2012

Energy in Maine

Kate Dickerson

Energy in Maine

Margaret Chase Smith Policy Center

University of Maine

Author
Catherine M. Dickerson

February 2012

Acknowledgements

I am deeply indebted to the following people for their assistance, guidance, patience and review in preparing this document.

Stacey Fitts
Todd Gabe
Gary Hunt
David Littell
Charles Morris
James S. Passanisi
Jonathan Rubin
Jeffrey Thaler
Sharon Wagner
Jake Ward
Betty Wilson

Any errors in this paper are the author's alone.

The Margaret Chase Smith Policy Center

The Margaret Chase Smith Policy Center, established in 1989, is a nonpartisan, independent research and public service unit of the University of Maine. The Center is dedicated to improving and promoting the quality of public dialogue about state, regional and national policy issues through applied policy research and projects that seek innovative solutions to practical problems. Our research is interdisciplinary in that it cuts across departmental lines and brings together faculty and external policy experts to address issues confronting the state and nation.

The strength of our staff is our depth and range of substantive knowledge, our commitment to working collaboratively, and our ability to integrate our combined expertise.

Table of Contents

1. Introduction

Maine, like all other states, must rely on energy to fuel its industry, heat its homes and transport its goods. In 2009 (the most recent data available from the Energy Information Administration (EIA)) fossil fuels made up 55% of the energy used in the residential, commercial, industrial, and transportation sectors. The next largest energy source for Maine is biomass, at 15%.[1]

Maine has no fossil fuel reserves nor any refining capacity [5], making Maine particularly sensitive to the fluctuations present in the worldwide market for fossil fuels. However, Maine does have significant potential to increase the diversity of current fossil fuels; enhance energy conservation and efficiencies; and produce alternative energy from Maine-sources including biomass, wind, solar and tides. All of these options could be used to reduce Maine's reliance on imported energy.

Energy policy is important to Maine as it looks for ways to modernize its industry, grow its economy, provide energy security to the state, and enhance the allure of Maine for its residents, businesses, and industries that are already here and those that are considering moving here. Current information regarding energy use is available at both the state and federal levels, through the Governor's Office of Energy Independence and Security (OEIS) and the U.S. Energy Information Administration (EIA). [6, 7] A full analysis of energy demands and supply (both actual and potential) is available at the federal level from EIA [8], while projections for state-level energy demands and supply are reliant upon individual reports. [9-12]

Energy in Maine presents a summary of the current state of energy production and use in Maine, and identifies some considerations for energy policy in Maine. The expectation is that this paper will provide a common foundation to assist policy makers as they work to move Maine forward. The intent of this work is to keep the focus on Maine and help inform decisions about what is best for the State of Maine.

2. Energy consumption and production in Maine

In order to best understand the different opportunities available regarding energy policy in Maine, it is important to have an understanding of where Maine currently stands with regards to energy consumption and production, including both traditional and alternative fuels and sources. The most recent data from EIA (2009) indicate that current energy use in Maine comes primarily from petroleum fuels (47%), biomass (15%), natural gas (8%), hydroelectricity (2%), with small amounts of on-shore wind (0.01%), geothermal (0.02%) and solar (0.05%) also in place.[2] Oftentimes, these energy sources are measured in different units: for example, gallons of heating oil or cubic feet of natural gas. In order to compare the different types of fuels and the energy they provide, it is necessary to use the same unit of measure. For this report, fuel (energy) comparisons are made in British Thermal Units (Btu), and the energy is "primary" energy – the energy in fuel that is consumed.

Total energy costs, consumption, production and imports for all six New England states are provided in Table 1; Table 2 compares New England energy consumption by sector; and Table 3

[1] Author calculations, based upon [1-4]; 2009 data.

[2] Author calculations, based upon [1-4]. Numbers do not add to 100% due to rounding, as well as not including electrical system energy losses.

provides a comparison of New England energy expenditures. For both Table 2 and Table 3, the residential and transportation energy numbers are provided per capita, since both sectors encompass the population of Maine.[3] The commercial, industrial, and transportation sectors are compared using Gross State Product (GSP), a measurement of the economic output for the state, as these sectors incorporate the businesses of Maine. Providing energy consumption and expenditures in this way allows for a direct comparison of related sectors across New England.

Table 1: New England Energy: Total Cost, Consumption, Production and Imports

State	Cost ($ billion)	Consumed (trillion Btu)	State Average Price (per MMBtu)	Produced (trillion Btu)	Percent of Energy Produced In-state	Percent of Energy Imported	Energy Imports ($ billion)
Maine	$5.66	430.5	$13.14	139.7	32%	68%	$3.82
Connecticut	$13.35	788.4	$16.93	200.3	25%	75%	$9.96
Massachusetts	$22.62	1426.0	$15.86	98.5	7%	93%	$21.05
New Hampshire	$4.90	303.0	$16.17	132.2	44%	56%	$2.76
Rhode Island	$3.43	219.3	$15.63	2.7	1%	99%	$3.39
Vermont	$2.50	158.1	$15.82	82.6	52%	48%	$1.19

Data from [14-22] and author's calculations. Population numbers are from 2010 census; energy and dollar numbers are from 2009.

Table 2: New England Energy Consumption

State	Total (MMBtu per capita)	Residential (MMBtu per capita)	Transportation (MMBtu per capita)	Total (Btu per GSP)	Commercial (Btu per GSP)	Industrial (Btu per GSP)	Transportation (Btu per GSP)
Maine	324	70.76	92.97	86.03	14.65	27.92	24.68
Connecticut	221	73.41	68.51	34.65	8.68	3.67	10.76
Massachusetts	218	67.12	81.38	39.55	8.04	6.74	14.78
New Hampshire	230	36.19	98.47	51.28	14.02	7.92	21.28
Rhode Island	208	65.77	81.93	46.20	11.93	6.24	13.45
Vermont	253	45.92	89.87	64.20	12.92	9.91	21.74

Data from [1-4, 14-19, 22-43] and author's calculations. Population numbers are from 2010 census; energy and dollar numbers are from 2009.

[3] EIA definitions for each sector:
"Residential: An energy-consuming sector that consists of living quarters for private households.
"Transportation: An energy-consuming sector that consists of all vehicles whose primary purpose is transporting people and/or goods from one physical location to another.
"Commercial: An energy-consuming sector that consists of service-providing facilities and equipment of: businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups.
"Industrial: An energy-consuming sector that consists of all facilities and equipment used for producing, processing, or assembling goods." [13]

Table 3: New England Energy Expenditures

State	Total (per capita)	Residential (per capita)	Transportation (per capita)	Total (per GSP)	Commercial (per GSP)	Industrial (per GSP)	Transportation (per GSP)
Maine	$4,260	$930	$1,222	$0.113	$0.019	$0.037	$0.032
Connecticut	$3,735	$1,243	$1,160	$0.059	$0.015	$0.006	$0.018
Massachusetts	$3,454	$1,065	$1,099	$0.063	$0.013	$0.011	$0.020
New Hampshire	$3,722	$585	$1,544	$0.083	$0.023	$0.013	$0.034
Rhode Island	$3,257	$1,028	$948	$0.072	$0.019	$0.010	$0.021
Vermont	$3,998	$1,222	$1,354	$0.102	$0.020	$0.016	$0.034

Data from [1-4, 14-19, 22-43] and author's calculations. Population numbers are from 2010 census; energy and dollar numbers are from 2009.

Maine is not that different from other New England states when it comes to energy produced in-state, or energy imports. Maine has the lowest average price per million Btu (MMBtu) in New England, but also the highest per capita energy and Btu per GSP costs. Virtually all of this can be attributed to the amount of energy used in the industrial sector[4].

Electricity in Maine is different than the other energy sources and fuels: electricity is a regional market and Maine is part of ISO-NE.[5] ISO-NE is responsible for operating the New England power grid and wholesale electricity markets. [47] Maine is a net electricity exporter, and has the lowest electricity prices at the point of delivery from the power plant in New England [48-50]. Supply is only one of the two components that make up electricity expenses; delivery is the other.[6] The delivery price is made up of transmission and distribution fees as set by the Maine Public Utilities Commission (MPUC) and the Federal Energy Regulatory Commission (FERC). [49, 52] MPUC has indicated that transmission costs will continue to increase, primarily due to investments in transmission by ISO-NE. [51]

3. Energy options for Maine

In order to evaluate Maine's energy options, it is necessary to have an understanding of where Maine currently stands and the alternatives available. An in-depth analysis of the different energy sources that are imported is not provided in this paper.

3.1. Current options

Existing energy sources and technologies could have significant impact on the feasibility of alternative energy sources taking hold in Maine. Foremost among these are natural gas, which is widely expected to be relatively inexpensive for some years to come, and conservation and efficiency programs that help reduce energy use into the future. Maine also has the option of continuing with current practices (status quo).

[4] Maine is the only New England state in which industry is the largest energy-consuming sector. [44, 45]
[5] ISO-NE is the acronym for Independent System Operators-New England, established in 1997. [46]
[6] As explained by Maine Public Utilities Commission: "Delivery includes transmission, distribution and customer-related functions such as metering and billing, and supply includes the production and provision of electric energy and capacity." [51]

3.1.1. Status Quo

Fossil fuels account for 55% of the total energy used in Maine, with biomass next at 15%. The residential sector in Maine is heavily dependent upon heating oil: approximately 70% of households in Maine use Number 2 heating oil for their homes, the highest heating oil dependency in the U.S. [53] Electricity generation in Maine makes up 28% of the total energy used. One half of total electricity generation in Maine is accomplished with renewable energy sources, as follows: hydroelectric power (almost 26%), wood/wood waste (approximately 21%), and wind (about 2%). [54] Table 4 provides an overview of current energy use in Maine by both type of energy and sector.

Table 4: Overview of Energy Use in Maine: Total Percentage by Source/Type and Sector

	Natural Gas	Petroleum[1]	Hydroelectric	Biomass[2]	Electricity[3]
Percent of total energy[4]	**8%**	**47%**	**2%**	**15%**	**28%[5]**
Sector					
Residential	0%	9%	--	1%	11%
Commercial	1%	5%	0%	1%	10%
Industrial	6%	4%	2%	13%	7%
Transportation	0%	28%	--	--	--

Data from [1-4] and author's calculations. Energy numbers are from 2009.

Notes: 1: Petroleum includes aviation gasoline, distillate fuel oil, kerosene, jet fuel, liquefied petroleum gas (LPG), lubricants, motor gasoline, residual fuel oil, asphalt, and road oil.

2: For residential percentage, biomass includes wood only. For commercial and industrial percentages, biomass includes "Wood, wood-derived fuels, and biomass waste."[1-3]

3: This includes both retails sales and electrical system energy losses, which are "Incurred in the generation, transmission, and distribution of electricity plus plant use and unaccounted for electrical system energy losses." [1-4]

4: Coal, solar/PV, and geothermal are also used in Maine, and account for 0.19%, 0.05% and 0.02% respectively.

5: Coal is used to generate 12% of electricity generation in the ISO-NE region. [55]

3.1.2. Natural gas

Natural gas is a fossil fuel, with domestic supply expanding due to recent innovations in the technology used to mine natural gas. [56-58] The use of natural gas as a heating fuel is expanding for residential users in Maine [59, 60], and there is considerable interest from state leaders to expand the infrastructure (discussed in Section 4.2.2) to high energy-use industries, such as paper mills, that currently rely on heating oil. [61-65].

