

## Chapter 4 - European overview of sustainable policies and approaches in COST C25 Member countries

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### 4.1 INTRODUCTION

The implementation of the principles and methods towards a Sustainable Construction varies across different countries in Europe. In some countries, the sustainability of the construction sector has been effectively taken into consideration over the last years, while in other its implementation is at an initial stage. Many reasons may be pointed out for this situation. Different countries have different understandings of what is entailed in Sustainable Construction. Different cultural and educational backgrounds, along with different priorities in each country, are also contributing for the lack of a common European approach.

General frameworks, aiming to cover every aspect of Sustainable Construction and to provide a consistent and integrated approach, such as Agenda 21 for Sustainable Construction, gave a major advance in the search for a common approach for the construction sector. However, general agreed methodologies and tools to make this common approach operational are still missing.

The European Commission has long committed itself to promote and implement actions towards the sustainable development of the construction industry. Over the last years, numerous European Directives have been released in the context of Sustainable Development and Sustainable Construction, which lay down certain provisions to be achieved in every Member State. Then, within a pre-defined period of time, National Authorities have to adapt their laws, or even create new laws, in order to achieve the goals in each Directive. However, each Member State is free to decide how to do so, taking into consideration national situations. Therefore, a long period of time is often needed before European Directives are effectively applied in each Member country. In addition, the consideration of different national contexts may lead to different approaches and policies in each country.

The harmonization of different national approaches requires a strong endeavouring from international organizations for standardization. The International Organization for Standardization and the European Committee for Standardization have been responsible for the development of a series of standards in the area of sustainable buildings and construction assets. Hopefully, the publication of these standards will contribute to a common understanding and effective implementation of sustainable construction objectives in European countries.

This chapter aims to provide an overview of European perspectives of the sustainability of the Construction Sector at the end of Action C25. A survey regarding the current situation in the sector of construction of COST C25 Member countries was performed during the Action, and the final results are presented in the following sections.

The main aspects covered in the survey were: (i) policies and legislation in relation to the implementation of objective measures towards the sustainability of the sector; (ii) sustainable methodologies and tools being used or under development; (iii) use of eco-labels; and (iv) development of national case studies representing sustainable achievements.

## 4.2 SUSTAINABILITY POLICIES AND APPROACHES: THE DUTCH CASE

### 4.2.1 Introduction

In 1990, Sustainable Construction (SuCo) became a policy issue in the Netherlands via the National Environmental Policy Plan Plus of the Ministry of Housing, Spatial Planning and the Environment ([www.vrom.nl](http://www.vrom.nl)). The national and municipal government authorities in majority stimulated the developments of eco-innovations by means of a reasonable coherent mix of policy instruments focused at energy efficiency, sustainable use of resources and health. In line with the internationally agreed UN Millennium Development Goals, the 4<sup>th</sup> National sustainability policy plan (NMP4) 2001 in the Netherlands described the government strategies to achieve a sustainable society within a period of 30 years.

The most important *direct* laws and *regulations* in the field of construction in the Netherlands are the Spatial Planning Law and the Housing Law. The first defines where it is allowed to establish a built environment via spatial planning and zoning schemes, the second defines the criteria for building permit applications and which quality requirements for buildings are included in the Building regulations and building codes.

Only after 1995 a first breakthrough for SuCo took place, when *direct regulations* such as the Energy Performance Norm (EPN) came into force being part of the Building Code. Building permits are only issued when building specifications meet the energy performance requirements expressed in the energy performance coefficient. How this energy efficiency target is achieved is left over to the actors in the CI, which makes this policy instrument highly appreciated by the CI ([www.senternovem.nl/epn/](http://www.senternovem.nl/epn/)).

The building regulations 2003 (Bouwbesluit) define the minimal requirements for safety, health, functionality, energy efficiency and environmental impact. Municipalities and public utility companies are in principle not allowed to set additional technological requirements beyond the 2003 building regulations. Yet there are some municipal regulations such as for example the regulations regarding waste disposal and separation of waste. Besides, some municipalities grant building lots at prices that are based on the level of sustainability of the envisaged building. Other municipalities have a particular regulation with requirements for sustainable building construction (e.g. The Hague, Delft). Municipalities also may establish agreements on sustainable building with housing corporations, utility companies and builders. These have actually no legal enforcement and generally are named Regional Covenants.

*Indirect policy instruments* -largely used in the Dutch SuCo policies- encompass both negative (based on the polluter pays principle) and positive instruments, such as subsidies and tax relief. For (1) consumers there are energy subsidy schemes and for (2) eco-innovators and project developers there are Innovation Subsidies managed by different Ministries.

*Self-regulation instruments* to stimulate SuCo are the Energy Performance Advise (EPA) to stimulate energy saving in existing buildings; DuBo packages (DuBo = Dutch for SuCo); the establishment of a DuBo information centre; the development of sustainability assessment methods and demonstration projects, (e.g. in which designers were pointed at the opportunities of SuCo practices such as Industrial, Flexible, and Demountable (IFD) building methods). DuBo packages were developed to provide information and support to increase awareness and knowledge about SuCo in the form of almost hundred guidelines for SuCo Terms of Reference, Design, Construction, and Use and several prescriptions related to waste & material management. The packages had no legal enforcement power and were mainly applied in combination with DuBo-contracts. These were agreements between municipalities and private companies to adhere to the DuBo guidelines. The packages were rather practical, but too detailed in prescribing how to implement SuCo. Freedom in design and construction was gone, provoking resistance among the building industry. The *DuBo*-information centre for SuCo, was created in collaboration with market parties and research institutes. Several regional SuCo consultants support the DuBo-centre. In the course of time several sustainability assessment methods were developed, such as GreenCalc, a software programme to assess environmental costs throughout the building life cycle. Other tools such GPR are rating tools comparable to the US Leed and UK Bream sustainability rating tools that support communication and decision making in design for SuCo, without prescribing them.

Broad support for the Dutch SuCo policy could have been achieved by its development in close collaboration with the target group. (Bueren and Priemus, 2002). Improvements in SuCo practices thanks to the coherence of the Dutch SuCo policy mix. However the actual results in terms of reduction of environmental pressure by the CI were less significant. Sustainability measures are usually considered in the early phases of new construction projects whilst sustainable maintenance and demolition is often still neglected. (Sunikka and Boon, 2002) The learning effects of demonstration projects appeared too small, since often these projects are not evaluated and if so, then the results are not widely communicated. Klunder (2002) mentions that the decrease of environmental pressure by measures regarding sustainable material utilization is rather limited: 0% by dematerialization and 5% by reusing and recycling of building parts and materials. However 13% decrease of environmental pressure is established by selection of particular materials and industrialized construction and 20% by an increase of the quality and lifespan of the building and building parts. (Klunder, 2002) This underpins the valuable contribution which industrialized construction can have to improve sustainability in the construction industry. The real threat to sustainable building, however, is the lack of market demand. SuCo measures are not adopted and implemented on a large scale and only a small part of the market uses SuCo as a mean to distinguish itself. (Bueren, 2001) A market research in 2001 concluded that there was still not much interest in sustainable building in the Netherlands. (Sunikka and Boon, 2002) Costs, capacity and knowledge amongst construction clients (e.g. housing associations) and acceptance by building users and tenants, are important barriers to sustainable construction. For example only 44% of the interviewed housing corporations mentioned to be interested in having a green image, whereas 41 % said they rarely profile themselves as being sustainable. They indicated that only 33% of their tenants have interest in sustainable building, 49% tenants are only interested to a certain extent and 9% are not interested at all. Moreover the willingness to invest in SuCo is rather limited: only 16% of the tenants are willing to pay extra for environmental measures. It has changed in the meantime, although the actual implementation of SuCo practices in the Netherlands still have not very much taken off.

CI stakeholders do not want to pay for environmental building practices but consider SuCo a collective responsibility of the government. After years of promotion and stimulation of environmental building practices, the Dutch government has decided to chance its policy line into a more commercial approach. From 2004, the market was expected to pick up SuCo.

The sustainability policies as from 2004 are based on principles concerning sustainable development in terms of a balanced situation between social, economic and environmental aspects. This implies 1. Prevention, of. the negative impacts of activities; 2. Fight negative impacts at their source; 3. The polluter pays ; 4. Preventing a negative sustainability balance As Low As Reasonably Achievable (ALARA). The idea is to codify these principles in the Dutch laws (e.g. laws and regulations on environmental protection; spatial planning, transport, energy, technology developments) in line with EU agreements on sustainability. The actual effect on achieving a sustainable situation depends on how the principles are codified in policies in practice. Yet prolongation or even intensifying of the prevailing policies will not be sufficient to meet the ambitions set for sustainability in 2030. There are too many barriers to tackle which can be seen as failures in the prevailing political-economic system in the country.

In the meantime it is understood that sustainable development requires an integrated policy. For example policies focussed at stimulating sustainable urban development, which encompasses a well balanced integrated consideration of social, economic and environmental aspects will be a good basis for the achievement of a sustainable built environment. Within such a framework projects can be developed for sustainable development of different urban areas and individual buildings. The establishment of a sustainable urban development plan then should take place in an integrated manner by involvement of all stakeholders, such as building users, real estate developers, municipalities, designers etc. However this requires a shift in the present building practices. Evidence and theories have shown that such a shift takes time and investment and truly requires policy support. (Egmond, 2009) Government support was and still is an absolute condition to create loyalty to SuCo in the Netherlands. Subsidies for example are considered as an important stimulation measure by the stakeholders in the Dutch construction industry.

Recently the Dutch Ministry of Housing, Spatial Planning and Environment (VROM) put forward that the Netherlands needs to dedicate itself continuously to investments in sustainabil-

ity given the acknowledgement that sustainability is the engine for the economy. Emphasized was that the Dutch government should prioritize sustainability in the overall policies. It is considered a indispensable to stimulate the Dutch industry, population and environmental activists to collaborate to achieve a sustainability agreement that underpins and strengthens coherence between climate, resources, production chains and biodiversity. The Ministry argues that it is thus important to benchmark our prosperity and well-being against the available national social and natural capital, in order to get sustainability out of the non-committal way of thinking. (Huizinga, 2010) These views are thus far not yet reflected in the policies.

The Ministry follows the recommendations of the Dutch Socio-Economic Advisory Board (SER) to concretize sustainability by means of a set of indicators and targets for a long term sustainability strategy, which will be included in the 2<sup>nd</sup> Sustainability Monitor which will be ready at the beginning 2011. Social costs and benefits should be elucidated. Only then the sustainability ambitions and targets of different governmental policies can be compared. An important aspect in the strategies to stimulate sustainability by the Dutch government will be the establishment of a “green” tax system, which already has proven to be successful. The SER also emphasized that sustainability should be considered in line with innovation as well as with the EU programs. The character of integrated aspects of sustainability should be strongly embedded in policy making and the responsibilities for meeting the sustainability targets should be made clear. (<http://www.ser.nl/>) Yet again it has to be said that the realisation of this all depends on the policy views of ruling policymakers of the new government in 2010.

### 4.3 SUSTAINABLE POLICIES AND APPROACHES: THE FINNISH CASE

#### 4.3.1 *Introduction*

Sustainable development has been a part of the Finnish mindset and policies for decades. However, the Government started to support the ecological principles in the beginning of the 1990s including promotion of eco-efficient and sustainable construction. During the 1980s and 1990s, environmental know-how increased in the country and environmental protection yielded good results in a number of sectors. Special emphasis was put on the material and energy intensive industries (forest, basic metal and energy) that characterized the economy. The activities included development of legislation, broad co-operation networking, research programmes, and promotion of voluntary measures. Finland, Sweden and Denmark were among the first countries as regards introduction of environmental management systems.

The Finnish National Commission on Sustainable Development was established in 1993 as a tripartite forum for communication in ecological sustainability and greening the economy. Its task is to promote implementation of sustainable development in Finland. It is co-ordinated by the Ministry of the Environment. Both peak employer organisations and trade union confederations have been active. The national strategy "Towards sustainable choices - A nationally and globally sustainable Finland" was adopted by the Commission and adopted by the Council of State in 2006.

The Academy of Finland launched the Research Programme for Ecological Construction in 1995 that lasted four years. It aimed at discovering the theoretical basis and solution models for the concepts of ecology and sustainable development in construction and the use of constructed areas. The Programme was multidisciplinary and included the fields of architecture, urban and landscape planning, civil and environmental engineering, materials technology, wood science, and ecology (SA 2002).

The Ecologically Sustainable Construction Programme was set up by the Finnish Government in 1998 which aimed to

- decrease the environmental loads of construction and the building stock substantially
- promote environmental knowledge and technology as a national competition factor in the construction sector
- increase the construction and real estate sector's abilities in environmentally based decision making
- increase ecological sustainability in community development.



Participation in this programme was voluntary, but the programme was designed through close co-operation between the authorities and committed stakeholders in the construction and property sectors.

The Finnish Government approved the Long-term Climate and Energy Strategy in 2008. The strategy outlines the definitions, objectives and measures of the Finnish climate and energy policy. Related to the strategy the Ministry of Employment and the Economy set up a committee to prepare measures for energy saving and energy efficiency. The committee proposals concern the community structure and buildings as follows:

#### Community structure

- increasing the effectiveness of the steering of the community structure in accordance with national area utilisation targets
- developing the necessary legislation and instruments for planning and implementation
- drawing up regional climate and energy strategies and genuinely linking them to the steering of land use and the development of transport systems
- improving the coordination of land use and transport in urban regions and taking all levels of zoning into account
- developing planning and assessment methods suited to the assessment of community structure based on common concepts and indicators to support decision-making, by which to evaluate the sustainability of the community structure.

#### Buildings

- speeding up renovation construction by means of well-targeted financial incentives
- extensive introduction of a range of tools and their development as part of the acquisition processes for building planning, use and maintenance
- developing concepts for planning and supporting customer-oriented implementation of renovation construction
- putting public buildings to more efficient use (e.g. using them in alternate turns) and effectively employing appropriate guidance according to existing needs
- providing guidance on energy consumption in an appropriate way to support the activity and decision making
- introducing the best solutions to the markets by taking advantage of the demand mechanisms for new solutions.

Research and development programmes have been an essential mechanism in development of the sustainability approaches for various sectors of the economy and society. The Finnish cluster research programmes started in 1997 as a part of new industrial policy that was based upon economical cluster-concepts. These programmes were organised under several ministries, and searched for a broad co-operation. The Environmental Cluster Research Programme run until 2005 aiming at raising the level of environmental know-how, improving the state of the environment and creating favourable preconditions for entrepreneurship. The preliminary study on eco-efficient construction was conducted in 1999 aiming at definitions and indicators (Häkkinen et al. 1999). The third phase of the programme was focused on infrastructure.

The Centre of Technology and Innovations (Tekes) is the main funding organisation of joint technology research projects. Its ongoing programme Sustainable Communities (2007-2012) aims to generate renewable business activities in designing, constructing and maintaining sustainable and energy efficient areas and buildings. One core theme of the programme is a noticeable improvement in the energy efficiency of buildings and communities as well as the promotion of adopting renewable energy sources.

As part of Finland's national programme to promote sustainable consumption and production, a material efficiency centre has been set. It is connected to Motiva Oy, a company run as an agency of the Ministry of Employment and the Economy, which already provides many expert services promoting energy-efficiency and the use of renewable energy.

Finland strives to promote energy efficiency, the use of renewable energy and reductions in fossil carbon emissions through various national and international climate and energy policies. The European Union has set targets calling on all member states to improve energy efficiency, cut their emissions and obtain more of their energy from renewable sources. At national level, Finland's efforts towards these goals are largely guided by our national climate and energy strategy, related action plans and other national legislation.

Finland is also striving to achieve emission reductions through voluntary means such as energy efficiency agreements and energy audits conducted to identify scope for energy savings. To help achieve the goals of Finland's climate and energy policies, the Government provides significant financial subsidies for energy audits, investments designed to enhance energy efficiency, and schemes involving the adoption of renewable energy and new energy efficient technologies

#### 4.3.2 Methodologies and tools

Several tools that support sustainable building have been developed in Finland. In most cases they are, however, not systematically used to support sustainable approach. More often they are used occasionally, e.g. in development of new concepts or guidelines. In any case they form a good basis for further development.

The Life Cycle Assessment (LCA) of construction products is particularly well developed in Finland. The manufacturers of building materials have additionally established a widely used environmental product declaration system. The first evaluation methods designed for individual buildings to be applied in practice in Finland were related to the "PIMWAG" criteria used in Helsinki's Eco-Viikki housing project. The latest and most advanced Finnish environmental evaluation criteria for assessing existing and new buildings form part of the PromisE environmental classification system.

### EcoProp

VTT Technical Research Centre of Finland has developed a software tool to help property developers and contractors to identify customer and user needs and manage them throughout a building project. The tool is to help especially the pre-design phase of a new building, and for this reason it uses simplified life-cycle cost standard (ISO 15686) and life cycle environmental assessment methods based upon five indicators (ecoprop 2010). It is usable support for communication with all stakeholders.

The ecoprop software is a standalone Windows application, and it has been developed at VTT based on the VTT ProP<sup>®</sup> performance classification (see Figure 1).

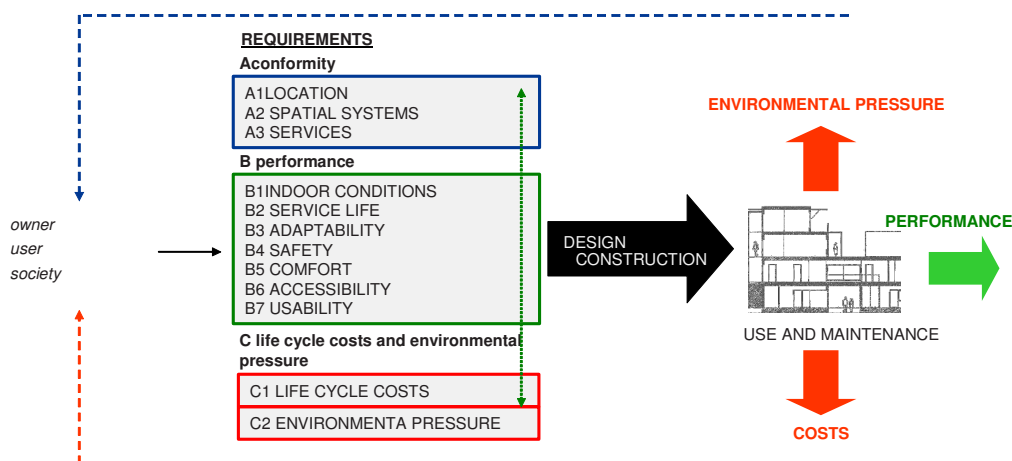


Figure 4.1. The VTTProp hierarchy of the building requirements.

The ecoprop comprises a database of performance requirements and easy-to-use interface to the database. There are a number of requirements definition sets, which correspond to the possible requirements of different project types. The user can select from one to five pre-set performance levels for each requirement and then add own comments. The application provides estimates the life cycle costs of the building. This analysis is based on the cost factors associated with different performance levels and the baseline information of the project. The ecoprop can be used to manage performance requirements for new building projects, and it can also be used to some extent for evaluation the performance levels of existing buildings.

## BeCost

BeCost is a www-based tool for life cycle assessment of building structures and for the whole building. The program includes (VTT 2010):

- environmental profiles, costs and maintenance costs of building materials produced in Finland
- the structures for designing outdoor walls, indoor walls, roofs, floors, etc.
- material quantity calculations;
- environmental profile calculation for designed structure
- result as plot of environmental profile (emissions), energy- and raw-material use, and cost impact for the structure and whole building.

BeCost is an easy to use program - the user should first define the building by making relevant choices, by choosing the structure and materials, by giving the volumes in m<sup>2</sup> and by choosing the service life of the building.

This can be used for different purposes

- to examine the ecological effect of building choices related to materials used and service life of the whole building (designer and constructors use)
- verifying environmental characteristics' fulfilment, if such has been demanded (designer use)
- for owners to examine their building's environmental profiles (owner use)
- checking the affect of care, maintenance and repairing actions on the environment
- comparing environmental profiles of structures having the same functional units and
- comparing environmental impacts of produced- and competing materials in certain structure or building (use of building material producer).

## PromisE

PromisE is an internet-based environmental classification system that has been developed to facilitate evaluations of the environmental properties of buildings in Finnish conditions (YM 2008<sup>b</sup>). The system has two main versions: one for evaluating existing buildings and properties, and the other for use in the construction of new buildings.

The PromisE system grades properties or individual buildings, and different versions can be applied to assess shops or commercial buildings as well as housing. Whole properties are assessed, including areas not built over. Environmental factors are divided into four main groups: health, use of natural resources, ecological impacts and environmental risk management. Each of these main areas includes a total of 35-40 indicators that can be measured numerically or otherwise evaluated. Indicators have been carefully chosen to include the most important environmental impacts of construction, while ensuring that evaluation work does not involve too much time or expense.

The basic data used in evaluations of energy and material consumption includes actual figures, numerical values calculated from plans, or other estimates. Indicators and groups of indicators are weighted according to their overall environmental significance.

After the weighted indicator values are summed, properties are given an overall environmental rating ranging from A to E. The E rating corresponds to the basic levels defined in building regulations, whereas an A rating means that a property's environmental impacts are roughly 50% more favourable overall than those of buildings that merely comply with the regulations.

PromisE has been developed primarily to encourage firms in the property and construction sector to focus on environmental considerations, as well as the technical, functional and financial aspects of construction work. The PromisE system can also be applied in public sector projects, however. Local authorities can apply the system to set targets for use in their own construction projects or in setting contractual conditions for the sale of land with building rights. The system can also be applied in conditions for loans for housing construction schemes.

The following table introduces the categories and indicators included in the PromisE-system for new buildings. The table also shows the weight of different categories and indicators (VTT 2010).

Table 4.1. Indicators included in the PromisE-system

	Weighted value of the indicator		
	Office build-ings	Residential buildings	Retail build-ings
HEALTH OF USERS	25	25	20
Management of indoor climate	35	40	40
Setting of requirements and level of requirements	35	35	30
Quality of design	25	30	35
Quality of supervision and documentation	20	20	15
Quality of real estate management contract	20	15	20
Indoor air quality	30	30	30
Volume of air ventilation	40	25	20
Purity of incoming air	30	30	25
Surface materials emissions	30	45	55
Management of moist damages	30	30	30
Quality of building-physical design	40	30	25
Quality of moist control on site	45	55	65
Quality of building maintenance manual	15	15	10
Illumination	5	0	0
Intensity and uniformity	55	0	0
Prevention of reflections and glare	45	0	0
Consumption of natural resources	30	30	35
Energy consumption	45	40	45
Setting of requirements for energy consumption	15	15	15
Heat consumption	25	40	25
Use of real estate electricity	35	20	35
Energy consumption management	15	15	15
Quality of acceptance inspection	10	10	10
Water consumption	5	10	5
Quality of water distribution system	100	40	100
Water consumption monitoring facilities	0	60	0
Land use	10	10	10
Utilization of existing built environment	55	55	55
Utilization of existing networks	45	45	45
Materials consumption	20	20	20
Total use of raw materials (excluding by-products)	70	55	70
Recycling rate of building materials	30	20	30
Savings in space areas with help of common spaces	0	25	0
Service life	20	20	20
Design service life	20	25	20
Level of carefulness and detail of service life design	30	50	30
Level of adaptability	50	25	50
Environmental loadings	35	35	35
Emissions into air	50	50	45
Environmental impact of building products	25	25	25
Environmental impact from energy use	75	75	75
Wastes	20	20	20
Quality of waste management of building	50	50	50
Quality of waste management on building site	50	50	50
Sewage	0	5	0



Table 4.1. Indicators included in the PromisE-system (cont.)

	Weighted value of the indicator		
	Office build-ings	Residential buildings	Retail build-ings
Environmental loadings (continuation)	35	35	35
Utilization of rain water	0	100	0
Bio-diversity	10	10	10
Soil sealing	30	30	30
Removal of soil materials on site	30	30	30
Value of the building lot with regard to nature protection	30	30	30
Appearance of rare species on site	10	10	10
Environmental loadings from traffic	20	15	25
Level of public transportation services	50	45	60
Vicinity of pedestrian and bicycle routes	35	25	30
Level of other services needed by users	15	30	10
ENVIRONMENTAL RISKS	10	10	10
Environmental risks of building site	35	35	35
Level of purity of building site	100	100	100
Environmental risks of building	65	65	65
Building materials' risks	40	40	25
Risks of refrigerants	0	0	25
Level of environmental risk management on building site	30	30	25
Level of health risk management on building site	30	30	25

### Integrated life cycle tools

Tools of life cycle assessment, energy efficiency assessment, service life assessment, maintenance manual, optimization of refurbishment, and SB rating are important methods in design, use and refurbishment of sustainable buildings. The use of these methods requires the availability of tools and a lot of additional information compared to a traditional building process. In order to rationalize and support the use of methods, those should be integrated with BIM processes.

There are different solutions for integrating Life Cycle Assessment software and Building Information Modelling BIM. VTT has developed prototype software which uses design information represented by IFCs (Industry Foundation Classes) together with separate product information represented in Product Modelling Ontology (PMO) and calculates environmental results by combining the effects of different building elements. IFCs aim at providing an open definition for data structures to capture and exchange information. PMOs are used for describing product classes, properties and interrelationships on products of different complexity levels including standard catalogue items and complex configurable products.

