HOLLAND COMMUNITY ENERGY EFFICIENCY AND CONSERVATION STRATEGY

"CREATING A GLOBAL COMPETITIVE COMMUNITY"

Project Work Team Report

Dated September 9, 2011

Prepared by:

Garforth International llc

in collaboration with

City of Holland
Holland Board of Public Works

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Acknowledgements

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Condition Statement

This report recommends a forty year energy strategy for the City of Holland to achieve a range of economic, environmental and supply reliability goals. These recommendations should be seen in the context of providing an agreed strategic basis for future detailed decision making. Some elements of these recommendations will obviously need to be refined with investment grade due-diligence.

Executive Summary

The City of Holland recognizes that our world will be facing critical energy challenges in the coming years. The City also recognizes that with these challenges come opportunities. The City must find ways to reduce their dependence on foreign energy and fossil fuels, improve efficiency and costs, enhance sustainability and expand energy sources and systems. Holland is committed to be a highly-competitive world-class community, supported by innovative energy solutions that benefit the citizens, the business community, and the environment. The City is developing a comprehensive, long-range Community Energy Plan from today to 2050 as a roadmap to prepare for the challenges and opportunities ahead.

The **Community Energy Plan (CEP) Report** recommends approaches to meet three primary goals:

- Ensure economic competitiveness
- Provide reliable and affordable energy
- Protect the environment

Successful implementation will ensure that Holland's residents will have cleaner, reliable, affordable energy for decades to come. The City will remain a competitive place for business to invest and a desirable place to live and work. Further, the CEP recommendations were developed with the understanding that Holland can adapt to changing technologies, legislation, and market conditions.

Global Energy Challenges

Worldwide energy demand grew five-fold between 1950 and 2000 and could double again by 2030.

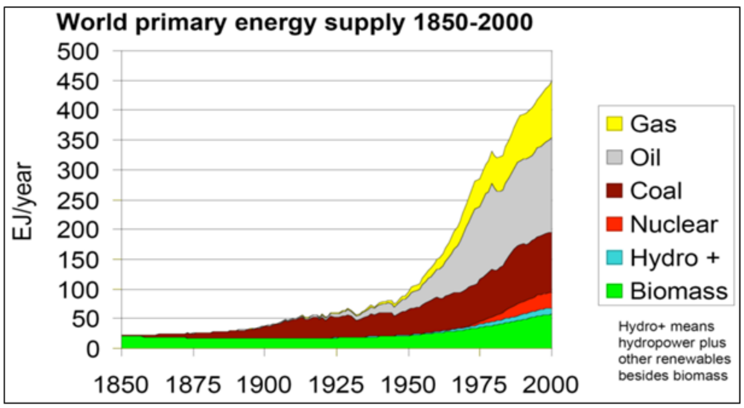

Figure ES.1 Worldwide Use of Energy (1850-2000)

This growth puts major pressure on energy supplies, costs and environmental impact. Energy creates about 70% of all manmade greenhouse gas emissions, with the rest coming from industry and agriculture. Figure ES.2 shows 2008 greenhouse gas emissions for selected countries, in metric tons carbon dioxide equivalent (mt CO_2e) per capita.

Country	Per Capita Emissions
USA	22.2
Canada	22.1
Russian Federation	15.8
European Union	10.5
Germany	11.7
United Kingdom	10.3
Japan	10.1
France	8.6

Figure ES.2 National Greenhouse Gas Emissions per Capita for 2008

The U.S. spent about $1.2 Trillion on energy[1] in 2007, which has increased in the past three years. Half of this was spent on expensive transport fuels. Residential (homes) and non-residential buildings used over 40% of all energy; transportation used 28%; with the balance used in industry. The U.S. imports about 30% of its energy, straining the national deficit and overall security.

Michigan spent about $37 Billion on energy in 2007, of which $26 Billion was imported from other states or countries. Costs from 1982 to 2007 are shown in Figure ES.3.

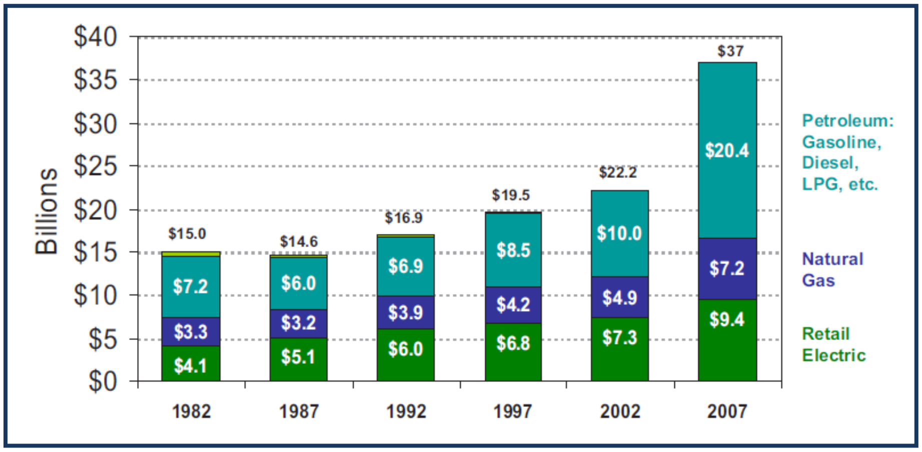

Figure ES.3 Michigan – Total Retail Energy Cost

The largest expense which grew the fastest was that of petroleum products, which has always been vulnerable to fluctuations in global oil pricing. Coal accounts for 60% of Michigan's electricity production, nuclear 26%, natural gas 10%, hydroelectric and other renewable sources 4%. The $7.2 Billion of natural gas end-use represented here was used primarily for heating Michigan's relatively inefficient buildings.

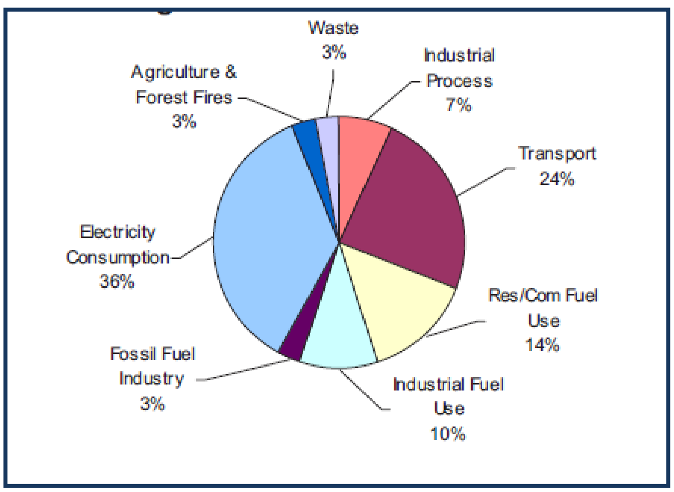

Figure ES.4 Michigan - Total GHG Emissions

The 2007 greenhouse gas emissions for Michigan were 248 Million metric tons (Mmt) of CO_2e. Of this, 87% or 216 Mmt came from the production and use of energy, equivalent to about 21 mt/capita.

[1] http://www.eia.gov/totalenergy/data/annual/txt/ptb0306.html

Energy Baseline for Holland

In 2010, Holland spent $135 Million on energy shown by fuel type and end-use in Figure ES.5.

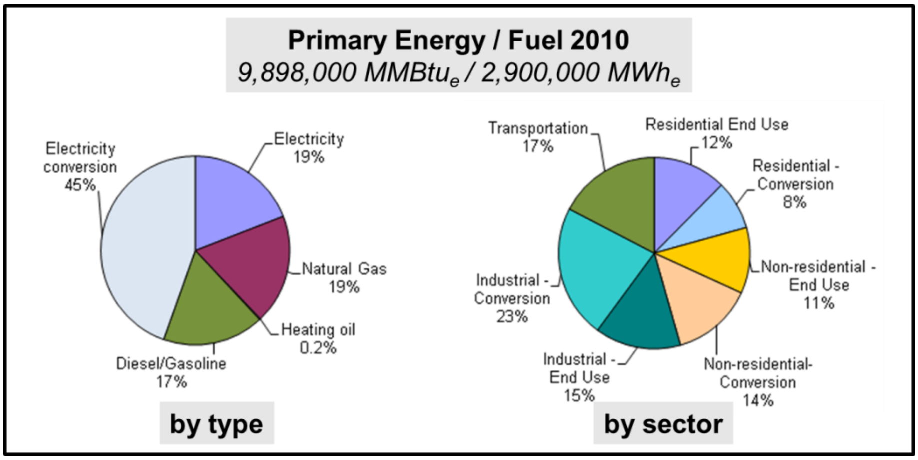

Figure ES.5 Holland Primary Energy by Type and Sector

Diesel and gasoline account for 17% of Holland's energy use, overwhelmingly in cars and other light vehicles. Typical of most cities in the upper mid-west, natural gas is mainly used to heat Holland's homes and buildings. The electricity used in the City is 19% of all energy. The energy needed to generate and transport electricity to customers is the largest part of the energy use of Holland. As in Michigan in general, the majority of this electricity is generated by coal.

The bulk of Holland's homes and buildings were built when codes were very inefficient, creating a major improvement opportunity. Michigan as a whole has historically had building codes with relatively low energy efficiency.

Holland has its own electrical utility owned by the City of Holland, operated by the Holland Board of Public Works (HBPW). HBPW distributes electricity to the City and to neighboring communities. They also have significant generating capacity in the City; the De Young coal-fired plant, and natural gas peaking plants. This combination allows HBPW to provide reliable, low-cost electricity valued by residents and businesses in the City. Holland's energy had a "carbon footprint" of 792,500 mt in 2010, or 24 metric tons per resident.

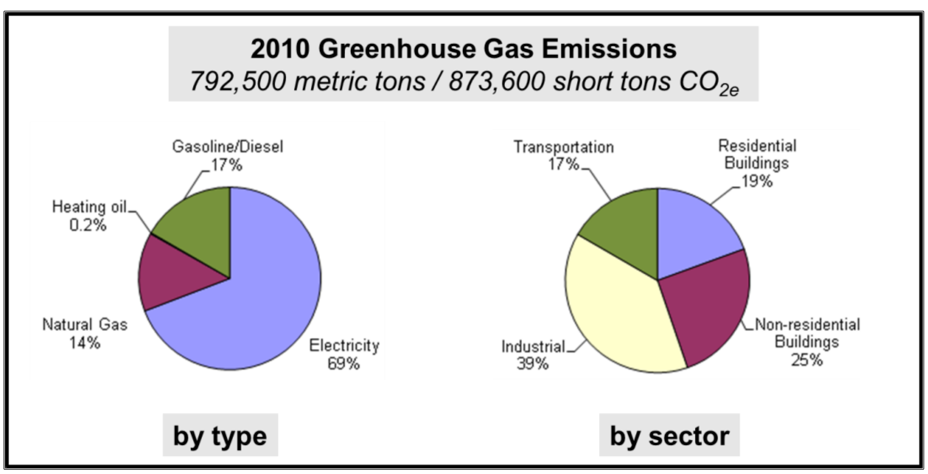

Figure ES.6 Holland GHG by Type and Sector

By sector, nearly two-thirds of all emissions come from non-residential buildings and industry, underlining the impact of Holland's employment mix and industry. By energy type, 69% of emissions are from the use and generation of electricity. Fuels for heating and hot water, mostly natural gas, are 14% of the total. Transportation fuels including diesel, gasoline, compressed natural gas, and some biofuels account for the balance of 17%.

Outlook for Energy Use in Holland

To assess the impact of various strategies for the City of Holland, a "business-as-usual" forecast for the next 40 years was developed. This estimate shows the potential picture of growth in energy use and GHG emissions based on relatively constant efficiencies with the same mix of fuels and supply of gasoline, diesel, gas and electricity. This Base Case is the model against which future scenarios are compared. The anticipated energy supply need in the Base Case is shown in Figure ES.7**.**

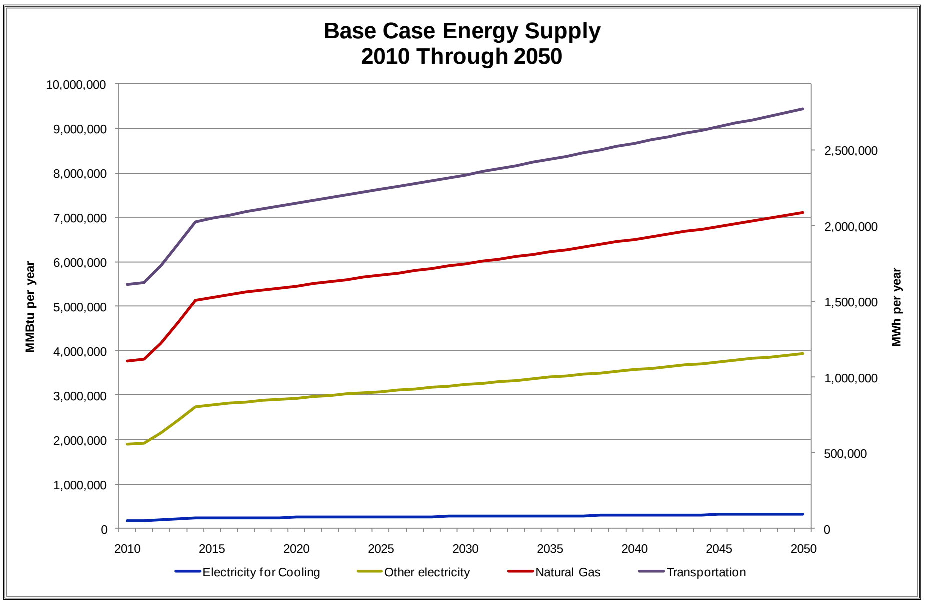

Figure ES.7 Base Case Energy Supply - 2010 to 2050

This unrestrained outlook shows energy demand growing by over 75%, driven by strong industrial development in the south-east of Holland and some population growth. In the Base Case, electricity consumption doubles from 2010 to 2050, underlining the impact of industry. To meet future electricity demands for electricity and keep the cost and reliability of local generation, the City currently has a permit to add 70 MW of solid fuel generation.

In the Base Case, greenhouse gas emissions from all energy uses would nearly double to 1.5 Million metric tons by 2050. This equates to an increase from 24 mt CO_2e per resident in 2010 to 36.7 mt CO_2e by 2050.

Transforming Holland's Future Energy Use

Under guidance from the Sustainability Committee, the City, HBPW, and the public, the Project Work Team (PWT) was challenged to create a world-class energy plan for the City that goes far beyond incremental efficiency improvements. Implementation of this plan will achieve breakthrough levels of economic and environmental performance with high levels of reliability and quality.

The PWT recommends the target to economically and reliably reduce the City's greenhouse gas emissions per capita from the baseline level of 24 metric tons in 2010, to 10 metric tons by 2050.

Annual GHG emissions will be no more than 10mt CO_2e per capita by 2050

Greenhouse gas emissions per capita (CO_2e/capita) is a widely used general measure for the overall efficiency, costs and environmental impact of energy use by a community. This is used as a key metric in the CEP. It will be used primarily to measure Holland's long-term progress against its own goals. It also has value to compare the City's performance against communities worldwide.

Strategic Recommendations

The recommended energy strategies make substantial progress in meeting Holland's 2050 energy targets. The key elements are:

- Encourage inbound industrial investment
- Make large-scale efficiency improvements
- Enable heat recovery and efficient energy distribution
- Create a flexible balance of clean, reliable energy supply choices

Scenarios Evaluated

In developing the recommendations, four scenarios (A through D), combining energy efficiency, distribution and supply were evaluated. They are summarized in Figure ES.8 – "Green" indicates the measure is included in the Scenario, "Red" that it is not included.

Strategic Measure	Base	A	B	C	D
Efficient renovation – all buildings	Red	Green	Green	Green	Green
Focused retrofits – single homes	Red	Green	Green	Green	Green
Energy performance labels	Red	Green	Green	Green	Green
Transportation efficiency gains	Red	Green	Green	Green	Green
Expanded appliance rebates	Red	Green	Green	Green	Green
Ongoing industrial efficiency gains	Red	Green	Green	Green	Green
Downtown district heating network	Red	Green	Green	Green	Green
Expanded snow melt services	Red	Green	Green	Green	Green
Industrial Park – district energy network	Red	Green	Green	Green	Green
Industrial environmental services	Red	Green	Green	Green	Green
70 MW solid fuel expansion (30% biomass)	Green	Red	Red	Green	Green
70 MW CCGT expansion	Red	Green	Green	Red	Red
30 MW CHP in Industrial Park	Red	Green	Green	Green	Green
10 MW Landfill gas capacity	Green	Green	Green	Green	Green
20 MW Bio-gasification expansion (2031)	Red	Red	Green	Red	Red
24MW Solar Power (PV)	Red	Red	Green	Green	Red
10% biogas in gas network	Red	Red	Green	Green	Red
37 MW Wind power	Red	Red	Green	Green	Red

Figure ES.8 2010 to 2050 - Scenarios Overview

The four scenarios are similar from an efficiency standpoint and focus on recommendations that have clear value to both the final end user and to HBPW in terms of either investment avoidance or new business opportunities. They differ in the combinations of energy supply and fuel choices.

Of the four scenarios evaluated the PWT is recommending Scenario B. The elements are:

- Existing buildings, with the exception of single-family homes, will be 30 to 50% more efficient than the current average after major renovations. By 2050, all existing buildings will have been renovated.

- All 7,400 single-family homes will be renovated in two phases. The first phase between 2013 and 2033 will be retrofitted with a "moderate efficiency package" that will result in efficiencies that are 53% higher than the current average. In the second phase, to 2050, the retrofit will be a "high efficiency package" to be 66% more efficient. This will be enabled by a City-wide investment facility.
- Most buildings will have an Energy Performance Label available when sold or rented to raise market awareness of their actual energy performance and to encourage performance improvements.
- Transportation efficiency will primarily come from revised Federal Standards, material weight reductions, smaller vehicles and more efficient drivetrains. A small portion will come from a slightly denser urban design and the walkability impacts of expanded snow-melt services.
- Transition of about 7% of the car fleet to electric vehicles is assumed by 2050, an important aspect given the focus on battery manufacture in Holland. Under Scenario B this is carbon neutral relative to conventional fuels, in all others it is carbon negative.
- Incentives on existing HBPW refrigerator and A/C replacement incentive programs will be strengthened to accelerate the replacement of inefficient models with new units having Energy Star rated or higher efficiencies. By 2030, at least 5,000 refrigerators and 7,500 air conditioners will have been upgraded, on track to a 100% replacement by 2050.
- Industry will successfully implement Corporate Energy Management Programs that deliver year-on-year continuous efficiency improvements.
- Higher density areas around downtown, the Hope College campus, the Hospital and the High School will have a significant ratio of district heating.
- District heating services will be offered north of 24th Street, initially anchored on Hope College, Holland Hospital, the Aquatic Center and major City-owned properties. The plan to upgrade Central Avenue will be expanded to include district heating feeder pipes.
- Downtown district heating will be configured to be a suitable source for extending the offering of snow-melt services
- The prospering industrial area in the south-east (Holland Industrial Park) will also be configured to have district heating services, associated with using new combined heat and power (CHP).
- To serve growing electricity demand, a 70 MW combined cycle gas turbine (CCGT) will be added in two to three phases. This will be on the James De Young site and will be configured for district heating.
- Industrial services will be based on a 30 MW CHP, with capacity added in sync with industrial development and combined with district heating and other services.
- 10 MW of "Green Power" from landfill gas will be included in the electricity supply portfolio.
- A 20 MW biomass generating block will be added on the De Young site. This would use advanced bio-gasification.
- 24 MW photovoltaic (PV) solar electricity generation will be installed at a rate set by market evolution of installed costs and available incentives. This helps HBPW meet State renewable requirements and, more importantly, significantly reduces the summer electric peak.
- 37 MW of wind power will be added by 2020. This both reduces the emissions of the City and helps meet State renewable requirements.

As a note the information from the MPPA was also taken into account during the PWT analysis and scenario overview development.

Scenario Results

- ***Total Fuel Use and Mix***

The evolution of the total fuel use and mix for the City is strategically important in a number of ways:

- Cost is in large part driven by the total fuel needs of the City. This in turn is driven by the overall efficiency of the consumption, distribution and conversion of energy for transportation, heating, domestic hot water, cooling and all other electrical uses. In the 2010 baseline estimates, the total energy cost of the City was about $135 Million.
- Cost at any given time is also driven by the market price of different fuels and the relative mix. For most of the 40-year CEP period, the four fuels that are critical will be the relative pricing of natural gas, oil, coal and biomass.
- Cost in later years will also be influenced by the operating cost of wind and solar electricity generation.
- Flexibility to adjust the fuel mix based on the availability and price of particular fuels is a critical aspect in managing the overall reliability and cost of the energy system.
- Fuels have different greenhouse gas content. The overall mix defines the carbon footprint of the City. The evolution of legislation to reduce greenhouse gas emissions is highly uncertain and may or may not penalize high-carbon sources. Flexibility to adjust the fuel mix based on the carbon content of specific fuels is a critical aspect in managing the environmental risks.

The fuel mix for the City's energy use in industry, residential buildings non-residential buildings, and transportation based on the four scenarios is shown in Figure ES.9. The fuel mix includes the fuel used outside of Holland to generate electricity that is ultimately used in Holland, mostly coal.

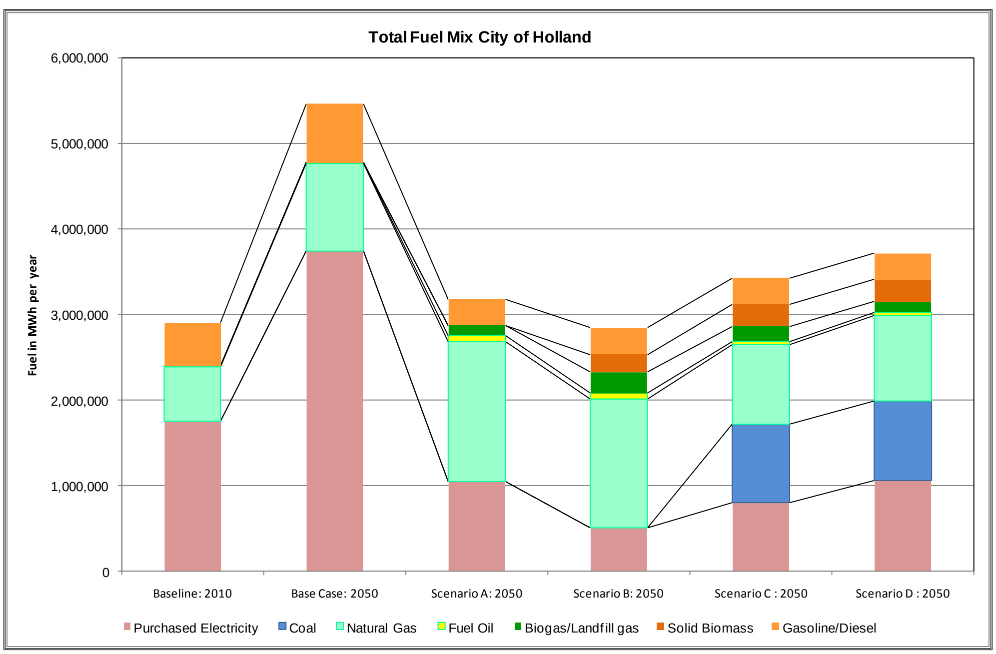

Figure ES.9 Scenarios A through D – 2050 Total Fuel Mix for Holland

In Scenario B, the total fuel used by Holland forty years from now is actually less than that used in 2010 even though this includes the energy needs of significant growth in employment and population. Different fuels cause different levels of greenhouse gas emissions. The total GHG emissions caused by each of the scenarios are shown in Figure ES.10.

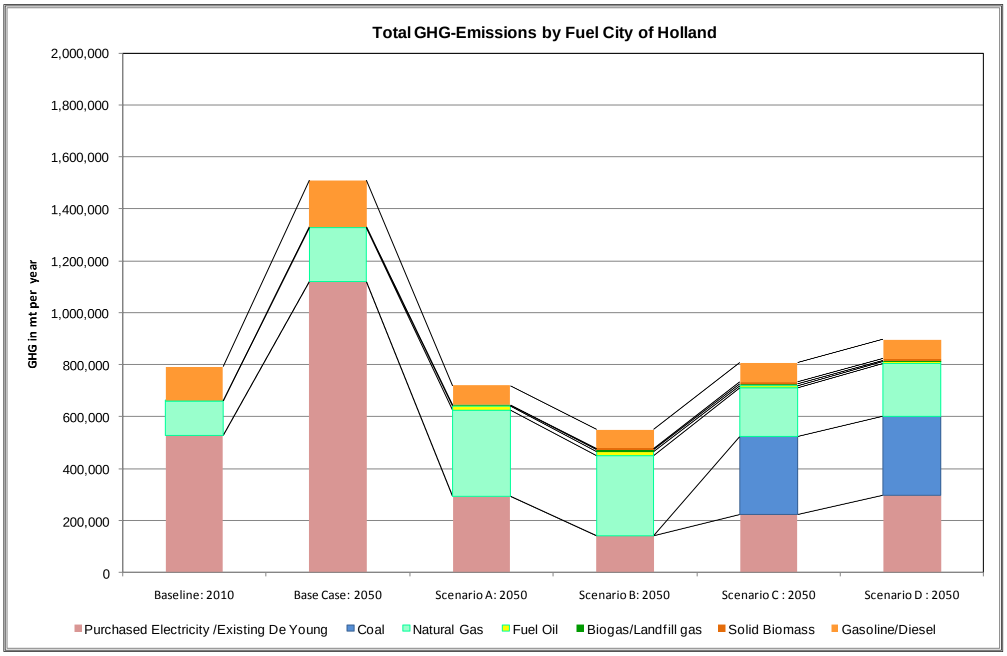

Figure ES.10 Scenarios A through D – 2050 Total GHG by Fuel Mix for Holland

All scenarios provide for significant greenhouse gas emissions reductions relative to the Base Case. Scenario B has the greatest proportional reduction relative to energy use. The total emissions of Scenario B by major strategy are shown in Figure ES.11.

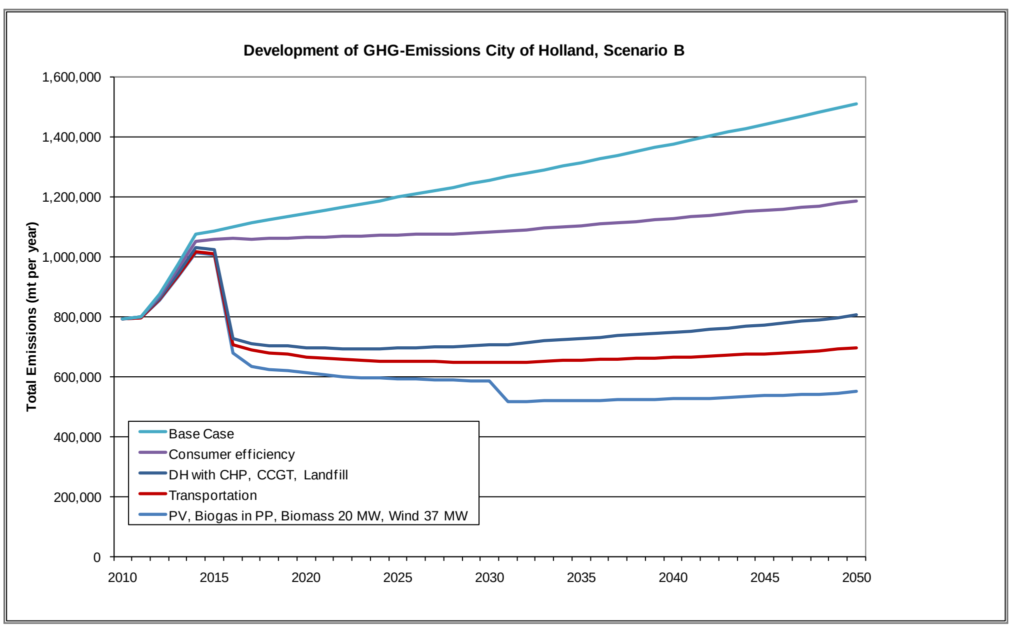

Figure ES.11 Scenario B – 2010 to 2050 Total GHG by Major Strategy

In 2050, total emissions are 522,000 mt for Scenario B, or 65% less than the Base Case. The per capita emissions from 2010 to 2050 for Scenario B (and other scenarios) are shown in Figure ES.12

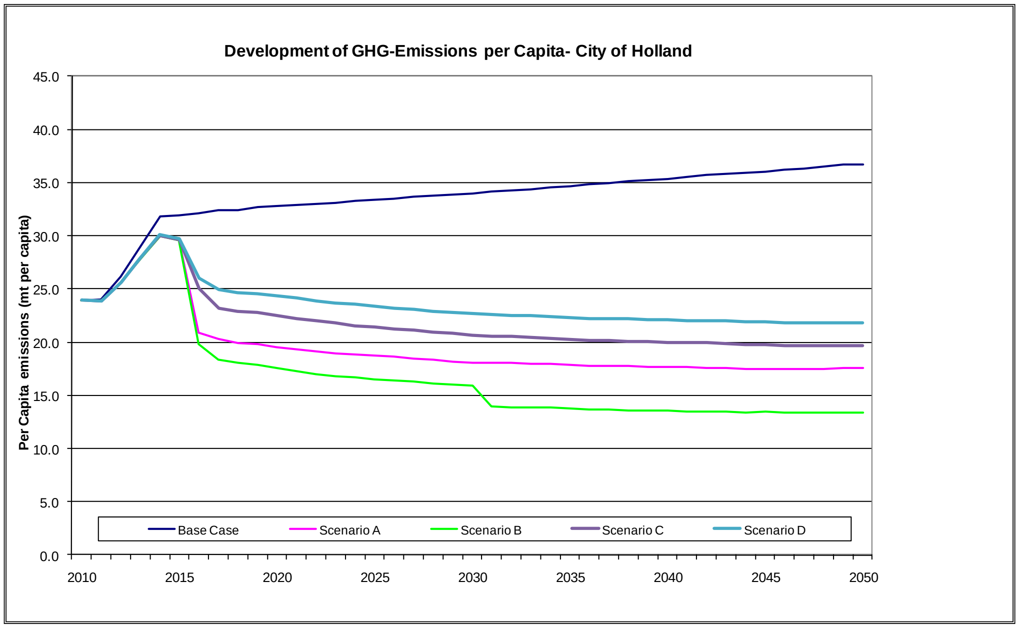

Figure ES.12 Scenario B – 2010 to 2050 per Capita GHG

Scenario B results in per capita emissions of 13.4 mt CO_2e compared to the 36.7mt CO_2e/capita estimate for the "business-as-usual" Base Case. While not meeting the CEP framing goal of 10mt/capita CEP goal, Scenario B puts in place a number of parallel strategies all of which have the potential to be accelerated. Specifically, the home and buildings efficiency recommendations are relatively modest compared to global best practice and could be intensified.

Holland Electricity Investment Scenarios

The City faces a major decision concerning future electricity capacity. These decisions will impact all three of the CEP goals – reducing energy costs, reducing greenhouse gas emissions and enhancing supply security. Each scenario has a different investment profile summarized in Figure ES.13. For comparison with the earlier Black and Veatch study, these are calculated from now to 2030.

Item	Base $ M	Scen A $ M	Scen B $ M	Scen C $ M	Scen D $ M
De Young 70 MW SF/DH	$270	-	-	$270	$270
De Young 70 MW CCGT/DH	-	$105	$105	-	-
Industrial 30 MW CHP/DH	-	$60	$60	$60	$60
Solar PV (8 of 24MW)	-	-	$32	$32	-
Industrial DH Network	-	$10	$10	$10	$10
Downtown DH Network	-	$10	$10	$10	$10
SFH Retrofit – Total Investment	-	$125	$125	$125	$125
SFH Retrofit Owner Share	-	-$63	-$63	-$63	-$63
Refrigerator Incentives	$0	$1	$1	$1	$1
AC Buyback (7,500)	$0	$2	$2	$2	$2
Industrial Efficiency		$0	$0	$0	$0
Additional Snow-Melt	NA	NA	NA	NA	NA
Total 2030 Investment	**$270**	**$250**	**$282**	**$447**	**$415**

Figure ES.13 All Scenarios – Total Investments to 2030

The capacity planning behind these takes into account the expected electricity requirements for HBPW's clients outside the City of Holland.

There is some uncertainty about the timing of new industrial demand. With the approach including 30 MW of CHP and possible phasing of the 70 MW of CCGT, there is flexibility to power generation as needed. Investment of $111 Million for a wind capacity of 37MW to meet the state RPS requirements is being confirmed; however recent negotiations suggest a more cost effective approach for HBPW to source the equivalent capacity through a power purchase agreement.

The single-family home retrofit total investment of $125M assumes about 4,500 homes being renovated. The added values of the avoided peak and efficiency have been divided equally between HBPW and the homeowner.

The basic investments in the DH networks are relatively modest, especially if they can be anchored on cost-effective larger projects as is being recommended. District heating is a key factor in reducing the long-term emissions of the City through the use of recovered heat.

The Project Work Team recommends Scenario B as the basis for finalizing the CEP.

Following future acceptance of the Report by City Council a joint implementation team comprising City and HBPW staff would be tasked to develop multiple detailed implementation plans including investment grade assessments of key high priority projects.

Getting into Action

Successful implementation of the CEP recommendations will require the engagement of all parts of the Holland community, sustained and reinforced over many decades. This need gives rise to the following additional recommendations:

Scale Projects

Immediately planning and implementing the five recommended scale projects will jump-start the CEP and allow the community to fine tune the strategies for successful implementation.

SP1: Holland Industrial Park Integrated Energy Services

In SP1, a portfolio of energy services will be developed, specifically tailored to the current and future industrial employers. This will allow these companies to be more competitive and achieve their corporate emissions goals.

SP2: Historic District Single-Family Neighborhood

Holland has over 7,000 inefficient single-family homes which create a major energy demand on the City and these are a major strategic efficiency focus for the CEP. SP2 encompasses about 150 homes as a testing ground for the technical, financial and neighborhood approaches required to tackle this efficiency opportunity in a strategically effective way to add value for HBPW and homeowners.

SP3: Hope College Campus

Hope College has the scale and opportunity to reconfigure its energy supply, distribution and user efficiencies to achieve substantial cost savings and emissions reductions, and to establish new educational opportunities around innovative energy approaches. It is ideally located to be a node in the development of a downtown district heating network.

SP4: High School, Hospital, Aquatic Center

This cluster of significant energy users has the potential to develop both individual “campus” energy plans, and a local neighborhood strategy that can significantly reduce costs and emissions, and can mitigate against some substantial future risks that could adversely affect their financial options. They are well located to be another node of the wider municipal district heating network.

SP5: Initial Downtown District Heating Network

The combination of climate, urban structure and local generation make significant parts of Holland excellent candidates for modern district heating services. This could reduce heating costs and volatility, create new business opportunities for HBPW and contribute significantly to reducing the carbon footprint of the City. This scale project evaluates creating the first elements of the DH network by linking SP3 and SP4 with the De Young site and a few other significant heating users.

The CEP Project Work Team recommends these five scale projects for immediate detailed evaluation with the aim to implement within the first decade of the CEP timeline.

Enabling Mechanisms

Successful implementation of the CEP requires an energy literate population supported by appropriate skills, resources, information and decision making processes. Putting these mechanisms in place will ensure that the thousands of individual decisions that affect the City's energy performance will deliver the long-term goals established in the CEP. Combined, these will transform Holland's relationship to energy over the forty years of the CEP.

The focus is on the following nine areas:

- EM1: Financial Incentives
- EM2: Greenhouse Gas Emissions Management
- EM3: Energy Performance Labeling
- EM4: Understanding Community Engagement and Energy Literacy
- EM5: Energy Education and Training
- EM6: Standards, Codes and Guidelines for Buildings
- EM7: Institutionalizing Breakthrough Energy Planning and Implementation
- EM8: Changed Role of HBPW
- EM9: Regional Energy Planning

The CEP Project Work Team recommends that these nine enabling mechanisms be put in place to change the culture, decision making framework and overall community awareness of the City's energy performance and its progress towards the CEP targets.

Results that Transform Holland's Future

The energy and GHG impacts arising from the CEP recommendations have been assessed on an annual basis from 2010 to 2050, providing a detailed basis for tracking Holland's progress in achieving their targets. Recommendations include deep efficiency improvements in homes, buildings, industry and transportation, integrated with a restructured clean and renewable energy supply. The CEP also outlines measures for good community governance and support, energy literacy and awareness.

By implementing the recommendations in the CEP, over the next 40 years Holland can absorb significant population and job growth and still use less fuel than today. At current prices this would save the City $40 Million per year, and greatly reduce the impacts of future price volatility. On a per capita basis, greenhouse gas emissions would fall from 2010's 24 metric tons to 13.4 metric tons by 2050.

The availability to locally managed flexible, reliable low-carbon energy supplies will be a magnet for high-quality companies of all types seeking to manage their energy and climate risks. Through their commitment to breakthrough energy performance, Holland will also be a magnet for clean energy companies seeking to establish and grow national and global businesses.

Many other cities, states and countries are becoming aware of the dangers of neglecting future energy changes. As Holland successfully implements the CEP, its skills and experiences will become valuable resources far beyond the borders of the City.

Chapter 1: Community Energy Plan Background

Project Work Team - Process and Methodology

The City of Holland recognizes that it will face some critical energy challenges in the coming years. It also recognizes the wider uncertainty over the cost, supply security and environmental impact of energy use. At a local level, some major community decisions are imminent that could set the direction of the electricity and possible district heating supply system for decades to come. These combined challenges present an opportunity to rethink the City's overall approach to energy and its role in the competitiveness and quality of life of the community.

In January 2011, the leadership of the City of Holland, the Holland Sustainability Committee and the Board of the Holland Board of Public Works, charged the Community Energy Plan Project Work Team[2] ("PWT" or "Team") to develop a 40-year integrated energy strategy for the City. The Team included representatives from the City and the consultants. The PWT met regularly from January 2011 through August 2011 to establish the energy baseline and develop the CEP recommendations. Numerous meetings were held to engage the community in the process, including two Energy Town Hall Meetings. A full list of the meetings and participation is summarized in Appendix 1.

This Community Energy Efficiency and Conservation Strategy Plan ("Community Energy Plan" or "CEP") was prepared by the PWT with guidance and direction from the Sustainability Committee, the Mayor's Energy Task Force[3], along with input from the wider community. The CEP is submitted to the City Council, through the Sustainability Committee, as the PWT's recommendation for the City of Holland's long-term energy strategy.

Throughout the CEP, the level of greenhouse gas emissions arising from energy use will be used as a general indicator of both energy productivity and environmental impact. This will be stated both in terms of the evolution of total emissions of the City and as emissions per resident. This latter is becoming a common index for municipalities around the world, and is a useful general metric for tracking the overall progress when implementing the CEP.

Energy Mission and Goals

Holland will ensure its competitiveness for decades to come as summarized by its Energy Mission:

Energy Mission

Enhance the attractiveness of the City to investors, businesses and residents through the availability of cost effective, reliable and clean energy supply.

This will be achieved by meeting the following energy related goals:

Energy Goals

1. Provide lower energy cost than neighboring communities.
2. Develop industrial energy services tailored to investors' needs.
3. Secure highly reliable electricity and heat supply from local sources.
4. Enable flexibility to meet changing technologies, legislation, fuel costs and other market conditions.
5. Meet commitment to the U.S. Conference of Mayors Climate Protection Agreement.
6. Be a leader in developing a regional energy strategy.

[2] See Acknowledgements Section for PWT Membership
[3] See Acknowledgement Section for membership of the Mayor's Energy Task Force

1. *Lower Energy Costs*

A community's ability to offer lower and less volatile energy costs than competing communities is an increasingly important factor in attracting investment, and thereby creating and retaining high quality employment opportunities. This is also important to local residents, as it enhances the affordability of Holland as a place to live. Over time home pricing will likely adjust to reflect these lower energy costs, especially if the rising cost of energy becomes a factor in future years. Lower energy costs will make commercial property more competitive, resulting in higher rent values and lower vacancy rates.

In 2010, the entire City of Holland spent over $135M on energy of all types, a number that is likely to increase substantially in the future. The CEP recommendations achieve lower energy costs by combining above-average efficiency with flexible, efficient and clean energy supply choices for all types of users. The 30 to 50% efficiencies resulting from the CEP recommendations produce investment potential, current cost reductions and will help to offset future energy price increases.

2. *Industrial Energy Services*

High-quality industrial companies will be attracted to sites that offer a wider than normal range of energy services at high levels of reliability and economic costs. In addition to traditional electricity and gas supplies, integrated industrial parks can offer incoming industry a portfolio of energy services tailored to their needs including such utilities as heating, cooling, process steam, compressed air, etc.

Holland has been successful in attracting world-class companies, many active in emerging sustainable energy markets. Implementation of the CEP recommendations will ensure the availability of clean, cost-effective, and flexible utilities of all types for industrial users, making the City attractive for industrial investment. By creating an energy supply with a very low carbon-footprint, Holland will be the ideal location for the growing number of companies with aggressive corporate greenhouse gas (GHG) emissions reduction targets.

3. *Reliable Local Energy Supplies*

Communities with significant local power generation benefit from reduced waste in transporting power over long distance, as well as higher levels of service reliability. Supply interruptions from weather and other causes are becoming increasingly significant in the U.S., further emphasizing the value of reliable local supplies. Holland has been well served by HBPW for many decades. The CEP recommends building on the local supply options by adding flexible and more efficient local power generation including cleaner and renewable sources.

Heating accounts for over half of all energy used by Holland's built environment. Providing local supply of efficient heating is a key element of the CEP. This will in part utilize heat traditionally wasted in generating electricity. High levels of reliability for both electricity and heating will benefit all energy users and be a magnet for future investors and residents.

4. *Flexibility to Meet Future Changes*

The prices and availability of fuels are becoming highly volatile and unpredictable, as is the outlook for future legislation aimed at reducing the environmental impacts of energy use. Changes in technology, public opinion and market trends around many aspects of energy use and its impacts are equally unpredictable.

Implementation of the CEP recommendations will give Holland's energy system the flexibility to adapt to fuel costs and availability, along with changing technologies as they emerge. The CEP recommendations were developed anticipating changing legislative and market expectations and they contain elements that will preemptively allow the City to remain a competitive leader, regardless of the outcome of these yet unknown factors.

5. Meet Climate Protection Agreement

By signing the U.S. Conference of Mayors Climate Protection Agreement[4] in 2008, Holland recognized the importance of reducing GHG emissions to help manage legislative risks, environmental uncertainty and overall energy costs and efficiency.

The CEP recommendations provide a solid base to greatly reduce the City's overall energy related GHG emissions. Reducing GHG emissions has further environmental benefits by also greatly reducing other pollutants such as mercury, particulates and various nitrous and sulfurous emissions. This further enhances Holland's attractiveness as a place to live, work and play.

6. Be the Regional Energy Leader

The focus of the CEP is on the City of Holland, and to some extent the wider territory served by HBPW. The CEP recommendations represent breakthrough levels of economic, environmental and supply security performance. These are likely to attract national and even international attention especially as Holland and the CEP continue to attract world-class investors. Holland will be well positioned to be the catalyst of a wider regional process encompassing substantial parts of western Michigan, further extending the benefits of a rational energy strategy for the City and the neighboring communities. In implementing the CEP recommendations, Holland and HBPW will develop the wide range of educational training services, skills and businesses needed to create an energy efficient City. These will be made available to serve wider markets, further adding value to Holland's economy.

Measuring Progress

The CEP was developed with a 40-year time horizon and provides a consistent, simple framework for measuring progress. The recommendations include adopting seven key measures of success that will be tracked and reported on a consistent basis for decades to come. More detailed recommendations for each of these measures and the reporting process are included in Appendix 4.

Figure 1.1 CEP Seven Key Measures of Success

Competiveness will be measured by three indicators. The first will be tracking average energy costs for different classes of uses on a standardized basis. The second indicator will be employment created by the CEP. This will be measured in businesses attracted by the CEP and by the "Green Jobs" created by implementing the CEP in the City and beyond. The third indicator will be investments attracted by the CEP in industry, commerce, property development and the energy supply and distribution system.

[4] See Appendix 3 for the full text of the U.S. Conference of Mayors Climate Protection Agreement

Supply security will also have three measures of success. Supply security for heating, electricity and other energy services will be measured by indexes that track the frequency and durations of service failures. Supply quality will be measured by the degree to which each utility deviates from target levels of performance. Flexibility will be tracked by the degree to which the energy system responds to changes in fuel pricing, environmental legislation or technical advancement.

Environmental performance will be measured by the overall greenhouse gas emissions caused by the production and use of energy. This will be both on a total basis for all activity in the City and indexed on a per capita basis for the community as a whole. Industry specifically will also have a need for consistent GHG intensity in delivered utilities for corporate tracking purposes.

Overall Benefits

The benefits that flow from the successful implementation of the CEP recommendations will touch all stakeholders in the community, summarized in Figure 1.2.

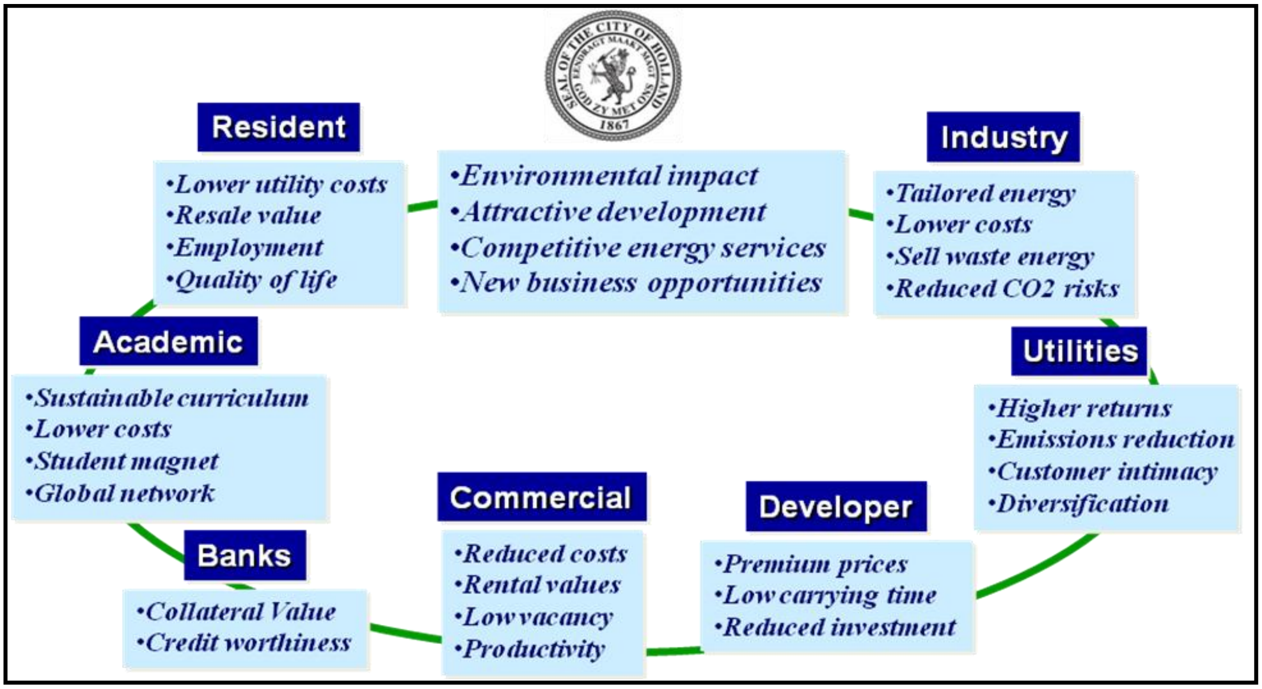

Figure 1.2 CEP Benefits for all Stakeholders

These benefits leverage each other and grow over time. Some will be visible relatively early in the implementation of the CEP, while others may take years to appear. This underlines the importance of long-term tracking of the key measures of success. It also highlights the importance of developing a high level of dialogue between many of the City's current and future stakeholders.