3.1.3. Conservation and/or efficiency programs

Energy efficiency and conservation programs work on the premise of reducing demand for energy by using it more efficiently. This could incorporate everything from peak and off-peak pricing and metering, equipment upgrades for efficient furnaces and boilers, the weatherization of homes, to lighting replacements. There are significant savings in both economic and energy costs that can be realized with the implementation of conservation and efficiency programs. [66-68]

Maine currently has statewide conservation and efficiency programs in place through Efficiency Maine and MaineHousing. Efficiency Maine Trust has programs targeting both homeowners and businesses, with rebates, low-cost loans, incentives, advice from experts on staff, and a listing of private companies that can provide efficiency assistance. [69-72] MaineHousing programs target low-income households in the areas of weatherization, central heating improvements and appliance replacements, and have low cost energy loans available to qualified moderate-income households. [73]

Efficiency programs also are available through commercial entities. The only current program is a rebate available to commercial, industrial, institutional and multi-family residential customers of Unitil. [74]

3.2. Alternatives to fossil fuels for Maine

As noted in Section 3.1.1, Maine currently produces almost 50% of its electricity from renewable power: hydroelectric (26% of the 50%), wood and wood waste (21%), and wind (2%)[7] [54]. The 50% more than meets the Renewable Portfolio Standards (RPS) Class II requirement that 30% of total electricity sales must come from existing renewable resources. Maine also must meet a RPS requirement for Class I (new renewables developed after 2005), of 10% by 2017 (a 1% annual increase that started in 2008). [75]

Current energy research throughout the world is addressing the need to reduce or eliminate continued reliance on fossil fuels, and Maine is no exception. In Maine there is active research at both public and private institutions in the areas of biofuels, biomass, off-shore wind, tidal energy and hydroelectric, as well the growing use of distributed solar generation for heat or electricity. These areas are discussed in further detail in the sections that follow.

3.2.1. Biofuels

First generation biofuels include biodiesel from waste fat and grease, and ethanol from sugar. Maine does not produce first-generation ethanol, but does have one biodiesel manufacturer [76] and quite a few companies that sell biodiesel blends.[8] These companies provide biodiesel either as a blend for vehicles or in a mix with heating oil, primarily in southern and mid-coast Maine.

The development of second generation biofuels from sources such as algae and biomass (in the form of cellulosic biofuels) is currently in the research and development stage. [82-90] One of the challenges that biofuels faces is production technology that can produce these fuels at a cost competitive with market prices.[9]

3.2.2. Biomass

Biomass is used for both electricity generation and heating. Currently, there are residential, business, commercial, and governmental energy users of biomass throughout Maine. [92-97] There are four wood pellet manufacturers in Maine [98, 99] with one planned for 2013 [100], a different pellet manufacturer using mixed sources [101], and research and development in Maine using grass pellets for commercial boilers. [94]

Another use of biomass is being planned with a recent announcement by a Maine pulp mill to produce torrefied wood (also known as biocoal) by the end of November 2012. Torrefied wood is an energy source that can be used in place of coal. [102-107] The planned market for torrefied wood

[7] Numbers do not add to 50% due to rounding, as well as not including the categories of "MSW Biogenic/Landfill Gas" and "Other Biomass."

[8] Companies include: Maritime Energy, Coastal Energy, Downeast Energy, Harvest Energy and Sprague Energy. [77-81]

[9] A recent U.S. Naval contract for 450,000 gallons of advanced drop-in biofuel has an estimated price of $7/gallon. [91]

is Europe and U.S. electricity producers who currently burn coal, with shipments out of Searsport. [106]

3.2.3. Wind

Wind has been used as an energy source starting with sailing ships, progressing to windmills on land for grinding grain and pumping water, and now to generate electricity and charge batteries. [108-110] The current use of wind for energy has focused on wind farms (utility-scale) that provide electricity to the grid.

3.2.3.1. On-shore wind

Maine currently has seven utility scale wind farms in operation, totaling 325.5 MW and generating 939.9 million kWh per year, and two more under construction. [111-119] As of December 2011, approximately "1,350 MW of proposed resources in Maine (primarily wind) have entered the ISO queue, representing 27% of the proposals in New England."[10] [75]

3.2.3.2. Deepwater off-shore wind

Off-shore wind facilities are wind turbine facilities located in coastal waters. While near shore off-shore wind energy has a long history in Europe [122], there are no floating deepwater[11] offshore wind farms operating in the world. Research is currently underway in the Gulf of Maine to determine how to build, capture and transport 5 gigawatts of wind energy from deepwater sources. [9, 50] Deepwater offshore wind will require both updates of the electricity transmission system in Maine and up-front investments by ISO New England (ISO-NE).[12] [123]

3.2.4. Tidal energy

The use of tidal action to generate power goes back to at least 900 C.E. [124] There are some commercial-scale tidal projects world-wide but none in the United States. [12] In 2008 electricity was generated from the Bay of Fundy currents, and a commercial power system will be installed in Cobscook Bay in 2012. [125, 126] A different feasibility study is underway in Passamaquoddy Bay, with construction expected to begin in 2013. [127]

3.2.5. Hydroelectric

Hydroelectric power has been used to produce electricity in U.S since the early 1900's. [128] As noted in Section 3.2, hydroelectric power generation is the largest source of renewable electricity generation in Maine. [54] Current research and development is exploring ways to minimize the environmental impacts of existing hydroelectric facilities, especially with regard to fish species and dam removals. [129] One project in particular, the Penobscot River Restoration Project, is a collaborative effort[13] to remove some dams and upgrade existing facilities, with the intent to

[10] This does not include additional proposals outside of the ISO-NE region in northern Maine, which is served by the Northern Maine Independent System Administrator, Inc. [120, 121]

[11] Deepwater offshore wind refers to ocean floor depths of greater than 60m (197 feet).

[12] As a member of ISO-NE, Maine's needed transmission upgrades rely on the investment provided by ISO-NE, and electricity generated in Maine is added to the entire ISO-NE grid

[13] The Penobscot River Restoration Project is made up of made up of PPL Corporation, Black Bear Hydro LLC, Penobscot Indian Nation, American Rivers, Atlantic Salmon Federation, Maine Audubon, Natural Resources Council of Maine, Trout Unlimited, U.S. Department of Interior (Bureaus of Fish and Wildlife; Indian Affairs; National Park Service), and the State of Maine (State Planning Office; Department of Natural Resources; Department of Inland Fisheries and Wildlife; and Atlantic Salmon Commission). [130]

maintain at least the same amount of electricity generation and increase the amount of fish habitat. [130, 131]

3.2.6. Distributed Generation Solar (DGS)

Distributed generation solar systems are small-scale solar systems located where the energy is used (on-site) [132], such as solar hot water heaters and photovoltaic rooftop systems that generate electricity. Maine currently has 50 companies that are involved in solar space heating, solar water heating and/or photovoltaic system installation. [133, 134] The largest impediment to DGS is the upfront cost of purchasing and installing the system. [135] Currently there are no Maine-specific data identifying either the range of unit costs or the payback periods for residents and businesses to adopt the one of the available DGS systems. There also is no existing research on the optimal DGS technologies for use in Maine. This is now being researched by an economist at the University of Maine, along with analysis of the types of subsidies and education that may encourage DGS adoption. [133]

4. Maine's strengths and needs

4.1. Knowledge

The alternative energy sources being developed in Maine will require many of the same occupations that are in demand now: electricians, welders, builders, engineers, scientists, designers, and mechanics, to name a few. There also is a need to develop new educational programs and training for up-and-coming areas, with current examples being the wind power technology program at Northern Maine Community College, [136] and energy auditor training courses. [137]

The knowledge base for energy issues in Maine encompasses public and private education through the Maine Community College System and the United Technology Center; the University of Maine and the University of Maine System; Maine Maritime Academy; private universities in the state; privately run training institutes such as the Cianbro Institute and Northeast Technical Institute; and Efficiency Maine Trust through their Qualified Partner program and Building Operator Certification program. [138-144]

4.2. Infrastructure

Maine's current energy use relies on an established infrastructure of truck transport, oil and natural gas pipelines, and electric transmission lines.

4.2.1. Transportation and facility infrastructure

Much of Maine's current energy delivery relies almost entirely upon the use of trucks, a delivery model that is used not just for oil, but also wood pellets [145, 146] and biodiesel [76-81, 147], and could be used for biofuels as they reach commercialization. Maine also has an active network of rail lines, connected to many industrial energy users in the state, as well as cargo ports in Portland, Searsport, and Eastport, Bangor, and Bucksport. [148] The infrastructure needed for developing off-shore wind and tidal energy, such as ports, facilities and equipment, and companies with in-house knowledge is already in place. [50]

4.2.2. Oil and natural gas pipelines

Portland-Montreal Pipe Line (PMPL) provides oil pipeline service in Maine. PMPL has two tank farms, one at each end of the pipeline: South Portland, Maine and Montreal, Quebec. [149] Portland Harbor is "one of the largest oil receiving terminals on the East Coast" [150], and "the only oil port on the U.S. East Coast that is linked to an inland pipeline." [151]

There are two major natural gas pipelines serving Maine: the Portland Natural Gas Transmission System (PNGTS) and the Maritimes and Northeast Pipeline, with the natural gas supplied from the southeast U.S., and Canada. [152] Natural gas service pipelines are being laid throughout the state, in both urban areas of the state (Portland, Bangor), as well as major industrial users such as Lincoln Paper & Tissue, Woodland Pulp LLC, and Great Northern Paper in Millinocket. [61-65]

4.2.3. Electric transmission lines

Maine is currently an "export-constrained load zone" in ISO-NE, meaning that there are parts of Maine where electricity demand is met but the excess generated electricity cannot be exported due to a lack of transmission capabilities. [55] Existing electric transmission lines in Maine are in need of an upgrade to meet both current reliability and transmission needs [153], as well as accommodating the installation of smart grids and any new electricity generation from wind, hydropower, or tidal energy. [11, 12, 154]

4.3. Regulatory requirements and programs

Government is a multi-layered endeavor, from the direct democracy of town meetings, to the representative government of city councils, county commissioners[14], the state legislature, and the federal government. As a result, there is fragmented power and responsibility that affect energy related actions and opportunities throughout the state. Most often, the regulatory requirements of one level of government have to build upon the requirements of another level.

Although a comprehensive overview of the regulatory requirements for each level of government in Maine is beyond the scope of this paper, what follows is a summary of those that have the greatest influence on Maine's current system and options for the future with regards to energy.

At the local level the major regulatory mechanism impacting energy policy is zoning, which affects primarily electricity transmission lines, wind energy systems and natural gas pipelines. While local approval has long been needed for transmission lines, ordinances for wind energy systems are a fairly new local issue. A significant number of local ordinances have been put in place in recent years, with over 25 local governments having implemented wind energy ordinances, most covering grid-scale systems. [156-180]

A summary of the state programs, codes, agencies and one regional program is provided in Table 5; federal agencies and departments are listed in Table 6.

