Proceedings of the Fábos Conference on Landscape and Greenway Planning

Volume 3
Issue 1 *Proceedings of the Fabos Conference on Landscape and Greenway Planning 2010*

Article 56

2010

Blueprints for Green Communities: Climate change visioning and participatory landscape planning for resilient low-carbon communities

David N. Flanders
University of British Columbia, Collaborative for Landscape Planning (CALP)

Stephen R.J. Sheppard
University of British Columbia, Collaborative for Landscape Planning (CALP)

Ellen Pond
University of British Columbia, Collaborative for Landscape Planning (CALP)

Sarah Burch
University of Oxford, Environmental Change Institute

Alison Shaw
University of British Columbia, Collaborative for Landscape Planning (CALP)

See next page for additional authors

Blueprints for Green Communities: Climate change visioning and participatory landscape planning for resilient low-carbon communities

Authors
David N. Flanders, Stephen R.J. Sheppard, Ellen Pond, Sarah Burch, Alison Shaw, and Stewart Cohen

Blueprints for Green Communities: Climate change visioning and participatory landscape planning for resilient low-carbon communities

David N. Flanders[1], Dr. Stephen R. J. Sheppard[1], Ellen Pond[1], Dr. Sarah Burch[2], Dr. Alison Shaw[1], and Dr. Stewart Cohen[3]

[1] *University of British Columbia, Collaborative for Landscape Planning (CALP),*
[2] *University of Oxford, Environmental Change Institute,*
[3] *Environment Canada, Adaptation and Impacts Research Division/University of British Columbia, Dept. of Forestry Resources Management.*

Introduction

Emerging 3D visualization tools and future visioning methods offer new ways to make climate change impacts and potential responses explicit, and accelerate holistic solutions. Previous research at UBC's Collaborative for Advanced Landscape Planning (CALP) and elsewhere confirms that 4D visioning processes using landscape visualizations of recognizable places under alternative future conditions can improve community engagement and awareness on complex environmental and planning issues (Tress and Tress, 2002; Sheppard and Meitner, 2005; Schroth, 2007). This paper examines a visioning process (Sheppard, 2008) that applies visualization and other landscape planning methods to explore high and low-carbon futures of the affluent, sub-urban hillside community of North Vancouver with climate change, and its surrounding scenic North Shore sub region of Metro Vancouver, BC, Canada.

Landscape Planning Approaches: Phase 1 - A community visioning process to enhance local capacity for change

The visioning process integrates downscaled climate science (*localizing*), ecosystem and planning information, and stakeholder input, through a participatory mapping approach (*spatializing*) structured around future landscape scenarios and leading to graphic 3D computer landscape simulations (*visualizing*) (Shaw et al., 2009).

In order to ensure visualizations were driven or informed by spatial modelling and based on credible science, the research team integrated regionally downscaled snow pack and snowline forecasts for the North Shore generated by researchers at Environment Canada. Subsequent "downstream" effects stemming from this and other extreme weather conditions include heightened risk of forest fires and storm blow-down, changing stream health, risk of debris flows and constrained water supplies (see Figure 1). Additional projections of population and economic growth were performed with GB QUEST modelling (Robinson and Tansey, 2006).

