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SUSTAINABLE ENERGY UTILITY DESIGN: OPTIONS FOR THE CITY OF SEOUL

FINAL REPORT

TO

SEOUL DEVELOPMENT INSTITUTE

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SUSTAINABLE ENERGY UTILITY DESIGN: OPTIONS FOR THE CITY OF SEOUL

Final Report

to

Seoul Development Institute

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Energy is a critical part of our modern economy. For over a century, the energy used to generate electricity, heat homes and businesses, and power our transportation system has come mostly from fossil fuels – coal, oil, and natural gas. The challenges associated with countries like the United States and South Korea whose heavy reliance on fossil fuels have been brought into sharp focus by concerns over fuel price volatility,[1] dependence on imported energy, peak oil, pollution, and the climate crisis.[2]

In response to these challenges, cities and states around the United States are playing a leadership role in enacting innovative policies to promote energy sustainability. These include policies such as public benefit funds, net metering, green power marketing, and renewable portfolio standards. Even without strong federal policies targeting climate change, state and local sustainable energy programs are projected to result in reductions in carbon dioxide emissions of nearly 670 million tons by 2010, and 1.7 billion tons by 2020.[3] These figures are probably conservative since states and cities are continually strengthening existing policies. For example, twenty-nine states and the District of Columbia have passed renewable portfolio standards that require or encourage utilities to derive a percentage of their electricity from renewable sources.[4] Of these, fifteen states have either enacted or significantly strengthened their RPS policies during the first eight months of 2007.[5] Given the magnitude of the present energy challenges, a growing number of states and cities are seeking even more aggressive policies in order to fundamentally alter energy demand from the bottom up.

This trend has given rise to the concept of the *sustainable energy utility,* which was first established through legislation by the State of Delaware in 2007. A sustainable energy utility is an independent and financially self-sufficient entity responsible for delivering energy efficiency, energy conservation, and customer-sited renewable energy[6] to end users. An SEU targets all sectors and

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[1] Between 1998 (when electricity and natural gas deregulation were legislated) and 2006, U.S. residential electricity prices increased by 38%, residential natural gas prices by 99%, residential heating oil prices by 200%, and gasoline prices (regular grade) by 146%. See U.S. Energy Information Administration, *Short Term Energy Outlook – Monthly Prices*. Available at: http://tonto.eia.doe.gov/steo_query/app/pricepage.htm

[2] The most recent report of the Intergovernmental Panel on Climate Change indicates evidence in support of a finding of human impact on climate that exceeds a 90% probability standard. See IPCC, (2007). *Climate Change 2007: The Physical Basis – Summary for Policymakers.* Available at: http://www.ipcc.ch/SPM2feb07.pdf Over 70% of the observed warming effect is attributable to fossil fuel combustion.

[3] Byrne, J., Hughes, K., Rickerson, W., & Kurdgelashvili, L. (2007). American policy conflict in the greenhouse: Divergent trends in federal, regional, state, and local green energy and climate change policy. *Energy Policy* 35(9), 4555-4573.

[4] See Database of State Incentives for Renewables and Efficiency (2007). Available at: http://www.dsireusa.org

[5] Rickerson, W. (2007). What can the U.S. learn from the German experience with renewable energy policy? Presented at the Capitol Hill Climate Change Lunch Series, Washington, DC, August 27 (sponsored by the German Marshall Fund of the United States and the Heinrich Böll Foundation).

[6] Customer-sited renewables are often called "distributed renewable energy sources" or "distributed renewables" – see the 2005 report by the University of Delaware's Center for Energy and Environmental Policy (CEEP), *Policy Options to Supported Distributed Resources*. Available at: http://ceep.udel.edu/publications/energysustainability/2005_es_policy_options_distributed%20resources%5B1%5D.pdf. Key advantages of customer-sited renewables are: decongestion of transmission and distribution lines, allowing the postponement or cancellation of costly upgrades; reduced outage rates; and reductions in energy related emissions (while new utility-scale renewable energy plants built to serve expected demand growth can slow the rate of future increases in CO_2 (for example), customer-sited renewables reduce the need for existing plant operation and avoid the need for future capacity increases, thereby directly lowering actual emissions).

fuels, including transportation. This is a major departure from supply-side approaches, and from traditional demand-side policies, which tend to address only certain types of fuels (e.g. electricity, but not heating or transportation), or limited "silos" of end users (e.g. residential but not municipal consumers).

This report reviews the sustainable energy service delivery models of several leading jurisdictions in the United States and compares their structure, function, and design to that of the sustainable energy utility concept. The report then examines the potential energy and environmental impacts of a sustainable energy utility if adopted by the city of Seoul.

2. Learning form Pioneers in Sustainable Energy Development

The states and cities in the Northeast and the mid-Atlantic region of United States are increasingly playing a leadership role in sustainable energy policy development. During the late 1990s, East Coast states were among the first in the country to establish renewable portfolio standards and public benefits funds. These policies have since diffused rapidly across the country to both regulated and deregulated states. To date, twenty-two states have established public benefits funds to support renewable energy, energy efficiency and/or low-income weatherization. These funds have supported the majority of the customer-sited sustainable energy service programs around the country during the last decade.

The structure and governance of each of these funds varies, and this section reviews the design and management of funds in the states of Massachusetts, Vermont, and New Jersey to depict this variety. Each state has greater than five years of experience in offering programs promoting energy efficiency and/or customer-sited renewable energy. Each state is an acknowledged leader in the field of sustainable energy development.[7] Importantly, each state has taken a different approach to sustainable energy service delivery: Massachusetts is noted for its use of utilities to deliver sustainable energy services; New Jersey has pioneered a public sector approach in which regulatory and economic development-focused agencies oversee sustainable energy service delivery, often using competitive bidding procedures; and Vermont is acknowledged as the first jurisdiction to evolve a sustainable energy service delivery system planned and organized by a non-profit corporation employing competitive bidding procedures for implementation of goals set for it by a public sector regulatory body. Recently, Cambridge, Massachusetts has taken the Vermont model a step further in designing a similar approach for municipal use. Because this innovation has just begun, it cannot be discussed in the same detail as the efforts of the three states. Nonetheless, the Cambridge Energy Alliance offers an indication of further thinking on sustainable energy service delivery.

This Section describes the approach taken in the three states and one locality of United States in order to capture the organizational and financing elements that make their models work. The impacts of each model on energy affordability and environmental sustainability are documented.

Following the review of these jurisdictions' efforts, the sustainable energy utility model and its implementation in the State of Delaware is examined. While also being new, the model learns from the efforts Massachusetts, New Jersey and Vermont and seeks a more comprehensive energy focus – addressing all fuels and all end users – while pioneering a financing model that is self-sustaining without the need to increase utility rates or taxes.

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[7] See the following references: Blumstein, Carl, et al (2005) « Who should administer energy efficiency programs?" *Energy Policy* 33: 1053-1067; CEEP (2000) *Environmental policies for a restructured electricity market: A survey of state initiatives*. http://ceep.udel.edu/publications/energy/reports/2000_energy_restructured_market.pdf; CEEP (2004) *Transportation strategies to improve air quality.* http://ceep.udel.edu/publications/sustainabledevelopment/reports/sd_transport_strategies/2004_transport_strategies.pdf; CEEP (2001) *Planning for sustainable communities: A survey of sustainable practices among twelve communities in the United States*. http://ceep.udel.edu/publications/sustainabledevelopment/reports/sd_sustainable_communities/2001_sustainable_communities.pdf

2.1 Massachusetts – A Utility-led Service Delivery Model

Massachusetts was one of the first states to pursue electricity restructuring in 1997. As part of its restructuring legislation, the state established two separate system benefits charges (SBC) on each kilowatt-hour of electricity sold in the state: one for energy efficiency and low-income weatherization, and one to support renewable electricity. The state also established three distinct governance structures for the energy efficiency, low-income weatherization, and renewable electricity funds. The experience and design of each of the three programs is reviewed below.

2.1.1 Energy Efficiency

Utilities in Massachusetts are responsible for managing the energy efficiency funds and programs within their own service territories. This is the most prevalent model of energy efficiency program management in the US, though some states are moving away from this model as will be discussed in more detail below.

The gas and electric utilities in Massachusetts have provided energy efficiency programs to their customers since 1980. The initial focus of utility programs was on maximizing the number of residential energy audits performed each year. After program reviews revealed that few residents were adopting the efficiency measures proposed following the audits, however, the programs were redesigned in 2000 to attempt to provide greater incentives for energy efficient technology adoption.

The SBC rate supporting the state electric utilities is 2.5 mills for each kWh. The SBC was first collected in 1998 and will be reviewed in 2012. Since 2002, the fund has collected approximately $124 million annually, and it is projected that $1.71 billion will be collected during the life of the program. The SBC funds are used to provide rebates for residential, commercial, and industrial electrical efficiency. Electrical utilities are also responsible for developing incentives to encourage thermal efficiency in residences that use oil heat.

In order to support the energy efficiency programs of the state natural gas utilities, an energy conservation charge is included in the natural gas rates. In 2006, the aggregate natural gas utility program budgets were $25 million. Natural gas utilities provide rebates, grants, and loan programs to encourage thermal efficiency improvements such as insulation, high-efficiency boiler installation, and duct insulation.

2.1.1.1 Energy Efficiency Program Structure

The Massachusetts Division of Energy Resources (DOER) provides oversight and coordination all the utility programs, while he utilities administer the programs (Figure 2.1). Evaluation and cost-effectiveness oversight for the programs was the responsibility of the Department of Telecommunications and Energy until it ceased to exist in April 2007. Its successor organization, the Department of Public Utilities, is now responsible for program evaluation. DOER encourages collaboration between utilities for services offered, and approves individual utility plans, programs, and budgets. In 2001, the state grouped the residential energy efficiency programs of each utility under the umbrella of the MassSAVE program. MassSAVE, which is administered by DOER, is a web-based clearinghouse for residential energy efficiency resources. Residential customers enter their zip codes and heating fuel type and get a list of energy rebates, programs and services they can take advantage of. Each utility also maintains separate programs for commercial and industrial customers, which are not centrally coordinated through MassSAVE.

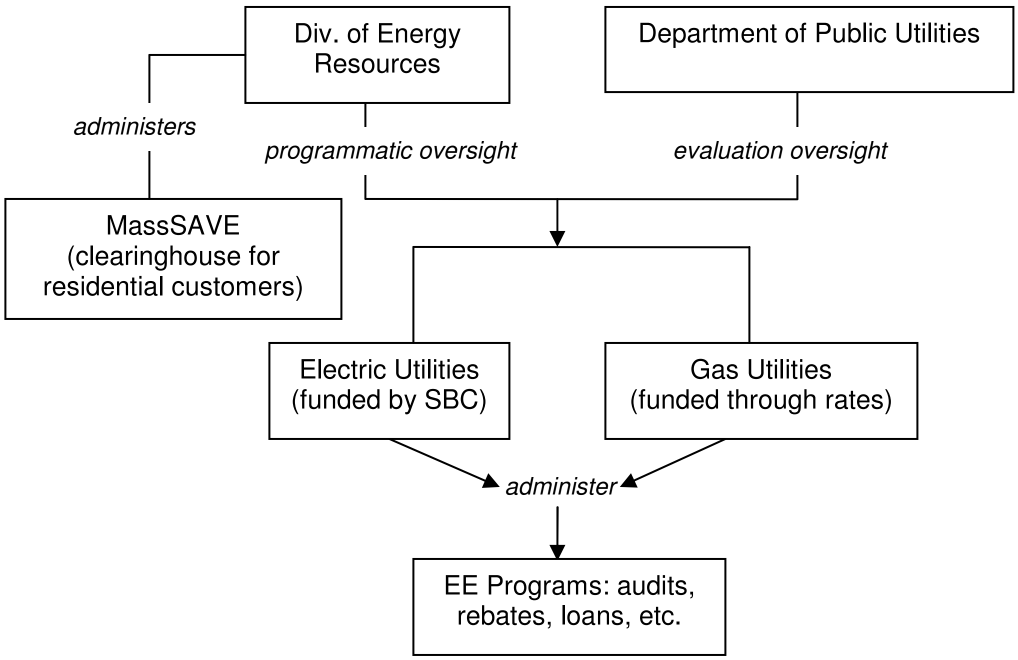

Figure 2.1 Total Annual Budget for Affordable Energy Programs in Massachusetts

In order to implement the energy efficiency programs, each utility also hires private sector contractors (e.g. ICF International, Conservation Services Group, Honeywell, etc.) to implement the programs themselves.

2.1.2 Affordable Energy[8] Services

In addition to standard energy efficiency programs, Massachusetts also offers a range of assistance programs to low-income customers. All utilities (gas and electric) are required to offer rate discounts for residents at 175% of poverty level or below. In 2004 this totaled $42.5 million for both gas and electric. Discounts for customers range from 20% to 42% of their bills.

In addition to the rate discounts, utilities also offer energy efficiency programs to low-income residents. These programs are funded from an earmarked portion of the efficiency SBC: 0.25 mills per kWh out of the total 2.5 mill surcharge. In 2005, revenues from this surcharge were approximately $14 million. For gas utilities, a conservation charge is built into the rate, equating to approximately $7 million in 2005. The total spending for gas and electric utilities was $21.2 million in 2005.

In 2006 Federal Low Income Home Energy Assistance Program (LIHEAP) funding totaled $82.76 million, serving 134,756 households. From the LIHEAP funding, $8 million is dedicated to

[8] In this report, "affordable energy services" refers collectively to low-income energy efficiency, weatherization, renewable energy, and bill assistance programs

HEATWRAP, a heating system repair/replacement program. In 2006 Federal Weatherization Assistance Program (WAP) was funded at $6.94 million.[9]

Total annual funding for affordable energy programs is $160.9 million (Figure 2.2). Approximately 134,000 households receive fuel assistance annually, reducing the average household bill by 20%-42%.

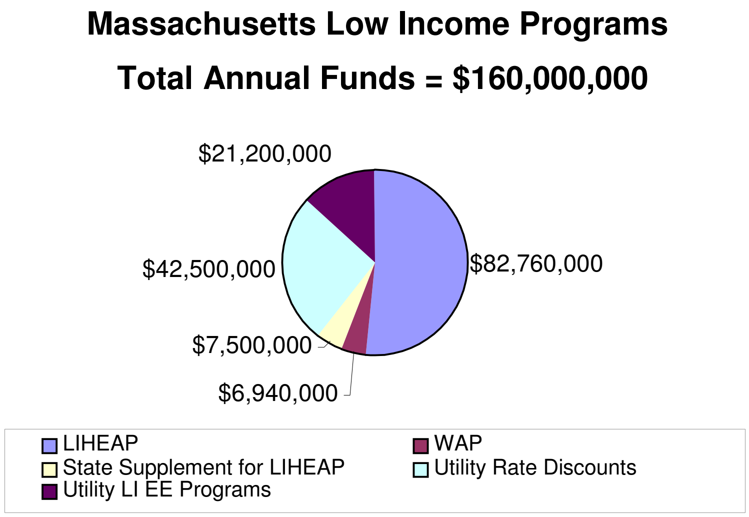

Figure 2.2 Total Annual Budget for Affordable Energy Programs in Massachusetts

2.1.2.1 Structure and Governance

LIHEAP and WAP are administered through the Department of Housing and Community Development's Community Services Unit. The services are delivered by Community Action Agencies (CAAs).[10] Residents must be at 200% of the federal poverty level or lower to receive LIHEAP and WAP funding.

Similar to the standard energy efficiency programs, the services offered under the affordable energy efficiency programs are managed by (and vary by) the individual utilities, and include audits, free weatherization (insulation, air sealing, and heating system replacement), lighting retrofits, clock thermostats, and appliance management.

National Grid's Appliance Management Program (AMP), for example, is only available to customers located within the utility's service territory. The program is administered through the local CAAs and provides funding for home appliance surveys, education about energy use of appliances, and appliance energy efficiency installations. The AMP program is unique in its service

[9] LIHEAP funds are used to reduce low-income households' energy bills and to prevent fuel or electricity shut-off due to bill non-payment. WAP services improve a household's energy efficiency, thus reducing energy consumption and energy expenditures

[10] Also known as Community Action Programs, CAAs are private, non-profit service and advocacy organizations that provide services to low-income residents.

delivery model: the service personnel work closely with the homeowner in a co-learning atmosphere, instead of dictating behaviors or making adjustments without informing clients. National Grid spends about $4.5 million each year on AMP.

All of the affordable energy services in the state are overseen by the Low-Income Energy Affordability Network (LEAN), which was created by the 1997 restructuring legislation. LEAN is a collaborative organization with representatives of all affordable energy agencies in the state, and works to ensure that all of the services are coordinated, cost-effective, high-quality, convenient, and accessible. LEAN also negotiates on behalf of low-income ratepayers in rate cases.

2.1.3 Renewable Energy

The revenues from the state renewable electricity SBC are not managed by the individual utilities. Instead, the revenues are collected as the Massachusetts' Renewable Energy Trust, which is managed by a quasi-public agency called the Massachusetts Technology Collaborative (MTC). The MTC is overseen by its own board of directors with no direct oversight from any other state agencies. MTC administers its programs through grants, solicitations, feasibility studies, support for outreach programs, and other incentive agreements.

The Trust is funded by an SBC of 0.5 mills per kWh for investor-owned utilities and municipal utilities that choose to participate, and by proceeds from the renewable portfolio standard's alternative compliance payment (ACP). The RPS ACP, which is adjusted for inflation and currently set at $57.12 per kWh, accounted for $19.6 million in Trust revenue in 2005.[11] The ACP revenues are placed in a separate account, and used only for projects that maximize the commercial development of new renewable energy generation facilities. During 2003-2006, MTC spent an average of $48 million annually (Figure 2.3), which amounts to $7.56 per capita or 0.77% of utility revenues.

MTC has used the Trust to support over 6.6 megawatts (MW) of onsite renewables through programs such as the Small Renewables Initiative, the Community Wind Collaborative, and the Large Onsite Renewables Initiative, with many more in-line to receive these incentives in the coming years. The Trust also manages several programs that promote clean energy economic development, rather than emphasizing end-user services. These accounted for 11% of the Trust budget in 2006.

Among the Trust's more recent programs is the Green Affordable Housing Initiative, through which MTC has awarded $25 million to state, city, municipal, and private sector partners to manage the installation of up to 1.5 MW of distributed renewables on affordable housing developments around the state.[12]

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[11] MA DOER (2007) http://www.mass.gov/doer/rps/rps-2005annual-rpt.pdf
[12] MTC (2007). Green Affordable Housing Initiative. http://www.mtpc.org/renewableenergy/afford_housing.htm

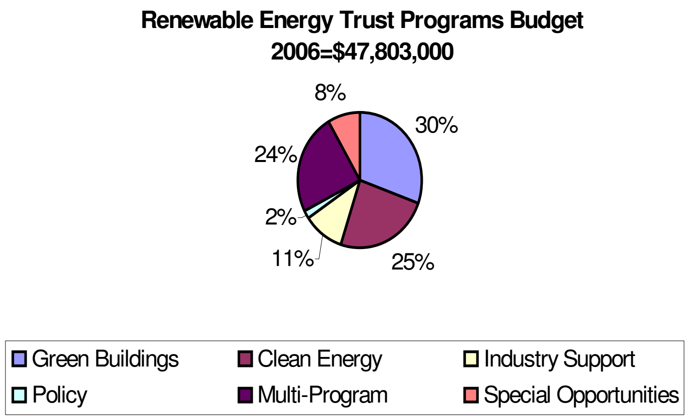

Figure 2.3 MTC Renewable Energy Program Budget for 2006

2.1.3.1 Structure and Governance

The Trust is overseen by the MTC Board of Directors, which consists of senior managers from industry, universities, and government. The Board has statutory authority and fiduciary responsibility for the management of the Trust. A RET Committee oversees the management of the Trust and several advisory committees support various initiatives within the Trust. Twenty-seven staff members work for the Trust directly, not including MTC support staff and directors.

Programs are managed by MTC staff but are often contracted out through grants, contracts, loans, rebates, and investments. Some programs are handled in-house and some fully contracted out. For example, the Small Renewables Initiative rebate program is fully managed within MTC, but the Public Awareness Initiative operates wholly by distributing grants for media advertising, trainings, workshops, information distribution, etc.

2.1.4 The Cambridge Energy Alliance

In addition to the state programs for sustainable energy services, the City of Cambridge has launched an ambitious sustainable energy service delivery program known as the Cambridge Energy Alliance (CEA). The CEA is a non-profit founded through a partnership between the City, the Henry P. Kendall Foundation, NSTAR, and other stakeholders to create "a large-scale, $100+ million cross-sector conservation initiative that involves massive energy efficiency implementation, along with distributed generation (CHP and renewable energy) and demand-response resources, with the goal of reducing peak demand by 50 megawatts, approximating 15% of the City's total energy load."[13]

The CEA is responsible for designing, managing, and financing programs to achieve these goals. A central part of the CEA model is the establishment of a revolving loan fund with which to finance aggregated sustainable energy services. Savings from the financed projects will then be used to replenish the fund. Initial funding is being provided by the Kendall Foundation, the Barr Foundation, and the Chrous Foundation. While its priority goal is to shave peak electricity load, the CEA plans to eventually affect energy use for heating and transportation (including electricity,

[13] See http://www.cambridgeenergyalliance.org

natural gas, oil, gasoline, diesel fuel), as well as water usage. There is also an affiliated and parallel effort to create a Boston Energy Alliance.

