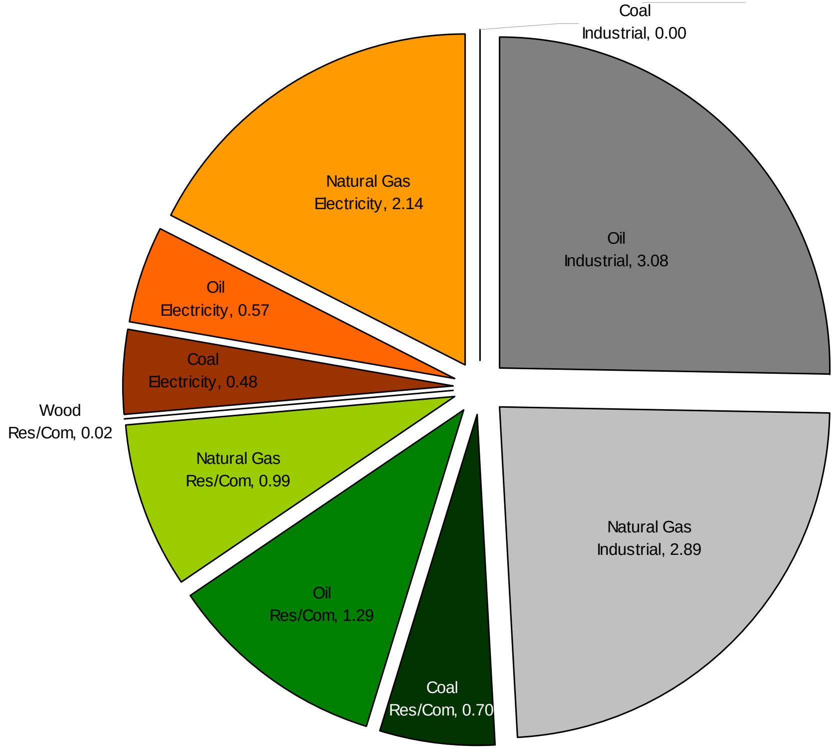
Chapter 4
Energy Supply and Demand

Overview of GHG Emissions

Energy supply and demand (ESD) covers policies that can reduce greenhouse gas (GHG) emissions from electricity production, and residential, commercial, and industrial (RCI) processes, not fuels used exclusively for the oil and gas industry. In Alaska, ESD use resulted in an estimated 12.2 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) emissions in 2005 (see Figure 4-1), or just under one-quarter of all of Alaska's human-caused GHG emissions.

Figure 4-1. Estimated 2005 emissions by sector and fuel in energy supply and demand ($MMtCO_2e$)



$MMtCO_2e$ = million metric tons of carbon dioxide equivalent; Res./Com. = residential and commercial

Electricity use, defined as fuel used for the purposes of explicitly generating electricity for both grid and distributed generation, accounts for just over one-quarter of ESD emissions (over two-thirds of this is due to natural gas burned in Railbelt generators). Industrial oil and gas use—here defined as fuels consumed on site for heat or power by industries in Alaska (such as fisheries, manufacturing, mills, and mining, but not oil and gas extractive facilities[1])—accounts for nearly

[1] Oil and gas extractive processes and facilities emitted approximately 20 $MMtCO_2e$ in 2005. The policies which address these emissions can be found in Appendix I—Oil and Gas Recommended Policy Options

half of ESD emissions. Finally, residential and commercial uses account for the last quarter of ESD emissions.

Electricity sales are projected to increase at a rate of 0.8% annually during 2005–2025. Residential on-site fossil fuel use is estimated to fall by 0.2% per year; while industrial and commercial use is forecasted to fall in 2009–2010, but then begin rising after 2010 at a rate of about 0.7% per year.

Key Challenges and Opportunities

This chapter focuses on ESD policies that can help reduce Alaska's GHG emissions. Alaska presents challenges in finding policy solutions that will address energy-based emissions broadly. The size of the state, the lack of a state-wide electrical grid, and unique regional challenges and opportunities may require policies with disparate results across the state. In Alaska, ESD policies were considered side by side to balance considerations of both centrally located and highly distributed power producers, as well as urban and rural needs and requirements.