Chapter 2: Energy and Climate Challenges

Energy – A Defining Issue of the 21st Century

The ready availability and affordability of energy supplies since the start of the Industrial Revolution have driven unprecedented growth in the global economy, raising lifestyle expectations and creating vast new businesses. In more recent years, the rapidly growing global demand for fossil fuels is creating new uncertainties about their cost and availability, and exacerbating international tensions. In addition, greenhouse gas and other emissions created from fossil fuels combustion are negatively affecting our immediate environment and likely the global climate. The effectiveness with which we use energy in all forms is increasingly becoming a defining issue of the 21st Century.

Accelerating Global Energy Demand

Worldwide energy demand grew five-fold between 1850 and 2000 (Figure 2.1), and could double again by 2030[5]. The fast growing economies of China and India have made these countries major global energy consumers with increasing imports; a trend that is likely to accelerate.

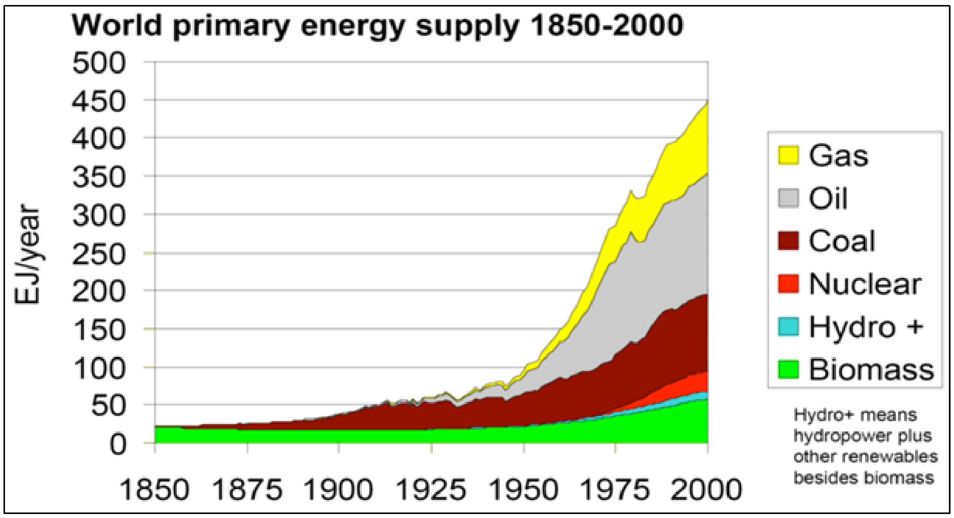

Figure 2.1 Worldwide Use of Energy (1850-2000)

All major global economies rely on imported energy. The U.S. is a major oil importer, the European Union (EU) imports about 50% of all its energy needs, and both China and India are significant importers of oil and coal. The pattern of growth and imports has led to market globalization and resulted in higher volatility in pricing. Supply security and its impact on economic competitiveness and foreign policy are growing challenges.

The recognition that all traditional fuel sources are ultimately finite adds to the uncertainty. World production of crude oil peaked in 2006 according to the International Energy Agency.[6] As demand for oil continues to grow, it is increasingly met by unconventional sources, such as tar sands and oil shale. Harvesting these sources is more expensive and environmentally challenging. This passing of "Peak Oil" strongly suggests the era of inexpensive oil is over.[7]

To some extent, the tightness of oil supply has been balanced by the development of major new sources of natural gas providing a critical, lower-polluting bridge to a more sustainable energy picture. Coal, while a widely available resource for many decades to come, is under rising pricing pressures from both global demand and environmental issues. The use of renewable energy, including wind,

5 IIASA plus updates from BP, IEA, EIA et al

6 http://www.worldenergyoutlook.org/docs/ weo2010/WEO2010_ES_English.pdf

7 http://www.netl.doe.gov/publications/ others/pdf/Oil_Peaking_NETL.pdf

biomass, hydro and solar to generate both heat and power is expanding rapidly, as the cost, technology and reliability improve, adding new options to meet global energy demand.

Energy and National Competitiveness

The way energy is used by countries, communities, businesses and individuals is critical in a competitive global economy, with energy efficient communities and economies having a significant competitive advantage. This advantage will grow as energy prices rise. Figure 2.2 highlights energy productivity differences between major countries in the world economy. [8]

Region	Population	GDP	Energy	Energy /Capita	Energy /GDP
USA	4.6%	18.9%	19.5%	*100*	*100*
EU	7.5%	25.1%	14.8%	*47*	*57*
Japan	1.9%	8.8%	4.3%	*52*	*47*
China	20.0%	4.5%	16.3%	*19*	*355*
India	17.0%	1.5%	4.9%	*7*	*317*
World	100%	100%	100%	23	97

Figure 2.2 Economic and Energy Indicators by Major Regions (2008 data)

The U.S., with just 4.6% of the world's population, creates 18.9% of global Gross Domestic Product (GDP), using 19.5% of the entire world's energy to do so. By comparison, the European Union, with 7.5% of the world's population, generates 25.1% of the world's GDP using only 14.8% of the world's energy to do so. This means that the U.S. is using 100 units of energy to make $1 of GDP, while the EU uses only 57 units of energy, 43% less, to make the same $1 of GDP. At the scale of the total U.S. economy, this roughly translates into a $500 Billion competitive disadvantage for the U.S.

China and India use more energy relative to GDP than the U.S. today. However, their energy efficiency is improving quickly as they modernize and grow. To remain strategically competitive and to ensure secure, high-quality energy supplies, all major global economies must become substantially more efficient in both the end use of energy and in the use of all fuels. With its relatively low energy productivity, this is more so the case for the U.S.

Greenhouse Gas Emissions

Energy use accounts for roughly 70% of all manmade greenhouse gas emissions worldwide, with the remainder caused by industrial processes along with land use and forestry changes. Since the start of the Industrial Revolution, there has been a substantial rise in the concentration of atmospheric GHG, largely due to the use of fossil fuels. The International Panel on Climate Change, an organization consisting of the world's leading climate scientists, as well as most major national climate research bodies, attribute the increase in average global temperatures to the increased use of fossil fuel, along with major changes in land use (Figure 2.3)[9].

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[8] IEA 2008 World Energy Statistics & IMF economic data at 2008 exchange rates
[9] Sources – UK Met Office; NASA; NOAA, UNFCCC

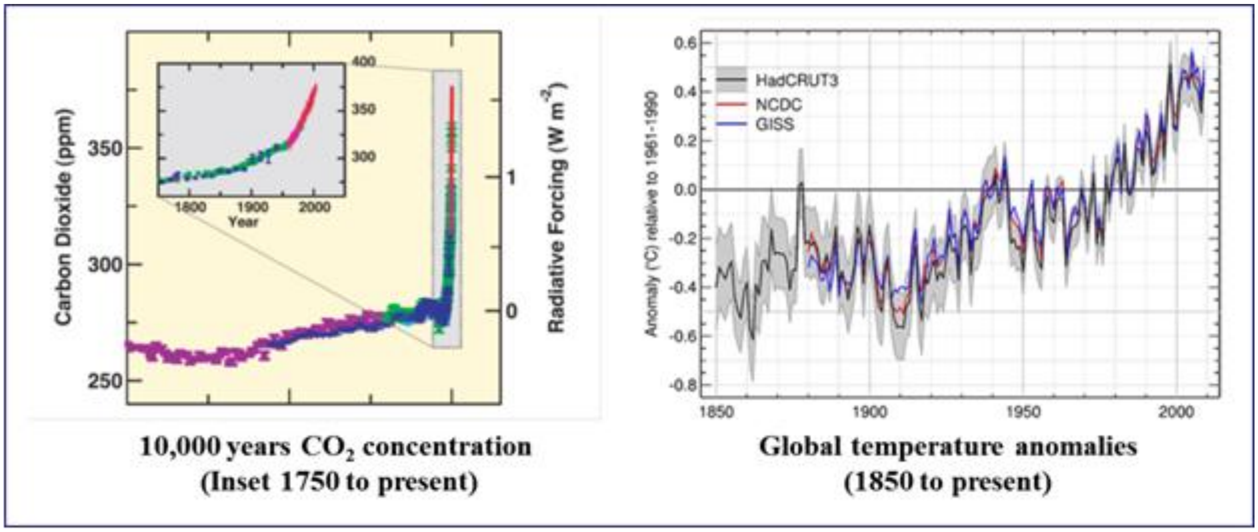

Figure 2.3 Greenhouse Gas Concentrations and Global Temperatures

There is evidence this is already causing more severe and more frequent extreme weather events.

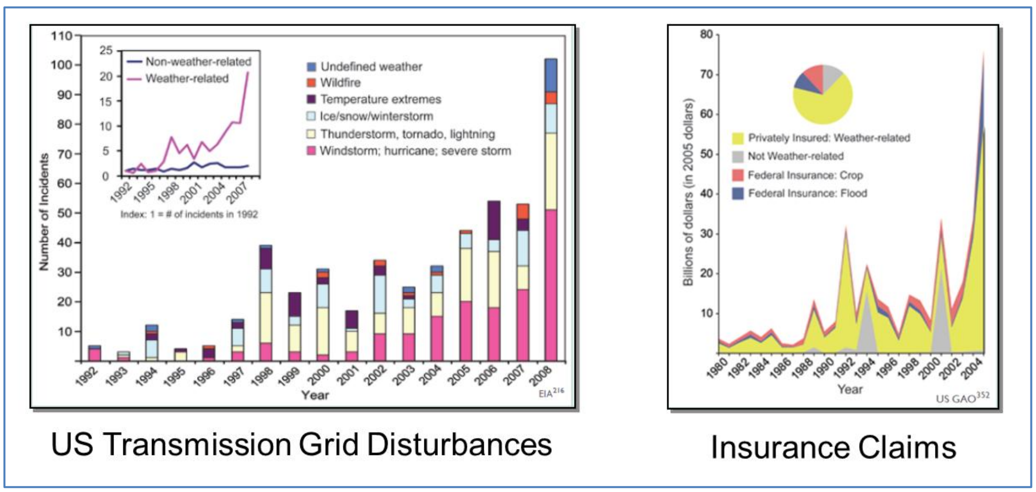

Figure 2.4 U.S. Weather Related Electricity Disturbances and Insurance Costs[10]

These events have a major impact on energy supply reliability and consequential disturbance costs. Many efforts to limit the risk of climate change through reduced emissions are underway. Nearly 200 countries signed the Kyoto Protocol in 1997. China has recently set regional targets to reduce overall greenhouse gas intensity. The EU inaugurated its emissions trading scheme in 2005, and recently approved further reduction targets. Some U.S. states and Canadian provinces have enacted local legislation. Over 1,050 U.S. cities[11] and counties[12] have made commitments to voluntarily reduce GHG emission.

Irrespective of the continuing debate over climate science, the levels of greenhouse gas emissions and their intensity remains one of the better measures of the overall efficiency and productivity of a country's energy system. Figure 2.5 summarizes the annual greenhouse gas emissions during 2008 for a number of countries in metric tons carbon dioxide equivalent (mt CO_2e) per capita.[13]

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[10] Sources : US DOE-EIA and US GAO
[11] http://www.usmayors.org/climateprotection/map.asp -
[12] http://www.conservationleaders.org/cool.counties.htm
[13] United National Statistics Division, http://unstats.un.org/unsd/environment/air_greenhouse_emissions.htm

Country	Per capita emissions
USA	22.2
Canada	22.1
Russian Federation	15.8
European Union	10.5
Germany	11.7
United Kingdom	10.3
Japan	10.1
France	8.6

Figure 2.5 Selected National Greenhouse Gas Emissions per Capita for 2008

United States Energy Use

In 2007, the U.S. spent about $1.2 Trillion on energy[14], a level which has increased in the past two years. About half of this cost was on transport fuels. Residential (homes) and non-residential buildings used over 40% of all energy, transportation used approximately 28%, and the balance was used in industry. In the U.S., around 70% of all energy use is in cities and other urban areas.

For much of its history, the U.S. was an oil exporter, but now imports 60% of its needs.[15] Despite recent discoveries, it also is a net importer of natural gas.[16]. Other countries' imports of coal also impact U.S. energy costs as prices globalize. Rising energy costs combined with high levels of volatility are likely to be the norm for the U.S. into the future.

There has been a long period of under-investment in efficiency, the electric grid, upgraded power generation, domestic oil refining, rail infrastructure for hauling coal, as well as limitations on the exploration and production of natural gas. Combined these constrain domestic resource and supply availability. Power outage events have more than doubled since 1990 and are about ten times the levels seen in Germany and Japan[17]. More severe and frequent weather events including hurricanes, tornadoes, heat waves, and drought further exacerbate temporary blackouts and prolong outages. Managing supply reliability and quality will be a growing necessity for communities and business for the foreseeable future.

With among the highest energy densities as indicted by per capita GHG emissions in Figure 2.5, the U.S. has substantial opportunity for savings and economic returns.[18]

Michigan Energy Profile

In 2007, Michigan's businesses and households used about 3.2 Trillion Btu of energy of all types, the equivalent of about 313 Million Btu/capita, about 10% less than the City of Holland. Imports accounted for 97% of all transport fuels, 80% of natural gas, and all Michigan's coal and uranium supplies.

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[14] http://www.eia.gov/totalenergy/data/annual/txt/ptb0306.html
[15] http://www.eia.gov/totalenergy/data/annual/diagram2.cfm
[16] http://www.eia.gov/totalenergy/data/annual/diagram3.cfm
[17] http://tli.umn.edu/blog/security-technology/the-rising-tide-of-power-outages-and-the-need-for-a-smart-grid/
[18] http://www.epa.gov/climatechange/emissions/ downloads10/US-GHG-Inventory-2010_ExecutiveSummary.pdf

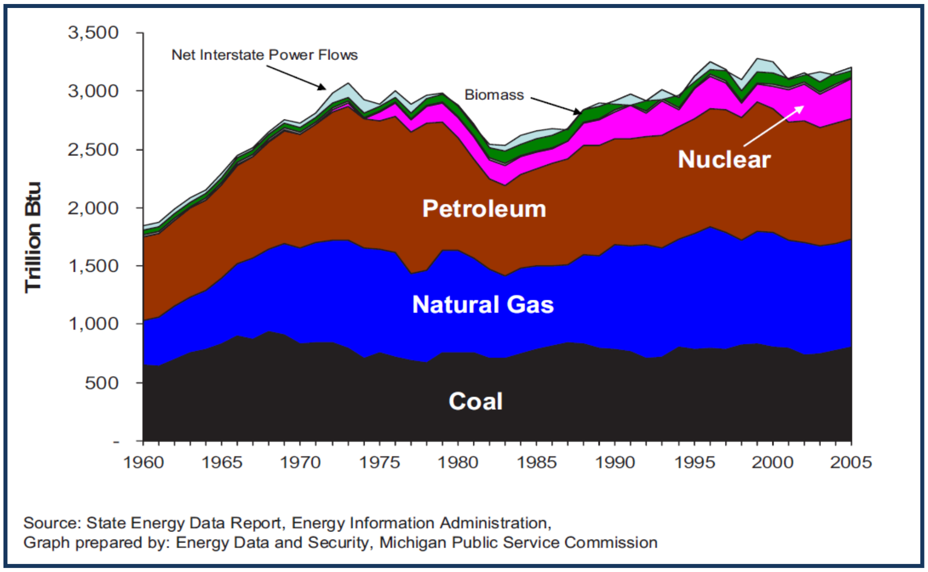

Figure 2.6 Michigan – Total Energy Use by Fuel Type

In total, the state spent about $37 Billion on purchases of energy, of which $26 billion was imported from other states or countries.

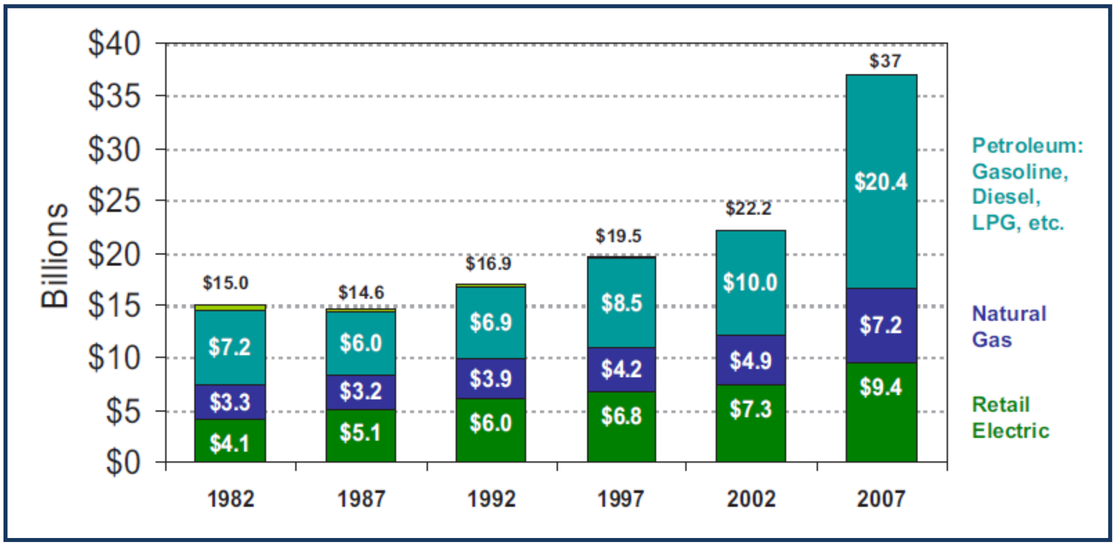

Figure 2.7 Michigan – Total Retail Energy Cost

By far, the largest expense and the largest increase were on petroleum products, though all energy types show a rising cost trend. Natural gas usage is high and mostly used for space heating and domestic hot water in homes due to the combination of climate and relatively inefficient construction. While Michigan has significant local gas sources, it still relies on imports for 80% of its needs.

Most electricity is generated in the state. Coal accounts for 60% of all electricity, nuclear 26% and natural gas about 10%. The remaining 4% is from hydroelectric and other renewable sources. Generally speaking, Michigan's retail electricity and natural gas prices are at or below the U.S. average.

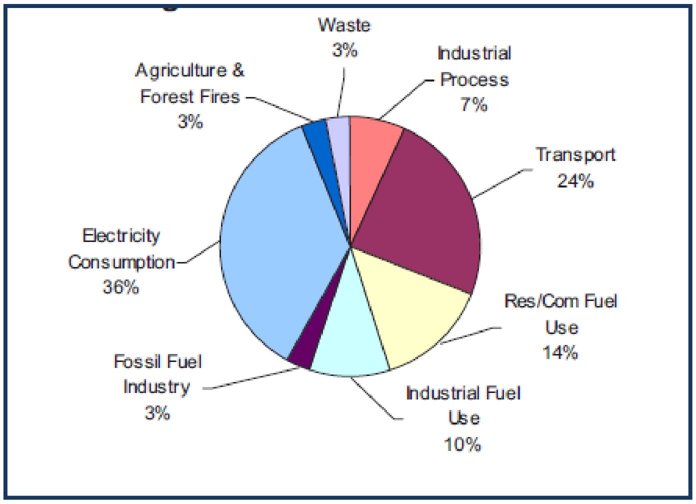

Figure 2.8 Michigan - Total GHG Emissions

Total greenhouse gas emissions for Michigan were 248 Million metric tons (Mmt) of CO_2e, of which 87%, or 216 Mmt were from the production and use of energy, equivalent to about 21 mt/capita.

Michigan Energy and Climate Change Policies

In March 2009, the Michigan Climate Action Council published the State's Climate Action Plan[19] under the leadership of Governor Granholm. This calls for a 20% reduction in GHG levels by 2020 and an 80% reduction by 2050. This advisory report was intended to be the basis of an ongoing implementation action plan. It contains a wide-ranging set of recommendations covering efficiency and supply. It is uncertain how this will move forward with the election of Governor Snyder in November 2010.

From a legislative standpoint, PA 295 Clean, Renewable and Efficient Energy Act, passed in 2008, requires all Michigan electric providers to produce at least 10% of their supply from renewable sources by 2015, with interim targets in place starting in 2012. Appendix 5 has further information on Michigan RES. The State also has a relatively modest range of energy efficiency incentives for home, industry and non-residential building owners.

From a building codes standpoint, Michigan generally adopts the recommendations of the International Code Council for homes and ASHRAE for non-residential buildings, with some delay. From an energy efficiency standpoint, Michigan is at or slightly below the U.S. average in terms of applicable codes. These recommendations are typically updated every three to four years. Their adoption is at the discretion of the State.

City of Holland's Current Energy Situation

Holland's use of heating energy is very typical of most cities in the upper mid-west. Heating is a major element of the City's energy use due to the combination of climate and a relatively inefficient building stock. Its homes and buildings are nearly all heated with natural gas, supplied by SEMCO.

Unlike many other communities, Holland has its own electrical utility wholly owned by the City, the Holland Board of Public Works (HBPW). This utility distributes electricity to the City and to neighboring communities. It also has significant power generating capacity within the City. This results in electricity prices lower than the surrounding averages, combined with high levels of reliability. This is a major positive factor for businesses and residents of Holland.

[19] http://www.miclimatechange.us/ewebeditpro/items/O46F21226.pdf

Relative to the size of the community, Holland has a large and rapidly growing industrial base which is expected to be a major driver of electricity demand over the coming decades. Many of the companies that are manufacturing in Holland are themselves associated with the alternative energy business and include lithium-ion battery producers, wind turbine component manufacturers and building management and controls suppliers. Holland is also home to office equipment manufacturers that are a major part of the national green buildings thrust.

About 90% of the electricity used in Holland is generated by coal, both remotely and from the De Young solid fuel plant located in the City and owned and operated by HBPW and this plant has a capacity of 56 MW. To meet the rapidly growing industrial demand and to retain a strong local generating component, the City has been granted a permit to add 70 MW net capacities to the solid fuel power capacity if it chooses to do so. HBPW also owns 46MW capacity share at the J H Campbell[20] and Belle River[21] Power Plants, both coal fired.

HBPW also operates the water and waste-water services for the City and operates the snow-melting network in the downtown area. HBPW does not distribute natural gas; there is nothing in their charter that would prevent them doing so.

Population and Economic Growth

The population of Holland is expected to grow 33% from 33,100 in 2010 to 41,100 in 2050. The economic outlook is uncertain. Like much of Michigan in the past years, Holland has seen a decline in manufacturing jobs. There are strong signs that this may be poised for a turn around based on the anticipated growth of existing companies and new industrial investors. The most optimistic assessments have the approximately 15,000 current jobs in the City doubling within 15 years. Lower estimates are about half these rates. Competitively meeting the energy needs of industrial growth is a key aspect of the CEP.

Quality of Life

Holland has a unique character, retaining many features of traditional Dutch lifestyle, blending them with a typical U.S. mid-western community. The remodeled/restored downtown is an attraction for both residents and tourists. The downtown already has an energy-related added value with the snow-melt system operated by HBPW, extending the walkability of the area and making it a year-round attraction.

This unique quality of an attractive small city combined with high levels of energy efficiency can be expected to make it a choice for new employees generated from the growing industrial base. The future availability of efficient homes, affordable and reliable energy and a clean environment will be important factors in the overall quality of life for the City.

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[20] http://www.consumersenergy.com/content.aspx?id=1332

[21] http://www.powerplantjobs.com/ppj.nsf/PowerPlants3?OpenForm&cat=6034&companyname=Detroit%20Edison%20Co&plantname=Belle%20River

Chapter 3: Baseline and Base Case Projections

Background

The first step in developing the CEP was to establish a reasonably accurate profile of current energy use, including energy cost and supply and associated greenhouse gas emissions. The agreed baseline year was 2010, chosen as representative of the post-recession reality and avoiding the worst of the volatility of late 2008 and 2009.

The next step established a Base Case projection of energy use to 2050 using an outlook where all efficiencies remain static with energy use evolving based on employment and population growth. This "Base Case" is the starting point for the development of the alternative energy scenarios for the City.

Data Sources

The quality and credibility of the data used for the baseline is critical. This must be an accurate representation of all the energy uses and sources in the City. The data must cover energy use in residential and non-residential buildings, transportation and industry. It also must include information about the factors that will substantially impact future energy needs, including population, employment growth, property details, likely urban developments and other economic development indicators.

The City has a complete inventory of all buildings by age, size and type, cataloged in a well-structured Geographic Information System (GIS). The Holland Board of Public Works (HBPW) has electricity consumption data available using the same GIS coordinates. The GIS ensures a high degree of confidence in the energy and emissions baseline for the City as a whole. This data quality allowed energy use to be broken into 10 Energy Planning Districts (EDs), allowing for a higher degree of assessment specificity.

Data sources used to establish the baseline, Base Case and Scenario outlooks to 2050 are summarized in Figure 3.1.[22]

Data	Source
Current Population	City data
Population Growth	Extrapolation from 2005-2010 City data – adjustments agreed with City
Employment	City economic development data
Employment Growth	Extrapolation from 2005-2010 City data – adjustments agreed with City
Building Inventory	City GIS property data by type/location/age/size – grouped by ED
Total Electricity Use	HBPW GIS linked 2009-2010 monthly meter data – grouped by ED
Total Gas Use	SEMCO GIS 2009-2010 monthly meter data – grouped by ED
Gas & Electricity Use – Key Sites	Actual 09/10 usage for Aquatic Center, Freedom Village, City Flats, Schools, Hospital, Hope College, city Buildings, Central Wesleyan Church
Vehicle Miles Travelled	Extrapolated from 2009 VMT Survey for Ottawa County
Vehicle Mix	Extrapolated from 2010 Michigan State Survey
Fuel Efficiency	US EPA 2009 estimates for U.S. by vehicle category
Electricity Sources	HBPW supplied 2009-2010 grouped by De Young, gas peakers and grid
Electricity CO_2 Indexes	PWT estimated by electricity source agreed with HBPW staff
Gas CO_2 Index	U.S. DOE Energy Information Agency
Fuels CO_2 Indexes	U.S. EPA national estimates – gasoline and diesel
2010 Energy Prices	Electricity – HBPW / Gas – SEMCO / gasoline-diesel – market averages

Figure 3.1 Summary of CEP Data Sources

[22] Many sources have been used and are referenced at the appropriate point in the Report. Further background is available from the PWT.

City of Holland 2010 Energy Baseline

The City consumed 9,898,000 Million Btu_e (2,900,000 MWh_e) of energy of all types for all uses. The estimated cost was $135 Million. The breakdown by energy type and end use is shown in Figure 3.2.

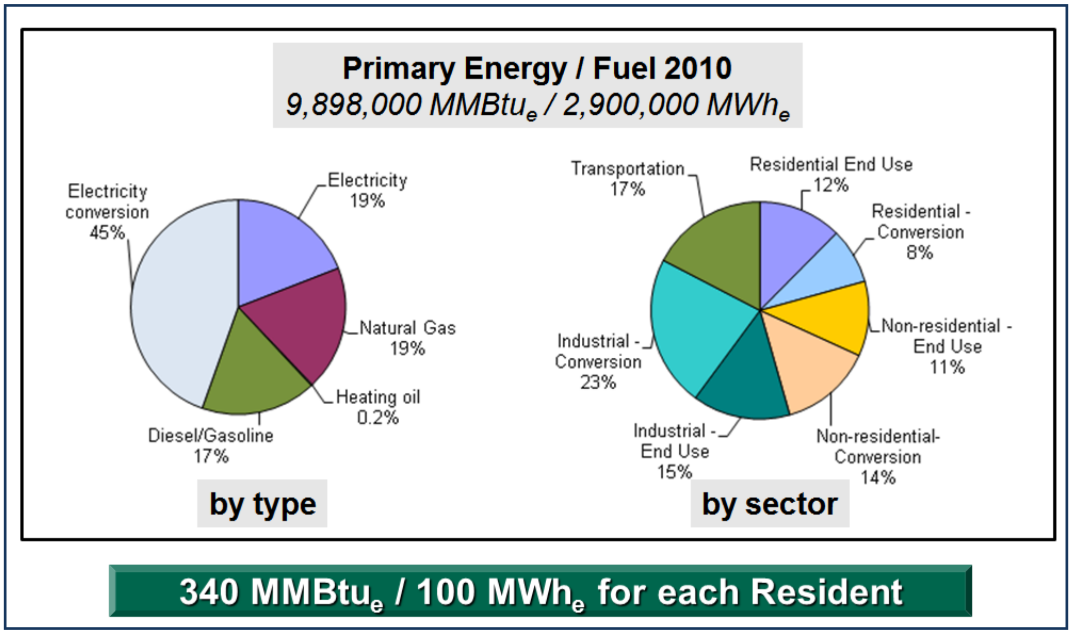

Figure 3.2 Primary Energy and Fuel Use by Type and Sector

The total energy used by type breaks into two distinct parts. The first is the energy actually used in the City in the forms of electricity, transportation fuels, natural gas and a small amount of heating oil. This is 55% of the total. The remaining 45% is the energy used to convert fuels to electricity at power plants in the City and elsewhere and to transport that electricity to the City. This conversion energy is a direct result of Holland's activities, paid for by the City's consumers.

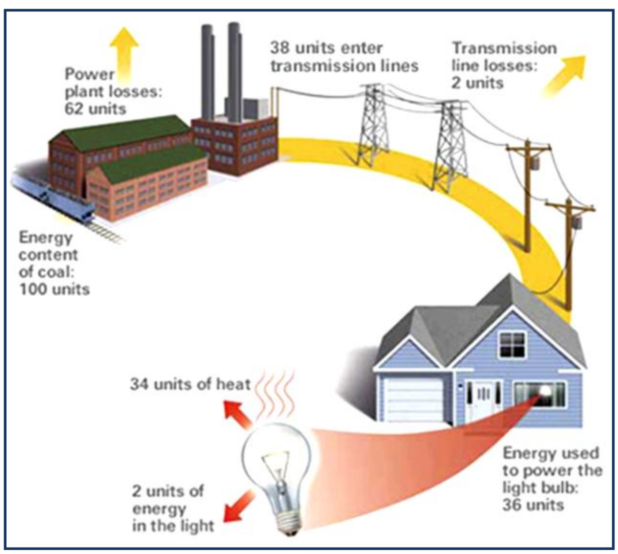

Figure 3.3 Typical Electricity Conversion Losses

As shown in Figure 3.3, about 70% of the energy in the primary fuel is used in generation and transmission. In Holland the primary fuel is 90% coal with some natural gas. Reducing the scale and impact of these losses is a major focus of the CEP recommendations.

Buildings account for over 45% of the City's energy use, divided into 20% in the residential sector (housing) and 25% in non-residential buildings. Collectively this is often called the "built environment"; a term that will be used throughout the CEP. A high percentage of this energy is wasted through inefficient construction, equipment and operation. Reducing this unnecessary energy waste is a major focus of the CEP recommendations.

Industry accounts for 38% of the City's energy use, with a large part of this being electricity which carries with it a significant proportion of the overall conversion losses. This sector is expected to grow rapidly provided that Holland remains an attractive and competitive location for investors. Ensuring industry has affordable, clean and reliable energy is a key element of the CEP recommendations.

Transportation makes up the remaining 17% of energy used in the City. Over 90% of energy used in transportation is from cars and light trucks. A major focus of the CEP recommendations will be on reducing the impacts of transportation energy use through efficient choices of individual vehicles, and possible development in the City as to gradually reduce total vehicle usage. Given the importance of the adoption of Electric Vehicles in North America, the CEP makes specific recommendations to encourage their use.

City of Holland 2010 GHG Emissions Baseline

In 2010, total energy-related greenhouse gas emissions caused by the City were 792,500 metric tons of carbon dioxide equivalent (mt CO_{2e}). This is often called the "carbon footprint" of the City.

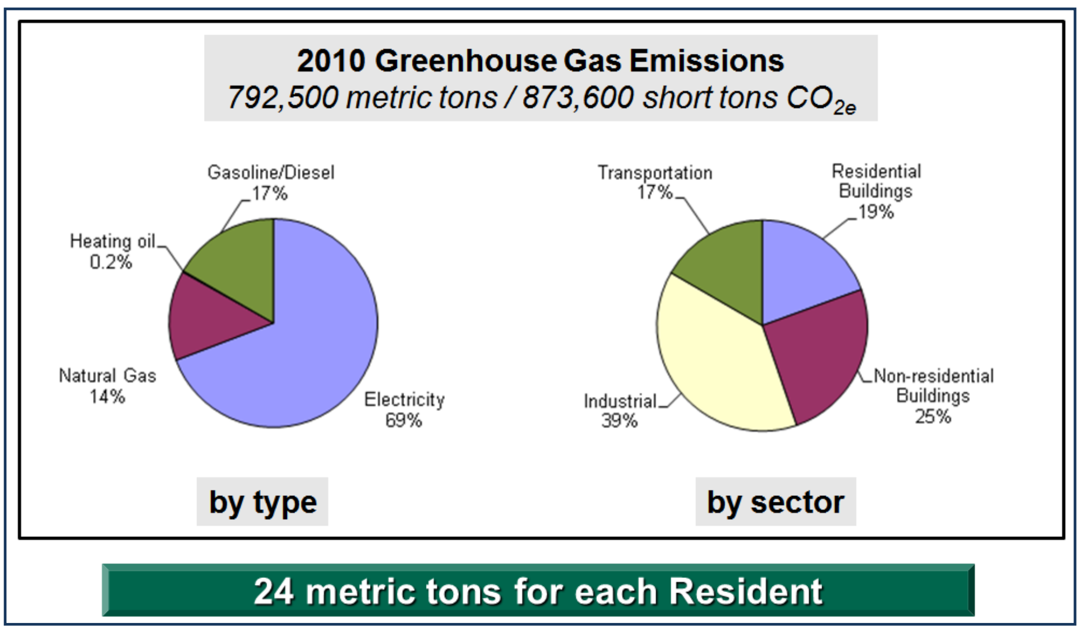

Figure 3.4 Greenhouse Gas Emissions by Type of Fuel and Sector

The use of electricity causes 69% of all GHG emissions[23]. Fuels for heating and hot water, predominantly natural gas, make up 14% of the total emissions. Fuels for transportation, mainly gasoline and diesel, account for the balance of 17%.

By end use, nearly two-thirds of all emissions come from non-residential buildings and industry, underlining the impact of Holland's employment mix and the impact of industry. Many of the large corporations located in Holland, or planning to locate in the City, have challenging corporate targets to reduce greenhouse gas emission or to be "carbon neutral". The CEP will include recommendations aimed at helping them to meet these challenges.

[23] The GHG emissions resulting from electricity generated in the City but used outside in the balance of the HBPW Service area are not included on the Carbon Footprint of Holland.

Residential buildings of all types create nearly 20% of total emissions underlining the possible contribution of homeowners' and tenants' actions to lower household energy costs and reduce the City's carbon footprint. In a similar way, individual decisions over the choice and use of vehicles will have a major impact on the transportation component.

The carbon footprint represents GHG emissions of 24 mt CO_2e per resident. This is an index commonly used by communities around the world to track their own progress toward meeting emissions targets, and the CEP will use it in this context. It has some value as a basis for comparison, but should be used with caution since the circumstances of different communities vary widely in terms of activity mix, climate and energy systems.

The established carbon footprint of Holland excludes impacts from agricultural, forestry, defense, mining, extraction, shipping and airline activities that are typically accounted for in the national or regional GHG inventories. These activities clearly benefit the City and its residents in one form or another. However, not including these is in accordance with widely accepted worldwide practices used to establish municipal carbon footprints.

The following emissions indexes were used to develop the carbon footprint of Holland:

Energy Type	CO_{2e} Index	Source
Electricity	990 kg/MWh (2,178 lbs/MWh)	HBPW based on supply mix (own sources / grid)
Natural Gas	203 kg/MWh (131 lbs/MMBtu)	U.S. DOE EIA (low heating value)
Diesel	267 kg/MWh (22.2 lbs/US gal)	U.S. EPA
Gasoline	206 kg/MWh (19.3 lbs/US gal)	U.S. EPA
Heating oil	251 kg/MWh (20.9 lbs/US gal)	Industry averages

Figure 3.5 Greenhouse Gas Emissions Indexes

The footprint established in this report also does not include GHG emissions from non-energy related industrial processes within the City. Given the likely profile of industry in Holland, these are expected to be less than 5% of the energy-related industrial emissions and can be treated as "de minimus".

Energy District Baseline

In order to get a more granular view of the City's energy use and GHG emissions balances, the energy and emission were broken down into 10 CEP Energy Districts shown in Figure 3.6.

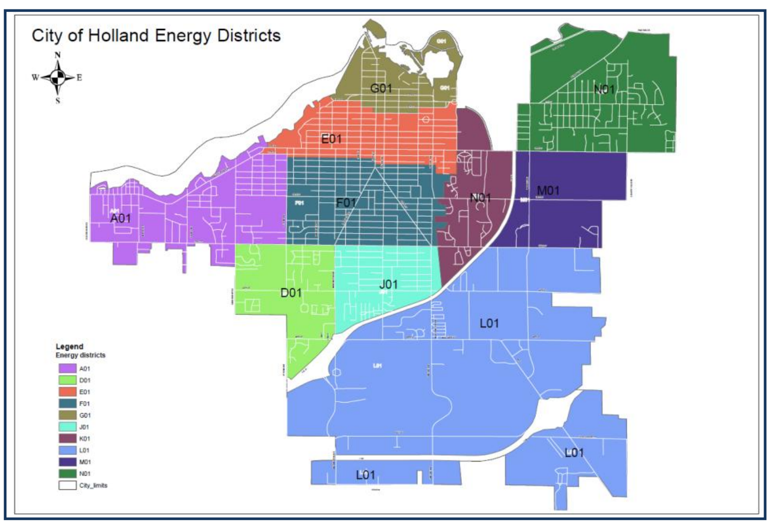

Figure 3.6 Boundaries of CEP Energy Districts

This was only possible in large part to the excellent status of the GIS information and the cooperation of HBPW and SEMCO in supplying the appropriate energy data. These districts are broadly based on current community planning areas representing a combination of planning features and some common use and community style. These districts were evaluated in terms of current energy use and future development, and are a useful tool in developing local energy strategies, recognizing that the energy needs of different neighborhoods will vary. While all of the ED's need to be considered in detail over time, some are worthy of note given some specific energy characteristics in the current baseline:

G01 – Includes the De Young Power Plant, some major city facilities, and "Freedom Village"
E01 – Includes Hope College and its energy system and the Heinz Plant
F01 – Includes major energy consumers- Holland Hospital, Aquatic Center, Holland High School
L01 – Industrial area with low energy density growing quickly, includes HBPW Peakers

The Baseline energy demand per acre for each of the Energy Districts is shown in Figure 3.7.

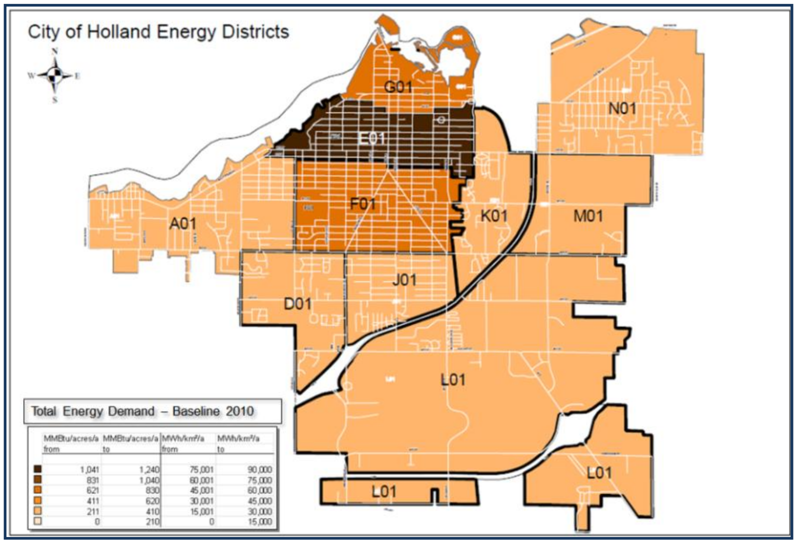

Figure 3.7 2010 Total Energy Demand Density by Energy District

This mapping includes energy used heating, cooling and lighting homes and buildings, the electricity for all other equipment and appliances in the built environment, and the totality of energy used by industry. It does not include transportation energy as there was no rational way to evaluate this by ED.

The greenhouse gas emissions in each ED for 2010 are shown in Figure 3.8.

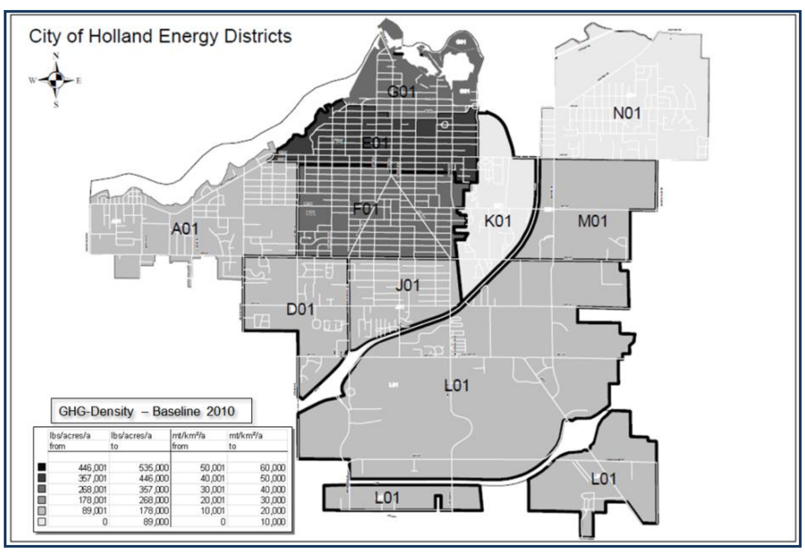

Figure 3.8 2010 Greenhouse Gas (GHG) Density by Energy Districts

Further examples of ED energy mapping are in Appendix 7. The ability to view energy usage by ED is a valuable tool to highlight areas where differentiated approaches have the greatest impacts and guides many of the CEP recommendations.

Energy Use in the Built Environment

The built environment uses 45% of all energy. It represents a complex mix of energy needs. For the purpose of establishing the baseline, these were grouped into heating, cooling, lighting and other electrical needs. In homes, other needs would be mostly appliances, personal computers and entertainment. In non-residential building, they represent a wide range of uses from IT and office equipment through catering, advertising, retail displays, etc.

It is not possible to identify each of these end uses from the metered energy use. A computer modeling approach was used to refine the baseline. Energy models were developed for seven building categories, aligned with the total gas and electricity utility data for each of the EDs. To include less efficient older construction, each building category was split into older and newer construction. All simulations were done with EnergyPlus Version 6.0, an energy analysis simulation program developed by the U.S. Department of Energy.

For specific buildings including the Aquatic Center, Freedom Village, schools, Holland Hospital, Hope College, City buildings, and Central Wesleyan Church, detailed utility data was provided by the owners. For these buildings, standardized estimates were used based on the specific building and application characteristics.

Holland’s housing uses an estimated 76 kBtu of energy per square foot (kBtu/sq.ft.) of conditioned space per year. With conversion losses included, each home uses about 101 kBtu/sq. ft. of primary energy. The Midwest Region data from the U.S. DOE Residential Energy Consumption Survey (RECS) database shows average residential buildings energy consumption is about 47 kBtu/sq. ft., underlining the potential to reduce energy use in homes in Holland.

The “top-down” approach was validated by a “bottom-up” check using samples of actual building energy consumption compared with the modeled averages. The modeled energy use matched very well with the total metered energy consumption for electricity and gas of the EDs, giving a high degree of confidence in the computer modeled baseline. Appendix 9 has further details of the process used to establish the energy needs for the built environment.

Street lighting is also a category of energy use that is significant in the built environment. In Holland this is not metered and is estimated to be about 2,000 MWh of electricity, equivalent to about 5,000 MWh of fuel per year.

Transportation Energy Baseline

Transportation accounts for 17% of total energy use. The baseline was effectively 100% gasoline and mineral diesel. A feasibility project on bio-diesel in city-owned vehicles is in the early stages. The driver of energy use is vehicle miles travelled (VMT) by vehicle type, summarized in Figure 3.9.

Total Vehicle Miles Travelled (Thousands) - 2010 Estimate

	Interstate	Arterial	Other	Totals
Motorcycle	324	296	98	***718***
Car & Light Truck	72,673	138,482	46,053	***257,208***
Truck and Semi	7,859	9,025	3,001	***19,885***
Bus	162	148	49	***359***
Totals	***81,018***	***147,951***	***49,202***	**278,171**

Figure 3.9 Total VMT by Road and Vehicle Types

The fuel used and the resulting greenhouse gas emissions are a consequence of the average efficiency of each class of vehicle. This fuel energy and emissions profile is summarized in Figure 3.10.

Transportation Energy and GHG Totals - 2010 Estimate					
	Fuel US gallon	Fuel Litres	Energy MMBtu	Energy MWh	Greenhouse Gas mtCO2e
Gasoline	10,530,859	39,863,639	1,211,048,816	354,834	92,545
Diesel	3,916,725	14,826,418	507,215,936	148,613	39,496
Totals	**14,447,585**	**54,690,057**	**1,718,264,752**	**503,447**	**132,041**

Figure 3.10 Total Energy Use and Emissions by Fuel Type

Holland has not recently conducted any detailed traffic surveys. The above estimates are based on Michigan State estimates for Ottawa County adjusted for population and road types. The vehicle mix information was estimated from statewide estimates. Fuel efficiencies by vehicle type are U.S. Environmental Agency estimates. Details of the assumptions used are summarized in Appendix 6.

There is no significant use of Electric Vehicles in Holland.

Base Case Projections to 2050

To assess the effect of various strategies, a Base Case for energy and GHG emissions over the next 40 years was established. The main assumptions used are summarized below:

- Energy for residential and non-residential buildings will continue to be supplied from the existing gas and electricity networks.
- Existing buildings will have the same efficiency.
- The mix of primary fuel for the electricity and gas supplied by SEMCO and HBPW will remain unchanged.
- Population will increase from 33,100 in 2010 to 41,100 in 2050.
- Employment will increase from 15,100 in 2010 to 28,400 by 2050, with faster growth rates anticipated in the coming five years than in the remaining period.
- Residential square footage increases in line with population, with a higher ratio of attached single-family homes and apartments relative to detached single family homes.
- To account for estimated demolitions, 10% of new construction will replace existing buildings.
- Non-residential building area will grow at a rate of 1% per year. A quarter of new construction will replace aging buildings and the balance is supporting population and employment growth.
- New construction is assumed to be fully compliant with the applicable building code in 2010 with no changes over time. For residential this is IECC 2006 and for non-residential ASHRAE 90.1 – 2007.
- Heating and cooling will be provided by gas fired individual boilers, furnaces, and electric chillers.
- On the transportation side, VMT will increase 0.54% per year due to population growth and a further 0.25% per year due to employment growth. The mix and efficiency of vehicles remains the same as 2010.
- Industrial growth is based on the preexisting electrical load estimates by HBPW, which include anticipated expansion phases of the major battery manufacturers. The industrial demand for gas will grow at the same rate.
- The efficiency of industrial capacity will be constant once it is installed.

Clearly, there are likely to be gains in industrial, building and vehicle energy efficiency arising from the evolution of technology, construction codes and operating practices. Other gains will come specifically from CEP recommendations. Both categories are accounted for in the scenarios.

These Base Case assumptions result in the energy supply outlook shown in Figure 3.11, broken down into electricity for cooling, electricity for other uses, natural gas and transportation fuels.