Service life (SL) design needs information about the effect of different parameters. For instance, the ENNUS programs developed at VTT help designers to predict SL and determine parameters that affect the SL. These parameters include materials, details, assembling, outdoor and indoor conditions, use conditions, and care and maintenance. When integrating SL assessment with BIM, the initial data needed for defining the values of parameters should be available through the properties of the model or with help of integrated databases. The latter may concern for example material properties. However, also the design solution itself affects SL. Thus, for example the structural model should include all information about the quality of structures that is needed as initial information for the SL assessment of structures. The structural model software should support the designer to define the structural parameters needed in the assessment of SL.

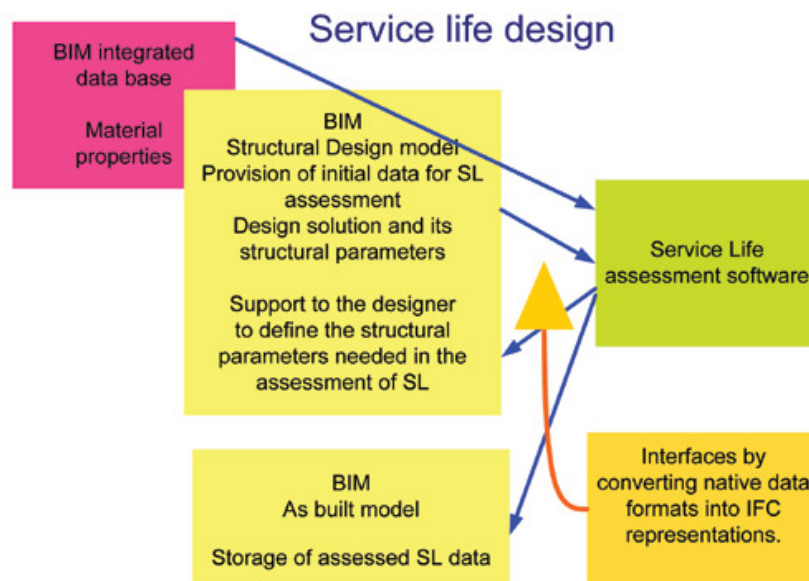


Figure 4.2. Integrated Service Life Design Tools (VTT 2008).

#### 4.3.3 National codes and legislation

Land use, spatial planning and construction are controlled by the Land Use and Building Act in Finland, which came into force in 2000. The Land Use and Building Act aims to

- organise land use and building to create the basis for high quality living environments,
- promote sustainable development,
- ensure open planning and participatory processes,
- ensure that a wide range of planning expertise is available.

#### The Building Code

The Finnish Building Code is given under the Land Use and Building Act, and lays out technical Regulations and Guidelines for new buildings. The Building Code is feature-based, i.e. requirements are mainly set for technical characteristics and the implementation of individual building components.

The most important parts of the Code in relation to energy efficiency in environmental issues are

- insulation regulations governing the implementation of noise insulation, water proofing and thermal insulation of buildings
- regulations on indoor climate, HVAC and energy economy, giving regulations and guidelines on water and sewage systems, ventilation and indoor climate, energy economy in general and efficiency requirements for boilers

The Building Regulations were amended by the Ministry of the Environment in order to comply with the Energy Performance of Buildings Directive of the EU. They became into force from 1 January 2008.

The applicant for the building permit has to verify that the completed building will fulfil the requirements. The building permit will be approved by the local building supervision authority. The energy requirements are the same for all buildings and include

- maximum U-values
- requirement on average insulation level
- requirement on heat losses of the building (building envelope, ventilation and air-tightness)
- requirement on calculation of the energy demand of the building per metre squared of floor area.

The building regulations were updated in 2010; the revision strengthened efficiency requirements, and new buildings built following the revisions are about 30% more energy efficient than earlier.

## Maintenance Manual

A maintenance manual is drawn up during design and execution of a new building in order to give the owner and the user advice on the care and maintenance of both the materials used and the equipment installed. The maintenance manual is used to ensure maintenance of the property and its external areas and to further the correct preparation of property maintenance contracts and the performance of maintenance work. The manual acts as a data management system equivalent to a motor car service book, covering the repair history of the building, details of finishes, maintenance work and timing, and target values for internal air quality and the lifecycle of the building and its component parts.

Compilation of a maintenance manual has been mandatory for state-subsidised housing construction for 5 years. Since 2000 it has been mandatory for all housing and it is also drawn up for the buildings owned by the private sector.

### 4.3.4 Eco-labels and EPDs

The Nordic Council of Ministers adopted a decision in 1989 to introduce a positive, voluntary ecolabelling scheme. An ecolabelling organization was set up in each Nordic country to manage this scheme. In Finland, the standardization organisation SFS is the responsible organisation. The Swan Label ecolabelling scheme is a voluntary system, in which the basic rule is that the requirements imposed must be at least as strict as the relevant requirements imposed by the authorities (Norden 2001).



Figure 4.3. The Nordic Ecolabel applied to construction products, too.

There are several product groups already in the building and construction sector that may apply a licence for the swan mark in accordance with an established criteria document. The requirements are based on environmentally relevant aspects of the life cycle of a product like for example, raw materials, environmental impact of the manufacturing process, operation, use and final disposal. The list of available documents include the following products (Ympäristöuutiset 2009)

- windows and external doors
- chemical construction products like adhesives and sealants
- treated timber
- air heat pumps
- floor coverings
- interior paints and lacquers
- wood burning heaters
- houses and hotels.

The common long term objectives of the Swan label are presented in the following list.

Table 4.2. List of objectives of the Swan label system

Environmental threat	Long-term environmental objective of Swan labelled products
Climate change	A significant reduction in emissions of greenhouse gases that may cause an increase in the temperature of the earth.
Depletion of the ozone layer	A significant reduction in ozone depleting chemicals that may cause increased ultra-violet radiation
Acidification	A significant reduction in emissions of substances that may cause for example acid rain (for example sulphur and nitric oxides) primarily through cleaner technology, secondarily through the treatment of emissions
Local air pollution and noise	A significant reduction in emissions of air pollutants and in noise levels that impact upon the local environment.
Ground level ozone formation	A significant reduction in emissions of chemicals that lead to photochemical ozone formation causing harm to for example human health and vegetation.
Water pollution and overfertilization	A significant reduction in emissions of fertilizers and chemicals that lead to poorer water quality and lack of oxygen.
Emissions of eco-toxins and heavy metals	A significant reduction in chemicals and heavy metals that may build up in the eco system or have an acute toxic effect.
Emission of substances harmful to health	A significant reduction in types of chemicals that may effect human health.
Accumulations of waste and unsorted waste	Minimizing waste generation, increased use of recyclable and readily degradable materials.
The spread of organisms to environments in which they do not belong	Preventing foreign organisms from causing damage to the natural eco system (the precautionary principle).
Reduced biodiversity	Preventing the death of species and the reduction in the genetic resources of the planet.
Radioactive radiation	Preventing and substituting radiation processes that may harm the genetic code of organisms (the precautionary principle).
Excessive use of land and water	Saving living space for the natural eco-system or for use for other activities.
Over-extraction of scarce resources and nonrenewable scarce raw materials	A significant reduction in the use of fossil non-renewable raw materials and rare raw materials that are not returned to the natural cycle.
The use of dangerous technology	A significant reduction in the use of technology that may cause environmental catastrophes, for example in the form of explosions (the precautionary principle).

### EKA Environmental Assessment

EKA is a Finnish national, voluntary method for environmental assessment of building products. VTT formulated the method on the request by The Confederation of Finnish Construction Industries RT. The method describes the principles that should be followed in the environmental assessment of building products and introduces the format of environmental declarations.

The procedure for environmental assessment and declaration of building products includes the following issues (VTT 2010)

- principles for data collection and data handling (Life Cycle Inventory, LCI)
- generic environmental profiles for energy and transportation
- the declaration format
- procedure of environmental assessment; auditing, approval and publication of declarations
- principles that one should follow when using the environmental profiles of building products within building design.

VTT has developed different kinds of tools for the environmental assessment of buildings and products. These tools aid manufacturers to consider environmental aspects in product development and in environmental reporting. Tools has been developed for various materials and products, for example for cements, concrete products, natural stone products, underground structures, masonry products, wood products, flooring materials, building services systems and

HVAC products, and steel products. For example, with help of the BERTTA tool, which has been developed for concrete manufactures, the effect of different kinds of parameters on the environmental profiles of concrete products and structures can be assessed

#### 4.3.5 Case studies

##### 4.3.5.1 Ecological criteria for experimental construction, Viikki

The Viikki housing project near the centre of Helsinki represents a landmark in ecologically sustainable planning and construction in Finland (Huovila et al 2008). It was selected as a testing place of principles that were developed during the 1990s. The area included rural landscape and ecologically sensitive and valuable protected waterfronts.

The City of Helsinki and the Eco-Community Project organized a design competition for experimental building in. The competition was initially organised to find an ecologically sustainable planning model for the whole area. It aimed to save nature and natural resources, to have a high quality with regards to their architecture and functionality of the dwellings, and to be feasible to construct. A group of building consultants devised a tool for the ecological assessment of building plans.

Viikki's ecological criteria is a method that defines minimum ecological levels for building and estimates the ecological degree of various development projects. Minimum ecological levels for building have been dimensioned to enable their implementation in residential construction to be carried out at a reasonable additional cost. The fulfilling of ecological criteria will also enable cost savings during the use period.

In Viikki, ecologically conscious building progressed as a four-step process: a minimum level of ecological criteria applied to all projects, supportive PIMWAG points for significant trial projects with a high expectation value, experimental image buildings representing radical ecological construction, and follow-up studies for mapping information about projects under construction. Examples of the required minimum levels are as follows (difference from reference building)

- CO<sub>2</sub> 3.200 kg/grm<sup>2</sup>, 50 years (- 20 %)
- waste water 125 l/resident/day (- 22 %)
- construction site waste from building 18 kg/grm<sup>2</sup> (- 10%)
- waste produced by residents 160 kg/residence/year (- 20 %).

Detailed planning was done on the basis of the winning proposal, which featured east-west-oriented rows of buildings interspersed alternately with narrower belts of gardens along streets, and wider green belts. Architectural competitions were organised for housing blocks, emphasising the role of ecological innovation and practical environmentally friendly construction design. These competitions attracted plenty of interest from major Finnish construction companies.

##### 4.3.5.2 Business based on recycling of wastes (SKJ Companies)

In Finland there are two steelworks based on blast furnace hot metal production (Raahe and in Koverhar). There are also two steelworks with electric arc furnace technology (Tornio and Imatra). Processes and business models of the steel industry are nowadays developed aiming at eco-efficiency which includes recycling, reduction of waste and emissions and energy-efficiency. Recycling in the steel industry means primarily either returning by-products into metallurgical processes or utilisation of the by-products elsewhere. Efforts towards a waste-free industry have facilitated new activities based on the useful application of by-products.

SKJ Companies, a subsidiary of the Finnish steel group, Rautaruukki Oy, is responsible for utilising the by-products of steel industry. Activities over the whole range of the by-product business from by-product treatment to product development, marketing and export. SKJ has developed into products and is marketing approximately 90% of the by-products of Finnish steel industry totalling about 1.4 million tonnes (Huovila et al 2008). Slags are the largest product group by volume, and they are marketed to road construction, agriculture and the building materials industry.



SKJ companies have activities in the fields of by-product treatment, product development and technology know-how. With regard to the technology know-how SKJ also has activities within export. The primary export countries have been Russia and East European countries.

#### 4.3.5.3 MERA Multistorey Passive House Concept

The Reponen Construction Company executed the first pilot building of its multi-storey Passive House Concept MERA in Espoo in 2005, after a five year development project. The special solution of the building is that there are no radiators but its heating is based on people and appliances even during the most of the winter time. The remaining need is supplied through ventilation. According to a constant monitoring of the building, it is possible to save about 70% of heating costs. The encouraging results from the first pilot building led to a residential building of 7 000 square meters.

The actual costs of construction were only 1,7% higher than those of a normal building. Taking into account that the heating costs can be saved up to 70%, the concept proves to be very favourable. In addition, the indoor air quality can be adjusted as healthy and comfortable.

#### 4.3.5.4 Paroc Passive House Concepts

Paroc Oy Ab has developed a Passive House Concept for the cold climate on the Nordic and Baltic housing market. The concept applies the requirements that were developed in the Promotion of European Passive Houses project (<http://www.europeanpassivehouses.org>) of the European IEE (Intelligent Energy Europe) programme.

Paroc Passive House project included a number of demonstration buildings in Finland and Sweden. These buildings locate from the latitudes of Stockholm and Helsinki up to Polar Circle in the Finnish Lapland. The passive house concept was developed through a process from concept development to solutions for cold climate applications, design and construction and certification. Two of the houses, one in Vantaa nearby Helsinki and in Valkeakoski in Central Finland are also being monitored for performance verification.

Paroc Passive House is a heavy-weight concrete building and Paroc Lupaus is a wooden house (Haikonen et al 2010). An important feature in the process was to ensure that the buildings fulfil the requirements set for a good indoor climate in terms of required ventilation rates, and that the building structures'  $n_{50}$  values for Paroc Passive and Paroc Lupaus were 0,3 1/h and 0,35 1/h according to repeated tests. Hygrothermal performance was assessed by intensive dynamic calculations. The main features of the two passive houses are presented in the following table:

Table 4.3. Characteristics of the two passive-houses

	Requirements Germany	Requirements Vantaa Valkeakoski		Assessment Vantaa Valkeakoski	
Heating demand, kWh/m <sup>2</sup>	≤ 15	≤ 20	≤ 25	18	23
Heat demand, W/m <sup>2</sup>	10		-		-
Primary energy demand, kWh/m <sup>2</sup>	≤ 120	≤ 130	≤ 135	≤ 130	≤ 135
Over heating hours / a Indoor temperature > 25°C, %	10		-		-
Air tightness, $n_{50}$ 1/h	0,6		0,6	0,3	0,35
Functional unit, m <sup>2</sup>	Treated floor area		Gross floor area		Gross floor area
Calculation tool	PHPP		Optional		VTT House/IDA-ICE

#### 4.3.5.5 Eco-efficient renewal of old neighbourhoods

Eco-efficient renewal of the suburb Peltosaari of the city Riihimäki is an example of the Finnish efforts to refurbish technical and functional performance as well as appearance and value of a neighbourhood.

According to an assessment by VTT it is possible to gain a recovery of the value loss of approximately 70 M€ compared to nearby housing areas and even exceeded by a value increase of 100 M€ (Väkevä – Harjula & Nieminen 2010). This requires both thorough refurbishment of the building stock, demolition and re-building of the buildings in poor condition, and development of services, urban comfort and connections to the city centre of Riihimäki. The whole renewal process costs roughly 80 – 90 M€ but at the same time it incurs costs savings in energy costs on the average of 2 M€ a year. The level of present technology allows for at least 70% reduction in heating demand, and at the same time utilization of renewable energy sources in the area. Development of the master plan allows for extensions to buildings and infill construction, thus enabling financing for the renewal. The location close to rail transport can be utilized in developing new jobs and services in the area.

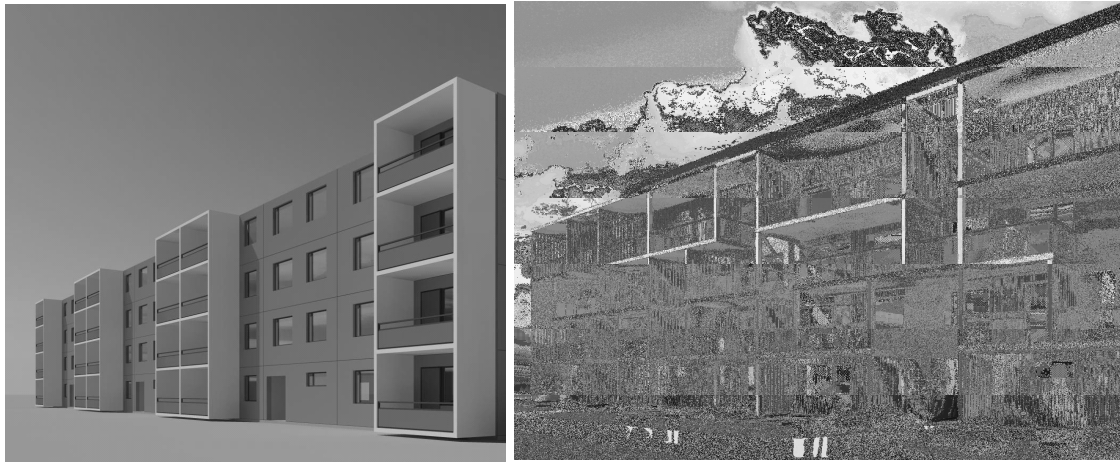


Figure 4.4. Refurbishment can substantially improve the appearance and attractiveness of an old building (Lahti 2010).

Tools available for the city administration are master plan development, site release and rental agreements, other agreements between the city and site owners, organization of ideas and other competitions, co-operation initiatives with various stakeholders, and implementation of innovative development projects.

## 4.4 SUSTAINABLE POLICIES AND APPROACHES: THE GREEK CASE

### 4.4.1 Introduction

In Greece, from an academic point of view, sustainable construction is well-known as a valuable and unique method in order to protect the environment and prevent the waste of energy resources. On the other hand, practitioners and industries have not until now well recognised the necessity and the benefits of an adequate sustainable design. Then again, governments address the issue mainly when the European Community appends targets that must be accomplished (compulsory achievement); thus, Life Cycle Analysis (*LCA*) methodologies, do not concern or interest the current country policy. As a result, only a few objective actions have been accomplished over the last years at a national level. Mainly, most of them concern research studies in universities or research centres. In addition, during the last decade, some sustainable development issues have been adopted in Greece's construction industry, changing the conventional and well-established methods and technology (classified task actions, primarily by large companies). As it is mentioned by *Manoliadis et al.* (2006) the most important influences on sus-

tainable construction in Greece are energy conservation measures, resource conservation strategies and waste reduction.

However, due to the lately shown interest of the European Community on this theme it is expected that in the next years a lot of fields of the construction sector will be dominantly modified. The mandatory compliance of European Directives in member countries at the end will force governments to follow and apply in an efficient way the recognized principles of sustainable construction. For example, the Directive 2002/91/EC on the energy performance of buildings shifts towards the way of recovering the buildings' overall energy efficiency (Papadopoulos and Giama, 2007). Moreover, the continuing spreading of knowledge to the public (scientific and public debates), the competitiveness in several fields of construction have been forcing companies to fulfil special demands (product innovation and certifications, such as green eco-labels or energy-class performance of products) and demonstrate their responsibility in terms of social, economic and environmental aspects. On this basis of potentials, all involved parts can gain a vital profit. It is clear that the accomplishment of the fundamental principles of sustainable construction becomes gradually more significant. *LCA* methods are expected to be employed in order to promote the built environment.

In order to support sustainable development in Greece a small amount of national projects are being developed and elaborated lately. In the next paragraphs, the parts involved in these actions are briefly mentioned (national sites, excluding universities):

- *Ministry of Development* ([www.ypan.gr](http://www.ypan.gr))
- *Ministry for the Environment, Physical Planning and Public Works* ([www.minenv.gr](http://www.minenv.gr))
- *General Secretariat of Research and Technology* ([www.qsrt.gr](http://www.qsrt.gr))
- *Regulatory Authority for Energy* ([www.rae.gr](http://www.rae.gr))
- *Public Power Corporation (PPC)* ([www.dei.gr](http://www.dei.gr))
- *Hellenic Transmission System Operator* ([www.desmie.gr](http://www.desmie.gr))
- *3rd Community Support Framework Programme* ([www.3kps.gr](http://www.3kps.gr))
- *National Statistical Service of Greece* ([www.statistics.gr](http://www.statistics.gr))
- *Greek Solar Industry Association* ([www.ebhe.gr](http://www.ebhe.gr))
- *Photovoltaic Market in Greece* ([www.helapco.gr](http://www.helapco.gr))
- *Greek Association of RES Electricity Producers* ([www.hellasres.gr](http://www.hellasres.gr))
- *Association of Greek Industries*
- *Centre for Renewable Energy Sources (CRES)* ([www.cres.gr](http://www.cres.gr))

*CRES* was founded in 1987 and is a public entity, supervised by the *Ministry of Development*, *General Secretariat of Research and Technology*, and has financial and administrative independence.

The *CRES* is the Greek national entity for the promotion of renewable energy sources, rational use of energy and energy conservation. In the modern demanding energy sector *CRES* is dynamically active, in the frame of the national and community policy and legislation, for the protection of the environment and sustainable development. Working in the state of the art of technology development, *CRES* implements innovative projects and significant activities for the promotion and market penetration of new energy technologies.

Its main goal is the research and promotion of *Renewable Energy Sources (RES)* / *Rational Use of Energy (RUE)* / *Energy Saving (ES)* applications at a national and international level, as well as the support of related activities taking into consideration the principles of sustainable development.

*CRES* operates in two main fields of activity:

(I) as a *Research and Technological Centre* for *RES/RUE/ES*, by developing applied research for the new energy technologies and by technically supporting the market for the penetration and the implementation of these technologies;

(II) as a *National Energy Centre*, working on energy planning and policy for *RES* and *ES* and developing the necessary infrastructure to support the implementation of *RES & ES* investment projects.

In the framework of its mission, *CRES*:

(i) is the official consultant of the Greek government on matters of *RES/RUE/ES* in national policy, strategy and planning;

(ii) carries out applied research and develops innovative technologies which are both technically/economically viable and environment-friendly;

(iii) organises, supervises and carries out demonstration and pilot projects, to promote the above technologies;

(iv) implements commercial *RES/RUE/ES* applications in private sector energy projects, local authorities, professional associations, etc.;

(v) provides technical services and advice, in the form of specialised know-how and information, to third parties;

(vi) disseminates technologies in its areas of expertise and provides reliable information and support to interested organisations and investors;

(vii) organises and/or participates in technical and scientific seminars, educational programmes, specialised training courses, meetings, etc.

#### 4.4.2 Methodologies and tools

First of all, it is important to mention that the Life Cycle Analysis (*LCA*) of a building should not start from the construction stage but from the initial design stage, in which the architect and the consultant confirm a crucial role in adopting more environmentally friendly practices. However, although the design stage affects the whole of the project's life cycle, it does not have any direct environmental impact that can be analysed in a *LCA* context (Sustainable construction, 2006).

Unfortunately, *LCA* methodologies and tools in Greece are still at an initial point, although the growing demand for building certifications is critical. Most engineers and architects pay no attention or have no regard to those sustainable procedures. Nevertheless, there are a few individuals that are familiar with *LCA*. With the intention of carrying out their effort, most of them assume international methodologies or tools; national methodologies or tools are not often developed or applied. When this happens, national foreseen demands are considered. As it is clear, the benefits and importance of *LCA* are still known moderately (limited knowledge). On the other hand, due to economic motives a number of practitioners are familiar with Life Cycle and Cost Analysis (*LCCA*) methodologies and tools.

However, lately national organisations and universities associated to sustainable issues participate in international actions, such as *iiSBE* (International Initiative for a Sustainable Built Environment), *GBC* (Green Building Challenge) and *ECTP* (European Construction Technology Platform). In order to provide a valuable assist to those actions, several methodologies and tools are employed, such as *GBTool*, *BEES*, *ATHENA* and *LEED*. Those methodologies and tools aim to assess the sustainable development and the environmental performance of the urban environment. More specifically, *GBTool* is the software implementation of Green Building Challenge (*GBC*) method. *GBC* method is the method for the assessment of buildings' environmental performance and profile. *GBTool* can be thoroughly adjusted to the special conditions deriving from any type of building and from the characteristics, needs and priorities of every region (*iiSBE*, 2004). Moreover, *BEES* (Building for Environmental and Economic Sustainability) deals with the environmental and economic profile of building materials. In this software a database with information about the environmental and economic profile of the most commonly used building materials is included (Lippiat, 2002). Additionally, *ATHENA* has been developed and designed in order to perform life cycle assessment of buildings (basically North American). Extracted results provide valuable information about several environmental issues, such as en-



ergy, raw materials or water consumption, emissions to the air, water or soil, etc. Finally, the method *LEED* (Leadership in Energy and Environmental Design) is a rating system, which aims to estimate the environmental performance of a building; hence, *LEED* is not a software tool). In order to take a credit, the building must fulfill some special conditions, which in turn are achieved with committing the appropriate actions, given by this rating system. Eventually, the building is characterized as certified, silver, gold or platinum, according to the total points it achieves (U.S. Green building council, 2001).

At this present stage, in the *Laboratory of Building Construction & Building Physics* of the *Aristotle University of Thessaloniki*, *SimaPro 7.1* (LCA software) and *Ecoinvent 2* (life cycle inventory database), have been adopted. *SimaPro* is a vital tool in order to collect, analyze and monitor the environmental performance of building components or entire building assemblies. Therefore, it is possible to model and analyze complex life cycles in an easy, precise, systematic and flexible way, following the *ISO 14040* series recommendations. In the near future, it is intended to employ this program together with the previously mentioned database for the purpose of assessing thoroughly the environmental impact of building components or under-construction buildings. It is essential to point out that the database should be initially modified and adjusted, due to several dissimilar industrial processes that are valid in Greece.