[14] According the U.S. Census Bureau (based upon 2007 data): there are 850 local governments in the State of Maine. [155]

Table 5: Maine and Regional Programs with Regulatory Oversight in Energy Areas

Agency or Program	Summary
Efficiency Maine Trust	Specific energy efficiency targets in electricity, natural gas and heating fuel consumption, as well as weatherization. Accomplished through work done by Efficiency Maine Trust. [69, 181-185]
Maine Building Codes	Statewide building codes and statewide energy code, required for municipalities with more than 4,000 residents; municipalities with less than 4,000 residents may chose to adopt this code or have no code. [186-188]
Maine Department of Conservation - Land Use Regulation Commission	LURC is responsible for planning, zoning and subdivision control the unorganized and deorganized townships of the state [189], including energy generation and transmission projects. [190]
Maine Department of Environmental Project	Air emission; erosion and sedimentation control; hydropower and dams; mining, natural resources protection, shoreland zoning; site location and wind projects [191, 192]
Maine Department of Marine Resources	Aquaculture, marine patrol, protected resources, resource management, and sea-run fisheries & habitat. [193]
Maine Department of Inland Fisheries and Wildlife – Bureau of Resource Management	Management and preservation of wildlife resources and inland fisheries. [194]
Maine Public Utilities Commission	Utilities: electric, natural gas, telecommunications, and water; and ferries. [195] Programs include: Renewables Portfolio Standard (RPS) [196]; certification program [197]; net metering [198]; energy conservation loan program through the Finance Authority of Maine (FAME) [199];
Maine State Historic Preservation Commission	Review of any projects that may impact an archeological site or National Register of Historic Places site. [200]
Maine State Planning Office	Hydroelectric licensing, renewable ocean energy, and uniform building and energy codes. [201]
Regional Greenhouse Gas Initiative	Market-based regulatory program to reduce carbon dioxide emissions by power plants. Ten northeast and mid-Atlantic states are participating. [202]

Table 6: Federal Programs with Regulatory Oversight in Energy Areas

US Agency or Program	Summary
Army Corps of Engineers	Any work and/or structures located in, under or over navigable waters; the discharge of dredged or fill material into waters; and the transportation of dredged material for ocean disposal. [203]
Bureau of Ocean Energy Management	Renewable energy production on the Outer Continental Shelf (OCS), including leases, right-of-way (ROW) grants, and right-of-use and easement (RUE) grants; and RUEs for the alternate use of OCS facilities for energy or marine-related purposes. [204]
Bureau of Safety and Environmental Enforcement	Outer Continental Shelf: oil, gas and sulphur operations; geologically and geophysical explorations; prospecting and operations for other minerals. Oil spill response requirements for facilities seaward of the coastline. [205]
Department of Energy	Oversight of electric energy transmission and natural gas importation and exportation. [206]
Federal Energy Regulatory Commission (FERC)	Interstate transmission of electricity, natural gas, and oil; review proposals for liquefied natural gas terminals and interstate natural gas pipelines; license hydropower projects. [207]
Federal Aviation Administration	Height of objects in airspace [208]
Fish and Wildlife Service	Bald and Golden Eagle Protection Act, Endangered Species Act, Marine Mammal Protection Act, Migratory Bird Treaty Act. [209]
National Marine Fisheries Service	Endangered Species and Marine Mammal permits. [210]
Coast Guard	Fisheries law enforcement, marine environmental protection, and navigational aids. [211]

4.4. Environmental impacts

Any new fuels or energy approaches in Maine will undoubtedly have some type of environmental impact. The environmental impacts of current energy use have been studied fairly extensively, and won't be discussed in this paper.[15] Rather, a brief overview of some emissions and environmental impacts resulting from energy alternatives is provided.

The use of alternative fuels discussed in this report results in either lower air emissions than the fossil fuels they replace or emissions that are not measurably different. For wind, tidal energy or hydroelectric, the full environmental impact is dependent on the site, and those specific impacts will have to be addressed on a site-by-site basis.

4.5. Economic development

Energy development in Maine can be an opportunity for economic development because it offers the opportunity to substitute state-based energy for imported energy. There is no universally accepted definition of economic development, and the number of definitions is almost unlimited. [212-219] However, there are some characteristics found in many definitions of economic development that can be helpful, including:

[15] Similarly, an analysis of the environmental impacts from the manufacture and delivery of each potential alternative energy source is beyond the scope of this paper.

- Governmental or community-based organizations using policies to create and retain jobs, wealth, and improving the quality of life. The policies put in place can encompass virtually any area. Some examples include taxes, education, the environment and zoning.
- Using labor, capital, and technologies together to improve the economy.
- Expanding or maintaining business activities and/or employment.

Along with the many definitions of economic development, there are also myriad ways to determine the impact of economic development programs. Some of the most common measurements include employment growth, income growth, and indicators of firm location. [220] When measuring energy related economic development, some of the impacts that can be evaluated include: the actual cost of energy to businesses and residents; how energy costs effect other areas of the economy (food, education, training, employing more people), and opportunities for economic growth in the energy industry itself. [221]

4.6. Economics

The final consideration in identifying viable alternative energy sources in Maine is the one that will almost certainly drive energy option decisions: the economic costs and benefits, and how these compare to current energy sources. As noted in Table 1, in 2009 Maine spent $5.66 billion dollars on energy, with $3.82 billion of that sent out of the state. One incentive to ongoing research and development in Maine is to provide an opportunity for some of those energy dollars to remain in the state.

Changes to the current energy mix in Maine will require investments in education, training, and infrastructure. These costs exist whether the change involves going from one fossil fuel to another (for example heating oil to natural gas), or to full-scale implementation of alternatives (such as a deepwater offshore wind farm in the Gulf of Maine, or the switchover of homes from oil heat to wood pellets). Direct comparisons of economic costs and benefits are complex, with careful consideration needed on both the types and sources of data used, as well as the methods used for any projections.

5. Trade-offs

Virtually all decisions require trade-offs, whether determining what product to buy, how much time to invest in a project, or what energy policy is best for Maine. Trade-offs can include issues at the national, regional and local levels. In simplest terms, a trade-off involves paying a cost to receive a benefit; if there is more benefit than cost, the trade-off is worthwhile. Energy policy trade-offs are not necessarily easy to quantify either in a monetary sense or in other quantifiable ways.

When determining the best route for Maine, there are many different things to consider. For example, changes in fuels can cause changes in distribution systems and infrastructure, which then can change the numbers and types of employment. Some of the more specific trade-offs may include:

- Local economic development: where will development occur, and how will it impact the state and the particular region?
- Jobs: what jobs will be created and what jobs may be eliminated (and where) based upon the policy chosen?

- Emissions reductions: will emissions increase or decrease, and where?
- Energy security: will Maine's energy security be increased by switching fuel sources?
- Cost to ratepayers: will a change result in a cost increase or decrease to Mainers? How much will the cost increase or decrease be?

Trade-off evaluation often requires a great deal of information, some of which may not be readily available. Effective decisions should determine the trade-offs for a specific project while considering overall policy implications. It should be pointed out that an important component of any project's cost is the opportunity cost of not spending that money on other projects.

6. Summary

There are extensive energy options available to Maine, all of which can have an impact not only in the type of energy used, but also in other areas including: building a knowledge-base throughout the state, enhancing infrastructure, and providing economic development. There are always trade-offs to consider, with policy makers having to rely heavily on the economics, and the recognition that what was is best for the present and near-term may not be true five-to-ten years down the road. All policy decisions require trade-offs and considering as many as possible helps ensure decisions reflect what's best for Maine.

Part of the considerations when determining energy policy and the best course of action for Maine begin with defining Maine as it pertains to energy needs: Is it industry? Is it the retail sector, including tourism? Is it the residents? There are other considerations well: who is Maine competing with for economic development and how does the cost and types of energy come into play? Is a comparison to the rest of New England valid? Or is an assessment relative to other states with similar industries and per capita income the best approach? Should Maine compare itself to states with similar populations and levels of education? All of these areas are intertwined, and understanding how best to address each area individually and as a whole will help provide the framework needed to make energy decisions that are best for Maine.

While *Energy in Maine* is intended as a foundational brief, it provides (at best) an incomplete analysis of the energy options for Maine. Further research and analysis on each topic area (including a more detailed comparison of different energy options and a realistic time-frame for their implementation) will begin to provide more comprehensive guidance for determining the energy decisions that are best for Maine.

Citations

1. U.S. Energy Information Administration, *Table CT4. Residential Sector Energy Consumption Estimates, Selected Years, 1960-2009, Maine*, 30 June 2011.Table providing information regarding residential fuel use in Maine, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/res/use_res_ME.html&mstate=Maine>, accessed 12 January 2012.

2. U.S. Energy Information Administration, *Table CT5. Commercial Sector Energy Consumption Estimates, Selected Years, 1960-2009, Maine*, 30 June 2011.Table providing information regarding commercial fuel use in Maine, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/com/use_com_ME.html&mstate=Maine>, accessed 12 January 2012.

3. U.S. Energy Information Administration, *Table CT6. Industrial Sector Energy Consumption Estimates, Selected Years, 1960-2009, Maine*, 30 June 2011.Table providing information regarding industrial fuel use in Maine, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/ind/use_ind_ME.html&mstate=Maine>, accessed 12 January 2012.

4. U.S. Energy Information Administration, *Table CT7. Transportation Sector Energy Consumption Estimates, Selected Years, 1960-2009, Maine*, 30 June 2011.Table providing information regarding transportation fuel use in Maine, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/tra/use_tra_ME.html&mstate=Maine>, accessed 12 January 2012.

5. U.S. Energy Information Administration, *Table PT2. Energy Production Estimates in Trillion Btu, Maine, 1960-2009*, 30 June 2011.Table providing information regarding fuel production in Maine, found at <http://www.eia.gov/state/seds/sep_prod/pdf/PT2_ME.pdf>, accessed 18 August 2011.

6. Governor's Office of Energy Independence and Security (OEIS), (©2006). *Welcome to the Governor's Office of Energy Independence and Security*. Webpage. Last updated: NA. Date accessed: 22 December 2011. Content: Introduction page to the Office of Energy Independence and Security. Available from: http://www.maine.gov/oeis/index.html.

7. U.S. Energy Information Administration (USEIA), (2011). *Today in Energy*. Webpage. Last updated: New post 21 December 2011. Date accessed: 22 December 2011. Content: Home page for EIA. Available from: http://www.eia.gov/.

8. U.S. Energy Information Administration (U.S. Department of Energy), (2011). *Annual Energy Outlook 2011 with Projections to 2035*. (Document type: report) DOE/EIA-0383(2011) April 2011, pp. 236.

9. Dagher, H.J. (Advanced Structures and Composites Center), (2009), *Deepwater Offshore Wind in Maine: the Plan the Timeline.* (Document type: Presentation) University of Maine, Orono. 18 June 2009. <http://www2.umaine.edu/aewc/images/stories/web_uploads/wind_test_center.pdf> (accessed 29 November 2011).

10. Federal Energy Regulatory Commission (FERC), (2003). *New England Natural Gas Infrastructure.* (Document type: Staff Report) Docket No. PL04-01-000 December 2003, pp. 79.

11. ISO New England (2010). *New England 2030 Power System Study: Report to the New England Governors. 2009 Economic Study: Scenario Analysis of Renewable Resource Development.* (Document type: report) February 2010, pp. 59.

12. Ocean Energy Task Force (2009). *Final Report of the Ocean Energy Task Force to Governor John E. Baldacci.* (Document type: task force report) December 2009, pp. 71.

13. U.S. Energy Information Administration (EIA), *Definitions of Energy-Use Sectors and Related Terms*. Webpage. Last updated: NA. Date accessed: 2 February 2012. Content: Definitions for common terms used throughout EIA. Available from: http://www.eia.gov/neic/datadefinitions/sectors25B1.htm.

14. U.S. Census Bureau (2011). *2010 Census Interactive Population Search*. Webpage. Last updated: NA. Date accessed: November 10 2011. Content: One page summary of business paterns, population, housing status, population by sex/age, population by ethnicity and population by race in Maine. Available from: http://2010.census.gov/2010census/popmap/ipmtext.php?fl=23.

15. U.S. Census Bureau (2011). *2010 Census Interactive Population Search*. Webpage. Last updated: NA. Date accessed: November 28 2011. Content: One page summary of business paterns, industry: establishments, population, housing status, population by sex/age, population by ethnicity, and population by race in Connecticut. Available from: http://2010.census.gov/2010census/popmap/ipmtext.php?fl=09.

16. U.S. Census Bureau (2011). *2010 Census Interactive Population Search*. Webpage. Last updated: NA. Date accessed: November 28 2011. Content: One page summary of population, housing status, population by sex/age, population by ethnicity, and population by race in Massachusetts. Available from: http://2010.census.gov/2010census/popmap/ipmtext.php?fl=25.

17. U.S. Census Bureau (2011). *2010 Census Interactive Population Search*. Webpage. Last updated: NA. Date accessed: November 28 2011. Content: One page summary of population, housing status, population by sex/age, population by ethnicity, and population by race in New Hampshire. Available from: http://2010.census.gov/2010census/popmap/ipmtext.php?fl=33.

18. U.S. Census Bureau (2011). *2010 Census Interactive Population Search*. Webpage. Last updated: NA. Date accessed: November 28 2011. Content: One page summary of population, housing status, population by sex/age, population by ethnicity, and population by race in Rhode Island. Available from: http://2010.census.gov/2010census/popmap/ipmtext.php?fl=44.