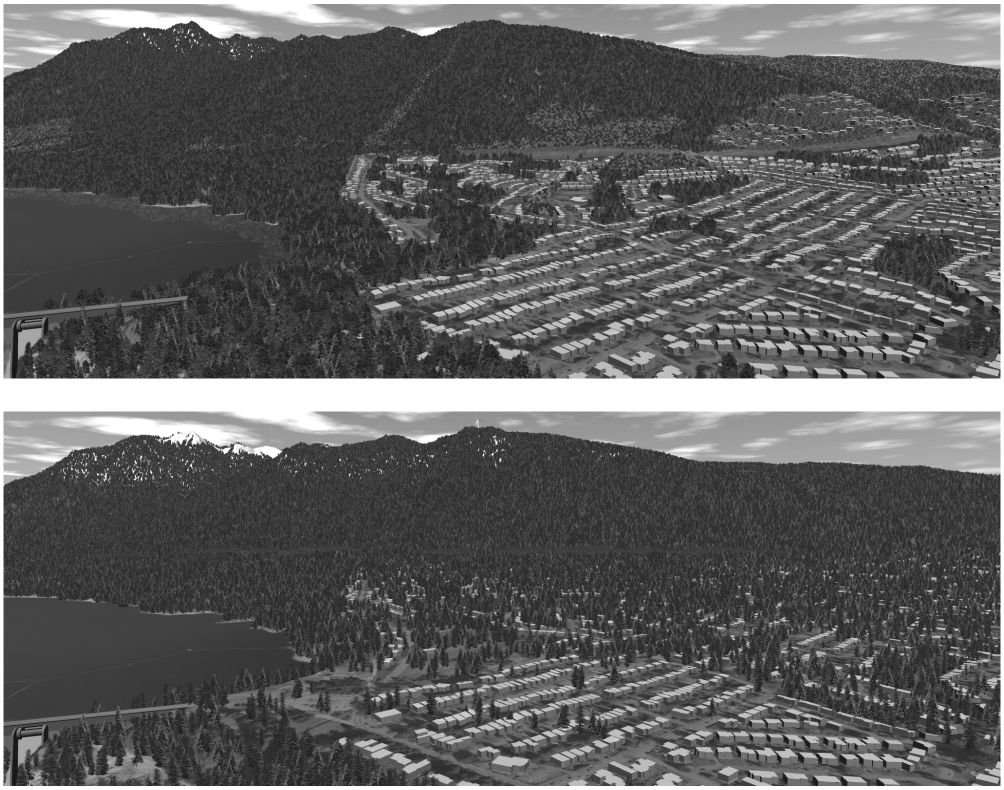

Figure 1: 3D Visualizations of North Vancouver, the top image shows a high-carbon "World 1" scene with localized forecasts of snow pack reduction and a visibly altered landscape due to cumulative impacts: unhealthy, shifting forest ecosystems, sprawling, high-carbon suburban community expansion, and changing water levels in the municipal reservoir (front, left of image). The bottom image shows a more sustainable, low-carbon "World 4" scenario.

Over the course of several workshops with local stakeholders, including landscape architects, planners, scientists, foresters, engineers, government and practitioners, the working group discussed plausible development trajectories, or "Worlds", to frame the future of North Vancouver. The first workshop was primarily to familiarize the group on the intent of the research, the visioning process, and how it may relate to decision-making in North Vancouver. The second workshop brought participants together for a mapping exercise to begin spatializing relevant impacts to different areas of North Vancouver. Brainstorming suitable adaptation and mitigation strategies was given particular attention. Proposed strategies in the areas of public infrastructure, forest health, water management and recreation could be cross-checked with current engineering challenges while being aligned with future development planning. A final workshop provided an opportunity to present preliminary visualizations for feedback and address any unresolved issues before the research team could construct a final "visioning package," consisting of scientific data, charts, precedent imagery, and visualizations of impacts and responses.

The Worlds provided a framework for community visioning with regional storylines that took into account greenhouse gas emissions (GHGs), population and economic growth, energy and land use. The scenarios included a high-carbon "business-as-usual" World, a similarly high-carbon "adapt-to-risk" World emphasizing adaptation, an "efficient development" World with moderate emissions reductions, and a very low-carbon "deep sustainability" World which, although still requiring some adaptation, would be sufficient to stabilize further climate change if adopted globally. These scenarios illustrate differential impacts on forest, open space and landscape health, snowpack, stream corridors, recreational opportunities, as well as a range of mitigation and adaptation measures examining urban design, landscape, and energy planning strategies (see Figure 2).

