.

iii) *As a difference of requirements and/or systems for LEED*. This means that the same construction practice is required for both designs, but the details of that requirement are different. Two separate costs should be prepared for these items and added to their respective budgets.

Given this organization, each row documented in one of these three ways should be included separately in the prepared *costing document*. For example, the LEED design includes the requirement of premium low-flow faucets with a flow of 1.9 L/min while the standard practice design would use a more commonly-available 9.5 L/min model. A separate line item for faucets illustrating the base cost and cost premium for the low-flow faucets should be prepared.

This document is also accompanied by a minimal set of architectural drawings and mechanical/electrical design briefs for use during the costing exercise. These drawings are concept drawings only and should not be assumed ready for construction. However, if important information relevant to the costing exercise is missing from these drawings, or from anywhere in this specification, please inform Antoni Paleshi or Martin Jewitt of Enermodal so that the right information can be provided.

As a general rule, any assumptions about standard practice that are not included as part of this document, but are important for determining the cost of construction, should be assumed to follow the best judgment of the principal contractor and his sub-contractors. For clarity, when preparing the *costing document*, please list and describe any such assumptions in the appropriate categories or as an addendum.

## *Design & Construction Difference List Sections*

# 1. General Construction Requirements

## 1.1. General site management requirements

***LEED Site Management***

Allowance for manpower on site to manage LEED documentation, supervise trades, meet with LEED consultant, etc.

- Expect at least 1 to 3 hours per day at supervisor labour rate.

## 1.2. Best practice for minimizing site disturbance during construction

***GENERAL Site Disturbance Requirements***

Design construction program and schedules to minimize impact on adjacent field, forest and river watershed ecology as required by the Grand River Conservation Authority.

***LEED Site Disturbance Requirements***

Limit boundary of construction activities to within 40 feet of planned building perimeter and 5 feet beyond parking and walkway footprint.

***LEED Erosion Control Measures***

Allowance for:

- installation and regular maintenance of “stabilized construction entrance” (refer to detail ECS-01)
- material stockpiling and surface roughening (refer to detail ESC-02)
- installation of silt fence around perimeter of extents of construction (refer to detail ECS-04)
- installation of check dams (refer to detail ECS-08)
- filtration of dewatering activities (refer to detail ESC-13)

Allowance for weekly inspection of above erosion control measures (1-2 hours)

## 1.3. Construction waste management

***LEED Construction Waste Management Measures***

Allowance for:

- Installation of separate waste bins for plastic, wood, drywall, concrete/rubble, steel, cardboard, and mixed waste
- Daily management of bins to ensure no cross contamination
- Collection and tracking of waybills for waste disposal

## 1.4. Indoor air quality control during construction and pre-occupancy

***LEED IAQ Measures***

Allowance for:

| |
|---|
| ▫ temporary sealing of building envelope (if required)<br>▫ proper storage of materials on site:<br>▫ absorptive materials – elevated and covered to protect from moisture<br>▫ hazardous materials – outside of building envelope<br>▫ regular housekeeping (using sweeping compounds, wet dusting, etc)<br>▫ temporary enclosures of finished areas (ie: dust curtains) to prevent cross contamination of spaces during construction<br>▫ use of MERV 8 filters on any return ducts serving HVAC equipment operated during construction<br>▫ temporary sealing of ductwork openings during construction<br>▫ vacuuming of ductwork (if required) |
| Allowance for weekly inspection of IAQ measures (1-2 hours) |

# 2. Architectural/Structural Systems

## 2.1. Site services and preparation

### 2.1.1. Site grading and clearing

| *General Grading and Clearing Requirements* |
|---|
| Design construction plan to disturb the natural site grading and ground-cover as little as possible during construction. Present plans for site grading and clearing to design team for approval before such activities begin. |
| Make all efforts to reuse site materials removed for purposes of grading and clearing in other grading and landscaping activities. Discussion of reuse should be included in plans available for review. |

### 2.1.2. Drainage and storm water management

| *General Stormwater Management Requirements* |
|---|
| Stormwater management swales and drainage paths as per Landscaping drawings to contain all rain water on-site and away from potential run-off paths into the adjacent Grand River. |

## 2.2. Landscaping

### 2.2.1. Hardscaped areas (parking & walkways)

| *Standard Practice Hardscaping Requirements* | *LEED Hardscaping Requirements* |
|---|---|
| Standard quality asphalt parking lots and driveways | Use of white concrete in lieu of asphalt for parking lots and driveways. |
| Standard quality, low-cost paving stones for walkways and paths which require stones. | Use of light coloured stamped concrete or pre-cast paving stones for walkways |

### 2.2.2. Managed beds & trees

| *Standard Practice Planting Requirements* | *LEED Planting Requirements* |
|---|---|
| Least-cost available shrubs, trees and bedding plants located as shown on landscaping design. For this cost estimate, do not use prescribed plant types given by landscape architect. Instead, consider alternatives which are cheaper and more readily available from normal suppliers. | Native, adaptive plant species throughout (as per landscaping design requirements) and located as shown on landscaping drawings. Please indicate sources of plant species used for estimates. |

## 2.3. Building Structure

### 2.3.1. Concrete foundation and formwork

***General Formwork Requirements***

Reuse existing formwork (i.e. used in other construction projects) wherever possible.

***LEED Foundation Requirements***

Use of Supplementary Cementing Mixtures (SCMs - flyash, slag) in concrete mix design to reduce amount of Portland cement needed. Mix design to be completed by structural consultant. Impact on construction can be extra set time required for concrete curing.

- Allow an additional 2-3 days for concrete pouring

### 2.3.2. Structural wood framing & sheeting

***General Structural Requirements***

Construct sloped roof and supporting structure from pre-engineered wood trusses positioned at a maximum of 24” centre-to-centre.

Construct walls and supporting structure from 2x6” wood studs at a maximum of 16” centre-to-centre and with appropriately-thick exterior plywood sheathing for lateral strengthening (min ½”).

Since structural drawings are not provided, please assume best practice for sizing and quantities of material from similar past projects.

***Structural Materials - LEED Requirements***

Source all structural materials for construction within 400 km of project site. Please indicate those materials for which there is no cost difference to source from this distance. If the materials are traveling most of the way by boat or rail, the approved distance is 1200 km.

For at least 50% of structural beams and columns (especially those used in the main lobby, lounges, break-out space, and hospice living spaces) use salvaged sources (e.g. old timbre and railway ties).

All non-reused structural products must be Forestry Stewardship Council (FSC) certified and be Urea-formaldehyde free (UF-free).

See the material source list in the appendix (MSL-01) for some local providers of reused, FSC, and UF-free wood products. Please indicate in the costing document which sources, if any, were used for quoting purposes.

## 2.4. Building Envelope

### 2.4.1. Roofs

| ***Roof Construction – Standard Practice*** | ***Roof Construction – LEED Design*** |
|---|---|
| From inside to outside (R-30 minimum):<br>▫ 5/8” Gypsum board (painted finish discussed below)<br>▫ Vapour barrier (5 mil poly.)<br>▫ 2x10 studs at 24” oc. Cavity filled with sprayed glass fibre | From inside to outside (R-30 minimum):<br>▫ Airtight Drywall Approach in place of typical gypsum board and vapour barrier (see ADA discussion in appendix)<br>▫ 2x10 studs at 24” oc. Cavity filled with sprayed cellulosic |

| | |
|---|---|
| insulation (or cheapest spray-fill with similar R-value)<br>▫ Attic space (properly vented)<br>▫ ½" plywood sheathing<br>▫ Standard asphalt shingles with perimeter weather guard<br>▫ Prefab. metal fascia | fibre insulation<br>▫ An additional 2" minimum of cellulosic fibre sprayed on top of studs<br>▫ Attic space (properly vented)<br>▫ Steel roofing (light grey in colour)<br>▫ Prefab. metal fascia & eaves for rain-water collection (discussed further in section 3.3.5) |
| ***Roof Materials – LEED Requirements*** | |
| Source all roofing envelope materials for construction within 800 km of project site. Please indicate those materials for which there is no cost difference to source from this distance. If the materials are traveling most of the way by boat or rail, the approved distance is 2400 km. | |
| Source steel roofing, fascia and eaves that are made with at least 20% post-consumer (40% post-industrial) recycled materials. | |
| Source drywall products that are made with at least 20% post-consumer (40% post-industrial) recycled materials. | |
| See material source list in Appendix 2 (MSL-01) for some local providers of reused, recycled, FSC, and UF-free products. Please indicate in the costing document which sources, if any, were used for quoting purposes. | |
| **2.4.2. Walls** | |
| ***Wall Construction – Standard Practice*** | ***Wall Construction – LEED Design*** |
| From inside to outside (R-13 minimum):<br>▫ 5/8" Gypsum board (painted finish discussed below)<br>▫ Vapour barrier (5 mil poly.)<br>▫ 2x6 studs at 16" oc. 3.5" batt insulation in stud cavities leaving 2" air gap at interior.<br>▫ ½" plywood sheathing<br>▫ Wood Finish OR Field Stone Finish (as per architectural drawings) | From inside to outside (R-22 minimum):<br>▫ Airtight Drywall Approach in place of typical gypsum board and vapour barrier (see ADA discussion in Appendix 2)<br>▫ 2x6 studs at 16" oc. Cavity filled with 5.5" sprayed polyurethane foam.<br>▫ ½" plywood sheathing<br>▫ Wood Finish OR Field Stone Finish (as per architectural drawings) |
| ***Wall Materials – LEED Requirements*** | |
| Source all wall envelope materials for construction within 800 km of project site. Please indicate those materials for which there is no cost difference to source from this distance. If the materials are traveling most of the way by boat or rail, the approved distance is 2400 km. | |
| Source at least 50% of field stone and wood finish from local salvaged sources. | |
| Source all new wood products from Forestry Stewardship Council (FSC) certified and Urea-formaldehyde Free (UF-free) sources. | |
| Source drywall products that are made with at least 20% post-consumer (40% post-industrial) recycled materials. | |
| See material source list in Appendix 2 (MSL-01) for some local providers of reused, recycled, FSC, and UF-free products. Please indicate in the costing document which sources, if any, were used for quoting purposes. | |

### 2.4.3. Floors

| | |
|---|---|
| ***General Floor Requirements*** | |
| Insulate the slab-on-grade floors at the exterior perimeter (3 feet vertically and at least 3 feet inwards horizontally) with 2" rigid insulation (minimum R-10). | |
| Insulate the underground walls vertically at least 6 feet from grade with 2" rigid insulation (minimum R-10). | |
| ***Floor Insulation – LEED Requirements*** | |
| Insulate below the hospice wing slab-on-grade over the entire floor area with 2" rigid insulation (minimum R-10). This insulation is necessary to accommodate in-floor radiant heating (discussed in section 3.5.4 below). | |

### 2.4.4. Windows & Doors

| ***Windows – Standard Practice Design*** | ***Windows – LEED Design*** |
|---|---|
| Glazing – All<br>▫ Exterior Pane: 6 mm tempered glass with low-emissivity coating (approx. e=0.09) on inside surface.<br>▫ 13 mm air space<br>▫ Interior Pane: 6 mm tempered glass, clear.<br>▫ Edge spacer: Aluminum.<br>(U-value = 1.75 W/m²K ; Solar Heat Gain = 0.54) | Glazing #1 – Lower sections throughout (i.e. vision glass) and upper sections not marked as G2.<br>▫ Exterior Pane: 6 mm tempered glass with low-emissivity coating (approx. e=0.09) on inside surface.<br>▫ 13 mm argon-filled space<br>▫ Middle Pane; 6 mm float glass<br>▫ 13 mm argon-filled space<br>▫ Interior Pane: 6 mm tempered glass with low-emissivity coating on outside surface (approx. e=0.09).<br>▫ Edge spacer: Insulating<br>(U-value = 0.76 W/m²K ; Solar Heat Gain = 0.46)<br><br>Glazing #2 – as marked on glazing labeling drawing<br>▫ Solera S™ with clear glass (see MSL-01)<br>(U-value = 1.1 W/m²K ; Solar Heat Gain = 0.44 to 0.51) |
| Framing<br>▫ Material: Aluminum<br>▫ Thermal Break: at least 3 mm<br>▫ Operation: All windows fixed. | Framing<br>▫ Material: Fiberglass (see MSL-01)<br>▫ Operation: Operable windows marked on glazing labeling drawing. There should be at least one in every room. |
| ***Glass Doors – Standard Practice Design*** | ***Glass Doors – LEED Design*** |
| Glazing – same as above. | Glazing (U-value = 0.76 W/m²K ; Solar Heat Gain = 0.46)<br>▫ Exterior Pane: 6 mm tempered glass with low-emissivity coating (approx. e=0.09) on inside surface. |

| | |
|---|---|
| | ▫ 13 mm argon-filled space<br>▫ Interior Pane: 6 mm tempered glass, clear<br>▫ Edge spacer: Insulating |
| Framing<br>▫ Material: Aluminum<br>▫ Thermal Break: at least 3 mm | Framing<br>▫ Material: Fibreglass (if available), otherwise aluminum.<br>▫ Thermal Break (for aluminum): at least 9 mm |

## 2.5. Interior Finishes

### 2.5.1. Wall Coverings

| |
|---|
| ***General Wall Finish*** |
| Finish all walls with latex paint (colour to be specified). |
| ***Paint – LEED Requirements*** |
| Use only low (or zero) Volatile Organic Compound (VOC) water-based premium latex paints. |
| Coordinate paint types and application process with requirements for the Airtight Drywall Approach. |
| See MSL-01 for acceptable paint manufacturers. Please indicate in the costing document which sources, if any, were used for quoting purposes. |

### 2.5.2. Ceiling Finish

| |
|---|
| ***General Ceiling Finish*** |
| Finish ceilings in hospice rooms, hospice living areas, main lobby, central lounges, central break-out space, and basement meeting rooms with latex paint or decorative stucco finish (to be determined). |
| Finish ceilings in corridors, catering kitchen, service/storage areas and bathrooms with dropped ceiling tiles to accommodate access to mechanical equipment and ductwork stored above these ceilings. |
| ***Ceiling Materials - LEED Requirements*** |
| Use only low (or zero) Volatile Organic Compound (VOC) water-based premium latex paints. |
| Use of acoustic tile with at least 50% recycled content. |
| Coordinate installation of suspended ceiling with requirements for the Airtight Drywall Approach. |
| Coordinate paint types and application process with requirements for the Airtight Drywall Approach. |
| See MSL-01 for acceptable paint, drywall and tile manufacturers. Please indicate in the costing document which sources, if any, were used for quoting purposes. |

| 2.5.3. Flooring | |
|---|---|
| ***General Requirements*** | |
| Finish floors in Hospice quiet room and all retreat flooring (except washrooms, corridors and service/storage areas) with carpeting. | |
| Finish floors in south-west Hospice living area in hard wood or bamboo. | |
| Finish all other Hospice rooms, corridors, washrooms and service/storage areas with resilient flooring products as specified below. | |
| ***Resilient Flooring – Standard Practice*** | ***Resilient Flooring – LEED Design*** |
| Use the most cost-effective vinyl flooring product suitable for use in health-care applications. | Use of resilient flooring with rapidly renewable content. Specifically, a cost for using linoleum products is desired. |
| ***Flooring – LEED Requirements*** | |
| Use of environmentally friendly wood flooring including either reclaimed or FSC-certified and UF-free products. | |
| Use of CRI green label carpet with high recycled content. | |
| Install a high-quality permanent entry grates in the main vestibule and for the first 6 feet around the main entrance. This track-in system will have a drain to the basement mechanical room (directly below) to simplify cleaning in the winter. | |
| See MSL-01 for acceptable flooring manufacturers. Please indicate in the costing document which sources, if any, were used for quoting purposes. | |