19. U.S. Census Bureau (2011). *2010 Census Interactive Population Search*. Webpage. Last updated: NA. Date accessed: November 28 2011. Content: One page summary of population, housing status, population by sex/age, population by ethnicity, and population by race in Vermont. Available from: http://2010.census.gov/2010census/popmap/ipmtext.php?fl=50.

20. U.S. Energy Information Administration, *Table P2. Energy Production Estimates in Trillion Btu, 2009*, 30 June 2011.Table providing information regarding energy production in estimates by state., found at <http://www.eia.gov/state/seds/sep_prod/pdf/P2.pdf>, accessed 24 August 2011; 28 November 2011.

21. U.S. Energy Information Administration, *Table C3. Primary Energy Consumption Estimates, 2009 (Trillion Btu)*, 30 June 2011.Table providing information regarding fuel consumption by state., found at <http://www.eia.gov/state/seds/sep_sum/html/pdf/sum_btu_totcb.pdf>, accessed 24 August 2011; 28 November 2011.

22. U.S. Energy Information Administration, *Table E9. Total End-Use Energy Expenditure Estimates, 2009 (Million Dollars)*, 30 June 2011.Table providing information regarding energy expenditure estimates by state., found at <http://www.eia.gov/state/seds/sep_sum/html/pdf/sum_ex_tx.pdf>, accessed 7 September 2011; 28 November 2011.

23. Bureau of Economic Analysis (U.S. Department of Commerce), (2011), *Economic Recovery Widespread Across States in 2010 - Advance 2010 and Revised 2007-2009 GDP-by-State Statistics.* (Document type: News Release). 7 June 2011. <http://www.bea.gov/newsreleases/regional/gdp_state/2011/pdf/gsp0611.pdf> (accessed 1 February 2012).

24. U.S. Energy Information Administration, *Table CT4. Residential Sector Energy Consumption Estimates, Selected Years, 1960-2009, Connecticut*, 30 June 2011.Table providing information regarding residential fuel use in Connecticut, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/res/use_res_CT.html&mstate=Connecticut>, accessed 23 January 2012.

25. U.S. Energy Information Administration, *Table CT4. Residential Sector Energy Consumption Estimates, Selected Years, 1960-2009, Massachusetts*, 30 June 2011.Table providing information regarding residential fuel use in Massachusetts, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/res/use_res_MA.html&mstate=Massachusetts>, accessed 23 January 2012.

26. U.S. Energy Information Administration, *Table CT4. Residential Sector Energy Consumption Estimates, Selected Years, 1960-2009, New Hampshire*, 30 June 2011.Table providing information regarding residential fuel use in New Hampshire, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/res/use_res_NH.html&mstate=New%20Hampshire>, accessed 23 January 2012.

27. U.S. Energy Information Administration, *Table CT4. Residential Sector Energy Consumption Estimates, Selected Years, 1960-2009, Rhode Island*, 30 June 2011.Table providing information regarding residential fuel use in Rhode Island, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/res/use_res_RI.html&mstate=Rhode%20Island>, accessed 24 January 2012.

28. U.S. Energy Information Administration, *Table CT4. Residential Sector Energy Consumption Estimates, Selected Years, 1960-2009, Vermont*, 30 June 2011.Table providing information regarding residential fuel use in Vermont, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/res/use_res_VT.html&mstate=Vermont>, accessed 24 January 2012.

29. U.S. Energy Information Administration, *Table CT5. Commercial Sector Energy Consumption Estimates, Selected Years, 1960-2009, Connecticut*, 30 June 2011.Table providing information regarding commercial fuel use in Connecticut, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/com/use_com_CT.html&mstate=Connecticut>, accessed 23 January 2012.

30. U.S. Energy Information Administration, *Table CT5. Commercial Sector Energy Consumption Estimates, Selected Years, 1960-2009, Massachusetts*, 30 June 2011.Table providing information regarding commercial fuel use in Massachusetts, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/com/use_com_MA.html&mstate=Massachusetts>, accessed 23 January 2012.

31. U.S. Energy Information Administration, *Table CT5. Commercial Sector Energy Consumption Estimates, Selected Years, 1960-2009, New Hampshire*, 30 June 2011.Table providing information regarding commercial fuel use in New Hampshire, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/com/use_com_NH.html&mstate=New%20Hampshire>, accessed 23 January 2012.

32. U.S. Energy Information Administration, *Table CT5. Commercial Sector Energy Consumption Estimates, Selected Years, 1960-2009, Rhode Island*, 30 June 2011.Table providing information regarding commercial fuel use in Rhode Island, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/com/use_com_RI.html&mstate=Rhode%20Island>, accessed 24 January 2012.

33. U.S. Energy Information Administration, *Table CT5. Commercial Sector Energy Consumption Estimates, Selected Years, 1960-2009, Vermont*, 30 June 2011.Table providing information regarding commercial fuel use in Vermont, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/com/use_com_VT.html&mstate=Vermont>, accessed 24 January 2012.

34. U.S. Energy Information Administration, *Table CT6. Industrial Sector Energy Consumption Estimates, Selected Years, 1960-2009, Connecticut*, 30 June 2011.Table providing information regarding industrial fuel use in Connecticut, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/ind/use_ind_CT.html&mstate=Connecticut>, accessed 23 January 2012.

35. U.S. Energy Information Administration, *Table CT6. Industrial Sector Energy Consumption Estimates, Selected Years, 1960-2009, Massachusetts*, 30 June 2011.Table providing information regarding industrial fuel use in Massachusetts, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/ind/use_ind_MA.html&mstate=Massachusetts>, accessed 23 January 2012.

36. U.S. Energy Information Administration, *Table CT6. Industrial Sector Energy Consumption Estimates, Selected Years, 1960-2009, New Hampshire*, 30 June 2011.Table providing information regarding industrial fuel use in New Hampshire, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/ind/use_ind_NH.html&mstate=New%20Hampshire>, accessed 23 January 2012.

37. U.S. Energy Information Administration, *Table CT6. Industrial Sector Energy Consumption Estimates, Selected Years, 1960-2009, Rhode Island*, 30 June 2011.Table providing information regarding industrial fuel use in Rhode Island, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/ind/use_ind_RI.html&mstate=Rhode%20Island>, accessed 24 January 2012.

38. U.S. Energy Information Administration, *Table CT6. Industrial Sector Energy Consumption Estimates, Selected Years, 1960-2009, Vermont*, 30 June 2011.Table providing information regarding industrial fuel use in Vermont, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/ind/use_ind_VT.html&mstate=Vermont>, accessed 24 January 2012.

39. U.S. Energy Information Administration, *Table CT7. Transportation Sector Energy Consumption Estimates, Selected Years, 1960-2009, Connecticut*, 30 June 2011.Table providing information regarding transportation fuel use in Connecticut, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/tra/use_tra_CT.html&mstate=Connecticut>, accessed 23 January 2012.

40. U.S. Energy Information Administration, *Table CT7. Transportation Sector Energy Consumption Estimates, Selected Years, 1960-2009, Massachusetts*, 30 June 2011.Table providing information regarding transportation fuel use in Massachusetts, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/tra/use_tra_MA.html&mstate=Massachusetts>, accessed 23 January 2012.

41. U.S. Energy Information Administration, *Table CT7. Transportation Sector Energy Consumption Estimates, Selected Years, 1960-2009, New Hampshire*, 30 June 2011.Table providing information regarding transportation fuel use in New Hampshire, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/tra/use_tra_NH.html&mstate=New%20Hampshire>, accessed 23 January 2012.

42. U.S. Energy Information Administration, *Table CT7. Transportation Sector Energy Consumption Estimates, Selected Years, 1960-2009, Rhode Island*, 30 June 2011.Table providing information regarding transportation fuel use in Rhode Island, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/tra/use_tra_RI.html&mstate=Rhode%20Island>, accessed 24 January 2012.

43. U.S. Energy Information Administration, *Table CT7. Transportation Sector Energy Consumption Estimates, Selected Years, 1960-2009, Vermont*, 30 June 2011.Table providing information regarding transportation fuel use in Vermont, found at <http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/tra/use_tra_VT.html&mstate=Vermont>, accessed 24 January 2012.

44. (Energy Information Administration), (2009). *Maine*. Webpage. Last updated: November 2009. Date accessed: 5 December 2011. Content: Available from: http://www.eia.gov/state/state-energy-profiles.cfm?sid=ME.

45. Olesen, T., *BioEnergy and the Forest Products Industry in the Atlantica Region.* Maine Policy Review, 2008. Vol 17(No. 2): pp. 4. <http://mcspolicycenter.umaine.edu/files/pdf_mpr/olesen_V17N2.pdf>

46. ISO New England (©2011). *History*. Webpage. Last updated: NA. Date accessed: 26 October 2011. Content: Webpage describing the history of the electricity market in New England. Available from: http://www.iso-ne.com/aboutiso/co_profile/history/index.html.

47. Federal Energy Regulatory Commission (FERC) (FERC), (2011). *Electric Power Markets: New England (ISO-NE).* website. Last updated: 1 December 2011. Date accessed: 2 December 2011 2011. Content: Informational page describing ISO-NE. Available from: http://www.ferc.gov/market-oversight/mkt-electric/new-england.asp.

48. ISO New England (ISO-NE), (2011). *LMP Map, Real Time Market - Zonal LMP - Dollars per MWH.* Applet, available via link "ISO New England—Location Marginal Price Map" [javascript:pop('http://www.iso-ne.com/portal/jsp/lmpmap/Index.jsp',800,600)]. Last updated: 6 December 2011, 15:15. Date accessed: 6 December 2011. Content: Applet providing real time electricity market data for New England states, as well as some information from New York State and Canada. Available from: applet found via http://www.nationalgridus.com/masselectric/business/programs/3_demand_response.asp.

49. Wagner, S.J. to K. Dickerson (2012). Personal communication: email. Comments on draft documents. 4 January 2012.

50. University of Maine and James W. Sewall Company (2011). *Maine Deepwater Offshore Wind Report.* (Document type: Report) 23 February 2011, pp. 567.

51. Maine Public Utilties Commission (MPUC), (2011). *2010 Annual Report.* (Document type: Report) 1 February 2011, pp. 82.

52. Littell, D.P. to K. Dickerson (2011). Personal communication: email. Explanation of real-time electricity costs in Maine. 27 December 2011.

53. U.S. Census Bureau (2010). *HOUSE HEATING FUEL. Universe: Occupied housing units. 2010 American Community Survey 1-Year Estimate.* Webpage. Last updated: NA. Date accessed: January 23 2012. Content: Online database providing information regarding Maine's home heating fuel by congressional district. Data is based upon 2010 American Community Survey. Available from: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YR_B25040&prodType=table.

54. U.S. Energy Information Administration (USEIA), (2011). *Maine Renewable Electricity Profile.* Webpage. Last updated: July 2011. Date accessed: 24 January 2012. Content: Table 1: 2009 Summary Renewable Electric Power Industry Statistics (Maine). Available from: http://www.eia.gov/cneaf/solar.renewables/page/state_profiles/maine.html.

55. ISO New England Inc. (2011). *2010 Annual Markets Report.* (Document type: Internal Market Monitor, report) 3 June 2011, pp. 170.

56. U.S. Energy Information Administration (USEIA), (2011). *What is shale gas and why is it important?* Webpage. Last updated: 4 August 2011. Date accessed: 16 January 2012. Content: Energy in Brief website explaining the production of natural gas from shale formations. Available from: http://www.eia.gov/energy_in_brief/about_shale_gas.cfm.

57. U.S. Energy Information Administration (USEIA), (2011). *Review of Emerging Resources: U.S. Shale Gas and Shale Oil Plays.* (Document type: Report) July 2011, pp. 105.

58. U.S. Energy Information Administration (USEIA), (2012). *Short-Term Energy Outlook.* (Document type: Report) 10 January 2012, pp. 44.

59. McCrea, N. (2011) *Bangor Gas falling behind, leaving customers scrambling to heat homes.* Bangor Daily News. 3 November 2011, news article. Accessed 10 November 2011. Found at

<http://bangordailynews.com/2011/11/03/news/bangor/bangor-gas-falling-behind-leaving-customers-scrambling-to-heat-homes/>.

