Energy and
Environmental
Policy

Thermal Renewable Energy and Efficiency Act of 2010:

Economics and impacts

Mark Spurr, IDEA Legislative Director

> TREEA is intended to stimulate investments in low-carbon thermal energy infrastructure, focusing on renewable energy to meet heating and cooling needs.

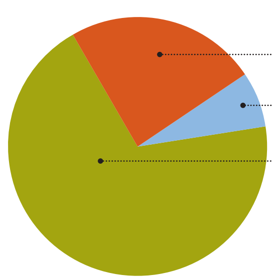
By the time this column is in print, I expect that the Thermal Renewable Energy and Efficiency Act of 2010 (TREEA) will have been introduced in both the Senate (by Sen. Al Franken, D-Minn., and Sen. Kit Bond, R-Mo.) and in the House of Representatives (by Rep. Betty McCollum, D-Minn.). This article summarizes the rationale for the bill and projects its impacts, per the June 9 version of the bill, on energy use, greenhouse gas emissions and federal costs.

Why the Act Is Important

Even if a U.S. climate bill is passed in 2010, it is likely to be many years before a cap-and-trade system has an impact on energy use. With continued uncertainties regarding U.S. climate legislation, it is now more essential than ever that the U.S. implements other policies that move us toward reduced fossil fuel consumption and lower greenhouse gas emissions. The Thermal Renewable Energy and Efficiency Act of 2010 will stimulate increased use of renewable energy sources to heat and cool buildings throughout the country.

Thermal energy must be a key part of near-term energy and environmental policy. Thermal energy is an essential, but often overlooked, part of the U.S. energy picture. Of the total primary energy consumed in 2005, 31 quadrillion Btu (quads), representing 31 percent, was used for heating and cooling buildings and industrial processes (fig. 1). Thermal energy is the key to unlocking a wide range of opportunities for reducing greenhouse gas emissions, including renewable thermal energy sources as well as combined heat and power and other energy-efficient technologies.

Figure 1. U.S. Primary Energy Consumption for Thermal End Uses Compared With All Other End Uses, 2005.



Source: Analysis by IDEA using data from the U.S. Energy Information Administration (EIA), Table 5.2 End Uses of Fuel Consumption, 2002; EIA, Table 2.3 Manufacturing Energy Consumption for Heat, Power, and Electricity Generation by End Use, 2002; EIA, Energy Market and Economic Impacts of S. 280, the Climate Stewardship and Innovation Act of 2007; Energy and Environmental Analysis Inc. and IDEA, District Energy Services: Commercial Data Analysis for EIA's National Energy Modeling System, August 2007; IDEA member surveys, 2003-2009; IDEA, TREEA Analysis Detailed Model, June 30, 2010.

Examples of use of renewable thermal energy resources to reduce greenhouse gas emissions include the following:

- Seattle Steam Co. found that directly producing heat with its new biomass heating plant was the most feasible approach to making productive use of waste wood, given specific pricing and contractual issues with the power utility.
- District heating serving the Oregon Institute of Technology uses low-temperature geothermal resources to provide a clean, renewable source of campus heat.
- Cornell University constructed a piping system that uses naturally occurring cold lake water for building air conditioning, cutting electricity consumption by 87 percent.
- At the University of California, Los Angeles, landfill gas is used for CHP, producing heating, cooling and power.

Provisions and Overview of Benefits

TITLE I: THERMAL ENERGY PRODUCTION TAX CREDITS

Background

The Internal Revenue Code (U.S.C. 26 Section 45) provides a production tax credit (PTC) for generation of electricity using certain renewable resources. Wind, geothermal and "closed-loop" bioenergy (which is powered by dedicated energy crops) are eligible for a PTC of $0.022/kWh of electricity produced. Other technologies, such as "open-loop" biomass, incremental hydropower, small irrigation systems, landfill gas and municipal solid waste, receive $0.011/kWh.

