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REEL in Alaska ROADMAP*

How to meet end-use electricity needs in the Railbelt region in 2025, using half the electricity used in 2000.

*"REEL" = Railbelt Electricity Efficiency Landscape

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Although every possible effort has been made to present information accurately, the opinions and recommendations contained in this report are the those of the authors, and should not be taken as a reflection on the good work done by others whose literature is cited herein. Any inadvertent inaccuracies or inconsistencies with prior work cited herein unintentional, and are the sole responsibility of the authors.

The ***REEL in Alaska Roadmap*** builds on previous work and publications completed by the Cold Climate Housing Research Center, the Alaska Energy Authority, the Alaska Housing Finance Authority, the Institute of Social and Economic Research at the University of Alaska Anchorage, Renewable Energy Alaska Project (REAP), the Alaska Legislature, Black & Veatch, the six Railbelt utilities, and dozens of others, without whom this ***Roadmap*** would not have been possible, and to whom the authors express their gratitude.

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About Natural Capitalism Solutions

Natural Capitalism Solutions helps companies, countries, and communities implement genuine sustainability. In 2007 and 2008, Natural Capitalism Solutions worked with clients representing approximately 3% of U.S. Gross Domestic Product.

Natural Capitalism Solutions was founded on the three principles of Natural Capitalism, which form the basis for the transition to genuine sustainability. These principles describe how businesses and communities can shift from unsustainable to more sustainable, restorative practices adopting policies and programs to:

- ***Increase efficiency:*** *Dramatically increasing the productivity of resources, including energy, water, materials, and people. This slows resource depletion, lessens pollution, and increases employment in meaningful jobs. It lowers costs for business and society, halts the degradation of the biosphere, makes it more profitable to employ people, and preserves vital living systems and social cohesion.*
- ***Redesign industrial processes and the delivery of products and services to do business as nature does, using such approaches as biomimicry and cradle to cradle:*** *Using innovative green processes to eliminate waste and toxics, while delivering superior products and services. This approach enables a wide array of materials to be produced with low energy flows, in processes that run on sunlight, emulating nature's genius. It shifts to circular economies in which materials are reused, remanufactured and waste is eliminated.*
- ***Manage institutions to be restorative of human and natural capital:*** *Restoring and enhancing natural and human capital resources, while increasing profitability and competitive advantage. Such approaches enhance human well-being and enable the biosphere to produce more wealth from its intact communities and abundant ecosystem services and natural resources.*

Natural Capitalism Solutions is recognized internationally for its work in the field of sustainability. Formed by Hunter Lovins, co-author of the acclaimed book Natural Capitalism: Creating the Next Industrial Revolution, Natural Capitalism Solutions is led by Lovins, Toby Russell and Paul Sheldon, who have a combined total experience of over 80 years in business, sustainability and communications. Together with their network of best in class sustainability professionals, the Natural Capitalism staff has an impressive record in developing innovative and practical ways to increase efficiency and environmental practices, as well as economic sustainability, for a long list of government and corporate clients.

Natural Capitalism Solutions' mission is to educate senior decision-makers in business, government and civil society about the principles of sustainability. Natural Capitalism Solutions shows how to restore and further enhance natural and human capital while increasing prosperity and quality of life. In partnership with leading thinkers and groups, Natural Capitalism Solutions creates innovative, practical tools and implementation strategies for companies, communities and countries. Natural Capitalism Solutions (NCS) is a 501(c)(3) non-profit organization.

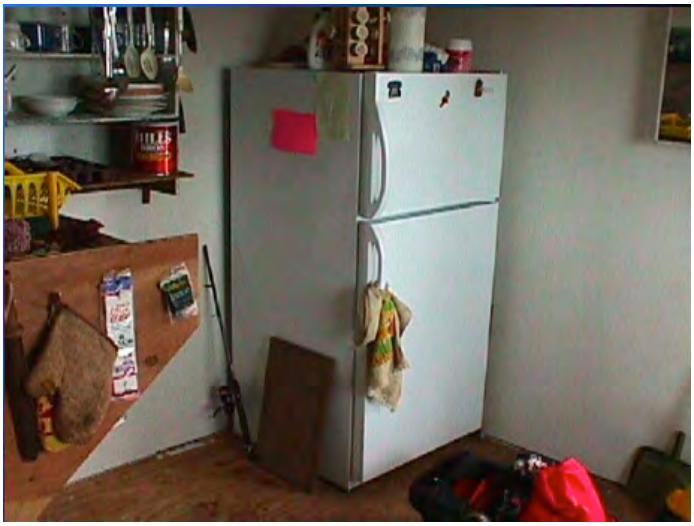
http://www.natcapsolutions.org

Preface

As noted in the Profile in Appendix H, 65% of Alaskans live in the Railbelt region around Anchorage, Homer and Fairbanks—approximately 477,000 people.[1,2] The Railbelt region is currently served by six separate electricity utilities, who collaborate on a shared transmission and distribution network providing over 4 thousand megawatt hours (MWh) of electricity each year:

Chugach Electric Association (CEA)	1,112 MWh
Municipal Light & Power (ML&P)	880 MWh
Matanuska Electric Association (MEA)	532 MWh
Homer Electric Association (HEA)	477 MWh
Seward Electrical Systems (SES)	55 MWh
Golden Valley Electric Association (GVEA)	1,071 MWh
Railbelt Region	**4,127 MWh**

These six Railbelt utilities and many other locally-based organizations provide outstanding resources for ways that Alaskans can more efficiently meet their electricity needs for light, heat, entertainment, pumps, motors, and other services. For example, the Alaska Housing Finance Corporation (AHFC) helped one Alaskan family replace a refrigerator that used more than 1,300 kilowatt hours (kWh) per year, with one that uses 437 kWh per year, producing a savings of at least 863 kWh—an improvement in efficiency of at least 66%. At a price of $0.215/kWh for electricity, this saves the owner $186 per year, which will provide a positive return on investment in just a few years.



Although some very useful examples of Alaskan opportunities such as the one above will be cited in this ***Roadmap***, much of the information and many of the examples contained in this ***REEL in Alaska Roadmap*** come from outside of Alaska, simply because Alaska-specific information isn't available yet. Similarly, many examples provide statistics for one house, one business, or one project, rather than a whole community or service area. This is because many of the strategies described here have been implemented on a scale large enough to demonstrate feasibility, profitability, and cost effectiveness, but not

[1] Alaska Energy Authority and Alaska Center for Energy and Power. *Alaska Energy.* Alaska Energy Authority. January 2009. http://www.aidea.org/aea/PDFpercent20files/AKpercent20Energypercent20Final.pdf.

[2] U.S. Census Bureau. *Alaska.* State & County QuickFacts. September 2009. http://quickfacts.census.gov/qfd/states/02000.html.

on a community-wide or utility-wide basis yet. Nonetheless, the examples provide indications of the viability of the various strategies and technologies described.

The authors of this ***Roadmap*** sincerely hope that Alaskans will find this additional "outside" information useful in charting a course to a sustainable energy future—a future based on the abundance, independence, prosperity, and resilience that have always been the basis for Alaska's greatness.

This scope of this ***Roadmap*** is electricity use in the Railbelt region. As such, the ***Roadmap*** does not address energy used for thermal heating or for transportation, except as these services require electricity. Though very important to Alaska's energy future, renewable energy technologies and supply sources are also outside the scope of this ***Roadmap****.*

Alaska already has numerous local resources to empower and support her citizens in improving the efficiency with which electricity is used. In the *Alaska Energy Efficiency Program and Policy Recommendations Report* of June 5, 2008, the Cold Climate Housing Research Center provided a brief list of some of the organizations with expertise in how to use electricity more efficiently, which is included in this ***Roadmap*** as Appendix A.

Including the existing Railbelt utilities, many of these Alaska-based organizations are non-profit, Alaska-based groups that exist to serve the community. The actions taken by these groups directly reflect the interests of the community members involved and serve as examples of how Alaskans can help themselves, without heavy reliance on outside groups, corporations, or strong government intervention.

Executive Summary

Alaska remains a land of incredible opportunity and potential—Alaska's relatively small population—the frontier—the "can-do" spirit that makes incredible things happen (e.g. the Alaska oil pipeline, the Alaska Highway, Iditarod)—Alaska's world-class understanding of energy, thanks to the oil and gas industry—the dedicated men and women of Alaska's existing infrastructure, who have made life on the frontier possible for so many years—all combine to provide unprecedented possibility for abundance and prosperity.

This ***REEL in Alaska Roadmap*** demonstrates how Alaskans in the Railbelt region can meet their real electricity needs, with up to 50% greater efficiency in the use of electricity from centralized generation, by 2025 (as compared to the year 2000).

Setting a destination of improving efficiency by potentially as much as 50% represents an improvement of 3.3% per year over the next 15 years, which has been shown to be achievable through harvesting "low-hanging fruit"—a combination of market-based incentives and clearly-stated policies, backed by appropriate and affordable financing, for improvements in lighting, heating, ventilation, appliances, machines, and infrastructure. Sections of this ***Roadmap*** address each of these opportunities.

One example of this opportunity is Anchorage's transition to LED street lighting, which uses 50% less electricity already. The program is saving Anchorage $360,000 per year, for only $2.2 million invested. Anchorage will start receiving profits on their investment in approximately 6 years. If these new streetlights last 15 years, this investment will yield an annual monetary return rate of 9.3%, between 2010 and 2025, while improving efficiency by 50%.[3]

This annual overall efficiency improvement level of 3.3% per year is less than what has been accomplished elsewhere: Vermont will achieve 4% improvement in its energy efficiency in 2010, for an investment of less than $0.03 per kWh of improved efficiency[4]; Houston reduced electricity use for traffic lights by 90% in one year, by installing LED traffic signals[5]; and Taiwan plans to improve overall electricity efficiency by 60%, and has achieved up to 85% improvement on the electricity used for traffic lights by switching to LEDs.[6]

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[3] *Anchorage leads the country with innovative and aggressive lighting program*, press release from Anchorage Mayor's Office, 10/31/2008, viewed December 23, 2009 at http://www.muni.org/Departments/Mayor/PressReleases/Pages/CITYINSTALLSFIRSTOF16,000LEDSTREETLIGHTS.aspx.

[4] *Efficiency Vermont Annual Plan 2009-2011*, December 16, 2008, downloaded December 25, 2009, from http://www.efficiencyvermont.org/stella/filelib/EVT%20Annual%20Plan%202009-2011.pdf

[5] *The City of Houston's Path Towards Sustainable Growth,* September, 2009. Viewed December 23, 2009, at www.greenhoustontx.gov/epr/sustainablegrowth2009.ppt.

[6] Huang, Vicki, 2009. *Green Light: Energy conservation measures focusing on more efficient lighting are seeing results.* Taiwan Review, viewed January 8, 2010, at http://taiwanreview.nat.gov.tw/fp.asp?xItem=53226&ctNode=1355

Furthermore, energy efficiency improvements are not new. In 1999, six states, some of which are rural, cold weather states, improved their electricity efficiency by 4% or more, as a percentage of total electricity sold in 1998 (the six states that reported at least 4% savings as a fraction of sales in 1998 were Washington, Oregon, Wisconsin, Rhode Island, Minnesota, and Vermont).[7]

What kind of lighting is in use where you are, right now? Is it daylight? If not, is it from solid-state, LED technology? Compact fluorescents? Fluorescent tubes? Incandescent bulbs? Firelight?

The urgent question is, "Could the efficiency of this use of electricity be improved by 3.3% this year?" If the answer to this question is yes and if Alaskans take the opportunity to ask and implement efficiency improvements every year, up to a 50% improvement is possible by 2025.

Obviously, there are some opportunities to improve efficiency by more than 3%, such as 75% or 90% improvements, as discussed in this ***Roadmap***. These dramatic examples of "low-hanging fruit" make the journey to a destination of as much as 50% improvement by 2025 much more achievable. However, a thorough, baseline assessment of current end uses of electricity in the Railbelt region will be required to determine the actual potential for improved efficiency. For example CEA has measured that overall electricity usage DECREASED by 5% between 2004 and 2009, bringing overall usage to the same levels as in 2002. By selecting a year 2000 baseline, this ***Roadmap*** intends to include these historic gains in efficiency. The baseline, end-use study is necessary to determine whether these recent decreases are the result of changing behavior patterns, or if, perhaps, some of the "low-hanging fruit" of energy efficiency, such as installing CFLs, has already been harvested, and in which areas. Also, once a new, Railbelt-specific baseline is available, the overall goal for energy efficiency in the year 2025 can refer to the new baseline, e.g. 2010.

Energy efficiency does not mean freezing in the dark. Energy efficiency does not mean doing without. It does not mean having less than Alaskans want or need. Energy efficiency, done right, results in spending less money to provide increased levels of service—providing the services Alaskans need, in affordable, and efficient ways, with no sacrifice in convenience, comfort, or affluence. This is the difference between energy efficiency and "conservation."

A 50% improvement in the Railbelt's electricity efficiency could generate an increase of up to $947,992,100 in economic output, $290,927,800 in wages, $53,499,850 in business income, and 9,350 new jobs.[8]

By 2025, Alaska's Railbelt region can meet its end use needs using potentially as little as 50% of the electricity from centralized generation previously required in the year 2000.

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[7] ACEEE, *State Scorecard on Energy Efficiency,* April, 2000. Viewed December 24, 2009 at http://www.aceee.org/pubs/u004.htm.

[8] Based on reducing demand by up to 425MW through efficiency. ECONorthwest, *Economic Impact Analysis of Energy Trust of Oregon Program Activities.* 2003, Table 9. http://www.energytrust.org/library/reports/ETOecon_impacts_Final.pdf?link_programs_reports_lin1Page=3.

REEL in Alaska Roadmap

1. **STARTING POINT (baseline assessment of end-uses of electricity)**

2. **LANDMARKS—Lighting, Heating/Ventilation, and Plug-in Appliances**

END USE	**ANNUAL IMPROVEMENT** (as % of total electricity use)	**TOTAL BY 2025**
Lighting	1.3%	20%
Heating & Ventilation	1%	15%
Plug-in Appliances	1%	15%
TOTAL	**3.3%**	**50%**
BONUS: Smart Grid	**BONUS** 1.3%	**BONUS** 20%

3. **FINANCING**
   a. Decoupling efficiency from kWh sold – “bills not rates”
   b. Protecting utility margins
   c. Repayment of financing tied to property
   d. On-bill financing
   e. Addressing split landlord/tenant incentives

4. **POLICY**
   a. Policies designed to support voluntary, free-market solutions
   b. Mandatory security provisions to ensure stability and equity
   c. Leveraging public resources to increase benefits

REEL in Alaska Recommendations

1. **Set a goal to reduce Railbelt region electricity use from fossil fuels, by 50% by 2025, through efficiency improvements.**
   - In coordination with Governor Palin's goal of 50% renewable energy, this could enable the Railbelt region to meet all its energy needs from renewable sources, while bringing additional jobs and savings.[9]

2. **Implement the RIRP recommendation for a baseline, end-use study of electricity uses.**

   As stated in the Alaska Energy Authority's draft Alaska Railbelt Regional Integrated Resource Plan, "… it is important that a comprehensive technical and achievable potential study be completed, including the comprehensive cost-effectiveness evaluation of the available DSM/EE [energy efficiency] measures and using Railbelt-specific information." [10,11]

3. **Form a Railbelt regional authority for energy efficiency to serve as an energy efficiency utility, as recommended by prior reports, to improve the efficiency of lighting, heating, plug-in appliances and other electricity uses in residential, commercial, institutional, and industrial sectors.**

   "… it is Black & Veatch's belief that a regional entity should be formed to develop and deliver DSM/EE programs on a regional basis, in close coordination with the six Railbelt utilities. This entity could be the proposed GRETC organization or another entity focused exclusively on DSM/EE programs."[12]

4. **Provide statewide legislation to enable property-based financing and other incentives for energy efficiency and renewable energy.**
   - See the Implementation Strategies section, below.
   - Sample legislation from Colorado is available at the following website:
     - http://www.newrules.org/energy/rules/municipal-financing-renewables-and-efficiency
   - Support additional revenue from financing and accomplishing energy efficiency and distributed renewable energy projects, through strategies such as dynamic pricing, time of use rates, inverted block rates, net metering, and feed-in tariffs.

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[9] For example, California's commitment to energy efficiency has kept per-capita energy use flat for more than 30 years, while their economy has grown. Energy efficiency measures have enabled California households to redirect their expenditure toward other goods and services, creating about 1.5 million FTE jobs with a total payroll of over $45 billion, driven by well-documented household energy savings of $56 billion from 1972-2006. See Roland-Horst, David, *Energy Efficiency, Innovation, and Job Creation in California*, 2008, published by Next 10 and available for download from http://www.Next10.org.

[10] Black and Veatch, *Alaska Railbelt Regional Integrated Resource Plan (RIRP) Study Draft Report.* December 2009. Page 11-16. (DMS/EE stands for "demand side management/energy efficiency). More information on DSM/EE is contained, below, in this *REEL in Alaska* Roadmap.

[11] Though no such end-use baseline studies exist in Alaska yet, an example of an end-use baseline study for lighting is available at: http://www.energy.ca.gov/efficiency/lighting/VOLUME01.PDF; and Canada's Survey of Household Energy Use is included in this *Roadmap* as Appendix F.

[12] Black and Veatch, RIRP, 2009, op. cit. Additional information on DSM/EE is contained, in this *REEL in Alaska* Roadmap.

5. **Additional Next Steps:**
    a. **Implement the State Energy Policy and Programs Recommendations.** In October 2009, the State Senate Resources and Energy Committees recommended a specific list of actions to improve Alaska's energy efficiency, many of which are also paralleled by proposals in the House.[13] All of the recommendations of the Senate Committees' report are consistent with the ***Roadmap***. The full Senate Committees' report is included in this ***Roadmap*** as Appendix B.
    b. **Organize and Implement "Social Mobilization" for Energy Efficiency.** (See "The Importance of Local and Regional Mobilization," page 92.)

[13] Wielechowski, Bill and Lesil McGuire, *State Energy Policy and Program Recommendations,* October 19, 2009. Viewed December 29, 2009 at http://www.aksenate.org/energy/101909_Draft_E_policies.pdf

Overview

The primary goals of providing energy services are survival, comfort, prosperity, and stability. This Railbelt Electricity Efficiency Landscape in Alaska ("***REEL in Alaska***") ***Roadmap*** demonstrates how the Railbelt region can increase the efficiency with which people's end-use needs are met by as much as 50%, by 2025, as measured against the amount of electricity used to meet those needs in 2000.

When considering efficiency improvements, the most important question to ask is, "What are we using the electricity for?" Or, "What are the **end-use needs** for which we need energy?"

Too often, planners seek to increase energy supply, without asking about the most efficient and appropriate ways to meet **end-use needs**. For example, sometimes people think they need more supply—because they don't have enough electricity to produce light using incandescent bulbs—when the most cost-effective way to meet the **end-use need** for lighting is to replace the inefficient, incandescent bulbs with solid state lighting technologies, like light emitting diodes (LEDs), as Anchorage is doing with its street lights.

As documented below, some returns on investments in improved efficiency include:

- Saving money for residents, businesses, institutions, industries, and utilities;
- Creating new jobs for hard-working Alaskans;
- Increasing regional energy security;
- Reducing exposure to volatile prices of fossil fuels; and
- Increasing regional prosperity and "economic multiplier" by freeing up money spent on electricity for other uses.

The 50% destination used for this ***Roadmap*** is a method to move past conventional thinking—to drive breakthroughs that will lead to greater prosperity, by achieving an incremental improvement of just 3.3% per year.

Alaskans are already working on a wide variety of energy efficiency activities and programs. The ***REEL in Alaska Roadmap*** both builds on these accomplishments, and counts on Alaskans' expertise, to determine and implement next steps. In addition to these outstanding accomplishments, the ***REEL in Alaska Roadmap***'s recommendations are based on other examples that have been demonstrated to work elsewhere, and which may also work in Alaska.

In an economy in which stocks are falling and investments are not made on a whim, investing in electricity efficiency is currently one of the safest investments. Energy efficiency investments (including thermal and electricity) have a high rate of return. In 2009, "Energy efficiency recorded the highest investment returns… at 30%, followed by carbon finance at 24%."[14]

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[14] Chestney, Nina. *World climate business revenue $2 trillion by 2020: HSBC*. Reuters. 2009. http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE58H2FM20090918.

Similarly, McKinsey states that by investing up to $520 billion in energy efficiency improvements the United States could save up to $1.2 trillion by 2020.[15] These efficiency improvements include approaches such as lighting retrofits, heating and ventilation upgrades, and ENERGY STAR appliances and equipment. Figure 1, below, shows examples of investments in various energy efficiency improvements versus energy saved. ALL of the improvements shown are cost effective in today's dollars, and pay back in less than 10 years.

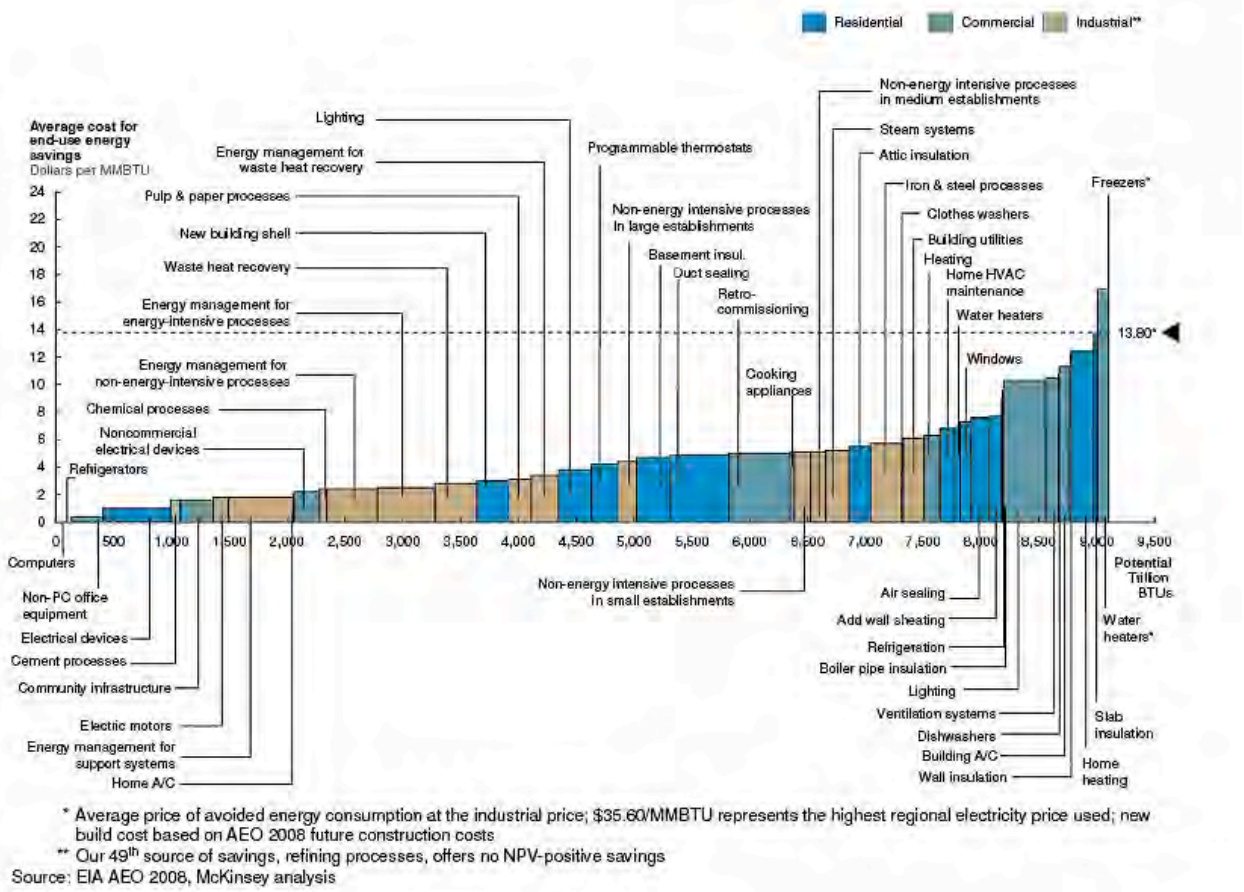

Figure 1. McKinsey Analysis on Savings From Energy Efficiency.[16]

In reference to the Alaska State Senate Resources and Energy Committees' recent report,[17] Senator Lesil McGuire said, "The recommendations focus on improving energy efficiency, among many other strategies. Increasing efficiency is a way to cut costs without compromising comfort or productivity. Energy efficiency is a way to do the same or more with less, to use energy smartly."[18]

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[15] Galbraith, Kate. *McKinsey Report Cites $1.2 Trillion in Potential Savings from Energy Efficiency.* New York Times. 29 July 2009. http://greeninc.blogs.nytimes.com/2009/07/29/mckinsey-report-cites-12-trillion-in-potential-savings-from-energy-efficiency/.

[16] Though this chart is difficult to read in this form, the original is slightly more legible, ibid.

[17] Wielechowski and McGuire, op. cit.

[18] Alaska State Legislation. Senators Release Energy Recommendations: Call for Investments in Energy Efficiency, Renewable Energy and More Oil and Gas Development. 19 October 2009. http://www.aksenate.org/index.php?compress_id=417.

REEL in Alaska Roadmap

1. **STARTING POINT—baseline assessment of end-uses of electricity**

2. **LANDMARKS—Lighting, Heating/Ventilation, and Plug-in Appliances**

3. **FINANCING**
    a. Decoupling efficiency from kWh sold—“bills not rates”
    b. Protecting utility margins
    c. Repayment of financing tied to property
    d. On-bill financing
    e. Addressing split landlord/tenant incentives

4. **POLICY**
    a. Policies designed to support voluntary, free-market solutions
    b. Mandatory security provisions to ensure stability and equity
    c. Leveraging public resources to increase benefits

Starting Point—Baseline End-Use Study

As noted throughout this ***Roadmap***, there is a conspicuous absence of accurate information about the ways Alaskans currently use electricity in the Railbelt Region. Before any comprehensive attempt to improve efficiency can be undertaken, it will be necessary to complete a thorough study of existing end-uses of electricity.[19]

Focus on End-Uses—Lighting, Heating, Appliances

The fundamental value on which this ***Roadmap*** is based is **meeting Alaska's end-use needs. End-use needs** are the services provided by electricity, such as indoor task lighting, outdoor lighting, warm houses, and plug-in appliances (like TVs, refrigerators, washers, dryers, game consoles, cable TV set top boxes, satellite dishes, computers, printers, battery chargers, and industrial machinery), all of which can be at least 30% to 50% more efficient, using currently-available, cost-effective technologies.

Electric utilities were formed to provide electricity and also to meet rate-based revenue goals. This ***Roadmap*** proposes an expanded role for Alaska's Railbelt utilities—expanded to include meeting **end-use needs,** by additional means beyond merely generating, transmitting, and selling electricity. In essence, this means that the Railbelt utilities can become providers of services like light and warmth in efficient ways, some of which require less, not more electricity, as shown by the programs sponsored by the Alaska Housing and Finance Corporation.

Alaskans need services like light, heat, entertainment, pumping, and industrial shaft power. Providing for these needs, in efficient, stable, cost-effective ways will provide known opportunities for economic growth and development beyond merely generating and transmitting more electricity.

[19] See the *REEL in Alaska Roadmap* Details section, below, for additional information and resources relating to end use surveys.

Regional Authority

This *REEL in Alaska Roadmap* endorses Black & Veatch's REGA and RIRP recommendations regarding the benefits of a "comprehensive technical and achievable potential study," as well as formation of a regional authority.

The Alaska Energy Authority commissioned Black & Veatch to "Identify and assess a list of options for the management, operation, access rules, ownership, resource planning, and regulatory structures of the Railbelt generation and transmission system." In their Final Report, aptly titled "Alaska Railbelt Electrical Grid Authority (REGA) Study," Black and Veatch recommended creation of a regional energy authority, to provide comprehensive approaches to energy supply and efficiency improvements. This "REGA" concept has also been introduced in the Alaska Legislature as "GRETC" or "Greater Railbelt Energy & Transmission Corporation."[20] Both of these strategies would also include efficiency improvements and renewable sources of energy.

In the follow-up draft Regional Integrated Resource Plan (RIRP), Black and Veatch further noted:

> First, it is important that a comprehensive technical and achievable potential study be completed, including the comprehensive cost-effectiveness evaluation of the available DSM/EE [energy efficiency] measures and using Railbelt-specific information. …Second, it is Black & Veatch's belief that a regional entity should be formed to develop and deliver DSM/EE programs on a regional basis, in close coordination with the six Railbelt utilities. This entity could be the proposed GRETC organization or another entity focused exclusively on DSM/EE programs.[21]

Whether the REGA/GRETC entity is a State run organization, a utility/community co-operative, or an independent corporation, the process of meeting the Railbelt's **end-use needs** will be harmonized by combining the generation, and transmission efforts of all utilities into one authority, which can also promote efficiency improvements and distributed, renewable sources of supply. While it might also seem beneficial to constitute the energy efficiency authority as a distinct entity—an "energy efficiency utility," such as those in Oregon and Vermont, the relatively small size of the Railbelt population, as well as the need to carefully coordinate supply, transmission, and end-use needs make it likely that generation, transmission, and meeting end-use needs through efficiency and distributed sources of generation should all be consolidated under one, regional authority.

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[20] To see Black & Veatch's REGA recommendations please refer to the report at: http://www.aidea.org/aea/REGAFiles/9-12-08_AlaskaRailbeltREGAStudy_MasterFinalReport.pdf.

[21] Black and Veatch, *Alaska Railbelt Regional Integrated Resource Plan (RIRP) Study Draft Report.* December 2009. Page 11-16. "DMS/EE stands for "demand side management/energy efficiency." More information on DSM/EE is contained, below, in this *REEL in Alaska* Roadmap.

Energy Efficiency Utilities

To be truly effective, the REGA/GRETC authority must also function as an "energy efficiency utility." Even if the legislature chooses not to implement a regional authority, it would still be advantageous to create a statewide or regional energy efficiency utility. In most areas that are developing them, energy efficiency utilities are funded by a fee on utility bills or by private or public investors, such as the $0.01/kWh "consumer benefits surcharge" recommended in AEA's draft RIRP.[22] These organizations work to provide low-to-no cost energy efficiency services for communities. Most of the early energy efficiency utilities are non-profit organizations, but as the return on investment for energy efficiency improvements becomes more recognized within the finance community, it is likely that structures similar to today's investor-owned utilities will also become viable. For Alaska's Railbelt region, the non-profit model seems compatible with the existing utility structure, and could easily be included in the organizational structure of a regional authority.

Energy Efficiency Utilities are emerging as a strategy to reduce peak load and overall demand, while engaging the community and educating consumers, through efficiency incentives and programs throughout their service territories. Organizations like the Energy Trust of Oregon and Efficiency Vermont improve efficiency through an approach similar to Demand Side Management ("DSM" which is described later in this ***Roadmap***).

Efficiency Vermont was formed in 2000, as a not-for-profit entity under contract with the Vermont Energy Investment Corporation. Funded by a 4.5% fee on consumers' electricity bills. By contrast the consumer benefits surcharge recommended by AEA in the draft RIRP is $0.01/kWh, which would be 10% of $0.10/kWh.[23] Efficiency Vermont has helped almost 60% of Vermont's customers since its formation, and is the first such entity to reduce annual load growth by 1.8% through efficiency measures alone. In 2009, Vermont will reduce its overall electricity consumption by 3%, and is projected to reach 4% overall reduction in 2010.[24] Unlike the early days of DSM, where conservation was touted as the best strategy, energy efficiency utilities offer free services that will increase the efficiency of meeting end use needs for electricity, without sacrificing comfort or affordability. These include free energy audits, technical advice, and sometimes subsidizing the cost of equipment such as improved lighting, efficient appliances, insulation, new water heaters, furnaces, or windows.[25]

Delaware has begun the most ambitious energy efficiency utility to date: Delaware's Sustainable Energy Utility (SEU) aims to improve the efficiency of all fuel consumption in the residential, business and transportation sectors by one-third by 2015. Delaware will fund SEU through a 36-cent surcharge on each utility bill each month, as well as a $30 million private bond issue. This "sustainable energy" bond will NOT be guaranteed by

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[22] Black & Veatch, 2009. Op. cit., pp. 40 and 227.
[23] Ibid.
[24] Efficiency Vermont, 2008. Op. cit.
[25] Chang, Susan. "The Rise of the Energy Efficiency Utility." Institute of Electronics and Electronics Engineers, May 7, 2008. http://spectrum.ieee.org/green-tech/conservation/the-rise-of-the-energy-efficiency-utility.

the full faith and credit of the state, which reduces the risk of any negative impacts on the cost of borrowing or on Delaware's credit standing. Instead, the SEU bond will be paid back by sharing a portion of each dollar of energy savings by residents. When a resident purchases an efficient appliance, a hybrid car, or installs energy efficient measures into their home, the SEU will help pay the difference up front, but will collect 35% of the customer's energy savings for the first five years. To complement this incentive program, Delaware plans to boost their renewable energy production to 300 MW by 2019.[26]

The Energy Trust of Oregon is another example of an energy efficiency utility that is reducing demand. The Energy Trust of Oregon is organized by the Oregon Public Utility Commission and funded by a 3% "public purpose charge" on utility bills from the two largest investor-owned utilities in Oregon—once again, less than what has been proposed by AEA in the draft RIRP. Since it's formation in 2002, the Energy Trust has saved customers of Portland General Electric, Pacific Power, NW Natural, and Cascade Natural Gas, $440 million, $144 million in 2008 alone. Energy Trust states, "Since 2002, our investments created more than 1,800 Oregon jobs, and stimulated $60 million in wages and $9.1 million in new business income."

Using the methodology applied to the Energy Trust of Oregon's results by ECONorthwest, (by calculating statistics per MW of reduced demand), if the Alaska Railbelt region's peak demand is 850MW, reducing that demand by half could eliminate the need for 425MW of generating capacity. If similar to Oregon's success, this would produce an increase of up to $947,992,100 in economic output, $290,927,800 in wages, $53,499,850 in business income, and 9,350 new jobs.[27]

Successful efficiency programs also help to keep utility costs stable, because new power plants are not needed when efficiency and renewables are used instead of demanding more power.[28]

The Energy Trust of Oregon offers a comprehensive package of services including energy audits, cash incentives for efficiency measures, and extensive information on no-to-low cost solutions. The Energy Trust set goals for 2009 to save an average of 31 MW of electricity, 1.8 million thermal units of gas, secure 3 MW of renewable energy, and continue to use less than 11 cents per dollar for administrative costs.[29]

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[26] Chang, Susan. "The Rise of the Energy Efficiency Utility." Institute of Electronics and Electronics Engineers, May 7, 2008. http://spectrum.ieee.org/green-tech/conservation/the-rise-of-the-energy-efficiency-utility.

[27] Based on reducing demand by up to 425MW through efficiency. ECONorthwest, *Economic Impact Analysis of Energy Trust of Oregon Program Activities.* 2003, Table 9. http://www.energytrust.org/library/reports/ETOecon_impacts_Final.pdf?link_programs_reports_lin1Page=3

[28] When discussing "new" power plants, it is important to note that this does NOT refer to the replacement of older, inefficient plants by more modern, more efficient plants. For example, the replacement of an old, inefficient, fossil fuel plant by a newer, more efficient natural gas plant, would not be considered new construction.

[29] Energy Trust of Oregon. Retrieved November 9, 2009. http://energytrust.org/about/who-we-are/.

REEL in Alaska Roadmap Details

As described previously, the basic ***Roadmap*** consists of:

1. **STARTING POINT (baseline assessment of end-uses of electricity)**

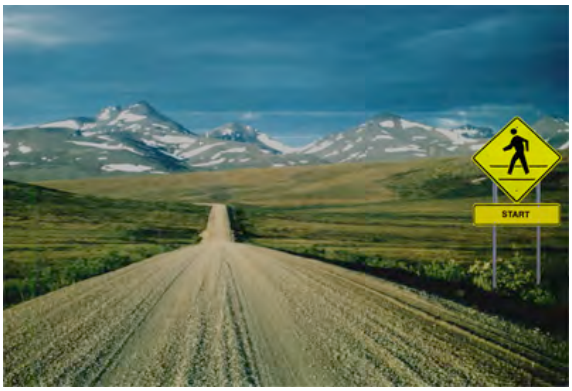
2. **LANDMARKS—Lighting, Heating/Ventilation, and Plug-in Appliances.**

3. **FINANCING**
    a. Decoupling efficiency from kWh sold
    b. Protecting utility margins
    c. Repayment of financing tied to property
    d. On-bill financing
    e. Addressing split landlord/tenant incentives

4. **POLICY**
    a. Policies designed to support voluntary, free-market solutions
    b. Mandatory security provisions to ensure stability and equity
    c. Leveraging public resources to increase benefits

1. Starting Point

A roadmap is only useful if the traveler knows where they're starting. As identified by Black & Veatch in the draft Railbelt Integrated Resource Plan, there is a conspicuous lack of Railbelt-specific data about the end uses of electricity:



> *First, it is important that a comprehensive technical and achievable potential study be completed, including the comprehensive cost-effectiveness evaluation of the available DSM/EE [energy efficiency] measures and using Railbelt-specific information.* – Black & Veatch[30]

Thus, the first step on the journey to increased electricity efficiency in the Railbelt region must begin with a comprehensive assessment of the ways Alaskans are using electricity in the Railbelt region now. End-use assessment differs from a supply profile. An end-use assessment provides specific measurements of the kinds of services being provided by electricity in the Railbelt region, such as lighting, heating, ventilation, air circulation, and plug-in appliances, across various sectors, such as residential, commercial, industrial, and institutional users of electricity. For example, in a recent assessment, CEA found that 29% of the sockets in residences in their service area already have CFLs—a very useful statistic to know, before planning to increase efficiency in lighting. Commercial and residential sectors represent 78% of electricity use. Because government is such a large portion of the Alaska economy (21.6% of gross state product in 2001,[31]) and also because energy efficiency options can be sector-specific, it will be very useful if this end-use baseline assessment specifically identifies institutional sectors, such as government agencies, schools, universities, and hospitals, as separate sectors, with end-uses identified, measured and reported separately from the "commercial" sector.

The U.S. Energy Information Agency provides information about conducting energy assessments on their website.[32] The European Union also provides descriptions of their end use survey methodology and resulting regulations on their website.[33] The EU provides more detailed information on methodology on a separate website,[34] with accompanying reports.[35]

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[30] Black and Veatch, *Alaska Railbelt Regional Integrated Resource Plan (RIRP) Study Draft Report.* December 2009.
[31] http://www.city-data.com/states/Alaska-Economy.html
[32] http://www.eia.doe.gov/oiaf/servicerpt/energydata/chapter3.html
[33] http://ec.europa.eu/energy/efficiency/studies/efficiency_en.htm
[34] http://www.evaluate-energy-savings.eu/emeees/en/home/index.php
[35] http://www.evaluate-energy-savings.eu/emeees/en/publications/reports/EMEEES_Final_Report.pdf

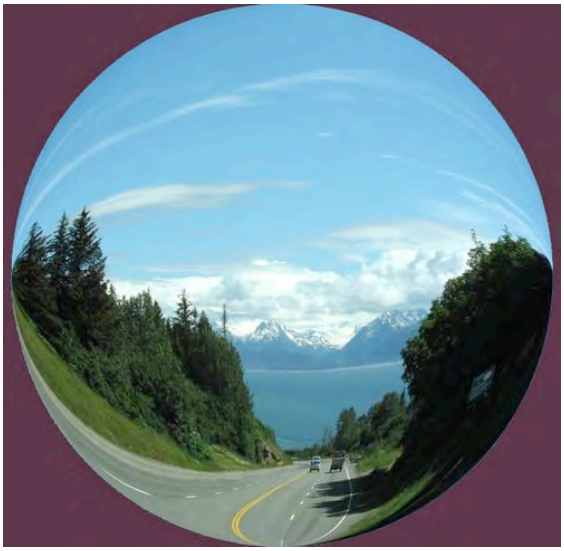
In Canada, BC Hydro offers comprehensive end-use energy assessment services to their customers.[36] Natural Resources Canada also provides detailed information about end-use audits, including copies of their comprehensive, national phone surveys on household energy use as well as commercial and industrial end-use surveys. A complete copy of Canada's comprehensive 2003 Survey of Household Energy Use is included in this ***Roadmap*** as Appendix F. [37]

California has conducted extensive end-use surveys in various sectors and end uses. Itron has completed commercial end-use surveys,[38, 39]and Heschong-Mahone,[40] Ecos,[41] and Itron[42] have done additional end-use surveys on lighting and appliances.

Until a Railbelt-specific, end-use, baseline assessment has been completed, any numeric quantification of the potential for improvements in end-use efficiency would be premature.

Local and Regional Mobilization

Achieving any community-wide goal generally requires social mobilization. To be effective, social mobilization begins with community mapping—identifying key stakeholders and resources required to achieve meaningful, measureable change. Once key influencers have been identified, their participation in an orchestrated program of community strategy can lead to productive actions. Additional information on social mobilization is contained below, in the Section titled, "The Importance of Local and Regional Mobilization" (see page 92).



[36] http://www.bchydro.com/powersmart/commercial/power_smart_partners/energy_study.html
[37] http://oee.nrcan.gc.ca/publications/infosource/home/index.cfm?act=category&category=03&attr=1
[38] http://www.energy.ca.gov/ceus/
[39] http://capabilities.itron.com/ceusweb/
[40] http://www.h-m-g.com/downloads/LET/lighting_efficiency_technology.htm
[41] http://www.efficientproducts.org/product.php?productID=11
[42] http://www.calmac.org/publications/PGE_PotentialStudy_Vol1_05242006.pdf

2. Landmarks

When using a roadmap, identifying landmarks can be very useful for navigation purposes. Thus, this ***REEL in Alaska Roadmap*** invites Alaskans to notice lighting, heating/ventilation, and plug-in appliances, as the points by which to navigate the journey to increased energy efficiency.

For example, Boeing Company (which contributed $246 million to Alaska's economy in 2007 and supported more than 700 direct and indirect jobs in Alaska[43]) has set a company-wide goal of increasing energy efficiency by 25% by 2012.[44]

In addition to these simple landmarks, service providers can also create what is known as a "Smart Grid"—a distribution system that provides real time information about how much electricity is being used, and for what purposes, as well as providing electronic communication and coordination, using computers, to manage generation, transmission facilities, and distribution networks, to optimize the use of available supplies of electricity. In places like North Carolina, smart grids have been shown to decrease electricity use by as much as 20%, though these included uses such as air conditioning, which might not apply in Alaska.[45]

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[43] Viewed December 28, 2009 at http://www.boeing.com/news/releases/2008/q4/081113b_nr.html.
[44] Viewed December 28, 2009 at http://www.boeing.com/aboutus/environment/measures.html.
[45] New York Times, *Smart Grid Project Cuts Electricity Usage,* September 21, 2009, viewed December 23, 2009 at http://greeninc.blogs.nytimes.com/2009/09/21/smart-grid-project-cuts-electricity-usage/. Because Alaskan conditions are different, Railbelt utilities should test smart grid technology to ensure that similar savings are also possible in Alaska.

3. Financing

Decoupling Efficiency from kWh Sold

Every journey has to be paid for somehow. "Decoupling" utility revenues from kilowatt hours (kWh) sold allows energy service providers to balance gross revenue with innovative ways to meet customers' end-use needs—focusing on bills rather than rates. Carefully redesigned rate structures can protect utility margins, permitting utilities to sustain the staffing, maintenance, depreciation, capital, and infrastructure needed to provide a reliable system.

Because Alaska already has procedures in place to permit Railbelt utilities to adjust rates by up to 8% per year, efficiency improvements of 3.3% per year would not require any additional legislation or policy. What is required is to re-orient the emphasis from the rate charged for electricity to the total amount paid on consumers' bills. If an efficiency improvement of 3.3% causes an offsetting rate increase of 3.3%, the fuel savings would result in a net drop in the consumer's total bill, as long as the consumer improves efficiency by 3.3%, which can be accomplished with improvements in lighting, heating, and plug-in appliances.

More complete information on decoupling and financing strategies is contained in section on Decoupling on page 70.

Protecting Utility Margins

This ***REEL in Alaska Roadmap*** proposes several funding mechanisms that will enable Alaska's Railbelt utilities to continue to meet annual revenue goals, while separating out the amount of electricity sold, from total revenue (see Implementation and Strategies Section, Utility Rate Structures). Most of these are incremental changes based on **3.3% per year** of overall improvement in the ways customers in the Railbelt region meet **end-use needs**.

Utilities all over the world, such as Oregon's Energy Trust, Energy Efficiency Vermont, and Finland's Motiva Oy are discovering creative ways to meet **end-use needs—**ways that go beyond merely generating, transmitting, and delivering electricity, to include improving the efficiency with which customers use electricity, as well as providing locally resilient, renewable sources of electricity.

These expanded roles create new jobs and new sources of revenue, because dollars previously spent on fuel costs become available for investment in local energy stability and security; and because capital previously tied up in large, decades-long financing of

centralized generation facilities can be made available to meet end-use needs in more resilient, affordable ways, that repay investments in a few years, rather than decades, thus providing greater circulation of dollars within the local and regional economies.[46]

More efficient investment of dollars previously spent on fuel and proposed for large centralized generating facilities will improve Alaska's economy, by increasing the number of local and regional jobs, providing better infrastructure, installing more reliable and dependable equipment, and circulating investment dollars through the community more often.

This ***REEL in Alaska Roadmap*** demonstrates that the most cost-effective way to protect against rising energy prices and prevent the need for costly investments in capital-heavy generating capacity is to improve the efficiency with which electricity is used, while also investing wisely in renewable sources of supply, to complement fossil-fuel based supply options. Improving the efficiency with which electricity is used and investing in renewable sources of supply will result in more stable prices for meeting the Railbelt region's real needs, because energy efficiency improvements and renewable sources of supply are not dependent on fluctuating fossil fuel prices.

Energy planning documents often present the most expensive options as most important—new sources of supply are almost always stressed before any discussion of increasing the efficiency with which real **end-use needs** are met.

With regard to electricity, Alaskans would be served more effectively by considering best buys first, which means investing $0.00 to $0.15 per kilowatt hour (kWh) to provide better task lighting, warmer buildings, and more efficient appliances, before investing as much a $0.20 per kWh in new sources of electricity.

New sources of electricity should be considered only AFTER investing all available capital in things that cost less, like improving the efficiency with which **end-use needs** are met.

Alaskans need warm houses and task lighting, not necessarily new power plants, other than replacing and upgrading existing facilities.

Additional Financing Strategies

Providing repayment of energy efficiency financing tied to property, rather than the current rate payer, allows long-term amortization of energy-related capital improvements.

Similarly, on-bill financing allows utilities to provide and bill for end-use services in the same ways they have billed for electricity, so that customers don't have to pay the entire, up-front costs, and utilities can invest capital in meeting end-use needs through efficiency improvements, deriving increased revenue from selling LESS electricity, rather

[46] Geller, Howard, and Marshall Goldberg. *Energy Efficiency and Job Creation in Colorado*. Rep. Apr. 2009. Southwest Energy Efficiency Project. 14 July 2009. http://www.swenergy.org/pubs/EE_and_Jobs_Creation_in_Colorado-April_2009.pdf.

than always having to spend limited capital on new sources for more electricity generation and supply. What matters is that the consumer's bill stays the same or goes down in total charges.

Addressing split landlord/tenant incentives (where landlords own the buildings, but tenants pay the utility bills, such as "triple net" commercial leases) enables energy efficiency improvements on leased or rented properties.

Implementing these and other financing strategies will provide important landmarks for navigating the journey to increased energy efficiency.

Empowering Procurement Officers

Because procurement officers are often required to purchase goods and services for the lowest available price, it is important for senior management to specify and support procurement policies that include "life cycle analysis" (also known as "life cycle cost analysis"[47]), to consider the entire, lifetime operating costs of purchases, not just the acquisition cost. Implementation of these policies is evident in the procedures and resources offered by various institutions, including state and federal agencies, school districts, universities, hospitals, and industrial facilities, such as President Obama's Executive Order,[48] California's Green Building Action Plan,[49] the Collaborative for High Performance Schools (CHPS) Plan for Energy Efficiency,[50] the United States Green Building Council's (USGBC) Leading Energy and Environmental Design (LEED),[51] the ENERGY STAR Industrial Energy Management Information Center,[52] and the Green Guide for Health Care.[53]

Procurement officers will be further enabled to implement energy efficiency if procurement standards and policies include a clear definitions of "cost-effective" and also call for a "life cycle cost assessment" model, such as those specified in California Governor Schwarzenegger's Executive Order S-20-04[54]:

> "'Cost effective,' means that the economic benefits derived from the energy conservation measures (ECM) outweigh all of the associated implementation costs over the expected useful life of the measure."

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[47] http://www.green.ca.gov/LCCA/default.htm
[48] http://www.whitehouse.gov/assets/documents/2009fedleader_eo_rel.pdf
[49] http://www.energy.ca.gov/greenbuilding/documents/background/02_GREEN_BUILDING_ACTION_PLAN.PDF
[50] http://www.chps.net/dev/Drupal/node/288
[51] http://www.usgbc.org/
[52] http://www.energystar.gov/index.cfm?c=industry.bus_industry_info_center#process_resources
[53] http://www.gghc.org/
[54] http://www.green.ca.gov/LCCA/default.htm

Impact on Jobs

Meeting the Railbelt region's **end-use needs** more efficiently may require redefining some people's jobs. For example, some jobs previously dedicated to managing generation and transmission of electricity may be redefined to serve customer needs through efficiency improvements, distributed, renewable sources of supply, or computerized, "smart" grid technologies. With an incremental energy efficiency improvement rate of 3.3% per year, Railbelt utilities should be able to accommodate these shifts through the normal turnover rate. As mentioned above, national trends have demonstrated that investments in energy efficiency improvements create more jobs, not fewer, in part because dollars previously directed towards fuel and capital costs can be redirected towards meeting **end-use needs.** In Alaska, investments in clean energy and energy efficiency can create between 1,000 and 9,000 new jobs, by 2020.[55]

As stated previously, improving efficiency by 50% would also produce an increase of up to $947,992,100 in the Railbelt region's economic output, $290,927,800 increase in wages, $53,499,850 in increased business income, and 9,350 new jobs.[56]

This maturing of Alaska's energy infrastructure represents potential career advancement for key members of Alaska's work force—developing new skills and resources to meet Alaska's basic **end-use needs**.

Increasing the Railbelt region's end-uses of electricity by up to 50% by 2025 will mean a gradual improvement of 3.3% per year, which should not create significant, unplanned disruption in employment patterns.

[55] E2, *Clean Energy and Climate Policies Lead to Economic Growth in Alaska*, viewed December 18, 2009, at http://www.e2.org/ext/doc/State%20Fact%20Sheet%20Alaska.pdf;jsessionid=377BB3217CA2A52D48CC4D67CD018F1D.

[56] Based on reducing demand by up to 425MW through efficiency. See calculations in ECONorthwest, *Economic Impact Analysis of Energy Trust of Oregon Program Activities.* 2003, Table 9. http://www.energytrust.org/library/reports/ETOecon_impacts_Final.pdf?link_programs_reports_lin1Page=3.

4. Policy

Because Alaska is a region characterized by fierce independence from government intervention, it is essential that initial policies be designed to support voluntary, free-market solutions, with a minimum of government interference.

Nonetheless, just as traffic policies keep drivers on the proper sides of streets and going the right direction on one-way streets; just as restaurants are required to meet mandatory health requirements, to protect public safety; and government verification of weights and measures provides security to ensure stability and equity on commodities like a gallon of gas or a quart of milk; it may be necessary to implement mandatory levels of energy efficiency, to ensure that all parties protect the economic security and resilience of Alaska's energy systems equitably.

When implementing large-scale energy efficiency programs, there are also many opportunities to leverage public resources to increase benefits, such as permitting financing for energy efficiency improvements to be repaid through property tax bills or solid waste districts, attached to individual buildings, rather then temporary occupants. The subsequent sections on policy in this ***Roadmap*** provide specific recommendations for which policies will produce the maximum benefit in the shortest duration of time.

End-Uses

The fundamental value on which this ***Roadmap*** is based is **meeting the Railbelt region's end-use needs. End-use needs** are the services provided by electricity, such as indoor task lighting, outdoor lighting, warm houses, and plug-in appliances (like TVs, refrigerators, washers, dryers, game consoles, cable TV set top boxes, satellite dishes, computers, printers, and battery chargers), all of which can be at least 30% to 50% more efficient, using currently-available, cost-effective technologies.

Electric utilities were formed to provide electricity and also to meet rate-based revenue goals. This ***Roadmap*** proposes an expanded role for Alaska's Railbelt utilities—expanded to include meeting **end-use needs,** beyond merely generating, transmitting, and selling electricity. In essence, this means that the Railbelt utilities can become providers of services like light and warmth in efficient ways, some of which require less, not more electricity, as shown by the programs sponsored by the Alaska Housing and Finance Corporation.

Alaskans need services like light, heat, entertainment, pumping, and industrial shaft power. Providing for these needs, in efficient, stable, cost-effective ways will provide known opportunities for economic growth and development beyond merely generating and transmitting more electricity.

Meeting End-Use Needs—"Best Buys First"

Completing the baseline "technical and achievable potential study" recommended by AEA's RIRP draft and REGA study will establish Railbelt-specific needs and opportunities. Once this is complete, Alaskan planners can begin to evaluate the options in terms of "best buys first":

As a simple example, if the Alaska Energy Authority (AEA) or another agency were to issue a request for proposals, inviting local and regional contractors to meet end-use needs for $0.01 or less per kWh saved (or a similar target per million BTUs of natural gas heat), they could create jobs and eliminate the need for a measurable portion of the current supply capacity, simply by replacing lighting technologies and plugging air leaks.

If, having completed all the cost-effective savings at $0.01/kWh or less, a second RFP were issued the next year (or next season), calling for bids to meet end-use needs at a cost of $0.02/kWh saved, bidders would present a whole new round of cost-effective savings possibilities, with more lighting improvements, and other cost-effective strategies, eliminating the need for more of the current generating capacity, or making it available to support population growth. What is important here is not the particular strategy, but that the energy service providers begin to prioritize best buys first, leaving the strategy up to the bidders. This process could be repeated continuously; until the investment required to meet current needs more efficiently exceeds the investment required for proposed new sources of supply, which may not occur until after technological innovations have demonstrated that renewable sources of electricity are the next most cost-effective investment.

In conducting a program as described above, it is important to include capital financing, in the same ways that larger capital projects are financed, namely, for 10, 15, 20 years, or more.

A baseline assessment will also document how much Alaskans are paying for "peak load" electricity during the times of highest demand. "Firing up" inefficient naphtha or diesel generators can cost $.50/kWh or more.[57] Improving efficiency by providing more efficient lights and appliances, at $0.01-$0.15/kWh, seems like a much better investment.

[57] Institute of Social and Economic Research University of Alaska Anchorage. 2003. *Alaska Electric Power Statistics (with Alaska Energy Balance)*.

Destination: 50% Improvement in Efficiency

By proposing a potential 50% improvement, this ***REEL in Alaska Roadmap*** puts Alaska slightly ahead of Illinois (which has committed to a 43% improvement in efficiency), but not yet equal to Boeing, which has committed to 25% improvement in efficiency by 2012,[58] and Walmart, which has committed to 100% renewable energy. It is worth noting that Walmart has made this commitment not out of any spirit of altruism, but because such investments save money and increase security, thereby making Walmart's "everyday low prices" even more competitive, while investing wisely in a more secure, resilient America, which is less vulnerable to price fluctuations of fossil fuels.

By starting with a year 2000 baseline, it is possible that the Railbelt region has already made measurable progress towards increasing efficiency. Even without this historic progress, assuming the baseline study of Alaska's real needs is consistent with similar assessments in other areas—i.e. it reveals opportunities for savings in lighting, heating/ventilation, and plug-in appliances—achieving an overall efficiency improvement of up to 50% is fairly straightforward: over the next 15 years, improved lighting can increase the efficiency by up to 20-30% of total electricity currently used[59]; improvements in air circulation and building heating technologies can deliver an additional improvement in overall efficiency of up to 10-15%; and improved electrical appliances, motors, and pumps can improve the total by up to another 20%. Any increase in overall population can be accommodated by new, renewable sources of energy, such as wind, tidal, and geothermal projects, complemented by long-term storage of energy generated by solar technologies in the summer and stored using strategies such as compressed air, pumped hydro, improved battery storage, fuel cells, plug-in hybrid vehicles, and installation of a "smart grid" system to provide real-time information on levels of end-uses and supply.

In particular, improvements in "Smart," computerized, interactive, electrical grids, combined with dynamic pricing, can achieve 20% reductions in overall electricity use in the U.S. by 2019, potentially carrying Alaska well beyond the 50% improvement goal.[60]

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[58] Viewed December 28, 2009 at http://www.boeing.com/aboutus/environment/measures.html.