60. Turkel, T. (2011) *Demand for natural gas stays pent-up in Maine*. The Portland Press Herald. 28 November 2011, Accessed 1 December 2011. Found at <http://www.pressherald.com/business/residents-face-waiting-game-for-natural-gas_2011-11-28.html?pageType=mobile&id=3&start=1>.

61. Mack, S.K. (2011) *Baileyville pulp mill to get natural gas with $12M conversion*. Bangor Daily News. 18 September 2011, news article. Accessed 1 December 2011. Found at <http://bangordailynews.com/2011/09/18/business/baileyville-pulp-mill-to-get-natural-gas-with-12m-conversion/?ref=relatedSidebar>.

62. Sambides Jr, N. (2011) *Lincoln paper mill prepares to anchor proposed gas pipeline*. Bangor Daily News. 18 November 2011, news article. Accessed 1 December 2011. Found at <http://bangordailynews.com/2011/11/18/business/lincoln-paper-mill-prepares-to-anchor-proposed-gas-pipeline/>.

63. Sambides Jr, N. (2011) *As LePage visits, paper mill owners say they will hire 220 more workers*. Bangor Daily News. 24 October 2011, news article. Accessed 1 December 2011. Found at <http://bangordailynews.com/2011/10/24/business/as-lepage-visits-paper-mill-owners-announce-plans-for-more-workers-products/>.

64. Leary, M. (2011) *LePage looking to expand natural gas in Maine*. Bangor Daily News. 18 September 2011, news article. Accessed 1 December 2011. Found at <http://bangordailynews.com/2011/09/18/politics/lepage-looking-into-natural-gas-for-maine/>.

65. Sambides Jr, N. (2011) *Snowe pushes federal government for funds for natural gas line to Katahdin mills*. Bangor Daily News. 17 November 2011, news article. Accessed 1 December 2011. Found at <http://bangordailynews.com/2011/11/17/politics/snowe-pushes-federal-government-for-funds-for-natural-gas-line-to-katahdin-mills/>.

66. Voorhees, D., *Tapping the Potential of Energy Efficiency to Create Greater Economic Security for Maine*. Maine Policy Review, 2008. Vol 17(No. 2): pp. 9. <http://mcspolicycenter.umaine.edu/files/pdf_mpr/voorhees_V17N2.pdf>

67. Pollin, R., H. Garrett-Peltier, J. Heintz, and H. Scharber (PERI), (2008). *Green Recovery - A Program to Create Good Jobs and Start Building a Low-Carbon Economy*. (Document type: Report) Center for American Progress; Political Economy Research Institute - University of Massachusetts. September 2008, pp. 38.

68. Erario, S. to K. Dickerson (2011). Personal communication: email. Weatherization Assistance Program results. Information sheet provided: MaineHousing Weatherization Program Monitoring and Evaluation Highlights. 22 December 2011.

69. Efficiency Maine *Leading the Way to a Brighter Future*. Webpage. Last updated: NA. Date accessed: December 6 2011. Content: Home page of Efficiency Maine. Available from: http://www.efficiencymaine.com/.

70. Efficiency Maine *Cash Incentives*. Webpage. Last updated: NA. Date accessed: December 12 2011. Content: Description of Efficiency Maine's Business Program cash incentives. Available from: http://www.efficiencymaine.com/at-work/business-programs/cash-incentives.

71. Justard, L. to K. Dickerson (2011). Personal communication: telephone call. Clarification of the cost requirements for the Efficiency Maine Qualified Partners program. 12 December 2011.

72. Efficiency Maine *Home Energy Savings Program FAQs*. Webpage. Last updated: NA. Date accessed: December 12 2011. Content: Listing of frequently asked questions and their answers. Available from: http://www.efficiencymaine.com/at-home/hesp_program/faqs.

73. MaineHousing (Maine State Housing Authority), *Energy Assistance Programs*. Webpage. Last updated: NA. Date accessed: December 6 2011. Content: Summary of available energy assistance programs available through MaineHousing. Available from: http://www.mainehousing.org/programs-services/energy/energy-assistance-programs.

74. Database of State Incentives for Renewables & Efficiency (DSIRE), (2011). *Maine -- Incentives/Policies for Renewables & Efficiency. Unitil (Gas) - Commercial Energy Efficiency Programs* Webpage. Last updated: 27 October 2011. Date accessed: December 6 2011. Content: Summary of Unitil commercial energy program available to the commercial, industrial, multi-family residential and institutional sector. Available from: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ME11F&RE=1&EE=1.

75. ISO New England (ISO New England Inc.), (2011). *Maine 2011-12 State Profile.* (Document type: Report) December 2011, pp. 2.

76. Maine Standard Biofuels (2011). *Maine Standard Biofuels*. Webpage. Last updated: NA. Date accessed: November 17 2011. Content: Introduction to company. Available from: http://www.mainestandardbiofuels.com/.

77. Maritime Energy (2011). *Maritime Energy*. Webpage. Last updated: NA. Date accessed: November 17 2011. Content: Introduction to company. Available from: http://www.maritimeenergy.com/.

78. Coastal Energy (2011). *Energy Fuels*. Webpage. Last updated: NA. Date accessed: November 17 2011. Content: Explanation of available biofuel blends and benefits of biofuel. Available from: http://www.coastal-energy.com/fuels.htm.

79. Downeast Energy (2011). *Oil/Propane/Solar*. Webpage. Last updated: NA. Date accessed: November 17 2011. Content: Explanation of available heating oil and propane delivery in Maine and New Hampshire. Available from: https://www.downeastenergy.com/oil-propane-maine-nh.

80. Harvest Energy (2011). *Home Heating Oil, Biofuel, Propane and Friendly Service*. Webpage. Last updated: © 2007 - 2011. Date accessed: November 17 2011. Content: Description of company, with emphasis on B-20. Available from: http://www.harvestenergymaine.com/.

81. Sprague Energy (2011). *Products*. Webpage. Last updated: © 2011. Date accessed: November 17 2011. Content: Explanation of available petroleum products. Available from: http://www.spragueenergy.com/pages/content.aspx?p=petroleum_products.

82. (Forest Bioproducts Research Institute), *Forest Bioproducts Research Institute*. Webpage. Last updated: NA. Date accessed: October 18 2011. Content: Webpage describing the Forest Bioproducts Research Institute. Available from: http://forestbioproducts.umaine.edu/.

83. Bigelow Laboratory for Ocean Sciences *Bigelow Laboratory for Ocean Sciences Strategic Plan 2009-2014*. (Document type: report) NA, pp. 22.

84. Coultas, C. (2011) *Fueling its future - Biobutanol holds promise for the next phase of Old Town Fuel & Fiber*. Mainebiz. 27 June 2011. Accessed 17 November 2011. Found at <http://www.mainebiz.biz/news48120.html>.

85. (Forest Bioproducts Research Institute), *Research Projects - Characterization and Upgrading Pyrolyis Oils from Woody Biomass*. Webpage. Last updated: NA. Date accessed: November 17 2011. Content: Webpage describing the research project. Available from: http://forestbioproducts.umaine.edu/research-projects/characterization-and-upgrading-pyrolyis-oils-from-woody-biomass/.

86. (Forest Bioproducts Research Institute), *Research Projects - Fuels and Chemicals from Woody Biomass-Derived Syngas*. Webpage. Last updated: NA. Date accessed: November 17 2011. Content: Webpage describing the research

project. Available from: http://forestbioproducts.umaine.edu/research-projects/fuels-and-chemicals-from-woody-biomass-derived-syngas/.

87. (Forest Bioproducts Research Institute), *Research Projects - Fermentation of Pulp Mill-derived Hemicellulose Extract to Ethanol* Webpage. Last updated: NA. Date accessed: November 17 2011. Content: Webpage describing the research project. Available from: http://forestbioproducts.umaine.edu/research-projects/fermentation-of-pulp-mill-derived-hemicellulose-extract-to-ethanol/.

88. Bigelow Laboratory for Ocean Sciences (BLOS), (©2012). *Corporate Alliances and Technology Transfer (CATT).* Webpage. Last updated: NA. Date accessed: 17 January 2012. Content: Description of the Office of Corporate Alliances and Technology Transfer (CATT), including a listing of the initiatives being pursued. Available from: http://www.bigelow.org/catt/catt-front-page-alternative/.

89. Bigelow Laboratory for Ocean Sciences (BLOS), (2011). *BioProcess Algae, LLC Becomes Founding Member of Bigelow Laboratory's Corporate Affiliate Program (CAP).* Webpage. Last updated: 29 November 2011. Date accessed: 17 January 2012. Content: News release regarding the founding member of BLOS's Corporate Affiliate Program (CAP). Available from: http://www.bigelow.org/news/news_2009/biopro/.

90. Old Town Fuel & Fiber (©2009). *Innovative Production, Technology and Self-Sufficiency*. Webpage. Last updated: NA. Date accessed: 17 January 2012. Content: Description of Old Town Fuel & Fiber hemicellulose extraction and conversion of the lignocellulosic extract. Available from: http://www.oldtownff.com/Default.aspx?tabid=88.

91. Lane, J. (Ascension Publishing, Inc.), (2011), *Solazyme, Dynamic Fuels score big US Navy aviation fuel contracts.* (Document type: Electronic newsletter, BiofuelsDigest). 6 December 2011. <http://biofuelsdigest.com/bdigest/2011/12/06/solazyme-dynamic-fuels-score-big-us-navy-aviation-fuel-contracts/> (accessed 4 January 2012).

92. Parent, J. (Northern Maine Community College), (2011), *News Release: NMCC breaks ground on new biomass boiler that will provide energy savings, environmental benefit, and experiential learning opportunities for students.* (Document type: News Release). 14 November 2011. <http://www.nmcc.edu/modules/download_gallery/dlc.php?file=1557> (accessed 17 November 2011).

93. Farwell, J. (2011) *Switching to wood pellets - Maine-made appeal rekindles nascent industry*. Mainebiz. 5 September 2011, news article. Accessed 21 November 2011. Found at <http://www.mainebiz.biz/news48409.html>.

94. Nagle, M. (2011) *Growing Alternative*. UMaine Today. Winter 2010. Accessed 17 November 2011. Found at <http://umainetoday.umaine.edu/past-issues/winter-2010/growing-alternative/>.

95. Lynds, J. (2011) *UMFK to get greener with new $858,000 biomass boiler system*. Bangor Daily News. 24 May 2011, news article. Accessed 17 November 2011. Found at <http://bangordailynews.com/2011/05/24/news/aroostook/umfk-to-get-greener-with-new-858000-biomass-boiler-system/>.

96. Gibson, L. (2011) *Maine university, school partner for biomass district heat*. Biomass Power & Thermal. 7 November 2011. Accessed 17 November 2011. Found at <http://biomassmagazine.com/articles/5950/maine-university-school-partner-for-biomass-district-heat/>.

97. University of Maine Fort Kent (2011), *UMFK, MSAD #27, receive $2.6 million for biomass system; grant will save $4 million in heat costs; stimulate local economy.* (Document type: News Release). 4 November 2011. <http://www.umfk.edu/valleyvision/release/default.cfm?release=11112> (accessed 17 November 2011).

98. Maine Pellet Fuels Association (2011). *Pellet Manufacturers & Bulk Delivery*. Webpage. Last updated: ©2011. Date accessed: November 21 2011. Content: Listing of association members in Maine who produce and deliver wood pellets. Available from: http://www.mepfa.org/Pellet_Manufacturers_Bulk_Delivery.htm.

99. Spelter, H. and D. Toth (United States Department of Agriculture - Forest Service; Forest Products Laboratory), (2009). *North America's wood pellet sector.* (Document type: report) FPL-RP-656 Forest Products Laboratory,. August 2009, pp. 21.

100. Turkel, T. (2011) *Proposed Maine plant would ship wood pellets overseas.* Morning Sentinel. 25 October 2011, news article. Accessed 21 November 2011. Found at <http://www.onlinesentinel.com/news/planned-plant-would-ship-wood-pellets-overseas_2011-10-24.html>.