What the Act Does

The Act expands the PTC to production of renewable thermal energy. (Tax credits for thermal energy would be the same, per unit of energy produced, as the current electricity tax credits. One kilowatt-hour of energy, whether it is electricity or thermal energy, is equivalent to 3,412 Btu. This conversion factor can be found in any thermodynamics textbook and is familiar to engineers all over the world. Although in the U.S. it is not common to measure thermal energy in kilowatt-hours, in Europe the kilowatt-hour is the conventional unit of measure for both thermal energy and electricity.)

Rationale

By limiting PTCs to electricity only, we are significantly limiting our ability to shift to a low-carbon sustainable future. There are substantial opportunities to expand the use of renewable resources to meet thermal energy needs (i.e., space heating, air conditioning, domestic hot water, and process heating and cooling). There is support for this concept. For example, renewable thermal energy PTCs were included in S.1370, the Clean Energy Investment Assurance Act of 2007, sponsored by Senators Maria Cantwell, D-Wash.; John Kerry, D-Mass.; and Gordon Smith, R-Ore. A renewable thermal energy PTC would provide an extremely important incentive to invest in these systems, accelerating our nation's transition to a low-carbon future.

TITLE II: EXPANSION OF TAX-EXEMPT BONDING

Background

The Internal Revenue Code (U.S.C. 26 Section 142) provides for exempt facility bonds for financing a range of facilities with public benefits, including airports; facilities furnishing water, electric energy or gas; and "local district heating or cooling facilities." The latter is defined as "a pipeline or network (which may be connected to a heating or cooling source) providing hot water, chilled water, or steam to two or more users for residential, commercial, or industrial heating or cooling, or process steam."

What the Act Does

The Act enables tax-exempt bonds to be used for financing district energy plant and building connection assets as well as distribution piping.

Rationale

The capital costs of district energy systems include not only the piping distribution systems but also the plant facilities for producing thermal energy and the equipment for transferring thermal energy to building heating and cooling systems. Potential plant investments provide key opportunities for increased efficiency, use of renewable energy and reduced carbon emissions. By reducing interest costs, tax-exempt financing reduces debt service costs and thus stimulates increases in the application of these low-carbon systems and the public benefits they provide.

TITLE III: ENERGY SUSTAINABILITY AND EFFICIENCY GRANTS FOR INSTITUTIONS

Background

The Energy Independence and Security Act of 2007 authorized the Energy Sustainability and Efficiency Grants for Institutions program. In conjunction with efforts to appropriate funds for this program, TREEA would amend the authorization to eliminate constraints that impair the effectiveness of the program.

What the Act Does

The Act:

- raises the cap on the program's grants to $20 million (while increasing the local cost-share requirement from 40 percent to 70 percent);
- increases caps on technical assistance grants (while retaining local cost-share requirements);
- increases the authorized annual funding for the grant program to $500 million;
- extends program eligibility to not-for-profit district energy systems; and
- extends the time period of the grant and loan program through FY 2015.

Rationale

The increase in the cap will enable grants to larger projects with greater efficiency gains, and the increase in authorized funding will result in an increased number of beneficial projects. These increases are consistent with the characteristics of projects submitted in response to a U.S. Department of Energy solicitation using $156 million in American Recovery and Reinvestment Act funds. In this solicitation, which was oversubscribed by a 25-to-1 ratio, the maximum requested federal share was $60 million, with an average of more than $10 million. The time extension will allow Congress to appropriate funds to this program – which remains to be done. These changes will expand the ability of this program to reduce greenhouse gas emissions, create jobs, increase grid reliability and enhance energy security.

