Appendix I
Energy Supply and Demand
Policy Options

Summary List of ACCMAG Options

	Policy Option	GHG Reductions ($MMtCO_2e$)				Net Present Value 2010–2025 (Million $)	Cost-Effective-ness ($\$/tCO_2e$)	Level of Support
		2015	2020	2025	Total 2010-2025			
ESD-1a	Transmission, Rural	*0.00*	*0.00*	*0.01*	*0.05*	*$44*	*$897*	
ESD-1b	Transmission, RE Grants	*0.06*	*0.08*	*0.09*	*1.06*	*-$2*	*-$2*	
ESD-1	Transmission Optimization and Expansion (Total a & b)	0.07	0.08	0.09	1.11	$42	$38	
ESD-246a	Energy Efficiency for Residential and Commercial Customers, 1% per year	0.34	0.80	1.18	9.22	-$557	-$60	
ESD-246b	Energy Efficiency for Residential and Commercial Customers, 2% per year	0.34	1.07	1.84	12.41	-$728	-$59	
ESD-3	Implementation of Renewable Energy	1.99	2.35	3.86	32.52	$297	$9	
	Sector Total After Adjusting for Overlaps*	**1.93**	**2.77**	**4.67**	**37.51**	**-19.46**	**-4.24**	
	Reductions From Recent Actions				**0.34**			
	Sector Total Plus Recent Actions	**1.93**	**2.77**	**4.67**	**37.85**	**-19.46**	**-4.24**	

ESD-1. Transmission Optimization and Expansion

Policy Description

A policy of Transmission Optimization and Expansion in Alaska will offset sources of greenhouse gases by linking load centers with both existing and new renewable energy, and improving the efficiency of rural generators by increasing capacity-sharing capabilities. This option is directed toward establishing improvements in the electrical network of Alaska that will provide:

a) Improved opportunities for renewable resource utilization;

b) Enhanced coordination between electricity end-users and energy providers; and,

c) Promote the reduction of electric energy losses associated with inadequate and aging infrastructure.

The best renewable resources may not be near existing transmission lines. New transmission, as well as upgrades to existing transmission lines, may be needed to accommodate extensive deployment of renewable generation capacity.

ES&D 1 is intended to target transmission projects with established scopes and budgets submitted and accepted for seed funding by the AEA's Renewable Energy Fund, as well as broadly-defined transmission systems between remote rural areas. While addressing the need for improved optimization and the desirability of smart-grid features, ES&D 1 does not provide the costs and benefits of incremental grid improvements or a systematic overhaul.

Policy Design

The policy would be implemented through the adoption and revision of existing programs, as well as financial and logistical coordination with electric cooperatives and utilities throughout Alaska. While no specific funding mechanism is currently proposed to implement either transmission expansion or optimization projects, there are a number of mechanisms which could be used either in part or in whole:

1. Revolving-door mechanism financed by the state via either the AEA revolving loan fund, or using Power Cost Equalization (PCE) endowment funds for project development;
2. A Public Benefit Fund (PBF) in concert with ES&D Policy 2; used to fund generator efficiency via village-to-village transmission upgrades;
3. State revenues generated auctioning carbon allowances under a national cap-and-trade policy (or alternately, funding from a carbon tax under a similar framework);
4. Power project loans from the Alaska Energy Authority to qualified entities for constructing, improving, and expanding transmission and distribution facilities;
5. Permanent Fund or other tax revenues by AK State;
6. Utilities include transmission O&M in rates.

Goals:

- Interconnection of major generation facilities within the applicable regions of Alaska
- Access to identified hydroelectric, wind, tidal and other non-fossil fired generation resources.
- Displacement of less-efficient industrial and commercial electrical generation facilities (including Alyeska Pipeline pump stations, North Slope production facilities, Cook Inlet production facilities, fish processing generation, and others).
- Improved access for combined heat and power production facilities at industrial locations.
- Reduced diesel-fired generation in remote locations.
- Electricity access for resource development such as mining, tourism, fisheries, and others in remote locations.
- Regional or micro grids supplied by specialized resources (e.g. geothermal facilities).

Timing: To meet anticipated national GHG goals, transmission projects which effectively reduce GHG emissions would need to begin implementation by 2015; interties applying for AEA RE Funds are scheduled to start operation between 2010 and 2013.

Parties: (see below)

Electric transmission facilities, while primarily owned and/or operated by utility organizations, are subject to regulatory oversight by a host of state and federal agencies. As transmission facilities are notably visible and by their very nature have a wide range of ecological impacts, numerous non-governmental organizations also participate in various ways on transmission system issues. The primary participants in implementation of a statewide policy of transmission optimization and expansion are:

- The Alaska Energy Authority and Alaska Industrial Development and Export Authority: these two organizations are currently charged with distributing state funding for RE Energy and PCE-related funding.
- The electric utilities of Alaska – private, municipal, cooperative, joint action agencies and various operating organizations among utilities.
- The Denali Commission.
- The Regulatory Commission of Alaska
- The Alaska Department of Natural Resources
- The USDA Rural Utilities Service
- The US Fish and Wildlife Agency
- The Army Corp of Engineers
- Statewide commercial and industrial enterprise owners

Implementation Mechanisms

A statewide policy promoting enhancement of the state's transmission system will be implemented through regulatory polices of the state to reduce barriers to development and to establish, for example, a structural framework for providing low-cost funds for financing system expansion and technological improvements. The Denali Commission and AIDEA/AEA would be the agencies of significance in providing financial and technology support.

Legislation could create a new transmission authority, charged with (1) funding improvements in the electric transmission infrastructure and development of energy storage technologies; (2) facilitate the transmission and use of renewable energy by financing or planning, acquiring, maintaining, and operating electric transmission facilities, storage facilities and related infrastructure; and (3) facilitate and guide transmission siting process between utilities, municipalities, cooperatives and electric authorities, villages, and commercial entities. Such an entity could be funded through one or more of the mechanisms described above.

Related Policies/Programs in Place

The State of Alaska and the Denali Commission have had programs in place to enhance the transmission system. Alaska's AIDEA/AEA has developed transmission facilities, retaining ownership while delegating maintenance and operation to utility participants, and includes transmission system development as a component of expanded access to renewable resources by utilities. The federal government has supported improved transmission, as by the authorization of the various components of the Southeast Alaska Intertie system that has benefitted from periodic contributions of appropriated funds for design and construction by various electric utility organizations.

Seed monies for scoped transmission projects are currently provided by the AEA under the umbrella of the Renewable Energy Fund, while other transmission projects have obtained direct state appropriations.

Type(s) of GHG Reductions

Types: **CO_2, N_2O**

Negative impacts: Loss of CO_2 sink in forests displaced by transmission lines; fuel used in construction and maintenance of transmission lines.

Estimated GHG Reductions and Net Costs or Cost Savings#	Policy	GHG Reductions ($MMTCO_2e$)				Net Present Value 2010-2025 (Million 2008$)	Cost Effectiveness ($/t$CO_2$e)
		2015	2020	2025	Total 2010-2025		
ES&D-1a	Transmission, Rural	0.00	0.00	0.01	0.05	$44	$897
ES&D-1b	Transmission, RE Grants	0.06	0.08	0.09	1.06	-$2	-$2
ES&D-1	**Transmission Optimization and Expansion**	**0.07**	**0.08**	**0.09**	**1.11**	**$42**	**$38**

The two analyses under this policy option are designed to separately quantify the benefits from a rural transmission program and a renewable energy access program. In both cases, proxies cases are included as examples to assist in the quantification of the cost efficacy of these two GHG reduction mechanisms. "Rural Transmission" explores the costs of connecting two hundred villages with dispersed microgrids, easing load-following requirements for small-scale generators. Higher efficiency results in reduced fuel consumption and GHG emissions. "RE Access Transmission" tests the net value of implementing transmission to existing renewable energy sources. This analysis does not include the marginal GHG savings associated with reducing line-losses along established grid networks or the fuel efficiencies gained by connecting remote industries and Alyeska pump stations to the existing grid.