#### 4.4.3 National codes and legislation

The demand to improve the energy behaviour and dynamic thermal response of buildings is primarily defined by the necessity to reduce the energy consumed by *HVAC* units. Therefore, the energy requirements in the building sector represent a major fraction of the annual final energy use in Europe (approximately 40%). In Greece, the under development legislative framework concerning the thermal insulation regulations of buildings aims to improve and optimise the environmental performance and sustainability of existing and under construction building envelopes (quality of urban environment). Thus, these regulations that concern the rational use and energy saving of buildings will take into account the fundamental principles of buildings' bioclimatic design. In addition, these regulations will be in conformation with the European Union guides *SAVE 93/76/EE* (stabilisation and restriction of  $CO_2$  emissions due to the energy performance of buildings). Moreover, the compliance and adoption of an energy conscious design of buildings can reduce the quantities of fossil fuels consumed and consequently condense the amounts of emitted  $CO_2$  and  $SO_2$  into the atmosphere. These under development national regulations (national code) are assigned to *CRES* under the supervision of the *Ministry for the Environment, Physical Planning and Public Works*.

Furthermore, it is useful to mention that during the last few years several industries and producers of construction material or building products, such as ceramic bricks or concrete, have begun to follow and fulfil the standardisation *CEN/TC350*. Thus, in Europe a series of standards is being developed by *CEN/TC350* to support the sustainability assessment of construction products and the built environment. The aim of the effort of *CEN/TC350* is to provide a framework with principles, requirements and guidelines for the development of standards to support the sustainability assessment of 'construction works'. As it is clear, this standard is related to sustainability of construction works, while it enables the exchange of sustainability information of products and services. The *CEN/TC350* standard takes into account the associated *ISO* standards and *CEN* documents, as well as to *EU* policies and directives (mandate *M/350*). In order to assess the environmental performance of complete buildings, based on aggregation of their components, this standard is intended to be forced as a compulsory condition for all *EC* countries.

#### 4.4.4 Eco-labels and EPDs

Eco-labels signify green products and services. The most regular eco-label in Greece is the European Eco-label (EU Eco-label, [www.ec.europa.eu/environment/ecolabel](http://www.ec.europa.eu/environment/ecolabel)), which is indicated by the flower. The EU Eco-label scheme (new Regulation *{EC} No 1980/2000*) is part of a wider approach on Integrated Product Policy (*IPP*) within the current Action Programme (contribute to sustainable development). It is a voluntary scheme designed to encourage businesses to market products and services that are kinder to the environment and for European



consumers - including public and private purchasers - to easily identify them (greener products). The European eco-label is part of a broader strategy aimed at promoting sustainable consumption and production. In the main, in Greece eco-labels are not used for construction materials, buildings or other constructions. Hence, eco-labels are broadly used mostly for indoor paints and varnishes.

The overall goal of an Environmental Product Declaration (*EPD*) is to provide relevant, verified and comparable information to meet various customer and market needs. The international *EPD* system has the ambition to help and support organisations to communicate the environmental performance of their products (goods and services) in a credible and understandable way ([www.environdec.com](http://www.environdec.com)). At this time *EPDs* for construction materials and products are not developed or used in Greece. However, it is expected that their consideration will turn out to be existing in a little while.

#### 4.4.5 Case studies

Several case studies on the construction sector are conducted in the Greek region. Some of them are shortly described in the following paragraphs.

##### 4.4.5.1 Buildings' environmental performance assessment with the use of GBC method (Giarma et al., 2005)

This study was conducted by *C. Giarma, T. Koimtsidou and D.K. Bikas*, in the *Laboratory of Building Construction & Building Physics*, of the *Department of Civil Engineering (Aristotle University of Thessaloniki, Greece)*. In the context of this study the environmental performance of an office building in northern Greece was assessed. This building was chosen to be studied on the basis that sustainability principles and environmentally friendly strategies and measures were applied in the context of its design and construction. The aim of this study was to explore the possibility of using a thorough and flexible tool such as *GBTool* for the environmental performance assessment of buildings in Greece, as well as to demonstrate the improvement of a building's environmental performance that results from the application of environmentally friendly measures (passive solar systems etc.). The results and the conclusions of this study were analytically presented.

##### 4.4.5.1 Investigating the impact of urban context on the environmental performance of buildings (Tsikaloudaki and Giarma, 2005)

This analysis was conducted by *K. Tsikaloudaki and C. Giarma*, in the *Laboratory of Building Construction & Building Physics*, of the *Department of Civil Engineering (Aristotle University of Thessaloniki, Greece)*. The study focused on the environmental performance assessment of buildings in the urban context. Criteria for this assessment were not only conventional issues, such as the energy profile of buildings, but also matters regarding resource consumption, environmental loadings, indoor air quality, etc. The evaluation was conducted by means of the *GBTool*, developed by *iiSBE*. The parametric analysis concerned an office building, taken as the reference case, while the variables were the density and the geometry of the urban context, expressed as a range of view angles of the surrounding buildings for different parts of the urban nest. The results were diagrammatically displayed and lead to conclusions regarding the issues and the categories of the environmental performance of buildings, which are mostly affected by the urban context layout.

##### 4.4.5.2 Towards the effective use of a modified version of GBTool for the environmental performance assessment of buildings in Greece (Giarma and Bikas, 2005)

This analysis was conducted by *C. Giarma and D.K. Bikas*, in the *Laboratory of Building Construction & Building Physics*, of the *Department of Civil Engineering (Aristotle University of Thessaloniki, Greece)*. In this study, the experience derived from a few attempts to use *GBTool*, a buildings' environmental performance assessment tool developed by *iiSBE*, for the evaluation of the environmental profile of a building in Greece is presented. After a short presentation of the tool and the changes in its latest version, the interest was focused on the lack of databases,

regulations and other data in Greece, as it was revealed through the difficulties that came up during the assessment procedure. Based on these observations, the authors suggested a series of actions towards the creation of the appropriate conditions for the effective use of *GBTTool*. Keeping in mind that the use of such tools by building designers in every day practice is of great importance, suggestions for the modification of *GBTTool* aiming at the simplification of its use were made.

#### *4.4.5.3 Lifetime parameters in the assessment methodologies for the buildings' environmental performance (Safouri et al., 2005)*

This analysis was conducted by *G. Safouri, C. Giarma and D.K. Bikas*, in the *Laboratory of Building Construction & Building Physics*, of the *Department of Civil Engineering (Aristotle University of Thessaloniki, Greece)*. The vast majority of the tools assessing buildings' environmental performance ignore, more or less, the lifetime parameters. The assessments they perform are based on initial conditions and characteristics. The alterations of the building elements' attributes are not taken into consideration. Consequently, the evaluations' results are a "photograph" of the environmental profile of the building at time "0". Most of the assessment tools result in a static profile of a building by the time it is built, while a realistic evaluation should take into consideration the dynamic nature of the phenomena. Based on the previous observations, the authors tried to make a more systematic approach to this subject. In the paper, some of the most commonly used tools were examined under the prism of the integration of time into their philosophy. The observations were commented. Issues and parameters that should be included in the tools, so that time is in fact taken into consideration were noted, while various ways of integrating these parameters into the structure of the tools, without creating extra complexity for the user, were suggested.

#### *4.4.5.4 A study of the effect of the use of photovoltaic technology on the environmental performance of a building in northern Greece (Bikas et al., 2005)*

This analysis was conducted by *D.K. Bikas, C. Giarma and M. Papalexandrou*, in the *Laboratory of Building Construction & Building Physics*, of the *Department of Civil Engineering (Aristotle University of Thessaloniki, Greece)*. In this paper, a parametric study was presented, concerning the effect of application of photovoltaic elements onto a building in Northern Greece, on its environmental profile. The integration of photovoltaic elements into every surface of the building (facades, roof), successively, were considered. Using a simplified tool, the photovoltaic elements' annual energy output was calculated, depending, among others, on the surface area of the elements, the orientation of the façade, the solar radiation data of the region and the type of photovoltaic element. The results were used as input data for *GBTTool*. The building's environmental performance was evaluated for each case considered and the results are compared. The initial evaluation of the building (real building / no photovoltaic elements integrated) was used as an additional case, so that the contribution of photovoltaic technology's application to the improvement of the building's environmental performance was enlightened. The results and the differences among them for the cases considered appearing during the comparisons were discussed and several conclusions were extracted.

#### *4.4.5.5 Environmental performance evaluation of thermal insulation materials and its impact on the building (Papadopoulos and Giama, 2007)*

This study was performed by *A.M. Papadopoulos and E. Giama*, in the *Laboratory of Heat Transfer & Environmental Engineering*, of the *Department of Mechanical Engineering (Aristotle University of Thessaloniki, Greece)*. The objective of this work was to investigate the environmental performance of buildings on the basis of the selected insulation materials. Inorganic fibrous materials and organic foamy ones was the subject of this study. The two materials' production process was registered and evaluated based on environmental criteria with *LCA*'s implementation which was supported by the model *GEMIS* model. The results obtained were used to set operating performance indicators and environmental condition indicators based on the *ISO 14031* standard guidelines and carry out the environmental performance evaluation (*EPE*) for both assumed materials. In addition, the life cycle of materials against the

life cycle of a building was investigated and expressed on the basis of energy consumption indicators. Hence, the extracted results for both assumed insulation material types show an immense interest from an environmental point of view.

## 4.5 SUSTAINABLE POLICIES AND APPROACHES: THE ITALIAN CASE

### 4.5.1 Introduction

In Italy the use of Life Cycle Assessment (LCA) presents some delays in every application sector and thus also in the construction sector. Private and public structures have low sensibility to utilize the LCA to give more efficient to the sustainability policies and better react to the new regulations framework. The active structures in the LCA field is narrower than some other countries and an important Italian defect is the episodic nature of the numerous experiences in the LCA applications.

In the last years some national initiatives, however, started to focus on the most relevant research and application of LCA in national policies on energy, in environment and industry activities, also developing some communication instruments to diffuse the knowledge and rules of the LCA. One example of the Italian channel for the technical and scientific divulgation of LCA methodology is the LCA Italian Network. It is an initiative aimed at promoting the dissemination of LCA methodology through the creation of a network to exchange knowledge, information, methods and good practices on LCA state of the art and perspectives in Italy. The initiative is promoted and coordinated by ENEA (Italian National Agency for New Technologies, Energy and the Environment), with the support of the Ministry of Environment. The network involves the main Italian experts of LCA systems (universities and research centers, consultants, companies, national and regional agencies, etc.). The network has an informal nature based on voluntary contribution of participants. A website has been implemented ([www.reteitalianalca.it](http://www.reteitalianalca.it)), and it provides information services (website, newsletter, mailing list, ect.), working groups, annual meetings and annual surveys on the Italian LCA situation. In particular in the 2010 the LCA Italian Network wrote the last National map of LCA teams and activities.

The map of the teams active in Italy was developed based on a survey of nature, dimension of the teams, type of activity, application fields, development perspectives, etc. A questionnaire was available on line at the LCA network website. 47 questionnaires were registered from which result the following information. The following data are a meaning, but partial, survey of actual national LCA activities present in Italy:

- Groups are divided into five classes according to their institutional nature: University: 51%; consultancy: 28%; research agencies: 19%; enterprises: 2%.

- In the classes are considered the different number of people: class A (1-5 people), 36 structures (77%); class B (6-10 people), 7 structures (15%); class C (11-15 people), 3 structures (6%); class D (> 15 persons), 1 structures (2%).

- Areas of expertise/application recorded on the basis of activities and projects carried out in the last two years. Sectors with more applicants are: energy (19), waste management (19), construction (17) and the food sector (16).

- Fields and rules for the application of LCA methodology are classified into four categories: LCA studies, development of methodologies, development of tools, use of LCA as support for certification (EPD, energy);

- Tools for sustainability: was considered in the application of the different instruments of sustainability, taking into account that each group can occupy even more themes simultaneously. These tools have been detected: ecodesign, GPP, innovative technologies, development of guidelines and other tools with LCA approach (LCC, environmental accounting, industrial ecology, multicriteria analysis, etc..)

- International collaborations: Distribution partnerships, projects and/or international activities.

- Geographic distribution: the distribution of groups on the territories and their institutional nature are analyzed.

Table 4.4. Specialization area of the LCA teams in Italy.

LCA applications	Number of applications
LCA studies	42
Certification support	22
Methodology development	12
Tool development	11
<b>IPP tools</b>	
Ecodesign	20
EMS (Environmental Management Systems)	17
Life cycle approach model or methods	17
Guidelines	8
Innovative technologies	5
GPP (green public procurement)	

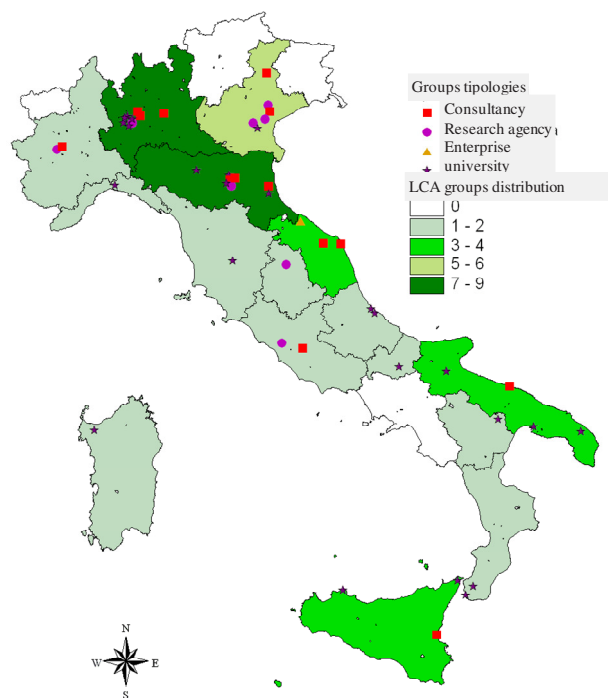


Figure 4.5. The distribution of groups on the Italian territories and their institutional nature (Cappellaro and Scalbi, 2010a).

#### 4.5.2 Methodologies and tools

In Italy the main international methodologies and tools for LCA analyses are used. They are inserted in the principal commercial (and/or not commercial) software and they are applied to many sectors. Italy is late for national database in many fields, but in particular in the construction field.

The actual developing situation in Italy about the use of LCA in different sectors also involves the develop of Italian database. In the present, for instance, the Marche Region and ITACA (Institute for the transparency of contracts and of the environmental compatibility) are developing an Italian LCA database of building materials. The database represents an institutional project to define the first national inventory. The goal of the regionalized LCA database is to provide a sound basis for eco-preferred building materials.

Due to a lack of Italian LCI data, the first step of the database development has been the screening of existing databases (e.g. Ecoinvent, BRE, INIES, VTT, INES, Italian EPDs) on useful inventory data for the selected building materials. In the next step, environmental hot spots have been identified (energy, transport, production and waste disposal) which have been sub-

ject to regionalization studies, in order to understand how to adapt the selected LCIs to the Italian situation.

The result of the regionalization is an Italian LCA database of 128 building materials, what is not meant to be static, but a database that will develop in time adding primary data of individual companies, eager to get their product published in a public database of eco-preferred building materials. The LCIA method has been partially regionalized by selecting existing and meaningful environmental indicators in relation to the Italian building sector. The MCA has been developed for the selection of eco-preferred building materials, giving evidence to both the mean and the deviation of the indicator scores.

#### 4.5.3 *National codes and legislation*

The Italian Public Administrations know that sustainability criteria have to insert in Regional construction standards and laws, because they have to join with Agenda 21. This necessary involves the insertion of sustainability incentives in terms of volumes, energy efficiency, ect. Some years ago the Italian Regions and Provinces instituted the ITACA, the Association of Italian Regions and Provinces. Its goal is to promote the innovation and environmental compatibility of public works. In the year 2004, the ITACA Protocol was approved by the Conference of the Presidents of the Italian Regions. The ITACA Protocol was then updated in 2005 and in 2007 with the definition of a simplified version. The different Italian Regions have to define their own local regulations and customize the ITACA Protocol to their territories. The Marche Region has been the first region to customize the Protocol in 2009. The criteria of evaluation are organized in thematic areas: Site, Consumption of the resources, environmental Loads, environmental Quality indoor, Quality of the service, social - economic Aspects. The value zero represents the minimum acceptable performance determined in reference to the Italian technical rules and the legislation in force or to the constructive standard procedure. In the scale of the scores the number 3 represents the best available constructive practice, the number 5 the excellence.

The certification process provides an auto-evaluation from the designing group that is analyzed and validated by certification body through accredited auditors. The conclusion of the certification process takes place with the issue of the certificate ITACA Protocol by the SBC Italia (Sustainable Building Council).

#### 4.5.4 *Eco-labels and EPDs*

The section of the Italian Economic Develop Ministry, that is defining the building energy certification guidelines, is also analyzing the rules for an environmental certification for buildings. In Italy many building materials and elements had the Ecolabel certification.

Products in the world that have been awarded the eco-EPD (Environmental Product Declaration) are 511. They were analyzed with Norwegian, Swedish, Japanese and South Korean methodologies. In Italy the Swedish and Norwegian systems were only applied: 5 Italian products have received the EPD with the Norwegian system, against the 141 Norwegians. 52 Italian products have received the EPD with the Swedish system, against the 49 Swedes. Globally, the sector that scored the highest number of Environmental Product Declarations is to engineering industry, while considering the only Italy the sector that has gotten more brands EPD is the building materials.

#### 4.5.5 *Case studies*

Many case studies are conducted in Italy in many sectors and in particular in construction sector. The important data is that case studies were developed for materials, elements and entire constructions. In the following table a list of recent Italian LCA case studies of material and element for construction or entire constructions is shown together the principal news of the relative groups of research.



Table 4.5. Case-studies.

Name	Type of organization	LCA			Description of case studies
		Case study	Develop of Methodologies	Certification support (EPD, energetic efficiency, Eco-label, ...)	
CE.Si.S.P.: Centre for the Development of Products Sustainability	University	yes	yes	yes	<ul style="list-style-type: none"> <li>- Research project in the field of energy recovery from waste-AITEC (Italian Technical and Economic Cement Association)</li> <li>- Research project in the field of EPD for cement products - AITEC (Italian Technical and Economic Cement Association)</li> <li>- LCA of Reinforcement products in Glass Yarn – Saint Gobain Revetex &amp; STAR (Advanced Technological Risk Systems)</li> <li>- CORDATA Project, funded by the Pro.Di.G.A. programme of Toscana region: Streamlined LCA on the wood frames</li> </ul>
BEST: Building Environment Science & Technology. Politecnico di Milano	University	yes	no	yes	<ul style="list-style-type: none"> <li>- Thermal performances and environmental behavior of masonry units (ANDIL)</li> <li>- LCA application on metal external surface covering (MIUR)</li> <li>- LCA application of iron elements for construction (ACAD)</li> </ul>
Dip. di Tecnologie per l'Ambiente Costruito Università di Chieti-Pescara	University	yes	yes	yes	<ul style="list-style-type: none"> <li>- Guideline for a LCA approach in construction field (several case studies for materials and elements construction and entire constructions (Neri, 2008)</li> </ul>
DREAM: Dip di Ricerche Energetiche ed Ambientali. Università di Palermo	University	yes	yes	yes	<ul style="list-style-type: none"> <li>- Sustainable energy system ecobuildings "bringing Retrofit innovation to application in public buildings - BRITA</li> <li>- Building Energy Performance: A LCA Case Study of kenaf-fibres insulation board</li> <li>- "Net Zero Energy Buildings" - International Energy Agency</li> </ul>
Faculty of Architecture University of Reggio Calabria STAFAs	University	yes	yes	yes	<ul style="list-style-type: none"> <li>- LCA application for porized bricks</li> </ul>
University of Reggio Calabria	University	yes	yes	yes	<ul style="list-style-type: none"> <li>- A model for the evaluation of building sustainability in agrifood industry.</li> </ul>

List of other corporations:

- Ambiente Italia srl - Istituto di Ricerche
- CIRIAF - Centro Interuniversitario di Ricerca sull'Inquinamento da Agenti Fisici
- CNR - National Research Council
- Consorzio TRE - Tecnologie per il Recupero edilizio
- Consorzio Venezia Ricerche
- Enea - Italian National agency for new technologies, Energy and sustainable economic development
- LCA-lab
- SiTI - Istituto Superiore sui Sistemi Territoriali per l'Innovazione
- 2B

## 4.6 SUSTAINABLE POLICIES AND APPROACHES: THE NORWEGIAN CASE

### 4.6.1 Introduction

Environmental issues, and later sustainability, have been on the agenda in Norway some decades, and this is also reflected in the construction sector. Requirements from user and clients, as well as policy and regulations, have led to changes in attitude and solutions among the actors. In the period 1972-1990 energy savings was the important issue, but also indoor climate and use of hazardous substances have been emphasized.

#### 4.6.1.1 Government initiatives - policy

The environmental challenges faced by the housing and building sector, was initially described in St.meld. no.28 (1997-1998), “Habitat follow-up”, the Ministry of Local Government and Regional Development’s Environmental Action Plan for 2001-2004, and St.meld. no.23(2003-2004) On Housing Policy (Boligmeldingen).

One of the overall goals of housing and construction policy is to ensure healthy and environmentally sustainable building. Ministry of Local Government and Regional Development’s Environmental Action Plan for 2001-2004 defined 6 targeted areas, and these are also elaborated in St.prp no.1 (2004-2005) of the Ministry of Local Government and Regional Development. The Housing Proposition identifies six priority areas;

- To enhance spatial efficiency and attention to biodiversity
- To reduce energy consumption in the building stock
- To document and reduce the use of hazardous substances in construction
- To reduce construction waste and increase recycling /re-use of materials
- To focus on high quality and good building style in the built environment
- To ensure environmentally sound building management and maintenance

Further the Accessibility for all shall be ensured by the principle of Universal Design. The same six priorities are used in Environmental Action Plan for the housing and construction sector, 2005-2008

#### 4.6.1.2 The Norwegian State Housing Bank

As the government and the parliament determine the national housing policy goals, the legislative and the financial framework, the State Housing Bank (HB) is the implementing agency and provides loans, grants and guidance as well as initiates new development and research. HB works closely with local authorities and the private sector to improve the quality of housing on the housing market in general, which is dominated by direct and indirect (co-operative) home ownership (77%). It does this through financial incentives, working with public authorities to develop suitable standards and building skills and participating in negotiations and discussions with all parties involved in development. Particular weight is given to the promotion of universal design and environmentally friendly solutions in the housing and building sectors. HB also works to promote aesthetic housing and building design.

The State Housing Bank supports capacity building, and gives grants that shall be used, amongst other purposes, to stimulate environmental measures in housing and construction. The Bank collaborates with municipalities and others in the construction sector to achieve its aims, and priority are given to projects that have a high degree of relevance for others and which can, over time, contribute to achieving national environmental goals. Particularly ambitious experimental and pilot projects may be given grants in addition to mortgages, up to 90 % of costs. Amongst other themes, the Bank has provided support to:

- development of low energy housing
- massive wood construction applied in “passive” houses
- development of environmental technology for housing and buildings
- develop systems for energy-branding
- environmentally friendly maintenance and management
- life cycle costing and durability
- user-friendly internet databases for selection of ecological materials and building components
- a database of best practice sustainable buildings
- recycling / re-use of building materials and products
- international cooperation

The Housing Bank has established [lavenergiboliger.no](http://lavenergiboliger.no) (low energy houses), where information for achieving low energy houses, with examples and pilot houses.

#### *4.6.1.3 Sustainability in infrastructure*

The Norwegian Roads Recycling R&D Program was a four-year (2002 - 2005) research and development program with the main objective to facilitate the use of recycled materials in road construction. The project was operated by the Road Technology Department at the Directorate of Public Roads.

The most important topic today is climate adaptation.

#### *4.6.1.4 Energy use*

Enova SF is owned by the Ministry of Petroleum and Energy (MPE). It was established to take a leading role in promoting environmentally friendly restructuring of energy consumption and energy generation in Norway. Enova's goal is to make it easier for public and private enterprises to choose simple, energy-efficient and environmentally correct solutions. The goals are improved energy efficiency, more flexibility in the energy supply and decreased dependence on direct electricity for heating, and an increased share of renewable energy sources, other than large hydropower, in the energy supply mix are key features of Norwegian energy policy.

Enova's objectives, adopted by the Norwegian Parliament in the spring of 2000, are:

- to limit energy use considerably more than if developments were allowed to continue unchecked
- to increase annual use of water-based central heating based on new renewable energy sources, heat pumps and waste heat of 4 TWh by the year 2010
- to install wind power capacity of 3 TWh by the year 2010
- increase environmentally friendly land-based use of natural gas

Enova focuses its efforts on both the energy supply and the energy demand side, and the development and adoption of reliable methodologies for performance measurement and verification of results are high priorities.

Each year in Norway, about NOK 130 billion (15 billion €) is spent on new construction and rehabilitation of existing buildings. These investments impact how future energy solutions are shaped by establishing a framework for how energy consumption can be managed.

ENOVAs support program aims to contribute to lasting changes within the built environment market sector. The projects covered under the program include both existing and new commercial and residential buildings, as well as construction projects such as water supply and sewage

systems, road lighting and sports facilities. Enova prioritizes projects that yield a high kWh result relative to the needed financial support.

The target group is people who make decisions and investments in projects with energy goals. Advisors, architects, contractors, manufacturers and suppliers of goods are important drivers for developing and implementing the projects. Advisors and other competent actors can apply on behalf of a project owner when the application is sufficiently established with the project owner.