Analysis of Impacts

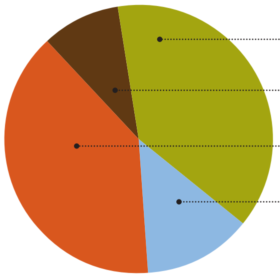
SCOPE OF THE ANALYSIS

This analysis addresses the impacts of Title I, which is anticipated to affect both the district energy sector and the industrial sector. Title II impacts will be entirely within the district energy sector. Title II is expected to stimulate borrowing that would otherwise not occur, so there is not expected to be foregone interest income tax revenue. Title III amends the authorization for a program created by the Energy Independence and Security Act of 2007, but will have no impact unless and until funds are appropriated.

The analysis focuses on four types of impacts:

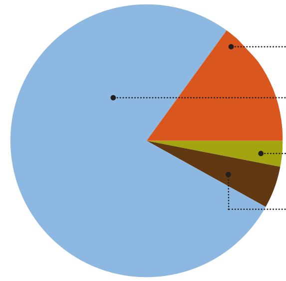
1. Project economics – How will the provision affect the economics of representative projects such that it provides an appropriate and effective incentive to invest?
2. Extent of impact – How many and what kinds of projects will occur as a result of the provision?
3. Scoring – What level of investment will be stimulated by the provision, and what are the projected costs to the U.S. Treasury?
4. Primary energy and greenhouse gas reduction – What level of reductions will occur in primary energy consumption and greenhouse gas emissions?

Figure 2. U.S. Primary Energy Consumption for Thermal Purposes by Sector and End Use, 2005.



Source: Analysis by IDEA using data from the U.S. Energy Information Administration (EIA), Table 5.2 End Uses of Fuel Consumption, 2002; EIA, Table 2.3 Manufacturing Energy Consumption for Heat, Power, and Electricity Generation by End Use, 2002; IDEA, TREEA Analysis Detailed Model, June 30, 2010.

Figure 4. U.S. District Energy Fuel Consumption by Fuel Type, 2005.



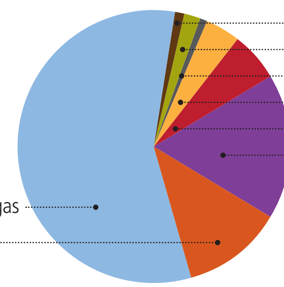
Source: Analysis by IDEA using data from Energy and Environmental Analysis Inc. and IDEA, District Energy Services: Commercial Data Analysis for EIA's National Energy Modeling System, August 2007; IDEA member surveys, 2003-2009; IDEA, TREEA Analysis Detailed Model, June 30, 2010.

Figure 3. Direct and Indirect Beneficiaries of Thermal Production Tax Credit.

Direct	For-profit district systems
	Energy performance contractors
Indirect	Colleges and universities
	Local governments
	Municipal utilities
	Nonprofit district systems
	Equipment vendors

Source: IDEA.

Figure 5. U.S. Manufacturing Fuel Consumption for Thermal Energy Production, by Fuel Type, 2005.



Source: Analysis by IDEA using data from U.S. Energy Information Administration (EIA), Table 5.2 End Uses of Fuel Consumption, 2002; EIA, Table 2.3 Manufacturing Energy Consumption for Heat, Power, and Electricity Generation by End Use, 2002; EIA, Table 10.10 Capability to Switch Coal to Alternative Energy Sources, 2002.

The analysis draws on data and studies from the U.S. Energy Information Administration (EIA), the International District Energy Association (IDEA) and confidential, project-specific engineering and economic data from studies undertaken for consulting clients. Figure 2 shows how the primary energy consumed for thermal end uses breaks down by sector and type of thermal end use.

BENEFICIARIES

The PTC requires sale of the energy produced. Therefore, taxable district energy companies and energy performance contractors can benefit directly from the PTC. A wide range of other entities can benefit indirectly by purchasing thermal energy from the direct beneficiaries at a lower cost as a result of the PTC. These indirect beneficiaries include colleges, universities, local governments, municipal utilities and others, as summarized in figure 3.