# 3. Mechanical Systems

## 3.1. General Mechanical Requirements

| |
|---|
| ***General Mechanical Requirements*** |
| Labeling / Identification of equipment, piping and valves. |
| Firestop sealant to ULC approved methods. |
| Isolated and acoustically treated equipment to minimize noise levels throughout. Special care should be taken for ductwork and systems near the guest rooms and the mediation room. |
| Mechanical services, combustible or otherwise, penetrating rated separations to be sealed by fire stop systems (donut, caulking, etc.). Voids around services penetrating rated or non-rated/0-rated fire separations sealed using fire-rated caulking compatible with the remaining fire stop systems in the building |
| Testing, Adjusting and Balancing (TAB) of all air and water heat/cool systems required |
| ***General LEED Requirements*** |
| Use only low-VOC paints, coatings, adhesives and sealants for all mechanical applications. |
| 3-phase motors shall be “premium” efficiency or “best-in-class” efficiency. |

## 3.2. Insulation & Duct Sealing

| |
|---|
| ***General Requirements (as required by OBC through Ch. 12 MNECB path)*** |
| Duct sealing to SMACNA requirements generally and specifically:<br>▫ Minimum A2 for air leakage |
| Equipment, piping and ductwork insulation provided according to the requirements of Model National Energy Code (MNECB) including:<br>▫ Horizontal storm drainage and roof drain bodies<br>▫ Refrigeration/cooling equipment condensate drain piping<br>▫ Heating water piping - supply and return, including run-outs.<br>▫ Hot, cold, tempered, re-circulating domestic and cistern water piping, including run-outs.<br>▫ Supply, return, fresh air and exhaust ductwork<br>▫ Combustion air and outdoor intake ductwork<br>▫ Hot and cold equipment including boiler vents, water pumps, valves, strainers, etc. |

## 3.3. Plumbing & Drainage

### 3.3.1. Natural Gas

| | |
|---|---|
| ***General Requirements*** | |
| Natural gas to serve kitchen equipment, laundry room dryer, and domestic water heaters. | |
| Gas utility to run new service to building complete with suitably-located meter at the exterior wall near the basement service entrance. Gas piping within building by mechanical contractor. | |
| ***HVAC Gas Piping - Standard Practice*** | ***HVAC Gas Piping – LEED Design*** |
| Gas connections to all HVAC equipment as discussed below. Connections required to each hospice room, in mechanical attic above hospice living space and in basement mechanical room. | Gas connection for HVAC only to boiler serving heating coils in the building air handling units and providing in-floor heating throughout in the hospice area floors. |
| Preliminary estimated gas load = 0.29 $m^3$/min + generator | Preliminary estimated gas load = 0.07 $m^3$/min + generator |

### 3.3.2. Domestic Water Distribution

| | |
|---|---|
| ***General Requirements*** | |
| Well driller subcontractor to mechanical contractor to drill well, install pump and run 40mm (1-1/2”) water main from well to basement mechanical space for treatment and distribution throughout the building. Well and pump location to be determined in detailed design. | |
| Domestic water meter assembly and backflow preventer for the building, coordinated with the well installation. Backflow preventers to suit application and the level of hazard to be provided throughout. | |
| Softening and treatment requirements if necessary based on test well results or based on results shared from adjacent farm. | |
| Water piping to be sized according to design standards for adequate water pressure. | |
| Hot water re-circulating piping and pump complete with integral thermostat and time control, maintains adequate delivery of water at remote fixtures. | |
| ***Water Demand – Standard Practice*** | ***Water Demand – LEED Design*** |
| Preliminary estimate of consumption:<br>▫ Potable Uses: 1100 litres/day; 291 usgal/day<br>▫ Irrigation: 8900 litres/day; 2351 usgal/day<br><br>Maximum probable flow: can calculate if required | Preliminary estimate of consumption:<br>▫ Potable Uses: 200 litres/day; 53 usgal/day<br>▫ Non-potable uses: 400 litres/day; 106 usgal/day<br>▫ Irrigation / Hand Watering: 2100 litres/day; 555 usgal/day<br><br>Maximum probable flow: can calculate if required |
| ***Domestic Hot Water – Standard Practice*** | ***Domestic Hot Water – LEED Design*** |
| DHW supplied by standard efficiency gas fired tank type water | DHW supplied by high efficiency gas fired tank type or |

| | |
|---|---|
| heater located in basement.<br>Minimum efficiency 80%<br>Estimated Capacity: 6.2 kW (21 MBH) | instantaneous water heater located in basement.<br>Minimum efficiency: 95%<br>Estimated Capacity: 2.4 kW (8 MBH) |
| ***LEED Requirements – Cistern Distribution*** | |
| Post-treated well water supplied to cistern for make-up water. See discussion of general cistern requirements below. | |
| Trap seal primers supplied off cistern water mains for sealing of sanitary odour. | |
| ***LEED Requirements – Laundry & Dish Wash Connection*** | |
| Laundry and Hospice kitchen to have separate supplies of cistern water and potable water for use in laundry machines and dishwasher, respectively. | |
| A separate instantaneous or small tank type high-efficiency gas fired water heater for separate connection to cistern water for laundry washing machine and kitchen dish washer connection.<br>Estimated Capacity of Laundry Water Heater: 1 kW | |

### 3.3.3. Sanitary Drainage System

| |
|---|
| ***General Requirements*** |
| Approximate # fixture units: 50 (including floor drains). Maximum probable drainage rate: *to be determined* |
| Mechanical contractor responsible for sanitary drainage system within building. 100mm (4”) building drain at least 1.0% slope extended and terminated at a suitable point 3’-4” (1.0m) from the building perimeter for continuation to on-site septic system. Likely septic location is west of the building. |
| Sanitary drain, waste and vent systems to fixtures, floor, funnel and hub drains and equipment, and extended to building sanitary services. |
| Floor drains provided in service areas, shower areas, mechanical rooms, storage areas, washrooms, food preparation, serving areas and elevator pit. Floor drain types to suit floor finishes and application and as recommended by manufacturer. Funnel floor drains installed to serve equipment drains, condensate drains and relief valve drains. Cleanouts to suit floor finishes and application, as recommended by manufacturer. Location to OBC requirements and to permit easy access while minimizing encroachment into frequently used areas or risk of tripping. |
| *Site septic design not currently available. Costing based on standard practice and from similar projects in the area.* |

### 3.3.4. Storm Drainage System

| |
|---|
| ***General Requirements*** |
| 150mm (6”) [to be confirmed] storm building drain at 1% slope to be provided for the building and diverted to general stormwater control features (e.g. swales and drainage ditches west of building). See landscaping drawings for current drainage plan. |
| Weeping tile around the building perimeter and at elevator sumps provided to control ground water/perched water conditions. Weeping tile and associated cast-in-place sumps, where required, by general trades. |

| *Storm Water – Standard Practice* | *Storm Water – LEED Design* |
|---|---|
| Strom water from roof, where possible, to run directly onto adjacent gardens and sloped hardscaping. Where necessary to avoid water accumulation, use residential grade eaves troughs and downspouts. | All roofs drained through eaves troughs to downspouts and connected to storm drainage as per ME-3. Downspouts by general trades.<br>Approximate # of roof downspouts: 6. |
| All storm water directed towards on-site drainage. | Except as marked in schematic drainage plan, all storm water diverted through the rainwater cistern and extended and terminated at suitable point(s), 3'-4" (1.0m) from the cistern for continuation to on-site drainage. |

### 3.3.5. Rainwater Collection Cisterns

| *LEED Requirements – Cistern* |
|---|
| Except as marked ME-3, all rainwater from all the building roofs to be collected in a cast-in-place rainwater cistern which also serves as the storage tank for sprinkler or fire protection water. |
| Approx. 110000 litres (29060 usgal) in useable capacity, cistern supplies water, through the cistern distribution piping in the building, to all water closets, hospice wing washing machines, exterior wall hydrants (approximately 5), trap primers and the boiler water make-up systems. All piping and hose bibs labeled 'non potable water – do not drink'. |
| The building system shall be provided with a sediment chamber, inlet strainer, duplex pumps with automatic controls, sand filter, automatic well water make-up to ensure year round operation, backflow protection and flow meter. |
| A back-flow prevented overflow pipe and pumping system will empty into site drainage after passing over a waterfall feature at the exterior of the building (as per landscaping drawings). |

### 3.3.6. Plumbing Fixtures

| *General Requirements* |
|---|
| Plumbing fixtures, i.e. lavatories, sinks, toilets, drains, etc to be of good quality, cost competitive commercial grade units, specified based on user demand and previous product experience. Specifications to be determined at detailed design stage. |
| Fixtures equipped with supply valves, ceramic cartridge faucets, traps, tailpieces, supports, connections, escutcheons, hangers, carriers, seats, etc. Exposed piping, valves and traps to be chrome plated. Colour of fixtures, except stainless steel sinks, or similar, to be white. |
| Public lavatory faucets shall be fitted with a metering system capable of automatic water shut-off when lav is not in use. |
| Mop sinks shall be stain resistant, complete with accessory mop hanger, splash wall guards and wall faucet with integral stops, vacuum breaker, wall brace, pail hook and 900mm lg hose. |
| Emergency eye washes to be provided in the mechanical rooms in accordance with Occupational Health and Safety Act. Emergency showers will not be provided. |
| Non-freeze tamper-proof exterior hose bibs to be evenly spaced around the building including an extra hose bib at base of north-west |

| | |
|---|---|
| ground-level terrace for use by gardeners. | |
| Drinking fountains shall be wall mounted barrier-free type c/w push button/pad operators and stainless steel surfaces. No refrigeration is proposed. Have one drinking fountain outside main floor and basement washrooms in retreat side of building (total of 2). | |
| ***Faucet & Showerheads – Standard Practice*** | ***Faucet & Showerheads – LEED Design*** |
| Lavatory and counter sink faucets to be maximum 9.5 L/min flow.<br>Shower heads also to be maximum 9.5 L/min flow. | Lavatory and counter sink faucets to be fitted with low flow (1.9 L/min at 551 kPa) aerators.<br>Shower heads to be fitted with low flow (6.0 L/min at 551 kPa) flow control devices.<br>See plumbing cutsheets for faucet and showerhead options. |
| ***Toilets – Standard Practice*** | ***Toilets – LEED Design*** |
| Standard, best-cost toilets proposed throughout using floor mounted water closets complete with press assist tanks. Toilets to meet or exceed 500g (solids removal) MaP performance.<br>Standard, best-cost urinals in retreat men’s washroom. | Dual flush (2.5L/4L) toilets proposed throughout using floor mounted water closets complete with press assist tanks. Toilets to meet or exceed 500g (solids removal) MaP performance.<br>Low-flow urinals proposed in retreat men’s washroom.<br>See plumbing cutsheets for dual flush toilet and urinal options. |

### 3.3.7. Plumbing Systems

| |
|---|
| ***General Requirements*** |
| Fixtures, floor, funnel and hub drains, fixture trim, carriers, backwater valves, floor, line and stack cleanouts, etc. and including miscellaneous fitments, components and accessories provided to complete the entire plumbing installation. |
| Cold, and hot domestic water system to serve fixtures and equipment, using thermostatic mixing valves as necessary. |
| Shut-off valves to be provided on water piping to each group of fixtures. Each washroom considered as a group and valved as a unit. Shut-off valves also provided under each fixture. |
| Provide shut-off valve on connection to each tank or item of equipment on system side of union or compression fittings. |
| Heat traps provided in hot and cold water feeds to tank type water heaters. |
| Thermostatically controlled high/low flow mix station (71°C to 49°C) provided to maintain adequate delivery of hot water at the remote fixtures. Barrier-free fixtures to be further protected with anti-scald devices for hot water delivery at 42°C. |

## 3.4. Fire Protection

| |
|---|
| ***General Requirements*** |
| Wet pipe sprinkler systems provided for the entire building. Sprinkler design based on performance type specification in compliance with NFPA13. Individual sprinkler floor / area/ zone monitoring to code. |
| Approximate 3-hour sprinkler water or hydrant water volume: X,XXX L (X,XXX usgal) |
| Portable fire extinguishers in compliance with NFPA10 to be sized and located to code and fire department requirements. Extinguisher cabinets to be provided for public spaces. |

| ***Sprinkler Water Storage – Standard Practice*** | ***Sprinkler Water Storage – LEED Design*** |
|---|---|
| A sprinkler water tank to be installed in mechanical basement storage area. | Sprinkler water requirements to be added with cistern water capacity and both uses will share a single multi-chamber cast-in-place tank (as per schematic plumbing design). |

## 3.5. Heating, Ventilation & Air Conditioning

### 3.5.1. General

***General Requirements***

Mechanical systems designed, installed and operated not to exceed the following noise levels:

- Guest rooms, Meditation Room, Treatment Rooms, Quiet Room: NC 20
- Office spaces, Board Room, Meeting Rooms, Nurse Station: NC 30
- Utility spaces, Storage: NC 45
- All other areas: NC 35

Filtration to be specified for all building air handling systems as follows:

- Re-circulating air systems: MERV 11
- Outdoor fresh air systems (to re-circulation systems): MERV 11

| ***Duct Liners – Standard Practice*** | ***Duct Liners – LEED Design*** |
|---|---|
| Accoustic duct insulation as necessary to save cost in control of duct noise. Flame spread rating of liners shall not exceed 25 and smoke development classification not to exceed 50 per code requirements. | The use of acoustic duct insulation (interior duct liners) shall be minimized. Fiberglass duct lilner to be GreenGard certified. In lieu of fibreglass, a cotton based post-industrial recycled liner, covered with IAQ surface facing, providing mould, mildew, fungi and pest resistance, to be specified If available,. Liner shall be VOC, formaldehyde and phenol free, shall meet ASTM G21 and G22 fungi and bacterial resistance requirements and ASTM C1104 moisture absorption standards. Thermal resistance shall be a minimum R-0.7 m²K/W at 24°C. Flame spread rating shall not exceed 25 and smoke development classification not to exceed 50 per code requirements. |

***LEED Requirements – Duct Sizing***

Ductwork to be sized at a friction rate of 0.67 Pa/m for supply/make-up and 0.36 Pa/m for return/exhaust to reduce fan power. Similarly, duct bends or elbows to be made with a radius of not less than 1.5 times the width of the duct. Where this is not possible, turning vanes shall be used. Where branch ducts connect to main ducts, full radiused fittings or minimum 150mm lg. 45° entry to be provided. Branch take-offs to be 45° conical laterals, conical spin-in collars or 45° square to round fittings. Flexible duct to grilles and diffusers kept at a maximum length of 1.2 m.