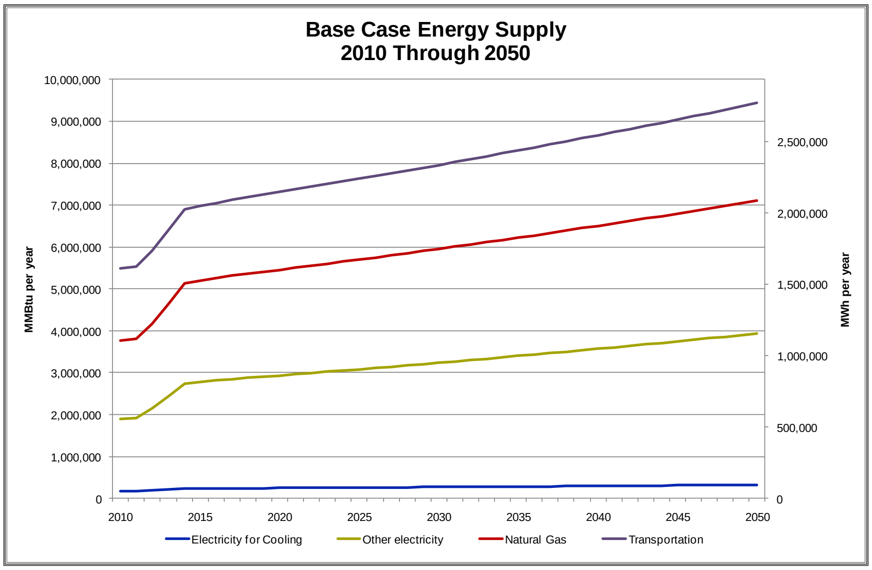

Figure 3.11 Base Case Energy Supply from 2010 to 2050

Electricity use doubles from 554,000 MWh in 2010 to 1,152,300 MWh in 2050, mostly driven by industry in ED L01. Natural gas use, mostly for heating and hot water, grows from about 1,850,000 MMBtu to 3,840,000 MMBtu. The 2050 Base Case built environment energy demand is shown in Figure 3.12.

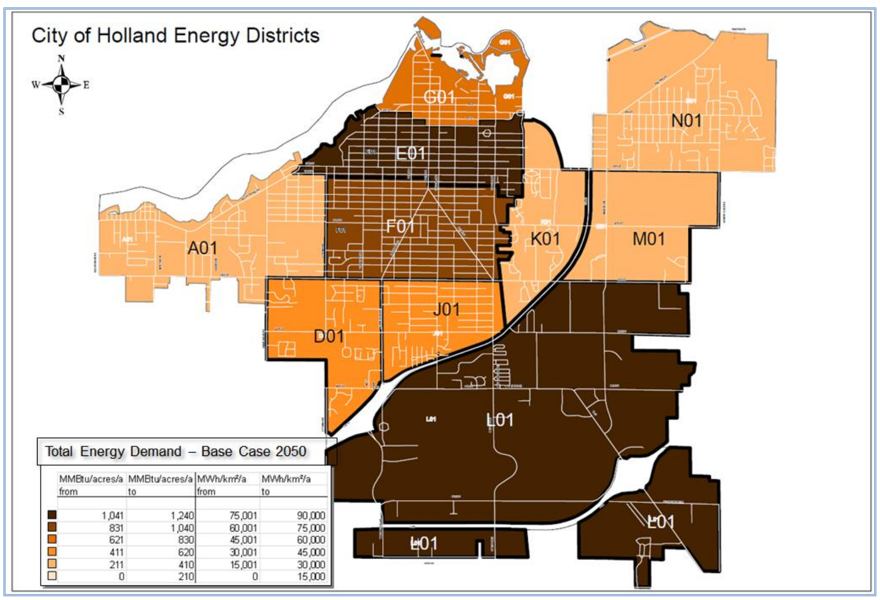

Figure 3.12 2050 Base Case Energy Demand Densities by Energy District

As would be expected, the highest energy densities are in the industrial areas and the downtown. The greenhouse gas emissions caused by this energy use is shown in 3.13.

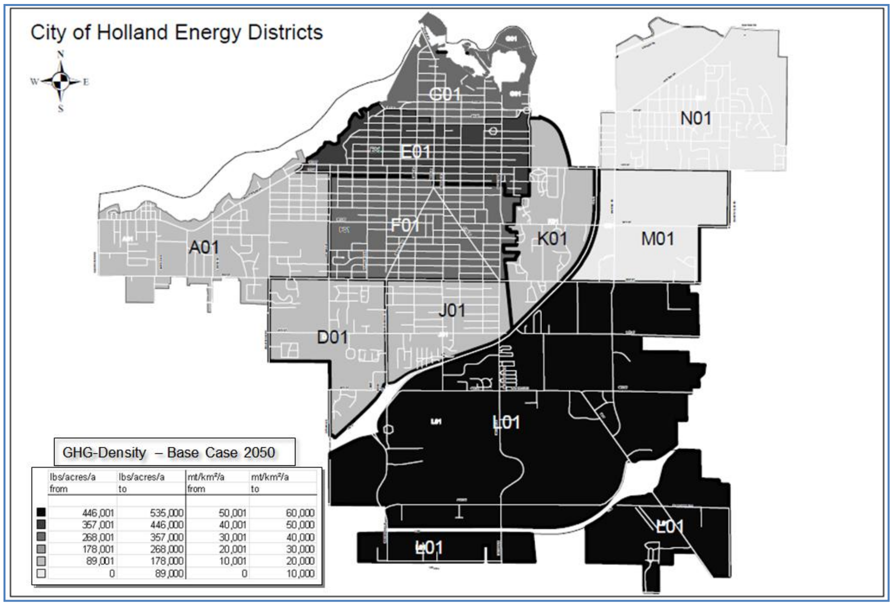

Figure 3.13 2050 Base Case Greenhouse Gas (GHG) Densities by Energy District

Included in Appendix 7 are the Base Case energy demand and supply density maps by ED, broken out by heating and hot water, cooling, other electricity demand, electricity supply, and natural gas supply.

The total use of diesel and gasoline in the City is projected to grow from 14.5 million gallons in baseline year 2010 to 19.7M gallons in 2050. There is insufficient data available to break this down by ED.

In the Base Case, the total greenhouse gas emissions from all energy use would grow by 91%, from 792,500 metric tons of carbon-dioxide equivalent (mt CO_2e) in 2010 to 1,511,000 mt CO_2e in 2050. This equates to an increase from 24 mt CO_2e per resident in 2010 to 36.7 mt CO_2e in 2050.

Base Case projection GHG emissions per capita rise from 24mt in 2010 to 36.7 mt in 2050.

Chapter 4: Community Energy Plan Goals

Community Expectations

The community expectation is for Holland to have a world-class energy plan for decades to come. There is a clear desire to have an energy strategy that attracts investors, businesses and residents through an increasingly cost effective, reliable, clean energy supply.

Holland's energy planning and overall performance was compared with communities from around the world to establish some benchmarks from which the City could establish the framing goals for the CEP. These benchmark communities included Guelph, Ontario, Canada; Mannheim, Baden-Württemberg, Germany; Arlington County, Virginia, USA; and Copenhagen, Denmark. These communities are recognized for their commitment to the sustained increase in energy efficiency and greenhouse gas emissions reductions while retaining competitive energy costs and a high quality of life.

Structured Framework for the CEP

The benchmark communities consistently follow a prioritized "loading order" to develop energy strategies and prioritize investment and implementation. This is known as the "California Loading Order" in the U.S. and the "Trias Energetica" in Europe, summarized in Figure 4.1, and is the framework used to develop the energy plan for the City of Holland.

- **Energy efficiency – If you don't need it don't use it**
  - Efficient buildings
  - Efficient industry
  - Urban design for transport efficiency
  - Local employment for commuting efficiency
- **Heat Recovery – If it's already there – use it**
  - Combined heat and power
  - Use existing "waste" heat
  - Structure mixed-use neighborhoods to share heat
  - Structure industrial sites to maximize heat use integration
- **Renewable energy – If it makes sense, go carbon free**
  - Renewable electricity – Photovoltaic, wind,
  - Renewable heat - solar thermal, biomass, biogas, geothermal
  - Renewable heat and power – waste-to-energy, biomass
  - Renewable transport fuels – ethanol, biodiesel
- **Energy distribution – Invest where it makes sense**
  - Flexible distribution – electricity, gas, district heating, cooling…
  - Multiple fuels and energy conversion technologies
  - Optimize local / regional investments

Figure 4.1 CEP Framework – Holland Loading Order

In a typical plan, efficiency has the highest priority as a "source" of energy, usually being the cheapest to achieve, with the lowest ongoing pollution and the best reliability. This is generally followed by various approaches to reduce wasted heat in all forms. In Holland, over 45% of all the energy paid for by the City is effectively waste heat, which if it can usefully be harvested, is an immediately available existing resource. To further drive down pollution and create a more flexible system, renewable energy supply for both heat and electricity is an increasingly valuable part of the total portfolio for a community.

However, this should only be considered where there is a compelling economic, environmental or system reliability case for inclusion.

Successful communities recognize that the sourcing and distribution of energy can be substantially more efficient, flexible, and cost effective. Changes to include more local distributed heat and power sources along with new distributions approaches including district heating are not uncommon solutions. Any such changes should be done in concert with the owners and operators of the existing regional and City gas and electricity networks. The goal should always be to enhance the efficiency and cost-effectiveness of both the City energy structure and the wider regional energy networks.

Specifically, in the case of Holland, HBPW owns both existing power generation and distribution within the City and to nearby communities. As a result, many of the CEP recommendations are aimed at enhancing HBPW's total asset and energy services portfolio, including district heating and potentially retail natural gas.

Successful Examples of Implementing the CEP Loading Order

There are examples of communities that are systematically implementing the Loading Order over many years. The EU has many cities where this has resulted in significantly lower energy densities than in comparable communities in the U.S. Many are in Germany and Scandinavia with climates comparable to Holland.

Mannheim is a highly industrialized city in Germany. Its energy-related per capita greenhouse gas emissions are about 11 mt; less than half of those Holland. Like Holland, it is heavily reliant on coal-fired electricity and has major industrial activity in the surrounding areas. Copenhagen, the capital of Denmark, has emissions of less than 3 mt per capita; one-sixth the level of Holland.

Both Mannheim and Copenhagen have reliable, competitively priced energy. They have highly efficient buildings served by a mix of utilities including district energy networks as well as traditional electric and gas utilities. The district energy makes extensive use of heat recovered from various sources including power generation and municipal and industrial waste. Energy in all forms is supplied from a wide variety of clean, renewable and traditional energy sources. Energy services are managed by a municipal multi-utility.

Transportation energy use is reduced through efficient urban design combined with multi-modal transport options including the efficient use of private vehicles. Copenhagen in particular is now investing in the community-wide infrastructure needed to support widespread use of electric vehicles, and to take advantage of the nighttime production of wind-generated electricity.

Both cities have successful inbound investment with good track records on employment and economic development. In 2009, Copenhagen was ranked as the second most livable city in the world with a thriving, innovative economy combined with an attractive, competitive lifestyle. They exemplify the fact that energy productivity and competitiveness can go hand in hand. Both have ongoing goals to further increase their energy productivity. Mannheim is targeting a further reduction of 25% in emissions per capita by 2020. Copenhagen's goal is zero to become the world's first carbon neutral major city.

These examples are the result of decades of city planning that systematically combines efficiency, flexible distribution and efficient fuel use, in later years supported by regional policies. There are no comparable benchmark examples of cities in North America; however, St. Paul[24], in Minnesota is a good example of a city adopting a similar integrated approach, and is in a climate similar to Holland's.

In 2010, the City of St. Paul adopted a Comprehensive Plan that includes a particular focus on reducing GHG emissions. The land use planning encourages selective densification, mixed-use neighborhoods, and transit-oriented developments. St. Paul requires energy efficient building for its own facilities, and

[24] http://www.stpaul.gov

actively encourages private development to follow suit through a multi-faceted incentive and advisory approach.

St. Paul recognizes the economic and environmental benefits of modern urban district energy. The city has been steadily expanding heating services managed by a municipal company, District Energy St. Paul (DESP). Energy is supplied through a mix of efficient and renewable sources including natural gas fired combined heat and power (CHP), oil and coal-fired boilers and biomass. The system currently serves about 187 non-residential and 300 residential customers. It also offers district cooling in the downtown, enhancing the year-round efficiency and reducing peak demand on the wider electrical grid. DESP offers heating and cooling services at rates lower than neighboring Minneapolis. It is a profitable business contributing to the City revenues.

St. Paul is a Solar America City[25], and is planning a large scale deployment of solar electricity to reduce its carbon footprint and further reduce summer peak. While early in the implementation process, St. Paul's overall community energy target is to reduce its current per capita greenhouse gas emissions of about 25mt to around 15mt by 2025.

These examples from two continents are becoming increasingly typical around the world. There are comparable examples from China and other parts of Asia. Communities recognize that their quality of life and competitiveness will be significantly influenced by how effectively they manage their energy and water needs. Many cities are also realizing that the goods and services needed to support the transition to higher levels of energy productivity are important to creating and retaining high quality "green jobs".

Deciding on an Incremental or Transformative CEP

Holland's baseline energy intensity as indicated by emissions per capita is 24 metric tons. The 2050 Base Case is 37 metric tons per capita. Before starting to develop the various strategies that would make up the final CEP recommendations, the Project Work Team worked with the community to establish a headline emissions target for 2050. Setting this framing target early in the CEP process essentially decides whether the Plan will be ***incremental*** or ***transformational***. The difference between these is visualized in Figure 4.2.

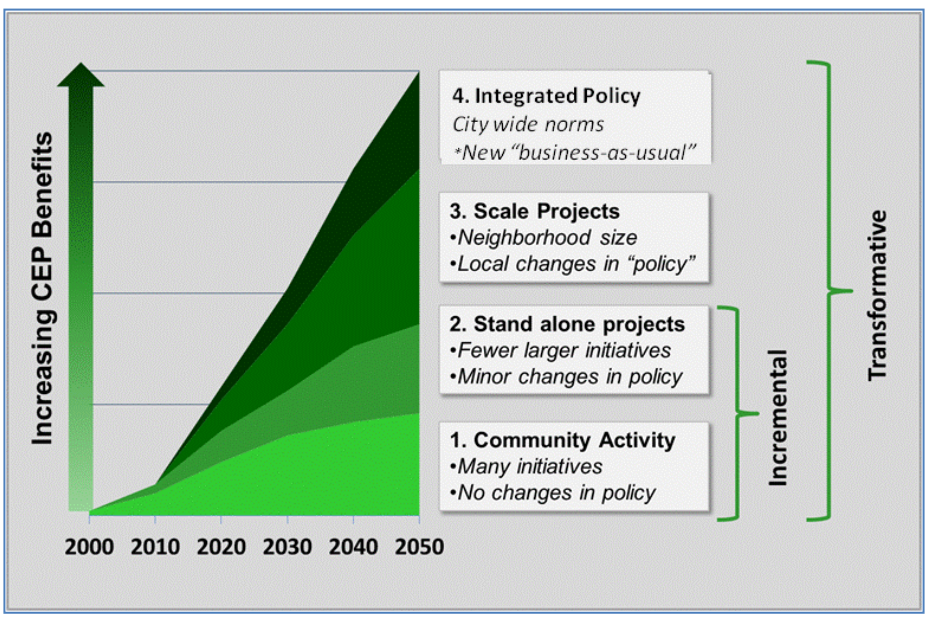

Figure 4.2 Incremental or Transformative CEP

25 http://solaramericacommunities.energy.gov/solaramericacities/minneapolis_saint_paul/

A good incremental CEP delivers substantial efficiency gains and emissions reductions through a combination of a high degree of community energy awareness and engagement in a myriad of green initiatives. These will typically be combined with individual projects with small to medium investments that generally need no changes in either City policy or local norms.

Holland has many voluntary energy related initiatives underway. The City already engages citizens through churches and many other organizations. A selection of current initiatives is highlighted in Figure 4.3, with a more complete overview included in Appendix 8.

- Energy efficiency upgrades of city-owned facilities
- Pilot program for biodiesel in city vehicles
- Community outreach on energy and emissions reduction
- Installation of LED traffic signals
- Efficient re-lamping of street lights
- Training on residential assessments for historic districts
- Creation Care Workshops – Neighborhood Associations and Churches
- Active Sustainability Committee supporting development of CEP
- HBPW efficiency incentives – refrigerators, A/C, lighting…..
- Public School and Hope College education and outreach

Figure 4.3 Holland Existing Energy Efficiency Initiatives

Incremental plans are heavily influenced by the availability of incentives and by passionate individuals, and risk losing inertia as incentives or local support changes.

A successful transformative plan sets the stage for sustained energy productivity gains and emissions reduction at levels well over twice those typically achieved from an incremental plan, with results that are economically and socially sustainable for decades. Transformative plans also require high levels of community engagement and multiple smaller initiatives to be successful.

They are characterized by the willingness of the Community to take on larger "Scale Projects" that typically would encompass entire neighborhoods or require substantive changes in energy supply or distribution approaches. These Scale Projects address not only technical aspects, but also investment strategies, business structures, systematic incentives and eventually City policy. Over time, this combination of community engagement, smaller initiatives and Scale Projects has the effect of creating a new energy "business-as-usual" for the City.

The City, the Sustainability Committee and Holland Board of Public Works, with input from public workshops, charged the Project Working Team with developing a transformative long-term Community Energy Plan.

The Energy Plan will deliver world-class results in terms of energy supply reliability, overall economics for the City and greenhouse gas emissions reductions.

Selecting a Headline Energy Goal

Based on the guidance from the community, the PWT recommended establishing a 2050 framing goal in terms of greenhouse gas emissions per capita. Various boundary conditions listed below were considered before a final recommendation was made:

CEP Base Case - With minimal improvements in overall efficiency and retaining the same supply structure, emissions would rise from 24 to 37 mt/capita by 2050.

US Mayors Climate Protection Agreement – This agreement, which was signed by the City in 2008, implies meeting an absolute 7% reduction in emissions for the whole City relative to 1990 levels by

2012 with no clear targets beyond. Reliable 1990 data was not available for the City. Given the remaining time frame, the 2012 target cannot be met.

US Federal Legislation (Draft) – In 2010, the U.S. House passed legislation with emissions reductions from 2005 levels of about 80% by 2050, which would equate to between 4 and 7 mt/capita for Holland depending on how the increasing industrial component were treated. This legislation was voted down in the Senate and was not approved. Therefore the bill is dead unless some group or members in the Senate try to rejuvenate it.

Comparable Benchmark City – Mannheim has a comparable mix of industry and population to that in Holland. It has a predominantly coal fired electricity. It had 2008 emissions of 11 mt/capita, with a 2020 target of 9 mt.

Global Best Practice – Scandinavia – Cities such as Stockholm, Helsinki, and Copenhagen have similar climates to Holland. They have been implementing transformative energy policies for some decades. They have emission indexes in the range of 3 to 6mt/capita. All have plans for further reductions.

International Agreements – The last relevant inter-governmental declaration on greenhouse gas emissions was at the UN Climate Conference in Copenhagen in 2009, where a target of not more than 2ºC average atmospheric temperature rise was established. This would equate to a 2050 target similar to the draft US Federal Legislation.

Of all of the above, the most appropriate logic was to focus on a target that was achievable but challenging enough to require a commitment to widespread community engagement in efficiency, some restructuring of energy service business approaches, implementation of Scale Projects and deep change. This led to a recommendation of 10mt/capita by 2050 for the CEP, based on current global best practice for comparable communities in comparable climates.

The PWT recommends a 2050 goal of 10 metric tons CO_2 equivalent greenhouse gas emissions per capita as the basis for developing strategic recommendations.

Using greenhouse gas emissions per capita as a headline target is as much an indicator of fuel flexibility, fuel efficiency, energy end-use efficiency and cost effectiveness as it is an environmental indicator. This is completely consistent with the balanced economic, supply security and environmental objectives of the CEP.

Chapter 5: Energy Strategies and Scenarios

Strategic Summary

The following strategic elements are recommended to make substantial progress towards the headline goal of 10mt/capita by 2050, mostly structured around the Holland Loading Order. They are common to all the scenarios assessed:

Encourage Inbound Industrial Investment

- Offer a range of energy services on the Holland Industrial Park that far exceeds the quality, cost, reliability and greenhouse gas expectations of potential world-class global industrial investors when compared with competing communities in the U.S. and Canada.

Efficiency

- Substantially increase the efficiency of Holland's 7,400 single-family homes through a neighborhood focused renovation supported by a structured investment program.
- Systematically renovate the balance of Holland's existing buildings by 2050 to higher levels of energy efficiency as a part of normal renovation and remodeling.
- Ensure all new construction meets or exceeds the likely evolution of the IECC national recommendations.
- Create transparency over the ongoing energy use of buildings by encouraging the availability of Energy Performance Labels on ***all*** real estate transactions.
- Recognize and encourage the evolution of the wider market to more fuel efficient, lower emissions vehicles.
- Encourage the adoption of electric cars.
- Recognize and encourage the continuous improvements in energy performance expected from the world-class industries operating in Holland.

Heat Recovery and Efficient Distribution

- Offer reliable, cost-effective district heating services to homes and buildings in higher density neighborhoods using heat from many sources including heat recovered from local power generation.
- Widen the availability of snow-melt services to both increase neighborhood accessibility and attractiveness, and wherever possible make use of available recovered heat.

Clean, Reliable, Flexible Energy Supplies

- Ensure Holland is able to serve its anticipated growth in electricity and heating demand with local distributed generation that reduce dependency on any one fuel and overall emissions.
- Ensure new generating capacity is configured to meet the district heating and snow-melt demands of the City.

Strategic Scenarios

In developing recommendations, four different scenarios combining energy efficiency, distribution and energy supply were evaluated. These are described below. Each was assessed for its contribution to the overall energy and carbon footprint of the City, the scale and risk of some key investments, along with how each might affect the economic development of the City. No scenario has been selected that does not improve the energy reliability of the City.

To ensure all scenarios also had sufficient capacity to meet the electricity needs of HBPW's customers in the surrounding communities outside the City of Holland, a supplementary assessment has been made. Details of this supplementary analysis are in Appendix 2.

All scenarios cover the energy needs of the forecasted population and employment development of the City of Holland as described in Chapter 3.

Scenario A

In this scenario, it is assumed that all existing buildings will be efficiently renovated by 2050. New buildings will be systematically more efficient compared to current average and current code. Industry will successfully continue to implement Corporate Energy Management Programs that deliver year-on-year efficiency improvements.

Higher density areas around downtown, the Hope College Campus, the Hospital and Holland High School will have a significant amount of district heating installations. The district heating will also be configured to be suitable for extending the possibility to offer snow-melt services. The downtown district heating uses heat recovered from expansion of local electricity generation using a natural gas combined-cycle gas turbine facility located on the existing James De Young site. This is described in further detail in Chapter 7 – Scale Projects 3, 4 and 5.

The prospering industrial area to the south-east (Holland Industrial Park) will also be configured to have district heating services, associated with new combined heat and power (CHP) capacity alongside the existing gas peaking capacity. Recognizing the importance of low-carbon, low-cost reliable energy services to industrial investors, the City will potentially offer other energy services tailored to a customer's specific needs. This concept, common in Europe and Asia, is described in more detail in Chapter 7 - Scale Project 1.

Scenario A uses the following specific assumptions:

- Existing buildings, with the exception of single-family homes, will be 30 to 50% more efficient than the current average after major renovations. By 2050, all existing buildings will have been renovated at the rate of 2.5% per year.
- Single-family homes will be targeted for focused renovation in two phases. In the first phase between 2013 and 2033, homes will be retrofitted with a "moderate package" to be 53% more efficient than current average. The second phase, between 2034 and 2050 will be retrofitted with a "high efficiency package" to be 66% more efficient. The cost and details of these packages are described in Appendix 8. A preliminary assessment for approximately 150 homes in the Historic District is included in Chapter 7 – Scale Project 2.
- Buildings will have Energy Performance Labels available to raise market awareness of their actual energy performance. EPLs are described in more detail in Chapter 8.
- Industrial services will be based on 30 MW of CHP, added in sync with industrial development and combined with district heating.
- Incentives on the existing HBPW Refrigerator and A/C replacement program will be strengthened to accelerate the installation of units with Energy Star rated or higher efficiency. By 2030 at least 5,000 refrigerators and 7,500 air conditioners will have been upgraded on track to a 100% replacement by 2050.
- District heating services will be offered north of 24th Street, initially anchored on Hope College, Holland Hospital, the Aquatic Center and major City properties. The pre-existing plan to upgrade Central Avenue will be expanded to include district heating feeder pipes. DH services and extension of the snow melt can be extended to customers near district heating pipe routes.
- To serve the growing electricity demand for Holland, a 70 MW combined circle gas turbine (CCGT) configured for district heating will be located on the De Young site from 2016.
- Ten MW of "Green Power" from landfill gas will be included in the electricity supply portfolio.
- Transportation efficiency gains will come primarily from revised Federal CAFÉ Standards, material weight reduction, smaller vehicles and more efficient drive-trains. A small portion will come from a slightly denser urban design and the walkability impacts of expanded snowmelt services. The detailed assumptions behind the transportation efficiency gain are described in Appendix 9.

- Transition of about 7% of the car fleet to electric vehicles is assumed by 2050; an important aspect given the focus on battery manufacture in Holland. Under all scenarios except B this is carbon negative relative to conventional fuels. In Scenario B it is carbon neutral.

Scenario B

This scenario includes all measures and assumptions described in Scenario A, along with the addition of significant renewable energy sources. The approach is flexible enough to integrate these when they are available and most cost effective, or when they are required for legislative or regulatory reasons. The CEP analysis used some basic timing assumptions, but these can be easily adjusted.

Scenario B uses the following additional specific assumptions:

- Installation of 24 MW photovoltaic (PV) solar electricity generation between 2012 and 2050. The rate of installation may be accelerated if installed costs continue to fall, or if incentives or market prices for renewable electricity change. This helps meet State RPS requirements, and more importantly, it is a significant contributor to the reduction of the summer electric peak.
- Addition of 20 MW biomass generating block on the De Young site, replacing part of the existing coal fired capacity. This would use bio-gasification and be in service after 2030.
- Use of gas with 10% biogas blend by 2023 for both CHP and CCGT. This is based on a wider evolution of natural gas market and is clearly beyond the decision control of the City or HBPW.
- Addition of 37 $MW_{nominal}$ of wind powered electricity generation by 2020 to both reduce the carbon footprint of the City and to contribute to meeting the State RPS.

Scenario C

This scenario is identical to Scenario B with two exceptions: a new solid fuel plant instead of the CCGT will be used for the major expansion of local electrical generating capacity, and there will be no added biomass generating block.

Scenario C uses the following additional specific assumptions:

- A new solid fuel power plant is used instead of the CCGT at the De Young site.
- The new plant has generating capacity of 70 MW from 2016 configured to supply district heating.
- The fuel mix will be approximately 30% biomass (wood chips) and 70% coal. Note: the fuel flexibility could vary widely based on many current or future possible options.

Scenario D

This is identical to Scenario C with the exception that the wind and solar photovoltaic capacity will not be added.

All Scenarios – Existing JDY Solid Fuel Plant

The existing JDY coal fired plant is around 50 years old, so inevitably the question of potential decommissioning dates and phasing arise. The CEP treated this question as an operational decision between the City and HBPW based on plant age, operating costs, and various community factors.

The impact from primary energy and emissions points of view for the City is minimal, since the emissions index for electricity purchased from the grid is almost identical to the emissions index from the existing JDY Plant. The CEP treats grid electricity and electricity from the existing JDY Power Plant as identical from an analytical standpoint.

Scenarios' Results

Total Fuel Use and Mix

The evolution of the total fuel use and mix for the City is strategically important in a number of ways:

- Energy cost is in large part driven by the total fuel needs of the City. This in turn is driven by the overall efficiency of the consumption, distribution and conversion of energy for transportation, heating, domestic hot water, cooling and all other electrical uses. In the 2010 baseline estimates, the total fuel cost of the City was about $135 Million.
- Cost at any given time is also driven by the market price of different fuels and the relative mix. For most of the CEP period, the relative pricing of natural gas, oil, coal and biomass will be the main drivers of the overall energy costs of the city.
- Cost in later years will also be influenced by the operating cost of wind and solar electricity generation which is a significant component of two of the four scenarios.
- Flexibility to adjust the fuel mix based on availability and price of particular fuels is a critical aspect in managing the overall reliability and cost of the energy system.
- Fuels have different greenhouse gas content. The overall mix defines the carbon footprint of the City. The evolution of legislation to reduce greenhouse gas emissions is highly uncertain and may or may not penalize high-carbon sources. Flexibility to adjust the fuel mix based on the carbon-content of specific fuels is a critical aspect in managing the environmental risks.

The estimated fuel mix for the City's use of energy for all purposes in industry, homes, other building, and transportation based on the four scenarios is shown in Figure 5.1.

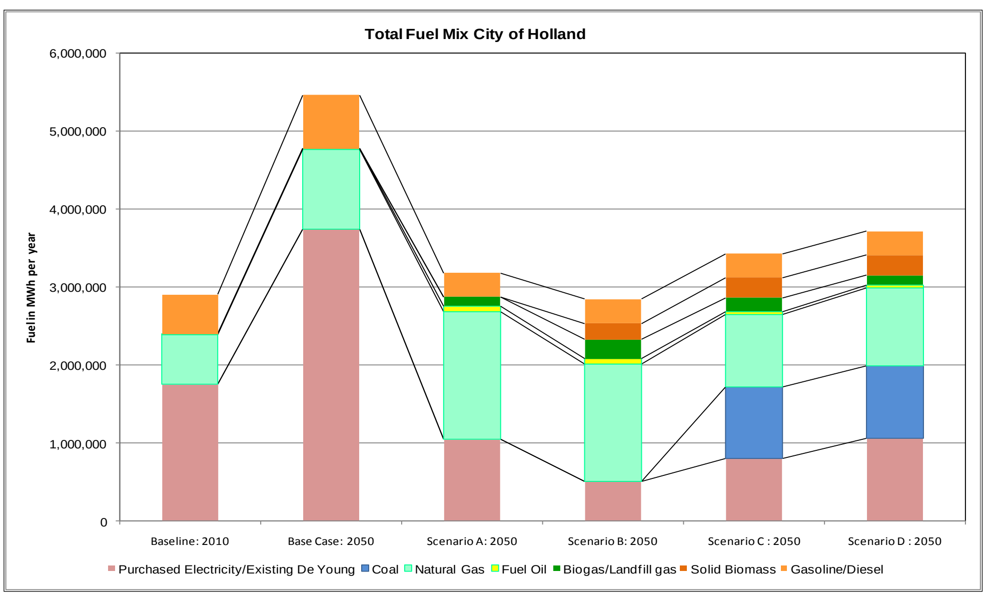

Figure 5.1 Scenarios A through D – 2050 Total Fuel Mix for Holland

By 2050, all scenarios use at least 30% less fuel than the Base Case. In Scenario B, the total fuel used 40 years from now is actually less than that used in 2010 even with significant growth in employment and population. This reduction is primarily driven by the following factors:

- Higher efficiency in vehicles, buildings, homes and industry.
- Increased efficiency of electricity generation.
- Use of waste heat from electricity generation for heating purposes in industry and downtown.

- Use of renewable energy mainly in electricity and district heating generation.

Different fuels cause different levels of greenhouse gas emissions. The total GHG emissions caused by each of the scenarios are shown in Figure 5.2.

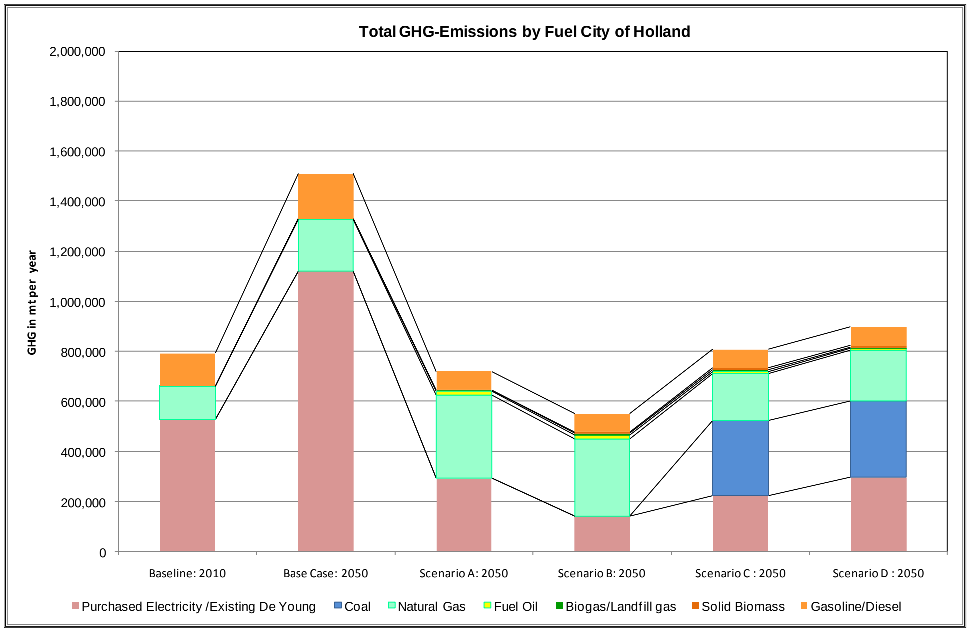

Figure 5.2 Scenarios A through D – 2050 Total GHG by Fuel Mix for Holland

All scenarios avoid significant greenhouse gas emissions relative to the Base Case. Scenario B shows an even greater proportional reduction on total greenhouse gas emissions shown in Figure 5.3.

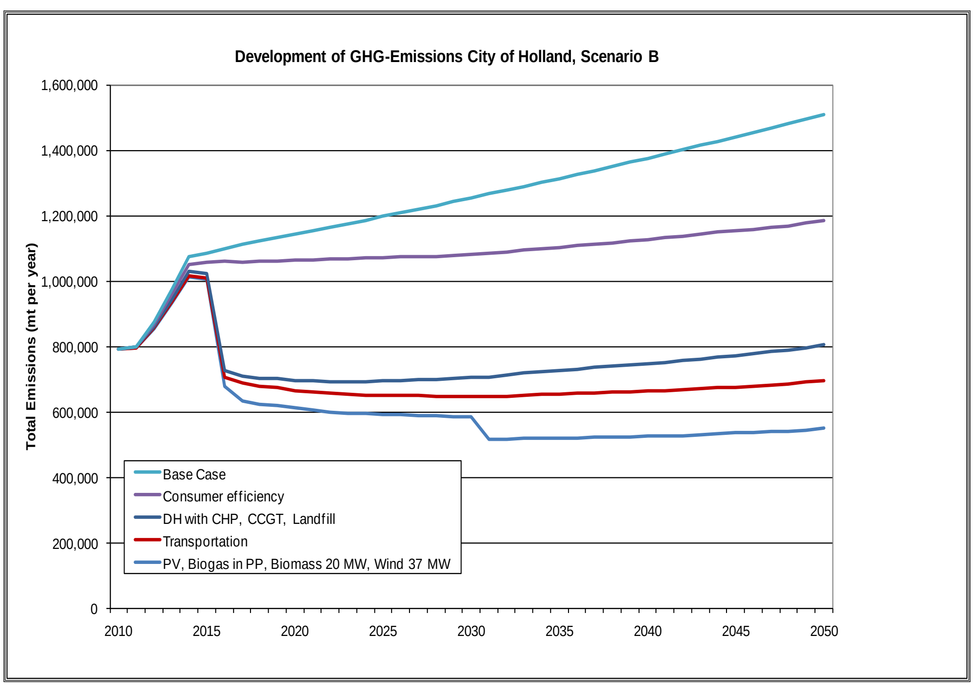

Figure 5.3 Scenario B – 2010 to 2050 Total GHG by Major Strategy

In 2050, total emissions are 522,000 mt, or 65% less than the Base Case. For the built-environment and industry, three factors contribute to the reduction:

- Overall consumer efficiency gains.
- District heating combined with CCGT and CHP generation expansion.
- Renewable energy sources of all types.

Transportation efficiency gains, mostly driven by improved vehicle technology and consumer choices, complete the reduction picture. If there is a substantial shift to electric vehicles, the impact on the City-wide emissions remain neutral assuming the EVs are grid charged.

The per capita emissions to 2050 for all scenarios are shown in Figure 5.4.

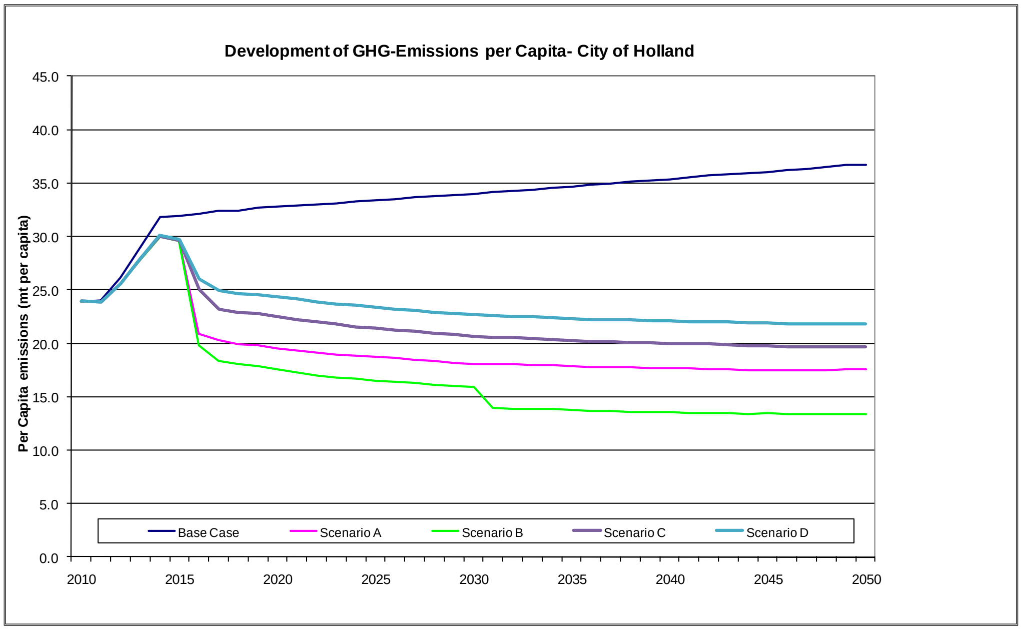

Figure 5.4 All Scenarios – 2010 to 2050 per Capita GHG

Scenario B results in per capita emissions of 13.4 mt CO_2e compared to the 36.7 mt CO_2e/capita estimate for the "business-as-usual" Base Case. From 2030 on, the emission per capita remain steady as gains in efficiency are eaten up by successful industrial growth.

While not meeting the CEP framing goal of 10mt/capita, Scenario B puts in place a number of parallel strategies all of which have the potential to be accelerated. Specifically, the home and buildings efficiency recommendations are relatively modest compared to global best practice and could be intensified.

Holland Electricity Fuel Use and Mix

Holland has a major advantage over many communities by having its own municipal utility, HBPW, currently delivering electricity, water, waste water and some snow melt services to the City. It owns and operates the 56 MW coal fired De Young power plant, and two natural gas peaking plants in ED L01. It also owns about a 46 MW share of coal fired capacity at the JH Campbell and Belle River Plants, and has contracted for about 10 MW of landfill gas capacity.

In total, Holland owns or controls 108 MW of mostly coal fired base load capacity, 22 MW of oil fired and 147 MW of natural gas fired peaking capacity.

Holland has to make some major investment decisions concerning future electricity generating capacity either owned or contracted by HBPW on behalf of the City. These decisions will have impacts on all of the CEP goals – energy costs, greenhouse gas emissions reductions and supply security.

HBPW currently delivers about as much electricity to customers outside the City of Holland as it does to the City itself. To ensure their electricity needs were recognized, the team incorporated an assessment of the evolution of electricity demand from 2010 to 2050 from outside of the City in the CEP. Details including the rules for allocating GHG emissions are in Appendix 2.

The key drivers behind the review of long-term electrical generating mix of HBPW are:

- Having the ability to serve the anticipated future electricity demand created by successful industrial growth and its collateral effect on both the commercial and residential demands.
- Filling the gap left by a possible future decommissioning of some or all of the existing De Young coal-fired plant without losing cost control or dispatching flexibility.
- Meeting the requirements of the Michigan State RPS.
- Managing the risks related to future greenhouse gas regulation and potential cost penalties on carbon
- Meeting the expectations of citizens over the quality of life in the City including energy cost, reliability and environmental impact.
- Retaining or enhancing local flexibility over the fuel mix to manage future price, availability and environmental uncertainties.

This specific electrical service supply challenge will be reviewed in light of all four scenarios. The total electricity needs for cooling, lighting, industrial processes and other uses in the built environment were estimated as part of the overall energy assessment for the City. This is summarized in Figure 5.5.

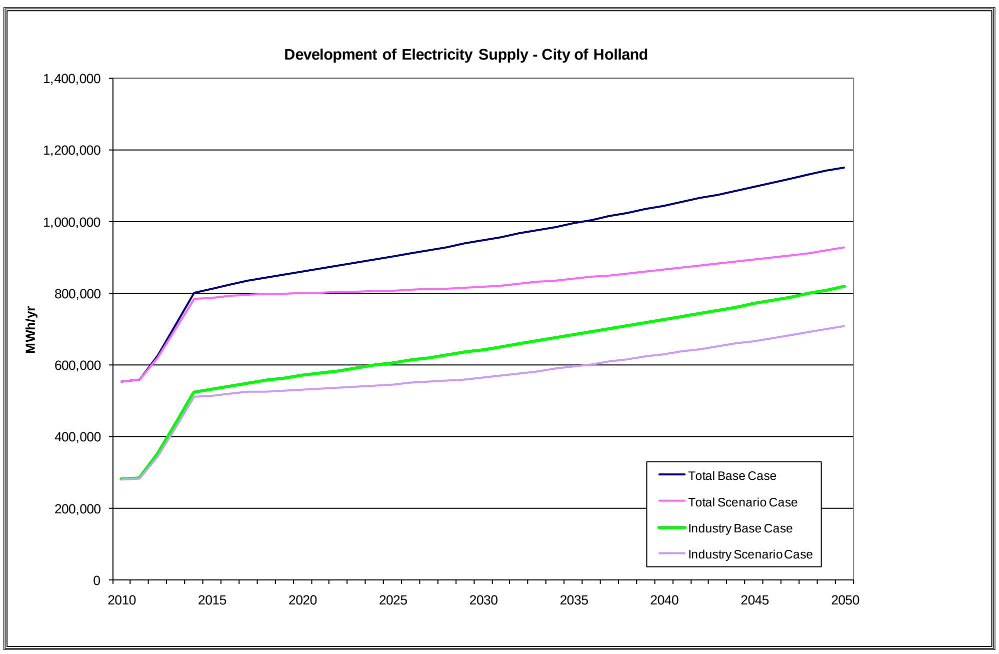

Figure 5.5 All Scenarios – 2010 to 2050 Electricity Supply for Holland

Two things immediately show from the above information. The various efficiency strategies are a major contributor to the electricity supply scenario. The PWT estimates this has a peak capacity impact of about 30 MW by 2030[26].

The rapid increase in the first 5 to 10 years, represent the phased expansion of major industrial facilities used for the manufacture of lithium ion batteries. Assuming this successful growth does happen, this will require a further 40 MW of peak capacity by 2030. Aside from this specific anticipated growth, the

[26] 2030 was used as a milestone by Black & Veatch. For continuity of comparison, the CEP will use this milestone to discuss the mix of electrical assets.

underlying growth in industrial electrical demand rises faster than the electrical need of the City as a whole. This is one of the reasons for recommending 30 MW_{el} of efficient base-load capacity in ED L01.

The fuel mix to meet these electricity supply needs is summarized in Figure 5.6.

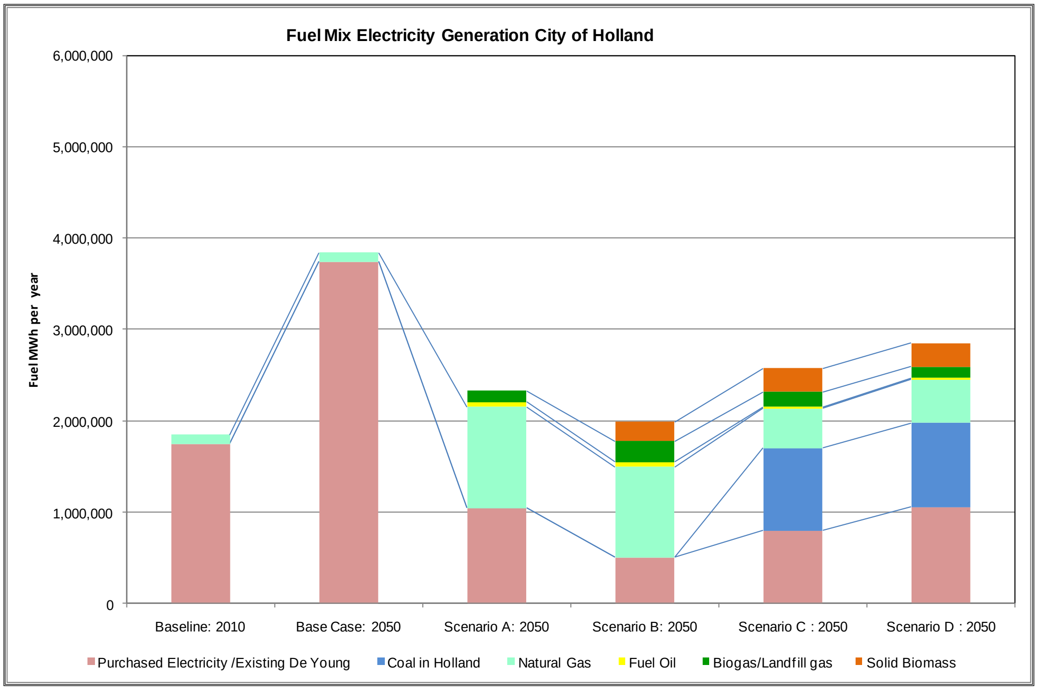

Figure 5.6 Scenarios A through D – 2010 and 2050 Electricity Fuel Mix for Holland

Again, Scenario B uses the least fuel to meet the City's electricity demands. The greenhouse gas emissions from each scenario are summarized in Figure 5.7. Emissions have been allocated between Holland and elsewhere in the following way:

- Emissions from electricity generation at De Young allocated system-wide.
- All purchased electricity from outside the HBPW service area allocated system-wide.
- Solar and Industrial Park CHP that would not have happened without CEP allocated to the City.

Further allocation details are in Appendix 10.

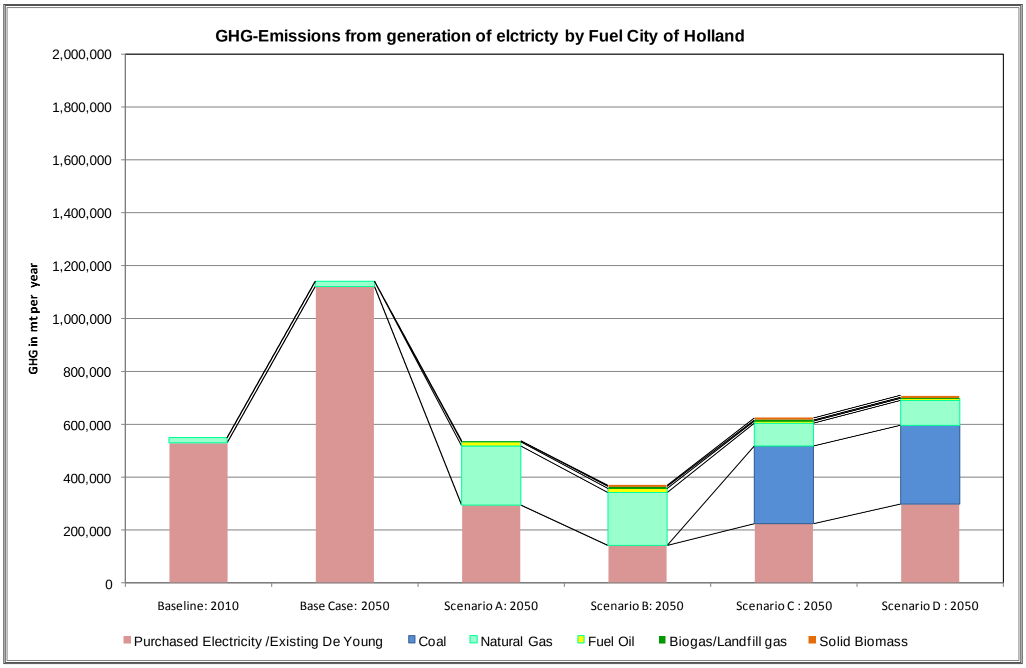

Figure 5.7 Scenarios A through D – 2010 to 2050 GHG Emissions from Electricity for Holland

The electricity emissions picture shows that Scenario B is far and away the least impact solution.