District Energy

IDEA estimates that there are more than 2,500 district energy systems in the country serving 8.4 billion sq ft of building space, equal to 12 percent of total commercial floor space. Figure 4 summarizes district energy fuel consumption in the U.S. The predominant fuel is natural gas, providing 77 percent of total fuel, with coal a distant second at 15 percent, oil at 5 percent and biomass at 3 percent. We estimate that greenhouse gas emissions by district energy systems total 63 million metric tons of carbon dioxide equivalent ($MMTCO_2e$), or 1 percent of total U.S. energy-related greenhouse gas emissions. Of the total emissions, 56 $MMTCO_2e$ are direct emissions from district energy facilities, and 7 $MMTCO_2e$ are indirect emissions from purchased electricity.

> $7.6 billion in capital investment in eligible facilities is projected to occur as a result of TREEA's PTC provisions.

Industrial Energy Use

The primary industrial uses of thermal energy are in manufacturing. Data from the EIA shows that total direct fuel consumption in all manufacturing (NAICS codes 311-339) in 2005 was 13,434 trillion Btu, of which an estimated 11,212 trillion Btu (84 percent) was for thermal purposes. Figure 5 summarizes the breakdown of industrial thermal energy sources by fuel. The predominant fuel is natural gas, providing 57 percent of total fuel with coal at 12 percent; black liquor, 6 percent; biomass, 4 percent; and "other," 17 percent. [Black liquor is the spent cooking liquor from the kraft process when digesting pulpwood into paper pulp. "Other" includes net steam (the sum of purchases, generation from renewables, and net transfers) and other energy that respondents indicated was used to produce heat and power.]

We estimate that greenhouse gas emissions by industry for thermal energy production total 834 $MMTCO_2e$, or 12 percent of total U.S. energy-related greenhouse gas emissions. Of the total emissions, 623 $MMTCO_2e$ are direct emissions from district energy facilities, and 211 $MMTCO_2e$ are indirect emissions from purchased electricity.

Major Renewable Thermal Energy Opportunities

BIOMASS

The largest near-term opportunity for renewable thermal energy production is biomass. Biomass is nonhazardous organic material such as urban waste wood (e.g., tree trimmings), forest industry mill residues, residues from sustainable forest harvesting, agricultural residues, food waste, algae, energy crops, animal waste and animal byproducts (including biogas and any solid produced by micro-organisms).

Communities, universities and other energy users in the U.S. have been investigating and implementing the potential for biomass and other local sources of sustainable energy. In Sweden and other European countries, biomass has already become an important energy source for district energy systems.

Increasing interest in biomass is driven by advances in technology, greenhouse gas emission goals, energy supply and price stability, and the potential for significant spinoff employment in fuel procurement and processing. Using biomass for energy also can eliminate disposal problems for some materials and create income. Residues from wood processors can be diverted from landfills or incineration. Manure from livestock operations can become an energy source instead of a disposal problem.

Solid biomass can be combusted directly in boilers to produce heat and/or power. Liquid or gaseous fuels can be produced from biomass for combustion in reciprocating engines or gas turbines. Biomass can provide a constant, stable energy supply, unlike wind and solar, and price stability, unlike oil and natural gas.

GEOTHERMAL

Low- to medium-temperature geothermal resources can be used to heat communities and some industrial processes in many (primarily Western) states. During the 1990s, the Geothermal Low-Temperature Resource Assessment Program identified 271 geothermal resource sites having a temperature of 122 degrees F or above that are within 5 miles of a population center. These co-located sites represent a population of 7.4 million. Low- to medium-temperature geothermal resources are not useful for geothermal power production but are perfectly suited for supplying thermal energy.

NATURAL AIR CONDITIONING

Deep water cooling is a technology that uses cold water drawn from deep sources such as lakes, seas, or underground aquifers to provide cooling needs to buildings connected to a district cooling system. There are a number of district cooling systems utilizing deep water cooling throughout the world, particularly in Sweden. For example, in Stockholm, the Baltic Sea is used to air-condition downtown Stockholm.