2.2 New Jersey – A Governmental Service Delivery Model

Like Massachusetts, New Jersey initially established energy efficiency and renewable energy funding as part of its electricity restructuring legislation in the late 1990s. New Jersey's Electric Discount and Energy Competition Act was signed into law in February 1999, and the New Jersey Board of Public Utilities underwent a rulemaking process to establish regulations for governing clean energy fund collection and distribution. In its initial iteration, the New Jersey Clean Energy Program (as its renewable energy and energy efficiency programs were collectively known) was managed in manner similar to Massachusetts's programs: energy efficiency programs were managed by individual utilities, while renewable energy funds were managed by a state agency: New Jersey's Office of Clean Energy.

The recently reorganized New Jersey Clean Energy Program (NJCEP) has transitioned away from a largely utility- and state-administered model, however, and toward a competitive model. While state agencies have authority over the goal-setting, program design and program monitoring and evaluation processes, the new NJCEP relies on competitive bidding for service delivery. Overall administration is supplied by state agencies, but day-to-day implementation relies on third parties.

2.2.1 Sustainable Energy Funding

The Clean Energy Program is funded by a Societal Benefits Charge ('SBC'). The SBC is collected as a non-bypassable charge imposed on all customers of New Jersey's seven investor-owned electric and gas utilities. Through rulemaking, the BPU determines the amount that will be collected. A total of $358 million was collected in 2001, 2002 and 2003, while $124 million was collected 2004. A total of $745 million will be collected in 2005, 2006, 2007 and 2008. Of this, 63% will be allocated for energy efficiency, and 37% will be allocated for renewable energy (Table 2.1).

Table 2.1 Clean Energy Program Funding Levels (2005-2008)

Year	Total Funding Level	Energy Efficiency	% of Total	Renewable Energy	% of Total
2005	$140,000,000	$103,000,000	74%	$37,000,000	26%
2006	$165,000,000	$113,000,000	68%	$52,000,000	32%
2007	$205,000,000	$123,000,000	60%	$82,000,000	40%
2008	$235,000,000	$133,000,000	56%	$102,000,000	44%
Total	$745,000,000	$472,000,000	63%	$273,000,000	37%

Source: BPU Docket EX04040276

The NJCEP budget is set through BPU rulemaking. The SBC rate therefore depends upon the size of the annual NJCEP budget as set by the BPU. The ACEEE[14] estimated that the average mill rate

[14] ACEEE (2007). Summary table of public benefit programs and electric utility restructuring (August 2007) Available at: http://www.aceee.org/briefs/aug07_04.htm

for energy efficiency has been $0.00102/kWh, and $0.00086/kWh for renewable energy.[15] There is also a separate SBC of $0.00006/kWh[16] for affordable energy programs (see below).

The services and incentives available under the NJCEP include both residential and nonresidential energy efficiency programs. Residential programs include energy audits, weatherization incentives through the EPA ENERGY STAR Home Performance program, and heating and cooling efficiency rebates. Nonresidential[17] programs include incentives for standard electrical and thermal efficiency technologies,[18] and emerging technologies such as geothermal heat pumps and combined heat and power systems. The total amount of energy efficiency funding available in 2005 was $128 million (Figure 2.4).

The NJCEP renewables programs include low interest loan programs, competitive grants for large renewable energy systems over 1 megawatt in size, and the Clean Onsite Renewable Energy (CORE) program, which provides rebates to customer-sited renewable systems. Like the MTC programs, the NJCEP also provides incentives for clean energy businesses. Of these programs, the majority of the NJCEP renewable energy funds were historically allocated to the CORE program (Figure 2.5).

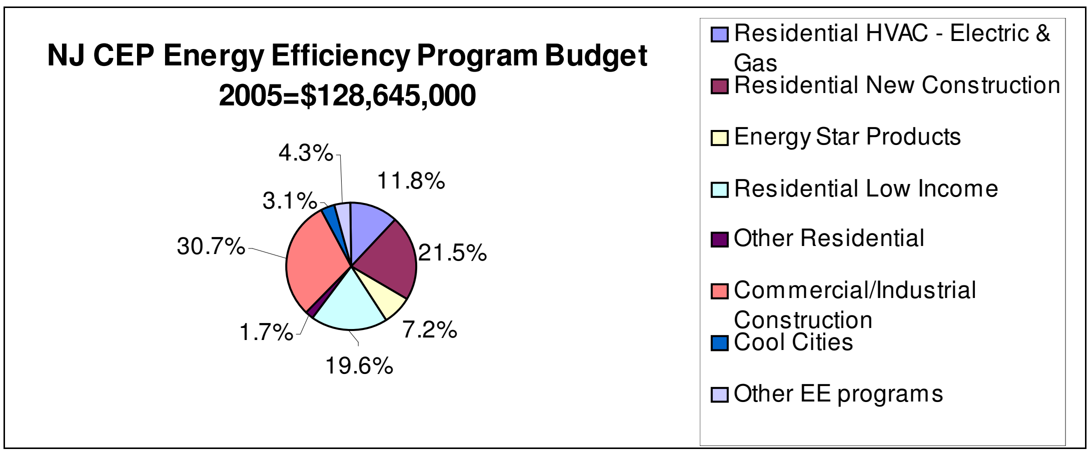

Figure 2.4 NJCEP Energy Efficiency Program Budget for 2005

Source: NJ BPU Sept. 14, 2006 Order on Docket EX04040276

[15] That is, 1.02 and 0.86 mills, respectively.
[16] That is, 0.06 mills.
[17] Commercial, industrial, agricultural, state, and municipal
[18] E.g. lighting retrofits and controls, HVAC, boiler upgrades, variable frequency drives, motors

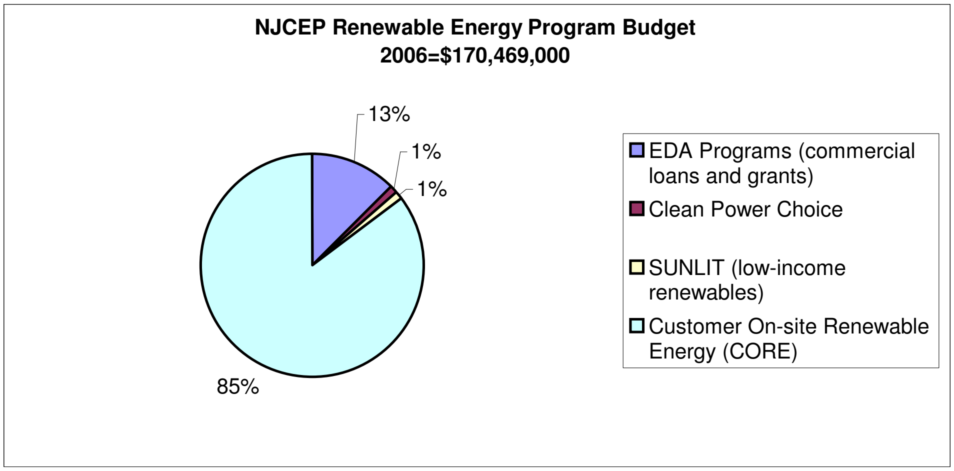

Figure 2.5 NJCEP Renewable Energy Program Budget for 2006
Source: NJ BPU Sept. 14, 2006 Order on Docket EX04040276

NJCEP incentives have encouraged the installation of over 26 MW of renewable energy since 2001, of which the large majority has been solar (Figure 2.6). The rapid growth of New Jersey's PV market is the result of its CORE funds coupled with a progressive renewable portfolio standard (RPS) requiring 2% of state electricity be supplied by solar energy by 2020. Because of this policy, solar renewable energy certificates (SRECs) in New Jersey sell for $200-$250 per MWh in the state market. It should be noted, however, that New Jersey is transitioning away from CORE funding for PV to an entirely SREC-based system of PV support,[19] and the CORE PV rebates will be phased out by October of 2008.

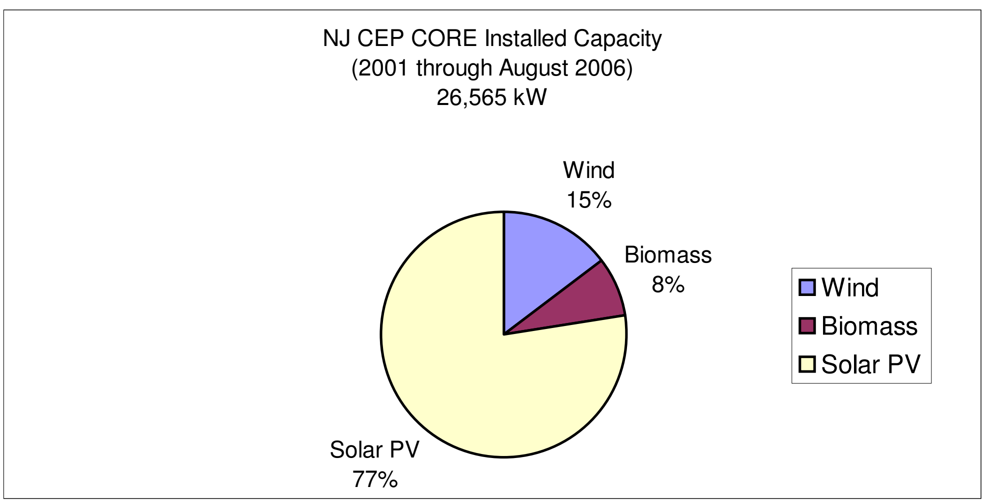

Figure 2.6 Renewable Energy Capacity installed through the CORE Program

[19] Winka, M. (2006). "Transition to a market-based REC financing system," in *New Jersey's Solar Market* (White Paper series) (pp. 2-7). Trenton, NJ: New Jersey Clean Energy Program.

2.2.2 A New Structure for NJCEP

As discussed above, the New Jersey's Clean Energy Program (CEP) is undergoing a transition to a third-party management structure. Under the new structure, the Board of Public Utilities will continue to be responsible for overseeing the regulatory process that governs the Clean Energy Program. The Clean Energy Council, composed of renewable energy stakeholders, will advise the BPU on the design, budgets, objectives, goals, administration, and evaluation of the Clean Energy Program.

The biggest change under the new structure is that clean energy program management will be competitively bid out to third party organizations. The New Jersey Office of Clean Energy, which formally managed the renewable energy programs, will hire a state-employed Contract Manager. The Contract Manager is responsible for releasing competitive contracts for a Fiscal Agent, a third-party Program Coordinator, and an evaluation agent. The Program Coordinator will supervise three Market Managers, who will manage programs for Residential Efficiency, Commercial and Industrial Efficiency, and Renewable Energy, respectively. The Fiscal Agent will be an independent entity responsible for collecting and disbursing Clean Energy Program funds, while the evaluation agent will conduct program monitoring and verification, and report back to the BPU and Clean Energy Office. At present, the evaluation role is to be performed by the Center for Energy, Economic & Environmental Policy at Rutgers University

The Office of Clean Energy will no longer be responsible for managing the renewable energy program, but will be responsible for carrying out and enforcing the regulations created by the BPU, and working with the third-party Program Coordinator to develop policies and procedures to carry out the Clean Energy Program.

2.2.3 Affordable Energy Services

In addition to the renewable energy and energy efficiency SBCs, New Jersey's restructuring legislation also established an SBC of approximately $0.00006/kWh for affordable energy programs. As with the other SBCs, the affordable energy SBC must be approved by the BPU. The SBC funds three programs: the Universal Service Fund, which helps low-income households pay no more than 6% of their annual income on combined gas and electric services, up to a cap of $1,800 per household; the New Jersey Lifeline, which provides low-income seniors and disabled residents with a $225 yearly credit on utility bills; and New Jersey Comfort Partners, which provides weatherization services. New Jersey's Department of Human Services administers each program.

Applications for all affordable energy programs are accepted and processed by non-profit organizations under contract in each of the 21 counties in the state. Households with income at or below 175% of federal poverty guidelines are eligible for all three programs. The amount of the energy assistance benefit is determined by the applicant's income, household size, fuel type, and heating region. The Department of Human Services also administers the federally-funded LIHEAP program (FY 2006: $77,346,024), while the NJ Department of Community Affairs administers the federally funded WAP program (FY 2006: $5,266,959 million). The same application form applies for LIHEAP, WAP, and the state Universal Service Fund.

A summary of New Jersey's affordable energy programs are included in Table 2.2 below.

Table 2.2 New Jersey's Affordable Energy Efficiency and Fuel Assistance Programs

Program	Funding (2006)	Funding Source	Administration
Low Income Home Energy Assistance (LIHEAP)	$77,346,024	Federal	Department of Human Services
Weatherization Assistance Program (WAP)	$5,266,959	Federal	Department of Community Affairs
Universal Service Fund (USF)	$156,400,000	SBC	Department of Human Services
NJ Lifeline	$72,000,000	SBC	Department of Health and Senior Services
NJ Comfort Partners (Part of NJ Clean Energy Program)	$21,300,000	SBC	Gas and electric utilities

Source: NJ LIWAP and NJ Comfort Partners Comparison of Programs and Evaluation Findings. APPRISE, 2004.

2.3 Vermont – A Third Party-led Model

For most of the 1990s, Vermont's energy efficiency programs were utility-administered, similar to the approach in Massachusetts. In 1999, Vermont pioneered the concept of an *energy efficiency utility* in which an independent entity is created to manage the energy efficiency programs in aggregate. Management of the energy efficiency utility is competitively bid out, and the utility is now known as Efficiency Vermont. Although Efficiency Vermont has proved to be a highly successful model for energy efficiency delivery, renewable energy and affordable energy services are still administered by government agencies.

2.3.1 Energy Efficiency

Vermont electric and gas utilities were first required to offer comprehensive energy efficiency services in 1991. With over 21 distribution utilities in Vermont, program coordination was confusing for customers and inefficient for utilities to administer. In 1999 the regulated utilities and the Department of Public Service developed a Memorandum of Understanding[20] which led to the creation of a statewide energy efficiency utility (EEU), later called Efficiency Vermont.

Currently Efficiency Vermont is financed by an energy efficiency surcharge, the amount of which is determined each year by the Vermont Public Service Board. The charge is collected by the distribution utilities, but used to support Efficiency Vermont activities. The charge is equivalent, on average, to 2.82% of total electricity payments (3.2 mills per kWh), and the FY 2006 budget was $14.8 million (Figure 2.7). In August 2006, the Board released an order that expanded the allowable budget of the energy efficiency utility to $24 million for 2007, and $30.75 million for 2008. In order to pay for these increases, the Board is conducting workshops and meetings to investigate different

[20] Docket No. 5980

options for financing energy efficiency projects. These options include establishing an entity with bonding authority to implement EEU financing, securitization, commercial financing, and making energy efficiency projects available for reduced cost funding under the Sustainable Priced Energy Enterprise Development (SPEED) program.

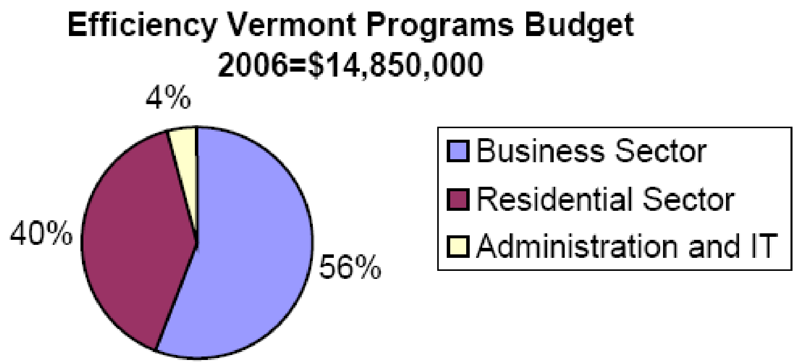

Figure 2.7 Efficiency Vermont Energy Efficiency Program Budget for 2006

Vermont's goals for the Efficiency Vermont include: (1) maximizing societal net benefits while acquiring comprehensive cost-effective electric efficiency savings; (2) using markets to increase the level of and comprehensiveness of energy efficiency services; (3) effectively capturing lost opportunity markets; and (4) striving for distributional equity across customer classes and geographic regions. To better accomplish these goals, Efficiency Vermont shifted from a programmatic approach to energy efficiency to a market approach. This shift away from rigidly defined programs was justified in the 2004 Annual Plan:

> "[Goals include] simplifying customer and strategic partner participation, working more effectively throughout supply chains to impact energy affecting decisions, and eliminating gaps in services. Service gaps occurred when customers did not fall into the traditional residential or business segments, (and) did not fit pre-conceived 'program' definitions…Efficiency Vermont has transitioned organizationally to this market-focused perspective by developing a team approach to better serve the breadth of the markets…".

Efficiency Vermont's current programs offer energy efficiency audits, outreach and education, rebates, grants, and loans to a broad range of customer types across the state. In addition to standard residential and commercial programs, Efficiency Vermont has also developed customized programs to address market sectors that might be overlooked by conventional efficiency programs (e.g. ski areas, dairy farms, multifamily buildings, schools, and wastewater treatment facilities).

From 2000 to 2005, the EEU spent $77 million, and saved Vermonters over $220 million (2003 dollars) in total benefits. The EEU has also saved 50,915 MWh of electricity (Figure 2.8).

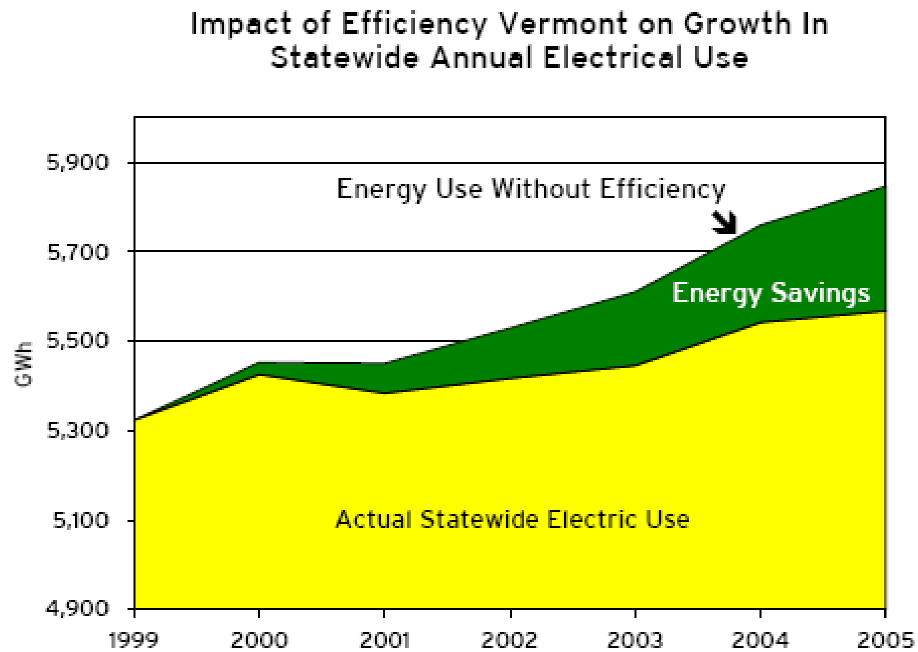

Figure 2.8 Impact of Efficiency Vermont Model

2.3.1.1 Structure and Governance

The energy efficiency utility (EEU) operates as an independent contractor to the Public Service Board under the name Efficiency Vermont. The Vermont Department of Public Service (DPS) is an executive agency that evaluates the EEU's performance and makes recommendations to the Board. The Board contracts with the EEU to run Efficiency Vermont for three-year contracts, with the option of renewal after the first three years. If renewed, the contract must be put out to bid again after the sixth year. Vermont Energy Investment Corporation, a non-profit organization, won the contract for 2000-2002, for 2003-2005, and again for 2006-2008. In addition a program adminstrator, the Board also hires a Contract Administrator to manage the Board's contract with the EEU, and a Fiscal Agent to receive and disburse funds. The Board also appoints a multi-stakeholder Advisory Committee (Figure 2.9).

Efficiency Vermont has 108 staff members. Staff categories include: Business Services (42), Residential Energy Services (19), Marketing and Business Development (16), Integrated Services (10), Planning and Evaluation Services (8), Customer Service (4), Executives (3), Finance (3), and Human Resources (3).

