Practitioners' Community Energy and Emissions Modelling (CEEM) Tools Matrix – March 2015

Energy and GHG emissions modelling enables local governments to better understand the energy and GHG implications of future development scenarios in their communities. Such modelling has been often used explicitly to support the development or review of community ghg targets, policies and actions in Official Community Plans (OCPs), Regional Growth Strategies (RGSs), Community Energy and Emissions Plans (CEEPs), and Integrated Community Sustainability Plans (ICSPs). Local government planners are central to these community energy and emissions modelling (CEEM) efforts. With practitioner support (i.e., private sector, not-for-profits), planners use CEEM to explore the GHG and energy implications of future land use development, and to actively engage their fellow financial and engineering colleagues, gaining insights and priorities from their community constituents, and direction from their elected officials.

The following "**Practitioners' Community Energy and Emissions Modelling (CEEM) Tools Matrix**" provides a high-level comparative snapshot of 8 active models and/or approaches that practitioners have been using to support local governments across BC. The models/approaches in the Matrix below were selected based on knowledge from the BC CEEM Community of Practice. The models and services provided by these organizations vary widely: covering one to a number of community sectors (e.g., buildings, transportation, solid waste); from parcel-level to region-wide applications for both small and large communities; from simple excel spreadsheets and user-friendly 'guides' to sophisticated geospatial models with interconnected land use and transportation policy implications; and with recommendations for local governments that range from a small listing of off-the-shelf policies to comprehensive, quantitative, customized reports.

"Endnotes" follow the Matrix below, providing a short profile of each model, those local governments involved to-date and links to additional information. The Matrix may be updated periodically to reflect advancements in modelling. Local Government's Climate Action Toolkit website @ http://www.toolkit.bc.ca/ceem hosts this Matrix.

Criteria ↓ / Model		CEEMAP Developer → Golder Associates et al.[i]	CEEP –QuickStart BC Hydro PowerSmart/ CEA[ii]	CIMS Community MKJ&Associates & Navius Research[iii]	Climate Action Navigator C2MP	Community Energy & Emissions Analysis Enerficiency Consulting[iv]	GHG Proof Sustainability Solutions Group[v]	Green Building Model Pembina Institute[vi]	Energy for Sustainable Communities E4SC MMM Group[vii]
Sectors of Analysis	Transportation	√	√	√	√	√	√	x	x
	Personal vehicles	√	√	√	√	√	√		
	Commercial vehicles	√	√	√	x	√	√		
	Transit	√	√	√	√	√	√		
	Bicycling	√	√	√	√	√	√		
	Walking	√	√	√	√	√	√		
	Buildings	√	√	√	√	√	√	√	√
	Residential	√	√	√	√	√	√	√	√
	Commercial & Instit, S-M Ind	√	√	√	√	√	√	√	√
	Large Industrial	x	x	x	x	x	√	√	√
	Waste/Water	√	√	√	√	√	√	x	√
	Solid waste	√	√	√	√	√	√		x
	Liquid waste	x	x	x	x	x	√		x
	Water use	x	x	x	x	x	X		√
	Others	√	√	x	√	x	√	x	√
	Agriculture/Livestock	√	x		x		√		x
	Ecosystems/Forests	√	x		√		√		x
	Energy supply facilities	√	√		√		x		√
	Embodied energy	√	x		x		√		√
	Other	x	x		purchased offsets		x		x

Practitioners' Community Energy and Emissions Modelling (CEEM) Tools Matrix – March 2015