[59] California will improve overall efficiency of electricity used for lighting by 50% by 2018. Technically, an improvement of 78% is possible. See overview of lighting improvements at http://californiaenergyefficiency.com/docs/lighting/LightingTechnologyOverview.pdf

[60] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential,* June 2009. Page xii. (Available at http://www.ferc.gov/legal/staff-reports/06-09-demand-response.pdf). Note, this national smart grid estimate applies to commercial and industrial sectors in Alaska, but not necessarily to residential, because the national numbers are based heavily on air conditioning.

Regional Authority

As noted in the Overview, above, this *REEL in Alaska Roadmap* endorses AEA and Black & Veatch's REGA and RIRP recommendations regarding the benefits of a "comprehensive technical and achievable potential study," as well as Black & Veatch's and the State Senate Resources and Energy Committees' recommendation to form a regional authority.

The Alaska Energy Authority commissioned Black & Veatch to "Identify and assess a list of options for the management, operation, access rules, ownership, resource planning, and regulatory structures of the Railbelt generation and transmission system." In their Final Report, aptly titled "Alaska Railbelt Electrical Grid Authority (REGA) Study," Black and Veatch recommended creation of a regional energy authority, to provide comprehensive approaches to energy supply and efficiency improvements. This "REGA" concept has also been introduced in the Alaska Legislature as "GRETC" or "Greater Railbelt Energy & Transmission Corporation."[61] Both of these strategies would also include efficiency improvements and renewable sources of energy.

In the follow-up draft Regional Integrated Resource Plan (RIRP), Black and Veatch further noted:

> … it is Black & Veatch's belief that a regional entity should be formed to develop and deliver DSM/EE programs on a regional basis, in close coordination with the six Railbelt utilities. This entity could be the proposed GRETC organization or another entity focused exclusively on DSM/EE programs.[62]

Whether the REGA/GRETC entity is a State run organization, a utility/community co-operative, or an independent corporation, will have to be determined by further study; but, the overall process of meeting Alaska's **end-use needs** will be harmonized by combining the generation, and transmission efforts of all utilities into one authority, which can also promote efficiency improvements and distributed, renewable sources of supply. While it might also seem beneficial to constitute the energy efficiency authority as a distinct entity—an "energy efficiency utility," such as those in Oregon and Vermont, the relatively small size of the Railbelt population, as well as the need to coordinate energy efficiency targets with supply, transmission, and end-use needs make it likely that generation, transmission, and meeting end-use needs through efficiency and distributed sources of generation should all be consolidated under one, regional authority.

However, if the legislature decides not to create GRETC, it would still be cost effective to create a regional or statewide energy efficiency utility.

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[61] To see Black & Veatch's REGA recommendations please refer to the report at http://www.aidea.org/aea/REGAFiles/9-12-08_AlaskaRailbeltREGAStudy_MasterFinalReport.pdf.

[62] Black and Veatch, *Alaska Railbelt Regional Integrated Resource Plan (RIRP) Study Draft Report.* December 2009. Page 11-16. "DMS/EE stands for "demand side management/energy efficiency." More information on DSM/EE is contained, below, in this *REEL in Alaska* Roadmap.

Misperceived "Barriers" to Energy Efficiency

Many planning documents that focus primarily on increasing energy supply mischaracterize aspects of energy efficiency as "barriers." Four simple examples:

1. **Absence of baseline data** is not a barrier to implementing efficiency improvements. Rather, collecting current, end-use data provides an excellent opportunity to capitalize on lessons learned in other regions.
2. The relative **fragmentation and duplication of the current Railbelt utility environment**, rather than a barrier, provides clear opportunities to create regional structures for energy efficiency, such as in Oregon, Vermont, and Finland, as well as better coordination of generation, transmission, and delivery systems.
3. **Absence of policies** is not a barrier, but rather an opportunity to tailor strategies from other jurisdictions to meet Alaska's unique needs. Setting an ambitious target—a target which many said was impossible or too expensive at the time—is what got the Alaska pipeline built, despite rumors in 1976 that the pipeline was too expensive, too ambitious, and not even possible.[63]
4. The **"culture" of utility organizations**, while historically oriented towards generating, transmitting, and selling electricity, can easily adapt to the expanded vision of working together to meet end-use needs, just as the transportation industry adapted from horses, boats, and dogsleds to provide roads, automobiles, snow tires, snowmobiles, landing strips and bush planes in profitable ways.

[63] http://www.pbs.org/wgbh/amex/pipeline/filmmore/pt.html.

Business Case for Electricity Efficiency

Increasing the efficiency with which Alaska provides services will produce a net increase in GDP between $14 million and $42 million and a net increase of jobs of 352 to 1,052 through an investment of $21 million to $62 million.[64] As the American Council for an Energy Efficient Economy states,

> "Conserving energy reduces the energy bills paid by consumers and businesses, thereby enabling greater purchase of non-energy goods, equipment, and services. ...Regarding the different effects, less than 10% of the net jobs created are associated with direct investment in efficiency measures while more than 90% are associated with energy bill savings and re-spending of those savings."[65,66]

By investing in electricity efficiency, individuals, businesses, and governments can save money, while also improving Alaska's social, environmental, and health conditions. In Portland, OR, "conservation eliminated the need for six new power plants in the past three decades and can meet 85% of the new power needs in that region over the next 20 years..."[67]

Electricity efficiency can be seen as an additional supply source, which can be integrated into regional, state, and national energy resource plans using comprehensive strategies.[68] If seen as an investment, electricity efficiency will reduce Alaska's demand on natural resources, while allowing individuals to live comfortable lives, and at the same time saving money for individuals, companies, and institutions. To reach this end goal, it is necessary to use a network of incentives, partnerships, programs, and policies among regional, state, and national constituencies.

The potential for energy efficiency is largely tied to financing and the level of investment per kWh that a sponsor or investor is willing to pay. As the cheapest energy efficiency measures become saturated, the remaining energy savings begin to require a higher level of investment. As shown in Table 1 there is a significant opportunity for Alaska to invest more money in electricity efficiency initiatives, and receive positive returns.

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[64] Based on estimates from Geller, Howard, and Marshall Goldberg. Energy Efficiency and Job Creation in Colorado. Rep. Apr. 2009. Southwest Energy Efficiency Project. 14 July 2009 http://www.swenergy.org/pubs/EE_and_Jobs_Creation_in_Colorado-April_2009.pdf. Where the average cost of efficiency improvements is $0.01 per kWh to $0.03 per kWh and *for each million dollars* of investment in electrical energy efficiency, there will be a net gain of 17 jobs created and an increase of $670,000 in wage and salary compensation.

[65] Geller, Howard, John DeCicco, and Skip Laitner. *Energy Efficiency and Job Creation*. Rep. no. ED922. 1992. American Council for an Energy-Efficient Economy. http://www.aceee.org/pubs/ed922.htm.

[66] Although many of the statistics listed in this section refer to energy efficiency these statistics for energy efficiency are assumed to be comparable for electricity efficiency improvements.

[67] Hollander, Zaz. *Energy use project invites light competition*. *Anchorage Daily News*. September 22, 2009. http://www.adn.com/news/alaska/matsu/story/944953.html.

[68] U.S. EPA, *National Action Plan for Energy Efficiency Vision for 2025: A Framework for Change.* 2008, www.epa.gov/eeactionplan.

Table 1. Energy Efficiency Spending in Select States.[69]

State	Total Spending ($000)	Per Capita Spending	Ranking by Spending Per Capita	Score
Alaska	103	0.16	40	0.0
Montana	8,002	8.63	14	5.5
Washington	88,522	14.26	5	9.5
Vermont	14,000	22.54	1	15.0
California	380,009	10.68	10	7.0

As an example, in 2007 the Los Angeles Department of Water and Power (LADWP) residential total energy use was 8,426 GWh.[70] A 10% energy savings would require an investment in the range of $0.03/kWh and would yield annual savings of 842.6 GWh. Additionally, Nevada Power Company estimates that there is potential to save 3,093 GWh of power (14.3% off the baseline projection) by 2030. These represent gains beyond codes and standards over this time period.[71]

Various Southwest states have assessed what they call a "System Benefit Charge" (SBC)—a small fee of a fraction of a cent per kWh sold, and invested the revenue in energy efficiency. The Table 2, below, shows the relative savings achieved by each state and the Southwest region[72]:

Table 2. Cost/Savings from System Benefit Charge

State	SBC cost (million $)	Total savings (million $)	Net savings (million $)
Arizona	2,640	8,130	5,490
Colorado	1,790	4,010	2,220
Nevada	1,290	3,170	1,880
New Mexico	780	2,050	1,270
Utah	1,040	1,440	400
Wyoming	500	825	325
Region	8,040	19,625	11,585

[69] Information Insights. Alaska Energy Efficiency Program and Policy Recommendations 5 June 2008. Note: funding for energy efficiency in Alaska has increased significantly since 2008.

[70] *Energy Consumption by Planning Area*. Energy Consumption Data Management System. CA.gov. 15 July 2009 http://ecdms.energy.ca.gov/elecbyplan.asp.

[71] *Nevada Power Company Integrated Resource Plan 2010-2012. Demand Side Plan 2010-2012*. Issue brief. Nevada Power Company d/b/a NV Energy. http://www.swenergy.org/news/2009-07-NV_Power_DSM_Plan_01.pdf.

[72] Geller, Howard, *Utility Energy Efficiency Programs and System Benefit Charges in the Southwest,* April, 2002. Southwest Energy Efficiency Project, Boulder, CO.

In another example, in 2007 Vermont published the results of a comprehensive study on their energy efficiency potential and concluded that across all sectors (residential, commercial, and industrial) they had an achievable cost effective potential to save a cumulative total of 1,286 GWh, or 19.4% of their project energy sales by 2015.[73]

Figure 2, below, shows the Vermont Residential Electric Energy Efficiency supply curve.

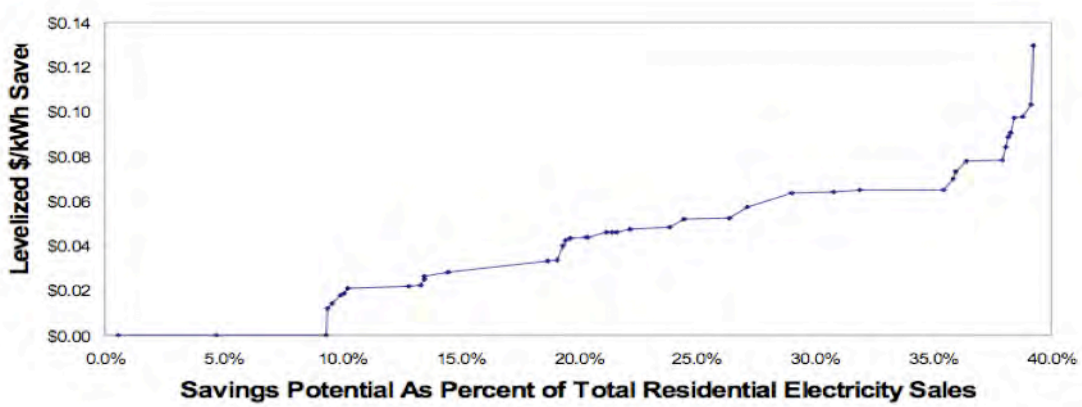

Figure 2. Residential Electric Energy Efficiency Supply Curve for Vermont.[74]

The initial investment is returned with profit and has a relatively short payback period. Many utilities have seen savings in end-use electricity consumption for $0.01 to $0.03 per kWh.[75,76] For example, Massachusetts' ENERGY STAR lighting program achieved dramatic savings in the amount of electricity needed for lighting, for just $0.01 per kWh saved.[77] Likewise, the North Carolina Utilities Commission achieved similar savings for an investment of under $0.03 per kWh saved, as an average cost across all sectors.[78]

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[73] GDS Associates, Inc. *Vermont Electric Energy Efficiency Potential Study, Final Report*. Rep. Jan. 2007. Vermont Department of Public Service. http://publicservice.vermont.gov/energy/vteefinalreportjan07v3andappendices.pdf.

[74] GDS Associates, Inc. *Vermont Electric Energy Efficiency Potential Study, Final Report*. Rep. Jan. 2007. Vermont Department of Public Service. http://publicservice.vermont.gov/energy/vteefinalreportjan07v3andappendices.pdf.

[75] Arizona Public Service (APS) company saved 3,276 GWh with an investment of $0.011 per kWh. *APS Energy Efficiency Program Update*. Resource Alternative Stakeholder Meeting. 6 June 2008. Arizona Public Service. 13 July 2009. http://www.aps.com/_files/various/ResourceAlt/Wontor_EE_Program_Update_Final_06042008.pdf.

[76] *2008 Electric Energy Efficiency Program Annual Report.* Rep. 1 Apr. 2009. Public Service Company of New Mexico. 14 July 2009 http://www.swenergy.org/news/2009-04-PNM_2008_Electric_DSM_Annual_Report.pdf.

[77] Between October 2007 and December 2008 the Public Service Company of New Mexico achieved lifetime energy savings of approximately 302 GWh for $0.013 per kWh. Nexus Market Research, Inc., RLW Analytics, Inc., Shel Feldman Management Consulting, and Dorothy Conant. *Market Progress and Evaluation Report Evaluation Report (MPER) For the 2005 Massachusetts* ENERGY STAR Lighting Program. Rep. 29 Sept. 2006. Cape Light Compact, Massachusetts Electric Company, Nantucket Electric Company, NSTAR Electric, Western Massachusetts Electric Company. 8 July 2009 http://www.cee1.org/eval/db_pdf/474.pdf.

[78] GDS Associates, Inc. A Study of the Feasibility of Energy Efficiency as an Eligible Resource as Part of a Renewable Portfolio Standard for the State of North Carolina. Rep. Dec. 2006. North Carolina Utilities Commission. 9 July 2009. http://www.ncuc.commerce.state.nc.us/reps/NCRPSEnergyEfficiencyReport12-06.pdf.

As noted in Black & Veatch's REGA report, unlike fixed prices for efficiency, coal and natural gas prices are predicted to increase by 15 and 30%, respectively, by 2020.[79] Fossil fuels are very connected to resource availability and market prices, while the price of energy efficiency remains stable.[80] Compared to efficiency improvements, the external and variable costs of natural gas and coal are also extremely large and, if included, can increase the price of electricity.

The number of efficiency jobs is increasing, while the number of jobs in the fossil fuel industry has been declining.[81,82] Although lower than the national unemployment rate of 9.8%, the increasing trend in Alaska's unemployment indicates that introducing a new sector of energy efficiency jobs will help to replace declining jobs in the oil and gas industry.[83,84] In 2008, Alaska's oil and gas industry lost 300 jobs.[85] This trend is consistent with overall trends in the U.S. indicate a continuing decline in the number of jobs supported by the fossil fuel electric power generation industry.[86]

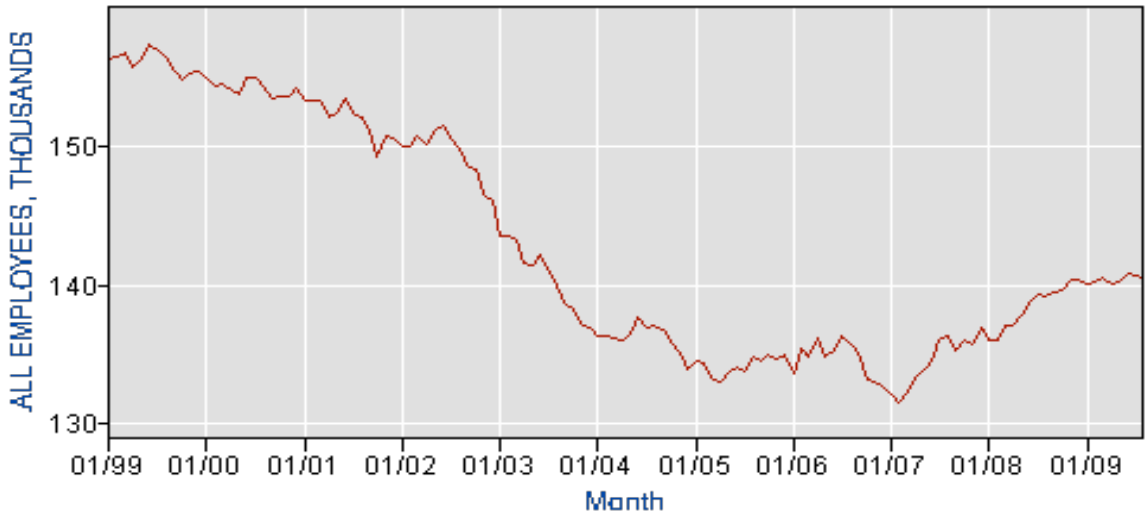

Figure 3. Number of People Employed by the Fossil Fuel Sector in the U.S.[87]

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[79] *ALASKA RAILBELT ELECTRICAL GRID AUTHORITY (REGA) Study*. Black & Veatch. 12 September 2008. http://www.aidea.org/AEA/REGAFiles/9-12-08_AlaskaRailbeltREGAStudy_MasterFinalReport.pdf.

[80] "Alaska Railbelt Electrical Grid Authority Report." *Black and Veatch.* 12 September, 2008. www.akenergyauthority.org/.../9-12-08_AlaskaRailbeltREGAStudy_MasterFinalReport.pdf.

[81] Geller, Howard, and Marshall Goldberg. *Energy Efficiency and Job Creation in Colorado*. Rep. Apr. 2009. Southwest Energy Efficiency Project. 14 July 2009 http://www.swenergy.org/pubs/EE_and_Jobs_Creation_in_Colorado-April_2009.pdf.

[82] *Employment, Hours, and Earnings from the Current Employment Statistics survey (National).* Bureau of Labor statistics. Data extracted on: 20 October 2009. http://data.bls.gov/PDQ/servlet/SurveyOutputServlet;jsessionid=a23056f4e776631633a3.

[83] State of Alaska Department of Labor and Workforce Development, Research and Analysis section. http://labor.alaska.gov/news/2009/news09-58.pdf.

[84] As of September 2009, unemployment rates in Alaska reached 8.4%, up from 8.1% in August 2009 and 6.7% one year previously, in September 2008.

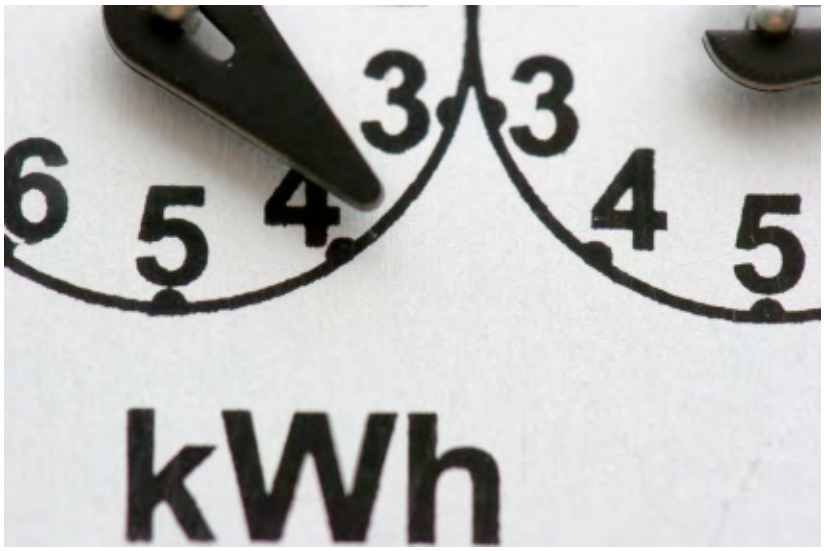
[85] *Employment, Hours, and Earnings from the Current Employment Statistics survey (National).Bureau of Labor statistics*. Data extracted on: 20 October 2009. http://data.bls.gov/PDQ/servlet/SurveyOutputServlet;jsessionid=a23056f4e776631633a3.

[86] Ibid.

[87] Ibid.

In contrast, there is a net increase in jobs in the field of energy efficiency. For example, the Southwest Energy Efficiency Project estimates that in Colorado, by 2025, *for each million dollars* of investment in electrical energy efficiency, there will be a net gain of 17 jobs created and an increase of $670,000 in wage and salary compensation.[88] Other studies have shown that investments in energy efficiency produce ten times more jobs per megawatt hour produced than coal or natural gas.[89]

Similarly, the renewable energy sector also provides a substantial increase in jobs. The American Society of Mechanical Engineers estimates that the number of jobs created by coal and natural gas technology is 11 job-years per megawatt-hour of electricity produced, while wind and solar can provide up to 100 and 121 job years per megawatt-hour of electricity produced.[90] This number for total job years seems high, but the trend is clear—investments in renewable energy and energy efficiency produce more jobs than fossil fuels.



[88] Geller, Howard, and Marshall Goldberg. *Energy Efficiency and Job Creation in Colorado*. Rep. Apr. 2009. Southwest Energy Efficiency Project. 14 July 2009 http://www.swenergy.org/pubs/EE_and_Jobs_Creation_in_Colorado-April_2009.pdf.

[89] John Grieco, *How Much in Job Years?* Power & Energy 1(3) (October, 2004), available at http://www.memagazine.org/supparch/peoct04/letters/letters.html, cited in Cooper, Christopher and Dr. Benjamin Sovacool. *Renewing America: The Case for Federal Leadership on a National Renewable Portfolio Standard*. Report written for Network of New Energy Choices. June 2007. http://www.newenergychoices.org/dev/uploads/RPS percent20Report_Cooper_Sovacool_FINAL_HILL.pdf.

[90] Ibid.

The worldwide energy efficiency industry is projected to grow rapidly. The industry already employs over 8.5 million people and generates over a trillion dollars in revenues nationally. The energy efficiency industry has the potential to create 500,000 more jobs and $44 billion in revenues by 2030.[91] For example, in Alaska, more than 45,000 homes are eligible for weatherization services.[92] Although not all of these jobs will improve electricity efficiency use, a portion of thermal improvements will improve electricity use and this could mean hundreds of jobs for Alaskan residents in need of reliable employment.[93]

Instead of continuing to direct limited resources to fossil fuels in a boom-bust pattern, investing in energy efficiency will bring stable economic growth into Alaska's local communities, ensuring prosperity for the future.

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[91] American Solar Energy Society (ASES) *Green Collar Jobs Report*, December 2008.

[92] Cold Climate Housing Research Center. *2005 Alaska Housing Assessment Study.* http://www.cchrc.org/statewide+housing+survey.aspx.

[93] Energy Information Administration statistics on end use electricity values, show that approximately 10% of energy used for heating homes comes from electricity. Likewise, for non-mall buildings approximately 2% to 5% is used for heating and an additional 3% to 37% is used for ventilation. EIA. *End use consumption of electricity 2001.* http://www.eia.doe.gov/emeu/recs/recs2001/enduse2001/enduse2001.html and EIA. *Table E5. Electricity consumption by end use for non-mall buildings.* 2003. http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/2003set19/2003pdf/e05.pdf.

Electricity Efficiency Actions in Alaska

Emergency Measures in Juneau—Effective, but Short-Term

Energy efficiency does not mean freezing in the dark. It does not mean doing without. It does not mean having less than we want or need. Energy efficiency, done right, results in lower costs for increased levels of service—providing the services Alaskans need, in comfortable, affordable, and efficient ways.

When an avalanche took out the transmission line providing electricity to Juneau, residents were faced with an emergency crisis.

Figure 4. Transmission Tower Knocked Down by Spring Avalanche.[94]

Before the time of the outage residents were paying under $0.10 per kWh. After the outage, when residents had to depend on diesel run generators, people had to pay up to $0.52 per kWh. As a result of the massive price increase residents began implementing electricity efficiency measures to improve usage in:

- Lighting;
- Heating and ventilation; and
- Plug loads.

Examples of recommended measures included:

- Replacing old, inefficient lighting with compact fluorescent light bulbs;
- Turning off business lights during evening hours;
- Using a clothesline in place of a dryer; and
- Turning off electrical equipment when not in use, such as computers.

[94] Morrison, Eric. *Avalanche downs Snettisham line, again.* Juneau Empire. 13 January 2009. http://juneauempire.com/stories/011309/loc_376861007.shtml.

The wide-scale adoption of these measures increased electricity efficiency by 45% within one month, but most people seemed to resent the inconvenience, and went right back to prior patterns of consumption within a few months.[95]

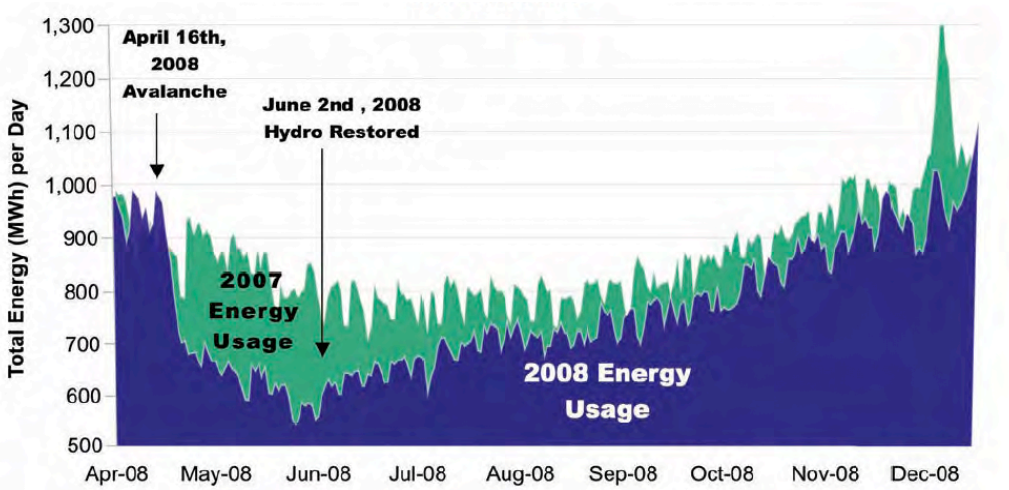

Figure 5. Electricity Consumption by Juneau Residents Before and After Hydroelectric Power was Disrupted.[96]

As can be seen in Figure 5, electricity usage went right back up to pre-avalanche levels within seven months. This example shows that a dramatic increase in electricity efficiency is possible with a wide-scale implementation and a cost driver. But if the measures include a sense of "doing without" or having less, the effects do not last.

Energy Watch Campaign—Short Term Crisis, Not Long-Term Solution

In the winter of 2009-2010, Anchorage started a campaign to anticipate potential natural gas shortages—a problem that had built up over the course of many years. The campaign, titled "Energy Watch" used three categories of stable, caution, and alert, to warn residents about the levels of natural gas demand during peak load times. For each color, there was a recommendation for the degree to which individuals should lessen their energy use during certain times of day. For instance, during "Alert" periods, it was recommended that families use the microwave for cooking meals instead of the natural gas oven, to save natural gas.[97]

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[95] Morrison, Eric. *Avalanche downs Snettisham line, again.* Juneau Empire. 13 January 2009. http://juneauempire.com/stories/011309/loc_376861007.shtml.

[96] Juneau Economic Development Council. *Juneau's spring 2008 hydroelectric shortage: business impact survey*. 3 March 2009. http://www.jedc.org/forms/Spring2008HydroelectricBusinessImpactSurvey.pdf.

[97] Energy Watch Press Release, Mayor's Office. September 30, 2009. http://www.muni.org/departments/mayor/energy/Pages/default.aspx.

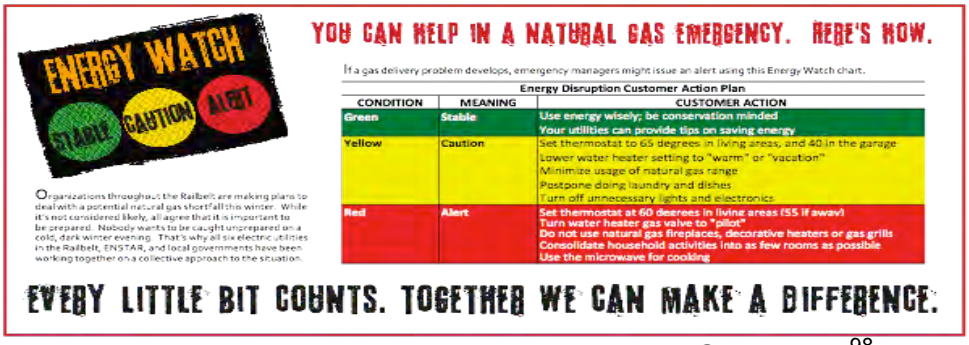

Figure 6. Anchorage's "Energy Watch" Campaign[98]

On Thursday, October 22, 2009, a two-hour trial run of the city's energy use reduction plan was declared. Over the two-hour period, peak demand was reduced by nearly 5%—enough to avert a crisis if one occurred.[99] This approach saved a little gas—probably enough to prevent a system failure, which was the intent of the program. But "doing without" sends a partial message—it does not meet end uses in comfortable, affordable ways, nor does it inspire participation on a broad scale. Because people don't like to be inconvenienced, nor to feel like there is not enough to go around, the likely result of continuing or repeating such efforts would be to avert an immediate crisis, but probably also create demand for expensive investments to increase supply, rather than simple actions to meet end-use needs more efficiently. Conversely, the goal of effective efficiency programs is to meet end uses in ongoing, cost-effective ways, without sacrificing comfort or affordability. Time of day pricing, combined with smart meters to show consumers how much energy they are using, has been shown to be more effective in achieving reductions of 15% or more (see "Peak Load Pricing," pages 80-81).

Village End-Use Efficiency Measures Program

Although mostly outside the Railbelt region, it is worthy of note that the Alaska Energy Authority (AEA) works with rural Alaskan communities to upgrade community buildings through the Village End-Use Efficiency Measures (VEUEM) program. The program is funded by the Denali Commission and from January 2005 to January 2007 worked with 17 villages.[100]

The improvements include several electricity efficiency actions such as:[101]

- Upgrading or replacing inefficient lighting with energy efficient lighting;
- Installing switch boxes; and
- Occupancy sensors.

Other improvements are geared towards non-electricity uses.

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[98] Halpin, James. "Energy savings drill reduced use by 2-4 percent," Anchorage Daily News, October 22, 2009.

[99] Halpin, James. "Energy savings drill reduced use by 2-4 percent," Anchorage Daily News, October 22, 2009.

[100] AEA. *Village End Use Efficiency Measures (VEUEM)*. End Use Efficiency. 2009. http://www.akenergyauthority.org/programsalternativeVEUM.html.

[101] AEA. *Village End Use Efficiency Measures (VEUEM)*. End Use Efficiency. 2009. http://www.akenergyauthority.org/programsalternativeVEUM.html.

The intent of the program is to improve energy efficiency (including electricity and non-electricity efficiency sources) and accurately size new power systems to balance demand and supply side issues. The program helps communities achieve significant progress towards efficiency. In Phase I, the average grant fund per village was $37,771 with a total program grant fund of $642,116. Significant in-kind contributions from the local school districts helped expand the reach of this program."[102]

Alaska's unique geography, location and climate require a unique approach to boosting electricity efficiency within the Railbelt region. The ultimate goal is to improve efficiency in a manner that will save or create revenue for individuals and governments, create jobs for hard working Alaskans, protect a healthy environment and secure Alaska's energy future. The sections below present several additional "best in class" examples of programs that address demand side management programs, available electricity efficiency technology, policy strategies, and the potential for renewable power within Alaska.

Renewable Energy Alaska Project's Efficiency Challenge

Renewable Energy Alaska Project (REAP) is collaborating with SmartPower, a non-profit marketing firm, to launch an energy efficiency campaign in Southcentral Alaska called the *Alaska Efficiency Challenge.* The goal of the *Alaska Efficiency Challenge* is making people more aware of the importance of their energy choices, while saving them money on energy that they can spend elsewhere in the community. The campaign is developing an online platform where participants will access a list of more than 400 personalized energy saving tips, including both behavioral changes to conserve energy and different ways to be more energy efficient. The *Challenge* will combine these energy reduction strategies with competitions between residents, schools, organizations, and entire communities to see who can save the most energy.

[102] Alaska Energy Wiki. *Alaska Energy Authority*. 2009. http://energy-alaska.wikidot.com/alaska-energy-authority.

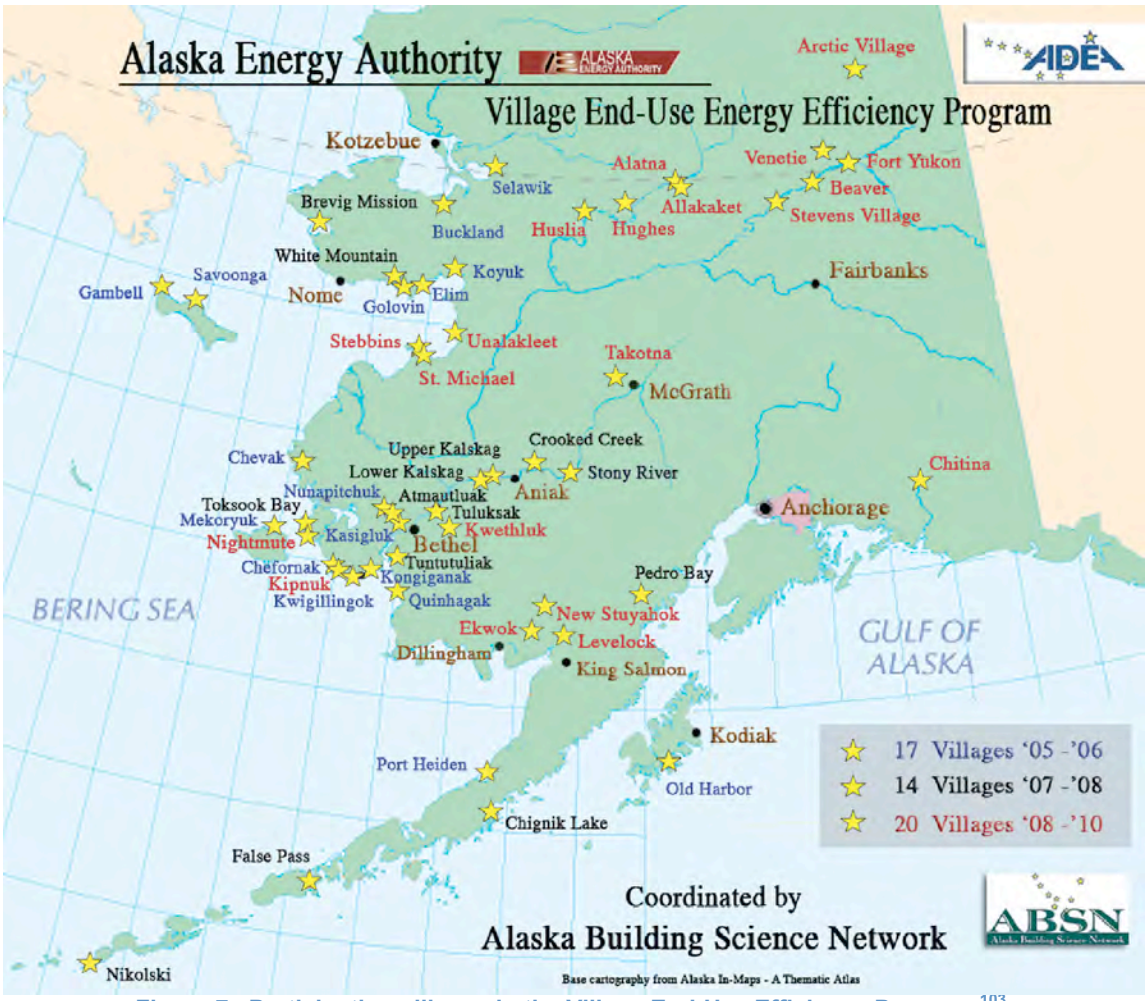

Figure 7. Participating villages in the Village End-Use Efficiency Program.[103]

[103] Alaska Energy Wiki. *Alaska Energy Authority*. 2009. http://energy-alaska.wikidot.com/alaska-energy-authority.

Existing, Utility-Sponsored Programs

Lighting Efficiency Programs

MEA has set itself apart by partnering with ENERGY STAR in an effort to improve their customers understanding of lighting improvements. ML&P is doing its part by becoming a major sponsor of Green Star's Lighting Energy Efficiency Pledge (LEEP). The Lighting Energy Efficiency Pledge encourages businesses to improve the efficiency of their lighting through upgrades and retrofits. Businesses that take the pledge are promoted by Green Star and also receive technical support and resources to go towards their lighting efficiency upgrades. ML&P also improves access to information on efficiency improvements by providing a link to the Home Energy Saver, a "web-based do-it-yourself energy audit tool" sponsored by the Department of Energy. CEA improves the public's awareness of lighting efficiency improvements by providing free energy workshops. CEA works with Smart Power to provide a workshop titled "Energy Lighting 101," which is designed to improve the public's understanding of the benefits associated with CFLs.[104]

In partnership with Matanuska Electric Association and Municipal Light & Power, Chugach Electric Association has encouraged energy conservation by expanding its *Smart Power* Program. The utilities arranged special price reductions with area retailers on 4-packs of SATCO-brand compact fluorescent lights (CFL). (SATCO, an ENERGY STAR Partner of the Year, manufactures CFLs with the lowest mercury level of any CFL currently being manufactured).[105] In the Chugach service area, 29% of sockets have CFLs. This percentage corresponds to 2,350,600 sockets in 63,000 households.[106] According to ENERGY STAR, the residential socket saturation in the United States is only 11 percent, meaning that Chugach has achieved a CFL saturation rate nearly three times the national average.[107]

Chugach also offered members the opportunity to trade their incandescent holiday light bulbs for energy-efficient mini-LED bulbs during the 2009 holiday season.[108]

GVEA's lighting efficiency programs are contained in their Home$ense, Energy$ense, Business$ense, and Builder$ense programs as described, below.

Heating and Ventilation Efficiency

Golden Valley Electric Association has the first emerging utility rebate program for energy efficiency in the state of Alaska. Energy$ense has three different programs, Home$ense, Builder$ense, and Business$ense, which are all designed to incentivize

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[104] Green Star. *Energy Efficiency Resources*. Resources. http://www.greenstarinc.org/EEresources.php (accessed December 8, 2009).

[105] CEA Press Release. *Utilities join forces to expand Smart Power program*. September 25, 2009. http://www.chugachelectric.com/news/pr2009-09-25.html.

[106] Smith, Dave and Carol Heyman. *Chugach Smart Power: Partners for Alaska energy efficiency*. http://www.alaskapower.org/pdf/**Chugach**EEAPA4.pdf.

[107] US Department of Energy. *CFL Market Profile*. March 2009. http://www.energystar.gov/ia/products/downloads/CFL_Market_Profile.pdf.

[108] Smart Power AK. *Chugach offers holiday light trade-in to members*. http://www.smartpowerak.com/.

energy efficiency. During a Home$ense audit, homeowners receive education materials on energy efficiency, up to 12 compact fluorescent bulbs to replace inefficient incandescent bulbs, refrigerator thermometer, and coil cleaning brush. If the home has a 220-volt electric water heater, participants receive an insulating blanket for the water heater, ten feet of pipe insulation, two faucet aerators, and a low-flow shower head. This type of audit is $40, but is free for those who qualify for the Low-Income Weatherization Assistance Program. Builder$ense provides rebates for efficiency measures such as LED light fixtures, motion sensors, water heater timers, and insulation, when built into the home. Business$ense provides similar rebates to commercial operations that replace their lighting with energy efficient alternatives.

Plug Load Efficiency Programs

GVEA also makes daily energy saving easy with a "Room by Room Energy Saving Checklist." These options are for educating consumers on how to save energy in their daily lives, not just during a power emergency. These tips include using ENERGY STAR appliances, unplugging appliances that are not in use, cleaning refrigerator coils, and replacing light bulbs with CFLs. Turning down the heat is only one of twenty ways to save energy illustrated on the tip sheet.[109]

AHFC has documented dramatic savings from replacing appliances. For example, as mentioned in the Preface, above, a refrigerator using 437 Kwh per year, replaces one that previously used 1300-2000 Kwh, resulting in a savings of at least 863 kWh. At a price of $.215/kWh, this saves the owner $186 per year for each family—an improvement in efficiency of between 66 and 77%.[110]

Alaska has allocated $658,000 to disabled Alaskans for purchase incentives for electricity efficient appliances.[111] Any disabled Alaskan who gets rid of old, inefficient appliances and purchases a new, ENERGY STAR certified appliance. The program is administered by the AHFC, working closely with Governor Sean Parnell's administration.

Disabled Alaskans can request a rebate of up to $500 for refrigerators and freezers in rural areas, and $300 rebate in urban centers.[112]

[109] (Also Image Credit) Golden Valley Electric Association (GVEA), Energy$ense program. Retrieved November 9, 2009. http://www.gvea.com/energyprograms/energysavingtips/.

[110] Waterman, Scott. *Energy Efficiency*, AHFC. Viewed December 18, 2009 at www.alaska.edu/uaf/cem/.../ResidentialEfficiencyS.**Waterman**AHFC.pdf.

[111] Delbridge, Rena. *Applicance rebates limited to disabled Alaskans*. Renewable Energy Alaska Project. 15 October 2009. http://alaskarenewableenergy.org/2009/10/appliance-rebates-limited-to-disabled-alaskans/.

[112] ibid.

Implementation Strategies

As mentioned in the ***Roadmap*** description, above, achieving potential increase in energy efficiency of 50% can be accomplished through improvements of 3.3% per year:

Landmarks

END USE	ANNUAL IMPROVEMENT	TOTAL BY 2025
Lighting	1.3%	20%
Heating & Ventilation	1%	15%
Plug-in appliances	1%	15%
TOTAL	**3.3%**	**50%**
BONUS: Smart Grid	**BONUS** 1.3%	**BONUS** 20%

Efficient technologies, demand side management programs, incentives to implement these approaches, proper financing, policy strategies, and renewable sources of energy combine to create a well-rounded energy efficiency future for Alaska's Railbelt region.

End Use Targets

Figures 8-11 demonstrate how much electricity is used by different sectors in the United States. Using these statistics as a baseline it is possible to estimate how much electricity Alaska's Railbelt region could save by improving lighting, heating and ventilation, and plug loads.[113]

NOTE regarding baseline data: *These national statistics include air conditioning, which is generally not used in Alaska. So specific estimates for Alaska should be adjusted accordingly and should be based on actual, Alaska-specific, baseline data obtained from a comprehensive assessment of end-uses of electricity in the Railbelt region—the "Starting Point" discussed in the previous section. Nonetheless, potentially as much as 50% of electricity can be saved by a 3.3% annual improvement through recommended upgrades to lighting, heating/ventilation, and plug loads, with additional savings possible through a "smart grid."*[114]

[113] Energy Information Administration statistics on end use electricity values, show that approximately 10% of energy used for heating homes comes from electricity. Likewise, for non-mall buildings approximately 2% to 5% is used for heating and an additional 3% to 37% is used for ventilation. These should be verified for Alaska as part of the Baseline Survey. EIA. *End use consumption of electricity 2001.* http://www.eia.doe.gov/emeu/recs/recs2001/enduse2001/enduse2001.html and EIA. *Table E5. Electricity consumption by end use for non-mall buildings.* 2003. http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/2003set19/2003pdf/e05.pdf.

[114] NCS conservative estimates.

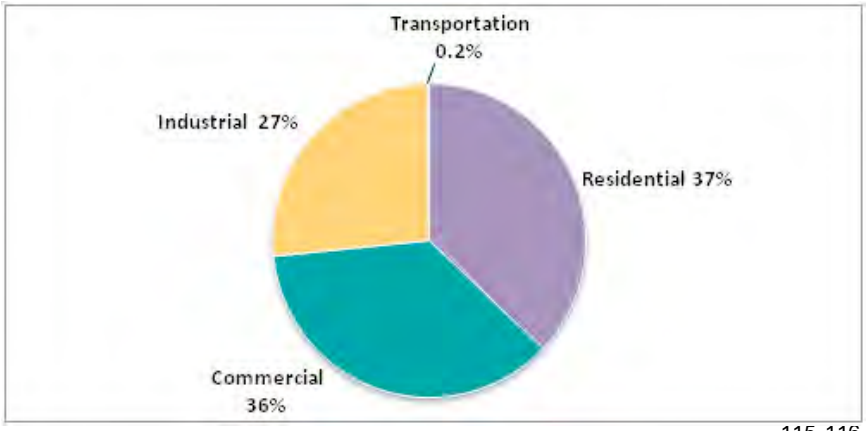

Figure 8. Total U.S. Electricity End Uses by Sector.[115] [116]

Further breakdowns for each sector are shown in Figures 9 through 11.

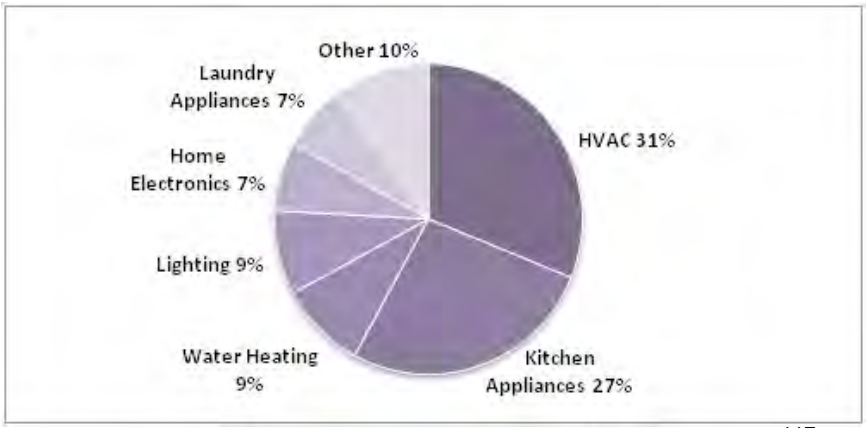

Figure 9. U.S. Residential Energy Consumption.[117]

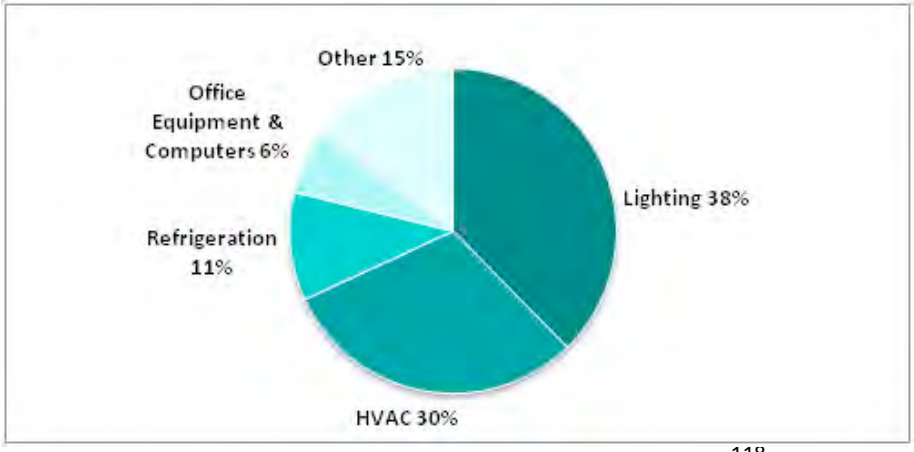

Figure 10. U.S. Commercial End Uses.[118]

[115] EIA, *Electric Power Monthly*, Table 5.1, April 22, 2009. http://www.pewclimate.org/technology/overview/electricity.

[116] Specific statistics for electricity end uses trends are not available for Alaska, but are available for national trends.

[117] EIA, *U.S. H.ousehold Electricity Reports*, Table US-1, 2005. http://www.pewclimate.org/technology/overview/electricity.

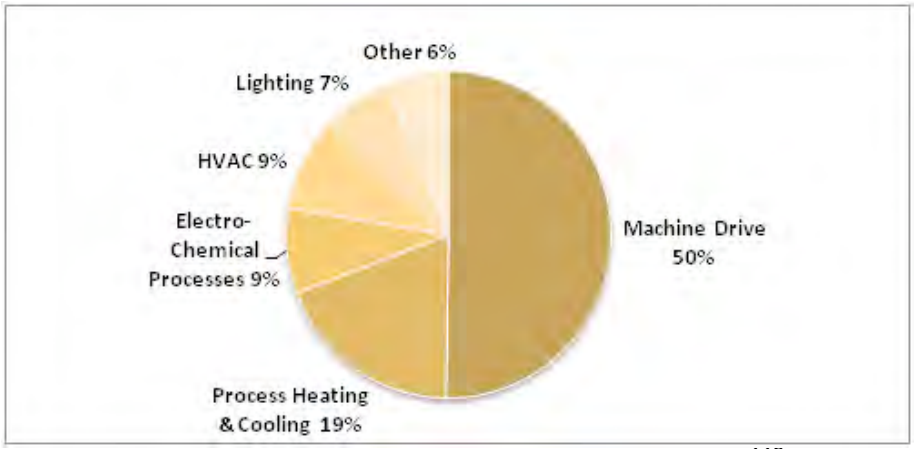

Figure 11. U.S. Manufacturing End Uses.[119]

[118] EIA, *Commercial Buildings Energy Consumption Survey (CBECS)* http://www.eia.doe.gov/emeu/cbecs/, Table E5A, 2008. http://www.pewclimate.org/technology/overview/electricity.

[119] EIA, *Manufacturing Energy Consumption Survey (MECS)*, Table 5.2, 2005. http://www.pewclimate.org/technology/overview/electricity.

Lighting

The examples below illustrate ways to improve the efficiency with which lighting is provided in the Railbelt region enough to reduce overall electricity use in the region by 1.3% per year, beginning with installing more efficient LED lighting wherever possible, and CFL or other efficient lighting in locations for which LEDs are not yet cost-effective or are not yet available.

Elmendorf AFB
Alaska's Elmendorf Air Force Base is implementing President Obama's Executive Order to improve energy efficiency. Elmendorf replaced a large number of fluorescent tube lights and magnetic ballasts with energy efficient lights and electronic ballasts. The switches will not only save the base $225,000 annually, but provide a more well-lit and comfortable work environment.[120]

CFL Giveaways and Rebates
As evidenced by the Railbelt utility programs cited previously, many utility companies and regional entities are choosing to give away free compact fluorescent lights (CFLs) to users on their power grid, encouraging them to switch out their old incandescent bulbs to the newer, more efficient CFLs. In addition to conversion to CFLs, this ***Roadmap*** predicts that advances in solid state lighting technology in the next ten years, will enable Alaska's Railbelt region to go beyond CFL giveaways, to implement leading edge, solid-state lighting technologies that improve efficiency of electricity use for lights by as much as 90%.[121]

In 2009, Puget Sound Energy (PSE) began a massive CFL giveaway campaign titled "Rock the Bulb." PSE hosted 16 bulb swaps at different hardware store locations in the Puget Sound area, where residents could exchange up to 10 incandescent bulbs for free CFLs. At the same time, PSE partnered with Project Porchlight, a team of volunteers who distributed over 275,000 CFLs door-to-door in PSE's service area. In total, PSE gave away 494,421 CFLs, which replaced existing incandescent bulbs, and will save over 114 million kWh of electricity and $21 million on energy bills over the lifetime of the CFLs. The campaign also offered a $45,000 prize to the winner of an Energy Rock Star contest, incentivizing volunteering at Rock the Bulb events and with Project Porchlight.[122]

What is missing from all currently existing CFL giveaway programs is the kind of social and regional mobilization discussed in this ***Roadmap***. Alaska's Railbelt region can be the first to engage in comprehensive community mapping and social mobilization to achieve the levels of participation in efficient lighting technologies that have been seen with other electronic technologies, such as washing machines, refrigerators, telephones, and televisions.

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[120] Turner, Laura. "Elmendorf Saves Thousands on New Lighting." Elmendorf Air Force Base, October 24, 2008. http://www.elmendorf.af.mil/news/story.asp?id=123121111.
[121] *The City of Houston's Path Towards Sustainable Growth,* September, 2009. Op. cit.
[122] Rock the Bulb and Puget Sound Energy. Retrieved November 3, 2009. http://www.rockthebulb.com/.

Lighting Retrofits
Simple actions like turning off unneeded lights for several hours each day can result in substantial electricity savings for any small business, sometimes as much as 15-20%. Day-lighting—through windows, skylights, and "sun-tubes" that allow daylight into rooms can reduce lighting electricity consumption and costs by as much as 75% and electricity consumption between 50 and 80%.[123,124] In Alaska, the potential for day-lighting is reduced in winter months, but extended during the summer.

Lighting controls are among the most underutilized technologies; yet automated controls offer some of the most significant savings. Controls can reduce electricity consumption by 65 to 80%, when integrated effectively within a facility.[125]

Dimming lights by reducing their total output to 75% levels can result in electricity and cost-savings of 20%; if lights are dimmed to 50% levels, the savings increase to 40%. Furthermore, when lights are dimmed to 50% levels, bulb lives increase and can be expected to last 20 times longer.[126]

The combination of using day-lighting sensors with occupancy sensors can reduce electricity demands from lighting by approximately 45%.[127] In windowed offices where the occupants work primarily at desks, automatic day-lighting provides greater savings, compared to occupancy sensors.

LED lighting has been shown to use as much as 87% less electricity than incandescent bulbs.[128]

BEST IN CLASS EXAMPLES

John Deere Credit in Des Moines, Iowa,[129] reduced the annual electricity use in its new building by 35% through the incorporation of lighting controls, day-lighting, and higher-efficiency heating and ventilation equipment.

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[123] Hashmi, Kallie. Benefits of Daylighitng. Department of Sustainable Energy Management. http://ciralight-europe.com/(S(p4hymgibo33iimimxlpj3k45))/docs/Benefits_of_daylight.pdf Retrieved on December 7, 2009.
[124] BetterBricks, follow the link to Day-lighting Basics from this link (3rd subsection): www.betterbricks.com/default.aspx?pid=daylighting , 13 August 2007.
[125] Energy and Power. "Lighting Technologies Produce Energy Savings", May 2006, www.climatemanual.org/Businesses/Lighting/EnergyPowerMay2006Reprint.pdf, 13 August 2007.
[126] "Dimmer Switches Save Energy". Carolina Country. 2006. http://www.carolinacountry.com/StoryPages/howtos/Dimmer/dimmer.html
[127] Department of Energy, "How to Select Lighting Controls For Offices and Public Buildings" Pg. 4, http://www1.eere.energy.gov/femp/pdfs/light_controls.pdf, Assessed on December 3, 2008
[128] Huang, Vicky. Green Light. Taiwan Review. 1 July 2009. http://taiwanreview.nat.gov.tw/ct.asp?xItem=53226&CtNode=1355.
[129] Iowa Small Business Development Center, "Energy Efficiency Case Studies" http://www.natcapsolutions.org/solutions/solutions.pdf and http://www.energy.iastate.edu/ers/download/CH-06-1-5 percent201.pdf, 13 August 2007.

The **Iowa Association of Municipal Utilities** also slashed its electricity use by 45% through the use of day-lighting, dimming controls, occupancy sensors and other technologies in its 15,000-square-foot training facility.

The owner of **Basil Bandwagon Natural Market in Flemington, New Jersey,**[130] Alice Celebre, wanted to make sure that her 6,000-square-foot store was as efficient as possible. The new store, built in 2006, incorporated day-lighting with solar tubes, T-8 lighting, high-efficiency air circulation, and other efficiency measures, including LED exit signs. The store's estimated annual savings over conventional lighting and electricity use are 103,000 kWhs (kWh) and $7,800.

Procter and Gamble in Toronto, Canada,[131] used several electricity control strategies that reduced consumption by 66%. The strategies employed "task tuning" (using dimmable ballasts to match lighting levels with tasks in specific areas), personal controls, scheduling, occupancy sensors, daylight harvesting (e.g., photo sensors that turn off or dim lights when there is sufficient daylight), and demand controls for times of peak system use.

The Mishkan Shalom congregational facility, Philadelphia, prioritized the purchase of energy-efficient appliances and installed motion and occupancy sensors that turn off lights when not in use. Through these simple measures, the facility saves about $5,700 on energy use annually.[132]

[130] ENERGY STAR® award, www.energystar.gov/index.cfm?c=sb_success.sb_2006winners#basil, 13 August 2007.

[131] Mocherniak, Terry. *Energy & Power Management.* Lighting Technologies, May, 2008. Vol 31, No. 5. http://www.enviro-energytech.com/Encelium_EnergyPower_05-06.pdf.

[132] No baseline data is available. Mishkan Shalom moved in to their facility that year and received funding to improve efficiency upon their initial move in.

Heating and Ventilation

***NOTE**: Although the greatest uses of energy in Alaska's Railbelt region are for heating and transportation, and there is a much greater opportunity for efficiency improvements in those areas, this **Roadmap** deals only with the **electricity** uses relating to heating and ventilation, such as fans and pumps, not thermal energy such as natural gas or fuel oil.*

The examples below illustrate ways to improve the efficiency with which the electrical components of heating and ventilation systems in the Railbelt region can be improved enough to reduce overall electricity use in the Railbelt region by 1% per year, beginning with installing energy efficient air sealing, duct sealing, insulation, and windows in all buildings in all sectors.