Alaska's electrical topography may be categorized as follows:

- The Railbelt, which serves the majority of Alaska's population, includes the Anchorage and Fairbanks metropolitan areas, and features a reliable electricity grid that connects these areas (76% of energy served);
- Southeast Alaska, with several larger towns and cities such as Juneau, Ketchikan, and Sitka, has a series of discontinuous local grids serving a mix of hydroelectric and diesel-based power (13%); and
- Rural villages and towns, some of which, like Nome and Kotzebue, are home to several thousand residents, but are more often small villages that rely on diesel-fired generation to provide electricity, and that are often not interconnected by an electricity grid (11% of energy served).

The cost of providing electricity varies widely throughout the state. From hydroelectric-supplied cities in the Southeast to diesel fuel generators in the central Yukon, electricity prices can vary by several hundred percent.[2] The Power Cost Equalization (PCE) Program, administered by the Alaska Energy Authority (AEA), helps reduce this discrepancy for high-cost rural areas.[3] However, policies to reduce GHG emissions will not only impact average costs, they will also certainly have widely varying regional impacts in both costs and benefits.

The principal supply policies to meet Alaska's needs of improved electricity reliability and lower GHG emissions include improving transmission and distribution systems, installing new renewable generation, creating more efficient fossil-fired generators, and exploring new technologies, such as small-scale nuclear power. Already, Alaska is working quickly toward improving renewable energy availability; House Bill (HB) 152 (2008) authorized and provided

[2] See Alaska Energy Authority (2003), Alaska Electric Power Statistics, 1960–2001. Pro-forma electricity prices in Juneau ($0.10/KWh) and Tanana ($0.60/KWh).

[3] PCE Program. AS 42.45.100-170. Guide and link to statute available at: http://www.aidea.org/aea/programspce.html

funding for AEA to increase renewable energy generation through seed funds.[4] In 2009, Governor Palin called for 50% of Alaska's energy to be supplied by renewable sources by 2025.[5]

The principal demand-side policies include RCI sector energy efficiency. The state has pursued specific energy efficiency programs in the past, often toward reducing energy bills for low-income residents. Senate Bill (SB) 214 (2006) dramatically increased funding toward a low-income housing Weatherization Program and a Home Energy Rebate Program for housing improvements.[6] However, the state does not yet have institutional experience in comprehensive utility, private, or state-run efficiency programs, or state-mandated efficiency standards for buildings, appliances, or industrial processes.

Overview of Policy Recommendations and Estimated Impacts

The ESD Technical Work Group (TWG) recommends a set of three comprehensive policies for the ESD sector that offer the potential for significant GHG emission reductions in the state. The GHG emission reductions and costs were quantified for eight of these policies, which could lead to emission savings from reference case projections of:

- Nearly 4.7 $MMtCO_2e$ per year by 2025, and
- Cumulative savings of approximately 37.5 $MMtCO_2e$ from 2010 through 2025.

The three quantified policies could result in net cost savings of over $19 million for 2010–2025 on a net present value (NPV) basis.[7] The weighted-average cost of these policies is a net savings of $4.2 per $MMtCO_2e$.

The Alaska Climate Change Mitigation Advisory Group (MAG) approved all of the ESD policy recommendations by unanimous consent. These recommendations and results are summarized in Table 4-1 and laid out in detail in Appendix G.

[4] HB 152, 25th Leg. (May 22, 2008). Statutes available online at: *http://www.legis.state.ak.us*

[5] State of Alaska, "Governor Palin Releases Energy Guide," news release, January 16, 2009. Available online at: *http://gov.state.ak.us/archive.php?id=1783&type=1*

[6] SB 214, 24th Leg. (March, 24, 2006). Statutes available online at: *http://www.legis.state.ak.us*

[7] The net cost savings, based on fuel expenditures, operations, maintenance, and administrative costs, and amortized, incremental equipment costs, are shown in constant 2008 dollars. All NPV analyses here use a 5% real discount rate.