| ***Description of Mechanical Systems – Standard Practice*** | ***Description of Mechanical Systems – LEED Design*** |
|---|---|
| Heating-only Systems: Vestibules/Entryway, Hospice Attic Utility Area and Basement Storage and Utility Areas: Heating only – no cooling:<br>▫ Heating load, estimate: 7.5 kW; 25,610 BTU/hr<br>▫ Design Temperatures: Indoor 18°C (65°F)<br>▫ Space heating by ceiling-mounted gas-fired unit heaters or electric wall-mounted panel heaters as necessary. | Heating-only Systems: Vestibules/Entryway, Hospice Attic Utility Area and Basement Storage and Utility Areas: Heating only – no cooling:<br>▫ Heating load, estimate: 7.5 kW; 25,610 BTU/hr<br>▫ Design Temperatures: Indoor 18°C (65°F)<br>▫ Space heating by wall-fin radiators, convectors, unit heaters and/or radiant panel heaters. To be determined during detailed design. Heating devices connected to condensing boiler system. |
| VVT or Single-Zone Packaged Systems: (1) Ground Floor Meeting and basement Amenities (including catering prep.), (2) Main Lobby, Lounges, Offices, Library and Breakout Space; (3) Meditation Room, Boardroom, Treatment Rooms; (4) Hospice Kitchen and Living Space.<br>• Cooling load, estimate: 76.7 kW; 15.0 Tons sensible<br>• Heating load, estimate: 84.6 kW; 288,900 Btu/hr<br>• Design Temperatures: Indoor 22 to 24°C (72 to 75°F) (operated normally at 20 to 25°C)<br>• Design RH : indoor up to 60%<br>• Space heating and cooling with packaged Direct-Expansion (DX) units with gas heating sections. Units 1 and 2 located in service basement and serving retreat wing using VVT control. Unit 3 located in attic mechanical space over hospice kitchen/living area and serving only those areas. | GSHP Systems: (1) Ground Floor Meeting and basement Amenities (including catering prep.); (2a/b) Main Lobby, Lounges, Offices, Library and Breakout Space; (3) Meditation Room; (4) Boardroom; (5) Treatment Rooms; (6) Hospice Kitchen and Living Space.<br>▫ Cooling load, estimate: 48.1 kW; 10.7 Tons sensible<br>▫ Heating load, estimate: 29.1 kW; 99,390 Btu/hr<br>▫ Design Temperatures: Indoor 22 to 24°C (72 to 75°F) (operated normally at 20 to 25°C)<br>▫ Design RH : indoor up to 60%<br>▫ Space heating and cooling with water-to-air GSHPs. Units located as per schematic HVAC mechanical drawings.<br>▫ All heat pumps connected to common ground heat exchanger. ***NOTE: Please also include in quote the option for all HPs on separate residential-style ground heat exchangers.*** |
| Packaged Terminal A/C (PTAC) Units: Guest Rooms; Volunteer/Staff Areas; Quiet Room<br>▫ Cooling load, estimate: 15.3 kW; 4.4 Tons sensible (10 units)<br>▫ Heating load, estimate: 51.2 kW; 174,850 Btu/hr<br>▫ Design Temperatures: Indoor 22 to 24°C (72 to 75°F)<br>▫ Design RH : indoor 30 to 60%<br>▫ Space heating using gas-fired sections in PTAC units.<br>▫ Space cooling using PTAC DX coil.<br>▫ PTAC units mounted at exterior wall of each room and connected to outdoor condensers situated next to each patio | Ductless Split Air Conditioners (DSAC) & In-floor Heating: Guest Rooms; Volunteer/Staff Areas; Quiet Room<br>▫ Cooling load, estimate: 12.4 kW; 3.1 Tons sensible (10 units)<br>▫ Heating load, estimate: 9.5 kW; 32,450 Btu/hr<br>▫ Design Temperatures: Indoor 22 to 24°C (72 to 75°F)<br>▫ Design RH : indoor 30 to 60%<br>▫ Space heating using in-floor radiant tubes connected to condensing boiler system.<br>▫ Space cooling using one fan unit for each room with 2 common condensers located in attic space above hospice |

| | |
|---|---|
| exit. | living space. Mount DSAC units high on washroom walls (as per schematic drawings. |

### 3.5.2. Plant (Energy Source/Sink) Systems

***LEED Requirements – Condensing Gas Boilers***

Two high efficiency condensing gas boilers will provide heating water for radiant floors, heating coils and convectors.
Approximate Size (per boiler): 10.1 kW; 34,470 Btu/hr

- Manufacturers: Viessmann, Buderus, P-K, Lochinvar

**Note: Please include option in quote for only one boiler to be installed instead of two.**

***LEED Requirements – Ground Heat Exchanger***

Ground heat exchanger to be a linear or slinky horizontal loop installed in an appropriate location to the north and west of the building footprint. Ground loop to connect to internal heat pump loop through a heat exchanger in basement service/mechanical room.
Approximate System Capacity: 41.1 kW; 12 tons
Approximate Loop Length: 3300 m;  10850 ft

### 3.5.3. Ventilation Systems

***General  Requirements***

Exhaust fan with thermostat shall be provided for Elevator Machine Room.

Fresh air to be provided for all spaces (meeting ASHRAE 62-2004 and building code requirements).

Residential-type Kitchen exhaust hood for hospice kitchen.

Cooking appliances in catering kitchen served by grease hood(s) to NFPA96 shall comply with fire codes. Hood exhaust fan(s) to be variable speed based on user demand, and interlocked to the variable volume fresh air serving the space [to be confirmed].

| ***Ventilation Systems – Standard Practice*** | ***Ventilation Systems – LEED Design*** |
|---|---|
| Retreat System:<br>▫ Outdoor air ducted from outdoors directly to VVT systems serving retreat area.<br>▫ Separate exhaust-only systems will exhaust all washrooms and storage/utility spaces as necessary. | Retreat System:<br>▫ 100% outdoor air to be provided by Energy-Recovery ventilator ducted to the supply air duct of each GSHP. Tempered fresh air will be continuously available at each occupied space without the need to operate the GSHP, thus minimizing energy use.<br>▫ ERV will exhaust each washroom and utility room.<br>▫ Washroom exhaust and general exhaust to be separately ducted and to join close to the ERVs.<br>▫ HP-1,2a,2b,3,4, and 5 connected to “ERV-Retreat”.<br>▫ Air quality (CO2) sensors or occupancy (motion) sensors will control ventilation based on demand. They will operate air |

<table>
<tr><td></td><td>dampers (see HP zone control description below) and to control ERV speed.<br>Approximate ERV Size:<br>ERV-Retreat => 650 l/s</td></tr>
<tr><td><u>Hospice System</u>:<br>▫ 100% outdoor air to be provided by a separate Dedicated Outdoor Air (DOA) unit and distributed to room through ductwork.<br>▫ Exhaust for DOA from washrooms, laundry, kitchen (when hood not running), and janitor/service room.<br>▫ DOA-1 to supply all hospice areas (including living space).<br>▫ Laundry dryer to be exhausted to outdoors at a suitable location. Make-up air for dryer from DOA-1 by turning off laundry-room exhaust when dryer is running.<br><br>Approximate DOA Size:<br>DOA-1 => 300 l/s;</td><td><u>Hospice System</u>:<br>▫ 100% outdoor air to be provided by a separate ERV and distributed at floor level using displacement ventilation flow rates. Care must be taken in placing supply grills away from possible guest bed locations to avoid potential cool draft.<br>▫ 100% exhaust air from washrooms, laundry, kitchen (when hood not running), and janitor/service room routed through the ERV for energy recovery/ air tempering.<br>▫ “ERV-Hospice” to supply all hospice areas.<br>▫ ERV also connected to operable window sensor in each guest room to turn off room supply when windows are open. Exhaust remains on to bring fresh air into space.<br>▫ Use of “room unoccupied” switch to turn off ventilation supply and exhaust, turn off lighting and set back heating when room is unoccupied.<br>▫ Laundry dryer to be exhausted to outdoors at a suitable location. Make-up air for dryer from ERV-4 by turning off laundry-room exhaust when dryer is running.<br>Approximate ERV Size:<br>ERV-Hospice => 270 l/s;</td></tr>
<tr><td colspan="2">LEED Requirements – ERV Units</td></tr>
<tr><td colspan="2">Make-up air for washrooms, laundry and mechanical/service spaces shall be transferred from adjacent areas via door undercuts, door grilles or transfer grilles at ceiling.</td></tr>
<tr><td colspan="2">Packaged energy recovery ventilation units will provide both outside air and exhaust air, independently of the heating and cooling systems.</td></tr>
<tr><td colspan="2">Efficiency to be > 75%, sensible and latent energy (heat and moisture) recovery. A total energy wheel exchanger to be used to maximize energy efficiency and allow free cooling</td></tr>
<tr><td colspan="2">Units should be capable of variable-speed flow relative to changes in duct pressure, or based on signal from zone-level controls.</td></tr>
<tr><td colspan="2">Units equipped with:<br>▫ Variable Frequency Drive (VFD) supply and exhaust fans<br>▫ Connection to Air quality (CO2) sensors or occupancy sensors for demand control ventilation</td></tr>
</table>

| |
|---|
| Frost protection on units through pre-heat of exhaust air by separate hot water coil (as per mechanical schematics) |
| Manufacturers: Greenheck, Venmar, vane (example Greenheck product provided) |
| **3.5.4. HVAC Delivery Systems** |
| ***LEED Requirements – Ground-Coupled Heat Pumps*** |
| All heat-pumps connected to ground-coupled water loop circuit providing both ‘sink’ and ‘source’ of energy. Water is circulated in an insulated 2-pipe loop inside the building. |
| Simultaneous heating / cooling is available on an individual basis throughout the year, providing reliable operation (failure of one unit does not affect others – minimum impact on patients or staff). |
| Zone-control strategy with variable geometry VAV diffusers. Requires variable-speed fans or bypass damper to control duct pressure. |
| Manufacturers: Florida Heat Pump, Climatemaster, WaterFurnace |
| ***LEED Requirements – Ductless Split Air-conditioning (DSAC)*** |
| Air–cooled condensing units are mounted on the roof or in attic space and are connected to multiple indoor fan units. |
| Indoor units to have individual thermostat control |
| Efficiency to be >15 SEER |
| Manufacturers: Daikin, Sanyo, Fujitsu, Mitsubishi, LG |
| **3.6. Building Automation / Monitoring** |
| ***LEED Requirements – Energy Management System (EMS) & Optional Building Automation System*** |
| A separate energy management system for monitoring building energy and water use will be installed to conform with best-practice measurement and verification requirements.<br>Possible consultants: Carma Industries Inc. (http://www.carmaindustries.com/) |
| A Building Automation System (BAS) for control and monitoring of mechanical equipment and systems, designed to reduce building energy consumption, maintain occupant comfort and provide diagnostic O&M data from major equipment may be required. |
| Remote-user access to EMS and BAS via internet to be provided if required. |
| **3.7. Backup Generator** |
| ***General Requirements*** |
| Electrical Generator to be an indoor gas-fired unit interconnected with mechanical room emergency ventilation system.<br>▫ Chimney shaft with appropriate rating shall run from generator to appropriately placed exhaust grille. |

# 4. Electrical Systems

## 4.1. Electrical Service

### 4.1.1. General

| | |
|---|---|
| ***General Requirements - Service*** | |
| Electrical service as per electrical design brief, March 3, 2008. | |
| ***General LEED Requirements*** | |
| Use only low-VOC paints, coatings, adhesives and sealants for all mechanical applications. | |

### 4.1.2. Backup generator

| | |
|---|---|
| ***General Requirements*** | |
| A backup generator will be used to provide low rate ventilation, building heat, and backup lighting in the hospice wing. The generator will be located in the ground floor service room as discussed above in the mechanical section. | |

## 4.2. Lighting and control systems

### 4.2.1. Interior Lighting

| | |
|---|---|
| ***General Requirements*** | |
| Fixture placement as per electrical design brief descriptions. Fixture types to be similar across standard practice and LEED designs, but bulb and ballast types to be different as below. | |
| All interior building lighting will be 120V. | |
| ***General Performance – Standard Practice*** | ***General Performance – LEED Design*** |
| Use lighting options which reduce cost but meet performance requirements as below. | Indoor lighting will be exclusively provided by fluorescent fixtures. |
| Lighting power densities (LPD) will be designed to achieve a target equal to the OBC requirements (i.e. ASHRAE 90.1-2004 levels) while meeting IESNA recommended light levels. | Lighting power densities (LPD) will be designed to achieve a target of 25% less than the OBC requirements (i.e. 25% below ASHRAE 90.1-2004 levels) while meeting IESNA recommended light levels. |
| ***Lighting Technology – Standard Practice*** | ***Lighting Technology – LEED Design*** |
| Where compact fluorescent fixtures are required, consider lower-cost incandescent fixtures instead. Please list replacement fixtures | Use premium quality compact fluorescent bulbs and ballasts for all such fixtures. |

| | |
|---|---|
| considered. | |
| Use standard quality T8 linear bulbs and electronic ballast combinations. Please list all bulb and ballast combinations used. | Use premium quality T8 linear bulbs and electronic ballast combinations as per electrical design brief. |

### 4.2.2. Exterior - General

***General Requirements***

Outdoor lighting will be accomplished with both pole and building-mounted fixtures. The light source for outdoor fixtures will be metal halide, which produces white light.

Outdoor lighting will be controlled by a time controller and input from a photocell. All of the exterior lights will be turned on when the photocell senses a pre-set light level.

***LEED Requirements – Cut-off***

All exterior fixtures will be IESNA-rated full cutoff fixtures with no up-light components to reduce glare and light trespass to the surrounding areas. Parking lot lighting will conform to the LEED requirements for lighting levels and uniformity. See lighting cutsheets for example exterior fixture.

## 4.3. Communication Systems

### 4.3.1. Telephone and Data

***General Requirements***

A conduit pathway from telephone and data locations will be brought back to the data and telephone backboard. Outlet jacks will be placed in all occupant suites, care rooms, offices, meeting rooms, and kitchen. Locations will be proposed by Enermodal and reviewed and adjusted by the client. Telephone and data system design and installation by others.

### 4.3.2. Cable Television

***General Requirements***

A conduit pathway for CATV cabling will be provided from all suite and patient care areas back to a distribution backboard in the main electrical room. Locations will be proposed by Enermodal and reviewed and adjusted by the client. CATV design and installation by others.

## 4.4. Life Safety Systems

### 4.4.1. Emergency Exit Lighting

***General Requirements***

Areas to have emergency lighting are corridors, stairwells, electrical and mechanical rooms, infirmary areas, and others as directed by the owner.

All required building exits will be marked with LED exit signs. Emergency lighting will be provided by fixtures with battery packs installed. These fixtures will also be connected to the backup generator for extended outage use.

### 4.4.2. Fire Alarm System

***General Requirements***

The building and its occupants will be protected by a multi-zone, fully programmable, addressable, single stage fire alarm system. Remote annunciator will be placed at the main entrance to the building and a zone display mounted at the nurses station. The fire alarm panel shall be monitored by the building security system. The fire alarm panel will monitor the flow and pressure switches for the building sprinkler system.

Smoke detectors will be installed in all hospice rooms, corridors and stairwells. Smoke detectors located in hospice rooms will be equipped with relay bases and will be connected to visual signals in the corridors via the nurse call system to identify location of initiation by staff as required by OBC 3.2.4.20.

Heat detectors in all storage/utility/equipment rooms.

Audio/visual horn-strobes will be installed in all sleeping room corridors and as required by the OBC. Sound pressure levels in sleeping rooms of residential occupancy shall be not less than 75dBA.

### 4.4.3. Nurse Call

***General Requirements***

A dedicated nurse call system will be specified and installed in all hospice guest rooms. These signals will alert the nurse staff of a need or emergency of a hospice guest. There will be a nurse call button located next to each bed and inside each personal washroom. The bed station will have 2-way voice capabilities while the washroom station will be an emergency pull cord.

## 4.5. Security and Accessibility

### 4.5.1. Security Rough-in

***General Requirements***

The building security system (designed and installed by others) shall monitor outputs from the fire alarm panel and communicate alarm status to the local fire department in conformance with OBC 3.2.4.8.

Conduit rough-in for security devices such as door contacts, motion sensors, and cameras can be accommodated if security coordination by the client’s designated contractor is completed in advance of the tendering process.

| 4.5.2. Barrier-Free |
|---|
| ***General Requirements*** |
| Barrier-free entrances will be installed at the main entrance (North-east, main level) and at the service entrance (North, basement). Each door will be provided power for the connection of an operator and pushbuttons by others. |

Note: The appendices of this document have been removed from this formal printed version of the thesis. Please see the augmented version at:

http://sites.google.com/sites/keepbuildingsustainability.