Data Sources, Methods, and Assumptions

The analysis of this policy is based on two sub-scenarios, which are analyzed under a separate construct. Detailed assumptions can be found in at the end of the policy descriptions. Data sources, quantification methods, and key assumptions are explained briefly below for each of the two sub-scenarios:

Transmission for Renewable Energy Access (ES&D 1a)

The transmission for renewable energy access shares a similar quantification structure with the implementation of renewable energy projects analysis in ESD 3.

Data Sources: This quantification assumes that projects submitted for seed funding from the AEA Renewable Energy Fund are implemented. Only projects which focus exclusively on transmission to renewable energy are included in this analysis. This includes five projects: (1) Metlakatla - Ketchikan Intertie, (2) North Prince of Wales Intertie, (3) Kake - Petersburg Intertie, (4) Transmission and Control Infrastructure [for wind in Nome], and (5) the Lake and Peninsula Borough wind/hydro intertie.

Program description and data for quantifying emissions reductions were obtained from the following sources:

1. Renewable Energy Fund Applications and Analysis; Alaska Energy Authority; http://www.akenergyauthority.org/RE_Fund_Applications.html
2. Distributing Alaska's Power: A Technical and Policy Review of Electric Transmission in Alaska, September 4, 2008. Prepared for the Denali Commission. http://denali.gov/
3. Alaska Electric Power Statistics (with Alaska Energy Balance): 1960-2001, November 2003. Prepared for the Alaska Energy Authority, Regulatory Commission of Alaska, and Denali Comission by the Institute of Social and Economic Research, University of Alaska, Anchorage.
4. Governor Palin press conference at Alaska Energy Authority, January 16, 2009: Palin Unveils Energy Goals for Cities, Villages; http://www.newsminer.com/news/2009/jan/16/palin-unveils-energy-goals-cities-villages/
5. Energy Information Administration, 2009. Assumptions for the Annual Energy Outlook 2009: with Projections to 2030. http://www.eia.doe.gov/oiaf/aeo/assumption/index.html
6. Alaska Energy: A First Step Towards Energy Independence, Alaska Energy Authority, http://www.akenergyauthority.org/ , January 2009.

Quantification Methods: The model is structured from standard analyses conducted by the AEA to determine which RE Fund projects could obtain seed funding. Each project lists (amongst other variables) annual expected renewable generation which would be accessed, O&M costs, avoided fossil fuel use, local expected prices for fuels, and capital costs. Capital costs are amortized across the expected lifetime of the project (also given by the AEA) starting from the first year of generation. The net present value is determined from the discounted costs (including amortized capital costs) and benefits through 2025. Avoided fuel use is translated into avoided CO_2 emissions. Total cost efficacy is calculated as the cumulative carbon avoided (to 2025) divided by the net present value.

Key Assumptions: Costs, avoided costs, timing and avoided fuel uses assumed by the AEA and partners in the RE Fund analysis (see ESD 3 quantification for details). Carbon emission coefficients are extracted from the AEA analysis.

Rural Transmission (ES&D 1b)

Data Sources: The quantification is an exercise in village-to-village connectivity, assuming a fixed number of villages in rural AK (northern, SW, and Kodiak) which are not currently connected. Village generators reduce fuel use when connected to another village.

Quantification Methods: This is a simple spreadsheet model, based on a scenario designed by the working group, and using data inputs from Alaska Power Statistics. Using 2001 statistics, 161 villages were identified which generated power only from diesel oil combustion turbines and were not connected to either a central power grid or other towns or villages. The total power generated from these villages was recorded, and their approximate location (latitude and longitude) with Google Maps. The absolute straight-line distance between each village pairing was determined (in miles). Every village pairing within a 60 mile threshold was considered a viable transmission pairing; 31 villages fit this criterion, serving 102,667 MWh of diesel-fired generation in 2003, or 1.6% of Alaska load in 2009. The average distance between nearest villages within this grouping is 30 miles.

Transmission project were assumed to begin in 2012 and end in 2020, with 3-4 villages being connected each year.

Input assumptions included a $300,000 per linear mile cost of transmission, a 15% savings in fuel consumption by connecting two villages, a 20 year economic life of transmission lines, and a 5% discount rate. The capital cost of transmission lines were amortized over the 20 year period; there was no cost assumed for operations and maintenance nor new generators (assumed to be replaced as transmission is built).

Key Assumptions: The model is highly sensitive to the distances between villages, the expected fuel efficiency savings from connecting two villages, as well as the average energy use per village. The total number of villages involved (161), as well as the average energy use per village was determined from the AK Energy Statistics (2003) dataset. Communities in this analysis were those which were listed as using internal combustion generation (assumed diesel) and were not obviously connected to larger community with other energy sources already available. The analysis is sensitive to the assumed expected fuel savings and the threshold distance for connecting villages. Because actual linear distances were calculated, and each village serves a different amount of load, the savings and costs on a village-by-village basis are quite different. This analysis did not attempt to distinguish the most cost effective set of villages (i.e. those which are both near to each other and serve significant load, where significant savings might be realized). However, we did conduct a sensitivity on the threshold distance and possible savings from connecting two villages. Table ESD 1.1 below shows the results of this sensitivity as a function of the threshold distance and fuel savings expectation.

Threshold distance (miles)	Villages in Analysis	Average distance (miles)	Load served (MWh)	Cost effectiveness ($/TCO2e) at interconnection fuel savings		
				5%	15%*	25%
20	9	11.8	9,096	$3,489	$969	$464
50*	29	28.3	74,149	$3,274	$897	$422
100	51	49.2	174,717	$4,350	$1,255	$637
200	109	104.2	319,538	$11,188	$3,535	$2,004

Table ESD 1.1: Carbon cost efficacy of village-to-village interties, depending on expected fuel savings from connecting two villages and maximum distance threshold between two villages. Costs in 2008$ per tCO_2e.

*Default value

Key Uncertainties

Transmission for Renewable Energy: If projects are the only feasible interties available; if the implementation of new medium to large-scale renewable energy projects would spur interest or need for new transmission connections to a central grid.

Rural interties analysis: Distances between villages, number of villages impacted or participating, direct connection from village to village, efficiency gains expected by connection of two or more villages, cost of transmission, expected start and end of transmission projects, feasibility of connecting multiple villages per year, and avoided costs of diesel (currently from AEA RE Grants program, Round 1, project 110 – Kong Wind).

National climate policy and both world oil and natural gas markets will influence the cost-effectiveness of future projects.

Additional Benefits and Costs

Increased transmission and access to renewable generation will produce several co-benefits for Alaska. These include:

- Lower electricity costs, and increased reliability in rural areas and villages.
- Reduced environmental damage and costs associated with cleanup of diesel fuel spills in rural villages and along watercourses;
- Reduced criteria and toxic air pollutant emissions from diesel generators.

Feasibility Issues

Transmission infrastructure is often costly and difficult to site based on property, environmental, and line operation and ownership considerations. The siting process requires the participation of large groups of stakeholders with diverse interests and conflicts. In addition, transmission lines in remote areas may be difficult to service, and in AK are prone to icing, treefall, landslides, and other disturbances.

Statewide GHG benefits will be greatest if this policy is coordinated and integrated with ESD 2,4 and 6, energy efficiency for residential, commercial and industrial customers and building codes and standards. However, avoided fuel costs and displaced carbon will be lower than calculated when combined with energy efficiency.

Fossil fuel use may be avoided in large part if distributed generation renewable energy projects (i.e. ESD 3) are implemented on a village scale. Village-to-village transmission may still be beneficial for reliability purposes, but will displace less fossil fuel if renewable resources are used instead.