Criteria ↓ / Model / Developer →		CEEMAP Golder Associates et al.	CEEP -QuickStart BC Hydro PowerSmart/ CEA	CIMS Community MKJ&Associates & Navius Research	Climate Action Navigator C2MP	Community Energy & Emissions Analysis Enerficiency Consulting	GHG Proof Sustainability Solutions Group	Green Building Model Pembina Institute	E4SC MMM Group
Policy Support	Selection & analysis of local government (LG), Provincial (P) and/or Federal (F) policy options on sectors covered	LG, P, F	LG, P, F	LG, P, F	LG, P, F	LG, P, F	LG, P, F	LG, P. F	LG
	Tool has been used to develop: Regional Growth Strategies Official Community Plans ICSPlans CEEPlans Zoning (e.g, neighbourhood)	√ √ √ √ √ √	√ x √ x √ x	√ x x x √ x	√ x x x √ x	√ x x x √ x	√ √ √ √ √ √	x policy recommendation only	√ x x √ √ X
	On-site renewable energy (biomass, wind, geothermal, geoexchange, solar, ocean)	- District energy (DE) - Biomass - Solar HW + PV - Geoexchange + geothermal - Heat pumps - Wind - Micro-hydro	DE (eg, renewables/ bioenergy) Building-scale (eg, green heat; solar HW)	- Geo-exchange - Solar HW & PV - Landfill Gas electricity	- District energy supply options (eg biomass) - Building-scale renewables (eg solar HW, ground source heat pumps	- Any technology may be included as action items	- DE density thresholds - Building-scale renewable - Energy mix: % electric/NG - Transportation technologies	- Biomass - Geoexchange - Solar (HW, PV)	- Any technology may be included as action items
Spatial Scale	Parcel Building Block Neighbourhood Municipality Regional District	√ √ √ √ √ √	x x x x √ √	x x x x √ √	√ √ √ √ √ √	x x x x √ √	√ √ √ √ √ √	x x x √ √ √	√ √ √ √ x x
	Best suited for urban or rural communities?	Rural or Urban	Rural or Urban	Rural or Urban	Urban	Rural or Urban	Rural or Urban	Rural or Urban	Rural or Urban
Temporal Scale	Model baseline year(s)	Any baseline year	2007, 2010	2007	2007	Any baseline year	Any baseline year	2007 or 2010	Any baseline year
	Model target year(s)	Any target year	Annual to 2050	At 5-yr intervals up to 2050	2020; 2041; 2080	Any target year	Any target year	Any year to 2050	Any target year
Architecture / Methodology	Software used	Excel, VBA, ArcGIS, SQL	Excel	Excel	Web-based SQL, Excel, GIS	Excel	Excel, GIS SAP	Excel	Matlab, Java, TRNSYS, RETScreen, ArcGIS, DOE2.x,others
	Does the Model respond in 'real time'? (**interactive** application)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes of No

Criteria ↓ / Model → / Developer →		CEEMAP Golder Associates et al.	CEEP -QuickStart BC Hydro PowerSmart/ CEA	CIMS Community MKJ&Associates & Navius Research	Climate Action Navigator C2MP	Community Energy & Emissions Analysis Enerficiency Consulting	GHG Proof Sustainability Solutions Group	Green Building Model Pembina Institute	E4SC MMM Group
User-Friendliness	Inputs: Major datasets used	- LG/ICIS parcel fabric - BCAssess building attributes - CEEI - Utility custom data requests - Current utility rates - NRCan Comprehen. Energy Use database - BC Hydro CPR Review - Transport. Origin-Destin. tables - ICBC - Capital costs - Operating costs - BC Stats or Stats Canada populations - Future growth projections - Technology replacement assumptions - Area of forest land - Area of agri. land - Proximity calculations - Others, add to list	- LG/ICIS parcel fabric - BCAssess building attributes - CEEI - Utility data - Utility rates - NRCan Comprehensive Energy Use database - BC Hydro CPR Review - Transpo Origin-Destin. tables - ICBC vehicle ownership - Capital costs - Operating costs - BC Stats/Stats Can demographic data - Future growth projections - Technology replacement assumptions - Forest cover - Ag Land cover - Proximity calculations - Street/Transit Networks	- CEEI - BC Stats or Stats Canada populations - Future growth projections	- CEEI - NRCan Comprehen. Energy Use database - Capital costs - Operating costs - BC Stats or Stats Canada populations - Technology replacement assumptions OTHER: -Dynamic cost and preference assumptions	- LG/ICIS parcel fabric - BCAssess building attributes - CEEI - Current utility rates - NRCan Comprehen. Energy Use database - BC Hydro CPR Review - Transport. Origin-Destin. tables - Capital costs - Operating costs - BC Stats or Stats Canada populations - Future growth projections - Technology replacement assumptions	- CEEI	- LG/ICIS parcel fabric - BCAssess building attributes - CEEI - Current utility rates - NRCan Comprehen. Energy Use database - BC Hydro CPR Review - Transport. Origin-Destin. tables - ICBC - Capital costs - Operating costs - BC Stats or Stats Canada populations - Future growth projections - Technology replacement assumptions - Area of forest land - Area of agri. land - Proximity calculations	- NRCan Comprehen. Energy Use database - BC Hydro CPR Review - BC Stats or Stats Canada populations - Future growth projections - Technology replacement assumptions OTHERs: - input from community on sales (house and buildings), number of retrofits	- LG/ICIS parcel fabric - Utility custom data requests - Current utility rates - NRCan Comprehen. Energy Use database - Capital costs - Operating costs - BC Stats or Stats Canada populations - Future growth projections - Technology replacement assumptions - Proximity calculations OTHER: - Weather - Topography - Performance coefficient of energy components