## OUTCOME #5

### AOR Project Difference List Costing Summary

| Category | Feature | Baseline Design | LEED Concept Design | Basline Cost ($) | Incremental Cost ($) | % Cost Increased | % of Total Incremental | Related LEED Category |
|---|---|---|---|---|---|---|---|---|
| General Contract | Consultant Fees | Van Del Fees | EEL Design & Construction Support Fees | $ 58,500 | $ 28,800 | 49% | 4% | I.D. |
| | Site Setup & General Conditions | Common basic site requirements. | | $ 156,100 | $ - | 0% | 0% | N/A |
| | Site Services & Excavation | Allowance for services | | $ 193,300 | $ - | 0% | 0% | N/A |
| | Site Supervision | Standard Practice | Additional supervision time to ensure LEED site requirements achieved. | $ 111,300 | $ 32,000 | 29% | 4% | SS, MR, IEQ |
| | Waste Management | Standard Practice | Weekly clean-up and disporal requirements are increased. Additional sorting of waste required. | $ 41,100 | $ 31,300 | 76% | 4% | MR |
| | **TOTAL** | | | **$ 560,300** | **$ 92,100** | **16%** | **11%** | |
| | | | | **17%** | | | | |
| Structural | Consulatant Fees | No structural services yet contracted. | | $ 15,000 | | | | N/A |
| | Concrete Foundations & Floors | Standard Mixture - assumed 9% Flyash | High-SCM Mixture: 35% Flyash | $ 188,300 | $ - | 0% | 0% | MR |
| | Framing | 2x6 stud walls (16" o.c.) with plywood support<br>Wood joist floors with plywood finish<br>Metal beams and columns (as necessary)<br>Engineered roof trusses (24" o.c.) | All studs, joists, trusses as FSC wood<br>Reused timbre beams where possible | $ 200,600 | $ 52,100 | 26% | 6% | MR |
| | **TOTAL** | | | **$ 403,900** | **$ 52,100** | **13%** | **6%** | |
| | | | | **12%** | | | | |

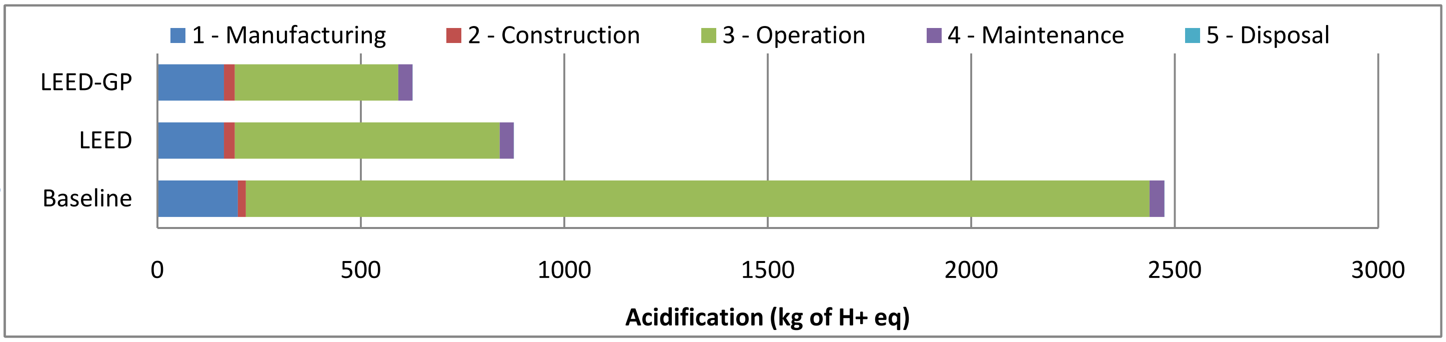
| Category | Feature | Baseline Design | LEED Concept Design | Basline Cost ($) | Incremental Cost ($) | % Cost Increased | % of Total Incremental | Related LEED Category |
|---|---|---|---|---|---|---|---|---|
| Architectural | Consultant Fees | RJC Dyck and Associates Fees | | $ 150,000 | | | | N/A |
| | Building Envelope (heat, moisture, fire, sound) | Roof - 10" fibreglass, poly, gypsum (R-30)<br>Walls - 3.5" fibreglass, poly, gypsum (R-15)<br>Floors - 2" XPS @ exterior for 3 ft. (R-10) | Roof - 12" cellulose, Air-tight Drywall Approach (R-30)<br>Walls - 2" polyurethane, 3.5" cellulose, ADA (R-24)<br>Floors - 2" XPS over full slab & basement walls (R-10) | $ 162,200 | $ 44,900 | 28% | 5% | EA, MR |
| | Exterior Finishes (incl. siding & soffits) | Roofing - Typical built-up asphault shingles<br>Walls (upper) - Tung & groove Cedar<br>Walls (lower) - "Cultured Stone" finish | Roofing - Light-colour steel roofing<br>Walls (upper) - Tung & groove cedar (same)<br>Walls (lower) - Local field stone masonry wall | $ 200,000 | $ 70,200 | 35% | 9% | SS, MR |
| | Millwork & Woodwork | As per drawings | In FSC wood | $ 70,800 | $ 23,600 | 33% | 3% | MR |
| | Windows | Glazing: standard double with low-e coating<br>Frames: Vinyl (residential style) | Glazing: triple, two low-e coats, argon fill<br>Daylighting glass: Okalux+ light-diffusing glass<br>Frames: Fibreglass | $ 62,500 | $ 79,100 | 127% | 10% | EA |
| | Doors & Aluminum Entrances | Hollow metal exterior doors, wood interior doors, folding door & allowances. | | $ 72,400 | $ - | 0% | 0% | N/A |
| | Flooring | Retreat - standard commercial carpetting<br>Hospice (general) - vinyl composite tile<br>West Hospice Living - hardwood flooring | Retreat - interface carpetting tiles<br>Hospice (general) - marmoleum (linoleum tile)<br>West Hospice Living - bamboo flooring | $ 81,000 | $ 18,600 | 23% | 2% | MR, IEQ |
| | Wall Painting & covering | Standard practice latex paints | Low-VOC paints<br>Air-tight Drywall Approach | $ 46,700 | $ 18,300 | 39% | 2% | IEQ |
| | Misc. Finishes | Hardware, washroom finishes, elevator. | | $ 75,000 | $ - | 0% | 0% | N/A |
| | **TOTAL** | | | **$ 920,600** | **$ 254,700** | **28%** | **31%** | |
| | | | | **28%** | | | | |
| Mechanical | Consulatant Fees | EEL Design Fees | EEL Commissioning Fees | $ 14,700 | $ 14,000 | 95% | 2% | EA |
| | Fire & Sprinkler System | Allowance<br>Sprinkler tank in basement storage | No sprinkler tank required | $ 150,000 | -$ 5,000 | -3% | -1% | N/A |
| | Plumbing - Domestic Water | Fixtures: OBC-compliant fixtures, auto-shut-off<br>Hot Water: 80% efficient gas-fired<br>Standard piping and drainage. | Fixtures: ultra low-flow showers, faucets, toilets, urinals<br>Hot Water: 95% efficient gas-fired heater<br>Add. piping & heating of non-potable water from cistern. | $ 122,700 | $ 10,000 | 8% | 1% | WE, EA |
| | Plumbing - HVAC | None | Heating: 93% efficient gas-fired boiler<br>Circulation: VSD pumps & Hospice in-floor delivery | $ - | $ 22,800 | | 3% | EA |
| | Plumbing - Cistern | None | 110 m³ combined cistern & sprinker tank<br>Additional aluminum troughing and piping connections<br>Additional concrete formwork and pouring<br>Additional excavation costs | $ - | $ 34,400 | | 4% | WE |
| | Air-side HVAC | Retreat: Full VVT with 80% eff. heating; EER=8.5<br>ventilation through units & washroom exhaust.<br><br>Hospice: PTAC with electric heat & EER=8.5<br>ventlilation through central fan & general exhaust. | Retreat: distributed ground-source heat pumps<br>ventilation from separate ERV, CO2 control.<br><br>Hospice: split-system cooling, heating as above<br>ventilation from separate ERV, occupancy control. | $ 185,000 | $ 104,000 | 56% | 13% | EA, IEQ |
| | **TOTAL** | | | **$ 472,400** | **$ 180,200** | **38%** | **22%** | |
| | | | | **15%** | | | | |

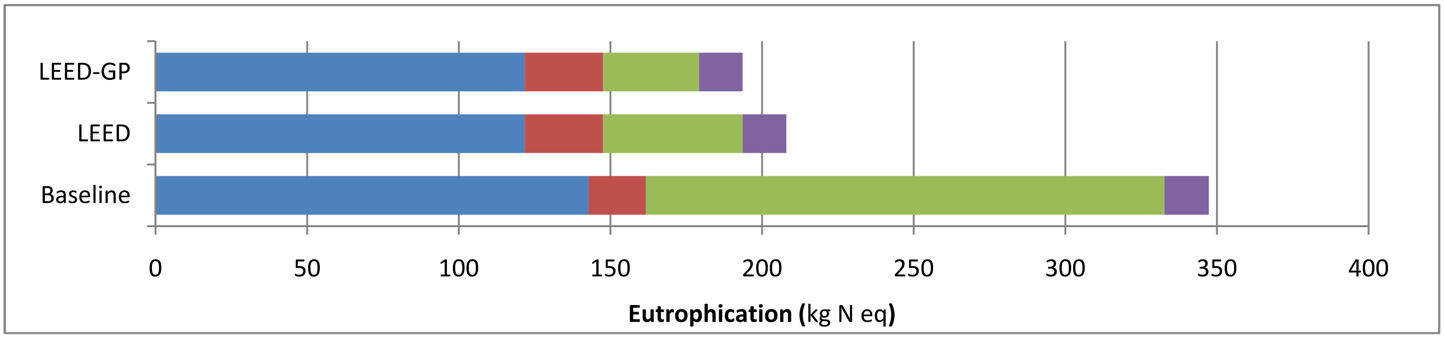
| Category | Feature | Baseline Design | LEED Concept Design | Basline Cost ($) | Incremental Cost ($) | % Cost Increased | % of Total Incremental | Related LEED Category |
|---|---|---|---|---|---|---|---|---|
| Electrical | Consulatant Fees | EEL Fees | EEL M&V Fees | $ 14,700 | $ 15,000 | 102% | 2% | EA |
| | General - Service, Distirbution Systems & Ancilliaries | Standard practice, low-rise construction<br>Nurse call, security, fire alam, emergency exit signs.<br>Communications & Cable - conduit & termination only | Additional paneling to separate plugs & lighting for M&V | $ 93,000 | $ 13,000 | 14% | 2% | EA |
| | Emergency System | Back-up generator | | $ 30,000 | $ - | 0% | 0% | |
| | Lighting - Interior & Exterior | Inside: ASHRAE 90.1-2004 compliant power densities with low-cost fluorescent & incandescent fixutres. Control with dimmer and on/off switches.<br>Outside: ASHRAE 90.1-2004 LPDs, full cut-off fixtures. control with photocell. | Inside: CEE flurorescent bulbs & ballasts and better layout. Control with occupancy sensors in all regularly occupied rooms and daylight sensors in retreat & hospice living.<br>Outside: Improved cut-off & power requirements | $ 122,000 | $ 45,000 | 37% | 5% | EA, IEQ |
| | Photovoltaic System | None | 3.9 kW system above amphitheatre | $ - | $ 39,000 | | 5% | EA |
| | Measurement & Verification System | None | Montoring of HVAC equipment<br>Metering of energy systems | $ - | $ 30,000 | | 4% | EA, IEQ |
| | **TOTAL** | | | **$ 259,700** | **$ 142,000** | **55%** | **17%** | |
| | | | | **8%** | | | | |

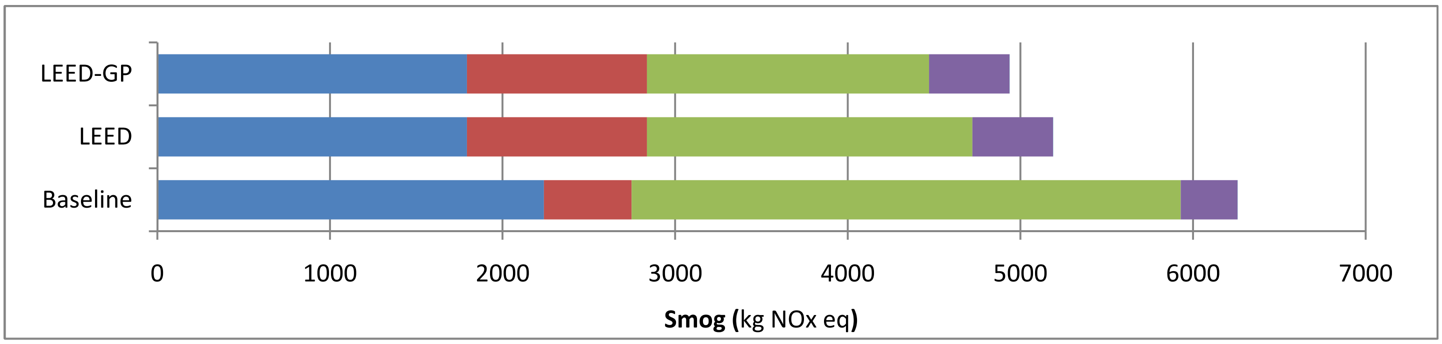
| Category | Feature | Baseline Design | LEED Concept Design | Basline Cost ($) | Incremental Cost ($) | % Cost Increased | % of Total Incremental | Related LEED Category |
|---|---|---|---|---|---|---|---|---|
| LANDSCAPING | Consultant Fees | GSP Fees | | $ 33,200 | | | | N/A |
| | Hard Surface Areas | Asphault Paving | "Grass Pave" (parking section) | $ 98,700 | $ 31,800 | 32% | 4% | SS |
| | Hardscapes | Ramps, concrete pavers, limestone screening | | $ 115,000 | $ - | 0% | 0% | N/A |
| | Trees, Shrubs & Beds | All landscaped planting as per current drawings | | $ 158,900 | $ - | 0% | 0% | N/A |
| | Grading & Seeding - General | Assume standard grass seed, regularly watered | Lowmow mixutres - Hydroseed & Meadow Mix | $ 20,000 | $ 42,800 | 214% | 5% | WE |
| | Grading & Seeding - Woodland Mix | None | Rehabilitation of woodland adjacent to forest | $ - | $ 24,300 | | 3% | SS |
| | Structures & Fixtures | Pavillions, Benches, Bike Racks, Litter Receptacles, Play Structure, Arbours, Featured Stones | | $ 192,600 | $ - | 0% | 0% | N/A |
| | **TOTAL** | | | **$ 618,400** | **$ 98,900** | **16%** | **12%** | |
| | | | | **19%** | | | | |
| ALL | **GRAND TOTAL** | | | **$ 3,235,300** | **$ 820,000** | **25%** | | |