#### 4.6.1.5 Industry initiatives

The construction sector have had energy savings, environmental issues and sustainability on the agenda for some decades, but more emphasised through the The EcoBuild programme, a five-year programme (1998-2002) which intended to increase eco-efficiency in the Norwegian building and real estate sector. The industry itself took in 1997 the initiative to establish the programme in order to co-ordinate increasing environmental activities. Funding has been split evenly between the industry and government (four different ministries). The focus in the programme, and in following activities and projects, was:

- energy efficiency
- material efficiency
- waste
- hazardous chemicals
- indoor air quality

Partly as a follow-up activity, Byggemiljø (Building Environment) was established to be the buildings and construction industries environmental secretariat which has the objective to do dissemination and communication of environmental friendly solution to increase the knowledge and improve practice within industry and government associated to the construction industry. This is a reciprocal binding cooperation for the period 2005-2009.

The first national action plan for construction and Demolition Waste was made in 2000, as a cooperation between the different construction industries. The action plan describes the industries own targets and 27 measures to reach these targets. The targets were

- All environmentally hazardous waste should be handled in a safe and secure way
- No waste should be illegally disposed
- By the end of 2005 should no more than 30 % of construction waste be disposed
- By the end of 2005 should new buildings be planned so
  - Amount of waste are less than 50 % compared to 1998 level
  - Source separation when possible as an integrated part of the construction work
  - Every building should be planned with the thought of reuse of material and environmental friendly demolition

When updating the action plan for the period 2007-2012, the ambitions were higher, and before 2012 at least 80 % of the C&DW should be recycled or reused.

#### 4.6.1.6 Green taxation

Norway has a long experience with environmental taxation. Taxes have been introduced to reduce environmentally harmful emissions to air and water, and to reduce the amount of waste generated. Taxation had of course an environmental impact long before taxes was established as an instrument in environmental policy. Already in 1931 Norway introduced a petrol tax. The first tax that had an explicit environmental purpose was levied on sulphur in mineral oil in 1971. However, a wide-spread use of environmental taxes was not seen until the late 1980s and early 1990s. Taxes on mineral fertilisers, pesticides and lubricant oil were introduced in 1988, CO<sub>2</sub> tax on petrol, auto diesel oil, mineral oil and the petroleum sector (only offshore) in 1991, while the sulphur tax on mineral oil was increased substantially. Since the early 1990s tax instruments have played an important role in providing incentives for cleaner production and consumption patterns, even though regulation has remained the main policy instrument to abate environmental damage.

Environmental taxes are imposed to use of fossil fuel, waste, health and environmental hazardous substances, greenhouse gasses, and package.

#### 4.6.2 Methodologies and tools

Several tools for environmental assessment of buildings, construction and built environment, and also for decision support in planning and design, have been developed and introduced in the Norwegian market. With a more global construction industry, where the larger developers are working in more countries, also international assessment systems, as LEED and BREEAM, are introduced on the Norwegian market.

##### 4.6.2.1 Ecoprofile

Ecoprofile for buildings started in 1994 when the Environmental Protection Department created a branch based, public steering committee for the development of a national method for environmental assessment of buildings. The method was meant to be used in the purchase and take-over of existing buildings, in connection with project engineering and renovations, additions and building of new buildings. The method was tested on 11 large commercial buildings in a pilot project in the fall of 1995 (Fossdal et al., 1995).

In December 1997 the Norwegian Building Research Institute was given the job of completing Ecoprofile for commercial buildings. The project's contents were however changed in the spring of 1998 when it became relevant to combine Ecoprofile with the environmental assessment method "Environmental and Resource Effective Commercial Buildings" that Storebrand and Gjensidige (two Norwegian insurance companies) had developed on their own initiative. The goal of the pre-project was to develop a tool to map the three principal areas "Energy/Power", "Indoor Climate" and "External Environment" for commercial buildings. The mapping should result in a classification of status for the three main areas, with an associated identification and prioritisation of measures to improve the condition.

The new Ecoprofile is divided into three principal components: External Environment, resources, and Indoor Climate, and includes 82 parameters. Each parameter is based on a classification scale (1, 2 or 3 or larger, medium or lesser environmental impact. These form the basis for the classification of the sub-areas. Figure 2.2 shows the principles of Ecoprofile.

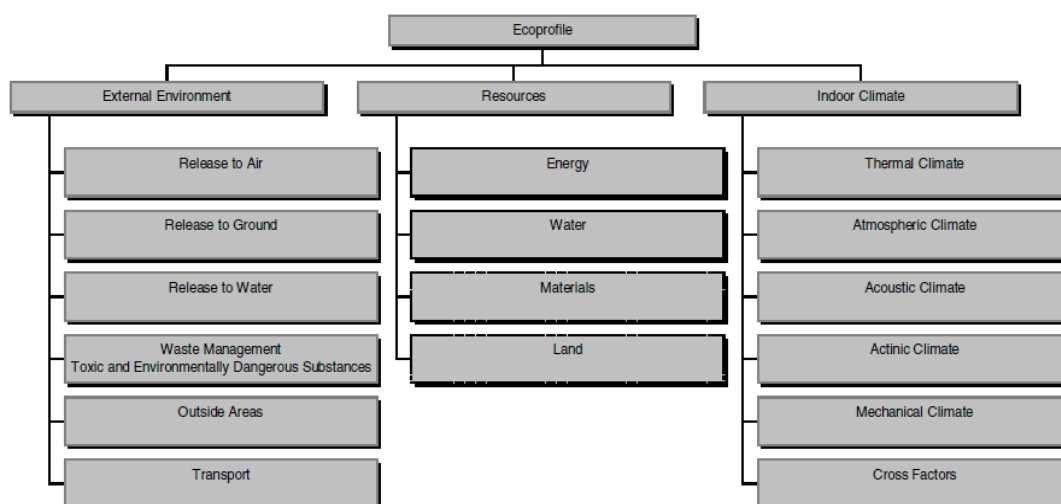


Figure 4.6. Structure of the three principle components of Ecoprofile

A building's Ecoprofile can be visualised in two ways. The principal components can be combined in a bar graph according to large, medium or small environmental impact for external environment, resources and indoor climate, compared to the average building, see Figure 2.3. Rose diagrams show more detailed survey results. High values represent a large environmental impact, see Figure 2.4.



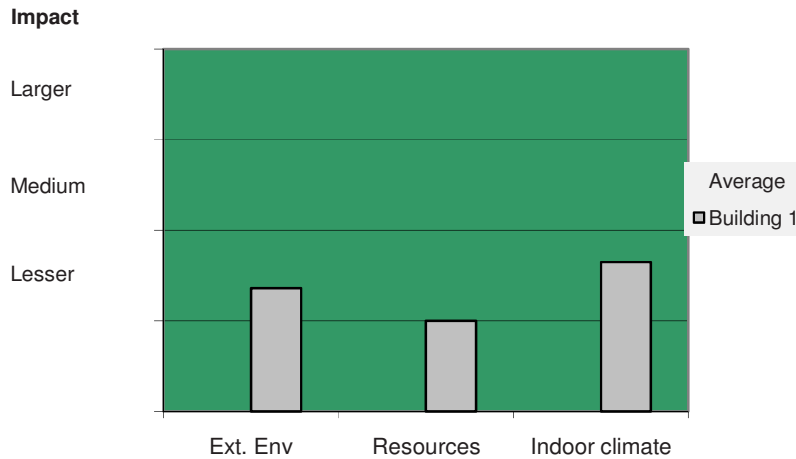


Figure 4.7. Graphical presentation of results at principal component level

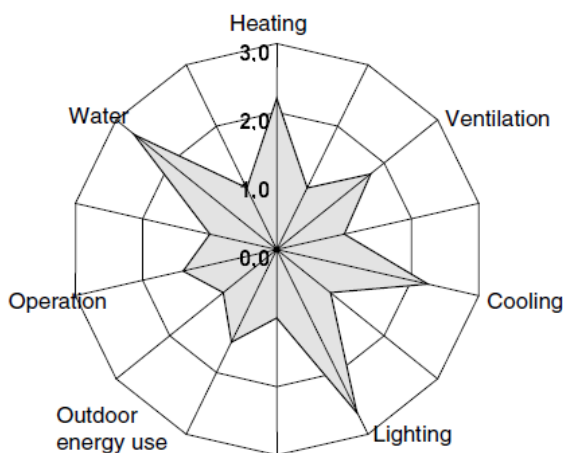


Figure 4.8. Graphical presentation of results as a rose-diagram

Ecoprofile is also developed for residential buildings, and as a planning tool for residential buildings, giving examples for sustainable solutions.

#### 4.6.2.2 Environmental programming - miljøprogrammering

Environmental programming, [www.miljoprogrammering.no](http://www.miljoprogrammering.no), is a web based tool developed by SINTEF for Oslo municipality and Statsbygg to develop operative environmental programs in cities and urban areas. The tool helps to obtain better environmental qualities in the public planning and development. The objectives of the tool are:

- Create consciousness and basis for discussions of which environmental targets to have in the specific projects
- Contribute to achieve good overall solutions by connecting targets and topics
- Contribute to giving the project a better environmental quality, above minimum level, by assisting the formulation of verifiable and concrete targets
- Make existing knowledge available for all actors in the building and construction industry
- Make the decision processes more transparent

ECOproduct is a user friendly tool for selection of environmental friendly building products, developed by NAL | Ecobox in cooperation with SINTEF Byggforsk and Norsk byggtjeneste oda as. ECOproduct is useful for the developers as well as architects, engineers, and construction companies. ECOproducts is both a methodology for environmental assessment as well as a data base.

#### 4.6.2.3 ECOproduct

ECOproduct is a set of criteria that the environmental documentation of a product is compared to. The documentation should be a 3<sup>rd</sup> part certified EPD. Figure 2.5 shows how a product result is presented, the main categories are Indoor environment, Health and environmental hazardous substances, Resources, and Global warming potential. The ECOproduct method is based on the Phd work The MaSe decision support system (Strand, 2003).





<b>Indoor environment</b>		
Degassing	2	
Emission of particles and fibers	2	
<b>Health and environmental substances</b>		
Environmental harmful substances	2	
<b>Resource use</b>		
Raw materials	4	
Energy	6	
Waste	2	
<b>Greenhouse effect</b>		
Emission of gases that contribute to global warming	7	
Basis of assessment	Declaration type III – controlled by 3 <sup>rd</sup> part	
Date of assessment	19.08.05	
Moisture resistance	Moderate	
Cleaning	Poor	
Life	15 years	

Figure 4.9. Presentation of ECOproduct results from the ECOproduct database

#### 4.6.3 National codes and legislation

##### 4.6.3.1 Legislation

Topics of importance for Sustainability in construction is treated in several laws and regulations, the most important are:

- The Planning and Building act (1985), with amendments (2005) (under revision). Planning pursuant to the Act is intended to facilitate coordination of national, county and municipal activity and provide a basis for decisions concerning the use and protection of resources and concerning development and to safeguard aesthetic considerations.
- Technical Regulations under the Planning and Building Act 1997 (revised 2007, under revision) which states “The life of works shall in all phases, i.e. execution, usage and demolition, be managed with a reasonable load on resources and environment, and without worsening quality of life and living conditions. Materials and products for use in construction works shall be manufactured with justifiable use of energy and with the aim of preventing unnecessary pollution. Construction works shall be so designed and executed that little energy is consumed and little pollution is caused during the life of the works, including demolition.”
- Regulations on Environmental Impact Assessment with the purpose to ensure that the environment, natural resources and community are taken into account in the preparation of plans or projects, and when a decision is made as to whether, and if so on what conditions, plans or projects may be carried out.
- The Public Procurement act (2001) which says that all public bodies under planning of the procurement should take life cycle costing, universal design and environmental consequences of the procurement into account.
- The Environmental Information Act (2003) relating to the right to environmental information and participation in decision-making processes relating to the environment

- The Pollution Control Act (1981) with the purpose to protect the outdoor environment against pollution and to reduce existing pollution, to reduce the quantity of waste and to promote better waste management.
- Product regulation – regulations relating to restrictions on the manufacture, import, export, sale, and use of chemicals and other products hazardous to health and the environment

The public procurement act clearly specifies that public authorities shall when planning procurements have regard to the resource implications and environmental consequences of the procurement. The related regulations do specify that the tender documents have to describe the performance, either as a requirement specification or by use of functional requirements. When formulating the requirements the life cycle costs and environmental impact of the procurement should be emphasised. Preferable it should be set concrete environmental requirements to the products performance or function.

The public procurement act should ensure that the public buildings and construction related activities have a life cycle approach, and that life cycle thinking is an integrated part of the processes. By using performance requirements the act should also initiate innovation and innovative solutions.

The technical regulations are also performance based, and give few exact values for impacts of construction works. The only specifications are related to energy use, where the main requirement says that buildings shall be executed in a way which promotes low energy demand. Further, there are specifications for maximum energy demand, examples given in Table 4.6.

To improve the energy efficiency the maximum energy demand will be updated at least every 5 year.

Table 4.6. Maximum energy demand in different building categories

Building category	kWh/heated area year
Single family houses	125 + 1600/heated area
Appartement buildings	120
Kinder gardens	150
Office buildings	165
Schools	135
Universitet/høyskole	180

Norway has implemented the EPBD as part of the EEA agreement, and the first Energy certificates are issued in 2009. For residential buildings the system is based on self-evaluation. New building which fulfil the regulations minimum requirements will normally be classified as C.

#### 4.6.3.2 Standardisation

Standardisation is an important tool for more sustainable construction. Standards describe methods, rules, and tools for descriptions, calculations, and documentation, and hence are helpful to ensure transparency and comparability.

International and European standards are often incorporated as Norwegian standards. For sustainability in construction important standards are the work of ISO TC59 SC 14, ISO 15686 Service life planning, SC 17 Sustainability in building construction, and CEN TC350 Sustainability of construction works.

On the basis of these European standards, also taking into account EPBD and other directives or regulations, the construction industry has initiated a project within the industry, supported by research organisations, to achieve consensus on calculation and assessment rules, and in the next phase, criteria, for assessment of buildings and constructions with related products and systems.

Also Norwegian standards are of importance for achieving more sustainable construction. The last addition is the NS3466:99 Environmental programme and follow-up system in the construction sector. This standard gives the requirement to content in a building or construction

projects environmental programme and the follow-up system, and points out which processes and evaluations that shall lead to the decisions of solutions.

For energy use the Norwegian standard NS3031 give the rules for calculation of energy demand, in addition the prNS3700 Criteria for low energy and passive houses – residential buildings.

Another standard important for ensuring life cycle thinking is NS3454 Life Cycle Costing. The standard is no in revision.

## 4.7 SUSTAINABLE POLICIES AND APPROACHES: THE POLISH CASE

### 4.7.1 *General information*

#### 4.7.1.1 *Association with the European Communities*

The decision of the Polish Government on the association with the European Communities in 1991, and then subsequently, on submitting Poland's Application for Membership to the European Union on 8 April 1994, has established a strategic goal of Polish foreign policy - i.e. integration with the EU. Since then, all the action undertaken by the Government were aimed at the adaptation to the EU requirements. Generally speaking, there have been three fundamental reasons for advocating Poland's accession to the EU and Polish presence in the EU, namely, economic considerations, political reasons, and social reasons. It is for the same three reasons that the EU should adopt and accept Poland as a Member State enjoying equal status and rights.

#### 4.7.1.2 *National Development Plan*

The next phase in Poland's preparation to the EU membership and to obtaining Structural Funds and Cohesion Fund, is the preparation of the National Development Plan (NDP) 2004-2006. The goal of the National Development Plan between 2004-2006 and its strategy should take under consideration not only the perspective of the first few years after joining the EU, but also address challenges to be shared by all EU countries in the next programming period, at least until 2013. The sum total of EU and Polish funds potentially engaged in the implementation of the National Development Plan for the next programming period should make possible the continuation of the development strategy to be implemented within the next few years and concerning the scope of modernization processes, and that of shaping the socio-economic situation of the entire country and its regions.

The strategic goal of the National Development Plan consists in increasing the development of a competitive economy based on know-how and innovations, able to ensure long-term, sustainable development, growth of employment, and the achievement of social, economic and regional cohesion with the European Union on a regional and national levels.

The goal formulated in this manner is in accordance with the basic assumptions of the Government's economic program for 2002-2025, referring to innovativeness, development and employment. It is also a direct extension of the goals formulated in the Preliminary National Development relating to structural activities, co-financed between 2000-2013 by the resources from EU funds. It is also to promote creation of the foundations for strengthening competitiveness of Polish economy and improving the standard of living in the perspective of joining the European Union.

### 4.7.2 *Polish Sustainable Development Strategy*

#### 4.7.2.1 *Sustainable Development Strategy for Poland up to 2025*

Polska 2025 has a relevant time-frame until the year 2025 and tries to include this demand by visions of the future society, economy and environment. The Strategy contains 3 parts:

1. Visions for sustainable development, goals and political backgrounds.
2. Policy fields and measurements in relation to society, economy and (national) state, including environment.

### 3. Implementation and monitoring.

The study's main topics are:

- dynamics of the economic growth,
- life standards,
- level of employment as well as
- quality of the environment and rational use of resources.

An important focal point and a distinguishing feature of the Polish approach is the role of the family, which is considered as the basis for a good functioning society. The strategy denotes the importance of „to assure the growth of wealth of Polish families, to strengthen their material independence and their feeling of security“. The Polska 2025 defines wealth as covering the material needs, but also to enabling people to achieve a better life in a healthy environment. The aspect of security is conceptualized very widely: Pension securities for older people, health and life protection, compliance with law, external security (assuring the sovereignty of the country) and ecological security, which includes the rational use of resources. Other chapters of the Polska 2025-strategy deal with the education system, science and research, or the structure of economy: development of the national innovation system or the modernization of agriculture and traditional industries as well as developments in energy-, transport- and communication infrastructure. The protection of the environment is part of the “State”-Chapter, like spatial structure and regional development. Finally the strategy takes international agreements into account, including concepts defined in the V and VI EU-Programme with regards to environmental protection and sustainable development of the European Union, the Agenda 21 and the Transformation Programme towards sustainable development of the OECD.

#### 4.7.2.2 Other national plans and strategies

Polska 2025 is an overarching strategy that aims at creating the structural frame and direction of development for other national and regional strategies or plans such as:

- Second National Environmental Policy (from 2000);
- Strategy of Public Finances and the Economic Development in Poland 2000 -2010;
- National Strategy of Regional Development 2000-2006;
- Concept of the Spatial Management of the Country;
- National Strategy of Employment Growth and Development of Human Resources;
- A National Strategy for the Conservation and Sustainable Use of Biological Diversity – Together with an Action Programme (from 2003);
- National Strategy of Environment Protection 2000-2006;
- National Strategy of Transport Development 2000-2006;
- National Plan of Development 2004-2006;
- Polish Energy Policy up to the Year 2020;
- Polish Climate Policy up to the Year 2020 (from 2003);
- WSSD Implementation Plan (from 2003);
- Strategy of Sustainable Development of Production and Consumption. .

#### 4.7.3 National Strategy for Environmental Protection

##### 4.7.3.1 Premises of national strategy

National Strategy for Environmental Protection consist mainly of developed in 1990 document The Environmental Policy of the State, which significantly contributed to ecologisation of the structures of the state. Due to a growth of ecological awareness of the society, growing investment outlays for proecological tasks and scrupulous implementation of legal and economic mechanisms of The Policy. we noted a reduction of environmental pressure and a general improvement of environmental quality. Therefore, it can be said that The Policy was effective and served its purpose. After a decade of functioning of The Environmental Policy of the State there are reasons for its verification to include new tasks and to carry out the ones, which have not been completed.

The overall objective of The 2nd Environmental Policy of the State is to ensure ecological security of the country (its in-habitants and its social and natural resources), as well as determi-



nation of the strategy of sustainable development of the country. We have to implement such model of growth, which would guarantee effective realization, and control of environmental use by all the people in the manner which would not threaten the quality and preservation of environmental resources.

The following premises were adopted as the basis and the highest priority of the development of the new environmental policy of the state:

- Pursuant to the Constitutional Act of the Polish Republic the state is to ensure environmental protection in accordance with the principle of sustainable development; it is further stated in the aforementioned document that environmental protection is the obligation of public government which through the adopted policy should ensure ecological security to both contemporary and future generations;
- The highest priority of the policy of the Republic of Poland is man, and consequently, it is man who will be the highest priority of the environmental policy of the state;
- Man lives in natural environment; maintenance of the balance in that system requires a coherent and integrated management of the access to environmental resources and liquidation and prevention of adverse environmental effects of man's economic activity;
- Ecological security of the society and of the national economy is subject to the introduction of a system of safeguards against adverse environmental effects of man's economic activity, as well as adequate protection of resources available to man (water, land, forests, protected areas);
- Further social and economic development should be based on the principle of sustainable development resulting due to adverse effects (to the environment, to human health and also to the economic activity itself) of the hitherto intensive economic growth with uncontrolled and often irrational use of natural resources;
- Poland maintained and still has large areas of unique natural values and rich biological diversity, which should be subject to special protective activities.

#### *4.7.3.2 Principles of national strategy*

The 2<sup>nd</sup> Environmental Policy of the State specifies the twelve principles emphasizing the priority position of sustainable development in the implementation of the environmental policy of the state, namely:

- 1) the principle of sustainable development - the most important principle of the environmental policy of the state on the turn of the century;
- 2) the principle of far-sightedness - providing for solution of the problems as soon as there appears a justified probability of a hazard and not after it has already appeared and been identified;
- 3) the principle of integration of environmental policy with the policies of other sectors - i.e. the integration of environmental goals together with economic and social goals into the policies of other sectors;
- 4) the principle of equal access to natural environment – meaning intergenerational equity and equal treatment of man and nature;
- 5) the principle of regionalization - i.e. more powers for local government and coordination of regional policy with regional ecosystems in Europe;
- 6) the principle of socialisation - i.e. the creation of institutional, legal and material framework for the participation of citizens groups and extra-governmental organisations in the implementation of the environmental policy of the state;
- 7) the "polluter pays" principle - holding the polluter responsible for environmental pollution effects;
- 8) the principle of prevention - emphasising the need to prevent adverse environmental impact; such impact should be taken into account at the very planning stage;
- 9) the principle of best available techniques (BAT);
- 10) the principle of subsidiarity - meaning that the European Union is under-taking the activities which do not fall within its discretion, only if the objectives of the proposed activities cannot be achieved by the Member States;
- 11) the principle of saving clauses - meaning the right allowing the Member States in justified cases to use stricter measures than required under the Community environmental law;

12) the principle of ecological effectiveness and economic (cost) effectiveness - applied in selection of environmental protection investment projects.

#### 4.7.3.3 *Stages of implementation process*

The 2<sup>nd</sup> Environmental Policy of the State provides for the three stage implementation process:

a) Stage one - the years 2000-2002 -implementation of short-term objectives during the period of applying for the European Union membership. The overall objectives of that stage include:

- reduction of adverse impact on human health and on the environment of the so-called „hot points" i.e. the most industrialised and urbanised areas including large point sources of pollution, the areas of the former Soviet military bases and old dumping grounds for pesticides and other hazardous substances and waste;
- the necessary (in the accession process) adjustment of national legislation to the Union legislation and the reform of the mechanisms of environmental protection management to adjust the latter to the Union requirements;
- successive implementation of legal solution adopted in the years 2000-2002 and adoption of the requirements of the Union environmental law;
- successive integration of the objectives of environmental policy with the objectives of sector policies and development programmes for other sectors;
- creation of legal and organisational conditions for the implementation by Poland of international conventions on natural environment;
- full implementation of the reform of the state management in all institutions related with environmental protection, in particular on the poviát and voivodship level and in relevant administrative agencies;
- improvement of the system of environmental emergency prevention and development of the system of ecological rescue and liquidation of the effects of such emergencies;
- initiation of the introduction into the environmental policy of the state of modern and effective mechanisms and procedures from the field of economics, finances and planning and management; their implementation is to be completed during the next stage.

b) Stage two - years 2003-2010 - implementation of medium-term objectives during the first years of the European Union membership. The overall objectives of that stage include:

- significant improvement of environmental quality;
- implementation of environmental regulations and standards of the European Union, the provisions of international conventions (regional and global), arrangements of bilateral agreements with the neighbouring states;
- further strengthening of the institutional framework to ensure effective realisation of far-sighted strategy of sustainable development of the country;
- continuation of the implementation of modern mechanisms, methods and procedures of realisation of environmental policy, including the achievement of environmental goals of sector strategies and programmes.

c) Stage three - after the year 2011 -implementation of long-term objectives under The Strategy of Sustainable Development of Poland for the Period Ending 2025, prepared by the Council of Ministers on the basis of the Sejm's resolution of March 2, 1999. The overall objectives of that stage include:

- strengthening of the Constitutional principle of sustainable development as the permanent basis of economic and social policy of the state, of self-government bodies, social institutions and the very citizens through appropriate political, legal and administrative and organisational actions and through active ecological education facilitating the development of pro-ecological attitudes and behaviour;
- strengthening of the principles of effective control by the state of the strategic environmental resources (water, forests, mineral resources);
- full integration of the environmental policy of the state with the policy of other sectors of economy, spatial planning policy and regional policy, as well as consumer policy through appropriate modification of the existing sector programmes or development of new programmes adjusted to the proposed strategy of sustainable development of the country;
- a thorough reconstruction of the model of production and consumption towards the improvement of effectiveness of energy and resources consumption and minimisation of adverse impact

on human health and environment of any forms of economic activity and civilisation development;

- introduction of the mechanisms of response to new challenges in environmental protection which will appear as a result of application of new techniques and technologies;
- resignation, due to the principle of farsightedness, from some achievements of science and technology which might have adverse environmental impact (e.g. certain biotechnologies);
- as complete as possible repair of environmental damages and the creation of a system preventing such damages in the future ( e.g. due to the deficiencies of market mechanisms);
- preservation of the existing ecosystems (including natural habitats and the flora) of high natural and cultural value, as well as other areas important from the point of view of environmental protection;
- preservation of areas of adequate size and of high recreational value as the base for effective rest and recreation;
- reconstruction of areas of high natural values;
- effective growth of the value of production in agriculture and forestry through better use of biological potential of agricultural and forest production area and through the improvement of technological and ecologically healthy quality of the products while preventing excess intensity of production processes and intensive farming and breeding methods which might threaten biological diversity.