Status of Group Approval

TBD – [until MAG moves to final agreement]

Level of Group Approval

TBD – [until MAG moves to final agreement]

Barriers to Consensus

TBD – [until MAG moves to final agreement]

ES&D 2/4/6: Demand-Side Energy Efficiency and Conservation

Policy Description

This policy option seeks to reduce electricity, natural gas and fuel oil consumption in the residential, commercial and industrial sectors through energy efficiency and demand-side management measures using a variety of programs and policies including state and utility efficiency programs, appliances standards, and building codes. Details of these programs and policies are provided under "Implementation Mechanisms" below. This policy option involves a variety of stakeholders including state agencies, utilities, fuel distributors, advocacy groups, energy service companies, and local governments. The potential funding sources for this policy option includes, but not limited to the state funding through legislative actions, system benefit charge, and a state-capitalized end-use efficiency endowment.

Energy efficiency reduces energy consumption required by appliances and heating and cooling equipment while maintaining or improving upon the quality of energy services. Providing strong programs for energy efficiency and conservation in Alaska is one of the most cost-effective and fastest methods to reduce energy use and greenhouse gas emissions. The Interior Issues Councils' Cost of Energy Task Force report, *Fairbanks Energy*, states:

> "Conservation and efficiency increases are by far the most effective means of reducing cost, reducing emissions and reducing fuel usage. The beauty of increasing efficiency is we can start today."

A recent report by the Cold Climate Housing Research Center[1] agrees with this view and states:

> "To be sure, supply side solutions are necessary in Alaska, but efficiency measures should be step one in any energy plan – they are the single least expensive way to decrease demand and save energy".

Indeed, energy efficiency has been acknowledged across the nation and by the Federal government as the least expensive energy solution and a growing number of states are requiring states and/or utilities to tap into cost-effective energy efficiency measures first before developing supply side solutions. Contrary to these notions, Alaska has implemented few energy efficiency programs for more than a decade. This means that Alaska has significant untapped energy efficiency resources compared to other states.

The articulation of an energy efficiency vision by the Governor, and the ensuing design and implementation of a comprehensive set of energy efficiency and conservation programs could rapidly set in motion a significant energy use reduction for all sectors in the state: commercial, industrial, institutional and residential. The state has recently (2008) invested significant funding toward residential weatherization. Similar levels of support for the other sectors and for

[1] Alaska Energy Authority and Alaska Housing Finance Corporation, 2008. *Alaska Energy Efficiency Program and Policy Recommendations*. Prepared by the Cold Climate Housing Research Center.

residential electrical efficiency are now needed to reduce energy use, and to reduce the energy costs in these homes and buildings.

Policy Design

Goals: Energy efficiency programs and policies to reduce energy consumption for electricity, natural gas and fuel oil based on two scenarios: (1) the annual incremental energy savings increases to 1% of retail energy sales by 2015 (2) the annual incremental savings further increases to 2% by 2020.

Annual Incremental Target

Scenario	2010	2015	2020	2025
1% per year	**0.20%**	**1%**	**1%**	**1%**
2% per year	**0.20%**	**1%**	**2%**	**2%**

Approximate annual cumulative target

Scenario	2010	2015	2020	2025
1% per year	**0.20%**	**3%**	**8%**	**11%**
2% per year	**0.20%**	**3%**	**11%**	**18%**

Timing: Early action to begin with increased funding in current state programs in 2009.

Parties Involved: Alaska Energy Authority, Regulatory Commission of Alaska, Electric utilities, AHFC, Tribal governments, municipal and local governments, industrial partners, AIDIA, possible third-party efficiency operators.

Other: Programs and policies including state and utility energy efficiency programs, appliance standards and building energy codes. Efficiency programs include, but not limited to public education, comprehensive whole-house energy audits, rebate incentives for installing energy efficient equipment for all sectors, commercial and institutional building energy audits and retrofits, whole village retrofits, incentives to vendors and contractors, low cost loans, vendor training.

Implementation Mechanisms

Design and fund a comprehensive set of state and utility energy efficiency programs that will encourage the installation of energy efficient equipment and encourage the conservation of energy in all sectors. These programs would include:

1. Public education
2. Comprehensive whole-building energy audits and retrofits for all sectors
3. Rebates and incentives to end-users for installing energy efficient equipment
4. Village retrofit and weatherization programs, including possibly an expanded whole village retrofit program prior to re-sizing local power plants
5. School energy efficiency program for new and existing schools

6. Incentives for vendors, retailers and contractors for selling or installing energy efficient equipment and also for optimizing the size of HVAC equipment

7. Low cost loans for energy efficiency improvements

8. Training of related professionals (such as commercial energy auditors, HVAC maintenance staff, and retail sales staff)

9. Performance incentives for program administrators (e.g., utility and/or third party)

10. Energy savings measurement and verification studies.

11. Other programs such as new construction program, whole-building program for retrofit, a refrigerator trade-in and recycling program, and pilot testing smart meter installations, R&D testing of EE equipment in Alaska's climatic conditions

In addition to the programs, certain other actions are recommended to knock-down barriers to the implementation of energy efficiency measures, including:

- Energy efficiency building codes for residential and commercial properties state-wide (to avoid the current problem we face of older buildings with very poor energy performance and high energy costs).
- Aggressive appliance standards
- Change the rate structure of energy utilities to encourage their participation in providing aggressive energy efficiency and conservation programs, or alternatively, allow the utilities to pay a certain customer charge into the state-wide energy efficiency delivery office(s), which will provide the above programs, incentives, rebates, loans, and trainings. This model is working exceptionally well in Oregon and avoids the internal conflict that utilities face regarding efficiency programs' detrimental effect on their sales revenues.
- Review the Power Cost Equalization program to determine if energy efficiency incentives can be effectively built-in to encourage, rather than discourage, energy efficiency measures for these communities.

New or increased funding is necessary for engaging in most of the programs and policies mentioned above. The potential short-term funding source is the state funding through legislative appropriation. The potential long-term funding source is utility system benefit charge (e.g., a few mills per kWh for every ratepayer) or a state-capitalized end-use efficiency endowment (when system benefit charge is politically difficult to establish).

Most of these elements of the policies and programs are outlined in the "Alaska Energy Efficiency Program and Policy Recommendations" report published by the Cold Climate Housing Research Center June 12, 2008. That report is the culmination of a significant project to determine future program and policy needs in Alaska related to energy efficiency, and serves as the roadmap and menu of needed actions.

Related Policies/Programs in Place

The Energy Independence and Security Act of 2007 has three titles particularly relevant to this policy option: Title III (Appliance and Lighting Efficiency), Title IV (Energy Savings in Building and Industry), and Title V (Energy Savings in Government and Public Institutions).

- **The Weatherization Program:** Targeted at Alaskan residents with incomes below the state median. Funding increased in 2008 from ~$6 million to $300 million. Administered by the Alaska Housing Finance Corporation.
- **The Home Energy Rebate Program:** Targeted at homeowners who do not qualify for the Weatherization Program. Provides rebates for high efficiency home upgrades exceeding AHFC standards. Administered by the Alaska Housing Finance Corporation.
- **Second Mortgage Program for Energy Conservation:** Targeted for homeowners to make cost-effective energy improvements.[2]

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

Table E-1.1 and E-1.2 below presents the estimated GHG reductions and net costs or costs savings from implementing ESD-2,4,6. Figures following the tables present the projected total energy consumption for all residential, commercial and industrial (RCI) sectors for electricity, natural gas, and fuel oil under the 1% and 2% scenarios as well as the baseline energy consumption by sector in the background.

