PRESENT LAW AND BACKGROUND RELATING TO TAX CREDITS FOR ELECTRICITY PRODUCTION FROM RENEWABLE SOURCES

Scheduled for a Public Hearing
Before the
SUBCOMMITTEE ON SELECT REVENUE MEASURES
of the
HOUSE COMMITTEE ON WAYS AND MEANS
on May 24, 2005

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CONTENTS

INTRODUCTION

The Subcommittee on Select Revenue Measures of the House Committee on Ways and Means has scheduled a public hearing for May 24, 2005, on tax credits for electricity production from renewable sources. This document,[1] prepared by the staff of the Joint Committee on Taxation, provides a description of the present law and the legislative history pertaining to the present-law credit for the production of electricity from certain renewable resources (section 45 of the Internal Revenue Code). This document also discusses issues related to section 45.

[1] This document may be cited as follows: Joint Committee on Taxation, *Present Law and Background Relating to Tax Credits for Electricity Production from Renewable Sources* (JCX-36-05), May 19, 2005.

I. PRESENT LAW AND LEGISLATIVE HISTORY

A. Present Law

In general

An income tax credit is allowed for the production of electricity from qualified facilities sold by the taxpayer to an unrelated person (sec. 45). Qualified facilities comprise wind energy facilities, "closed-loop" biomass facilities, open-loop biomass (including agricultural livestock waste nutrients) facilities, geothermal energy facilities, solar energy facilities, small irrigation power facilities, landfill gas facilities, and trash combustion facilities. In addition, an income tax credit is allowed for the production of refined coal.

Credit amounts and credit period

In general

The base amount of the credit is 1.5 cents per kilowatt-hour (indexed for inflation) of electricity produced. The amount of the credit is 1.9 cents per kilowatt-hour for 2005. A taxpayer may claim credit for the 10-year period commencing with the date the qualified facility is placed in service. The credit is reduced for grants, tax-exempt bonds, subsidized energy financing, and other credits. The amount of credit a taxpayer may claim is phased out as the market price of electricity (or refined coal in the case of or refined coal production credit) exceeds certain threshold levels.

Reduced credit amounts and credit periods

In the case of open-loop biomass facilities (including agricultural livestock waste nutrient facilities), geothermal energy facilities, solar energy facilities, small irrigation power facilities, landfill gas facilities, and trash combustion facilities, the 10-year credit period is reduced to five years commencing on the date the facility is placed in service. In general, for eligible pre-existing facilities and other facilities placed in service prior to January 1, 2005, the credit period commences on January 1, 2005. In the case of a closed-loop biomass facility modified to co-fire with coal, to co-fire with other biomass, or to co-fire with coal and other biomass, the credit period begins no earlier than October 22, 2004.

In the case of open-loop biomass facilities (including agricultural livestock waste nutrient facilities), small irrigation power facilities, landfill gas facilities, and trash combustion facilities, the otherwise allowable credit amount is 0.75 cent per kilowatt-hour, indexed for inflation measured after 1992.

Credit applicable to refined coal

The amount of the credit for refined coal is $4.375 per ton (also indexed for inflation after 1992 and equaling $5.481 per ton for 2005).

Other limitations on credit claimants and credit amounts

In general, in order to claim the credit, a taxpayer must own the qualified facility and sell the electricity produced by the facility (or refined coal in the case of the refined coal production credit) to an unrelated party. A lessee or operator may claim the credit in lieu of the owner of the qualifying facility in the case of qualifying open-loop biomass facilities originally placed in service on or before the date of enactment and in the case of a closed-loop biomass facilities modified to co-fire with coal, to co-fire with other biomass, or to co-fire with coal and other biomass. In the case of a poultry waste facility, the taxpayer may claim the credit as a lessee or operator of a facility owned by a governmental unit.