Role of Solar Photovoltaic

For any electricity generating portfolio, the ability to meet peaks is as important as the ability to meet average demand. In each for the scenarios, the base load additions and subtractions track the underlying demand growth and are peak relevant. Solar PV is in two of the scenarios aimed specifically at the City's ability to respond to peak demand. This is visualized in Figure 5.8.

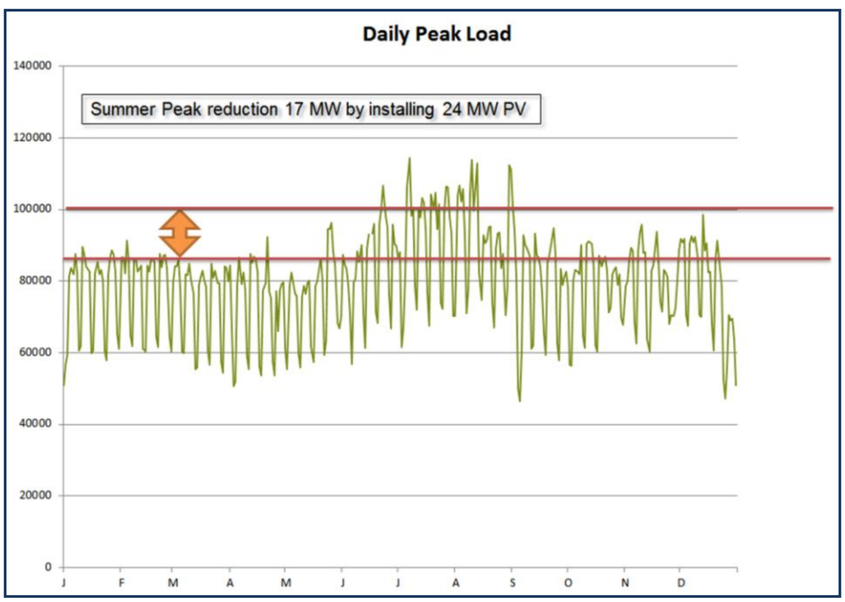

Figure 5.8 Scenarios B and C – 2050 Impact of Solar PV on Peak Electrical Demand

About 24 MW of Solar PV will be installed in the City in scenarios B and C starting 2012 and completed by 2050. This has a maximum generating capacity of about 17 MW during the summer afternoons, the same time the grid peaks due to air-conditioning demand. The Solar PV avoids the need for this amount of standby conventional capacity.

Role of Wind Generation

Scenarios B and C include 37 MW of wind capacity installed in 2016/2017. Due to the unpredictability of wind, this is not peak relevant, and is blended into the base load mix. This will generate about 90,000 MWh per year or about 10 to 11% of the 2050 requirements. Combined with other renewables and efficiency this will be more than enough to meet the State RPS.

Holland Electricity Investment Scenarios

Each scenario has a different investment profile summarized in Figure 5.9. For comparison with the earlier Black and Veatch study, these are calculated from now to 2030.

Item	Base $ M	Scen A $ M	Scen B $ M	Scen C $ M	Scen D $ M
De Young 70 MW SF/DH	$270	-	-	$270	$270
De Young 70 MW CCGT/DH	-	$105	$105	-	-
Industrial 30 MW CHP/DH	-	$60	$60	$60	$60
Solar PV (8 of 24MW)	-	-	$32	$32	-
Industrial DH Network	-	$10	$10	$10	$10
Downtown DH Network	-	$10	$10	$10	$10
SFH Retrofit – Total Investment	-	$125	$125	$125	$125
SFH Retrofit Owner Share	-	-$63	-$63	-$63	-$63
Refrigerator Incentives	$0	$1	$1	$1	$1
AC Buyback (7,500)	$0	$2	$2	$2	$2
Industrial Efficiency		$0	$0	$0	$0
Additional Snow-Melt	NA	NA	NA	NA	NA
Total 2030 Investment	**$270**	**$250**	**$282**	**$447**	**$415**

Figure 5.9 All Scenarios – Electricity Oriented Investments to 2030

There is some uncertainty about the timing of new industrial demand. In the approach including 30 MW of CHP and possible phasing of the 70 MW of CCGT or long-term grid contracts, there is flexibility to power generation as needed. They are currently assumed to be in place between 2016 and 2018.

The Solar PV investments are higher than the level of installed costs in China today. Given the speed with which Solar PV costs are dropping, this could be a candidate for acceleration.

The single-family home retrofit total investment of $125M assumes about 4,500 homes being renovated, completing Phase 1. The added values of the avoided peak and efficiency have been divided equally between HBPW and the homeowner.

The basic investments in the DH networks are relatively modest, especially if they can be anchored on cost-effective larger projects as is being recommended. District heating is a key factor reducing the long-term emissions of the City through the use of recovered heat. It is assumed these would be investments made by HBPW as a part of their diversification strategy.

In a very preliminary assessment, all scenarios add higher levels of local value than the Base Case as they are implemented. Of the four, Scenario B will have the highest level of local value added.

Electricity and Heat Cost of Generation

A stand-alone assessment of the cost of generation for both electricity and incremental district heating for the three major thermal alternatives being assessed – CCGT, CHP and solid fuel has been done. This is described in Appendix 10. Depending on the assumptions used for current and future gas and coal pricing, and the cost impact of climate legislation, almost any conclusion can be reached. However, there is no obvious reason to disqualify any of these options based purely on a stand-alone generating cost assessment.

From a future uncertainty standpoint, two clear uncertainties must be managed. For coal, the biggest unknowns are the long-term price impacts of Chinese demand and the potential cost of climate legislation. For natural gas, the key uncertainty is around price as it becomes the low-carbon fuel of choice globally, an obvious alternative to nuclear in the wake the events that occurred at the Dai-Ichi reactor in Japan following the March 11, 2011 Tōhoku earthquake and tsunami. Natural gas remains the key industrial feedstock for the petrochemical and agrochemical industries.

The provisional conclusion is that heat and electricity generating cost differences are not reasons to accept or reject any given scenario.

Preliminary Recommendations

By focusing on efficiency, all scenarios contribute to reduced emissions, reduced future price risks and lowering the risks of peak interruptions. The efficiency recommendations relative to global best practices are relatively modest and could be accelerated. This is likely one area to close the gap between the 13.4 mt/capita resulting from Scenario B and the 10 mt/capita CEP framing goal.

District heating is a proven and cost effective way to offer high quality heating services and to reduce the overall energy use of the City and lower its carbon footprint. Given that heating represents about half of the energy needs of Holland and that local distributed generation is available, there do not appear to be any reasons not to selectively develop this strategy. This would also provide a great platform to extend the popular snow-melt services.

Holland is lucky to have the prospect for a thriving high-quality industrial base with a good growth forecast. The PWT has interviewed the operating leadership of three of the key industrial stakeholders and all are excited about the prospect of an integrated, cost-effective, low-carbon approach for ED L01.

An approach that could both meet the State of Michigan RPS and also contribute to peak reduction as an ancillary value would tend to favor an accelerated Solar PV solution rather than investing in the wind alternative.

The high level of uncertainty over the impacts of greenhouse gas legislation favors a strategy with maximum fuel flexibility between high, low and no carbon fuels. The mix in Scenario B does this, combined with the future flexibility offered by more extensive district heating. Below is a schedule related to the projects identified in scenario B:

Strategic Measure	2011 2030 2050
Efficient renovation – all buildings	2012--2050
Focused retrofits – single homes Moderate	2013----Linear increase----2032
Focused retrofits – SFH High Efficiency	2033—Linear Increase-----2050
Transportation efficiency gains	2011----------Year on year improvement-------------------------------2050
Ongoing industrial efficiency gains	2011----------Year on year improvement-------------------------------2050
Downtown district heating network	2012--- 2016---------Demand driven growth---------------------------2050
Industrial Park – district energy network	2016---------Demand driven growth---------------------------2050
70 MW CCGT expansion	2016-----------Full operation-------------------------------------2050
30 MW CHP in Industrial Park	2016-----------Full operation-------------------------------------2050
10 MW Landfill gas capacity	2011--------------------Full operation--------------------------------------2050
20 MW Bio-gasification expansion (2031)	2031—-Full operation------2050
24MW Solar Power (PV)	2012-----------------Linear increase------------------------------------ 2050
10% biogas in gas network	2014----------------Full operation-------------------------------------2050
37 MW Wind (or outsourced equivalent)	2016----------------Full operation------------------------------2050

Figure 5.10 Scenario B – Implementation Schedule

Having HBPW already in place as a trusted supplier of services is an excellent starting point for an energy services portfolio for the City of Holland, and possibly extending elsewhere in the future. This would clearly add substantial local value both in the implementation phase of the CEP, and in the ongoing services phase that will included heating and potentially other industrial-related energy services.

The Project Work Team recommends Scenario B as the basis for finalizing the CEP.

Following future acceptance of the Report by City Council a joint implementation team comprising City and HBPW staff would be tasked to develop multiple detailed implementation plans including investment grade assessments of key high priority projects.

Chapter 6: Recommended Initial Scale Projects

Scale Projects Background

Holland has embraced the challenge to develop an integrated Community Energy Plan that will deliver transformational results. A key to its success will be engaging in "Scale Projects" at an early stage of the implementation process.

Scale Projects address entire neighborhoods in the City. They represent developments with the size and timing such that guidelines which are in line with the CEP can be applied within relatively large, but contained boundaries. They are large enough to address both energy demand and supply within a single project. They are also projects where the number of decision makers is small. Over time, multiple Scale Projects blend together. This "connecting the dots" creates the City-wide energy transformation.

Scale Projects Summary

Five initial Scale Projects are recommended. Each is aimed at a specific aspect of accelerating the implementation of Scenario B. They were selected on the basis that they meet most, if not all, of the following general criteria:

- Clearly demonstrate a key element of the recommended strategy.
- Have a high probability of being implemented in a timely fashion.
- Have a manageable number of key decision makers.
- Are large enough for technically and economically viable integrated energy solutions
- New business models are possible:
    - Efficiency levels above statutory levels.
    - Distribution – heating, cooling, power, and other.
    - Distributed clean and renewable supplies.
    - Innovative financing.
- Are economically, socially, environmentally and operationally attractive.
- Can potentially link to other Scale Projects.

Four of the scale projects are focused on neighborhoods in Holland, shown in Figure 6.1.

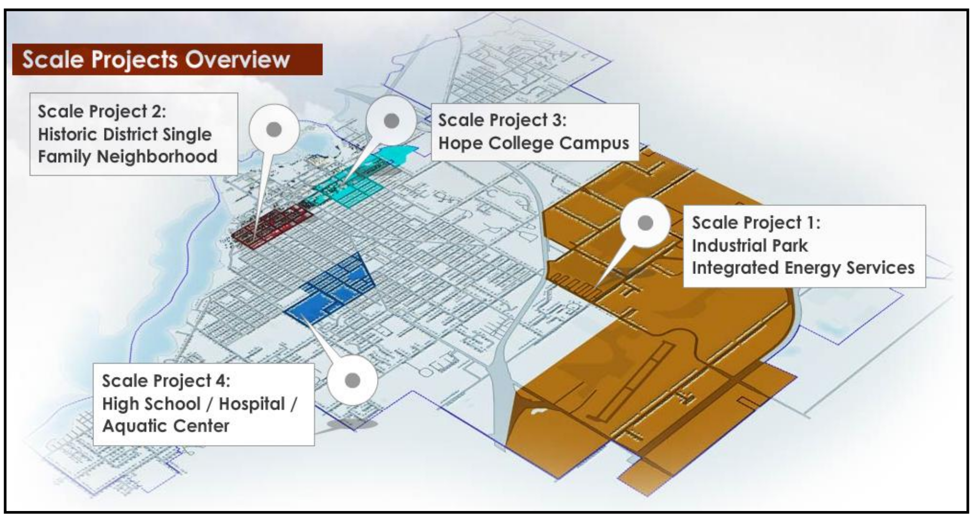

Figure 6.1 Four Neighborhood Scale Projects

Each Scale Project has received a preliminary assessment that indicates the energy strategies that are likely to be successful. For the Hope College Campus and for the Historic District Single-Family

Neighborhood, assumption driven quantitative assessments have been completed. For the other two, narrative descriptions of likely energy measures and potential benefits have been completed. These projects fit into the overall energy strategy outlined in Chapter 5 in the following way:

SP1: Holland Industrial Park Integrated Energy Services

In SP1, a portfolio of energy services will be developed, specifically tailored to the current and future industrial employers based on the energy district boundaries. This will allow these companies to be more competitive and achieve their corporate emissions goals.

SP2: Historic District Single Family Neighborhood

Holland has over 7,000 inefficient single-family homes, which when combined create a major energy demand on the City and are a major strategic efficiency focus for the CEP. SP2 encompasses about 150 homes that will be a testing ground for the technical, financial and neighborhood approaches that are required to tackle this efficiency opportunity in a strategically effective way that will add value both for the HBPW and for the individual homes and homeowners.

SP3: Hope College Campus

Hope College has the scale and opportunity to reconfigure its energy supply, distribution and user efficiencies to achieve substantial cost savings and emissions reductions, and to establish new educational opportunities around innovative energy approaches. It is also ideally located to be a node in the future development of a wider district heating network, a major strategic component of the CEP.

SP4: Holland High School, Hospital, Aquatic Center

This cluster of significant energy users has the potential to develop both individual "campus" energy plans, and potentially a local neighborhood strategy that can significantly reduce costs and emissions, and mitigate substantial future financial risks. They are also well located to be another node of the wider municipal district heating network.

In addition to the four neighborhood-oriented Scale Projects above, a fifth Scale Project is recommended that that builds on the potential for SP3 and SP4 to be nodes in a municipal district heating system.

SP5: Initial District Heating Network

The combination of climate, urban structure and local generation make significant parts of Holland excellent candidates for modern district heating services, and seriously exploring this possibility is a strong recommendation. This could enhance the competiveness of the City, create new business opportunities for HBPW and contribute significantly to reducing the overall carbon footprint. This scale project will evaluate creating the first elements of the DH network by linking SP3 and SP4 with the De Young site and a few other significant heating users including City Hall and the Library.

Scale Projects Next Steps

Following approval of the CEP by the City Council, the expectation is that the appropriate decision makers around each of the Scale Projects will gather the appropriate resources to develop a detailed Integrated Energy Master Plan (IEMP). These IEMPs will be decision grade assessments that will be the basis for the respective ongoing implementation plans.

The Scope of Work of a detailed IEMP will always be specific to the site and to the Community Energy Plan that is framing it. In all cases it will evaluate the structural and operation efficiency potentials, along with the choices for efficient energy distribution supply. The IEMP will aim for an optimum balance between current benefit and future risk avoidance around energy cost, reliability and emissions reduction. A sample of an IEMP Scope of Work for a major mixed-use urban complex[27] is included in

[27] Crystal City, Arlington, Virginia included courtesy of Arlington County and Charles E Smith.

Appendix 11 to provide an example of the range of aspects that are typically included in a neighborhood IEMP. There is a high probability that some funding to develop these IEMPs would be available from the DOE.

Scale Project 1: Industrial Park Integrated Energy Services

Strategic Basis

Holland will encourage inbound industrial investment to create high quality local employment, in part by offering a range of energy services on the Holland Industrial Park that far exceeds the quality, cost, reliability and greenhouse gas expectations of potential world-class global industrial investors when compared with competing communities.

Overview

Industrial energy use in Holland is 38% of the City total, and this sector is expected to grow at a faster rate than the City as a whole. Attracting and retaining high quality industrial employment is a major economic development focus for Holland. The companies the City is aiming to cultivate all have sophisticated energy management targets, usually including year-on-year efficiency gains and stringent greenhouse gas reduction targets. They also actively manage energy costs and energy risks including reliability. Their energy related needs are significantly different from homes and buildings. This Scale Project is aimed at ensuring that Holland's industrial services create a clear competitive advantage for these companies.

Industrial Park Description

The Industrial Park is located in the south-east of Holland between Route 31 and Interstate 196.

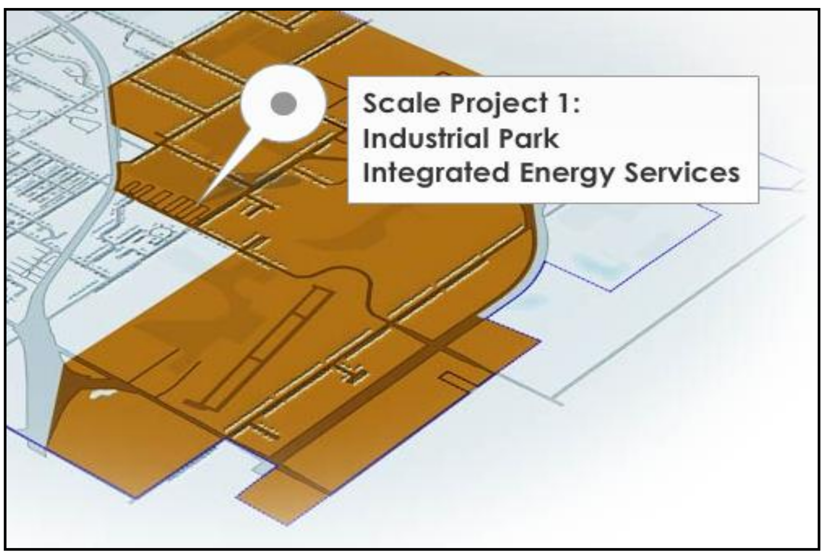

Figure 6.2 Scale Project 1 – Holland Industrial Park Integrated Energy Services

The highways and the airport in the south-west make the Park attractive from a transportation standpoint. The Park is already home to some world-class companies. Johnson Controls (JCI) has both its automotive and lithium ion battery activities represented. Tiara Yachts is diversifying and is now manufacturing 50 meter wind turbine blades. LG Chem is completing the first phase of its large North American lithium ion battery plant aimed at the growing electric vehicle market, and is planning major growth in more phases. Other prestigious companies exist in this area and the Park has space to allow for both growth of existing companies and to offer first-class sites to new investors.

Technical Energy Solutions

The guiding principle will be to ensure any user in the Park has the tailored energy services they need to meet their business objectives. The first service must include highly reliable electricity supplies at competitive prices with sufficient flexibility to keep pace with the growth. Ideally this should also be electricity that has an outlook to have substantially lower greenhouse gas emissions than at present generation levels, to enable the companies to manage their carbon footprints and associated risks.

The next service would be providing heating and cooling, ideally supplied in the form of district energy (DE). DE has the added value of freeing up valuable space, reducing the equipment investment and lowering overall operating costs. This would potentially have much lower greenhouse gas content than traditional gas fired heating and electricity based cooling.

Some manufacturing process may require process steam or process cooling which could be delivered as a locally-sited integrated utility, again freeing up space, investment and labor costs. As the integrated multi-utility concept evolves for the site, the energy service operator can also use one client's waste heat as a source for wider redistribution, further reducing costs and pollution.

There is an HBPW peaking plant in the center of the Park. This is an ideal location for further development of integrated energy services. In the first phase, the solution would most likely be the installation of a local combined heat and power (CHP) generator, combined with the distribution of district heating. Depending on the connected customers, this could either eliminate existing heat sources or co-opt them into the network for efficient sharing between multiple users.

Based on the forecasted heat demand, a possible concept is to implement a Combined Cycle with gas and steam turbines (CCGT). A probable size for the next 5 to 10 years could be a system with 30MW of electrical power and about the same thermal capacity. Depending on the timing of area development and readiness of existing companies to become part of the shared infrastructure (district heating) the CCGT could be one unit or two modules.

Specifically**,** the battery production process has trace VOCs in the exhaust gases which need to be thermally eliminated, adding supplementary costs. It could be considered to provide a service that would take this exhaust and use it as turbine combustion air. There is conceptually no limit to the options that may be offered once the basic business model is in place, including non-traditional shared utilities such as compressed air.

Economic Indications

No specific financial analysis of this option has been done due to the necessity of having the investment determined based on the finally agreed configuration, the phasing and total service offering. The estimate for about 30MW of CHP along with a basic district heating network would be approximately a $60M investment with reasonably favorable operating economics.

Implementation Recommendations

This would logically be a business diversification opportunity for HBPW, and would build on their existing electricity sales. The first step would be for HBPW to develop a business plan jointly with existing and future energy users. Initial discussions with some of the existing major industrial consumers indicate a willingness to pursue this idea further.

Despite their favorable costs, operational and environmental benefits, the concept of Industrial Parks with shared multi-utilities is relatively unknown in the U.S. and Canada. However, they are a very common concept in Germany, Scandinavia and Korea. An early stage implementation recommendation would be to arrange site visits to understand the options and the challenges.

Scale Project 2: Historic District Single-Family Home Neighborhood

Strategic Basis

Holland will substantially increase the efficiency of its 7,400 single-family homes through neighborhood focused renovation, supported by a structured investment program aimed at reducing costs, improving property values and avoiding investment in additional generating capacity.

Holland will create transparency over the ongoing energy use of buildings by encouraging the availability of Energy Performance Labels whenever a home is sold, rented or renovated.

Overview

Residential energy use in Holland is about 20% of the City's total. Of the 12,500 single and multi family homes, 7,400 are single-family homes. These are mostly older homes with poor efficiency. Retrofitting this entire pool of single-family homes as soon as possible is a high priority focus of the CEP recommendations. This Scale Project is aimed at realizing high levels of efficiency in a single-family home neighborhood that would act as a pilot for the City as a whole. It will incorporate technical, investment and community approaches.

Historic District Neighborhood Description

The Historic District is framed by Central Avenue, W 13th Street, Van Raalte Avenue and West 9th Street.

Figure 6.3 Scale Project 2 - Historic District Single-Family Home Neighborhood

The District includes 162 detached homes and 27 attached homes with a total area of 340,000 sq ft. These are mostly older homes classified as historic. The estimated annual energy use of these 189 homes is 1,620 MWh of electricity and 6,400 MWh (21,800 MMBtu) of gas. There are some commercial buildings which will be excluded from the Scale Project unless attractive synergies come to light during detailed planning. The following narrative gives an indication of a possible approach that will need to be further developed in the Integrated Energy Master Planning (IEMP) process.

Technical Efficiency Solution

Over a period of about two years, all the homes will be renovated using the standardized "moderate" efficiency package[28]. The renovation package is based entirely on proven, available technology ensuring it will have predictable performance and known costs. The basic measures are:

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[28] See Appendix 9 for further details of the "moderate" package

- Replacement and/or caulking of windows.
- Insulation of roofs, walls, slab and basements.
- Replacement of heating, air conditioning and ventilation systems and controls.

While there will be variations from home to home, the goal is for all homes to be brought to a level of efficiency at least 50% higher than the current average. By completing over 150 renovations in the space of two years, it will be possible to assemble effective renovation teams and potentially capture significant discounts in labor and materials. This project will also be a good pilot to measure the impact on both the individual home and the total neighborhood consumption of energy. In addition to the home renovation packages, smart metering for both gas and electricity will be installed to support the Scale Project's role as a CEP Pilot. Once renovation has been completed, a standardized Energy Performance Label will be issued by the contractors, and updated regularly.

Economic Indications

The average total investments for the "moderate" efficiency package are $17.5/sq. ft. for detached homes and $10.1/sq. ft for attached units. This includes discounts based on standardized technical solutions and planning, competitive RFP process, volume and potential for similar projects in the rest of the City. For this Scale Project, the total investment will be about $5.65 Million. The net present value (NPV) and internal rate of return (IRR) for this investment was calculated based on the following assumptions:

- Current energy prices of $11.70 /MMBtu for gas and 10 ct/kWh for electricity.
- Price escalation between 4 to 6% per year depending on scenario.
- Avoided investment to support 0.57MW peak electric reduction (3kW per home).
- Investment financing costs of 5%/year.
- Conservative greenhouse gas risk – no penalty for GHG emissions..
- Regulated greenhouse gas risk – cost impact based on the National Association of Manufacturers mid-range estimates.

This yields positive NPV of between a low of $0.62M and a high of $2.2M, with an IRR between 6.4% and 9.5%. These returns do not include investments that would be made anyway due to the normal replacement cycles. If these are included, then the programmatic returns would improve. The returns also do not include any positive effect on the market value of the property. The investment does not include any incremental costs for smart electric and gas metering. This is assumed to be a "normal course of business" cost for HBPW and SEMCO Energy.

Implementation Recommendations

SP2 has benefits for the homeowners, the City, HBPW, renovation contractors and potential EPL certifiers. A case can be made that the real estate industry would benefit as well, if the view that proven energy performance will ultimately affect the value of the real estate. There is also potential benefit for investment companies seeking utility-like returns from energy efficiency. Some of the benefits will be immediate, related to the SP itself. Some are future benefits that would accrue if the SP is a success and proliferates to the remaining 7,100 single-family homes. Proliferation beyond Holland is clearly a possibility if a successful model can be put in place. This is also an educational opportunity for workforce development and urban energy planning. This would be of interest for Hope College and the Community College.

The first step recommendation is to create a SP Task Force consisting of representatives of local residents, HBPW, City, contractors and real estate agents. This should be a small group committed to developing a credible IEMP that would share both the investments and the benefits between the most interested parties.

The key to the success of this project is to have a high percentage of homeowners implementing the measures. This will be the result of their understanding of the overall benefits, and the ease of financing. Most similar programs fail to achieve scale since they put 100% of the investment liability on the homeowner, and fail to recognize the other beneficiaries. The lack of scale in turn means discounts are not available and incremental costs increase. In parallel, the peak load reduction does not occur and the utility does not capture avoided investments.

The SP Task Force will need to create a financing mechanism, guaranteed by the various beneficiaries of about $6M. This should be activated only if a certain percentage of the homes commit to renovate; 75% commitment would be a good starting point for discussion.

The entire project would be documented as a study project to track its social, business, technical and economic performance; potentially this could be a post-graduate project for Hope College to develop. This data would be the evidence to proliferate the concept to the entire inventory of Holland's homes.

A well-structured project like this would be a natural magnet for public interest support from Federal, State or Private Foundation resources. It would also be a natural market for business development support for companies seeing this as a potential market opportunity.

Energy and GHG Balance

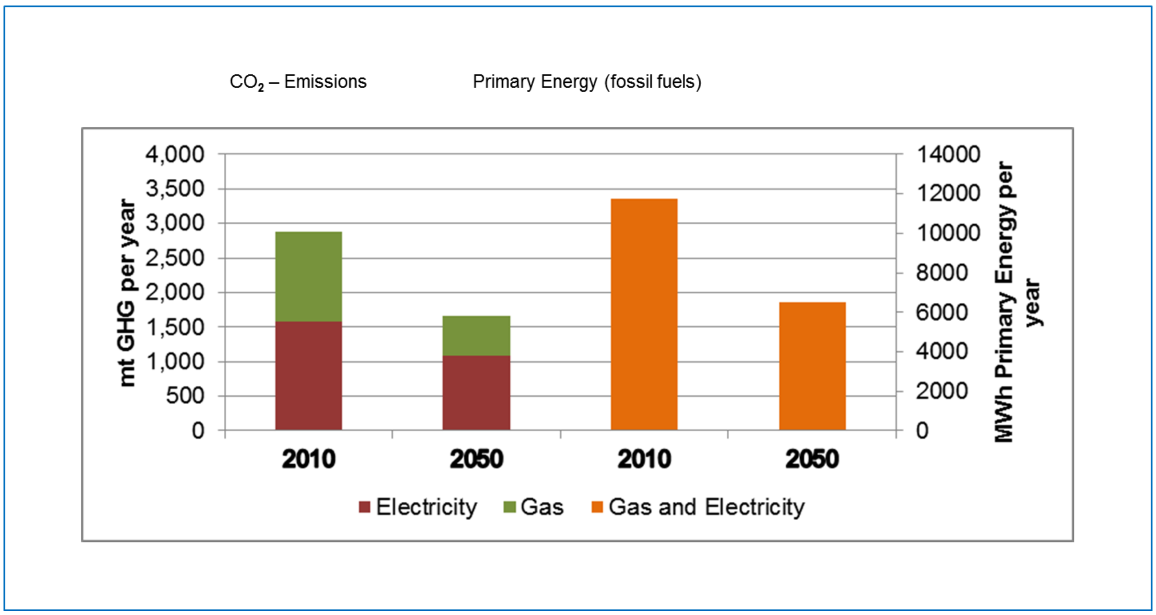

Figure 6.4 Scale Project 2 – GHG and Energy Balance

The efficiency increases create a dramatic reduction in fuel and GHG emissions summarized in Figure 6.4.

Scale Project 3: Hope College Campus

Strategic Basis

Holland will systematically renovate its existing buildings by 2050 to higher levels of energy efficiency as a part of normal renovation. Holland will ensure all new construction meets or exceeds the likely evolution of the IECC national recommendations. Holland will create transparency over the ongoing energy use of buildings by encouraging the availability of Energy Performance Labels.

Holland will offer reliable, cost-effective district heating services to buildings in the higher density neighborhoods.

Hope College will include sustainability in its curricula and its campus will be a living example of efficient energy best practice.

Overview

Campuses have a crucial role in any community energy plan, designed essentially as a small village with relatively simple ownership. They are the thought leaders of the community and can serve as a microcosm for the entire community. In many cases, as in Holland, campuses are embedded in the urban infrastructure and can serve to jump-start wider transformations of the energy infrastructure. It is also very common that colleges are committed to improving their energy performance even before the community becomes focused on the topic. New energy solutions provide opportunities to lower operating costs and reduce future risks. They are also platforms that can be used to develop new curricula and to raise community energy literacy and awareness. As in Holland, it is very common for college campuses to be a high priority Scale Project.

Hope College Campus Description

Hope College is situated in a residential area two blocks from the central business district of Holland.

Figure 6.5 Scale Project 3 - Hope College Campus

The Campus is situated on 120 acres and consists of 119 buildings, of which 98 are student housing units. It was founded in 1866 and has continued to grow and update its buildings. The 3,200 students are offered a wide range of courses at Hope College.

Integrated Energy Solution

The PWT visited the Campus and the energy data was made available for analysis. Consulting members to the Team had recently completed a detailed Integrated Energy Strategy for a campus with similar infrastructure and prepared the following conceptual energy solutions using the indexes from this plan, adjusted for the specific profile of the Hope College Campus. Based on multiple college studies done by the consultants in similar climates, the conclusions presented are realistic. However, before any implementation recommendations can be made, a detailed Integrated Energy Master Plan would need to be completed specifically for the Hope College.

Hope College uses about 56,000 MWh of gas and electricity combined. Over 60% is supplied by natural gas primarily used for heating buildings. The College spends about $3M per year on energy, a major part of their overall costs. Like most U.S. consumers, Hope College has enjoyed a few years of unusually low natural gas prices; a picture that is by no means guaranteed for decades to come.

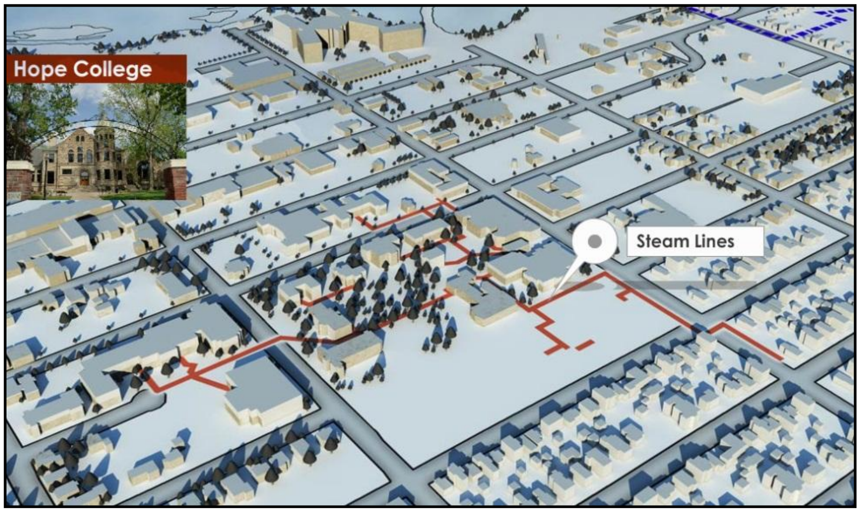

Figure 6.6 Hope College Campus – Current Steam Distribution

The annual average use of energy of all types is about 386 kWh per square meter, a level significantly higher than comparable benchmarks from Europe, indicating a substantial efficiency improvement potential. Most of the bigger buildings are supplied with heat via an existing steam network shown in Figure 6.6.

Following the Loading Order, the first priority is to evaluate the efficiency potential of the buildings. Typically this is done analytically for the larger buildings. Smaller buildings are modeled in groups. Since metering is not available on single buildings, the energy use is simulated. The following energy efficiency measures are evaluated depending on building size, equipment and usage:

- BMS and metering upgrade (energy controlling)
- Windows replacement and caulking
- Wall and roof insulation
- Optimization of HVAC-Systems (CAV to VAV, demand controlled ventilation, VFD)
- Lighting equipment upgrade, twilight and motion sensors
- Conversion from steam to hot water

Based on the observed condition of the Hope College Campus, an overall energy saving of at least 30% is possible with an implementation time for the measures of between 5 and 10 years.

More effective energy supply options focus on heat, since cooling is only needed for a few weeks of the year and is managed through optimization in the buildings. The main buildings are heated by steam, a relatively inefficient method. Converting to a hot water network is a realistic option. Steam pipes would be incrementally replaced with hot water piping. During the conversion, the Campus will continue to use the existing steam boilers, now connected via a heat exchanger. Once the conversion is complete, there will be reduced energy losses in the buildings and network as well as a reduction in permanent maintenance costs. There are now a number of supply options possible:

- Continuing temporary use of the existing steam boilers with heat exchangers.
- Base load generation with gas fired CHP engines making heat for the network and feeding the electricity to the grid. Use of existing boilers for peak and emergencies.
- Connect to the future City district heating network, once the generation and distribution is in place, using the campus boilers as a source for the City system.

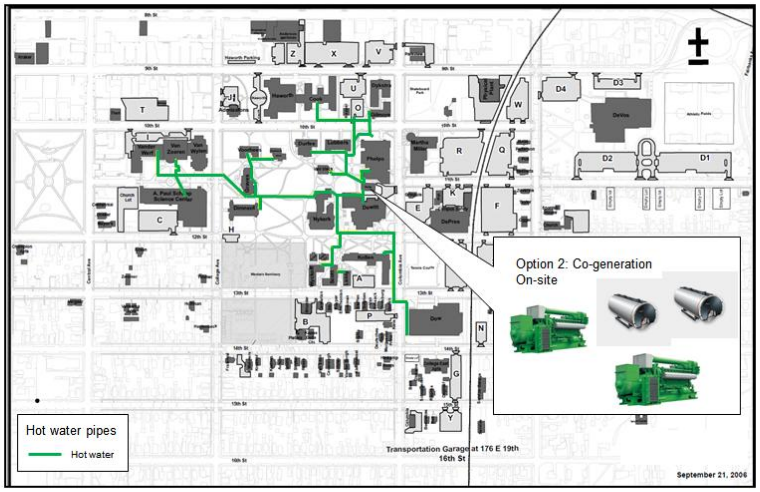

Figure 6.7 Hope College Campus – Potential Future Supply Structure

The combination of efficiency, CHP engines and peaking boilers feeding a hot water network would be the optimum solution for the Campus, until the possibility to connect to the City system is available.

As the metering and control is put in place allowing individual buildings to be actively managed, Energy Performance Labels would be prepared and displayed across the entire Campus. These would be a key part of a campus-wide program to engage staff, faculty and students in the active management of the energy impacts of the Campus on an ongoing basis.

Economic Indicators

Based on the above assumption a range of investment is calculated assuming a complete implementation timetable of about 10 years.

EEMs and Supply	Investment $M
Building automation/metering/control	1.5 to 2
Building efficiency (EEMs)	8 to 10
Building conversion to hot water	3 to 4
Pressurized hot water distribution (network)	4 to 5
Heat generation on site (engines and boilers)	7 to 9
Total Investment	$23M to $30M
Internal rate of return (IRR),depending on energy prices / GHG costs	10 to 15%

Figure 6.8 Scale Project 3 - Possible Investment Scenario and IRR

Figure 6.8 summarizes the range of investment for the option with gas fired engines on the Campus. The total investment is between $23M and $30M with an internal rate of return of between 10 and 15%, depending on energy price scenarios and future carbon penalties. This is equivalent to a payback in 7 to 10 years.

If SP3 is implemented, Hope College now has a system that is fuel flexible and much more efficient to protect against future price uncertainties. The College is also configured to be a node in the future City district heating strategy. From a business and operating point of view, it could be a possibility for

HBPW to acquire and upgrade the campus heating and heating supply systems, as a precursor to fully integrating it into the future City district heating system.

Energy and GHG Balance

The campus-wide efficiency creates a dramatic reduction of fuel and emissions shown in Figure 6.9.

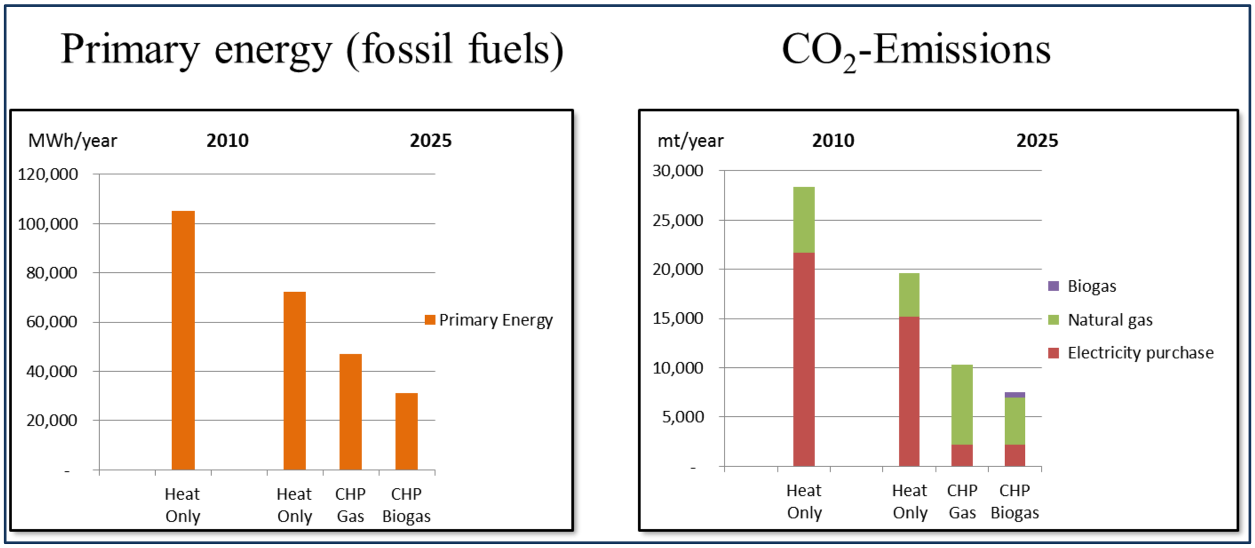

Figure 6.9 Scale Project 3 – Energy and GHG Balance

Fossil fuels consumption and associated GHG emissions drop by 70%. In the future there may be possibilities to lower this further with various renewable supply choices as they become more cost effective.

Scale Project 4: High School, Hospital, Aquatic Center

Strategic Basis

Holland will ensure the competiveness of their businesses (including healthcare) by minimizing their exposure to energy related risks.

Holland will systematically renovate its existing buildings by 2050 to higher levels of energy efficiency as a part of normal renovation. Holland will ensure all new construction meets or exceeds the likely evolution of the IECC national recommendations. Holland will create transparency over the ongoing energy use of buildings by encouraging the availability of Energy Performance Labels through labeling all public buildings.

Holland will offer reliable, cost-effective district heating services to buildings in the higher density neighborhoods.

Holland Public Schools will include sustainability in its curricula and its sites will be living examples of energy best practices. All facilities used regularly by the public will be living examples of energy best practices.

Overview

Concentrations of large energy consumers in small areas have many of the characteristics of a single campus as outlined in SP3. They have an energy profile large enough to yield high levels of integrated benefits, while still having relatively few owners and decision makers. Like campuses, these clusters are often identified as possible Scale Projects within Community Energy Plans.

High School, Hospital, and Aquatic Center Cluster Description

The High School, Hospital and Aquatic Center are three large energy consuming facilities aligned along 24th Street and bounded in the east by Michigan Avenue.

Figure 6.10 Scale Project 4 – Hospital – High School – Aquatic Center Cluster

Healthcare facilities are complex high energy consumers often with substantial energy savings potential. In the U.S. they are operating in an industry with a very unclear future as public healthcare policy changes, creating a growing reason for them to focus on rigorous cost control, including energy, to be prepared for future eventualities.

In a similar way, facilities that rely heavily on public funding, such as the Aquatic Center, are facing major uncertainties in both budgets and policy. In addition to improved efficiency and cost reduction opportunities, the High School should be a living example of the CEP in practice. Students graduating when the CEP is put in place will be beginning to retire by the time its 2050 horizon comes around. Gaining their engagement will be key to the CEP's success.

Integrated Energy Solution

SP4 is a focal point for possible energy savings and efficient energy supply. It is also a potential node for integration into a wider City energy system. The PWT was given the energy consumption data of all three locations. The first step was to assess the current situation of the three sites and the possible impacts of the same range of energy efficiency measures as are proposed for Hope College:

- BMS and metering upgrade (energy controlling)
- Windows replacement and caulking
- Wall and roof insulation
- Optimization of HVAC-Systems (CAV to VAV, demand controlled ventilation, VFD)
- Lighting equipment upgrade, twilight and motion sensors
- Conversion from steam to hot water for the hospital heating system

The Aquatic Center specifically has high heat recovery opportunities from exhaust air and water from pools and showers. A reduction of the overall energy needs of between 20 to 30% is achievable.

Given the local climate, energy supply options mainly focused on heating. The key will be to make all buildings "district heating ready". This means converting all internal structures to hot water by replacing any steam infrastructure or converting direct heated systems to water based systems. This may be a multi-year process for technical and economic reasons, but once the efficiency and conversion measures are complete, energy waste will be greatly reduced along with maintenance costs. At this point supply configuration can be assessed. The two most likely steps are:

- Base load heat generation with gas fired CHP engines in one of the facilities or in a new separate building. The three facilities could be linked with a small district heating network to efficiently share heat. Electricity would be fed into the City network. Existing boilers and standby generators, especially in the Hospital, would be trained to both serve peak demand and emergencies.
- Connect to the future City district heating network, once the generation and distribution is in place, using the newly configured heat supply as a shared source on the City system.

Figure 6.11 shows a possible future structure with a shared heating infrastructure.

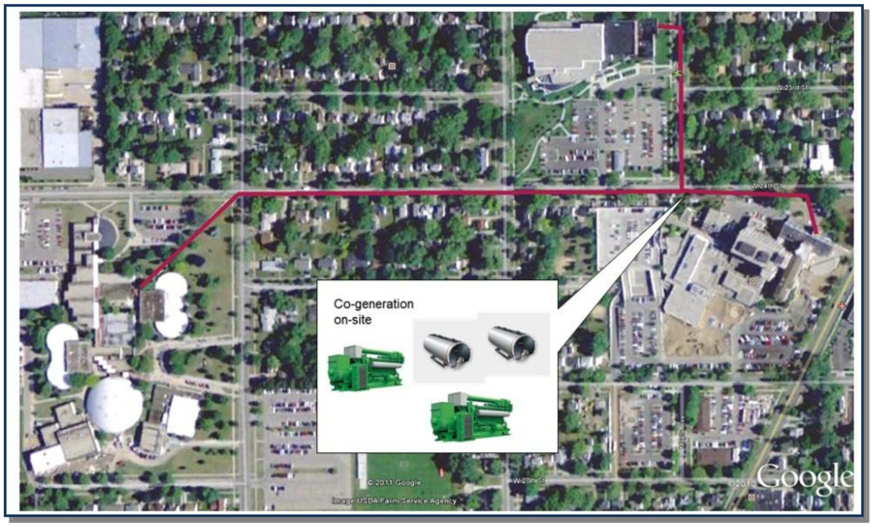

Figure 6.11 Scale Project 4 – Possible Heat Supply Structure

From a business and operating point of view, HBPW could acquire and upgrade the heating network and supply systems as a precursor to fully integrating it into the future City district energy system.

Energy and GHG Balance

Implementation of SP4 has significant potential for the reduction in fossil fuel use and associated greenhouse gas emissions reductions, as indicated in Figure 6.12.

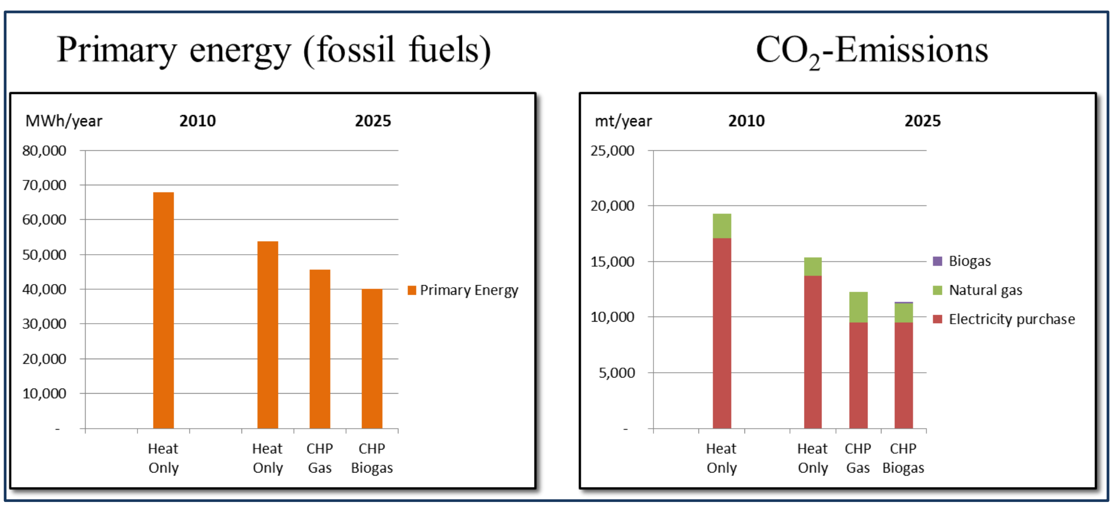

Figure 6.12 Scale Project 4 – Energy and GHG Balance

Scale Project 5: Initial District Heating Network

Strategic Basis

Holland will offer reliable, cost-effective district heating services to buildings in the higher density neighborhoods utilizing heat from multiple sources, including heat recovery from local power generation.

All facilities used regularly by the public will be living examples of energy best practices.

Overview

District energy (DE) is a proven approach to providing cost effective, low-carbon, high quality heating and cooling service to multiple buildings. Specifically in climates such as Holland's where heating energy needs far outweigh the total cooling needs, focusing on district heating makes sense. District heating also provides a convenient and practical way to reconfigure power generation to reduce the overall waste of fuel and associated pollution. District heating also enables high levels of future fuel flexibility and waste heat recovery.

Downtown District Heating Description

The recommendation is to combine upgrading the De Young Power Plant, the Hope College Campus and the Hospital/High School/Aquatic Center Cluster as the starting point for the eventual creation of a significant district heating system covering the downtown area of the City. It is an assumption that this will be owned and operated by HBPW as a business expansion of their existing utility business.