#	Policy	GHG Reductions (MMtCO2e)				Net Present Value 2010–2025 (Million $)	Cost-Effectiveness ($/tCO2e)
		2015	2020	2025	Total 2010-2025		
ESD-246a	1% EE, Electric	0.16	0.38	0.56	4.35	-$187	-$43
ESD-246a	1% EE, Natural Gas	0.11	0.26	0.39	3.03	-$117	-$39
ESD-246a	1% EE, Oil	0.07	0.16	0.23	1.85	-$252	-$137
ESD-246a	**1% EE, Total**	**0.34**	**0.80**	**1.18**	**9.22**	**-$557**	**-$60**

Table ESD-2.1. Estimated GHG reductions and net costs of or cost savings from ESD-2,4,6 under 1% scenario. GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $\$/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

[2] Alaska Housing Finance Corporation. Home Energy Rebate, Weatherization, and Loan Programs. Updated 04/22/09. Available online at: http://www.ahfc.state.ak.us/energy/weatherization_rebates.cfm

#	Policy	GHG Reductions ($MMtCO_2e$)				Net Present Value 2010–2025 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
		2015	2020	2025	Total 2010-2025		
ESD-246b	2% EE, Electric	0.16	0.50	0.88	5.86	-$246	-$42
ESD-246b	2% EE, Natural Gas	0.11	0.35	0.61	4.09	-$155	-$38
ESD-246b	2% EE, Oil	0.07	0.21	0.35	2.45	-$327	-$134
ESD-246b	**2% EE, Total**	**0.34**	**1.07**	**1.84**	**12.41**	**-$728**	**-$59**

Table ESD-2.1. Estimated GHG reductions and net costs of or cost savings from ESD-2,4,6 under 1% scenario.

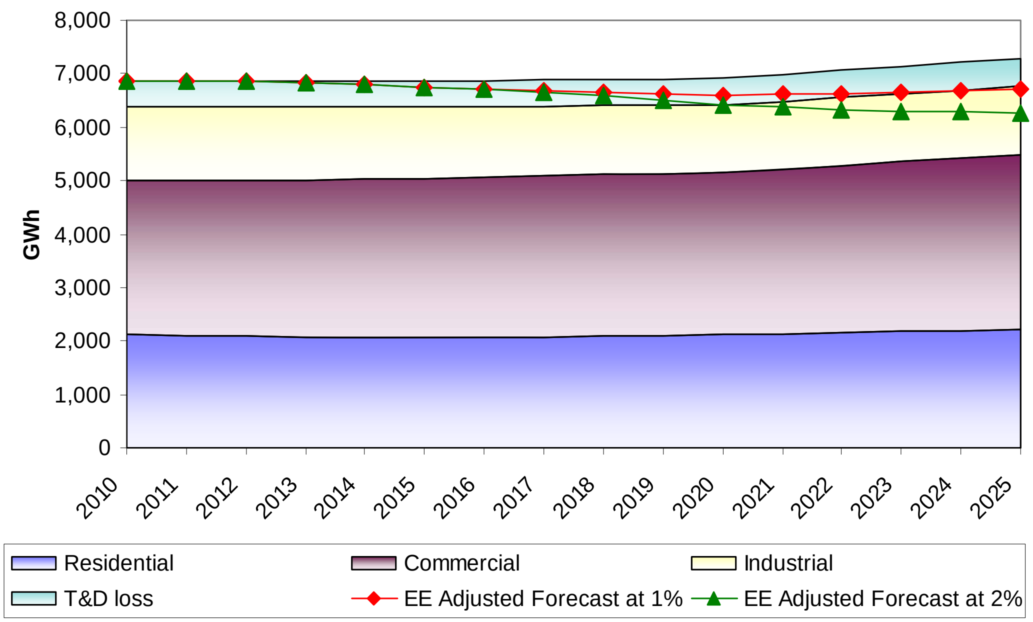


Figure E-1.1. Electricity Demand Forecast with/without Energy Efficiency Scenarios

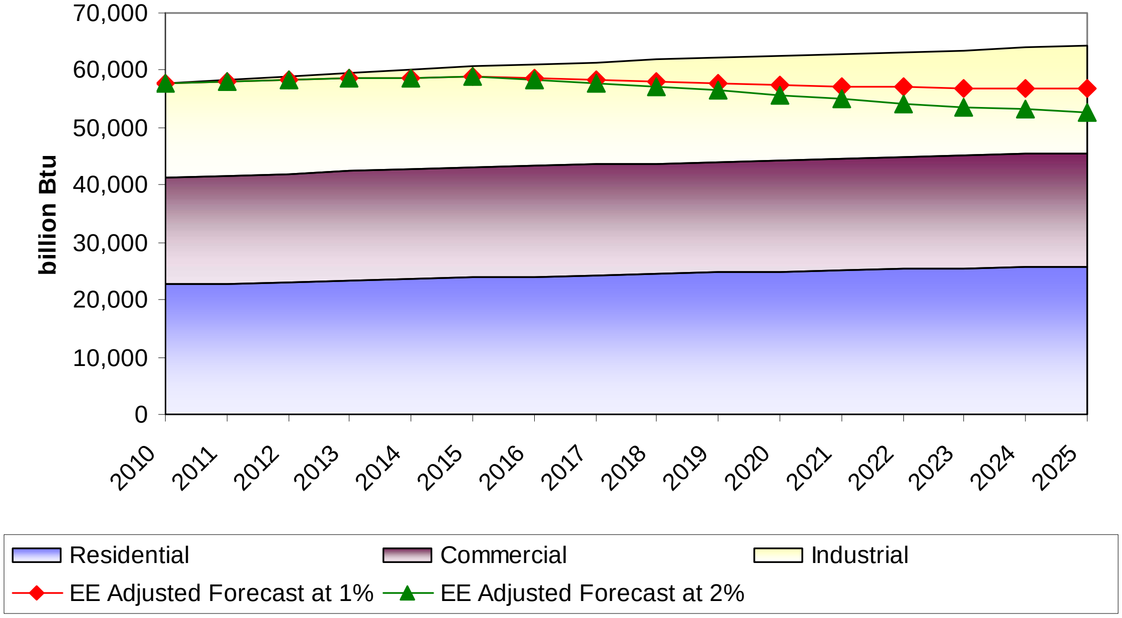


Figure E-1.2. **Natural gas demand forecast with/without energy efficiency scenarios**

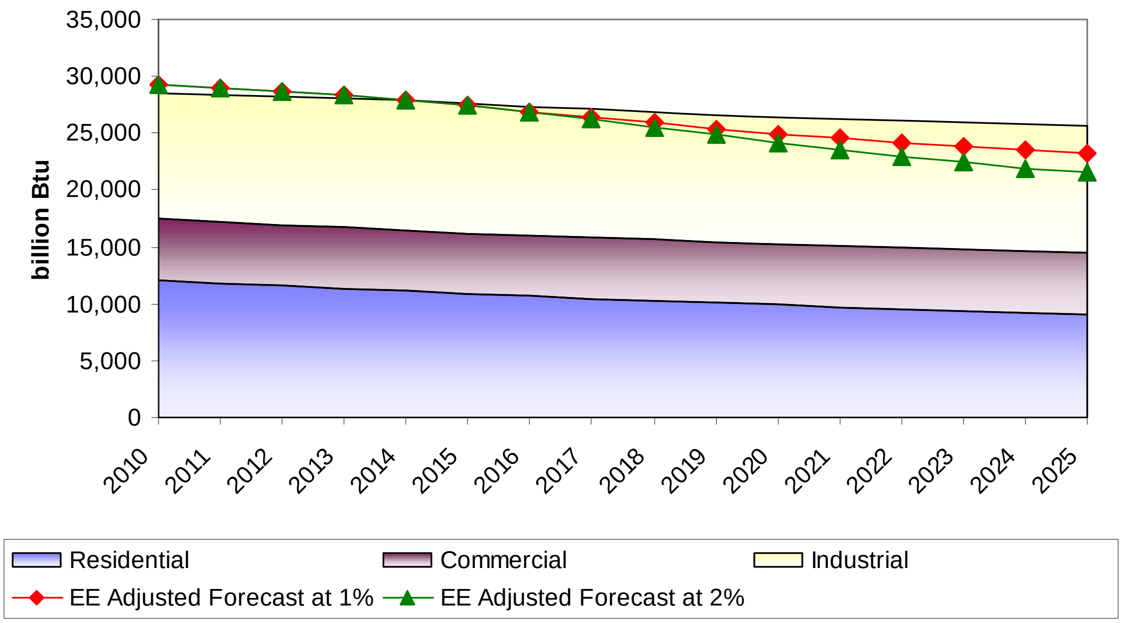


Figure E-1.3. **Fuel Oil Demand Forecast with/without Energy Efficiency Scenarios**