Criteria ↓		Model / Developer →	CEEMAP Golder Associates et al.	CEEP -QuickStart BC Hydro PowerSmart/ CEA	CIMS Community MKJ&Associates & Navius Research	Climate Action Navigator C2MP	Community Energy & Emissions Analysis Enerficiency Consulting	GHG Proof Sustainability Solutions Group	Green Building Model Pembina Institute	E4SC MMM Group
User-Friendliness	Service Delivery Model	- LG uses, no support		√	√			√		
		- LG uses with support			√			√	√	
		- Consultant uses with LG input	√	√ (frequent)	√	√	√	√ (frequent)	√	√
	Model Usability/ Accessibility	User guide provided?	n/a	Yes	Yes	No	n/a	Yes	No	No
	Experience	# LG Model Users	~20	23	2	1	2	20+	12	1
	Outputs	Energy GHGs Other	√ √ Numerous	√ √ Avg energy $ by fuel type	√ √ % Energy use technologies	√ √ Cost/tonne CO2e	√ √	√ √	√ √ # Buildings affected	√ √ Numerous
		Capital Costs(CC) Operating Costs(OC)	CC OC	No	No	CC OC	No	CC (Infrastructure)	No	CC OC (Energy only)
		Numeric Graphic Maps	√ √ √	√ √ x	√ √ x	√ √ √	√ √ x	√ √ √	√ √ x	√ √ √

Endnotes: For each model/approach above, the following Endnotes provide the reader with some additional information from the contributing practitioner organization. The following 5-point framework is used:

Name of Model – Name of Organization

1. **Model Objective(s)**
2. **Model Description**: A short overview with selected bullets to enable local governments to 'glimpse' at the nature of the model/approach, beyond the comparative nature of the above Matrix.
3. **Local Governments Involved** – provide a listing of local governments involved with the model/approach to-date (up to Summer, 2014)
4. **Future Enhancements Planned** – if known.
5. **For Further Enquiry -** specific resource(s) providing further information, potentially including at least one set of 'coordinates' (contact person(s), email address(es)), available case studies and/or a website where greater detail can be found.

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[i] **Community Energy and Emission Modeling and Planning (CEEMAP) Tool – Golder Associates et al**

1. **Model Objective** – CEEMAP integrates diverse data sets and generates rich graphical outputs to support strategic community energy and emission planning. CEEMAP enables internal and external stakeholders to explore, optimize, integrate, implement and monitor strategies at neighbourhood, community and regional scales. The model has been designed for medium to large communities in urban core, suburban and rural contexts.