Upgrading Heating and Ventilation in Alaska's Railbelt region
Improving heating and ventilation systems can lead to substantial electricity savings. Statistics from the Energy Information Administration on end use electricity values for the residential sector, show that approximately 10% of energy used for heating homes comes from electricity. Likewise, for non-mall buildings approximately 2% to 5% is used for heating and an additional 3% to 37% is used for ventilation.[133]

Buildings can lose up to 30% of their heating energy from windows.[134] By installing blinds or shades, the loss can be reduced to only 15%, which reduces electricity consumption by the fans used in the heating system.

An efficient system can save up to 50% on heating, and ventilation costs, with a commensurate reduction in the electricity used for fans. For example, a high efficiency heat pump could reduce heating costs by up to 50%, with a comparable reduction in electricity used to produce air movement.[135]

These simple devices are widely available at appliance and hardware distributors, cost from $50 to $200, and can save around $150 annually—producing a positive profit on minimal investment in about one year.[136]

Leaky ducts can reduce heating system efficiency by as much as 20%. Sealing ducts increases efficiency and can often return the investment made in a few months.

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[133] EIA. *End use consumption of electricity 2001.* http://www.eia.doe.gov/emeu/recs/recs2001/enduse2001/enduse2001.html and EIA. *Table E5. Electricity consumption by end use for non-mall buildings.* 2003. http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/2003set19/2003pdf/e05.pdf.

[134] "The Skinny: Energy-Efficient Windows." Center for Resource Conservation. conservationcenter.org/assets/docs/WindowsSkinny_000.pdf, 8 June 2007.

[135] BGE, Electric Heat pumps, http://www.bge.com/portal/site/bge/menuitem.19e39919acab696509c031e0da6176a0/. As with Smart Grids, Alaska's unique conditions will require additional testing to determine if similar opportunities can be realized in Alaska.

[136] ibid.

More than 80% of buildings constructed prior to 1980 lack sufficient insulation, which means their heating and circulation systems are oversized, with comparably oversized use of electricity for air movement.[137] According to the U.S. Census Bureau, the median owner-occupied home in Alaska was built in 1980, and the median renter-occupied home was built in 1977. Overall, 48.7% of owner-occupied homes and 59.4% of renter-occupied homes were built before 1980, making over half of Alaska's 282,234 homes at least 30 years old.[138] Furthermore, Alaska's Cold Climate Housing Research Center found in a 2005 housing study that more than 45,000 homes are qualified for weatherization services.[139]

Within six months any investment in sealing leaks typically returns a profit through the reduction in energy use. Properly insulating a building can cut heating costs by up to 30%, with commensurate reduction in the electricity used for air movement.[140]

Although only 10% of buildings in the Railbelt region are heated directly with electricity, the Alaska Housing Finance Corporation estimates that the electricity used to power fans for air circulation can account for as much as 30% of the total electricity used in a building.[141]

U.S. Government—Leading by Example

On October 5th, President Obama signed an Executive Order establishing a series of targets in energy efficiency by 2020. Among these targets is net-zero energy use in new buildings starting in 2020.[142]

U.S. Navy Secretary Mabus plans to make energy efficiency a mandate in new contracts: All proposals must include the lifetime energy costs of buildings and systems.[143]

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[137] http://www.reliant.com/en_US/Page/Shop/Public/esc_topics_hi_attic_insulat_home_shp.jsp.

[138] US Census Bureau, Census 2000 Summary File 3 - Sample Data. http://factfinder.census.gov/servlet/QTTable?_bm=y&-geo_id=04000US02&-qr_name=DEC_2000_SF3_U_QTH7&-ds_name=DEC_2000_SF3_U.

[139] Cold Climate Housing Research Center. "2005 Alaska Housing Assessment Study." http://www.cchrc.org/statewide+housing+survey.aspx.

[140] Leadership in Energy and Environmental Design, www.usgbc.org, 13 August 2007.

[141] Estimate provided by AHFC in personal communication with the authors.

[142] Eilperin, Juliet. "Agencies Told to Reduce Emissions." The Washington Post, October 6, 2009. http://www.washingtonpost.com/wp-dyn/content/article/2009/10/05/AR2009100502725.html.

[143] This section except otherwise noted: Feldman, Stacy. "Fuel-Thirsty US Navy Pledges 50 percent Cut in Oil Use by 2020, And More." Solve Climate, October 16, 2009. http://solveclimate.com/blog/20091016/fuel-thirsty-u-s-navy-pledges-50-cut-oil-use-2020-and-more.

BEST IN CLASS EXAMPLES

AHFC provides many examples of energy efficiency upgrades that improve the end uses of electricity for heating and ventilation. In 2010, AHFC will expand their range of services to include commercial buildings. Extensive information about AHFC's programs and their effectiveness is available on the AHFC website at: http://www.ahfc.state.ak.us/.

In addition to the services offered by AHFC, several Energy Service Companies, such as Siemens, Honeywell, Johnson Controls, and others provide energy efficiency services in Alaska, to larger facilities, such as colleges, universities, schools, industrial plants, and hospitals.

ADDITIONAL EXAMPLES FROM OUTSIDE ALASKA:

As a **RE/MAX office in Fort Lauderdale, Florida** was remodeled, the facility's manager, Rich Potter, incorporated some simple, energy-efficiency practices—measures that have resulted in savings of approximately $7,900 annually. He made sure that all exterior windows and doors were sealed and caulked to prevent energy loss. All of the building's poor ductwork was removed and replaced with more tightly-sealed ducts.,[144]

Lentz Engineering, of Sheboygan Falls, Wisconsin, can increase the efficiency of the electricity use in most commercial heating and ventilation systems by 50 to 80% using their "Regenerative Dual Duct™" system, and offers 80 to 90% improvements in data center cooling systems.[145]

The **Thomas Mott Bed and Breakfast**, in Alburg, VT, originally built in 1838, has been remodeled over the years. During its most recent remodel, the inn's owner, Patrick Schallert, decided to make the inn more efficient, through some simple building retrofits. He started by opening all of the walls and installing insulation throughout the building. His next step was to install 39 new high performance, energy-efficient windows, to minimize heat loss and make the building more comfortable. He also installed a new, continuous-flow hot water system, with a state-of-the-art boiler. Schallert's final touches included replacing all of the lighting, with highly efficient CFLs and planting trees on the grounds, to provide shade in the summer. Because of Schallert's efforts, the inn saves about $10,000 annually, which over a period of six years has provided a return on investment sufficient to cover the costs of the remodel. The investment will continue providing savings for years to come. [146]

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[144] EnergyStar, 2004 Small Business and Congregations Award Winners, www.energystar.gov/index.cfm?c=sb_success.sb_2004winners, 13 August 2007.
[145] http://www.lentzengineering.com/
[146] Thomas Mott Homestead Bed and Breakfast, www.thomas-mott-bb.com/, 13 August 2007.

Plug-in Appliances

The examples below illustrate ways to improve the efficiency of plug in appliances in the Railbelt region sufficiently to reduce overall electricity use in the Railbelt by 1% per year, beginning with upgrading the efficiency of everything from household appliances and entertainment devices, to commercial signs, displays, office equipment, computers, and medical equipment, to industrial battery chargers, pumps, and motors.

As noted previously, AHFC has demonstrated examples of improving the efficiency with which refrigerators use electricity by as much as 75%.

Many plug-in devices waste electricity when they are turned "off." These "**phantom loads**" also known as "**low power**" or "**standby**" modes can account for between 5% and 10% of total electricity use, and can be eliminated simply by unplugging the device, by the use of "smart" plug strips, or by purchasing newer, more efficient devices.[147] Cable TV set top boxes, game consoles, computers, displays, and battery chargers are among the most easily-identified consumers of "phantom loads."

Most computers and monitors have features that automatically put them into sleep mode and then power them down after a specified period of inactivity. Activating system standby and power down settings can cut the energy used by your computer in half, saving up to $75 per computer annually.[148] Purchasing ENERGY STAR computer equipment can provide additional savings from increased energy efficiency.

A standard desktop computer in standby mode consumes 412 kWh per year and costs about $40 annually, while an ENERGY STAR desktop unit consumes about a 100 kWh less than a conventional unit and will cost $10 less to operate each year—another example of a 75% improvement in efficiency. The savings from using the sleep and power down features can vary significantly depending on the type of computer and/or monitor.[149] Computers displaying the ENERGY STAR "80-Plus" certification have internal power supplies that are at least 80% efficient, as compared to older power supplies that can waste as much as 60% of the electricity being drawn by the power supply.[150]

When computers, adapters, and related electronic equipment are plugged into a power strip, the "phantom load" can be completely disconnected from the power supply, because when the strip is turned off, the phantom load is eliminated. Many stores in the Railbelt region now offer power strips that can be programmed to turn off at designated times, or when no movement or activity is sensed, removing the need to turn them on

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[147] http://oee.nrcan.gc.ca/residential/business/manufacturers/pdf/standby-power-fact.pdf.
[148] ENERGY STAR. "Activating power management features in enterprises" 2008. http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_enterprises.
[149] ENERGY STAR. "Office Equipment: Computers" 2008. http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CO.
[150] http://www.80plus.org/.

and off manually. Plugging devices into power strips and turning them off when not in use can save $23 per year per strip.[151]

For businesses at the end of the day, employees do not have to turn off every piece of equipment; they just have to turn off their power strip. Better yet, with smart power strips all the employee has to do is disconnect or turn off their computer or other key device, and all other equipment turns off automatically.

Other, more sophisticated strips have occupancy sensors built in. Occupancy strips only turn equipment on when there is movement in a workspace. These are best used in cubicles, private offices, and in areas that are only used periodically (like a photocopy room or garage).

The typical American home consumes about 10,656 kWh a year, with appliances and home electronics making up roughly 20% of the electricity bill.[152,153] A residential consumer, therefore, can reduce his or her electricity usage by switching to more efficient appliances, which in turn saves money. The easiest way to start these savings is to upgrade older, less energy-efficient appliances with new ENERGY STAR certified

[151] http://acebargains.stores.yahoo.net/ensapost.html.
[152] US Department of Energy: Energy Efficiency and Renewable Energy, 2005 Building Energy Data Book, Table 4.2.1 "4.2.1.pdf" http://www1.eere.energy.gov/consumer/tips/home_energy.html.
[153] Energy Information Administration: Department of Energy. http://www.eia.doe.gov/emeu/recs/recs2001/enduse2001/enduse2001.html.

appliances. On average, ENERGY STAR appliances are about 15 to 20% more energy efficient than older comparable models.[154]

Energy efficient products are widely available now, from refrigerators and light bulbs to dishwashers and computers. The best way to identify if a new appliance is to check the energy efficiency of the model, and see if it is ENERGY STAR certified. California and other states have identified appliance efficiency as a major source of financial savings, and generally adopts ENERGY STAR standards as statewide requirements.[155]

Figure 12 compares the annual operational cost of standard appliances to ENERGY STAR certified appliances, which shows significant savings can be achieved through energy efficiency.

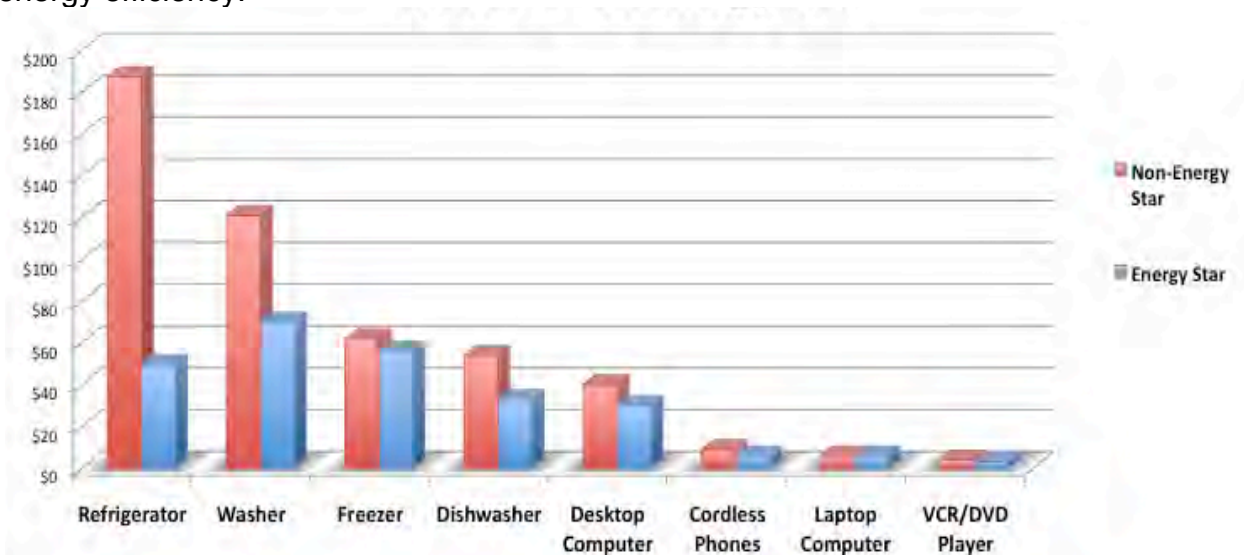

Figure 12. Annual Cost to Operate ENERGY STAR and Non-ENERGY STAR Appliances. [156]

Average ENERGY STAR Refrigerators are at least 16.57% more efficient than standard refrigerators depending on the age and model of the replaced refrigerator. The cost saving of an ENERGY STAR over the newest standard refrigerator is small, about $10 annually. However, the age of the refrigerator being replaced by an average ENERGY STAR refrigerator makes a big difference in savings: the older the replaced refrigerator, the higher the savings from the ENERGY STAR refrigerator.[157]

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[154] ENERGY STAR. "Appliances: Refrigerators" 2008. http://www.energystar.gov/index.cfm?c=refrig.pr_refrigerators.

[155] http://www.energy.ca.gov/appliances/

[156] NCS calculations based on ENERGY STAR, EPA, and Lawrence Livermore Laboratories data.

[157] ENERGY STAR "Consumer Residential Refrigeration Savings Calculators" 2008. http://www.energystar.gov/index.cfm?c=refrig.pr_refrigerators and http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator&manu=2001-2006&tvol=21.5-24.4+Cubic+Feet&rconfig=Bottom+Freezer&rate=0.097&screen=4&submit.x=82&submit.y=16.

To run a typical clothes washer costs about $121 and uses 12,768 gallons of water annually, while an ENERGY STAR model costs only $70 to run and uses a greatly reduced 5,790 gallons of water annually.[158]

Because pumping water for municipal systems uses large amounts of electricity, water savings carry related electricity savings, which have not been calculated as part of the ***Reel in Alaska Roadmap***. However, in many jurisdictions nationally, electricity to pump water is a significant use, and therefore should be evaluated in the end-use assessment recommended in this ***Roadmap.***

ENERGY STAR qualified dishwashers use at least 41% less energy than the federal minimum standard for energy consumption, saving a typical household 107 kWh's and $21 in electricity costs annually, as well as reducing water consumption by about 5,000 gallons for a total of $40 utility savings annually.[159]

Today's TVs, when combined with related products like DVD players and set-top boxes, make up about 10% of a household's annual electricity bill. An ENERGY STAR qualified TV uses about 30% less energy than a standard unit, and will save about $12 a year.[160]

Americans spend more money to power DVD players when turned off than when actually in use, because even when not in use older VCR and DVD players consume phantom loads increasing energy consumption and electricity bills. ENERGY STAR DVD players consume a quarter of the energy of a standard DVD model when turned off.[161]

Small space heaters are typically used when the main heating system is inadequate or when central heating is too costly to install or operate. In some cases, small space heaters can be less expensive to use if you only want to heat one room or supplement inadequate heating in one room. They can also boost the temperature of rooms used by individuals who are sensitive to cold, especially elderly persons, without overheating your entire home.

Although most space heaters rely on convection (the circulation of air in a room) to heat a room, some rely on radiant heating; that is, they emit infrared radiation that directly heats up objects and people that are within their line of sight. Radiant heaters are a more efficient choice when you will be in a room for only a few hours, if you can remain within the line of sight of the heater. They can be more efficient when using a room for a short period because they avoid the energy needed to heat the entire room by instead directly heating the occupant of the room and the occupant's immediate surroundings.[162]

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[158] ENERGY STAR. "Appliances: Clothes Washer" 2008. http://www.energystar.gov/index.cfm?c=clotheswash.clothes_washers_save_more.

[159] ENERGY STAR. "Appliances: Dishwasher" 2008. http://www.energystar.gov/index.cfm?c=dishwash.pr_dishwasher.

[160] NCS calculation and ENERGY STAR; http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=TV.

[161] ENERGY STAR. "DVD and Blu-ray Products" 2008. http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=DP.

[162] United States Department of Energy. "Your Home: Portable Heaters" February 2009. http://www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12600.

Plug-in Hybrid Electric Vehicles
In the 21st Century, no discussion of plug loads would be complete without mention of "plug-in hybrid electric vehicles" ("PHEVs")—gasoline/electric cars that have gasoline engines, but also plug in to electric outlets or charging stations to charge their batteries. Because PHEVs can be charged during off-peak hours, it is likely that they can be accommodated on the existing system, without need for additional generating capacity. This off-peak feature is complemented by PHEVs capacity to deliver electricity to the grid during peak hours as well, as a net-metered, distributed energy source. Advanced PHEVs will allow their owners to set minimum levels of battery charge. For example, someone who knows that they will only be driving less than 100 miles in a vehicle with battery capacity for 300 miles, can set their battery level to 40%, allowing the "Smart Grid" to pull 60% of the electricity from the PHEVs battery during peak demand periods automatically.[163] However, the amount of electricity required to charge PHEVs could easily exceed capacity of local substations in residential areas, so transmission and distribution capacities may need to be carefully monitored, if PHEVs become as popular as cell phones.[164]

BEST IN CLASS EXAMPLES FROM OUTSIDE ALASKA

The New York State Energy Research and Development Authority (NYSERDA) office in Albany, New York is a 54,000-square-foot building with two floors that are occupied by about 200 full-time employees. NYSERDA purchased ENERGY STAR office equipment with enabled electricity management features, employed simple timers on coffee makers and water coolers, and installed occupancy sensors on vending machines. These changes reduced NYSERDA's annual plug-load electric costs by an estimated 38% or $9,330.[165]

Buffalo Public School District installed more than14,000 computers and monitors as part of its commitment to deliver high-quality education. It costs more than $1.1 million annually to power the computers, monitors, and related equipment. By implementing a monitor-electricity management system and electricity conservation strategies, the school district reduced its electricity costs by nearly 60%, saving $688,500 annually. [166]

Yale University Facilities departments left their computers on 24/7 to accommodate nighttime backups and software updates. Once they realized the amount of energy wasted in this practice, they convinced their end users to turn off their computers before leaving work and set them to automatically wake up, back up, and shut off during the night. This saved over $40 per computer annually. Assuming that plug loads can represent between 10 and 17% of total commercial building needs and computers

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[163] http://www.technologyreview.com/read_article.aspx?ch=specialsections&sc=transportation&id=17930
[164] http://news.cnet.com/greentech/?keyword=PG%26E
[165] New York State Energy Research and Development Authority (NYSERDA) "New York State Energy Research and Development Authority (NYSERDA) Sets the Pace for New York Energy $mart Offices:. http://www.nyserda.org/programs/offices/case_studies/nyserda.pdf.
[166] New York State Energy Research and Development Authority (NYSERDA) " Big Savings for the Buffalo Public Schools". http://www.nyserda.org/programs/offices/case_studies/BuffaloCitySchools.pdf.

represent up to 75% of that load, updating computer settings saved the departments between 7.5 and 13% of total electricity use. [167]

Arrowhead Credit of Southern California integrated energy awareness into the organization after a recent renovation. The company educated its employees about the importance of turning off lights and computers when not in use. Due to employee compliance, Arrowhead Credit is now saving $7,200 annually. [168]

Spring Branch Independent School District in Texas activated the sleep settings on the operating systems of 7,000 computers, to save $230,000 annually. [169]

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[167] New York State Energy Research and Development Authority (NYSERDA) " Big Savings for the Buffalo Public Schools." http://www.nyserda.org/programs/offices/case_studies/BuffaloCitySchools.pdf.

[168] ENERGYSTAR, 2004 Small Business and Congregations Award Winners, www.energystar.gov/index.cfm?c=sb_success.sb_2004winners, 13 August 2007.

[169] ENERGY STAR, "Success Stories". http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_ss#ge.

Smart Grid

The Smart Grid concept means creating a dynamic response to distributing power in a reliable way, based on each region's circumstances. In a recent test in North Carolina, a smart grid was shown to improve the efficiency with which electricity was used, by 20% in the first year.[170] This example is not from Alaska, and included air conditioning and other technologies that might not be relevant, so implementing Smart Grids in Alaska's Railbelt region will require local testing and adaptation.

Alaska's Railbelt region has an opportunity to take the Smart Grid concept to the next level, by designing an innovative energy network that is appropriate for Alaska's energy use and supply, unique conditions, and location.

A Smart Grid in Alaska's Railbelt region could mean providing a more reliable, efficient, high-quality power supply without risking blackouts or shortages, while saving the Alaskan government, individuals, and the Railbelt utilities money.

A Smart Grid can distribute both energy and information, allowing utilities to understand and predict blackouts and shortages and address each issue with precision. In the lower 48, today's grid is 99.97% reliable but still succumbs to disturbances that cost at least $150 billion per year, which amounts to $500 for every American. As an example, in 2003, the Northeast experienced a blackout that resulted in a $6 billion loss to the regional economy. The disruption to Juneau's service in 2008 was similarly inconvenient.

As described in the Black & Veatch/AEA RIRP, the Railbelt grid is made up of two types of distribution systems: transmission systems, which deliver energy from power plants to distribution substations, and distribution systems that bring the energy from the substation to end-use consumers.

This dual grid allows for large power plants to operate in remote areas while delivering electricity to end-use consumers in service areas located many miles from the transmission facility. Smart Grids aim to improve this system by adding local grids that are smaller and more manageable, and therefore more reliable and efficient.

There is no official definition of what makes up a Smart Grid. According to the National Energy Technology Laboratory (NETL) a Smart Grid looks like this:[171]

- Self-healing from power disturbance events;
- Enabling active participation by consumers in demand response;
- Operating resiliently against physical and cyber attack;
- Providing power quality for 21st century needs;
- Accommodating all generation and storage options;
- Enabling new products, services, and markets; and
- Optimizing assets and operating efficiently.

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[170] New York Times, http://greeninc.blogs.nytimes.com/2009/09/21/smart-grid-project-cuts-electricity-usage/.

[171] http://www.netl.doe.gov/moderngrid/.

The result is a power grid that includes additional, decentralized sources of power to serve local areas, and adapts to local conditions and demand issues. Smart grids do not replace existing transmission and distribution facilities, but, if properly designed, tested, and implemented, have been shown to increase efficiency.

One aspect of a Smart Grid that is key to meeting demand more efficiently is Advanced Metering Infrastructure (AMI). Energy prices, which are calculated in real-time, respond to increases in demand with spikes in prices. AMI technologies send signals to end-use appliances, when energy use and/or peak load prices reach a certain level, by communicating directly with the appliances and adjusting their power usage according to the customer's typical usage. With proper technology, this can be controlled by the consumer, or by the utility.[172]

With AMI technology, Smart Grids operate intelligently, smoothly, reliably, and responsively. Large-scale energy storage, efficient building and appliance standards, use of existing infrastructure, energy efficiency improvements, advanced sensing and monitoring, integrating renewable sources of energy, and enabling hybrid and electric vehicles to plug-in anywhere in the region will be essential to the modern "smart" grid.

The Smart Grid technology will add to the matrix of solutions Alaska's Railbelt region needs to increase global competitiveness and security, reduce negative environmental and health impacts, maintain affordability, boost the regional economy, and create an electricity grid that is reliable and efficient.[173]

[172] *The Smart Grid: An Introduction*, Department of Energy. September 2008.
[173] *Modern Grid Strategy*, National Energy Technology Laboratory (NETL). Retrieved November 9, 2009. http://www.netl.doe.gov/moderngrid/.

Financing

Financing Strategies Overview

In addition to the many programs offered through the Railbelt region's utilities, Alaska is already home to one of the nation's leading energy efficiency finance programs—the Alaska Housing Finance Corporation (AHFC). With a strong track record in providing financing for residential energy efficiency improvements, AHFC is poised to enter into new agreements to extend its expertise to the commercial sector.

In addition to AHFC, Alaska also hosts local offices of several, national energy service companies (ESCOs), such as Siemens, Johnson Controls, and Honeywell. These ESCOs offer Alaskan institutions opportunities to invest in energy efficiency improvements, by financing the related costs through sharing in long-term savings.

Nationally, several aspects of energy efficiency have been clearly identified:

- Financing is one of the barriers, but not the only barrier.
- Public support for loan programs is key.
- New financing mechanisms have little to no experience.
- Current financing options have not been able to fully support those most in need of efficiency improvements, e.g., those with low incomes, fixed incomes, and renters typically have higher energy cost burdens, while their residences or businesses have higher energy usage from poor insulation, leaks, inefficient equipment and appliances, etc. [174]

Utilities and policy makers can do much more to ensure effective and successful financing options, as suggested in the ***REEL in Alaska Recommendations*** Section on page 7, above, by:

- Conducting outreach to raise public support and address any remaining non-financial barriers;
- Implementing proven financing mechanisms such as decoupling, on-bill loans and tariffs, and property tax based repayment mechanisms; and
- Offering financing options to lower income communities who are often most in need of the improvements.

Currently seven popular energy-efficiency financing strategies are used throughout the United States. Six of these are shown in Table 3, below, plus government funded revolving loan funds, which are described in the subsequent sub-section by that name:

[174] Valdez, Roger. "Keeping PACE with energy efficiencies." Sightline Daily. 20 November 2009. http://daily.sightline.org/daily_score/archive/2009/11/20/keeping-pace-with-energy-efficiencies.

Table 3. Summary of Popular Financing Mechanisms.[175]

Financial Assistance Type	Program	Target Customer	Transaction Point Opportunity	Source of Capital, How Secured	Terms/ Payment	Credit Quality/ Enhancements
Third Party Loan	Keystone HELP; Colorado Clean Energy Finance Program	Residential	HVAC purchase/Whole House retrofit	State Treasurer	Typical loan is 5-7 year term. Rates vary 5% to 9%.	Loss reserve available to lender that backs up loans
On-Bill Loan	Manitoba Hydro	Residential	Equipment purchase	Utility	4.9%	None.
	United Illuminating; Sempra Energy Utilities	Small Business	Energy retrofit	Utility	Negotiated	In CT, state's public benefit program backs up loans.
On-Bill Tariff	Midwest Energy	Residential	Energy retrofit	Utility	180 months residential; 120 months commercial	None
Special Charge-based Financing	The Babylon Project	Residential	Energy Retrofit	Solid Waste Fund	3% interest loan; term tied to measure life	Failure to pay results in obligation on property tax bill; ultimately, foreclosure.
Property Tax Based Financing	BerkeleyFIRST	Residential	Solar PV install	Bonding + Private Investor	Up to 20 years	Failure to pay results in foreclosure; property tax has highest priority for payment.
	ClimateSmart	Residential & Small Commercial	EE Retrofits and RE installations	PAB & Municipal Revenue Bonds	15 years	
Energy Efficient Mortgage Loan	Colorado ENERGYSTAR Mortgage	Residential	Home purchase	Bank and State of Colorado	Terms set by mortgage, but with incentive rate discount.	None noted

Recommended Financing Mechanisms

On-Bill Loan and On-Bill Tariff

Two of the most promising mechanisms for energy efficiency financing due to their ease of implementation are on-bill loans and on-bill tariffs. These two programs allow customers participating in energy efficiency upgrades to avoid the substantial cost of installation. Instead, the utility company pays for the initial upgrade and attaches a charge on the customer's monthly bill. By amortizing the cost of energy efficiency upgrades, utility companies are able to make them a feasible option for a much larger group of customers. This type of program not only makes energy efficiency appealing to a larger sector of the population but also makes the implementation of such a program

[175] Brown, Mathew H., and Beth Conover. *Recent Innovations in Financing Clean Energy*. Southwest Energy Efficiency Project. 2009. http://www.swenergy.org/pubs/Recent_Innovations_in_Financing_for_Clean_Energy.pdf.

less labor and cost intensive. Because customers already have a set billing system with the utility company it makes the addition of an energy-efficiency upgrade charge far simpler.

The major difference between on-bill loans and on-bill tariffs is where the burden of the debt is placed. On-bill loans place the burden of the debt on the customer and the debt must be repaid before the customer moves or sells the home. If the customer moves before the debt is repaid it is often possible to repay the loan through the increase in the home's value, resulting from the energy efficiency upgrades.[176]

On-bill tariffs place the burden of the debt on the meter or house instead of the customer. This typically allows for a much longer period for the customer to pay back the loan. It also allows the loan to be paid back by multiple customers. On-bill tariffs are appealing to the commercial and industrial sector because they amortize the payments over a longer period of time, allowing for a lower monthly payment. On-bill tariffs also allow renters to participate and benefit from energy efficiency upgrades and loan programs due to the fact that on-bill tariffs can easily be transferred between multiple owners or renters in both residential and commercial sectors. The advantages and disadvantages to each financing mechanism are shown in Tables 4 and 5.

Table 4. Advantages and Disadvantages of On-Bill Loans.[177]

Advantages	*Disadvantages*
➢ Easy for customer/borrower to see effect of reduced energy consumption on overall bill. ➢ Can be a turnkey program for customer/borrower because it requires billing, and energy audit is accomplished through an existing mechanism and utility/customer relationship. ➢ Can easily be combined with utility rebate programs.	➢ Utilities are often reluctant to take on role of financing entity because of potential exposure to consumer lending laws and because alternations to billing systems are often complex and costly. ➢ Businesses or homeowners must pay off entire loan upon sale of home, and may not benefit from some measure of energy savings. ➢ Classified as debt, thus disqualifying some potential borrowers who cannot qualify for loans.

[176] Brown, Mathew H., and Beth Conover. *Recent Innovations in Financing Clean Energy*. Southwest Energy Efficiency Project. 2009. http://www.swenergy.org/pubs/Recent_Innovations_in_Financing_for_Clean_Energy.pdf.

[177] Brown, Mathew H., and Beth Conover. *Recent Innovations in Financing Clean Energy*. Southwest Energy Efficiency Project. 2009. http://www.swenergy.org/pubs/Recent_Innovations_in_Financing_for_Clean_Energy.pdf.

Table 5. Advantages and Disadvantages of On-Bill Tarriffs.[178]

Advantages	Disadvantages
➢ Long term of these financing arrangements (with obligation passed from one occupant to another) allows for low monthly financing surcharges that can provide customer/borrower with an immediate financial benefit – even without rebates and subsidies. ➢ Financing charges and amortization period are typically based on the life of the efficiency measure rather than an arbitrary personal loan term. ➢ Since the financing charge is not classified as debt, lower income borrowers or those who do not have the ability to take on new debt may still take advantage of these programs. ➢ Typically tied to disconnection for failure to pay, thus provides a secure revenue stream.	➢ Require utility commission approval of a new tariff. ➢ May not be appropriate for properties that change hands and function frequently (such as a small business facility that transforms from a restaurant to a retail shop to a Laundromat) with different energy consuming equipment in each case. ➢ Because the financing program is operated and financed by a utility, it effectively removes third party lenders and their financing capital and services from the programs.

On-Bill Loan Examples

Due to the availability of state and federal funding as well as the minimal initial upgrade cost, it has been possible for utility companies to implement on-bill loan systems in numerous cities across the U.S., as shown in Table 6.

[178] ibid. http://www.swenergy.org/pubs/Recent_Innovations_in_Financing_for_Clean_Energy.pdf.

Table 6. Summary of On-Bill Loan Programs Offered by Various Utilities Across the Country[179]

Program Name	Utility	Source of Funds	Interest Rate	Maximum Loan Amount	Maximum Term	Program Budget ($ millions)	Annual # of Projects
ERC Loan Program	Dixie Electric Cooperative (AL)	n/a[i]	5%	$5,000	60 months	n/a	n/a
Home Improvement Loan Program	First Electric Cooperative (AR)	n/a	5.5%	$15,000	60 months	n/a	n/a
On-Bill Financing Program	Southern California Edison (CA)	Public Benefit Funds	0%	n/a	60 months	n/a	n/a
On-Bill Financing Program	San Diego Gas and Electric (CA)	Public Benefit Funds	0%	$100,000 for business and $250,000 for government sector	60 months	n/a	n/a
On-Bill Financing Program	Southern California Gas Company	Public Benefit Funds	0%	$100,000 for business and $250,000 for government sector	60 months	$1.25	n/a
Small Business Energy Advantage	United Illuminating Company (CT)	Public Benefit Funds	0%	n/a	36 months	$1.6	310
Small Business Energy Advantage[ii]	Connecticut Light and Power (CT)	Public Benefit Funds	n/a	n/a	30 months	$7.5	955
Small Business Energy Advantage	Western Massachusetts Electric (MA)	n/a	0%	n/a	n/a	n/a	n/a
Small Business Program	National Grid (MA, NH and RI)	Public Benefit Funds	0%	$50,000	24 months	$9.7	1,625

[i] n/a = information not available.
[ii] This program is in transition; the utility currently offers a loan to its customers but sends two bills, one for the loan and one for the utility bill. The utility is currently making the computer system changes necessary to put the loan on the utility bill. (Steve Bruno, Connecticut Light and Power, personal Communication, June 2008).

Connecticut's United Illuminating Company (UI) provides its commercial customers with various on-bill loan payment options that allow them to finance energy efficiency upgrades. In order to finance the program UI uses funds from the Connecticut Energy Efficiency Fund and provides rebates for up to 40% of the total project cost. This program is one of the longest running on-bill loan programs in the United States and has completed energy efficiency upgrades to nearly 5,500 customers.

[179] Brown, Mathew. *Paying for Energy Upgrades Through Utility Bills.* Alliance to Save Energy. http://ase.org/uploaded_files/5476/On-Bill percent20Loans percent20- percent20Final.pdf.

Table 7. Summary of Connecticut's United Illuminating Company program.[180]

Program focus:	Energy efficiency improvements in small businesses for measures identified in an energy audit.
Mechanism:	Business loans paid through the utility bill.
Source of capital:	Utility funds with state public benefit funds available to cover loan defaults.
Active Since:	2000
Notable:	On bill financing combined with rebates to offer immediate financial benefits to small businesses. Relationships with contractors are well developed.
Challenges:	Continued evolution of contractor relationship. Program has been so successful that it is hitting its utility commission-determined dollar cap of $4.5 million.
Website:	www.uinet.com/uinet/connect/UINet/Top+Navigator/Your+Business/

A study done by the Alliance to Save Energy states that Connecticut's United Illuminating Company on-bill loan programs directed at "commercial and industrial customers with an average peak demand of 150 kW or less… has been in operation since 2000, has paid out $6.9 million in rebate incentives for energy efficiency while loaning $21 million through the on-bill financing program."[181] The study also presents the payment and payback for a hypothetical loan program, see Table 8, below.

[180] Brown, Mathew H., and Beth Conover. *Recent Innovations in Financing Clean Energy*. Southwest Energy Efficiency Project. 2009. http://www.swenergy.org/pubs/Recent_Innovations_in_Financing_for_Clean_Energy.pdf.

[181] Brown, Mathew. *Paying for Energy Upgrades Through Utility Bills.* Alliance to Save Energy. http://ase.org/uploaded_files/5476/On-Bill percent20Loans percent20- percent20Final.pdf.

Table 8. Hypothetical Payback Periods and Monthly Payments for On-Bill Loans.

Assumptions:

Annual Energy Savings	42,301 kWh
Annual Energy Cost Savings	$6,927
Monthly Energy Cost Savings	$577

Assumed Loan Term	16 Month Term	24 Month Term	36 Month Term
Material Costs	$9,204	$9,204	$9,204
Labor Cost	$6,571	$6,571	$6,571
Tax (CT 6%)	$947	$947	$947
Total Project Cost	$16,722	$16,722	$16,722
Approved UI Rebate	$7,887	$7,887	$7,887
Net Total Project Cost	$8,835	$8,835	$8,835
Monthly 0% Loan Payment	*$552*	*$368*	*$245*
Difference Between Energy Cost Savings and Monthly Payments	*$25*	*$209*	*$332*

Dennis O'Connor, United Illuminating Company, June, 2008

It is important to note that the difference between the energy cost savings and the monthly payment dramatically increase if the payback period is extended from a 16-month term to a 36-month term. This illustrates the fact that energy efficiency upgrades are long-term investments and should by viewed as such by the commercial and industrial sectors. These long-term, capital investments belong on the balance sheet, not on the income statement.

A small business in Connecticut participated in an on-bill loan program enabling the building owner to "install high performance lighting, light-emitting diode (LED) exit signs, evaporator fan controls, door heater controls, and evaporator fan motor replacements (for refrigeration)."[182] The monthly costs and savings of the program are shown in the Table 9, below.

[182] Hyams, Michael. *"On-Bill Financing" for Energy Efficiency*. Columbia University. April 2009. http://www.sipa.columbia.edu/energy/researchprograms/urbanenergy/documents/On percent20bill percent20Financing percent20FINAL.pdf.

Table 9. Example of Small Business On-Bill Financing.[183]

Total Project Cost (with sales tax)	$20,968
Existing State of Connecticut lighting upgrade rebate	- $4,333
Existing State of Connecticut refrigeration upgrade rebate	- $3,579
Net cost to customer	$13,056
Estimated annual energy savings due to efficiency upgrades	$8,315
Estimated monthly energy savings due to efficiency upgrades	$693
Monthly On-Bill Loan Payment Options	
Option 1: 0% for 20 months	$653 = Net savings $40/month
Option 2: 0% for 27 months	$493 = Net savings $200/month

Southern California Gas provides residential and non-residential customers with an option of an on-bill loan program.

Residential Customers:

- 0% interest, unsecured.
- Loan amount: $5,000 to $100,000 per meter.
- Maximum project payback period (based on projected annual energy savings) is five years.

Non-Residential Customers:

- Loan amount: $5,000 to $250,000 per meter.
- Maximum project payback period (based on projected annual energy savings) is ten years or useful equipment life, whichever is shorter.[184]

On-Bill Tariff Examples

One example of the on-bill tariff is the Pay-As-You-Save (PAYS) program. The PAYS program allows homeowners to install energy efficiency improvements to their homes with no up front cost or debt obligation. The installation cost is provided by the local utility company and is eventually recovered through payments made on the customer's monthly utility bill. However, the monthly payment is always less than the product's estimated savings, allowing the installation to benefit both the utility company and the customer. It is also important to note that the payment is attached to the house or meter and not the individual customer, thus preventing individual customers from being unduly burdened by the debt of the installation.

There are three critical components of a PAYS program:

1. A tariff assigned to a meter location, not to an individual customer;
2. Billing & payment on the utility bill with disconnection for non-payment; and
3. Independent certification that products are appropriate & savings estimates exceed payments.[185]

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[183] ibid.

[184] Southern California Gas Company. *On Bill Financing*. 2009. http://www.socalgas.com/business/rebates/onBillFinancing.html.

[185] PAYS America. *What is Pay As You Save?*. March 2005. http://www.pge.com/includes/docs/pdfs/about/rates/rebateprogrameval/advisorygroup/intro2pays.pdf.

The New Hampshire Electric Cooperative (NHEC) and Public Service Company of New Hampshire (PSNH) used PAYS to fund the town of Stratford's street lighting change out program.[186] The effort required an initial investment of $13,050 to change out the lights. Results from the program saved an estimated $6,300 annually, with a profitable return on investment in just over 2 years. A member of the Selectboard said, "We could not have done it without PAYS." Despite the robust savings, voters had turned down this project just a few years before. However, the PAYS project did not require voter approval and the town of Stratford was able to receive substantial annual savings.[187]

In Lincoln, NH, Forest Ridge Condominium replaced aging dehumidifiers for their residents. By using the PAYS program, the Forest Ridge Condominium pays $530 per month with a net savings of $460 per month from installing the system.

The How$mart® program implemented by Midwest Energy in Kansas is an example of a successful implementation of the on-bill tariff system used to encourage customers to install energy efficient upgrades in their homes. The energy efficiency upgrade is initially funded by the utility that then attaches a charge to the existing costumer's monthly energy bill; avoiding the upfront capital cost for improvements. The charge is typically less than the energy savings, so the customer still ends up saving money overall. This allows for a program that benefits both the customer and the utility company. Additionally, the liability for the monthly payment is attached to the home and not the individual customer allowing the payments to be amortized over a long period of time. The project has been highly successful, with an "average surcharge [of] $39.94 and average estimated savings [of] $49.02." per month."

Table 10. Summary of How$mart Program.

Program focus:	Energy efficiency improvements, primarily implemented in homes, based on audits.
Mechanism:	Surcharge on utility bill; no loan required.
Source of capital:	Utility and Kansas Housing Resources Corporation.
Active Since:	2007
Notable:	Repayment through surcharge on utility bill allows for long amortization period. Operated through contractors and utility staff.
Challenges:	Contractor relationships and notification of new owners/occupants of residences.
Website:	http://www.mwenergy.com/howsmart.aspx

[186] ibid.
[187] ibid.

Property Tax and Fee-Based Financing

Property tax and fee-based financing are effective energy efficiency financing mechanisms that have been successfully implemented in cities throughout the United States. The Southwest Energy Efficiency Project states, "Local government provides financing for these loans, and borrowers (who are typically property owners) pay the loan back through a surcharge on their property tax or as part of their municipal service charges (a sewer or solid waste bill, for example). The local government typically places a lien on the property. When the homeowner sells the property, the loan repayment obligation is transferred to the new homeowner."[188]

A similar financing method attaches the liability for the energy efficiency loan to the home rather than the customer. This allows the payments to be amortized over a longer period of time due to the fact that they do not have to be paid off when the house is sold. Instead, the payments can be transferred to the subsequent owner.

Table 11. Advantages and Disadvantages of Property Tax or Municipal Fee-Based financing.[189]

Advantages	*Disadvantages*
➢ Long term of these financing arrangements (with obligation passed from one occupant to another) allows for low monthly financing charges.	➢ Often requires state authorizing legislation.
➢ Because of lien placed on property (in case of property tax-based mechanism) and high priority in case of foreclosure, loans are more secure than unsecured loans referenced above, and may have a lower cost of capital as a result.	➢ Interest rates are fixed, but in the existing interest rate environment, may be higher than those available to homeowners who can use a home equity line of credit.
➢ Does not require proof that homeowners have equity in their home in order to qualify.	➢ Requires significant commitment on the part of local government to establish infrastructure to administer program – including loan origination and servicing, property owner qualification, staffing, etc.
➢ Interest costs for property tax mechanism should be tax deductible in most cases for borrower.	

Projects such as these can get a jump-start from funds provided by the local government Energy Efficiency and Conservation Block Grants (EECBG) program.

Property Assessed Clean Energy (PACE) financing is a strategy used by local governments to help fund energy efficiency improvements and renewable energy technologies for homeowners. PACE is a version of on bill financing where payments are attached to a homeowner's property tax. The payment is spread out over time and when the home is sold, the new owner will continue to pay back the local government. The local government funds the program by selling bonds, often within local or regional markets.

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[188] Brown, Mathew H., and Beth Conover. *Recent Innovations in Financing Clean Energy*. Southwest Energy Efficiency Project. 2009. http://www.swenergy.org/pubs/Recent_Innovations_in_Financing_for_Clean_Energy.pdf.

[189] Brown, Mathew H., and Beth Conover. *Recent Innovations in Financing Clean Energy*. Southwest Energy Efficiency Project. 2009. http://www.swenergy.org/pubs/Recent_Innovations_in_Financing_for_Clean_Energy.pdf.

Several states and municipalities have implemented PACE type programs across the country. New York passed PACE legislation, Boulder County, Colorado offered a PACE program in 2009, and Oregon just passed HB 2626 for PACE legislation.[190]

Table 12. Sample Statistics on Existing Property Tax and Fee-Based Municipal Financing Mechanisms.[191]

	Berkeley, CA –FIRST	Annapolis EZ	Sonoma County	Boulder, CO – ClimateSmart Loan Program	Palm Desert, CA - Energy Independence Program	Long Island Green Homes Program, Babylon, NY
Program Launch Date	Nov-08	Nov-08	Apr-09	Apr-09	Oct-08	Aug-08
Current Status	38 projects financed; only $1.5 MM avail	Pilot - working on contracts	Approved - for energy and water improvements	517 projects committed	End of Phase 2; 206 applications; maxed out financing	108 projects in queue; $1.6 MM still available
eligible (non-rental) units	21436	8647	111896	81180	23430	59200
participation rate	0.177%			0.637%	0.879%	0.182%
Funding source	Municipal revenue bonds; microbonds	local banks	County Treasury Notes at 5% above UST	Tax-exempt + private activity bond repaid through special fee on HH property tax bills	Phase I: City's General Fund ($2.5 million); Phase 2: $5 MM in Bond Issuance	municipal solid waste revolving fund
$ committed to program	$1.5 MM pilot Phase II will be larger (75 residential, 25 commercial)	$1.5 MM	$5 MM	approved to sell up to $40 MM bonds, including $14 MM in Tax Exempt bonds	$7.5 MM	$2 MM from solid waste reserve fund acts as revolving fund; $.5M for solar
interest rate	7.75%	5.50%	8.50%	6.75%	7%	3%
term	20 yrs	20 yrs	10-20 yrs (if over $5000), 5 yrs if < $5000	15-20 years	up to 20 years	based on matching savings with payments
Admin Fee paid by PO	1-2% total loan value	$250	5%	$75	$200	3% interest rate covers admin costs
Other expenses			$150 onsite inspection fee; title check of $65-$215	1-2% total loan value for loan processing fee	$360 title insurance policy	$250 audit cost

In the spring of 2009 the City of Boulder, Colorado began the implementation of the ClimateSmart program. The program started with an initial investment of $40 million financed by two bonding mechanisms, Municipal bonds and Private Activity Bonds. By attaching a loan to the property tax of participating households and businesses the ClimateSmart program makes it possible for residential and commercial customers to upgrade the energy efficiency of their homes or buildings.

[190] Valdez, Roger. "Keeping PACE with energy efficiencies." Sightline Daily. 20 November 2009. http://daily.sightline.org/daily_score/archive/2009/11/20/keeping-pace-with-energy-efficiencies.

[191] Bailey, Mark and Claire Broido Johnson. *Innovative Energy Efficiency Financing Approaches.* U.S. Department of Energy. 2009. http://www.eecbg.energy.gov/Downloads/EECBG_Innovative_EE_Financing_Approaches_Webcast_060109.pdf.

Table 13. Summary of ClimateSmart Loan program.[192]

Program focus:	Greenhouse gas emissions reductions through energy efficiency and renewable energy investments by residents and businesses.
Mechanism:	Loan is attached to property tax bill as a special assessment that transfers with the property. Obligation is senior to primary mortgage.
Source of capital:	Financing provided through Municipal Bonds and Private Activity Bonds. County provides debt security. No general duns obligations.
Active Since:	First round of loans made in April 2009, and bonds sold May 2009. Second round to be made in September 2009, with bonds to be sold in October 2009. Commercial loan applications will begin in fall 2009 with a target bond sale of February or March 2010.
Notable:	Level of initial capitalization higher than other programs at $40 million. Default rate far below 1%. County negotiated program to work through six separate utilities operating within the political boundary, and 10 municipalities opted in by ordinance.
Challenges:	If the ClimateSmart program grows significantly, it may stretch the capacity of a county government agency to process a much larger loan volume.
Website:	www.bouldercounty.org/bocc/cslp/

Decoupling—"Bills Not Rates"

The principle of decoupling is fairly simple: "decouple" the rate charged by the utility, from the amount of electricity delivered to the customer. Pay attention to the total amount people pay on their bills, not the rate they pay per kWh—**bills, not rates**.

For example, a customer whose bill is usually $50 per month will be satisfied if their bill goes down to $45. They don't particularly care if they used 50% less electricity, and paid 40% more for what they used:

Electricity Used	Amount Charged	Total Due
500 kWh	$0.10/kWh	$50.00
250 kWh	$0.18/kWh	$45.00

As long as the customer doesn't have to pay more on their BILL, they're generally not going to be concerned about the RATE. There are some complex calculations to be completed, regarding utility margins, fuel savings, return on energy efficiency loans, which will require specific negotiations among regulators, legislators, utilities, and advocacy groups, to determine exactly the mix and distribution of resulting savings, but the basic concept remains the same—as long as consumers' bills remain the same or go down, they will be likely to support efficiency improvements.

Under traditional revenue structures the money that a utility makes is based on the amount of electricity sold to consumers and the rate at which that electricity is sold, plus various fees and charges. Using this approach the rate at which electricity is sold remains fixed, while the amount of electricity sold and the total revenue fluctuate (until the utility negotiates acceptable rate increases with the local regulating authority, if there is one). If consumers use less electricity the revenue that utilities receive will decrease.

Under decoupling, utilities receive stable revenue, by changing the rate charged for electricity, as the amount of electricity sold changes. **With decoupling, the revenue**

[192] More information on Boulder's Climate Smart program is available at: http://www.beclimatesmart.com

stream is not directly dependent on the amount of electricity sold. Utilities receive approximately the same amount of money regardless of successful efficiency efforts. If properly organized, decoupling allows utilities to cover their margin costs, while selling less electricity. Through this approach utilities become active participants in improving electricity efficiency, by encouraging their consumers to shift towards more efficient practices and, in some cases, providing the capital to consumers, with various repayment options.

Alaska allows a similar procedure: Alaska Statutes 42.05.381(e) and 3 AAC 48.700 to 3 AAC 48.790 provide for a simplified rate filing process for electric cooperatives that are subject to economic regulation by the Regulatory Commission of Alaska, aptly named "Simplified Rate Filing" ("SRF")–a procedure whereby utilities are permitted to submit a simplified rate filing, adjusting their rates up to 8% in any 12-month period, not to exceed a combined total of 20% in any 3-year period, to compensate for reductions in demand or increases in fuel prices. Because the SRF procedure is already in place, it is not necessary for Alaska's Railbelt region to engage in further decoupling policies, except as they may pertain to other utilities not regulated by the Regulatory Commission of Alaska.[193]

Twelve states have decoupling measures in place and another 26 are considering policy measures to allow decoupling.[194] Idaho Power has been involved in a three-year decoupling pilot program. The revenue that the utility receives is directly proportionate to the amount of electricity sold—if less electricity is sold, then the base revenues are small; but if more electricity is sold, then revenues are higher. In Idaho, each year, the utility can raise rates up to 3% if they do not receive at least $188 million in revenue.[195] If they receive too much money then the utility must also decrease the rate at which electricity is sold, to compensate.

For example, if Alaska's Railbelt region were to adopt this ***Roadmap***, and thereby increase efficiency by 3.3% per year, avoiding a drop in revenue of 3.3% would require a Simplified Rate Filing to adjust rates. Under Alaska Statute 42.05, the regulated utility would be permitted to increase rates by 3.3% to maintain its required operating margins.

Careful planning is required for this type of arrangement, to ensure that subsidies and additional incentives are made available to **low-income customers**, so that they can reap the benefits of increased efficiency, without bearing an unfair proportion of the costs. A Railbelt version of Alaska Energy Authority's Power Cost Equalization Program would be one model for this type of equalization.[196]

NW Natural, an Oregon gas company, has been decoupled since 2002. Because consumers have been using less energy as a result of the utility's conservation efforts, many of the staff members have been shifted from marketing to customer service.

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[193] http://rca.alaska.gov/RCAWeb/ForConsumers/GeneralInfo.aspx, and email communications between the authors and Chugach Electric Association.

[194] Smith, Rebecca. *Less Demand, Same Great Revenue.* Washington Journal. http://online.wsj.com/article/SB123378473766549301.html.

[195] Smith, Rebecca. *Less Demand, Same Great Revenue.* Washington Journal. http://online.wsj.com/article/SB123378473766549301.html.

[196] http://www.akenergyauthority.org/programspce.html

Rather than trying to sell more energy, the utility is focused on working with and meeting the end-use needs of the customer. In essence, they are moving from solely supplying energy, to providing energy services.[197]

Decoupling helped Puget Sound Power and Light convert from a laggard to a leader in energy efficiency. In its first decoupled year, the company's efficiency programs saved almost as much electricity as during the three previous years combined. In its second year, it boosted savings another 60% and single-handedly accounted for 40% of all electricity savings in the Northwest states—outdoing even the region-wide federal Bonneville Power Administration—at half the cost.[198]

Rural Cooperatives, Municipally-Owned Utilities, and Decoupling

Does decoupling apply to rural electricity cooperatives ("coops") and/or municipally owned utilities ("munis")? Most experts say, "No," for two reasons: First, decoupling was originally proposed to protect the profits of investor owned utilities. Coop and muni utilities do not have "profits"—coops and munis talk about "margins." Coops and munis have no private shareholders and no profits. Any revenue in excess of defined expenses is rebated to customers, either directly as rebate checks, through decreased rates, or through future investments. Since coops and munis have no profits, decoupling does not apply to protecting their non-existent profits. Second, as non-profit and/or publicly owned entities, most coops and munis are exempt from regulation by the public utility commissions or other jurisdictional entities that regulate for-profit, investor-owned utilities, and preside over decoupling policies.

Although the above conditions apply to Alaska's utilities—they are not-for-profit entities, and their non-existent profits are not subject to regulation by a statewide public utility commission—the Regulatory Commission of Alaska does set policies, which apply to the Railbelt Utilities. Fortunately, Statute 42.05 already allows regulated utilities to adjust rates by up to 8% per year, which is sufficient to accomplish the goals recommended in this ***Roadmap***.

Alaska's utilities and the State Legislature should not defer efficiency improvements because of issues of rates and pricing. They should simply ensure that successful implementation of efficiency improvements is orchestrated in such a way as to provide necessary revenue for utilities to meet margin requirements. For example, if the Railbelt utilities can successfully meet end use needs using 50% of the electricity delivered in the year 2000, then, planners and regulators need to be sure that measures are in place to allow the utilities to maintain operating margins, and to subsidize equitable distribution of efficiency improvements and their related savings. In addition, it is important that the efficiency improvements be funded directly by the utilities, by a "public benefit charge," and/or public subsidies, so that the utilities can derive additional revenue, to avoid having to increase rates.

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[197] Sightline Institute. *Clean Utilities: How to get there by decoupling.* http://www.sightline.org/research/sust_toolkit/solutions/decoupling-utilities-seperating-profits-from-energy-use.

[198] Sightline Institute. *Decoupling Turbocharging Efficiency Programs.* 21 January 2009. http://www.sightline.org/research/energy/res_pubs/Decoupling-Primer-in-Template.pdf.

Decoupling would also allow opportunities for utilities to reposition their revenue streams, to include other services, in addition to charging for kWh delivered, such as loan financing, "top ten" recommendations for most efficient technologies, technical assistance, and consumer education services.

In the United States Energy Independence and Security Act of 2007 (EISA 2007), non-regulated utilities (such as munis and coops) were required to consider a new proposed regulatory standard, which encourages utilities to align utility incentives with the delivery of cost-effective energy efficiency and to promote energy efficiency investments by customers.

An example of the language used by one municipal utility district, the Sacramento Municipal Utility District (SMUD) to mandate decoupling, in compliance with EISA 2007, is attached to this ***Roadmap*** as Appendix C.[199]

Briefly, the SMUD Board adopted the following provision: "In general, **the rates allowed to be charged by any electric utility shall align utility incentives with the delivery of cost-effective energy efficiency; and promote energy efficiency investments.**"

The Board further stipulated that the utility "shall consider removing the throughput incentives and other regulatory and management disincentives to energy efficiency; providing utility incentives for the successful management of energy efficiency programs; including the impact on adoption of energy efficiency as one of the goals of retail rate design, recognizing that energy efficiency must be balanced with other objectives; adopting rate designs that encourage energy efficiency for each customer class; allowing timely recovery of efficiency related costs; and offering home energy audits, offering demand response programs, publicizing the financial and environmental benefits associated with making home energy efficiency improvements, and educating home owners about all existing Federal and State [and local] incentives, including the availability of low-cost loans, that make energy efficiency improvements more affordable."

SMUD has also adopted a resolution mandating a 15% reduction in electricity consumption by 2018; inclining block rates that increase as usage increases; time of use (TOU) rates in conjunction with plans to roll out advanced metering infrastructure (AMI); and rate structure goals that: "reflect the cost of energy used; reduce on peak use; encourage energy efficiency and conservation; minimize "sticker shock" in transition from one rate design to another; offer flexibility and options; are simple and easy to understand; meet the needs of people with fixed low incomes and severe medical conditions; and equitably allocate costs across customer classes."