Data Sources:

Experience in other states on cost of energy efficiency:

- U.S. Environmental Protection Agency (EPA) and U.S. DOE. (July 2006), *National Action Plan for Energy Efficiency*, p. ES-4, Available at: http://www.epa.gov/cleanrgy/documents/napee/napee_exsum.pdf.
- Synapse Energy Economics (August 2008). Costs and Benefits of Electric Utility Energy Efficiency in Massachusetts, prepared for the Northeast Energy Efficiency Council, available at http://www.synapse-energy.com/Downloads/SynapsePresentation.2008-08.0.Sustainability-and-Costs-of-Efficiency-Impacts.S0051.pdf
- K. Takahashi and D. Nichols (2008), "The Sustainability and Costs of Increasing Efficiency Impacts: Evidence from Experience to Date," proceedings of the 2008 ACEEE Summer Study on Energy Efficiency in Buildings, ACEEE, pp. 8-363 - 8-375.
- Bill Prindle (2007), "Energy Efficiency: The First Fuel in the Race for Clean and Secure Energy," presentation at the National Action Plan for Energy Efficiency Southeast Energy Efficiency Workshop on September 28, 2007. Available at: http://www.epa.gov/cleanenergy/documents/southeast-meeting/prindle_new_napee_presentation_atlanta_9_28_07.pdf.
- Martin Kushler, Dan York, and Patti White (April 2004), *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies*, Washington, DC: American Council for an Energy Efficient Economy. Available at: http://www.aceee.org/pubs/u041.htm.
- WGA 2006—Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors' Association (January 2006), *The Potential for More Efficient Electricity Use in the Western United States*. Denver, CO: Western Governors' Association. Available at: http://www.westgov./wga/initiatives//%20Efficiency-full.pdf.

Cost of saved natural gas:

- Southwest Energy Efficiency Project 2006. Natural Gas Demand-Side Management Programs: A National Survey, available at www.swenergy.org.

Cost of Saved Fuels and Measure Lifetime:

- U.S. DOE, Office of Energy Efficiency and Renewable Energy (2007, "Industrial Assessment Centers (IAC) Database." Available at: http://www.iac.rutgers.edu/database/.
- Suzanne Tegen and Howard Geller (**January** 2006), Natural Gas Demand-Side Management Programs: A National Survey, Boulder, CO: Southwest Energy Efficiency Project. Available at: www.swenergy.org.
- U.S. Environmental Protection Agency (EPA) and U.S. DOE. (July 2006), *National Action Plan for Energy Efficiency*, p. ES-4, Available at: http://www.epa.gov/cleanrgy/documents/napee/napee_exsum.pdf.

- Martin Kushler, Dan York, and Patti White (January 2005), *Examining the Potential for Energy Efficiency To Help Address the Natural Gas Crisis in the Midwest*, Washington, DC: American Council for an Energy Efficient Economy. Available at: http://www.aceee.org/pubs/u051.htm.
- SWEEP (January 2006), Natural Gas Demand-Side Management Programs: A National Survey, Southwest Energy Efficiency Project, available at www.swenergy.org.
- Optimal Energy Inc. et al. (October 2006). Natural gas Energy Efficiency Development Potential in New York, October 31, 2006.

Quantification Methods:

Project energy savings based on the stated energy savings (electricity, natural gas, & oil) target based on two scenarios: (1) a 1% per year annual incremental reduction in total annual consumption by 2015; (2) further increasing to 2% per year by 2020. Adjust annual consumption each year based on the previous year's DSM impacts.

All sectors included in analysis, including residential, commercial, and industrial.

Estimate the total cost of energy savings using state-specific or region-specific data on cost of saved energy from energy efficiency measures.

Estimate the GHG emission reductions through the energy efficiency measures.

Key Assumptions:

Discount Rate: 5% real.

Avoided Cost of Electricity: 9.5 cents/kWh as the population-weighted avg. cost of avoided electricity in different regions:

- Railbelt: 6 cents/kWh based mainly on the cost of natural gas power plants
- Southeast: zero due to hydro dominant energy sources in the region
- Rural: 22 cents/kWh based on oil-based electricity and $96/barrel of oil (2008$/barrel), as the levelized price of oil price for lower 48 oil price over the study perio. The oil data is obtained from the U.S. EIA's *Annual Energy Outlook 2009*(AEO 2009).
- The conversion rate between oil and electricity is based on the range of electricity price from 12 to 30 cents/kWh for $50 to $147/barrel of oil, obtained from the TWG members.

Avoided Cost of Natural Gas: $5.28 $/mmBtu (2008$), the levelized cost of projected natural gas prices. The natural gas avoided cost was projected using (1) the average Alaska city gate price of natural gas in 2008 and (2) the trend in projected natural gas prices in the Annual Energy Outlook 2009 (AEO2009) for the Pacific region.

Avoided Cost of Fuel Oil: $20.11 $/mmbtu (2008$) (placeholder assumption), levelized price of distillate fuel oil for the Pacific region AEO2009 between 2009 and 2025)

T&D Loss: 7% for electricity, 0% for natural gas, 0% for fuel oil

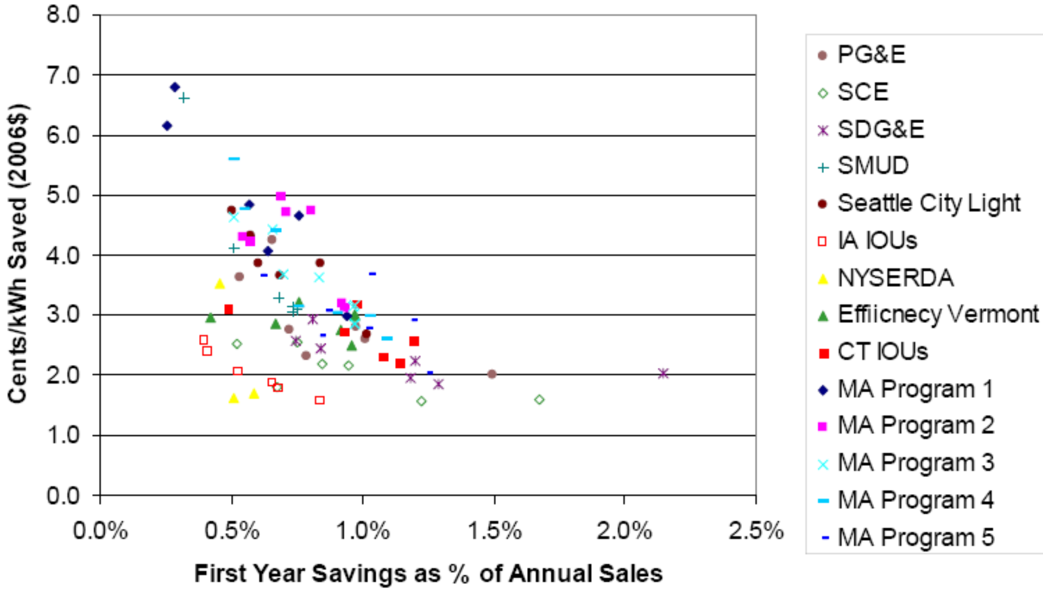
Cost of Electric Energy Efficiency Measures: 5 cents / kWh for electricity – inflated from "typical" price of EE in lower 48. The utility cost of saved energy (CSE) for electric energy efficiency programs (that does not include participants' costs of efficiency measures) range from 1 to 5 cents/kWh saved with the average about 2.4 cents/kWh saved based on experience in other states (CSE). These data are presented in the table and figure below. Assuming the cost split between utilities and participants is about 60%/40%, the total cost of energy efficiency programs would be about 4 cents/kWh on average. This estimate was then inflated by 25% to take into account higher costs of products and services in Alaska.