It is recommended that the first steps of SP5 should be taken in the next 12 months. Holland is planning to renew the surface of Central Avenue between 7th and 19th Streets. Prior to the CEP, it was planned to include a low temperature water system to extend the existing snow melt system. The PWT is recommending changing this to be a pre-insulated 6 to 8 inch district heating pipe. This would provide sufficient heat capacity for the anticipated future district heating base load supply. This would be a very small additional investment from the original plan, and would make use of an opportunity that may not be repeated for several decades.

The next steps will be to connect SP3 and SP4 as these projects are completed. At this point, rationalizing the local and HBPW ownership of the system should take place.

Next, the district heating connection to the De Young Power Plant should be made to the new CCGT units which will already be configured to supply heat at the necessary temperature, typically up to 250°F (120°C). In the transition phase, the Central Avenue pipes could be used with the current low temperature level for snow melting, or could be converted to a higher temperature system with the snow melt connected by local heat exchangers.

Other buildings will connect over time, as part of the overall City strategy as the district heating utility expands. Typically they would connect when their existing heating plant is due for replacement, or when they undergo a major retrofit. New construction would generally connect to the network wherever possible. Obvious candidates for early connection to the DH network are the Library, City Hall and Freedom Village. Depending on the final layout of the initial phases, the preliminary estimated investment for the district heat pipes is between $5M and $10M.

As the system evolves, a western run for the district heating network could be considered, extending beyond the SP4 and past the Heinz plant, potentially collecting waste heat for redistribution from the plant, and closing the loop at the De Young site.

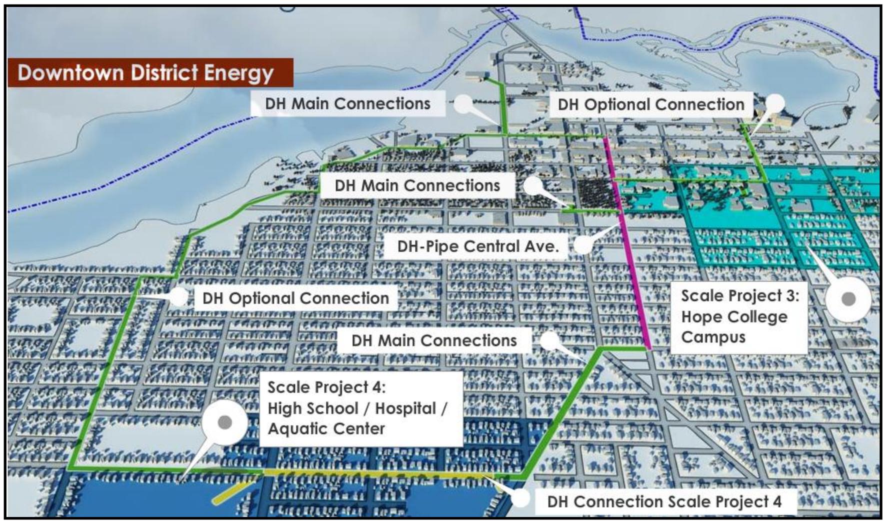

Figure 6.13 Scale Project 5 - Initial District Heating Network

Implementation of district heating is a key item to achieve significant fuel efficiency and greenhouse gas emissions reduction targets. An early implementation of this strategy is strongly recommended.

Chapter 7: Enabling Mechanisms

Overview

The preceding chapters describe the key strategies associated with efficiency, energy distribution and energy supply that make substantial progress toward meeting the framing goal of 10 mt/capita, along with favorable economics and improved reliability. Successful implementation will require an energy literate population and leadership, supported by appropriate information and decision making processes. Putting these mechanisms in place will ensure the thousands of individual decisions that affect the City's energy performance will deliver the long-term goals established in the CEP. Nine such cross-cutting measures or "Enabling Mechanisms" are recommended.

The effective implementation of these Enabling Mechanisms will require the active engagement of many stakeholders including the City's elected leadership and staff, HBPW, the Holland Area Chamber of Commerce[29], and the Holland Sustainability Committee. The Sustainability Committee was established in 2009 and is described more fully in Appendix 8.

Enabling Mechanism 1: Financial Incentives

Holland will establish a comprehensive information service on available financial incentives for businesses and residents. In addition they will design and manage local financial incentives essential for the successful implementation of the CEP.

Background

There is a wide range of financial incentives and other resources available to encourage energy efficiency and greenhouse gas emissions reduction. These are aimed at industrial companies, residential and non-residential building owners, operators and builders, vehicle owners and transportation system operators. Financial incentives may include tax rebates, discounts and grants associated with the purchase of an energy efficient home appliance, commercial office equipment, computing devices, and vehicles. Other incentives defray training costs for tradespeople in efficient construction and facility teams in efficient building or industrial operation. Increasingly, incentives are available to companies and communities to support the costs of feasibility studies and long-term energy planning.

There is a growing range of financial incentives aimed at increasing clean and renewable energy supplies. These can include tax rebates, grant and planning assistance. The use of feed-in-tariffs for renewable and clean electricity where the market price is guaranteed, common for many years in parts of Europe, is increasingly seen in the U.S. and Canada.

Incentives are available through Federal, State and Utility programs. In addition, it is common for various national and international private and non-profit trusts to support specific programs. Private companies may offer preferential pricing or financing to solutions or products incorporating cleaner and efficient energy aspects.

A summary of the some of the incentives available today are listed in Appendix 12. Over the next forty years, these can be expected to change rapidly and substantially. Ensuring that businesses and residents are aware of the incentives available at any given time will be a key to accelerating the successful implementation of the CEP.

Information on Energy Incentives

The City and HBPW staff should ensure that current information on incentives is readily available and facilitate the following guidance and activity:

- Maintain a comprehensive database on the available financial incentives.

[29] http://www.hollandchamber.org/index.php?submenu=About&src=gendocs&ref=AbouttheHollandChamber&category=Main

- Provide information on rules and limitations of energy-related financing in general, including mechanisms like energy-efficient mortgages and performance contracting.
- Seek early adopters from major public or private property owners, religious communities, civic associations, or other community groups to promote their success in utilizing incentives.
- Work with owners, developers and others to engage decision makers early in a project to help ensure required energy narratives include the financial aspects.
- Act as an intermediary to maximize potential for Holland to receive State, Federal and Foundation incentives.

The incentives database and associated services should initially be created by City staff with a structure that could allow shared costs between public and private sources. Some of the companies in Holland whose business includes energy efficient and alternative energy may be candidates for participation.

Specifically at a local level, two strategic areas have been identified where local incentives need to be developed:

Local Incentive 1: Single-Family Home Retrofit Packages

The CEP calls for the deep retrofit of Holland's 7,400 single-family homes in two phases:

- Phase1 – 2013 to 2033 "Moderate" Retrofit
  - By 2033 about 4,500 homes will have been retrofitted to be 53% more efficient
  - Average cost will be $28,000 per home
  - Total investment $126M
- Phase 2 - 2034 to 2050 "High Efficiency" Retrofit
  - Between 2034 and 2050 about 3,000 homes will be retrofitted to be 66% more efficient
  - Average cost will be $60,000 per home
  - Total investment $180M

This benefits the homeowner with reduced operating costs and enhanced property value; it benefits HBPW with an approximate 25MW peak electricity demand reduction; and it is a major contributor to the overall GHG emissions reduction target in the CEP. Considering the benefits, the City and HBPW should facilitate the creation of a revolving financing facility to retrofit between 200 and 300 homes per year. Risks and costs should be structured to reflect the benefits accruing to the homeowner, the City and HBPW. The payments are most likely to be made via either utility or property tax mechanisms. Scale Project 2 is intended to be a pilot program to establish this financing facility.

Local Incentive 2: Refrigerator and Air Conditioner Replacement Incentives

As in most U.S. cities, Holland has a large inventory of inefficient residential refrigerators and air-conditioners. During the summer months, these are costly for the homeowner to run. Combined they greatly increase the peak electricity demand and create a major source of GHG emissions. The CEP calls for an aggressive replacement of these with units that on average will be 30 to 50% more efficient. The target is to replace about 300 refrigerators a year and about 450 air conditioners.

Holland does have existing incentives in place for the replacement of refrigerators[30] and air conditioners[31] with modest rebates and equally modest acceptance. To be valuable to the utility in terms of effectively reducing peak demand, faster and wider replacement is essential. Increasing the average rebate for refrigerators to $200, and $250 for AC units is recommended. HBPW should work

[30] http://www.hollandbpw.com/SiteCollectionDocuments/Green%20Initiatives/Energy%20Smart/Brochure/MPPA_Oldfridge_Holland.pdf
[31] http://www.mienergysmart.com/holland.html

with the City, and potentially some private companies, to design an incentive that will meet the accelerated efficiency targets.

Enabling Mechanism 2: Greenhouse Gas Emissions Management

The City will acquire, register, and report greenhouse gas emissions data. Where appropriate the City should monetize emissions reductions or emissions avoidance where it is possible and cost-effective.

Background

The 2010 energy use in the City caused 792,500 mt of energy related greenhouse gas emissions. Under the CEP Scenario B, this will be constrained to be no more than 521,805 mt in 2050, compared to the Base Case with an estimated increase of 1,511,400 mt in 2050.

The emissions level is a key measure for the City’s energy performance, and should be tracked and publicly reported on an ongoing basis, recommended to be at least twice a year. Acquiring emissions data will be a relatively easy task for industry and the built-environment using the excellent energy metering and GIS already available from the City, HBPW and SEMCO Energy. Overall transportation emissions will continue to be estimated from selected traffic surveys.

Legislation in some countries, and even some U.S. States, already requires independent registration of GHG emissions by various companies and organizations. New EPA legislation due to go into force in 2011, will require GHG emissions registration by all major emitters, including power generators, as the first step in curtailing their overall emissions level.

In some parts of the world, including some provinces in Canada, emitters may have to pay carbon-taxes based on the carbon-content of the fuel they use. In other parts of the world, most notably the EU, a cap-and-trade scheme is used, whereby emitters can meet their emissions “cap” by either selling emission permits if they are able to be more efficient than the limit, or buying permits of they exceed their “cap”. The market sets the price of the permit based on availability. Currently there is no national cap-and-trade scheme in the U.S. for GHG. There are regional emissions markets in the north-east for power producers only[32] and soon in California[33] for all eligible emitters. In addition, there is a voluntary market in the U.S. for greenhouse gas emissions reductions.

GHG Registration

To participate today or in the future in any of these carbon markets and to prepare for legislated markets will require qualified registration of emissions with a recognized independent registry. The PWT recommends that the City’s emissions be registered with The Climate Registry[34] which is recognized by 42 U.S. States, 6 Mexican States and 10 Canadian Provinces.

The Registry offers systems for tracking both emission levels and emission reductions using widely recognized methodologies. Certifying emission reductions in this recognized way creates credibility and can allow emissions reductions to be qualified for future trading purposes. This registration would be in addition to any regulatory requirements under the EPA regulations for any entity in the City. The registration would likely be best coordinated by HBPW. Holland’s emissions would be registered in three groups:

- ***Group 1: City Operations***

The city has been tracking energy and other data on its buildings and vehicles at a level sufficient for their emissions to be registered and certified by the Climate Registry and updated annually.

[32] http://www.rggi.org/home
[33] http://www.arb.ca.gov/cc/cc.htm
[34] http://www.theclimateregistry.org/

- ***Group 2: Selected Scale Projects***

Where a Scale Project is supported by a detailed Integrated Energy Master Plan with clear operational boundaries, the recommendation is to formally register these projects' baselines, with annual updates and verification.

- ***Group 3: City-wide Emissions Balance***

The City can use the Registry data tools to track emissions that do not have the necessary details or ownership suitable for formal verification (i.e. everything not included in Groups 1 and 2).

GHG Monetization

Emissions reductions registered in Groups 1 and 2 above can be verified and converted into Climate Reserve Tons (CRTs) which are tradable securities. Depending on future legislation and market demand, their value may rise. Due to current low values, monetizing at this stage is not being recommended.

Enabling Mechanism 3: Energy Performance Labeling

Holland will create transparency over the current and ongoing energy use of buildings by encouraging the voluntary availability of Energy Performance Labels on all real estate transactions. The labels will be prominently displayed in buildings frequently used by the public to both inform and educate.

Background

An Energy Performance Label (EPL) summarizes a building's energy and GHG performance, reflecting both site and source energy use. The EPLs compare the building's actual energy performance to the CEP goals and to comparable buildings. EPLs for buildings can be considered similar to a miles-per-gallon (mpg) rating for vehicles as a performance indicator.

The PWT is recommending that the City, Holland Public Schools, Hope College, Freedom Village, HBPW, Churches and other major property owners and opinion leaders, lead by example and post EPLs in their buildings. Some of Holland's major businesses have interest in the wider market for efficient buildings. The EPL could be an area for potential sponsoring.

Energy Performance Labels should be posted in buildings used regularly by the public to both inform and educate about their actual energy and GHG performance. Voluntary EPLs could be available to prospective buyers or renters to both test market feedback and acceptance.

Experience where EPLs have been adopted shows there is a steady improvement in the energy efficiency, often exceeding local codes or targets. Following successful voluntary trials in Denmark and Germany, the EU made EPLs mandatory beginning in 2007 for all properties. In the EU, the availability of EPLs in real estate transactions is an accepted practice. In the U.S., ASHRAE, Resnet and DOE are supporting voluntary labeling program on a national basis.

The PWT is not recommending any particular EPL format. That decision will be part of subsequent implementation planning for the CEP. Examples from Germany, the UK and the U.S. are shown in Figure 7.1.

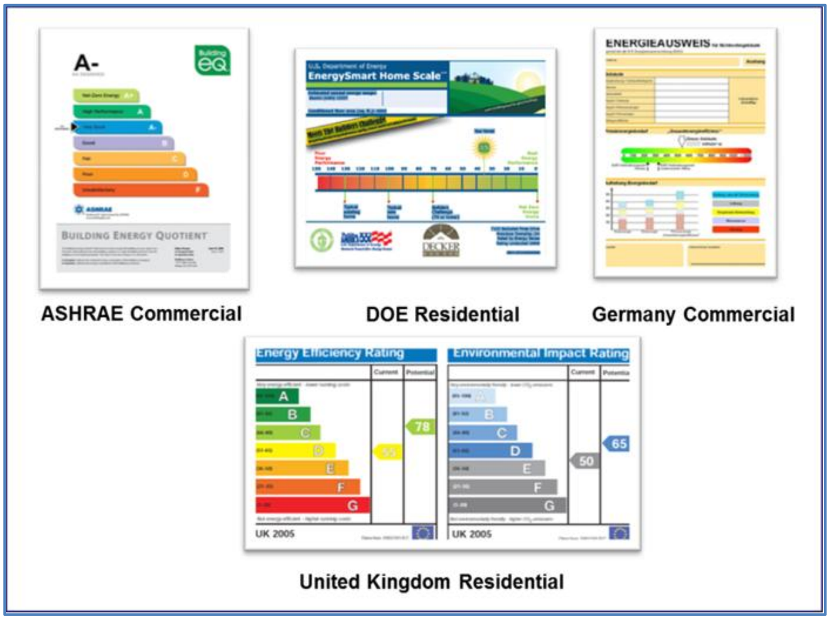

Figure 7.1 Energy Performance Labeling Examples

A study has been recently completed summarizing the EPL experience in all the EU member states at the end of 2010[35]. The ASHRAE Building Energy Quotient[36] labeling initiative is at an earlier stage. It reflects many aspects of the EU program and is mainly focused on non-residential buildings. Resnet[37] has a comparable initiative for homes.

Whatever the final decision on format, the EPL should meet the following criteria:

- Be intuitive in terms of higher or lower performance
- Communicate clearly the energy and GHG performance in numerical/quantitative terms
- Compare the performance against peer properties
- Provide recommendations for cost-effective energy performance
- Have low cost to implement
- Be made available on request to buyers and renters
- Include a credible rectification guarantee if actual performance falls short

An effective, voluntary EPL program needs the engagement of many stakeholders to:

- Provide information and education to residents, realtors, mortgage lenders, property developers and builders about the benefits of EPLs;
- Ensure consistency with City-recommended voluntary EPL guidelines for both new and existing properties;
- Commit all city-owned buildings to publicly post EPLs;
- Seek out early adopters including property owners, developers, builders and property renters;
- Incorporate EPLs in all Scale Projects and neighborhood energy plans; and
- Offer Holland as a state or national pilot, both to attract incentives and to gain possible regulatory exemptions.

[35] http://www.epbd-ca.org/Medias/Downloads/CA_Book_Implementing_the_EPBD_Featuring_Country_Reports_2010.pdf
[36] http://www.buildingeq.com/
[37] http://www.resnet.us/home-energy-ratings

Enabling Mechanism 4: Degree of Community Engagement and Energy Literacy

Holland will establish a process to regularly and systematically measure public understanding of energy use and supply. The results will guide ongoing public energy education and training.

Background

The National Academy of Sciences conducted a 2010 national survey[38], which concluded that the public has a relatively good understanding of recycling issues and transportation choices. However, there were large gaps in understanding energy use in homes and buildings, the potential of energy efficiency, and an overall lack of "energy literacy." Good general knowledge by the community about the complexities of energy use and supply and its impacts on everyday life and future risk is critical to achieving the goals of the CEP.

Energy is intrinsically related to personal and professional decisions involving home and business location, transportation choices, and appliance and equipment purchases and use. Knowing the level of the community's awareness and understanding is a key to the success of the CEP. A community-wide survey could be conducted that would help identify possible areas of improvement around energy literacy. This could provide a tie in to EM5, involving local colleges in collecting and extrapolating the data. They could possibly hold community workshop that would address the areas where improvement is shown to be needed.

The enhancement of the community's knowledge can be accomplished in many ways. Some examples could include holding community workshops through organizations already showing interest in sustainability; direct mail flyers or other media published through HBPW; providing information and examples from the City during community events; and best practice and idea sharing among local businesses such as City Flats Hotel who have taken steps to reduce their energy usage. The last item could also be a process encouraged by the Chamber of Commerce.

Enabling Mechanism 5: Energy Education and Training

Holland will ensure that their college, school and workforce training curricula appropriately reflect the goals and priorities of the Community Energy Plan for decades to come.

Background

Education and training of all citizens should be an ongoing and evolving process. As basic energy literacy grows, programs can focus on more complex concepts to enable sophisticated decision making about energy use. Teaching and training all segments of the population is critical for Holland to achieve breakthrough energy performance.

The 40-year time horizon addressed by the CEP make it important to address all ages using multiple educational resources. Today's adults will start the energy transformations that will be inherited and adapted in the future by today's students. Educational approaches must adapt as technology and opportunities evolve.

Public and Private Schools

Schools have a powerful opportunity to include energy efficiency in individual choices, career opportunities, and future policy. Curricula should be adjusted to raise energy literacy for all ages. Students should also be encouraged to become more involved in the management of energy in their own schools, creating hands-on learning opportunities. This can also be a catalyst to applying their energy knowledge at home.

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[38] http://www.aceee.org5

This is already recognized by Holland Public Schools[39]. Extracurricular programs such as LEAF-Environmental Awareness Group - focus on environmental issues. Build 21, the program developed around school construction, in part focuses on sustainability and is guided by a team comprised of staff and parents. In addition to the more day-to-day items, the School District's Strategic Plan calls on HPS to examine, evaluate and implement energy efficiency measures. Specific retrofits and measures around making new construction more efficient are underway. These will both cut costs and be living examples to the students, parents, faculty and staff.

The Career Center offers courses and apprenticeships in the applied trades. Their vocational training should be adjusted to meet the needs of the CEP and to prepare tomorrow's workforce for the wider opportunities in the energy field.

Hope College

Hope College[40] has a Vision clearly supporting a sustainable view of the future:

- We are striving to meet our present and future needs while minimizing our negative impacts on the ecosystems upon which all life depends.
- In our academic courses, student life programs, campus ministry activities, food services, building and grounds policies, and business operations we seek to be responsible stewards of the earth entrusted to us by God.
- Called to be global citizens, we will engage the world constructively through our teaching, research, and community service in order to shape Hope College into a model of sustainability.

In addition to programs in energy policy, law, business, scientific research, and technology development, the College hosts seminars and lecture series associated with sustainability. In its own operations, it focuses on energy reduction. This is being achieved through lighting changes, more efficient equipment operation, purchase of energy efficient equipment and a wide range of scheduling and operational improvements.

Holland is not the only community developing community-wide energy plans. This trend is already highlighting a shortfall of suitable professionals in energy engineering, energy planning, energy economics, urban planning and policy, alternative energy business development and so on. This presents a significant opportunity to Hope College to adjust its educational offerings, not only to serve the needs of Holland's CEP, but also to raise its attractiveness for future students.

Workforce Retraining

Implementing the CEP will create an immediate need for qualified and trained professionals in multiple sectors, including construction, building operations, finance, planning, energy services, and law. The need for this enhanced expertise will not be limited to Holland and should be seen as a wider opportunity for Holland and be coordinated with other regional training efforts.

Holland should develop a comprehensive understanding of the necessary workforce restructuring. The effort should be sustained by a network of voluntary, academic and public and private professional resources, including non-governmental organizations, trade groups and business associations. Wherever possible, this could be achieved by realigning and reprioritizing existing programs and resources, both to create consistency and to minimize incremental costs.

Areas that require significant changes from current practice can be targeted for focused education, outreach and workforce development programs. These will include efficient construction and operation of buildings, design and installation of integrated energy solutions including smart metering, district

[39] www.Hollandpublicschools.org
[40] www.Hope.edu

heating and distributed heat and power generation. The business aspects of how these are financed and run will also open up new skill requirements, including carbon management.

The companies located in Holland that have significant interests in energy efficient markets are a natural partner to include in this dialogue.

Enabling Mechanism 6: Standards, Codes & Guidelines for Residential and Non-residential Buildings

Holland will ensure that clear current planning, renovation and construction guidelines for homes and buildings that support the energy and greenhouse gas performance targets of the CEP are in place. The guidelines will include district heating connection and specific expectations for larger scale developments.

Background

In 2010, Holland's residential and non-residential buildings accounted for about 45% of the City's energy use and greenhouse gas emissions. To meet the overall energy productivity goals, the CEP calls for efficient renovation, deep retrofits of single-family homes, and more efficient new construction. It also calls for ongoing improvements in efficiency over time. The actual energy performance of buildings will be visible through Enabling Mechanism 3: Energy Performance Labeling.

In Michigan, it is the State that establishes the state-wide building energy codes, not the municipality[41]. During the baseline year of 2010, the applicable residential code was based on the 2003 International Code Council (ICC) International Energy Conservation Code (IECC). In the same year, the applicable non-residential code was ASHRAE 90.1-1999. These are below the U.S. average. Updates have been delayed over numerous legal challenges and there is a convoluted history of implementation in Michigan.

The Michigan State Energy Codes for all new construction was changed in March 2011. Residential codes will now meet the 2009 International Energy Conservation Code, and non-residential will meet ASHRAE 90.1-2007. This brings Michigan in line with the majority of U.S. states and represents at least a 20% energy efficiency improvement from the previous situation. There are no explicit energy standards for major renovations. The State reviews its energy codes every three years. Both IRC and ASHRAE have updated code recommendations. The 2012 IERC is adopted as a national recommendation and will be at least 15% more efficient than the 2009 code. The evolution of efficiency for IERC is summarized in Figure 7.2.

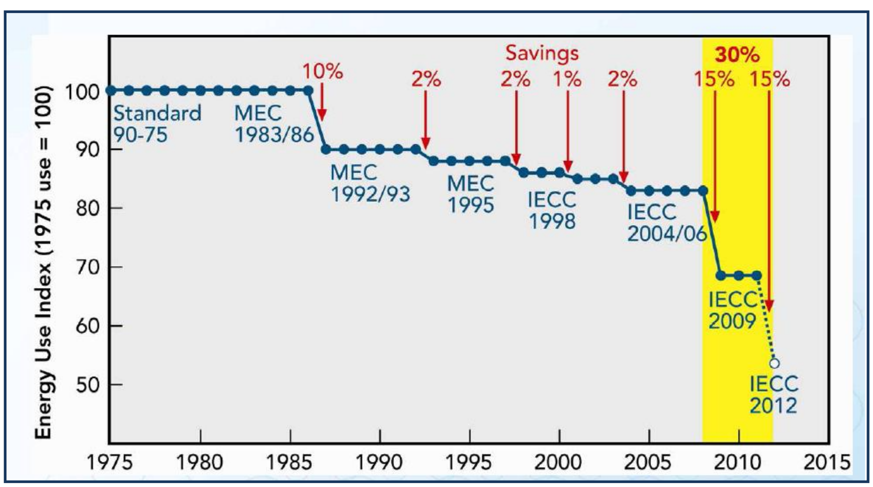

Figure 7.2 History of U.S. Residential Efficiency Codes (IERC)

[41] See http://bcap-ocean.org/state-country/michigan for an independent summary of the background to Michigan State Energy Codes.

ASHRAE 90.1 – 2010 is 25% more efficient than the 2007 code. The evolution of efficiency for ASHRAE 90.1 is summarized in Figure 7.3

Figure 7.3 History of U.S. Commercial Efficiency Codes (ASHRAE)

This background indicates that much of the efficiency gain called for in the CEP could be achieved by rigorous implementation of existing or anticipated codes. The City should establish clear guidelines that lay out their expectations for new construction, recognizing that the formal jurisdiction remains with the State.

For renovation, the city will need to develop guidelines that clearly state the energy performance expectations over time. While not legally binding, they will generally be relatively easy to meet, especially in the first decade or two of the CEP, given the relatively low overall efficiency of the baseline.

The City guidelines will be different for developments that are single large buildings, or that encompass multiple buildings clustered in neighborhoods. These would include a request for an assessment of local distributed supply options or connection to the district heating network if this is a possibility.

Many communities are asking for major new construction or renovation to meet other voluntary ratings such as the ENERGY STAR label, introduced by the Environmental Protection Agency (EPA) for commercial buildings in 1999. Buildings achieving a score of 75 or higher (on a 1–100 scale) are eligible for the ENERGY STAR label, indicating that they are among the top 25% in the country for energy performance, with an average 35% less energy use.

Another widely known rating system is Leadership in Energy and Environmental Design (LEED), developed by the U.S. Green Buildings Council. LEED is not just about energy efficiency as it promotes a whole-building approach to sustainability. Ratings are from LEED certified to LEED Platinum. However, a LEED building need not be more energy efficient than one that is ASHRAE compliant.

If the City anticipates using one of these as a backdrop to the CEP guidelines, they must always be combined with EPLs to ensure ongoing energy performance and market transparency. Unlike the EU's 2008 recast of the Energy Performance in Building Directive (EPBD)[42], none of the U.S. Codes or rating systems specifically calls out the greenhouse gas performance of buildings. The City of Holland guidelines should do this. Again the EPL is the logical tool to gain transparency around this.

There is often concern about challenging property owners, developers and builders with expectations that may exceed the current legal minimum. It has been the experience of the consulting members of

[42] http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2010:153:SOM:EN:HTML

the PWT that the real estate industry is increasingly recognizing the competitive benefits of energy efficient buildings, served by flexible, cleaner energy supplies. Expected objections frequently do not materialize and there is a positive reaction to engaging with a community that is developing a coherent long-term energy strategy.

Enabling Mechanism 7: Institutionalize Long-term Breakthrough Energy Planning and Performance

Holland will put in place the necessary institutional framework to deliver breakthrough energy performance for decades to come.

Background

Once the CEP is finalized and accepted by the City Council, Holland needs to institutionalize the recommended changes. This will require work across all City departments and with numerous community partners. In addition to the initial implementation, the City will need to create a continuous improvement process that is effective and simple. From the City Government side, the following actions are recommended:

- Adopt a resolution to accept the CEP as the basis for the City's long-term energy strategy.
- Develop an Implementation Plan.
- Annually report progress against the seven measures of success.
- Integrate the Implementation Plan into the City's Comprehensive Plan.
- Plan to review and update the CEP as needed.
- Establish a City Energy Advisory Group representing all the major interests of the City. It will help to attract new investments and clean energy businesses, and act as a sounding board and offer guidance for the City and neighborhood teams throughout this effort.
- Consider a position for a City Energy Manager responsible for the overall CEP implementation and reporting.

Enabling Mechanism 8 –Changed Role of HBPW

Holland will establish a process to formally expand the business mission of HBPW to be a full service municipal multi-utility company.

Background

The CEP recommendations include adding district heating in the downtown and a range of utility services in the Industrial Park. The City should formally designate those parts of the City to be serviced by HBPW acting as a Municipal Energy Company (HBPW-MEC). This will be a role distinct from HBPW's role as a regulated electrical utility.

HBPW-MEC has been granted by charter the right to supply thermal (heating and cooling), domestic hot water and snow-melt services by district heating systems on an exclusive basis anywhere within Holland.

Enabling Mechanism 9: Encouraging Regional Energy Planning

Holland will positively engage with Holland Township and other surrounding communities to widen the geographic scope and benefits of the CEP.

Background

The CEP currently focuses solely on the City of Holland. However, there are opportunities for added benefits to the surrounding communities; especially since HBPW already provides service to clients beyond Holland and some utility infrastructure is shared. As the City's CEP activities increase, it is important to seek State-level support to accelerate its success. Holland's leadership in developing the CEP could serve as a catalyst to address regional utility, transportation, and energy use opportunities.

Chapter 8: Role of HBPW as Municipal Energy Company

Background

The recommendations have some very specific impacts on the possible business role of HBPW as a potential supplier of the following services:

HBPW Multi-Utility Services			
Services	**Citywide**	**Downtown**	**Industrial Park**
Electricity	[Green]	[Green]	[Green]
Natural Gas	[Orange]	[Orange]	[Orange]
District Heating	[Orange]	[Green]	[Green]
Domestic Hot Water	[Orange]	[Orange]	[Orange]
Snow Melt	[Orange]	[Green]	[Orange]
District cooling	[Orange]	[Orange]	[Orange]
Process steam	[Red]	[Red]	[Orange]
Process Chilling	[Red]	[Red]	[Orange]
VOC Incineration	[Red]	[Red]	[Green]
Compressed air	[Red]	[Red]	[Orange]
Industry heat recovery	[Red]	[Red]	[Orange]
Solar PV – Own/Operate	[Green]	[Red]	[Green]
End use EPC	[Orange]	[Orange]	[Orange]

Figure 8.1: HBPW Multi-Utility Services – Possible Portfolio

The items in Green are realities and immediate recommendations, and will be those covered in the following paragraphs which outline the ways in which they may adapt the role of HBPW. The Orange items are services that could be delivered in the future. Those in Red are unlikely possibilities.

Establishing HBPW-Municipal Energy Company

The HBPW-MEC would be established as a separate operating company, distinct from the regulated electrical utility. There would appear to be no regulatory barriers in Michigan to establishing a district energy company as long as the diversification clearly did not affect HBPW's ability to fulfill its statutory role.

As summarized in the description of Enabling Mechanism 8, the City would grant HBPW-MEC the exclusive right to supply district energy anywhere in the City of Holland.

HBPW-Municipal Energy Company Ownership Structure

HBPW is currently wholly-owned by the City of Holland. In principle, HBPW-MEC as a separate company could have a different ownership structure. Typical ownership structures seen around the world are summarized in general terms in Appendix 16.

The CEP PWT as a whole is not making any firm recommendation on the ownership structure in part due to possible conflicting interests. The Consulting Team is recommending that serious consideration be given to the following HBPW structure of a City-owned Company

HBPW-MEC would be 100% owned and operated by the City. It would deliver services under service quality and financial terms agreed with the City. It would act as cooperative from a business model standpoint. The obvious advantage of a cooperative structure is the possibility to ultimately return benefits from efficiency and other factors back to the rate-payers of the City. This is an extension of the current HBPW structure.

HBPW has also demonstrated willingness to innovate beyond an “electricity only” business model with the development of the snowmelt system, and the operation of the water and waste water services. With this background, there is no valid reason why public ownership would be in conflict with an innovative service approach.

As long as the HBPW-MEC provides extended service limited by the existing electricity services area, the consultants’ recommendation is for it to remain a public entity. However, the skills that HBPW and HBPW - MEC develop is certain to be of interest to other communities, and as such presents a longer term opportunity. If the decision is made to pursue this future opportunity, HBPW-MEC may consider a public/private partnership or a public/public partnership as the basis for one or more special purpose companies.

Structure of HBPW-Municipal Energy Company

Whichever ownership and control model is finally chosen, the operational business model should be developed that clearly shares the investments and benefits equitably between the property owners, energy consumers, and the HBPW-MEC. Some variation on the following concepts should be used based on successful worldwide practices:

Physical Assets

The MEC could own and operate the following assets that comprise the district energy system:

- Network of highly insulated pipes that carry heating and cooling between supply sources and connected buildings including the necessary various pumps and controls.
- Thermal sub-stations, including heat exchangers, meters and ancillary equipment, to transfer heating and cooling from the network to buildings.
- Low temperature substations to connect snow melt loops.
- The HBPW-MEC parent company would own energy sources and would also purchase the output of sources owned by others under long-term contracts. The definitive configuration will be specific to each district energy area of the City and will change over time. Initially it will include:
    - Existing chillers, boilers and furnaces reassigned to the district energy system.
    - New chillers, boilers and furnaces assigned to the district energy system.
    - Distributed CHP generation.

As the district energy network grows, and depending on cost and technical evolution, other thermal sources may be added to the network including geothermal loops, solar thermal collectors, biofuel heat or CHP, and waste heat recovered from various sources.

The owner of a property connected to the district energy network would no longer own heating and cooling assets. Even if they are still in the building, the district energy assets will be shared across the network (i.e. the horizontal infrastructure, owned and operated by the HBPW-MEC). This reduces the total investment and the operating costs from the perspective of the property owner. This may free up resources for property owners to invest in efficient renovation and above-code new construction.

Revenues/Pricing

District energy heating, hot water and cooling services should be invoiced by the MEC using heating and cooling meters. Prices would be competitive with prevailing heating or cooling equivalents using natural gas or electricity. In a multi-tenant apartment or commercial complex, there would typically be a single tariff meter, supported by low-cost allocation meters, allowing for end-user billing.

Due to the inherent efficiency and the flexibility of district energy to make use of multiple fuels and waste heat, and the long-term nature of the service agreements, the costs for the end-user should be equal or less than business-as-usual. This is consistently the case in the majority of European district energy systems. A specific example is lower district energy heating cost in St. Paul, MN compared to equivalent higher costs in neighboring Minneapolis, MN using individual heating.

Energy Services

The expectation is that project owners for all major renovations, new commercial buildings and apartment blocks could determine what it would take to create district energy-ready buildings as outlined earlier. This will accelerate the rate at which HBPW-MEC could interconnect buildings and gain the operating and economic advantages.

Depending on the specifics of a neighborhood, HBPW-MEC could also invest in the energy assets and heating and cooling interconnection of a single building to make it economically attractive for the developer/owner to make efficiency and interconnection adjustments. HBPW-MEC could then operate these assets and deliver heating, hot water and cooling services to the stand-alone building in anticipation of its future interconnection to the district energy system. It is also important to keep in mind that other potential opportunities with the industrial customers on the Industrial Park. The ability to have HBPW-MEC operates and maintains a plant’s utility equipment has potential benefits to an industrial customer.

Energy Zoning

Mandatory district energy zoning for designated areas is common practice in many cities around the world. The main reason is to accelerate the evolution of the infrastructure and to avoid competition between natural gas and DH infrastructure. Holland could use the combination of district energy-ready development, scale project planning, and City sponsorship to review the option of creating a viable alternative to standard zoning. The positive involvement of major property developers and owners in the evolutionary planning of the City’s district energy strategies could be a crucial factor in any alternative zoning’s early success.

Glossary of Terms

The following is a summary of selected terms and abbreviations used in the CEP Final Report. In some cases, terms are defined in the body of the text and may not be repeated here.

Term	Definition
Air Pollutants	In addition to greenhouse gases, these include: Sulphur dioxide (SO2), Nitrogen oxide (NOx), Hydrogen chloride (HCl), Hydrogen fluoride (HF), carbon monoxide (CC), and non-methane volatile organic compounds (NMVOC).
ASHRAE	The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
Base Case	Forecast of the 2010 to 2050 energy needs assuming no changes in efficiency and fuel mix.
Baseline	Estimation of the present energy use, greenhouse gas emissions, and the prevailing conditions affecting them
Biomass	Vegetation such as wood, agricultural or animal waste, catering waste or landfill gas, etc. with the potential to be used as a fuel. Suitably separated municipal waste may fall into this category.
Btu	British thermal unit (BTU or Btu) is a unit of energy defined as the amount needed to heat one pound of water one degree Fahrenheit. For the purposes of the CEP PWT Report, 1,000 Btus are labeled kBtu, while 1,000,000 Btus are labeled MM Btu.
Building Code	Legally required construction practices.
Building Standard	Voluntary construction practices, generally exceeding code Requirements.
Built Infrastructure	General term referring to all the residential and non-residential buildings in Holland
CAFÉ	Corporate Average Fuel Economy, defined as the sales weighted average fuel economy, expressed in miles per gallon (mpg), for a fleet of vehicles. This is a mandatory standard regulated by the EPA. The 2009 version includes greenhouse gas emissions per mile for the first time.
Carbon Dioxide	The most common form of greenhouse gas. Over 70% of man-made greenhouse gas emissions are from the use of fossil fuels (oil, gas, cola) and are in the form of Carbon-dioxide.
Cap and Trade	Regulatory approach to reduce greenhouse gas and other emissions. The Cap is the maximum permitted emissions. An emitter who emits less than the Cap can sell the difference to an emitter who is exceeding their cap. The price is set by the supply and demand needs in a free market.
Carbon Dioxide Equivalent	Where "e" is used to denote the term "equivalent": Greenhouse effect of the other five greenhouse gases identified in the Kyoto Treaty expressed in equivalents of carbon dioxide. This unit of measure is used to allow the addition of or the comparison between gases that have different global warming potentials (GWPs). Since many greenhouse gases (GHGs) exist and their GWPs vary, the emissions are added in a common unit, CO_2e. To express GHG emissions in units of CO_2e, the quantity of a given GHG (expressed in units of mass) is multiplied by its GWP.
Carbon Tax	Regulatory approach to reduce emission to reduce greenhouse gas emissions by taxing the carbon content of fossil fuels.
Certified Emission Reduction	Generic term used to describe metric ton of greenhouse gas reduction or avoidance that has independently validated certification and can be traded in a recognized regulated market. Certified Emission Reductions come in many forms.
CHP	See "Cogeneration."
City of Holland or City	Entire content including all buildings and entities inside the City of Holland boundaries.
city	Government agency and responsibilities only.
Clean and	This phrase is used to indicate some combination of renewable energy and

Renewable Energy	cogeneration (CHP) energy sources.
CO_2	See "Carbon dioxide"
CO_2e	See "Carbon dioxide equivalent"
Cogeneration	Generating electricity in such a way that most of the heat produced is usefully used. A common definition is that an average minimum overall fuel efficiency of 70% is expected. Peak efficiency would typically exceed 90%. Also known as "CHP."
Combined Heat and Power	See "Cogeneration."
Commercial Buildings	Non-residential buildings; often owned or operated by for-profit entities.
Cooling Degree Days	A measure of how hot a location was over a period, relative to a base temperature. In the CEP PWT Report the base temperature is 65°F and the period is one year. If the daily average temperature exceeds the base temperature, the number of cooling degree-days for that day is the difference between the two temperatures. However, if the daily average is equal to or less than the base temperature, the number of cooling degree-days for that day is zero.
Day lighting	Designing buildings to maximize the use of natural daylight to reduce the need for electricity.
District Cooling	Cooling services delivered via district energy systems.
District energy	Networks that deliver heating or cooling to energy consumers carried through the medium of chilled or hot water, or (in older systems) steam. Heating and cooling is transferred to the home or buildings via a heat exchanger.
District Heating	Heat services delivered via district energy systems.
Electrical Conversion Losses	The difference between the energy values of the fuel used to make electricity and the energy value of the electricity itself.
Energy Performance Label	This would be an easily recognizable benchmark that energy auditors, retrofitters, lenders, realtors, and consumers can use to compare home energy performance and identify the most energy efficient residential and non-residential buildings. It would show how much energy a home or building actually used per utility bills, as opposed to energy modeling which attempts to predict how much energy a home or building would use, and would compare that structure to similar structures.
ENERGY STAR®	Joint U.S. Environmental Protection Agency and U.S. Department of Energy programs **http://www.energystar.gov/** supporting energy efficiency as a cost-effective way to reduce greenhouse gas emissions in home, buildings, industry and equipment.
EPL	See "Energy Performance Label"
EU	European Union
EV	Electric Vehicle
Fossil Fuels	Combustible material obtained from below ground and formed during a geological event. For purposes of the CEP PWT Report, examples of such fuels include coal, oil and natural gas.
GDP	See "Gross Domestic Product"
Geothermal systems (low temperature)	Systems that use the relatively constant temperature of the ground starting about 6 to 10 feet below ground to cool buildings in summer and heat them in winter.
GHG	See "Greenhouse Gases"
Global Warming Potential	A relative measure of the warming effect that the emission of a GHG might have on the Earth's atmosphere. It is calculated as the ratio of the time-integrated radiative

	forcing (i.e. the amount of heat-trapping potential) (measured in units of power (watts) per unit of area (square meters) that would result from the emission of 1 kg of a given GHG to that from the emission of 1 kg of CO_2. For example, the GWP for nitrous oxide (N_2O) is 310, which means that 1 kg of N_2O emissions is equivalent to 310 kg of CO_2 emissions.
g/m	Grams of CO_2 per vehicle mile - term used to describe GHG emissions as they apply to transportation
Green Energy	Energy derived from conservation, renewable sources of energy and clean distributed energy. What energy forms are included varies depending on local jurisdictions and practices.
Greenhouse Gases	A greenhouse gas absorbs and radiates heat in the lower atmosphere that otherwise would be lost in space. The main greenhouse gases are carbon dioxide (CO_2), methane (CH_4), chlorofluorocarbons (CFCs) and nitrous oxide (N_20), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFC) and perfluorinated carbons (PFC). The most abundant greenhouse gas is carbon dioxide (CO_2).
GHG Monetization	Processes to convert tradable energy and environmental benefits into cash or cash equivalents.
Gross Domestic Product	The total value of goods and services produced by a country during a given time period, most commonly a year.
GWP	See "Global Warming Potential"
HBPW	Holland Board of Public Works – City owned utility currently responsible for electricity distribution, water services, sewage and waste water services to the City of Holland. HBPW also serves some customers in surrounding communities.
Heating Degree Days	A measure of how cold a location was over a period, relative to a base temperature. CEP PWT Report, the base temperature is 65°F and the period is one year. If the daily average temperature is below the base temperature, the number of heating degree-days for that day is the difference between the two temperatures.
IECC	International Energy Conservation Code - a model energy building code produced by the International Code Council (ICC). The code contains minimum energy efficiency provisions for residential and commercial buildings, offering both prescriptive- and performance-based approaches. The code also contains building envelope requirements for thermal performance and air leakage. Primarily influences US and Latin American markets.
IEMP	Integrated Energy Master Plan – A comprehensive plan defining the energy efficiency of construction, energy distribution and energy supply to achieve agreed economic, environmental and other goals. Typically an IEMP would cover at least 15 years into the future and would apply to large developments, campuses or neighborhoods.
Insolation	The amount of solar energy received on a surface over a period of time. It is usually expressed in units of kilowatts-hours per square meter (kWh/m^2), "peak sun hours", megajoules per square meter (MJ/m^2) or Langleys (L), for the given period such as a day or hour. $1kWh/m^2$ = 1 peak hour = 3.6 MJ/m^2 = 0.00116 L
Institutional Buildings	Nonresidential buildings generally owned by public administration, education, public or private healthcare facilities and other not-for-profit entities.
KBtu	See "Btu"
Kilowatt-hour	A unit of electrical energy universally used as the basic billing unit and equals the use of one thousand watts of electrical energy in one hour. One kWh is about 3,412 Btu.
Kilowatt-hour Equivalent	A unit of energy from any source equivalent to one kilowatt-hour of electricity. Used to get a standard measurement for comparison of different forms of energy.
KWh	See "Kilowatt-hour"
KWhe	See "Kilowatt-hour equivalent"
Kyoto Treaty	International Treaty sponsored by the United Nations aimed at reducing man-made greenhouse gases through reduced use of fossil fuels and reduced impact forestry

	and agriculture. Signed in 1997 and ratified in 2005 by most industrialized countries accepting mandatory targets; and by many other countries accepting mandatory reporting and voluntary goals.
Leadership in Energy and Environmental Design	A voluntary system for rating existing and new residential and non-residential buildings and neighborhoods based on their overall environmental performance including energy and water use. Developed by US Green Buildings Council, a non-profit group.
LEED	See "Leadership in Energy and Environmental Design"
Megawatt-hour	A unit of electrical energy equals the use of one million watts of electrical energy in one hour.
Megawatt-hour-equivalent	A unit of energy from any source equivalent to one megawatt-hour of electricity. Used to get a standard measurement for comparison of different forms of energy.
Metric Ton	Unit of weight equal to 1,000 kilograms. Often used in the CEP Project Work Team Report as a measure of greenhouse gas emissions. 1 mt = 1.102 US ton (or short ton).
MM Btu	See "Btu"
Mt	See "Metric Ton"
Municipal Energy Company	While individual buildings that are customers in a district energy network are owned by property owners and developers, a Municipal Energy Company (MEC) is an organization that operates and maintains the district energy network, i.e., the horizontal infrastructure of district energy piping and equipment. The MEC can also wholly or partially own the district energy network.
MWh	See "Megawatt-hour"
MWhe	See "Megawatt-hour equivalent"
NGOs	Non-governmental organizations
NREL	National Renewable Energy Laboratory, part of U.S. DOE
OECD	Organization for Economic Cooperation and Development
Per Capita	For each person in the registered population of the City; generally referred to as a resident.
PV	See "Solar Photovoltaic Systems"
Renewable energy	Energy generated from sources other than fossil fuels, most commonly sun, wind, water and various animal and plant derived fuels. These create the least greenhouse gases in operation.
RECS	The U.S. DOE The Residential Energy Consumption Survey (RECS) provides information on the use of energy in residential housing units in the United States.
RPS	Renewable Portfolio Standard
Scale Projects	Developments with the size and timing such that new guidelines in line with the CEP can be applied within relatively large, but contained boundaries. These are projects large enough to capture the combined value of efficient use, efficient distribution, and clean and renewable energy, but are bounded such that benefits can be clearly identified and risks fully understood. They can range from entire mixed-use neighborhoods to single large commercial or institutional developments. Over time, multiple Scale Projects blend together.
Smart Growth	Approach to developing areas of cities to use minimum resources, to maximize social interactions with a balanced mix of demographics, usually associated with creating mixed-use, walk able neighborhoods, often with local distributed sources of energy.
Smart Meters	Energy meters (heat/electricity/cooling/gas) capable of gathering energy use patterns, applying different tariffs depending on time of day and use level, and capable of being integrated into wider information and control systems.
Solar Photovoltaic Systems	Systems that directly convert sunlight into electricity either for use locally or for delivery to the wider grid.
Sustainability	Meeting the needs of the present generation without compromising the ability of

	future generations to meet their own needs.
TOD	See “Transit Oriented Design”
Transit Oriented Design	Land development that takes into account transportation choices as a means of reducing oil and other energy use. Typically it would combine public transit with walk able, mixed-use communities, and approaches to minimize the impact of individual vehicles and commuting.
UNFCC	United Nations Framework Convention on Climate Change
Vehicle Miles Traveled	The distance traveled by vehicles on the road.
VMT	See “Vehicle Miles Traveled”

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Appendix 1
CEP Meetings and Participation

First Energy Town Hall Meeting Summary

January 17, 2011, City Hall, Holland, Michigan

Question/Comment	Response
1. How to educate the public related to the energy activity?	Use of multi-layer approach by informing customers, craftsman, business personal. Everyone needs to be informed in order to share concepts and possibilities that will ultimately form the Community Energy Plan (CEP).
2. Why set a boundary for only the City? Why not use the service boundary of the Holland Board of Public Works?	The focus is not only on electricity. It is also on what we currently can control. We hope to bring others outside of the City of Holland to the discussion but we are not letting this stop us from moving forward. We understand that energy does not have a specific boundary so we hope to get others involved. We have invited members of the City of Zeeland and Holland and Park Townships to attend the discussions.
3. Obviously any energy project needs to make economic sense, but there is also health concerns related to the existing power plant's local pollution.	At this stage there are no conclusions and no specific recommendations. The projects need to be evaluated based on many factors, including the health and other costs of highly inefficient energy usage both in making and using energy. These costs can be extreme. At this stage, we have no comments on the health impacts of any recommendations, but we can be certain that energy efficiency combined with heat recovery greatly diminishes pollution.
4. About 5 or 6 years ago, there was a study done on something similar and now we are finally seeing a plan, efficiency is the key.	Obviously, the consulting team is not familiar with all the details of previous discussions, and energy planning frequently has more than one "take". We need to focus on current opportunities and develop the plan based on current data, recognizing that even in the preceding 6 years; concerns and opportunities around energy in the U.S. have significantly changed.
5. Energy conservation and contractor support are pivotal points.	Absolutely agree. They are keys to a better educated and better served consumer. Throughout the development of the CEP, the Project Team and the Mayors' Task Force will ensure all reasonable efforts are made to engage the community on the role of conservation and to work with the contractor and developer community to get their inputs to the CEP.
6. What was the solar power used for from the Arlington example?	Peak management of electrical power during the summer when demand is greatest from air conditioning and the regional grid is most stressed. In Michigan, with the relatively short cooling season, this peak reduction value is even greater. Arlington will also use some solar thermal (heating) energy for heating and domestic hot water applications.
7. How is Arlington doing on reaching their goals?	Their final plan is not approved yet but it should receive formal approval by the end of March or early April.
8. Is there a lot to gain by consumers choosing to install "green power" or opt to buy it from their utility?	Individual actions are vitally important in any successful CEP. That being said, a few small actions to supply or source "green power" will rarely move the needle at a City level. We prefer to make recommendations that achieve the scale use of clean and renewable energy of all types that truly serve a valuable purpose such as the peak reduction in Arlington, and end up saving money for both the consumer and the City, not the reverse. The honest answer is that mandated green energy policies have a major impact. Areas like Ontario and Germany, where green power can be sold to the grid at special Feed-

	in-Tariff rates, have proved to be an effective stimulus.
9. Closing comments by the SusCom and Mayor.	All residents are invited and encouraged to be an active part of the input and review process at various public meetings.