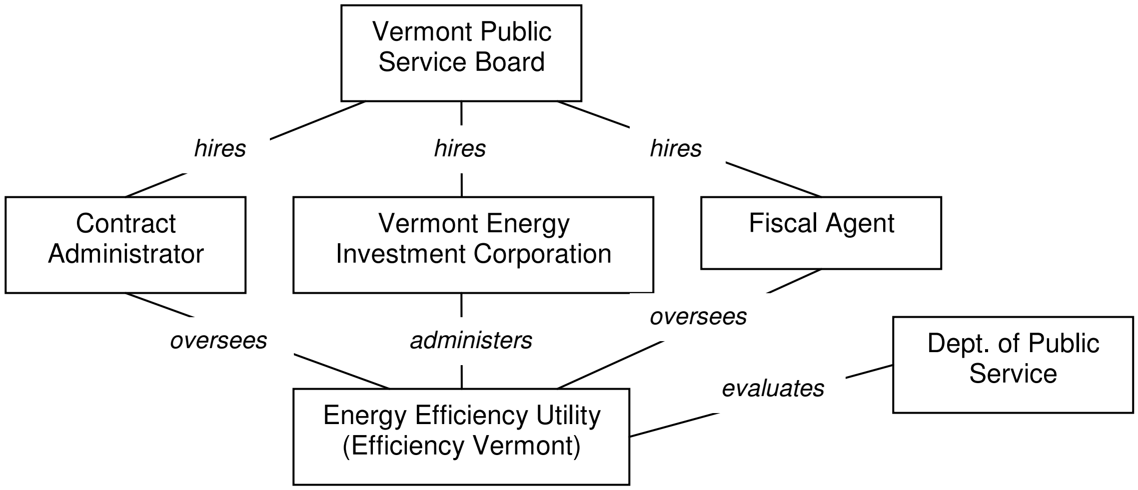

Figure 2.9 Efficiency Vermont Organizational Structure

2.3.2 Affordable Energy Services

In addition to federal funds, affordable energy services in Vermont are also supported by EEU funds, but the programs themselves are managed by state agencies.

In 2006, Vermont received $13.68 million in federal LIHEAP funding, and $1.35 million in WAP funds. To be eligible to receive the federal funds, participants must generally be at 125% of the federal poverty level, although some services are provided at 150% of the poverty level.

The federal programs are supplemented by statewide affordable energy programs, which include the Weatherization Trust Fund and affordable energy programs funded through the SEU. Established in 1990, the Weatherization Trust Fund provides additional funding for WAP services, and is financed through a 0.5% gross receipts tax on regulated utilities and all non-transportation fuels, except wood ($4 to $6 million annually). In 2005 $4.9 million was spent out of the WAP. The money can be spent on weatherization or moved over to supplement LIHEAP funds if necessary.[21]

In addition to federal and Weatherization Trust Fund monies, the EEU contract also stipulates that 15% of funds must be spent on affordable energy services ($2.23 million in 2006). The EEU's programs target low-income single-family homes and multifamily homes. Each of these programs offers weatherization services. The EEU weatherizes approximately 1,000 low-income single-family homes each year, in addition to almost all subsidized affordable multifamily housing.

In providing affordable energy services, the EEU has a goal of eliminating historic geographic gaps in energy efficiency services. The EEU has two affordable energy programs: Low Income Single Family (LISF) and Low Income Multifamily (LIMF).

The EEU provides all single family affordable energy services through the existing WAP administering organizations (Community Action Agencies) by supplementing the services they

[21] In 2006, $3.5 million was used from the Weatherization Trust to support LIHEAP funding).

offer and providing training for the WAP auditors; guidelines, screening tools, and technical resources; and financial resources for the incentives, fees, and administrative expenses. Efficiency Vermont's Low-Income Housing Services supplements the weatherization program by paying for efficient lighting installation, free refrigerator replacement, sealing doors and windows, insulation, low-flow shower heads, replacement of electric heat with oil, gas or propane (WAP pays for 25%, EEU pays for 75%), and referral to other loans, mortgage products, or energy services.

Almost all subsidized affordable housing in Vermont receives services from the EEU. The EEU provides customized technical assistance and incentives, such as design assistance, fuel switching, and efficiency lighting and water systems. Individual renters are referred to the WAP program for further services. The EEU is also beginning to work with private, non-subsidized low-income multifamily residences as well. EEU programs are fuel neutral and the EEU partners with Vermont Gas and Burlington Electric District (BED) to provide consistent services for all customers.

Approximately $22 million is spent annually on affordable energy efficiency and fuel assistance in Vermont. About 20,000 households receive fuel assistance annually, and 1,000 receive weatherization services (Figure 2.10).

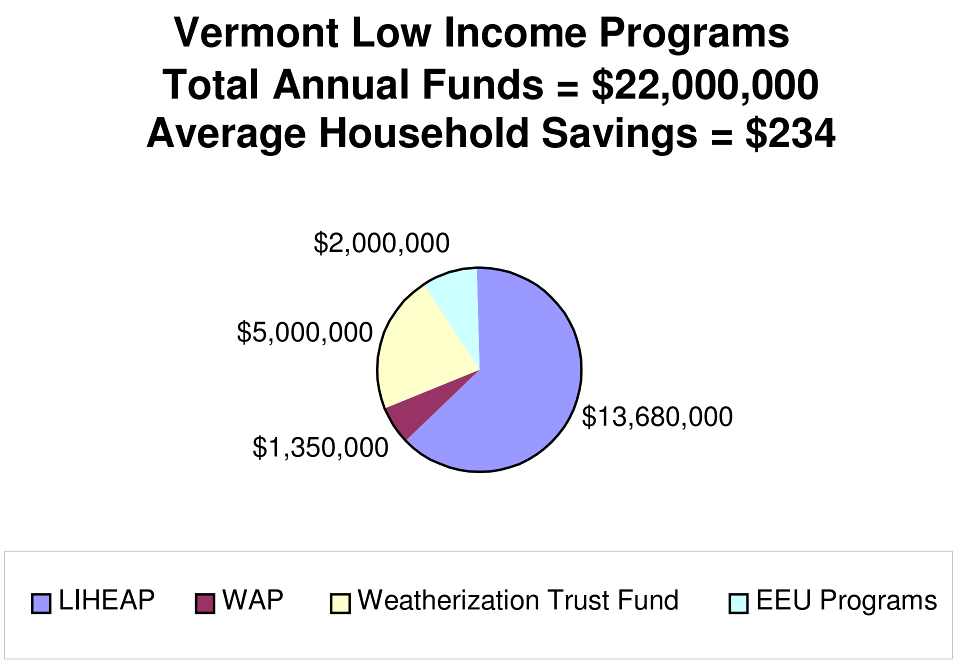

Figure 2.10 Vermont's Typical Affordable Energy Program Budget

2.3.2.1 Structure and Governance

LIHEAP and WAP are administered by the Economic Services Division (ESD) within the Department of Children and Families, as are the affordable energy funds collected through the SEU (Figure 2.11). A network of 21 local Community Action Agencies and nonprofit entities is responsible for administering the affordable energy programs, and they receive technical assistance and training from SEU staff.

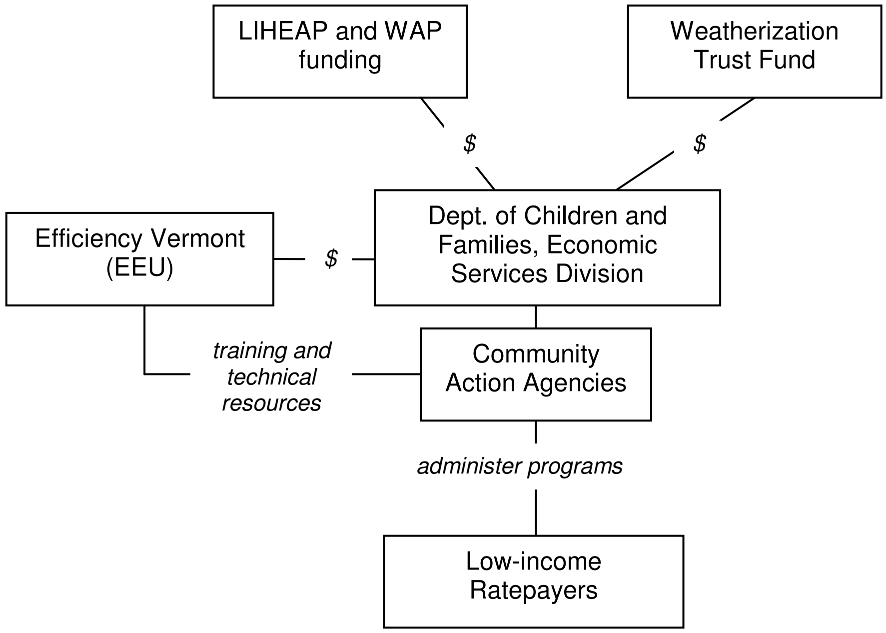

Figure 2.11 Organizational Structure of Vermont's Affordable Energy Program

2.3.3 Renewable Energy

Compared to its support for energy efficiency and affordable energy, Vermont's program for promoting renewable energy is relatively new. The Clean Energy Development Fund (CEDF), which began in 2005, supports the Solar and Small Wind Incentive Program, a rebate-style incentive program for solar energy and wind electricity systems, and loan and grant programs for CHP and biomass. The Fund receives money through two Memoranda of Understanding between the state and Entergy regarding the utility's nuclear facility. Funding for the CEDF will be between $6.2 and $7 million annually until 2012. Prior to 2005, the Solar and Small Wind Incentive Program had been funded with money from the petroleum violation escrow fund.

Since 2003 the Solar and Small Wind Incentive Program has helped install 345 renewable energy systems with an electrical capacity of 434 kW and solar water heating capacity of 1,500 million Btu/yr. The Vermont Small-Scale Wind Energy Demonstration Program, a separate program supported with funds from the US Department of Energy, has installed 20 ten kilowatt wind turbines.

2.3.3.1 Structure and Governance

The CEDF is administered by the Department of Public Service with the support of: a Fund Administrator, who writes RFPs, grant agreements, and annual reports, and Advisory Committee that reviews program design, 5-year strategic plans, annual plans, and operating budgets; and Investment Committee that approves plans and budgets, and helps review large grant and investment proposals. While the Department of Public Services manages the CEDF, the management of the Solar and Small Wind Incentive Program has been bid out, and is currently administered by the Renewable Energy Resource Center, a project of the Vermont Energy Investment Corporation.

3. Delaware's Sustainable Energy Utility

3.1 Evolution of the Sustainable Energy Utility Model

The sustainable energy utility (SEU) builds on, and offers an alternative to, the energy service delivery models discussed in the sections above.

As demonstrated by the experience of Vermont and New Jersey, state energy programs have begun to reorganize to emphasize competitively selected third-party program implementers and comprehensive services that cross fuels and energy end uses. This strategy is particularly important considering that buildings are responsible for almost half of U.S. energy consumption, and three-quarters of U.S. electricity consumption,[22] while transportation represents the largest source of imported energy use and is the fastest growing source of greenhouse gas emissions. Achieving a sustainable energy future will require: significant gains in buildings-based energy efficiency for all fuels and end uses (including weatherization and other building envelope improvements); rapid introduction of customer-sited renewable energy to reduce demand for conventional energy in heating, cooling and eventually transport markets: a major shift to clean vehicles, and green transport/transit options (including carshare, free/low-fare transit, employee commute planning); adoption of comprehensive affordable energy solutions that enable all families and small businesses to participate in the daily affairs of the society and economy. The task is to make these options typical choices in daily household and business life. The SEU model seeks to provide the full spectrum of sustainable energy services to end-users through a third-party management model.

Moreover, the SEU seeks to streamline customer-sited energy service delivery. Many traditional sustainable energy service models discourage prospective participants because of their complexity. Conventional energy suppliers are highly organized and able to market and deliver their products.[23] By contrast, energy users who are interested in improving energy efficiency, lowering their energy bills, and using renewable energy are faced with a fragmented array of equipment distributors, consulting firms, contractors, energy services companies; and participants often have little access to financing for sustainable energy choices, and must negotiate complex, bureaucratic labyrinths to secure funds. The traditional approaches for supplying sustainable energy services do not address this problem.

The most important feature of the SEU concept is that energy users can build a relationship with a single organization whose direct interest is to help residents and businesses *use less energy* and *generate their own energy cleanly*. Simply stated, the sustainable energy utility (SEU) becomes the point-of-contact for efficiency and self-generation in the same way that conventional utilities are the point-of-contact for energy supply. Further, it offers an infusion of funds and other resources to

[22] Dan Wrightson (for the American Institute for Architects), Presentation to the Task Force, February 20, 2007. Available at http://www.seu-de.org/docs/Wrightson_AIA_Presentation_2-20.pdf

[23] The energy supply industry in the U.S. and elsewhere has received significant and sustained subsidies over the past century. See, for example: Richard F. Hirsh (2002) *Technology and Transformation in the American Electric Utility Industry* (NY: Cambridge Press); Vaclav Smil (2005) *Energy in World History* (Boulder, CO: Westview Press); and Byrne et al, eds. (2006) *Transforming Power: Energy, Environment and Society in Conflict* (New Brunswick, NJ and London: Transaction Publishers). The achievements and current costs of this industry depend upon past and current subsidies.

provide a broader and better supported array of affordable energy services. It is important to note, however, that:

- The SEU does not supplant other private-sector activities, but complements them by providing a focal point for energy efficiency, affordable energy and renewable energy information, expertise, and incentives.

- The SEU is a public/private partnership that uses public funding sources, consumer savings, and renewable energy credit markets, combined with private sector funds and management skills, to address the shortcomings of traditional approaches.

These concepts form the core of the Delaware Sustainable Energy Utility. The sections below describe the SEU in detail, and include overviews of the SEU's legislative history, the SEU structure, and the SEU's funding strategy.

3.2 Creating the Delaware SEU

The Delaware SEU concept was first proposed by Delaware Senator Harris McDowell and Dr. John Byrne (director of the Center for Energy and Environmental Policy (CEEP) at the University of Delaware) in spring 2006, in response to high gasoline prices and a 59% increase in electric rates after a seven year cap on residential rates was lifted. The Delaware General Assembly passed Senate Concurrent Resolution 45 in June 2006 to create the Sustainable Energy Utility Task Force. The SEU Task Force, which is co-chaired by Senator McDowell and by Dr. John Byrne, consists of members of eight state legislators form both houses and both major parties of the Delaware General Assembly, the Delaware Public Advocate, the State Energy Coordinator (Delaware Energy Office), and three representatives of community and environmental organizations. The Task Force worked for eight months to develop a set of recommendations for how best to structure the SEU.[24] These recommendations directly informed the final version of legislation that defined the SEU and set the following SEU performance goals:

- Provide market development for residential and business purchases of high-efficiency alternatives in energy-using equipment to enable 30% savings in household and company energy use, with 33% of Delawareans participating by 2015 – this is estimated to cut annual household energy costs by $1,000
- Provide expanded weatherization services to residences, with a focus on the needs of low- and moderate-income families, doubling the number of annually weatherized units by 2015.[25]
- Assist Delaware households and businesses to install at least 300 MW of customer-sited renewable energy by 2019 through the use of incentives and other policy measures. These renewable energy systems will include at least 100 MW of solar photovoltaics and at least 200 MW of solar thermal, wind, geothermal, and other renewable resources.

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[24] Full details of the SEU Task Force structure, meetings, and reports can be found online at http://www.seu-de.org.

[25] Energy costs for low-income households account for a much larger proportion of household income than for others (see CEEP, 2006, *Energy, Economic and Environmental Impacts of the Delaware Low-Income Weatherization Program*; available at http://ceep.udel.edu/energy/publications/2006_es_weatherization%20program_evaluation_Delaware.pdf). Low-income renters and homeowners also reside in homes that consume significantly more energy per square foot than other housing. At the same time, there is a backlog of about five years for low-income consumers eligible for weatherization projects to improve home energy efficiency.

On June 28th, 2007, Delaware Governor Ruth Minner signed Senate Bill 18 into law and created Delaware's Sustainable Energy Utility.

3.3 SEU Structure and Governance

Delaware's SEU draws inspiration from and completes the model for competitively delivered sustainable energy services begun chiefly by Vermont and New Jersey. Although both Vermont's EEU and New Jersey's Clean Energy Program are remarkably successful, they have yet to capture the synergistic benefits of having a single statewide clearinghouse coordinate sustainable energy services across all end-use markets and all end-use fuels. The SEU model relies on competitive contracts and performance incentives to build in-state markets for sustainable energy services. The SEU can leverage private sector investment in energy services to help overcome the disincentives that can prevent people from benefiting from cost-saving and carbon-saving energy improvements. The SEU also minimizes administrative costs compared to other states by providing end-users with a single point-of-contact.

The SEU is overseen by the Delaware Energy Office, led by the State Energy Coordinator, and an Oversight Board. The SEU is an independent nonprofit entity unaffiliated with any Delaware utility. Similar to Vermont and New Jersey's competitive processes, the Energy Office will hire an SEU Contract Administrator through a competitive bidding process. The SEU Contract Administrator will plan all SEU programs and will competitively select Implementation Contractors to deliver actual services. The Energy Office will also contract for an independent Fiscal Agent who will act as the treasurer of the SEU funds. An Oversight Board will oversee the SEU's operations and set yearly and multi-year targets for sustainable energy service levels and impacts. The Delaware Energy Office has funding and the authority to ensure compliance with performance targets and to provide policy recommendations to the legislature that would improve SEU operations. The responsibilities and roles of each of the SEU participants are as follows (see also Figure 3.1):

The Delaware Energy Office is responsible for:

- Preparing requests for proposals to contract the SEU Contract Administrator and the Fiscal Agent
- Determining the contract terms, including length of contract (3-5 years) and performance incentives
- Reporting biannually to the Oversight Board
- Ensuring congruity between contract periods
- Ensuring compliance with performance targets

The Oversight Board is responsible for:

- Reviewing and approving RFPs for the Contract Administrator and the Fiscal Agent
- Reviewing and approving contract SEU performance targets recommended by the Contract Administrator
- Reviewing and approving modifications to performance targets or program designs
- Contracting with an independent agency to provide third-party review of monitoring and verification of results reported by the SEU Contract Administrator

The Fiscal Agent is responsible for:

- Oversight of all financial transactions at the program and implementation contract levels as the SEU's treasurer
- Receiving and disbursing SEU funds, interacting with bond and revenue authorities, and overseeing REC and solar lifeline financial transactions

The SEU Contract Administrator is responsible for:

- Program research and design and administration of implementation contracts
- Ensuring monitoring, and verification and program performance
- Reporting on overall program efficacy while also balancing services between customer classes, energy sectors, income levels, and technology types
- Ensuring that the work of the SEU targets efficiency improvements in electricity, natural gas, oil, propane, and gasoline
- Maintaining a high level of customer satisfaction by creating a comprehensive virtual utility that acts as a clearinghouse for all of its services.
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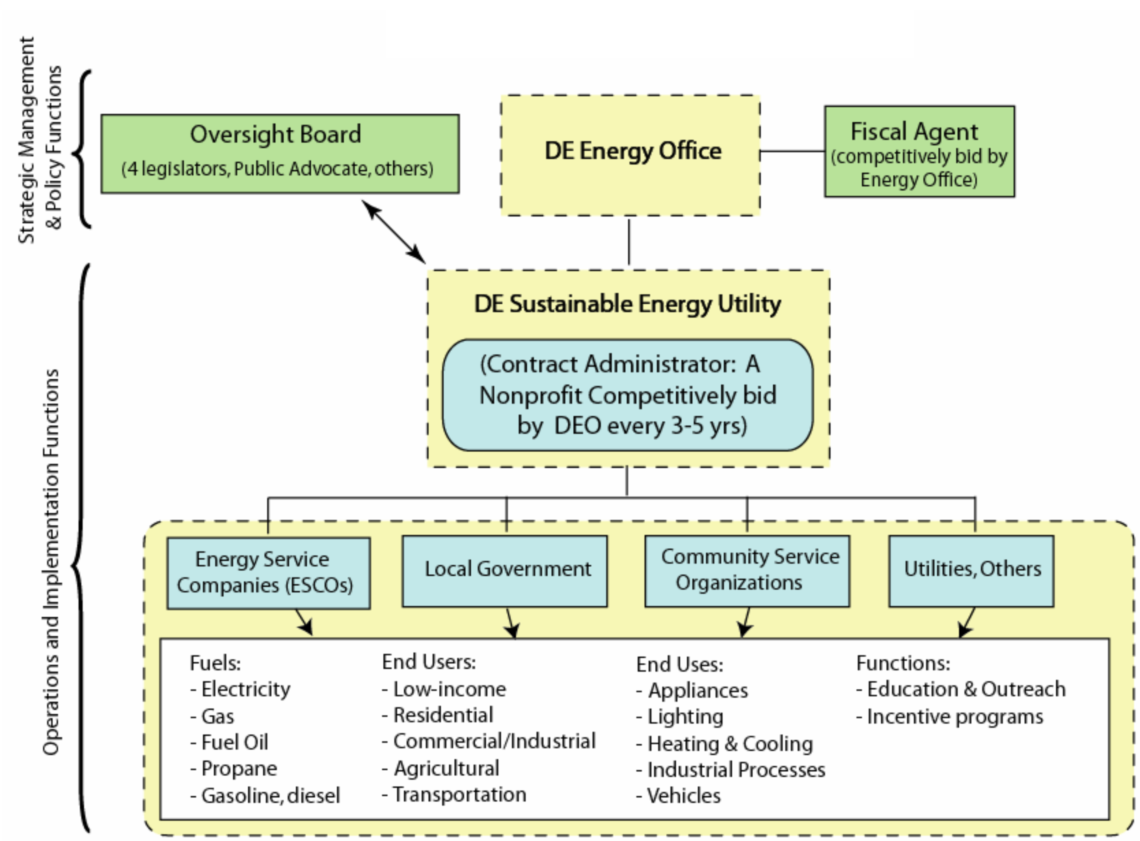

Figure 3.1 Organizational Chart of the Delaware Sustainable Energy Utility

3.4 Delaware's Sustainable Energy Funding Strategy

In addition to using a competitive management model to address all fuels for all customer classes, another distinguishing feature of the SEU is that it is designed not only to be financially self-sufficient, but to expand its programs as its revenues grow. This represents a fundamental shift away from energy efficiency and renewable energy programs that rely primarily on a fixed annual income from energy surcharges.