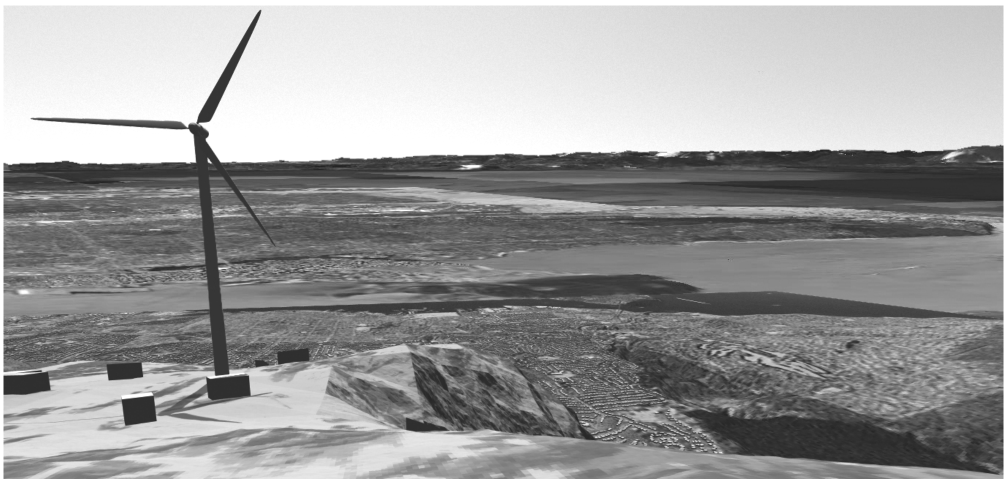

Figure 2: The "snowboarder's view" of Grouse Mountain, North Vancouver, demonstrating integration of wind energy in a recreational facility in a low-carbon future scenario.

20 local practitioners, government staff and residents were invited to attend group sessions to view the results of the visioning exercise. Attendees filled out pre- and post-survey questionnaires, which were combined with researcher observations of participants and some follow-up interviews. In this manner, the visioning packages were tested for their influence on the public in three areas: affect (emotional response to climate change and perception of the risk), cognition (understanding of climate change, its impacts and response options), and behavioral intent (the likelihood that behavioral changes would occur as a result of the visioning sessions).

Results revealed that perceptions appeared to shift and attitudes on how to deal with climate change significantly changed (See Table 1). Participants became more aware of climate change impacts and response options, and were motivated for more significant societal changes to occur sooner. The perception that adaptation responses alone weren't sufficient to address the climate problem prompted researchers to further investigate mitigation options.

Published by ScholarWorks@UMass Amherst, 2010

Table 1: Selected results of the visioning presentation testing sessions

Perception tested	Perception before visioning session	Perception after visioning session	Significance (paired sample t-test)
Manner in which society must be transformed in order to address climate change (affect)	Radically: 52.6% Gradual reforms: 47.4%	Radically: 78.9% Gradual reforms: 21.1%	$P_{0.05}$=0.041
Understanding of greenhouse gas emissions reductions (cognition)	Very good: 10.5% Quite good: 68.4% Neutral: 21.1%	Very good: 25% Quite good: 60% Neutral: 15%	$P_{0.05}$=0.056
Level of understanding of the effects of climate change on the respondents' local area (cognition)	Very knowledgeable: 0% Quite knowledgeable: 42.1% Neutral: 42.1% Not knowledgeable: 15.8%	Very knowledgeable: 20% Quite knowledgeable: 55% Neutral: 25% Not knowledgeable: 0%	$P_{0.05}$=0.001
Perceptions after visioning (agree/disagree with statement provided):			
Empowerment: actions taken now would not matter in 2100 (behavioural intent)	Strongly disagree: 95.2%		
Empowerment: community action will not have impact on global climate change (behavioural intent)	Strongly disagree: 57.1% Somewhat disagree: 4.9% Strongly agree: 19% Somewhat agree: 19%		
Credibility of visioning presentation	70% found presentation to be quite or very credible		

Phase 2 - Climate change mitigation through low-carbon energy planning

Here researchers continued collaboration with local planners and engineers to address the enormous data gaps left by conventional planning in assessing the capacity of local areas to achieve an 80% reduction in GHG emissions (the lowest-carbon scenario from the above study) by focusing on alternative energy sources. This target for 2050 matched the mandate recently set by the provincial government. Low-carbon energy systems investigated across the North Shore sub region include:

Biomass: The FORECAST ecosystem model tool (Kimmins, 1997) provided estimations of biomass harvest volumes within the forested lands inside of North Shore municipal boundaries) consistent with long-term adherence to sustainability thresholds for soil health and productivity. Protected parks and watersheds were not considered part of the fuel source, and the remaining harvestable stands saw simulated thinning at rates between 25 and 45% for overstory species, with very productive stands being thinned at 50% for understory species as well (Figure 3). Additional biomass generation in the form of managed wood lots was also proposed on heavily managed vegetated lands such as electricity transmission line corridors.