Table E-1.3. Utility cost of saved energy compiled by U.S. DOE and EPA

Entity	State	CSE (cents/kWh)
Austin Energy (TX)	TX	3
Bonneville Power Administration (ID, MT, OR, WA)	Multiple	3
CA Utilities (CA)	CA	1
CT Utilities (CT)	CT	1
Efficiency Vermont (VT)	VT	2
MA Utilities (MA)	MA	3
MN Electric and Gas Investor-Owned Utilities (MN)	MN	1
Nevada (NV)	NV	3
NYSERDA (NY)	NY	2
Seattle City Light (WA)	WA	2
SMUD (CA)	CA	3
WI Department of Administration (WI)	WI	5
Average		2.4

Source: U.S. DOE, Office of Energy Efficiency and Renewable Energy (2007, "Industrial Assessment Centers (IAC) Database

Figure E-1.4. Utility cost of saved energy for multiple utilities over multiple years



Source: Synapse Energy Economics (August 2008). Costs and Benefits of Electric Utility Energy Efficiency in Massachusetts, prepared for the Northeast Energy Efficiency Council
Note: this study concluded that the utility cost of energy efficiency programs tend to decrease as the scale of energy efficiency increases.

Cost of Saved Natural Gas: $ $2.99 per MMBtu for natural gas– inflated from average cost of saved NG (SWEEP '06). Natural gas savings per dollar of program investment is 72,700 million cubic feet per year per million dollars, based on the average cost of a number of gas DSM programs reported in Tegen and Geller (2006). The RCI TWG will estimate the cost of saved natural gas per million Btu (MMBtu) based on (1) the natural gas savings per program investment above, (2) a 12-year average measure lifetime, and (3) a real discount rate of 5%.

Costs of Saved Fuel Oil and Propane: For residential and commercial uses, these costs are assumed to be the same as the cost of saved natural gas in terms of $/MMBtu. For the industrial sector, data available at DOE's IAC database might be useful.[3]

Utility cost of saved energy: the utility cost of saved energy (including incentives, marketing and admin) is assumed to be 60% of the total cost of energy efficiency. This cost does not include costs paid by participants. Utility costs of saved energy were obtained and adjusted upward to estimate the total costs using the 60/40 cost split.

Energy efficiency measure lifetime: 12 years on average.

Displaced emissions for electricity: 0.655 MTCO2 per MWh as the population-weighted avg. emissions in different regions:

- Railbelt: 0.7468 MTCO2 per MWh. A typical emission rate for natural gas power plants. Input from the TWG members. The data is obtained from U.S. EPA's Egrid database.

[3] U.S. DOE, Office of Energy Efficiency and Renewable Energy (2007, "Industrial Assessment Centers (IAC) Database." Available at: http://www.iac.rutgers.edu/database/.

- Southeast: zero due to hydro dominant energy sources in the region. Input from the TWG members.
- Rural: 0.5754 MTCO2 per MWh. A typical emission rate for oil power plants. Input from the TWG members. The data is obtained from U.S. EPA's Egrid database.

Displaced emissions for natural gas: 0.0528 MTCO2 per million Btu

Displaced emissions for natural gas: 0.0724 MTCO2 per million Btu based on the emission rate of distillate fuel

Key Uncertainties

The source of funding to implement the aggressive DSM program envisioned here is uncertain.

There are few data on the cost of saved fuel oil. For this analysis, it was assumed that the costs of saved fuel oil equal the $ per MMBtu saved for natural gas. To the extent that oil appliances are similar to natural gas appliances, the costs will be similar among fuel-saving measures per MMbtu saved. While there are similar applications among all fuels (e.g., water heating, cooking), the similarities between specific appliances running on different fuels are less clear. On the other hand, given that there has not been any significant effort to promote oil-efficient appliances in the US, there may be more “low-hanging fruit” in energy efficiency measures for oil which are not realized in this quantification.

Additional Benefits and Costs

Indoor comfort and air quality improvements, with related improvements in health and productivity.

Savings to consumers and business on energy bills. Benefits to the low income by reducing utility costs.

Electricity system benefits: reduced peak demand, reduced capital and operating costs, improved utilization and performance of electricity system.

Reduced risk of power shortages.

Reduced pollutants from emissions, improved health from fewer pollutants and particulates and reduced water use for cooling.

Green-collar employment expansion and economic development.

Reduced dependence on imported fuel sources.

Reduced energy price increases and volatility.

Feasibility Issues

None known

Status of Group Approval

TBD – [until MAG moves to final agreement]

Level of Group Support

TBD – [until MAG moves to final agreement]

Barriers to Consensus

TBD – [until MAG moves to final agreement]

ESD-3. Implementation of Renewable Energy

Policy Description

This policy option focuses on encouraging renewable energy development through implementation of legislation passed by the Alaska legislature in 2008, and the recent Alaska Energy Authority report on energy independence. The goals of this policy are:

- Fifty percent of all electricity in Alaska is generated from renewable sources by 2025.
- Maximum cost-effective implementation of renewable energy systems for direct heating, where "cost-effective" includes a monetized value of avoided GHG emissions as determined by prevailing national or state policy.

Renewable energy systems can directly offset fossil fuel use. This is especially true in Alaska's rural villages, which rely on expensive diesel fuel for electricity generation. Renewable energy systems include wind, biomass, hydro, geothermal, solar photovoltaic, solar thermal, and other systems relying on energy flows driven directly or indirectly by solar radiation or geothermal heat. The purpose of this policy is to secure a reduction in the use of fossil fuels by establishing an economic and regulatory environment that will allow and encourage utilities and individuals to install capital-intensive renewable energy systems. Electricity generation is likely to be a promising sector for early actions.

Policy Design

To achieve the two policy goals, the State of Alaska will:

- Aggressively publicize, pursue, and monitor progress toward the target of 50% of electricity generation from renewable sources by 2025;
- Set benchmark targets for renewable energy use until 2025;
- Follow through with the existing Renewable Energy Fund process and consider additional funding to support more projects;
- Shift priorities in the Power Cost Equalization (PCE) endowment to reward utility, co-op, and village investment in renewable systems; transfer funds from reimbursements to infrastructure.
- Remove or reduce existing legal barriers to renewable energy systems, such as land use laws, land leasing requirements, or school funding formulas that might reduce reimbursements if a school or community invests in a wind turbine to reduce utility bills.
- Change the utility regulatory system – by statute if necessary – to provide for reasonable and predictable returns on utility investments in cost-effective renewable systems;
- Change the utility regulatory system – by statute if necessary – to provide for reasonable and predictable treatment of small-scale renewable systems installed by individuals and connected to the electric grid;

- Provide access to capital for cost-effective renewable energy investments through a combination of grants, rebates, loans, loan guarantees, tax incentives, and other means.

Timing

This policy is already underway through the Governor's goal statement and the Renewable Energy Fund. Implementation will need to continue through 2025, with an aggressive push toward statutory and regulatory changes during the next two years.

Parties Involved

The entire apparatus of state government must be engaged to ensure that renewable systems are promoted and not stifled. For round 1 and 2 renewable fund projects, HB 152 designated the Alaska Energy Authority as the lead agency. The renewable energy fund is to be administered by the Department of Revenue. HB 152 also states that the Alaska Energy Authority is to coordinate project review with the Department of Natural Resources. Other agencies and organizations that are anticipated to be involved in policy implementation are:

- Governor
- Legislature
- OMB
- Regulatory Commission of Alaska
- Renewable Energy Alaska Project
- Electric utilities
- Tribal governments
- Municipal and local governments

Implementation Mechanisms

The Alaska Energy Authority has been designated the lead agency to implement renewable energy projects. AEA has completed their review of projects submitted under rounds 1 and 2. AEA is also the lead agency designated to design, develop and implement the *Alaska Energy: A First Step Towards Energy Independence* report. Additional policy, regulations and statutory requirements may be required in order to fully achieve the report's goals and objectives.