The SEU Task Force Research Staff developed an economic model for the SEU. This model took the estimated costs of building efficiency programs in the residential and commercial/industrial sectors, transportation energy efficiency programs, renewable energy programs, marketing and education, and SEU administration into account. The Staff then examined four potential funding sources: the green energy fund, sales from RECs, energy shared savings programs, and tax-exempt bonds. The model demonstrated that the SEU could meet ambitious performance targets with minimal public liability and maximum leveraged private participation.

Under the SEU legislation, the SEU was given bonding authority with a cap of $30 million to support initial SEU programs and operations. The bonding is "special purpose" and will not add to the State's General Obligation bonding. Bonds will be sold in two or more offerings to match expected expenditures during the early years of SEU operation. The bond debt will then be paid for by SEU revenues from three sources:

- Shared savings agreements with participants
- Partial proceeds from the sale of Renewable Energy Credits in local and regional markets
- Green Energy Fund monies.

Once the bond debt is repaid, these revenue streams will be fully directly to expanding the SEU's budget and its programs. Each of the revenue streams is discussed below, followed by a discussion of SEU cash flows.

3.4.1 Shared Savings Agreements

The SEU will cover the full incremental cost of high-efficiency equipment for all participating households. This includes the difference in price between qualifying ENERGY STAR®[26] and standard appliance and equipment models, and the difference in price between average and high-efficiency passenger vehicles.

In return for this investment, SEU clients enter into a shared savings agreement,[27] pledging to share 33% of the estimated savings created by the installed measures for a period of 3-5 years. Customers reap 67% of the gains from energy efficiency upgrades during the first 3-5 years of operation without the obligation to cover the incremental investment cost for their installation. In other words, customers incur no added investment cost and receive of 67% of total savings as revenue during the

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[26] The Energy Star© rating was developed jointly by the U.S. Department of Energy and the U.S. Environmental Protection Agency. See the following website for details: http://www.energystar.gov/

[27] Shared savings agreements have been used for several years by energy services companies (ESCOs), utilities and municipalities to secure investments in energy efficiency. See, for example, the program by Madison Gas & Electric http://www.mge.com/images/PDF/Brochures/Business/SharedSavingsOverview.pdf

first 3-5 years. After the shared savings period ends, the customer receives 100% of the savings from the investment.[28]

Employing the shared savings model, the SEU will be able to substantially increase Delaware's investment in energy efficiency in a short period of time. During the period 2008-2010, average SEU efficiency spending is projected to be $6.7 million annually. However, increased revenues will allow the average annual expenditure to expand to $8.7 million per year overall through 2019 (Figure 3.2). A two-part table including the analyses that these revenue projections are based on can be found in Appendix 1.

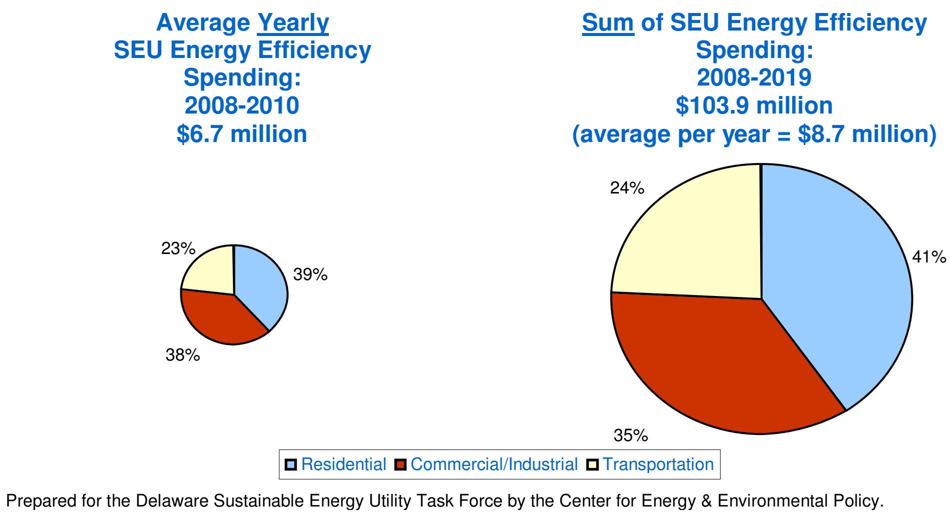
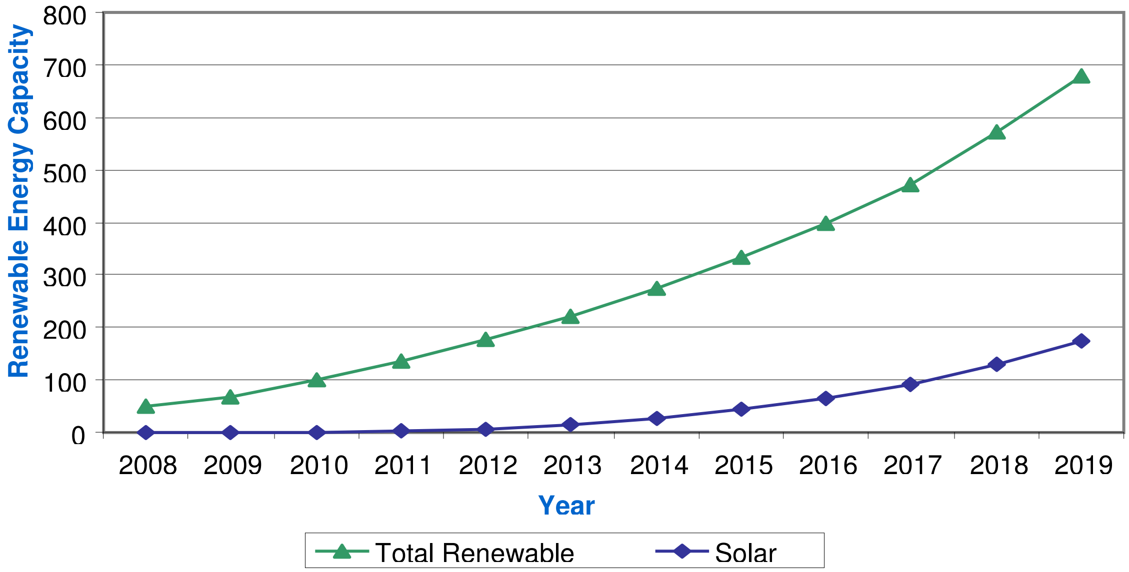


Figure 3.2 Projected SEU Investments in Energy Efficiency

3.4.2 SEU Fees for Renewable Energy Credits

A second revenue stream for the SEU will derive from renewable energy credit sales. Delawareans who site renewable energy on their premises will be eligible to receive SEU incentives equal to the difference in incremental cost of conventional energy supply and that provided by renewables. The planned investment in customer-sited solar thermal, wind, geothermal and solar electric technologies is significant. The forecast of SEU-incentivized renewable energy capacity is given in Figure 3.3.

[28] This assumes the client maintains or decreases energy consumption for the affected use(s) (i.e., appliances, vehicles, building envelope, etc.) during the lifetime of the installed measures.



Prepared for the Delaware Sustainable Energy Utility Task Force by the Center for Energy & Environmental Policy.

Figure 3.3 Cumulative Installed Renewable Capacity from SEU Investments

In return for providing rebates, the SEU will seek 25% of the proceeds from the sale of Renewable Energy Credits (RECs) for systems in which it invests. RECs are a commodity separate from the actual power produced by a renewable energy system. Producers of "green" power can sell RECs and utilize the energy generated by their system. REC buyers include companies seeking to improve their public image and utilities seeking to comply with RPS obligations. When RECs are traded, the entity purchasing the REC gains the right to claim associated environmental benefits.

REC markets are well-established in the Mid-Atlantic region, with multi-year purchase contracts being the norm. In 2007, Delaware's RPS policy was upgraded and now includes a mandate that 20% of the electricity sold in the state must derive from renewable sources by 2019, and that 2% of the state's electricity must be supplied by solar resources specifically.

The SEU can save owners of small- to medium-scale renewable energy systems the transaction costs of participating in the solar RPS by aggregating and selling customer RECs. In this way, the system owners benefit, and the SEU will earn a 25% share of REC revenue created by its incremental investment on behalf of SEU clients. Estimates of the yearly revenues earned by the SEU from its Distributed Renewables Program are summarized in Appendix 2.

3.4.3 Green Energy Fund

Delaware's Green Energy Fund (GEF), which was created by Delaware's restructuring legislation in 1999, collects revenue from electricity sales of its default electricity provider (Delmarva Power).[29] In 2007, the Delaware General Assembly passed legislation increasing the GEF surcharge

[29] Municipalities and the Delaware Electric Cooperative are not obligated to contribute to the Green Energy Fund. But several of these electricity providers have chosen to create their own versions of this Fund.

rate from 0.000178 cents per kWh to 0.000356 cents per kWh. It is projected that this increase will double the Green Energy Fund's annual revenue from to approximately $3.2 million.

GEF funds have historically been managed directly by the Delaware Energy Office. Under the SEU, GEF revenues will play a strategic role in meeting the new utility's early financial needs. This can be shown by comparing the relative shares of SEU finances received from shared savings agreements, REC sales and the GEF during 2008-2010 and 2019 (Figure 3.4). In 2008-2010, the GEF will account for approximately 41% of the SEU's revenues. By 2019, shared energy savings revenues will account for 83% of SEU funds, while the GEF's contribution will be only 7%.

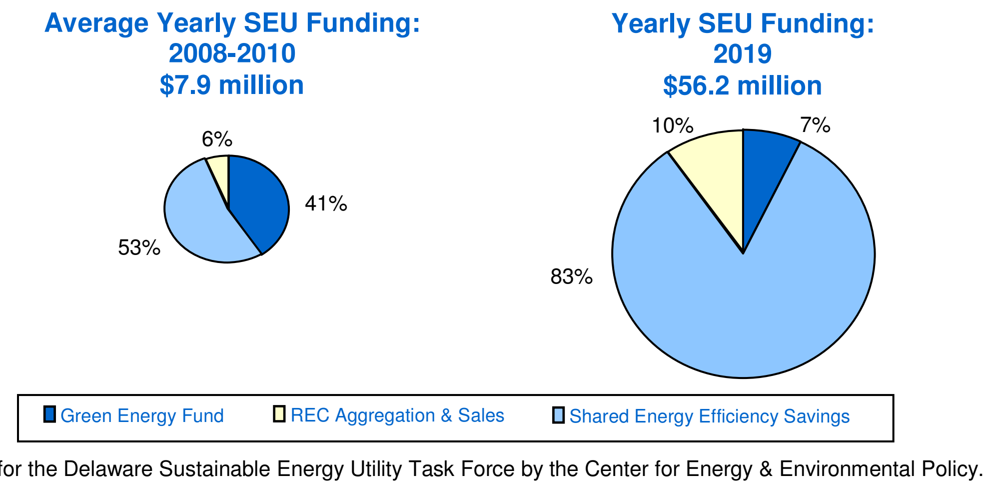


Figure 3.4 Evolution of Funding Sources for Delaware SEU Activity

3.4.4 Projected SEU Cash Flows

Given the three projected revenue streams discussed above, the CEEP research team built a financial model to estimate SEU costs, revenues and early capital investment needs. The cash flow output of the model is provided below.

Table 3.1 Projected Cash Flow of the SEU

Year	Expenditures: SEU Contract	Expenditures: SEU Program Costs (Rebates, Incentives, EM&V, etc.)	Expenditures: SEU / DEO Education & Marketing	Expenditures: Bonus Fund	Expenditures: Expenditure Totals	Revenues: SEU Revenues: 0.25RECs + 0.33SS (yrs 1-5) + GEF Revenues	Balance: Annual Cash Balance
2008	-$800,000	-$5,953,981	-$300,000	-$100,000	-$7,153,981	$3,140,411	-$4,013,569
2009	-$816,000	-$8,823,059	-$300,000	-$175,000	-$10,114,059	$7,630,898	-$2,483,161
2010	-$832,320	-$10,520,922	-$300,000	-$192,962	-$11,846,205	$12,864,141	$1,017,936
2011	-$848,966	-$17,429,788	-$261,447	-$288,291	-$18,828,492	$19,219,402	$390,910
2012	-$865,946	-$21,628,684	-$432,574	-$392,609	-$23,319,812	$26,173,902	$2,854,090
2013	-$909,243	-$32,364,351	-$647,287	-$664,624	-$34,585,505	$33,231,192	-$1,354,313
2014	-$954,705	-$38,569,611	-$771,392	-$759,003	-$41,054,712	$37,950,155	-$3,104,557
2015	-$1,002,440	-$42,212,500	-$844,250	-$841,412	-$44,900,602	$42,070,590	-$2,830,012
Sub-totals	-$7,029,621	-$177,502,896	-$3,856,950	-$3,413,900	-$191,803,367	$182,280,690	-$9,522,677
2016	-$1,052,562	-$41,052,588	-$821,052	-$937,295	-$43,863,498	$46,864,759	$3,001,262
2017	-$1,105,191	-$44,887,443	-$897,749	-$1,020,003	-$47,910,386	$51,000,162	$3,089,776
2018	-$1,160,450	-$45,173,259	-$903,465	-$1,068,534	-$48,305,708	$53,426,697	$5,120,989
2019	-$1,218,473	-$42,744,016	-$854,880	-$1,123,466	-$45,940,835	$56,173,305	$10,232,470
Totals	-$11,566,296	-$351,360,203	-$7,334,096	-$7,563,199	-$377,823,794	$389,745,614	$11,921,820

Prepared for the Delaware Sustainable Energy Utility Task Force by the Center for Energy & Environmental Policy.

As is commonly seen in start-up operations, the SEU has negative cash flow in its initial two years (Table 3.1). When projected investments in distributed renewables ramp up in the 6th program year,[30] negative cash balances reappear. By the 9th year of its operations, however, the SEU is earning positive cash balances at a compound rate.

To address the SEU's early working capital needs, the SEU Task Force recommended that the SEU be given bonding authority to issue "special purpose," tax-exempt bonds.[31] Tax-exempt bonds do not add to the State's General Obligation bonding, and are not tied to a specific revenue source. The legislation that created the SEU granted the SEU bonding authority with a $30 million cap. A prospectus for the SEU revenue bonds is included as Appendix 3. Based on a conservative analysis of revenues and financing, and using upper-bound expectations of program and administration costs, the SEU's cash flow is expected to be positive after approximately two years. Thereafter, the SEU will be self-sustaining.

3.4.5 Projected Economic, Energy and Environmental Impacts of the SEU

Through the implementation of energy efficiency, affordable energy and renewable energy programs across all sectors, the SEU is expected to deliver significant economic, energy and environmental impacts. A summary of these impacts is shown below:

- The SEU will eliminate the need for *any* new electricity generation built outside of Delaware's RPS requirements

[30] Logically, the SEU is expected to concentrate its attention in the first 5 years of operation on energy efficiency market development.

[31] Although Delaware chose to employ a bond, other financial mechanisms and approaches are available to create a financially self-sustaining SEU. As discussed in Section 2.3.1, Vermont is currently reviewing several different types of financing mechanisms to expand its energy efficiency programs.

- An average participating household will be able to reduce annual energy expenditures by more than $1,000. Reductions of this magnitude have important positive implications for the local economy.

- The State will be made less vulnerable to fossil fuel and electricity price spikes in the future. Energy efficiency and renewable energy provide "hedges" against price increases and will dampen price volatility.

- Energy efficiency and customer-sited renewables will help to reduce grid congestion and its associated costs. Congestion costs are borne by electricity ratepayers in the form of higher rates, regardless of supplier.

- Aggressive, energy efficiency and customer-sited renewable energy development can also stimulate thousands of new jobs in Delaware by creating an active in-state energy service market within the state. Jobs would also be created in the critical manufacturing sector, historically a source of stable, high-paying employment.[32]

- Delaware is unique in applying the SEU concept to transportation. Many of the State's air quality problems can be traced to emissions from gasoline and diesel-fueled vehicles. The State will benefit from lower vehicle emissions caused by the SEU's Green Vehicles Incentive Program, its Carsharing Program, and new thinking about transit and employee commute planning incentives, all of which will improve the State's capacity to meet EPA Clean Air standards.

Finally, the State's Carbon Footprint will be reduced by 33% due to SEU-sponsored investments in energy efficiency and customer-sited renewables, amounting to a cut in 2020 emissions compared to business-as-usual of 5.5 million metric tons of CO_2. While strategies that build cleaner energy facilities to meet future demand growth can slow, delay or even flatten future CO_2 releases, the SEU *cuts* carbon emissions by lowering the utilization of or eliminating altogether the need for current, as well as future, energy supply facilities. Indeed, the *Delaware SEU impacts are expected to sufficient to allow the State to lower its 2020 emissions to 2003 levels*. The impacts on carbon emissions are shown in the following Figure 3.4:

[32] CEEP's 2005 Briefing Paper on RPS impacts reviews several studies showing job growth associated with sustainable energy market development. Available at http://ceep.udel.edu/energy/publications/2005_es_Delaware%20Senate_RPS%20briefing%20paper.pdf (see especially, pp. 9-12 of the Briefing Paper).

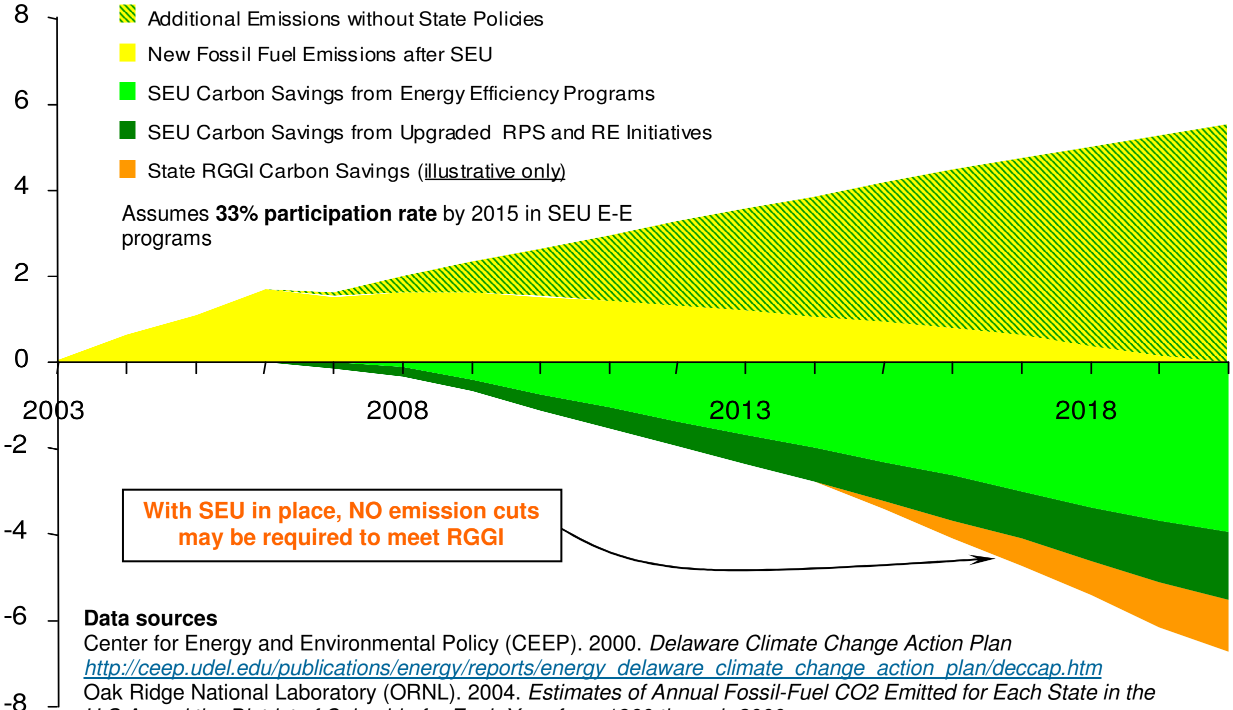


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Figure 3.4 Carbon Emission Reductions from SEU Policies

4. Sustainable Energy Utility Design Considerations

The Delaware Sustainable Energy Utility builds off of the experience and best practices of states like Massachusetts, Vermont, and New Jersey, and represents a new chapter in the evolution of sustainable energy service delivery. This section summarizes the policy and structural innovations embodied SEU model, and discusses how each of the state models discussed in this report measure up to these criteria. These innovations include:

- Central coordination: Sustainable energy services coordinated by through a single point of contact.
- Comprehensive programs: Programs target efficiency, conservation, and renewable energy across all fuels (electricity, heating, transportation) and customer classes (low-income, government, industrial, commercial, residential, etc.), regardless of utility service territory.
- Flexible incentives: Sustainable energy services are not constrained by strict programmatic criteria that might exclude, or inadequately serve, certain customer groups
- Self-sufficiency: A financing plan that ensures self-sufficiency by generating revenue through the supply of customer-sited sustainable energy services
- Independence: A governance system based on competitive procurement of independent management services

In addition to these criteria, an important component of SEU success is the existence of a policy framework that supports customer-sited sustainable energy services. Key policies include an RPS that encourages distributed generation, net metering regulations, green building mandates, and alternative fuel vehicle incentives.