Domestically, a deep lake water cooling system has been implemented to air-condition the Cornell University campus. In Toronto, the largest lake water cooling system in the world has been developed using Lake Ontario as its water source.

Impact on Project Economics

Key technical and economic parameters for example projects that would be eligible for the renewable thermal energy production tax credit are summarized in table 1. These parameters are based on recent thermal energy projects. Capital costs are converted to annual costs assuming a weighted average cost of capital of 9.5 percent over 20 years (30 percent equity at 15.0 percent return and 70 percent debt at 7.2 percent interest.

Biomass

A range of sizes of biomass thermal-only facility scenarios is shown in table 1. In the modeling of biomass projects, we assume that the biomass fuel is open-loop and thus eligible for half credit ($0.011/kWh). Most of the expected implementation of biomass facilities will be for supply of thermal energy to already-established district energy systems in downtown areas and university campuses and in industrial facilities.

Biomass projects generating electricity already qualify for the PTC in current law. Biomass CHP generates both electricity and thermal energy. In the June 9 version of TREEA, a project producing both electricity and thermal energy could only receive the PTC for either of those outputs but not both. In the biomass CHP case in table 1, if the PTC was applied to the electricity output, annual costs would be reduced by 7 percent, whereas if the PTC was applied to the thermal output, the cost reduction would be 18 percent. If the PTC was applied to the combined output, the total annual cost reduction would be 25 percent.

> The PTC is projected to bring the cost of biomass thermal energy down from $12.18/MMBtu to $8.96/MMBtu.

In contrast, biomass thermal-only facilities would see annual cost reductions ranging from 23 percent to 26 percent,

Table 1. Projected Renewable Thermal Production Tax Credit Costs to the U.S. Treasury (in Millions of Dollars).

	Biomass				Geothermal	Natural Air Conditioning
TECHNICAL PARAMETERS	**CHP**	**Thermal Only**	**Thermal Only**	**Thermal Only**		
Power generation capacity (MW)	22					
Thermal output capacity (MMBtu/hr)	180	180	120	90	18	240
Thermal output capacity (tons of refrigeration)						20,000
Power efficiency	19%					
Thermal efficiency	46%	65%	65%	65%	95%	96%
Total efficiency	65%	65%	65%	65%	95%	96%
Heat rate (Btu/kWh)	17,963					
Capacity factor	0.80	0.80	0.80	0.80	0.23	0.25
CHP power generated (MWh)	154,176					
Thermal energy generated (MMBtu)	1,261,440	1,261,440	840,960	630,720	36,266	525,600
Primary fuel reduction (MMBtu fuel per MMBtu of heat produced)		1.43	1.43	1.43	1.43	1.04
Fuel used (MMBtu)	2,769,488	1,576,800	1,051,200	788,400		
COSTS						
Fuel price ($/MMBtu)	$4.00	$4.00	$4.00	$4.00		
CHP nonfuel operating costs ($/MWh)	$18.00					
Thermal-only nonfuel operating costs ($/MMBtu)		$2.00	$2.50	$2.90	$3.00	$1.75
Capital costs ($ million)	$81.4	$57.6	$40.8	$32.4	$8.1	$70.0
Annual costs ($ million)						
Amortization of capital	$9.2	$6.5	$4.6	$3.7	$0.92	$7.94
Fuel	$11.1	$6.3	$4.2	$3.2	$-	$0.50
Nonfuel operating costs	$2.8	$2.5	$2.1	$1.8	$0.11	$0.92
Total	$23.1	$15.4	$10.9	$8.7	$1.03	$9.36
Unit costs						
Assumed market value of electricity ($/MWh)	$50.0					
Net cost of thermal energy ($/MMBtu)	$12.19	$12.18	$13.01	$13.73	$21.90	$11.36
PRODUCTION TAX CREDIT						
Per unit of output						
$/MWh of electricity	11.00					
$/MMBtu	3.22	3.22	3.22	3.22	6.45	6.45
Percentage reduction in annual costs						
Taken for power	7%					
Taken for thermal	18%	26%	25%	23%	23%	36%
Total	25%	26%	25%	23%	23%	36%