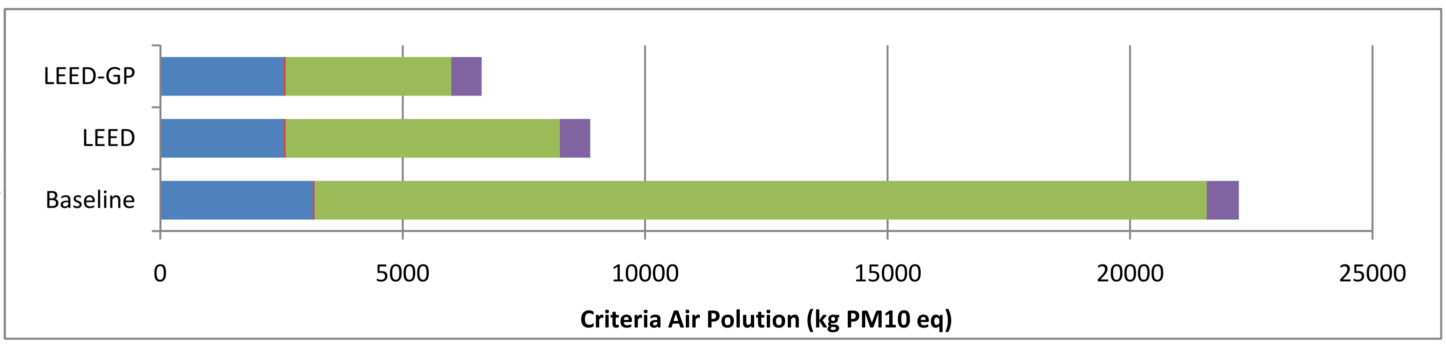
**Note: All capital costs and fees are approximate for budgetting purpose only. Sections highlighted require further discussion, even for budgetting.**

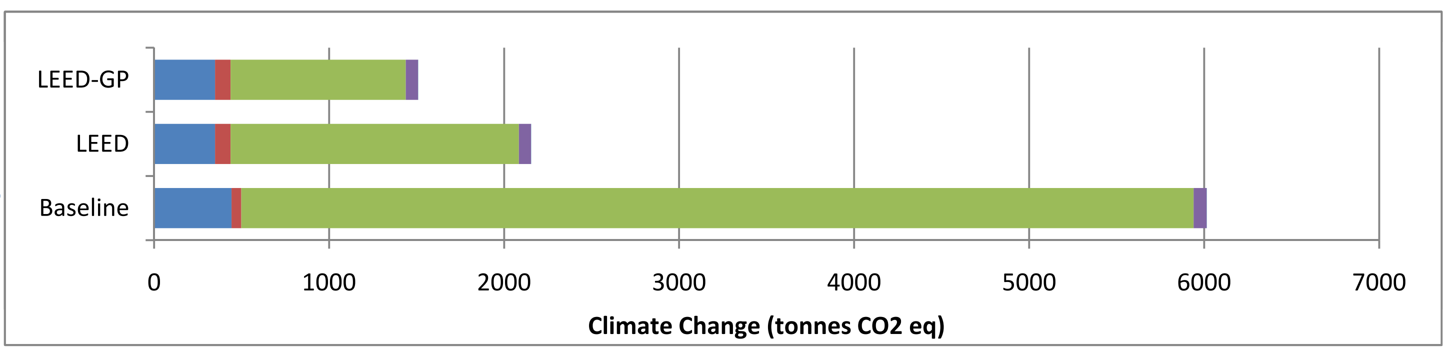
## OUTCOME #6 Emissions-Based Impacts



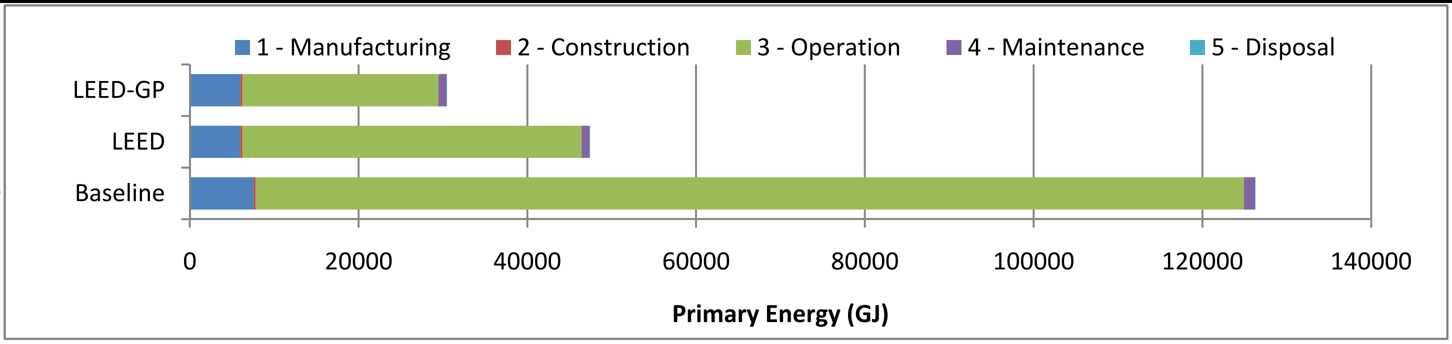



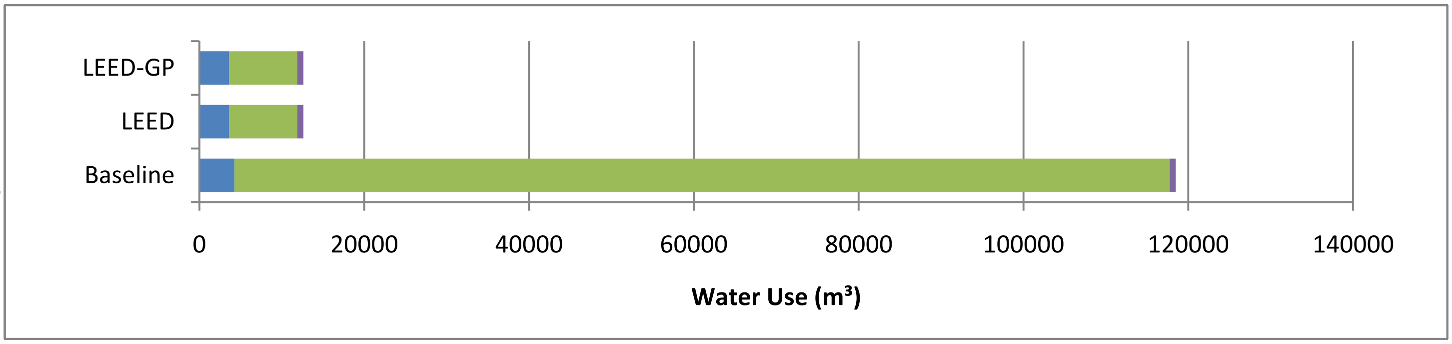



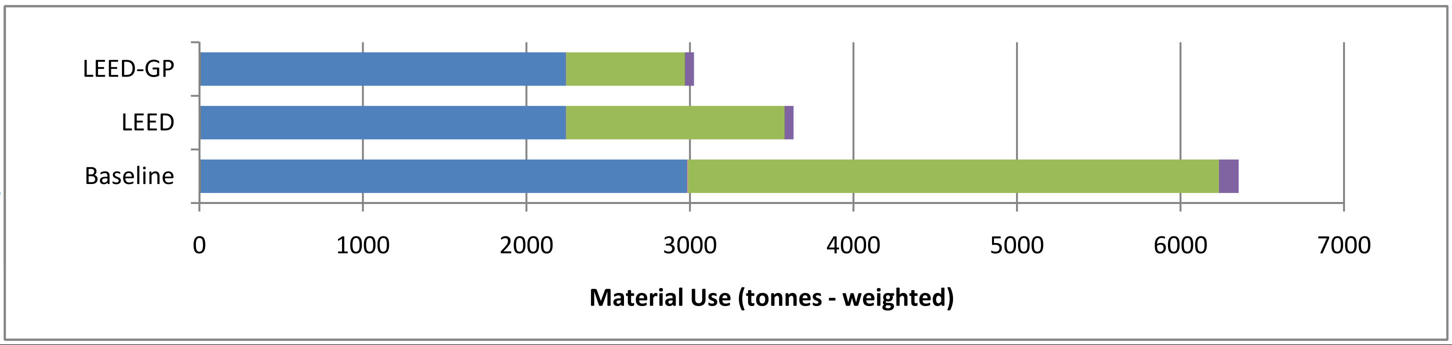



## Consumption-Based Impacts



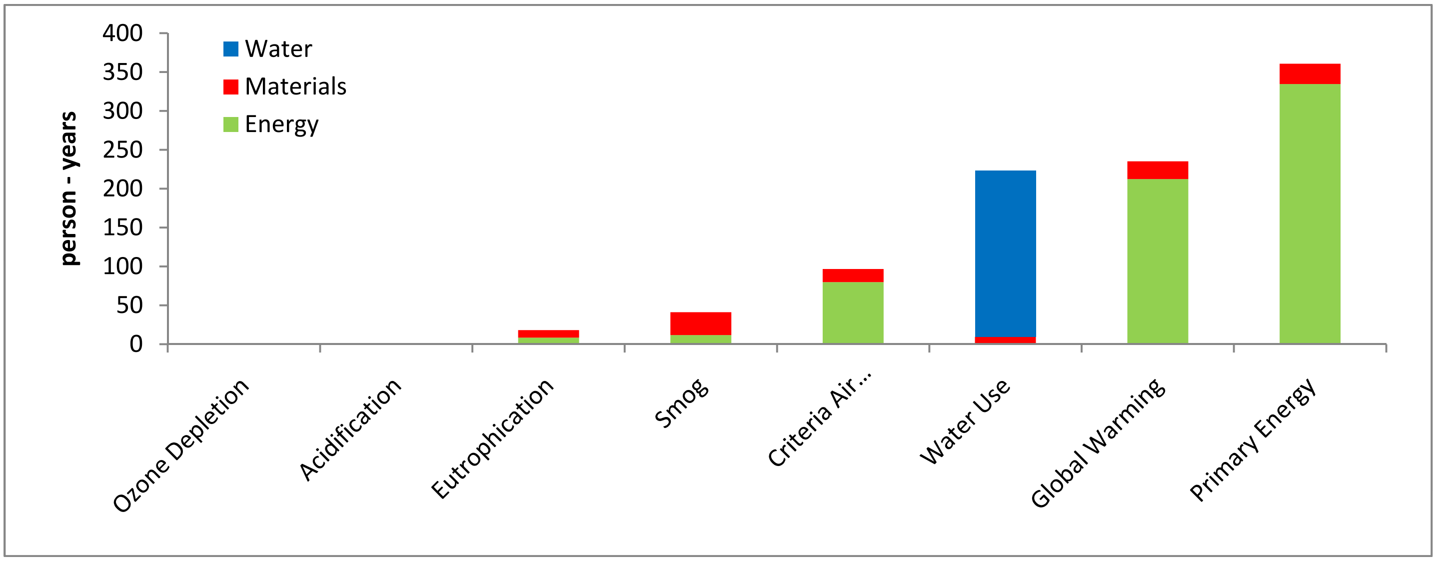



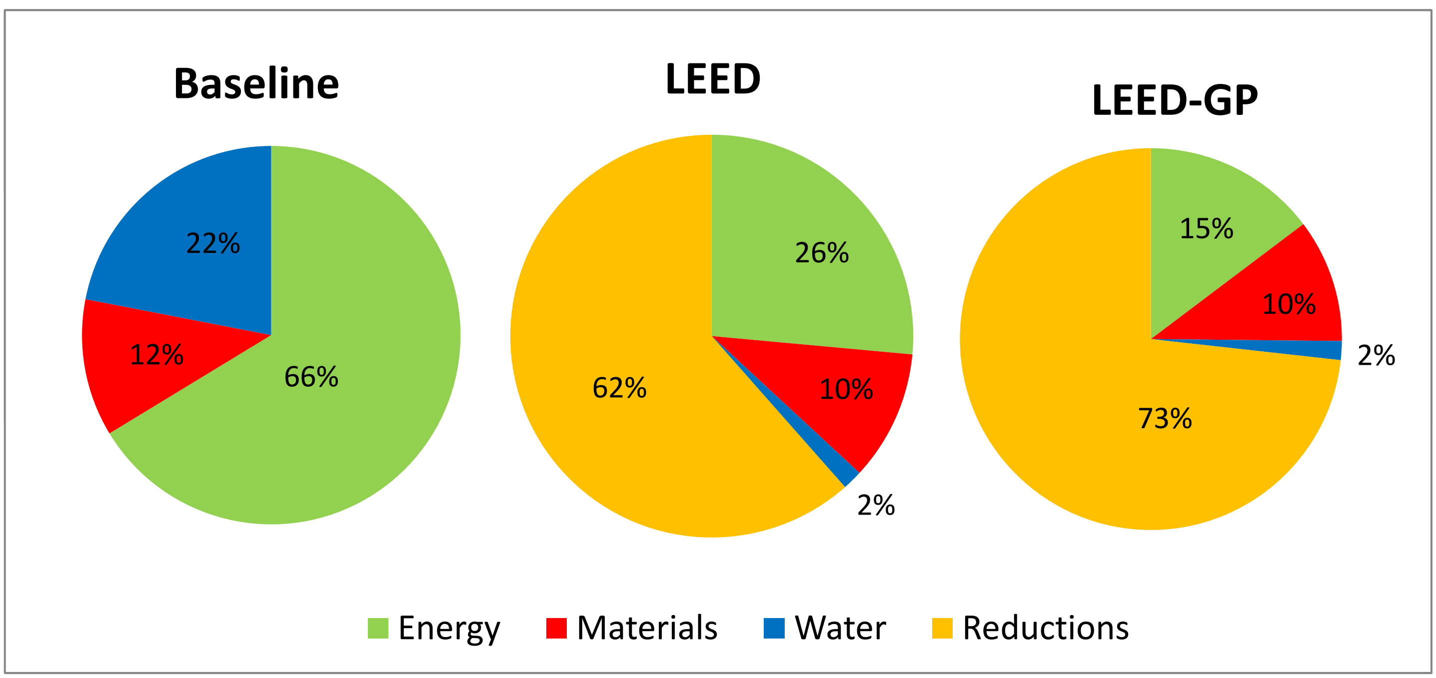

## Qualitative Observations & Actions

| Model | Manufacturing | Construction | Operation | Maintenance | Disposal |
|---|---|---|---|---|---|
| **Both LEED & Baseline** | - | **C1)** Construction team hired from within the Region of Waterloo. | **O1)** A room for recycling bin storage (let's assume it will be used). | - | - |
| **LEED** | **M1)** Efforts made to source local materials whenever possible.<br><br>**M2)** Modest re-use of old timbers and field stone. | **C2)** Full recycling of construction waste planned and budgetted.<br>**C3)** Testing of the indoor air quality before occupancy.<br>**C4)** Commissioning of HVAC & envelope to ensure quality. | **O2)** Monitoring of building energy, water, and waste during occupancy. | **T1)** low-maintenance required for in-floor heating.<br><br>**T2)** Full maintenance plan for HVAC provided by commissioning agent. | - |

| Normalization of Results | | | | |
|---|---|---|---|---|
| **Impact Category (TRACI*)** | **Annual Impact (USA data)** | **Unit of Normalization** | **Person-Years (Baseline)** | **Person-Years (LEED)** |
| Ozone Depletion | 0.3 | kg CFC-11 equiv. / (person * year) | 0 | 0 |
| Acidification | 7860.0 | kg H+ equiv. / (person * year) | 0 | 0 |
| Eutrophication | 19.2 | kg N equiv. / (person * year) | 18 | 11 |
| Smog | 152.0 | kg NOx eqiv. / (person * year) | 41 | 24 |
| Criteria Air Pollution | 231.0 | kg PM10 equiv. / (person * year) | 97 | 34 |
| Water Use | 530.0 | $m^3$ of water / (person * year) | 224 | 39 |
| Global Warming | 25.6 | tonnes CO2 equiv. / (person * year) | 235 | 84 |
| Primary Energy | 350.0 | GJ / (person * year) | 361 | 136 |
| Total | | | **976** | **327** |

* - the modifications to the TRACI normalization factors used is the addition of a Primary energy normal I calculated from 2007 U.S. data



# Appendix #3 – USGBC On-line Material: LEED 2009 motivations & Pilot Credits

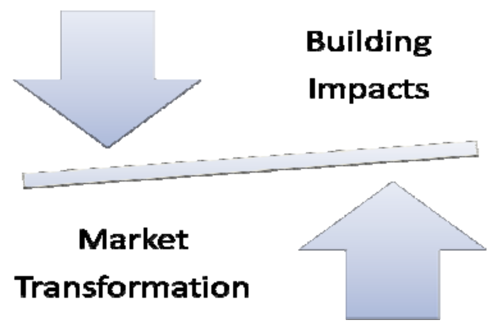
# LEED 2009 Credit Weighting

May 1, 2008

## Introduction

LEED is a building assessment and rating tool. In LEED version 2.2, credit weights reflected number of credits in different credit categories and a qualitative sense of the value of credits for LEED's market transformation mission. In other words, the number of credits associated with an issue implicitly increased it relative important and the points allocated to a credit reflects

The success of green building has created new expectations, including the notion that green building practices can contribute solutions to social, economic, and environmental problems. Such solutions typically mean reductions in negative impacts associated with buildings or, in some cases, positive change associated building design and operation (e.g., brownfield restoration).