CEP Focus Forum: Education, Churches and Non-Profit Organizations

January 18, 2011, City Hall, Holland, Michigan

Question/Comment	Response
1. There are toxic chemicals released by the power plant, mercury and other contaminants from coal. Energy alternatives need to address the health costs on society of burning fossil fuels.	At this stage, there are no conclusions and no specific recommendations. The projects need to be evaluated based on many factors, including the health and other costs of highly inefficient energy usage both in making and using energy. These can be extreme. At this stage, we have no comments on the health impacts of any recommendations, but we can be certain that energy efficiency combined with heat recovery greatly diminishes pollution.
2. Lighting retrofits in some churches have been completed and it is important to consider how to get a monetary value for homeowners.	The efficiency gained from lighting is usually a pretty cost-effective first step in improving efficiency of most buildings, and it is good to hear that churches are already embracing this. Gaining wider awareness of this and other energy efficiency measures is certain to be integral in the CEP.
3. How can we be more effective and tie projects together? How much energy do we need and is it a single solution?	We need to analyze how much energy we need and not rely on a single solution. We also need to look at energy use on a neighborhood level recognizing that one solution will not fit all. For this reason we will divide our data analysis into distinct energy planning areas.
4. How will we reach the targets?	We do not know what the CEP targets are yet, but to be world-class they will need to be dramatically different than business as usual. We need to focus on the targets that make sense economically, environmentally, and in terms of reliability, or all of the above. There will be significant community discussions as options are evaluated. We do know that targets will not be reached without wide community engagement.
5. We have concerns over health issues. How will health issues be addressed? Will the recommendations include information about the health impact in the schools?	The official scope of the project does not address specific health issues. However, there will certainly be major energy consumption reductions and more efficient use of all fuels and energy sources. This in turn will lead to large category pollution reductions, which will positively impact health issues. As the CEP process evolves, these health comments will also be reviewed by the City.
6. There are two counties that exceed the EPA limit. What is competitive energy pricing?	On overall energy cost, the expectation is that energy usage will be dramatically lowered which would have an impact on the overall energy cost. Using waste heat also decreases total energy cost. Building energy efficiency improvements and supply efficiency will also reduce overall energy cost. Regarding EPA attainment levels, the same general comments about overall pollution impacts are the same.
7. EPA is stating that wind is a competitive energy source.	In 1981, the U.S. was a major wind supplier worldwide and now it is a relatively small player in a rapidly growing world market. Wind can be a utility-scale generation option in some parts of the U.S., but this is unlikely to be the case near Holland when considering local wind quality. In much

	of the U.S., wind is a small scale option, but with improved regulation it could move forward with one of the key components being market access.
8. We need to tap into some of the school systems that have sustainability forums and use world-class schools and organizations. How do we get the educational groups involved?	There are many moving parts to this process to help improve energy awareness and skills. There is an essence of excitement and there is a fabulous message and how we communicate to the public, especially through our schools, will be a key element of the CEP.
9. Can the power plant be part of our discussions?	Yes, they are involved in the CEP process and all options will be assessed. The information/members for this project are on the City website.
10. Closing comments by the SusCom and Mayor.	All residents are invited and encouraged to be an active part of the input and review process at various public meetings.

CEP Focus Forum: Business

January 18, 2011, City Hall, Holland, Michigan

Question/Comment	Response
1. Is this project for the City of Holland or other outside communities?	The jurisdictional limits of the project only include the City of Holland, but there are requests to have members outside the City of Holland attend the discussions.
2. Is this a community energy plan?	We have not specifically engaged all the other communities but we have invited representatives from the City of Zeeland and Holland and Park Townships to attend the discussions. We hope others will engage with us on this program.
3. Are the benchmark communities in Europe operating under a different sense of governance vs. those in the US?	In Copenhagen, the city core initiated the activity. Municipalities started community energy planning first, not the central governments. Individual energy plans became community energy plans, which then became governmental plans. It is incorrect for people in the US to stereotype actions in Europe, because the European actions are not based on central governmental planning, but instead community/municipal planning which drove the change and development of best practices which are shared.
4. What is the fuel mix in Copenhagen?	The approximate supply is 25% coal; 30% municipal waste-to-energy; 20% biomass; 20% natural gas; and 5% solar PV. The focus is the effective and efficient use of energy source types. Copenhagen used systematic renovation, consumer education and an integrated approach.
5. What were the key measures?	The key items were GHG emissions, energy costs, employment increases which are summed up in competitiveness, reliability/security and the environment.
6. The investment and payback are critical factors to consider, such as in renovating old buildings in downtown to enhance energy reduction. Many opportunities have upfront investments and need to develop a long-term strategy or vision.	Strategies and vision are very important with an energy plan and we will look at many factors and let the data drive the recommendations.
7. Closing comments by the SusCom member.	

Summary CEP Focus Forum: Property Development

January 18, 2011, City Hall, Holland, Michigan

Question/Comment	Response
1. Will the study analyze using water as an energy supply?	The overall loading order stays the same and water initiatives are related more to the 3rd layer. Water could be comparable to the renewable supply alternatives.
2. The League of Women Voters: Moratorium on use of coal in our power plant because it is a health concern. There are health concerns due to children at our high school being sick and we need a safe and cleaner fuel supply.	The City Energy Plan will analyze heat recovery options for the energy supply and the data analysis will guide us to our options.
3. Comments on the study and upgrade to the Police Station Building.	The district heating systems in the US are typically old and not well maintained. Thus there is a perception that all district heating systems are inefficient. Modern systems in Copenhagen use an integrated system approach and are very efficient and less expensive. Education of these types of systems is very important.
4. The Copenhagen energy supply comes from what fuels?	The approximate supply is 25% coal; 30% waste-to-energy; 20% biomass; and 25% renewable and natural gas. The focus is the effective and efficient use of all energy source types.
5. Approximately 35 years ago there was a study completed in Holland for a district heating concept but it never developed.	The district heating approach is unique within the U.S. and benchmarking is important to confirm content and cost. This concept is not new in Europe and operates very efficiently, although new to the U.S.
6. Closing comments by the SusCom member.	

Summary CEP: City Council, Sustainability Committee, Board of HBPW

May 5, 2011, City Hall, Holland, Michigan

Question/Comment	Response
1. What were the assumptions for energy supply cost?	The CEP assessment of costs is “work in progress at this stage”. The assumptions for gas and coal cost based on a market escalation. Price impacts both with and without a carbon penalty will be assessed.
2. What is the estimate of the reliability of the forecast of the results going forward?	Firstly, the key message from the CEP is that setting up the processes that will systematically manage the various levels of the loading order is key. The results are a measure of how well and consistent the process is being managed. The need is to look at efficiency gains first, along with efficient distribution and a portfolio of supply sources. Assuming these processes are put in place, the variation of the expected outcomes is probably plus or minus 20% with the first 20 year range and the importance of keeping the project moving forward.
3. What is the importance of the entire HBPW service area compared to just the City of Holland currently being evaluated, when you focus on capital investment and payback?	The original RFP designated the focus for the CEP to be the City of Holland. The various CEP scenarios, especially as it relates to available electrical supply capacity and assets will create added value outside the City of Holland. By not including the community energy profile outside the City boundaries, the investment returns may be incompletely reflected. The scope of the project

	really needs to be expanded to deal with this issue.
4. What is the European building code standard? •	The current building codes in the European Union are significantly more energy efficient than the current levels in the US. Standards in Europe are well advanced above the US proposed new building standards.
5. Are there any other states stretching themselves to the European building standards?	In the US, California has been consistently more efficient than the rest of the country through the regular mandatory update of their local construction codes. In Canada, the new Ontario Building Code due to be fully enforced by 2012 is getting close to the immediate prior versions of the Scandinavian and German levels. In the US the Californian code is very close to the current German code.
6. What is the cost of HBPW delivered power per kWh?	Larger Commercial customers and Industrial user pay about 6-7 US cents per kWh. Residential and light commercial consumers pay about 9-10 US cents. These are highly competitive levels compared to other areas of the US or global levels.
7. How do we sell this concept due to the costs associated with the project?	Firstly, whatever the final levels of investment and benefits, if there is no community ownership the CEP will not gain traction and the results will not be achieved. There needs to be early adoption, engagement, and development of a detailed implementation plan. The current levels of engagement between the city, community and utility is doing well. Secondly, the early successful implementation of Scale Projects and other recommendations including raising community energy literacy will add to create inertia for wider proliferation. Thirdly assuming energy costs continue to increase, high levels of volatility, or both, the community will naturally become more engaged. So the need is to alleviate that cost, do pilots quickly, and these pilots stand out from others. Currently there is a good combination of city, community and utility involvement.
8. What % of wasted heat can be used for heating systems in this building and what are losses?	Maybe 1 to 2 % of total, concerning the total system losses in Mannheim were 10-12%.
9. What are the differences related to combined cycle vs. solid fuel?	There will be some degradation of the system efficiency but analysis is needed to confirm and a case can be made on either option.
10. There could be changes to the HBPW responsibilities, how to finance projects and what are efficiency improvements?	Need to build on existing framework of the HBPW organization. For residential the supply strategy and loading is similar. Need to confirm the efficiency and the reliability of district heating because it is also very important.
11. With the major nodes for heating such as Hope College can single-family homes also be tapped off of the system?	Yes, typical residential homes can also be tapped off of the system but it is a matter of timing and need anchor tenants, once the core or high density homes are set than can add more homes later, phase in based on priority and timing is critical.
12. When you look at the community as a whole what is the payback?	The focus needs to be implementation in larger quantities and not just do a few projects every year. This changes the overall payback and implementation process.
13. The team took 3-4 months to gather what are the next steps going forward and what is the	The framework and strategy will be complete by August, also there needs to be work done on an implementation

schedule to make a decision?	plan, protocol and timing, so project will not waiver or become stagnant after the initial concept is approved.

Summary CEP Town Hall Meeting

June 20, 2011 7:00-8:30 PM, City Hall, Holland, Michigan

Chairman Stuk of the Holland Community Sustainability Committee welcomed everyone to the meeting and then provided background on the CEP process to date. Stuk then welcomed Peter Garforth and noted that Mr. Garforth was here to describe the preliminary indications, to answer questions and to get public input.

Peter Garforth then provided the public with a presentation as to why the City and HBPW have embarked on this study, why is it critically important, and what do we intend to achieve? After providing the public with a 20-25 minute Power Point presentation, Mr. Garforth then facilitated a 45 minute Q and A session that is summarized with the following:

Question/Comment	Response
1. How does Scenario B align with the International Climate Change Partnership (ICCP) recommendations for 2050?	Scenario B will still provide 2 x more carbon equivalent than the ICCP target for 2050. However, Scenario B will get us well on the way to potentially reaching the target at a future time. Scenario B is an excellent stepping stone.
2. A representative from the Holland Area League of Women Voters read a statement that lays out their support for Scenario B. They believe this scenario provides a more balanced approach for a municipal energy plan that the other scenarios.	
3. What is included in the $135 million that City residents and businesses pay in energy costs per year?	That monetary figure is for fuel to heat buildings, make electricity and fuel our vehicles.
4. Should we still look to reduce our use of fossil fuels even beyond the efficiencies that are being planned for?	Right now over 90% of the electricity consumed in the City is produced using fossil fuels. In Copenhagen, Denmark which is one of the most fuel efficient and low carbon community's in the world, it still derives 25% of its electricity from coal. Holland needs to first of all concentrate on diversifying its fuel mix to produce electricity, and in the future when it is much more efficient than its current state it may go after a total reduction of fossil/carbon based fuels.
5. Public education needs to be a very large component of the CEP. Efficiency is really going to be the key as to whether this plan succeeds, or not.	Agreed that education is central. This is about rationale, flexible ways to meet demand.
6. The 25 largest industries in town use most of the electricity. Are they concerned with the possibility of increasing prices to finance these improvements?	These large industrial users are already very efficient when it comes to their energy use. These industries understand that through vigorous efficiency measures they can actually save very large sums of money. They understand that these same principles can and should be applied to the municipal landscape, thus saving them even more money in the long run by avoiding large capital expenses that otherwise would be included in their electric rates.
7. Is it more beneficial for municipal utilities to be owned by the public vs. investor owned?	Not necessarily. There are plenty of examples of municipal utility systems that are public-private partnerships, and others that are outright owned by private entities, although in the latter case a municipal government would hold a franchise or licensing agreement to require at

	least a baseline level of performance. That having been said, a good municipal utility can go horizontally with an electric and district heating system that would be very difficult for a large investor utility to achieve.
8. What is the cost ratio of providing electricity through efficiency and conservation measures vs. generating additional supply?	Conservation and efficiency measures generally cost only 20-33% of the amount to produce additional capacity.
9. Is data available to show that energy efficient homes are worth more than typical homes?	Prior to the financial crisis of 2008 and the ensuing meltdown of housing markets, there was sales data that indicated additional value for energy efficient homes. That additional value has now virtually disappeared.
10. Is housing energy efficiency almost more important than vehicle gas mileage?	Yes, on a general level the energy efficiency of our housing stock is poor, so there are huge gains in efficiencies to be had in the housing stock.
11. Does it make sense to have more people involved in the generating of electricity on their roof tops and on their property?	Yes, but we need to do the planning for distributed electricity supply by going to very large scales, which has the ability to make a large difference vs. small scale individual systems which a utility cannot plan on.
12. The HBPW needs to move from being a power generation utility to a power management utility.	

APPENDIX 2
ELECTRICITY SUPPLY BY HBPW OUTSIDE THE CITY OF HOLLAND

2.1 Background

The City of Holland Community Energy Plan is aimed at significantly increasing the energy productivity, security and flexibility. The CEP scope as a fully integrated energy plan is limited to the jurisdictional boundary of the City. Under recommended Scenario B, HBPW will continue to own and operate a significant power generation plant that will not only serve the City of Holland, but also provide electricity to a large number of consumers in the surrounding areas. These areas include parts of Holland Township, Park Township, Fillmore and Laketown. For the purpose of this Appendix, the HBPW service areas in these municipalities will be collectively called the "Townships".

To ensure these assets are sized correctly for the entire HBPW service area, the electricity service needs of customers outside the City of Holland within the existing HBPW service have also been taken into account, and have been incorporated into the overall integration of the CEP.

2.2 "Townships" Electricity Baseline – 2010

In calendar year 2010, HBPW supplied a total of 375,199 MWh of electricity to consumers in the "Townships" or about 40% of its total electricity generation.

Sector	Holland Township	Park Township	Laketown	Fillmore	"Townships" Total	City of Holland	HBPW Area Total
Residential	54,864	26,057	4,150	847	***85,918***	102,900	***188,818***
Commercial	126,998	7,949	856	467	***136,270***	171,000	***307,270***
Industrial	152,657	354	-	-	***153,011***	280,100	***433,111***
Totals	**334,519**	**34,360**	**5,006**	**1,314**	***375,199***	**554,000**	***929,199***

Figure A2.1 – HBPW Electricity Deliveries - 2010 Baseline

This data is accumulated from various HBPW metering databases. There were some discrepancies in the consolidation used for the baseline and the overall account data. The system-wide total deliveries were about 3% higher. In the context of Community Energy Plan, this discrepancy was deemed acceptable by the Project Working Team. The summary in Figure A2.1 was accepted as the baseline for the Plan.

2.3 Estimating "Townships" Electricity Demand – 2010 to 2050

The electricity demand for the "Townships" from the baseline year of 2010 to 2050 was estimated on a year-on-year basis using the following assumptions.[1] A basic assumption is that there will be no significant geographic expansion of the HBPW electrical service area over the plan period.

2.3.1 ***Existing Residential and Commercial Buildings – "Townships"***

The mix of existing property in terms of building types, sizes and ages in the "Townships" was assumed to be statistically equivalent of the property mix in the City of Holland (see Appendix 9). It was further assumed that all cooling needs would be supplied by stand-alone electrical compressor chillers.

Existing property would have some significant renovation at a rate of about 2.5% per year, such that by 2050 all property would have undergone some level of renovation. The energy savings gained through building renovation depends on many things. These include customer habits, awareness, contractor skills, incentives, polices fuel prices, etc. In the City of Holland, the adoption of the CEP will create an

[1] At the time of writing (August 2011) the US economy is going through a period where the future outlook is uncertain. This could significantly reduce demand through economic slow-down and even spur deeper consumer efficiency. These extreme uncertainties are not reflected in the balance of this Appendix, and are effectively being treated as a period of turmoil that will stabilize in a year or two.

actively managed improvement in efficiency far above market trends. The efficiency gains in the "Townships" are assumed to follow the overall State and national trends. Clearly this could change if the Townships embrace the rationale behind the CEP in the City of Holland, and the initiative becomes a sub-regional dynamic. Traditionally, most renovations in the U.S. have been primarily undertaken for functional or cosmetic reasons, with energy efficiency being a neglected aspect. This is changing slowly, and as either energy prices increase, or the economy tightens, this is expected to accelerate. In the "Townships" it is assumed that energy savings from renovations will start slowly and increase steadily over time.

The next five to ten years will be less energy efficient as renovations still aim at remodeling or expansion and still frequently miss basic energy efficiency aspects due to contractors and customers habits, perceptions and skills. Considering a stronger awareness, higher fuel prices etc. higher energy savings can be expected in the following years. Therefore, in the CEP calculation, the following development of electricity savings was used as a result of renovations in both homes and commercial buildings:

- 2011 to 2015: 5%
- 2016 to 2025: 15%
- 2026 to 2050: 20%

Renovation in this context embraces a wide range of possible projects. These could range from replacement of an existing inefficient air-conditioner and upgrading a temperature or other control system, to whole room remodeling or functional extensions. It would also include projects specifically aimed at energy saving such as attic insulation and weatherization, replacement of windows and reinsulating and cladding walls, or relighting commercial buildings.

2.3.2 New Residential and Commercial Construction – "Townships"

The rate of new construction is assumed to follow the rate of growth of the population. This data was sourced directly from the staff of the "Townships".

New construction codes are the jurisdiction of the State of Michigan, so the assumption is that the "Townships" will follow the likely evolution of State codes. This is the same assumption that was used in the City of Holland. Michigan typically follows the IECC recommendations for residential and ASHRAE for commercial construction. The State is an average to slow adopter of code changes. The assumed breakpoints for code changes from the current code occur every five years, such that by 2050 the code is nominally 50% more efficient than today.

The enforcement of code compliance is a big topic in a lot of U.S. States. Various studies show that the code compliance is seldom 100%. This means that even at commissioning, new homes and buildings fail to meet the standards of the applicable code. This is before above-code ratings such as LEED and Energy Star Homes etc. are discussed.

The topic is further complicated by the degree to which homeowners and commercial building managers manage ongoing efficiency, and there is a dearth of systematic studies. On an individual building basis the indications are that buildings operate on average 10 to 20% less efficiently than their commissioning level.

Based on information available[2], Oregon and Washington State are the closest to full energy compliance at commissioning; Idaho and Arkansas are in the 50 to 60% range; California is in the 70% range. Unfortunately there is not a published study for every U.S. State.

At least one major company in the building arena does a regular internal assessment and the U.S. average is generally below 70% at commissioning. This information is made available to some State

[2] Desk work and field experience from Ebert and Baumann Engineers – Washington DC

Energy Offices but is not available in the public domain. The City of Holland staff estimate Michigan to be about 65%. A conservative 70% compliance rate has been assumed to estimate the electrical demand for the "Townships" resulting from new construction.

2.3.3 Statutory DSM Programs

The assumption is that the "Townships" will continue with utility managed DSM programs operated under PSC guidelines. These are funded by a "System Benefit Charge". EPRI estimates the cumulative savings to be:

Year	2010	2020	2030
Residential	0.8	3.9	7.8
Commercial	0.4	5.1	8.7
Industrial	0.2	4.0	7.1

Figure A2.2 – EPRI Estimates of Realistically Achievable Potential Savings under DSM

These are the estimates used in the recent Black & Veatch study. Linearized this translates to:

- Residential: About 0.4% per year to 2030
- Commercial: About 0.44% per year to 2030

Between 2031 and 2050, the assumption is that this rate will halve to avoid double counting the compounding impact of renovation. These assumptions were used to estimate the electrical demand of the "Townships" for the residential and commercial sectors.

2.3.4 Industry

In estimating the industrial demand, two assumptions were used. The growth rate of industrial activity was assumed to be the same as for the City of Holland, with the exception of the impact of the lithium ion battery cluster in City of Holland Energy District L01.

The same efficiency gains of 1% per year following commissioning as for the City of Holland were used.

2.3.5 Evolution of Electrical Demand – "Townships"

Based on the above assumptions, the evolution of the electricity demand for the "Townships" is summarized below.

Sector	2010	2020	2030	2040	2050
Residential	85,918	88,045	87,355	86,408	85,374
Commercial	136,270	142,560	143,790	145,264	146,410
Industrial	153,011	167,019	177,210	189,088	201,315
Totals	**375,199**	**397,624**	**408,355**	**420,760**	**433,099**

Figure A2.3 – Estimates of "Townships" Electricity Demand 2010 to 2050

This represents a growth of 15% from baseline, and will be used as part the basis for the estimation of the overall capacity requirements for the CEP for the City of Holland. As mentioned earlier, there is potentially a 3% consolidation error in the baseline, well within the statistical variances of these forecasts.

APPENDIX 3
TEXT OF THE U.S. CONFERENCE OF MAYORS CLIMATE PROTECTION AGREEMENT

The U.S. Mayors Climate Protection Agreement

As endorsed by the 73rd Annual U.S. Conference of Mayors meeting, Chicago, 2005 and signed by the City of Holland under Mayor Al McGeehan on June 18th, 2008

A. We urge the federal government and state governments to enact policies and programs to meet or beat the target of reducing global warming pollution levels to 7 percent below 1990 levels by 2012, including efforts to: reduce the United States' dependence on fossil fuels and accelerate the development of clean, economical energy resources and fuel-efficient technologies such as conservation, methane recovery for energy generation, waste to energy, wind and solar energy, fuel cells, efficient motor vehicles, and biofuels;

B. We urge the U.S. Congress to pass bipartisan greenhouse gas reduction legislation that 1) includes clear timetables and emissions limits and 2) a flexible, market-based system of tradable allowances among emitting industries;

C. We will strive to meet or exceed Kyoto Protocol targets for reducing global warming pollution by taking actions in our own operations and communities such as:

1. Inventory global warming emissions in city operations and in the community, set reduction targets and create an action plan.

2. Adopt and enforce land-use policies that reduce sprawl, preserve open space, and create compact, walk able urban communities;

3. Promote transportation options such as bicycle trails, commute trip reduction programs, incentives for car pooling and public transit;

4. Increase the use of clean, alternative energy by, for example, investing in "green tags", advocating for the development of renewable energy resources, recovering landfill methane for energy production, and supporting the use of waste to energy technology;

5. Make energy efficiency a priority through building code improvements, retrofitting city facilities with energy efficient lighting and urging employees to conserve energy and save money;

6. Purchase only Energy Star equipment and appliances for city use;

7. Practice and promote sustainable building practices using the U.S. Green Building Council's LEED program or a similar system;

8. Increase the average fuel efficiency of municipal fleet vehicles; reduce the number of vehicles; launch an employee education program including anti-idling messages; convert diesel vehicles to bio-diesel;

9. Evaluate opportunities to increase pump efficiency in water and wastewater systems; recover wastewater treatment methane for energy production;

10. Increase recycling rates in city operations and in the community;

11. Maintain healthy urban forests; promote tree planting to increase shading and to absorb CO_2; and

12. Help educate the public, schools, other jurisdictions, professional associations, business and industry about reducing global warming pollution.

APPENDIX 4
CEP MEASUREMENTS AND REPORTING

4.1 CEP Measurements

There are seven recommended measurements areas (see Figure 1.1 in the main report) to measure competitiveness, security and environment. The intentions are that these will be tracked for decades to come on a consistent basis. The key is to have headline indexes that are readily understood by most of the population and do not change over time.

The following matrix indicates a suggested approach:

	Suggested tracking measures	**Comments**
Competiveness		
Energy Cost	• Res: Typical cost per household • Com: Average cost per square foot • Industry: Unit costs (electricity/gas/heating/cooling)	• Tracked against both City performance over time and compared to regional/national/global levels • Should include transportation
Employment	• Jobs in energy-related businesses • Jobs attracted / retained by CEP commitment	• Use Brookings Institute "Green Jobs" definition • Use investor interview data for non-energy related jobs
Investment	• Investments attracted by CEP commitment	• See above
Security		
Supply Security	• Rate of service interruptions	• All utilities offered (heating. cooling, electricity…)
Supply quality	• % compliance with service standards	• See above
Supply Flexibility	• Reserve capacity – supply and distribution • Balance of primary fuels	• See above • Minimize domination by any one fuel
Environment		
Greenhouse gas	• Total GHG emissions CO_2e • GHG Emissions per capita • Industry: Unit indexes (electricity/gas/heating/cooling)	

Figure A4.1 – Suggested CEP Tracking Indexes

These are indicative approaches. Once the CEP has been accepted these will be detailed out as part of the implementation stage. As a general rule, the easier it is to capture the raw data to device the indexes. The above indexes are all relatively easy to capture through either normal utility data, or economic development information. Since HBPW is the recommended basis for the municipal multi-utility business, which potentially could include natural gas as well as district heating and industrial energy services, data capture will be relatively easy. The one exception is transportation, which will probably remain reported on a sample basis from traffic surveys for the foreseeable future.

4.2 CEP Reporting

All cities that have successfully delivered breakthrough energy performance have put in place a discipline to report progress to their key stakeholders on a regular basis. The following is the recommended approach.

The City Manager should report to the City Council at regular public meetings on the following schedule:

- Quarterly:
    - Key initiative updates
    - All tracking indexes except transportation relative to Holland prior performance and targets
- Annually
    - Key initiative updates
    - All tracking indexes except transportation relative to Holland prior performance and CEP targets
    - All tracking indexes except transportation relative to external benchmarks
    - Transportation assessments based on traffic surveys or other best available data
- Triennially
    - Key initiative updates
    - All tracking indexes except transportation relative to Holland prior performance and CEP targets
    - All tracking indexes except transportation relative to external benchmarks
    - Transportation assessments based on current traffic survey
    - Assessment of progress against key CEP strategies
    - Recommendations for strategic adjustments

All reports should be coordinated with HBPW and Economic Development. Quarterly reports should be brief and as routinely prepared as possible, presented in graphic form and available to the general public. The annual reports are essentially the same except they have the external benchmarking and transportation aspects. Somewhere between three and five years the CEP strategy should be assessed and potentially adjusted.

APPENDIX 5
REQUIREMENTS OF MICHIGAN RENEWABLE PORTFOLIO STANDARD

5.1 Summary

Michigan's renewable portfolio standard (RPS), adopted by the legislature and signed into law in October 2008, requires all electric providers in the state to provide at least 10 percent of their electricity using renewable energy sources by the year 2015. In addition, the State's two largest investor-owned utilities—Detroit Edison and Consumers Energy—have an additional capacity requirement of 500 and 600 megawatts by 2015, respectively.

RPS implementation and rulemaking falls under the jurisdiction of the Michigan Public Service Commission (PSC). Renewable energy credits may be used for compliance, and the PSC must select a REC tracking and trading entity to administer the program. Penalties for non-compliance vary depending on the type of electric provider. A cost cap prevents retail rates from exceeding $3.00 per month per residential customer meter, $16.58 per month commercial customers, and $187.50 per month for industrial customers.

5.2 Covered Utilities

The renewable energy generation requirements apply to all electric providers in the State. However, the renewable energy capacity requirements apply only to large investor-owned utilities (with 1,000,000 or more retail customers on 1/1/08 (www.ucsusa.org).

5.3 Timeline

Compliance with the RPS begins in 2012 for all electric providers, and gradually ramps up to 10% by 2015. Each provider has a unique annual obligation based on the amount of its existing use of renewable energy in 2012, and the amount of generation that would be required to meet the full 10% target during the respective compliance year. The applicable percentage obligation for each electric provider begins at 20% of the total 2015 (10%) obligation in 2012. It then increases to 33% of the total 2015 obligation in 2013, 50% of the total 2015 obligation in 2014, and then 100% of the total obligation in 2015, and each year thereafter. There is also a capacity requirement (additional to the generation requirement) for large-scale electric providers. An electric provider with more than 1,000,000 but less than 2,000,000 retail electric customers in Michigan on 1/1/08 must acquire 200 megawatts (MW) of renewable energy by 2013, and 500 MW by 2015. An electric provider with more than 2,000,000 retail electric customers must acquire 300 MW by 2013 and 600 MW by 2015.

5.4 Eligible Resources

"Renewable energy resource" means a resource that naturally replenishes over a human, not a geological, time frame and that is ultimately derived from solar power, water power, or wind power. A renewable energy resource comes from the sun or from thermal inertia of the earth and minimizes the output of toxic material in the conversion of the energy and includes, but is not limited to, all of the following:

- Biomass, which means "any organic matter that is not derived from fossil fuels, that can be converted to usable fuel for the production of energy, and that replenishes over a human, not a geological, time frame
- Solar and solar thermal energy
- Wind energy
- Hydroelectric, defined as kinetic energy of moving water, including water released through a dam and waves, tides, or currents
- Geothermal energy

- Municipal solid waste (at facilities brought into service before October 2008)
- Landfill gas produced by municipal solid waste

Subject to certain conditions and Public Service Commission approval, electric providers may use energy efficiency or advanced cleaner energy resources (gasification, industrial cogeneration, coal gasification with carbon capture and storage) to meet up to 10% of their annual requirement. Up to 10% of an electric provider's obligation may be met using a combination of energy efficiency measures and advanced clean energy resources (gasification, industrial cogeneration, coal gasification with carbon capture and storage), and no more than 70% of the 10% limit may be met using advanced energy systems in existence on or before January 1, 2008. Energy efficiency credits may be substituted at a one to one ratio to renewable energy credits, while most advanced energy credits are substituted at a ratio of 10 to 1. Exceptions to this are industrial cogeneration and plasma arc gasification, which are credited at a one to one ratio.

If a renewable energy system uses both a renewable energy resource and a non-renewable energy resource to generate electricity, eligibility shall be based on the percentage of the electricity generated from the renewable energy resource.

APPENDIX 6
DATA AND ASSUMPTIONS USED FOR TRANSPORTATION

6.1 Baseline 2010 Vehicle Miles Travelled (VMT)

There was no recent study for traffic in Holland. To assess VMT for the CEP, the following sources were used:

- Ottawa County Vehicle Miles Travelled by Road Type - 2009
- Michigan Travel Activity by Vehicle Type – 2009
- Michigan DOT Ottawa County Road Map – 2009
- US Census Bureau data for Holland and Ottawa County

These were cross indexed to create the breakdown shown below:

	Interstate	Arterial	Other	Totals
Motorcycle	324	296	98	***718***
Car & Light Truck	72,673	138,482	46,053	***257,208***
Truck and Semi	7,859	9,025	3,001	***19,885***
Bus	162	148	49	***359***
Totals	***81,018***	***147,951***	***49,202***	**278,171**

Figure A6.1 – 2010 VMT by Vehicle Category and Road Type (thousands)

Vehicle mix breakdown is by the use on Holland's roads, not the ownership by Holland's residents.

6.2 Baseline 2010 Transportation Energy and Emissions

There was no community or state specific data available for vehicle fleet average efficiencies. The U.S. EPA 2009 efficiency estimates by vehicle category and fuel type were used.

Vehicle Type	% Diesel	mpg
Motorcycle	0.0%	56.1
Car	0.7%	25.8
Light Truck	5.2%	19.2
Bus	96.5%	5.9
Truck	91.3%	6
Semi	100.0%	5

Figure A6.2 - Vehicle Type Efficiencies and Fuel

To estimate greenhouse gas emissions, again the EPA sources were used (see: http://www.epa.gov/oms/climate/420f05001.htm#carbon). The indexes used were 8.79 kg CO2e per U.S. Gallon for gasoline and 10.08 kg/gallon for diesel.

6.3 Base Case 2010 – 2050 Transportation Energy and Emissions

The following assumptions were used to establish the base case for energy use and greenhouse gas emissions from the transportation sector between 2010 and 2050:

Item	Note / Value
Transport – MCycle Efficiency/emissions	56.1 mpg / 157 g CO2e/mile
Transport – Car Efficiency/emissions	25.8 mpg / 341 g CO2e/mile

Transport – Lt Truck Efficiency/emissions	19.2 mpg / 461 g CO2e/mile
Transport – Bus Efficiency/emissions	5.9 mpg / 1,701 g CO2e/mile
Transport – Truck Efficiency/emissions	6.0 mpg / 1,662 g CO2e/mile
Transport – Semi Efficiency/emissions	5.0 mpg / 2017 g CO2e/mile
2050 Vehicle mix	Unchanged
2050 Vehicle fuel mix and types	Unchanged – 100% gasoline or diesel
2050 Vehicle efficiency by types	Unchanged from 2010 averages
VMT Growth due to population	0.54% / year
VMT growth due to local employment	0.25% / year - incremental

Figure A6.3 - Base Case Efficiencies and Fuel

No electric or hybrid vehicles were assumed in the Base Case.

6.4 Scenario Case 2010 – 2050 Transportation Energy and Emissions

The future evolution of transportation energy use was based on seven strategies, each affecting the overall fuel efficiency of each VMT, or the impact on total VMT. The same seven strategies were applied to all CEP Scenarios (A, B, C and D).

6.4.1 __Strategy 1 – Evolution of Materials Technology__

Irrespective of changes in vehicle style choices and travel patterns, the global automotive industry is under regulatory pressure to increase average fleet efficiencies. Examples are the recently announced U.S. target to achieve nearly 55 mpg by 2025, and the EU target to meet 90 grams CO_2/km by 2020. There is a major push to incorporate advanced composites and lighter metal structures. Over the plan period these will reduce the weight of light vehicles by at least 30%, and 20% for heavier vehicles, resulting in 21% and 14% fuel efficiency gains, respectively.

6.4.2 __Strategy 2 – Evolution of Drive Trains__

The same regulatory pressure on efficiency is moving the trajectory of the market to drive trains with higher efficiencies. These include clean diesels, gasoline and diesel hybrids combined with more sophisticated fuel management. By 2050 this will have had a further 30% impact on LV efficiency and a 20% impact on HV efficiency.

6.4.3 __Strategy 3 - Change of Vehicle Mix__

Irrespective of the technology represented by strategies 1 and 2, the average weight of the fleet will reduce. This will be a continuation of the trend already underway as consumers purchase more “cross-overs” (station wagons), hatchbacks and smaller SUVs. This is driven by the demographics of smaller families, urban convenience, fuel price concerns and increased marketing as auto companies adjust their sales to meet fleet average efficiencies. By 2050, this will have a further 30% efficiency impact on LVs and have no impact on HVs.

6.4.4 __Strategy 4 - Change of Commuting Patterns__

Thriving local employment will reduce average commuting for residents. There are no structured transportation studies to quantify this, so the impact on VMT is based on a best estimate of 5% reduction for light vehicles only. There is no significant impact for HVs.

6.4.5 __Strategy 5 - Impact of Urban Design__

In Holland there will be some modest degree of urban densification, probable extension of the snow melt and walk able neighborhoods. Combined these will modestly reduce VMT for light vehicles. There are no structured transportation studies to quantify this, so the impact on VMT is based on a best estimate of 3%.

6.4.6 *Strategy 6 - Reduction of Carbon Content*

The availability of environmentally benign biofuels derived from agricultural waste, forest byproducts and algae is a high probability evolution over the coming decades. The outlook used in the CEP is based on both EU and U.S. estimates. This only impacts the greenhouse gas emissions, and is assumed to have a GHG impact of 10% for all vehicle classes by 2050.

6.4.7 *Strategy 7 - Use of Electric Vehicles*

The use of EVs or plug-in Gas/Electric and Diesel/Electric Hybrids will increase. These vehicles will be the market for the major new industries establishing operations in Holland, so this is an area where the City has both local energy and community economic development interests. The outlook is based on a PWT conservative assumption. The EV share of all VMT for cars will be 7% by 2050 starting in 2013. The average efficiency of an EV is assumed to be constant at 32 kWh/100 miles (20 kWh/100 km) a level slightly better than the NISSAN Leaf today. The emissions level caused by the EVs is based on the electricity mix of the City of Holland grid and is different depending on the CEP scenario used.

6.5 Other Transportation Inputs to the 2010 Baseline

There were some other pre-existing City inputs to the transportation energy baseline that were considered:

- Existing bike paths
    - While valuable, the use and extent of the bike paths was not considered statistically significant to the transportation Base Case at this stage.
- Biofuels
    - A useful pilot program is underway with some selected city vehicles to evaluate the efficiency and maintenance impacts of using biodiesel. Again this is not statistically significant for whole City modeling. The biofuels impact is incorporated in “Strategy 6”.
    - Some of the city vehicles are “flex-fuel” capable, but appear to be conventionally fuelled.
- Street lighting and traffic signals
    - Traffic lights and some street lights are high-efficiency LED, maintained by HBPW. These are not metered. An estimated 2000 MWh has been incorporated into the overall electricity demand of the City.
- Electric vehicles
    - There are current plans in the City for 15 to 20 EV Charging Stations which have not yet been implemented. This would be consistent with Strategy 7 above, and it may make tactical sense to team the effort with LG Chem and JCI Saft.

APPENDIX 7
BASELINE AND BASE CASE ENERGY MAPS BY ENERGY DISTRICT

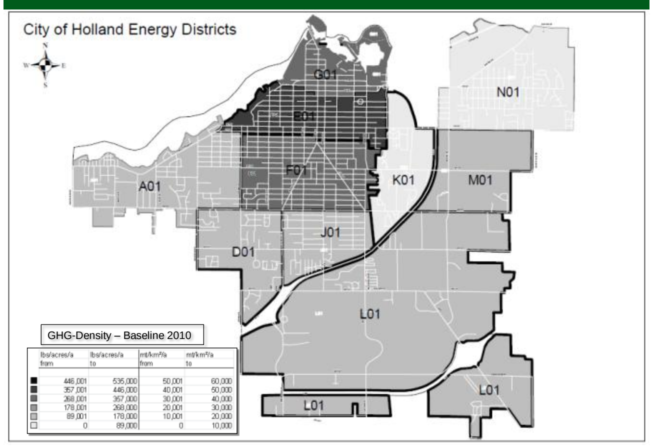
7.1 Background to Energy Districts

The use of Energy Districts (ED) to gain an insight as to the current and future distribution of energy demands and emissions in the City was described in Section 3 of the main report. A detailed inventory by building type, along with an estimate of future evolution was developed for each. The energy demand and supply for heating, cooling and other electricity was modeled for both the 2010 baseline and the Base Case to 2050. The Base Case models assumed electricity was use for cooling, and natural gas for heating. In the Base Case the Coefficient of Performance (COP) used for converting cooling demand to electricity is 0.4, and to convert heating demand to natural gas is 0.8.

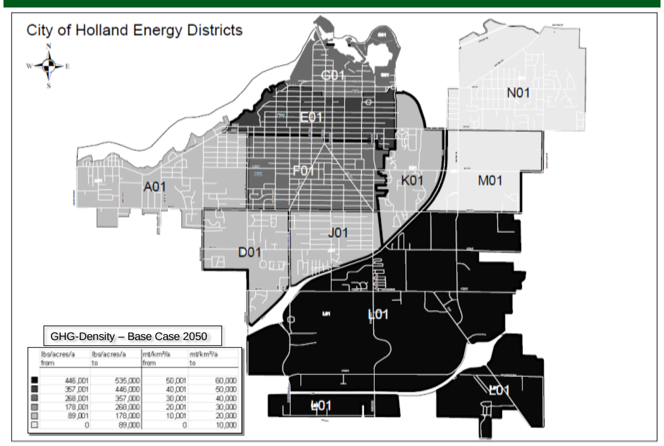
The impact in terms of greenhouse gas emissions was also estimated. This appendix contains the maps showing energy or emissions densities relative to the total area of each ED. A darker color is a higher density of energy or emissions per square mile. Large print versions are available on demand from the Project Working Team.