4.1 Coordinated Sustainable Energy Services

Central coordination is key for avoiding customer confusion, creating cross benefits between incentives, reducing administrative costs. As noted above, Massachusetts has three different systems for renewable energy, energy efficiency, and affordable energy services. Moreover, on the energy efficiency side, energy service delivery is further subdivided by utility service territory and fuel. To a certain extent, the state has tried to organize resources through clearinghouses like MassSAVE and networks like LEAN. However, these resources do not cover the full spectrum of available services.[33] A commercial customer attempting to procure sustainable energy services for its facility, for example, would most probably have to submit separate

Navigating a Confusing System in Massachusetts

Even with the MassSAVE coordination for residential customers, residential incentives can still be confusing. As an example, a residential customer in Boston that purchases electricity and also uses oil to heat its home would rely on NSTAR to provide incentives for both electrical and thermal efficiency. KeySpan, the gas utility, offers significant incentives to upgrade to more efficient natural gas heating systems. If the customer switches to gas, the customer only has access to KeySpan's thermal rebates (although electrical rebates are still available through NSTAR). KeySpan's thermal rebates are actually lower than NSTAR's, however. NSTAR offers a 50% upfront rebate on insulation, while KeySpan only offers a 20% reimbursement. These kinds of discrepancies can lead to complicated opportunities for gaming, where a customer with oil heat should take NSTAR's richer thermal rebates first, before taking KeySpan's incentives for switching to more efficient gas. The SEU avoids this type of confusion and discrepancy.

[33] As noted above, MassSAVE is only for residential, not commercial customers

applications to MTC for renewable electricity, to a gas utility for thermal efficiency, and to an electric utility for electrical efficiency. The transaction and learning costs of this process can be a barrier to sustainable energy technology adoption. Moreover the lack of coordination across programs can cause significant customer confusion and create unnecessary programmatic discrepancies (See text box). Vermont and New Jersey have sought to partially address these problems through Efficiency Vermont and the NJCEP, but these organizations only coordinate energy efficiency, and renewable energy and energy efficiency, respectively. The SEU is unique in that it serves as a central clearing house and point of contact for *all* statewide sustainable energy services, regardless of fuel type.

4.2 Market-responsive Programs that Target All Fuels and All Customer Classes

As discussed above, one of the goals of Efficiency Vermont is to move away from a programmatic model that would exclude or inadequately serve certain classes of customer. The SEU has adopted a similar market-responsive stance, but has expanded it to include all fuel types and income levels. The SEU is empowered to provide customers with a comprehensive set of sustainable energy services, customized to customer needs, and targeting electricity, heating, and transportation. This approach allows the SEU to supply services that are not possible under more programmatic approaches. For example, SEU funds can be used to target reflective roofs on low-income households, whereas federal affordable energy programs cannot. Similarly, the SEU can support the simultaneous installation PV and solar water heating systems at sites that have high electrical and hot water demand. The MTC by contrast, is limited to providing incentives only for renewable electricity, and cannot support renewable heat. As a result, customers seeking to install technologies like solar water heating are not eligible for an incentive in Massachusetts.[34] Finally, the SEU has the flexibility to serve all income levels: programs are designed to cover the full incremental cost of sustainable energy services for its customers, but incentives be adjusted to more deeply subsidize affordable energy clients. In many states, the cost-share required under sustainable energy service programs prevents many low-income end-users from taking advantage of the SBC-funded incentives they help support. This is not the case under the SEU model.

4.3 A Financing Plan for Self-Sufficiency

As discussed in Section 3.4, the SEU's business plan requires initial working capital, but envisions that this capital will be paid back through revenue-generating activity. Moreover, revenues generated through REC sales and shared savings agreements will allow the SEU to continually expand the size and scope of its programs. This entrepreneurial business plan is unique among state clean energy service models, and allows the SEU to increase its budget without the need for legislation. This not only creates an environment under which new energy service businesses can flourish, but it also ensures reliable and continuous service provision. This kind of certainty is lacking under programs like Vermont's CEDF, which is supported through utility funds that have a predetermined sunset clause, or MTC's Green Affordable Housing Program, which is effectively a one-time funding allocation of funds to the affordable housing community.

[34] KeySpan Energy Delivery offers rebates for solar heating applications (water heating and air heating) as part of its natural gas energy efficiency programs, but similar programs are not available statewide.

4.4 Competitively Procured Independent Management Services

The SEU's financing plan is enabled by the fact that the programs are managed by competitively procured and independent entities. Energy efficiency and customer-sited renewable energy systems reduce utility sales and revenues. Utilities therefore lack an incentive to exceed energy efficiency and renewable energy targets mandated by law. Shifting management to independent entities removes this sort of conflict and provides an incentive to *exceed* performance targets in order to be competitively positioned for subsequent rounds of contract renewal.

4.5 Comparison of Different Models for Sustainable Energy Service Delivery

The approach to program coordination, service provision, financing, and management for each of the four states is summarized and compared in Tables 4.1 and 4.2, below. The Tables also include information on the Cambridge Energy Alliance, which is similar in many ways to the Sustainable Energy Utility model. The primary differences between the SEU and the CEA are: 1.) the SEU has direct responsibility for ratepayer-funded clean energy funds, while the CEA is not affiliated with the MTC or utility funds; 2.) the SEU has public bonding authority which can be replicated by other public agencies, while the CEA is relying on charitable foundation support to provide working capital; 3.) the SEU is designed to cover the full incremental cost of sustainable energy services for all income levels, while cost share is required under the CEA model; and 4.) at least initially, the CEA is focused on electric load peak shaving as its principal goal, while the SEU is organized from the outset to address all fuels and all end uses.

Table 4.1 Comparison of Different Models I

Program Scope & Coordination				
State/City	Energy Efficiency		Renewable Energy	Affordable Energy
	Electricity and Gas	All Other		
Delaware	Sustainable Energy Utility			
Massachusetts	Utilities (programs distinct)	N/A	MTC	DHCD (federal) and Utilities (state)
New Jersey	New Jersey Clean Energy Program	N/A	New Jersey Clean Energy Program	NJ Department of Human Services
Vermont	Efficiency Vermont	N/A	Department of Public Service	Department of Children and Families
Cambridge, MA	CEA	Initially focused on electricity	CEA (initially focused on renewable electricity)	TBD

Table 4.2 Comparison of Different Models II

Program Structure			
State/City	Service Approach	Financing Plan	Program Management
Delaware	• All fuels targeted • Flexible programs • Incremental cost covered	• Self-sufficient through revenue generating activities • Initial funding from bonding	Third party
Massachusetts	• Electricity and gas targeted • Rigid programs	• Renewable SBC • Energy efficiency SBC	• Utilities for efficiency • Quasi-state for renewable electricity
New Jersey	• Electricity and gas • Rigid programs	• Renewable + Efficiency SBC • Low-income SBC	Third party
Vermont	• Electricity, gas, some heat targeted • Flexible programs	• Efficiency and low-income SBC • MOU with utility for RE	Third party
Cambridge, MA	• All fuels targeted • Flexible programs	• Self-sufficient through revenue generating activities • Initial funding provided by foundations	Third party

4.6 A Policy Framework for Customer-Sited Sustainable Energy Services

The SEU model benefits from the existence of other policies designed to support customer-sited sustainable energy services. In addition to public benefit funds, the most significant polices for customer-sited renewable energy are the renewable portfolio standard and net metering. There are also a range of policies that support alternative fuel vehicle ownership. The policy framework for all four states are summarized below and in Table 4.3.

Renewable Portfolio Standards

As discussed in Section I, renewable portfolio standards (RPS) have diffused rapidly around the country during the past few years. All RPS policies set targets for achieving a certain percentage or renewable energy[35] by a certain date, but the mechanisms for meeting these targets vary widely from state to state. Although RPS is generally a supply-side policy, most states allow distributed generators to participate, and ten states have requirements within their RPS to support customer-sited resources.[36] Of the states discussed above, Vermont has a voluntary goal that utilities supply load growth from 2005 to 2012 through power purchase agreements with new renewable generators, Massachusetts has a requirement that utilities supply 4% of electricity sold in the state from renewable sources by 2009, and New Jersey has a mandate for 22.5% by 2021. Distributed generators are not permitted to participate under Vermont's RPS. Distributed generators are allowed to participate in the Massachusetts RPS, but receive no preferential treatment under the law. As discussed in Section 2.2.1, New Jersey's 2% solar RPS tier targets customer-sited PV and has driven very rapid PV market growth during past few years. The SEU Task Force recommended that Delaware harmonize its RPS with that of New Jersey, and in 2007, Delaware increased its RPS from 10% to 20% by 2019 and established a 2% photovoltaic requirement. In addition Delaware include solar heating as an eligible resource under its main RPS tier.

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[35] Or capacity in the case of Texas and Iowa.
[36] AZ, CO, DE, MD, NV, NH, NJ, NM, NY, PA. Information available at http://www.dsireusa.org

Net Metering

Net metering is a policy that permits onsite renewable energy owners to receive credit from utilities for excess electricity that they generate. Net metering is available in 44 states and the District of Columbia. In Vermont, systems up to 15 kW in size are eligible for net metering, and farm-based systems up to 150 kW are eligible. In Massachusetts, systems up to 60 kW are eligible, and in New Jersey, systems up to two megawatts are eligible for net metering. Delaware previously had a system cap of 25 kW for its net metering policies, but the SEU Task Force again recommended that the state harmonize its policy with that of New Jersey. In 2007, Delaware passed legislation that expanded the state's net metering cap to two megawatts for investor-owned utilities and 500 kW for cooperative and municipal utilities

Clean Vehicle Incentives

In addition to policies to support renewable electricity many states have also established policies to support alternative fuels and efficient vehicles.[37] Vermont and Massachusetts currently have no incentives for alternative fuel vehicles, although the Massachusetts legislature is considering bills that would award tax deductions, HOV lane driving rights, and parking discounts to alternative fuel vehicles. In New Jersey, hybrid vehicles may use the HOV lanes on the NJ Turnpike regardless of number of passengers inside, and The AFV Rebate Program, and local governments can get rebates of up to $12,000 to purchase alternative fuel vehicles or hybrids, or convert conventional fuel vehicles to alternative fuels. In addition to the programs that will be available through the SEU, Delaware waives sales tax on the purchase of alternative fuels. Grants for biodiesel are also available on a case-by-case basis from the non-profit Delaware Soybean Board.

Table 4.3 Policies to Support Sustainable Energy Services in DE, MA, NJ and VT

State	RPS	Net Metering	Clean Vehicle Services
Delaware	• 20% by 2019 • 2% solar electricity • DG eligible for main tier	• 2 MW (IOUs) • 500 kW (coops and munis)	Alternative fuel sales tax exemption
Massachusetts	• 4% by 2009 • DG eligible	60 kW	None
New Jersey	• 22.5% by 2021 • 2% solar electricity • DG eligible for main tier	2 MW	• HOV rights for hybrids • Rebates for municipal fleets
Vermont	• Load growth between 2005-2012 • DG ineligible • Voluntary goal	• 15 kW • 150 kW for farms	None

[37] See US Department of Energy (2007). Alternative fuels data center: State & Federal incentives & laws. Available at: http://www.eere.energy.gov/afdc/laws/incen_laws.html

5. A Sustainable Energy Utility for the City of Seoul

5.1 Building from Strength

Korea has several supportive policies towards renewable energy and energy efficiency, which are largely dependent on government-administered initiatives. These policies are similar to those adopted by the American states of Massachusetts and New Jersey examined in previous section. Unlike the active role played by state and local governments in the U.S., renewable energy and energy efficiency programs are largely organized by the national government in Korea.

One of the key policy tools for supporting renewable energy in Korea is compensation for the difference between the System Marginal Price (SMP) and the reference price[38] set by the government for each alternative energy source. This mechanism, similar to the feed-in-tariff (FIT) used in some European countries like Germany, was enacted in the 2002 Promotion for Alternative Energy Act. There are currently seven distinct new and renewable energy technologies that are eligible for the benefits of the mechanism: PV, wind power, hydropower, waste incineration, bioenergy (including landfill gas), ocean energy and fuel cells. The government rebate in a facility should not exceed 30% of the investment cost in a qualifying renewable energy option. As of 2007, the reference price for PV is 677 Won/kWh for systems over 30kW and 711Won/kWh for systems less than 30kW. PV system must be larger than 3kW to qualify for support. The reference price for wind power is set much lower than PV. The wind power generator with more than 3kW capacity will receive 107.29 Won/kWh. The FIT assures 15 years but the rate will drop 4% annually after the third year for PV installation. As the fund for feed-in-tariff is limited, there is a cap on the gross generation capacity for each technology. For example, FIT will be available as long as the gross PV capacity is less than 100MW and 1,000MW for wind power. The facilities built after the capacity cap will be no longer eligible for FIT, but still receive SMP.

The funding source of the feed-in-tariff is dependent on the "Electricity Industry Infrastructure Fund (EIIF)" collected as a surcharge on every electricity customer, which is set at 4.591% of the electricity sale price. The EIIF, created through electricity industry restructuring legislation in 2002, supports not only renewable energy but also various other energy related projects including demand side management, the R&D for the electricity industry, subsidies for local communities near power plants (particularly nuclear plants). Of the 1.3 trillion won (US $1.3 billion) of the EIIF disbursed in 2007, 76 billion won (US $76 million) is designated for renewable energy development (including 100,000 PV rooftop systems) and mainly to cover the difference in generation costs between new/renewable and conventional options.[39] The Korea Power Exchange (KPX) and Korea Electric Power Corporation (KEPCO) are responsible for the administration of the program.

Another policy scheme for renewable energy development is a concessionary loan program which provides eligible renewable energy producers with long-term, low interest loan. Korea Energy Management Corporation (KEMCO) is responsible for the administration of the program. In 2007, the total budget allocated to this program was 121.3 billion Won ($ 121.3 million), which was financed by a Special Fund for Energy and Resource Projects and the EIIF ($53.6 million from the

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[38] The price set by the government (MOCIE) reflecting generation costs and appropriate margins for each new and renewable generation technology.
[39] MOCIE. (2007). Electricity Industry Infrastructure Fund in 2007. Press Release.

Special Fund and $65 million from the EIIF). In 2007, the interest rate was fixed at 3.5% for a 10-year payment period after a 5-year deferral for most renewable energy technologies. However, less favorable loan conditions apply to bioenergy and waste incineration technology: 5-year of payment periods after 3-year of deferral.[40]

In order to accelerate commercialization and diffusion of renewable energy technologies, Korea provides rebates for the initial cost of renewable energy facilities. The maximum rebate is 80% of total installation cost for demonstration facilities and 60% for general facilities.[41] In addition, for public buildings with an area of larger than 3,000 m^2 are required to invest 5% of the total construction cost in new and renewable energy.[42] Both programs are administered by KEMCO.

Korea has sought to cut its energy intensity since the 1980s, particularly following the oil crisis and global recession that contributed to declining export growth in the 1970s.[43] In 1980, state-owned Korea Energy Management Corporation (KEMCO) was formed to encourage energy efficiency improvement. Industrial energy conservation was encouraged with tax credits for high-efficiency technology conversions. Supply oriented energy policy was reconsidered when KEPCO added demand-side-management (DSM) for the first time in its 1993 Long-Term Power Development Plan. Currently, there are various energy efficiency programs in Korea, which are largely administered by the national government.

One such program promotes Energy Service Companies (ESCOs), which was introduced in 1992 to encourage energy efficiency improvement especially by private participation. ESCOs are companies that invest in energy efficiency equipment at energy-user sites and recover the investments and profits through energy savings created from energy efficiency. The main business areas involve installation of energy conserving equipment, energy saving lighting, reuse of waste heat, improvement of industrial processes and ice thermal storage.[44] With government support, the ESCO market has grown substantially. The number of ESCOs has increased to 163 in 2006 from 4 in 1992 and the market has grown to $240 million in 2006 from $0.5 million in 1993. Government support include concessionary loans (a fixed interest rate of 3%), tax credits for companies investing in ESCO programs, and technical support.[45] The impact of ESCOs since their establishment in 1992 is shown in Table 5.1.

Table 5.1 Economic and Energy Savings of ESCO

	‘93-‘00	2001	2002	2003	2004	2005	2006	Total
Investment ($million)	198	75	140	100	83	183	133	913
Economic Savings ($million)	74	26	65	43	33	61	77	378
Energy Savings (1,000TOE)	248	78	206	114	80	118	156	999

[40] Korea New and Renewable Energy Center (KNREC). (2007). Support for Dissemination. Retrieved November 22, 2007 from http://www.knrec.or.kr/
[41] *Ibid*
[42] *Ibid*
[43] Byrne, John, Leigh Glover, Hoesung Lee, Young-Doo Wang, & Jung-Min Yu. (2004). Electricity Reform at a Crossroads: Problems in South Korea's Power Liberalization Strategy. *Pacific Affairs*, 77(3), 493-516.
[44] MOCIE. (2007). *Guide for ESCO business*.
[45] *Ibid*. *Reform Strategy for ESCO*.

Source: Ministry of Commerce, Industry and Energy (MOCIE). (2007). *Reform Strategy for ESCO*.

In the industrial sector, Voluntary Agreement (VA) is implemented to encourage energy conservation. If industrial facilities with annual energy consumption over 2,000 TOE participate in the program, they receive financial and technical assistance from the government to meet their voluntary targets of energy and carbon savings. As of 2005, 1,288 industrial plants out of eligible 1,628 have participated in this program. According to a MOCIE White Paper (2005), 1,021 industrial facilities planned to save approximately 6.8 MTOE, which is equivalent to 10 % of these facilities' energy consumption in 2003 and about $15 billion through 2004-2009.

In order to reduce energy intensity in the building sector, KEMCO and MOCIE are implementing three energy efficiency programs: "Energy Efficiency Standards & Labeling," "High Efficiency Appliance Certification," and the "e-Standby Program." Energy Efficiency Standards & Labeling is a mandatory program, which requires manufacturers and importers to provide information about energy efficiency and prevents the selling the products which fail to meet the minimum efficiency standards. This program applies to high energy consuming and largely used products such as electric appliances, lighting, domestic gas boilers and automobiles. High Efficiency Appliances Certification is a voluntary program administered by KEMCO. Appliances that realize a certain efficiency standard are certified by KEMCO. As shown in Table 5.2, eligible products include induction motors, windows, industrial/domestic gas boilers, inverters, etc. Korea's e-Standby program is specifically designed to reduce standby power which is being wasted regardless of usage of electric appliances (such as remote control and monitor indicating light). The standby power wasted in the residential sector is substantial, amounting to 11% of total electricity consumption. This program applies to 17 items covering office and domestic appliances such as computers, fax machines, copiers, scanners, TVs, radios, stereos and DVD players.[46]

Table 5.2 Energy Efficiency Program

Program	No. of items	Applied products	Type of program
Energy Efficiency Labeling	18	Refrigerator, domestic boiler, fluorescent lamp, automobiles etc.	Mandatory
High Efficiency Appliances Certificate	34	Induction motors, windows, pumps, industrial gas boilers etc.	Voluntary
e-Standby	17	Computers, printers, TV, DVD players etc.	Voluntary

Source: Choi (2007)[47]; KEMCO (2007)[48].

In addition to efficiency programs for appliances and equipment in the building sector, there are three efficiency improvement programs specifically for buildings: Standards for Building Insulation and Energy Efficiency Design, Energy Efficiency Labeling for Buildings, and the Green Building Certification Program. Standards for Building Insulation & Energy Efficiency Design was

[46] Ministry of Commerce, Industry and Energy and Korea Energy Management Corporation. (2004). *Consumer Purchasing Guide for Energy Saving Products*. Retrieved January 3, 2008 from http://www.kemco.or.kr/

[47] Choi, Jong-Won. (2007). *Energy Efficiency Potential in South Korea*. Analytical Paper for the Degree of Master of Energy and Environmental Policy. Newark, DE: University of Delaware.