2. **Model Description** – CEEMAP is an ArcGIS and Excel-based tool that has supported diverse communities meet a range of strategic objectives:
    - Connect diverse data sets, illuminating powerful relationships between land use, buildings, road networks, transit routes, car ownership, municipal infrastructure, industrial activity, topography, geology, urban forests, agriculture and more;
    - Support analysis, scenario planning, and strategy development across all key community energy and emission sectors (i.e., transportation, industry, buildings, distributed energy/district energy, land use, solid waste, forest and agriculture).
    - Community wide and neighbourhood district energy screening;
    - Foster deep understanding of energy and emissions implications of community planning, development, transportation and infrastructure;
    - Integrate community energy and emission planning into existing planning agendas and departments, including transportation, long range planning, community development, utilities, solid waste management, environmental planning.
    - Develop high impact strategies that recognize the challenges and opportunities of unique local governments and communities;
    - Establish defensible short and long-term targets and benchmarks to support strategy development, implementation, monitoring and adaptive management;
    - Regional EV charging station network planning, including location optimization and host recruitment;
    - Provide graphically rich maps, charts and graphs that effectively communicate the key issues and paths forward; and
    - Attribute energy and emission reductions to policies driven by local and senior government, utilities and transit authorities.

    CEEMAP can show diverse community-wide and neighbourhood energy and emission profiles (e.g., overall carbon/energy intensity, household intensity, and sectoral breakdowns), as well as serve projects at diverse scales: regional, city-wide, or neighbourhood. Its modular structure enables sub-models to run separately, e.g. forest carbon, land use/transportation, EV charging infrastructure, land use/buildings or land use/district energy/buildings.

    Originally developed at the boutique sustainability firm Holland Barrs Planning Group, CEEMAP has iteratively evolved over several mergers. Golder and Associates now hold it and collaboratively run it with other independent co-creators: Blue Cedar Ventures and Boston Consulting.

3. **Local Governments Involved** – CEEMAP has served approximately 20 local governments on 30 projects including neighbourhood, community or regional plans and sectoral initiatives.
   - Capital Regional District (Victoria Area)
   - City of Campbell River
   - City of Coquitlam
   - City of Edmonton
   - City of Langford
   - City of Nelson
   - City of North Vancouver
   - City of Prince George
   - City of Richmond
   - City of Surrey
   - City of Victoria
   - City of Winnipeg
   - District of North Vancouver
   - District of West Vancouver
   - Metro Vancouver
   - National Capital Region, including NCC
     - City of Ottawa
     - Ville de Gatineau
   - Town of Markham
   - Township of Langley

   CEEMAP has also been used to support policy and planning with the BC Government, Federal Government (Natural Resources Canada), BC Hydro, and university and private sector real estate development.

4. **Future Enhancements Planned** – CEEMAP is constantly refined to account for new and improved knowledge about energy and emissions across all sectors, as well as unique client policy interests or geographical contexts. Recent enhancements include an EV charging infrastructure planning module, excel based implementation planning tool, and rural transportation and land use methodology.

5. **For Further Enquiry –** Contact: Aaron Licker, Golder, 604-688-9769 x124, aaron_licker@golder.com; Alex Boston, Boston Consulting, 604-928-2347, alex@bostonconsulting.co; Micah Lang, Blue Cedar Ventures 778-968-5264, micah.lang@bluecedarinc.com.

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[ii] **Community Energy and Emissions (CEEP) Quick Start – Community Energy Association**

1. **Model Objective -** Rapid, action-oriented CEEP. Deliverables include capacity development in staff and elected officials, a practical plan with specific actions with accountabilities by year, a draft Community Energy and Emissions Plan, estimated impacts by action. CEEP process recognizes limited staff time and financial resources available to many local governments and leverages an extensive list of well-documented actions, unique facilitation techniques, and a relentless focus on practical, measurable actions and plans.