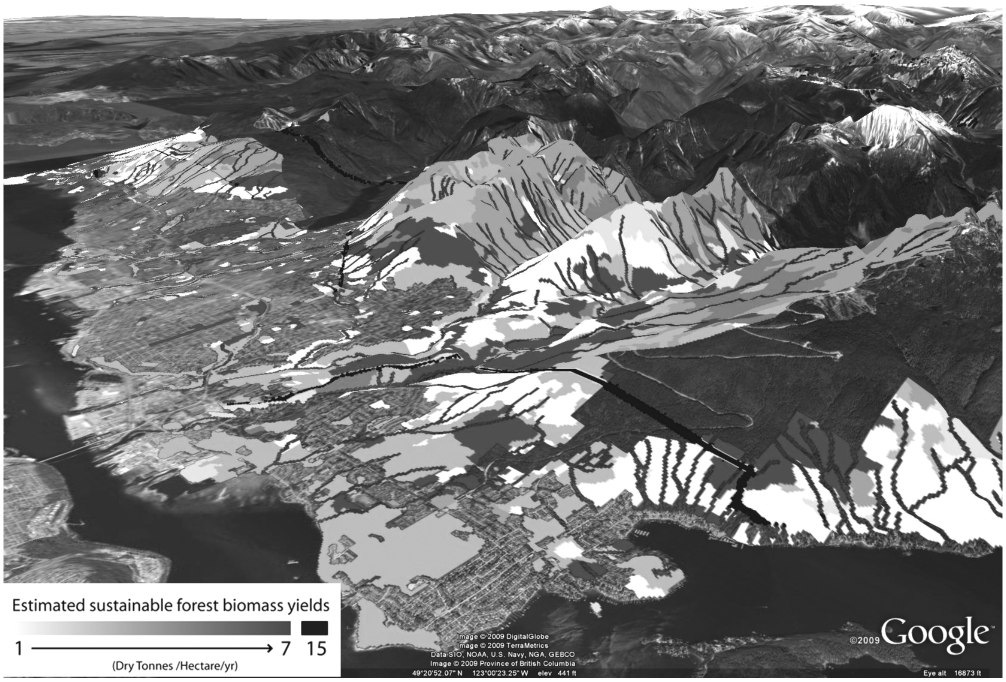

Figure 3: Sustainable forest biomass yields across the North Shore simulated using the FORECAST ecosystem modeling tool, shown here mapped in Google Earth. The linear red features are power line corridors suitable for high-yield wood lot production.

Waste to energy: Municipal waste streams were estimated from Metro Vancouver inventories, including woody biomass waste (for combustion / gasification), Municipal Solid Waste (for waste to energy via incineration), sewage (to produce biogas methane), and biosolids (for waste to energy via liquid waste).

Micro-hydro: Using existing feasibility studies and estimates of stream flows as a starting point for calibration, potential hydro generation for all suitable streams across the North Shore were estimated using a formula which accounts for streamflow velocity, elevation change and seasonality. Where no data was available, streamflow was estimated based on watershed area.

Solar P/V, Solar thermal hot water: The Canada Solar Atlas (NRCan, 2009) and recent LiDAR-based research on the effects of tree-shading on solar access (Tooke, 2009) were used to assess the solar resource for energy generation on buildings across the North Shore. This data set the upper bounds of generation, which was refined based on available roof area and assumed adoption rates to set realizable limits on electrical and hot water production.

Geoexchange: Horizontal or vertical geoexchange systems were assumed to be viable for 50% of heating / cooling base loads for multi-family residential buildings, as these have the shortest payback period (6-9 years) and could demonstrate the largest uptake (Compass Resource Mgmt., and MK Jaccard and Assoc., 2005).

All systems were mapped using a GIS-based suitability analysis showing the "footprint" or area that each system would require, along with a quantitative estimate of energy generation potential from each. Heat, electrical and cogeneration production, including energy conversion rates and efficiencies were considered, and related to inventories of actual demand. Strategies that would fall under the management of government and individual home-owner are indicated, as well as the relative contributions of each towards the total energy budget of the region. Estimates of individual system contributions ranged between 4.6 and 13.5% of total *current* energy demand, with overall generation potential of up to 31.5% (Figure 4).