7.2 GHG Emissions Mapping

Baseline GHG Emissions 2010

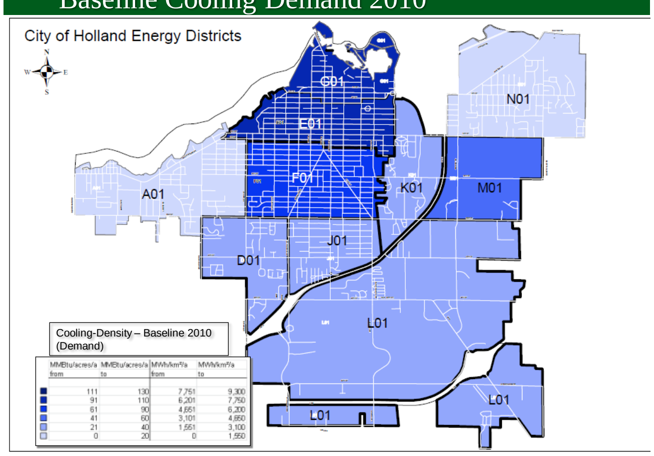


Base Case GHG Emissions 2050

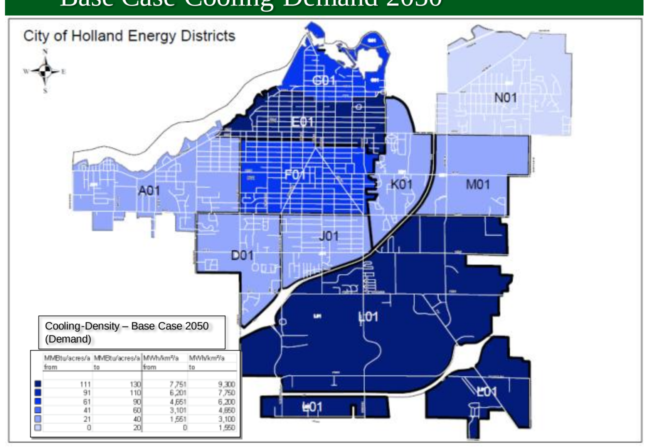


7.3 Energy Demand Mapping

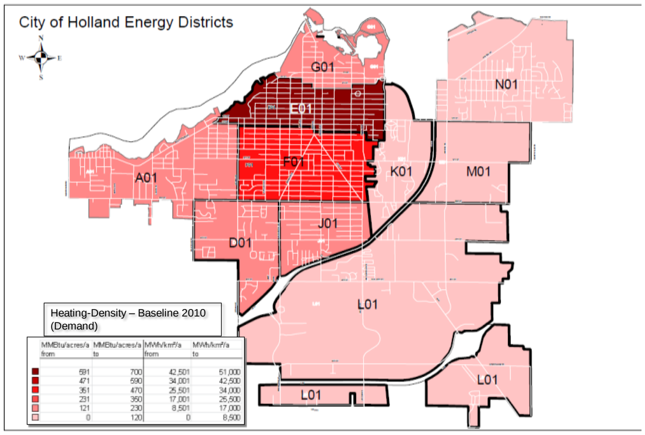
Baseline Cooling Demand 2010



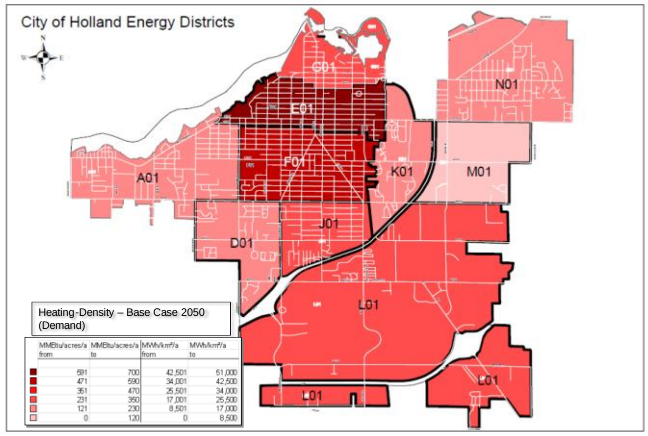
Base Case Cooling Demand 2050



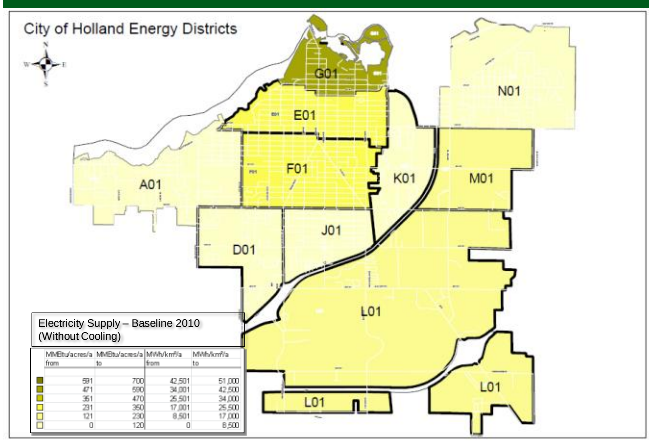
Baseline Heating Demand 2010



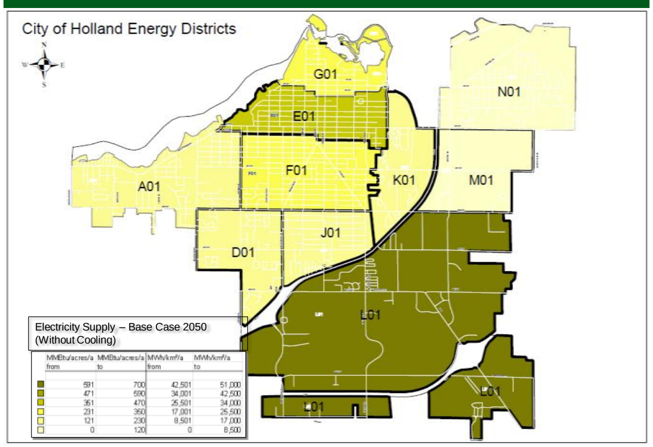
Base Case Heating Demand 2050



Baseline Other Electrical Demand 2010

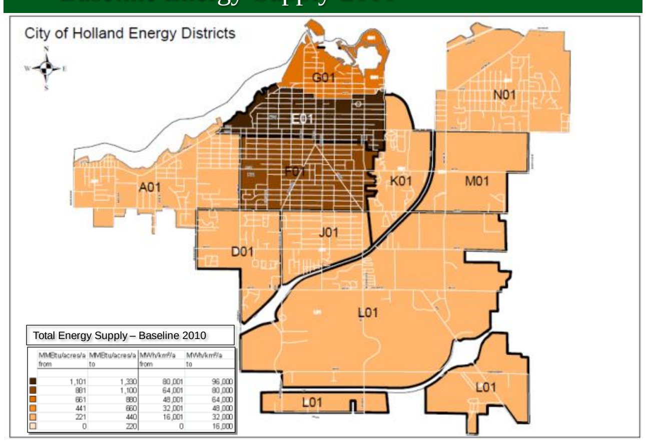


Base Case Other Electrical Demand 2050

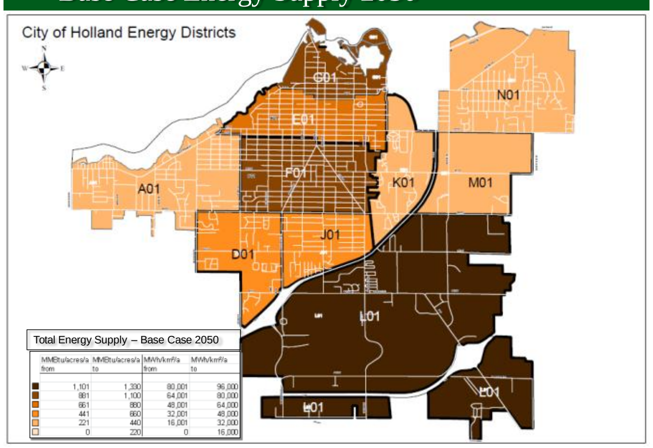


7.4 Energy Supply Mapping

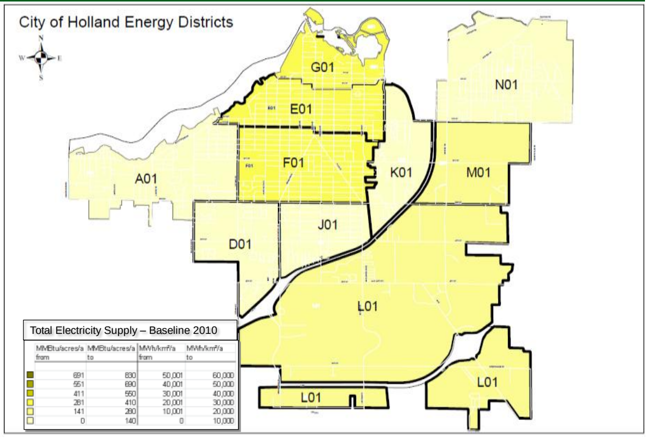
Baseline Energy Supply 2010



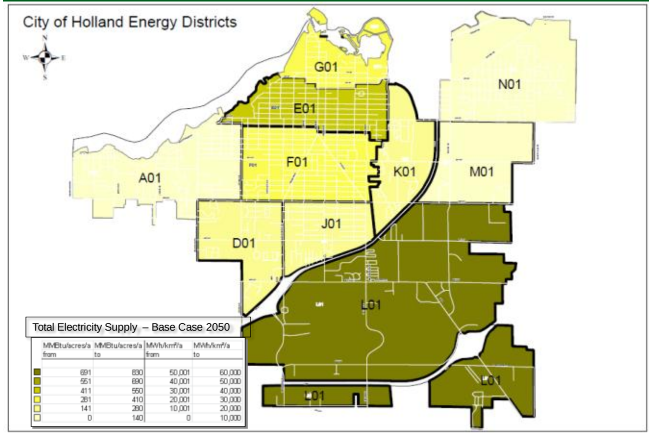
Base Case Energy Supply 2050



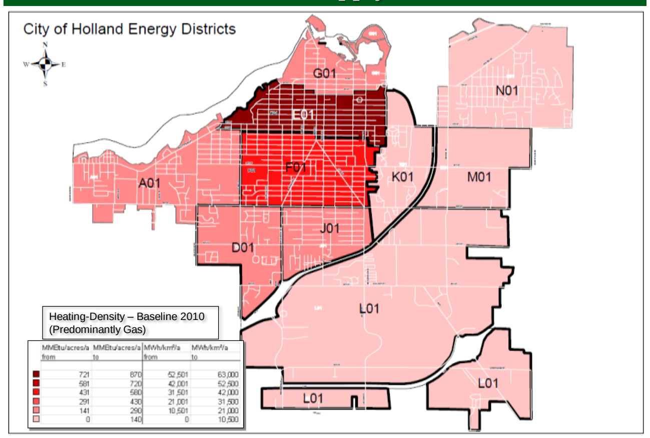
Baseline Electricity Supply 2010



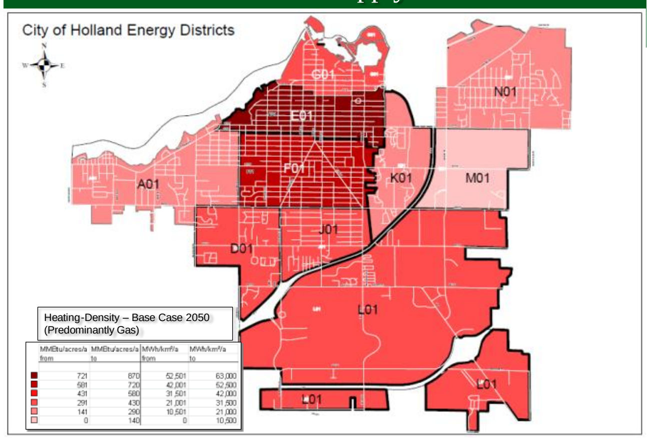
Base Case Electricity Supply 2050



Baseline Natural Gas Supply 2010



Base Case Natural Gas Supply 2050



APPENDIX 8
EXISTING HOLLAND AREA SUSTAINABILITY COMMITTEE INITIATIVES

The Holland Community Sustainability Committee (HCSC) was organized in 2009 under the auspices of the Board of Directors of the Holland Board of Public Works (HBPW) as well as the Holland (MI) City Council. Both the City of Holland and the HBPW recognized the realities of a changing environment—a changing ecology with implications on this community's economic, social and environmental landscape.

The HCSC is guided by a charter with instructions to study, gather input, raise awareness, and provide recommendations back to the HBPW and the City of Holland regarding sustainability issues and challenges as well as best practices found in similar communities. Specific issues on which the HCSC is to advise the HBPW and Holland City Council include: energy conservation, efficiency and supply; implementation of the City facility energy audits; air quality; waste recycling and reduction; water quality and conservation; and transportation. To date, the HCSC has been focusing their efforts in the areas of energy management and water management with the majority of their time focused on the Community Energy Planning process.

The HCSC has also been diligently working on a framework approach to the preparation of a broad based Community Sustainability Plan using the STAR Community Index approach of ICLEI as a guideline. The HCSC has drafted a Sustainability Statement for the Community as follows:

> The Holland community is a caring and thoughtful group of people with a deep interest in the natural, economic and human environments. The relationships of people to one another and their community are strong and based in the historical faith and family traditions. It is the desire of the City Governance to embrace and support sustainable practices in all aspects of the city operations and community actions. We will approach sustainability with a triple bottom line evaluation approach. Social, environmental and economic evaluations should be used to review ideas and direct decision making. While we will begin with the activities within the city we recognize that true sustainability must be a regional, multi governmental, broad social and economic activity.

Identified sustainability focus areas are aligned under the three aspects of the Triple Bottom Line as follows:

Society

Quality of Life

Ultimately it is the feelings and state of mind of individuals in the collective that make up a community's quality of life. The community through governmental, religious, business and social organization make decisions and support actions that contribute to the community's wellbeing.

Community & Neighborhood

The fiber of our lives can be traced to the places we live and the individuals we interact with on a daily basis. The places we live support the development of our personalities and perspectives on life. Communities at all scales have a vital role to play. Encouraging vital and effective communities is an important element.

Community Knowledge

The collective knowledge of the community is an incredible resource. The ability to tap into this intelligence is essential for continued growth. In both formal and informal channels the community knowledge and energy must be channeled to where it is needed.

Environment

Environmental Awareness/Action

The natural and built environments interact with one another over time with intended and unintended consequences. Our history is one of exploiting the natural environment and ignoring the results. The effects of a healthy natural ecosystem are clear and our ability to reverse impacts is limited.

Smart Energy

Our way of living requires a stream of energy to operate personal and infrastructure devices. We know that energy is produced with scarce resources and the byproducts impact our environment. We need to use both conservation and efficiency measures to manage the resources we have to provide access to reliable and cost effective energy.

Transportation

The movement of people, goods, and services within the area is an evolving process. We interact with other regional, national and international elements to create a total network.

Economic

Economic Development

The business community is the driving engine within the area. While it is dependent on the community resources and structure for support, it generates capital essential to growth and development. Holland will be a location of choice for new business and industry.

Information regarding the ongoing activities of the HCSC may be accessed at: **http://www.cityofholland.com/sustainability/sustainability-committee-members**

APPENDIX 9
BUILT ENVIRONMENT ENERGY NEEDS

9.1 Background

This Appendix summarizes the multi-dimensional process used to evaluate the current and future energy needs of the existing and new residential and commercial buildings in the City. This Appendix also elaborates on the process used to assess the energy service needs of industry. Collectively the CEP uses the term “Built Environment” for the residential, non-residential and industrial structures in the City.

9.2 Baseline Energy Supply and Demand

A detailed inventory of all current structures in the City was available from the excellent GIS system, which gave the type, location, age and size of each property. For the purpose of estimating the total energy demand of the City, buildings were grouped in the following categories:

Category	Subcategories
Single-family Homes - detached	Pre & post 1980; heat only; heat & cool;
Single-family Homes - attached	Pre & post 1980;
Multi-family Home	Pre & post 1980;
Freedom Village	None = single complex
Mobile Home Park	None = single complex

Office	Pre & post 1980;
Retail	Pre & post 1980;
Retail (mixed)	Pre & post 1980;
Hotel	Post 1980
Aquatic Center	None = single complex
Industrial	None
Schools	None = Homogenous category
Hospital	None = single complex
Hope College	None = single complex
Churches	None = Homogenous category
Wesleyan Church	None = single complex

Figure A9.1 - Building Categories and Sub-categories

Item	Value
Residential – Single-family homes	7,433 homes
Residential - MFH/Town House/Duplex	5,125 homes
Residential – Total area	15.4 M sq ft
Non-Residential – Offices & Retail 2010	6.7 M sq ft
Non-Residential – Institutional & Recreational 2010	4.6 M sq ft
Industrial property – 2010	12.5 M sq ft

Figure A9.2 - City Built Environment Basic Data

The energy demand for the residential, retail and office categories was modeled using EnergyPlus Version 6.0.0 tools. The other categories were benchmarked against their relevant peer grouping in the DOE database. The energy demand was broken down into the following uses: cooling, heat rejection, heating, fans, pumps, equipment, interior lighting, exterior lighting, domestic hot water, and industrial process.

Model (IP)	Space Cooling	Heat Rejection	Space Heating	Fans	Pumps	Equipment	Interior Lighting	Exterior Lighting	Process	Domestic Hot Water	Total
	Site Energy (Gas & Electricity)										
	MMBtu/a	MMBtu/a	MMBtu/a	MMBtu/a	MMBtu/a	MMBtu/a	MMBtu/a	MMBtu/a	MMBtu/a	MMBtu/a	MMBtu/a
SFHd-pre1980 Heat only	0	0	494,993	0	308	123,777	46,592	4,806	0	29,680	700,155
SFHd-pre1980 Heat and Cool	7,499	0	150,555	16,811	0	21,979	8,273	853	0	9,373	215,343
SFHa-Pre1980	3,818	0	64,284	3,421	0	9,872	3,721	2,238	0	4,270	91,623
SFHa-Post1980	4,941	0	41,234	2,712	0	16,807	6,336	3,810	0	6,405	82,243
MFH-Pre1980	2,307	0	19,828	3,801	0	5,816	4,760	320	0	5,417	42,248
MFH-Post1980	2,008	0	18,451	2,865	0	8,492	6,950	468	0	6,621	45,854
Freedom Village	1,465	0	15,539	2,766	0	8,197	6,708	451	0	4,829	39,954
Mobile Home Park	118	0	1,985	125	0	360	136	82	0	132	2,937
Type B	0	0	0	0	0	0	0	0	0	0	0
Office-pre1980	4,650	0	19,612	7,415	0	8,804	10,301	2,182	0	903	53,868
Office-post1980	3,562	0	15,592	5,925	0	7,820	9,149	1,938	0	788	44,773
Retail-Pre1980	11,465	0	82,201	15,306	0	7,190	50,727	9,945	0	0	176,834
Retail-Post1980	6,375	0	48,894	9,302	0	4,749	33,507	6,569	0	0	109,397
Retail(mixed)-pre1980	1,741	0	10,960	2,952	0	2,640	7,460	1,591	0	471	27,814
Retail(mixed)-post1980	115	0	646	203	0	207	584	125	0	36	1,915
Hotel-post1980	2,623	0	2,947	1,193	9	4,351	5,251	1,405	0	3,341	21,121
Aquatic Center	1	0	12,662	3	0	4	4	1	0	626	13,301
Type D	0	0	0	0	0	0	0	0	0	0	0
Industrial	59,864	0	573,055	144,169	0	188,220	220,258	48,056	295,266	8,009	1,536,898
Schools	3,433	0	61,284	8,538	0	11,268	13,183	2,792	0	3,029	103,528
Hospital	22,169	1,230	6,163	4,794	1,956	8,681	11,114	434	0	352	56,892
Hope College	9,776	0	90,933	11,527	0	34,163	27,957	1,881	0	31,904	208,141
Church	423	0	3,618	499	0	1,478	1,209	81	0	1,270	8,578
Mega Church	565	0	4,831	666	0	1,973	1,615	109	0	1,695	11,452
City	803	0	19,889	1,998	0	2,637	3,085	653	0	162	29,227
All Others	0	0	0	0	0	0	0	0	0	0	0
Type F	0	0	0	0	0	0	0	0	0	0	0
Type G	0	0	0	0	0	0	0	0	0	0	0
Type H	0	0	0	0	0	0	0	0	0	0	0
Totals	***149,721***	***1,230***	***1,760,155***	***246,988***	***2,273***	***479,486***	***478,879***	***90,789***	***295,266***	***119,309***	***3,624,096***

Figure A9.3 - 2010 Residential / Commercial Baseline in MMBtu per Year

Cooling demand was converted to electricity using a Coefficient of Performance of 0.4, and heating/DHW was converted to natural gas with a COP of 1.25.

Electricity metering data was available by the same parcels so could be matched to individual properties in most cases. The data was also made available by Energy District. Natural gas data was also available by property category and Energy District. This unusually detailed level of community energy metering allowed the computer modeled energy demand for various technical functions in the building to be matched against the supplied electricity and gas. The correlation was in the range of 0.8 to 1.4, which for a total community level plan is very high.

9.3 Base Case Energy Supply and Demand

The Base Case energy demand and supply from 2010 to 2050 was estimated using similar modeling approaches with the following assumptions:

Item	Value
2010 / 2050 Population	33,100 / 41,000
2010 / 2050 Employment	15,100 / 28,400
Employment growth – first 5 years ~ after that to 2050	3.7% /year ~ 1.3% / year
Existing Buildings efficiency 2010 to 2050	Unchanged
Residential new construction 2010 to 2050 code assumption	IECC 2006 fully compliant
Commercial new construction 2010 to 2050 code assumption	ASHRAE 90.1 (2004)
Residential SFH – detached growth to 2050	0.35% / year
Residential SFH – attached growth to 2050	1.56 % / year
Residential MFH – growth to 2050	1.06% / year
Commercial Buildings – growth to 2050	1.2% / year
Institutional Buildings – growth to 2050	1.3% / year
Cooling technology	Electric stand-alone

Heating / DHW technology	Natural Gas stand-alone
New construction year on year mix - growth/replacement through 2050	90%/10%
Industrial growth – battery plants – all energy types	Nissan benchmarks
Industrial growth – other electricity	HBPW Estimate
Industrial growth – heat / DHW	% as electricity
Industrial efficiency	As installed

Figure A9.4 - Built Environment Base Case Assumptions

The efficiency of existing buildings was assumed to retain their 2010 baseline performance for as long not the future as they existed. This is an optimistic assumption since, as a general rule, building energy performance deteriorates over time.

New buildings were assumed to be fully compliant from an energy standpoint with the Michigan Code in force in 2010 (IECC 2006 / ASHRAE 90.1 (2004). In general, actual construction fails to meet these standards by as much as 35% (See Appendix 2 for more background), making this again an optimistic assumption, at least in the first years.

As with the baseline, cooling demand was converted to electricity using a COP of 0.4, and heating/DHW to natural gas with a COP of 1.25.

9.4 Scenario Case Residential and Non-Residential Energy Demand

The baseline modeling highlighted major areas of potential efficiency in the residential and non-residential buildings in the City. Enabling Mechanism 3 will ensure the wide adoption of energy performance labels that will validate the Scenario Case energy performance of buildings. Enabling Mechanism 4 will be the basis to raise awareness of the workforce and population of energy efficiency and benefits.

9.4.1 Renovation of Existing Buildings excluding Single-family Homes

The market norm in the U.S. is for an average of between 2 and 3% of the existing buildings to be renovated in some way each year. The CEP assumes 2.63% per year, chosen to ensure all property in the City has had some degree of renovation by 2050. The range of renovation will be wide. These could range from replacement of an existing inefficient air-conditioner or furnace or upgrading a temperature or other control system, to whole room remodeling or functional extensions. It would also include projects specifically aimed at energy saving such as attic insulation and weatherization; replacement of windows; reinsulating and cladding walls; and relighting in commercial buildings.

Multi-family homes will be renovated and operated more efficiently than the baseline against the following schedule:

Building type/Energy Type	2013-2017	2018-2022	2023-2050
Office/Retail/ MFH			
Electricity	30%	30%	30%
Heating	30%	40%	50%
Public Buildings			
Electricity	30%	30%	30%
Heating	30%	40%	40%

Figure A9.5 - Renovation Efficiency Rates – MFH and Non-Residential

9.4.2 Renovation of Single-family Homes

The baseline revealed that the 7,433 single-family homes in the City had a very high efficiency potential, giving rise to the focused renovation strategy outlined in the main report, and supported by Scale Project 2.

They will be renovated in two phases: “Moderate” and “High Efficiency”.

Phase 1 - The first phase will take place between 2013 and 2033 with a “Moderate” retrofit package. Moderate represents changes that can be made fairly easily to the existing building. The typical package would include the following measures.

M - Interior Lighting and Appliances

The first place to look at reducing energy usage is with the interior equipment and lighting. For the moderate case only the lighting was reduced. This was done by changing incandescent light bulbs to energy saving florescent light bulbs. These are readily available and reduce the energy consumed by the lighting fixture by 80% (20W florescent bulb is the equivalent of a 100W incandescent bulb).

M - Construction

Weather-proofing and insulation is added to the houses to reduce the heating and cooling requirements throughout the year, with specifications as follows:

- Lowering Infiltration – We considered weather-proofing the entire house, sealing up cracks between the windows and walls, and under the doors. To reflect this in the modeling we reduced the infiltration rate from 0.5 ach to 0.3 ach.
- Improving Walls –R-16 insulation was added to the walls.
- Improving Roof – R-30 insulation was added to the roof.
- Improving Floor – R-10 insulation was added to the floor.
- Changing the Windows – The windows were changed to average double paned windows.

M - Heating and Cooling

The mechanical systems in the house were upgraded moderately to improve the efficiency of the heating and cooling.

- Heating – Boiler efficiency was increased to 90% as was the gas furnace.
- Cooling – If the house included cooling, the direct expansion coil was given a COP of 3.4.

Phase 2 - The second phase will be implemented between 2034 and 2050 with a “High Efficiency” retrofit package. This package builds on the modifications for the “Moderate” case. The typical package would include the following measures:

HE - Interior Lighting and Appliances

Energy saving bulbs will be installed and all appliances will be replaced by Energy Star appliances.

Energy Star Appliances	Savings
Washer	37%
Dishwasher	10%
Refrigerator	20%
Freezer	10%
TV	40%

Figure A9.6 - Efficiency Gains from Energy Star Appliances

An average 23% energy savings was used for household appliances.

HE - Construction

Along with the improvements in the “Moderate” retrofit house, for the HE house more insulation was added. In addition to lowering heating and cooling energy, this reduced the infiltration rate in the house even further to 0.2 air changes per hour (ach).

- Walls –R-40 insulation using both cavity fill and added exterior insulation was added.

- Roof – R-60 insulation was added to the roof.
- Floor – R-20 insulation was added to the floor.
- Windows – Changed to higher quality double paned windows (u-1.0 W/m2.K).

HE - Heating and Cooling

The mechanical systems in the HE house have to be changed fairly dramatically. Due to the increased tightness in the structure, outdoor air has to be added to ensure good ventilation.

- Outdoor Air System – The amount of outdoor air entering is now controlled in line with ASHRAE 62.1 – 2007.
- Heat Exchanger – The indoor air in the winter passes through the heat exchanger as it leaves and passes its residual heat to the cold air being drawn in. This minimizes the waste of the heating energy. In the summer is process the reversed to minimize the waste of cooling energy.
- Economizer – Added alongside the heat exchanger, and comes on when outside temperature is between 20°C and 26°C and the house needs cooling. This air bypasses the heat exchanger so that it maintains its temperature.
- Heating – Boiler efficiency was increased to 93% as was the gas furnace.
- Cooling – If the house included cooling, the direct expansion coil was given a COP of 4.22.

Single-family homes will be renovated and operated more efficiently than the baseline against the following schedule:

Building type/Energy Type	2013-2033	2033-50
Single-family detached		
Electricity	56%	56%
Heating	61%	73%
Single-family attached		
Electricity	29%	32%
Heating	16%	53%

Figure A9.7 - Renovation Efficiency Rates – Single-family Homes

9.4.3 New Construction

New construction codes are the jurisdiction of the State of Michigan. The CEP assumption is that the City of Holland will follow the likely evolution of State codes. Michigan typically follows the IECC recommendations for residential construction and ASHRAE for commercial construction. The State is an average to slow adopter of code changes. The assumed breakpoints for code changes from the current code occur every five years. From 2015, average efficiency for new construction increases 10% relative to current code, and incrementally there after every five years. By 2050, all new construction is assumed to be 50% more efficient than current code.

The CEP has recommendations for a number of measures including Energy Performance Labeling and outreach programs aimed at raising energy literacy to ensure and average compliance with code is 100%. As outlined in more detail in Appendix 2, this compares with about 65 to 70% compliance for Michigan as a whole. Programs exist that encourage better-than-code energy performance. As the energy literacy of the City grows, it is assumed residents and business will demand more of themselves and the construction industry.

In the residential sector, the DOE Builder's Challenge[3] and the National Association of Homebuilders National Green Building Program[4] both have the capability to target 30% or better than average U.S.

[3] **http://www1.eere.energy.gov/buildings/ challenge/builders.html**
[4] http://www.nahbgreen.org/

code. For commercial buildings, ASHRAE has produced the Advanced Energy Design Guides[5] , which set targets of 30% and 50% better than ASHRAE 90.1, while the U.S. Green Building Council's LEED NC[6] includes standards that would exceed code efficiency by 30% or more.

For those builders wishing to get close to world-class efficiency performance, the Passive House Institute has appropriate recommendations. The City should draw on all these sources in establishing future planning and construction guidelines. Any efficiency that may occur as a result of using these above-code standards is excluded from the City modeling to avoid undue optimism.

9.4.4 __Building Operations and Occupant Behavior__

Achieving a substantial amount of the proposed efficiencies is feasible at modest cost through improved construction with good quality control; most coming from the ways in which buildings are lived in and maintained. Improved building operations will only be achieved with a significantly heightened public awareness of conservation, the impacts of lifestyle choices, and day-to-day attention to effectively managing the operation of residential and non-residential buildings.

For years, energy professionals and others have drawn a distinction between the terms "energy efficiency" and "energy conservation." Energy efficiency is usually regarded as physical improvements in buildings, equipment, and appliances to obtain the same energy services (e.g. heat, light) at reduced energy cost. Energy conservation is usually defined as behavior practices (e.g. turning down a thermostat, or turning off a light) that reduce energy costs through a reduction in energy services. We regard both strategies as important components of energy demand management (EDM). Smart energy demand management should be practiced by residents and occupants of buildings, as well as by the professionals operating large residential and non-residential buildings.

In Holland in a typical year, about 15 to 30% of all energy used in residential and about 35 to 50% in non-residential buildings comes from lighting, appliances, entertainment equipment, computing devices and miscellaneous electrical uses. More than half of the energy used in buildings is for heating, and the remaining energy used is for air-conditioning.

The impact that homeowners can have on both the overall energy use and their own energy costs through a range of individual actions is substantial. Purchasing energy efficient appliances, installing programmable thermostats, using high-efficiency lighting and weather-proofing homes are all relatively low-cost measures that have substantial impacts. Even lower cost solutions can be achieved by changing a few habits including planning trips to minimize car use; setting back heating and cooling temperatures a degree or two; not leaving appliances in stand-by mode; and switching off unused lights. In addition to these energy reduction measures, homeowners and property managers should be encouraged to preserve mature trees and plant young trees on their property to further enhance the tree canopy, which provides shade and reduces the energy needed to cool their buildings.

Similarly, many homeowners will renovate a portion of their homes every few years. These occasions offer opportunities to upgrade windows, to make different heating and cooling choices and to add insulation at relatively low incremental costs.

Proper building operations in the non-residential sector can have major impacts on overall energy use. Buildings should be heated, cooled and lit only as much as is needed. Preparing buildings based on the anticipated weather can also have substantial efficiency benefits.

9.5 Industrial Efficiency

Industry accounts for a large portion of Holland's current and predicted energy use. Industry has a much longer track record of more rigorous attention to managing energy costs, risks and efficiency. A

[5] http://www.ashrae.org/technology/page/938
[6] http://www.usgbc.org/DisplayPage.aspx? CMSPageID=220

growing percentage has corporate wide carbon targets. The CEP recognizes this general commitment to continuous improvement by increasing the energy efficiency of industry in any given year by 1%. Two of the GIL consultants (Garforth and Bremer) have extensive hands-on corporate leadership experience in energy and are actively engaged with the U.S. Energy Star Industries Focus Groups. Their collective experiences and that of many peer benchmark companies are reflected in the 1% assumption.

APPENDIX 10
GENERATION CAPACITY AND COSTS FOR ELECTRICITY AND DISTRICT HEAT

10.1 Background

This Appendix gives further background to the capacity balances for the electricity generation options summarized in Scenarios A, B, C and D. It also gives further background on the assessment of stand-alone generating costs for both electricity and district heating for the different technology options.

This Appendix summarizes the approach taken to allocate greenhouse gas emissions between the City of Holland and the balance of the HBPW service area.

10.2 Electricity Capacity Balances

To maintain continuity of comparison with the previous Black & Veatch study, a reference year of 2030 is assumed.

10.2.1 Estimated Customer Electricity Demand in 2030

The Black & Veatch Study estimated the customer electricity demand for the entire HBPW service area (City plus "Townships") at 308 MW in 2030 before any focused DSM or efficiency actions.

The comparable CEP assessment is similar at 307 MW based on 2030 estimates of power consumption:

- City of Holland Base Case consumption: 948,100 MWh
- "Townships" re-estimated consumption: 408, 355 MWh
- Total HBPW service area total: 1,356,455 MWh

Assuming the peak to base ratio in 2030 is the same as the 2010 baseline; the reassessed 2030 customer demand is 307 MW. Unlike the B&V study, this does include the assumptions of gains from statutory DSM in the "Townships" (see Appendix 2).

10.2.2 Comparison of Peak Capacity Balances in 2030

The electricity capacity balances for the four scenarios described in the main report are as follows:

Item	B&V	Scen A	Scen B	Scen C	Scen D
Capacity in MW	***359***	***351***	***356***	***356***	***351***
De Young - existing - (SF)	46	0	0	0	0
De Young - new - (SF/DH)	70	0	0	70	70
De Young - new – (CCGT/DH)	0	70	70	0	0
Campbell/Belle River (SF)	46	46	46	46	46
Peakers (NG)	147	147	147	147	147
Oil Distillate	18	18	18	18	18
Landfill (Gas)	10	10	10	10	10
Industrial ED L01 – (CHP/DH)	0	30	30	30	30
PV (Solar)	0	0	5	5	0
Statutory DSM	22	0	0	0	0
Elect Efficiencies-Holland	0	30	30	30	30
Customer demand	***308***	***307***	***307***	***307***	***307***
Reserve Margin - MW	***51***	***44***	***49***	***49***	***44***
Reserve Margin - %	***17%***	***13%***	***16%***	***16%***	***13%***

Figure A10.1 - Electricity Capacity Balances – 2030 Estimates

In all of the CEP scenarios, the assumption is made that the existing De Young coal plant will reach the end of its useful life by about 2016. If this is not the case, it has minimal difference on the conclusions since the fuel mix of the grid is nearly 100% coal. All expansion scenarios on the De Young site assume any new plant will be configured for significant heat generation to serve the downtown district heating strategy.

The CEP analysis approach has been done year-on-year, so the 2030 picture above is a snapshot chosen to make a comparison with the former B&V study. A comparable balance for any scenario in any year is available on request. By 2030, the bulk of the major capacities in all scenarios have been completed. The one exception is the Solar PV. By 2030, approximately one-third (5 MW) of summer peak relevant capacity will have been installed, leaving a 10 MW balance to be installed between 2030 and 2050. This affects Scenarios B and C only.

10.2.3 Renewable Electricity Capacity

HBPW is required to meet the Michigan State Renewable Energy Standard in its total deliveries (see Appendix 5). In the CEP scenarios, the landfill capacity, Solar PV and a portion of the efficiencies will qualify. Specifically in Scenarios C and D, the new solid fuel plant has been modeled on the assumption it would run at 30% biomass, which would also qualify to support compliance with the RES.

The other alternative that is being considered is for HBPW to invest in about 37 MW of wind capacity within Michigan in a location with somewhat better wind characteristic than the immediate surroundings of Holland.

10.3 Electricity Capacity Investments

The electrical capacity investments for each scenario have been estimated using recognized indexes summaries in the following table:

Item	Base $ M	Scen A $ M	Scen B $ M	Scen C $ M	Scen D $ M
De Young - new - (SF/DH)	$270	-	-	$270	$270
De Young - new – (CCGT/DH)	-	$105	$105	-	-
Industrial ED L01 – (CHP/DH)	-	$60	$60	$60	$60
Solar PV (8 of 24MW)	-	-	$32	$32	-
Industrial DH Network	-	$10	$10	$10	$10
Downtown DH Network	-	$10	$10	$10	$10
SFH Retrofit – Total Investment	-	$125	$125	$125	$125
SFH Retrofit Owner Share	-	-$63	-$63	-$63	-$63
Refrigerator Incentives	$0	$1	$1	$1	$1
AC Buyback (7,500)	$0	$2	$2	$2	$2
Industrial Efficiency		$0	$0	$0	$0
Additional Snow-Melt	NA	NA	NA	NA	NA
Total 2030 Investment	**$270**	**$250**	**$282**	**$447**	**$415**

Figure A10.2 - Electricity Capacity Investments – Rough Estimates

It is a judgment call as to what should be included in this rough investment comparison. The key efficiency and district heating investments were included in all the CEP scenarios on the assumption these would need some form of community based infrastructure financing mechanism. Wind was included in two of the scenarios that had a strong renewable mix. Since the main reason for the wind is to meet the State RPS, there is a case to be made to include in all scenarios.

The key assumptions used to develop the above investment estimates were agreed between the all members of the PWT prior to inclusion in the report, and are shown below:

Item	**Investment Index**	**Source**

De Young - new - (SF/DH)	$3,828 / kWe	$3,828 / kWe
De Young - new – (CCGT/DH) 70MW	$1,500 / kWe	$1,500 / kWe
De Young - new – (CCGT/DH) 55 MW	$1,640 / kWe	$1,640 / kWe
Industrial ED L01 – (CHP/DH) 30MW	$ 2,000 / kWe	$ 2,000 / kWe
Financing cost – SF/CCGT/CHP	5% Bonds	5% Bonds
Depreciation 70 MW Solid Fuel	30 years	30 years
Depreciation CCGT/CHP	30 years	30 years
DH Industry network	$ 300 / ft installed	$ 300 / ft installed
DH Downtown network	$ 350 / ft installed	$ 350 / ft installed
Refrigerator buy-back	$ 200 / unit	$ 200 / unit
AC buy-back	$ 250 / unit	$ 250 / unit
SFH-detached – Moderate upgrade	$17.5 / sq ft	$17.5 / sq ft
SFH-attached – Moderate upgrade	$ 10.1 / sq ft	$ 10.1 / sq ft
SFH-detached – High efficient upgrade	$ 55.9 / sq ft	$ 55.9 / sq ft
SFH-attached – High efficient upgrade	$ 31.3 / sq ft	$ 31.3 / sq ft

Figure A10.3 - Investment Indexes

10.4 Electricity and Heat Generating Costs

The following charts estimate the cost of generation for electricity and district heating for the three generating technologies– Solid Fuel (SF), Combined Cycle Gas Turbine (CCGT), and Combined Heat and Power (CHP). All are assumed to be configured to provide heat at a quality suitable for a modern pressurized hot water district heating system.

They have been calculated on a stand-alone basis and do not include the costs of distribution for either electricity or heat. In all cases a 30-year depreciation cycle has been used as a common basis for comparison.

10.4.1 Solid Fuel Generating Costs

De Young - new - (SF/DH)	**Value**
Operating hours at 70MW capacity	7,500
2012 coal price based on thermal content of coal	$8.50/ MWh
2012 to 2050 fuel price escalator	4 % / year
Peak fuel consumption rate	865,000 MBtu/hr
Electrical efficiency	27.6%
Greenhouse gas based on thermal content of coal	325 kg/MWh
Variable O & M Costs	$5.18/MWhe
Variable O&M Cost escalator 2012 to 2050	2% / year
Fixed O & M Costs	$3.85/MWhe
Fixed O&M Cost escalator 2012 to 2050	2% / year
Fuel increment for DH extraction relative to thermal	0.5 kWh / kWhth
GHG cost range 2014/2050	$9.85 / $78.79 /MWhe

Figure A10.4 - Solid Fuel Operating Cost Indexes

De Young - new - (SF/DH)	**2016**	**2030**	**2050**	**Comments**
Fuel	31.5	54.5	119.5	*33% Electric efficiency*
Interest & Depreciation	33.5	33.5	33.5	*5 % Bonds / 30 years*
O&M	10.0	13.2	19.6	*B&V estimate*
Electricity Cost/MWh	***74.9***	***101.2***	***172.5***	*No GHG penalty*
Electricity Cost/MWh	***98.6***	***180.0***	***251.3***	*With GHG penalty*
District Heat Cost / MWh	***5.2***	***9.0***	***19.7***	*No GHG penalty*

Figure A10.5 - Solid Fuel Generating Costs – 4% Coal Price Escalator

The generating cost calculation has been made on the basis of Powder Basin Coal. It also assumed the plant would run 100% on coal only for cost calculation purposes. In the total City consolidation in Scenarios C and D, it has been assumed to be operating with 30% biomass. The generating cost summary in Figure A10.5 assumes a coal price escalator of 4%. This is based on the assumption that coal price volatility going forward over the coming decades will be higher than for natural gas. This is the view of some market observers and the Consultants.

There is a legitimate countervailing view that suggests the price drivers and risks around both coal and gas, while different in nature, will be similar in total impact. Figure A10.6 makes the same cost estimate for solid fuel with a 3% escalator.

De Young - new - (SF/DH)	**2016**	**2030**	**2050**	**Comments**
Fuel	30.00	45.4	81.96	*33% Electric efficiency*
Interest & Depreciation	33.5	33.5	33.5	*5 % Bonds / 30 years*
O&M	10.0	13.2	19.6	*B&V estimate*
Electricity Cost/MWh	***73.46***	***92.02***	***135.0***	*No GHG penalty*
Electricity Cost/MWh	***97.1***	***170.8***	***213.8***	*With GHG penalty*
District Heat Cost / MWh	***5.0***	***7.5***	***13.5***	*No GHG penalty*

Figure A10.6 - Solid Fuel Generating Costs – 3% Coal Price Escalator

10.4.2 CCGT Generating Costs

De Young - new – (CCGT/DH) 70MW	**Value**
Operating hours at 70 MW	7,500
2012 fuel price based on thermal content of gas	$19.70/ MWh
2012 to 2050 fuel price escalator	3 % / year
Electrical efficiency	48%
Greenhouse gas based on thermal content of gas	203 kg/MWh
Variable O & M Costs	$3.0/$MWh_e$
Variable O&M Cost escalator 2012 to 2050	2% / year
Fixed O & M Costs	$1.47/$MWh_e$
Fixed O&M Cost escalator 2012 to 2050	2% / year
Fuel increment for DH extraction relative to thermal	0.4 kWh / kWh_{th}
GHG cost range 2014/2050	$4.23 / $33.83 /$MWh_e$

Figure A10.7 - CCGT Operating Cost Indexes

De Young – new – (CCGT/DH) 70MW	**2016**	**2030**	**2050**	**Comments**
Fuel	47.6	72.0	130.0	*48% Electric efficiency*
Interest & Depreciation	13.0	13.0	13.0	*5 % Bonds / 30 years*
O&M	4.9	6.5	9.7	*B&V estimate*
Electricity Cost/MWh	***65.5***	***91.5***	***152.7***	*No GHG penalty*
Electricity Cost/MWh	***75.7***	***125.3***	***186.5***	*With GHG penalty*
District Heat Cost / MWh	***9.1***	***13.8***	***25.0***	*No GHG penalty*

Figure A10.8 - CCGT Generating Costs

The CCGT alternative to a solid fuel expansion is assumed to be located on the current De Young Site to give the maximum flexibility for integrating downtown district heating and minimizing the need to invest in new distribution infrastructure. The technology would allow phasing, but there is no obvious reason to recommend this.

10.4.3 CHP Generating Costs

Industrial ED L01 – (CHP/DH) 30MW	Value
Operating hours at 70 MW	7,500
2012 fuel price based on thermal content of gas	$19.70/ MWh
2012 to 2050 fuel price escalator	3 % / year
Electrical efficiency	45%
Greenhouse gas based on thermal content of gas	203 kg/MWh
Variable O & M Costs	$4.0/MWh$_e$
Variable O&M Cost escalator 2012 to 2050	2% / year
Fixed O & M Costs	$2.0/MWh$_e$
Fixed O&M Cost escalator 2012 to 2050	2% / year
Fuel increment for DH extraction relative to thermal	0.45 kWh / kWh$_{th}$
GHG cost range 2014/2050	$4.51 / $36.09/MWh$_e$

Figure A10.9 - CHP Operating Cost Indexes

Industrial ED L01 – (CHP/DH) 30MW	2016	2030	2050	Comments
Fuel	50.8	76.8	138.7	*45% Electric efficiency*
Interest & Depreciation	23.7	23.7	23.7	*5 % Bonds / 30 years*
O&M	6.6	8.7	13.0	*PWT Estimate*
Electricity Cost/MWh	***81.1***	***109.2***	***175.4***	*No GHG penalty*
Electricity Cost/MWh	***91.9***	***145.3***	***211.4***	*With GHG penalty*
District Heat Cost / MWh	***10.3***	***15.6***	***28.1***	*No GHG penalty*

Figure A10.10 - CHP Generating Costs

The obvious assumption is to locate this on the 48th Street Peaker site to both have available shared electrical distribution infrastructure and to have good thermal access to major industrial users.

10.5 Allocating Greenhouse Gas Emissions

The CEP framing emissions target is 10 mt CO2e/capita. The various scenarios create reductions through a combination of efficiency, distribution and supply choices for heat and electricity. Each scenario has a different outcome in terms of emissions.

In Appendix 2, the scale and evolution of the electricity that would be delivered by HBPW and used in the "Townships" was summarized. This electricity is either generated in Holland or source from the grid. This raises the challenge to allocate the primary fuel and emissions from assets located in Holland, but serving a wider area. The following allocation rules have been used in the CEP:

- All electricity generation at De Young will be allocated by HBPW system-wide, whether CCGT or Solid Fuel (coal and/or biomass).
- All purchased electricity from outside the HBPW service area will be allocated system-wide, irrespective of the original source and including wind and landfill.
- All generation that results from specific strategies that would not have happened without a fully integrated CEP, supported and implemented by the City as a whole, will be allocated to the City. In the current scenarios this will include:
  - CHP on the industrial park,
  - CHP as part of the De Young site that is dedicated to serving district heating,
  - Aggressive Solar PV aimed at peak reduction and carbon reduction.
- Statutory DSM will not be allocated statistically to the City of Holland, since this is already incorporated in the various efficiency initiatives:

  - Existing and new buildings renovation, construction and operation,
  - Energy Performance Labels,
  - Industrial Efficiency,
  - Aggressive appliances buy-back.
- Electrical DSM will be allocated statistically to the “Townships” residential and commercial sectors using percentage based on the levels agreed by HBPW. (See Appendix 2).
- Electrical DSM will not be allocated to industry in both Holland and the “Townships”, since the assumption is that corporate efficiency programs will be as effective outside Holland as inside the City.
- There will be no significant HBPW distributed generating assets of any type (fossil or renewable) located outside the City of Holland, but within the balance of the HBPW Service area.

APPENDIX 11
TYPICAL IEMP SCOPE OF WORK

The CEP recommends that each of the five Scale Projects develop a local detailed energy plan, also known as an Integrated Energy Master Plan (IEMP). These will be distinct for each Scale Project. As a reminder the five scale projects are:

1. Hope College Campus
2. Holland Hospital/Aquatic Center/High School Cluster
3. Historic District Single-family Home Neighborhood
4. Industrial Park
5. Downtown District Heating

Under the auspices of a 2010 study for Arlington County, a sample Scope of Work for a Scale Project was developed as an example that is typical of a high-density neighborhood designated as a district energy candidate. It has been included here to give a sense of the scope of a large, fully integrated Energy Master Plan. In the City of Holland, all the anticipated Scale Projects would be of a somewhat smaller scale. The following has been reproduced courtesy of Arlington County, Virginia.

Note that the outline structure and numbering in this Appendix from here forward is separate from the other sections in the document.

Crystal City

Decision Grade Integrated Energy Master Plan

Scope of Work for Request for Proposal

DRAFT

Version dated August 21st, 2010

Prepared for

Arlington County – Vornado – WGL Holdings, Inc.

Prepared by Garforth International llc

(Preparation of this draft funded under Arlington County Community Energy Plan Contract No. 439-09)

REQUEST FOR PROPOSAL

Decision Grade-Integrated Energy Master Plan (DG-IEMP) for Crystal City

1. BACKGROUND TO RFP

This is a Request for Proposal (RFP) for Consulting Services for a Decision Grade Integrated Energy Master Plan for Crystal City (IEMP) issued by a Consortium (Consortium) consisting of Arlington County (County), Vornado/Charles E. Smith (Vornado), and WGL Holdings, Inc. (WGLH).

The Crystal City Site (Site or Crystal City) will enter a period of major renovation and restructuring over the coming years. The Crystal City Sector Plan (Sector Plan) process has already started between Vornado and the County. The Sector Plan is targeted to be completed by September 2010. For the purposes of this Request for Proposal, Crystal City will be defined identically to the Sector Plan. Figure 1 shows the boundaries.

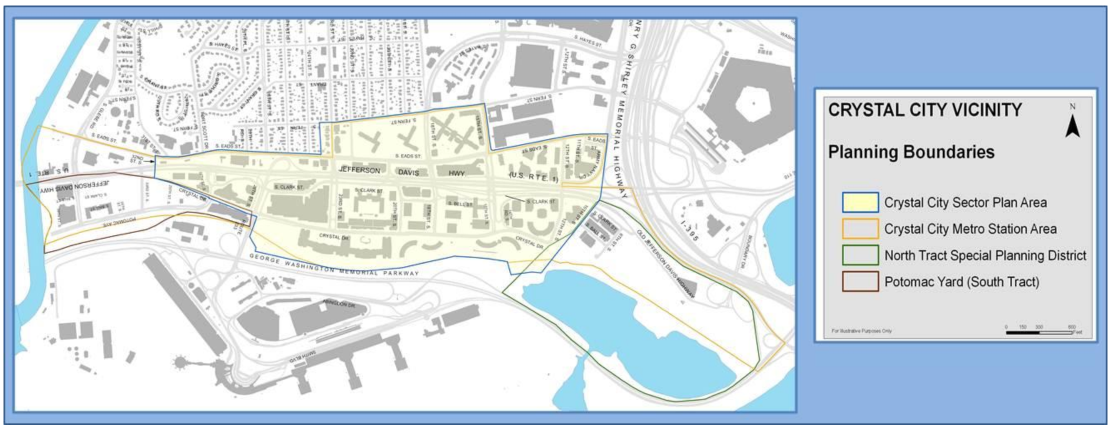


Figure 1: Boundaries of Crystal City for IEMP Purposes

In March 2010, the County initiated the development of a comprehensive Community Energy Plan (CES Task Force Final Report) aimed at substantially reducing the energy use and energy related greenhouse gas (GHG) emissions of the County as a whole, while improving the overall competitiveness of the County and the quality and reliability of its energy services.

The CES Task Force Final Report uses 2007 as its baseline year and has a planning horizon to 2050. The CES Task Force Final Report is scheduled to be approved by the County Board in spring 2011. It is expected that a headline goal of the CES Task Force Final Report will be to reduce energy related GHG per resident from the 2007 baseline of 13.5 metric tons to about 4.5 metric tons by 2050. This includes energy use in homes and buildings and for transportation for all public and private uses.

In May 2010, the CES Task Force Final Report Task Force, a community body set up to oversee the CES Task Force Final Report development process, selected Crystal City as one of four high-priority potential Energy Scale Projects (ESP). Each ESP will be expected to develop an IEMP over the coming months. The final recommendations of the IEMP, provided they are accepted by the Consortium, shall be integrated into the overall planning process for Crystal City.

Further background on the CEP project process is available on the County web site (http://www.arlingtonva.us/departments/DES-CEP/CommunityEnergyPlan/CommunityEnergyPlanMain.aspx)

2. CRYSTAL CITY GENERAL BACKGROUND

Crystal City is currently one of the largest energy consuming areas of Arlington County, using 19% of all energy and creating 20% of all GHGs of the entire County total.

The Sector Plan anticipates deep renovation and repurposing of existing structures, along with substantial increases in total finished commercial and retail space, hotel rooms, and housing units. The summary of the current sector planning is included in Appendix 1.

The Arlington County CES Task Force Final Report will include Narratives for each of the four priority Energy Scale Projects. The draft Crystal City Scale Project Narrative is included in Appendix 2, and includes additional background.