2. **Model Description** - The CEEP Quickstart model is one part of an integrated CEEP development process that produces not only a CEEP but also significant learning and capacity development in both staff and elected officials. Highlights include:
   a. Investment of 2 days of time from staff and elected officials – a compressed, high impact process;
   b. Leverage existing data such as Community Energy & Emissions Inventory (CEEI), BC Stats, and BC Assessment Authority
   c. Lead local government through the CEEP development process
   d. Support the creation of a practical project plan based on specific policy, regulatory, fiscal and operational actions
   e. Engage Council for CEEP approval enabling electricity and GHG savings

3. **Local Governments Involved** – As of April 2012:
   1. Burns Lake
   2. Cowichan Tribes
   3. Esquimalt
   4. Golden
   5. Invermere
   6. Kimberley
   7. Alert Bay
   8. Port McNeil
   9. Armstrong
   10. Sicamous
   11. Lake Country
   12. Lumby
   13. Valemount
   14. Taylor
   15. McBride
   16. Peachland
   17. Qualicum Beach
   18. Barriere
   19. Clearwater
   20. 100 Mile House
   21. Lake Cowichan
   22. Mackenzie

4. **Future Enhancements Planned** – Update to allow for selection of comparison community, enhance look & feel as well as graphic output, update to CEEI 2010 format.

5. **For Further Enquiry -** Visit:
   www.bchydro.com/powersmart/business/programs/sustainable-communities/ceep/quickstart.html
   or contact Dale Littlejohn, Executive Director, Community Energy Association 604-628-7076 or
   dlittlejohn@communityenergy.bc.ca.

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[iii] CIMS Community – MKJ & Associates and Navius Research

1. **Model Objective -** To provide a free and user-friendly community energy and emissions forecasting tool that can be used by local governments to quickly produce results under various future assumptions and scenarios.

2. **Model Description** - CIMS Community simulates how market and policy conditions affect the acquisition, use and retirement of the energy using technologies found in communities from the present to 2050, covering light bulbs to buildings and cars and truck. Consequently, it simulates energy consumption and greenhouse gas emissions under a range of future scenarios. The model can:
   - Be set-up to represent any community covered by the BC community energy and emissions inventories in a matter of minutes;
   - Quickly produce reference scenario energy and emissions forecasts for communities based on the CEEI reports and user defined assumptions such as energy prices and population growth;
   - Show the effect that alternative assumptions and inputs will have on final energy and emissions results; and
   - Provide realistic analysis of individual and multiple policies that affect energy and emission. Realistic analysis means the model considers both the technologies and human behaviour that result in energy consumption and emissions. This consideration includes the lifespan of existing technologies, the emergence of new technologies and the diversity of human decision making and behaviour when purchasing, using and retiring these technologies (i.e., organizations are not perfectly rational cost-minimizers and we all have different preferences).

   The model can be used by people with any level of energy and emissions modeling experience to:
   - Produce a standalone forecast for a community that has not completed an energy and emissions plan.
   - Update an existing energy and emissions analysis if there are changes in fundamental assumptions, senior government policy, mandates for emissions targets, or the community vision for emissions abatement.
   - Test the sensitivity of an energy and emissions plan to a range of assumptions or to a different methodology.
   - Produce assumptions, such as the effect of a specific policy or changes in reference case technologies, to inform other analyses
   - Educate people on how current conditions, future assumptions, and market and policy drivers may affect the energy system.

   This model specializes in realistically forecasting the evolution of technologies within a community, but the impact of changing urban form is based upon user assumptions. These assumptions include:
   - Transportation demand (e.g., how far people need to travel in their daily lives)
   - Building type (e.g., attached vs. detached house)
   - Building area (e.g., reducing growth in average home area)

3. **Local Governments Involved** – Development was supported by staff at the Nanaimo Regional District (RDN) and the Sunshine Coast Regional District (SCRD).

4. **Future Enhancements Planned**. Future improvements include producing energy, operating and capital cost outputs, incorporating a representation of district energy, and developing a neighbourhood-scale version of this model.

5. **For Further Enquiry -** Please contact Michael Wolinetz (604-683-1490, Michael@naviusresearch.com).