Table 4-1. Summary list of Energy Supply and Demand policy recommendations

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)				Net Present Value 2010–2025 (Million $)	Cost-Effective-ness ($/t$CO_2e$)	Level of Support
		2015	2020	2025	Total 2010-2025			
ESD-1a	Rural Village-to-Village Transmission	*0.00*	*0.00*	*0.01*	*0.05*	*$44*	*$897*	Unanimous
ESD-1b	Renewable Energy Grants for Transmission Upgrades	*0.06*	*0.08*	*0.09*	*1.06*	*–$2*	*–$2*	Unanimous
ESD-1	Transmission Optimization and Expansion (Total a & b)	0.07	0.08	0.09	1.11	$42	$38	Unanimous
ESD-2	Energy Efficiency for Residential and Commercial Customers	*Quantified with ESD-2/4/6*						*See below*
ESD-2/4/6	Energy Efficiency for Residential, Commercial, and Industrial Customers, 2% per year	0.34	1.07	1.84	12.41	–$728	–$59	Unanimous
ESD-3	Implementation of Renewable Energy	1.99	2.35	3.86	32.52	$297	$9	Unanimous
ESD-4	Building Standards/Incentives	*Quantified with ESD-2/4/6*						*See above*
ESD-5	Efficiency Improvements for Generators	*Moved to Research Needs Work Group*						
ESD-6	Energy Efficiency for Industrial Installations	*Quantified with ESD-2/4/6*						*See above*
ESD-7	Implementation of Small-Scale Nuclear Power	*Moved to Research Needs Work Group*						
ESD-8	Research and Development for Cold-Climate Renewable Technologies	*Moved to Research Needs Work Group*						
ESD-9	Implementation of Advanced Supply-Side Technologies	*Moved to Research Needs Work Group*						
	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**	

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/t$CO_2e$ = dollars per metric ton of carbon dioxide equivalent. Note: Sector Total is indicative of potential savings, see note in chapter.

Energy Supply Sector Policy Descriptions

ESD-1. Transmission Optimization and Expansion

ESD-1 will offset sources of GHGs by linking load centers with existing and new renewable energy, and improving the efficiency of rural generators by increasing capacity-sharing capabilities. 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. Implementation of this policy will also decrease the state's reliance on inefficient diesel generators. ESD-1 is intended to target transmission projects with established scopes and budgets submitted and accepted for seed funding by AEA's Renewable Energy Fund, as well as broadly defined transmission systems between remote rural areas. The benefits and costs/cost savings from this policy are sensitive to the distances between villages that would be connected. Table G-1.2 in Appendix G illustrates this sensitivity.

This policy was unanimously approved by the MAG.

ESD-2/4/6. Energy Efficiency for Residential, Commercial, and Industrial Customers, 2% per year

ESD-2/4/6 is a consolidation of three original policy options:

- ESD-2. Energy Efficiency for Residential and Commercial Customers.
- ESD-4. Building Standards/Incentives.
- ESD-6. Energy Efficiency for Industrial Installations.

These policies were designed to reduce electricity, natural gas, and fuel oil consumption in the RCI 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. Because of wide-ranging and cross-sector overlaps, these policies were bundled into a single analysis. The combined policy includes strategies building on the recommendations included in the July 2008 *Alaska Energy Efficiency Program and Policy Recommendations* report completed by the Cold Climate Housing Research Center.[8] This policy was originally analyzed using two scenarios: an assumption that energy efficiency could reduce use from baseline growth by (a) 1% per year, or (b) 2% per year. The cost of saved energy for both of these assumptions is the same: a 2% energy efficiency program (already common in leading states) achieves more reductions, but requires significant management, state commitment, and creative approaches to reduce energy consumption.

[8] Cold Climate Housing Research Center (2008), *Alaska Energy Efficiency Program and Policy Recommendations*. Prepared for the Alaska Energy Authority and Alaska Housing Finance Corporation. Available at: http://www.cchrc.org/alaska+energy+efficiency+program+and+policy+recommendations.aspx.

This policy was unanimously approved by the MAG, using scenario (b), 2% energy efficiency per year.

ESD-3. Implementation of Renewable Energy

ESD-3 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.[9] The goals of this policy are to generate 50% of all electricity from renewable sources by 2025, and 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. This policy includes the benefits and costs/cost savings associated with projects included in rounds one and two of AEA's renewable energy portfolio. To reach the 50% goal by 2025, additional renewable resources are assumed to be provided by large-scale hydroelectric projects that are currently under discussion.

This policy was unanimously approved by the MAG.