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[199] *Draft Sacramento Municipal Utility District Public Utility Regulatory Policies Act of 1978* as Amended by the *Energy Indepence and Security Act of 2007*, *Staff Report and Proposed Board Determination on the Rate Design Modifications to Promote Energy Efficiency Investments Standard*, viewed December 31, 2009 at http://www.smud.org/en/about/Documents/reports-pdfs/draft-rate-design-mod-EE-invest-standard.pdf

Other Funding Options for the Commercial and Industrial Sectors

Manufacturing Extension Partnership

The Manufacturing Extension Partnership (MEP) program is affiliated with the National Institute of Standards and Technology (NIST) and works with manufacturing companies to reduce costs and increase profits. Though MEPs do not necessarily concentrate on energy efficiency improvements they do provide a valuable resource for companies looking to reduce costs and increase profits, which can than be used to invest in energy efficiency improvements. During the 2004 fiscal year, 4,644 clients who worked with MEP reported:[200]

- $721 million in cost savings;
- $941 million invested in modernization, including plant and equipment, information systems, and workforce training;
- Increased or retained $4.5 billion in sales; and
- Created and retained 43,624 jobs."[201]

One of the methods for improving energy efficiency within the industrial sector encourages modernization of older, inefficient equipment. Clients of MEP show that these measures have dramatic impacts throughout the business in terms of cost savings and job creation.

The Oregon Manufacturing Extension Partnership (OMEP) has helped A.R.E Manufacturing, Inc. make significant improvements in operations. Some of the quantifiable gains OMEP has helped to make possible are:[202]

- Created 15 new jobs since beginning the Lean process.
- Over 50 employees have received Lean training.
- Average employee wage increased from $13.62 per hour to $15.54 per hour.
- Significant improvement in employee involvement and morale.
- Saved $300,000 due to improved practices and inventory reductions.
- Increased sales by $500,000.
- Increased on-time delivery from 75% to 96%.
- Decreased customer reject rates by 43%.

Energy Service Companies

Energy Service Companies (ESCO) offer financial services to ranges of businesses within the commercial and industrial sectors. Funding supports site assessments, energy efficiency and renewable energy project installations, maintenance energy management and building control.[203] Contractual agreements range from 7 to 10 years, where the commercial or industrial entity pays the ESCO back with savings earned from improved energy performance. These contracts are sometimes known as "performance contracts." Examples costs and benefits from ESCOs are shown in Tables 14 and 15.

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[200] NIST. *NIST Hollings Manufacturing Extension Partnership.* Fact Sheets from NIST. 2006. http://www.nist.gov/public_affairs/factsheet/mep_overview.htm.

[201] Ibid.

[202] OMEP. *A.R.E. Manufacturing, Inc*. Success Stories. http://www.omep.org/projects/are_manufacturing/index.html.

[203] Musser, Phil. *Utility-Affiliated ESCOs: Is the Honeymoon Over?*. Transmission and Distribution World. 2003. http://tdworld.com/business/power_utilityaffiliated_escos_honeymoon/.

It is important to note that ESCOs typically improve efficiency by only around 10-15% of energy usage when it is actually possible for them to increase efficiency up to 75%. (Consequently, it is important to recommend that ESCOs perform a more in-depth overhaul of energy efficiency improvements in the industrial sector.) The 10-15% reduction in energy usage that ESCOs typically invest in provides the quickest and highest-margin return on investment (ROI). Thus, ESCO's are often accused of "cream-skimming," while neglecting more comprehensive, less lucrative improvements. Consequently, it is necessary to require ESCOs to make improvements that cut closer to 75% of energy usage in order to make a complete overhaul cost effective. By cutting closer to 75% of energy use it is possible to balance the improvements that provide a large ROI with those that do not.

Table 13. Example Cost and Benefits for Institutional ESCO Projects.[204]

Market segment	N	Total project costs (10^6 US$)	7% discount rate: Direct economic benefits (10^6 US$) gross	net	Benefit/cost ratio 25 val	median	75 val	10% discount rate: Direct economic benefits (10^6 US$) gross	net	Benefit/cost ratio 25 val	median	75 val
K-12 schools	289	714	803	88	0.7	1.0	1.7	633	-81	0.5	0.8	1.3
State/ local gov't	159	276	581	305	1.0	1.7	3.0	471	195	0.9	1.4	2.4
Univ./ colleges	100	301	809	508	1.2	1.7	3.1	637	336	0.9	1.4	2.4
Federal gov't	58	153	280	126	0.9	1.7	3.2	225	72	0.8	1.4	2.6
Health/ hospital	134	136	365	229	1.6	2.3	3.8	295	159	1.3	1.9	3.3
Public housing	31	96	140	45	0.7	1.5	1.8	114	18	0.6	1.2	1.4
Institutional sector	771	1677	2978	1301	0.9	1.6	2.5	2375	698	0.7	1.3	2.0

Table 14. Example Costs and Benefits for Private Sectors ESCO Projects.[205]

Market segment	N	Total project costs (10^6 US$)	10% discount rate: Direct economic benefits (10^6 US$) gross	net	Benefit/cost ratio 25 val	median	75 val	15% discount rate: Direct economic benefits (10^6 US$) gross	net	Benefit/cost ratio 25 val	median	75 val
Commercial[a]	192	137	349	212	1.7	2.2	3.7	265	128	1.3	1.7	2.8
Industrial	76	95	181	86	1.3	1.8	2.7	136	41	1.0	1.4	2.2
Other[b]	41	28	47	18	0.8	1.8	2.7	34	6.3	0.7	1.3	2.0
Private sector	309	260	576	317	1.4	2.1	3.2	435	176	1.1	1.6	2.6

[a]Includes hotels/hospitality, retail space, and commercial offices.

[b]Includes residential and projects that were classified as "other" by the ESCO.

Siemens, a large energy service company, is performing the largest performance contract for Eastern Kentucky University to help them meet their goal of a 40% increase in energy efficiency. Rather than get taxpayers to fund energy improvements Siemens provides the University a loan and the University pays Siemens back from the savings incurred and at no time will the University's monthly payments exceed their current payments. According to the Associate Vice President for Capital Planning and Facilities Services for the university, James Street,

> *"We have seen very tangible results and have had a great deal of success with this project … the guaranteed energy savings performance project focuses on upgrades and retrofits to energy-intensive building systems across the campus including heating, ventilation [and air conditioning] systems, lighting and other systems that consume water and fossil-fuel based energy resources like electricity and natural gas. … Eastern's utility*

[204] Goldman, Charles, Nicole Hopper, Julie Osborn, and LBNL. *Review of U.S. ESCO Industry Market Trends: An Empirical Analysis of Project Data*. Environmental Energy Technologies Division. January 2005. http://eetd.lbl.gov/EA/EMP/reports/52320.pdf.

[205] Ibid.

bill is approximately $6.4 million annually … With Siemens help we will be saving nearly $8,000 a day in energy expenses and when you add that up, we're going to be cutting our on-campus utility consumption roughly in two."[206]

Providing Capital

In order to implement financing programs such as these it is necessary to have a source of funding for the initial investment. Fortunately, there is a variety of sources available to provide such funding. A study done by the Southwest Energy Efficiency Project states: "One of the innovations in recent clean energy finance programs has been to access new sources of public and private capital, including bank capital (through a loan), federal funds, and state treasury funding."[207]

Loans

Loans from private investors such as Bank of America and Wells Fargo Bank are available for funding energy efficiency programs.

Green Loans

If coming up with immediate capital is an issue, green loans have the advantage of requiring little or no down payment. Green loans are specifically designed for efficient and sustainable investments and can be supplied by a bank, the government, or a private party. Typically, they have a lower interest rate; lower minimum loan amount, or longer terms than standard loans. Sometimes, the incremental payments are designed so they can be made with the savings generated by the investment.

Entering into a loan situation that uses businesses credit will decrease the amount of credit available for other projects. As with any investment, cash flow will decrease, but in most cases it will be minimal as the savings from utility bills should cover the cost of the project. Also, since green loans were created to promote efficiency, they may be limited to specific projects, so recipients would be well advised to shop around to find the loan that meets individual needs. Subsequent study is required to determine which institutions offer these types of loans in Alaska's Railbelt region. As with any loan, there will be qualifications that must be met to obtain the loan.

Standard Loans

If a customer cannot set up a green loan, standard loans can be used. Like green loans, they involve incremental payments reducing upfront costs, and the interest is a possible deduction on the businesses taxes. However, standard loans involve higher interest rates, as well as down payment requirements that substantially increase the initial investment. Although savings should compensate for cash flow, the incremental loan payments will encumber available credit and decrease the ability to qualify for other investments within the timeframe of the loan. In order to obtain the loan, the customer will be required to meet the loan qualifications. The customer can apply for a loan through their current banking institution, or they can shop around for a loan that best fits their situation. If an individual business is having difficulty qualifying for loans, the Small Business Administration assists for-profit small businesses that cannot qualify for loans

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[206] Shannon, Ronica *EKU sustainability project already showing savings.* Richmond Register. 17 November 2009. http://www.richmondregister.com/localnews/local_story_321081653.htm.

[207] Brown, Mathew H., and Beth Conover. Op. cit.

through traditional lending sources, by supplementing the ability of certain lenders to provide them loans.

Federal Funds
New federal stimulus funds can be used to support energy efficiency loan programs. Boulder County is using some federal funds to cover a portion of a loan program's administrative costs in their Climate Smart Loan Program.

Revolving Loan Funds
The American Recovery and Reinvestment Act (ARRA) has made available funding totaling $3.1 billion for State Energy Programs (SEP).[208] One available source for ARRA funds is a long term financing mechanism known as revolving loan funds (RLF). The advantage of a revolving loan fund is that it does not require states to pay back loans within three years, which is typically required for loans provided by the ARRA. However, no additional loans may be made after the initial three-year period.

An RLF operates by making loans to borrowers, by following standard lending practices, and when the borrowers eventually repay the loans the money is returned to the RLF to be loaned out to additional borrowers. This gives the fund a longer shelf life, allowing it to benefit far more borrowers. The fund's capital base remains intact through fees and interest collected from borrowers. RLFs are typically used for specific purposes such as "affordable housing, historical preservation, energy efficiency, safe drinking water, and small business development."

Ratepayer-Supported Energy Efficiency Funds
According to the Consortium for Energy Efficiency, approximately $3.1 billion was used from ratepayers to support energy efficiency projects.[209] This money was either used by states or was directed by the states for use by local entities.

Utility companies, state agencies, and private administers typically operate these programs, through the use of tariffs, authorized by the state regulatory agency, that put a fee on electric and/or gas ratepayers. Ratepayer programs have the advantage of not having to be paid back to the funding source. Instead, various agencies are able to use these funds for a variety of energy efficiency projects. However, to maintain equity, it is often necessary to include a low-income subsidy program, to ensure that the on-bill tariff does not unfairly burden low-income customers.

[208, 11] Booth, Sam. *Revolving Loan Funds (RLF).* National Energy Renewable Laboratory. July 2009. http://www.eecbg.energy.gov/Downloads/Revolving_Loan_Funds_070609.pdf (accessed November 24, 2009).

[209] Brown, Mathew. *Funding Mechanisms for Energy Efficiency.* Alliance to Save Energy. http://ase.org/content/article/detail/5057.

INNOVATIVE FINANCING

Excel Energy

Xcel Energy is proposing a peak load pricing system to be used in conjunction with the smart grid currently being developed in Boulder, Colorado. If regulators approve the program it would be applied to a pool of 2,000 Xcel customers and would run from June 2010 to December 2011. For these residents electricity prices would be higher between the hours of 2-8 p.m. in order to reduce demand when it is at its highest.

Also, by encouraging customers to use more energy during the night as opposed to the peak hours of the day, it would allow them to use more wind energy, which is produced mostly at night, regardless of the changing demand.[210]

Babylon, New York

In Long Island, New York, the Babylon energy efficiency program is funded by a town code that defines carbon as a waste product of energy. In 2008 the town of Babylon was able to establish a Town's Solid Waste Fund of $2 million. The fund has been used to mitigate carbon emissions by financing energy efficiency upgrades in local residential homes. As with many of the other case studies this program has seen a positive return on investment. A report published by the Southwest Energy Efficiency Project states: "In the first year, the Town of Babylon audited 158 homes and completed energy efficiency retrofits on 98 of those. The average cost of improvements was $7,203, with average annual energy savings to the homeowner of $986. This yielded an average payback period of 7.8 years for these investments."[211]

Table 15. Babylon Energy Efficiency Program.[212]

Program focus:	Residential Energy Efficiency Improvements
Mechanism:	Municipal Special Charge. Program is based on a revolving loan fund with 3% interest.
Source of capital:	$2 million pilot from Town's Solid Waste Fund, through town code that defined carbon as a waste product from energy, thus allowing the fund to provide services to mitigate it. No additional tax or government giveaway provided. Program pays for itself with little or no cost to homeowners and taxpayers.
Active Since:	October 2008
Notable:	Creation of a new repayment mechanism not based on property tax or utility bill.
Challenges:	Contractor training and marketing are critical.
Website:	www.thebabylonproject.org

Clean Energy Deployment Administration (The Green Bank)

The Green Bank is essentially an "independent, government-sponsored enterprise to support, via loan guarantees, debt instruments and equity, the emergence of the U.S. clean-energy industry." The bank would provide capital for a variety of renewable energy and efficiency programs.

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[210] Environmental Leader. *Pilot Utility Pricing To Charge More During Peak Hours*. 2009. http://www.environmentalleader.com/2009/11/09/pilot-utility-pricing-to-charge-more-during-peak-hours/.

[211] Ibid.

[212] ibid.

The Clean Energy Deployment Administration starts with seed money provided by the government. The underwriting and financing is then shared with the private sector. The final step is an investment in energy efficient technologies and projects, renewable energy technologies and projects, and other low carbon technologies and projects.

The idea is that these investments will then pay back the governments initial investment and will provide an ROI on the investment made by the private sector.[213]

Clean Energy Victory Bonds (Green Bonds)
Green bonds are currently being implemented on the national level but it might shift to a municipal or state level. Green bonds are funded by private individuals, loaned to the federal government, and issued to those pursuing renewable energy and efficiency programs.[214]

Tax Credit Bond Options
Supported by the federal stimulus program, the IRS issues federal tax credits as payments to bond buyers.[215] The bonding authority is provided with options to raise money for any renewable energy and efficiency projects.

City Funds
Homeowners borrow money from the city to fund a residential renewable energy or efficiency project and then repay the loan back at low interest payments to the City.

Peak Load Pricing and Smart Grid Technology in Sequim, Washington

Research conducted on a small scale regarding the implementation of peak load pricing and smart grid technology has shown promising results. In Sequim, Washington 100 test houses implemented a smart grid system very similar to the one Xcel is beginning to implement in Boulder. The outcomes being hypothesized for the Boulder Smart Grid became a reality in Sequim. Through the use of peak load pricing the Sequim smart grid reduced consumer costs and at the same time cut costs for energy producers by smoothing out power peaks. The smart grid allowed Jerry Brous, a resident of one of the smart grid test homes, to program various appliances in his home to run at non-peak times while still giving him the option to override the system whenever needed. Through the use of peak load pricing the system encouraged Brous to use energy at non-peak times when prices were lower. Additionally, the implementation of the in-home panel made Brous more aware of the energy he was consuming throughout the day, thus reducing his overall output. The end result was a 15% decrease in Brous's monthly energy bill. The producer benefits associated with a smoother demand curve are also substantial. Roger G. Pratt, program manager at Pacific Northwest National Laboratory,

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[213] Pernick, Ron, and Clint Wilder. 2009. *Five Emerging U.S. Public Finance Models: Powering Clean-Tech Economic Growth and Job Creation*. Clean Edge, Inc. and Green America. http://www.greenamericatoday.org/PDF/FiveEmerging_US_PublicFinanceModels.pdf (accessed on October 27, 2009).
[214] Ibid.
[215] Ibid.

stated, "The total amount of power needed when demand was the greatest was cut by 15%."[216]

Peak Load Pricing and Consumer Surplus in Japan

In a study done by Isamu Matsukawa he shows that a voluntary peak load pricing scheme benefits both consumers and producers in Japan. He states that, "total surplus, excluding measurement costs, is estimated to have risen by approximately ten dollars per Japanese residential customer."[217] This increase in total surplus is a clear indication for the positive effect a peak load pricing scheme can have and as Matsukawa goes on to say is a much greater increase than had previously been estimated. Additionally, Matsukawa found that consumption during the peak periods greatly decreased when peak load pricing was implemented (See Time of Day (TOD) and Non-TOD Group Characteristics in the table, below).

Table 16: TOD and Non-TOD Group Characteristics[218]

TOD and Non-TOD Group Characteristics	TOD Households	Non- TOD Households
Total number of samples	279	92
Total number of electric water heaters	253	26
Total summer electricity consumption (kWh/month)	626.3	328.5
Average peak-hour consumption share (%)	35.6	66.0
Average annual income (US$100)	911.4	865.8
Average number of household members	3.9	3.6
Average square feet of residence	1705.6	1747.8
Average number of electric room air-conditioners	1.4	1.7
Average number of electric clothes dryers	0.3	0.3
Average number of electric space heaters	0.5	0.2

Peak Load Pricing Issues

Although, the potential savings associated with a peak load pricing scheme are considerable there are various obstacles still standing in the way of the widespread implementation of peak load pricing, such as state and local regulations as well as consumer willingness to allow varying energy prices to control their consumption.[219] However, in the study done by Isamu Matsukawa he shows that consumer elasticity of demand for electricity is high enough that it allows individuals to easily change their

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[216] Carey, J. *A Smarter Electrical Grid*. Business Week Online, 23, 329-355. 2008. http://web.ebcohost.com/ehost/detail?vid=1&hid=116$sid=ee5 7abe5-4058-4e52-824a-98 (accessed October 15, 2008).

[217] Matsukawa, I. *Household Response to Optimal Peak-Load Pricing of Electricity*. Journal of regulatory Economics, 20:3, 247-267. 2006. http://www.springerlink.com/content/p283374120375728/fulltext.pdf (accessed October 13, 2008).

[218] Ibid.

[219] Marcus, Alfred A. *Controversial Issues in Energy Policy*. California: Sage. 1992.

demand schedules for electricity.[220] In Matsukawa's study, the Japanese consumer's high elasticity of demand for electricity translated into benefits for both consumers and producers.

Equity is another issue. In order to ensure that a peak load pricing scheme is equitable towards those with lower incomes it is necessary to provide rebates funded by the increase in revenue resulting from the higher prices during peak periods.

Block Rates, Dynamic Pricing, and Feed-in Tariffs

Though not selected as preferred strategies for this ***Roadmap***, other jurisdictions have implemented block rates, dynamic pricing, and feed-in tariffs, as pricing incentives to inspire improved energy efficiency and stimulate local, renewable energy projects. All of these are worthy of further study to determine their usefulness in Alaska.

Split Incentives

Split incentives occur when the ability to accomplish a task is split between two or more parties.

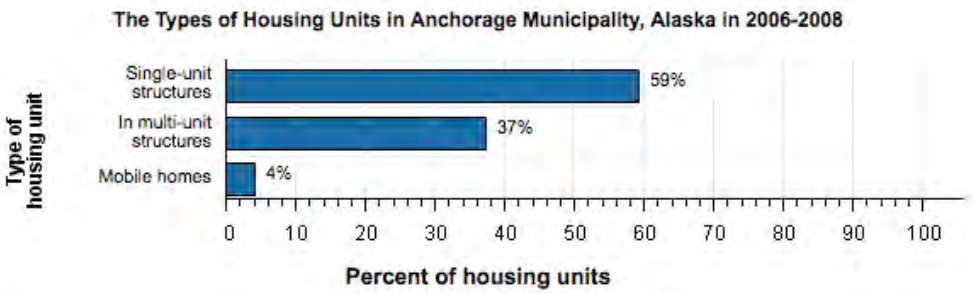

Figure 17. Types of Housing Units in Alaska.[221]

In Anchorage the majority of housing units are single-unit structures, 59%, with multi-unit structure representing 37%, and mobile homes 4%.[222]

The different parties are subject to contradictory rewards and as a result, do nothing. There are a variety of split incentives as described below.

In situations where an individual or business leases a residential or commercial space from a landlord, both parties might feel hesitant to make efficiency upgrades, if a majority of the cost savings goes into the pocket of the other party. For example, if a tenant pays a fixed rate regardless of how much energy is used, there is little incentive to reduce energy or retrofit a space the tenant does not own. Similarly, if the landlord pays nothing for utilities, he or she has little or no financial reason to increase the efficiency of energy use in the building. It is possible, however, to make upgrades that benefit both parties financially—often substantially. It just takes a little more effort and communication.

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[220] Matsukawa, I. Op. dit.

[221] U.S. Census Bureau, 2006-2008 American Community Survey. http://factfinder.census.gov/servlet/NPTable?_bm=y&-qr_name=ACS_2008_3YR_G00_NP01&-geo_id=05000US02020&-gc_url=&-ds_name=&-_lang=en.

[222] Ibid.

In addition to cost savings, there are other financial benefits as well: owners of efficient buildings prosper from increased property value and the ability to charge higher rent. Businesses in efficient spaces often experience heightened worker productivity due to the increased comfort, health, and well being of their employees. Residents in energy efficiency spaces often report greater comfort and satisfaction, which can increase the duration of tenancy. For commercial properties, both parties can publicize their environmental responsibility in their marketing materials for a stronger reputation and brand image.

In leased spaces, especially in multi-tenant buildings, the implementation of efficiency lags due mostly to the split-incentive barrier.[223] A study by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers found that this split-incentive barrier affects up to 90% of commercial leased office spaces.[224]

Landlords and tenants ignore efficiency possibilities due to contradictory rewards. Why change if the other receives the benefits? Done correctly all parties should benefit from implementing sustainability. Owners of efficient buildings prosper from increased property value and the ability to charge higher rent. Businesses in efficient spaces often experience heightened worker productivity due to the increased comfort, health, and well-being of their employees as well as decreased utilities.

[223] Edward Sullivan, *BOMA Helps Office Buildings Turn Green*, April 2, 2007, www.facilitiesnet.com/blogs/designconstruction.asp?BlogID=193&Blog=Design / Construction, 18 May 2007.

[224] American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), *Study of Market Failures' Effect on End-Uses of Energy Released,* www.ashrae.org/aboutus/page/1257#market, 18 May 2007.

Shared Incentives

Often, when an individual or business rents of leases space owned by another entity, the tenant pays the utility bills. This creates a shared incentive: the landlord owns the capital infrastructure, such as the building envelope, heating system, lighting fixtures, and windows, while the tenant pays the higher utility bills caused by inefficient aspects of the building. Tenant and landlord share the incentives to improve efficiency, but often, neither has the means or the desire to do so on their own.

For example, a tenant wants to decrease how much they pay towards their utility bills and improve their working environment with efficiency upgrades, such as increasing their use of day-lighting and replacing old equipment with efficient models. They pay the utility bills, but do not own the building or the equipment, such as the furnace. If the tenant wants to invest in efficiency improvements, they often don't have the capital required or won't be in the space long enough to reap profitable return on investments. So the tenant has only one part of the shared incentive to improve.

Conversely, the landlord may want to retain current tenants and gain new ones by making improvements to the building such as installing a better furnace and insulating the walls and attic. But the current tenants have no incentive to endure the disruption of construction, nor necessarily to share the resulting savings. If tenants are not involved, it is unlikely they will pay more in rent or sign a "green" lease that involves paying more for space, but less for utility bills, making it difficult for the landlord to recoup the costs.

It just takes a little effort and communication from both parties to share the workload and mutually benefit from the results.

Benefits to Landlords from Sharing Incentives with Tenants

It is easier for willing landlords to overcome split incentives, since they own the space. By involving tenants in the process, landlords are more able to contribute towards the suggested improvements. By participating in energy efficiency upgrades to their space, tenants can more invested in their space, causing them to treat it better.

Tenants are willing to pay more, renew their lease or extend it if they have cheaper utility bills and a more comfortable environment that offset the costs. With more vacant space now than in any time in recent history, having a building that is more efficient can be attractive to prospective tenants, who will save money overall and enjoyed increased comfort and productivity. For the same reasons, the building's property value will also increase. "As of 2006, [energy efficient] buildings were selling at price 30% above the non-energy efficient buildings, on average."[225]

[225] http://nreionline.com/green/green-buildings/.

AN EXAMPLE OF A SHARED INCENTIVES

The Coxsackie Antique Center, New York

Diane and Bill Johns owned an Antique Center in West Coxsackie, New York, which operated out of a rented space in a single-occupancy building. While the building's ambiance was quaint, cold drafts rattled through the old, un-insulated building all winter long. Not only were the energy bills high, but the shop would also lose customers in the winter because the building was uncomfortably cold.

The dissatisfied tenants approached their landlord and came up with a cost-sharing plan where the Johns' paid for new insulation in the building and the landlord covered the replacement of the existing roof.

The Johns' enjoyed a more comfortable building, which increased their sales and lowered their utility bills by over $400—which allowed them to recoup their costs in less than three years. The landlord now has a more valuable building where tenants are likely to stay longer.

When tenants work with their landlords they can reap the rewards from implementing efficiency measures. Landlord involvement enables permanent changes to be made. Since the landlord will also be benefiting from the improvements to the building, costs of implementation should be also be shared.

Systematic Shift

Tenants and landlords finding a way to work together is ideal, but sometimes one party will not cooperate. To prevent the split incentive barrier, as much as Alaskans dislike government regulation, such government regulations for energy efficiency similar to those for health codes create a responsibility for improvement. Regulations are already being considered in a number of regions of the U.S.

Tenants and landlords working together will help show legislators that efficiency regulations are important and desired. Landlords are already feeling the pressure from tenants: 65% of landlords believe tenants will cause them to "go green" within five years.

FOREIGN EXAMPLES OF FINANCIAL INCENTIVES

European Bank for Reconstruction and Development in Russia

Although the U.S. and Russian governments are different, Russian weather conditions are similar to Alaska's. Early in the fall of 2009, Russian President, Dmitry Medvedev, declared that he will be making bold commitments to increase energy efficiency in Russia. Like Alaska, Russia is known for using much more energy than necessary, especially in industry. Almost 50% of fossil fuel produced by Russia is lost due to outdated pipelines and machines, while at the same time Russian companies consume, on average, four times the amount of energy of similar companies in other countries.

Medvedev admits that state subsidies on energy contribute to Russia's extremely high energy intensity (ratio of energy use to GDP), and vows to take policy action by 2010.[226]

The European Bank for Reconstruction and Development (EBRD) has begun a $300-million lending program to large banks and their corporate clients who wish to undertake energy efficiency improvements in Russia. The EBRD found in a 2007 study that Russia has the ability to reduce energy consumption by 30% purely by implementing existing efficiency technologies that provide a profitable return on investment in 1 to 5 years. This room for improvement mainly stems from the fact that Russia uses three times as much energy in relation to their GDP as the United Kingdom, India, or Japan. To enact a strategy, EBRD established the Sustainable Energy Initiative, with a focus on energy efficiency, and has pumped over $5.2 billion into energy efficiency projects in Russia so far.[227]

Research, Development, and Deployment in Sweden

Like Alaska, Sweden has a very cold climate. But Sweden currently draws 26% of its energy from renewable sources, just as Alaska draws 24% from hydroelectricity. Although the Sweden still relies on oil products and nuclear power, great strides have been made in wind generation, electricity from combustible biomass and waste, and with hydropower. Due to the cold climate, Sweden has higher average energy consumption per capita than the rest of Europe, showing a similar situation to Alaska. Sweden's energy policy is based on two Energy Policy Agreements adopted in 1997 and 2002. Sweden recognizes in its policy strategy that energy efficiency is essential component of any successful energy strategy.

As part of its energy policy, Sweden has incorporated a network of energy taxes, tax rebates, subsidies, grants, community education, and funding for research and development of new technologies. All of these programs help to shift residents to a more efficient lifestyle. Some of the programs that are in place in Sweden include the Energy Efficiency Investment Program for Public Buildings, Sustainable Municipality Program, National Program for Energy Efficiency and Energy "Smart" Buildings, the Program for Energy Efficiency in Energy Intensive Industry, and investment support for conversion from direct heating to district heating, bio-energy, heat pumps, and solar heating.[228]

Now, Sweden is expanding its energy efficiency policy ideas to the entire European Union. On July 1, Sweden took office as the EU's President, which is a rotating political leadership position that lasts six months. Swedish Environment Minister Andreas Carlgren argues that Sweden is the first industrial country to forge a unified vision for reducing fossil fuel reliance. Sweden has outlined 75 measures in ten priority areas,

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[226] *Russia to boost energy efficiency*, United Press International. UPI.com, October 5, 2009. http://www.upi.com/Science_News/Resource-Wars/2009/10/05/Russia-to-boost-energy-efficiency/UPI-46831254779095/.

[227] *EBRD rolls out new Russian energy efficiency lending initiative*. Press Release, European Bank for Reconstruction and Development, July 14, 2009. http://www.ebrd.com/new/pressrel/2009/090714.htm.

[228] Material in this section unless otherwise noted, is from: *In-depth Review of Energy Efficiency Policies and Programmes of Sweden,* Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects, 2006.

including energy performance standards for appliances and electronics and energy standards for new buildings. Currently, Sweden is updating this plan and will have clear policy strategies for the EU in the winter of 2010. The European Commission has proposed a goal of 20% energy use reduction by 2020. Sweden agrees this is possible, and has described their EU environmental strategy as a "transition into an eco-efficient economy."[229]

Finland

> "From as early as the 1990s, Finland has employed a voluntary agreement scheme in a drive to promote energy efficiency. The practical measures boosted by the agreements such as energy audits and analyses subsidized by the government, provide companies and communities with an excellent means of ascertaining their own energy usage and the scope for improving it, as well as integrating improvements in energy efficiency in their daily operation. The government also subsidies certain related investments."[230]

Calgary, Alberta, Canada

A unique, public-private partnership in Alberta, Canada promotes the development of innovative opportunities for improving energy efficiency. In the spring of 2000, a non-profit program began the search for office space in Calgary. They leased and renovated 4,900 square-feet in the Connaught district, an affordable alternative to high-rent downtown properties. For this entity, the cost of renovating the space was comparable to leasing a conventional office in the Calgary market.

The landlord needed to be persuaded of the following before energy-efficient improvements could begin:

- Energy efficient design is mechanically sound and looks professional;
- The added energy-efficient features would save the building owner money; and
- The office could be a showcase for prospective lessees.

The non-profit originally signed a three- to five-year lease, which prompted them to choose furniture and carpet tiles that could be moved to another location in the future. They also considered moveable wall partitions, but the landlord ultimately required permanent walls.

The entire office was designed around the use of natural light. Glass walls around private offices and meeting rooms helped distribute natural light and provided a more open, pleasant feeling. A ribbon of self-adhesive obscuring film on the glass gave privacy to the occupants of the offices. Horizontal louver blinds on exterior windows helped manage daylight intensity. The blinds were mounted with a gap at the top to harvest daylight while maintaining privacy. The non-profit used lighter colors for the ceiling, window walls, and flanking walls to bounce daylight and reduce glare.

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[229] *Sweden Seeks to Steer EU onto Energy Efficient Path.* EurActiv.com, June 25, 2009. http://www.euractiv.com/en/energy-efficiency/sweden-seeks-steer-eu-energy-efficient-path/article-183378.

[230] Motiva Oy. *Finland Energy Efficiency Agreements 2008 – 2016*.

The lighting that the tenant installed uses one-quarter of the energy of the lighting in a standard office. The tenant saves $2,500 Canadian per year in lighting efficiency. Some of the lighting features used include:

- Highly efficient T-5 and T-8 fluorescent tubes with electronic ballasts. Specifying 300 to 500 lux (lux is a measure of light intensity), or 30 to 50 foot-candles (another light intensity measurement for ambient lighting. The old standard of 700 to1,000 lux (70 to 100 foot-candles) is actually too high for visual comfort, particularly when using computer screens.
- Individual task lighting at work stations.
- Occupancy sensors that turn lights off when a room is empty.

Policy And Programs

Innovative policies are bringing energy efficiency to the forefront almost everywhere. Countries, states, and local governments are making policy choices to guide their constituents toward energy efficiency for a variety of reasons, such as cost savings, regional and national security, jobs, and economic vitality.

Policies that can help improve energy efficiency include incentives, mandates, and regulations. Incentives encourage the use of energy efficient systems by providing financial or social compensation to individuals and organizations, such as subsidies, discounts, and loan programs. Mandates and regulations are rules put forth by government agencies, and can be most effective at the regional and state level, where policy can be adapted according to the circumstances of specific areas. The Renewable Energy Alaska Project (REAP), categorizes energy efficiency policies and programs into eight fields[231]:

1. Utility-sector and public benefits programs and policies;
2. Transportation policies;
3. Building energy codes;
4. Combined heat and power;
5. Appliance efficiency standards;
6. Lead by example in government facilities and fleets;
7. Research, development, and deployment; and
8. Financial and information incentives.

Effective legislative, regulatory administrative policy dictates and enables programs to implement the policy.

Existing recommendations and legislation from House and Senate Committees, AEA's REGA and RIRP studies prepared by Black & Veatch, and CCHRC's *Alaska Energy Efficiency Program and Policy Recommendations* are sufficient to establish legislative priorities.

Examples of policy legislation from other states are available at the following website: http://www.newrules.org/energy/rules/municipal-financing-renewables-and-efficiency

An example of policy for lighting has been implemented at the federal level to specify performance standards based on lumens per watt (U.S. Energy Independence and Security Act of 2007, also known as "EISA" requires that all lighting fixtures provide at least 45 lumens per watt by 2018).[232] Examples of programs to implement this policy are revised labeling requirements, to display lumens per watt (e.g. ENERGY STAR and recommendations of Pacific Gas & Electric Company to California Energy Commission, 2008), and "fee-bate" systems, that charge fees to purchasers of inefficient lighting products and appliances, then rebate the money to purchasers of more efficient technologies.

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[231] Renewable Energy Alaska Project. Retrieved October 23, 2009. http://alaskarenewableenergy.org/energy-efficiency/policies/.

[232] EISA 2007, Section 321 (a)(6) available at http://www.govtrack.us/congress/billtext.xpd?bill=h110-6

Demand Side Management Programs

Another example is Demand Side Management, or "DSM," programs that help to reduce overall energy use, on the consumer's side of the meter, especially during peak loads. Among other benefits, DSM is designed to relieve the pressure on local utilities and regional electricity producers, while potentially decreasing the market price during these "peak," high-demand, high-cost intervals, when electricity suppliers might have to purchase extra electricity at premium prices.

Some DSM programs that have been enacted by local governments and utilities require massive compact fluorescent light giveaways and rebates provided by utility companies for consumers and suppliers who adopt ENERGY STAR appliances, efficient lighting, efficient pumps and motors, or weatherization of buildings.

Many DSM programs also include methods of controlling efficiency in generation, load management, and load growth, which are not included in this ***Roadmap***. Originally, DSM programs were administered by local utilities. Now, DSM programs are more widespread, with government agencies and energy efficiency utilities taking part (energy efficiency utilities are a relatively new strategy for providing end-use improvements with a service model similar to providing electricity supply, as described elsewhere in this ***Roadmap***). In 1999, DSM offices in 459 large local utilities helped to save 50.6 billion kWh, representing 1.5% of annual U.S. electric sales.[233]

The U.S. Navy wants to take their commitment to the next level by committing to improve overall energy efficiency by 50%, much of which will be accomplished five years before the deadline, by 2015. Secretary of the Navy Ray Mabus has committed to transitioning the Navy to renewable energy for its buildings.[234]

The following examples were recognized as 2007 leaders in implementing energy and water efficiency in U.S. Navy and Marine fleets and buildings at the annual Secretary of the Navy awards. Naval Base Ventura County invested $13 million in energy and water efficiency measures such as day-lighting, compressor replacement, and other measures, which will save $1.7 million annually. These measures have reduced their energy use by 14% since 2003. In San Diego, Naval Base Point Loma achieved a 25% energy reduction since 2003 by coupling an enthusiastic energy awareness campaign with a new 57.8 kilowatt photovoltaic system and replacing old boilers with energy efficient ones. This $1 million investment is saving Point Loma $500,000 annually. These are a few examples of bases all over the country that are making financial and programmatic commitments toward energy efficiency.[235]

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[233] Energy Information Administration, Department of Energy. http://www.eia.doe.gov/cneaf/electricity/dsm99/dsm_sum99.html.

[234] Kraemer, Susan. *U.S. Navy to Cut Greenhouse Gas Emissions 50 percent by 2015*. Gas 2.0, October 16, 2009. http://gas2.org/2009/10/16/us-navy-to-cut-ghg-emissions-50-as-soon-as-2015/.

[235] *Navy Recognizes Outstanding Energy Programs.* U.S. Navy, October 23, 2008. http://www.navy.mil/search/display.asp?story_id=40475.

Utility Rebate Programs

Rebates and tax incentives for implementing energy efficient measures are available at utility, city, county, state, and federal levels. Some Railbelt utilities already offer rebates, such as GVEA's Builder$ense. AHFC also assists participants in their some of their energy efficiency programs with rebates.[236] Utilities use rebates to encourage individuals within their service territory to adopt more efficiency measures. Individuals normally use electricity to provide various services during certain times of the day, creating a peak load that could be reduced if those services were provided more efficiently. All fifty U.S. states with the exception of West Virginia host utility companies that offer energy efficiency financial incentives. Minnesota boasts the highest number—44 utilities offer a total of 81 financial incentives.[237]

For example, utility companies may apply to be an official partner of ENERGY STAR, shared program of the U.S. EPA and Department of Energy that has created a measurable standard for energy efficient products. ENERGY STAR products are 10-to-25% more efficient than the federal standard. In 2008, ENERGY STAR products saved consumers $19 billion on their utility bills. Partnership with ENERGY STAR enables businesses, utilities, energy efficiency utilities (such as the Energy Trust of Oregon), residential construction companies, manufacturers, and retailers of products to leverage the ENERGY STAR label, obtain financing so that ENERGY STAR products become more affordable, and qualify for rebates from manufacturers, energy efficiency utilities, utilities and governments, for purchasing ENERGY STAR products. Individual utilities may then supply residents of their service territories with residential energy efficiency rebates after the purchase of an ENERGY STAR product or another product that reaches an efficiency standard.[238]

Several of the Railbelt utilities are already working with ENERGY STAR and offering programs to their consumers. These include:

Chugach Electric Association (CEA)[239]

- "Consumer Guide to Home Energy Savings" American Council for Energy Efficiency.
- "EPA Home Energy Quiz" ENERGY STAR.
- "Home Energy Yardstick" ENERGY STAR.

Anchorage Municipal Light and Power (ML&P)[240]

- Green Star Lighting Energy Efficiency.
- "Home Energy Saver" ENERGY STAR.
- ENERGY STAR Partner.

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[236] See: http://www.akrebate.com/rebate_about.aspx

[237] Database for State Incentives for Renewables and Efficiency (DSIRE), Retrieved November 3, 2009. http://www.dsireusa.org/.

[238] ENERGY STAR. Retrieved November 3, 2009. http://www.energystar.gov/index.cfm?c=join.join_index.

[239] "Energy Saving Tips" Chugach Electric Association. 2008. http://www.chugachelectric.com/energy/energy_tips.html.

[240] "Save Energy" Anchorage Municipal Light and Power. 2007. http://www.mlandp.com/redesign/save_energy.htm.

Homer Electric Association (HEA)[241]

- Wise Watts + Kick-n-Can (Lighting Retrofits).
- "Together We Save" Touchstone Energy Savers (Energy monitoring).

Matanuska Electric Association (MEA)[242]

- ENERGY STAR partner.
- Advocates for ENERGY STAR label.

Golden Valley Electric Association (GVEA)[243]

- Energy $ense Program: Residential, Business, and Builder.
- "Together We Save" Touchstone Energy Savers.
- Phantom Appliances.

The Database of State Incentives for Renewables and Efficiency, referred to as DSIRE, a project of the North Carolina Solar Center is funded by the Department of Energy. DSIRE has sorted through the extensive network and depth of utility, state, and federal incentives and made the database searchable by state.

In Alaska, Golden Valley Electric Association offers Business $ense, a commercial incentive program. Commercial buildings that reduce their lighting loads through energy efficient lighting installation can receive up to $1,000 per kW and a maximum of $20,000.

Xcel Energy, a public utility serving several states in the mid-west, offers a series of residential energy efficiency rebates based on product performances for appliances such as water heaters, boilers, furnaces, air conditioners, building insulation, and evaporative coolers. Their rebates range from $40 for an efficient water heater all the way up to $500 for an air source heat pump. Xcel also offers various commercial rebates, as well.[244]

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[241] *Conservation and Energy Efficiency* Homer Electric Association. 2009. http://www.homerelectric.com/ConservationEnergyEfficiency/AskMrWiseWatts/tabid/124/Default.aspx and http://www.homerelectric.com/ConservationEnergyEfficiency/tabid/60/Default.aspx.

[242] *Energy Conservation* Matanuska Electric Association. 2009. http://mea.coop/index.php?option=com_content&task=section&id=18&Itemid=154.

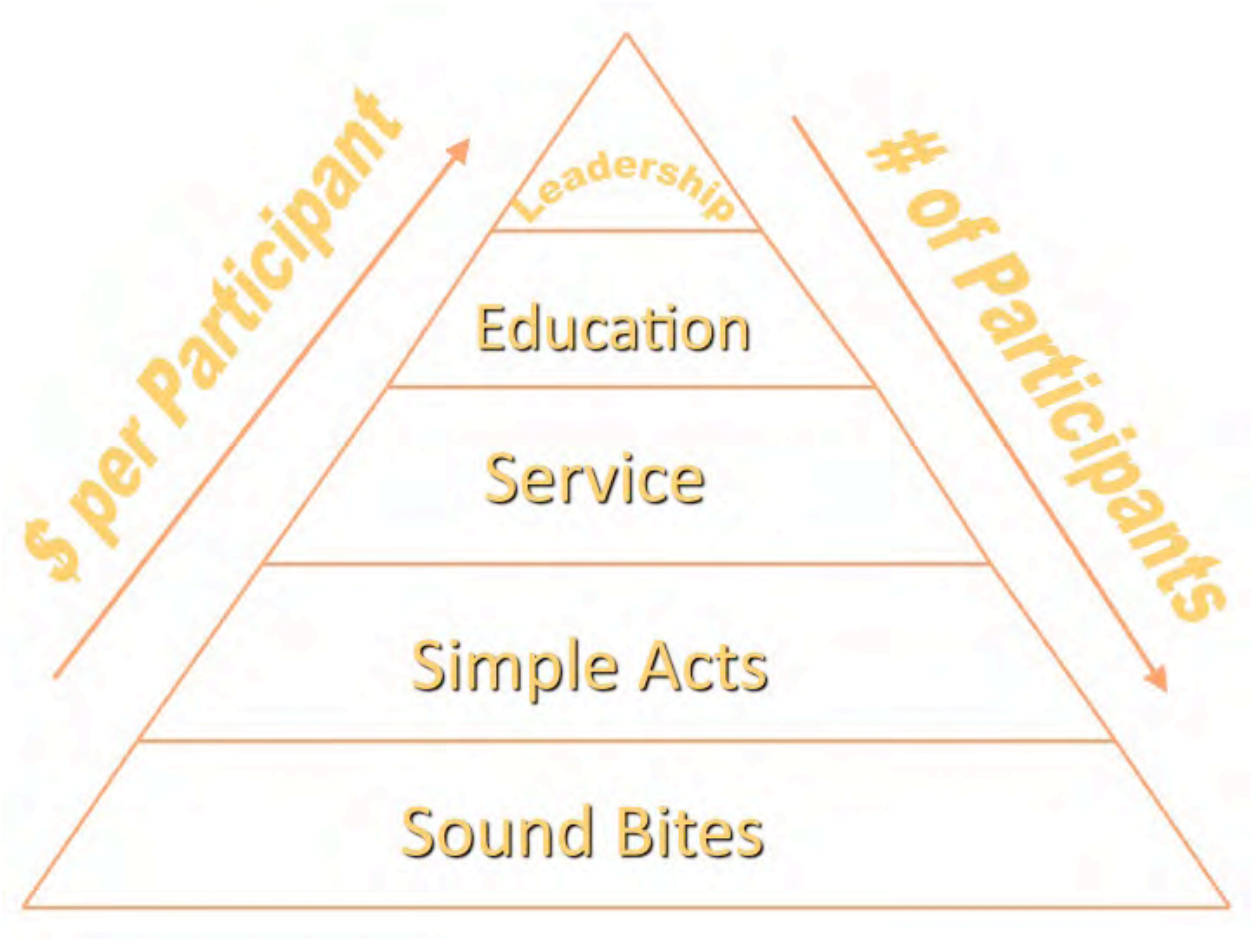
[243] *Save Money and Save Energy* Golden Valley Electric Association. 2009. http://www.gvea.com/content/?id=phantom-appliances and http://www.gvea.com/energyprograms/energysense/.

[244] Database for State Incentives for Renewables and Efficiency (DSIRE), Retrieved November 3, 2009. http://www.dsireusa.org/.

The Importance of Local and Regional Mobilization

Policy and programs are more effective when paired with social mobilization. In one small community near Fairbanks, voters declined to approve a bond to fund the rebuilding of a burned-down hospital, choosing instead to raise the needed funds privately. This example shows how well the residents of Alaska can come together to support a common cause effectively, without depending on public policy, programs or tax financing.

As mentioned previously, achieving any community-wide goal generally requires social mobilization. With regard to improving energy efficiency, this is particularly important, because given the proper financing opportunities, the technologies exist, and are cost effective, if people would only install and use them. To be effective, social mobilization begins with community mapping—identifying key stakeholders and resources required to achieve meaningful, measureable change. Once key influencers have been identified, their participation in an orchestrated program of community strategy can lead to productive actions, through a carefully orchestrated program of local and regional mobilization, as outlined on the next page:



The key to successful implementation of energy efficiency actions is developing an integrated delivery of properly scaled strategies. Examples of the strategies that should be integrated include:

Sound Bites: To communicate what needs to be done, effective sound bites create a "vocal and auditory sense of place"—a way for Alaskans to know they are part of something they care about. Through repetition over time, sound bites become the glue that holds different strategies together. Branding, messaging and marketing are all examples of sound bite strategies. Social marketing professionals have become very good at developing clear calls to action. Sarah Palin is a master of the sound bite.

Simple Acts: Actively engaging key constituents requires simple everyday actions that can be performed on a regular basis. Simple acts like plugging air leaks, turning off computers that aren't in use, or closing doors and windows when the heater is on give key constituents the opportunity to participate in community-wide process. The best simple acts will link directly to the high leverage actions. Without simple acts, the opportunity for people to personally engage in meeting their own needs on a regular basis is missed.

Service: An integrated strategy plan encourages people to work in groups. Working in groups helps folks know they are part of a larger movement. Juneau's emergency actions to reduce energy use in 2008 are an example of a group action. If the choice is between 1) sending out fleets of energy auditors with caulk guns or 2) organizing neighborhood events where the same fleets can focus on one neighborhood at a time, pick the second option—neighborhood events. There is tremendous value in employing strategies that bring people together for the common good.

Education: Each constituent group will require experts who can answer technical questions and explain why and how the actions that are being deployed are being done correctly. In Alaska, it is also common for citizens to want to understand what they are doing and why, before they get really motivated to change. By itself, education will not cause change. Still, resources like the deeper sections of websites and local training sessions ensure that there is someone nearby, who can explain the value of the actions and how to do what needs to be done.

Local Leadership: It has been said that all problems, at their root, are leadership problems. And while everyone can be a leader, there is something vitally important about having at least one person who notices problems, rallies people to implement actions, and keeps folks pointed toward the target. Depending on the constituent group these leaders could be neighborhood group leaders, small business department heads, or non-profit managers. Identifying and supporting these leaders are necessary parts of implementing a community campaign.

By using the pyramid model shown above, Alaska can obtain unique progress on the most effective strategies for community mobilization. Each level of the pyramid

provides important, synergistic relationships with the other components. For example, sound bites, which are the least expensive strategy, need to be delivered frequently to achieve an effective level of saturation. However, if service is left out of the mix, individuals are less likely to feel they are part of a larger movement. Conversely, leadership, which is the most expensive strategy to deliver, only requires a relatively small number of leaders, compared to the number of individuals participating in simple acts. The integrated, comprehensive strategy presented through the pyramid, moves the program from "talking about" to measurable actions on a community-wide basis.

National Mobilization

In late 2009, President Obama and President Jintao announced the launch of a new U.S.-China Energy Efficiency Action Plan. By investing in energy efficiency the two countries will be able to create new economic growth and job creation in the industrial, manufacturing, and commercial sectors.

"The U.S.-China Energy Efficiency Action Plan will help achieve this through:

- Green buildings and communities;
- Industrial energy efficiency;
- Consumer product standards;
- Advanced energy efficiency technology; and
- Public-private engagement."[245]

Both the U.S. and China are making immense investments in energy efficiency.

"The American Recovery and Reinvestment Act includes more than $17 billion in energy efficiency investments, including $5 billion for home weatherization and $4.5 billion to green federal buildings. China has set a goal of reducing the energy-intensity of economic activity by 20% in five years and has established a 'Top 1000 Enterprise' program to ensure that the country's largest industrial enterprises help meet the national efficiency target."[246]

[245] Office of the Press Secretary. *FACT SHEET: U.S.-China Energy Efficiency Action Plan*. The White House. November 17, 2009.
[246] Ibid.

Conclusion

As has been demonstrated throughout this ***REEL in Alaska Roadmap***, the Railbelt region stands to benefit dramatically—through improved security, economic vitality, resilience, employment, and comfort—from investing in more efficient ways to meet end use needs for the services that electricity provides.

Because of its vast resources, the rest of the United States and the Pacific Rim look to Alaska to be a leader in area of energy. By developing an economy based around energy efficiency, Alaska can lead the world in demonstrating the most sustainable ways to provide economic growth, prosperity, jobs and security, while also respecting and protecting the natural resources which provide the energy services. As a leader, Alaska's Railbelt region can add the additional export product of knowledge and experience to its long list of resources.

Alaska's future remains bright. The sequence is clearly laid out in the following ***Roadmap***:

REEL in Alaska Roadmap

1. **STARTING POINT (baseline assessment of end-uses of electricity)**

2. **LANDMARKS—Lighting, Heating/Ventilation, and Plug-in Appliances**

END USE	**ANNUAL IMPROVEMENT** (as % of total electricity use)	**TOTAL BY 2025**
Lighting	1.3%	20%
Heating & Ventilation	1%	15%
Plug-in Appliances	1%	15%
TOTAL	**3.3%**	**50%**
BONUS: Smart Grid	**BONUS** 1.3%	**BONUS** 20%

3. **FINANCING**
    a. Decoupling efficiency from kWh sold—"Bills not rates"
    b. Protecting utility margins
    c. Repayment of financing tied to property
    d. On-bill financing
    e. Addressing split landlord/tenant incentives

4. **POLICY**
    a. Policies designed to support voluntary, free-market solutions
    b. Mandatory security provisions to ensure stability and equity
    c. Leveraging public resources to increase benefits

REEL in Alaska Roadmap
EFFICIENCY INCREASE 50%
P
Policy
$
FINANCING
LANDMARKS
START

January 2010

REEL in Alaska ROADMAP*

How to meet end-use electricity needs in the Railbelt region in 2025, using half the electricity used in 2000.

Appendices

*"REEL" = Railbelt Electricity Efficiency Landscape

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Appendix A
Existing Alaska Energy Efficiency Resources
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Alaska Energy Efficiency Program and Policy Recommendations

Alaska Energy Efficiency Program and Policy Recommendations

DRAFT

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Cold Climate Housing Research Center
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Existing Alaska programs

Alaska Housing Finance Corporation (AHFC) - www.**ahfc**.state.ak.us

Alaska Housing Finance Corporation is designated as the State Energy Office for Alaska. It is the recipient of federal money for all energy efficiency and renewable energy programs for the state. In FY 2006,the State Energy Program received $316,800 in federal funding, while the Weatherization Assistance Program received $1.8 million. Outlined below is a summary of AHFC energy efficiency programs.

AHFC provides funding for weatherization programs delivered by non-profits and municipalities in Anchorage, Fairbanks, Juneau, and Rural - headquartered in Anchorage at RuralCAp and in Fairbanks at TCC. The function and reach of weatherization programs is outlined in a separate section. A brief description of other AHFC energy efficiency programs follows.

Supplemental Housing Grant: AHFC can contribute 20% (limited by State statute) of the total development cost of a HUD project. Energy Efficiency design features are one of the items for which this money is available. FY06 saw 16 grants to seven regional housing authorities with more than $4 million (of $6 million total) going into energy efficiency design features. These funds supplemented more than $30 million in NAHASDA funds.

Building Energy Efficiency Standard (BEES): New residential and community-owned construction underwritten by AHFC is required to meet BEES. BEES is based on the 2006 International Energy Conservation Code with Alaska Specific Amendments and acts as the minimum energy efficiency standard. Compliance with BEES means a Four Star Plus energy-rating or better. Requirements address the building envelope, air leakage, moisture control, heating system efficiency, and duct/piping insulation. Alaska has five climate zones with different envelope insulation requirements for each zone based on climate and fuel cost. BEES is supposed to be updated every three years but failed to see any changes for more than 10 prior to the recent adoption of changes suggested by the Cold Climate Housing Research Center, which was tasked with forming a workgroup and making recommendations. The new standard is based on the International Energy Conservation Code and the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) 62.2-2004 residential ventilation standards with Alaska specific amendments.

Research Information Center (RIC): The RIC at AHFC provides information and technical assistance to AHFC energy programs. RIC has an online database of their extensive library that includes books, reports, videos, fact sheets, and articles on a wide range of subjects relating to energy and building. RIC staff speaks to groups around the state, offer classes, respond to information requests and organize other educational opportunities.

Energy Efficiency Interest Rate Reduction: This AHFC program allows home buyers to qualify for a lower interest rate on their mortgages if they are purchasing a home with Five Star and Five Star Plus energy ratings. Rate reductions are also available by making energy improvements to existing homes, at time of purchase. Improvements are made based on an assessment done by a Home Energy Rater. This program was implemented in 1991 and more than 10,000 loans have been made, representing a total value of just under $1.8 billion.

Energy Ratings and AKWarm: AKWarm is an energy rating software utilized by certified energy raters. Nearly 30,000 homes in Alaska have energy ratings. New construction often receives an energy rating to show that they are in compliance with BEES, existing homes that have energy ratings are generally those that receive services from a weatherization organization. The energy

rating program has significant impact on the way in which new homes are constructed since AHFC underwrites nearly 40% of all residential loans and they require an energy rating demonstrating compliance with BEES.

State Energy Program (SEP): SEP is federal money, roughly $350,000 that is split between AHFC and the Alaska Energy Authority (AEA). The AHFC portion is used to fund education efforts and as a supplement to the Weatherization Assistance Program to fund electrical efficiency work in weatherization eligible homes.

Small Building Material Loan: Loans made under this program include energy upgrades and renewable energy systems. These loans are limited to residential properties located in "small communities", excluding urban Alaska and the majority of the state population.

Alaska Energy Authority (AEA) - http://www.aidea.org/aea/index.html

Alaska Energy Authority (AEA): The mission of AEA is to "reduce the cost of energy in Alaska". In their own words: Alaska Energy Authority projects and programs support its mission by 1) providing for the operation and maintenance of existing Authority-owned projects with maximum utility control, 2) assisting in the development of safe, reliable, and efficient energy systems throughout Alaska, which are sustainable and environmentally sound, 3) reducing the cost of electricity for residential customers and community facilities in rural Alaska, and 4) responding quickly and effectively to electrical emergencies.

State Energy Program (SEP): Federal SEP funding is split with AHFC. The portion that AEA receives is used to perform energy audits on commercial and public institutions.

Performance Based Contracting: The state, through AEA, has a negotiated performance based contracting arrangement with Siemens. This was complicated to set up but works well now. Local governments could utilize this contractual agreement. This has been hard to market and hard to track.

Whole Village Retrofit: AEA is a partner with AHFC, RuralCAP, and the Alaska Village Electric Cooperative to do a "whole village energy retrofit" in Nightmute. They hope to use metering to more closely measure impacts of measures taken to save energy. The group is looking for funding to provide services to residential units that are not weatherization income-eligible.

Energy Cost Reduction (ECR): ECR uses rural life cycle economics to estimate the benefit/cost ratio for each project to determine funding. All ECR funding is matched dollar for dollar by a local source. Putting in half the money motivates entities to take energy conservation measures.

Power Project Loan Fund (PPF): Loans made under this program can be used for a variety of projects including energy conservation measures. Loans are currently made at 4.5% (commercial bond rate) on projects with a 10-year payback. Loans are usually for generator upgrades, have also supported wind farms and hydro (Chena Hot Springs).