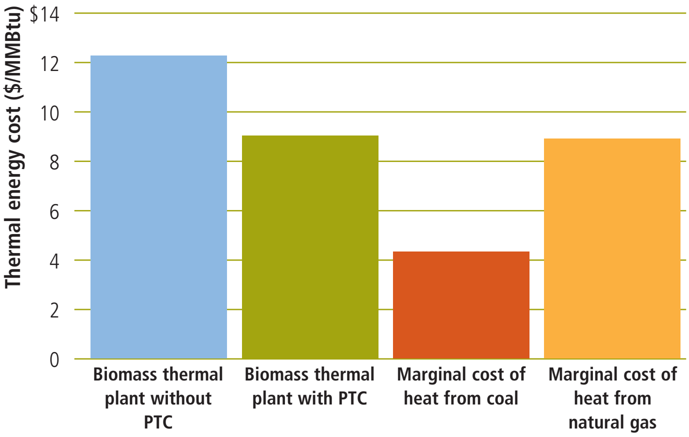
Source: Analysis by IDEA using data from IDEA, TREEA Analysis Detailed Model, June 30, 2010.

depending on size. Constructing a biomass CHP plant is more complex and expensive than a constructing a biomass thermal-only plant with a comparable thermal output. In order to encourage biomass power production, it is recommended that TREEA be modified to allow application of the PTC to both electricity and thermal energy.

The PTC is projected to bring the cost of biomass thermal energy down from $12.18/MMBtu to $8.96/MMBtu. Although the marginal fuel costs of heat from coal and natural gas are estimated to be only $4.17/MMBtu and $8.34/MMBtu, respectively, the PTC will make many projects viable considering other factors, including the drive to reduce carbon emissions and the avoided capital cost of additional boiler facilities to meet increasing energy demands. The comparative costs are illustrated in figure 6.

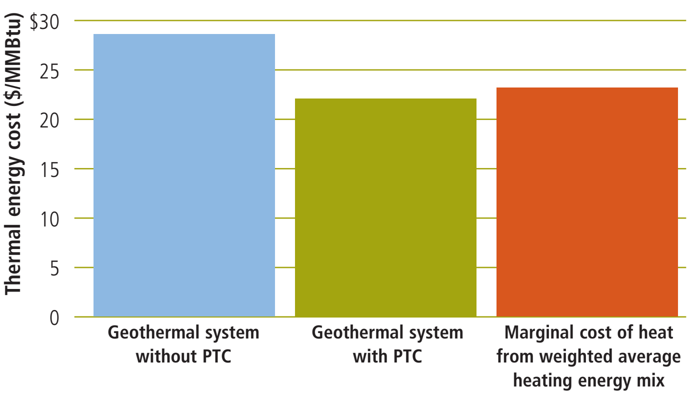
We project that more than 130 biomass facilities would result from the passage of the renewable thermal PTC.

Figure 6. Impact of Thermal Energy Production Tax Credit on Economic Viability of Biomass Heating.



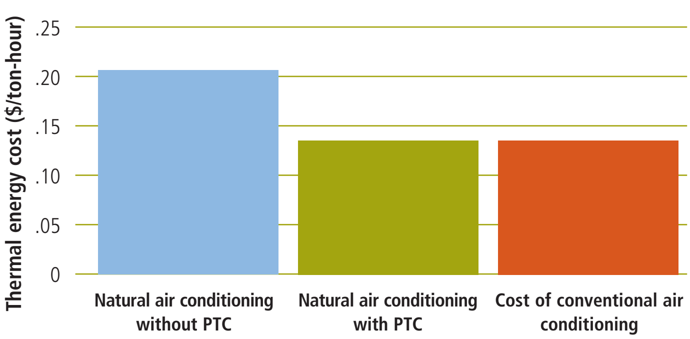
Source: Analysis by IDEA using data from IDEA, TREEA Analysis Detailed Model, June 30, 2010; U.S. Energy Information Administration, monthly energy price data (U.S. averages), 2009; FVB Energy Inc. confidential client data files.