Along with other factors, changes in market conditions and user requirements have encouraged the development of new credit weighting paradigm for LEED. This paradigm necessarily builds on LEED's foundation as a tool for market transformation by adding explicit consideration for the contribution of individual credits to building impacts. In this paradigm, credits are more valuable (i.e., worth more points) when they are associated with more important building impacts. The relative importance of impacts is evaluated with respect to specific impact categories.

This is fundamental change in how LEED credits are weighted. However, its consequences are incremental for the rating system as a whole. Existing credits are largely retained and assigned a substantial minimum weight, and the new, impact-driven paradigm is superimposed on the basic skeleton of the existing system. This means that new paradigm changes the relative emphasis of the system, but it does not constitute a wholesale reinvention of weightings.

## Intent

The LEED 2009 weighting system intends to provide a transparent and reproducible approach to assign weights to credits. The system is a flexible, decision support environment that allows decision makers with explicit control over the integration of analytical results, policies, and values.

Weighting for each LEED 2009 system are documented with a self-contained Microsoft Excel workbook. Each workbook contains all calculations and rules used to assign weights to individual LEED credits. The workbook also serves as a decision support tool to evaluate the consequences of alternative scenarios on credits or the rating system as a whole. At this time, the workbooks are prototypes, and they are not designed or intended to for independent use by project teams or the public (i.e., they are a tool for internal decision makers acting with assistance).

## Summary of changes

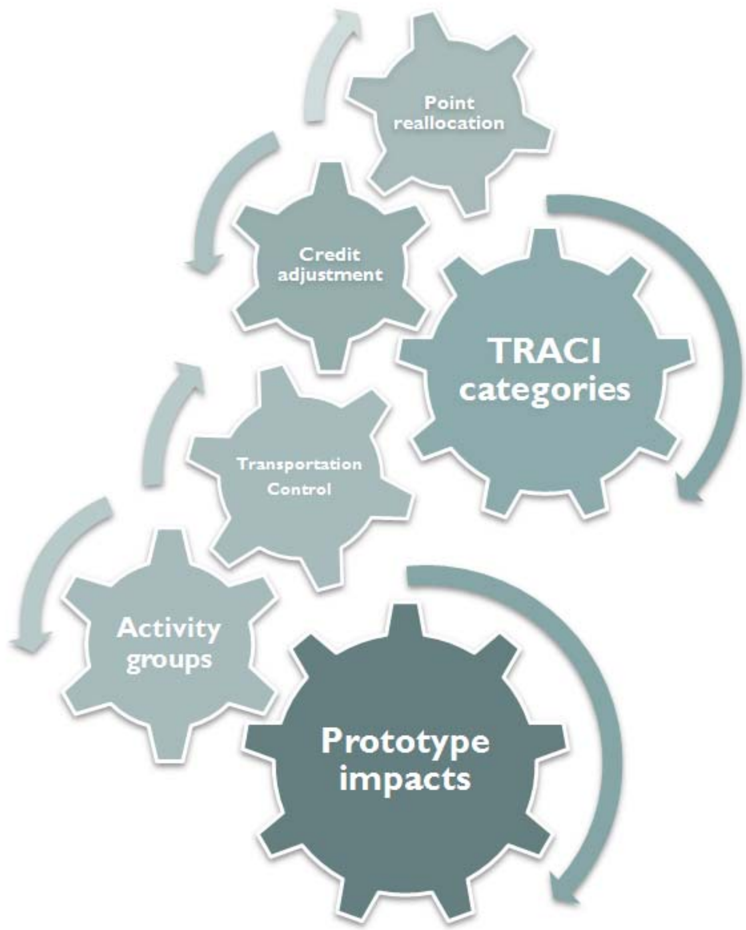
The weighting approach described here represents an incremental change to the LEED rating system. A number of key elements remain unchanged, including:

- Existing credits remain the same
- All credits receive a minimum score of 1
- Credits are positive, whole numbers – no fractional credits or negative values
- Credits have one set of "static weights" regardless of location or potential connections between credits

These elements were given design guidelines for the new weighting system. They limit the degree of change, and they impose significant constraints.

A number of important elements have changed, including:

- The total number of points – 100 points are now available excluding innovation and regional credits
- The relative allocation of points between credit categories – resulting in change in the relative emphasis of credit categories




## Components

The LEED 2009 weighting approach explicitly integrates building impacts with the existing structure of LEED. Weighed is carried out through six interacting components including:

- A building prototype
- Impact assessment categories
- Credit groups ("activity groups")
- Transportation control
- Credit adjustments
- Point reallocation

These components work together to provide a representation of building impacts and use this information to assign points to individual credits. Each component provides an opportunity to change the ultimate weight of a credit. The most important single factor is the selection of a building prototype. This decision has the great potential influence and is subject to the great range of potential conditions (i.e., observed variance in key parameters). This is followed closely by the weights applied to impact assessment categories (i.e., TRACI weights). The last three components essentially provide opportunities for fine tuning.

## Weighting process

LEED 2009 weighting can be described as a ten step process:

1. Building impacts are estimated based on a building prototype.
2. Impacts are described with respect to 13 TRACI impact categories
3. Impacts are associated with up to 6 groups of credits (activity groups) – this assigns some number of potential points to groups of credits.
4. Points are allocated proportionally to credits within an activity group – the default is that each credit in the group contributes equally to the impact associated with the category and consequently receives an equal score.
5. Some credit weights are adjusted to reflect the relative performance of individual credits – this changes the distribution of points *within* a category (points in other groups are not changed)
6. Impact scores for each activity group are adjusted based on individual and aggregate capabilities of existing credits (e.g., control over transportation) – this means “uncontrolled” points from transportation are distributed proportionally across the other groups.
7. Credit weights for the 13 TRACI impact categories are integrated by taking a weighted average across all impact categories based on weights from the TRACI/BEES exercise.
8. Combined credit weights are rounded to the nearest whole number and the “residual” created during the rounded is tallied.
9. Residual points (i.e., points created by rounding) are manually reallocated across the system based on specific rules – the LSC directed that points be allocated with priority for greenhouse gas emissions reduction potential.
10. Results are transferred back to the existing scorecard for each system.

## Information sources

The LEED 2009 weightings workbook necessarily brings together a number of information sources. Models and statistical information is used to estimate building impacts and associate impacts with individual TRACI categories. Specific information sources used in individual calculations are documented throughout each LEED workbook. The association between impact categories and information sources is illustrated in the following table.

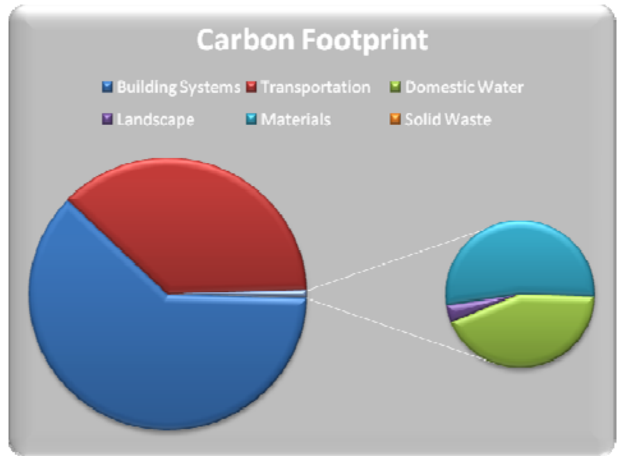
**Table 1.** Summary of information sources used for each impact category

| TRACI category | BEES weights | Description of category | Information source |
|---|---|---|---|
| Greenhouse gas emissions | 25 | Operational greenhouse gas emissions (CO2e/year) | Empirical calculations based on CBECS, the Bureau of Transportation Statistics, and other national data sources |
| Fossil fuel depletion | 9 | Consumption of non-renewable, fossil fuels | SimaPro/USA Input Output 98 library |
| Water use | 7 | Consumption of water *throughout the life cycle of a building* | SimaPro/USA Input Output 98 library |
| Land use | 5 | Consumption of land *throughout the life cycle of a building* | SimaPro/USA Input Output 98 library |
| Acidification | 3 | Generation of "acid rain" emissions associated with acidification *throughout the life-cycle of a building* | SimaPro/USA Input Output 98 library/Ecocalculator |
| Eutrophication | 5 | Generation of nutrient pollution *throughout the life-cycle of a building* | SimaPro/USA Input Output 98 library/Ecocalculator |
| | | Generation of nutrient pollution *at the site* | |
| Ozone depletion | 2 | Generation of ozone depleting emissions *throughout the life-cycle of a building* | SimaPro/USA Input Output 98 library/Ecocalculator |
| Smog formation | 4 | Generation of smog forming emissions *throughout the life-cycle of a building* | SimaPro/USA Input Output 98 library/Ecocalculator |
| Ecotoxicity | 6 | Generation of ecotoxic pollutants *throughout the life-cycle of a building* | SimaPro/USA Input Output 98 library/Ecocalculator |
| | | Generation of ecotoxic pollutants *at the site* | |
| Particulates | 8 | Generation of particulate emissions *throughout the life-cycle of a building* | SimaPro/USA Input Output 98 library/Ecocalculator |
| Human health - cancer | 7 | Generation of cancer-causing compounds *throughout the life-cycle of a building* | SimaPro/USA Input Output 98 library |
| Human health – non-cancer | 4 | Generation of non-cancer-causing compounds *throughout the life-cycle of a building* | SimaPro/USA Input Output 98 library |
| Indoor environmental quality | 15 | Impacts on building occupants and the indoor environment | No model; association based on credit function |

## Application of weighting tool

The impact-driven weighting tool described above was applied to LEED-NC, LEED-EB, LEED-CI, and LEED-CS. All weightings share following characteristics. The impact prototype is a:

- 135,000 square foot office building
- Operated *9-to-5*, 5 days per week – a total of 250 days/year
- 540 full time employees
- Impacts associated with construction and materials are amortized over a 50 year performance period




The LEED Steering Committee and USGBC staff also provided specific requirements that guide the weighting system. The most important of these requirements include:

- Credits will have one static, independent values
- Credits will be positive integers with a minimum value of 1
- Credits total 100 possible points, excluding innovation and regional credits

Specific characteristics of each rating system (i.e., LEED-NC vs. LEED-EB) required modifications to the basic weighting system. These modifications are described in the following sections. There are four primary types of modifications:

1. Changes in the impact model
   - For example, building circumstances, such as location, landscape area, or parking area

2. Changes in percentage control over impacts
   - For example, transportation, stormwater, solid waste

3. Credit adjustments within activity groups
   - Fine tuning weights to address the relative effectiveness of credits

4. Point reallocation between credits and potentially across activity groups
   - Allocating points to satisfy requirements for minimum credit values and point totals

**Table 2.** Summary of building scenarios used for each rating system – the labels "Median", "Highest", etc. refer to specific choices in the LEED 2009 weighting tool workbook. These choices essentially combine to represent a statistically average US office building matching the specifications of the prototype.

| System | Building systems | Transportation* | Water | Materials | Solid waste | Land use |
|---|---|---|---|---|---|---|
| NC | Median | Median (50%) | Median | Highest | n/a | Static |
| EB | Median | Median (40%) | Median | Highest | Median | Static |
| CI | Median | Median (40%) | Median | Highest | Median | Static |
| CS | Median | Median (?%) | Median | Highest | n/a | ? |

** Number indicates percentage control over transportation available through existing credits.*

**Table 3.** Description of the scenario used to drive weightings for all systems. This reflects the selected conditions indicated in Table 2. A wide range of alternative scenarios are available in the weightings tool workbook.

| Component | Description |
|---|---|
| Building systems | Energy use for the 135,000-sf prototype in climate zone 3 (4,750 heating degree days, 1,800 cooling degree days); 80% building energy from electricity; Energy Star 50 rating; no on-site renewable energy; electricity carbon intensity equivalent to the national average |
| Transportation | 5 day per week, 250 day per year work schedule, 20.5 mile average daily roundtrip commute; average fuel economy of 21 miles per gallon; 74% drive alone, 12% carpool, 4% rail, 3% bus, 1% rail, 1% bicycle, 1% walk; transient users and services are equal to 25% of commuters, |
| Water | Domestic water use: 50/50 male/female split; conventional toilets (1.6 GPF) and urinals (1 GPF), conventional facets (2.5 GPM) and showers (2.5 GPM)<br><br>Landscape water use: 1 acre of landscaping; water use equivalent to trees, shrubs in climate zone 3, conventional sprinkler irrigation systems, irrigated with potable water, national average embodied energy, electricity carbon intensity equivalent to the national average |
| Materials | Two story steel construction, 109,950-sf surface parking lot, |
| Solid waste | Solid waste generation of 4.9 tons/1000-sf |
| Land use | Combination of building footprint (67,500-sf), surface parking lot, 1 acre landscaping, |

## Summary of credit adjustments

Credit adjustments alter the weight of individual credits *within activity groups.* Adjustments alter the relative allocation of credits across the activity group. These adjustments are typically based on an interpretation of how credits function (i.e., their relative value within an activity group). This weight is set based on a judgment about the function a credit in practice, rather than quantitative analysis. The default setting is 1 which indicates an association between a credit and an impact area.

**Table 4.** Summary of credit adjustments made to each system. These changes alter the relative importance of credits *within* activity groups. Values of other activity groups are not changed.

| System | Description | Adjustment |
|---|---|---|
| NC | Change relative weight of energy credits | Remove EAc1.1; high (3) weight to EAc1.2, medium (2) weight to EAc2.1 and EAc5 |
| | Change relative weight of transportation credits | High (3) weight to SSc2 and SSc4.1; medium (2) weight to SSc4.3, low (1) weight to SSc4.2 and SSc4.4 |
| | | |
| EB | Remove credits | 0 weight for EAc1.1, EAc1.2, MRc1.1, MRc1.2, MRc4.2, MRc7.2 |
| | | |
| CI | Change relative weight of energy credits | Remove EAc1.1; high (3) weight to EAc1.2, medium (2) weight to EAc2.1 and EAc5 |
| | Change relative weight of transportation credits | High (3) weight to SSc2 and SSc3.1; low (1) weight to SSc3.2 and SSc3.3 |
| | Change relative weight of water credits | Medium (1.5) weight to WE1.1, low (1) weight to WEc1.2 |
| | Change relative weight of materials and resources credits | Medium (2) weight to MRc1.2 and MRc2.2 |
| | | |
| CS | Same as NC | |

## Summary of point reallocations

Point reallocation is the final step in the weighting process. Points are made available for reallocation when fractional weights are rounded to the nearest whole number. Round-off points are manually reallocated – there is no constraint on their allocation within or between. Round-offs can result in either net surpluses or deficits of credits. The number of points available is a function of the impact scenario, TRACI weights, transportation reallocation, and credit adjustments. Changes in any of these factors will change the number of points available for reallocation.