101. Pelletco (2011). *Products - Patented Bio Mass Energy Pellets Sourced Locally.* Webpage. Last updated: NA. Date accessed: November 21 2011. Content: Description of biomass fuel pellets produced by Pelletco. Available from: http://www.thepelletco.com/products.html.

102. Billodeau, M. to K. Dickerson (2011). Personal Communication: meeting. Meeting to get details regarding energy research & development taking place in Maine. 30 November 2011.

103. Adams, G. (2011) *Mill's reopening stokes hopes in Millinocket region.* Bangor Daily News. 24 November 2011 (online posting), news article. Accessed 30 November 2011. Found at <http://bangordailynews.com/2011/11/24/news/penobscot/mills-reopening-stokes-hopes-in-millinocket-region/>.

104. Field, J. (Maine Public Broadcasting Network), (2011), *New Owner of Maine's Great Northern Paper Sees Green in Biomass.* (Document type: website article, radio broadcast). 24 October 2011. <http://www.mpbn.net/Home/tabid/36/ctl/ViewItem/mid/3478/ItemId/18610/Default.aspx> (accessed 30 November 2011).

105. DeSumma, M. (WLBZ), (2011), *Cate Street announces plan to create energy at Katahdin paper mills.* (Document type: website article, television broadcast). 24 October 2011. <http://www.wlbz2.com/news/article/177188/3/Katahdin-paper-mills-plan-to-make-wood-pellets> (accessed 30 November 2011).

106. Sambides Jr, N. (2011) *Cate Street buys biocoal technology rights for $20M.* Bangor Daily News. 1 December 2011, news article. Accessed 9 December 2011. Found at <http://bangordailynews.com/2011/12/01/business/cate-street-buys-biocoal-technology-rights-for-20m/>.

107. Cate Street Capital (©2011). *Cate Street Announces Plans to Start Biofuel Manufacturing.* Website. Last updated: (scanned in news page) 8 December 2011. Date accessed: 17 January 2012. Content: Website with scanned in news article (Katahdin Region News) describing Cate Street Capital plans to manufacture torrefied wood within one year. Available from: http://www.catecapital.com/ViewNews/Cate-Street-Announces-Plans-to-Start-Biofuel-Manufacturing.

108. Iowa Energy Center (©2006 - 2012). *Wind Energy Manual - A History of Wind Energy.* Webpage. Last updated: NA. Date accessed: 26 January 2012. Content: An overview of windpower use from 5000 B.C. to present day. Available from: http://www.energy.iastate.edu/renewable/wind/wem/history.htm.

109. U.S. Energy Information Administration (USEIA), (2011). *Wind Explained - History of Wind Power.* Webpage. Last updated: 30 November 2011. Date accessed: 26 January 2012. Content: An overview of windpower use from 5000 B.C. to present day. Available from: http://www.eia.gov/energyexplained/index.cfm?page=wind_history.

110. Energy Efficiency & Renewable Energy (US DOE, EERE), (2011). *Wind Energy Technologies.* Website. Last updated: 19 October 2011. Date accessed: 26 January 2012. Content: Basic description of how wind energy technologies can be used. Available from: http://www.eere.energy.gov/basics/renewable_energy/wind.html.

111. Natural Resources Council of Maine (NRCM), *Wind Projects in Maine*. Website. Last updated: NA. Date accessed: 26 January 2012. Content: Listing of Maine wind projects that are operating, under construction, and/or in development. Available from: http://www.nrcm.org/maine_wind_projects.asp.

112. Natural Resources Council of Maine (NRCM), *Mars Hill Wind Project*. Website. Last updated: NA. Date accessed: 26 January 2012. Content: Description of the Mars Hill wind project. Available from: http://www.nrcm.org/mars_hill.asp.

113. Natural Resources Council of Maine (NRCM), *Stetson Ridge Wind Project*. Website. Last updated: NA. Date accessed: 26 January 2012. Content: Description of the Stetson Ridge wind project. Available from: http://www.nrcm.org/wind_stetson.asp.

114. Natural Resources Council of Maine (NRCM), *Stetson II Wind Project*. Website. Last updated: NA. Date accessed: 26 January 2012. Content: Description of the Stetson II wind project. Available from: http://www.nrcm.org/stetson_II_wind.asp.

115. Natural Resources Council of Maine (NRCM), *Rollins Wind Project*. Website. Last updated: NA. Date accessed: 26 January 2012. Content: Description of the Rollins wind project. Available from: http://www.nrcm.org/wind_rollins.asp.

116. Natural Resources Council of Maine (NRCM), *Beaver Ridge Wind Project*. Website. Last updated: NA. Date accessed: 26 January 2012. Content: Description of the Beaver Ridge wind project. Available from: http://www.nrcm.org/wind_freedom.asp.

117. First Wind (©2011). *Welcome to Mars Hill*. Website. Last updated: NA. Date accessed: 26 January 2012. Content: Description of the Mars Hill wind project. Available from: http://www.firstwind.com/projects/mars-hill.

118. Natural Resources Council of Maine (NRCM), *Vinalhaven Wind Project*. Website. Last updated: NA. Date accessed: 26 January 2012. Content: Description of the Vinalhaven wind project. Available from: http://www.nrcm.org/Vinalhaven_wind.asp.

119. Natural Resources Council of Maine (NRCM), *Kibby Mountain Wind Project*. Website. Last updated: NA. Date accessed: 26 January 2012. Content: Description of the Kibby Mountain wind project. Available from: http://www.nrcm.org/kibby_mountain.asp.

120. Northern Maine Independent System Administrator Inc. (NMISA), *NMISA - Northern Maine Independent System Administrator, Inc.* Last updated: NA. Date accessed: 27 January 2012. Content: Description of the non-profit NMISA responsible for the northern Maine transmission system and electric power markets. Available from: http://www.nmisa.com/.

121. Office of the Public Advocate (State of Maine), (©2005). *Wholesale Electricity Market*. Webpage. Last updated: NA. Date accessed: 27 January 2012. Content: Description of the New England and northern Maine wholesale electricity market. Available from: http://www.maine.gov/meopa/electric/wholesale.html.

122. European Wind Energy Association (European Wind Energy Association), (2011). *The Eurpean offshore wind industry key trends and statistics 2010*. (Document type: Executive Summary) January 2011, pp. 3.

123. ISO New England (2007). *New England Electricity Scenario Analysis: Exploring the economic, reliability, and environmental impacts of various resource outcomes for meeting the region's future electricity needs*. (Document type: report) 2 August 2007, pp. 80.

124. Ullman, P.W., *Offshore Tidal Power Generation—A New Approach to Power Conversion of the Oceans' Tides* Marine Technology Society Journal, 2002. Vol 36(No. 4): pp. 9.

<http://www.ingentaconnect.com/content/mts/mtsj/2002/00000036/00000004/art00005?token=0054164a53e1f47e2a46762c6b415d76666a702e23766d7b673f7b2f267738703375686f493e5babc4a5>

125. Ocean Renewable Power Company (2011). *Maine*. Webpage. Last updated: © 2011. Date accessed: November 21 2011. Content: Description of a tidal power project in the Bay of Fundy. Available from: http://www.oceanrenewablepower.com/projects_maine.aspx.

126. Maine Department of Environmental Protection, *Status of Tidal Power Project Proposals in Maine as of October 1, 2010*, 1 October 2010.Table providing a summary of active and inactive tidal power project proposals in Maine, found at <http://www.maine.gov/dep/blwq/docstand/dams/hydro_FERC_process/status_tidalpower.pdf>, accessed 21 November 2011.

127. Tidewalker Associates (2011). *The History of the Project (General)*. Webpage. Last updated: NA. Date accessed: November 21 2011. Content: Description of a tidal power installation in Passamaquoddy Bay. Available from: http://www.mainetidalpower.com/general.html.

128. Bureau of Reclamation (U.S. Department of the Interior), (2009). *The History of Hydropower Development in the United States*. Website. Last updated: 12 August 2009. Date accessed: 7 February 2012. Content: Description of hydropower development in the U.S. Available from: http://www.usbr.gov/power/edu/history.html.

129. University of Maine and University of Southern Maine (DSRRN), *Diadromous Species Restoration Research Network*. Website. Last updated: NA. Date accessed: 7 February 2012. Content: Website home for DSRRN, who's goal is "to advance the science of diadromous fish restoration and promote state-of-the-art scientific approaches to multiple-species restoration through workshops, conferences, web sharing, and journal publications." A joint project of the Senator George J. Mitchell Center for Environmental & Watershed Research at the University of Maine and the Univeristy of Southern Maine. Available from: http://www.umaine.edu/searunfish/.

130. Penobscot River Restoration Trust (PRRT), (©2005 - 2012). *Unprecedented Collaboration*. Webpage. Last updated: NA. Date accessed: 7 February 2012. Content: Description of the Penobscot River Restoration Project, including the partners and scope of the project. Available from: http://www.penobscotriver.org/content/4030/Unprecedented_Collaboration/.

131. Opperman, J.J., J. Royte, J. Banks, L.R. Day, and C. Aspe, *The Penobscot River, Maine, USA: a basin-scale approach to balancing power generation and ecosystem restoration.* . Ecology and Society, 2011. Vol 16(No. 3) <http://www.ecologyandsociety.org/vol16/iss3/art7/ES-2011-4117.pdf>

132. Office of Indian Energy and Economic Development (U.S. Department of the Interior), *Utility-Scale and Distributed Solar Energy Generation*. Webpage. Last updated: NA. Date accessed: 5 January 2012. Content: Description of different solar technologies that are available. Available from: http://teeic.anl.gov/er/solar/restech/tech/index.cfm.

133. Wagner, S.J. to K. Dickerson (2012). Personal communication: email. Overview of distributed solar generation in Maine, including availability and market. 5 January 2012.

134. Wagner, S.J. to K. Dickerson (2012). Personal communication: email. Compilation of solar companies in Maine, reference to National Renewable Energy Laboratory (NREL) solar water heating report, and contact information for a solar expert in the state. 5 January 2012.

135. Fischer, D. to K. Dickerson (2012). Personal communication: telephone call. Discussed solar energy in Maine, including the costs of generation and systems. 13 January 2012.

136. Northern Maine Community College *Wind Power Technology*. Webpage. Last updated: NA. Date accessed: December 1 2011. Content: Description of the wind power technology program offered at Northern Maine Community

College. Available from: http://www.nmcc.edu/pages/nmcc/academic-departments/trade-technical-dept/wind-power-technology.php.

137. Chapman, R. to K. Dickerson (2011). Personal Communication: email. Overview of the energy auditors in Maine, including certification requirements and numbers of auditors, and discussion of the return on investment for homeowners who undergo an energy audit and follow the recommendations. 14 November 2011.

138. Passanisi, J. (2011), *University of Maine System: Index of Selected Energy Courses*. (Document type: Microsoft Word Document; internal information.). Spring 2011. (accessed 21 October 2011).

139. Eldridge, R. to K. Dickerson (2011). Personal communication: email. Response to questions regarding MaineHousing's listing of Certified Energy Auditors on their website. 21 December 2011.

140. Cianbro (2011). *Cianbro Institute*. Webpage. Last updated: ©2011. Date accessed: November 10 2011. Content: Description of the Cianbro Institute, a training program "established to address the skills shortage of human capital in the construction industry". Available from: http://cianbro.com/Careers/CianbroInstitute/tabid/322/Default.aspx.

141. Northeast Training Institute (©2011). *About Northeast Technical Institute*. Webpage. Last updated: NA. Date accessed: December 1 2011. Content: Description of the Northeast Training Institute, its curriculum, and school history. Available from: http://www.ntinow.edu/about.htm.

142. Efficiency Maine *Qualified Partners*. Webpage. Last updated: NA. Date accessed: December 12 2011. Content: Description of Efficiency Maine's Qualified Partners program. Available from: http://www.efficiencymaine.com/at-work/qualified-partners.