[48] Korea Energy Management Corporation (KEMCO). (2007). Energy Efficiency Programs. Retrieved January 3, 2008 from http://www.kemco.or.kr/english/sub03_energyefficiency00.asp

established in 1972 introducing building insulation standards and requirements. This program was revised in 2001 and now requires 20% higher insulation and eight types of high-energy buildings addressing commercial offices and hospitals. These buildings have been mandated in a separate design standard for energy efficiency since then.[49] Energy Efficiency Labeling for Buildings is a voluntary program that provides financial incentives for facilities that meet specific performance standards. The Green Buildings Program is also voluntary. It is designed to evaluate environmental impacts throughout a life-cycle analysis of the building construction process. It was jointly initiated by the Ministry of Environment (MOE) and the Ministry of Construction and Transportation (MOCT) in 1999.

Energy saving potential from installing proper insulation in building shells can be substantial. The Korean government has subsidized insulation for residence since 1984. The program is limited to houses built prior to 1979. After that year, insulation was made mandatory.

Table 5.3 Loans for Insulation for Houses

	1984~2000	2001	2002	2003	2004	2005	Total
Loan Value ($ million)	65.8	0.73	0.36	0.26	0.31	0.19	67.7
Number of Residences	20,630	88	45	26	29	10	20,828

There are also several sustainable energy policies established recently by the City of Seoul. In particular, "clean urban planning" is policy priority of the new city government. The new mayor's environmentally-friendly energy declaration in 2007 pledges that Seoul would cut the energy consumption by 15% against a 2000 baseline and would reduce greenhouse gases 25% below their 1990 level. For this purpose, it will increase the share of renewable energy up to 10% by 2020.[50] In this vein, the City's first Department of Energy was created on April 5, 2007, which is primarily focused on energy conservation, energy efficiency, responses to climate change and renewable energy development.

Because the building sector in Seoul consumes about 60% of City's energy, the government established a "Seoul Green Building Standard," which aims to reduce energy use and greenhouse gas emissions from this sector. Furthermore, Seoul issued a municipal ordinance to create a "Climate Change Fund" in September 2007, the first in the country, which will invest $100 million by 2010. The sources of the Fund are: the City's general accounts and dividends from Korea District Heating Corporation and the Korea Gas Corporation. The purposes of the fund are identified as: to reduce the emission of greenhouse gases, develop and diffuse new and renewable energy, rationalization of energy use and assistance to energy-poor households.[51] According to City's plan for 2008, the budget for new and renewable energy installation is increased to $8.2 million from $3.9 million in the previous year.

With this strong policy and institutional framework, Seoul has already made some progress in renewable energy development. In 2007, Seoul installed 300 kW of PV at the Chung-gae Chun

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[49] Choi, Jong-Won. (2007). *Energy Efficiency Potential in South Korea*. Analytical Paper for the Degree of Master of Energy and Environmental Policy. Newark, DE: University of Delaware.

[50] City News. (December 17, 2007). Clean Seoul Energy. Retrieved January 11, 2008 from http://www.seoul.go.kr/seoul/citynews/majornews/1251905_8644.html

[51] *Ibid*

water filtration plant. The electricity generated from this PV system is used to maintain the water level in Chung-gae Creek by pumping the water from Han River.[52] In addition, in November 2007, Seoul and Korea Midland Power (KOMIPO) agreed to build 2,500kW of PV facilities by 2008. According to this agreement, Seoul will rent required land to KOMIPO and KOMIPO will be responsible for all installation investment and will be granted the right of operation for 15 years.[53] Because fuel cells offer distributed generation in the building sector using natural gas, Seoul has started a monitoring program with Korea Institute of Science and Technology (KIST), Korea Gas Corporation (KOGAS) and Daehan City Gas.[54] Seoul plans to install 30 fuel cells (1 kW) in hospitals, sports facilities and public buildings from 2008.[55]

The current national and local policy framework in Seoul lays the solid foundation for creating a Sustainable Energy Utility. In evaluating a transition to an SEU structure, the City will need to consider whether to add transportation services and other fuels, whether there are programmatic holes that could be addressed through a more flexible approach to incentive design, whether to establish a third-party management structure, and how best to design an SEU for financial self-sufficiency. The potential for integrating the policy framework described above into an SEU organizational structure is considered in Section 6.[56]

5.2 Building Sector Energy Sustainability – A Key Challenge

Energy consumption per unit of GDP is generally used to measure the "intensity" of energy requirements in a society to produce economic value. According to the International Energy Agency 2007 report, the electricity intensity of Korea continued to grow during 1990 to 2005 while other energy efficient OECD countries lowered or stabilized their electricity intensity in the same period.[57] The electricity intensities in several countries are shown in Figure 5.1, with each country's year 2000 rate used to index subsequent annual rates. While the electricity intensity of Korea increased 23% during 2000-2005, Sweden reduced its electricity intensity by 10%, Norway 8%, United Kingdom 7%, United States 6% and Japan 3% (Germany shows slight increase of 2% in the same period).

The country's energy (as opposed to electricity) intensity is also compared to advanced OECD countries. In 2004, while Germany's primary energy intensity was 0.18toe per thousand US dollars, Italy 0.17, United Kingdom 0.15 and the United States 0.22, Korea's primary energy intensity was approximately two times higher than these OECD countries, at 0.35toe per thousand US dollars (KEEI, 2007).[58]

[52] Nam, Su-Jung. (2007, 9 April). Completion of PV generation facility in Chung-gae filtration plant. *Korea Energy*. Retrieved January 11, 2008 from http://www.koenergy.co.kr/.
[53] City News. (December 17, 2007). Clean Seoul Energy. Retrieved January 11, 2008 from http://www.seoul.go.kr/seoul/citynews/majornews/1251905_8644.html
[54] According to City's 2007 budget, dividend from Korea District Heating Corporation and Korea Gas Corporation were $180,000 and $4,620,000 respectively (Seoul City, 2007).
[55] City News. (December 17, 2007). Clean Seoul Energy. Retrieved January 11, 2008 from http://www.seoul.go.kr/seoul/citynews/majornews/1251905_8644.html
[56] See the discussion in subsection 6.3.
[57] International Energy Agency. (2007). *Electricity Information 2006.* Paris: OECD/IEA.
[58] Korea Energy Economics Institute (KEEI). (2007). *Energy Info*. Euiwang, Gyung-gi do: MOCIE/KEEI.

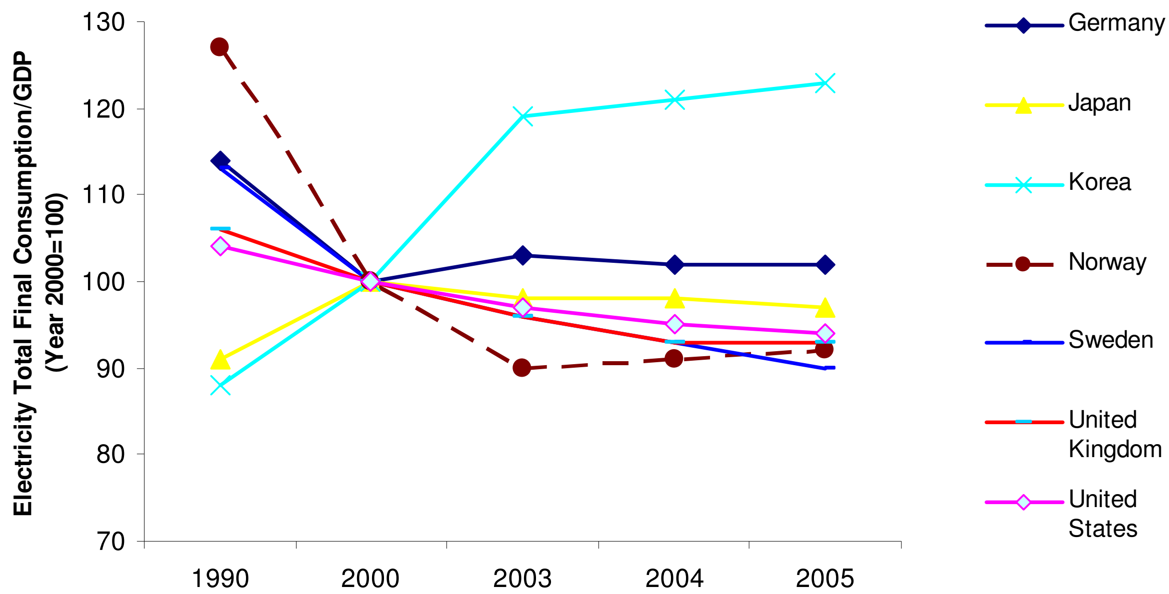

Figure 5.1 Electricity Intensity for Selected OECD Countries (Year 2000=100)

The high energy intensity of Korea is often explained as a result of the high share of energy/electricity intensive industry. However, on the other hand, it also indicates that there is great energy saving potential through upgrades in the efficiency of technologies and by industrial restructuring. Additionally, through the effective deployment of renewable energy technologies to lower conventional energy demand, energy and environmental sustainability goals can be advanced.

5.2.1 Energy Efficiency for Seoul's Building Sector

In order to take the path which will ensure less energy consumption and continued economic development, city-centered policy initiatives and appropriate programs can play an important role. In this regard, the SEU offers innovative alternative to the conventional energy supply oriented policy that can assist Seoul in its pursuit of low-carbon urban prosperity. We suggest that special attention should be paid to the City's building sector visualizing the energy saving potential. Because Seoul is a densely settled municipality, a large share of its energy use derives from the characteristics of its building stock and equipment, as well as the nature and volume of activity in its buildings. The energy consumed in the residential/commercial building sector accounts for about 60% of total energy use in Seoul. Further, while energy consumption in other end-use sectors decreased between 2002 and 2005 (especially the transportation sector), energy consumption in the building sector steadily increased (See Figure 5.2).

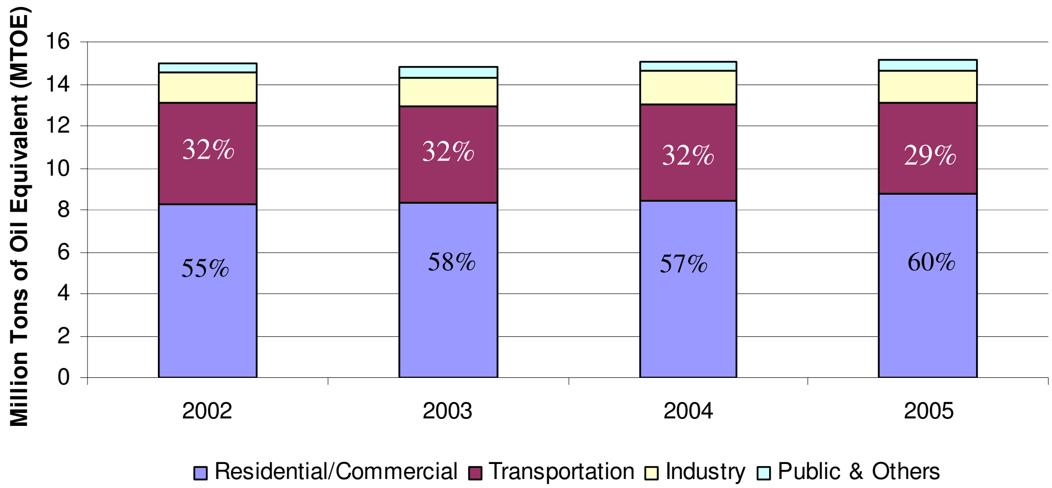

Figure 5.2 Energy Use by End Use in Seoul (2002-2005)

Source: Yearly Book of Regional Energy Statistics. KEEI (2003-2006).

One method of assessing the available energy efficiency potential in Seoul is to compare electricity/gas intensity for its residential and commercial buildings with other jurisdictions. Residential building electricity intensity can readily be measured as electricity use (in kWhs or toe) per unit of residential floor area. Similarly, measuring electricity/gas intensity for commercial buildings would be appropriate with commercial floor area. Building energy performance measured by the above indices can be calculated for Seoul and compared with other jurisdictions including Busan, Daegu, Inchon, Gwangju and Washington DC. Due to the difficulties in collecting city-wide data in the U.S., the analysis of Washington, DC is limited to electricity/gas intensity of residential buildings.

Residential electricity consumption was gathered from the Korea Electric Power Corporation (KEPCO) and Korea Energy Economics Institute (KEEI)[59]. Regional gas consumption by end use was obtained from KEEI's *Yearbook of Regional Energy Statistics* (2006). Floor area of residential buildings for each city was calculated using data from the Korea National Statistics Office. Residential electricity and gas consumption data for Washington, DC were gathered from the U.S. Energy Information Administration (EIA). Floor area was calculated using the U.S. Energy Information Administration's residential energy consumption survey data series and housing stock data reported by the U.S. Bureau of the Census. GDP data was obtained from U.S. Bureau of Economic Analysis.

As shown in Figure 5.3, both electricity and gas intensity of Seoul in 2005 are the highest among the other cities in the residential building sector. The City's high intensity can be explained by a number of factors, including income level, housing stock characteristics, differences in weather, and implementation of energy efficient measures. However, due to the lack of data, constructing a comprehensive model with adjustments of these factors is not available in this report. Still, it can be worthwhile to note that Seoul's electricity and gas consumption per square meter in the residential building sector is 17% and 54% higher, respectively, than Washington, DC which has similar weather[60], urban housing pattern; but, importantly, Washington, DC has three times higher per

[59] KEEI. (2006). *Yearbook of Regional Energy Statistics*. Euiwang, Gyung-gi do: MOCIE/KEEI.

[60] Seoul has higher cooling degree days but lower heating degree days, which means Seoul is hotter in summer but milder in winter than D.C.

capita income than Seoul and, nonetheless, has a significantly less energy-intensive housing stock.[61] The electricity prices in both cities were nearly the same in 2005: the average retail electricity price for residential use is 9.3 and 9.2 cents per kWh in Seoul and Washington DC, respectively. Washington DC's gas price for residential use is 17% higher than Seoul's.[62]

According to economic theory, energy price has a reverse relationship with energy consumption while level of income is positively related to energy consumption. With this in mind, it is fair to conclude that electricity use in Seoul's residential buildings is less efficient than that in Washington DC, considering that Seoul's income level is much lower while prices and other factors are more or less the same. With regard to residential sector gas intensity, although gas prices and income level offset each other to a certain extent, Seoul shows a 54% higher gas intensity than Washington DC, which also obviously indicates that gas is less efficiently consumed in Seoul's residential buildings.

Therefore, it is suggested that a Seoul City SEU needs to focus on energy saving measures appropriate to the residential building sector. Weatherization, energy efficient heating, ventilation and air conditioning, improved water heating technology and upgrades in residential appliances would seem to be important performance targets for the City to lower its electricity intensity. Accomplishing this goal must take place while addressing energy services affordability. Because the SEU financial model utilizes shared savings to remove the barrier of higher capital costs, a Seoul SEU can simultaneously pursue energy savings and affordability objectives.

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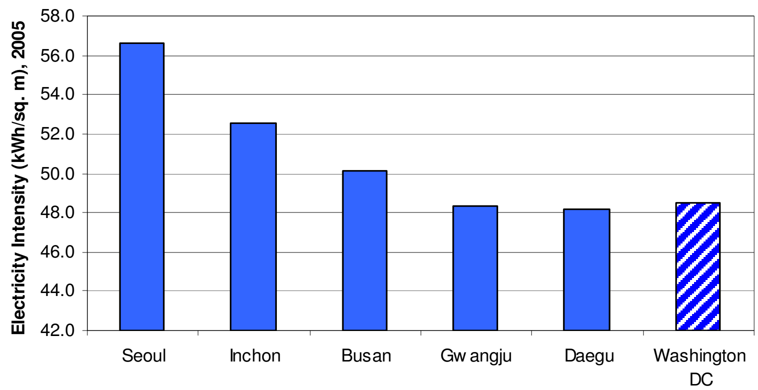
[61] In 2005, while per capita GDP of Seoul was about $14,300, DC was about $50,000 (note that Seoul's GDP is pegged at 2000 won value while DC's is chained at 2001 U.S. dollar value).

[62] In 2005, retail electricity price for residential in Seoul was 9.3 cents per kWh while 9.2 cents per kWh (1US dollar = 1,000won) (EIA. (2007). State Electricity Profiles 2005. Retrieved February 2008 from http://tonto.eia.doe.gov/ftproot/electricity/stateprofiles/05st_profiles/062905.pdf). Residential gas price in Seoul was $0.51/m3 while $0.60/m3 in the same year (EIA, 2008. Retrieved from http://tonto.eia.doe.gov/dnav/ng/ng_sum_lsum_a_EPG0_PRS_DMcf_a.htm)



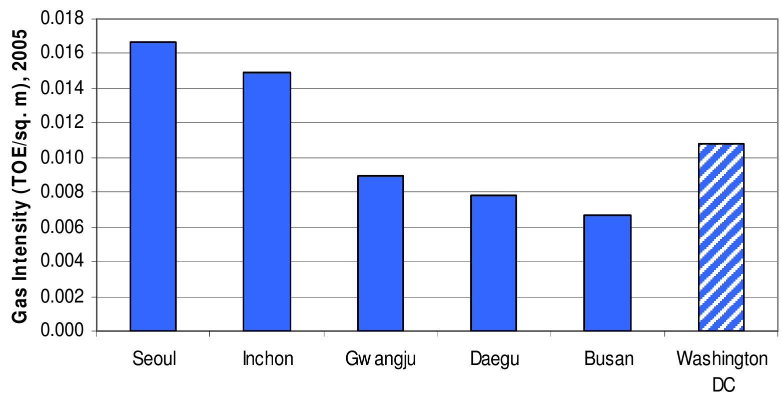


Figure 5.3 Comparison of Residential Building Sector Energy Intensities

Figure 5.4 shows electricity and gas intensities in the commercial building sector for five major cities in Korea without adjustment for local GDP or weather factor. According to this result, Seoul's electricity/gas intensity for the commercial building sector also ranks highest among the other Korean cities. In particular, Seoul City's gas intensity is more than double that of the other cities' gas intensities. This difference may be explained by the higher GDP per capita in Seoul City. An econometric model with more comprehensive data would verify the impact of income, weather and other factors in a more quantitative way. However, Seoul's 31-45% higher per capita GDP than the four other cities hardly justifies the City's 100% higher gas consumption.

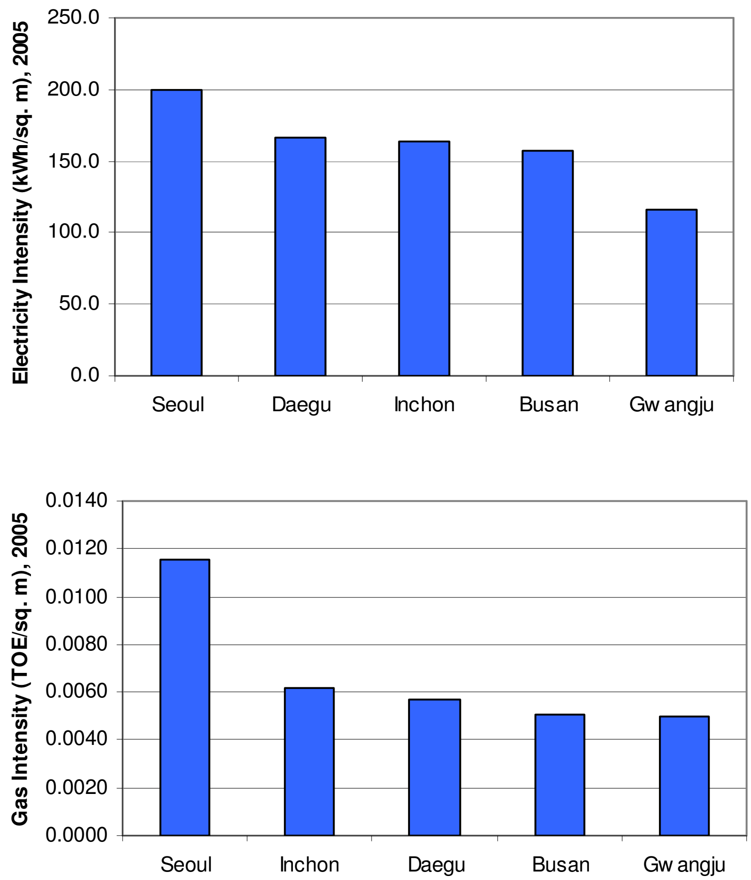


Figure 5.4 Comparison of Commercial Building Sector Energy Intensity

The results offer important guidance for policy formulation. The local economy of Seoul is overwhelmingly service-oriented, and its commercial building stock reflects this. It is common for this building stock to use a significant amount of energy on heating, cooling, lighting and motor loads. Well-designed programs to address these sources of energy demand can pay important dividends in lowering the City's energy intensity. Decisions regarding these end uses can involve equipment with lifetimes of 15 or more years. If efficiency is made a competitive option, a multi-year stream of benefits can be garnered. But if these decisions do not consider energy savings, the City will be saddled with the cost of lost opportunities. This point is even more germane regarding envelope quality, as most commercial buildings will stand for 50 or more years. Both the new construction market and the market for repairs and remodeling in this sector need to be high-priority targets for performance upgrades. A Seoul City SEU can target funds and programming to these high gain applications.