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[iv] **Community Energy & Emissions Analysis – Enerficiency Consulting**

1. **Model Objective** - To provide energy and GHG growth projections under Business As Usual and alternative scenarios, and assess the impact of individual actions.

2. **Model Description -** The Community Energy & Emissions Analysis model is an Excel based tool for analyzing energy and GHG growth projections under BAU and alternative scenarios. It utilizes baseline community energy emissions data from CEEI or other sources. Growth projections are based on population growth rates or other available data. The impact of reduction actions is modeled by a percentage reduction in the relevant sector. All actions are interactive, so that the overlapping impact of one action on another is taken into account. Actions are identified as impacting on existing emissions or new, and turnover of vehicles and building stock is taken into account. A number of actions are incorporated into the tool, including zoning and compact development, transit and cycling infrastructure, district energy, and recycling/composting, as well as higher level government policies and actions. However, any action can be incorporated into the model with appropriate estimates of the reduction impact. This is an in-house tool intended for use by the consultant for energy and emissions planning work, and is not for sale to the public.

3. **Future Enhancements Planned** - Expansion of available actions.

4. **Local Governments Involved** – Ktunaxa First Nation, City of Revelstoke.

5. **For Further Enquiry –** Michael Wilson, P.Eng., Enerficiency Consulting, 604-886-9864, mwilson@enerficiency.ca, www.enerficiency.ca.

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[v] **GHGProof – Sustainability Solutions Group**

1. **Model Objective(s) -** Sustainability Solutions Group (SSG) developed GHGProof to provide municipalities with a comprehensive yet simple to use tool to evaluate the GHG emissions, energy use and energy cost impacts of different future land-use scenarios.

2. **Model Description -** GHGProof establishes a baseline for GHG emissions, energy use and energy costs for existing conditions in a community. From this baseline, business as usual and future scenarios are developed showing projected and estimated trends (BAU), or desired or potential outcomes (future scenarios).

   There are two components to GHGProof. Following methodologies described in the Guidebook, the GIS analysis component can use any GIS platform. The second component is a comprehensive spreadsheet model that functions in either Microsoft Excel or Open office Calc. The spreadsheet component can be used independently of GIS if a spatial analysis is not required.

   Model inputs include GIS and statistical data related to buildings, transportation, solid and liquid waste, tree cover and agricultural practices. These inputs are translated into the spreadsheet model. The spreadsheet model allows users to evaluate the effects of spatial and non spatial strategies and policies a community may consider in reducing its GHG emissions, energy consumption and energy costs.

   GHGProof is open source (licensed under Creative Commons) and fully transparent. Users can freely download the latest version from SSG's website and customize the model according to their particular circumstances.

   Transportation data modelling is one of the most complex aspects of the tool. GHGProof uses three different transportation analysis methods, depending on the availability and quality of existing transportation models and/or origin-destination surveys. The first method is to create a spatial model of origins and destinations in GIS. Once the spatial model is created for the baseline, the user is able to evaluate the GHG emissions impact of different land-use scenarios according to the projected locations of additional dwellings, employment centres and other destinations. As a second approach, GHGProof can create a transportation gravity model in which Institute of Transportation Engineers trip generation numbers are assigned to each type of destination. A third approach uses regression analysis to correlate particular travel behaviours against land-use characteristics and then applies this relationship to future land-use patterns. All three methods can be calibrated against CEEI data if it is deemed of sufficient quality.

3. **Local Governments Involved:**
   - Fraser Valley Regional District
   - Regional District of Central Okanagan
   - Village of Masset
   - Village of Port Clements
   - Village of Queen Charlotte
   - City of Abbotsford
   - District of Kent
   - Halton Hills
   - West Hants
   - Summerland
   - North Saanich
   - UBC Neighbourhoods
   - District of North Cowichan
   - View Royal
   - Town of Comox
   - Lasqueti Island
   - Capital Regional District

4. **Future Enhancements Planned:**
   - Sensitivity analysis
   - Online version of the model

5. **For Further Enquiry:**

   Guidebooks, literature review, presentations, guidance videos, and the model are all available for download at: http://www.sustainabilitysolutions.ca/resources/GHGproof.