#### 4.7.4 Conclusions

The main goal of the socio-economic policy is to ensure the growth of welfare of the Polish families, to strengthen their material independence and safety. Such defined head goal takes into account social order, which is based upon recognising human rights, accepting family values, abiding by subsidiary principles and protecting common well-being, national identity and sovereignty by the state. Polish government aims at reducing a development gap with relation to highly developed countries and attaining standards of living that are comparable with the average within the EU. The strategy includes environmental protection, rational use of and access to natural resources, better quality of life in clean and natural environment, more rational consumption of energy and resources, as well as more rational use of labour force, development of environment-friendly technologies and principles of preserving Poland's cultural heritage and its natural history.

The implementation of the sustainable development in Poland at regional level is strictly related to the constitutional, legislative and administrative changes introduced in Poland during the last 14 years of transformation towards market economy, bound up in recent years with the process of preparation to the European Union membership. The main strategic principles and directions should be set at the central level, but more detailed planning, implementation and monitoring can also be undertaken at a decentralised level, with appropriate transfer of resources and authority.

## 4.8 SUSTAINABLE POLICIES AND APPROACHES: THE PORTUGUESE CASE

### 4.8.1 Introduction

At the Portuguese level, Sustainable Construction has long being recognized as an important goal, although only few objective actions have been implemented over the last years. However, given the emphasis of the European Community on the issue and the mandatory adoption of European Directives in Member countries, initiatives towards the effective application of the principles of Sustainable Construction are gaining a major importance in the construction sector.

The National Strategy for Sustainable Development and the respective plan of implementation were endorsed by Resolution no. 109/2007 (*Resolução de Conselho de Ministros n° 109/2007*). This strategy was elaborated in order to meet the guiding principles of the European strategy. Its main purpose is the development of a model for sustainable development to make

Portugal, by 2015, one of the most competitive and attractive countries of the European Union, in the frame of high economical, environmental and social standards.

In addition, the competitiveness in the construction sector has been forcing stakeholders to take actions in order to prove their awareness of the problem and to show their responsibility in terms of social, economic and environmental aspects. This can be seen by the increasing demand for certifications by the construction and real estate sectors. Also, construction materials manufacturers are aware of the importance of promoting the green credits of their products, and the use of green labels and EDPs is becoming more and more popular.

A few national initiatives are being developed in the country in order to promote the principles of sustainable construction. Some of these actions are described in the next paragraphs:

- Centro HABITAT – *Plataforma para a construção sustentável* (<http://www.centrohabitat.net/apresentacao.htm>)

Centro Habitat is an innovation platform for sustainable construction, created in 2007. This platform is based on a network of R&D centres, local authorities and companies related with the Habitat cluster, with the main goal being the concentration of resources in order to socially and economically value the knowledge, seeking to state an expertise on sustainable construction. Among other aims are:

- Production of know-how associated to the sustainability of the built environment
  - Dissemination of knowledge through specialized formation actions
  - Maintenance of a information system oriented towards sustainable construction
  - Detection and management of innovation opportunities for the members
  - Promotion of innovation projects and integration in the Habitat cluster
  - Promotion of a set of recommendations related to construction sustainability in the habitat cluster
- iiSBE Portugal – *Iniciativa Internacional para a Sustentabilidade do Ambiente Construído* (<http://www.iisbeportugal.org>)

iiSBE Portugal is a non profit organization, created in 2007, that represents at national level the mission of the *International Initiative for a Sustainable a Built Environment* (iiSBE). In order to promote and disseminate the aims of Sustainable Construction, the following actions are foreseen:

- To teach qualified experts in Sustainable Construction Assessment (SCA)
- To adapt SBTool to Portuguese background;
- To certify buildings in terms of sustainability;
- To be a national Forum regarding sustainable construction initiatives that are being developed in several regional and local entities involved in the sustainable construction;
- To promote and be represented in normative and legislative initiatives

#### 4.8.2 Methodologies and tools

Life Cycle Analysis (LCA) is not part of current practice for most architects and engineers. The advantages and importance of LCA are being recognized but yet its use is still very limited. Life cycle cost analysis are however more common, particularly by agencies that are responsible for the operation and maintenance of facilities for long periods of time (e.g. road authorities).

To give answer to the increasing demand for building certifications, tools for the sustainable assessment of the built environment are being developed. One of these tools is the *SBTool Portugal – Building Sustainability Assessment Tool* (SBtool<sup>PT</sup>) (<http://www.iisbeportugal.org>).

The “SBtool<sup>PT</sup>” building sustainability assessment methodology is a result of a research work from the University of Minho (DEC), with the main purpose to develop and propose a generic methodology to assess the sustainability of existing, new and refurbished buildings in urban areas, taking into account the Portuguese context.

As a first step, a methodology to assess the sustainability of residential buildings has been developed (SBTool<sup>PT</sup>-H). The reason for this priority is the fact that most of the impacts related to the construction sector are related to the housing sector.

The following requirements were taken into account in the development of the SBTool<sup>PT</sup>-H:

- A set of parameters wide enough to be meaningful and to comprise the most relevant building impacts, but at the same time limited enough to be feasible (fifty parameters at maximum);
- Whole building assessment, based upon the state-of-art methodologies, and considering ongoing standardization;
- Balancing between all different dimensions of sustainable development (environment, societal and economics);
- Limitation or exclusion of subjective and/or qualitative criteria that are hard to validate (e.g. aesthetics and technical innovation);
- Improved reliability through the use of accepted LCA methods for environmental performance;
- Assessment output and certification label that is easy for building users to interpret and understand, and enabling clients and designers to work with.
- Validation of the work by the development of a prototype tool and application on case study buildings.



Figure 4.10. SBTool<sup>PT</sup>-H building sustainability certificate

The SBTool<sup>PT</sup>-H is based in the international approach SBTool (<http://www.iisbe.org>), and in harmonization with CEN/TC350 draft standards “Sustainability of Construction Works – Assessment of Environmental Performance of Buildings”. This methodology allows future rating and labeling of buildings, in analogy with the Energy Performance of Buildings Directive (EPBD).

In terms of outputs, the methodology adopted a similar approach to the one used in existing labeling schemes such as the EU energy labeling scheme for white goods and the European Display<sup>TM</sup> Campaign posters. The performance of a building is measured against each category, sustainable dimension and global score (sustainable score), and will be ranked on a scale from A to G. Where, A is the best score, G the worst score, and F the score of the conventional



solution. Figure 2.8 represents the certificate of the SBTool<sup>PT</sup>-H methodology for a hypothetical case study.

For SBTool<sup>PT</sup>-H to be used as a rating system, validation by an independent third party is mandatory. When a formal certification is intended, the design team, or the project owner, has to submit to iiSBE Portugal the preliminary self-assessment results and design documentation. Then the project will be assessed and certified by an independent qualified expert in Building Sustainability Assessment (BSA). The building sustainability certificate is, at the end, issued both by iiSBE Portugal and iiSBE International. The certification process of a building is represented in Figure 2.9.

This methodology is, currently, at the final stage of development and, until now, it has not been applied to a real case study. Therefore the consequences of its application in the Portuguese construction market are still unknown. Nevertheless the methodology is intended to foster the awareness of Portuguese stakeholders in the construction sector. Simultaneously, it will allow adequate policy implementation on sustainable construction, since it supports measures towards the sustainable design and construction, through the definition of a list of objectives that are easily understandable by all intervenient in the construction sector and that are compatible with the Portuguese construction technology background.

Other examples of tools developed in Portugal are given below:

- LiderA Approach - Leadership by Environment ([www.lidera.info](http://www.lidera.info)), which is a voluntary rating system, based on LEEDs, but adapted according to national demands.
- EcoBlock (<http://gasa.dcea.fct.unl.pt/ecoblock>), which is a voluntary eco-label system for products or companies, based on a simplified life cycle analysis.

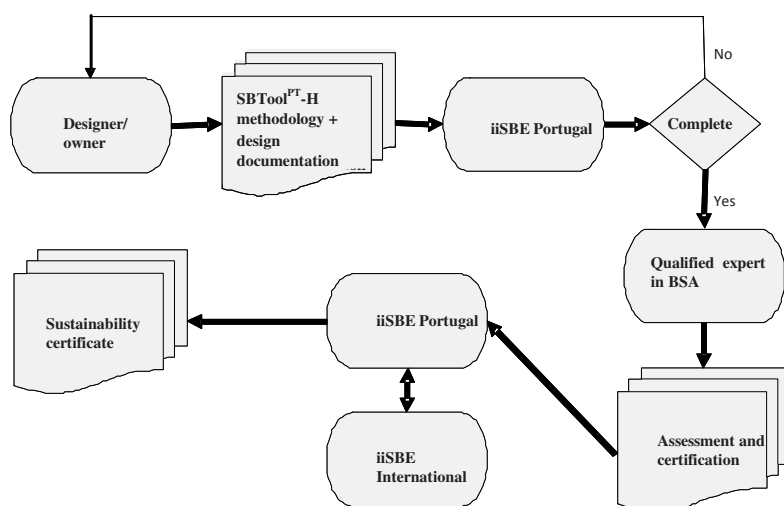


Figure 4.11. Certification process of a building according to SBTool<sup>PT</sup>-H

#### 4.8.3 National codes and legislation

Portugal has been adopting a series of measures to implement European directives related to Sustainable Construction into the national law. Most national codes and legislation, relevant to the sustainability of the construction sector, are derived from this process.

##### i) Energy regulation

In 2006, the Portuguese Government has adopted three Decrees that, together, constitute the transposition of the EPBD (European Directive 2002/91/CE, 2003) into national law:

- Decree 78/2006 – It creates and defines the operational rules for the System for Energy and Indoor Air Quality Certification of Buildings (SCE);

- Decree 79/2006 – RSECE (2006) – It establishes the new revision of the Regulations for HVAC systems, including requirements for regular inspection of boilers and air-conditioners;
- Decree 80/2006 – RCCTE (2006) - It establishes the new revision of the Thermal Regulations for Buildings.

These new/reformulated regulations specify requirements for new buildings and major renovations, which became mandatory since 3 July 2006.

The main objectives of the SCE are:

- To assure that the buildings fulfil the requirements included in RCCTE and RSECE, related to energy efficiency, use of renewable energy systems, and the indoor environment conditions;
- To certify the energy performance and the indoor air quality in buildings;
- To identify the appropriate measures or necessary improvements to archive higher energy performance.

The RSECE defines hygienic and thermal comfort conditions. It enforces rules for the efficiency of HVAC systems, for its maintenance, and for the indoor air quality. The main objectives of RSECE are:

- To assure the thermal comfort and indoor air quality conditions in buildings;
- To limit the energy consumption in buildings (by determining the maximum limits);
- To assure the quality of HVAC equipment in buildings (design, installation and maintenance);
- To ensure the renovation of the energy certificate (the certificate has a validity of 10 years or 6 years in case of services buildings with a total net floor area over 1000 m<sup>2</sup>).

The RSECE is applied in two different phases of the building life-cycle: design and operation. During the design phase, this law is used for the appropriate sizing of the HVAC equipment and to estimate the energy consumption. In the operation phase it is used to verify the estimated energy consumption. This regulation mainly concerns large buildings (net floor over 1000m<sup>2</sup>) or buildings with centralized HVAC systems, with an installed power over 25kW.

Residential and service buildings with a net floor area lower than 1000m<sup>2</sup> and/or with a centralized air-conditioned system, with an installed power bellow 25kW, are covered by RCCTE. RCCTE is applied both to new buildings and large refurbishing works (cost of the works 25% higher than a new building with the same characteristics). Compared to the former one, this new regulation of the thermal behaviour of buildings, almost duplicated the thermal performance requirements in both new and renovated buildings and imposed the use of solar collectors for hot water heating, whenever it is suitable their application.

The main objectives of the RCCTE are:

- To set the limits in the primary energy consumption per net square area of the buildings;
- To set the requirements for thermal comfort, during the heating and the cooling seasons as well as the minimum ventilation requirements in order to assure acceptable indoor air quality levels;
- To set the maximum U-value for all construction elements of the envelope;
- To impose the use of minimum shadow devices in all windows;
- To set the maximum energy consumption for sanitary hot water production, including the mandatory use of solar collectors for all buildings;
- To set the minimum quality and efficiency requirements to all cooling and heating systems (for non residential uses).

The energy certificate is aimed to inform the building's users, owners or potential buyers about the energy performance of the whole building or part of it (Figure 2.10). Energy certification is compulsory to obtain the operation permit of new buildings, in case of major refurbishing operations, when a residential or service building is sold or rented (the maximum validity of the certificate is 10 years) and it should be renewed each 6 years in case of service buildings with a net floor are over 1000m<sup>2</sup>.

The main content of the energy certificate (CE) is the Energy Performance Label. This label is divided in 9 energy classes. The energy class results from the ratio between the global annual

calculated demand and the maximum allowed global annual primary energy demand for heating, cooling and hot water heating.

A+ is the best performance class and is followed by the A, B, B-, C, D, E, F and G (worst) classes. Besides that the energy certificate gathers other information such as: description of the building; energy improvement measures and new energy class if they are considered; and description of the characteristics of the building's envelopes and acclimatization systems.

Certification is mandatory for all new buildings requesting a use permit after mid 2007. For public buildings, a certification is needed from 1 January 2008 or 2009, depending on size. Other buildings when rent or sold must have an energy performance certificate from 1 January 2009.

Inspections of boilers and air-conditioners are covered by RSECE and they shall become mandatory from the 1st January 2009. The procedures for inspection of boilers and air conditioning systems are still under discussion.

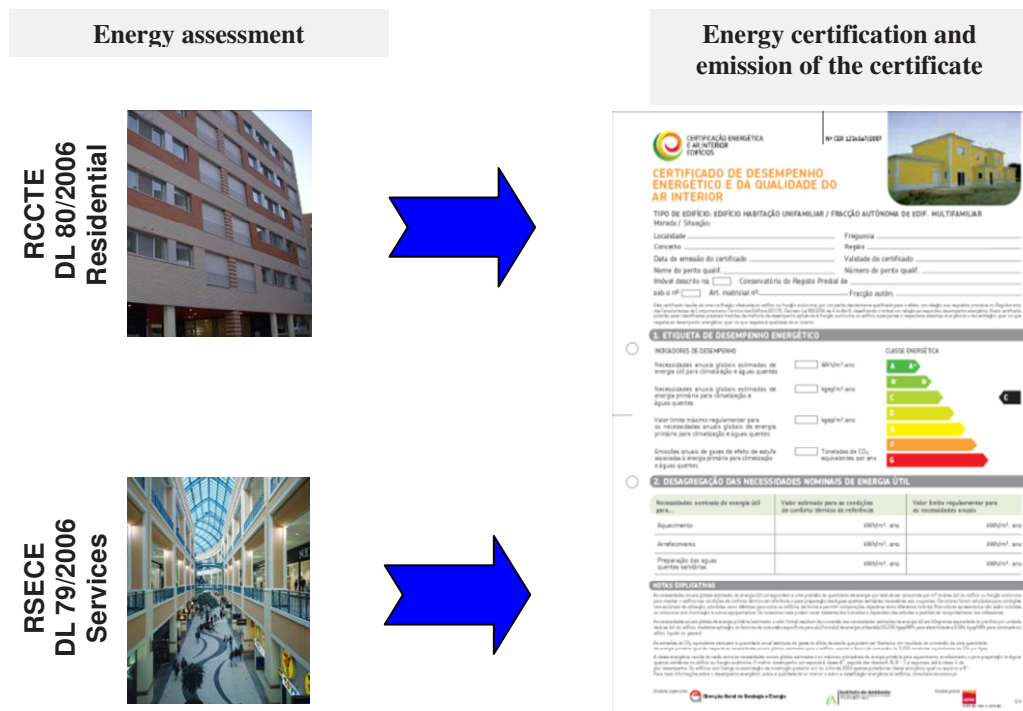


Figure 4.12. Energy certification system in Portugal (Decree-Law 78/2006)

ii) Materials regulation

Currently many Portuguese construction products have the CE marking in conformity with European directives.

The CE marking signifies that the products are suitable for construction works and satisfy the following essential requirements (one, some or all of these requirements may apply):

- Mechanical resistance and stability
- Safety in case of fire
- Hygiene, health and the environment
- Safety in use
- Protection against noise
- Energy economy and heat retention

Such requirements must, subject to normal maintenance, be satisfied for an economically reasonable working life.

Besides the certification provided by the mark, products assigned with the EC mark must be allowed free movement and free use for their intended purpose throughout the European Community.

## iii) Construction waste regulation

The transposition of the European Directive 2006/12/EC (2006) to the Portuguese law, gave rise to the revision of previous legislation and to the creation of a new legislative framework, decree no. 178/2006 [5], for the general management of waste. The management of waste from construction and demolition has been done according to the general requirements in this law. However, the complex management of this kind of waste, very often, create problems in the application of current legislation. Therefore, in March 2008, decree no. 46/2008 [6] was published that introduces a legislative framework for the specific management of construction and demolition waste. Among others, a new mandatory requirement in this law specifies a previous selection of the construction and demolition waste before its deposition in landfills, thus promoting the recycling of waste and the minimization of waste in landfills.

## iv) Green public procurement

Following guidance from the European Commission, the Portuguese government approved in 2007 the National Strategy for Green Public Procurement, for the period 2008-2010, by a resolution of the council of ministers (*Resolução do Conselho de Ministros* n° 65/2007). This strategy identifies the construction of public works as a priority area for which public entities should start their policy of green purchases. As a global aim it is expected that by 2010, 50% of all public procurement will include environmental criteria in their tender proceedings. The national strategy defined general and specific criteria to support the implementation of green purchases and foreseen the introduction of new requirements regarding green purchases in the new code of public contracting (D.L. n° 18/2008). General criteria includes energy efficiency, reduction of greenhouse gases, prevention of pollutants' emissions, waste reduction, recycled content of products, minimization of environmental impacts and preservation of nature and biodiversity. However, no guidelines or procedures are currently provided for the quantification of those criteria.

## 4.8.4 Eco-labels and EPDs

Following the European context of Integrated Product Policy, eco-labelling is being encouraged as a market tool in order to promote the trade of products with low environmental impacts and to stimulate consumer demand for greener products

International certification systems such as EMAS and ISO14001 are being achieved by companies and entities as part of their internal policies towards sustainable development. An example of a national certification system (voluntary) for the real estate sector was developed by the SGS Group Portugal (<http://www.pt.sgs.com/pt/>). Two systems were created: *DomusQual* and *DomusNatura*. While the first provides a certification in terms of the quality and conformity with technical requirements of the construction work, the second system provides a certification in terms of the sustainability of the construction (involving environmental aspects, energy efficiency, etc)

The most common eco-label in Portugal is the European Eco-label, which is regulated by "Regulamento (CE) no. 1980/2000".

The Portuguese Agency of Environment (<http://www.apambiente.pt/>) presents an eco-label, "Remade in Portugal", which aims to promote recycling of products. It is a voluntary label and can be applied to any product (except food and medical products) with a recycled content higher than 50%.

Currently, the development of EPDs is very limited, although, taking into consideration current policies, it is foreseen that the demand for EPDs will increase in the near future. One of few examples of Portuguese EPDs is a simplified EPD for concrete products developed in the framework of the European project "Stepwise EPD" by *CONCRETETOPE – Fábrica de betões*, S.A. in cooperation with INETI/CENDES (Carvalho, )

The *Centro Tecnológico da Cerâmica e do Vidro* (CTCV) has also published some environmental data for benchmarking about the national production of ceramic bricks and tiles (Amaral, 2005).



#### 4.8.5 R&D Case studies

##### 4.8.5.1 Sustainable Housing in Europe (SHE) – Portuguese Pilot Project

The Portuguese Pilot Project was the first sustainable social housing project in Portugal and a detailed description was provided in Chapter 3, section 3.2.1. Therefore, no further details are provided in this section.

##### 4.8.5.2 Edifício Solar XXI – demonstrative project in the field of renewable energies and energy efficiency in buildings Sustainable Housing in Europe – Portuguese Pilot Project

This project was developed by *Instituto Nacional de Engenharia, Tecnologia e Inovação* (INETI) ([http://www.ineti.pt/projectos/projectos\\_frameset.aspx?id=325](http://www.ineti.pt/projectos/projectos_frameset.aspx?id=325)), in order to prove that it is possible to build energy efficiency buildings without significant over costs. This project aimed to highlight the advantages of solar energy (thermal and photovoltaic) in buildings. The thermal optimization strategy included the integration of photovoltaic panels in the southern façade of the building, the use of solar thermal collectors for the heating and the integration of a cooling system by air ventilation through the ground floor of the building.



Figure 4.13. Edifício Solar XXI (INETI)

##### 4.8.5.3 Affordable Houses: A modular concept of a steel residential house

An international research project was launched by ArcelorMittal in 2009 with the goal to promote a low-cost dwelling adapted to the needs of society. This challenge involved eight universities around the world. In Portugal, this challenge was taken by a comprehensive team composed by several architects and engineers from the University of Coimbra (Murtinho et al., 2010).

For the development of the solution several stages were needed. In the first stage, together with the preliminary architectural project, a detailed analysis of the socio-economic characterization of the country was undertaken. The aim of the latter was to provide the team a perspective of current supply and demand in relation to the real estate sector. Based on this study, it was decided to focus the project on a dwelling for a standard family of a couple and two children (three main bed-rooms). The proposed solution is illustrated in Figure 4.14.





Figure 4.14. General perspective of the developed modular solution (Murtinho et al., 2010)

Furthermore, a modular concept was defined (see Figure 4.15) in order to be flexible and adaptable to future demands of the family. This modular concept enables, besides its adaptability for future requirements in the same house, a definition of many other types of solutions to fulfill particular demands, such as urban and topography constraints.

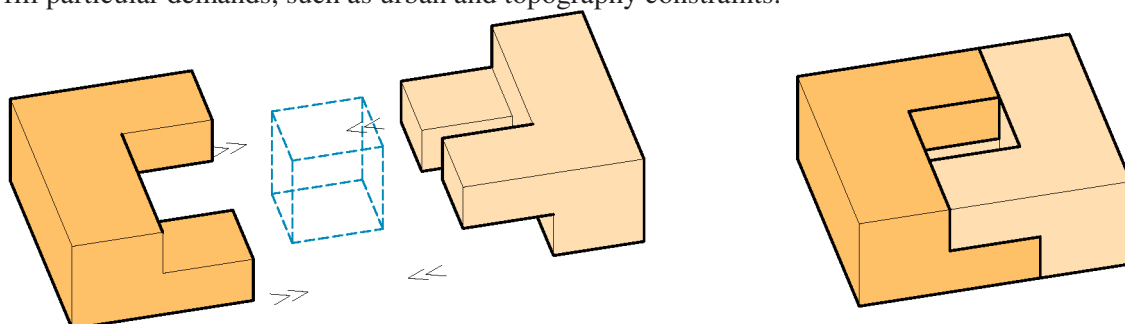


Figure 4.15. Definition of the modular concept (Murtinho et al., 2010)

The estimated nominal cost for the proposed solution was about 550 €/m<sup>2</sup> (VAT not included), which showed the competitiveness of the solution in comparison with typical traditional construction (Murtinho et al.). Nevertheless, despite being a construction system with a lower price, it did not mean that the quality standards were lower as well. The solution was properly detailed in order to achieve high quality standards with respect to thermal and acoustic behaviour, contributing to the well-being of the users. Moreover, the proposed solution provided an adaptable system to future demands of the family, enabling to extend the service life of the structure beyond the period of 50 years assumed in the analysis.

## 4.9 SUSTAINABLE POLICIES AND APPROACHES: THE ROMANIAN CASE

### 4.9.1 Introduction

The Government of Romania through the Ministry of Environment and Sustainable Development and the United Nations Development Program through the National Centre for Sustainable Development have created in July 2008, the National Sustainable Development Strategy - Romania 2013-2020-2030.

This National Strategy aims to connect Romania to a new philosophy of development, adopted by the European Union and widely shared globally—that of sustainable development.

Close to the end of the first decade of the twenty-first century, after a long, traumatic transition to pluralistic democracy and a market economy, Romania still needs to overcome significant gaps relative to the other Member States of the European Union, while seeking to absorb and implement the principles and practice of sustainable development in the context of globalization. Despite the notable progress it has made in recent years, it is a fact that Romania's economy still relies on intensive consumption of resources, society and the administration have yet to develop a shared vision, while the natural capital faces the risk of degradation that may become irreversible.

This Strategy sets specific objectives for moving, within a reasonable and realistic time-frame, toward a new model of development that is capable of generating high value added, is motivated by interest in knowledge and innovation, and is aimed at continued improvement of the quality of life and human relationships in harmony with the natural environment.