Village End-Use Efficiency Measures (VEUEM): Denali Commission funded this $1.2 million project to address village end-use in public or community facilities. The program is ongoing and successful.

Energy Efficiency Technical Assistance Program (ETAP): The program addresses energy efficiency improvements to help communities reduce fuel consumption to generate power and to heat major facilities. EETAP offers assistance to communities with high fuel prices in evaluating energy efficiency measures and in developing information for us in applying for grant or loan funding to implement the measures.

Institutional Conservation Program (ICP): ICP no longer exists but ran successfully for 15 years starting in the mid 1980's and ending in 2000. The program utilized US DOE funds to perform energy audits on institutions, such as schools and hospitals, and then offered to cost-share implementation of energy conservation measures.

Rebuild America 1996-2002: This program no longer exists. While the program was operational, AEA conducted energy audits on 490 schools and other facilities in 143 rural communities over five years. AEA identified energy conservation measures that were low-cost or no-cost, that could have saved an estimated $2.3 million per year with a one time cost of $4.1 million. According to AEA staff it is safe to say that none of these reports were utilized at the time they were done. Now that energy prices are increasing AEA is getting calls from places they audited that are looking for their old reports or looking for guidance in implementing them.

Cold Climate Housing Research Center - http://www.cchrc.org/

The Cold Climate Housing Research Center (CCHRC) is funded in large part by AHFC. CCHRC is a non-profit whose purpose is to "facilitate the development, use, and testing of energy efficient, durable, healthy, and cost effective building technologies for Alaska and the world's cold climate regions" CCHRC has a state of the art research facility in Fairbanks and manages research and data collection projects throughout the state. They also provide energy efficiency technical assistance to the Alaska Native housing authorities.

Weatherization

AHFC already has contracts with existing weatherization programs statewide:

- Municipality of Anchorage serves the Municipality of Anchorage.
- Interior Weatherization serves Fairbanks North Star Borough and the road system south to Cantwell and east to Delta junction.
- Tanana Chiefs Conference serves interior Alaska.
- Alaska Community Development Corporation serves the Matanuska-Susitna Borough, Kenai Peninsula Borough, Copper River Valley, Southeast Alaska (except Juneau), Prince William Sound and Aleutians.
- RurAL CAP serves western Alaska, northern Alaska and Juneau.

Interior Weatherization http://www.interiorwx.org/

Municipality of Anchorage www.muni.org

Alaska Community Development Corporation http://www.alaskacdc.org/

RuralCAP www.ruralcap.com

Weatherization services are provided by: Interior Weatherization and Tanana Chiefs Conference in Fairbanks and Interior villages, Alaska Community Development Corporation in the Mat-Su Borough, the Municipality of Anchorage in Anchorage, and RuralCAP (through two offices) in Juneau and in rural Alaska. Weatherization is funded by the US Department of Energy and the AHFC. In rural areas there are additional sources of funds for weatherization program services including HUD.

Weatherization services are provided for income eligible households, those below 60% of median income. Income eligibility is set by federal regulation. The programs serve roughly 600 homes annually, increasing indoor air quality, reducing fire hazards, and weatherizing the home so that energy is saved and the cost to heat the home decreases. The average home receiving

weatherization services can expect to see a 30% decrease in home heating bills. According to the 2005 Statewide Housing Assessment there are an estimated 45,000 eligible households in Alaska.

Weatherization programs have existed in Alaska since 1976 and their work and impact are widely respected. There are experts in the field, making significant reductions in energy consumption and providing individual education household by household. The state supplements federal funds for weatherization programs but the need amongst income-eligible households far outpaces funding.

Weatherization workers have decades of experience and are leaders in the building sciences in Alaska; transferring knowledge and skill about building in cold climates to the private sector through both formal and informal information exchange.

State of Alaska Heating Assistance Program (LIHEAP) provides 10% of their annual budget to weatherization services to reduce financial burden of heating.

Department of Transportation & Public Facilities (DOTPF) has no master energy efficiency program but they do administer contracts with ESCOs to retrofit public buildings. Additionally, whey equipment is replaced an effort is made to upgrade to more efficient models. Procurement for projects is done with the latest energy standards in mind but there are no formal guidelines. DOTPF has an Energy Improvement contract with Siemens (and ESCO) for Department of Corrections, Administration and Transportation buildings. Under this contract eight building have received energy retrofits and eight are in progress, an RFP is being drafted to expand this program to additional facilities. Buildings with the highest energy-use index were chosen first.

UTILITIES

Golden Valley Electric Association (GVEA) - www.gvea.com - is the only utility on the Railbelt with a developed end-use management program. Several factors motivated the establishment of this program. A group of individual utility "members", or rate-payers, in the community created awareness of, and advocated for, energy efficiency measures. This group of citizens was aware of the 1992 federal act requiring the consideration of Integrated Resource Planning (IRP) and put pressure on the utility and the regulatory commission. The result was that, without being formally mandated to do so, GVEA established an internal committee to consider end-use management as part of IRP. Programs expanded further with the proposed development of the Healy Clean Coal plant, a project that had enormous capital requirements and was potentially politically unpopular, burning coal just outside Denali national park. The need to justify this project added more political fuel to the end-use management fire.

Energy$ense at GVEA offers the following programs:

The Home*$ense* program provides energy efficiency residential audits for members, including whole-house all-energies advice (beyond electric energy) and the following:

- Education, behavior, choices
- Best practices, consumption budgeting
- Tools: kWh measuring monitor and refrigerator thermometer
- Efficiency options, devices and controls (installed): up to 12 CFLs, vehicle plug-in timer, & additional devices if there is an electric H2O heater in the house.

The Builder*$ense* program provides residential construction and design resources and lighting guidance for members as well as rebates for building-in efficiencies during new construction, major additions, rehabs and retrofits. Included are the following eligible measures:

- Fluorescent lighting

- Outdoor lighting
- Vehicle plug-in controls
- Electric H2O heating controls

The Business*$ense* program provides rebates up to $20,000 for retrofitting existing, inefficient lighting systems with upgraded energy efficient lighting systems. The program is available to eligible general service accounts. Members may qualify for either $1,000 per 1 kW reduced, or 50% of the material / labor costs (whichever less). Again, lighting guidance from GVEA is available.

Chugach Electric Association - www.chugachelectric.com - provides information through an energy savings guide, sponsors educational programs and helps commercial customers with an energy "walk-through".

Matanuska Electric Association (MEA) - www.mea.coop - provides energy conservation tips and links on their website and they are in the process of applying to become an Energy Star partner.

Municipal Light & Power (ML&P) - www.mlandp.com - provides links and tips on their website, has had one CFL give away event and is participating in a home energy audit pilot on eight homes with Green Star. ML&P has received input from the Mayor that he would like to see the utility offer an end-use management program. To that end a consultant has been hired to evaluate program options and will present findings to the Mayor and General Manager around the end of March 2008.

Homer Electric Association (HEA) - www.homerelectric.com - has a new energy efficiency program. Information is available on their website connecting rate payers with energy efficiency resources and an energy audit tool through the Touchstone Energy cooperative website. HEA offers limited lines of credit to their members; eligible items include a range of appliances and electrical equipment including CFLs.

Seward Electric – http://www.cityofsewardne.com/electric.htm - has limited, periodic energy efficiency information on the city website.

ENSTAR - www.enstarnaturalgas.com/ - has weatherization information and tips on their website and links to other energy sites.

Four Dam Pool Utilities - http://www.fdppa.org/index.jsp - The Four Dam Pool provides electricity to Copper Valley Electric, Ketchikan Public Utilities, Wrangell/Petersburg and Kodiak Electric Association.

Copper Valley Electric Association - www.cvea.org - has energy efficiency information on their website.

Ketchikan Public Utilities - www.city.ketchikan.ak.us - has energy efficiency information on their website, sends energy efficiency information in bills and provides periodic CFL give-aways.

Kodiak Electric Association - www.kodiakelectric.com - Recently added energy saving tips and links to website.

LOCAL GOVERNMENT

Energy Efficiency Policies and Programs of Alaska's Municipalities

Despite the fact that energy conservation is becoming a priority, due in large part to high fuel prices, there are few formal or codified policies for Alaska municipalities. The City of Homer is the one municipality actively working on a comprehensive energy conservation policy although

had yet to codify the results of their "Climate Action Plan" which was finalized in December 2007. The City and Borough of Juneau have codified conservation activity and passed city ordinance related to energy efficiency goals.

There are no weatherization or loan programs through local governments with the exception of Anchorage. The Municipality of Anchorage runs one of the AHFC funded weatherization programs. No written policies govern the purchase of energy rated goods, or mandated energy audits on facilities.

However, this is not to say that Alaska's communities do not practice energy conservation. Public Works Departments in all of the communities interviewed have employed energy conservation measures for more than a decade. Replacing lights and ballasts, installing passive heat and lighting controls and replacing high energy items with more efficient ones has helped reduce energy use and the cost of running government facilities.

Public works department staff in both Anchorage and Fairbanks cautioned that they have taken advantage of the easy energy savings and now will have to employ different, and perhaps more expensive, technologies and be more creative to reduce energy consumption much further.

Additionally, while energy rated goods are not required by written policy, every community we interviewed reported considering the energy cost of the product along with the purchase cost before making a decision to purchase.

Alaska Municipal League (AML) - http://www.akml.org/

According to AML, Alaska municipalities are just now starting to tackle the issue of energy efficiency. There are very few policies or programs that exist to address energy efficiency. The Mayor of Juneau has approached AML about hosting a 'Climate Change' summit in which they will address the affects of rising energy costs. The summit will take place in April or May of 2008.

Municipality of Anchorage (MOA) – www.muni.org

Anchorage is a member of the ICLEI Cities for Climate Protection Campaign. Mayor Mark Begich has made public statements indicating his support for conservation initiatives and policy within the municipality. The city has drafted an ordinance requiring all municipal building new construction, including school district buildings, be LEED Silver certified. The ordinance offers reduced permitting fees as an incentive for private contractors to build LEED Silver, or better, certified buildings. The ordinance will go before the assembly in February 2008.

Street Light Replacement: There are more than 16,000 street lights in Anchorage and they will all be re-lamped with energy efficient LED lights at a total one-time cost of $5 million. The expected payback time is 2.5 years - funding for the project has not yet been recognized. MOA is also in the beginning phases of a City Hall energy retrofit.

Anchorage School District (ASD) has not implemented any formal energy efficiency plan but they have a few key efficiency activities including incorporating efficiency measures into new construction, working with Seimen's to efficiently control heat in their buildings, an innovative pilot program in nine local schools, and working with an AEA grant and bonded money to implement energy conservation measures in 13 schools. .

Efficiency measures are incorporated into new projects and major renovations, i.e. Begich Middle school includes a lot of efficiency measures including efficient lighting and mechanics. Direct Digital Control (for heat) is reviewed with Siemens to ensure they are programming in an efficient way.

There is a pilot project in nine schools to address energy conservation measures that are user controlled. Presentations were made to teachers and staff at each school on how they could do their jobs and behave in an energy saving way. Each school was offered the financial incentive of being able to retain the money saved by reducing energy consumption. The pilot is underway and has not yet been evaluated.

The ASD received a grant from AEA to provide a 50/50 match to the $780,000 bond passed to fund ECM projects with three year or less payback period. AEA funds will allow more ECM at each of 13 schools that received energy audits. Grant funds will also go to develop a building administrator energy-use awareness training course.

City of Homer - www.ci.**homer**.ak.us

Homer, like other municipalities does not have a Weatherization or loan program for energy efficient upgrades. While no written policy exists for purchasing energy rated goods or conducting energy audits Homer has been actively working on these issues. Homer is a member of the ICLEI Cities for Climate Protection Campaign. The Homer City Council approved a Climate Action Plan in December 2007 addressing energy conservation with implementation strategies.

The City of Homer has been awarded a small grant (EPA funds) to develop an "Employee Sustainability Handbook." Those policies will promote energy conservation measures in day-to-day operations. The new Homer Public Library was the first LEED-Silver building constructed in Alaska. The City Council is exploring the idea of passing an ordinance specifying that all new City buildings will be LEED certified.

Fairbanks North Star Borough (FNSB) - co.fairbanks.ak.us

No Weatherization program or loan program for energy efficiency upgrades is available through the FNSB. There are no ordinances for the purchase of energy rated goods, FNSB public works employees expressed concern about such an ordinance, noting that technology moves fast and by the time one item is mandated via ordinance then another more efficient item is available. This problem can be addressed by tying the ordinance to a constantly updated source such as the Energy Star Appliance program. FNSB public works staff expressed support for a mandate to "cut energy use."

The FNSB does not conduct energy audits but does consider the energy usage of buildings and have been addressing high energy-use items in those buildings. Upgrades to lighting systems, installation of controls and addressing energy hogs like ventilation systems have been done throughout the years but not as part of an overall energy plan.

Energy conservation is considered in the design phase of a project—designing for the most energy efficient building with lighting controls, heating controls, etc. FNSB public works department recently created a new "energy efficiency engineer" position to focus more on the importance of energy conservation in their designs. They have been unable to fill the position.

Fairbanks North Star Borough School District (FNSBSD) reported similar responses. There are no formal procedures for energy audits but there is an energy specialist on staff (Electrician). Over the past 10+ years FNSBSD has addressed the biggest energy consumers—the mechanical equipment of the buildings and the lighting. They practice head bolt cycling as another example. The borough uses the software Utility Manager Pro, allowing staff to analyze rates of consumption and the costs of energy consumption.

While the State requires some energy efficiency in current building codes, FNSBSD goes well beyond what the regulations require for new construction. The cost of energy has risen far enough that it is now cost effective to purchase items that would have been considered 'uneconomical'

before. Examples include energy recovery systems and mechanical equipment for which the payback period was previously too long.

Basic energy saving measures that homeowners are just starting to employ have been in effect with larger institutions for quite some time (more efficient lighting, heat/cooling controls). They have plucked the 'low hanging fruit' and would have to take advantage of different technologies or more costly projects to reduce energy consumption much further.

City of Soldotna - www.ci.**soldotna**.ak.us

The community does not have ordinances or regulations relating to energy efficiency on new buildings beyond current building codes. It does employ energy conservation measures in new city owned facilities. Soldotna does not conduct formal energy audits on facilities but has performed energy use analysis on a number of buildings.

Soldotna has not adopted written policies but does consider energy cost in selecting motors, electronics, vehicles etc. Energy cost is part of operating costs that are considered in all purchases.

Examples of some recent energy saving activities include: Soldotna photocell activated streetlights are turned off in the summer, reflective ceilings were added to the community Sport Center, use of soft start capacitors on large motors, new maintenance shop was built with much higher insulation than is standard and includes a waste oil heater to provide some of the building heat. Despite lack of a formal program, energy conservation activity has been underway for more than a decade.

City & Borough of Juneau – www. juneau.org

In March of 2007 the city passed a resolution that "the City and Borough of Juneau, Alaska, will join ICLEI as a Full Member and participate in the Cities for Climate Protection Campaign and, as a participant, pledges to take a leadership role in promoting public awareness about the causes and impacts of climate change." This resolution states that Juneau will conduct greenhouse gas emissions inventory and projections, establish greenhouse gas emissions reduction target, establish action plan to meet target, implement action plan approved by assembly, and monitor and report progress.

The City & Borough of Juneau passed a resolution in June of 2007 titled "A Resolution Creating the Juneau Commission on Sustainability, and Repealing Resolution 2376 Relating to the Juneau Energy Advisory Committee". The resolution created the Juneau Commission on Sustainability comprised of nine members appointed by the Assembly plus one Assembly member and one Planning Commissioner.

Juneau has an Energy Conservation and Efficiency Policy that speaks to encouraging energy conservation measures through user behavior changes. Mandated activity includes Energy Life Cycle Cost Analysis consideration for all public capital projects with budgets exceeding $3M and/or exceeding 15,000 sq ft.

The Comprehensive Plan of the City and Borough of Juneau includes a number of policies designed to "encourage" energy efficiency including: recommendation that the Assembly should set an energy efficiency standard for new and existing multi-family housing and commercial buildings and enact water conservation ordinances.

Ketchikan - www.city.**ketchikan**.ak.us

City officials in Ketchikan suggested that most local governments *have been doing something* to address energy consumption for many years but that very little is done as part of an overall plan to reduce energy consumption. It would be useful, and possibly painless, to codify existing

practices to be sure they are reaching all departments and to ensure that they are part of every project.

Alaska Native Housing Authorities and Tribally Designated Housing Entities

Cook Inlet Housing Authority (CIHA) is the largest housing authority in the state and operates in the Cook Inlet region. Despite having no policy on the books regarding new construction energy building standards, all new construction is Five Star Plus thanks to the construction manager Bob Juliussen.

Cook Inlet Housing used to operate a weatherization and minor improvements program that offered home owners: a comprehensive energy audit free of charge, a $5,000 grant for improvements, and the option to receive an additional $15,000 loan given at 1% with no obligation to pay back until the owner sold the house. This program was successful for the home owners but extremely complicated to administer and was for that reason shut down in 2005 with the expectation that the services offered would be evaluated and the program streamlined and re-launched in a year or so. As happens, Cook Inlet Housing staff got busy with other projects and the program continues to sit on the back burner.

Nearly all Housing Authorities have minor repair programs for the housing units they own and/or operate as well as for shareholder homeowners. Many also receive LIHEAP funds that pay for weatherization (note: if an individual is eligible for LIHEAP through a Native corporation they are not eligible for state LIHEAP). Housing Authorities must consider the cost of operating the housing units they build so conservation measures are incorporated if: they are cost effective and/or they are known.

EDUCATION

Alaska Building Science Network (ABSN) is a member non-profit organization primarily funded by AHFC. The work they perform relevant to end-use management includes providing continuing education classes for contractors. The state of Alaska requires 16 hours, every two years, of continuing education in the building sciences.

ABSN provides classes focused on energy efficiency in residential construction. Additionally, ABSN staffs home shows across the state where educational materials and personal interactions offer an opportunity to educate thousands of people about potential energy saving in their homes. Outside the Railbelt ABSN is a partner in the Village End-Use Efficiency Management (VEUEM).

Green Star is funded through the Environmental Protection Agency, private donations, businesses, local corporate sponsors, and occasional local or federal government grants. Green Star works with businesses to guide them through the process of becoming energy efficient. Green Star offers energy evaluation walk-throughs for member businesses, working extensively with purchasing departments and building maintenance. Usually the first energy conservation measure taken is to retrofit lamps and ballasts – average payback of two years.

US Green Building Council, Alaska Chapter provides advocacy and education as well as participation in several workgroups including the Anchorage Sustainable Building Initiative whose goal is to "promote the adoption of ordinances, incentives, and practices that will achieve the vision of sustainable site and building design practices in Anchorage."

ENERGY SERVICE COMPANIES

Energy Service Companies (ESCO): While there are only two energy service companies currently operating in Alaska there is interest in doing Alaska work from ESCOs headquartered in the lower 48.

Siemens Building Technologies provides full energy audits at a rate of $0.30 to $0.50 per square foot and the full spectrum of energy efficiency upgrades. Seimens has a performance contracting agreement with the state, offers performance contracting for the private sector and generally works on only very large buildings.

Optimira Energy Company is a new addition to the Anchorage market, providing performance contracting to commercial vendors.

Alaska Energy Savers is a private energy consulting firm. The owner/operator provides energy conservation consulting for Commercial & Industrial companies, saving money through Power Factor Correction and Lighting Retrofits.

Appendix B
State Resources and Energy
Committees Recommendations

DRAFT SUMMARY

Compiled By Senator Bill Wielechowski and Senator Lesil McGuire,
Chairs of the Alaska State Senate Resources and Energy Committees

State Energy Policy and Program Recommendations

Energy Goals:

Goal 1: Ensure all Alaskans have access to reliable energy supplies at the lowest cost over the long-term.

Goal 2: Develop Alaska's energy resources in a responsible manner to sustain Alaska's economy and provide for the growth of Alaska's communities and industries.

Goal 3: Ensure continued responsible exploration and development of Alaska's oil and gas resources and manage these resources for the maximum long-term benefit of all Alaskans.

Goal 4: Reduce the dependence of Alaskan communities on fossil fuels for electricity and heat by developing our renewable and alternative energy resources and by promoting energy efficiency and conservation.

Goal 5: Strive to produce 50% renewable energy by 2025 and to increase energy efficiency by 10% by 2015.

Goal 6: Maintain a commitment to environmental stewardship and responsible resource development, anticipating the environmental effects of and regulatory response to climate change.

Goal 7: Promote energy research at Alaska's universities, energy education in our public schools, and workforce development programs at our post-secondary institutions and vocational schools.

Summary of Program Recommendations and Actions:

Powering Alaska	• Consolidate the six existing Railbelt utilities into a single entity for the purpose of planning, financing and building future electrical generation and transmission projects with maximum efficiency. • Hold legislative hearings in January to review the Regional Integrated Resource Plan for Southcentral Alaska and identify the best new sources of power production for the Railbelt. Add capital to the Railbelt Energy Fund to help finance projects that provide the lowest cost, most reliable energy for the Railbelt over the long-term. • Provide an additional $10 million to the state's Power Project Fund to provide loans for developing and upgrading power systems around the state. • Increase funding for the Rural Power System Upgrade Program to improve the efficiency of diesel power generation in rural Alaska. • Increase funding for the Rural Power Systems Technical Assistance Program to $200,000 to enable the Alaska Energy Authority to serve more communities, ensuring the reliability of rural power systems. • Fully fund the Power Cost Equalization (PCE) Program and ensure PCE rules are not a disincentive to developing local renewable energy sources and increasing energy efficiency. • Complete an Integrated Resource Plan for Southeast Alaska to prioritize Southeast power projects. Continue to develop Southeast Alaska's regional electric grid and hydropower systems to interconnect Southeast communities with renewable energy supplies. • Broaden the scope of the Southeast Alaska Energy Fund and capitalize it. • Increase funding for the Bulk Fuel Upgrade Program to $5 million a year for the next 3 years to ensure that communities have adequate storage to make cost-cutting bulk fuel purchases. • Revise the interest rates for the Bulk Fuel Revolving Loan Program and Bridge Fuel Loan Program to provide an incentive for communities to maintain good credit and business practices. • Increase state funding for programs that train power plant and bulk fuel operators as funding from

	the Denali Commission declines.
Heating Our Homes	• Invest an additional $150 million in the state's Weatherization Program and $50 million in the state's Home Energy Rebate Program over the next several years. • Expand the state's Heating Assistance Program in years when the state has a budget surplus and fuel prices are high to assist more Alaskan families struggling to heat their homes.
Maximizing Energy Efficiency	• Reduce demand statewide for electricity and heating fuels by 10% by 2015 through adoption of energy efficiency measures. • Draft legislation to create an ongoing appliance rebate program to encourage Alaskans to replace inefficient appliances. • Provide technical assistance to businesses to help them reduce their energy consumption and improve profitability. • Fund an ongoing "Smart Meter" or building energy monitor program to enable consumers to reduce energy use in response to meter readings. • Conduct a comprehensive public education campaign to increase energy efficiency and conservation statewide. • Work with school districts and the state Department of Education to encourage integration of energy efficiency lessons into K-12 curriculum. • Consider decoupling utility revenues from sales to provide greater incentives for utility promotion of and investment in energy efficiency. • Provide technical assistance to local governments interested in adopting energy efficiency standards for residential and commercial buildings. • Implement a voluntary Energy Efficiency Labeling Program for buildings. • Make low-interest loans available to Alaska's commercial fishers for energy efficiency upgrades.
Investing in Renewable Energy	• Pass SB 31, incentivizing the development of renewable energy sources through state production tax credits. • Establish a low-interest loan program for businesses, households, non-profits, and others interested

	in investing in renewable energy systems. • Lower the interest rate for Power Project Fund loans to utilities for renewable energy projects. • Continue to appropriate at least $50 million a year through 2012 to the Renewable Energy Fund. • Establish renewable energy portfolio standards or goals for the state. • Consider legislation to institute a net-metering program. • Encourage utilities to offer customers renewable energy purchase plans, such as Golden Valley Electric's SNAP program.
Ensuring that Energy Is Affordable for Alaskans	• Ensure Alaskans pay a fair price for the energy they consume through price gouging or related legislation. • Consider proposals to smooth out heating fuel price volatility or lower fuel prices when oil prices skyrocket. • Create predictable pricing methodology for Cook Inlet gas, either in statute or by requiring the Regulatory Commission of Alaska to work with stakeholders to develop one. • Charge the Alaska Energy Authority with helping to develop a statewide fuel-buying cooperative to reduce costs for Alaskans.
Developing Alaska's Resources	• Fully support efforts to bring Alaska's North Slope natural gas to market. • Evaluate Alaska's natural gas tax regime to ensure it maximizes returns to the state for its gas resources, while providing a reasonable incentive to monetize Alaska's gas. • Promote environmentally responsible drilling off Alaska's coast with significant sharing of associated revenues between the state and federal government. • Support the development and extraction of Alaska's heavy and viscous oil resources and the establishment of Alaska as a world center for heavy and viscous oil research and development. • Maintain pressure on Congress to authorize oil and gas development in the Arctic coastal plain. • Advocate for U.S. Senate ratification of the Law of the Sea Treaty to enable greater oil and gas development off Alaska's coast.

	• Advocate for responsible oil and gas development within the National Petroleum Reserve, Alaska by offering regular lease sales and streamlining permitting, while avoiding sensitive wildlife areas. • Support the Administration's efforts to expedite oil and gas exploration and development at Pt. Thompson. • Closely monitor all state oil and gas leases to ensure that leasees actively explore and develop state lands. Ensure that the Department of Natural Resources has adequate staffing to monitor lease activity. • Adequately fund efforts to evaluate the costs and benefits of constructing a bullet line from the North Slope to the Railbelt. Assess project feasibility, private sector interest in the project, and whether state participation is needed. • Provide incentives for new oil and gas development in Cook Inlet, such as tax credits or matching grants for exploration and creating state/private sector partnerships. • Support efforts to develop additional storage capacity for natural gas in Southcentral Alaska, open to all Cook Inlet producers. • Maintain the viability of the Flint Hills refinery and prepare an action plan to ensure its survival. • Support responsible exploration and development of Alaska's coalbed methane resources, while providing for meaningful public participation in development decisions. • Support the development of underground coal gasification technology in Alaska and draft legislation to craft a regulatory structure and permitting process appropriate for this technology. • Support efforts to separate propane from North Slope natural gas and transport it to communities around the state as a lower cost, local fuel source. • Support efforts to explore for natural gas in the Nenana Basin, Gubik Field and other promising areas. Maintain a comprehensive and accessible database on the resource potential of state lands for potential explorers, and provide predictable access to state lands.
Leading By Example: State Government Initiatives	• Set energy savings targets for state agencies. • Pass SB 121, directing the Department of Transportation and Public Facilities to adopt energy efficiency standards for new public facilities and to retrofit existing facilities.

	• Adopt regulations favoring the procurement of equipment bearing the "Energy Star" label. • Use energy efficient broad spectrum lighting sources on roadways, where safe and cost-effective. • Adopt a policy that favors the purchase of high-efficiency vehicles for the state fleet. • Commit to purchasing renewable energy, wherever available and affordable, for state use. • Incorporate viable renewable energy sources into the planning, construction, and operation of new public works projects.
Moving Forward: Transportation In the 21st Century	• Appropriate up to $3 million annually in matching funds to support community transit systems and enable local governments to secure federal funds. Consider creating a Community Transportation Trust Fund to provide long-term support for public transit programs. • Remove from state law current limits on the percentage of State Transportation Improvement Program funds that can be spent on alternative transportation infrastructure. • Consider creating a grant fund to incentivize purchase of electric cars and help local governments install recharging stations.
Supporting Emerging Energy Technologies	• Pass SB 150, creating and funding a grant program targeted toward the development of "pre-commercial" energy technologies that have a reasonable expectation of commercial viability within five years. • Support projects that employ liquefaction technologies, including gas-to-liquids and coal-to-liquids, to convert Alaska's natural gas and coal resources into synthetic fuels. • Support resource assessment, feasibility studies, and the research and development of hydrokinetic and wave energy technologies in order to encourage the development of Alaska's vast in-river, tidal, ocean current, and wave energy resources. • Support the assessment and study of North Slope gas hydrates and the research and development of gas hydrate extraction technologies. • Assess Alaska's largest landfills to determine the feasibility of capturing landfill gas and other waste products to generate heat and/or electricity. • Develop and maintain baseline data needed for conducting applied energy research in Alaska.

Providing Jobs For Alaskans	• Ensure adequate and ongoing funding for energy-related job training programs. • Encourage the University of Alaska to strengthen energy-related education programs.
Safeguarding Our Environment	• Schedule legislative hearings to consider the recommendations of the Alaska Climate Change Sub-Cabinet in an effort to help mitigate the root causes of global climate change. • Ensure that Alaska's interests are fully considered in climate change legislation being debated by Congress.
Ensuring a Bright Energy Future For Alaska	• Evaluate the administration of state energy programs and the desirability of centralizing energy offices to increase efficiency and focus greater attention on meeting the state's energy needs.

Appendix C
SMUD Sample Policy Document and
Energy Efficiency Program

DRAFT

SACRAMENTO MUNICIPAL UTILITY DISTRICT

PUBLIC UTILITY REGULATORY POLICIES ACT OF 1978 AS AMENDED BY THE ENERGY INDEPENDENCE AND SECURITY ACT OF 2007

Staff Report and Proposed Board Determination on the Integrated Resource Planning Standard

Summary

The Sacramento Municipal Utility District's (SMUD) Board of Directors has made its determination on the Integrated Resource Planning Standard set forth in section 111(d)(16) of the Public Utility Regulatory Policies Act of 1978 (PURPA), as amended by the Energy Independence and Security Act of 2007 (EISAct). The Board considered the Integrated Resource Planning Standard on the basis of its effect on conservation of energy, efficient use of facilities and resources, and equity among electrical consumers, and the objective and requirements of the Municipal Utility District Act (Cal. Pub. Util. Code, § 11501 et seq.).

Statement of Facts

The EISAct was enacted on December 19, 2007, adding several new obligations under Title 1 of PURPA. Among the new obligations, EISAct amended Section 111(d) of PURPA to require each non-regulated utility to consider a new proposed regulatory standard relating to integrating cost effective energy efficiency into resource planning and establishing energy efficiency as a priority resource. SMUD is a covered utility for the purposes of PURPA.

SMUD commenced consideration of the Standard on August 7, 2008, through Board Resolution No. 08-08-04. On Tuesday, November 17, 2009, the Staff Report and Findings on the Integrated Resource Planning Standard was presented and discussed at a public hearing conducted by the SMUD Board at the Policy Committee. Advertising providing notification of the hearing and standards being considered was placed in a local newspaper of general circulation. Data, views, and comments were requested from the public as to the need and desire for SMUD to adopt the Integrated Resource Planning Standard. The Staff Report and Findings were also made available to the public on SMUD's website at http://www.smud.org prior to the hearing. The public had an opportunity to comment on Staff findings. (insert number of speakers or written comments) comments on the proposed standard were received. Copies of verbatim transcripts of the public hearings and written materials submitted are available for public inspection.

Determination

The SMUD Board of Directors has considered the information contained in the report and the adoption of the Integrated Resource Planning Standard. The Board has determined that its consideration of the Integrated Resource Planning Standard, and the determinations made with respect thereto, are in accord with the provisions of the Municipal Utility District Act and the Public Utility Regulatory Policies Act of 1978, as amended by the EPISAct. The Integrated Resource Planning Standard has been considered in light of the record developed during the proceedings on the standard. The Board recognizes the importance of and concurs in the purpose of conservation of electrical energy, efficiency in the use of facilities and resources, and equitable rates as described in PURPA. These purposes were considered in reaching the determination below.

The Board's determination follows.

I. Standard Under Consideration:

THE INTEGRATED RESOURCE PLANNING STANDARD.

"Section 111(d)(16). Each electric utility shall—

"(A) integrate energy efficiency resources into utility, State and regional plans; and

"(B) adopt policies establishing cost-effective energy efficiency as a priority resource."

II. Findings:

1. SMUD has adopted Resource Planning Strategic Directive 9 (SD-9) which adopts an integrated resource planning approach and adopts energy efficiency as the first priority for providing its customers with a sustainable power supply.

2. In addition to specifying cost-effective, reliable and feasible energy efficiency and demand reduction resources as a priority resource, the Board of Directors has also adopted annual targets for reducing energy consumption by 15 percent by 2018. The targets are reviewed and revised every three years as necessary.

3. SD-9 was first adopted in May 2004 and was last amended in December 2008. The Board of Directors is expected to adopt additional changes to SD-9 at the November 19, 2009 Board of Directors meeting. (Copy of the proposed new SD-9 is attached.)

4. California Public Utilities Code Section 9615 establishes energy efficiency and demand reduction as a priority resource and requires that each publicly owned utility: (a) establish targets to reduce energy consumption by 10 percent by 2018; (b) reconsider the targets every three years; and (c) report annually to its customers and California Energy Commission on progress in achieving the goals.

5. As adopted by the SMUD Board, SD-9 meets or exceeds the requirements in Section 91615 and is consistent with the Integrated Resource Planning Standard.

III. Determination by the SMUD Board:

The Standard is appropriate for use by SMUD at the present.

Attachment

SMUD BOARD POLICY Draft (approval expected 11/19/09)	
Category: **Strategic Direction**	Title: **RESOURCE PLANNING**
	Policy Number: **SD-9**
Adoption Date: **May 6, 2004**	Resolution No. **04-05-11**
Revision: **May 6, 2004**	Resolution No. **04-05-12**
Revision: **September 15, 2004**	Resolution No. **04-09-11**
Revision: **May 17, 2007**	Resolution No. **07-05-10**
Revision: **December 18, 2008**	Resolution No. **08-12-15**

It is a core value of SMUD to provide its customer-owners with a sustainable power supply through the use of an integrated resource planning process. A sustainable power supply is defined as one that reduces SMUD's net long-term greenhouse gas emissions to serve customer load to 350,000 tonnes (10% of its 1990 carbon dioxide emission levels) by 2050, while assuring reliability of the system, minimizing environmental impacts on land, habitat, water quality, and air quality, and maintaining a competitive position relative to other California electricity providers.

To guide SMUD in its resource evaluation and investment, the Board sets the following interim goals:[1]

Year	Net Greenhouse Gas Emissions (metric tonnes)
2012	2,608,000
2020	2,318,000

In keeping with this policy, SMUD shall also achieve the following:

a) Acquire cost-effective, reliable and feasible energy efficiency and demand reduction resources (e.g. distributed storage, direct load management, and time-of-use pricing). Set a goal of reducing energy consumption by 15% by 2018 and meet the following milestones (these targets shall be reviewed and revised every three years):

[1] Note: These goals do not take into account the potential impacts of the electrification of transportation.

	Year	Gigawatt Hours	Peak Megawatts
	2008	107	28
	2009	145	40
	2010	175	51
	2011	180	53
	2012	192	54
	2013	195	55
	2014	197	55
	2015	199	57
	2016	206	59
	2017	208	59
Total		**1804**	**511**

b) Provide dependable renewable resources to meet 20% of SMUD's load by 2010, and 33% of its load by 2020, excluding additional renewable energy acquired for certain customer programs. . In acquiring renewable resources, SMUD shall emphasize local and regional environmental benefits.

c) Promote cost effective, clean distributed generation through SMUD programs. As part of this policy, SMUD shall continue to be a leader in solar power.

Monitoring Method: GM Report
Frequency: Annual

DRAFT

SACRAMENTO MUNICIPAL UTILITY DISTRICT

PUBLIC UTILITY REGULATORY POLICIES ACT OF 1978
AS AMENDED BY THE ENERGY INDEPENDENCE AND
SECURITY ACT OF 2007

Staff Report and Proposed Board Determination on the Rate Design
Modifications to Promote Energy Efficiency Investments Standard

Summary

The Sacramento Municipal Utility District's (SMUD) Board of Directors has made its determination on the Rate Design Modifications to Promote Energy Efficiency Investments Standard set forth in section 111(d)(17) of the Public Utility Regulatory Policies Act of 1978 (PURPA), as amended by the Energy Independence and Security Act of 2007 (EISAct). The Board considered the Rate Design Modifications to Promote Energy Efficiency Investments Standard on the basis of its effect on conservation of energy, efficient use of facilities and resources, and equity among electrical consumers, and the objective and requirements of the Municipal Utility District Act (Cal. Pub. Util. Code, § 11501 et seq.).

Statement of Facts

The EISAct was enacted on December 19, 2007, adding several new obligations under Title 1 of PURPA. Among the new obligations, EISAct amended Section 111(d) of PURPA to require each non-regulated utility to consider a new proposed regulatory standard which encourages utilities to align utility incentives with the delivery of cost-effective energy efficiency and promote energy efficiency investments by customers. SMUD is a covered utility for the purposes of PURPA.

SMUD commenced consideration of the Standard on August 7, 2008, through Board Resolution No. 08-08-04. On Tuesday, November 17, 2009, the Staff Report and Findings on the Rate Design Modifications to Promote Energy Efficiency Investments Standard was presented and discussed at a public hearing conducted by the SMUD Board at the Policy Committee. Advertising providing notification of the hearing and standards being considered was placed in a local newspaper of general circulation. Data, views, and comments were requested from the public as to the need and desire for SMUD to adopt the Rate Design Modifications to Promote Energy Efficiency Investments Standard. The Staff Report and Findings were also made available to the public on SMUD's website at http://www.smud.org prior to the hearing. The public had an opportunity to comment on Staff findings. (insert number of speakers or written comments) comments on the proposed standard were received. Copies of verbatim

transcripts of the public hearings and written materials submitted are available for public inspection.

Determination

The SMUD Board of Directors has considered the information contained in the report and the adoption of the Rate Design Modifications to Promote Energy Efficiency Investments Standard. The Board has determined that its consideration of the Rate Design Modifications to Promote Energy Efficiency Investments Standard, and the determinations made with respect thereto, are in accord with the provisions of the Municipal Utility District Act and the Public Utility Regulatory Policies Act of 1978, as amended by EPISAct. The Rate Design Modifications to Promote Energy Efficiency Investments Standard has been considered in light of the record developed during the proceedings on the standard. The Board recognizes the importance of and concurs in the purpose of conservation of electrical energy, efficiency in the use of facilities and resources, and equitable rates as described in PURPA. These purposes were considered in reaching the determination below.

The Board's determination follows.

I. Standard Under Consideration:

RATE DESIGN MODIFICATIONS TO PROMOTE ENERGY EFFICIENCY INVESTMENTS STANDARD.

"Section 111(d)(17) . . . .

"(A) IN GENERAL. – The rates allowed to be charged by any electric utility shall –

"(i) align utility incentives with the delivery of cost-effective energy efficiency; and

"(ii) promote energy efficiency investments.

"(B) POLICY OPTIONS. In complying with subparagraph (A), each . . . non regulated utility shall consider –

"(i) removing the throughput incentive and other regulatory and management disincentives to energy efficiency;

"(ii) providing utility incentives for the successful management of energy efficiency programs;

"(iii) including the impact on adoption of energy efficiency as 1 of the goals of retail rate design, recognizing that energy efficiency must be balanced with other objectives;

"(iv) adopting rate designs that encourage energy efficiency for each customer class;

"(v) allowing timely recovery of energy efficiency related costs;

"(vi) offering home energy audits, offering demand response programs, publicizing the financial and environmental benefits associated with making home energy efficiency improvements, and educating home owners about all existing Federal and State incentives, including the availability of low-cost loans, that make energy efficiency improvements more affordable."

II. Findings:

1. SMUD has adopted Competitive Rates Strategic Direction 2 (SD-2) which, among other things, provides that SMUD rates shall be designed to balance a number of priorities, including: reflecting the cost of energy used, reducing use on peak; and encouraging energy efficiency and conservation. (Copy of SD-2 attached.)

2. SMUD has adopted Environmental Leadership Strategic Direction 7 (SD-7) which establishes the organization's commitment to environmental leadership through, among other things, energy efficiency and conservation. SD-7 requires SMUD to promote the efficient use of energy by its customers and to proactively engage its customers-owners and other stakeholders in meeting the objective. (Copy of SD-7 attached).

3. SMUD has adopted Resource Planning Strategic Direction 9 (SD-9) which defines cost-effective, reliable and feasible energy efficiency and demand reduction resources as a priority resource and adopts annual targets for reducing energy consumption by 15 percent by 2018. The SMUD Board of Directors reviews and revises the targets every three years as necessary. (Copy of SD- 9 (including revisions expected to be adopted at the November 19, 2009 Board of Directors meeting) attached.))

4. SMUD's energy pricing includes inclining block rates (rates that increase as usage increases) for most residential and small commercial customers. Inclining block rates encourage customers to save energy by using less energy.

5. SMUD piloted time of use (TOU) rate options for residential and small commercial customers and will consider expanding this option with the roll out of its advanced metering infrastructure program. The residential pilot program studied the customer response to a residential TOU program, which included either educational material or a home monitoring device. Despite participants' positive perception of the

pilot program actual results were modest, in part because of the complexity of the pilot rate structure.

6. SMUD also conducted a pilot to determine how small commercial (<20 kW) customers would respond to a TOU rate with a critical peak on 12 peak summer afternoons. SMUD provided the participants with programmable thermostats and advised them to pre-cool before the late afternoon peak and then raise the temperature set point during the critical peak price time period. All participants but restaurants, saw a reduction in peak usage.

7. TOU rates are mandatory for SMUD's largest commercial customers. Mandatory TOU rates for these customers encourage commercial customers to invest in energy efficiency technologies that cut both peak use and energy consumption.

8. SMUD has begun the implementation of its advanced metering infrastructure (AMI) project. With the implementation of AMI will come new opportunities for transparency of energy usage and innovative rate design. The SMUD Board has the exclusive legal authority to establish the rates and rules for electricity customers within its service territory. The SMUD Board has begun the public process of considering how best to restructure rates to meet both the needs of SMUD customers and the organization's environmental goals.

9. SMUD's energy efficiency programs have resulted in customer savings of more than $500 million over the last 35 years. To promote energy efficiency, SMUD offers a wide range of incentives, rebates and financing on such household equipment as air conditioners, clothes washers, refrigerators and whole-house fans. Among its many programs, SMUD provides on-line auditing tools and energy report cards to customers to empower customers with information to better understand their energy usage and determine the best way to conserve. Using customer segmentation, SMUD tailors energy efficiency programs to encourage energy efficiency investment by all classes of its diverse customer base.

10. SMUD proactively engages in public education, outreach and advertising to reach all customer segments to promote energy efficiency.

11. As reflected in SD-2, SD-7, SD-9, and through its rate design, energy efficiency and public education programs, SMUD's current policies and business practices are consistent with the Rate Design Modifications to Promote Energy Efficiency Investments Standard.

III. <u>Determination by the SMUD Board</u>:

The Standard is appropriate for use by SMUD at the present.

Attachments

SMUD BOARD POLICY	
Category: **Strategic Direction**	Title: **Competitive Rates**
	Policy Number: **SD-2**
Date of Adoption: **May 1, 2003**	Resolution No. **03-05-08**
Revision Date: **October 16, 2003**	Resolution No. **03-10-14**
Revision Date: **February 21, 2008**	Resolution No. **08-02-06**
Revision Date: **October 16, 2008**	Resolution No. **08-10-09**

Maintaining competitive rates is a core value of SMUD.

Therefore:

a) The Board establishes a rate target of at least 10 percent below Pacific Gas & Electric Company's published rates for each customer class.

b) In addition, SMUD's rates shall be designed to balance and achieve the following goals:

   i) Reflect the cost of energy when it is used;

   ii) Reduce use on peak;

   iii) Encourage energy efficiency and conservation;

   iv) Minimize "sticker" shock in the transition from one rate design to another;

   v) Offer flexibility and options;

   vi) Be simple and easy to understand;

   vii) Meet the needs of people with fixed low incomes and severe medical conditions; and

   viii) Equitably allocate costs across customer classes.

c) SMUD will work with owners, renters and landlords, as well as with local jurisdictions, in implementing this policy.

Monitoring Method: GM Report
Frequency: Annual

SMUD BOARD POLICY	
Category: **Strategic Direction**	Title: **Environmental Leadership**
	Policy Number: **SD-7**
Date of Adoption: **August 21, 2003**	Resolution No. **03-08-13**
Revision Date: **October 16, 2003**	Resolution No. **03-10-14**
Revision Date: **July 21, 2005**	Resolution No. **05-07-10**
Revision Date: **December 18, 2008**	Resolution No. **08-12-14**

Environmental leadership is a core value of SMUD. The Board is committed to environmental leadership through community engagement, continuous improvement in pollution prevention, carbon reduction, energy efficiency, and conservation.

Therefore:

a) SMUD will conduct its business affairs and operations in a manner that reduces adverse environmental impacts, reduces pollution, and enhances resource conservation and stewardship.

b) SMUD will provide leadership in the reduction of the region's total emissions of greenhouse gases through proactive programs in all SMUD activities and development and support of national, State, and regional climate change policies and initiatives.

c) SMUD will promote the efficient use of energy by its customer-owners.

d) SMUD will proactively engage its customer-owners and other stakeholders in meeting this directive.

Monitoring Method: GM Report
Frequency: Annual

SMUD BOARD POLICY Draft (approval expected 11/19/09)	
Category: **Strategic Direction**	Title: **RESOURCE PLANNING**
	Policy Number: **SD-9**
Adoption Date: **May 6, 2004**	Resolution No. **04-05-11**
Revision: **May 6, 2004**	Resolution No. **04-05-12**
Revision: **September 15, 2004**	Resolution No. **04-09-11**
Revision: **May 17, 2007**	Resolution No. **07-05-10**
Revision: **December 18, 2008**	Resolution No. **08-12-15**

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c) Promote cost effective, clean distributed generation through SMUD programs. As part of this policy, SMUD shall continue to be a leader in solar power.

Monitoring Method: GM Report
Frequency: Annual

Energy Efficiency at SMUD

ACEEE Energy Efficiency as a Resource Conference

October 2, 2007

Jim Parks
Energy Efficiency and Customer R&D
Sacramento Municipal Utility District

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT
The Power To Do More.℠

Outline

- SMUD Profile
- The Need at SMUD
- LEEDERS Initiative
- Energy Efficiency Efforts
- Relevant Legislation
- Opportunities to Impact Efficiency

SMUD Profile

- Service territory area: 900 sq mi (2331 sq km)
- Population: 1.4 million
- Board Members: 7 members elected by voters
- Revenues: $1.4 Billion
- Employees: 2,200+
- Summer Peak: 3299 MW in July 2006
- 2nd largest muni in California, 6th in nation

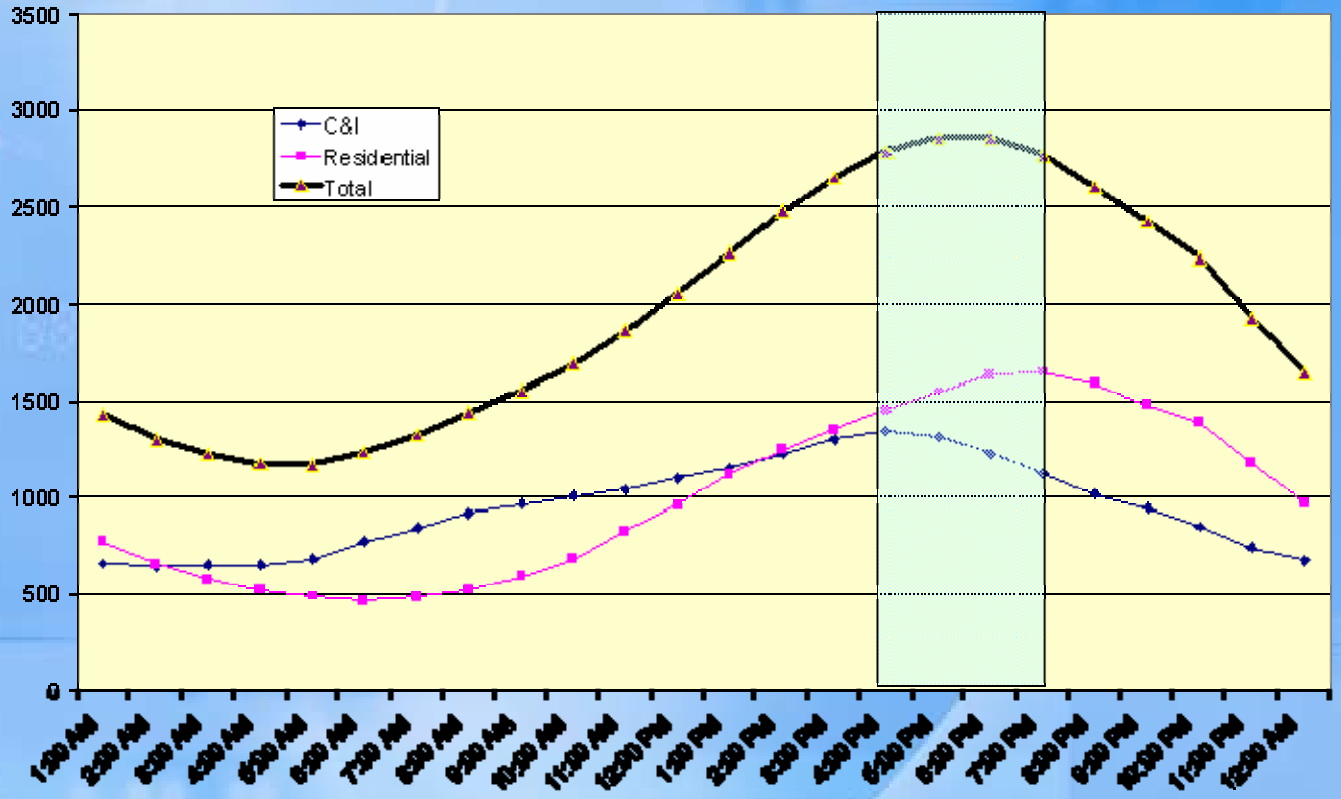
SMUD Profile

2006 Statistics

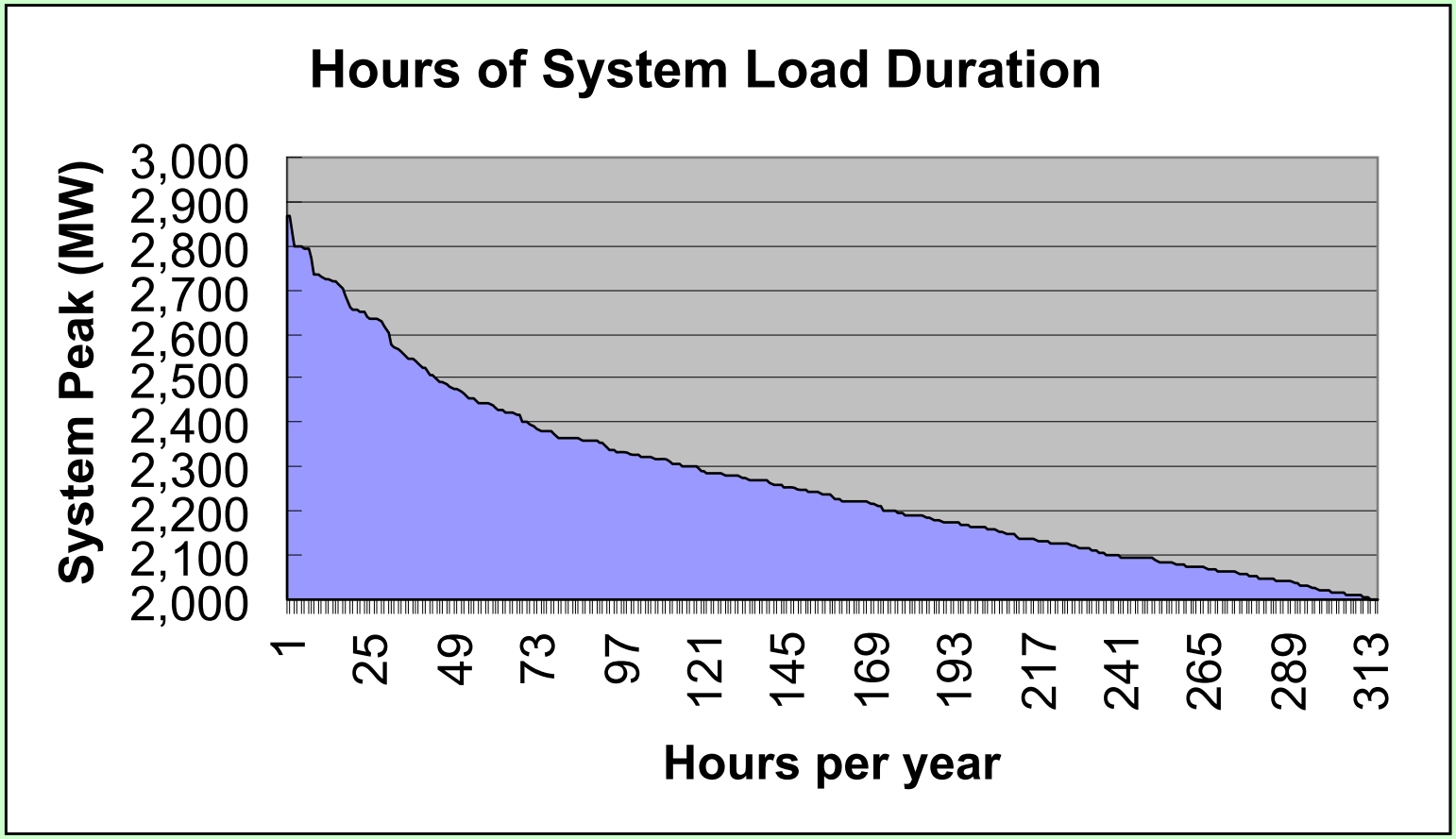
	Customers	GWh	Revenues
Residential	517,000	4,760	$515 M
Commercial	68,000	6,039	$567 M
Subtotal	585,000	10,799	$1,082 M
Sale of Surplus Power		3,964	$192 M
Sale of Surplus Natural Gas			$113 M
Total		14,764	$1.39 B

Average Annual Consumption and Cost		
Residential	9,200 kWh	10.8¢/kWh
Commercial	89,000 kWh	9.4¢ /kWh

The Need at SMUD



The Need at SMUD



LEEDERS Initiative

- The LEEDERS initiative was started at the request of SMUD's General Manager.
- Direction was to enhance SMUD's leadership in the areas of energy efficiency and environmental stewardship.

LEEDERS Core Mission

To propose a new long-term strategy for the aggressive integration of demand-side opportunities in district resource investment and operations.

Goals of LEEDERS

1. SMUD demonstrates energy and environmental leadership by example.
2. The highest levels of cost-effective energy efficiency are achieved along the entire fuel cycle.
3. Demand side measures are compared on a comparable basis to supply side options in the resource planning process.
4. Price signals are set to optimize efficiency and resource utilization.
5. Enhance energy efficiency offerings.
6. Engage the community.

Customer Carbon Program

- Includes a carbon counter so customers will know the impact of their activities--
  - Driving
  - Airline travel
  - Home - Energy use

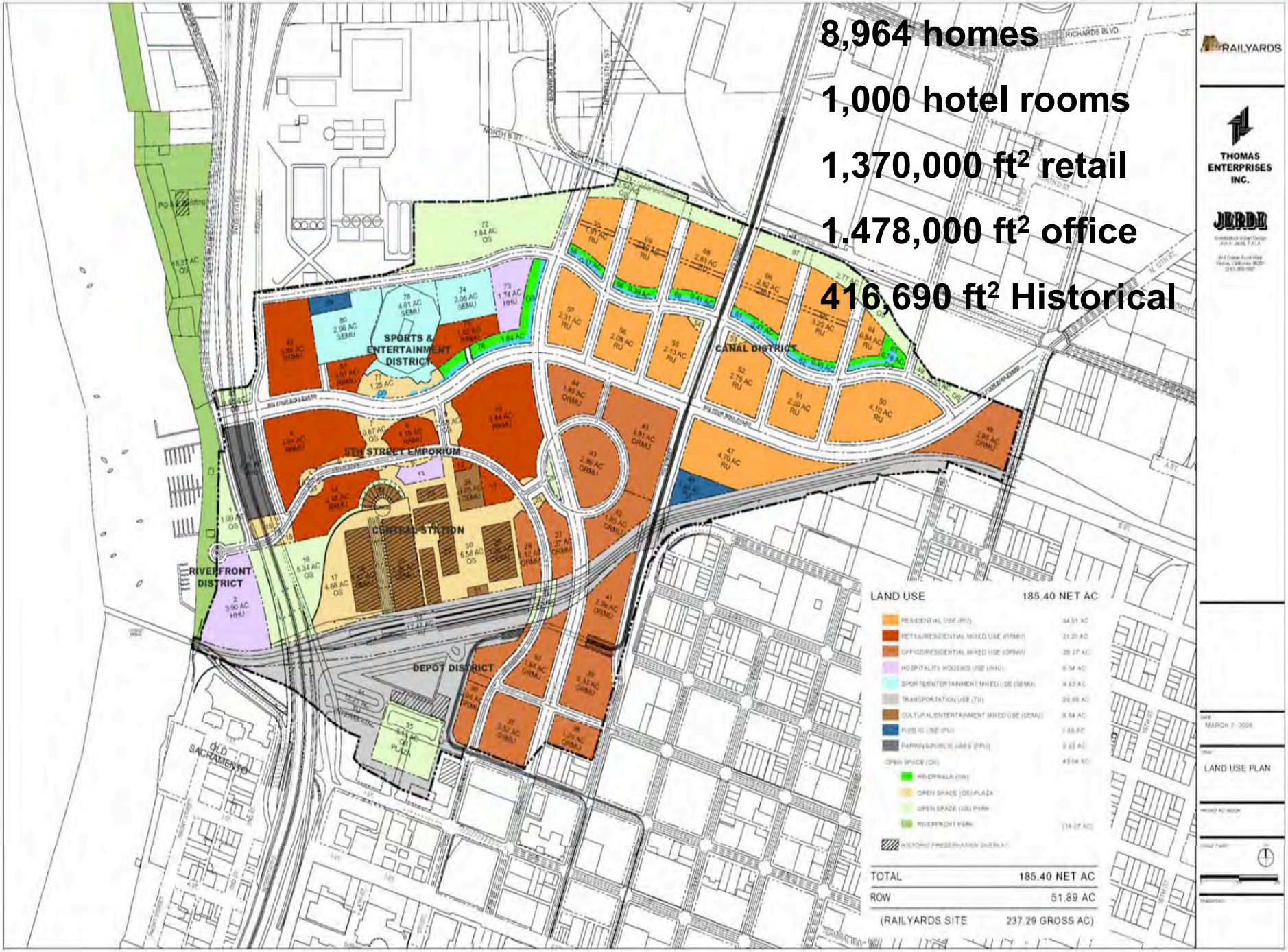
- Will work with local partners such as cities, county, SMAQMD, Tree Foundation, SACOG to enhance outreach and program effectiveness.