   For more information contact: Yuill Herbert - Director, Sustainability Solutions Group; 250-213-9029; yuill@sustainabilitysolutions.ca.

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[vi] **Green Building Model – Pembina Institute**

1. **Model Objective -** The Green Building Model (GBL) model is used to help local governments understand the impacts of building policies on community-wide energy use and greenhouse gas emissions.

2. **Model Description** - This modelling spreadsheet accounts for changes in energy use in buildings in the community over time. Primary strengths are its simplicity, transparency, and the ability to standardize to communities in BC. Any policy simulation is based on user input – users indicate the energy savings per building anticipated, and the expected participant rate of one or more of the policies options available. The model tracks these assumptions over time by keeping track of growth and replacement of housing and building stock.

3. **Local Governments Involved** – The model has been used by Pembina to estimate impacts of building policies in the following communities:
   - Campbell River
   - Cowichan Valley Regional District
   - Dawson Creek
   - Delta
   - Ladysmith
   - Regional District of Nanaimo
   - City of North Vancouver
   - Prince George
   - Smithers
   - Terrace
   - Tofino
   - West Vancouver
   - Whistler

   Note - BC Hydro has trained ten or more Community Energy Managers in their respective municipalities on the model.

4. **Future Enhancements Planned** – No current plans for enhancement.

5. **For Further Enquiry:**

   Alison Bailie, Senior Policy Advisor, Pembina Institute @ alisonb@pembina.org.
   For more information see: - http://www.greenbuildingleaders.ca/

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[vii] **Energy for Sustainable Communities (E4SC) - MMM Group**

1. **Model Objective:** The Model is able to quantify and verify accurate construction cost to for building profiles and alternative energy sources to find an optimum solution for an economically viable sustainable community.

2. **Model Description:** This community modelling tool has the capability to integrate together technologically appropriate building and renewable energy modeling programs to simulate community energy flows every hour. This integration tool will capture heat recovery opportunities within community and integrate renewable energy technologies. This tool has the further capability to optimize the mix of technologies at both the building level and community level for both life cycle cost and/or energy consumption, thus reducing overall construction and energy input costs over the life of a community.

   How can it help communities to achieve targets? The bottom-up model structure also allows for the phased addition of energy sources and loads over time to accurately capture the actual growth and construction of the community over time. This plays a crucial role as a planning decision making tool for municipalities trying to measure triple bottom line: social, economic and environmental objectives and achieve carbon and greenhouse gas reductions. It will assist in planning a scalable energy network for a community that will facilitate for future expansion in a cost effective and sustainable way.

   What E4SC achieves:
   1) **Efficiency target** – with actionable recommendations that give weigh to targets in policies to updates to Official Community Plan and land use policy to achieve Energy Efficiency targets
   2) **Verification** - Optimizing community plan for greenhouse gases, trade-off and embedded energy, multiple aspects of the community.
   3) **Alternative energy generation** – for example, geo-thermal technology and PVC panels – How to model neighbourhoods, urban centres, communities with accurate capital cost of infrastructure and construction to understand the scenario that balances the priorities between economic, social and environmental. The results can be used for the sustainable development of future communities.

3. **Local Governments Involved:**

   Lawrence Allen, Lawrence Allen Community Energy Implementation & District Energy Feasibility Plan, City of Toronto - The Lawrence Allen Revitalization Plan aims to raise the standard of living for local residents over the next 20-25 years. MMM is engaged to provide an energy implementation strategy conductive to this over-arching vision and plan. The community level energy implementation plan is complete, with recommended options including costs, environmental and energy impacts.

4. **Future Enhancements Planned** – No current plans for enhancement.

5. **For Further Enquiry:** contact Annie Li, Senior Project Manager, MMM Group, lian@mmm.ca; 604-685-9381 X 4154.