In terms of general orientation, this document addresses the following strategic objectives for the short, medium and long run:

*Horizon 2013: To incorporate the principles and practices of sustainable development in all the programmes and public policies of Romania as an EU Member State.*

*Horizon 2020: To reach the current average level of the EU countries for the main indicators of sustainable development.*

*Horizon 2030: To get significantly close to the average performance of the EU Member States in that year in terms of sustainable development indicators.*

The implementation of these strategic objectives will ensure high rates of economic growth in the medium and long run and, as a result, a significant reduction of social and economic disparities between Romania and the other Member States of the European Union. Considering the main indicator that measures convergence in real terms, Gross Domestic Product per person (GDPpc) adjusted for standard purchasing power parity (PPP), the implementation of the Strategy enables Romania to exceed in 2013 half of the current EU average, to approach 80% of the EU average in 2020 and to rise slightly above the EU average in 2030.

The commitments that Romania undertook as a Member State of the European Union are thus going to be fulfilled in conformity with the Treaty of Accession, along with the effective implementation of the principles and objectives of the Lisbon Strategy and the renewed (2006) Sustainable Development Strategy of the European Union.

The text of National Sustainable Development Strategy is structured in five parts:

Part I presents the conceptual framework, defines the notions used and describes the main points of the renewed EU Sustainable Development Strategy of 2006 (EU SDS), the state of play regarding the preparation of agreed sustainable development indicators, and the relevant steps Romania has taken during the pre- and postaccession periods.

Part II provides an evaluation of the current condition of Romania's natural, manmade, human and social capital. This approach is in line with the latest (May 2008) recommendations of the Joint Working Group for Sustainable Development Indicators formed by the EU Statistical Office (Eurostat), the UN Economic Commission for Europe (UNECE) and the Organisation for Economic Cooperation and Development (OECD).

Part III offers a prospective view and establishes precise objectives for the three time horizons, following closely the logic of the key challenges and cross-cutting policies as they are described in the renewed Sustainable Development Strategy of the European Union.

Part IV tackles the specific problems facing Romania and sets targets in order to accelerate the transformations toward a sustainable development model, while narrowing and closing the existing gaps in relation to the average performance of the other EU Member States.

Part V contains specific recommendations concerning the establishment and functioning of the institutional framework designed to ensure the implementation and monitoring of, and the reporting on, the results of the revised National Sustainable Development Strategy. The proposals take into consideration the experience and established practice of other EU Member States and envisage some innovative solutions, suited to Romania's specific circumstances, which are

aimed at promoting the accountability of public authorities and the active involvement of societal actors in an effort to meet the goals of sustainable development.

Rounding off the objectives included in national development strategies, plans and programmes, this Sustainable Development Strategy sets the main guidelines for action towards the adoption and implementation of the principles of sustainable development in the immediate future:

- Rational correlation of development goals, including cross-sector and regional investment programmes, with the established potential and sustaining capacity of natural capital;
- Accelerated modernisation of the educational, training and public health systems with due consideration of the unfavourable demographic trends and their impact on the labour market;
- Use of the best available technologies, by both economic and ecological standards, for publicly funded investments at national, regional and local levels, and encouraging the choice of such technologies on the part of private investors; entrenchment of eco-efficiency standards in all production and service activities;
- The ability to anticipate the effects of climate change, to prepare solutions for adaptation in the long run and to develop cross-sector contingency plans comprising portfolios of alternative crisis-management solutions in case of natural or man-made disasters;
- Ensuring food security and safety by turning to good account Romania's comparative advantages with regard to increased agricultural production, including organic farming; balancing the quantitative and qualitative growth of agricultural output for human and animal consumption with the higher demand for biofuel production without compromising the need to maintain and improve soil fertility, biodiversity and environmental protection;
- The need to identify additional, sustainable financial resources for large-scale projects and programmes, particularly in areas such as infrastructure, energy, environmental protection, food safety, education, healthcare and social services;
- Protection and promotion of Romania's cultural and natural heritage; efforts to meet the European norms and standards on the quality of life should be pursued together with the revival of traditional occupations and ways of life in a modern setting, especially in high mountain areas and wetlands.

The objectives set in this Strategy emerged from national and regional debates; they focus on the maintenance, consolidation, enhancement and continued adaptation of the structural configuration and functional capacity of natural capital as a foundation for the preservation and augmentation its support capacity and its ability to operate under the pressure of social development, economic growth and the foreseeable impacts of climate change.

The Strategy proposes an outlook of Romania's sustainable development in the next two decades by setting objectives that go beyond electoral cycles or opportunistic political preferences. For this reason the National Sustainable Development Strategy was submitted for endorsement by the Romanian Parliament, while the implementation, monitoring and reporting mechanisms and those for consultation with the civil society and the citizens are regulated by law.

Parallel to the implementation of the Strategy, the newly established executive and consultative structures will start, in 2009, a process of comprehensive re-evaluation of the national, sectoral and regional plans, strategies and operational programmes in order to make sure that they are in conformity with the principles and practice of sustainable development and with the evolving set of relevant EU regulations. Those structures will also be responsible for the preparation of Romania's views on, and contributions to, further reviews of the EU Sustainable Development Strategy.

The preparation of the revised National Sustainable Development Strategy (NSDS) is an obligation that Romania has undertaken as a EU Member State in conformity with agreed Community objectives and the methodological guidelines of the European Commission.

The document is the result of a joint project of the Romanian Government, though the Ministry of Environment and Sustainable Development, and the United Nations Development Pro-

gramme, through the National Centre for Sustainable Development in Bucharest. The project was approved by Government Decision HG No. 1216 of 4 October 2007, published in the Official Gazette of Romania No. 737 of 31 October 2007.

(a) For the execution of the project the following **functional and support structures** were created:

- **The National Public Debate Council** was the main deliberative forum and included authorised representatives of the relevant ministries and other central government agencies, political parties, business associations, labour unions, scientific and academic community, interested non-governmental organisations and other groups of the civil society.

The Council convened in monthly sessions to discuss the successive versions of the draft Strategy throughout the elaboration process. The comments, suggestions and recommendations that were made during the sessions of the Council or subsequently submitted in writing were considered by the Drafting Group and incorporated in the final version of the Strategy.

The deliberations of the National Council were conducted in open sessions and received reasonable coverage in the media.

- **The Regional Consultative Councils** convened twice in each of the eight Development Regions of Romania (in March and May 2008, respectively) with the participation of representatives of local public authorities, associations of elected officials, political parties, universities and research institutions, business community, chambers of commerce and industry, labour unions, professional associations, nongovernmental organisations and the mass media.

The resulting contributions were examined by the Drafting Group and incorporated in the final version of the Strategy.

- **The Scientific Council** consisted of members and corresponding members of the Romanian Academy and operated under its aegis to provide a critical review of the scientific accuracy of the draft Strategy.

- **The Drafting Group** was formed of specialists with recognized professional competencies in their respective fields of expertise; it prepared the conceptual framework, the thematic summary and the successive versions of the draft Strategy that were subsequently submitted for discussion to the National Public Debate Council, the Regional Consultative Councils and the Scientific Council.

The Drafting Group examined the comments resulting from the deliberative process and from public consultations, along with the written contributions received from various agencies, associations, interested groups and individual persons, and incorporated them in the final version of the draft document.

- **Working Groups** were established within ministries and other government agencies to provide the necessary factual information for the drafting process. The figures and other data used in the final version of the draft Strategy were checked and updated with the support of the National Forecasting Commission and the National Institute of Statistics.

- Administrative support was provided, on the basis of the Memorandum of Understanding between the Ministry of Environment and Sustainable Development and the United Nations Development Programme in Romania, by:

- **The Operational Secretariat** was established by the Ministry of Environment and Sustainable Development and was tasked with the coordination of relationships with central and local government authorities and other partners, and with the management of all official correspondence related to project;

- **The Technical Secretariat**, which operated at the National Centre for Sustainable Development /UNDP, prepared the terms of reference for the selection of the personnel involved in the project, organized the public debate process and provided the necessary logistical support.

(b) The methodology was designed in accordance with the recommended procedures of the European Commission and the UNDP practice.



At an early stage, the conceptual framework was prepared in the form of a draft table of contents that was further expanded to include the main theses to be developed in each chapter.

In parallel, an inventory of the main sources of reference was compiled on the principles, objectives and priorities of sustainable development, providing easy access to relevant official documents of the United Nations, the European Union and Romanian national plans, strategies and sectoral operational programmes.

In the following stage, the Drafting Group prepared preliminary versions for all chapters that were subsequently revised to include data provided by government agencies, to eliminate overlaps and redundancies, and to ensure the coherence of the document as a whole.

The comments and observations that were made in the course of the public debate process and those that were received in writing from institutions, associations or concerned individuals were incorporated in the final version of the Strategy, after consideration by the Drafting Group.

All the documents that were relevant to the elaboration of the Strategy (successive versions of the draft text, reference sources, minutes of the National Public Debate Council, Regional Consultative Councils, Scientific Council and Drafting Group meetings, written contributions and comments received from interested organisations and individuals) were posted on a dedicated Project Website.

The contact points for the project (Ministry of Environment and Sustainable Development, National Centre for Sustainable Development, and the EurActiv press agency) were publicized through the mass media in order to facilitate the collection of written comments and contributions from the public.

Along with the drafting process, an English version of the document was produced in order to obtain informal international consultation prior to the official presentation of the document to the European Commission. In this yet unfinished format, the draft National Sustainable Development Strategy for Romania was presented at the annual session of the European Chapters of the Club of Rome (Bucharest, 24-25 May 2008).

(c) The following statistics illustrate the **magnitude of the participatory** mechanism that operated during the preparation of the Romanian National Sustainable Development Strategy: (as of 24 July 2008)

- National debate events: 5
- Regional debate events: 16
- Meetings of the Scientific Council: 3
- Meetings of the Drafting Group, in plenary sessions or expert sub-sections: 21
- Meetings of the Drafting Group co-ordinators with representatives of public authorities, political parties, business and professional associations, labour unions federations, non-governmental organisations, youth groups and other concerned groups and persons: 39
- Total number of participants in public debate sessions at national level: 104
- Total number of participants in public debate sessions organised at regional level: 599
- Total number of interventions in public debate sessions at national and regional levels: 143
- Total number of written comments, contributions and observations received 147
- Total number of visitors to the website dedicated to the Strategy project [www.strategia.ncsd.ro](http://www.strategia.ncsd.ro): an average of 550 weekly hits between November 2007 and June 2008
- Number of draft versions of the Strategy submitted to public debate: 6; number of revisions 38.

#### 4.9.2 Methodologies and tools

Life Cycle Analysis (LCA) is not part of current practice for most architects and engineers. The advantages and importance of LCA are being recognized but yet its use is still very limited

#### 4.9.3 National codes and legislation

Romania has been adopting a series of measures to implement European directives related to Sustainable Construction into the national law. Most national codes and legislation, relevant to the sustainability of the construction sector, are derived from this process and have to deal with the following fields:



- Energy regulation
- Materials regulation
- Construction waste regulation

#### 4.9.4 *Eco-labels and EPDs*

Following the European context of Integrated Product Policy, eco-labelling is being encouraged as a market tool in order to promote the trade of products with low environmental impacts and to stimulate consumer demand for greener products.

Currently, the development of EPDs is very limited, although, taking into consideration current policies, it is foreseen that the demand for EPDs will increase in the near future.

#### 4.9.5 *Case studies*

##### 4.9.5.1 *R&D Activity developed at the Politehnica University of Timisoara*

- FP6 INCO-CT-2004-509119 / 2004-2008 Earthquake protection of historical buildings by reversible mixed technologies, Financing authority / Beneficiary: European Union
- RFCS-CT-2007-00050 STEELRETRO / 01.07.2007-31.06.2010 Steel solutions for seismic retrofit and upgrade of existing constructions, Financing authority / Beneficiary: European Commission - Research Fund for Coal and Steel
- 29/10.10.2005, 2005-2008 CEEEX MATNANTECH: Structural systems and advanced technologies for structures from high- performance steels for buildings located in high-seismicity areas - STOPRISC, Financing authority: Ministry of Research and Education
- 1434/27.04.2006: 2006-2008 CEEEX-ET, Dual steel structures with removable dissipative elements for buildings located in seismic areas, Financing authority: Ministry of Research and Education
- 04/15.09.2006., 2006-2008 Advanced training and research interdisciplinary platform "Centre for advanced studies and research in material and structural engineering". Financing authority / Beneficiary: Ministry of Education and Research
- 184/01.10.2007 TD-407. Solutions for consolidation and rehabilitation of masonry and reinforced concrete buildings placed in seismic areas using metallic materials. Beneficiary: UEFISCSU
- DIFISEK RFCS-CT-2007-00030, 01.07.2007. Dissemination of structural fire safety engineering knowledge throughout Europe. Financing authority / Beneficiary: European Union
- 31042/2007 PNCDI2 – PROACTEX. Structural systems and innovative technologies for protection of buildings under extreme actions taking into account sustainable design criteria. Financing authority / Beneficiary: ANCS-CNMP

This last project was developed in order to study sustainable building solutions for housing. Four examples of sustainable mixed building technologies, which combine steel and timber in the framing and different materials for cladding, roofing and flooring, in order to obtain highly performance thermo-energetic properties are studied. Some innovative design solutions have been used in these projects. Three examples present single family houses and one a block of flats, all of them built in Romania. All the buildings are located in medium and high seismic regions. There are analyzed aspects related to design and detailing, as well as solutions for cladding and roofing, including structural features, thermo-energetic performance and cost efficiency analysis.



Figure 4.16. Bulzesc's family house



Figure 4.17. Carmen's family house



Figure 4.18. Constantin's family house



Figure 4.19. Block of flats

## 4.10 SUSTAINABLE POLICIES AND APPROACHES: THE SWEDISH CASE

### 4.10.1 *Government initiatives*

#### 4.10.1.1 *National environmental goals (<http://www.miljomal.nu/english/english.php>)*

In 1999, 15 environmental quality objectives were adopted by Parliament. A 16th objective, on biodiversity, was adopted in November 2005. They define the state of environment which environmental policy aims to achieve and provide a coherent framework for environmental programmes and initiatives at national, regional and local level. The objectives, which are aimed to be reached within a generation, are formulated positively in terms that easily could be understood and communicated to the public.

The environmental quality objectives are:

1. Reduced Climate Impact
2. Clean Air
3. Natural Acidification Only
4. A Non-Toxic Environment
5. A Protective Ozone Layer
6. A Safe Radiation ...
7. Zero Eutrophication
8. Flourishing Lakes and ...
9. Good-Quality Groundwater
10. A Balanced Marine ...
11. Thriving Wetlands
12. Sustainable Forests
13. A Varied Agricultural ...
14. A Magnificent Mountain ...
15. A Good Built Environment
16. A Rich Diversity



Figure 4.20. Environmental objectives Illustrations:  
Tobias Flygar

For each objective an authority is appointed to formulate measurable indicators and regularly report the progress.

#### 4.10.1.1.1. Responsibilities

##### (a) *Environmental Objectives Council*

In January 2002 the Swedish Government established the Environmental Objectives Council to promote consultation and cooperation in implementing the environmental quality objectives adopted by Parliament. The Council consists of representatives of central government agencies, county administrative boards, local authorities, non-governmental organizations and the business sector. The Council is served by a Secretariat based at the Swedish Environmental Protection Agency.

The principal functions of the Council are:

- to monitor and evaluate progress towards the environmental objectives
- to report to the Government on how efforts to achieve the objectives are advancing and what further action is required
- to coordinate the information efforts of responsible authorities
- to ensure coordination of the regional application of the objectives, and
- to allocate funding for monitoring of progress towards the objectives, environmental monitoring, and reporting at international level.

##### (b) *County administrative boards and municipal authorities*

Sweden's 21 county administrative boards have overall responsibility for defining and monitoring regional goals relating to the environmental quality objectives. The county administrative boards support the municipalities which have overall responsibility for local adaptation of the national objectives.

#### 4.10.1.1.2. Authorities responsible for the environmental objectives

A number of national authorities have been given overall responsibility for the environmental quality objectives. This includes proposing and implementing measures as well as monitoring, evaluating and reporting progress.

Table 4.7. Environmental objectives

Authorities	Responsibility
Swedish Environmental Protection Agency	<p><i>Environmental objectives:</i></p> <p>Reduced Climate Impact Clean Air Natural Acidification Only A Protective Ozone Layer Zero Eutrophication Flourishing Lakes and Streams A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos Thriving Wetlands A Magnificent Mountain Landscape A Rich Diversity of Plant and Animal Life</p> <p><i>Broader issue related to the objectives:</i> The Natural Environment</p>
Swedish Radiation Protection Authority	<p><i>Environmental objective:</i> A Safe Radiation Environment</p>
National Chemicals Inspectorate	<p><i>Environmental objective:</i> A Non-Toxic Environment</p>
Geological Survey of Sweden	<p><i>Environmental objective:</i> Good-Quality Groundwater</p>
National Board of Forestry	<p><i>Environmental objective:</i> Sustainable Forests</p>
Swedish Board of Agriculture	<p><i>Environmental objective:</i> A Varied Agricultural Landscape</p>
National Board of Housing, Building and Planning	<p><i>Environmental objective:</i> A Good Built Environment</p> <p><i>Broader issue related to the objectives:</i> Land Use Planning and Wise Management of Land, Water and Buildings</p>
National Heritage Board	<p><i>Broader issue related to the objectives:</i> The Cultural Environment</p>
National Board of Health and Welfare	<p><i>Broader issue related to the objectives:</i> Human Health</p>

The other authorities responsible for the work in a specific sector also have a responsibility to work with the environmental issues. Banverket (<http://www.banverket.se/>) and the Swedish Road Administration (<http://www.vagverket.se/>) are two of these which are involved in the built environment and urban planning. The Swedish Work Environment Authority (<http://www.arbetsmiljoverket.se/>) and Swedish Energy Agency (<http://www.energimyndigheten.se/>) are also involved in the work with a sustainable development in many ways.

#### 4.10.1.1.3. Environmental indicators

The Environmental Objectives Portal currently presents more than 80 national indicators tracking progress towards the environmental quality objectives and interim targets.

Each agency is responsible for coordinating, developing and assuring the quality and operational reliability of indicators relating to its own particular environmental quality objective(s), and deciding how these indicators are to be used. Overall coordination is the task of the Environmental Objectives Council. The county administrative boards have worked together to develop joint indicators at the regional level. Much remains to be done to delimit a core set of carefully selected indicators, which will then guide decisions on what more detailed data needed to be collected and evaluated.

When choosing indicators, it is essential to coordinate as far as possible the data required for monitoring of progress towards the objectives with those needed by other users, especially for purposes of international reporting. This will lay a better foundation for long-term funding. In the short term, the authorities' efforts to develop indicators have focused on securing the necessary supply of data in the most cost-effective way possible. In the subsequent development of these indicators, there should be a greater focus on customizing them to different target groups, so as to facilitate communication of the results of monitoring.

The indicators that are of importance for the building sector are shown in Appendix 1.

#### 4.10.1.2 Regulations

##### 4.10.1.2.1. Responsibility

Based on laws The National Board of Housing Building and Planning (<http://www.boverket.se/templates/Page.aspx?id=1697>) is empowered to issue mandatory provisions and general recommendations, such as Building Regulations, BBR and Design Regulations, BKR. The provisions are in the form of functional requirements, referring to standards when applicable.

Boverket is responsible for the Environmental Quality Objective "A Good Built Environment":

"Cities, towns and other built-up areas must provide a good, healthy living environment and contribute to a good regional and global environment. Natural and cultural assets must be protected and developed. Buildings and amenities must be located and designed in accordance with sound environmental principles and in such a way as to promote sustainable management of land, water and other resources."

In more detail the objective outlines a long list of qualities to be reached, ranging from architectural qualities and cultural heritage preservation to a sustainable urban structure in terms of resource conservation, freedom from noise, healthy local climate, good quality public transport, waste recycling and unspoiled countryside.

##### (a) Interim targets

Interim targets have also been set by the Swedish Parliament, so that by 2010, inter alia,

- land use and community planning will be based on programs and strategies for a varied supply of housing, workplaces, services and cultural activities, in order to reduce transport demand; preservation and enhancement of cultural and aesthetic assets, green spaces and water bodies; promotion of the use of renewable energy resources and development of production plants for district heating, solar energy, biofuels and wind power.
- The number of people who are exposed to traffic noise will have been reduced by 5% compared with 1998.
- Extraction of natural gravel in the country will not exceed 12 million tonnes per year.
- The quantity of waste disposed of to landfill, excluding mining waste, will be reduced by at least 50% by 2005 compared with 1994.
- At least 50% of all household waste will be recycled through materials recovery, including biological treatment.
- The environmental impact of energy use in residential and commercial buildings will decrease and will be lower than in 1995.



- Radon levels in all schools and pre-schools are below 200 Bq/m<sup>3</sup> air
- The new building code was launched in 1<sup>st</sup> of July 2006 apart from the chapter 9 about buildings which use electricity for heating. This chapter is still on hearing.

#### 4.10.1.2.2. Energy use regulations

From the 1<sup>st</sup> July 2006 the demands on maximum energy use in new buildings are:

Residential buildings:

110 kWh/m<sup>2</sup>,yr for zone south (appr <62°N)

130 kWh/m<sup>2</sup>,yr for zone north (appr >62°N)

75 kWh/m<sup>2</sup>,yr for buildings with direct electrical heating - zone south

95 kWh/m<sup>2</sup>,yr for buildings with direct electrical heating - zone north

In addition the highest U-value for single parts of the building envelop should not exceed 0,5 W/m<sup>2</sup>,K.

Localities:

100 kWh/m<sup>2</sup>,yr for zone south (appr <62°N)

120 kWh/m<sup>2</sup>,yr for zone north (appr >62°N)

In addition the highest U-value for single parts of the building envelop should not exceed 0,7 W/m<sup>2</sup>,K.

#### Download

"[Legislation The Planning and Building Act](#). The Act on Technical Requirements for Construction Works, etc. The Environmental Code." Current wording June 1st 2004. It can be downloaded at <http://www.boverket.se/templates/Page.aspx?id=2323> . Observe that the English version is not the last.

#### 4.10.1.2.3. Subsidies

The building stock is divided in dwellings and localities. The National Board of Housing Building and Planning (<http://www.boverket.se/templates/Page.aspx?id=1697>) is responsible for subsidies to the building sector.

#### **Dwellings**

- Support for adaptation to disabled people
- Support for building dwellings in areas with shortage or lack of dwellings for students
- Klimp grants – support to municipalities for investments for CO<sub>2</sub> reductions (see below)
- Support for conversion from direct electrical heating to heat pumps or bio fuels in residential buildings
- Support for conversion from fossil fuel heating to heat pumps or bio fuels in single family buildings
- Support for actions to eliminate high radon levels
- Support for erection of multi-family houses (will be phased out with the new government)
- Support for installation of solar panels in residential buildings
- Support for arranging source separation in multi-family houses

#### **Localities**

- Support for common meeting rooms i residential buildings
- Support for building cultural localities as theatres and museums that are not owned by the state.
- Klimp grants – support to municipalities for investments for CO<sub>2</sub> reductions (see below)
- Support for installation of solar panels in some localities
- Support for installation of solar panels in commercial buildings
- Support for investments meant for increased energy efficiency or for conversion to renewable energy in public buildings

#### 4.10.1.2.4. Energy declaration

Because the directive (2002/91/EG) from the European Parliament Sweden like other EU countries is forced to introduce Energy Declarations for Buildings. The aim is to support energy efficiency while considering a healthy indoor environment and cost efficiency.

The energy performance of a building is the metered energy use for areas heated to at least 10oC. In principle should buildings be declared regarding energy performance along with suggestions for improved efficiency. The regulations are not fully implemented in Sweden yet.

#### 4.10.1.3 Chemicals

The Swedish Chemicals Inspectorate (<http://www.kemi.se/default550.aspx>) is responsible for the efforts to attain a non-toxic environment in Sweden. The Inspectorate has launched a risk reduction tool called PRIO. This tool is aimed at all companies with an intent to improve their environmental work. PRIO consists of a guide and a database containing about 4,000 dangerous chemical substances. It is a web-based tool intended to be used to preventively reduce risks to human health and the environment from chemicals. The aim of PRIO is to facilitate in the assessment of health and environmental risks of chemicals so that people who work as environmental managers, purchasers and product developers can identify the need for risk reduction. To achieve this, PRIO provides a guide for decision-making that can be used in setting risk reduction priorities.

The recommendations on which chemicals are prioritised for risk reduction measures are based on the environmental quality objective “A non-toxic environment” adopted by the Swedish parliament and the current proposal for the new EU chemical legislation. Although PRIO is based on Swedish legislation and Swedish considerations, PRIO can be used by companies or organisations in other countries as a source of knowledge or inspiration. PRIO can provide help in preparing for the EU’s new chemicals legislation and in the work towards sustainable development.

Substances in PRIO are divided into two levels of prioritisation: phase-out substances and priority risk-reduction substances. The level a substance belongs to depends on the hazardous properties of the substance.

##### ***Phase-out substances:***

- CMR (carcinogenic, mutagenic or toxic to reproduction, categories 1 and 2)
- PBT/vPvB (persistent, bioaccumulating and toxic/very persistent and very bioaccumulating)
- Particularly hazardous metals (mercury, cadmium, lead and their compounds)
- Endocrine disruptive
- Ozone-depleting

##### ***Priority risk-reduction substances***

- Very high acute toxicity (health)
- Allergenic
- Mutagenic Category 3
- High chronic toxicity (health)
- Environmentally hazardous, long term effects
- Potential PBT/vPvB

The efforts to avoid and reduce toxic substances in the building sector relates to the PRIO work as far as possible. One example of this is the BASTA project described below under “Buildingsector initiatives”.

#### 4.10.1.3.1. Chemicals - Databases

The Swedish Chemical inspectorate also administer a number of databases with information, data and statistics to help the work towards a non-toxic environment.