3. IEMP ASSESSMENT FRAMEWORK

The IEMP will evaluate the feasibility of adopting an integrated approach to efficient energy delivery and usage, increased energy efficiency, and optimized energy supply for Crystal City. The feasibility of the integrated approach will be assessed on energy-related investment returns; competitiveness of Crystal City as a whole; and the environmental impact in terms of avoided GHG. The overriding goal of the IEMP should be to radically reduce the environmental impact of total energy use and to provide high commercial and customer attractiveness.

The specific elements that are to be evaluated are detailed in the Scope of Work found in Section 6 of this RFP.

4. OVERALL TEAM FRAMEWORK

The IEMP Team (Team) will include members and skills from both the Consortium and from the responder to this RFP (Bidder). Irrespective of the final mix of the Team between Bidder and Consortium membership, the accountability for the completion of the IEMP meeting the Scope of Work (Section 6) lies with the Bidder.

The Team needed to successfully complete the IEMP will have a wide range of experience and skills summarized in Figure 2.

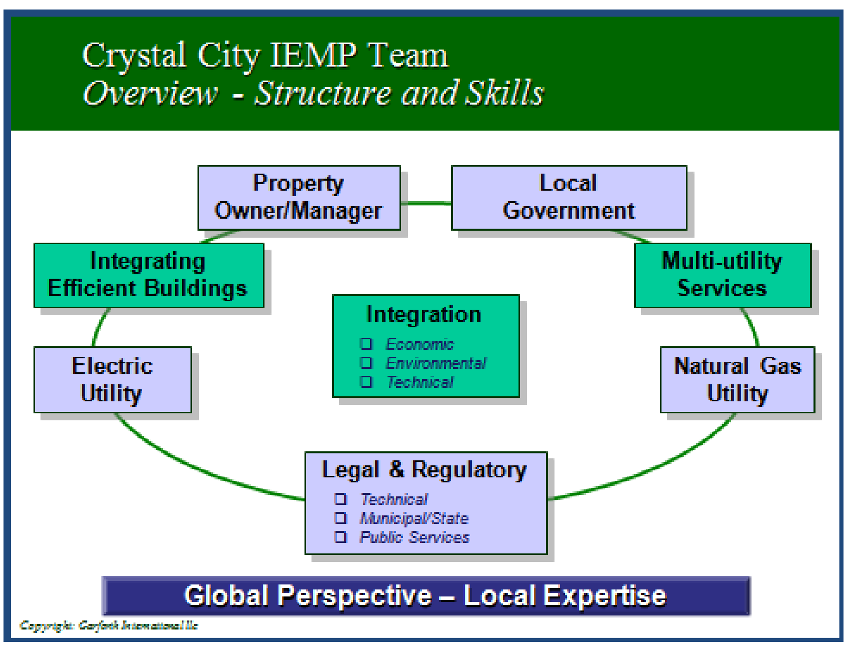


Figure 2: IEMP Team Structure and Skills

The Consortium is looking for a Bidder that can provide expertise highlighted in green in Figure 2. The successful Bidder will be able to demonstrate experience and expertise in these three areas, including:

Integrating Efficient Buildings

- US residential and non-residential building practices, HVAC and BMS systems
- US residential and non-residential building codes
- EU building codes, practices, performance, and performance validation (for benchmarking purposes)
- Building and community energy demand modeling for new construction and deep renovation
- Matching modeled energy data to metered data for baseline purposes
- Developing and modeling energy demand scenarios at both building and community level
- Integrating clean and renewable energy sources including district heating, district cooling, and on-site combined heat and power into both existing and new buildings
- Impacts of efficiency scenarios on construction and building operating costs

Multi-utility Services

- Designing, constructing, and operating community multi-utility energy networks delivering district energy (heating and cooling) in addition to natural gas and electricity
- Developing and evaluating centralized and decentralized heating and cooling generation strategies including combined heat and power generation from small-, medium-, and large-scale plants
- Integration of reliable and economically feasible renewable energy sources in both building and community systems
- Integration of smart multi-utility energy metering and management systems
- Impacts of energy supply and distribution scenarios on investments and supply system operating costs and revenues
- Impacts of energy supply and distribution scenarios on community direct and indirect greenhouse gas emissions

Integration

- Technical aspects of integrating efficient buildings with multi-utility supply options
- Investment, operating costs, and revenue aspects of integrating efficient buildings with multi-utility supply options
- Greenhouse gas aspects of integrating efficient buildings with multi-utility supply options
- Developing risk scenarios for differing energy prices, climate legislation, and regulatory outlooks
- Modeling business performance from the property owners/operators' standpoint
- Modeling business performance from energy services investors' and operators' standpoints
- Familiarity with different energy services, and energy investment business and operating models from the USA and elsewhere
- Familiarity with current and planned energy and climate legislation in the USA and elsewhere
- Familiarity with GHG emissions and efficiency monetization in both voluntary and regulated markets

In general, integrated community level approaches to efficiency and supply of urban energy services are common in Scandinavia, Germany, and other areas of central and northern Europe. A Team familiar with the technical, economic, and business approaches of various energy efficiency and supply scenarios from around the world is essential to ensure that best practices are recommended. At the same time, there must be a high level of US construction and building science knowledge.

The Bidder will be asked to include resumes of key personnel, similar project experience background including references, and samples of relevant project reports.

It is expected that some of the required expertise and local knowledge will be provided by the Consortium members. This could include:

- Details of the Crystal City build-out schedule
- Ownership of property
- Real estate market values
- Lease and purchase contracts' structures
- Virginia public service regulatory frameworks
- County regulatory frameworks including awarding rights-of-way to district energy
- Some business and institutional goals and constraints; short-, medium-, and long-term
- Baseline and historic electricity and gas consumption data from existing buildings and utility deliveries
- Local renewable portfolio standards and anticipated RPS programs
- Natural gas supply and infrastructure

The Bidder should also indicate if they have focused expertise in any of these areas.

5. INTEGRATED ENERGY MASTER PLANNING

The IEMP shall propose options to radically reduce the environmental impact of energy use while enhancing comfort, convenience, and cost for the owners and building operators. Total energy usage should be substantially less than a comparable development elsewhere in Virginia. The indicative target is that the energy use will be 60% less than current practice by 2040, with GHG levels being at least 70% less.

The IEMP shall recommend integrated approaches to providing Crystal City with energy services respecting the following goals:

1. To meet the commercial real-estate expectations of Vornado and other property owners in Crystal City in terms of market attractiveness and construction costs
2. To be sufficiently flexible to grow with the anticipated build out of Crystal City while retaining price competitiveness
3. To be sufficiently flexible to add neighboring areas to Crystal City if this should prove to be desirable in future – possible energy service extensions could include the Pentagon City, Potomac Yard, and the planned Arlington County Aquatic Center
4. To minimize direct and indirect greenhouse gases caused by energy use of Crystal City
5. To maximize the energy service reliability and affordability to all end users in Crystal City
6. To be sufficiently flexible to incorporate new operating strategies and technologies as they emerge
7. To be able to be integrated into a future wider County energy services concept through appropriate technology and operating business model choices
8. To be a role model of effective sustainable community design to enhance the competitiveness of Crystal City and to encourage proliferation of similar approaches

6. SCOPE OF WORK

The development of the IEMP shall be based on a number of clearly structured scenarios. The IEMP scenarios shall be reasonable combinations of the followings attributes:

- Buildings Energy Demand Estimates
- Buildings Energy Supply Estimates

- Site Additional Energy Demand Estimates
- Site Control and Interconnection
- Climate Change Legislation
- Energy Pricing Estimates
- Energy and Climate Performance Validation
- Investments
- Legislative and Regulatory (excluding financial incentives)
- Financial Incentives
- Ownership and Operating Structure
- Market Pricing

The timeline that should be considered for the assessment is the build-out timetable for Crystal City as defined in the summary of the current sector planning shown in Appendix 1 of this RFP. Financial and economic calculation will take into account a period up to 30 years. The final choice of scenarios will be a Team decision as part of the IEMP process.

The IEMP will address the following topics:

Topic	Description

1	Buildings Energy Demand Estimates
	Generally will be building specific with some grouping by type
	■ *Base case:*
	  ■ *Vornado's minimum commitment (Local Code is default)*
	■ *Scenario cases:*
	  ■ *Renovation: XX % below current practice – may be time related*
	  ■ *New Construction: YY % above Base-case – may be time related*

2	Buildings Energy Supply Estimates
	■ *Base case:*
	  ■ *Conventional boiler/furnace and electric AC and grid electricity including, where applicable, electricity for heating for the same percentage of buildings that are currently not using shared infrastructure through the Tenant Service Center*
	  ■ *Percentage of buildings with shared infrastructure through the Tenant Service Center will remain constant, with technologies and efficiencies at today's level*
	■ *Scenario cases - agreed mix of:*
	  ■ *In-building cogeneration and/or renewables*
	  ■ *On-site cogeneration and/or renewables*
	  ■ *District energy (heating and/or cooling)*
	  ■ *Conventional boiler/furnace and electric AC and grid electricity*

3	Additional Crystal City Energy Demand Estimates
	■ *Base case:*
	  ■ *Current construction densities with conventional supply (buildings)*
	■ *Scenario case:*
	  ■ *Higher construction densities*

4	Crystal City Smart Metering and Energy Management
	■ *Base case:*
	  ■ *Individual BMS systems for each building*
	  ■ *No interoperability guidelines for BMS, supply metering and controls*

	■ *Scenario cases to capture coincidence benefits – agreed mix of:* ■ *Interoperable BMS architecture between buildings* ■ *BMS interconnection standards to allow future integration* ■ *Site energy supply control and metering integrated with BMS architecture* ■ *Common metering information standards for all energy types* ■ *District energy-ready installation of heating, cooling and distributed generation units to allow future integration*
5	Climate Change Legislation ■ *Base case:* ■ *No financial value from reducing GHG emissions (in USA)* ■ *Scenario case:* ■ *National legislation in force similar to HR2454*
6	Energy Pricing Estimates ■ *Base case:* ■ *Evolution of prices using widely recognized market assumptions* ■ *Scenario case:* ■ *Evolution of energy prices assuming carbon pricing risk from HR2454 or similar*
7	Energy and Climate Performance Validation ■ *Base case:* ■ *No systematic approach with year-on-year energy efficiency loss* ■ *Scenario case:* ■ *Energy performance labeling (or similar) at initial point of sale* ■ *Energy performance labeling (or similar) at point of resale or lease*
8	Investments ■ *Base case:* ■ *Used as reference level* ■ *Scenario cases (each incremental to Base case):* ■ *Efficient building shell* ■ *Controls and metering* ■ *District heating and cooling* ■ *Alternative energy generation and supply (e.g. cogeneration and renewable energy)*
9	Legislative and Regulatory (excluding financial incentives) ■ *Base case:* ■ *Current or confirmed future status that has passed formal hurdles/votes* ■ *Scenario cases:* ■ *Possible future picture(s) agreed by Team*
10	Financial and other Market Incentives ■ *Base case:* ■ *Current or a confirmed future status that has passed formal hurdles/votes* ■ *Scenario cases (See Note 2):* ■ *Current incentives are not available* ■ *Clean and renewable energy including cogeneration is at least using net-metered conditions* ■ *Above plus marketing approaches and incentives agreed by the team including marketing, meeting customers' own environmental targets*

	and needs, and restructuring leases and tax incentives.

11	Ownership and Operating Structure
	■ *Base case:*
	   ■ *Currently planned property ownership and leasing conditions*
	■ *Scenario cases - agreed mix of:*
	   ■ *District Energy Utility ownership of selected energy supply and distribution assets, including recommendations on structure and governance*
	   ■ *Currently planned vertical property ownership and leasing conditions*
	   ■ *Evolutionary transfer of ownership of energy supply and distribution assets to District Energy Utility*
	   ■ *Restructured leases to align financial interest in efficiency*

12	Market Pricing of Property
	■ *Base case:*
	   ■ *Currently estimated sale and rental values and occupancy*
	■ *Scenario cases:*
	   ■ *Enhanced sales value as function of energy operating costs/other factors using assumptions agreed by the Team (see Note 1)*
	   ■ *Enhanced rental value as function of energy operating costs/other factors using assumptions agreed by the Team*
	   ■ *Increased occupancy as function of energy operating costs/other factors using assumptions agreed by the Team*

13	Analyses ■ *All analyses have to be done relative to Base case.* ■ *All agreed scenarios should have been done for at least two energy and carbon cost profiles.* ■ *The model should be structured to allow doing a series of "what-if" assessments.* ■ *All costs and benefits shall be calculated on a yearly basis as well as the estimation for all key variables.* ■ *Scenarios analyses must to be done from the perspective of the property developers/owners as well as of the District Energy Utility.* The minimum analysis sets will be: ■ ***Internal rate of return (IRR)*** ■ ***Net present value (NPV)*** ■ ***Energy use reductions*** ■ ***Avoided greenhouse gas emissions*** ■ ***Recommendations including timeline with milestones***

Notes for Bidder Consideration:

1. There is a growing body of market factors research and data that is indicating enhanced market value of "Green Buildings" to occupants, owners and tenants. These indicate a significant enhancement of rental value or sales value relative to the saving of energy costs. In addition, significant productivity factors are also becoming accepted as data is becoming more available. Lastly, the possibility for future carbon pricing may affect the property and rental values. However, as time goes on, and "Green Building" becomes a market norm as it is in Scandinavia and Germany, this market premium begins to disappear. The Team will agree value enhancement / destruction scenarios as part of the Scenario modeling exercise. The bidder is encouraged to present their suggested approach, background experience and knowledge in evaluating the market value of Green Developments.

2. The successful bidder will demonstrate knowledge and ideally experience of successful marketing approaches and incentives that can be applied to the sale and leasing of Green Developments. The Team as a whole will agree the extent these will be factored into the Scenarios as a value enhancement or value risk. Specifically a working knowledge of the property leasing and purchase requirements of GSA and the US Department of Defense is required.

7. REQUIRED DELIVERABLES

Proposal will be for the following deliverables:

1. Decision Grade Integrated Energy Master Plan – Full Report – The Full Report should also include an Executive Summary suitable for use as a stand-alone document for extended distribution as needed.
2. Decision Grade Integrated Energy Master Plan– Presentation – Bidder will present findings and recommendations in an oral presentation format. The presentation slides as used will also be submitted as part of this deliverable.
3. Meeting participation in 3 (three) or more milestone meetings to present and discuss findings and recommendations. These will include:
   - Project Kick-off Meeting
   - Mid-point Project Review and Developmental Recommendation Alignment
   - Final Recommendation Presentation (also see Deliverable 2)
   - Others as determined

8. REQUIRED TIMING

Deliverable 1 shall be delivered 180-days after signing of final contract. The Project Kick-off Meeting should be scheduled as soon as possible following contract signing, subject to mutual scheduling of the Team.

The Final Recommendation Presentation shall be completed no later than 30 days following the delivery of Deliverable 1, subject to mutual scheduling of the Team and stakeholders.

Deliverable 3 will be held at the discretion of the Consortium throughout the project as needed, subject to mutual scheduling of the Team.

9. RESPONSE CONTENTS

In addition to the proposal for the deliverables outlined in Section 7, the successful Bidder is expected to provide at least the following information:

- Detailed resumes of the proposed consulting team highlighting the elements specifically relevant to this Proposal
- Organization Chart of the overall IEMP Team showing the Bidders' Team members by name and role, and showing the Consortium Members by role only.
- General business background of the Team Members' home companies or organizations, if the Bidder's Team is from multiple entities. As long as the Team has the appropriate experience, a structure representing multiple organizations will be viewed as completely acceptable as long as there is a credible project management approach.
- A summary of the detailed sub-tasks and the resources assigned to each in hours for each team members

- Summary of the billing rates for each Team Member
- Summary of Team expertise and experience that highlights their fit to the three areas outlined in Section 4 of this RFP:
    - Integrating efficient buildings
    - Multi-Utility Services
    - Integration

  This summary should also address each of sub-bullets in these three main areas, also detailed in Section 4.

  If the team also has additional expertise that is relevant to the overall success of the IEMP, this should be highlighted.
- Reference projects that clearly demonstrate large area integrated energy planning, implementation and operating experience of the team members. These may include projects that have completed the detailed energy master planning stage, but have not yet been implemented. They may include projects where team members may have been members of a different team.
- The Consortium is committed to Crystal City being an example of competitive world-class practice. The successful bidder will be asked to clearly demonstrate their awareness and experience with Global Best Practices in all critical area. Specifically, detailed knowledge of EU integrated urban multi-utility energy systems would be expected

APPENDIX 12
ENERGY EFFICIENCY AND CLEAN ENERGY INCENTIVES

12.1 Background

There are many opportunities related to efficiency and clean energy incentives. This Appendix summarizes a variety of opportunities available when the CEP was drafted (August 2011). Incentives change very frequently, so this should be seen as an indicative list.

12.2 Federal Incentives

Federal financial incentives for renewable energy or energy efficiency development primarily targets business owners or individuals, rather than communities. However, these incentives can offer an advantage to cities when they undertake public-private partnerships. Local business or community groups can work together to bundle requests such that there is a greater impact on the overall community results.

12.2.1 Solar/Geothermal Investment Tax Credit

Up to 10% of the investment or purchase and installation amount of qualifying energy property can be claimed by a business when filing annual tax returns. Qualifying energy property includes equipment that uses solar or geothermal energy to generate electricity, to heat or cool (or provide hot water for use in) a structure, or to provide process heat.

12.2.2 Modified Accelerated Cost Recovery System

The Modified Accelerated Cost Recovery System (MACRS) allows businesses to recover investments in solar, wind, and geothermal assets through accelerated depreciation deductions. The MACRS establishes a framework for depreciating various types of property, ranging from 3 to 50 years.

12.2.3 Tax Exemption for Non-taxable Energy Grants or Subsidized Energy Financing

Energy grants and subsidized energy financing received by a business from federal, state, or local government entities may be exempt from federal taxation. Such grants and financing must be for the principal purpose of conserving or producing energy.

12.2.4 Renewable Electricity Production Credit (REPC) & Renewable Energy Production Incentive (REPI)

Private entities subject to taxation (corporations, small businesses, and individuals) that generate electricity from wind and "closed-loop" biomass facilities and sell this electricity to an unrelated party, are eligible to receive a production credit (REPC).

Non-taxpaying entities can apply for an incentive payment (REPI) from the U.S. DOE, for electricity produced and sold by new qualifying renewable energy generation facilities.

12.2.5 DOE Solar Energy Technology Program

The U.S. Department of Energy (DOE) Solar Energy Technologies Program (the Solar Program) has opened a request for information (RFI) under the SunShot Initiative, from solar industry stakeholders regarding a regional government challenge to drive improvements in market conditions for rooftop photovoltaic (PV) generation. Information from the RFI will be used in the development of a possible Funding Opportunity Announcement from DOE.

The Challenge is designed to drive improvements in market conditions for rooftop PV, with an emphasis on streamlined and standardized permitting processes. The proposed structure is intended to encourage participation by diverse entities and ensure meaningful results. The participants in the Challenge are intended to be partnerships of local governments, utilities, regional transmission organizations/independent system operators, and others across several jurisdictions. Reducing non-hardware costs and removing market barriers in major regions across the U.S. would lead to a significant increase in domestic PV sales.

There are four main action areas in the Challenge designed so that participants who succeed in all action areas will come out of the Challenge period with all the necessary elements in place to support a robust solar market in their region. While success in one action area would represent important progress, it is only with results in all four action areas that will truly reap the economic and environmental benefits associated with a healthy solar energy market.

The DOE SunShot Initiative is a collaborative national initiative to make solar energy technologies cost-competitive with other forms of energy by reducing the cost of solar energy systems by about 75% before 2020. Reducing the total installed cost for utility-scale solar electricity to roughly 6 cents per kilowatt hour without subsidies will result in rapid, large-scale adoption of solar electricity across the U.S.

12.2.6 FHA, Fannie Mae Launch Energy Efficiency Retrofit Program

On May 31, 2011, the U.S. Housing and Urban Development Department (HUD) announced its Green Refinance Plus, a program between HUD's Federal Housing Administration (FHA) and Fannie Mae to boost energy efficiency in older affordable housing. The program will allow owners of existing affordable rental housing properties to refinance into new mortgages that include funding for energy- and water-saving upgrades, along with other needed property renovations.

Under the program, FHA and Fannie Mae will share the risk on loans to refinance existing rent-restricted projects while permitting owners to borrow additional funds to make energy-saving improvements to their properties. Owners of existing multi-family affordable properties typically refinance their mortgages every 10 to 15 years. In older apartment buildings, however, owners are often hard-pressed to find additional financing to maintain or improve the physical condition of their properties, including making energy-efficient upgrades. Soon, Fannie Mae and its participating lenders will begin accepting applications to refinance owners' debt and improve the energy efficiency of their properties.

The initiative is intended to refinance the expiring mortgages of Low Income Housing Tax Credit properties, and other affordable projects, and to lower annual operating costs by reducing energy consumption. Fannie Mae and HUD anticipate approximately $100 million in initial refinance volume with an average loan amount of $3.5 to $5 Million. See the HUD press release and a fact sheet about the Green Refinance program.

12.3 State Incentives

Many states offer one or more financial incentives for investment in commercial and industrial applications of renewable energy technologies. These incentives include income tax credits, property tax exemptions, state sales tax exemptions, loan programs, special grant programs, industry recruitment incentives, accelerated depreciation allowances, as well as project development grants.

A number of U.S. states have recently established clean energy funds to accelerate the commercialization of renewable energy and energy efficiency. The 15 States that have established these funds to date expect to collect $3.5 Billion between 1998 and 2012 for renewable energy investments. The funds emphasize practical, local solutions to clean energy market barriers.

Some successes from these funds include a wind power financing program that has made Pennsylvania a wind power center in the East. Massachusetts has embarked on an aggressive green buildings program. Wisconsin has undertaken tough evaluation standards for its renewable energy programs. The Minnesota legislature has exempted energy-efficient residential products from sales tax.

A number of states also have solar photovoltaic programs that are steadily expanding the market for solar generation.

The state of Michigan has the following incentives: State loan programs, property tax incentives, personal tax credit, PACE financing, and local loan programs.

12.4 Local Financial and Other Incentives

The City of Holland through the HBPW has the following incentive programs:

12.4.1 Energy Smart

Incentives on a variety of new measures include intelligent surge protectors (or “smart power strips”), barrel wraps for injection molding equipment, engineered nozzles for compressed air applications, ECM upgrades for coolers and freezers, and night shields for coolers and freezers. In addition, incentive amounts have changed for central lighting controls and HID replacements.

12.4.2 Appliance Turn-In and Recycling

Older model refrigerators and freezers typically use twice the electricity as newer models. Turning in an old freezer/refrigerator qualifies for a $30 rebate. Window air conditioners receive a $15 rebate.

12.4.3 Residential High-efficiency HVAC Systems

This program encourages the selection of high-efficiency equipment when a home’s heating or cooling system is updated. Qualified central air conditioning units, heat pumps, gas furnaces with ECM motors and ENERGY STAR® room air conditioners and dehumidifiers are eligible for rebates.

12.4.4 Energy Optimization Program

Electric customers that may be recently unemployed or meet low and moderate income guidelines are encouraged to check out the Energy Optimization (EO) Program offered through the Ottawa County Community Action Agency and the Allegan County Resource Development Committee. Free home energy conservation services include the installation of compact florescent bulbs, a refrigerator replacement, furnace replacement, installation of wall and attic insulation, caulking to reduce air leaks, and other energy efficiency measures. Eligibility is based on household income being at or below 200% of the federal poverty level.[7]

12.4.5 Local Incentive Summary

Many financing tools have been developed to encourage energy efficiency and renewable energy development, ranging from tax incentives, such as tax credits for renewable power generation, to low interest revolving loan funds (loans that can be repaid with savings from efficiency measures) to revenue bond measures. Most of these tax credits and financial incentives are available to business owners rather than municipalities, and, as such, do not offer cities a direct way to finance their sustainable energy plans. In addition, these available grants and incentives may provide the necessary motivation for municipal governments to leverage private-public investments with local businesses.

This Appendix has shown just a few of some of the existing opportunities that are available. It is important to have an established system in place to track the Federal, State and local incentives on a continuous basis so that opportunities are not missed.

[7] See http://aspe.hhs.gov/poverty/11poverty.shtml

APPENDIX 13
WATER EFFICIENCY

13.1 Background

This Appendix is included as supplemental detail for the CEP. There are good reasons to include a view to the water use and water supply system in the Community Energy Plan, since there are close relationships between water use and energy. The most important of these relations are:

- Energy is a major part of the cost to treat and distribute water.
- The use of hot water is directly connected with the consumption of the energy and hot water savings automatically result in reduced energy consumption.

13.2 U.S. Water Withdrawal and Usage

The U.S. is by far the largest water user in the Organization for Economic Cooperation and Development (OECD)[8] countries in terms of total use, as well as per capita use. In the 2002 OECD ranking of annual water withdrawal (from groundwater, surface or saline sources) per capita, the U.S. was ranked highest among the 29 nations listed, with a water use of about 1,700 cubic meters (about 450,000 gallons) per person per year. The OECD average is about 900 cubic meters (240,000 gallons) per capita per year, with some countries much less, such as Germany at 450 cubic meters (120,000 gallons) per capita and year.[9] The total U.S. water use amounts to 1.55 Billion cubic meters (410 Billion gallons) per day, or 150 Trillion gallons per year.

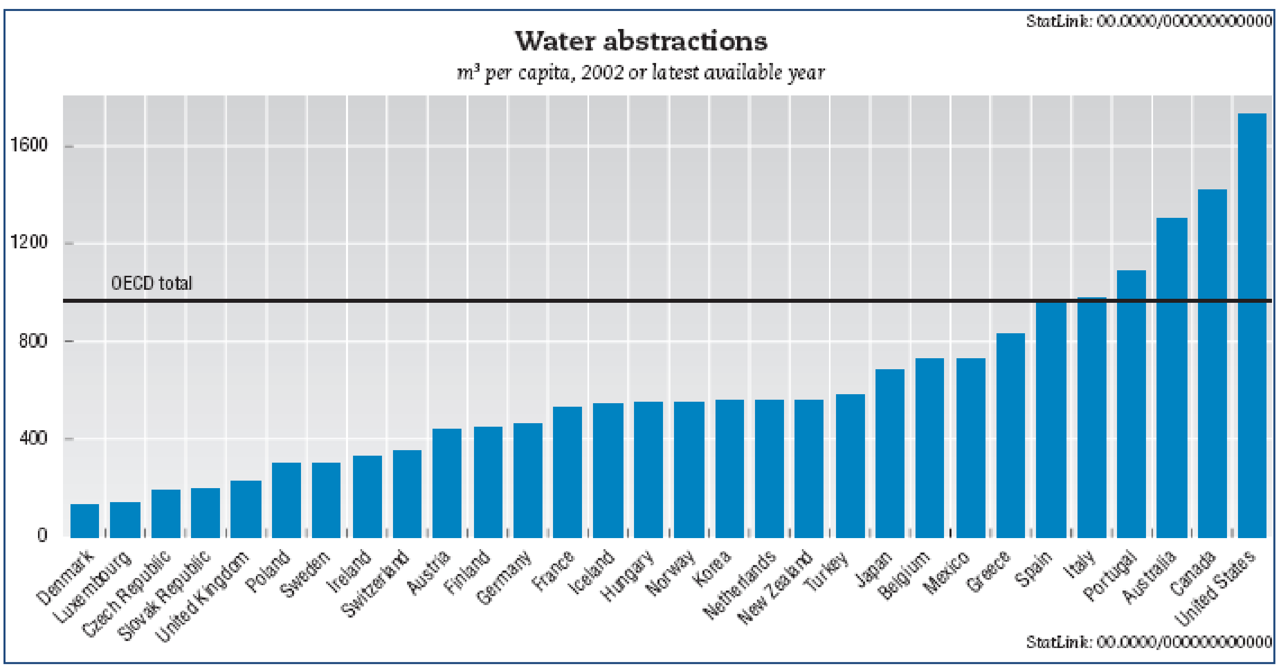


Figure A13.1 - Water Use Comparison

The largest share of that total withdrawal is used in thermoelectric power plants (49% of the total U.S. water use). The second largest water usage category is irrigation, which is about 31%. About 12% of the U.S. water withdrawal amount is being used for public supply, of which the largest part (approx.

[8] OECD-Organization for Economic Cooperation and Development www.oecd.org
[9] http://www.oecd.org/dataoecd/42/27/34416097.pdf

60%) is going to domestic (household) use, corresponding to a national average consumption of 99 gallons per capita per day (or 375 liters/capita per day).

The major categories of water use in the U.S. are shown in the following table:

	Public supply	Domestic	Irrigation	Live stock	Aqua culture	Industry	Mines	Power	Total
U.S. Mgal/d	44,200	3,830	128,000	2,140	8,780	18,190	4,020	201,100	410,000
U.S. %	10.8%	0.9%	31.2%	0.5%	2.1%	4.4%	1.0%	49.0%	100.0%

Figure A13.2 - Water Category Use

The average U.S. domestic consumption can be broken down to outdoor use of about 30 gallons per capita per day, and several indoor use categories totaling about 69 gallons per capita per day according to the following table:

Fixture/appliance	Gal/d
Toilet	18.5
Clothes washer	15.0
Shower	11.6
Faucets	10.9
Leaks	9.5
Other	1.6
Bath	1.2
Dishwasher	1.0
Total indoor	69.3

Figure A13.3 - Water Use by Category

13.3 Holland Water Usage

Compared to the 375 liters (99 gallons) per capita per day U.S. average domestic consumption, Holland has a substantially lower domestic consumption rate of 193 liters (51 gallons) per capita per day. However, as experiences from many other countries show, there is room for reduction by borrowing from best practice examples and implementing measures to increase water efficiency.

Holland is supplied with drinking water, managed and operated by HBPW which provides drinking water to homes and businesses and water for fire emergencies. Typical daily residential consumption is approximately 1.7 Million gallons a day. The total annual billed residential water consumption is about 615 Million gallons or $3M. The sewer or waste-water cost associated with outgoing water is also treated by HBPW for an annual cost of $2.8M.

A breakdown of the total water consumption and sewer or waste water for Holland, based on available data and reasonable assumptions, is shown in the following tables:

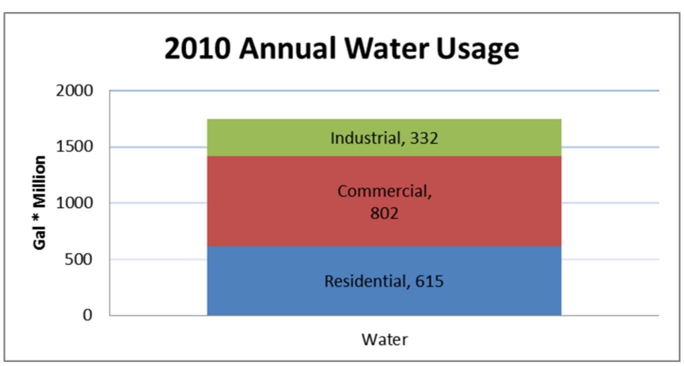


Figure A13.4 - Annual Water Usage Breakdown

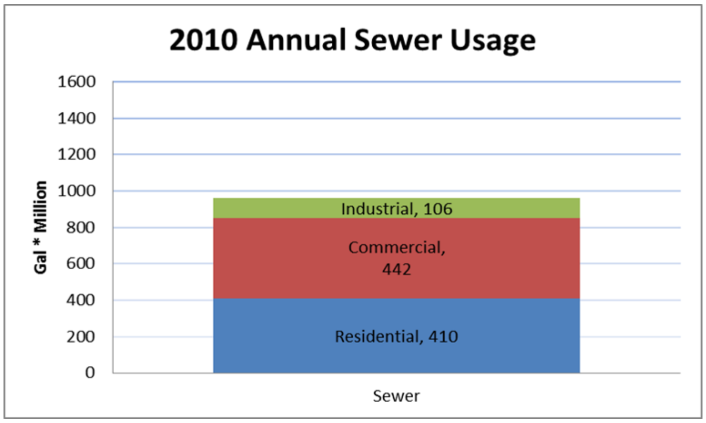


Figure A13.5 - Annual Sewer Breakdown

13.4 Global Practice: What Others Have Done and Achieved

In many countries water efficiency became an issue of public interest in the 1980s and 1990s, driven by increasing environmental awareness as well as rapidly increasing freshwater and sewage cost. This led to a substantial decrease in per capita water consumption. The following table compares the domestic consumption of a number of countries:

Country	Domestic consumption [l/ca/d]
United States	375
Canada	329
Italy	250
Sweden	200
France	150
Denmark	145
Israel	135
Germany	126
Belgium	120

Figure A13.6 - Benchmark Data

13.5 German Experiences and Practices

In Germany, domestic water consumption dropped 15% from 147 l/ca/d in 1990 to 126 l/ca/d in 2004 for private households and small business. The breakdown of these 126 liters is shown below:

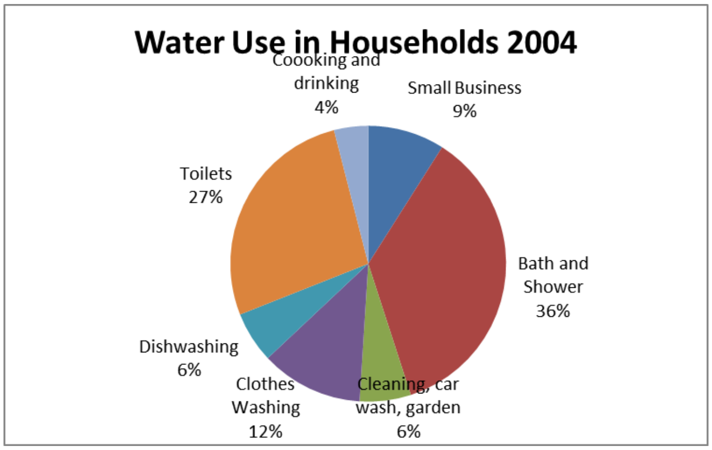


Figure A13.7 - Germany Water Usage Breakdowns

Along with a wide range of building and appliance standards and public education, price had a significant impact on consumption.

13.6 Copenhagen Water Saving Strategies

Copenhagen Water is a regional supplier delivering water to approximately 1 Million people in the greater Copenhagen area, located around the City of Copenhagen. Since 1989, Copenhagen Water is continuously implementing measures to reduce water consumption. In consequence, water consumption had decreased by 22% in 1997 and continues to fall.

The achievements have been due to the following measures:

- Information and motivation campaigns
- Water-saving consultancy for companies and housing associations
- Focused training for water and sanitation businesses such as plumbers
- Installation of individual water meters in apartments
- Using non-potable water in industry
- Systematic leak tests to reduce water losses
- New technologies for trenchless pipe renovation
- Increase in water prices and adaption of the tariff system

Unaccounted for water is less than 5%; lower than in any other major city in Europe.

13.7 U.S. EPA Study

In a 2005 U.S. EPA study, about 100 homes in three different cities were retrofitted with water efficient equipment (toilets, clothes washers, showerheads, faucets) while the consumption levels were monitored before and after the retrofit. It showed that an average consumption reduction from 245 l/ca/d to 149 l/ca/d, or an average of 39% savings, could be achieved. The estimated payback period for retrofitting costs averaged to 5.8 years. About 70% of the savings resulted from efficient toilets.

13.8 Approaches and Measures

In general, the best success in water efficiency programs is experienced where not only singular measures are implemented but a more holistic approach is taken, composed of a coordinated set of measures in individual areas. These measures include technical, institutional and public awareness/information measures.

13.9 Incentives for Technical Measures at Customers Installations

This type of measure provides subsidies for water efficient equipment. This can range from simple product giveaways (e.g. aerators, flow reducing fixtures, or gasket sets) to rebate programs or subsidies for water efficient appliances and installations. Typical programs include:

13.9.1 Toilet Replacement

This includes the replacement of existing inefficient toilets with water-efficient or ultra-low-volume (ULV) toilets.

13.9.2 Toilet Retrofits

This includes the retrofitting of existing toilet by installing water-saving devices, such as a toilet dam, water displacement device or alternative flush devices. There are also solutions to convert existing toilets with a dual-flush function, reducing up to 50% of water consumption.

13.9.3 Showerheads and Faucets

This includes the replacement of conventional showerheads, typically having flow rates up to 20 liters per minute, with low-flow showerhead that reduce the flow by half and still provide proper shower performance.

13.9.4 Flow Reducers/Aerators

This includes the installation of low-flow aerators in faucets that would reduce the water flow to about 6 to 9 liters per minute, from the average flow rate of 15 liters per minute for conventional faucets. Saving hot water in the bathroom saves money not only on the water bill but also on the energy required for heating up the water.

13.9.5 Clothes Washing Machine

A water-efficient washing machine can process a 5kg load of laundry with about 40 liters of water. For comparison, a 10 year old washing machine uses 84 liters and a 20 year old one 134 liters to process the same size load.

13.9.6 Dishwasher

A water-efficient dishwasher uses about 10 liters of water for a full load compared to an old dishwasher using 24 liters, again saving on water and heating.

13.9.7 Outdoor Water Efficiency

To save water in the garden and other irrigation use, several approaches should be considered:

- Using timers on outdoor taps for lawn watering.
- Drip irrigation systems which apply water only to the roots zone.
- Garden and lawn watering smart controllers measuring depletion of available soil moisture.
- Rain barrels or other collection systems as a source of irrigation water.

13.9.8 Leakage Reduction

A significant part of the water is lost through leakages in both the municipal water system and in building installations. The latter is from dripping taps, toilets or other leaky fixtures. This can be minimized by awareness campaigns and routine maintenance.

The main causes for leakages in municipal water supply systems are pipe corrosion, damages during construction work, leaky fixtures and poor sealing. Leak monitoring and a corresponding leak detection and repair strategy usually pays off very quickly. A remaining leakage rate of up to 10% is usually considered as acceptable in economic terms, depending of course on water price levels.

13.10 Institutional, Tariff and Regulatory Framework Measures

13.10.1 Metering

The most efficient systems have metering and sub-metering rates approaching 100% in order to give all customers the possibility to benefit from savings. This typically reduces water use by 10 to 20%, but can be capital intensive and time consuming.

13.10.2 Tariff

Some countries tax water use, based on consumption, the size of the house or number of occupants. These include Australia, Canada, Mexico and most European countries. Progressively graduated water prices based on taxes have been effective in helping to reduce water consumption in countries such as Denmark and Hungary. The same countries generally also have charges on waste-water. A tariff system with a (moderately) increasing unit price for the higher consumptions is stimulating savings.

13.10.3 Plumbing Code Improvements

In order to keep up with the improving technical development, increasing the efficiency standards for new construction and renovations should be considered. New large scale developments are good opportunities to out-perform existing standards.

13.11 Outreach and Awareness Programs

Effective water awareness programs should always accompany other measures, enabling water consumers to understand more efficient behavior and be aware of water efficient technology solutions.

13.11.1 Information and Promotion Campaigns

It is important to inform and motivate end user and professionals (plumbers). There is a wide variety of ways to reach the consumer, including brochures, ads, internet information campaigns, competition for the highest water saving. Below are links to examples of effective campaigns:

http://www.ec.gc.ca/water/e_main.html
http://www.peelregion.ca/pw/water/conservation/
http://www.toronto.ca/watereff/index.htm
http://www.cwwa.ca/WEED/Results_e.asp
http://www.epa.gov/watersense/
http://www.allianceforwaterefficiency.org/
http://www.danva.dk/sw323.asp
http://www.danva.dk/sw329.asp
www.waterwiser.org/

13.11.2 Water Efficient Product Information

In order to promote water efficient products and to support the customers in choosing the right equipment, the following approaches have proven successful:

- Labeling water efficient applications/equipment such as the U.S. EPA WaterSense label.
- Listing / rating database of water efficient equipment, which can also serve as eligibility criteria for incentives.

Examples for product information resources are:

http://www.waterefficientsolutions.net/
http://www.epa.gov/watersense/
http://www.waterrating.gov.au/index.html

13.11.3 Customer Relationship / Information Center

Holland should consider including information support for water efficiency as a part of its overall outreach and education efforts associated with the CEP given the linkages between energy use and water.

13.12 Industrial, commercial, institutional customers

Most of the measures for the residential sector also apply for the industrial, commercial and institutional sector. Moreover there are additional water uses that are potential targets for efficiency improvements. Some examples are cleaning procedures or cooling processes such as flow rate adaption, closed circulation systems; dry cooling towers, free cooling, etc. The water efficiency can be improved by water efficiency audits for indoor and outdoor water consumption uses, carried out by trained auditors.

13.13 Additional Water Efficiency Information Sources

http://www.isi.fhg.de/publ/downloads/isi07a05/residential-water-demand-in-germany.pdf
http://www.eaue.de/winuwd/132.HTM;
http://www.eaue.de/winuwd/132.HTM and http://www.eaue.de/winuwd/81.HTM
http://www.cwwa.ca/WEED/Search_e.asp
http://www.aquacraft.com/Publications/EPA_Combined_Retrofit_Report.pdf
http://www.peelregion.ca/watersmartpeel/indoor/toilet-program-1.htm
http://www.toronto.ca/watereff/flush/index.htm
http://www.toronto.ca/watereff/washer/index.htm
http://www.dvgw.de/fileadmin/dvgw/wasser/organisation/branchenbild2008.pdf
http://www.peelregion.ca/watersmartpeel/business
http://www.oecd.org/dataoecd/1/59/40317373.pdf
http://www.epa.gov/watersense/
http://www.waterwiser.org
http://www.epa.gov/owow/nps/nps-conserve.html

APPENDIX 14
RETIRING EXISTING GENERATING UNITS (RESERVED)

13.14 Background

The CEP has been neutral in making a recommendation on the timing and phasing of a possible decommissioning of the 50-year old coal-fired plant on the De Young site. This Appendix is reserved for an evaluation of the impacts of different decommissioning dates.

This would include impacts on:

- Timing of investments in electrical capacity on the JDY site
- Timing of investment in renewable electrical capacity
- Investment in integrated utility solutions on industrial site
- Marginal cost of power generation
- Downtown district heating
- Achieving City CEP goal of 10 mt/resident GHG by 2050 and intermediate year targets
- Overall economic development
- Other community factors

APPENDIX 15
EXISTING HOLLAND CEP SUPPORT GROUPS

The PWT preparing the recommended Community Energy Plan would like to acknowledge the efforts made by the following groups and organizations that have made valuable contributions to the development of the CEP.

BANK OF HOLLAND
CITY FLATS HOTEL
COMMUNITY ENERGY ADVISORY GROUP
ENERGETX COMPOSITES
FAITH BASED COMMUNITY
FIFTH THIRD BANK
HAWORTH
HERMAN MILLER
HOLLAN D AQUATIC CENTER
HOLLAND AREA CHAMBER OF COMMERCE
HOLLAND BOARD OF PUBLIC WORKS
HOLLAND CHRISTIAN SCHOOLS
HOLLAND COMMUNITY SUSTAINABILITY COMMITTEE
HOLLAND HOSPITAL
HOLLAND PUBLIC SCHOOLS
HOLLAND RESCUE MISSION
HOLLAND/ZEELAND COMMUNITY FOUNDATION
HOPE COLLEGE
JOHNSON CONTROLS SAFT
LAKESHORE ADVANTAGE
LATIN AMERICANS UNITED FOR PROGRESS
LEAGUE OF WOMEN VOTERS
LG CHEM
LUMIR INC.
MACATAWA AREA COORDINATING COUNCIL
MACATAWA CYCLING CLUB
MAX TRANSIT
RIVERVIEW GROUP
SEMCO GAS COMPANY
SIERRA CLUB
SOLID WASTE/COMPOSTING/RECYCLING CONTRACTORS
SUSTAINABLE ENERGY FINANCING LLC
TRANS-MATIC MANUFACTURING
WEST MICHIGAN CREATION CARE
WEST MICHIGAN ENVIRONMENTAL ACTION COUNCIL

APPENDIX 16
TYPICAL OWNERSHIP STRUCTURE FOR MUNICIPAL ENERGY COMPANY

Municipal Energy Company Ownership Structure

There are a variety of different ownership structures available for a MEC. Below are 4 examples which provide an overview of advantages and disadvantages for such a company structure and organization.

Option 1: City-owned Company

In this example, the MEC would be owned and operated by a city as a Public Corporation delivering services on a commercial basis, with net profits flowing to the city. The obvious advantage is the strategic alignment with the community's need for reliable, quality services and community ownership.

Possible disadvantages include using public financing for all investment along with the potential lack of innovation that could come from public ownership. However, cities like Heidelberg, Germany have successfully implemented this model. Stadtwerke Heidelberg[10] is owned by the city and delivers district energy, natural gas, electricity, water and even runs the parking and public swimming pools of the city. It teams with neighboring communities to create a regional services approach.

Successful municipal electric utilities in the U.S. such as the Sacramento Municipal Utility District [11] and Austin Energy[12] also demonstrate there is no inherent conflict between a publicly managed community energy service company and high quality innovative services. The City of North Vancouver, through its wholly-owned subsidiary, Lonsdale Energy Corporation[13], is a good example of a North American city creating district energy services using a public corporation as the vehicle.

Option 2: Public-Private Partnership

Under this option, the MEC would be jointly owned by a city and private investors. Investments and profit sharing would be in proportion to the ownership shares.

The investors would typically include strategic investors with a long-term interest in the district energy opportunity and could include existing regional utilities, property owners and ethical investors. These may be combined with a portion of ownership traded on the stock exchange.

The obvious advantages are that the risks are shared between the city and private capital, and that the private partners may be more motivated to develop both extended innovative energy services, and to expand their activity beyond the city. Potential challenges may come from differing public and private motivations relative to acceptable financial returns and public service priorities.

There are many examples of very successful city energy service companies that operate with this ownership model. Excellent examples are Mannheim[14], Germany and Stockholm, Sweden. Both offer a range of energy services including extensive district energy services and both have profitable activities that extend beyond the home city.

St. Paul, Minnesota, which has a modern district heating and cooling system serving the downtown, also has a public-private ownership model. The district energy distribution system is a non-profit cooperative co-owned and managed by the city and customers. The Board is structured with equal

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10 http://www.hvv-heidelberg.de/cms/Strom/Stadtwerke_Heidelberg_Energie_GmbH_.html

11 http://www.smud.org

12 http://www.austinenergy.com/

13 http://www.cnv.org/server.aspx?c=2&i=98

14 http://www.mvv-energie.de/cms/konzernportal/en/homepage.jsp representation from both, with a tie-breaking Director selected unanimously by the balance of the Board. On the supply side, separate for-profit entities have been established to run CHP, biomass and similar facilities, each with long-term supply agreement with the district energy distribution company.

In all cases, there needs to be a structure that ensures the priority to deliver acceptable services is never jeopardized. This is usually achieved by the community retaining a majority ownership or having over-proportional (greater than 50%) voting rights.

Option 3: Investor-owned Company

The MEC under option 3 would be 100% owned by private investors, operating under license from a city to deliver district energy services.

The advantage is that the financial risks are carried by private owners, with the possibility that a city would not automatically benefit from profit sharing. This could be mitigated by a licensing fee. The potential challenge remains to ensure the balance between being a long-term public service provider and a profitable investor-owned entity.

The city utility in Berlin, Germany, which is responsible for district energy and much of the gas and electricity services, is a large example of this model, being owned by Vattenfall AB[15] from Sweden. In the U.S., the investor-owned Con Edison in New York City supplies electricity, natural gas and district heating to the community.

Option 4: Site-specific Company

A final model would involve a single site for which a special purpose company would be established to provide district energy services specifically for that site.

Dockside Green Energy LLP[16] is an example of this option. It was established to run a small district heating system for the Dockside Green development in Victoria, BC. Siedlungswerk[17] a major property developer in Stuttgart, German has a wholly-owned district energy affiliate, which establishes development specific entities if appropriate municipal services are not available. In both of these examples, the intent is either to ultimately broaden the service area (Dockside Green) or to fill a gap until the wider community is ready to take over the services (Stuttgart).

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15 http://www.vattenfall.de/de/index.htm
16 http://docksidegreenenergy.com/index.html
17 http://www.siedlungswerk.de/