For all qualifying facilities, other than closed-loop biomass facilities modified to co-fire with coal, to co-fire with other biomass, or to co-fire with coal and other biomass, the amount of credit a taxpayer may claim is reduced by reason of grants, tax-exempt bonds, subsidized energy financing, and other credits, but the reduction cannot exceed 50 percent of the otherwise allowable credit. In the case of closed-loop biomass facilities modified to co-fire with coal, to co-fire with other biomass, or to co-fire with coal and other biomass, there is no reduction in credit by reason of grants, tax-exempt bonds, subsidized energy financing, and other credits.

The credit for electricity produced from renewable sources is a component of the general business credit (sec. 38(b)(8)). Generally, the general business credit for any taxable year may not exceed the amount by which the taxpayer's net income tax exceeds the greater of the tentative minimum tax or so much of the net regular tax liability as exceeds $25,000. Excess credits may be carried back one year and forward up to 20 years.

A taxpayer's tentative minimum tax is treated as being zero for purposes of determining the tax liability limitation with respect to the section 45 credit for electricity produced from a facility (placed in service after October 22, 2004) during the first four years of production beginning on the date the facility is placed in service.

Qualified facilities

Wind energy facility

A wind energy facility is a facility that uses wind to produce electricity. To be a qualified facility, a wind energy facility must be placed in service after December 31, 1993, and before January 1, 2006.

Closed-loop biomass facility

A closed-loop biomass facility is a facility that uses any organic material from a plant which is planted exclusively for the purpose of being used at a qualifying facility to produce electricity. In addition, a facility can be a closed-loop biomass facility if it is a facility that is modified to use closed-loop biomass to co-fire with coal, with other biomass, or with both coal and other biomass, but only if the modification is approved under the Biomass Power for Rural Development Programs or is part of a pilot project of the Commodity Credit Corporation.

To be a qualified facility, a closed-loop biomass facility must be placed in service after December 31, 1992, and before January 1, 2006. In the case of a facility using closed-loop biomass but also co-firing the closed-loop biomass with coal, other biomass, or coal and other biomass, a qualified facility must be originally placed in service and modified to co-fire the closed-loop biomass at any time before January 1, 2006.

Open-loop biomass (including agricultural livestock waste nutrients) facility

An open-loop biomass facility is a facility using open-loop biomass to produce electricity. Open-loop biomass is defined as (1) any agricultural livestock waste nutrients, or (2) any solid, nonhazardous, cellulosic or lignin waste material which is segregated from other waste materials and which is derived from certain forest-related resources, solid wood waste materials, or agricultural sources. Eligible forest-related resources are mill residues, other than spent chemicals from pulp manufacturing, precommercial thinnings, slash, and brush. Solid wood waste materials include waste pallets, crates, dunnage, manufacturing and construction wood wastes (other than pressure-treated, chemically-treated, or painted wood wastes), and landscape or right-of-way tree trimmings. Agricultural sources include orchard tree crops, vineyard, grain, legumes, sugar, and other crop by-products or residues. However, qualifying open-loop biomass does not include municipal solid waste (garbage), gas derived from biodegradation of solid waste, or paper that is commonly recycled. In addition, open-loop biomass does not include closed-loop biomass or any biomass burned in conjunction with fossil fuel (co-firing) beyond such fossil fuel required for start up and flame stabilization.

Agricultural livestock waste nutrients are defined as agricultural livestock manure and litter, including bedding material for the disposition of manure.

To be a qualified facility, an open-loop biomass facility must be placed in service after October 22, 2004 and before January 1, 2006, in the case of facility using agricultural livestock waste nutrients and must be placed in service at any time prior to January 1, 2006 in the case of a facility using other open-loop biomass.

Geothermal facility

A geothermal facility is a facility that uses geothermal energy to produce electricity. Geothermal energy is energy derived from a geothermal deposit which is a geothermal reservoir consisting of natural heat which is stored in rocks or in an aqueous liquid or vapor (whether or not under pressure). To be a qualified facility, a geothermal facility must be placed in service after October 22, 2004 and before January 1, 2006.