5.2.2 Integrating Renewable Energy into Seoul's Building Stock

Along with energy efficiency improvements, renewable resources can greatly contribute to the reduction of conventional energy needs in the buildings sector. In particular, PV among other renewable energies will fit in well with dense urban patterns of Seoul City because it can be easily installed on rooftops or façades of buildings. The City SEU may consider taking advantage of the City's availability of rooftop estate for PV installation.

The available rooftop area can be estimated from floor area data of different types of buildings in Seoul. Once the available rooftop area is estimated, we may calculate total capacity and generation of rooftop PV systems. As a first step to estimate available rooftop areas for PV, several assumptions are made. First, as buildings lower than three stories may have less insolation compared to higher buildings due to shadings, it is assumed that only 80% of the rooftop area of the lower buildings is available. In addition, it is assumed that only 40% of rooftop area can be used for PV systems due to solar orientation problems and design obstructions. Based on these assumptions, the PV-suitable rooftop real estate of existing residential, commercial, and public buildings is estimated to be 45.8 million m^2, which is approximately equivalent to 7% of the total area of Seoul City. The total PV capacity of this suitable rooftop area is estimated to 4,740 MW. Total electricity generation from rooftop PV will be 7,130 GWh, which accounts for 20% of Seoul's electricity consumption in 2006 (41.8TWh).

The economics of PV systems can be greatly enhanced by a combination of the City's SEU financing mechanism and current feed-in-tariff (FIT) scheme. Table 5.4 and Figure 5.5 show the financial feasibility of a 3kW building PV system under the SEU scheme. It is assumed that the City's SEU loan for a 3kW PV system is $9,000, or 50% of initial capital cost, and the loan period is 15 years. Two additional inverters are needed over 20 to 25 year life-time of the system. In addition, maintenance cost is assumed to increase annually at an inflation rate of 3%. The annual savings are from electricity sales to grid at FIT for the first 15 years and System Marginal Price (SMP) for the rest of the system's life time.[63] The system is subject to annual 1% degradation in efficiency and the FIT is projected to decline 4% annually from the fourth year.

Supported by an SEU loan and the feed-in-tariff, shown in Table 5.4 and Figure 5.5, the payback period is 10 years and the internal rate of return (IRR) is 8.3%. Given the relatively high IRR, it can be fairly concluded that the system can attract investment. There may be several mechanisms to share the savings for the PV project between the developers and the rooftop estate providers, depending on portion of initial costs and the responsibility for maintenance. For example, the developer and the rooftop estate provider can make a contract to share the initial capital cost and net savings equally. By doing so, each party will receive $4,570 after the recovery of the investment cost. The IRR declined to 6.2% but it is still sufficiently high to make this project commercially feasible.

Table 5.4 3kW PV Cash Flow with the City's SEU Loan and FIT

Year	SEU Loan Payment	Annualized Inverters Cost	Maint. Cost	**Total Cost**	Supplied kWh	**Value of Savings**	Net Cash Flow	**Cumulative Cash Flow**
	$9,000			$9,000		0	-$9,000	-$9,000
2009	$754	$317	$20	$1,091	3,143	$2,235	$1,144	-$7,856
2010	$754	$317	$21	$1,092	3,112	$2,213	$1,121	-$6,735
2011	$754	$317	$21	$1,092	3,081	$2,190	$1,098	-$5,637
2012	$754	$317	$22	$1,093	3,050	$2,082	$989	-$4,648
2013	$754	$317	$23	$1,094	3,020	$2,061	$967	-$3,681
2014	$754	$317	$23	$1,094	2,989	$2,040	$946	-$2,735

[63] See section 5.1 (pp. 36) for details of FIT design in Korea. SMP is set as 84won/kWh (approximately, 8.4cents/kWh) in 2007.

2015	$754	$317	$24	$1,095	2,959	$2,020	$925	-$1,810
2016	$754	$317	$25	$1,096	2,930	$2,000	$904	-$906
2017	$754	$317	$25	$1,096	2,901	$1,980	$883	-$22
2018	$754	$317	$26	$1,097	2,872	$1,960	$863	$840
2019	$754	$103	$27	$884	2,843	$1,940	$1,057	$1,897
2020	$754	$103	$28	$885	2,814	$1,921	$1,036	$2,933
2021	$754	$103	$29	$886	2,786	$1,902	$1,016	$3,950
2022	$754	$103	$29	$886	2,758	$1,883	$996	$4,946
2023	$754	$103	$30	$887	2,731	$1,864	$977	$5,923
2024	$0	$103	$31	$134	2,704	$280	$145	$6,068
2025	$0	$103	$32	$135	2,676	$281	$146	$6,214
2026	$0	$103	$33	$136	2,650	$282	$146	$6,360
2027	$0	$103	$34	$137	2,623	$283	$146	$6,505
2028	$0	$103	$35	$138	2,597	$284	$146	$6,651
2029	$0		$36	$36	2,571	$285	$249	$6,900
2030	$0		$37	$37	2,545	$286	$249	$7,149
2031	$0		$38	$38	2,520	$287	$249	$7,399
2032	$0		$39	$39	2,495	$289	$249	$7,648
2033	$0		$41	$41	2,470	$290	$249	$7,897
2034	$0		$42	$42	2,445	$291	$249	$8,145
2035	$0		$43	$43	2,421	$292	$249	$8,394
2036	$0		$44	$44	2,396	$293	$249	$8,643
2037	$0		$46	$46	2,372	$294	$248	$8,891
2038	$0		$47	$47	2,349	$295	$248	$9,139
						IRR	8.3%	

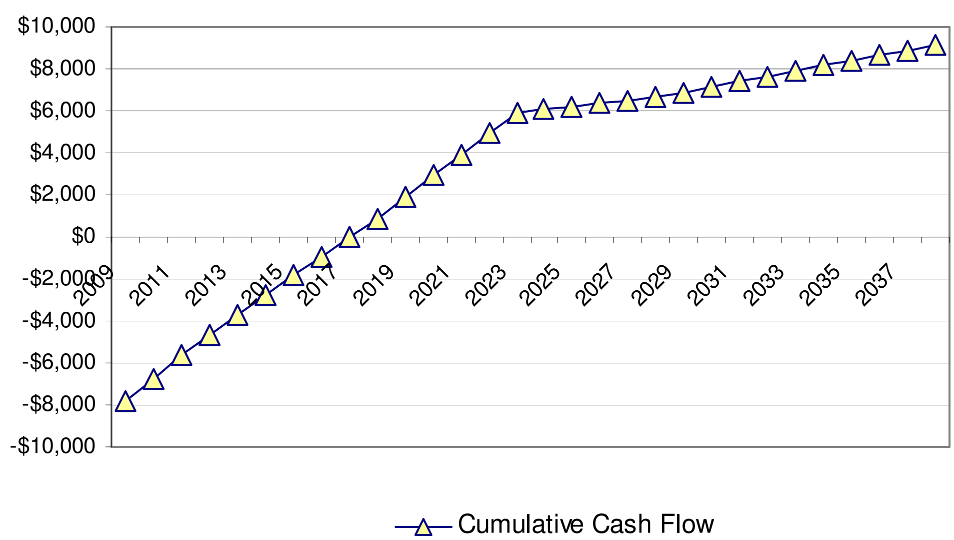
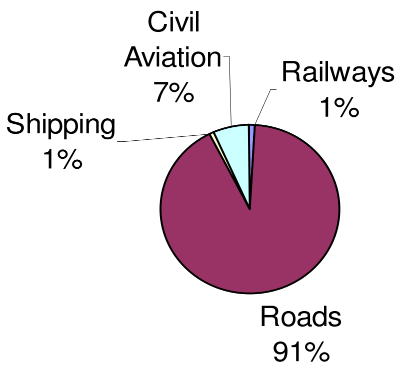


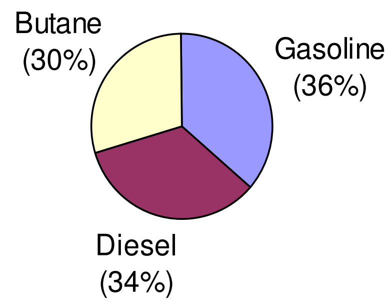
Figure 5.5 Cumulative Cash Flow of a 3kW PV System

5.3 A Transportation Focus for the Seoul SEU

As shown in Figure 5.2, the transportation sector is the second largest energy consumer in Seoul. In particular, as shown in Figure 5.6, road transportation accounts for 91% of total petroleum consumption in 2005. Gasoline, diesel and butane are the major fuels for road transportation, which accounts for 36%, 34% and 30%, respectively.[64] The large level of oil consumption for road transportation poses not only an economic burden on the City but also creates adverse impacts on urban air quality.



Total Petroleum Consumption in Transportation: 31,170,000 barrels (2005)



Petroleum Consumption in Road Transportation: 28,400,000 barrels (2005)

Figure 5.6 Petroleum Consumption by Transportation Types in Seoul

In this regard, the City's SEU needs to pay special attention to reducing oil consumption in road transportation through diverse financial mechanisms to switch from individual vehicles to public transportation and from less efficient vehicles to more efficient ones. One of the possible policy options is a congestion charge. It is a charge imposed on vehicles that enter a defined zone (for example, especially congested urban central area) during certain hours of the day.

London introduced congestion charging in February 2003 to relieve its heavy traffic tie-ups and associated air pollution. The charging zone has been expanded from the original designation of the central city area into West London. All revenue from the congestion charge is invested in improving the city's transport system, particularly its bus services. In fiscal year 2006-07, London's congestion charge raised £123 million (approximately, U.S. $243 million). After five years of operation, London's congestion charge policy has brought about a number of positive outcomes. The traffic reduction, as shown in Table 5.5, is significant: 16% in total vehicles, 21% in vehicles with four or more wheels and 30% in potentially-chargeable vehicles compared to 2002.[65] At the same time, passengers using bus in the central charging zone increased by 37% during the charging hours in the first year of operation.[66] Due to the re-investment of funds in the city's bus services, the reliability of bus system improved on the routes in and around the charging zone: excess waiting time for buses has been cut by 46% within the zone.[67] As well as adding more buses, London introduced new hybrid buses. London's congestion charge is thought to be responsible for a sizable emission reduction in transportation sector. According to Transportation for London (TFL), the congestion charge policy contributed to a reduction of 8% in oxides of nitrogen (NOx), 7% in fine particulate matter (PM_{10}) and 16% for carbon dioxide (CO_2).

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[64] KEEI. (2006). *Yearbook of Regional Energy Statistics*. Euiwang, Gyung-gi do: MOCIE/KEEI.
[65] Transport for London. (2007). *Central London Congestion Charging*. Impacts monitoring, Fifth Annual Report.
[66] Transport for London. (2007). *Central London Congestion Charging*. Impacts monitoring, Fifth Annual Report.
[67] BBC. (2007, 19 February). Where has the money gone?

Stockholm also introduced congestion pricing in 2006, which is more sophisticated than London's scheme and many positive results are documented: it reduced traffic by 15% and CO_2 emissions by 10 to 14%.[68] Given these positive results, New York City, where traffic congestion is one of the major problems the city faces, is also trying to introduce congestion pricing. The City's plan has been passed by City Council in March 31, 2008, but it is pending for approval of New York State's legislature.

Table 5.5 Key year-on-year changes in traffic entering the central London charging zone during charging hours (07:00~18:30)

	Change in inbound traffic				
Vehicle type	2003 vs 2002	2004 vs 2003	2005 vs 2004	2006 vs 2005	2006 vs 2002
All vehicles	-14%	0%	-2%	0%	-16%
Four or more wheels	-18%	0%	-3%	0%	-21%
Potentially chargeable	-27%	-1%	-3%	+1%	-30%
- Cars and minicabs	-33%	-1%	-3%	0%	-36%
- Vans	-11%	-1%	-3%	+2%	-13%
- Lorries and other	-11%	-5%	-4%	+6%	-13%
Non chargeable	+18%	+1%	-4%	-1%	+16%
- Licensed taxis	+17%	-1%	0%	-3%	+13%
- Buses and coaches	+23%	+8%	-4%	+3%	+25%
- Powered two-wheelers	+12%	-3%	-9%	0%	0%
- Pedal cycles	+19%	+8%	+7%	+8%	+49%

Although there exists some concerns about the regressive effects of a congestion charge (i.e., the accessibility to public spaces like the central city might be distributed by people's ability to pay), a well- designed pricing mechanism can relieve the uneven effects of the charge. For example, the congestion charging scheme may include some kind of progressive elements such as exemptions for the carpool passengers and handicapped drivers and discounts for small or alternative vehicles. In the long-run, the regressive effects might be offset by more convenient, reliable and affordable public transportation.

5.4 The Potential Impact of an SEU for Seoul – Setting Performance Targets

A detailed inventory of energy efficiency and distributed renewable energy opportunities is needed to properly assess the potential impact of a Seoul City SEU initiative. But if typical measures widely used by the three U.S. states discussed in Section 2 above are marshaled to address City building electricity and natural gas use, a preliminary estimate of impact can be obtained.

As noted in previous sections (see Section 3 and 4), special attention has been paid to the importance of energy efficiency improvement in building sector at the U.S. federal as well as state level. Recently, the U.S. Department of Energy (DOE) has established regulations that require most

[68] Environmental Defense Fund. (2007). Congestion Pricing. Retrieved April 27, 2008 from http://www.edf.org/page.cfm?tagID=6241

new federal buildings to achieve at least 30% improved energy efficiency over prevailing conditions. Over the next ten years, target is expected to save more than 40 trillion Btu and reduce carbon dioxide emissions by 2 million metric tons (NREL Newsletter, January 9, 2008). In February in the same year, DOE launched the Builders Challenge calling on the U.S. homebuilding industry to build 220,000 high-performance and energy efficient homes by 2012. The industry is asked to build 1.3 million high efficiency homes by 2030 allowing homeowners to collectively save as much as $1.7 billion in energy costs (NREL Newsletter, February 20, 2008). Before the federal targets had been announced, the Delaware SEU set an energy efficiency target of 30% reduction in residential and business building energy requirement by 2015.

The Joint Institute for a Sustainable energy and Environmental Future, comprised of prominent energy experts in Korea and the Center for Energy and Environmental Policy at the University of Delaware, conducted research on energy efficiency potential in each end use sector in Korea, the result of which was published by Maeil Kyung Jae in 2004 under the title *Energy Revolution*. According to this comprehensive research, energy saving potential for residential and commercial sector is 34% and 36% ,respectively, by 2020 compared to the government's business-as-usual scenario.

To prepare an impact estimation of a Seoul City SEU, we assume the following:

• The City of Seoul's GDP will continue to grow as it has been for the past five years (2000-2005);
• Electricity and natural gas use associated with economic growth will continue to increase in the City as they have been for the past five years, except for expectable technology improvements (which modestly reduce the rate of demand growth);[69]
• The City launches an SEU in 2009 with the aim of reducing residential and commercial building use by 30% by 2020;
• By 2020, the City's SEU has reached a 33% participation rate for its building-focused programs;
• A 10% City renewable energy target by 2020 is adopted, including a 3% of PV carveout, in order to offset conventional electricity use.[70]

With these assumptions, and 11 years of Seoul's GDP, electricity and natural gas use, and carbon emission data enlisted to establish tends, it is possible to project the potential energy and carbon impacts of a Seoul City SEU.

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[69] Economists sometimes refer to this phenomenon as 'automatic energy efficiency improvements' because a measure of continuous technology change is considered endogenous to the modern economy. Estimates of the U.S. AEEI very but are typically in the range of 0.5-1.0% per year. See Hassol, S.J., Strachan, N.D., Dowlatabadi, H. 2002. Energy efficiency: a little goes a long way. In: Watts, R.G. (Ed.), *Innovative Energy Strategies for CO_2 Stabilization*. Cambridge University Press, Cambridge, pp. 87–121. A deduction for AEEI of 0.75% per year is made for the impact projections for Seoul.

[70] Seoul's renewable target of 10% by 2020 is suggested after a review of experiences and policies of US states and renewable advanced countries. For example, Colorado requires its utilities with 40,000 or more customers to include 10 % of renewable electricity into their generation portfolio. Of the electricity from renewable energy, at least 4% is required to be generated from soar electric technologies. Nevada requires 20% of electricity sold in 2015 from renewables and 5% of standard is required to be generated or acquired from solar resources. Delaware and New Jersey also include 2% PV carveout programs in their RPS (20% by 2019 and 22% by 2021, respectively). The preliminary report for a renewable energy scenario for South Korea conducted by the Joint Institute of Sustainable Energy and Environmental Future also suggests a 10% of renewable energy standard with a 3% of PV carveout is by 2020. Seoul City's renewable target of 10% by 2020 was declared in 2007 (See also pp. 39). It should be noted that a renewable energy target is assumed to be applied to only electricity use in this report.

The SEU can be anticipated to create real, measurable, and verifiable energy savings. Without the SEU in place, conventional electricity and natural gas (city gas) use in the City is likely to grow by 10.8 MTOE through 2020. This represents a 26% increase from the 2005 level of 7.96 MTOE. Through a rigorous SEU program, the City will be able to reduce building use of conventional fuels by 1.49 MTOE, which accounts for about 50 % of energy in the building sector by 2020 despite continued economic growth of 2.71 % per year (Figure 5.6). CO_2 savings from the implementation of SEU are also significant. A City SEU can offset 1.67 MTC by 2020. This represents a 57% reduction from the 2020 business-as-usual forecast of Seoul's building sector emissions from electricity and natural gas use (see Figure 5.7). Again, this occurs while the Seoul economy maintains a healthy economic growth rate of 2.7%.

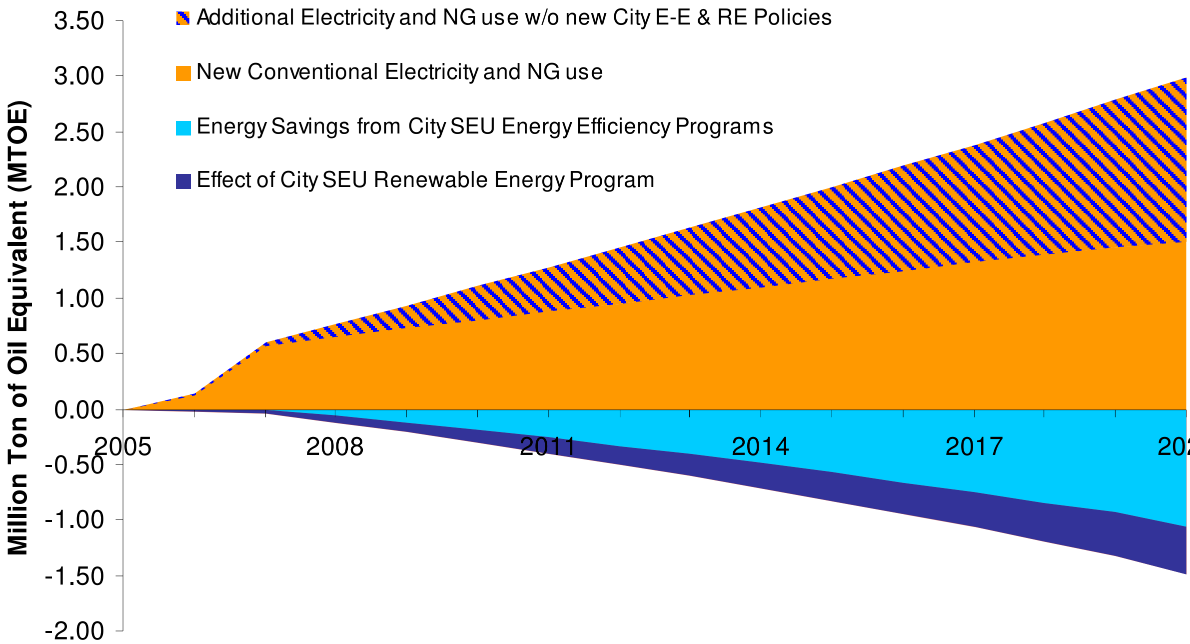

Figure 5.7 Potential Energy Impacts of Seoul Sustainable Energy Utility

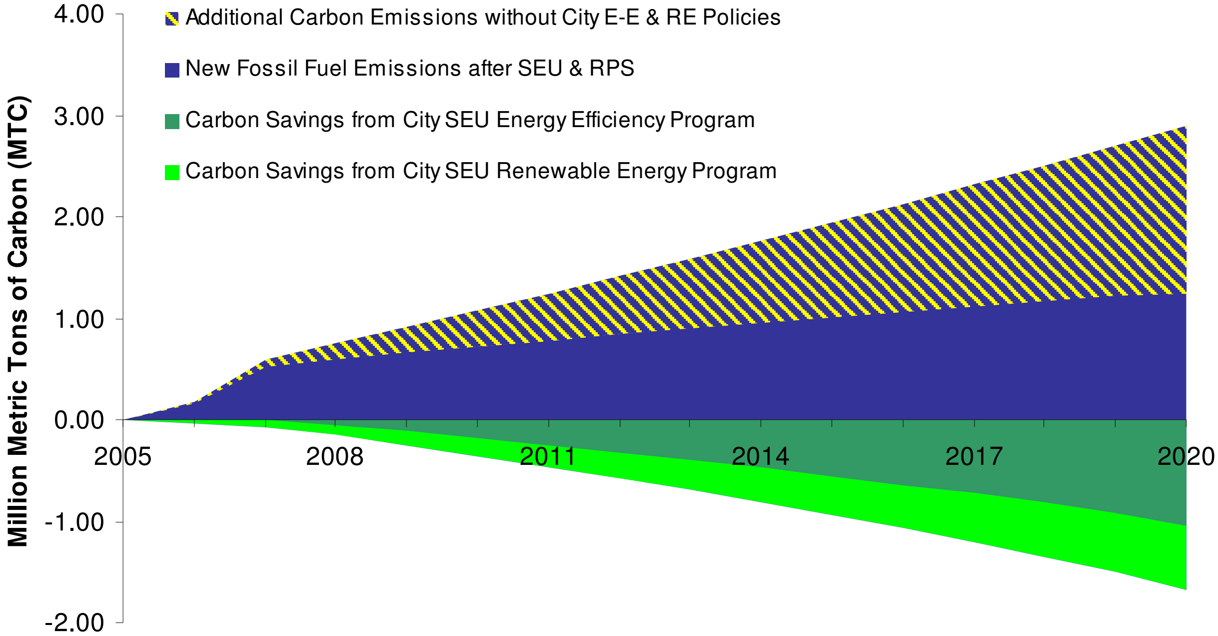

Figure 5.8 Potential Carbon Impacts of Seoul Sustainable Energy Utility

6. Moving Forward with an SEU Model for the City of Seoul

Seoul has unique challenges and opportunities to develop a meaningful sustainable energy policy and program. We are very optimistic about the potential for the City to be a leader in international efforts to balance the goals of energy affordability, economic development and environmental sustainability.