Table 4.8. Chemical databases

Databases wholly or partly produced and administered by the Swedish Chemicals Inspectorate ([http://www.kemi.se/templates/Page\\_\\_\\_\\_\\_2859.aspx](http://www.kemi.se/templates/Page_____2859.aspx) , 2006-11-22)

Database	Description
Classification List	The Classification List contains binding health and/or environmental classifications of 3,300 substances, isomers, closely related substances and other groups of substances, often representing the same "substance". Guide to Swedish search site.
Company register	The Company Register contains the names of companies having filed a product report to the Swedish Chemicals Inspectorate. Commercial agents and reported enterprises appear on separate lists.
Flow analyses	Flow analyses contain facts on substances and group of substances, for example manufacturing methods, use patterns and physical data. The flow analyses are part of Sweden's official statistics.
KemI-stat	KemI-stat is a tool for compiling statistical information based on the data in the Swedish Chemicals Inspectorate's (KemI) products register and pesticides register.
List of substances	The List of Substances contains over 130,000 chemical substances with CAS numbers. Approximately 100,000 of these also have an EINECS number. The register of the list contains 170,000 synonyms. Guide to Swedish search site.
N-Class	The N-Class Database contains information on the classifications of more than 7,000 substances. The data primarily concern environmental effects constituting the basis for classifications and classification proposals. Classifications of fire and health hazards are also included. Read more about N-Class.
Pesticides register	The Pesticides Register contains information on more than 2,000 approved (and previously approved) pesticide preparations in Sweden. Guide to Swedish search site.
PRIO	A web-based tool intended to be used to preventively reduce risks to human health and the environment from chemicals. PRIO replaces the Swedish Chemicals Inspectorate's Observation (OBS) list.
Restricted Substances Database	The contains information whether a substance or group of substances is restricted according to provisions laid down in regulations issued by the Swedish government or the Swedish Chemicals Inspectorate. Guide to Swedish search site.
Riskline	Riskline contains over 7,000 bibliographical references to peer-reviewed information on 3,000 chemical substances. Search by CAS no. to obtain best results.
The SPIN database	The SPIN database contains information on products on the market reported to each of the Nordic products registers. SPIN also contains data on amounts of substances and in what products and sectors the substances are used.

#### 4.10.1.4 Taxes

The following energy taxes are applied in Sweden:

Table 4.9. Summary of current taxes and charges applied on energy in Sweden (www.skatteverket.se , 2006-11-22)

Type of tax	Tax level	Comments
Energy tax and CO <sub>2</sub> tax	Differs among the fossil fuels	Applied on all fossil fuels.
Sulphur tax	SEK 30 /kg S	Applied on heavy fuel oils, coal and peat. If sulphur is removed from the exhaust gases the tax could be refunded in accordance with that
Tax on nuclear electricity production	SEK 10200/(MWh month)	Applied on nuclear power
Electricity consumer tax	SEK 0,201-0,261/kWh	Tax on electric power
Electricity consumer tax	SEK 0,005/kWh	Tax on electric power used in manufacturing industry and agriculture
Value added tax		Applied on all energy consumed
Natural Gravel Tax	SEK 13/tonne gravel	On quarried natural gravel
Waste tax on landfills	SEK 435 /tonne of waste	For waste brought into a landfill or at a facility where hazardous waste or other waste exceeding 50 tonnes per year, are deposited or stored for a longer time than three years.
Pesticide tax	SEK 30/kg(active constituent in the pesticide)	Applied on sale or use of pesticides within the country. Wood preservatives are exempt from the tax.
Property tax	1% of the assessed value	Tax on dwellings and property designated for dwellings
Road user charges (tolls) for foreign and national heavy goods vehicles	Differs	For trucks heavier with a total weight exceeding 12 ton.

#### 4.10.1.4.1. Green Taxation

The Swedish Environmental protection Agency has been instructed by the Government to analyse various alternative environmental taxes as a basis for Government green taxation proposals for the period 2005-2010 and submit proposed improvements to the effectiveness of green taxes.

Developing a Green tax reform has been under in Developing a Green tax reform is another environmental economic instrument. Taxes on environmentally harmful activities are increased in exchange for tax reductions on individual earnings.

Shifting the tax burden usually means that higher revenues from environmental taxes are used to offset a reduction in taxes on labour (or other distorting taxes). The effect of a green tax reform is not to increase taxes overall, but to redistribute tax revenues within a given framework, and to use taxation more specifically as an instrument of environmental control. The purpose of redistributing money is to promote environmentally sound activities and choices. Higher environmental taxes will result in a better environment (environmental benefit). In addition, they may benefit society by reducing unemployment (efficiency benefit).

#### 4.10.1.5 Klimp

The Swedish EPA is granting SEK 317 million to 25 local climate investment programmes (Klimp), and three special projects known as Guld Klimpar (“gold nuggets”). The total investment amounts to SEK 1.2 billion. The programmes are taking place throughout Sweden, and are estimated to cut Swedish greenhouse gas emissions by 203,000 tonnes per year, which corresponds to emissions from about 70,000 cars.

“The local climate investments are an important part of work to limit the greenhouse effect and to help us achieve the Swedish climate objective”. More than 40 per cent of the approved funding is earmarked for biogas projects, while about 20 per cent is for investments in district

heating. The remaining projects include measures to boost energy efficiency in buildings and industry, improved conditions for cycling and public transport and local information about the climate issue. The players include municipalities, companies, county councils and regional co-operation bodies.

The approved programmes are estimated to cut Swedish greenhouse gas emissions by 203,000 tonnes per year, of which carbon dioxide makes up about 184,000 tonnes and other greenhouse gases roughly 19,000 (calculated as carbon dioxide equivalents). Nearly half the reduction in emissions will occur in the transport sector. Total energy consumption will fall by about 215,000 MWh, of which about 97,000 MWh is electricity.

The climate investment programme, Klimp, is a type of government funding to municipalities and other local players who make long-term investments to reduce the greenhouse effect. The EPA takes care of the administration of Klimp, while the Council for Investment Support (RIS), with members appointed by the government, decides on the grants. Besides the Swedish EPA, the applications have been assessed by the National Board of Housing, Building and Planning, the Swedish Energy Agency, the National Road Administration and the National Rail Administration. The climate investment programme was introduced in 2003, and this is the third round of grants to be awarded. The closing date for applications for the next round is 1 November 2006.

In 2005, 51 applications were submitted for funding amounting to SEK 1.3 billion. 25 programmes, as well as three independent ones called Guldklimpar (gold nuggets), are now being granted a total of SEK 317 million in funding. The programmes are in: Borås, Gothenburg, Helsingborg, Hässleholm, Katrineholm, Knivsta, Kristianstad, Landskrona, Leksand, Lidköping, Lilla Edet, Luleå, Malmö, Olofström, Region Skåne, the Regional Council in Kalmar County, the Östsam Regional Development Council, Stockholm, Svedala, Söderhamn, Tranemo, Trollhättan, Ulricehamn, Varberg and Östersund. The three Guldklimpar are in Svedala, Söderhamn and Örnsköldsvik.

Read more at: <http://www.naturvardsverket.se/klimp>

#### 4.10.1.6 Official reports (<http://www.sweden.gov.se/sb/d/574>)

- [1] <http://www.sweden.gov.se/sb/d/574>
- [2] <http://www.utrikes.regeringen.se/sb/d/108/a/48012>
- [3] <http://www.utrikes.regeringen.se/sb/d/108/a/26994>
- [4] <http://www.utrikes.regeringen.se/sb/d/108/a/45734>

A number of Governmental reports about the subject have been published. Unfortunately we couldn't find them in English.

#### **Energy declarations**

Energideklarationer - Metoder, utformning, register och expertkompetens (<http://www.utrikes.regeringen.se/sb/d/108/a/48012>)

Miljö- och samhällsbyggnadsdepartementet, Utredningen om byggnaders energiprestanda N 2003:12, Statens offentliga utredningar (SOU) SOU 2005:67 4 augusti 2005

#### **Building declarations**

Byggnadsdeklarationer - Inomhusmiljö och energianvändning (<http://www.utrikes.regeringen.se/sb/d/108/a/26994>)

Miljö- och samhällsbyggnadsdepartementet, Byggnadsdeklarationsutredningen, Statens offentliga utredningar (SOU) SOU 2004:78 1 juli 2004

#### **Better indoor environment**

Bättre inomhusmiljö (<http://www.utrikes.regeringen.se/sb/d/108/a/45734>)

Miljö- och samhällsbyggnadsdep., Statens offentliga utredningar (SOU) SOU 2005:55 2 juni 2005



#### 4.10.2 Sector initiatives

##### 4.10.2.1 The Ecocycle Council – A Unique form of Cooperation

The Ecocycle Council is an association of around 30 organizations within the Swedish building and real estate sector. The aim of the organization is “*that the building sector, through voluntary efforts, on market grounds and in close co-operation with authorities and legislation, succeeds in conducting credible, effective, co-ordinated and systematic environmental work that results in permanent environmental improvements*”.

The history goes back to 1994 when the Swedish government through its "Ecocycle Commission" established informal contacts with a number of representatives of the building and property sector. To facilitate contacts with the Ecocycle Commission the representatives of the sector took the initiative to set up a network - the Ecocycle Council for the Building Sector. Now a more formal association just called “The Ecocycle Council”. The idea was to enable the sector's many different interested parties to get together to discuss and elaborate on this single issue: How should we formulate producer responsibility in the building and property sector? Today the aim is broader – that the building sector, through voluntary efforts, should reduce the environmental impact of the building sector.

The building and real estate sector is of significant importance to society. In Sweden the building sector occupies around 440 000 people and has a turnaround about 40-50 billion Euros. But the sector also stands for a big part, around 40 %, of the use of energy and materials in society but also a considerable part of the production of waste. This means that the sector has a great environmental impact. But the Swedish building and real estate sector has conducted a unique project – The Environmental program 2003-2010 – trying, on a voluntary basis, to reduce this environmental impact.

The Environmental Program is based on an environmental review, which has identified the significant environmental aspects of the building sector. From these significant environmental aspects – the use of energy, the use of materials, the use of hazardous substances and the impact on indoor air quality in buildings – the Ecocycle Council has formulated a number of environmental objectives and a plan of action.

The Environmental Program 2003-2010 was approved by The Ecocycle Council in October 2003.

##### ***The Environmental Review 2000***

The building sector has on its own initiative conducted an environmental review to identify the significant environmental impact of the sector. The study was carried out in accordance with the environmental management principles of ISO 14000. The idea was that the environmental review should create a basis for the voluntary undertaking of the sector to ensure “*that the building sector, through voluntary efforts, on market grounds and in close co-operation with authorities and legislation, succeeds in conducting credible, effective, co-ordinated and systematic environmental work that results in permanent environmental improvements*”. The environmental review is the first study that in a systematic way, and on the basis of environmental management principles, compiles a number of reports and studies into one common environmental review for the entire building sector.

##### ***Environmental objectives***

###### Energy Conservation

###### 1. Buildings:

- The use of purchased energy per square meter should be reduced by 10% between the years 2000 and 2010.
- The use of fossil fuels for heating purposes should be reduced by 20% between the years 2000 and 2010.

###### 2. Civil Engineering Works

- The use of fossil fuels for transports, construction machines and industries within civil engineering works should be reduced by 10% between the years 2004 and 2010.

#### Economizing with building materials

- To halve the volumes of landfill waste from construction works between 2004 and 2010.

#### Fading out hazardous substances

- The use of hazardous substances within the Building Sector should be reduced to a minimum by the year 2010.
- Latest by the year 2006 the main part (> 3/4) of the relevant building products on the Swedish market should have building product declarations.

#### Secure and sound Indoor Environment

- New buildings should be designed, built and maintained in a way that secures a sound indoor environment.
- Existing buildings that causes health problems should be identified and remedies should be carried out latest by 2010.

The Environmental Program 2003-2010 was approved by The Ecocycle Council in October 2003. Now it's the mission of all the organizations within the Council to inform their members and help them to implement the goals and actions in their businesses.

#### ***Plan of action 2003-2010***

The Ecocycle Council has formulated more than 20 different projects to support the implementation of the Environmental program. Most of these activities aim to a self-regulation of the processes of the building sector.

#### ***Building product declarations***

The Ecocycle council is also working with the development of building product declarations and draw up a proposal for common principles about how information about the building products should be organised and presented. Building product declarations are meant to gather information about the products use of materials, energy use and lifecycle.

This work has also continued in the building sector. Principles for building product declarations have been developed by SKASKA Sverige partly with grants from Svenska Byggbranschens Utvecklingsfond (SBUF). They have constructed an open database called "Byggarnas BVD-plats" (<http://www.byggarnas-bvdplats.com>) with building product declarations. It is voluntary for companies to make declarations. Today there are 1500 registered building product declarations in the system.

For chemical products there is also a database for the compulsory declarations with safety-data-instructions (säkerhetsdatablad), "Byggarnas VIB-plats". Today there are approximately 7000 registered declarations.

#### *4.10.2.2 Building, Living and Property – a dialogue project* (<http://www.byggabodialogen.se/EPIServer/templates/Page.aspx?id=123>)

The dialogue project Building, Living and Property Management for the Future is a unique cooperation between companies, municipalities and the Government with the purpose to achieve a development of a sustainable building and property sector in Sweden. By the means of this dialogue, the parties have reached a voluntary agreement to take concrete measures for a sustainable development.

The dialogue project Building/Living has three prioritised areas:

- Healthy indoor environment
- Efficient use of energy
- Efficient resource management

We would like our website visitors to understand what the dialogue project Building/Living implies in order for us to achieve a sustainable building and property sector, with an emphasis on the three prioritised areas. The website will also provide the visitor with news on how the

sector deals with management issues and the sustainable development of the building and property sector.

#### 4.10.2.2.1. *What is to be done?*

In the “Building/Living Project”, the Government, together with companies and municipalities, have expressed a number of aims that they wish to achieve. The actors have signed an agreement on concrete efforts that are now being implemented

#### 4.10.2.2.2. *The commitments*

Concrete efforts – the 7 areas The commitments that the actors sign are divided into seven areas that are concluded in the following recommendations:

- Plan for sustainable community planning!
- Adopt a holistic view for the entire life-cycle of the building structure!
- Establish quality and efficiency in the construction and property management processes and furnish new warranties for sustainable development!
- Property management with consideration to energy and environment!
- Classify buildings!
- Invest in research, development and training for sustainable building and property sector!
- Do follow-up and evaluation work!

#### 4.10.2.2.3. *Aims for the Building/Living project*

The aims encompass anything from the amount of disposed waste, tapped pit run, substances dangerous to the environment, health issues related to buildings, the use of chemicals - to the strain on the environment from energy application. Therefore, there are obvious connections to the national environmental quality aims that the Swedish Parliament and Government have developed.

**The “Building/Living” goals – goals that have been formulated within “the Project for Building, Living for a Sustainable Building and Property Sector in Trust for the Future”.**

1. The environmental stress from the energy application in homes and premises is decreasing and no later than 2025, heating and water heating will be made using only limited elements of fossil fuels. No later than 2015 more than half of the annual energy need will come from renewable energy sources.
2. The use of purchased energy in the sector will decrease with at least 30 % until the year of 2025 compared to 2000. The energy application is lower in 2010 than it was in 1995.
3. No later than 2005 there will be information adapted for the sector that will make it feasible not to choose construction material/constructional design which contain or are the cause of known substances which are health-impairing or dangerous to the environment.
4. No later than 2009, all newly built houses and 30% of the existing ones will be declared and classified as to the effect on health and environmental issues related to buildings.
5. The building and property sector is phasing out the use of substances and metals that are included in the Government’s guidelines for chemical application at least at the rate as is stated in the Government proposal 2000/01:65 Chemical strategy for a non-poisonous environment.
6. The quantity of disposed waste<sup>2</sup>, mine waste not included, will decrease with at least 50% to 2005 counting from the levels of 1994, while the total quantity of generated waste will not increase. No later than the year of 2010, disposed waste from new constructions and reconstructions, property maintenance and demolished houses will amount to no more than 25% measured in tons from the levels of 1994. In 2025 no more than 10% will be disposed.

7. In 2010 the tapped pit run in the country will not be more than 12 million tons per year and the share of recycled materials will amount to at least 15% of the ballast application.

#### 4.10.2.3 *Basta* (<http://www.bastaonline.se/2.4788e15710c6d12e91380002305.html>)

There is a great need to reduce the use of hazardous substances in construction products and chemical products. In the BASTA system, the Swedish construction sector has agreed on a common definition of the substance properties for the decision as to whether a product is to be accepted or not. These substance properties are based on the plans in the forthcoming REACH regulation. The burden of proof in the BASTA system is put on the supplier, who has to confirm whether the product meets the criteria or not. A system of self-declaration of this kind needs to be supplemented by a quality assuring auditing, and the BASTA project has drawn up the procedures to ensure that such validation can be carried out in a credible and cost-effective way.

For the dissemination of the suppliers' assessed products the BASTA project has developed a web-based database.

The industry standard for properties criteria has been developed with broad endorsement by large parts of the Swedish construction sector, which is crucial to the future success of the system. It has been possible for this to be done through great openness in the drafting of these criteria.

The validation method that is to assure the system of credibility consists principally of two parts: firstly requirements relating to the supplier's expertise, documentation and organisation, which are collated in a contractual document which each participating supplier signs, and secondly random-sample audits of the suppliers' data.

#### 4.10.3 *Other Non-Governmental initiatives*

##### 4.10.3.1 *The Swedish Environmental Management Council* (<http://www.miljostyrning.se/eng/>)

The Swedish Environmental Management Council (SEMC) is a company owned jointly by the Swedish Government, the Confederation of Swedish Enterprises and the Swedish Association of Local Authorities and Regions. The overall aim of the activities of the Council is to help and support private and public organisations to implement and carry out a systematic and progressive environmental work towards a sustainable development.

The Swedish Environmental Management Council administrates three tools – EMAS and EPD for improving and communication about the environmental performance of organisations and products/services and EKV for product-related guidance about ecologically conscious procurement.

The rationale of the Swedish Environmental Management Council is to provide a neutral platform stimulating a dialogue between all actors in society – from authorities, the business sector, non-governmental organisations as well as environmental organisations. The activities of the Council are carried out based on a broad consensus among different stakeholders in the field of environmental management both nationally and internationally.

##### 4.10.3.2 *Environmental assessment methods for buildings*

A number of methods for environmental assessment of buildings and/or building materials have been developed mostly by different companies active in the sector. They vary from simple checklists to sophisticated LCA tools and cover things like investigation of existing buildings. Year 2005 35 such Swedish methods were identified of which 27 were more actively used (Sundkvist et al., 2005) mainly by different enterprises. The only one with a more holistic and scientific approach is the EcoEffect method developed by KTH and the University of Gävle (<http://www.ecoeffect.org>).

This area is still under development and very slowly penetrating the market. The more sophisticated tools can more be looked upon as learning instruments about the relation between buildings and environmental impacts while the simpler are practicable but often trustworthy.

A broad new cooperation between the building sector and the academic world started a year ago aiming at developing a compromise between sophistication and simplicity regarding environmental assessment of buildings. This new method, “Environmental classification of buildings” is planned to be launched in the end of 2007. Since many representatives from the sector are involved in the development work it is expected to that this method, which is linked to the “Building, Living, Property” project mentioned above, will be widely used in the future.

*4.10.3.3 ISO 14000 (<http://www.sis.se/DesktopDefault.aspx?tabname=%40iso14000>) and EMAS (<http://www.emas.se>)*

There are environmental management systems which are used in the building sector and by other companies. The most common are ISO 14001 and EMAS. Many companies that are not certified have their own system built on the same principles. A lot of companies in Sweden are ISO 14001 certified. Sweden has the highest amount of certified companies in relation to the number of inhabitants. It's more common with ISO 14001 certification than EMAS-certification.

#### *4.10.3.4 Environmental labelling of building products*

There are three environmental labels available in Sweden. “Good Environmental Choice” is launched by the Swedish Society for Nature Conservation (<http://www.snf.se/english.cfm>). They have almost no labels for building products apart from electricity and an impregnation for concrete. The Swan is a Nordic Ecolabel (<http://www.svanen.nu/Eng/default.asp>). They have labels for a few building products as fibre board, gypsum board, chipboard, biofuel, boilers, fireplaces, white wares, impregnated wood, kitchen appliances and windows. The Flower is the European Ecolabel (<http://www.eco-label.com/default.htm>). They have labels for household appliances like dishwashers, refrigerators, vacuum cleaners and washing machines. They also have labels for indoor paints and varnishes.

Environmental Product Declarations (EPD) (<http://www.environdec.com/page.asp?id=105&menu=3,9,0>) administered by the The Swedish Environmental Management Council mentioned above are not environmental labels but can serve a similar purpose since all emissions and use of energy and materials should be declared. EPDs exist for particle boards, cement, concrete, glass, clay bricks, pellets, washing machines, fridge/freezers, district heat, electricity and solid waste treatment.

For wood products the labelling The Forest Stewardship Council (<http://www.fsc-sweden.org/>) (FSC) is used. The Forest Stewardship Council (FSC) promote environmentally appropriate, socially beneficial, and economically viable management of the world's forests. FSC in Sweden, called Svenska FSC, is a national based, not for profit organization and one of FSCs national initiatives, often referred to as NIs.

#### *4.10.4 Swedish Society for Nature Conservation*

Today the Swedish Society for Nature Conservation (SSNC) is the biggest nature conservation and environmental organisation in Sweden with 170 000 members and 274 local branches across the whole country.

The SSNC was established in 1909. At that time an elite group was concerned about the increasing degradation of Sweden's nature and wildlife due to rapid industrialisation. Until a few decades ago, the activities of the SSNC were primarily focused on national, i.e. Swedish, environmental issues and traditional conservationist concerns. In 1990 funds from the Swedish International Development Co-operation Agency (Sida) made it possible for the SSNC to cross borders and begin collaboration with environmental organisations in Europe and in the South.

The organisation works with building related issues when they interfere with environmental conservationist concerns. For example are they involved in promoting Forest certification ac-



ording to FSC, Forest Stewardship Council. Sweden has by now the world's largest area of FSC-certified forest.

#### 4.10.4.1 O2 Nordic ([www.o2nordic.org](http://www.o2nordic.org))

O2 Nordic is a network of people working active with design for a sustainable development. The network is organised as an economic organisation/förening with the headquarter in Gothenburg. O2 Nordic is part of the international O2 network. ([www.o2.org](http://www.o2.org))

##### **O2 Nordic Mission Statement:**

We believe that the development of a sustainable future is the greatest and most inspiring design challenge of our time.

O2 Nordic aims to influence and inspire industry to look at sustainability as a business opportunity, and authorities to formulate a clear and attractive sustainability vision.

O2 Nordic connects people in Sweden as well as between the Nordic countries as a permanent meeting place and a place for action.

#### 4.10.5 Swedish Association of Architects Environmental group (<http://www.arkitekt.se/miljo>)

The Environmental group in the Swedish Association of Architects are working with ecological, environmental and sustainable issues in the building and planning processes.

#### 4.10.6 Research

There is a lot of research being done in the field of sustainable building and planning in Sweden. The main research funds supporting and giving grants to research projects in the field of sustainable building and planning are FORMAS (<http://www.formas.se/>), VINNOVA (<http://www.vinnova.se/>), NUTEK (<http://www.nutek.se/>), Energimyndigheten (<http://www.energimyndigheten.se/>), Mistra (<http://www.mistra.org/>), ARKUS (<http://www.arkus.se/>).

#### 4.10.7 Sustainable building projects

Designing houses and planning to build a more sustainable society have been on the agenda in many projects in Sweden the last 30 years, but still there is more to be done. In the book "SAR:s Ekoguide" (1996) you can read about 150 of these projects. Larger developments with sustainable ideas that have been most recognised are Bo 01 (<http://www.malmo.se/miljohalsa/projektnatverk/projekt/vastrahammenbo01/faktabladbo01.4.314d1c9210a454075d480001445.html>, 2006.11.22), Lindås (<http://www.miljoportalen.se/boleva/boende/varma-hus-utan-uppvaermning>, 2006.11.22), Hammarby Sjöstad (<http://www.stockholm.se/Extern/Templates/Page.aspx?id=45463>, 2006.11.22).

### 4.11 SUSTAINABLE POLICIES AND APPROACHES: THE TURKISH CASE

#### 4.11.1 Introduction

As being a developing country Turkey did not finish the period of its industrial development. To reduce the impacts of climate change Turkey has developed the "National Climate Change Strategy" by taking into account Turkey's circumstances and capacity. This strategy has three terms: (i) Short term (within one year), (ii) Midterm (undertaken or completed within 1 to 3 years) and (iii) long term (undertaken over a 10 year period)

The strategy will lead the actions during 2010 - 2020 and will be updated if necessary. With Decision 26 /cp7 of the Seventh Conference of Parties (COP) in Marrakesh in 2001, Turkey was deleted from the list of Annex – II countries, under the United Nations Framework Convention on Climate Change (National climate change document (2010-2020)).

Turkey recognised with its special circumstances relative to other Annex-I countries, and placed in a different situation. Afterwards Turkey became a party to the United Nations Framework Convention on Climate Change on May 24, 2004.

Law no 5836 on the Endorsement of Turkey's Ratification of Kyoto Protocol to the United Nations Framework Convention on Climate Change was published in the official Gazette numbered 27144 and dated February 17, 2009 and Turkey officially became a party to the Protocol on August 26, 2009.