Local Government Initiatives

- SMUD serves 7 local governments: 6 cities and the County of Sacramento.
- Working to incorporate energy efficiency in general plans and developer agreements.
- Eliminate permit fees for retrofit photovoltaic installations. Also streamlined, consistent application process, over the counter review, and final inspection within 24 hours.
- Started the Build It Green Public Agency Council to bring together city managers, building officials, planning and development directors to promote efficiency on a broad scale.

District Energy

- Working to develop district energy at several locations including the airport, Railyards, Kaiser Hospital and others.


8,964 homes
1,000 hotel rooms
1,370,000 ft² retail
1,478,000 ft² office
416,690 ft² Historical
RAILYARDS
THOMAS ENTERPRISES INC.
JERDE
SPORTS & ENTERTAINMENT DISTRICT
CANAL DISTRICT
5TH STREET EMPORIUM
CENTRAL STATION
RIVERFRONT DISTRICT
DEPOT DISTRICT
OLD SACRAMENTO
LAND USE
185.40 NET AC
TOTAL
185.40 NET AC
ROW
51.89 AC
(RAILYARDS SITE
237.29 GROSS AC)
LAND USE PLAN

The Railyards

Fifth Street Emporium

Central Shops

Waterfront

Additional LEEDERS Efforts

- Re-vamp of energy efficiency portfolio
- Resource Planning Collaborative
- Improvements in internal practices
- Improvements in distribution, transmission and generation energy efficiency

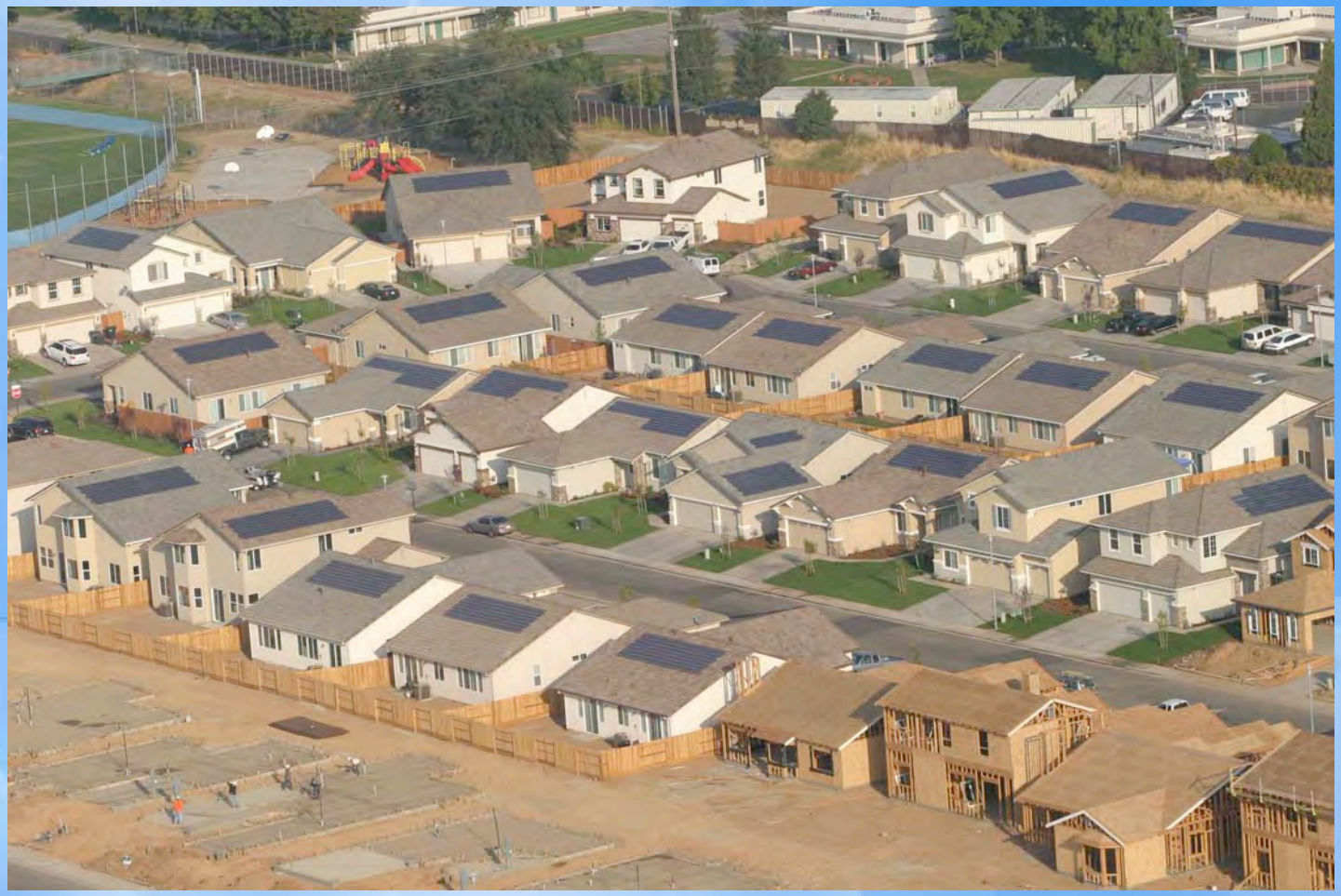
Emerging Technologies

- Demand side R&D and demonstration projects
- Supply side R&D and demonstration projects

Next Generation New Homes – Solar Smart

- Lennar Homes - 1,200+
- Tim Lewis Communities – 183
- Homes by Towne – 355
- Centex Homes – 107
- Combines energy efficiency with integrated PV
- Working with California Energy Commission to develop near zero-peak home through $2.5 M contract

Zero Energy Homes – Precursor to Solar Smart



Home of the Future Project

SMUD's Residential Energy Efficiency Programs

- Residential Services
- Solar DHW
- Shade Trees
- Energy Star Lighting
- Equipment Efficiency
- Appliance Efficiency
- New Construction
- Pool & Spa

SMUD's C/I Energy Efficiency Programs

- C&I New Construction (Savings By Design)
- C/I Retrofit Programs
  - Lighting and HVAC rebates
  - Small C/I HVAC Tune-Up
  - Retrocommissioning
  - Building Operator Certification
  - Process/industrial rebates

Energy Efficiency Loans

- Average $25 - 30 million in loans per year
  - 4000 - 5000 loans/yr
  - 99% residential
- $42 million portfolio
- 7 ½% interest rate
- Terms up to 10 years
- Program has operated for 28 years
- $389 million over life of program
- 127,500 loans

SMUD's Energy Efficiency Goals

- SMUD's board of directors adopted aggressive energy efficiency goals – 15% over ten years

10-YEAR ENERGY EFFICIENCY TARGETS ADPOTED BY THE SMUD BOARD OF DIRECTORS

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total	10-Yr Avg
GWh	70	107	145	196	200	205	209	213	217	222	226	1940	194
MW	18	28	40	58	59	60	62	63	64	66	67	568	57
Budget ($millions)	$ 25	$ 34	$ 40	$ 45	$ 45	$ 46	$ 46	$ 47	$ 48	$ 49	$ 50	$ 450	$ 45

The 10-year goals (2008-2017) were adopted by the SMUD Board of Directors on May 17,2007

Relevant Legislation – AB2021

- Focused on increasing municipal utility energy efficiency efforts
- Legislative intent is for the entire state to achieve 10% savings over ten years
- Submit ten year goals to CEC, update every 3 years
- Report to CEC annually on results

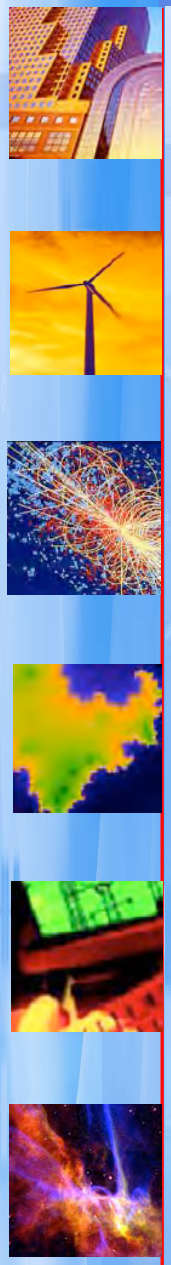
Relevant Legislation – SB1

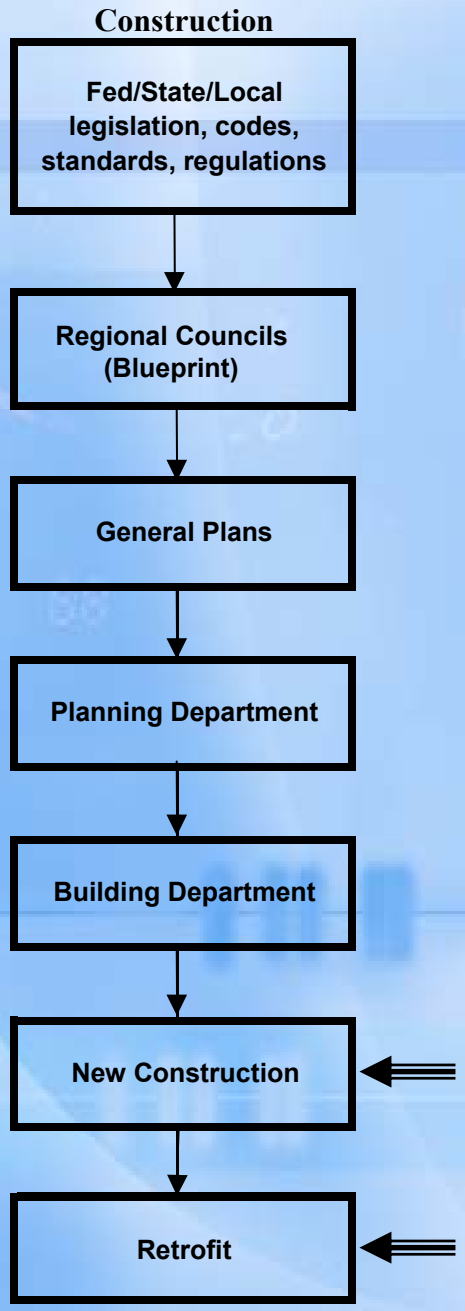
- Million solar roofs legislation
- Utilities must provide PV incentives with a statewide goal of achieving 3000 MW over ten years
- SMUD share is 125 MW
- SMUD has installed 11 MW over 20 year's of aggressive program activity

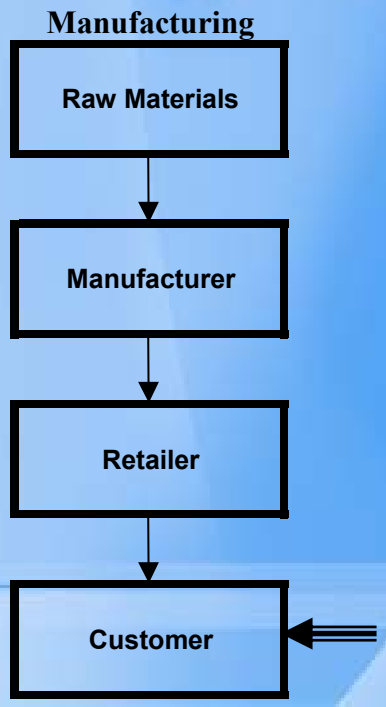
Relevant Legislation – AB32

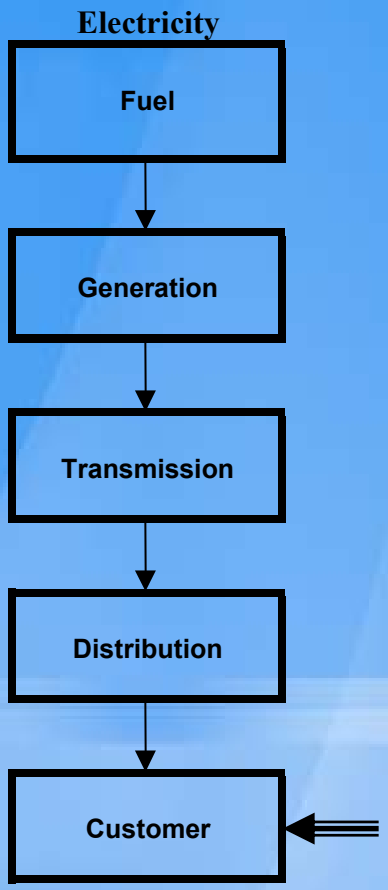
- Greenhouse gas legislation
- Requires reporting and verification of GHG levels
- Go back to 1990 levels by 2020
- State will monitor and enforce rules
- Working on several initiatives to meet the target

Opportunities to impact efficiency









The Potential is Big

- Working together we can make difference
- Working on upstream markets will have a greater impact
- Working simultaneously on multiple strategies (silver buckshot)—Codes and Standards, PV, EE, transportation, land-use planning—will yield the biggest benefits

Appendix D
Boulder, Colorado
Approved Energy Efficiency Measures

ClimateSmart™

LOAN PROGRAM

COMMERCIAL ELIGIBLE MEASURES LIST

ENERGY EFFICIENCY MEASURES			
Category	**Measure**	**Minimum Efficiency /Certification Requirements**	**Local & Federal Rebates & Incentives**
Commissioning/ Monitoring	**Recomissioning**		Xcel Energy, Platte River (pilot), City of Boulder (pilot)
	Energy Use Monitoring	Recommend paring with at least one funded improvement. 12 months min. of data from before the improvement, for ongoing comparison during loan lifetime. Data may be tracked in EnergyStar Portfolio Manager in addition to County database	Governor's Energy Office
	Sub metering	Recommend pairing with other funded improvements. Allows individual tenants to monitor energy use and pay only for what they use.	
Energy Management	**Energy Management Systems**	Computer-based Building Automation System with preventative maintenance program or contract. Third-party verification required.	Xcel Energy
	System Level Metering	Third-party verification required, with energy management data required after 1 year.	
	Direct Digital Control (DDC)	Custom evaluation of performance proposal comparing system cost with potential energy savings. Third-party verification required.	
	Automated Controls	Occupancy and CO2 sensors, lighting and day lighting controls, and automatic shading devices. See Lighting, Ventilation.	Xcel Energy; Platte River Power Authority
	Manufacturing Process Efficiency	Custom evaluation of performance proposal. Third-party verification required	Xcel Energy
Walls and Roof	**Wall Insulation**	Fill cavity to capacity and/or add min. R-5 rigid insulation to interior or exterior	Governor's Energy Office, Xcel Energy, Platte River Power Authority
	Roof Insulation	Fill cavity to capacity or min. R38 total, and/or add min. R-13 batt to lower side or R-10 rigid insulation to upper side (or combination totaling min. R-15)	Governor's Energy Office, Xcel Energy, Platte River Power Authority
	Air Sealing	Air sealing with expanding compound and mastic shall prioritize joints/seams, trims where accessible, windows/doors, mechanical and electrical penetrations, weather-stripping. Third-party verification required.	Governor's Energy Office, Platte River Power Authority
	Cool Roofs	Energy Star-qualified or white TPO and metal roofs, maintaining reflectance of at least 50% after 3 years, with 10-year material and labor warranty	Xcel Energy, Platte River Power Authority
	Green Roofs	Custom evaluation of performance proposal; recommended that new waterproofing be installed in conjunction with green roof.	

Windows and Doors	**Insulating Windows**	Assembly U max 0.45 metal / 0.35 nonmetal; SHGC max 0.46 (passive solar applications custom evaluation for higher SHGC's) Metal windows must include thermal break. Window replacement must be accompanied by air sealing around windows at minimum.	Xcel Energy, Platte River Power Authority
	Storefront Systems	Assembly U max 0.35; SHGC max 0.35 (passive solar applications custom evaluation for higher SHGC's) Metal windows thermally broken. Window replacement must be accompanied by air sealing around windows at minimum.	Xcel Energy, Platte River Power Authority
	Insulating Doors	Assembly U max. 0.5 opaque / 0.7 metal; Door replacement must be accompanied by air sealing around doors at minimum	Xcel Energy, Platte River Power Authority
	Loading Dock Curtains	Custom fitted and permanent	
	Low-E Films and Permanent Automated Blinds	Custom evaluation of performance proposal. 10-yr manufacturer warranty on film, removal, and replacement.	Xcel Energy
Combined Heating, Ventilation and Air-Conditioning	**Gas/Electric Package Units**	Min. 14 SEER. Must contain automatic economizer capable of introducing 100% outside air when appropriate for cooling. Maintenance schedule required. Programmable thermostat required. Backup systems not eligible.	Xcel Energy, Platte River Power Authority
Cooling, Heat Pumps, Ventilation	**Data Center Zone Cooling**	Time-of-Day programmable air handler control required.	
	Rooftop AC Units	13 SEER (0-65 kBtuh); 11 EER (65-135 kBtuh); 10.8 EER (135-340 kBtuh); 10 EER (240kBtuh) Programmable thermostat required. Backup systems not eligible.	Xcel Energy, Platte River Power Authority
	Condensing Units	Combine with HVAC system to reach qualifying (S)EER for that equipment.	Xcel Energy
	Central Split Systems	13.0 EER/7.7 HSPF (0-65 kBtuh); 10.6 EER/3.2 COP (65-135 kBtuh); 10.1 EER/3.1 COP (135+ kBtuh). Programmable thermostat required. Resistance electric heat may not be primary heat source in cold weather. Backup systems not eligible.	Xcel Energy, Platte River Power Authority
	Central Air Source Single Package System	14 SEER / 12 EER. Programmable thermostat required. Resistance electric heat may not be primary heat source in cold weather. Backup systems not eligible.	Xcel Energy, Platte River Power Authority
	Ground Source and Water Source Heat Pumps	Custom evaluation of performance proposal based on ASHRAE 189.1P Table C-2 criteria. Resistance electric heat may not be primary heat source in cold weather.	Xcel Energy, Platte River Power Authority
	Cooling Towers	Custom evaluation of performance proposal based on ASHRAE 189.1P Table C-8 criteria. Must include VFD fans.	Xcel Energy, Platte River Power Authority
	Chillers	Custom evaluation of performance proposal based on ASHRAE 189.1P Table C-8 criteria. Backup systems not eligible. Large chiller may be replaced with 2 smaller chillers.	Xcel Energy, Platte River Power Authority
	Economizers	Cooling Capacity > 54 kBtuh	Xcel Energy, Platte River Power Authority
	Evaporative Coolers	Min. 14 EER. Programmable thermostat required.	Xcel Energy, Platte River Power Authority
	Evaporative Condensers	Combine with HVAC system to reach qualifying (S)EER for that equipment.	Xcel Energy, Platte River Power Authority
	Demand-Controlled Ventilation	Carbon Dioxide sensors required. Third-party verification of installation and programming required.	

Boiler and Furnace	**Boiler System Tune-ups**	Programmable thermostat installation required. Includes steam trap replacements.	Xcel Energy
	Non-Condensing hot-water Boilers	Min. 85% efficient. Programmable thermostat required.	Governor's Energy Office, Xcel Energy
	Condensing Hot-Water Boilers	Min. 92% efficient. Programmable thermostat required.	Governor's Energy Office, Xcel Energy
	Modular Burner Controls	Third-party verification of installation and programming required.	Xcel Energy
	O2 Trim Controls, Outdoor Air Reset Controls, Stack Dampers	Third-party verification of installation and programming required.	Xcel Energy
	High-Efficiency Natural Gas Furnaces	80% AFUE min (0-225 kBtuh - SP); 90% AFUE min (0-225 split) Programmable thermostat required.	Governor's Energy Office, Xcel Energy
Energy Recovery, Redistribution, HVAC insulation	**Air Destratifiers**	Custom evaluation of performance proposal	
	Radiant Heating and Cooling	Non-electric only. Boiler must meet program qualifications. Programmable thermostat required.	
	Waste Heat Redistribution	Custom evaluation of performance proposal	
	Combined Heat and Power	Custom evaluation of performance proposal	Xcel Energy
	Energy (Heat)-Recovery Ventilation (ERV/HRV)	Min. SRE - 60%; no more than 500 cfm; no resistance heating	Xcel Energy
	VAV Boxes	Upgrade constant air volume	Xcel Energy
	Pipe Insulation	In exterior, unconditioned or semi-conditioned space: R-8 or maximum possible as explained in bid	
	Duct Sealing	In exterior, unconditioned or semi-conditioned space: R-6 or maximum possible as explained in bid	Governor's Energy Office, Xcel Energy
Water Heaters	**Efficient Gas Water Heaters**	over 75 kBtuh; 90% Et	Governor's Energy Office, Xcel Energy
	Efficient Electric Water Heaters	under 12 kW and greater than 20 gal. EF > 0.99-0.0012xVolume	Xcel Energy, Platte River Power Authority
	Tankless Water Heaters	0.81 EF or 81% Et	Governor's Energy Office, Xcel Energy
Lighting	**Incandescent,T-12 Fixture upgrade to T- 5, T- 8**	high-efficiency ballasts with low ballast factor (<= 0.85) required for T-series fixtures	Xcel Energy, Platte River Power Authority, Lyons Power
	Electronic Ballasts	high-efficiency ballasts with low ballast factor (<= 0.85) required	Xcel Energy, Platte River Power Authority
	Hardwired LED Lighting	Hard-wired; no edison base (screw-in)	Xcel Energy, Platte River Power Authority
	LED Exit Signs	Replace incandescent or fluorescent	Xcel Energy, Platte River Power Authority
	Ceramic Metal Halide	Replace incandescent, halogen, mercury vapor, high-pressure sodium	Xcel Energy, Platte River Power Authority
	Pulse-start Metal Halide	Replace incandescent, halogen, mercury vapor, high-pressure sodium	Xcel Energy, Platte River Power Authority
	Delamping and Re-switching	Delamping must permanently remove lamps, ballasts and sockets from fixture. Adding reflectors for remaining lamps is encouraged. Re-switching must make it possible to turn on fewer lights at a time, or just one area of a room at a time. Recommended target max. lighting power density 0.9 W/sq. ft.	Xcel Energy (delamping only)

	Day lighting	Replacement insulating skylights (max. U 0.69/SHGC 0.39) or new specular solar tubes, to max. 3% of roof area. Must include controls to turn off lighting when adequately day lit.	
	Automatic controls	Occupancy sensors for unoccupied rooms, not to be used with CFL's. Dimming controls for lights near walls with window-wall ratio of 25% or more: dim fixture within 12' of N/S window wall or within 8' of skylight edge.	Xcel Energy, Platte River Power Authority
	Parking Lot and Parking Garage Lighting and Re-Switching	Garage exterior must be switched separately from interior; Zoned switching of garage interior encouraged. Parking lot lighting maximum intensity <= 250 W pulse-start metal halide at 25' or equivalent.	Xcel Energy, Platte River Power Authority
	Exterior Lighting	Façade and signage lighting max. 0.2 W/sq. ft. Photocell or astronomical time switch required on all exterior lighting, except where preempted by code.	Xcel Energy, Platte River Power Authority
Motors and Drives	**Variable-Frequency Drives / Adjustable-Speed Drives**	For fans and pumps, to replace old or constant-speed drives. Must meet NEMA Premium Efficiency Standards.	Xcel Energy, Platte River Power Authority
	Efficient Motors	Must meet NEMA Premium Efficiency Standards	Xcel Energy, Platte River Power Authority
	Elevators	Custom evaluation of performance proposal	Xcel Energy
	Compressed Air	Performance test required to identify leaks. Test and repairs eligible (provided that min. 50% of leaks found are repaired)	Xcel Energy, Platte River Power Authority
Refrigeration and Food Service *** Only owner occupied buildings are eligible*	**Refrigeration Recommissioning**	Built-in equipment only	Xcel Energy
	Refrigeration Component Repair, Upgrade and Replacement	Built-in equipment only; replacement only except for energy upgrades. Product coolers; Evaporative Coolers; Anti-Sweat Heater Controls; ECM Evaporative Fan Motor for Walk-in Cooler, Reach-in Cooler or Freezer; Motion Sensors for Lighting in Walk-ins; Outside Economizer for Walk-in Coolers; Walk-in Cooler Curtains	Xcel Energy, Platte River Power Authority
	Vent Hood Controls	Built-in equipment only	Xcel Energy, Platte River Power Authority
RENEWABLE ENERGY MEASURES			
Solar Hot Water	**Solar Thermal Water Heating**	SRCC rated	Federal, Colorado; City of Boulder
	Solar Thermal Space Heating	SRCC rated	Federal, Colorado; City of Boulder
Solar Photovoltaics	**PV Systems**	grid-tied, net-metered	Federal, Colorado, City of Boulder, Xcel Energy, Longmont Power & Communications
Other Renewables	**Small Wind**	Custom evaluation of performance proposal	Federal
	Biomass	Custom evaluation of performance proposal	Federal
	Geothermal Electric, Fuel Cells	Custom evaluation of performance proposal	Federal
AEDG (Advanced Energy Design Guidelines "30% Guides")			
ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers)			

ClimateSmart™

Loan Program

Residential Eligible Measures List

ENERGY EFFICIENCY MEASURES		
Category	**Measure**	**Minimum Efficiency / Certification Requirements**
Air Sealing and Ventilation	**Air sealing**	Air sealing level must be measured by a blower door before and after improvement is made, and mechanical ventilation must be installed if air sealing reduces air changes per hour to below 0.35.
	Duct sealing	
	Energy or heat recovery ventilator	
	Whole house fan	Must have controls (thermostat or timer, multi-speed). Fan opening must be properly insulated and sealed in winter.
	Attic fan	Must have controls (thermostat or timer, multi-speed). Fan opening must be properly insulated and sealed in winter. May be solar-powered.
Insulation	**Attic**	R-38 minimum required in open attic; cathedral ceilings will vary.
	Wall	R-19 minimum, or fill wall cavity (e.g. for 2x4, R-13 will fill wall cavity)
	Floor (over unconditioned space)	R-19 minimum
	Ducts (in unconditioned space)	R-8 minimum
	Perimeter (foundation)	R-10 minimum
Space Heating and Cooling	**High efficiency furnace**	AFUE >= 90 %, plus sealed combustion. If home design precludes direct venting, an upgrade to minimum 80% AFUE is eligible.
	Boiler	AFUE >= 84%
	Ground source heat pump	Closed loop only. Must meet Energy Star: EER >14.1, COP >=3.3. Installer must be IGSPHA certified.
	Radiant heating and cooling (floor, wall, and ceiling)	Radiant systems must be powered by a heat pump (electric or gas-fired, or ground-source), efficient gas boiler, or solar system (not by electric resistance)
	Evaporative cooler	May not be installed along with an AC system; a home may have one or the other.
	Central air conditioner	14 SEER and 12 EER or higher for split systems; 14 SEER and 11 EER or higher for packaged systems. ***Only homes that currently have a central air system are eligible for an upgrade to a more efficient AC system. However, new evaporative coolers may be installed under this program.*
	Programmable Thermostats	

ENERGY EFFICIENCY MEASURES CONTINUED		
Category	**Measure**	**Minimum Efficiency / Certification Requirements**
Water Heating	**Demand/tankless**	Energy Factor of 0.82 or higher (Energy Star Listed)
	High efficiency natural gas storage	Energy Factor of 0.62 or higher (Energy Star Listed). R-16 tank insulation; Anti-Siphon valves; and hot water pipe insulation of at least 6 feet
Lighting	**Fixtures, ballasts**	T-4, T-5 or T-8 fixtures with electronic ballasts
	Timers, sensors	
Day lighting	**Light shelves**	
	Tubular skylights	
Windows, Doors and Skylights	**Exterior windows and glass doors**	Replacements only; not newly created windows and doors. U Value of 0.35 or less, low-e glass. ***Replacement windows permitted only as part of a package that includes air sealing and/or insulation, unless applicant can verify they have already completed priority air sealing and insulation measures. To verify that you have had prior air sealing and/or insulation, you must bring copies of an energy audit or prior invoices with you during your visit with the loan originator.*
	Storm windows	Meets IECC in combination with the exterior window over which it is installed, for the applicable climate zone.
	Window Film	Must meet Energy Star Criteria.
	Insulating shutters	R-5 minimum.
	Insulating exterior doors	R-4 minimum. Fiberglass doors only with weather-stripping and threshold. Any glass must be double paned and tempered.
	Skylights	Upgrades only, not new skylights. U value of 0.35 or less, low-e glass.
Reflective Roof	**Metal or asphalt roof**	Reflective shingles. Must be Energy Star Listed
Pool Equipment	**High efficiency pool circulating pump**	Variable flow and/or multi-speed with controllers. May only be financed by open loans **(not income-qualified loans)**.
	Automatic pool cover	May only be financed by open loans **(not income-qualified)**.
	Air source heat pump	HSPF >= 9, EER >= 13, SEER >= 15. May only be financed by open loans **(not income-qualified)**.
Landscaping	**Focused on heating/cooling**	Example: plant deciduous trees on south side of house. Consider future shading as trees grow. May only be financed by open loans **(not income-qualified)**.
RENEWABLE ENERGY MEASURES		
Solar hot water	**Rooftop (Includes replacement for orphan solar hot water systems)**	Must be rated by the Solar Rating and Certification Corporation
	Pool	Must be rated by the Solar Rating and Certification Corporation. May only be financed by taxable/open bond funds **(not income-qualified)**.
	Hot tub	Must be rated by the Solar Rating and Certification Corporation
Solar photovoltaics		Must be on California Energy Commission approved product list.
Small wind		
Wood/pellet stoves (Biomass only, no gas)	**Pellet stoves**	Minimum efficiency 78%, must be right-sized (not too big for house). Only upgrades to a more efficient model are eligible, not new stove installations, unless home does not have access to natural gas.
	High efficiency fireplaces & fireplace inserts	Only retrofits of existing fireplaces are eligible; not newly constructed fireplaces. Minimum efficiency 75%.
	Advanced combustion / gasification wood or pellet stoves	Minimum efficiency 75%. Only upgrades to a more efficient model are eligible, not new stove installations, unless home currently uses electric heat.

Appendix E

Railbelt Utility Contacts

Chugach Electric Association

Contact	Position	Phone Number
Main Line	Main Line	907/563-7494
Patty Bogen	PR Rep.	907/762-4736
Phil Steyer	Government Relations	

Golden Valley Electric Association

Contact	Position	Phone Number
Main Line	Main Line	907/452-1151
Dianne Porter	Marketing & Communications Coordinator	907-451-5604

Homer Electric Association

Contact	Position	Phone Number
Main Line	Main Line	907/235-8551
Joe Gallagher	PR Rep.	

Matanuska Electric Association

Contact	Position	Phone Number
Main Line	Main Line	907/761-9300
Lorali Carter	PR Rep.	907/761-9266

Municipal Light & Power

Contact	Position	Phone Number
Main Line	Main Line	907/279-7671
Robert Reagan	Supervisor of rates and charges	
Kim Robinson	Supervisor of rates and charges	
Marianne Hansen	Marketing Manager	907/263-5423

Seward Electric System

Contact	Position	Phone Number
Main Line	Main Line	907/224-4073
Kari Atwood	Customer Department	907/224-4067
John Fotz	Utility Manager	907/224-4071

Appendix F
Sample End Use Survey

2003

Survey of Household Energy Use (SHEU)

Summary Report

December 2005

Natural Resources Canada
Ressources naturelles Canada

Canada

Natural Resources Canada's Office of Energy Efficiency

Leading Canadians to Energy Efficiency at Home, at Work and on the Road

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Glossary 33

I INTRODUCTION

In 1993, Statistics Canada conducted an extensive survey for Natural Resources Canada (NRCan) entitled *1993 Survey of Household Energy Use (SHEU–1993)*. This survey provided an opportunity to collect detailed data on the energy consumption habits of households in Canada to be used by what would become the Office of Energy Efficiency (OEE).

The OEE decided to periodically conduct additional Surveys of Household Energy Use in a continuing effort to assess the changing characteristics of household energy consumption across Canada. The second Survey of Household Energy Use collected data for 1997 (SHEU–1997), and the third collected data for 2003 (SHEU–2003).[1] These surveys tie in directly with the OEE's mandate to strengthen and expand Canada's commitment to energy efficiency in order to reduce greenhouse gas (GHG) emissions that contribute to climate change.

The primary objective of SHEU–2003 was to gather information on energy use and the factors affecting energy use in households residing in houses and residential buildings with fewer than five storeys. More precisely, the survey involved collecting information on

- dwelling characteristics
- usage of appliances and other energy-consuming products
- energy efficiency characteristics
- energy consumption

The purpose of this summary report is to provide an overview of the main findings of SHEU–2003. A more detailed report entitled *2003 Survey of Household Energy Use – Detailed Statistical Report* is also available.

Natural Resources Canada's Office of Energy Efficiency (OEE) offers a wide range of programs and services to improve energy efficiency in every sector of the Canadian economy, including the residential sector. The OEE's Equipment Program helps Canadians make energy-efficient choices when buying, selling or manufacturing energy-using equipment. The OEE's Housing Program offers resources to help Canadians keep their homes comfortable and well ventilated for healthy indoor air quality while reducing energy costs for home heating. For more information on these and other programs, as well as tools, financial incentives, free publications and other resources to help save energy and reduce GHG emissions, visit oee.nrcan.gc.ca.

If you would like to learn more about this publication or the OEE's services, please contact us by e-mail at **euc.cec@nrcan.gc.ca**.

This summary report was prepared by Glen Ewaschuk of the Demand Policy and Analysis Division of the OEE. Indrani Hulan and Jean-François Bilodeau supervised the project, Vincent Fecteau and Michel Blais provided data assistance, and David McNabb provided project leadership.

To learn more about this survey and the topics discussed in this document, please contact:

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[1] Statistics Canada conducted SHEU–2003 in 2004 and therefore refers to it as the 2004 Survey of Household Energy Use. However, the reference period for this survey is the calendar year 2003 (that is, all data presented are for households during the 2003 calendar year). Therefore, this report refers to the survey as the 2003 Survey of Household Energy Use (SHEU–2003).

Analytical Summary

- Data from SHEU–2003 found that the average heated area of a Canadian dwelling was 1321 square feet (sq. ft.) in 2003. The average heated area of a Canadian dwelling has increased with each Survey of Household Energy Use (SHEU).

- Dwellings constructed after 1979 were, on average, larger and more energy efficient than dwellings constructed before 1980.

- The energy source used by households for space and water heating was primarily based on the location of the household within the country. The majority of households located west of Quebec used natural gas, while the majority of households in Quebec used electricity. Most households in the Atlantic region used either electricity or oil.

- The penetration rate[2] for condensing (high-efficiency) furnaces was 62 percent among dwellings constructed during 1990–2003 that used a natural gas, propane or oil furnace.

- An increasing number of basements / crawl spaces, attics / crawl spaces and attached garages are being insulated.

- SHEU–2003 found that more households used both a main and a secondary refrigerator than did the previous SHEUs. These additional refrigerators were also increasing in capacity. These trends have also coincided with a decrease in the penetration rate for freezers.

- Nearly one quarter of Canadian households used three or more television sets in 2003.

- The penetration rate for both central and window/room air conditioners increased from SHEU–1997 to SHEU–2003. Also, Ontario households accounted for 60 percent of all air-conditioning systems used in Canada in 2003.

- Almost 25 percent of the light bulbs used by the average Canadian household were energy-efficient light bulbs, such as halogen light bulbs, fluorescent tubes and compact fluorescent lights.

- ENERGY STAR® qualified products, which are among the most energy-efficient products on the market, have had a high penetration since the inception of the ENERGY STAR Initiative in Canada. However, a significant number of households did not know if their products were ENERGY STAR qualified, which may have resulted in an underestimation of the penetration rate of ENERGY STAR qualified products.

[2] Penetration rate is the percentage of a sample population that used a given product during a specific time. For the purposes of this report, the sample population is Canadian households (unless otherwise stated) during 2003.

Scope of Survey

The third Survey of Household Energy Use (SHEU–2003) used 2003 as its reference year. The previous SHEUs used 1993 and 1997 as their respective reference years.

SHEU–2003 covers over 11 million households across Canada. The survey is representative of households in all 10 Canadian provinces that resided in single detached houses, double/row houses, duplexes,[3] mobile homes and apartments in buildings with fewer than five storeys (low-rise apartments). Households in the territories were excluded in order to remain consistent with previous SHEUs.

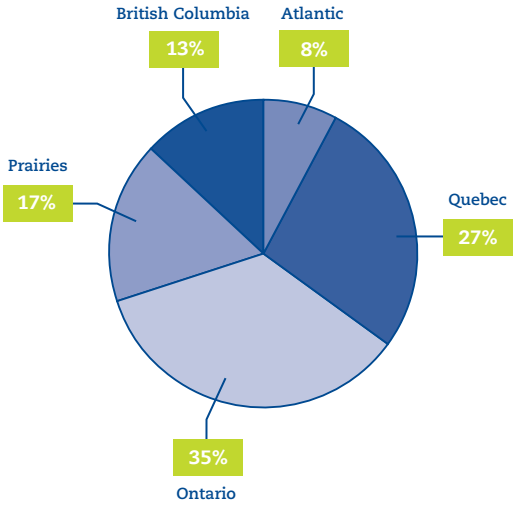
The survey data were collected through computer-assisted personal interviews with dwelling owners and renters. Also, landlords of rented dwellings and property managers of condominiums were interviewed in an attempt to obtain the most accurate responses possible. Landlords and property managers were asked questions only about the dwelling's heating and cooling equipment, features and conditions, energy use and energy consumption. Energy consumption data were obtained through either the energy supplier(s) of the household or the household providing the data from 2003 energy bills or statements.

SHEU–2003 found that, in 2003, the regional breakdown of households across Canada was as follows: Ontario, 35 percent; Quebec, 27 percent; the Prairies, 17 percent; British Columbia, 13 percent; and the Atlantic region, 8 percent (see Chart 1).

More detail about the methodology used for SHEU–2003 and a copy of the SHEU–2003 questionnaire can be found in the *2003 Survey of Household Energy Use – Detailed Statistical Report*.

Chart 1

Location of Households by Region



[3] Duplexes will be included in the double/row houses category for comparison purposes throughout this report.

Trends in Household Energy Use

Although each Survey of Household Energy Use has evolved to incorporate the changing characteristics of household energy consumption, a few essential topics have continued to be covered by each survey (SHEU–1993, SHEU–1997 and SHEU–2003). This provides an opportunity to evaluate developments in the Canadian residential sector through a comparison of findings from 1993, 1997 and 2003.

For comparison purposes, this section refers only to elements that are common to all three surveys. Also, this section presents data only from single detached houses, double/row houses and mobile homes. Data from low-rise apartments are excluded because the sample population of SHEU–1997 did not include this type of dwelling.

Finally, since the methodology used for all of the surveys was not exactly the same,[4] it should be noted that some of the discrepancies between the surveys might be partially attributable to methodological differences.

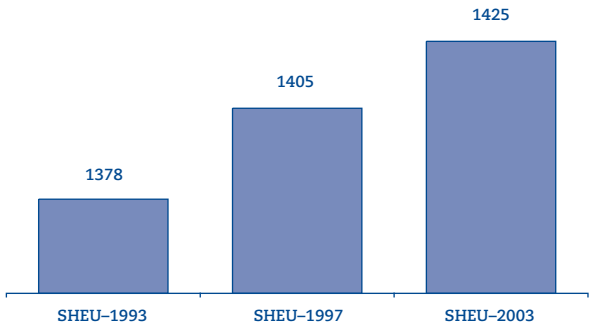
Changing Characteristics of Canadian Houses

Heated Area

The heated area of a house is defined as the total floor space of a house excluding the basement and the garage.

Chart 2

Average Heated Area of Houses (sq. ft.)



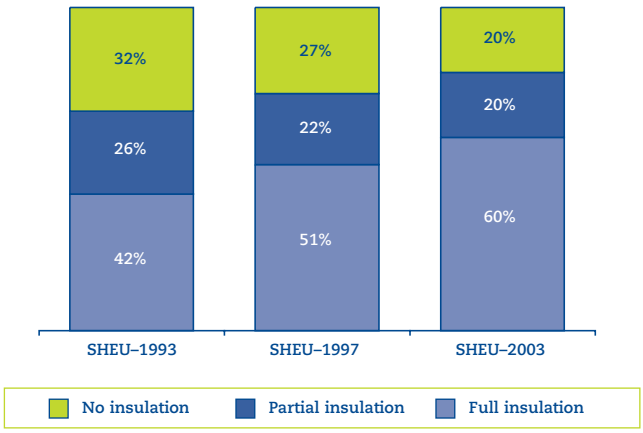
As shown in Chart 2, the average heated area of houses[5] across Canada has increased with each version of SHEU. The 1993 version found that the average heated area of a house was 1378 sq. ft. Next, SHEU–1997 observed that the average heated area of a house had increased to 1405 sq. ft. Finally, SHEU–2003 data show that the average heated area of a house in Canada had once again increased, to reach 1425 sq. ft.

Basements

Basements can be a prime source of heat loss within a house. In fact, basements can account for 20 percent to 35 percent of a house's total heat loss.[6] Canadian homeowners seem to have become more aware of this, as the percentage of fully insulated basements / crawl spaces has increased from 42 percent in SHEU–1993 to 51 percent in SHEU–1997 and to 60 percent in SHEU–2003 (see Chart 3).

Chart 3

Percentage of Basements / Crawl Spaces With Full, Partial and No Insulation on Inside Walls



[4] For example, the wording of questions and possible responses may have been refined from one survey to the next.
[5] Includes single detached houses, double/row houses and mobile homes.
[6] Natural Resources Canada, *Keeping the Heat In – EnerGuide, Gatineau*, 2004, p. 74.

There has also been a corresponding decrease in the percentage of basements / crawl spaces that had no insulation at all. In 1993, nearly one out of every three basements had no insulation. This ratio has decreased to one out of every five basements in 2003.

Changing Characteristics of Residential Heating

Average Age of Main Heating System

The average age of the main heating system in Canadian dwellings has gradually increased with each SHEU, from 12 years in SHEU–1993 to 14 years in SHEU–1997 to 15 years in SHEU–2003 (see Chart 4). As for the average age of the prominent types of main heating systems, electric baseboards have seen the largest increase in average age, going from 11 years to 19 years over the course of the three surveys. Similarly, the average age of heat pumps has also increased, but at a slower rate, starting from 6 years in SHEU–1993 and reaching 10 years in SHEU–2003. Other types of heating systems, such as furnaces and heating stoves, had average ages that slightly increased from SHEU–1993 to SHEU–1997 and then remained constant from SHEU–1997 to SHEU–2003.

Fireplaces

Gas fireplaces have become a cleaner-burning and potentially more energy-efficient alternative to conventional wood fireplaces.[7] Many homeowners are more attracted to gas fireplaces – because of their ease of use, cleanliness and environmental benefits – than conventional wood fireplaces. These factors seem to have contributed to the increase in the popularity of gas fireplaces in Canadian homes. This increase can be seen by comparing the penetration rate of gas fireplaces in all three SHEUs.

The penetration rate for gas fireplaces has steadily increased, from 5 percent in SHEU–1993 to 19 percent in SHEU–2003 (see Chart 5). In contrast, the penetration rate for wood fireplaces declined slightly, from 31 percent to 27 percent, over the same period.

Chart 5

Penetration Rate of Fireplaces by Type of Fireplace

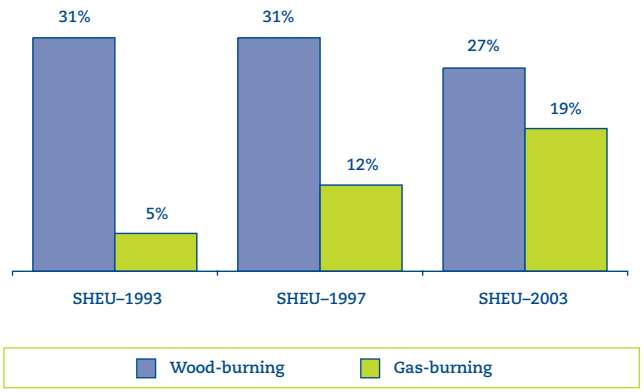


Chart 4

Average Age of Main Heating System (years)

	SHEU–1993	SHEU–1997	SHEU–2003
All heating systems	12	14	15
Electric baseboards	11	15	19
Hot-air furnace	13	14	14
Hot-water furnace	16	19	19
Heating stove	11	12	12
Heat pump	6	9	10
Other	15	11	14

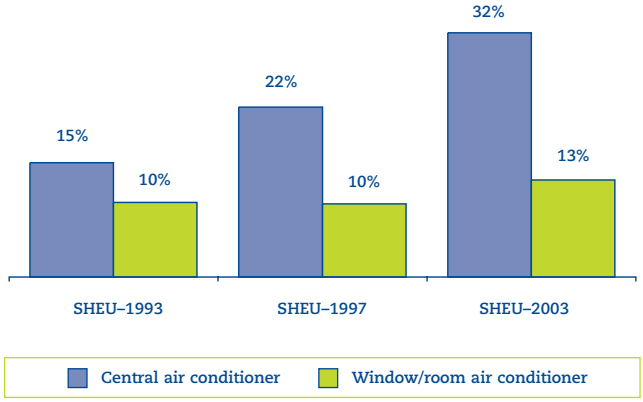
[7] Natural Resources Canada, *All About Gas Fireplaces*, Gatineau, 2004, p. 2.

Changing Characteristics of Air Conditioning of Houses

From SHEU–1993 to SHEU–1997, the penetration rate for central air conditioners increased from 15 percent to 22 percent, while the penetration rate for window/room air conditioners remained stable at 10 percent (see Chart 6). Data from SHEU–2003 found that the penetration rates for central air conditioners and window/room air conditioners had increased to 32 percent and 13 percent respectively. These increases since SHEU–1997 have coincided with warmer-than-average Canadian summers since 1998, with the exception of the summer of 2000.[8]

Chart 6

Penetration Rate of Air-Conditioning Systems by Type of System



Changing Characteristics of Appliances

Main and Secondary Refrigerators

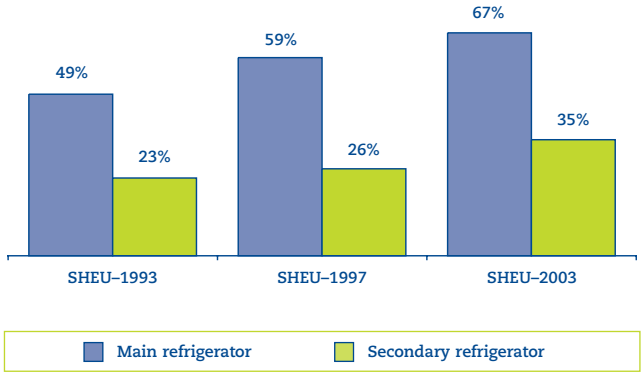
Refrigerators in general have become more energy efficient in recent years.[9] Given this fact, it is not unexpected that an increasing proportion of main refrigerators used by houses had a capacity larger than 16.4 cubic feet (cu. ft.). These models consume the same amount of energy as older models that had less capacity. As with main refrigerators, an increasing proportion of secondary refrigerators had a capacity larger than 16.4 cu. ft.

When a refrigerator has a capacity greater than 16.4 cu. ft., it is classified in the large or very large refrigerator capacity category.

The proportion of main refrigerators with a large or very large capacity has steadily increased, from 49 percent in SHEU–1993 to 67 percent in SHEU–2003 (see Chart 7). In contrast, the proportion of secondary refrigerators with a large or very large capacity increased slightly, from 23 percent in SHEU–1993 to 26 percent in SHEU–1997, but then jumped in SHEU–2003 to 35 percent.

Chart 7

Percentage of Main and Secondary Refrigerators With a Capacity Greater Than 16.4 cu. ft.



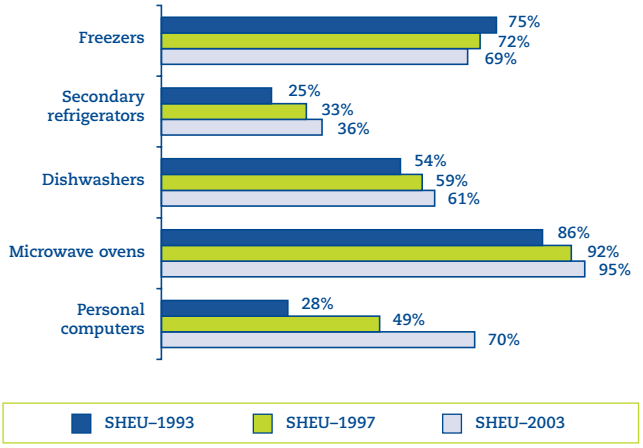
Selected Appliances

There has been a steady decline in the penetration rate for freezers, from 75 percent in SHEU–1993 to 69 percent in SHEU–2003 (see Chart 8 on page 7). This decline has coincided with an increase in the penetration rate of secondary refrigerators, from 25 percent in SHEU–1993 to 36 percent in SHEU–2003, and the previously discussed increase in the capacity of main and secondary refrigerators. Therefore, households seem to be slowly replacing freezers with additional and larger refrigerators, which include freezer sections.

[8] Natural Resources Canada, *Energy Use Data Handbook – 1990 and 1997 to 2003*, Gatineau, 2005, p. 22.
[9] Natural Resources Canada, *Energy Consumption of Major Household Appliances Shipped in Canada – Trends 1990–2003*, Gatineau, 2005, p. 9.

Chart 8

Penetration Rate of Selected Appliances



As was the case with secondary refrigerators, the penetration rates of many other appliances have increased over the 10 years since SHEU–1993. For example, the penetration rate of dishwashers in Canadian households has increased, from 54 percent to 61 percent. Also, the penetration rate for microwave ovens has increased, to the point where almost every household used a microwave oven in 2003. Additionally, there has been a dramatic increase in the penetration rate for personal computers, as it has risen from 28 percent to 70 percent.

Note: The results presented in this section excluded data from low-rise apartments. Unless otherwise stated, the analysis in the following sections covers the entire SHEU–2003 sample, which includes low-rise apartments.

The Stock of Dwellings in Canada

A dwelling is a living space that is structurally separate from others, with a private entry that permits access to the exterior of the building or to a stairwell or common corridor. There are many different types of dwellings across Canada with varying characteristics, such as size and year of construction. The interaction of these dwelling characteristics, along with other factors, influences the energy intensity level of a household.

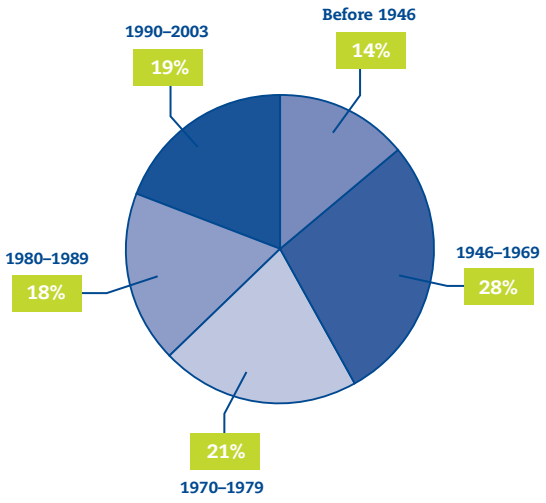
General Characteristics of Dwellings

Year of Construction

In 2003, almost 60 percent of Canadian residential dwellings were constructed after 1969 (see Chart 9). Among these dwellings, there was almost an equal proportion constructed in the seventies, in the eighties and from 1990 to 2003. As for dwellings built before 1970, only one third were built before 1946, while the remaining two thirds were built between 1946 and 1969.

Chart 9

Year of Construction of Dwellings



Year of construction is a determining factor in energy intensity analysis, which will be discussed later in this section of the report. Another determining factor in energy intensity analysis is the heated area of a dwelling.

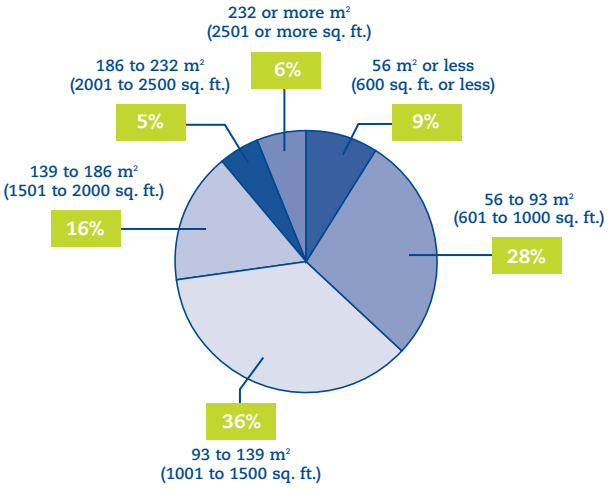
Heated Area

The heated area of a dwelling is defined as the total floor space of a dwelling excluding the basement and the garage.

SHEU–2003 found that 37 percent of dwellings had a heated area of less than 1001 sq. ft., and 36 percent had a heated area between 1001 and 1500 sq. ft. (see Chart 10). The remaining dwellings, which had a heated area larger than 1500 sq. ft., accounted for 27 percent of all dwellings. The average heated area of a Canadian dwelling was 1321 sq. ft.

Chart 10

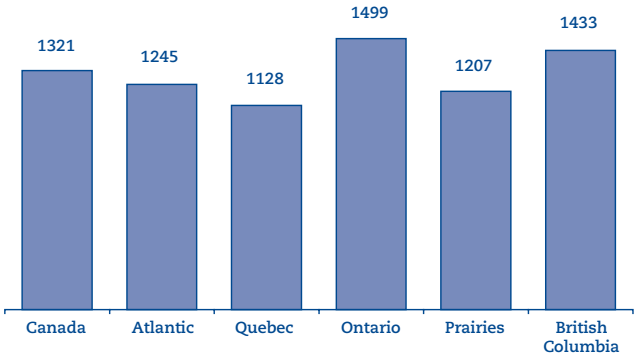
Heated Area of Dwellings



A regional analysis reveals that the average heated area of dwellings varied significantly by region in 2003 (see Chart 11).

Chart 11

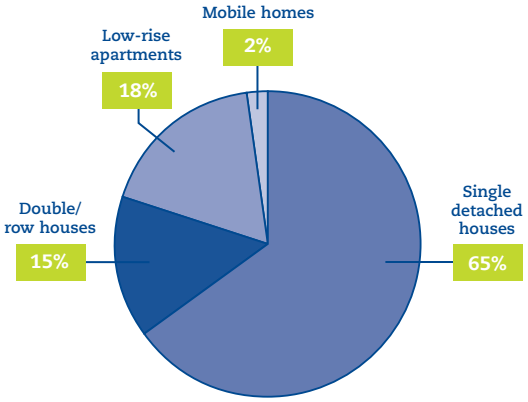
Heated Area by Region (sq. ft.)



Dwellings in Ontario had the largest average heated area at almost 1500 sq. ft. British Columbia dwellings had an average heated area of over 1400 sq. ft., while the average heated areas of dwellings in both the Atlantic region and the Prairies were over 1200 sq. ft. The only region where dwellings had an average heated area of less than 1200 sq. ft. was Quebec. This result was to be expected, given that the types of dwellings prevalent in Quebec differed greatly from those in the other regions in 2003. This will be discussed further in the following sub-section.