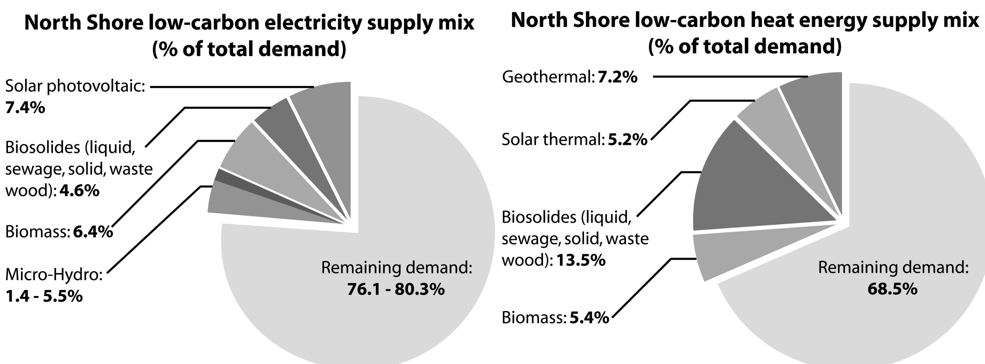

Figure 4: Relative potential contributions of the proposed alternative energy strategies for electricity (left) and heat (right) to the North Shore energy budget.

Combining this information with interactive visualization (Google Earth) provides insights on the compatibility of alternative energy solutions with local landscapes, ecosystems, sustainability criteria, and social implications in the North Shore.

Phase 3 - Implementation and policy change

CALP researchers remain involved in demonstrating the integration of energy planning with landscape design with all of the municipalities in the North Shore, helping them to bridge between climate knowledge and action. This information continues to be presented to groups such as the West Vancouver Climate Action Working Group, practitioners for decision-making such as North Vancouver's Official Community Plan review process, and as part of planning initiatives such as the 100-yr carbon-neutral planning charrette for the City of North Vancouver.

Discussion and implications for low-carbon, resilient attractive communities

The above work demonstrates the utility and credibility of the landscape planning/visioning tools and findings of this research within government and the case study communities, in addressing the need for community-based solutions to climate change mitigation and adaptation. This streamlined process is informative and practical for landscape planners in communities that cannot afford the high costs of assembling a suite of more complex engineering studies, and need to make immediate decisions about low-carbon community development.

In particular, it is clear that low-carbon energy planning will require increasing diversity and decentralization. This would shift communities from relying on only centrally produced electricity and natural gas heat, to an energy breadbasket of eight or more smaller, locally produced sources (as shown in Figure 4 above). Since production will be limited, demand-side reduction is of paramount importance in such a system. Where new sources of alternative energy are required to meet GHG reduction targets, landscape and urban design must be carefully applied to secure community support in overturning the high-carbon aesthetic that currently prevails as a symbol of prosperity and social status (Sheppard et al., 2009). Possible strategies for achieving this in Vancouver's North Shore may include the following:

1. Make provisions for the insertion of locally-managed wood lots in municipal open space, including educational interpretation facilities and well-sited circulation routes for biomass and waste trucks into and out of communities;
2. Incorporate technologies such as low-particulate emissions biomass gasification systems and solar energy modules into the local vernacular of buildings and infrastructure, while enhancing sense of place (which is often of greater concern than climate);
3. Connect lower-density, suburban-style developments, retrofitted with secondary suites and infill development, on district energy systems with small-scale shared energy plants;
4. Maximize solar exposure by not blocking incoming solar radiation to roof tops and south-facing windows;
5. Capitalize on open-space gains resulting from densification by planting wood lots for local management and consumption;
6. Designing schools and institutional buildings in the public domain close to micro-hydro generating creeks;
7. Expose aesthetically designed energy generation infrastructure to enhance awareness and acceptability without public objection to change;
8. Arrange higher-density mixed-use urban land-use corridors to link along district energy lines;
9. Maintain industrial land reserves at lower elevations for siting larger municipal solid waste and biomass waste-to-energy plants.