Turkey has the lowest values per capita of greenhouse gas emission, primary energy consumption per capita and historical responsibility among all OECD countries and the countries included in Annex -1 to the United Nations Framework Convention on Climate Change. Based on 2007 data, while Turkey's greenhouse gas emissions per capita was 5.3 tons of CO<sub>2</sub> equivalent, the average value of the 27 member states of the European Union was 10.2 tons of CO<sub>2</sub> equivalent and the average value of OECD countries was 15.0 tons of CO<sub>2</sub> equivalent (National climate change document (2010-2020)).

Considering its socio-economic indicators, greenhouse gas emissions profile, historical responsibility, emissions levels per capita, GDP per capita and energy consumption per capita indicators as well as its ranking in Human Development Index, Turkey is in the category of "middle income developing countries".

Turkey cannot make a greenhouse gas emission reduction commitment by taking a specific baseline year because of economic development status. Turkey plans to limit its greenhouse gas emissions in a way that it will not compromise sustainable development and poverty reduction priorities.

Within the scope of the conducted and planned studies, the primary energy density is planned to be reduced by 2023 at a rate of 20 percent compared to the amount in 2008 by Turkish authorities.

The development in the primary energy density throughout the period from 2000 to 2008 is provided in the graphic below.

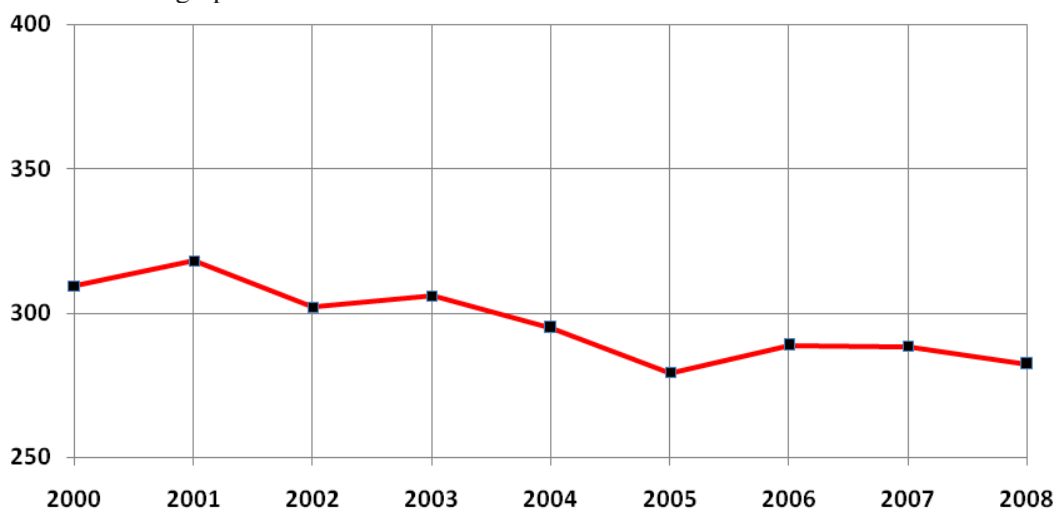


Figure 4.21. *Primary Energy Density (2000-2008) (kg equivalent oil/1,000 dollars) (Energy efficiency strategy for Turkey) (\*with the dollar price in 2000, according to the GDP in 1998)*

In the year 2008, the total primary energy consumption of Turkey has been 108 million Ton Equivalent Petroleum (TEP), and its production has been 29 million TEP. The graphic representing the primary energy resources production and the covering of the primary energy demand with importation in the period from 2000 to 2008 is provided below.

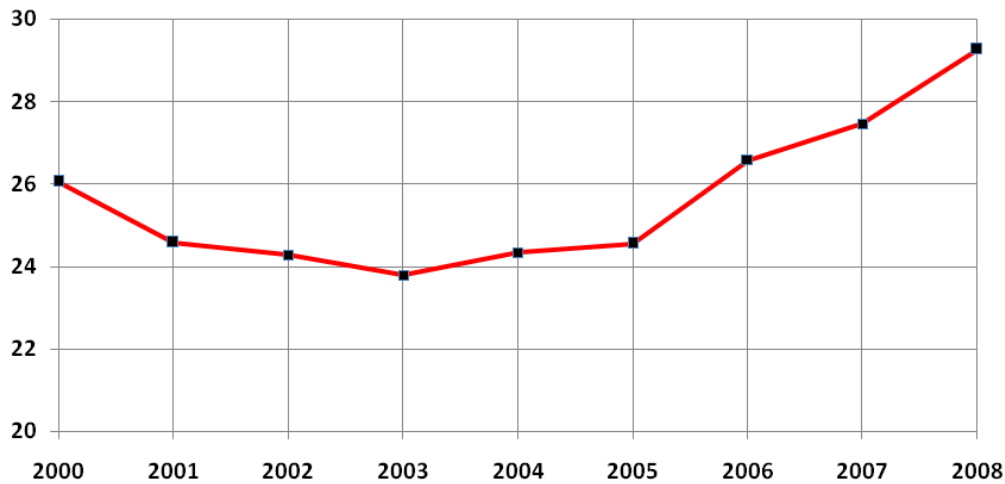


Figure 4.22. Primary Energy Resources Production (2000-2008) (million TEP) (Energy efficiency strategy for Turkey)

#### 4.11.2 Methodologies and tools

LCA (Life Cycle Analysis) is not a common tool for construction sector. Construction sector has started to use LEED and BREEAM methodologies.

In addition, there is no common methodology for LCC. Because of being a comparison if anyone take the same inputs, takes some results to compare. In Turkey, you have to consider the inflation rate per year. When comparing energy inflation rate takes a great importance. The inflation rate of natural gas at a average rate of nearly 13% over the past 5 years, and this is just the start. The rate increases of the last couple of years have been over 25%.

#### 4.11.3 National codes and legislation- Eco-labels and EPDs

A national code for sustainable construction has not produced yet. However, there are some national codes for solar energy usage but not for sustainable construction.

- TSE (Institute of Turkish Standards) Standards for solar energy usage;
- TS 3680 – Solar Energy Collectors;
- TS 3817 –Solar energy, water heating systems establishing, operating manual.

In addition, eco labels and EPDs are not common for construction materials.

There are not any LCC regulations that a construction owner has to obey. There are no investigations on new buildings to understand whether it is environmental friendly or not. LCC is being used by the owners of construction without any obligation.

#### 4.11.4 Case studies

##### 4.11.4.1 Solar energy

As a part of sustainable construction, there is a huge usage of solar power in Turkey. Solar power is mostly used for heating energy of water. The solar collectors in Turkey are 12 million m<sup>2</sup> and produce capacity per year is 750 000 m<sup>2</sup>. The total heat energy produced by solar energy 420 000 TEP (weight equivalence of petroleum as ton) per year (Güneş Pillerinin Dünü Bugünü ve Geleceğe Bakış Makalesi İbrahim ÜÇGÜL).

As a beginning to the solar energy potential determination, EIE (general directorate of electrical power resources surveying administration) had evaluated the historical solar energy data measured by the State Meteorological Organization between the years of 1968-1982. The results were published in two reports in 1983. On the basis of these evaluations, it is concluded that the average annual value of sunshine hours is 2640 and annual average solar intensity is 3.6 kWh /m<sup>2</sup>-day, while maximum annual sunshine hours is 3016 hours and maximum solar intensity is

5,8 kWh/m<sup>2</sup> –day [4]. Solar data acquisition systems have been installed in total 8 locations: Antalya, İzmir, Ankara, Aydın, Adana, Isparta, Kayseri and Balıkesir. The measurements in Antalya, İzmir and Aydın were completed ([http://www.eie.gov.tr/english/solar/solarEIE\\_e.html](http://www.eie.gov.tr/english/solar/solarEIE_e.html)).

Table 4.10. Monthly Average Solar Potential of Turkey (Source: General Directorate of EIE)

MONTHS	MONTHLY TOTAL SOLAR ENERGY	SUNSHINE DURATION	
	(Kcal/cm <sup>2</sup> -month) (kWh/m <sup>2</sup> -month)	(hours /month)	
January	4,45	51,75	103,0
February	5,44	63,27	115,0
March	8,31	96,65	165,0
April	10,51	122,23	197,0
May	13,23	153,86	273,0
June	14,51	168,75	325,0
July	15,08	175,38	365,0
August	13,62	158,40	343,0
September	10,60	123,28	280,0
October	7,73	89,90	214,0
November	5,23	60,82	157,0
December	4,03	46,87	103,0
TOTAL	112,74	1311	2640
AVERAGE	308,0 cal/cm <sup>2</sup> -day	3,6 kWh/m <sup>2</sup> -day	7,2 hours/day

Table 4.11. Regional Distribution of Solar Energy Potential of Turkey (Source: General Directorate of EIE)

REGION	TOTAL SOLAR RADIATION	SUNSHINE DURATION
	(kWh/m <sup>2</sup> -year)	(hours/year)
Southeastern Anatolia	1460	2993
Mediterranean	1390	2956
East Anatolia	1365	2664
Central Anatolia	1314	2628
Aegean	1304	2738
Marmara	1168	2409
Black Sea	1120	1971

#### 4.11.4.2 Photovoltaic Lighting Units

Battery of the system is charged by the electricity generated by photovoltaic modules during the day. Currently 5 units are installed, 2 in Ankara AOC, 2 in Didim Research and Training Center of EIE, and 1 in the EIE building, in Ankara. There is also a 160 Wp lighting system in Didim ([http://www.eie.gov.tr/english/solar/solarEIE\\_e.html](http://www.eie.gov.tr/english/solar/solarEIE_e.html)).



Figure 4.23. Photovoltaic Lighting Units in Ankara and Didim

Another project was developed by Vailant team in order to prove the usage of solar energy as a power for electricity. These panels produce electricity from solar energy. There are 4 panels at the south facade. With these 120 cm x 320 cm panels, they can produce electricity for the showroom. The company is also the producer of these panels.



Figure 4.24. Vaillant Izmir headquarter building

#### 4.11.4.3 Photovoltaic Water Pumping Systems

Of the systems that can be used in small-scale agricultural irrigation, the first consists of 616 Wp PV modules, an inverter and a submersible pump. The economical calculations indicated that the system is economically competitive with diesel engines, in sites without grid ([http://www.eie.gov.tr/english/solar/solarEIE\\_e.html](http://www.eie.gov.tr/english/solar/solarEIE_e.html)).



Figure 4.25. Photovoltaic Water Pumping Systems ([http://www.eie.gov.tr/english/solar/solarEIE\\_e.html](http://www.eie.gov.tr/english/solar/solarEIE_e.html))



#### 4.11.4.4 Photovoltaic Traffic Warning System

The system consists of a 50 Wp pv module and 70 Ah battery, as well as a flashing lamp ([http://www.eie.gov.tr/english/solar/solarEIE\\_e.html](http://www.eie.gov.tr/english/solar/solarEIE_e.html)).



Figure 4.26. Photovoltaic Traffic Warning System ([http://www.eie.gov.tr/english/solar/solarEIE\\_e.html](http://www.eie.gov.tr/english/solar/solarEIE_e.html))

#### 4.11.5 Wind energy

In the years 1960-1961, a survey recorded 749 wind mills of which 718 were used for water pumping and 41 for electricity production. A 1978-1979 survey revealed 871 water pumping and 23 electricity producing windmills. It is understandable that the use of wind energy in Turkey declined until the 1980's as elsewhere. The original idea was to build wind power plant in Bozcaada on the westcoast of Turkey (Hepbasli and Ozgener, 2004a).

On April 3<sup>rd</sup> 1998, Interwind initiated the first wind energy for a 7.2 MW project. Now, Turkey's wind power stations are totally 20.1 MW (Hepbasli and Ozgener, 2004a). The number of stations in 01.06.2008 was 13 and total power as 249.15 MW (see details in the following table).

Table 4.12. Turkey's wind power

PLACE	FIRM	START DATE	POWER (MW)	PRODUCER	NUMBER OF TURBINE
İzmir –Çeşme	Alize A.Ş.	1998	1.5	Enercon	3
İzmir –Çeşme	Güçbirliği A.Ş	1998	7.2	Vestas	12
Çanakkale - Bozcaada	Bores A.Ş	2000	10.2	Enercon	17
İstanbul -Hadımköy	Sunjüt A.Ş	2003	1.2	Enercon	2
Balikesir - Bandırma	Bores A.Ş	2006	30	GE	20
Istanbul - Silivri	Ertürk A.Ş	2006	0.85	Vestas	1
İzmir –Çeşme	Mare A.Ş	2007	39.2	Enercon	49
Manisa- Akhisar	Deniz A.Ş	2007	10.8	Vestas	6
Çanakkaler- İntepe	Anemon A.Ş	2007	30.4	Enercon	38
Çanakkale – Gelibolu	Doğal A.Ş	2007	14.9	Enercon	18
Hatay - Samandağ	Deniz A.Ş	2008	30	Vestas	15
Manisa- Sayalar	Doğal A.Ş	2008	30.6	Enercon	38
İzmir Aliağa	Innores A.Ş	2008	42.5	Nordex	17

In February 2001, Turkey passed the long-anticipated Electricity Market Law, which paves the way for a free market in power generation and distribution in the country. In the framework of restructuring the Turkish electricity sector, comprehensive and detailed studies to determine the basic parameters of the sector have been implemented by the consultants. The main goal of these studies is to establish an institutional structure and the corresponding regulatory framework for the sector (Hepbasli and Ozgener, 2004b).

At present, not only the electricity sector, the whole energy sector in Turkey is in a dynamic change.

Today there is a serious intention on the part of Turkish authorities to promote wind energy. The authorities are beginning to understand the potential of wind energy, the state of its technology and its possible contributions to the national economy.

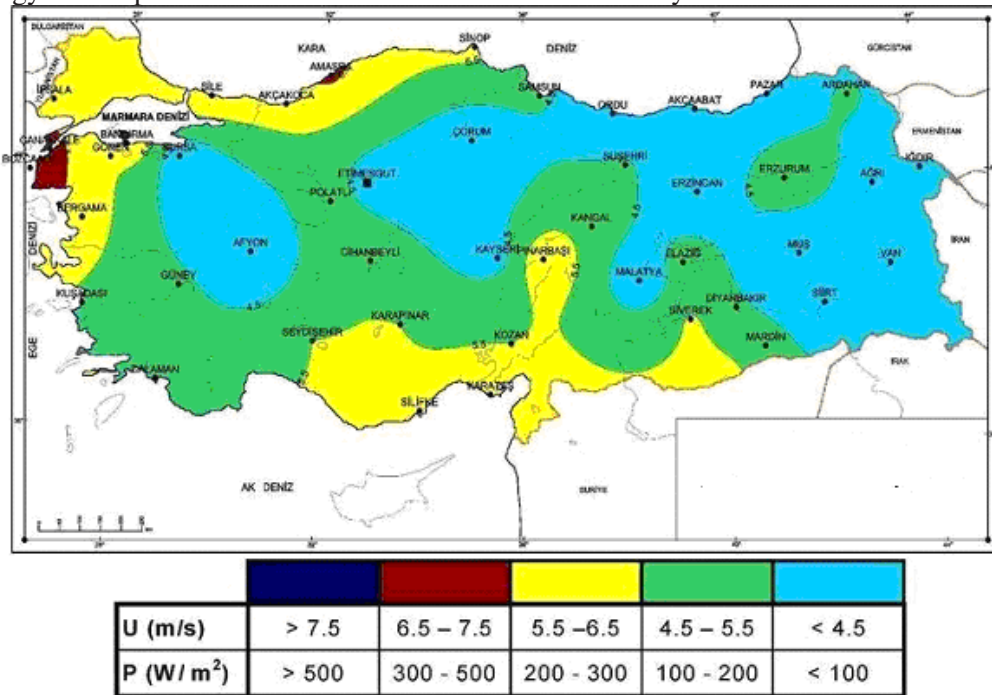


Figure 4.27. Turkey’s wind potential (Hepbasli and Ozgener, 2004b).

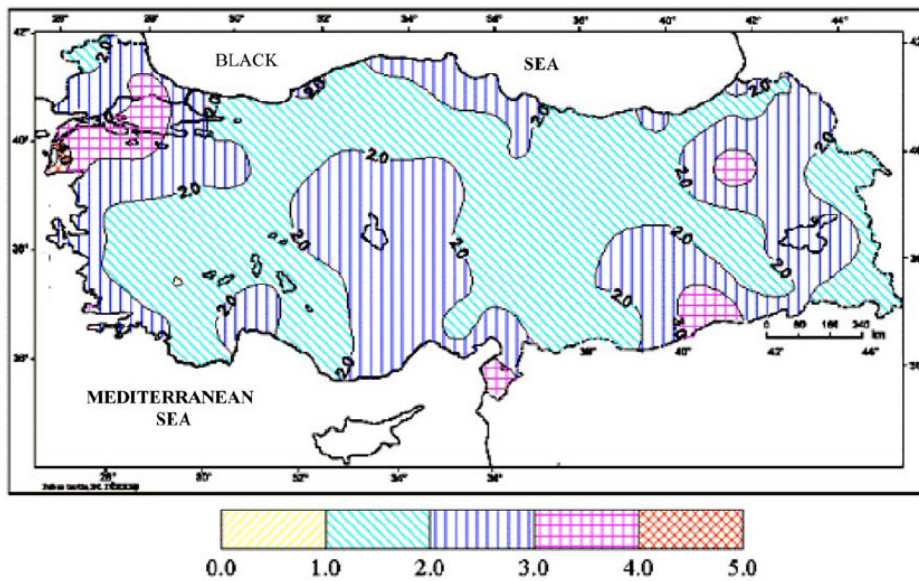


Figure 4.28. Wind speed distribution in Turkey (10 m height) (Solar and wind energy, 2002)

The annual average wind speeds range from a low of 2.1 m/s in the East Anatolia region to a high of 3.3 m/s in the Marmara region. The most attractive regions for wind energy applications are the Marmara, the southeast Anatolian and the Aegean regions. These regions are highly suitable for wind power generation, since the wind speed exceeds 3 m/s in most of these areas (Ediger and Kentel, 1999)

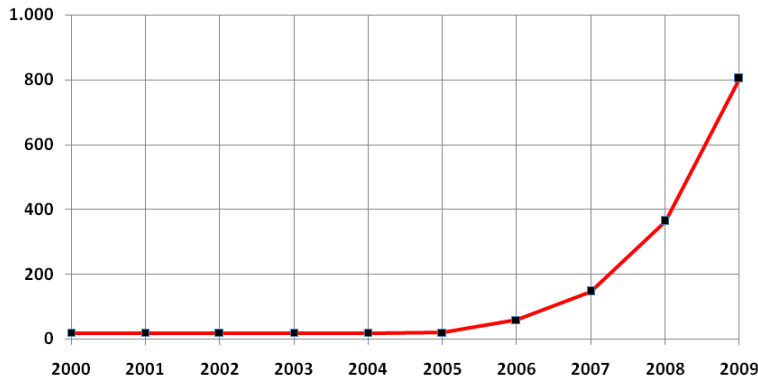


Figure 4.29. Development of Wind Energy Installed Capacity (2000-2009) (MW)

#### 4.11.6 Geothermal

Nearly 274 geothermal occurrences and fields are known to exist in Turkey according to MTA (the state owned directorate) records. About 25 of them are already being exploited at large scale for direct and indirect geothermal energy use, many fields are mainly used for balneological purposes by local public, and while others are still to be developed (Satman et al., 2007).

The present (2010) installed geothermal power generation capacity in Turkey is about 100 MWe, while that of direct use installations is around 795 MWt. Direct use of geothermal energy in Turkey has focused mainly on district heating. The first of these systems came on line at the low-temperature Gönen field in 1987. During 1991-2006 period other 19 district heating systems were installed (Satman et al., 2007).

Geothermal exploration in Turkey started in the early 1960s. At first, the work was focused on high-enthalpy fields for potential power production; Kızıldere was discovered in 1968. The Balçova and Seferihisar, two medium-temperature geothermal fields, were found and studied in the 1960s and 1970s, respectively. A second high-enthalpy system, Germencik, and various other medium-enthalpy fields, such as Salavatlı-Sultanhisar and Simav, were discovered in the 1980s. Turkey's low- and medium temperature resources have yet to be thoroughly explored and evaluated. With proper exploration methods and investments, some might be shown to contain higher-enthalpy fluids; geochemical data seem to support such a hypothesis (Satman et al., 2007).

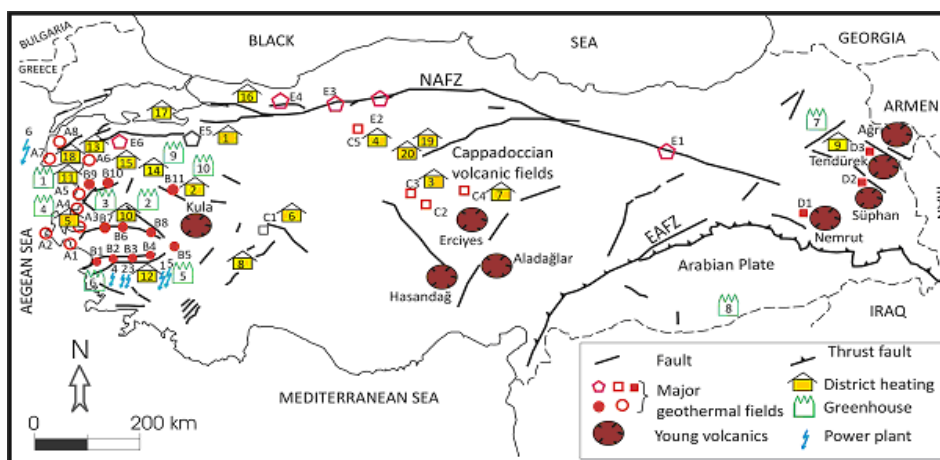


Figure 4.30. Locations of major geothermal fields, district heating and greenhouse installations and young volcanoes (Satman et al., 2007)

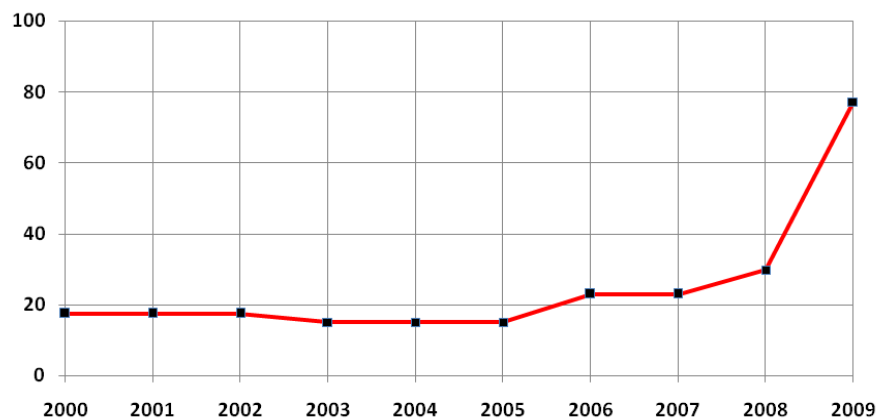


Figure 4.31. Development of Geothermal Energy Installed Capacity (2000-2009) (MW) (Satman et al., 2007)

#### 4.11.7 Biomass

Various agricultural residues such as grain dust, crop residues and fruit tree residues are available in Turkey as the sources of biomass energy.

Turkey relies on biomass to provide much of its energy requirement like many developing countries. The available biomass amount in Turkey is around 117 million tons. In case of its assessment it will be met approximately annual 32 Mtoep (Demirbas, 2008).

Among the different forms of renewable energy, biomass energy is one of the major resources in Turkey

Turkey's domestic energy consumption accounts for about 37% of total energy consumption. Of this, about 52% is from biomass-based fuels (Demirbas, 2001).

Direct burning in Turkey for many years has used fuelwood, animal wastes, agricultural crop residues and logging wastes. These sources are often called noncommercial energy sources, but in Turkey, fuelwood is a tradable commodity, since it is the primary fuel for rural and urban poor districts (Tasdemiroglu, 1986).



Figure 4.32. Biomass derived from tree roots and tree branches and its granulated state (Tasdemiroglu, 1986)

Stone Pine covers the most part of the area in Kozak Forest Sub-District. The most important source of income for the villagers is obtained from Stone Pine cones production. The sub-district building is heated with the materials, which are the waste of the cones remains after production.





Figure 4.33. Stone Pinea Collection (Tasdemiroglu, 1986)

Heating energy need of Aydınpınar Forest Sub-district administration building and 4 public housing will be provided with unused residues emerged after harvesting. It is estimated that usage of 250 kg biomass per day will be enough to heat both the administration building and the public housings.

#### 4.12 CONCLUDING REMARKS

The purpose of this chapter was to provide an overview of the ways that different European countries face the problem of sustainability.

Clearly, the efforts undertaken by the European Commission over the last years in the promotion and implementation of actions in relation to the sustainability of the construction sector have been very successful. Thanks to these efforts, most European countries are now forced to implement concrete actions in relation to the sustainability of the construction sector and related products.

Naturally, it is also expectable that upcoming standards will have also a major impact and will force countries to implement further concrete measures in the short term.

Nevertheless, from the overviews provided in this chapter, a distinction in the way different countries are dealing with various aspects of sustainable construction is perceptible, and the asymmetry between Northern and Southern countries is still very considerable. While Southern countries are mainly implementing actions due to commitments with the European Commission, Northern countries show a lot more initiative in the development of additional measures and actions towards the goals of Sustainable Development.

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