Chart 12

Dwelling Types of Households



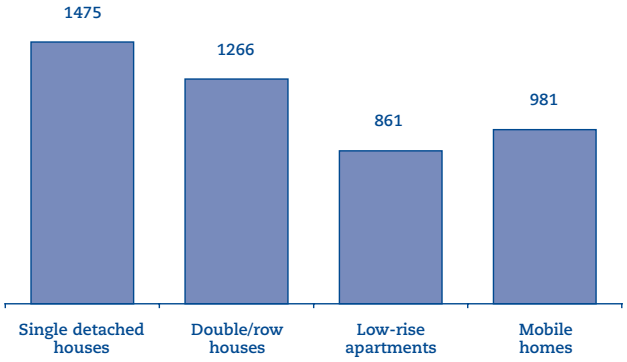
Dwelling Type

Across Canada in 2003, 65 percent of dwellings were single detached houses and 15 percent were double/row houses (see Chart 12). The remaining types of dwellings were low-rise apartments and mobile homes, which respectively accounted for 18 percent and 2 percent of all dwellings.

Typically, certain dwelling types have larger heated areas than other dwelling types. In 2003, the average heated area of a single detached house was 1475 sq. ft., and for a double/row house, it was 1266 sq. ft. (see Chart 13). These two types of dwellings were much larger than the average low-rise apartment (861 sq. ft.) and mobile home (981 sq. ft.).

Chart 13

Heated Area by Dwelling Type (sq. ft.)



Regionally, nearly half of all low-rise apartments across Canada were in Quebec. Since low-rise apartments were the dwelling type with the smallest average heated area, it was anticipated that Quebec would be the region with the smallest average heated area per dwelling.

Energy Intensity

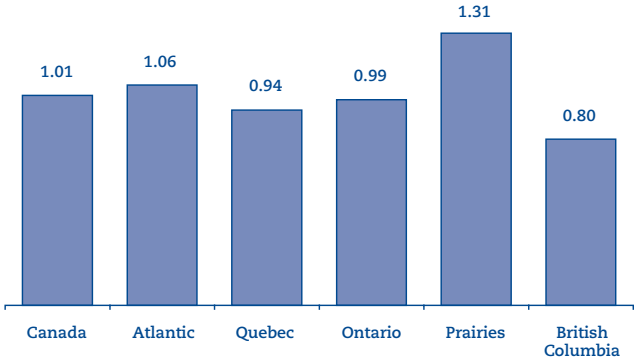
In this report, energy intensity is defined as the total amount of energy consumed per unit of heated area. It is expressed in gigajoules per square metre (GJ/m^2). The energy intensity level of a household depends on the interaction of many factors. And although these factors are difficult to isolate and study individually, SHEU–2003 enables us to determine the main factors influencing energy consumption.

Regional Intensity

While the average household energy intensity levels of the Atlantic region (1.06 GJ/m²), Quebec (0.94 GJ/m²) and Ontario (0.99 GJ/m²) were relatively close to the Canadian average of 1.01 GJ/m², the same cannot be said for the Prairies and British Columbia (see Chart 14). The Prairies had the highest intensity of any region, with a ratio of 1.31 GJ/m². In contrast, the region with the lowest intensity was British Columbia, which had a ratio of 0.80 GJ/m².

Chart 14

Energy Intensity by Region (GJ/m²)



Many factors can be used to help explain these regional discrepancies, including differences in climate, types of energy used and general dwelling characteristics, such as year of construction, heated area and dwelling type.

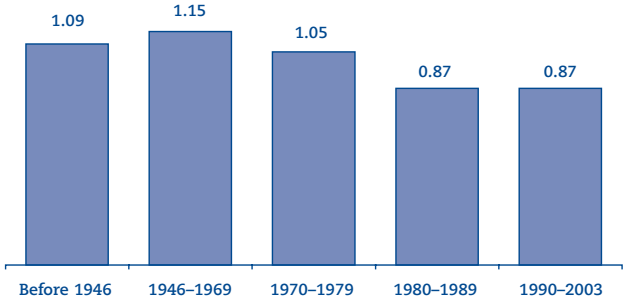
Year of Construction

Construction standards, techniques and materials vary considerably over time and exert a direct impact on energy use. The influence of these construction factors on a dwelling's energy use is evident when a comparison is made between the energy intensity ratios of dwellings built in different periods.

It is surprising to see in Chart 15 that dwellings built before 1946 had a lower energy intensity ratio (1.09 GJ/m²) than dwellings built during 1946–1969 (1.15 GJ/m²). A possible explanation is that dwellings built before 1946 were at least 58 years old in 2003, so some of these dwellings have probably undergone some type of retrofit,[10] which would have improved their energy efficiency.

Chart 15

Energy Intensity by Year of Construction (GJ/m²)



This unexpected outcome does not, however, hold true for dwellings built since 1945, as the more recently constructed dwellings had lower energy intensity ratios. This can be seen by observing the decline in the ratio, from 1.15 GJ/m² for dwellings built during 1946–1969 to 1.05 GJ/m² during 1970–1979 and to 0.87 GJ/m² during 1980–1989. The energy intensity ratio remained stable at the 1980–1989 level of 0.87 GJ/m² for dwellings constructed during 1990–2003. Therefore, dwellings constructed during 1980–1989 and 1990–2003 were, on average, the most energy-efficient dwellings built in Canada.

Heated Area

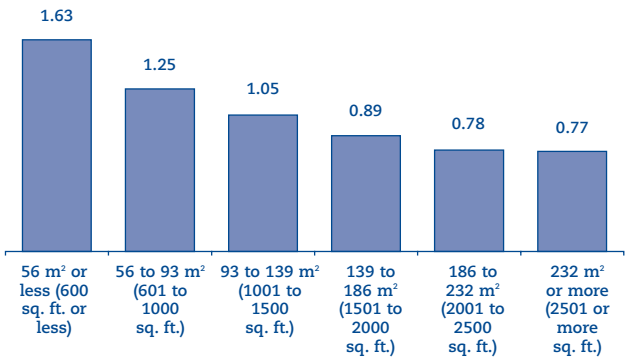
Based on SHEU–2003 data, the energy intensity of a dwelling decreases as its heated area increases. This negative relationship between heated area and intensity is evident when dwellings are divided into categories based on their heated area, and the average intensities of dwellings within each category are compared.

[10] A retrofit is any type of improvement of efficiency of energy-consuming appliances or thermal characteristics of the dwelling.

Dwellings in the smallest heated area category (less than 56 m²) had the highest energy intensity, with a ratio of 1.63 GJ/m² (see Chart 16). If the heated area is increased to the next category (56 m² to 93 m²) the intensity declines to a ratio of 1.25 GJ/m². This trend of increasing heated area and declining intensity continues to the largest heated area category (more than 232 m²) which had the lowest intensity with a ratio of 0.77 GJ/m².

Chart 16

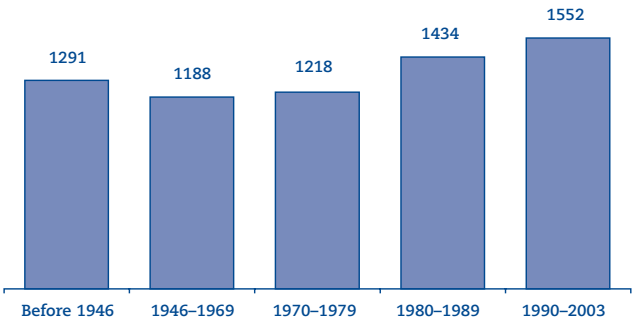
Energy Intensity by Heated Area (GJ/m²)



One reason for this negative relationship between the heated area of a dwelling and its energy intensity level is that many energy-consuming products, such as refrigerators, are considered necessities and are used by a high proportion of households regardless of their heated area. Obviously, these types of products have a greater impact on the energy intensity ratio of a smaller dwelling than a larger dwelling, since there is less heated area in a smaller dwelling.

Chart 17

Average Heated Area by Year of Construction (sq. ft.)



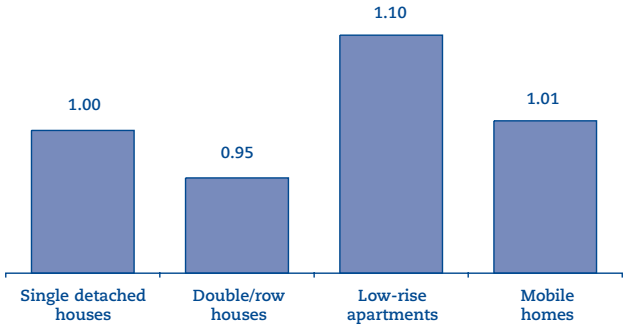
Another possible explanation for the decline in energy intensity ratios with an increase in heated area is the tendency for larger dwellings to have been constructed during the most recent periods, which were 1980–1989 or 1990–2003 (see Chart 17). And, as previously discussed in this section, dwellings constructed during these periods were, on average, the most energy-efficient dwellings built in Canada.

Dwelling Type

Since the average low-rise apartment and mobile home had smaller heated areas than the other dwelling types, and given that smaller dwellings generally had higher energy intensity ratios than larger dwellings, it is not surprising that low-rise apartments and mobile homes were the dwelling types with the highest intensity ratios, at 1.10 GJ/m² and 1.01 GJ/m² respectively (see Chart 18).

Chart 18

Energy Intensity by Dwelling Type (GJ/m²)



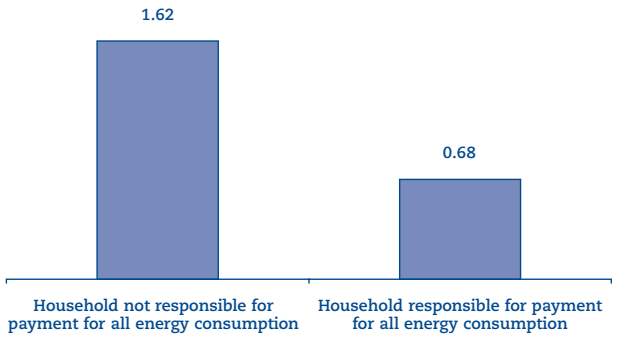
Also, as shown in Chart 18, it is not unexpected that double/row houses had a lower intensity ratio (0.95 GJ/m²) than single detached houses (1.00 GJ/m²). This is because a double/row house has at least one common wall with another house. A common wall reduces a dwelling's exposure to the exterior and enables a house to share heat with the adjacent house, therefore permitting a house to reduce its own energy consumption.

Given that low-rise apartments normally have at least two common walls, it could be considered surprising that this type of dwelling had the highest energy intensity ratio. However, other factors, such as the previously mentioned average heated area of low-rise apartments, may have diminished the influence of common walls on reducing the energy intensity level of low-rise apartments. Another factor may have been that only 32 percent of low-rise apartments were constructed since 1980, which was the lowest percentage among the dwelling categories.

An additional factor that may have influenced the high energy intensity ratio of low-rise apartments in 2003 was payment for energy consumed (see Chart 19). Low-rise apartments where someone other than the occupant (e.g. a landlord) was responsible for paying for at least one of the dwelling's energy sources had an energy intensity ratio of 1.62 GJ/m^2.[11] This was in stark contrast to the energy intensity ratio of 0.68 GJ/m^2 for low-rise apartments where the household was responsible for paying for all of its energy consumption. This suggests that a household may have been more conscious of its energy efficiency if it was responsible for paying for all of its energy consumption.

Chart 19

Energy Intensity Among Low-Rise Apartments by Responsibility for Payment for Energy Consumption (GJ/m^2)



It can be concluded that being responsible for paying for its energy consumption may also be a factor affecting a household's energy intensity level. The interaction of this factor with the energy-efficient practices of a household and the other factors previously discussed – such as regional climate, energy sources used, dwelling type, year of construction and heated area of a dwelling – influence the energy intensity level of a household.

[11] In cases where a low-rise apartment used a central heating system, the energy consumed by the apartment was an estimate based on the total energy consumption of the entire apartment building. Please refer to the methodological section of the *2003 Survey of Household Energy Use – Detailed Statistical Report* for more information.

The Thermal Envelope

The thermal envelope is the shell of a dwelling that protects us from the elements; it comprises the basement walls and floor, the above-grade walls, the roof and the windows and doors. To maintain our indoor environment, the envelope must control the flow of heat, air and moisture from the inside of the dwelling to the outdoors.

Insulation of the Thermal Envelope

Insulation wraps a dwelling in a layer of material that slows the rate at which heat is lost to the outdoors. And since heat flows from warmer to colder areas, it is important to insulate the entire thermal envelope. This includes the basement / crawl space, attic / crawl space and attached garage.

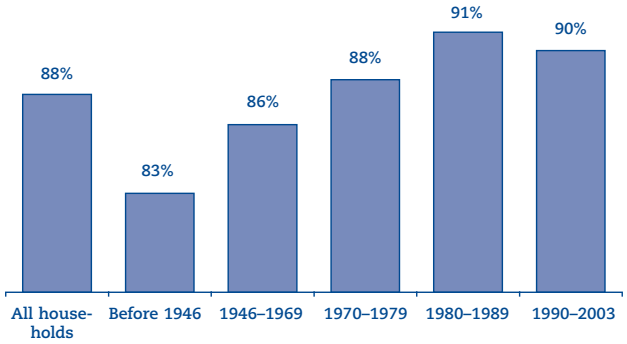
As reported in the "Trends in Household Energy Use" section of this report, each version of SHEU found fewer dwellings in Canada with no insulation in their basements / crawl spaces. Therefore, Canadian households' awareness of the importance of insulating their basements seems to be increasing. The same type of awareness also appears to be increasing for attics / crawl spaces.

In 2003, nearly 90 percent of attics / crawl spaces across Canada were insulated (see Chart 20). This result does not vary greatly based on the year of construction of dwellings. Nevertheless, there is a noticeable upward trend from dwellings built before 1946 (83 percent of attics / crawl spaces were insulated) until 1980–1989 (91 percent of attics / crawl spaces were insulated). The proportion of attics / crawl spaces that were insulated then declined slightly to 90 percent for dwellings constructed during 1990–2003.

Although SHEU–2003 found that the vast majority of basements / crawl spaces and attics / crawl spaces were insulated, the same cannot be said for garages attached to dwellings. Only 54 percent of dwellings with an attached garage had an insulated garage in 2003.

Chart 20

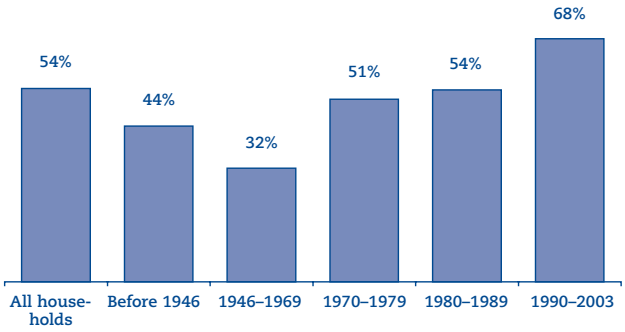
Proportion of Attics / Crawl Spaces That Were Insulated, by Year of Construction



It is important to insulate an attached garage because heat moves in any direction – up, down or sideways – as long as it is moving from a warm spot to a colder one. For example, a heated room over a garage will lose heat through the floor. Awareness of this fact seems to be increasing as dwellings with attached garages constructed during the most recent period, 1990–2003, were most apt to have an insulated garage (see Chart 21 on page 14). Moreover, the majority of dwellings with attached garages constructed after 1969 had insulated garages. Conversely, only 34 percent of dwellings with attached garages constructed before 1970 had insulated garages. The significance of these results is magnified by the increasing trend for dwellings to be constructed with attached garages instead of separate garages.

Chart 21

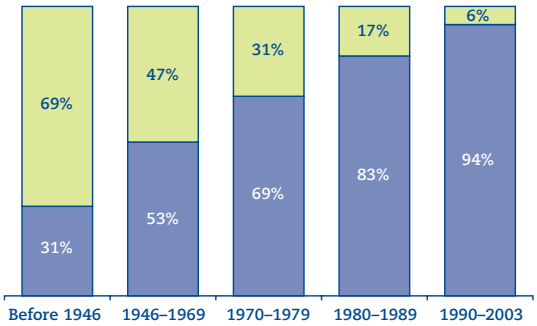
Proportion of Attached Garages That Were Insulated, by Year of Construction



Only 31 percent of dwellings with garages constructed before 1946 had an attached garage (see Chart 22). This percentage has dramatically increased in each successive period, peaking at 94 percent for dwellings constructed during 1990–2003. Therefore, with an increasing number of recently constructed dwellings having attached garages, it is imperative that the awareness of the importance of insulating attached garages also continues to grow.

Chart 22

Type of Garage Among Dwellings With a Garage, by Year of Construction

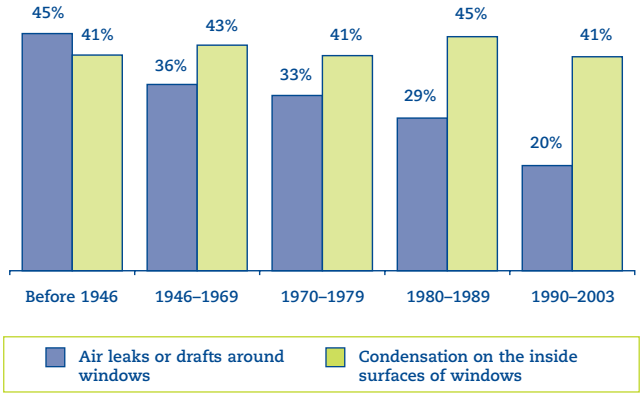


Windows

Windows can be responsible for unnecessary heat loss, high energy consumption and cold drafts and can be subject to condensation problems. SHEU–2003 data show that there is a link between a dwelling's year of construction and air leaks or drafts around windows (see Chart 23). Older dwellings were more prone to have air leaks or drafts around windows than more recently constructed dwellings. The percentage of dwellings reporting air leaks or drafts around windows decreased in each successive period, from dwellings built before 1946 (45 percent) up until 1990–2003 (20 percent).

Chart 23

Percentage of Dwellings With Window Drafts and Condensation Problems, by Year of Construction



Another problem associated with windows is condensation. Condensation problems on the inside surfaces of windows were reported by 42 percent of Canadian households. However, unlike air leaks and draft problems, condensation problems do not appear to be linked with the year of construction of the dwelling, as a comparable percentage of dwellings constructed in each period reported this problem.

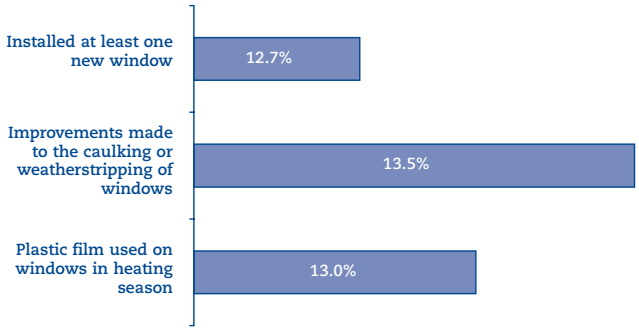
Condensation on the inside surfaces of windows can be the result of moisture problems and/or air leakage problems. Moisture problems can lead to window-frame damage and mould, while air leakage problems can lead to excessive heat loss and energy consumption. Moisture problems caused by excessive humidity levels can arise from poor ventilation within the dwelling. Ventilation can be improved with the use of an air exchanger, which will be discussed in the "Air Conditioning and Ventilation of Households" section of this report.[12] Air leakage problems can be addressed by installing new

[12] Natural Resources Canada, *Keeping the Heat In – EnerGuide*, p. 120.

windows or adding weatherstripping and caulking.[13] In 2003, about 13 percent of households installed at least one new window, and about 14 percent made improvements to the weatherstripping or caulking on at least one of their windows (see Chart 24). These measures can help reduce air leakage and draft problems and reduce a household's energy consumption. Another way to improve the energy efficiency of a dwelling's windows is to put up plastic film on the windows during the heating season. This is an inexpensive and easy way to improve the heat retention of a dwelling and also reduce window condensation.[14] SHEU–2003 found that 13 percent of Canadian households did this in 2003.

Chart 24

Percentage of Households That Made an Energy Efficiency Window Improvement in 2003, by Type of Improvement



Energy Efficiency Improvements

Homeowners and landlords / property managers were asked if they made any improvements to their dwelling that reduced energy consumption in 2003. Possible energy efficiency improvements included improvements to the following:

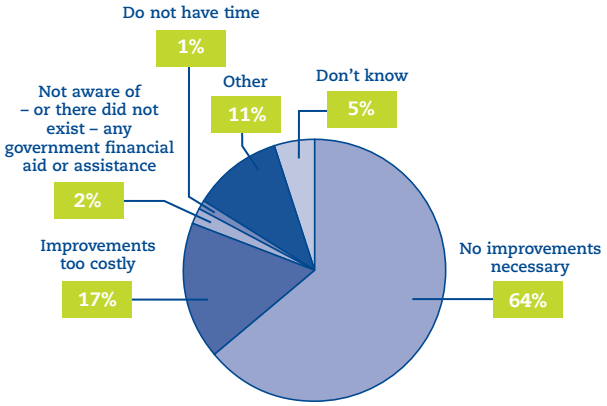
- the roof structure or surface
- the exterior wall siding
- the insulation of the roof or attic
- the insulation of the basement or crawl space walls
- the insulation of any exterior walls (excluding the basement)
- the foundation
- the heating equipment
- the ventilation or air-conditioning equipment

The survey found that 15 percent of dwellings underwent at least one of these energy efficiency improvements, and 40 percent of these dwellings underwent multiple improvements in 2003. Additionally, there were plans for 16 percent of Canadian dwellings to go through at least one of these improvements in 2004.

Among homeowners and landlords / property managers who did not make any improvements in 2003 and were not planning on making any improvements in 2004, the majority of them (64 percent) stated that improvements were not necessary (see Chart 25). Another 17 percent said that improvements were too costly, and 2 percent said they were not aware of – or there did not exist – any available government aid or assistance for the improvements.

Chart 25

Reasons for Not Making Any or Not Planning On Making Any Improvements in 2003 or 2004



[13] Natural Resources Canada, *Improving Window Energy Efficiency (fact sheet) – EnerGuide for Houses*, Ottawa, 2004, p. 3.
[14] Natural Resources Canada, *Keeping the Heat In – EnerGuide*, p. 109.

Residential Heating

Households use energy primarily for space and water heating, space cooling, the operation of appliances and lighting. Of these activities, space heating utilizes the most energy in the residential sector. It accounted for 60 percent of the total residential energy consumed in 2003.[15]

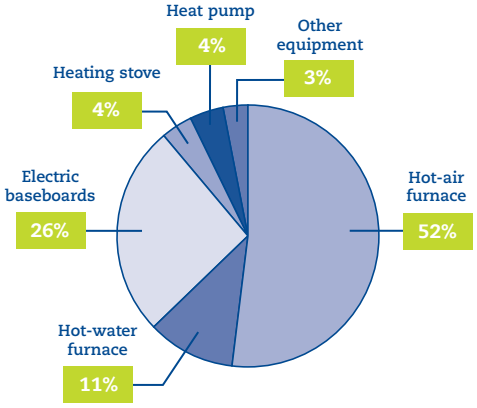
As a result, SHEU–2003 examined the types of heating equipment used by households, as well as the characteristics of the equipment, usage tendencies, supplementary heating equipment and prevalence of energy-saving heating equipment.

Main Heating Systems

In 2003, the majority of Canadian households, 63 percent, used a furnace as their main heating system (see Chart 26). Over 80 percent of these furnaces were hot-air systems, and the remaining furnaces were hot-water systems. Among the other types of heating systems used by Canadian households, electric baseboards were the most popular, with a penetration rate of 26 percent. The rest of the market was divided among heating stoves (4 percent), heat pumps (4 percent) and other equipment (3 percent).

Chart 26

Main Heating System of Households



A regional analysis reveals that each region, with the exception of the Atlantic region, had one type of heating system that the majority of households used in 2003 (see Chart 27). In Quebec, electric baseboards were used by over 60 percent of households for their main heating system. In regions west of Quebec, the majority of households used hot-air furnaces. In contrast to these regions where the majority of households used one specific type of system, the Atlantic region had an almost equal proportion of households using electric baseboards (33 percent) or hot-air furnaces (31 percent) to heat their dwellings.

Chart 27

Main Heating System by Region

Region	Heating System	Penetration Rate
Atlantic	Electric baseboards	33%
	Hot-air furnace	31%
Quebec	Electric baseboards	61%
Ontario	Hot-air furnace	76%
Prairies	Hot-air furnace	82%
British Columbia	Hot-air furnace	50%

Energy Source for Heating

The regional differences observed with main heating systems are once again found with the energy source used by heating systems, as each region, again with the exception of the Atlantic region, had one energy source in particular that the majority of households used (see Chart 28 on page 17). In Quebec, electricity was used by almost 75 percent of households to power their main heating system. In regions west of Quebec, the majority of households used natural gas. And once again, in contrast to the other regions where the majority of households used one specific heating energy source, the Atlantic region had an almost equal proportion of households using oil (39 percent) or electricity (38 percent) as their main heating energy source.

[15] Natural Resources Canada, *Energy Use Data Handbook – 1990 and 1997 to 2003*, p. 22.

Chart 28

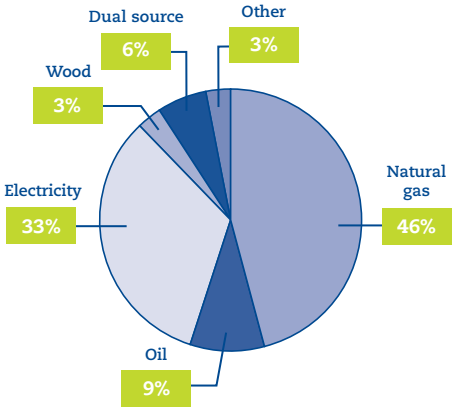
Main Heating System by Region

Region	Energy Source	Penetration Rate
Atlantic	Oil	39%
	Electricity	38%
Quebec	Electricity	73%
Ontario	Natural gas	68%
Prairies	Natural gas	78%
British Columbia	Natural gas	52%

For Canada as a whole, more households used natural gas to run their main heating system (46 percent) than any other energy source (see Chart 29). Other sources used by households for their main heating system were electricity, used by 33 percent of households; oil, used by 9 percent; and wood, used by 3 percent. Additionally, 6 percent of households used a combination of two sources of energy to power their main heating system. Over 50 percent of these dual-heating-source households used a combination of electricity and natural gas.

Chart 29

Main Energy Source for Household Heating

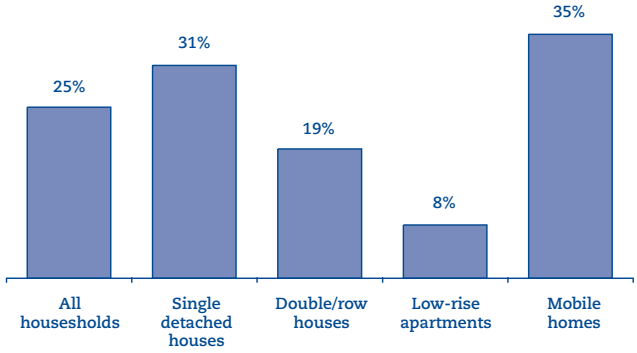


Supplementary Heating

One quarter of Canadian households used a secondary heating system to complement their main heating system during 2003 (see Chart 30). Interestingly, over 80 percent of these households which used a supplementary heating system did not have any common walls with another dwelling. As was previously discussed in "The Stock of Dwellings in Canada" section, a common wall can reduce the demand on a household's main heating system and, therefore, its need for supplementary heating. This relationship can be observed by comparing the penetration rates of supplementary heating systems for dwellings with and without common walls.

Chart 30

Penetration Rate of Supplementary Heating Systems by Dwelling Type

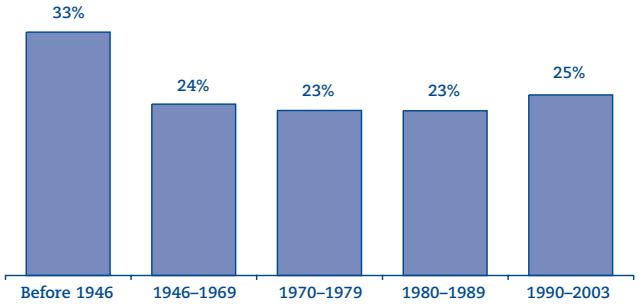


Dwellings without any common walls, such as single detached houses and mobile homes, had high penetration rates for supplementary heating systems (31 percent and 35 percent respectively). Double/row houses, which normally have at least one common wall, had a lower penetration rate (19 percent) and low-rise apartments, which normally have at least two common walls, had the lowest penetration rate (8 percent).

Another relationship that could be assumed is that the need for supplementary heating systems would diminish for more recently constructed dwellings since the quality of construction materials and practices, dwelling insulation and main heating systems have all improved over time. As shown in Chart 31 (on page 18), this assumption is accurate when the penetration rate of supplementary heating systems for dwellings built before 1946 (33 percent) is compared with the rate for dwellings constructed during 1946–1969 (24 percent). However, this assumption does not hold true for dwellings built since 1946, as their penetration rate has remained steady (around 25 percent).

Chart 31

Penetration Rate of Supplementary Heating Systems by Year of Construction



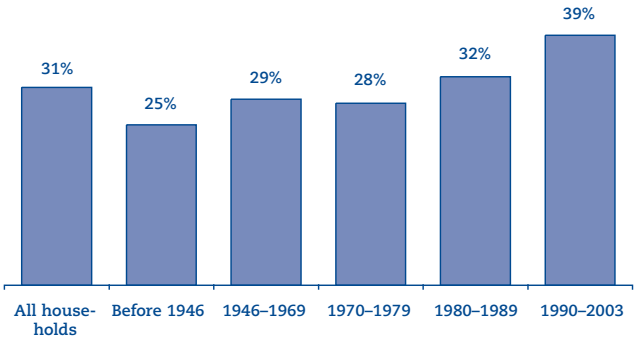
Energy-Conserving Heating Equipment

Programmable Thermostats

Programmable thermostats automatically adjust a dwelling's temperature setting, allowing households to save energy while they are away or sleeping. This energy-saving technology has become more common among Canadian households that have control over their dwelling's temperature (see Chart 32). The penetration rate for programmable thermostats has increased, from 28 percent for dwellings with temperature control that were constructed during 1970–1979 to 32 percent for those built during 1980–1989 and finally peaking at 39 percent for those built during 1990–2003. This emerging trend has resulted in 31 percent of all Canadian households with temperature control using this technology in 2003.

Chart 32

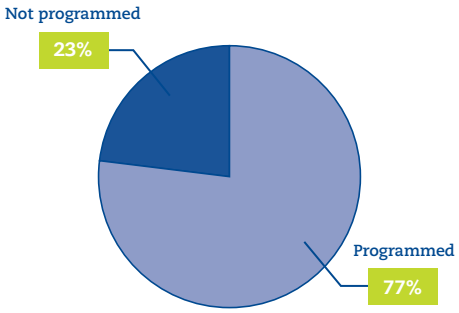
Penetration Rate of Programmable Thermostats Among Households With Temperature Control, by Year of Dwelling Construction



Even though this increasing penetration rate is beneficial towards reducing total residential energy consumption, its effects are somewhat diminished since nearly one out of every four programmable thermostats was not programmed in 2003 (see Chart 33). A programmable thermostat must be programmed in order to realize its full energy-saving potential.

Chart 33

Proportion of Programmable Thermostats That Were Programmed



Condensing Furnaces

Condensing furnaces are the most energy-efficient furnaces available on the market today. This is especially true if their energy source is natural gas or propane, as these furnaces can use 33 percent to 38 percent less energy than old furnaces and 10 percent less energy than a standard-efficiency furnace.[16] Conversely, a condensing oil furnace has the potential to be only marginally more efficient than a well-designed mid-efficiency oil furnace.[17] In 2003, condensing furnaces were used in 37 percent of all households that used a furnace fuelled by natural gas, propane or heating oil.

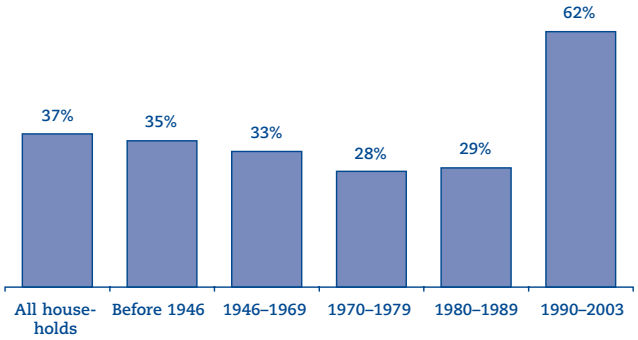
Since these high-efficiency furnaces are a relatively new technology – having appeared on the Canadian market over the last 20 years[18] – it is not at all unexpected to see that the penetration rate for this technology was higher for recently built dwellings (see Chart 34 on page 19). The penetration rate among dwellings constructed during 1990–2003 that used a natural gas, propane or oil furnace was 62 percent. This was extremely high compared with

[16] Natural Resources Canada, *Choose the Right Condensing Gas Furnace (fact sheet) – EnerGuide*, Ottawa, 2003, p. 1.
[17] Natural Resources Canada, *Heating with Oil – EnerGuide*, Gatineau, 2004, p. 35.
[18] Natural Resources Canada, *Heating with Gas – EnerGuide*, Ottawa, 2004, p. 32.

dwellings constructed during 1970–1979 and 1980–1989, which had penetration rates of 28 percent and 29 percent respectively. Given these results, it is interesting to note that dwellings constructed before 1946 and during 1946–1969 also had higher penetration rates (35 percent and 33 percent respectively) than those constructed during 1970–1979 and 1980–1989. A possible explanation for this finding is that furnaces in older dwellings have likely been replaced in recent years, and a condensing furnace can easily be installed as an energy-efficient replacement.

Chart 34

Penetration Rate of Condensing Furnaces Among Households That Used a Natural Gas, Propane or Oil Furnace, by Year of Dwelling Construction



Air Conditioning and Ventilation of Households

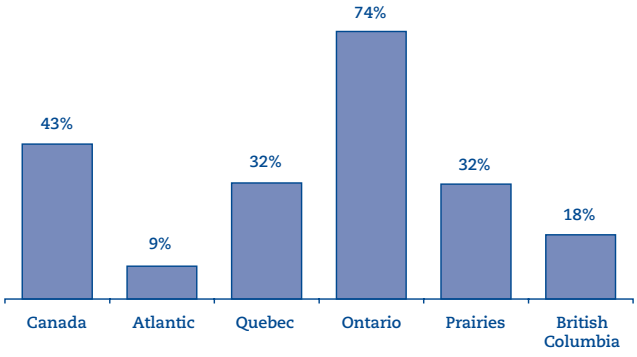
From 1993 to 2003, the energy consumed in the residential sector for space cooling has more than doubled.[19] Furthermore, as previously reported in the "Trends in Household Energy Use" section of this report, there has been a noticeable increase in the penetration rate of air-conditioning systems in Canadian households over the same period. Because of these trends, SHEU–2003 collected information on the characteristics and usage tendencies of residential air-conditioning and ventilation systems.

Air-Conditioning Systems – Regional Analysis

Almost 45 percent of Canadian households were equipped with some type of air-conditioning system in 2003 (see Chart 35). Options available to consumers for air-conditioning their dwellings include window/room air conditioners, central air conditioners and heat pumps. Within Canada, there were significant regional differences in the penetration rates of air-conditioning systems. As expected, the regions with the warmest summers – Quebec, Ontario and the Prairies – also had the highest penetration rates for air-conditioning systems.

Chart 35

Penetration Rate of Air-Conditioning Systems by Region



Nearly three out of every four households in Ontario were equipped with an air-conditioning system in 2003. These systems accounted for 60 percent of all the residential air-conditioning systems in Canada.

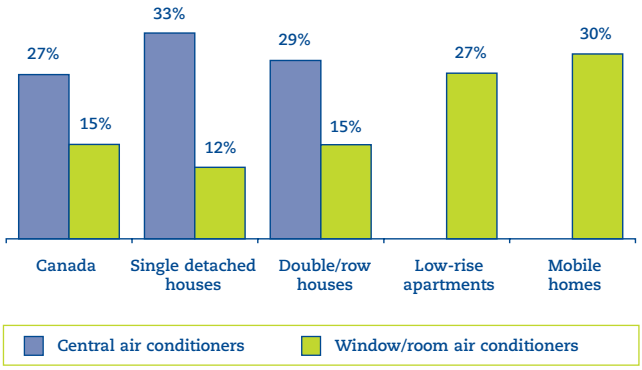
Other regions had much lower penetration rates. Both Quebec and the Prairies had rates of 32 percent, while 18 percent of households in British Columbia and 9 percent of households in the Atlantic region were equipped with an air-conditioning system.

Types of Air-Conditioning Systems

Central air-conditioning systems were the most prevalent type of air-conditioning system in Canadian households (see Chart 36). Over 25 percent of households were equipped with a central system in 2003. Window/room air conditioners were also commonly used in households, as 15 percent of households were equipped with this type of system. The third type of air-conditioning system – heat pumps – was not as prevalent across the country. Only 4 percent of households were equipped with one, and three quarters of these households were

Chart 36

Penetration Rate of Central and Window/Room Air-Conditioning Systems by Dwelling Type



[19] Natural Resources Canada, *Energy Use Data Handbook – 1990 and 1997 to 2003*, p. 22.

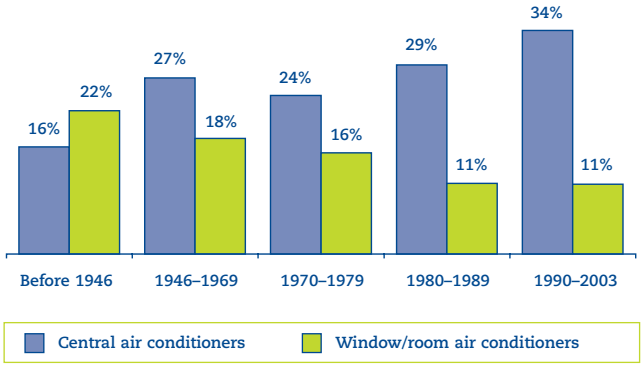
also equipped with either a central or window/room air conditioner. Given these findings, further analysis will deal only with central and window/room air-conditioning systems.

Usually, central air conditioners are used to cool an entire dwelling, while window/room air conditioners are used to cool a small space. SHEU–2003 found that this generality was valid, as central air conditioners were more prevalent in larger dwellings, such as single detached or double/row houses, while window/room air conditioners were more prevalent in smaller dwellings, such as low-rise apartments and mobile homes.

Additionally, the year of construction of a dwelling also appears to influence the type of air-conditioning system likely to be found within that dwelling (see Chart 37). The penetration rate for central air-conditioning systems has generally increased in dwellings constructed in each succesive period, peaking at 34 percent for dwellings constructed during 1990–2003. In contrast, the pentration rate for window/room air conditioners has steadily decreased, from 22 percent for dwellings constructed before 1946 to 11 percent for dwellings constructed during 1980–1989. The rate remained stable at 11 percent for dwellings constructed during 1990–2003.

Chart 37

Penetration Rate of Central and Window/Room Air-Conditioning Systems by Year of Construction



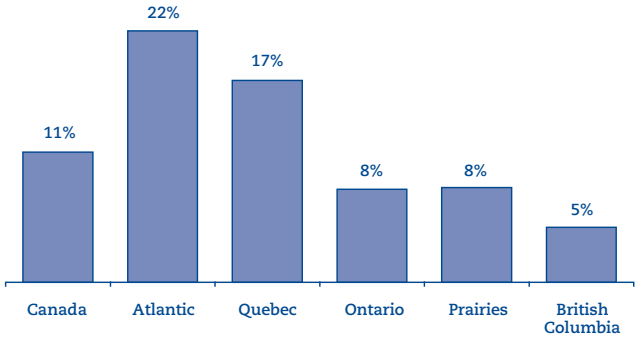
Central Ventilation Systems

Central ventilation systems, also known as air exchangers, can improve a dwelling's indoor air quality and reduce indoor humidity levels.[20] Despite these benefits, only 11 percent of dwellings were equipped with a central ventilation system in 2003.

A regional analysis found that the penetration rates for these systems were highest in regions east of Ontario, as 22 percent of dwellings in the Atlantic region and 17 percent of dwellings in Quebec were equipped with a system (see Chart 38). Conversely, Ontario, the Prairies and British Columbia had much lower penetration rates, at 8 percent, 8 percent and 5 percent respectively.

Chart 38

Penetration Rate of Central Ventilation Systems by Region



[20] Natural Resources Canada, *Moisture Problems (fact sheet) – EnerGuide for Houses*, Ottawa, 2003, p. 4.

Household Appliances

The operation of appliances is an important use of energy in the residential sector. As a result, SHEU–2003 examined the prevalence and characteristics of appliances in Canadian households during 2003.

Major Appliances

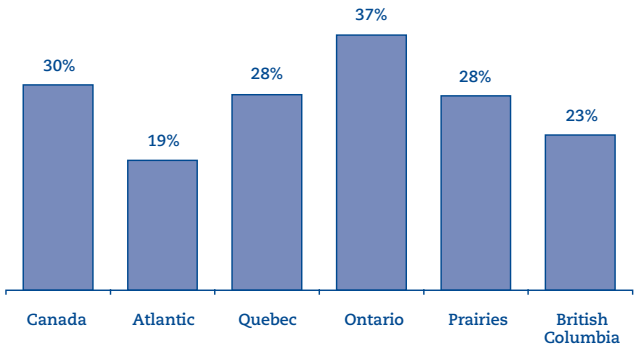
In 2003, major appliances[21] accounted for 62 percent of all the energy used by appliances in the residential sector.[22] Therefore, it was important that SHEU–2003 obtain information on the characteristics and usage of these appliances in Canadian households.

Refrigerators

Almost every household in Canada used a refrigerator in 2003, and 30 percent of all households used at least two refrigerators. A regional analysis shows that the percentage of households that used more than one refrigerator varied widely by region (see Chart 39). The results ranged from 19 percent of households in the Atlantic region to 37 percent of households in Ontario.

Chart 39

Percentage of Households That Used More Than One Refrigerator, by Region



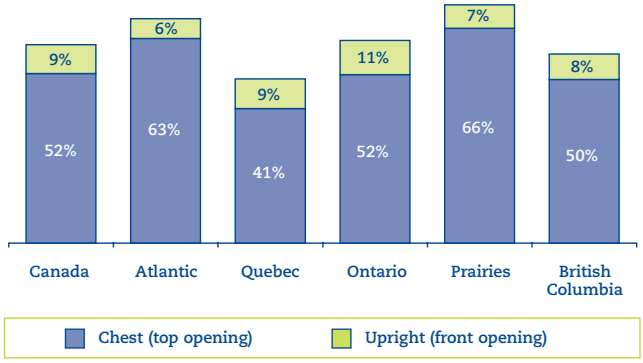
The characteristics of the average main and secondary refrigerator also varied widely. A household's main refrigerator had an average age of 9.6 years, and the majority of these refrigerators (54 percent) had a capacity between 16.5 and 20 cu. ft. Secondary refrigerators had an average age of 17.9 years and an equal probability of having a capacity between 16.5 and 20 cu. ft. (33 percent), 12.5 and 16.4 cu. ft. (34 percent) and less than 12.5 cu. ft. (31 percent).

Freezers

In 2003 the Atlantic region and the Prairies had penetration rates of freezers (69 percent and 73 percent respectively) well above the Canadian penetration rate of 61 percent (see Chart 40). These regions also had the highest penetration rates of chest freezers as the household's main freezer.

Chart 40

Penetration Rate of Freezers by Type, by Region



Chest freezers are generally more energy efficient than upright models. That is because lifting the door on a chest unit releases less cold air. Open the door to an upright freezer, however, and the cold air flows down and out.

Among households in the Atlantic and Prairie regions that used a freezer in 2003, over 90 percent used a chest freezer as their primary freezer.

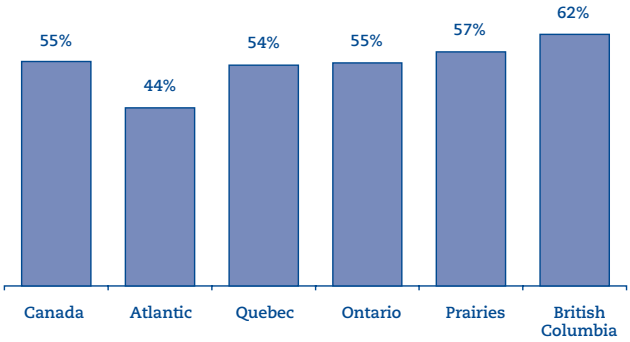
[21] "Major appliances" includes refrigerators, freezers, ranges, dishwashers, clothes washers and clothes dryers.
[22] Natural Resources Canada, *Energy Use Data Handbook – 1990 and 1997 to 2003*, p. 22.

Dishwashers

SHEU–2003 data found that 55 percent of Canadian households used a dishwasher in 2003. A region-by-region analysis reveals that British Columbia had the highest penetration rate of dishwashers at 62 percent (see Chart 41). The Atlantic region had the lowest penetration rate at 44 percent, while the other regions had penetration rates that were close to the Canadian rate of 55 percent.

Chart 41

Penetration Rate of Dishwashers, by Region



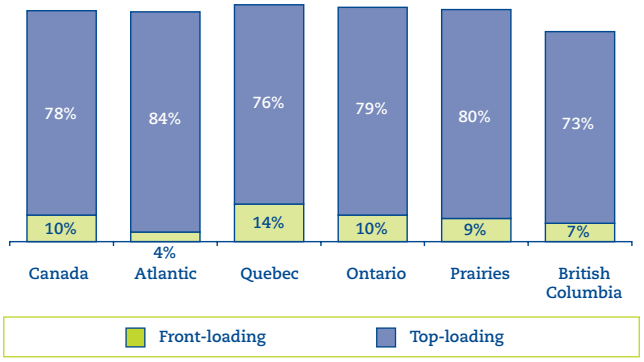
It is interesting to note that British Columbia was also the region with the highest penetration rate for compact dishwashers. A compact dishwasher is much smaller than a standard-size dishwasher as it only has a capacity of less than eight place settings and six serving pieces. Almost 8 percent of dishwashers used by households in British Columbia during 2003 were compact dishwashers. This high percentage of compact dishwashers in British Columbia may have contributed to the region also having the highest frequency of dishwasher use in Canada. Seventy percent of British Columbia households that used a dishwasher washed more than two loads of dishes in an average week.

Clothes Washers

Although the regional penetration rates of clothes washers did not diverge greatly from the Canadian rate of 88 percent (see Chart 42), the penetration rate of front-loading machines varied significantly from region to region, with a high of 14 percent in Quebec and a low of 4 percent in the Atlantic region.

Chart 42

Penetration Rate of Clothes Washers by Type, by Region



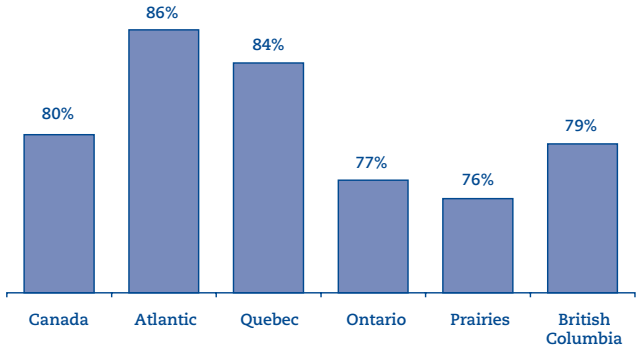
Both types of clothes washers – front-loading and top-loading – have about the same capacity; however, front-loading washers use about 40 percent less water per load and 50 percent less energy than top-loading washers. Front-loading machines also use less detergent.[23]

Even though the penetration rates for energy-efficient clothes washers varied greatly between Quebec and the Atlantic region, the energy-efficient clothes washing habits of these regions were quite similar.

An energy-efficient way to use a clothes washer is to rinse with cold water, since clothes rinsed in cold water come out just as clean as those rinsed in warm.[24] The Atlantic region and Quebec were the regions where the highest percentage of households with a clothes washer rinsed with cold water, at 86 percent and 84 percent respectively (see Chart 43).

Chart 43

Percentage of Households With a Clothes Washer That Used Cold Water for Rinsing, by Region



[23] Natural Resources Canada, *EnerGuide Appliance Directory 2005*, Gatineau, 2005, p. 192.
[24] Natural Resources Canada, *EnerGuide Appliance Directory 2005*, p. 193.

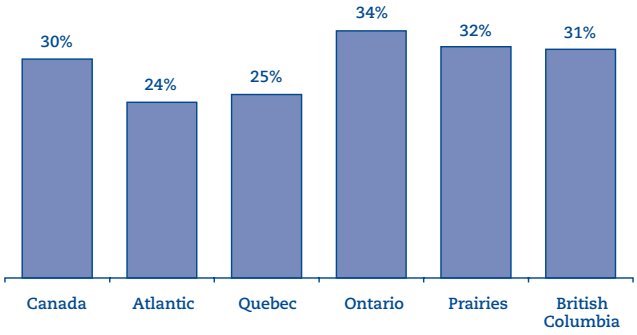
Clothes Dryers

Many new technologies are available in the Canadian market to help households reduce energy consumption. One such technology is a moisture detector, which is a sensor that automatically shuts off a clothes dryer as soon as the clothes are dry.

In 2003, 30 percent of households across Canada that used a clothes dryer within their household used a clothes dryer with a moisture detector (see Chart 44).

Chart 44

Penetration Rate of Moisture Detectors Among Households With a Clothes Dryer, by Region

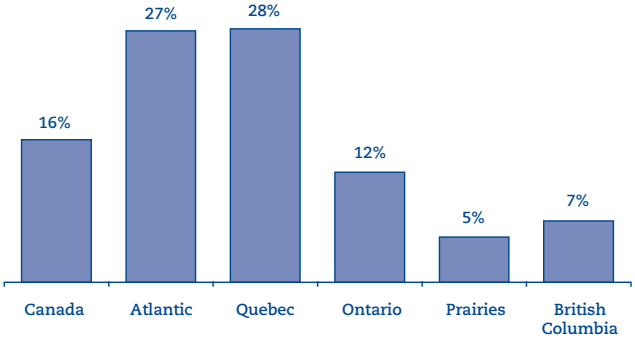


And while the Atlantic region and Quebec were the regions with the lowest penetration rates among households with a clothes dryer for this new energy-saving technology, 24 percent and 25 percent respectively, they were able to compensate for this lack of energy efficiency through a decrease in their seasonal clothes-drying energy consumption.

Over one quarter of households in the Atlantic and Quebec regions that used a clothes dryer within their dwelling in 2003 did not use their clothes dryer during an average week in the summer of 2003 (see Chart 45). Only 9 percent of households in other regions that used a clothes dryer in their dwelling in 2003 did not use their clothes dryer during an average week that summer.

Chart 45

Percentage of Households That Did Not Use Their Clothes Dryer During an Average Week in the Summer, by Region



Other Appliances

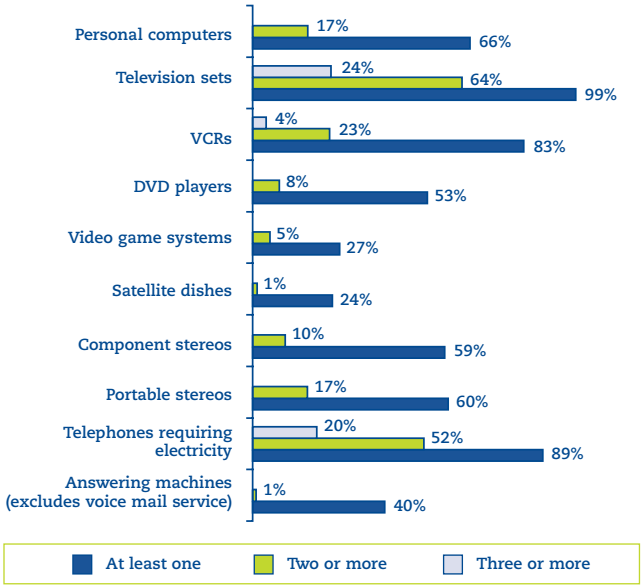
The energy used to power other appliances[25] in the residential sector increased by 63 percent from 1990 to 2003. This represents a large increase, especially when compared with the 12 percent decrease in energy used to power major appliances in the residential sector over the same period.[26] Since the energy used by other appliances increased at such a rapid rate in the residential sector in recent years, it is important to identify which of these other appliances were most prevalent in Canadian households in 2003.

Television sets had the highest penetration rate of all appliances included in the other appliances category, as almost every Canadian household used at least one television set in 2003 (see Chart 46 on page 25). Furthermore, nearly 65 percent of households used a least two televisions sets, and almost one quarter of households used at least three sets in 2003. No other appliance covered by SHEU–2003 had a higher probability of a household using at least three of them in 2003.

[25] Other appliances" includes small appliances, such as television sets, VCRs, DVD players, stereos and personal computers.
[26] Natural Resources Canada, *Energy Use Data Handbook – 1990 and 1997 to 2003*, p. 22.

Chart 46

Penetration Rates of Selected Energy-Consuming Appliances



Not surprisingly, given the high penetration rate of television sets, appliances that operate in conjunction with a television set also had high penetration rates. More than 80 percent of households used at least one VCR, and more than a quarter of these households used at least two VCRs. Also, over 50 percent of households used at least one DVD player, and about a quarter of households used at least one satellite dish. Additionally, more than one quarter of households used at least one video game system in 2003, and 20 percent of these households used two or more of these systems.

Other appliances that are not associated with television sets also had high penetration rates in 2003. Telephones requiring electricity had a penetration rate in Canadian households of 89 percent in 2003, and nearly 60 percent of these households used at least two of these telephones. In addition, the penetration rate of answering machines, excluding voice mail services, was 40 percent for households. And stereos were also popular in 2003, as both component and portable stereos had penetration rates around 60 percent.

Hot Water

In a typical Canadian home, water heating is the second biggest energy user, after space heating. In fact, water heating accounted for more than 20 percent of residential energy usage in 2003.[27] Therefore, it was important for SHEU–2003 to examine the characteristics of water-heating equipment and the prevalence of water conservation devices within households.

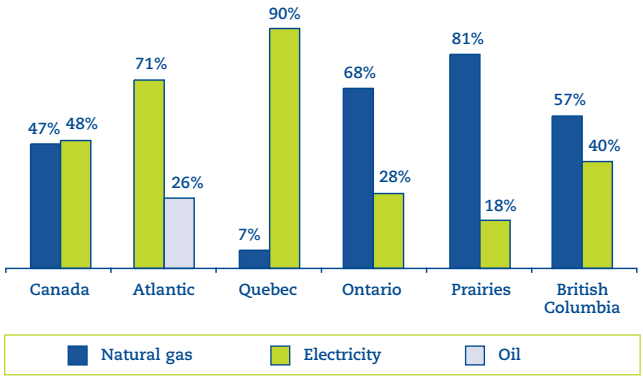
Water Heating

Almost an equal number of Canadian households used either electricity or natural gas to heat their water in 2003 (see Chart 47). Given this result, it is surprising to observe that there was no region in Canada where this same trend was observed. Each region actually had a clear majority of households using one of these energy sources over the other.

Households east of Ontario were most likely to have used electricity to heat their water, while households west of Quebec were more apt to have used natural gas. It is also interesting to note that the Atlantic region was the only region where a significant number of households used oil to heat their water.

Chart 47

Penetration Rate of the Two Most Popular Energy Sources for Heating Water, by Region



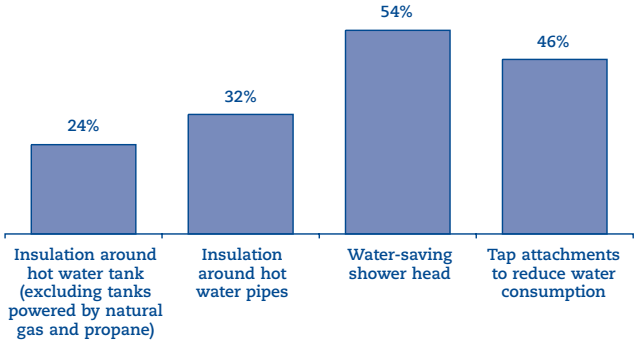
Hot Water Conservation Devices

While water is essential in a household, there are ways a household can conserve water and the energy used to heat it. Add-on insulation around the hot water tank and pipes ensures that energy used to heat water is not wasted. Also, water-saving shower heads and flow-reducing tap attachments conserve energy and water without changing water pressure.