Figure 7. Impact of Thermal Energy Production Tax Credit on Economic Viability of Geothermal Heating.



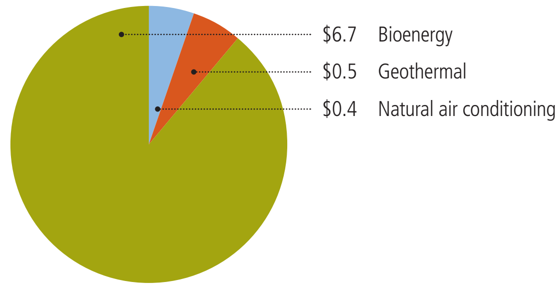
Source: Analysis by IDEA using data from IDEA, TREEA Analysis Detailed Model, June 30, 2010; U.S. Energy Information Administration, monthly energy price data (U.S. averages), 2009; FVB Energy Inc. confidential client data files.

Figure 8. Impact of Thermal Energy Production Tax Credit on Economic Viability of Natural Air Conditioning.



Source: Analysis by IDEA using data from IDEA, TREEA Analysis Detailed Model, June 30, 2010; U.S. Energy Information Administration, monthly energy price data (U.S. averages), 2009; FVB Energy Inc. confidential client data files.

Figure 9. Projected Capital Investment Stimulated by Thermal Energy Production Tax Credit (in Billions of Dollars).



Source: Analysis by IDEA using data from IDEA, TREEA Analysis Detailed Model, June 30, 2010; U.S. Energy Information Administration, Table 10.10 Capability to Switch Coal to Alternative Energy Sources, 2002.

Geothermal

Geothermal systems are expected to be considerably smaller than the biomass systems, with many likely to serve smaller communities and a limited number of low-temperature industrial processes. Because smaller communities generally have relatively low development density, the capital costs of thermal distribution systems (which are incorporated in the geothermal capital costs in these calculations) are high per unit of heat supplied. Geothermal production would receive full PTC credit, resulting in an estimated 23 percent reduction in annual costs.

The PTC is projected to bring the cost of geothermal heating down from $28.34/MMBtu to $21.90/MMBtu. Geothermal heat will most likely compete with a mix of high-cost energy sources including propane and electricity. With the marginal cost of heat from a representative mix of heat resources estimated to be $22.98/MMBtu, the PTC will make some projects viable, especially considering other factors, including the drive to reduce carbon emissions. The comparative costs are illustrated in figure 7.

We project that more than 60 geothermal heating systems would result from the passage of the renewable thermal PTC.

Natural Air Conditioning

Natural air conditioning systems are very capital-intensive projects. The installed costs of such systems will vary depending on case-specific circumstances, with a representative cost of $3,500 per ton of refrigeration capacity, more than twice the capital cost of conventional electrical chiller plants (1 ton is equivalent to the removal of 12,000 Btu of heat). However, natural air-conditioning systems reduce energy consumption by more than 85 percent. If the thermal energy PTC for natural air conditioning is provided at full credit ($0.022/kWh, like wind power), the annual costs of such systems would be reduced by an estimated 36 percent. (Note: The June 9 version of TREEA from the Senate Legislative Counsel only provides for half credit for natural air conditioning. This was an oversight in the original draft of the bill and should be corrected.)

The PTC is projected to bring the cost of natural air conditioning down from $0.21/ton-hr to $0.14/ton-hr of cooling. With the total cost of cooling production with conventional electric

Table 2. Projected Renewable Thermal Production Tax Credit Costs to the U.S. Treasury (in Millions of Dollars).