ESD-5. Efficiency Improvements for Generators,

ESD-5 was conceived for to increase the efficiency of electricity generators. Originally developed to estimate the efficacy of tuning, improving, or replacing current generating units, it was envisioned that these marginal improvements could save 3%–30% of fuel in any given unit simply by upgrading to more efficient equipment. However, it was decided that these improvements would, in the absence of direct state subsidies to support capital improvements, fall under the purview of actions taken and funded by utilities.[10] Instead, the policy was re-formed as a research and development (R&D) encouragement policy to create highly-efficiency next-generation generators.

The MAG unanimously opted to move the R&D policy to the Research Needs Work Group, and unanimously supported a non-quantified policy to encourage utility operators to invest in currently available efficient generators.

ESD-7. Implementation of Small-Scale Nuclear Power

ESD-7 seeks to develop technologies for small-scale nuclear generation in outlying rural areas. A series of low-maintenance, low-running-cost nuclear generators could reduce the need to import fuel to small villages and towns and reduce emissions from diesel engines. There are currently no small-scale nuclear units available on the market (or that have passed federal

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[9] Alaska Energy Authority (January 2009), *Alaska Energy: A First Step Toward Energy Independence*. Available at: http://www.akenergyauthority.org/

[10] Utility operators expressed that any generator improvements are intrinsically a utility cost-based decision. Capital costs for improvements and savings from reduced fuel use are passed through to utility ratepayers. Ultimately, if efficiency upgrades resulted in a net benefit for consumers, utilities would undergo these improvements regardless of GHG implications.

regulatory hurdles), and thus this policy could not be quantified for costs or potential benefits. The significant research agenda required to implement this policy rendered it appropriate as a research need.

The MAG unanimously opted to move the R&D policy to the Research Needs Work Group.

ESD-8. Research and Development for Cold-Climate Renewable Technologies

ESD-8 recognizes that Alaska's unique climatic conditions render some technologies difficult or impossible to deploy. The policy seeks to create one or more centers of expertise on cold-climate-compatible renewable energy in Alaska.

The MAG unanimously opted to move the R&D policy to the Research Needs Work Group.

ESD-9. Implementation of Advanced Supply-Side Technologies

ESD-9 would examine Alaska's capacity for significant improvements in generation technology, and look to develop and implement new or emerging forms of energy supply. Research in this area would focus on biomass gasification, coal-to-liquids conversion, carbon capture and storage, and enhanced geothermal systems, among others.

The MAG unanimously opted to move the R&D policy option to the Research Needs Work Group Policy Overlap and Currently Enacted Policies

There is potential for overlap in the expected emission reductions and costs between ESD-3 and ESD-2/4/6. Overlap reduces required energy production and baseline because of energy efficiency and standards. It is assumed that many of the renewable energy projects will still move forward, but will displace less energy and subsequently, fewer GHGs. Because energy efficiency mechanisms introduced in ESD-2/4/6 will reduce the need for significant new generation, this analysis removes select renewable energy projects that displace diesel to prevent overcounting petroleum requirements.[11] Indeed, if Alaska pursued aggressive, cost-effective energy efficiency at 2% reduction per year, built significant new renewable energy projects and a large hydroelectric facility, and still pursued the baseline expected repowering of the Healy coal plant and new natural gas facilities in Fairbanks with no retirements, then the state would appear to be over-powered. For the purposes of this analysis, it is not feasible to predict what types of existing power would be displaced by a significant new portfolio of resources. Therefore, the combined sector totals for ESD should be considered as indicative only.

Between sectors, there is potential minimal overlap between ESD-3 and Forestry, Agriculture, and Waste Management (FAW)-2, where biomass for combined heat and power is counted in both the FAW analysis and the ESD analysis. Renewable energy projects that rely on biomass were removed from the ESD analysis to prevent double counting.

[11] To prevent over-counting expected diesel offsets.

At the time of this analysis, AEA and the Alaska Housing Finance Corporation had received a $300,000,000 state and federal appropriation of funds for a residential weatherization improvement program and low-income household weatherization program. Using assumptions from public literature, it was estimated that these funds would weatherize nearly 20,000 low-income residences, and reduce emissions by approximately 0.34 $MMtCO_2e$.

The policy recommendations above, as well as the analysis of the weatherization program, are described in more detail in Appendix G. These policies result not only in significant emission reductions and costs savings, but also offer a host of additional benefits as well, including reduction in spending on energy by homeowners and businesses; reduced risk of power shortages, energy price increases, and price volatility; and improved public health as a result of reduced pollutant emissions by power plants.