Managing community forests for bioenergy can be balanced with ecological values (Klenner and Sullivan, 2009; Sullivan et al., 2009). Removing large sensitive areas of this land base from being managed for biomass energy reduced the total harvestable area by 20%, a significant reduction to an already small yield relative to regional energy demand. Although some forested areas such as riparian corridors must be conserved intact, the practice of partial retention or thinning, as simulated in our study, may be a suitable harvesting practice for minimizing the aesthetic, social and ecological impacts of harvesting. This would complement adaptive thinning to combat increased presence of pests, disease and fire risk due to changing climate.

Intensively managed wood lots, which in this study account for 1% of land in production, but 5% of biomass energy supply, have many implications for the use of currently underutilized open space, derelict, industrial and brownfield sites. With careful design, the conversion of small municipal parks and boulevards into locally managed wood lots could be achieved. If managed intensively, 0.4 Ha of land could support the space and hot water heating needs of a single home.

Using participatory processes with the local stakeholders, and emerging tools for spatial analysis and visualization, landscape architects and planners can and should take on the challenge of designing cross-scale landscape solutions to ensure the development of more resilient communities in the 21st Century.

References

Compass Resource Mgmt Ltd., and MK Jaccard and Assoc. 2005. Sustainable Energy Technology and Resource Assessment for Greater Vancouver. Prepared for Greater Vancouver Regional District - Demand Side Management – Innovative Technologies, Policy and Planning Department.

Kimmins, J.P. 1997. "Predicting sustainability of forest bioenergy production in the face of changing paradigms". *Biomass and Bioenergy* 13(4/5): 201-212.

Klenner, W. and T.P. Sullivan. 2009. Partial and clearcut harvesting of dry Douglas-fir forests: Implications for small mammal communities. For. Ecol. Manage. 257: 1078-1086.

NRCan (Natural Resources Canada) Solar Atlas: https://glfc.cfsnet.nfis.org/mapserver/pv/, last accessed, 2009.

Robinson, J., Tansey, J., 2006. Co-production, emergent properties and strong interactive social research: The Georgia Basin Futures Project. Science and Public Policy 33, 151–160.

Schroth, O. 2007. From Information to Participation - Interactive Landscape Visualization as a Tool for Collaborative Planning. Dissertation at the Institute for Spatial and Landscape Planning. ETH Zurich.

Shaw, A., Sheppard, S.R.J., Burch, S., Flanders, D.N., Wiek, A., Carmichael, J., Robinson, J., Cohen, S. 2009. Making futures tangible – synthesizing, downscaling, and visualizing climate change scenarios for participatory capacity building. Global Environmental Change 19(4): 447–463.

Sheppard, S.R.J. 2008. Local climate change visioning: A new process for community planning & outreach using visualization tools. Plan Canada. Canadian Institute of Planners. Canadian Institute of Planners. 48(1): 36-40.

Sheppard, Stephen, E. Pond and C. Campbell. 2008. Low-carbon, Attractive, Resilient Communities: New Imperatives for Sustainable Retrofitting of Existing Neighbourhoods. Climate Change and Urban Design: Proceedings in Third Annual Congress of the Council for European Urbanism in Oslo, Norway, Sept 14-16, 2008.

Sheppard, S.R.J., Meitner, M.J. 2005. Using multi-criteria analysis and visualization for sustainable forest management planning with stakeholder groups. Forest Ecology and Management 207, no. 1-2: 171-187.

Sullivan, T.P., D.S. Sullivan, and P.M.F. Lindgren. 2008. Influence of variable retention harvests on forest ecosystems: Plant and mammal responses up to 8 years post-harvest. For. Ecol. Mgmt 254: 239-254.

Tooke, T.R., N. Coops, J.A. Voogt. 2009. "Assessment of Urban Tree Shade Using Fused LiDAR and High Spatial Resolution Imagery". Proceedings in Urban Remote Sensing Joint Event in Shanghai China May 20-22, 2009.

Tress, B., Tress, G. 2002. Scenario visualisation for participatory landscape planning: A study from Denmark. Landscape and Urban Planning 982:1-18.