AEA is also involved in energy efficiency programs. Coordination between ESD 2,4 and 6 and ESD 3 will help to increase the level of GHG savings and their cost-effectiveness.

Overall, the scope for GHG reductions is:

ES&D 3a&3b: All projects submitted, reviewed and approved by the Alaska Energy Authority, as part of the implementation of Renewable Energy Grant Program Rounds 1 and 2 of HB 152.

ES&D 3c: Hydroelectric projects that include each of the identified Susitna locations (Watana, Low Watana, Watana/ Devil Canyon, Staged Watana/Devil Canyon and Devil Canyon)

Related Policies/Programs in Place

Major programs in place that should be continued are:

- Renewable Energy Fund (per HB 152)
- Railbelt Grid coordination efforts

Type(s) of GHG Reductions

Types: CO_2

Negative: Increased use of concrete for hydroelectric dams; loss of carbon-sink forests from reservoirs and transmission lines; transportation for servicing remote wind turbine sites and hydroelectric dams

Estimated GHG Reductions and Net Costs or Cost Savings

#	Policy	GHG Reductions ($MMTCO_2e$)				Net Present Value 2010-2025 (Million 2008$)	Cost Effectiveness ($/t$CO_2$e)
		2015	2020	2025	Total 2010-2025		
ES&D-3a	Renewable Energy Grants, Round 1	0.58	0.71	0.84	9.33	-$414	-$44
ES&D-3b	Renewable Energy Grants, Round 2	1.41	1.64	1.64	18.80	-$485	-$26
ES&D-3c	Large Hydroelectric	0.00	0.00	1.38	4.39	$1,196	$273
ES&D-3	**Implementation of Renewable Energy**	**1.99**	**2.35**	**3.86**	**32.52**	**$297**	**$9**

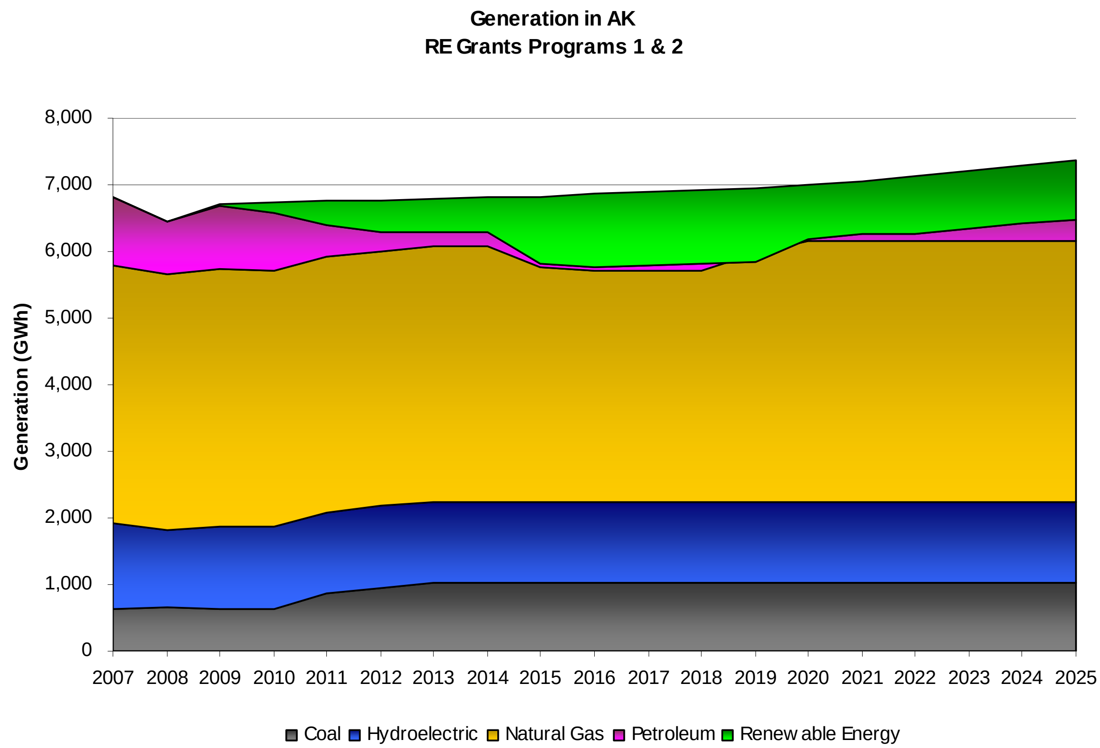


Figure ES&D 3.1: Fuel mix through 2025 with full implementation of AEA Renewable Energy Grant programs (limited to those selected for seed grant funding)

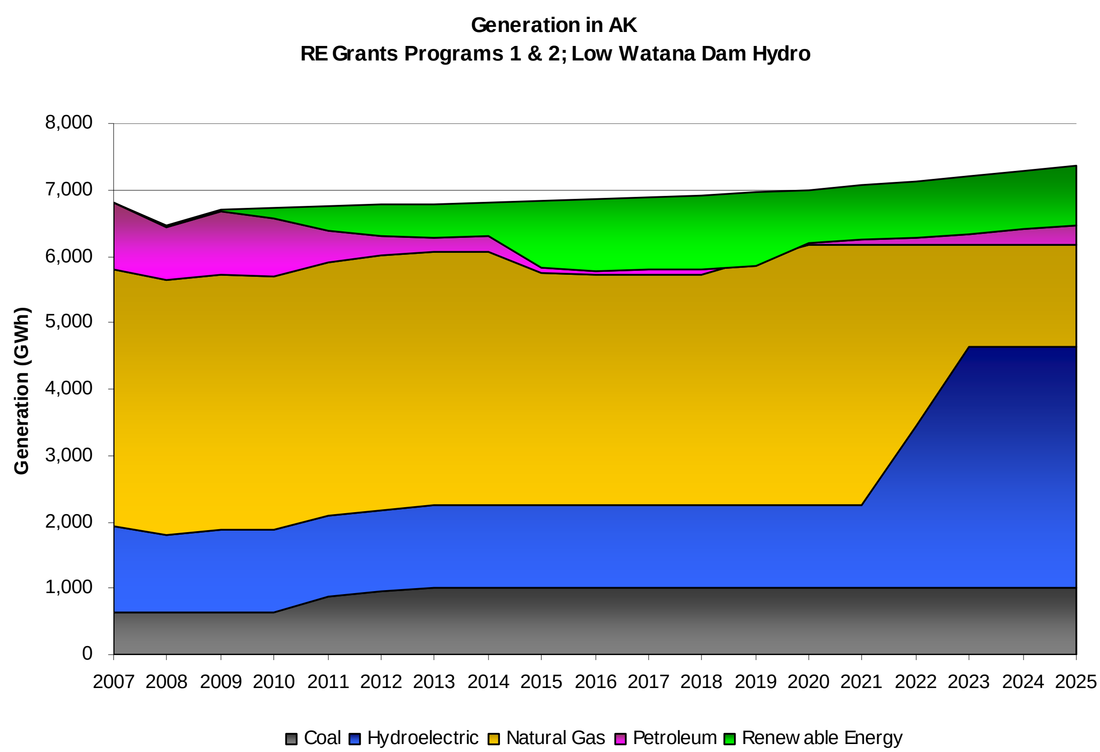


Figure ES&D 3.2: Fuel mix through 2025 with full implementation of AEA Renewable Energy Grant programs and large hydroelectric project (Low Watana dam equivalent)