143. Efficiency Maine *Become a Qualified Partner*. Webpage. Last updated: NA. Date accessed: December 12 2011. Content: Listing of the requirements and benefits of Efficiency Maine's Qualified Partners program. Available from: http://www.efficiencymaine.com/at-work/qualified-partners/become-a-qualified-partner.

144. Efficiency Maine *Building Operator Certification*. Webpage. Last updated: NA. Date accessed: December 12 2011. Content: Description of Efficiency Maine's Building Operator Certification program. Available from: http://www.efficiencymaine.com/professional-training/building-operator-certification.

145. Maine Woods Pellet Company (©2008). *Ordering Instructions*. Webpage. Last updated: NA. Date accessed: December 1 2011. Content: Description of delivery options available including amounts equaling 3 tons, bulk and full truck loads. Available from: http://www.mainewoodspelletco.com/orderform.html.

146. Geneva Wood Fuels (© 2011). *Bulk Wood Pellets Delivery*. Webpage. Last updated: NA. Date accessed: December 1 2011. Content: Description of Geneva Wood Fuels bulk delivery capabilities. Available from: http://www.genevapellets.com/aboutus/bulk_wood_pellets.html.

147. Frontier Energy (2011). *About Frontier Energy*. Webpage. Last updated: NA. Date accessed: November 17 2011. Content: Description of the Frontier Energy, a division of Frontier Oil Co., and the alternative fuels they offer. Available from: http://www.frontierenergy.org/index.html.

148. Maine Port Authority (MPA), *Cargo Ports*. Webpage. Last updated: NA. Date accessed: 9 December 2011. Content: Map with links identifying Maine cargo ports. Available from: http://www.maineports.com/cargo_ports.

149. (Portland Montreal Pipe Line), (2009). *Portland Montreal Pipe Line:: About us*. website. Last updated: not available. Date accessed: 26 January 2009. Content: Informational page concerning PMPL holdings and operations. Available from: http://www.pmpl.com/about.php.

150. Wilson, E.A., *Understanding the Global Energy Industry is Key to Meeting Maine's Energy Challenge.* Maine Policy Review, 2008. Vol 17(No. 2): pp. 15. <http://mcspolicycenter.umaine.edu/files/pdf_mpr/wilson_V17N2.pdf>

151. Hastings, W.H., *The Energy Challenge–Gone Today, Back Tomorrow: Maine's Key Role.* Maine Policy Review, 2008. Vol 17(No. 2): pp. 5. <http://mcspolicycenter.umaine.edu/files/pdf_mpr/hastings_V17N2.pdf>

152. U.S. Energy Information Administration (USEIA), (2007). *Natural Gas Pipelines in the Northeast Region.* Webpage. Last updated: Released 1 June 2007. Date accessed: 24 January 2012. Content: Description of the natural gas pipelines in the northeast region of the United States (Connecticut, Delaware, Massachusetts, Maine, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Virginia, and West Virginia). Available from: http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/northeast.html.

153. ISO New England (2011). *2011 Regional System Plan.* (Document type: report - system planning) 21 October 2011, pp. 188.

154. van Welie, G. and J. Norden (2010). *ISO on Background - New England Wind Integration Study.* (Document type: report, slide format) ISO New England. 15 December 2010, pp. 28.

155. U.S. Census Bureau (2011), *Exploring the Intricate Layers of State and Local Governments: Maine.* Governments Division. Accessed 3 January 2012; http://www2.census.gov/govs/pubs/state_snapshot/gov07-me.pdf.

156. City of Biddeford (16 September 2008), *Part III (Land Development Regulations), Article VI (Performance Standards), Section 75 (Small Wind Energy Systems).* C. Council. Accessed 11 January 2012; http://www.ecode360.com/15169378#15170677.

157. City of Saco (2009), *Zoning Ordinance - Article 7 Standards of Performance.* Section 730. Small Wind Energy Systems. (Amended 2 June 2008),. Economic Development. Accessed 11 January 2012; Specific ordinance found at http://www.sacomaine.org/departments/cityplanner/zoning7.pdf.

158. Eddington Planning Board (2011), *Town of Eddington Wind Energy Facility Ordinance.* Section 100: Large Scale Wind Energy Facility; Section 200: Small Scale Wind Energy Facility. Accessed 4 January 2012; http://www.eddingtonmaine.gov/wp-content/uploads/2011/04/Wind-Energy-Facility-Ordinance.pdf.

159. Jacobson, D. and C. High (2008), *Wind Energy and Air Emission Reduction Benefits: A Primer.* National Renewable Energy Laboratory Subcontractor Report. Accessed 14 December 2011; http://www.windpoweringamerica.gov/pdfs/policy/wind_air_emissions.pdf.

160. Town of Appleton *Town of Appleton, Maine - Wind Energy Facility Ordinance.* Accessed 10 January 2012; http://www.appleton.maine.gov/pdfs/new%20wind%20ord.pdf.

161. Town of Dixmont *Town of Dixmont - Wind Energy Facility Ordinance.* Accessed 11 January 2012; http://www.dixmontme.govoffice2.com/vertical/Sites/%7B6EAADA9B-2500-4441-A924-7171D5E3F559%7D/uploads/%7B576AA528-4C90-4A93-9C0D-31F9FF751735%7D.PDF.

162. Town of New Vineyard (12 March 2011), *Town of New Vineyard, Maine Wind Energy Facility Ordinance.* Accessed 11 January 2012; http://highlandmts.org/wp-content/uploads/2011/03/New-Vineyard.pdf.

163. Town of Phillips *Town of Philips, Maine, Wind Energy Facility Ordinance.* Accessed 10 January 2012; http://phillipsmaine.com/facts/WindEnergyFacilityOrdinance.pdf.

164. Town of Sumner (25 May 2011), *Industrial Wind Energy Facility Moratorium Ordinance -- Town of Sumner, Maine.* Accessed 10 January 2012; http://www.sumnermaine.us/PDF_Industrial_Wind_Energy_Facility_Moratorium_Ordinance.pdf.

165. Town of Vinalhaven (15 December 2008 (Special Town Meeting)), *Town of Vinalhaven Land Use Ordinance Amended Section 20: Wind Power Facility*. Accessed 11 January 2012; http://townofvinalhaven.org/ordinances/Amended%20Wind%20Power.pdf.

166. Town of Winthrop *Winthrop, Maine - Small Wind Energy Systems Ordinance*. Accessed 11 January 2012; http://www.winthropmaine.org/vertical/Sites/%7B46AE0912-004A-4267-BB56-098B44708FA1%7D/uploads/%7BA0AF7025-65C2-4BD3-B4D2-13E432CDC3C8%7D.PDF.

167. Cox, E. (2011) *Peru starts process for wind ordinance*. Sun Journal. 17 November 2011, news article. Accessed 11 January 2012. Found at <http://www.sunjournal.com/news/river-valley/2011/11/17/peru-starts-process-wind-ordinance/1116551>.

168. Curtis, A. (2010) *Montville voters OK ordinance for wind energy*. Bangor Daily News. 29 March 2010, news article. Accessed 11 January 2012. Found at <http://bangordailynews.com/2010/03/29/news/montville-voters-ok-ordinance-for-wind-energy/>.

169. Curtis, A. (2010) *Thorndike OKs strict wind ordinance*. Bangor Daily News. 21 March 2010, news article. Accessed 11 January 2012. Found at <http://bangordailynews.com/2010/03/21/news/thorndike-oks-strict-wind-ordinance/>.

170. Curtis, A. (2010) *Jackson residents approve wind turbine limits*. Bangor Daily News. 8 February 2010, news article. Accessed 11 January 2012. Found at <http://bangordailynews.com/2010/02/08/news/jackson-residents-approve-wind-turbine-limits/>.

171. Curtis, A. (2011) *Frankfort residents pass strict wind ordinance*. Bangor Daily News. 1 December 2011, news article. Accessed 11 January 2012. Found at <http://bangordailynews.com/2011/12/01/news/midcoast/frankfort-wind-ordinance-passes/>.

172. Hanstein, B. (2010) *Phillips approves new wind power ordinance*. Daily Bulldog. 16 September 2010, news article. Accessed 11 January 2012. Found at <http://www.dailybulldog.com/db/features/phillips-approves-new-wind-power-ordinance/>.

173. Hewitt, R. (2010) *Cell towers, wind turbines on hold in Penobscot*. Bangor Daily News. 4 March 2010, news article. Accessed 11 January 2012. Found at <http://bangordailynews.com/2010/03/04/news/hancock/cell-towers-wind-turbines-on-hold-in-penobscot/>.

174. Karkos, T. (2011) *Rumford wind ordinance OK'd; Charter amendment fails*. Sun Journal. 8 November 2011, news article. Accessed 11 January 2012. Found at <http://www.sunjournal.com/news/river-valley/2011/11/09/rumford-wind-ordinance-okd-charter-amendment-fails/1113035>.

175. Miller, K. (2011) *Ban on large wind turbines approved in Brooksville*. Bangor Daily News. 8 November 2011, news article. Accessed 11 January 2012. Found at <http://bangordailynews.com/2011/11/08/news/hancock/ban-on-large-wind-turbines-approved-in-brooksville/>.

176. Rhoda, E. (2010) *Moscow approves its first wind ordinance*. Morning Sentinel. 4 December 2010, news article. Accessed 11 January 2012. Found at <http://www.onlinesentinel.com/news/moscowtown-oks-its-first-wind-ordinance_2010-12-03.html>.

177. Ricker, N.-N. (2011) *Eddington residents enact strict wind ordinance*. Bangor Daily News. 22 March 2011, news article. Accessed 4 January 2012. Found at <http://bangordailynews.com/2011/03/22/news/bangor/eddington-residents-enact-strict-wind-ordinance/>.

178. The Associated Press (2010) *Maine residents push back against wind power farms*. Bangor Daily News. 18 February 2010, news article. Accessed 11 January 2012. Found at <http://bangordailynews.com/2010/02/18/politics/maine-residents-push-back-against-wind-power-farms/>.

179. Trotter, B. (2011) *Eastbrook approves wind turbine ordinance*. Bangor Daily News. 20 January 2011, news article. Accessed 11 January 2012. Found at <http://bangordailynews.com/2011/01/20/news/hancock/eastbrook-approves-wind-turbine-ordinance/>.

180. Friends of the Highland Mountains (©2012). *More Towns Take Refuge From Maine Wind Siting Laws*. Last updated: 1 December 2011. Date accessed: 11 January 2012. Content: Webpost listing the towns in Maine that have restrictive grid-scale wind turbine ordinances and those with grid-scale wind turbine moratoriums. Available from: http://highlandmts.org/?p=531.

181. Database of State Incentivers for Renewables & Efficiency (DSIRE), (2011). *Maine -- Incentives/Policies for Renewables & Efficiency. Energy Efficiency Targets.* Webpage. Last updated: 6 April 2011. Date accessed: December 6 2011. Content: Summary of energy efficiency targets required of the Efficiency Maine Trust. Available from: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ME17R&re=1&ee=1.

182. Efficiency Maine *Professional Training*. Webpage. Last updated: NA. Date accessed: December 6 2011. Content: Energy efficiency programs and techology training programs available through Efficiency Maine. Available from: http://www.efficiencymaine.com/professional-training.

183. Efficiency Maine *About Efficiency Maine*. Webpage. Last updated: NA. Date accessed: December 6 2011. Content: History and mission of Efficiency Maine. Available from: http://www.efficiencymaine.com/about.

184. Database of State Incentives for Renewables & Efficiency (DSIRE), (2011). *Maine -- Incentives/Policies for Renewables & Efficiency. Efficiency Maine Trust.* Webpage. Last updated: 17 March 2011. Date accessed: December 6 2011. Content: Summary of Efficiency Maine Trust. Available from: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ME11R&re=1&ee=1.