In support of the City's efforts, we offer below suggestions for building and sustaining leadership in this burgeoning area of innovative policy and program development.

6.1 Forming a Task Force

The Office of Clean Environment (OCE) in Seoul City may wish to consider formation of a Task Force initially to evaluate the sustainable energy services potential by fuel and use sector. Its purpose could evolve to assist the OCE in examining policy issues, program needs and barriers, and implementation challenges on an ongoing basis. The Task Force could include City Council members, OCE representatives, other public sector representatives, industry officials, community leaders and research experts.

6.2 Creating a Research Plan

It is suggested that a detailed research plan be prepared in order to identify near-, medium-, and long-term targets and markets for sustainable energy development in Seoul City. The residential and commercial building stock offer exceptional opportunities and special challenges to realize urban sustainability. In this regard, enactment of a Seoul Green Building Standard in August 2007 is an important step for the improvement of energy efficiency and diffusion of renewable energy technologies in the building sector. With a City SEU as the point-of-contact for all energy efficiency and self-generation, it is suggested that implementation of the City's Green Building Standard be an early obligation of the Seoul City SEU. Synergistic effects can be enhanced by linking building code, and energy efficiency and on-site renewable energy programs together. In particular, the role of a Seoul City SEU as a point-of-contact will be important for residential end-users because households largely lack the ability to access all of the information on energy efficiency and end-user-sited renewable energy opportunities. The City SEU can serve as a clearinghouse for government or third party energy service program information. By eliminating bureaucratic complexities in the process of adopting sustainable energy options, the City SEU can expand the market greatly for the residential end users and at the same time, making it very easy for households to routinely choose their most renewable sustainable energy options.

As domestic heating is the major end use in the buildings sector, particularly in the residential sector, special attention needs to be paid to high-efficiency building shell and window treatment and upgrades of gas and oil boilers, and where possible their replacement with solar thermal for domestic heating. Solar thermal systems in the residential sector increased during the 1990s but plummeted significantly since the 1998 financial crisis. This was mainly caused by bankruptcies of small solar thermal companies due to financial difficulties during the national financial crisis. But solar thermal systems are technologically mature and economically viable, and can significantly reduce conventional energy use in residential buildings once the market is revitalized through SEU-implemented actions.

According to MOCIE's recent Annual Report (2007), 1.2 million households fall into the "energy-poor" category that has to pay more than 10% of their income for energy needs. Although national and City government attention to this problem is growing, a systematic policy response with reliable budgets will be needed. An SEU can provide these features as part of an Affordable Energy Program, in particular, the weatherization needs of low- and moderate-income housing. Customer-sited renewable energy may play an important role in addressing the problem of 'energy disparity.' End-user sited renewable energy will not only provide environmentally sound energy options for the society but it also will help to relieve the economic burden for the energy-poor households. Once the City's SEU provides for the high, up-front cost of renewable energy systems for low- or mid-income households, the substantial monthly expenses for conventional fuel and electricity can be avoided. Thus, the SEU may consider customer-sited renewable energy to low- and moderate income households as a top policy agenda.

Seoul City may examine three or four potential funding sources: feed-in-tariffs[71], energy shared savings programs, and tax exempt bonds or its own Climate Change Fund (CCF). Unlike U.S. states, Seoul City does not have an authority to impose a surcharge on electricity sales of power providers to create special funds for sustainable energy service programs. However, as shown in the Delaware case, shared savings can provide significant funds for an SEU over the long run (See Figure 3.4 in Section 3). In turn, Seoul City can issue sustainable energy bonds, as Delaware is doing to provide investment resources for City programs and then utilize shared savings to repay the bonds. Thus, the absence of the revenue from the electricity sales will not undermine seriously the financeability of SEU.

To address the SEU's initial working capital needs, Seoul may examine two options. The City has recently created a "Climate Change Fund (CCF)," which will be raised from the City's tax revenue and income from dividends of KOGAS and Daehan City Gas. This fund can be used as an initial source of capital to support SEU programs. Like Delaware SEU, Seoul also may consider tax-exempt bonds as an initial source of capital for the SEU program. In order to receive a quality bond rating, the Seoul City's SEU proposal will need to demonstrate an attractive return on investment to potential bondholders. Projections of revenues based on shared energy savings and feed-in-tariffs (FIT) will be an essential component for the development in the research plan, along with an ability to show balanced use of trust funds to improve program and project performance.

The research plan for Seoul City should consider identifying "early success" programs in which the City could begin its involvement. Seoul has not previously coordinated long-term and comprehensive energy planning. In the early stage, the Seoul City SEU may focus on residential/commercial buildings sector, which is largely overlooked by conventional utilities and ESCOs despite its large energy saving potential. It might also be worth considering district-specific implementation rather than full-scale city-wide programs in the initial stage of SEU development.

[71] In the absence of an RPS framework, a REC market does not exist in Korea at this point. If an RPS substitutes for the current feed-in-tariff, REC revenue flows can be considered as an SEU funding source.

The key outcome of the research plan would be analytically based targets for efficiency gains, renewable energy utilization, and affordable energy development. Green employment and environmentally sustainability goals can also be integrated into a recommended targets protocol.
In sum, a research plan can furnish Seoul City with an analytically based set of achievable targets and strategic markets, a detailed map of SEU financeability, and a useful guide for present and future policy decision making.

6.3 Developing an Organizational Model that Learns from the Delaware and Washington DC SEU Approaches

This report has provided a detailed description of several organizational models for sustainable energy service delivery. Based on experiences in some pioneering U.S. states, a diagram of an SEU model for Seoul City is sketched (Figure 6.1). In this model, the OCE would implement and oversee a competitive process to appoint a Contractor Administrator (CA). The CA would administer the SEU and supervise implementation contractors delivering Seoul's sustainable energy services. The effort to create a one-stop shop through the CA is vital in avoiding confusion and redundancy that might otherwise discourage participation. The CA would report to the SEU Oversight Board composed of City policy authorities, experts and community leaders. An independent Fiscal Office would ensure proper monitoring and verification of all financial transactions.

Based on findings from the research plan and in consultation with other jurisdictions and experts in the City, a more detailed organizational model can be developed by the Task Force.

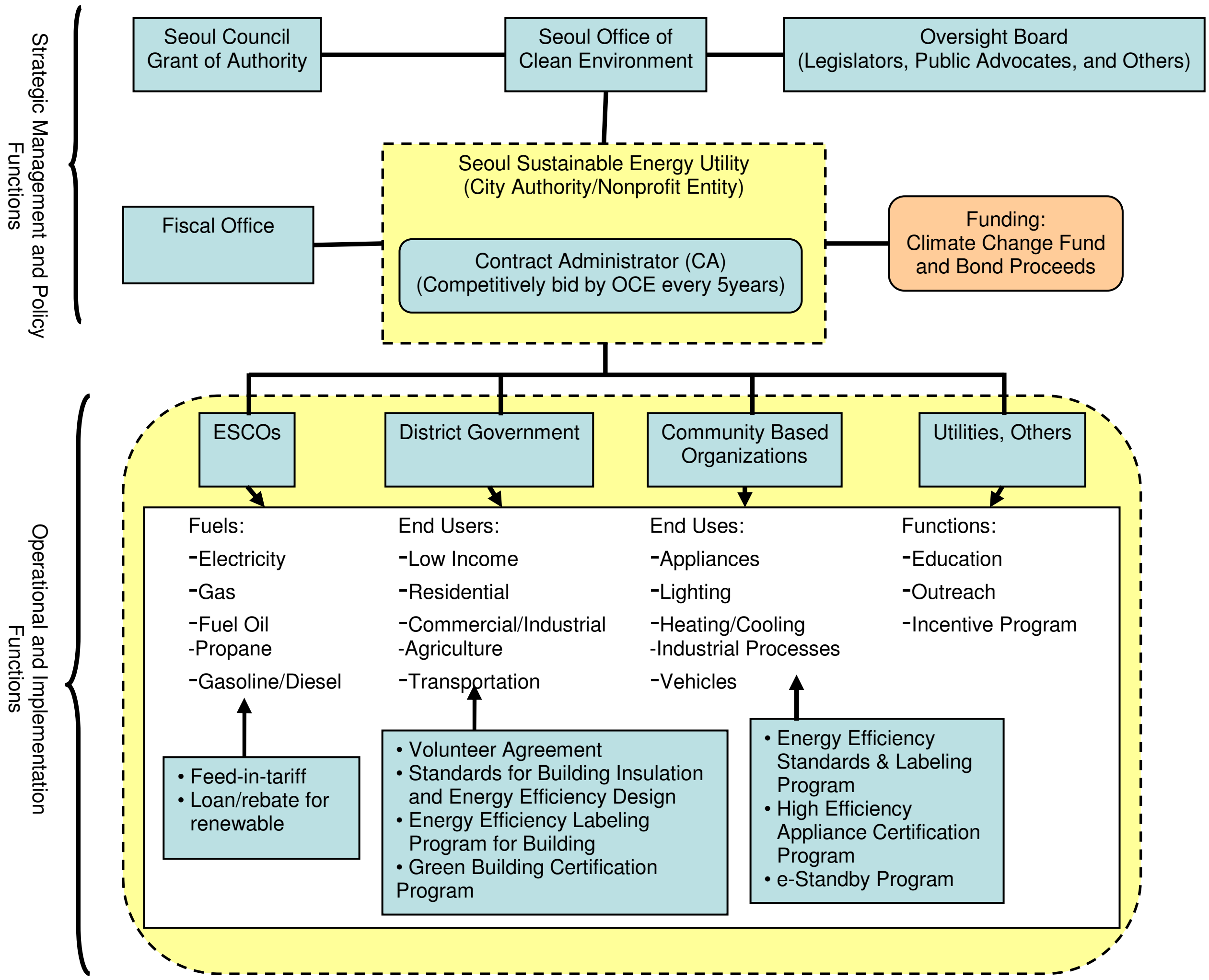

Figure 6.1 Proposed Seoul Sustainable Energy Commission Framework

APPENDIX 1

Estimates of Annual Electricity Savings for Targeted Residential Appliances

6.1.1.1.1 Part a. Residential Energy Efficiency Potential - Targeted Appliance Turnover Estimates								
		Delaware Appliance Stock		Existing Appliance Sales Rate				
	6.1.1.2 Appliance Type	Total % of households with 1 or more appliances[1]	Estimated Total No. of Appliances Based on No. of Delaware Households (assumes 1 per household)	Average National Replacement & New Sales Rate[1]	Estimated Delaware Sales for Replacement & New Sales	% of 2004 Sales that are Energy Star rated[2]	Targeted Energy Star Replacement rate (%)	Incremental Energy Star Replacement (no. of units)
Electricity	Refrigerators	100%	298,736	10%	30,551	30%	60%	9,165
	Clothes Washers	85%	253,926	10%	26,644	26%	50%	6,395
	Central AC w/o Heat Pump	51%	152,355	12%	18,187	33%	66%	6,002
	Central AC w/ Heat Pump	8%	23,899	17%	3,989	33%	66%	1,316
	Freezers	33%	98,583	7%	7,254	30%	66%	2,611
	Room AC	14%	41,823	32%	13,367	30%	66%	4,812
	Water Heaters - Electric	69%	206,128	11%	23,108	30%	66%	8,319

1. Based on EIA Residential Energy Consumption Survey, South Atlantic Region, 2001.
2. Based on U.S. DOE Energy Star and EIA.

Part b. Residential Energy Efficiency Potential - Targeted Appliance Turnover Estimates							
		Increase In Old Appliance Turnover			Annual Energy Savings		
	Appliance Type	Approximate No. of Appliances > 10 years old (i.e. likely to be replaced)[3]	Targeted Increase in Replacement Rate (%)	Targeted Incremental Replacements, Units > 10 years old (no. of units)	Total Targeted Energy Star Sales per year	Average Annual Electricity Savings per unit (kWh) (difference between E-Star and >10yr-old appliance)[4]	Total Annual Energy Savings (kWh/yr)
Electricity	Refrigerators	86,633	13%	38,836	48,001	750	36,000,751
	Clothes Washers	50,785	13%	33,010	39,405	815	32,115,057
	Central AC w/o Heat Pump	39,612	13%	19,806	25,808	1,794	46,299,326
	Central AC w/ Heat Pump	6,214	13%	3,107	4,423	1,511	6,683,491
	Freezers	16,759	13%	12,816	15,427	609	9,395,091
	Room AC	8,365	13%	5,437	10,249	385	3,945,915
	Water Heaters - Electric	80,390	13%	26,797	35,116	375	13,168,340

3. Based on EIA Residential Energy Consumption Survey, South Atlantic Region, 2001.
4. Based on Database for Energy Efficiency Resources (DEER) California, EIA Buildings Energy Data Book 2005, Energy Star, U.S. DOE.

Prepared for the Delaware Sustainable Energy Utility Task Force by the Center for Energy & Environmental Policy.

APPENDIX 2

Estimated Revenues from a 25% Aggregation Fee Assessed by the SEU on its Distributed Renewable Energy Investments

	Year	Installed Capacity From Rebate Program (kW)	Cummulative Capacity From Rebate Program (kW)	Cummulative Electricity From Rebate Program (MWh)	REC Price ($/MWh)	REC Sales ($)	SEU Aggregation Fee	SEU REC Income ($)
PV RECs	2008	80	700	1,002.40	$200	$200,480	0.25	$50,120
	2009	178	878	1,257.51	$200	$251,502	0.25	$62,876
	2010	315	1,193	1,708.65	$200	$341,729	0.25	$85,432
	2011	2,127	3,320	4,754.28	$180	$855,770	0.25	$213,943
	2012	3,741	7,061	10,110.92	$170	$1,718,856	0.25	$429,714
	2013	7,617	14,678	21,018.78	$150	$3,152,816	0.25	$788,204
	2014	11,992	26,670	38,191.90	$125	$4,773,987	0.25	$1,193,497
	2015	16,683	43,354	62,082.24	$100	$6,208,224	0.25	$1,552,056
Sub-totals		42,734				$17,503,365		$4,375,841
	2016	20,778	64,131	91,836.00	$75	$6,887,700	0.25	$1,721,925
	2017	27,332	91,463	130,975.58	$50	$6,548,779	0.25	$1,637,195
	2018	39,679	131,143	187,796.12	$50	$9,389,806	0.25	$2,347,452
	2019	43,897	175,039	250,656.51	$25	$6,266,413	0.25	$1,566,603
Totals		174,419				$46,596,063		$11,649,016

	Year	Installed Capacity From Rebate Program - Non-PV Renewables (MW)	Cummulative Capacity From Rebate Program - Non-PV Renewables (MW)	Cummulative Electricity From Rebate Program (non-PV RE) (MWh)	REC Price ($/MWh)	REC Sales ($)	SEU Aggregation Fee	SEU REC Income ($)
Wind, Geotherm al, Solar Thermal and Other RE RECs	2008	7	20	52,727.80	$35	$1,845,473	0.25	$461,368
	2009	14	34	89,840.13	$35	$3,144,404	0.25	$786,101
	2010	19	53	138,888.70	$35	$4,861,105	0.25	$1,215,276
	2011	22	75	196,320.08	$30	$5,889,603	0.25	$1,472,401
	2012	25	100	262,567.46	$30	$7,877,024	0.25	$1,969,256
	2013	28	128	336,881.62	$30	$10,106,449	0.25	$2,526,612
	2014	31	159	419,159.99	$25	$10,479,000	0.25	$2,619,750
	2015	34	194	509,357.59	$25	$12,733,940	0.25	$3,183,485
Sub-totals		181				$56,936,996		$14,234,249
	2016	38	231	607,964.26	$20	$12,159,285	0.25	$3,039,821
	2017	40	272	713,611.87	$15	$10,704,178	0.25	$2,676,044
	2018	51	323	848,383.90	$15	$12,725,759	0.25	$3,181,440
	2019	56	379	995,389.84	$10	$9,953,898	0.25	$2,488,475
Totals						$102,480,117		$25,620,029

Note: Installed capacity of PV systems is based on the proposed Solar Carveout to be submitted as an amendment to the State's current RPS policy. Installed capacity of non-PV renewable energy systems is based on the proposed upgrade of the RPS schedule, also to be submitted as an amendment to SB 161.

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APPENDIX 3

An SEU Prospectus with Tax Exempt Bonding

	Net SEU Revenues (before Debt Service)	SEU Bond Debt Service									Net SEU Revenue (after Debt Service & Bond Retirement)	SEU Bottom Line
Year	Balance of SEU Costs and Revenues	Tax Exempt Bond Floats			Annual Interest Cost for Bond 1 (Yield = 5.20%)	Annual Interest Cost for Bond 2 (Yield = 5.0%)	Annual Interest Cost for Bond 3 (Yield = 4.90%)	Annual Interest Cost for Bond 4 (Yield = 4.90%)	Bond Management	Debt Totals	SEU Balance + Bond Interest Cost + Bond Principal	Cumulative Cash Flow
2008	-$4,013,569	Bond 1: 5 yr Maturity	Yield = 5.20%	$7,700,000	-$400,400				-154000	-$554,400	$3,132,031	$3,132,031
2009	-$2,483,161				-$400,400					-$400,400	-$2,883,561	$248,469
2010	$1,017,936	Bond 2:	Yield = 5.00%	$0	-$400,400	$0			$0	-$400,400	$617,536	$866,006
2011	$390,910	Bond 3:	Yield = 4.90%	$0	-$400,400	$0	$0		$0	-$400,400	-$9,490	$856,515
2012	$2,854,090	Bond 4: 8 yr Maturity	Yield = 4.90%	$15,300,000	-$400,400	$0	$0	-$749,700	-$306,000	-$1,456,100	$8,997,990	$9,854,505
2013	-$1,354,313					$0	$0	-$749,700		-$749,700	-$2,104,013	$7,750,492
2014	-$3,104,557					$0	$0	-$749,700		-$749,700	-$3,854,257	$3,896,235
2015	-$2,830,012					$0	$0	-$749,700		-$749,700	-$3,579,712	$316,523
Sub-totals	-$9,522,677				-$2,002,000	$0	$0	-$2,998,800	-460000	-$5,460,800	$316,523	
2016	$3,001,262					$0	$0	-$749,700		-$749,700	$2,251,562	$2,568,084
2017	$3,089,776					$0	$0	-$749,700		-$749,700	$2,340,076	$4,908,161
2018	$5,120,989					$0	$0	-$749,700		-$749,700	$4,371,289	$9,279,450
2019	$10,232,470					$0	$0	-$749,700		-$749,700	-$5,817,230	$3,462,220
Totals	$11,921,820				-$2,002,000	$0	$0	-$5,997,600	-460000	-$8,459,600	$3,462,220	
										All Bond Interest		
										-$7,999,600		
										Total Bond Float		
										$23,000,000		

* Revenue Assumptions
$25 million in Sustainable Energy Special Purpose Bonds are authorized.
GEF mill rate is doubled.
Revenues from 33% Shared Savings Agreements for energy efficiency investments are received as projected.
REC revenues are received as projected based on declining price schedule.

Prepared for the Delaware Sustainable Energy Utility Task Force by the Center for Energy & Environmental Policy.