The LSC directed that reallocation points be allocated based on the relatively value of credits for greenhouse gas emissions.

**Table 5.** Summary of point reallocations for each rating system. Points are made available by rounding to whole numbers. Points are reallocated manually based on guidance from the LSC.

| System | Surplus/Deficit | Reallocation |
|---|---|---|
| NC | Rounded required *adding* 3 points | EAc1 +1, EAc2 +1<br>SSc4.2 +1 |
| | | |
| EB | Rounding required *adding* 14 points | EAc1.7 through EAc1.14+1<br>EAc2.1+1, EAc2.2+1<br>EAc4.2+1, EAc4.3+1<br>WEc2.2+1, WEc2.3+1<br>WEc3.2+1, WEc3.3+1 |
| | | |
| CI | Rounding required *removing* 12 points | WEc1.1-1<br>EAc1.1.1-1, EAc1.1.2-1,<br>EAc1.1.4-1, EAc1.2-1<br>EAc1.3.B.1-1, EAc1.3.B.2-1,<br>EAc1.4.1-1, EAc1.4.2-1<br>EAc2-1, EA3.B.1-1, EAc4-1 |
| | | |
| CS | Same as NC | |

## Uncertainty and limitations

The LEED 2009 weighting system is a decision support tool. It provides a framework for integrating the structure of the existing rating system with an impact-oriented weighting system. The system itself does not provide "answers" or weights as an output. Rather, it provides a framework for evaluating the interlocking set of issues that contribute to weights and, ultimately, changes in LEED scorecards.

The LEED 2009 system is driven by a building impacts model. The calculations used to estimate impacts are relatively simple scalars, such as energy use per square foot, emissions per gallon, therm, or kilowatt, etc. However, these simple calculations inherit the limitations of their data sources. In this case, one of the most important limitations is the degree to which the Department of Energy's Commercial Building Energy Consumption Survey (CBECS) represents the population of buildings LEED targets for market transportation. Errors or uncertainties in CBECS influence the degree to which the "median" prototype used here represents a national average condition.

More importantly, the choice of building scenario has a direct and profound impact on the LEED 2009 weighting system. Of course, this must be the case since the new system attempts to mesh the existing structure with explicit consideration for building impacts: when building impacts change, the importance of credits change and their relative weight within the system. The workbooks are designed to illustrate the consequences of the range of conditions found across the United States. However, the rating system ultimately requires selecting one prototypical condition and using it as the basis for weights.

Taking greenhouse gas emissions as an example, we see that total building-related greenhouse gas emissions vary by over a factor of 10 across the range of scenarios. More important for the current weightings framework, the fractions of impacts associated with different impact categories varies by nearly a factor of 2. For example, building systems may constitute 76% of emissions in one scenario, but only 47% in another. Alternatively, transportation may contribute 17% or 53%. These ranges are illustrative, but they do not bound the range of possible variation.

**Table 6.** Summary of greenhouse gas emissions scenarios available within the LEED 2009 weighting tool. Note that these scenarios illustrate plausible alternative conditions, and they do not fully bound the range of variation.

| Scenario | Building Systems CO2e [met T] | [%] | Transportation CO2e [met T] | [%] | Water CO2e [met T] | [%] | Materials CO2e [met T] | [%] | Total CO2e [met T] |
|---|---|---|---|---|---|---|---|---|---|
| Highest | 11137 | 76% | 2418 | 17% | 823 | 6% | 218 | 1% | 14595 |
| Median | 2832 | 62% | 1711 | 37% | 19 | 0% | 15 | 0% | 4577 |
| Lowest | 532 | 47% | 604 | 53% | 5 | 0% | 2 | 0% | 1143 |

Another important issue is the independent and context dependence of credit weights. It is clear that credits are not always independent, but they work together. For example, achieving higher levels of energy efficiency changes the relative value of different levels of green power purchasing. Of course, this is one of the central tenants of integrated design. The LEED 2009 weighting system does not yet internalize these considerations, because of the design requirement to provide static, independent weights.

The requirement for positive integers constrains the range of variation available within a 100 point system. This specification requires rounding fractional points and introduces a manual point reallocation step. This provides a potentially valuable tool for injecting policies or values into the weightings, but it is important to note that it is a specific consequence of a design constraint.

The requirement for positive integrates also makes it difficult to include credits that do more than simply reduce impacts. For example, some credits may create net positive benefits, rather than simply reducing impacts. These issues are recognized in the LEED 2009 credit weighting system but only partially addressed.

It is not possible to roll these issues up into some kind of composite measure of uncertainty associated with the weightings. The weightings are deterministically calculated within the limits of the system components. The impact model itself is subject uncertainty associated with the underlying data. Variation in outcomes associated with other components reflects policies and values – uncertainty in these outcomes can only be reduced through discussion, negotiation, and consensus. Fortunately, the LEED 2009 weighting system allows for explicit differentiation of the outcomes of analytical choices and rules, policies, and values.

These issues clearly indicate the potential value of a dynamic, context-sensitive weighting system. The LEED 2009 Weightings Tool provides a prototype for the capabilities needed for dynamic weighting in a future version of LEED. However, such a step would require substantial effort to move from the current prototype to an enterprise-level software system usable by project teams and capable of accommodating the breath of situations encountered in practice. Additionally, such a system would require substantial changes in LEED educational and certification processes.

## Conclusions

The LEED 2009 weighting system represents an incremental attempt to integrate the existing structure of LEED with an analytical assessment of building impacts. The system represents a series of compromises to accommodate goals for market transportation, consideration for building impacts, operational constraints, and system design requirements. Consequently, it represents a complex mixture of quantitative analysis, rules, policies, and values. Fortunately, this process can be described in detail and is ultimately transparent with regard to its assumptions and outcomes. The LEED 2009 system provides a first step toward a dynamic, context-dependent weighting system.

# LEED 2009 Weightings Background

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The LEED 2009 scorecards are the result of several important development initiatives undertaken by USGBC. The farthest-reaching and most technically complex feature is the re-weighting of credits in the LEED Rating Systems. Credit re-weighting, as used in this context, is the redistribution of the available points in LEED so that a given credit's point value more accurately reflects its potential to either mitigate the negative environmental impacts of a building or promote positive impacts.

The LEED rating system has always been implicitly weighted by virtue of the different point values assigned to each credit and category. LEED has been successful in promoting market transformation with its existing weightings but USGBC has undertaken a process to re-weight the rating systems and redistribute points in each rating system in an effort to maximize the positive benefit realized by LEED certified buildings and capitalize on the extraordinary market traction LEED has enjoyed. To do this, USGBC has sought and used the best scientific data available and, via the expertise of the volunteers serving on LEED committees, substantial market and buildings expertise. The resulting scorecards are a composite of scientific and market analyses.

The weightings process developed for LEED 2009 and beyond serves as a replacement for the previous point allocation system. It is an important upgrade that provides LEED developers with the ability to access the latest scientific data and use it to inform the development of LEED in a transparent and defensible way.

Point weightings have been introduced into LEED 2009 through the creation of a unique workbook that filters and synthesizes available environmental and building system data into an integrated, dynamic point allocation tool. Because the workbook delivers this data in a compiled format with analytical capabilities built in, decision-makers are free to spend time considering how this science should be incorporated into LEED rather than tracking down one piece of information at a time as necessary.

**The Big Picture**

The first step in weighting LEED involved deciding which environmental impacts LEED should be addressing. LEED 2009 uses US EPA's TRACI environmental impact categories. TRACI is a computer software tool developed by the U.S. EPA to assist with impact assessment for Life Cycle Assessment, Industrial Ecology, Process Design, and Pollution Prevention. The TRACI categories were selected because they represent a comprehensive, currently available complement to LEED which is appropriate for the North American building market.

Layered on top of the TRACI environmental impact categories are weightings devised under the auspices of NIST (National Institute of Standards and Technology) which compare the impact categories to each other and assign a relative importance to each. Together, the TRACI impact categories and the weightings assigned by the NIST process provide a foundation for discussion of the environmental impacts related to the design, construction, operations, and maintenance of the built environment.

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A matrix is then created which places weighted impact categories on one axis with LEED credits on another axis. This matrix can then be used to evaluate which credits address which impacts, and to what degree. USGBC, working alongside several expert consultants, guided the development of a weightings workbook tool to analyze how each LEED credit interacts with the list of impacts. This tool served as the starting point from which the LEED Steering Committee discussed the reallocation of points in LEED 2009.

**LEED 2009 Workbook Tool**

The workbook tool is a credit weighting software program developed in Microsoft Excel 2007 which understands building impacts and uses this information to assign weights to individual LEED credits. It is a synthesis of a range of complex phenomena relating to a number of environmental and human health impacts such as climate change, water use, etc.

The tool is transparent, showing what impacts have been considered and the relative importance attached to each impact category. It is also flexible, allowing for addition or revision as changes occur in our understanding of the importance of environmental and human health issues consistent with scientific and market advances.

This is advancement over the current LEED rating system. Presently, even though individual credits contain implicit weights, these credits are weighted equally, except when higher levels of performance receive one or more additional credits (e.g., EA Credit 1). The workbook tool outperforms current standards in terms of transparency and flexibility, providing additional information to facilitate educated decisions.

In spite of its ability to theoretically individualize the rating system to account for project-specific location and use, LEED 2009 will not presently consider this aspect for project certification.

**How It Works**

The 3 main tabs of the workbook feed project information into the tool. Each project will be measured against a typical building based on a prototype of the average LEED registered project. The prototype is defined by the characteristics of its location, utility, proximity to mass transit, population density, materials used, and contribution to climate change.

It is possible for individual project teams to compare results accruing from this ‘default’ data with buildings specific to their location and conditions of use. Users will have the chance to toggle around to capture the essence of the impact categories, and compare/measure the results/performance against each of the LEED credits, and weigh each credit’s relative importance under each building activity group.

However, this aspect of the tool will be limited to providing an understanding of the importance and relevance of each LEED credit to a specific building. This will afford the user an opportunity to make an informed decision to target certain credits and gain

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benefit for their project. It is not possible, at this time, for the user to utilize this data to claim extra credits.

**Scorecards & LEED credits**

Scorecards are the result of the data analysis processed by the workbook tool. The final weights are expressed as a percentage and each credit point is fed into a typical LEED scorecard to arrive at a sum total of 100 points for all the activity groups. A 100 point rating system informs the certification thresholds – certified, silver, gold or platinum require a 40%, 50%, 60% or 80% achievement of points, respectively.

Additionally, there will be 5 bonus points for Innovation and Design, 4 bonus points for Regionalization and 1 point for a LEED accredited professional. The total number of points available for each project is 110 points. These 10 points are over and beyond the 100 base points and will be used to help the project achieve its certification.

Scorecards have been derived to suit LEED for New Construction, LEED for Existing Buildings, LEED for Commercial Interiors, LEED for Core and Shell, and LEED for Schools.

**Assumptions Used in the Spreadsheet**

The impact categories are based off of a combination of data from existing studies and databases as well as the LCA database SimaPro. The data set combination chosen is reasonably representative of the U.S. economy within the confines of the analysis. The average building is considered to be a fully occupied, regularly working 2 story office building, with the physical characteristics of the average LEED registered project. Building scenarios for each rating system were envisaged in view of environmental analysis resulting from transportation control – this was kept in the median mode for most categories, except materials where it was fixed in the highest range. These scenarios were chosen for commonality of issues attached to U.S. buildings.

**Results**

The weightings process produced scorecards that look different from the existing scorecards. This was mainly due to the heavy emphasis on credits that reduce a building's carbon footprint.

Not surprisingly, credits showed fractional points; MR and IEQ credits got lower points than previously awarded, and some credits dropped to almost negligible value.

**Guiding Policy Decisions and Deviation from Straight Results**

The LSC vetted the straight workbook output with a USGBC vision/mission yardstick. Simulation of the workbook tool using the weighted model resulted in zero values for some LEED credits. Since scorecards recorded fractional and/or zero value credits, the LSC made a policy decision that fixed all existing LEED credits to at least 1 whole point. Additionally LSC favored a holistic view of environmental quality in place of indoor ventilation. As such, the NIST weights of the TRACI impacts were adjusted to allot 15% of credits to IEQ instead of 3% IAQ credits. Fractional value credits were rounded off to whole points and these remaining fractional points were allotted to

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credits related to climate change mitigation. This was justified from a market-oriented perspective to support market sectors that had invested considerable resources in that direction. It was also decided to allot 100 possible points to credits, excluding innovation and regional credits.

**Benefits of the Tool to Cull Ineffective LEED credits**
It is also envisaged that providing a substantial amount of information to the user will help inform about the immense possibilities that exist to maximize environmental savings relevant to the USGBC vision/mission.

It is hoped that the market will intuitively understand the revised weightings process as a methodology to identify high value credits and credits that are less important. Over time, the LSC has plans to phase lower valued credits out of LEED in favor of more effective credits. This methodology will be used to inform the market of such intentions well in advance.

**Conclusion**
One of the greatest benefits of the weighting process is that it does not change the language of LEED. The final LEED 2009 scorecards look quite similar to those that exist now, and the modest degree of change was the result of a conscious effort to enhance LEED's scientific muscle without alienating the market by changing too abruptly.

Though the scorecard results developed using the weightings process and explained here are not perfect, several different analyses have been prepared and the overall results are both consistent and intuitively correct. As such, LSC feels that this is a first step and a good start. The workbook immediately exposes holes in LEED where no credit exists to cover an impact category, thus identifying the areas around which research and development activities should be focused. The methodology is also quite flexible – an attribute that will allow LEED to respond to market advances much more nimbly and predictably than in the past. And as the science informing our weightings decisions advances, LEED will too.

**Attachments**
1. "LEED 2009 Workbook Tool" – the powerful new LEED 2009 Credit tool software

2. The following document (one document in two parts) provides details useful in understanding and using the workbook tool:
   - "Introduction to the LEED 2009 Credit Weighting Tool" – a manual for the workbook tool
   - "LEED 2009 Credit Weighting" – detailed weightings information by CTG Energetics

**Resources**
For more information about TRACI and NIST, please see the following resources:

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1. "TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts" in *Journal of Industrial Ecology*. By Jane C. Bare, Gregory A. Norris, David W. Pennington, and Thomas McKone. Vol 6, Number 3-4: 2003. http://www.epa.gov/nrmrl/std/sab/traci/

2. "Life Cycle Impact Assessment Weights to Support Environmentally Preferable Purchasing in the United States" In *Environmental Science & Technology*. By Thomas Gloria, Barbara Lippiatt, and Jennifer Cooper. Vol. 41, 7551-7557: 2007. http://www.bfrl.nist.gov/oae/software/bees/

**Weightings Documents to Review**

1. The weightings overview provides a summary of changes and description of the weightings process used in LEED 2009. This can be found in the Weightings link of the LEED 2009 section of the Public Drafts Page.

2. The weightings tool overview describes the components of the weightings tool and basic instructions for using the spreadsheets. This can be found in the Weightings link of the LEED 2009 section of the Public Drafts Page.

3. The weightings overlay tools are spreadsheets that allow commenters to understand the methods and calculations behind the weightings proposed for LEED 2009 in an interactive way. This can be found in the Weightings link of the LEED 2009 section of the Public Drafts Page.
*Please note that the weightings overlay tools in XLS format have reduced capabilities as they were created in XLSX format. If you do not have Microsoft Office 2007 you can upload a file conversion patch here to view the tool in XLSX format.*

4. The rating system scorecards show the proposed changes outlined in the spreadsheet as well as the proposed new prerequisites. These can be found under each rating system link of the LEED 2009 section of the Public Drafts Page.