185. Database of State Incentives for Renewables & Efficiency (DSIRE), (2011). *Maine -- Incentives/Policies for Renewables & Efficiency. Energy Efficiency Targets.* Webpage. Last updated: 6 April 2011. Date accessed: December 6 2011. Content: Summary of energy efficiency targets required of the Efficiency Maine Trust. Available from: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ME17R&re=1&ee=1.

186. (2008) "An Act To Establish a Uniform Building and Energy Code." 123rd Maine Legislature, Sponsered by Representative Smith of Monmouth, First Special Session, H.P 1619 - L.D. 2257. Enacted 15 April 2008. <http://www.mainelegislature.org/ros/LOM/LOM123rd/123S1/pdf/PUBLIC699.pdf> (accessed 2 November 2011).

187. Database of State Incentivers for Renewables & Efficiency (DSIRE), (2011). *Maine -- Incentives/Policies for Renewables & Efficiency. Maine Model Building Energy Code.* Webpage. Last updated: 10 June 2011. Date accessed: December 6 2011. Content: Summary of Maine Model Building Energy Code requirements. Available from: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ME10R&re=1&ee=1.

188. (Department of Public Safety - Bureau of Building Codes & Standards), *Legislation from the 125th Legislature.* Webpage. Last updated: NA. Date accessed: 2 November 2011. Content: Webpage describing the changes made to the 2008 law "An Act To Establish a Uniform Building and Energy Code," including the list of exceptions, what must be adopted for different categories and when, and removal of a requirement for the Technical Building Codes and Standards Board. Available from: http://www.maine.gov/dps/bbcs/Legislation%20from%20the%20125th%20Legislature.html.

189. (2010), *Statute Administered By Maine Land Use Regulation Commission, Department of Conservation, As Amended Through the Second Regular Session of the 124th Legislature.* Title 12. Conservation. Accessed 25 January 2012; http://www.maine.gov/doc/lurc/reference/Statute_2010_0901_Final.pdf.

190. Land Use Regulation Commission (LURC), *Reference Materials*. Webpage. Last updated: NA. Date accessed: 25 January 2012. Content: Description of LURCs mission, authority, and standing. Available from: http://www.maine.gov/doc/lurc/reference_new1.shtml.

191. Department of Environmental Protection (DEP), (© 2005). *Permits, Laws and Rules*. Webpage. Last updated: NA. Date accessed: 2 December 2011. Content: Page identifying the DEP programs that require permits; state-required professional certifications; fees and timelines; laws & rules in Maine; and related links. Available from: http://www.maine.gov/dep/permits.htm.

192. Bureau of Land & Water Quality (Department of Environmental Protection), (© 2005). *Permits & Standards*. Webpage. Last updated: NA. Date accessed: 2 December 2011. Content: Page identifying the programs run by the Bureau of Land & Water quality that require permits and have regulatory standards. Available from: http://www.maine.gov/dep/blwq/stand.htm.

193. Maine Department of Marine Resources (DMR), (© 2011). *About the Maine Department of Marine Resources*. Webpage. Last updated: NA. Date accessed: 2 December 2011. Content: Page identifying DMR organization, contact information, plans, policies, and job and volunteering opportunities. Available from: http://www.maine.gov/dmr/organization.htm.

194. Department of Inland Fisheries and Wildlife (IFW), (©2010). *Bureau of Resource Management*. Webpage. Last updated: NA. Date accessed: 25 January 2012. Content: Description of the Bureau of Resource Management. Available from: http://www.maine.gov/ifw/bureaus_divisions/resource_management.htm.

195. Maine Public Utilties Commission (MPUC), (© 2008). *About MPUC*. Webpage. Last updated: NA. Date accessed: 2 December 2011. Content: Page describing the responsibilites of the MPUC. Available from: http://www.maine.gov/mpuc/about/index.shtml.

196. Database of State Incentivers for Renewables & Efficiency (DSIRE), (2011). *Maine -- Incentives/Policies for Renewables & Efficiency. Renewables Portfolio Standard*. Webpage. Last updated: 2 September 2011. Date accessed: December 6 2011. Content: Summary of Maine PUC Renewable Portfolio Standard (RPS) Requirement. Available from: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ME01R&re=1&ee=1.

197. Database of State Incentivers for Renewables & Efficiency (DSIRE), (2011). *Maine -- Incentives/Policies for Renewables & Efficiency. Solar Hot Water Contractor Licensing*. Webpage. Last updated: 1 February 2011. Date accessed: December 6 2011. Content: Summary of eligiablility requirements for solar thermal rebate program through Maine PUC. Available from: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ME16R&re=1&ee=1.

198. Database of State Incentives for Renewables & Efficiency (DSIRE), (2011). *Maine -- Incentives/Policies for Renewables & Efficiency. Maine - Net Energy Billing*. Webpage. Last updated: 30 September 2011. Date accessed: December 6 2011. Content: Summary of required net energy billing program. Available from: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ME02R&re=1&ee=1.

199. Finance Authority of Maine (FAME), (©2009). *Energy Conservation Loan Program*. Webpage. Last updated: NA. Date accessed: December 6 2011. Content: Description of low-interest loan program to improve workplace energy efficiency, funded through PUC. Available from: http://www.famemaine.com/Files/Pages/business%5Cbusinesses%5Cdirect_loans/Energy_Conservation_Loans.aspx.

200. Maine Historic Preservation Commission (MHPC), (©2006). *MHPC Project Review Process*. Webpage. Last updated: NA. Date accessed: 25 January 2012. Content: Description of the Maine Historic Preservation Commission. Available from: http://www.maine.gov/mhpc/project_review/index.html.

201. Maine State Planning Office (SPO), (©2006). *Current Special Projects*. Webpage. Last updated: NA. Date accessed: 25 January 2012. Content: Description of the current and previous special projects undertaken by the Maine State Planning Office. Available from: http://www.maine.gov/spo/specialprojects/index.htm.

202. RGGI Inc. *Welcome*. Webpage. Last updated: NA. Date accessed: 2 December 2011. Content: Page providing a general overview of the Regional Greenhouse Gas Initiative (RGGI). Available from: http://rggi.org/.

203. US Army Corp of Engineers (New England District), (2011). *Regulatory / Permitting*. Webpage. Last updated: 30 November 2011. Date accessed: 2 December 2011. Content: Page describing the regulatory responsibilties the Corps of Engineers. Available from: http://www.nae.usace.army.mil/Regulatory/.

204. Bureau of Ocean Energy Management *Title 30: Mineral Resources, Part 585 - Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, Subpart A - General Provisions*. Electronic Code of Federal Regulations (e-CFR), 30 November 2011. (Document type: United States Code of Federal Regulations), found at <http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=f4389ecfb661803af8cdf9fc61a13b82&rgn=div5&view=text&node=30:2.0.3.5.13&idno=30#30:2.0.3.5.13.1.231.2> (accessed 2 December 2011).

205. Bureau of Safety and Environmental Enforcement *Title 30: Mineral Resources, Chapter II--Bureau of Safety and Environmental Enforcement, Department of the Interior, Subchapter B - Offshore*. Electronic Code of Federal Regulations (e-CFR), 1 December 2011. (Document type: United States Code of Federal Regulations), found at <http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?sid=d01bb4b3b5aff8a452aa81bba2afc057&c=ecfr&tpl=/ecfrbrowse/Title30/30cfrv2_02.tpl#200> (accessed 5 December 2011).

206. (National Archives), *Executive Order 10485--Providing for the performance of certain functions heretofore performed by the President with respect to electric power and natural gas facilities located on the borders of the United States*. Webpage. Last updated: NA. Date accessed: 5 December 2011. Content: Text of Executive Order 10485. Available from: http://www.archives.gov/federal-register/codification/executive-order/10485.html.

207. Federal Energy Regulatory Commission (FERC), (2010). *What FERC does*. Webpage. Last updated: 3 December 2010. Date accessed: 2 December 2011. Content: Page describing the responsibilties of FERC and identifies those areas that FERC does not regulate. Available from: http://www.ferc.gov/about/ferc-does.asp.

208. Federal Aviation Administration *Title 14: Aeronautics and Space, Subpart B - Notice Requirements*. Electronic Code of Federal Regulations (e-CFR), 30 November 2011. (Document type: United States Code of Federal Regulations), found at <http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=3506af380c65dc9f2c86c049e4bc18a1&rgn=div5&view=text&node=14:2.0.1.2.9&idno=14> (accessed 2 December 2011).

209. U.S. Fish & Wildlife Service (FWS), (2011). *Permits - Laws/Treaties/Regulations*. Webpage. Last updated: 6 July 2011. Date accessed: 5 December 2011. Content: Overview and brief summary of topic/law/treaty under the jurisdiction of FWS. Available from: http://www.fws.gov/permits/ltr/ltr.html.

210. National Marine Fisheries Service (NOAA), *Permits*. Webpage. Last updated: NA. Date accessed: 5 December 2011. Content: Listing of links for the National Marine Fisthers Service Permit Portal. Available from: http://www.nmfs.noaa.gov/permits.htm.

211. United States Coast Guard (USCG), (2010). *Missions - Maritime Stewardship*. Webpage. Last updated: 25 August 2010. Date accessed: 5 December 2011. Content: Description of the U.S. Coast Guard Maritime Stewardship mission, including reference to specfic laws. Available from: http://www.uscg.mil/top/missions/MaritimeStewardship.asp.

212. BusinessDictionary.com (WebFinance, Inc.), (©2012). *economic development*. Webpage. Last updated: NA. Date accessed: 5 January 2012. Content: Definition of economic development. Available from: http://www.businessdictionary.com/definition/economic-development.html.

213. Wikipedia (Wikimedia Foundation Inc.), (2011). *Economic development*. Webpage. Last updated: 10 December 2011. Date accessed: 5 January 2012. Content: Definition and description of economic development. Available from: http://en.wikipedia.org/wiki/Economic_development.

214. The Redevelopment Agency (City of Burbank), (©2010). *What is Economic Development?* Webpage. Last updated: NA. Date accessed: 5 January 2012. Content: Description of economic development and how it relates to Burbank. Available from: http://www.burbankca.org/redevelopment/econdev/whatised.html.

215. The Network (Economic Development Services, Inc.), (©2010). *What is Economic Development?* Webpage. Last updated: 31 December 2010. Date accessed: 5 January 2012. Content: Description of economic development and a collection of definitions. Available from: http://www.economicdevelopment.net/ad_n/about.htm#about.

216. Perry, S.E. (Canadian Centre for Community Renewal), (©2001-2003). *CED Definitions & Terminology*. Webpage. Last updated: NA. Date accessed: 5 January 2012. Content: Description of terms and definitions used in the field of economic development. Available from: http://www.cedworks.com/article_3.html#ed.

217. Department of Workforce Services (State of Arkansas), *Glossary*. Webpage. Last updated: NA. Date accessed: 5 January 2012. Content: A "list of list of terms that are often used in connection with employment and labor market information". Available from: http://www.discoverarkansas.net/?pageid=119#E.

218. SEEP Network (©2012). *Annex 1: Glossary for Economic Recovery Standards*. Webpage. Last updated: NA. Date accessed: 5 January 2012. Content: "...definitions for the commonly used terminology in the Economic Recovery Standards". Available from: http://communities.seepnetwork.org/econrecovery/node/851.

219. Centre for Financial & Management Studies (University of London), (©2012). *C116 - Unit 1: Conceptualising Development*. Webpage. Last updated: NA. Date accessed: 5 January 2012. Content: On-line learning unit; listing of "Key Terms and Concepts" for development. Available from: http://www.cefims.ac.uk/cedepapp/116_web_unit/page_32.htm.

220. Gabe, T. to K. Dickerson (2012). Personal communication: email. Comments on paper drafts. 25 January 2012.

221. Kelly, R. to K. Dickerson (2012). Personal communication: email. Response to questions regarding how to best describe and measure economic development, and how energy in Maine fits into economic development. 3 January 2012.

Margaret Chase Smith Policy Center
5784 York Complex, Bldg. #4
University of Maine, Orono, ME 04469-5784
Phone: (207) 581-1648 | Fax: (207) 581-1266
Email:info@mcspolicycenter.umaine.edu