In general, water-saving devices were more popular with Canadian households than add-on insulation products in 2003. This is apparent when the penetration rates for these devices are compared (see Chart 48). The penetration rates for water-saving shower heads and tap attachments were 54 percent and 46 percent respectively, while the rates for add-on insulation around the hot water tank and pipes were only 24 percent and 32 percent respectively.

Chart 48

Penetration Rate of Hot Water Conservation Devices



[27] Natural Resources Canada, *Energy Use Data Handbook – 1990 and 1997 to 2003*, p. 22.

Lighting

Lighting technology has changed dramatically in recent years, and this change is apparent in the increase in the variety of lighting products available to Canadian households. With this increase in variety, Canadian households have a growing opportunity to control the amount of lighting energy they consume.

Some of the lighting products available to households include ordinary (incandescent) light bulbs, halogen light bulbs, fluorescent tubes and compact fluorescent lights (CFLs). Each of these products has its advantages. Ordinary (incandescent) light bulbs have a low initial cost, but are not very energy efficient, as only 5 percent to 8 percent of the energy that goes into the fixture produces light, while the rest is dissipated as heat. Halogen light bulbs in some wattages can use 15 percent less energy and last two to four times longer than incandescent bulbs. Fluorescent tubes use 60 percent to 80 percent less energy and last 10 to 20 times longer than incandescent bulbs, but are not compatible with standard light sockets. CFLs, on the other hand, are compatible with standard light sockets, consume 67 percent to 75 percent less energy than incandescent bulbs and last up to 10 times longer.[28]

Lighting Choices – Regional Analysis

In 2003, 99 percent of households in Canada used at least one ordinary (incandescent) light bulb. The same cannot be said, however, for the other types of bulbs on the Canadian market.

Almost half of all households in Canada used at least one halogen light bulb in 2003 (see Chart 49). A region-by-region analysis reveals that Quebec had the highest percentage of households that used at least one halogen light bulb (58 percent) and the Atlantic region had the lowest (30 percent).

More than half of Canadian households used at least one fluorescent tube in 2003 (see Chart 50). Regionally, the percentage of households that used at least one fluorescent tube appears to generally increase the further west a region is located.

Chart 49

Penetration Rate of Halogen Light Bulbs by Region

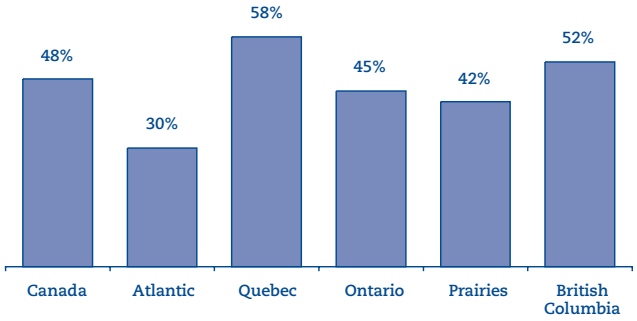
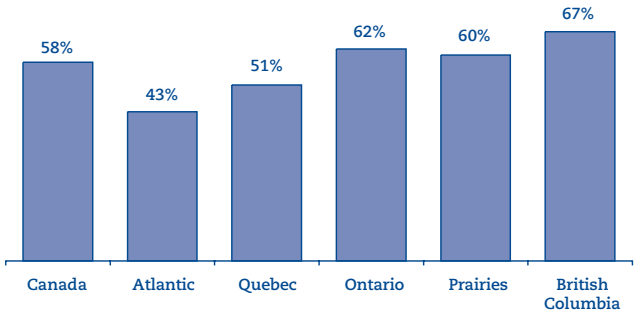


Chart 50

Penetration Rate of Fluorescent Tubes by Region



Consequently, British Columbia had the highest percentage of households that used at least one fluorescent tube (67 percent) and the Atlantic region had the lowest (43 percent).

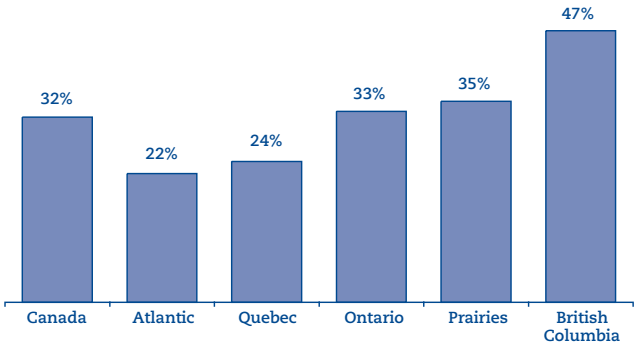
Unlike the case with halogen bulbs and fluorescent tubes, well less than half of Canadian households used a CFL in 2003 (see Chart 51 on page 28). In fact, only 32 percent of households used at least one CFL. However, as was the case with fluorescent tubes,

[28] Natural Resources Canada, *Household Lighting*, Ottawa, 1998, pp. 6–12.

the percentage of households that used at least one CFL in 2003 increases the further west the region is located. And once again, as was the case with fluorescent tubes, British Columbia had the highest percentage of households using at least one CFL (47 percent) and the Atlantic region had the lowest (22 percent).

Chart 51

Penetration Rate of CFLs by Region

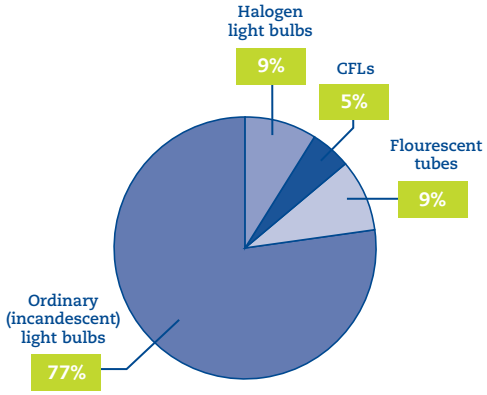


Number of Light Bulbs

SHEU–2003 found that the average Canadian household used 26.4 light bulbs. Over three quarters of the light bulbs used by the average household were ordinary (incandescent) light bulbs (see Chart 52). The remaining light bulbs used by the average household were comprised of halogen light bulbs (9 percent), fluorescent tubes (9 percent) and CFLs (5 percent).

Chart 52

Type of Light Bulbs Used by the Average Household

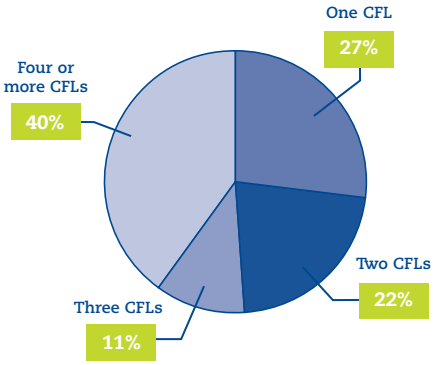


Even though energy-efficient light bulbs, such as halogen light bulbs, fluorescent tubes and CFLs, comprised nearly a quarter of the average household's light bulbs, the survey data shows that one out of every five households did not use any of these energy-efficient light bulbs in 2003. The reason 20 percent of households did not use any of these bulbs – yet these bulbs still accounted for nearly 25 percent of the average household's light bulbs – is that households that used one type of these energy-efficient light bulbs were likely to have used many of those particular bulbs.

Among households that used a halogen light bulb in 2003, only 28 percent used only one halogen light bulb, while 44 percent used four or more halogen light bulbs. Similar results were observed for fluorescent tubes and CFLs. Among households that used a fluorescent tube in 2003, only 26 percent used only one fluorescent tube, while 40 percent used four or more fluorescent tubes. And among households that used a CFL in 2003, only 27 percent used only one CFL, while 40 percent used four or more CFLs (see Chart 53).

Chart 53

Number of CFLs Used Among Households That Used at Least One CFL



ENERGY STAR®

The international ENERGY STAR® symbol is a simple way for consumers to identify products that are among the most energy efficient on the market. Only manufacturers and retailers whose products meet the ENERGY STAR criteria can label their products with this symbol. It is estimated that products displaying the ENERGY STAR symbol can help reduce energy and operating costs by 30 percent to 50 percent.[29]

In addition to helping save money, high-energy-efficiency household appliances and other everyday-use products help protect our environment by reducing GHG emissions that contribute to climate change. Their use also helps lower levels of other pollutants that cause urban smog and acid rain.

Since both SHEU–1993 and SHEU–1997 were performed before the ENERGY STAR Initiative officially entered the Canadian market in 2001, SHEU–2003 was the first Survey of Household Energy Use capable of asking questions about the initiative. However, given that in 2003 the ENERGY STAR Initiative in Canada was less than four years old and only covered certain product categories, not all households were asked if they used ENERGY STAR qualified products. A household was asked only if a particular product it used in 2003 was an ENERGY STAR qualified product, if the product in question was less than four years old and covered by the initiative.

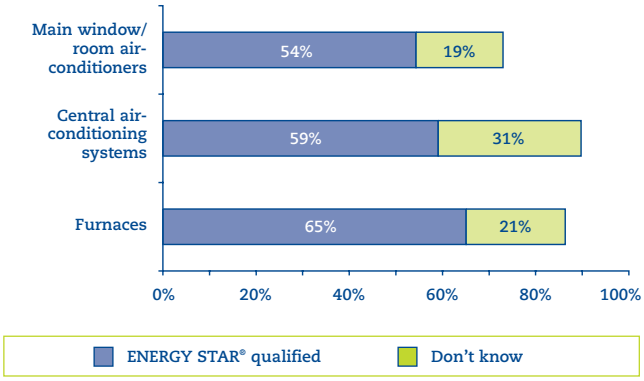
Hence the following analysis represents only the penetration rates of ENERGY STAR qualified products among households that used products less than four years old. This was done in an effort to reveal the penetration rates of ENERGY STAR qualified products since the inception of the initiative.

ENERGY STAR Heating and Air-Conditioning Systems

Among heating and air-conditioning systems, the ENERGY STAR Initiative covered furnaces, central air conditioners and window/room air conditioners in 2003. For each of these three system categories, among households that used a system less than four years old, the majority of households used an ENERGY STAR qualified system (see Chart 54).

Chart 54

Penetration Rate of ENERGY STAR Among Households With Systems Less Than Four Years Old in 2003



These results may underestimate the percentage of households that used ENERGY STAR qualified heating and air-conditioning systems, since a high percentage of households did not know if their systems were ENERGY STAR qualified. This could also reflect that many Canadian households were unaware of the ENERGY STAR Initiative or that the ENERGY STAR Initiative covers these system categories.

ENERGY STAR Major Appliances

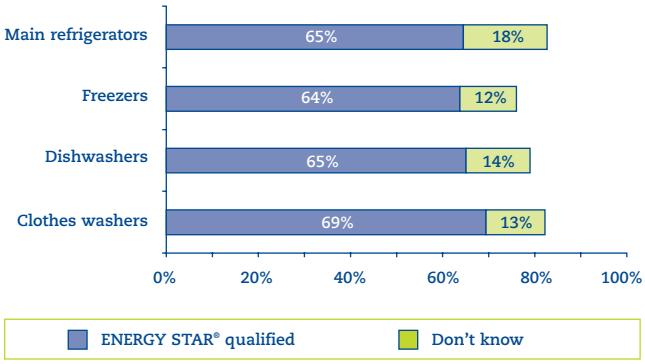
The major appliances covered by the ENERGY STAR Initiative in 2003 were refrigerators, freezers, dishwashers and clothes washers. For each of these

[29] Natural Resources Canada, *Look for ENERGY STAR*, Ottawa, 2003, p. 3.

appliance categories, among households that used an appliance less than four years old, well over 60 percent used an ENERGY STAR qualified appliance (see Chart 55).

Chart 55

Penetration Rate of ENERGY STAR Among Households With Major Appliances Less Than Four Years Old in 2003



As was the case with heating and air-conditioning systems, a high percentage of households did not know if their major appliances that were less than four years old were ENERGY STAR qualified. For example, nearly one out of five households with a main refrigerator less than four years old did not know if it was ENERGY STAR qualified. Therefore, the results may underestimate the percentage of households with ENERGY STAR qualified appliances.

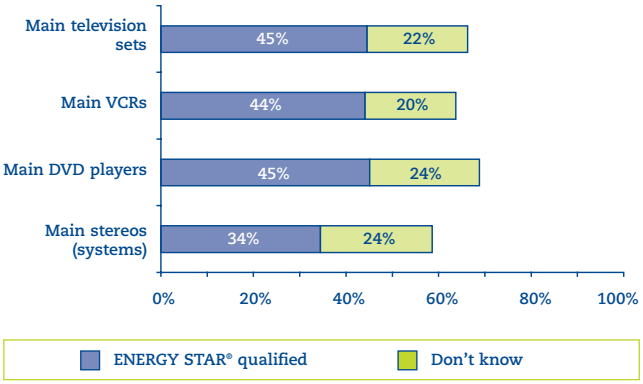
ENERGY STAR Other Appliances

In addition to the previously mentioned energy-consuming products, in 2003 the ENERGY STAR Initiative covered other appliances, such as televisions, VCRs, DVD players and stereos. For each of these product categories, with the exception of stereo systems, among households that used a product less than four years old, approximately 45 percent used an ENERGY STAR qualified product (see Chart 56). Nearly 35 percent of households whose main stereo (system) was less than four years old used an ENERGY STAR qualified stereo (system).

For each of these product categories, at least 20 percent of households that used a product less than four years old did not know if it was ENERGY STAR qualified. Once more, these results may underestimate the percentage of households that used ENERGY STAR qualified products in 2003. This could also reflect that many households were unaware of the ENERGY STAR® Initiative or that the ENERGY STAR Initiative covers these product categories.

Chart 56

Penetration Rate of ENERGY STAR Among Households With Other Appliances Less Than Four Years Old in 2003



ENERGY STAR Appliances – Regional Analysis

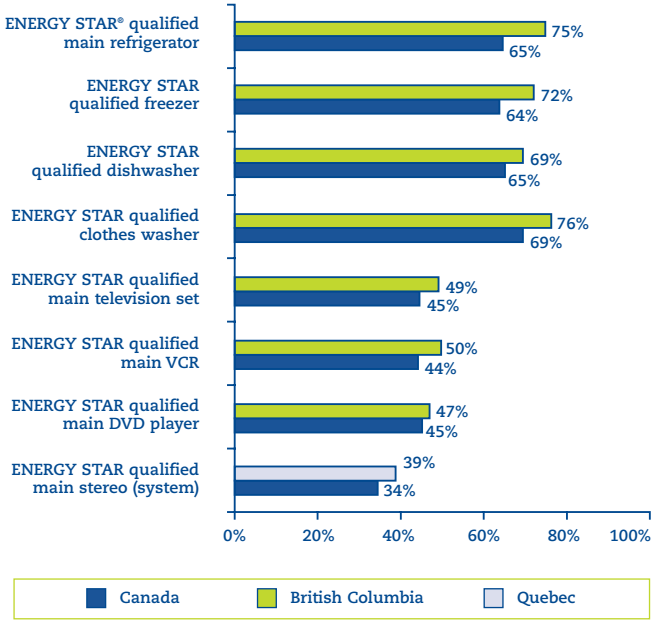
For each appliance category covered by the ENERGY STAR Initiative in 2003, with the exception of stereos, British Columbia had the highest proportion of households that used an appliance less than four years old that was an ENERGY STAR qualified appliance (see Chart 57). Quebec had the highest proportion of households that used a stereo less than four years old that was an ENERGY STAR qualified stereo.

Once again, these results only represent the penetration rates of ENERGY STAR qualified products among households that used products less than four years old. This was done in an effort to reveal the penetration rates of ENERGY STAR qualified products since the inception of the ENERGY STAR Initiative.

Please refer to the *2003 Survey of Household Energy Use – Detailed Statistical Report* to find data on the percentage of all households across Canada that used ENERGY STAR qualified products in 2003.

Chart 57

Penetration Rate of ENERGY STAR Among Households With Appliances Less Than Four Years Old in 2003, by Selected Regions



Glossary

Appliance: Device used in a house during the year. Appliances at the disposal of the head of the household for regular use are to be counted. Appliances that are owned by the household but are not used are not to be counted, except for air-conditioning units. An appliance that is temporarily inoperable, but which is generally used, is included if a serviceperson has been called or if it has been transported to a repair shop.

Caulking: Material used to seal spaces to make them airtight.

Central ventilation system (air exchanger): Device that takes stale air from inside a dwelling and exchanges it with fresh air from outside a dwelling.

Chest freezer: A freezer that is accessible from the top through a lid.

Compact dishwasher: Dishwasher with a capacity of less than eight place settings and six serving pieces.

Compact fluorescent light: General term applied to smaller-diameter fluorescent lights that are compatible with standard light sockets.

Condensing furnace (high-efficiency furnace): This type of furnace extracts most of the heat remaining in the combustion by-products through a condensing heat exchange process.

Condominium: Individual ownership of a dwelling in a multi-dwelling structure (such as an apartment building) or on land owned in common (such as a row house complex).

Crawl space: Ventilated open low space between the ground and the lowest storey of a dwelling, or a ventilated low space between the roof and highest storey of a dwelling.

Double/row house: House connected to at least one other dwelling, which together form a building. For SHEU–2003, duplexes (two dwellings one above the other, not attached to any other structure) are included in this category.

Dwelling: A living space that is structurally separate from others, with a private entry that permits access to the exterior of the building or to a stairwell or common corridor.

Energy intensity: Total energy consumption of a dwelling divided by the number of heated units of floor area. In this report, energy intensity is expressed in gigajoules per square metre (GJ/m^2).

ENERGY STAR®: As an international symbol of energy efficiency, the ENERGY STAR mark helps consumers identify which appliances on the market are the most energy efficient in their class. Administered in Canada by Natural Resources Canada, the ENERGY STAR symbol is used mainly to identify products offering premium performance levels in energy efficiency. The ENERGY STAR symbol can be found on product packaging, literature and advertising and on the products themselves. In some cases, you may also find it on the EnerGuide label. The following criteria are used to determine if an appliance qualifies for the ENERGY STAR mark:

- A standard-size refrigerator must exceed the minimum energy performance standard established by the Government of Canada by at least 10 percent in 2003 and at least 15 percent in 2004. A standard-size freezer must, in 2003, exceed these standards by at least 10 percent. Compact refrigerators and freezers must exceed these same standards by at least 20 percent.

- A standard-size dishwasher must exceed the minimum energy performance standards established by the Government of Canada by at least 25 percent in 2003. Only standard-size dishwashers can qualify for the ENERGY STAR mark.

- A clothes washer must use from 35 percent to 50 percent less water and at least 50 percent less energy per load than conventional washers.
- A television must use 3 watts or less when turned off, i.e., use 75 percent less energy than conventional televisions, which consume up to 12 watts when turned off.
- A video cassette recorder must use 4 watts or less when turned off, i.e., use 70 percent less energy than conventional video cassette recorders, which consume up to 13 watts when turned off.
- A DVD player must use 3 watts or less when turned off, i.e., use 75 percent less energy than conventional DVD players, which consume up to 10 watts when turned off.
- A stereo system must use 2 watts or less when turned off, i.e., use 70 percent less energy than conventional stereo systems, which consume up to 7 watts when turned off.
- A room air conditioner must exceed the minimum energy performance standards established by the Government of Canada by at least 10 percent in 2003. A central air conditioner must exceed these standards by 20 percent.
- A forced-air furnace must have an annual fuel utilization efficiency (AFUE) rating of 90 or higher. A furnace (boiler) with hot water or steam radiators must have an AFUE rating of 85 or higher.

Fluorescent tube: A linear (long, straight tube) fluorescent light bulb (lamp).

Gigajoule (GJ): Unit of measure for energy consumption, equal to 1 billion joules.

Halogen light bulbs: Incandescent lights containing halogen gases, which burn very hot while providing an intense white light.

Heat pump: Heating and cooling unit that draws heat from an outdoor source and transports it to an indoor space for heating purposes, or the inverse for cooling purposes.

Heated area: The total floor space of a dwelling, excluding the basement and the garage.

Household: Person or group of persons who occupy a dwelling. The number of households, therefore, is equal to the number of dwellings occupied.

Low-rise apartment: Dwelling located within an apartment building with fewer than five storeys.

Mobile home: Mobile dwelling designed and built to be transported by road on its own frame to a location where it may be placed on a temporary foundation, such as concrete blocks, pillars or other specifically designed foundation. It must be able to be moved again to another location, as required.

Moisture detector: A moisture detector is a sensor in a clothes dryer used to check the amount of moisture in the clothes and to terminate the dryer cycle automatically when the clothes are dry.

Ordinary (incandescent) light bulb: The standard incandescent light bulb is the original and most common type of bulb used in the house.

Penetration rate: Percentage of a sample population that used a given product during a specific period of time.

Programmable thermostat: A temperature-sensitive device that lets an individual choose the temperature to be maintained in one or several rooms of a dwelling during different times of the day.

Retrofit: Improvement of efficiency of energy-consuming appliances or thermal characteristics of a building.

Single detached house: House containing a single dwelling unit entirely separate from any other building or structure; generally known as a single-family house.

Supplementary heating: Heating system which can be used in addition to a main heating system, as desired, and which is flexible enough to respond to rapid variations in heating needs.

Thermal envelope: The facing materials that form the shell of a building, including walls, ceilings, roof, basement walls, windows and doors.

Upright freezer: A freezer that is accessible from the front through a door.

Weatherstripping: A felt or foam band, usually self-adhesive, placed at the joints of doors and windows to seal against air leaks and reduce heat loss.

Notes

Sample Technologies

This ***Roadmap*** is not intended to recommend specific technologies or manufacturers. The examples below are offered to demonstrate possibility and feasibility.

Proven and Anticipated, Leading-Edge Technologies

Because this report is intended to include efficiency improvements that can be implemented by 2025, it is important to include leading-edge technologies that will soon become generally available. Cell phones, iPods and other MP3 players are great examples of rapid, high distribution of an innovative technology, which was adopted quickly for reasons other than cost—they weren't the cheapest item, but nearly everyone has one, and the distribution has occurred in less than 15 years.

Technology is always adapting and evolving, and worldwide research and development have already produced energy efficiency technologies that can be accessible and easily-adapted into existing infrastructure and buildings. LED traffic lights are highly efficient, last six times longer than conventional traffic lights, require less maintenance, and are saving local governments thousands of dollars, such as the example of Anchorage saving money by installing LED streetlights. Other solid-state lighting technologies offer similar savings to obtain greater efficiency in meeting commercial, residential, industrial, and outdoor lighting needs.

High-energy batteries will hit the market before 2015, and will revolutionize the way Alaskans store electricity in everything from cars to hearing aids. In the area of consumer devices, like cell phones and iPods, an industrial race is going on between high-efficiency, small-scale batteries and nano-technology fuel cells, either of which could greatly increase the efficiency of hand-held devices.

Retrofitting and weatherization are methods to increase a building or a neighborhood's ability to store heat in the winter, thus reducing the electricity used to power the fans used in furnaces. Using simple technologies that include building insulation, pipe insulation, caulking, foaming insulation to fill cracks, and weather stripping for windows, individuals can increase their home's efficiency significantly, once again reducing the electricity used to power the fans in heating systems. For similar reasons, weatherization is also going to be an essential part of the Smart Grid[1] (see footnote for an explanation of "Smart Grid"). The Smart Grid concept is in development, and is intended to implement a computerized, interactive, reliable, and high-quality electricity grid that allows consumers, suppliers, distributors, and energy technologies to communicate in real-time. Real-time communication among the various providers and consumers of the electricity has been shown to enable significant increases in the efficiency with which end-use needs are met.

Retrofitting and weatherizing existing buildings to be more energy efficient is a no-to-low cost solution for older or inefficient homes and buildings. In this case, retrofitting an

[1] http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages.pdf

existing building means adding energy efficiency measures and insulation that will help weatherize the home and reduce it's overall energy consumption. Energy auditors perform a blower door test, where the door is sealed off and uses air pressure to determine where air leaks exist in the structure of the building. Residents or contractors can then plug these leaks with spot foaming insulation and wall and ceiling insulation, insulation for pipes and water heaters, weather strips for windows, and caulking. An average home that undergoes a complete weatherization can save 32% on their heating bill, which on a $100/month bill could amount to savings of over $350 per year.[2]

The Middle Class Task Force has made a call to "retrofit America," so that the energy efficiency industry will grow into a source of employment for middle class Americans affected by the economic downturn. Many homes in the United States are old and have no insulation at all. The Recovery Act has set aside $5 billion for weatherization assistance, up from $250 million in 2008, which all 50 states have received already. Steven Chu, the U.S. Secretary of Energy, estimates that 15,000-20,000 homes were weatherized in September alone, and thinks that weatherization could ramp up to 20,000-30,000 homes per month soon. Chu explains that not only will this assistance save residents on their utility bills, but also it is creating jobs and supporting businesses. Krendl, a maker of insulation machines, has increased its staff by 30%. Applied Energy Products, a distributor of Krendl Products, recently hired 60% more staff.[3]

Emerging technologies

LEDs

Anchorage announced in 2008 it would replace 16,500 sodium streetlights with light emitting diodes (LEDs). These LED bulbs will use 50% less electricity. The program is saving Anchorage $360,000 per year, and with $2.2million invested, Anchorage will start receiving profits on their investment in approximately 6 years, with a potential monetary return on investment of more than 9% over 15 years.[4] While this particular project resulted in a total improvement of less than 1% of the total Railbelt electricity use, it still demonstrates the possibility for significant improvements, if Alaskans choose to adopt similar efficiencies for its remaining outdoor and area lighting. Anchorage is also testing dimming control systems, and plans to phase in controls of all roadway lights for project completion.

Ecofit Lighting.

[2] http://www.energy.gov/news2009/print2009/7605.htm and http://www.pvrea.com/programs/index.html see also, LaMonica, Martin. *Weatherizing Homes: The Next Big Green Industry?* CNET News, January 28, 2009. http://news.cnet.com/8301-11128_3-10150977-54.html.

[3] Chu, Steven. *Saving Money by Saving Energy*. Huffington Post, October 30, 2009. http://www.huffingtonpost.com/steven-chu/weatherization-saving-mon_b_339935.html.

[4] Richard, Michael Graham. Treehugger.com, July 31, 2008. http://www.treehugger.com/files/2008/07/led-streetlights-anchorage-alaska-16000.php.

Ecofit Lighting of Kansas has designed a model of LED lighting that will enable governments to transition to LED streetlights more easily, for less money, and with better results. Instead of paying $700-900 and a half-hour worth of labor for a complete replacement of the streetlight, Ecofit's LED bulbs are designed to fit existing streetlights, eliminating the need for a full replacement and bringing the installation cost down to five minutes of labor and $400. Over its lifetime, which lasts six times longer than sodium streetlights, the LED bulb will perform with 60% more efficiency than the traditional bulbs.[5] The product has the shortest time to positive return on investment of all LED lights, and is made in the United States.[6] Although the Ecofit system may not be right for Alaska's Railbelt region, it is an example of the kinds of technologies that are emerging in the LED outdoor lighting sector. Other leading manufacturers include Albeo Technologies, of Boulder, Colorado, and Kenall Manufacturing, of Gurnee, IL.

In order to evaluate the performance of light emitting diodes (LED), Pacific Gas and Electric Company (PG&E) conducted an assessment of street lighting applications in San Francisco. 100-Watt high-pressure sodium (HPS) luminaires were replaced by LED luminaires from four manufacturers on four streets in a residential district of San Francisco. "Lighting performance, energy and power usage, economic factors (such as simple payback and net present value), and qualitative satisfaction" were all evaluated.[7] While achieving similar lighting performance, energy reductions ranged from 50 to 70 percent over the current HPS system. If HPS systems were replaced nationwide by LED technologies, PG&E estimated that annual electricity use could be reduced by 8.1 TWh.[8]

PG&E now actively promotes the financial benefits of LED technology, in the development of their new rate schedule "Electric Schedule LS-2 - Customer-Owned Street and Highway Lighting."[9]

The US Department of Energy (DOE) has published the results of several GATEWAY demonstration projects involving LED implementation. Like the PGE study in San Francisco, DOE replaced streetlights in a residential area in Portland, Oregon. Eight 100W HPS fixtures were replaced by LED luminaires manufactured by Leotek, Inc. Energy savings were measured at 55 percent, and estimated payback for the LED fixtures is 7.6 years for new installations and 20 years for replacements. In a resident survey, 10 of 11 respondents either noticed no difference or thought that lighting quality improved after the HPS replacement.[10]

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[5] Image Credit: Ecofit Lighting. Moon, Mariella. Cleantechnica.com, October 21, 2009. http://cleantechnica.com/2009/10/21/ecofit-promises-easier-transition-to-led-street-lighting/.

[6] (Also Image Credit) Ecofit Lighting. Retrieved October 26, 2009. http://www.ecofitlighting.com/ecofit-durastreet-competitive-advantages.html.

[7] Pacific Gas and Electric Company. *Emerging Technologies Program Application Assessment Report #0727*. December 2008. Detailed results can be found in the assessment report at http://www.pge.com/mybusiness/energysavingsrebates/rebatesincentives/ref/lighting/lightemittingdiodes/casestudiesfactsheets/index.shtml.

[8] Ibid.

[9] *PG&E Rates LED Street Lighting*, viewed January 18, 2010 at http://www.ledsmagazine.com/news/6/10/2

[10] US Department of Energy. *Demonstration Assessment of Light-Emitting Diode (LED) Street Lighting*. November 2009.

The City of Portland, Oregon, transitioned to LEDs over a period of three months. Using a combination of rebates and leasing, the transition required an investment of only $900,000. After installing over 13,000 LED traffic lights, the City of Portland reports saving 5.25 million kWh and $335,000 annually on energy, and $45,000 on maintenance. The City of Portland saw the project as a necessary investment, which brought a profitable return in three years.[11]

In Eugene, Oregon, LED potential was explored through the retrofitting of upright freezer cases in an Albertsons Grocery. In conjunction with occupancy sensors, the LED system reduced power consumption by 61 percent and resulted in a total annual energy savings of 2,659 kWh for a typical 5-door case, as compared against standard fluorescent lighting.[12]

In another demonstration in West Sacramento, California, a Raley's Supermarket parking lot was retrofitted with LED systems. Several metal halide (MH) lights were replaced by LED luminaires possessing motion-activated bi-level dimmers. The LEDs drew an average of 105 watts, compared to the MH demand of 346 watts. Energy savings potential approach 70 percent annually, and the system has a payback period of less than five years.[13]

Additional potential for residential LED applications was also demonstrated in two "green" showcase homes featured in the Eugene, Oregon 2008 Tour of Homes. LED downlights and LED undercabinet fixtures were evaluated. The LED downlight, manufactured by LED Lighting Fixtures Corporation, drew 12 watts. Compared to a 65 watt incandescent reflector lamp and a 75W halogen reflector lamp, the LED downlight reduced energy use by 82% and 84%, respectively. The LED undercabinet fixture drew 10 Watts, representing an 83% to 90% reduction in energy use as compared to a halogen product tested at high and low power settings.[14]

In another recent study OSRAM found that the energy used in the manufacturing phase of LED lamps represents only 2 percent of the total lifetime energy requirements of the lamps. This dismisses any concern that production of LEDs might be too energy-intensive and therefore too costly.[15]

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[11] City of Portland, Energy Efficiency Success Story. www.portlandonline.com/shared/cfm/image.cfm?id=111737.

[12] US Department of Energy. *Demonstration Assessment of Light-Emitting Diode (LED) Freezer Case Lighting*. October 2009.

[13] US Department of Energy. *Application Assessment of Bi-Level LED Parking Lot Lighting*. February 2009.

[14] US Department of Energy. Demonstration Assessment of Light-Emitting Diode (LED) Residential Downlights and Undercabinet Lights. October 2008.

[15] *LED Life Cycle Assessment,* viewed January 18, 2010 at http://www.osram-os.com/osram_os/EN/About_Us/We_shape_the_future_of_light/Our_obligation/LED_life-cycle_assessment/index.html; additional information about LED technologies is available from the U.S. DOE Solid State Lighting: http://www1.eere.energy.gov/buildings/ssl/index.html; and from LEDs magazine: http://www.ledsmagazine.com/

High-Energy Batteries

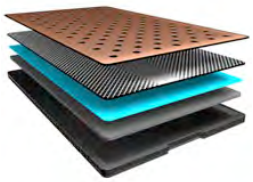

Figure 16. Re-Volt.

Switzerland-based company ReVolt is taking batteries to the next level in energy efficiency. SINTEF, a research institute in Norway, developed a zinc-air battery that stores three times the energy of lithium ion batteries by volume. ReVolt, which was formed in order to take the product to market, promises that they will cost half as much as a lithium ion battery. The battery uses oxygen to create a current, unlike traditional batteries that contain volatile chemicals, making ReVolt a safer choice. The battery has multiple layers that draw in oxygen and then uses catalysts to form hydroxyl ions, traveling through an electrolyte to an electrode where the zinc is oxidized (see Figure 16). This process releases ions, which generate a current. ReVolt's challenge is to make the battery reliable, long-lasting, and rechargeable multiple times, which ReVolt believes they have almost mastered. ReVolt will begin selling small "button cells" for hearing aids starting next year. They will expand the technology to fit cell phones, electric bicycles, and even electric vehicles, which they hope will increase their lifespan and be less expensive.[16]

[16] Bullis, Kevin. *High-Energy Batteries Coming to Market.* MIT Technology Review, October 28, 2009. http://www.technologyreview.com/business/23812/, Image credit: ReVolt.

Profile of the Railbelt Region

The Draft RIRP report contains very thorough profile information on the Railbelt region and its utilities, which is not repeated here, for purposes of brevity. For more thorough description, please refer to the RIRP.[1] In addition, the RIRP largely focuses on "supply-side" generation and transmission. These supply options offer additional opportunities for efficiency improvements, which would produce fuel savings for the utilities that generate electricity, and which might reduce the requirements for total generation; but these are not included in this ***Roadmap*** because the ***Roadmap*** focuses specifically on end-uses.

The Railbelt region is currently served by six separate electricity utilities, who collaborate on a shared transmission and distribution network.

Six Railbelt Utilities (and/or authorities)

Chugach Electric Association (CEA)	1,112.183 MWh
Municipal Light & Power (ML&P)	879.742 MWh
Matanuska Electric Association (MEA)	532.312 MWh
Homer Electric Association (HEA)	476.823 MWh
Seward Electrical Systems (SES)	54.940 MWh
Golden Valley Electric Association (GVEA)	1,071.392 MWh
Railbelt Region	**4,127.392 MWh**

65% of Alaskans live in the Railbelt region—approximately 477,000 people.[2,3] Alaska's statewide population is currently projected to increase from just over 670,000 in 2006 to well over 830,000 by 2030, representing roughly a 20% increase. The majority of this increase is expected to come in the Railbelt region and immediate surrounding areas.[4]

The Alaska Railbelt region includes the cities of Homer, Anchorage, and Fairbanks as well as the communities along the Alaska Railroad. It is comprised of six interconnected utilities that serve the following communities:

- Chugach Electric Association (CEA) serves Anchorage/Kenai Pennisula.
- Anchorage Municipal Light and Power (ML&P) serves Anchorage (old city).
- Homer Electric Association (HEA) serves Kenai Pennisula.
- Matanuska Electric Association (MEA) serves Anchorage/Mat-Su Valley.
- Seward Electric Systems (SES) serves Seward.
- Golden Valley Electric Association (GVEA) serves Fairbanks/Denali.

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[1] Black & Veatch, *RIRP*, op. cit.

[2] Alaska Energy Authority and Alaska Center for Energy and Power. *Alaska Energy.* Alaska Energy Authority. January 2009. http://www.aidea.org/aea/PDFpercent20files/AKpercent20Energypercent20Final.pdf.

[3] U.S. Census Bureau. *Alaska.* State & County QuickFacts. September 2009. http://quickfacts.census.gov/qfd/states/02000.html.

[4] Alaska Department of Labor and Workforce Development. *Alaska Population Projections 2007-2030.* July 2007. http://www.labor.state.ak.us/research/pop/projections/AlaskaPopProj.pdf.

The Railbelt region employs approximately 1,016 people in generating and distributing electricity from the current, centralized sources as follows[5]:

- Municipal Light and Power employs 230[6]
- Golden Valley Electric employs 100-250[7]
- Seward Electric employs 10[8]
- Homer Electric employs 125[9]
- Matanuska Electric Association employs 128[10]
- Chugach Electric employs 348[11]

With the exception of the GVEA, which serves the interior, all Railbelt utilities are located in the Southcentral Region of Alaska. Figure 20, below, provides a map of the Railbelt area.

Figure 20. Map of Railbelt Region.[12]

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[5] Based on conversations with utilities and research from each utility's website.

[6] *About ML&P.* Anchorage Municipal Light and Power. 31 December 2008. http://www.mlandp.com/redesign/about_mlp.htm.

[7] Golden Valley Electric Assoc. *Company Information*. 2009. http://www.jigsaw.com/id51308/golden_valley_electric_assoc_inc_company.xhtml.

[8] http://www.cityofseward.net/.

[9] *2008 Annual Report*. Homer Electric Association. 2008. http://www.homerelectric.com/Portals/0/PDFs/2008 percent20Annual percent20Report.pdf.

[10] *Comprehensive Economic Development Strategy*. Matanuska Electric Association. 2008. http://www.commerce.state.ak.us/oed/oedp/pubs/MatSuCEDS.pdf.

[11] *Chugach: General*. Edgar online. 2009. http://sec.edgar-online.com/chugach-electric-association-inc/10-k-annual-report/2008/04/14/Section3.aspx.

[12] *The best way to see Alaska is on the Railroad.* Alaska Railroad Vacation. 2009. http://www.alaskarailroad.com/Default.aspx?alias=www.alaskarailroad.com/travel.

Electricity Generation

The Railbelt region produces approximately 80% of the total electricity generated by Alaskan utilities. In total, the major Railbelt Region utilities currently have an installed capacity of 1248 MW.[13] A breakdown of generation capacity as a portion of the total capacity is shown in Figure 21.

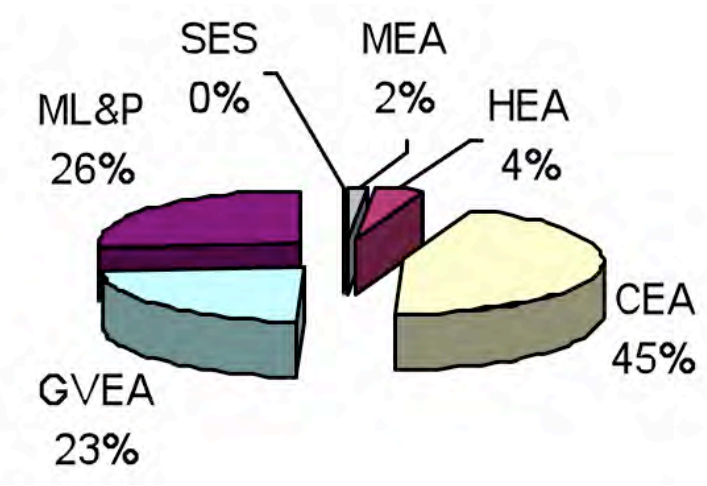

Figure 21. Generation Capacity by Railbelt Utility.[14]

Nearly 70% of the electricity generated in the Railbelt region comes from natural gas-fired power plants. Oil-fired and hydroelectric plants each provide approximately 13% of electricity to the region. Coal and petroleum plants provide the remaining 5% (sometimes as much as 15%, depending on the mix of sources and the level of demand).[15] The coal and oil plants are primarily located in the GVEA service area. The natural gas and hydroelectric power plants are located in the Anchorage and Kenai Peninsula area (CEA, ML&P, HEA service areas). Alaska does not currently produce any electricity using nuclear energy; however, plans are being discussed for small reactors near Fairbanks and Galena.[16]

The three hydroelectric generation plants in the Railbelt Region generate a total of approximately 150 MW: Bradley Lake (90 MW normally dispatch-able plus 30 MW of spinning reserves); Eklutna Lake (40 MW); and Cooper Lake (20 MW). All of the Railbelt utilities have at least partial ownership in hydroelectric generation. Bradley Lake, the largest hydroelectric plant in the region, is owned by the Alaska Energy Authority and operated by HEA.[17] All six utilities own a percentage of the electricity generated there. The Eklutna Lake was jointly taken over by ML&P, CEA and MEA and these three

[13] Black & Veath REGA Study p.61.
[14] Black and Veatch. Alaska Railbelt Electrical Grid Authority (REGA) Study. 2008. http://www.akenergyauthority.org/REGAFiles/9-12-08_AlaskaRailbeltREGAStudy_MasterFinalReport.pdf.
[15] Institute of Social and Economic Research University of Alaska Anchorage. 2003. *Alaska Electric Power Statistics (with Alaska Energy Balance)*.
[16] *Alaska: State Energy Profile.* Energy Information Administration. 25 November 2009. http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=AK.
[17] AEA Website: http://www.aidea.org/aea/projects.html.

utilities own a percentage of the power generated there.[18] Cooper Lake is owned and operated by CEA.[19]

Figure 22, below, contains an illustration of Alaska's power sources.

Figure 22. Map of Alaska's Current and Potential Energy Sources.[20]

Many of the Railbelt utilities have to purchase electricity from other sources, while some produce their own electricity, as shown in Figure 23.

[18] *About ML&P.* Municipal Light and Power Website. 2007. http://www.mlandp.com/redesign/about_mlp.htm.

[19] *Hydroelectric Power Generation.* Alaska Energy Wiki: powered by the Alaska Center for Energy and Power. August, 10, 2009. http://energy-alaska.wikidot.com/hydro; *The Company: Facilities.* Chugach: Powering Alaska's Future. 2007. http://www.chugachelectric.com/inside/facilities.html.

[20] ibid.

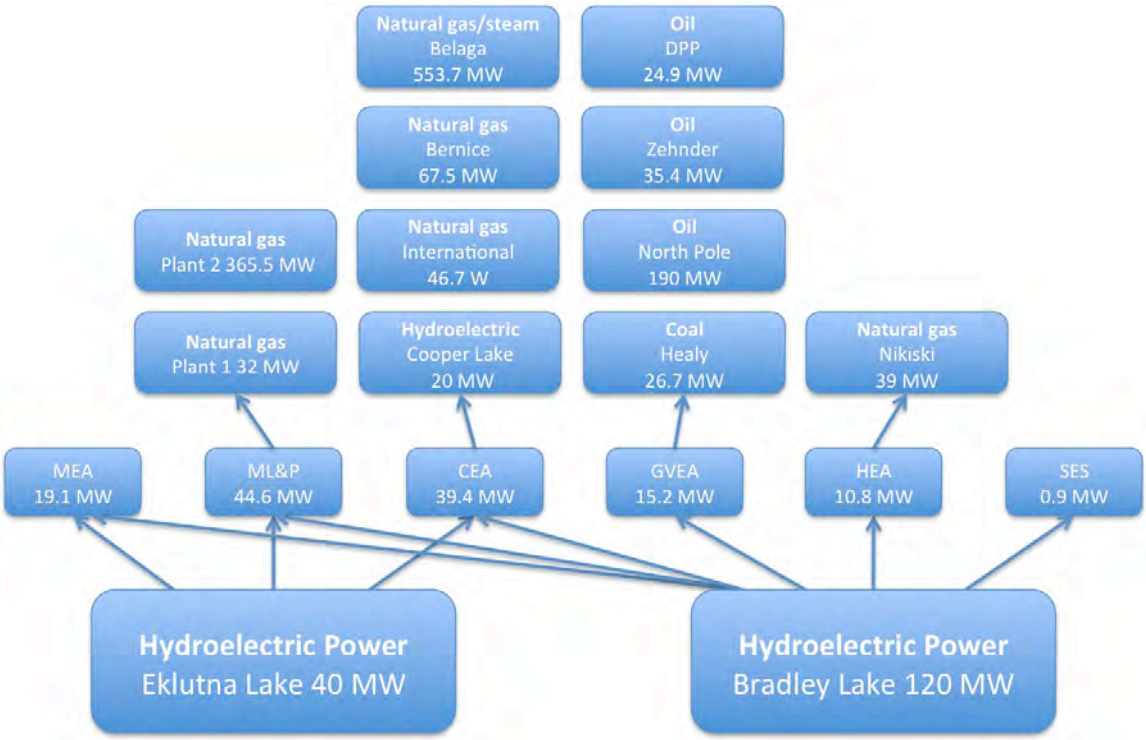

Figure 23. Electricity Purchasing Agreements Among Utilities.[21]

Electricity Consumption by Community and Sector

According to 2001 data, the Anchorage metropolitan area is the largest consumer of electricity in the Railbelt region, followed by the Fairbanks-Healy-Delta Junction area.[22] The Kenai Peninsula (of which Seward is a part) and the Matanuska-Susitna Valley make up the remaining electricity consuming areas in the region. Table 19, below summarizes the six major utilities along with communities they serve and electricity consumption.

[21] Information received from utilities. Refer to Appendix E for record of phone calls with utilities.
[22] Institute of Social and Economic Research University of Alaska Anchorage. 2003. *Alaska Electric Power Statistics (with Alaska Energy Balance)*.

Table 19. Railbelt Utility Service Areas.[23 24 25]

Utility	Community Served	Population	2001 Electricity Sales (MWh)	Percentage of Total Electricity Consumed
CEA	Anchorage/ Kenai Peninsula	175,000	1,112,183	27
GVEA	Fairbanks/ Denali	100,000	1,071,392	26
ML&P	Anchorage (old city)	93,000	879,742	21
MEA	Anchorage/ MatSu Valley	63,000	532,312	13
HEA	Kenai Peninsula	40,000	476,823	12
SES	Seward	6,000	54,940	1
TOTAL		**477,000**	**4,127,392**	

In the Railbelt region the commercial and residential sectors account for approximately 78% of the total electricity use. Industry and other uses make up the remaining 22%. Substantially more electricity is used for commercial operations than residential.

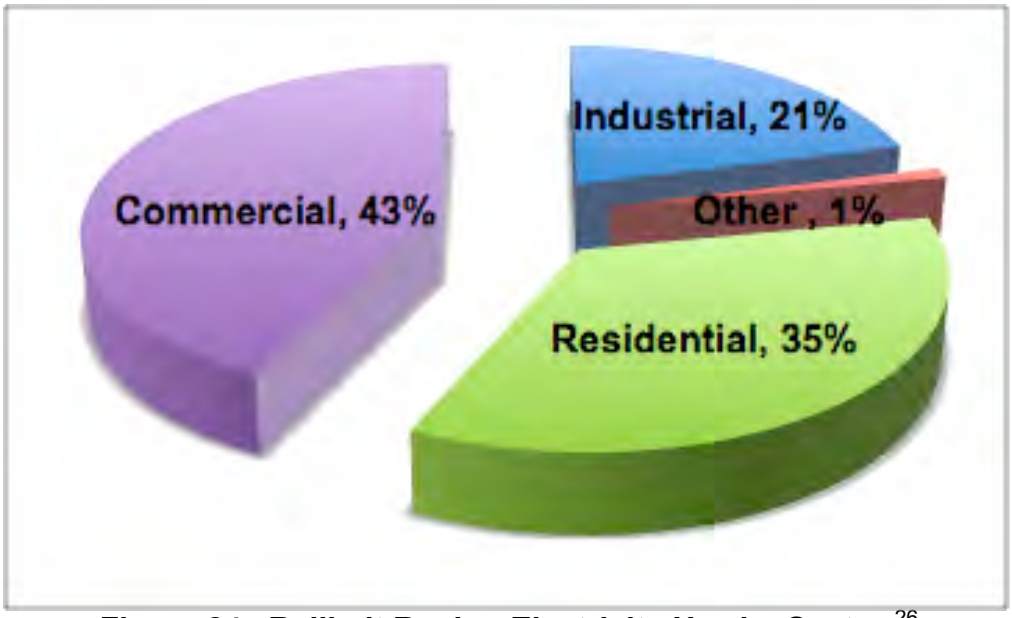

Figure 24. Railbelt Region Electricity Use by Sector.[26]

[23] Population estimates based on phone calls with different utilities. Refer to Appendix E for record of phone calls with utilities.

[24] Institute of Social and Economic Research University of Alaska Anchorage. *Alaska Electric Power Statistics (with Alaska Energy Balance)*. (p.19) 2003.

[25] The electricity that each utility sells is mainly consumed by customers of that utility and what is not consumed in the service area is sold as wholesale power to neighboring utilities to then be sold to their customers.

[26] Institute of Social and Economic Research University of Alaska Anchorage. 2003. Alaska Electric Power Statistics (with Alaska Energy Balance).

In Anchorage and the surrounding boroughs, all electricity is used almost exclusively in the commercial and residential sectors, with minimal industrial use. The majority of industrial use of electricity is located in GVEA and HEA service areas, representing 76% and 19% of the total, respectively.

On a per-customer basis, the largest consumer of electricity is the industrial sector with an average of 1,725,520 KWh per customer, compared to the commercial and residential sectors, with average uses of 68,883 and 8,145 kWh per customer. However, the industrial consumers also pay the lowest electricity rate at an average of 6.7 cents per KWh, compared to the commercial and residential sectors, at 10.8 and 9.9 cents per kWh respectively. This effectively subsidizes the inefficient use of electricity. A properly-balanced rate structure would charge the largest users the highest price, in order to incentivize efficiency.

Refer to Table 20 through Table 24 for a breakdown of electricity use by sector in each Railbelt utility service area.

Table 20. Average Electricity Usage and Costs Per Utility Company for Residential Sector.[27]

		Residential			
Utility	Community served	Revenue ($1,000's)	Sales (MWh)	Consumers accounts	Average cost per customer ($/kWh)
Chugach Electric Assn, Inc	Anchorage	$58,140	521,557	62,946	$0.11
City of Anchorage	Anchorage	$14,099	148,339	23,732	$0.10
City of Seward	Seward	$2,047	15,268	1,832	$0.13
Homer Electric Ass, Inc	Homer	$17,512	151,667	20,616	$0.12
Matanuska Electric Assn Inc	Mat-Su	$38,166	332,253	37,466	$0.12
Golden Valley Elec Assn Inc	Fairbanks	$28,135	283,060	31,693	$0.10

Table 21. Average Electricity Usage and Costs Per Utility Company for Commercial Sector.[28]

		Commercial			
Utility	Community served	Revenue ($1,000's)	Sales (MWh)	Consumers accounts	Average cost per customer ($/kWh)
Chugach Electric Assn, Inc	Anchorage	$50,363	557,619	7,973	$0.09
City of Anchorage	Anchorage	$53,401	721,040	5,954	$0.07
City of Seward	Seward	$892	5,910	305	$0.15
Homer Electric Ass, Inc	Homer	$15,280	161,720	3,190	$0.09
Matanuska Electric Assn Inc	Mat-Su	$18,718	199,372	3,016	$0.09
Golden Valley Elec Assn Inc	Fairbanks	$13,338	124,023	5,253	$0.11

Table 22. Average Electricity Usage and Costs Per Utility Company for Industrial Sector.[29]

		Industrial			
Utility	Community served	Revenue ($1,000's)	Sales (MWh)	Consumers accounts	Average cost per customer ($/kWh)
Chugach Electric Assn, Inc	Anchorage	$2,203	28,240	6	$0.08
City of Anchorage	Anchorage	-	-	-	-
City of Seward	Seward	$1,961	21,804	52	$0.09
Homer Electric Ass, Inc	Homer	$7,739	162,211	26	$0.05
Matanuska Electric Assn Inc	Mat-Su	-	-	-	-
Golden Valley Elec Assn Inc	Fairbanks	$46,947	664,309	424	$0.07

[27] Ibid.
[28] Ibid.
[29] Ibid.

Table 23. Average Electricity Usage and Costs Per Utility Company for Other Sectors.[30]

		Other			
Utility	Community served	Revenue ($1,000's)	Sales (MWh)	Consumers accounts	Average cost per customer ($/kWh)
Chugach Electric Assn, Inc	Anchorage	$1,320	4,767	65	$0.28
City of Anchorage	Anchorage	$1,491	10,303	267	$0.13
City of Seward	Seward	$151	11,958	145	$0.13
Homer Electric Ass, Inc	Homer	$153	1,225	87	$0.12
Matanuska Electric Assn Inc	Mat-Su	-	687	28	$0.22
Golden Valley Elec Assn Inc	Fairbanks	-	-	-	-

Table 24. Average Electricity Usage and Costs Per Utility Company for All Sectors.[31]

		Total			
Utility	Community served	Revenue ($1,000's)	Sales (MWh)	Consumers accounts	Average cost per customer ($/kWh)
Chugach Electric Assn, Inc	Anchorage	$178,595	1,112,183	70,090	$0.14
City of Anchorage	Anchorage	$87,431	879,742	29,953	$0.10
City of Seward	Seward	$6,481	54,940	2,334	$0.12
Homer Electric Ass, Inc	Homer	$41,084	476,823	23,919	$0.10
Matanuska Electric Assn Inc	Mat-Su	$58,459	532,312	40,510	$0.14
Golden Valley Elec Assn Inc	Fairbanks	$89,816	1,071,392	37,370	$0.09

Electricity Demand

The utility peak demand for the Railbelt region in 2010 is projected to be 1,131 MW and this number is expected to fluctuate with time staying relative constant around 1,100 MW as shown in Table 25 and Figure 25.

Table 25. Railbelt Load Forecast.[32]

	Utility Peak Demand (MW)					
Year	ML&P	CEA	GVEA	HEA	MEA	SES
2008	158	477	230	81	141	10
2010	168	489	237	78	149	10
2015	172	272	218	80	172	11
2020	177	285	226	80	186	12
2025	180	296	234	81	201	12
2030	185	307	243	82	216	13
2035	189	319	252	83	231	14
2037	191	324	256	84	237	14

[30] Institute of Social and Economic Research University of Alaska Anchorage. 2003. *op. cit*. (p. 54).
[31] Ibid.
[32] Black & Veatch. *Alaska Railbelt Electrical Grid Authority (REGA) Study*. 2008. p. 85. http://www.akenergyauthority.org/REGAFiles/9-12-08_AlaskaRailbeltREGAStudy_MasterFinalReport.pdf.

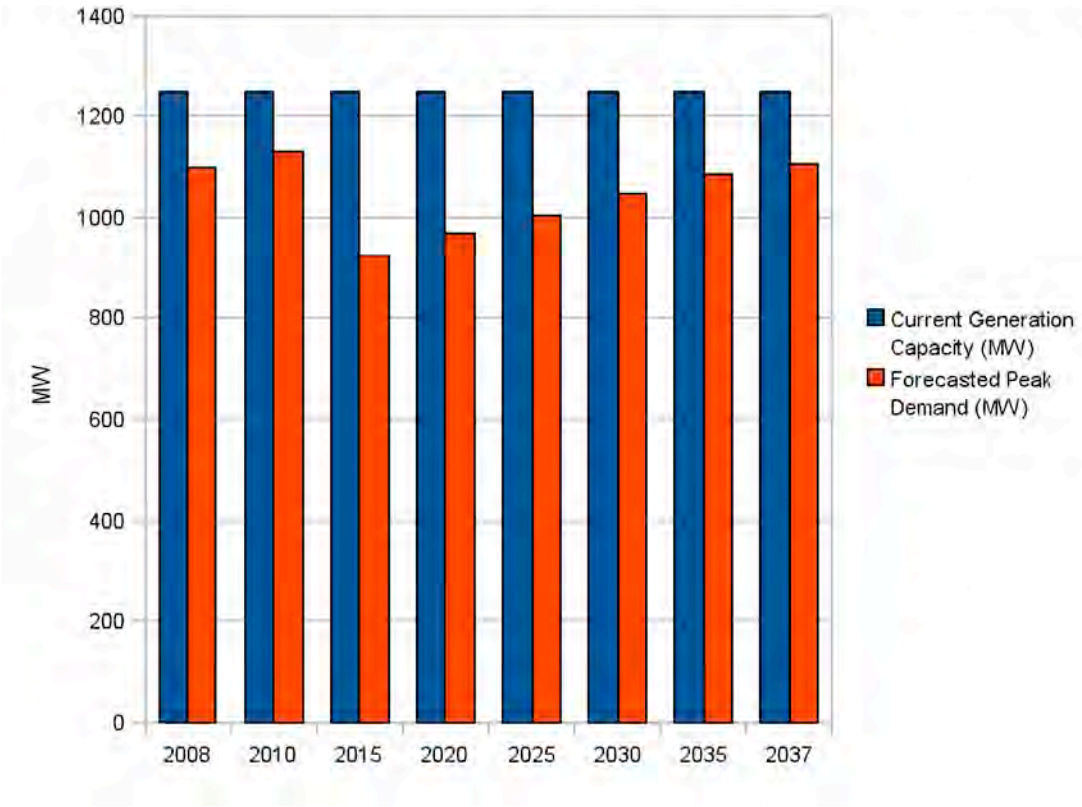

Figure 25. Railbelt Region Peak Demand Forecast vs. Current Generation Capacity.[33]

[33] Black & Veatch. *Alaska Railbelt Electrical Grid Authority (REGA) Study*. 2008. pg 61, 85.