# LEED Pilot Credit Library

## Pilot Credits 5 & 6: Preliminary Integrative Project Planning & Design

This credit is available for pilot testing by the following LEED project types:

- New Construction
- Core and Shell
- Schools
- Commercial Interiors

### Credit 5

*(This is a prerequisite and must be completed if projects plan on pursuing Credit 6)*

**Intent**

To maximize opportunities for integrative, cost-effective adoption of green design and construction strategies. To utilize innovative approaches and techniques for green design and construction.

**Requirements**

Use cross discipline design and decision making, beginning in the programming and pre-design phase. At a minimum, ensure the following process:

- **Preliminary Rating Goals**. As early as practicable and preferably before Schematic Design, conduct a Preliminary LEED meeting including a minimum of four key project team members, including the Owner or Owner's representative. As part of the meeting, create a LEED® action plan that, at a minimum, includes the following:
  - The targeted LEED award level (Certified, Silver, Gold, or Platinum);
  - The LEED credits that have been selected to meet the targeted award level; and
  - The primary responsible party selected to meet the LEED requirements for each prerequisite or selected credit.
- **Integrative Project Team.** Assemble and involve a minimum of four of the following project team members from the list below, including the Owner or Owner's representative, and as many as feasible.
  - Owner or Owner's Representative
  - Owner's capital budget manager
  - Architect or building designer
  - Mechanical Engineer
  - Electrical Engineer
  - Structural engineer
  - Energy Modeler
  - Equipment Planner
  - Acoustical Consultant
  - Telecommunications Designer
  - Controls Designer
  - Building science or performance testing

  - Green building or sustainable design consultant
  - User groups
  - Facility managers
  - Housekeeping staff
  - Functional and space programmers
  - Interior designer
  - Lighting consultant
  - Commissioning agent
  - Community representatives
  - Civil engineering, landscape architecture, habitat restoration, or land planning
  - Construction Management or General Contractor
  - Life cycle cost analysis; construction cost estimating;
  - Other disciplines appropriate to the specific project type.
- **Owner's Project Requirements Document**. Prepare an Owner's Project Requirements document for the project.
- **Design Charette.** As early as practicable and preferably before schematic design, conduct at least one full-day integrative design workshop with the Integrative Project Team as defined above. The goal of the workshop shall be to optimize the integration of green strategies across all aspects of the building design, drawing on the expertise of all participants.

**Potential Technologies & Strategies**

- Reinforce corporate/institutional commitments to environmental health and community responsibility.
- Use cross discipline design, decision-making, and charrettes. Use goal-setting workshops and build a team approach to the project.
- Prepare checklists for points and strategies prior to beginning the design process; refer to the checklist at milestones during the design process.
- Engage owner, staff, contractors, user groups and community groups, educating them on the benefits of green design and bringing them into the design process at key points in the decision-making process.
- Participate in peer-to-peer information exchange and problem solving.
- Consider performance-based incentives in professional contracts that reward achievement of Integrative Design Goals and Project Vision. Incentives may be based on life cycle cost-based equipment and material selection, levels of achievement in LEED, or comparisons to benchmarks of existing facility performance or combinations of these and other benchmarks.
- Contractually apportion professional fees to create specific line items for the Integrative Design Charette and subsequent monitoring and follow-up meetings. Integrative Design may benefit from re-apportioning design fees to provide a higher percentage early in the process leading to stronger integration and streamline in subsequent design stages.
- Consider seeking foundation support for integrative design initiatives.

**Credit 6**

*(This credit cannot be pursued without also completing Credit 5)*

**Intent**

To maximize opportunities for integrative, cost-effective adoption of green design and construction strategies. Utilize innovative approaches and techniques for green design and construction.

**Requirements**

Use cross discipline design and decision making for all phases of design and construction. At a minimum, ensure the following process:

- Achieve *Pilot Credit 5: Preliminary Integrative Project Planning & Design*
- Actively involve all team members referenced above in at least three of the following phases of project design and construction process:
  - Conceptual/schematic design
  - LEED planning
  - Preliminary design
  - Energy/envelope systems analysis or design
  - Design development
  - Final design, construction documents and specifications
  - Construction Administration
- Conduct meetings with the project team at least monthly to review project status, introduce new team members to project goals, discuss problems encountered, formulate solutions, review responsibilities, and identify next steps. In these meetings, utilize the process framework established by the ANSI Market Transformation to Sustainability Guideline Standard March 2007 revision for distribution Whole System Integration Process (WSIP).

**Potential Technologies & Strategies**

- Reinforce corporate/institutional commitments to environmental health and community responsibility.
- Use cross discipline design, decision-making, and charettes. Use goal-setting workshops and build a team approach to the project.
- Prepare checklists for points and strategies prior to beginning the design process; refer to the checklist at milestones during the design process.
- Engage owner, staff, contractors, user groups and community groups, educating them on the benefits of green design and bringing them into the design process at key points in the decision-making process.
- Participate in peer-to-peer information exchange and problem solving with other project teams implementing sustainable design, construction and operations.
- Consider performance-based incentives in professional contracts that reward achievement of Integrative Design Goals and Project Vision. Incentives may be based on life cycle cost-based equipment and material selection, levels of achieve-

ment in LEED, or comparisons to benchmarks of existing facility performance or combinations of these and other benchmarks.

- Contractually apportion professional fees to create specific line items for the Integrative Design Charette and subsequent monitoring and follow-up meetings. Integrative Design may benefit from re-apportioning design fees to provide a higher percentage early in the process leading to stronger integration and streamline in subsequent design stages.
- Consider seeking foundation support for integrative design initiatives.

# LEED Pilot Credit Library

## Pilot Credit 1: Life-Cycle Assessment (LCA) of Building Assemblies and Materials

This credit is available for pilot testing by the following LEED project types:

- New Construction

**(NOTE: If project teams intend to apply for LEED point(s) using this pilot credit, you must register to be considered, *and* receive approval. Upon approval project teams will receive the LEED Pilot Credit Library Evaluation Form, a required document as part of Step 4.**

STEP 1: Read the Credit Language and Reference Guide below, at a minimum, before beginning. The LCA Credit Backgrounder document is also useful; it contains information about Life Cycle Analysis (LCA), the credit's context within LEED, and the methodology used to arrive at LEED point values.

STEP 2: Use the Athena EcoCalculator to calculate and compare the environmental impacts of various material assemblies. Follow the guidance provided by the Athena Institute when using the EcoCalculator. Create Environmental Impact Estimates for your final design assembly.

STEP 3: Log on to the USGBC LEED Credit Calculator. Click on the LEED LCA Credit Calculator 2009 v6 file to begin (or select from your previously saved project files). Copy the results from the Eco Calculator's Summary Table page into the LEED LCA Credit Calculator for each impact category. The LEED LCA Credit Calculator will create LCA Impact Scores and generate the LEED Credits associated with your design(s).

IMPORTANT: The credit values derived from the LEED LCA Credit Calculator are for demonstration and testing purposes only during the Pilot period. All LEED 2009 projects that participate in the piloting of a credit or prerequisite will be awarded 1 point under the Innovation in Design credit 1 or Innovation in Operations Credit 1 after completing the required documentation and uploading it through the IDc1/IOc1 form in LEED Online for verification.

STEP 4: If you intend to submit for a LEED Innovation in Design or Innovation in Operations point, you must complete and submit the LEED Pilot Credit Library Evaluation Form, issued to approved projects, as part of your required documentation for the IDc1/ IOc1 form in LEED Online.

See Credit Language and reference Guide BELOW:

**Intent**

To encourage the use of environmentally preferable building materials and assemblies.

**Requirements**

**Part 1: LCA of Structure and Envelope *Assemblies*** *(Proposed as 5 post-pilot base points reallocated from MR Credit 1.1, MR Credit 4, and MR Credit 5. Pilot projects will only receive 1 point total for this credit.)*

Use an USGBC approved Environmental Impact Calculator[1] to identify and calculate environmental impact estimates for generic assemblies used in the project from the following assembly groups: columns and beams, floors, exterior walls, windows, interior walls, and roofs.[2] Transfer those impact estimates to the USGBC Credit Calculator to produce the LCA impact score and subsequent LEED points to be awarded. This credit is currently available only to projects located in the United States or Canada, since it is based on a database that addresses these regions.

a) Define the basic building type (high- or low-rise), geographic region, and area (square feet) of assemblies in each category.
b) If reusing portions of assemblies in-situ within a renovation of an existing building:
   - For each assembly specified in (a), indicate how many square feet are reused from the existing superstructure.
   - For each reused assembly, indicate the percent of the assembly's component materials that have been reused. Calculate the percent by estimated cost, as if installing a completely new version of the specific assembly. This will allow the Credit Calculator to give 100% credit for reused assembly components.

The Environmental Impact Calculator will:

- Report environmental impact metrics for assemblies specified
- Adjust for the benefits of assembly reuse within existing buildings (if applicable)

The USGBC Credit Calculator will:

- Apply USGBC-defined life cycle impact category weightings to those metrics
- Compare the results to the database average and best possible assemblies
- Provide an LCA score
- Calculate the number of possible LEED points.

Project teams *are not required* to perform LCAs on materials or assemblies, or to analyze LCA results since the Credit Calculator performs these functions based on information provided by the project team.

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[1] Current approved tool is the Athena Institute's Eco-Calculator for Assemblies available at http://www.athenasmi.org/tools/ecoCalculator/index.html. Further explanation can be found in the LCA Credit Background Document available to pilot projects.

[2] Additional information on LCA and the approach and methodology used in this credit can be found in The LCA Backgrounder available to pilot projects.

The credit's LCA does not include the assemblies' impacts on energy use during the building's operation phase. Accordingly, project teams should closely coordinate assembly choices with EA credit 1, Energy Optimization.

**Scoring for Credit Submittals that Specify All Assembly Groups**

For a submittal that specifies an assembly in each of the Credit Calculator's assembly groups, an LCA score (between 0 and 100) will be calculated by the Credit Calculator based on the equation:

LCA Score = 100*(B - S) / (B - T), rounded to the nearest integer, where:

> "B" (benchmark) is the sum, across all assembly categories, of the area-weighted environmental impact scores for the *average (mean) of all assemblies* in each of the assembly categories (area-weighted environmental impact score = area [square footage] of the specified assembly times the environmental impact score per square foot for the average of the assemblies in that group),
>
> "T" is the sum, across all assembly categories, of the area-weighted environmental impact scores for the *best performing assembly* in each of the assembly categories (area-weighted environmental impact score = area [square footage] of the specified assembly times the environmental impact score per square foot for the best performing assembly in that group), and
>
> "S" is the sum, across all assembly categories, of the area-weighted environmental impact scores for the *specified assembly* in each of the assembly categories (area-weighted environmental impact score = area [square footage] of the specified assembly times the environmental impact score per square foot for the specified assembly in that group).

The LCA score is converted into LEED points as follows *(this is theoretical for pilot projects):*

- LCA score 1-14: 1 point
- LCA score 15-28: 2 points
- LCA score 29-42: 3 points
- LCA score 43-56: 4 points
- LCA score 57-70: 5 points
- LCA score 71-84: 5 points + 1 LCA innovation point for exemplary performance
- LCA score 85-100: 5 points + 2 LCA innovation points for exemplary performance

**Scoring for Credit Submittals that Specify a Partial Set of Assembly Groups**

In some cases, an assembly cannot be found in the Credit Calculator because it is not in the Credit Calculator's assembly database. This might occur with a new, innovative approach or material[3]. If a project team cannot find an exact match for an assembly in the Credit Calculator, the area of the unspecified assembly(ies) must be entered into the "Other/Unspecified" line. The Calculator assumes that the LCA performance of an unspecified assembly is equal to the benchmark (average) level of performance for that assembly group. Since the LCA score is based on how much better than average the building's full set of assemblies performs, choosing "Other/ Unspecified" – the average – reduces the total possible LCA score.

## Credit Submittals:

- A screen shot of the LEED point results page from the LCA Credit Calculator. Add username and password for access to the online data file.
- A description of the specified assembly in each of the assembly groups (columns and beams, floors, exterior walls, windows, interior walls, and roofs).
- When claiming credit for in-situ assembly reuse within an existing building, provide a summary describing the reuse.

**STOP HERE!**

Only Step 1 is required to participate in this Pilot. Step 2 language is presented for review only. It will be required when and if this credit becomes an Alternative Compliance Path.

**Part 2: Materials Not Addressed by Part 1 (LCA)** *(Proposed as 2 post-pilot base point. Pilot projects will only receive 1 point total for this credit.)*

An LCA approach is only being applied to structural/ envelope assemblies at this time; LCA for additional assemblies and/ or products might be pursued in future versions of the credit. Therefore, two points (one point each reallocated from MR credits 4 and 5) are available for use within this alternative compliance path, to reflect environmental benefits of recycled and regionally manufactured finishes and other products not addressed in Part 1 of this credit.[4]

- One point is available from this portion of the credit for those projects that use non-structural, non-envelope assembly materials that meet the requirements of MR credit 4 for recycled content and, in total, constitute x% of the total value of all materials in the project. The denominator is the same as in the conventional MR credit 4.
- One point is available for those projects that use non-structural, non-envelope assembly materials that meet the requirements of MR credit 5 for regional materials and, in total, constitute x% of the total value of all materials in the project. The denominator is the same as in the conventional MR credit 5.

[3] It is possible to add new assemblies to the database underlying the LCA Credit Calculator but it can be a lengthy process. Requirements and the process for proposing new assemblies are available at [insert web address].
[4] Consistent with other MR credits, Mechanical, electrical and plumbing components and specialty items such as elevators shall not be included in the calculations. Only include materials permanently installed in the project. Furniture may be included, providing it is included consistently in MR Credits 3-7

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# Appendix #4 – Useful modeling tools

# Useful modeling software tools to integrate

## Tools for modeling building structures and components…

***Envelope:***

Therm - http://windows.lbl.gov/software/therm/therm.html

Window - http://windows.lbl.gov/software/window/window.html

Wuffi - http://www.ornl.gov/sci/ees/etsd/btric/wufi_software.shtml

FramePlus Online - http://tools.enermodal.com/webframeplus/

***Lighting:***

Visual - http://www.visuallightingsoftware.com/

***HVAC systems:***

HAP - http://www.commercial.carrier.com/commercial/hvac/general/1,,CLI1_DIV12_ETI496,00.html

Trace - http://www.trane.com/Commercial/Dna/View.aspx?i=1136

## Tools for modeling building systems and their connections to...

***Whole building energy use:***

DOE2.2 (eQUEST) - http://doe2.com/equest/

Energy Plus - http://apps1.eere.energy.gov/buildings/energyplus/

ESP-r - http://www.esru.strath.ac.uk/Programs/ESP-r.htm

TrnBuild (Trnsys) - http://www.trnsys.com/

***Lighting & daylight:***

AGI32 - http://www.agi32.com/

Ecotect - http://usa.autodesk.com/adsk/servlet/pc/index?id=12602821&siteID=123112

Radiance - http://radsite.lbl.gov/radiance/frameh.html

***Energy source/sink systems (also including "Renewables"):***

Trnsys - http://www.trnsys.com/

RETScreen - http://www.retscreen.net/

## Tools for modeling life-cycle environmental impacts…

***For buildings:***

Impact Estimator & EcoCalculator - http://www.athenasmi.org/about/index.html

BEES - http://www.nist.gov/el/economics/BEESSoftware.cfm

***General LCA:***

GaBi - http://www.gabi-software.com/index.php?id=85&L=6&redirect=1

SimaPro - http://www.pre.nl/simapro/