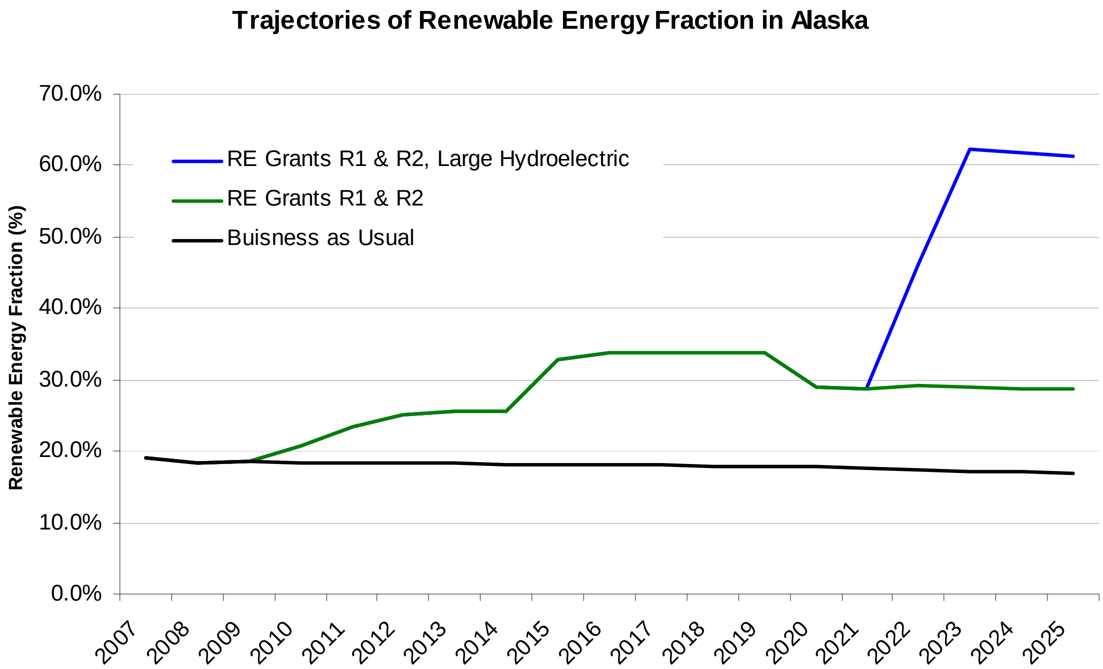


Figure ES&D 3.3: Trajectories of renewable energy fraction in Alaska: business as usual (no additional renewable energy or hydroelectric projects implemented); implementation of selected AEA renewable energy programs; implementation of large hydroelectric project (Low Watana dam equivalent)

Data Sources

Program description and estimates of emissions reductions were obtained from the following sources:

- *Alaska Energy: A First Step Towards Energy Independence*, Alaska Energy Authority, http://www.akenergyauthority.org/ , January 2009.
- Susitna Hydroelectric Project: Project Evaluation (Interim Memorandum, Final), March 16, 2009. Alaska Energy Authority; www.aidea.org/aea/SusitnaFiles/Susitna_Hydroelectric_Project_Project_Evaluation_wo_appendices.pdf
- Renewable Energy Fund Applications and Analysis; Alaska Energy Authority; http://www.akenergyauthority.org/RE_Fund_Applications.html
- Governor Palin press conference at Alaska Energy Authority, January 16, 2009: *Palin Unveils Energy Goals for Cities, Villages*; http://www.newsminer.com/news/2009/jan/16/palin-unveils-energy-goals-cities-villages/
- Energy Information Administration, 2009. *Assumptions for the Annual Energy Outlook 2009: with Projections to 2030.* http://www.eia.doe.gov/oiaf/aeo/assumption/index.html
- House Bill 152, Approved February 17, 2009, 25th Legislature; www.legis.state.ak.us

Quantification Methods: The model is structured from standard analyses conducted by the AEA to determine which RE Fund projects could obtain seed funding. Each of the Round 1 and 2 projects approved by the Alaska Energy Authority were analyzed using AEA assumptions. Projects accepted for seed funding (partial or complete) were included. Rejected projects excluded from analysis.

- Each project lists (amongst other variables) annual expected renewable generation which would be accessed, O&M costs, avoided fossil fuel use, local expected prices for fuels, and capital costs. Capital costs were amortized across the expected lifetime of the project (also given by the AEA) starting from the first year of generation. The net present value is determined from the discounted costs (including amortized capital costs) and benefits through 2025.
- Avoided CO_2 emissions are calculated from avoided use of natural gas and diesel.
- Total cost efficacy is calculated as the cumulative carbon avoided (to 2025) divided by the net present value.
- The quantity of energy and capacity provided by each approved Round 1 and 2 projects was calculated, and then aggregated. The quantity was compared to that of the Alaska goal of 50% renewable generation by 2025 against a business-as-usual load growth scenario.
- Hydroelectric energy was added to meet the Alaska renewable energy goal of 50% by 2025, using Susitna Low Watana Dam option as a proxy project. Grid-connected hydroelectric energy was assumed to displace natural gas.

Key Assumptions

- Diesel is the main fuel being displaced by the Round 1 and 2 projects; each project lists the expected displaced fuel and rate accordingly. Only current or projected electric demand is displaced (not conversions from fossil heat to electric-heat).
- The rate of new renewable energy generation was assumed to continue until the 50% renewable energy goal was attained in 2025.
- Different prices were used for the avoided costs of electricity and fuel at each RE project site, according to AEA estimations and projections. The price of avoided electricity on the grid was determined from AEA analyses, using proxy prices for the railbelt, south of the Alaska Range.
- It is assumed that the renewable energy projects proposed in Rounds 1 and 2 are the only renewable energy projects which will be implemented over the study period. Additional requirements for renewable energy to meet a 50% RE target by 2025 are assumed to be met by new, large-scale hydroelectric generation.
- It is assumed that proposed and accepted RE projects do not overlap; i.e. they do not propose to displace the same fossil fuel sources.

Key Uncertainties

There are several uncertainties regarding this analysis and the ability of Alaska to achieve its goal of 50% renewable generation by 2025:

- National climate policy and world oil and natural gas markets will influence the cost-effectiveness of future projects;
- According to this analysis, Alaska can meet the 50% renewable energy goal by building a large, grid-connected hydroelectric facility. However, the cost of this project for both equivalent carbon reductions and on a cost-of-energy basis appears to be more expensive than the distributed projects proposed for AEA Renewable Energy grants. The smaller projects are chosen (partially) on the basis of cost effectiveness, while the large hydroelectric project is not.
- Continued funding and/or development of funding mechanisms are necessary to ensure that the 50% renewable goal is reached by 2025;
- Eligibility of Alaska for revenue from the proceeds of federal carbon allowance auctions and the application of these funds to renewable energy projects

Additional Benefits and Costs

Increased renewable generation will produce several co-benefits for Alaska. These include:

- Lower electricity costs, and increased reliability, especially in rural areas and villages;
- Reduced environmental damage and costs associated with cleanup of diesel fuel spills in rural villages and along watercourses;
- Reduced criteria and toxic air pollutant emissions from diesel generators.

Increased renewable generation will require additional infrastructure in Alaska. In many cases, these are small-scale projects with relatively contained footprints (such as wind, local timber for wood-fired co-generation, and small hydroelectric facilities), but in some cases may have significant environmental impacts, such as:

- Flooding of forests and wildlands for large hydroelectric reservoirs and associated downstream impacts
- New transmission infrastructure and cleared corridors through protected lands.

Feasibility Issues

Statewide GHG benefits will be greatest if this policy is coordinated and integrated with ESD 2,4 and 6, energy efficiency for residential, commercial and industrial customers and building codes and standards.

Status of Group Approval

TBD – [until MAG moves to final agreement]

Level of Group Approval

TBD – [until MAG moves to final agreement]

Barriers to Consensus

TBD – [until MAG moves to final agreement]