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Renewable thermal energy eligible for credit (trillion Btu)										
Bioenergy	-	12	138	138	138	138	138	138	138	138
Geothermal	-	1	2	2	2	2	2	2	2	2
Natural air conditioning	-	1	3	3	3	3	3	3	3	3
Total	-	14	143	143	143	143	143	143	143	143
Credit amount ($/MMBtu)										
Bioenergy	$3.22	$3.22	$3.22	$3.22	$3.22	$3.22	$3.22	$3.22	$3.22	$3.22
Geothermal	$6.45	$6.45	$6.45	$6.45	$6.45	$6.45	$6.45	$6.45	$6.45	$6.45
Natural air conditioning	$6.45	$6.45	$6.45	$6.45	$6.45	$6.45	$6.45	$6.45	$6.45	$6.45
Annual costs to Treasury ($ million)										
Bioenergy	$-	$40	$446	$446	$446	$446	$446	$446	$446	$446
Geothermal	$-	$4	$14	$14	$14	$14	$14	$14	$14	$14
Natural air conditioning	$-	$4	$19	$19	$19	$19	$19	$19	$19	$19
Total	$-	$48	$479	$479	$479	$479	$479	$479	$479	$479
Cumulative costs to Treasury ($ million)	**$-**	**$48**	**$527**	**$1,006**	**$1,485**	**$1,965**	**$2,444**	**$2,923**	**$3,402**	**$3,881**

Source: International District Energy Association, TREEA Analysis Detailed Model, June 30, 2010.

chiller plants estimated to be $0.14/ton-hr, the PTC will make projects viable where cold water resource conditions make natural air conditioning possible. The comparative costs are illustrated in figure 8.

A relatively small number of natural air-conditioning systems are expected to be implemented because they require specific physical conditions and are time-consuming to plan and permit.

Impact on Capital Investment and Market Penetration

The renewable thermal energy PTC would become available upon the signing of TREEA into law. Per the June 9 version of the bill, eligible facilities would have to be placed in operation by Jan. 1, 2014. This provides a relatively narrow window of opportunity for planning, designing, financing and constructing major capital facilities. We are working to modify TREEA so that eligibility is extended to five years following enactment.

The renewable thermal energy PTC is projected to reduce district energy greenhouse gas emissions by 10.1 percent and industrial greenhouse gas emissions by 1.3 percent.

We project that $7.6 billion in capital investment in eligible facilities will occur as a result of the PTC provisions of TREEA, of which $6.7 billion, or 88 percent, will be for biomass, as illustrated in figure 9. Of the total $7.6 billion in investment, we project that $3.1 billion (40 percent) will occur to supply district energy systems, and $4.5 billion (60 percent) will occur to serve industrial facilities.

The industrial sector is far bigger than the district energy sector. However, because the PTC requires that the produced energy be sold, the percentage utilization of the PTC in the industrial sector will be significantly lower because it will require relatively greater participation by energy performance contractors to construct the facilities and sell the resulting thermal energy to industrial hosts.

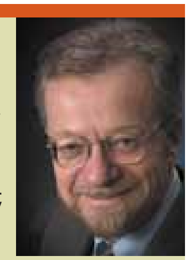
Impact on Primary Energy Consumption and Greenhouse Gas Emissions

The renewable thermal energy PTC is projected to reduce primary energy consumption by 204 trillion Btu annually, or 5.7 quads through 2040. Greenhouse gas emissions are projected to drop by 17.3 $MMTCO_2e$ annually, or 487 $MMTCO_2e$ through the year 2050.

The PTC is projected to reduce district energy greenhouse gas emissions by 10.1 percent and industrial greenhouse gas emissions by 1.3 percent.

Costs to the Treasury

Annual costs to the Treasury are projected in table 2. Cumulative 10-year costs are projected to be $3.9 billion. The federal cost amounts to less than $8.00 per metric ton of CO_2e.



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