Solar facility

A solar facility is a facility that uses solar energy to produce electricity. To be a qualified facility, a solar facility must be placed in service after October 22, 2004 and before January 1, 2006.

Small irrigation facility

A small irrigation power facility is a facility that generates electric power through an irrigation system canal or ditch without any dam or impoundment of water. The installed capacity of a qualified facility must be not less than 150 kilowatts but less than five megawatts. To be a qualified facility, a small irrigation facility must be originally placed in service after October 22, 2004 and before January 1, 2006.

Landfill gas facility

A landfill gas facility is a facility that uses landfill gas to produce electricity. Landfill gas is defined as methane gas derived from the biodegradation of municipal solid waste. To be a qualified facility, a landfill gas facility must be placed in service after October 22, 2004 and before January 1, 2006.

Trash combustion facility

Trash combustion facilities are facilities that burn municipal solid waste (garbage) to produce steam to drive a turbine for the production of electricity. To be a qualified facility, a trash combustion facility must be placed in service after October 22, 2004 and before January 1, 2006.

Refined coal facility

A qualifying refined coal facility is a facility producing refined coal that is placed in service after the date of enactment and before January 1, 2009. Refined coal is a qualifying liquid, gaseous, or solid synthetic fuel produced from coal (including lignite) or high-carbon fly ash, including such fuel used as a feedstock. A qualifying fuel is a fuel that when burned emits 20 percent less nitrogen oxides and either SO_2 or mercury than the burning of feedstock coal or comparable coal predominantly available in the marketplace as of January 1, 2003, and if the fuel sells at prices at least 50 percent greater than the prices of the feedstock coal or comparable coal. In addition, to be qualified refined coal the fuel must be sold by the taxpayer with the reasonable expectation that it will be used for the primary purpose of producing steam.

Summary of credit rate and credit period by facility type

Table 1.–Summary of Section 45 Credit for Electricity Produced from Certain Renewable Resources and Refined Coal

Electricity produced from renewable resources	Credit amount for 2005 (cents per kilowatt-hour; dollars per ton)	Credit period (years from placed-in-service date)[1]
Wind	1.9	10
Closed-loop biomass	1.9	10
Open-loop biomass (including agricultural livestock waste nutrient facilities)	0.9	5
Geothermal	1.9	5
Solar	1.9	5
Small irrigation power	0.9	5
Municipal solid waste (including landfill gas facilities and trash combustion facilities)	0.9	5
Refined Coal	**5.481**	**10**

[1] For eligible pre-existing facilities and other facilities placed in service prior to January 1, 2005, the credit period commences on January 1, 2005. In the case of certain co-firing closed-loop facilities, the credit period begins no earlier than October 22, 2004.

B. Legislative History

The Energy Policy Act of 1992 created section 45 as a production credit for electricity produced from wind and closed-loop biomass for production from certain facilities placed in service before July 1, 1999. The Ticket to Work and Work Incentives Improvement Act of 1999 added poultry waste as a qualifying energy source, extended the placed in service date through December 31, 2001, and made certain modifications to the requirements of qualifying wind facilities. The Job Creation and Worker Assistance Act of 2002 extended the placed in service date through December 31, 2003. The Working Families Tax Relief Act of 2004 extended the generally applicable placed in service date for wind facilities, closed-loop biomass facilities, and poultry waste facilities through December 31, 2005. The American Jobs Creation Act of 2004 ("AJCA") modified the provision to add as qualified facilities open-loop biomass (including agricultural livestock waste nutrients[2]), geothermal energy, solar energy, small irrigation power, and municipal solid waste (both landfill gas and trash combustion facilities). The AJCA defined refined coal as a qualifying resource eligible for credit. The AJCA also made other modifications.

At the time of passage of the credit in 1992, the House Committee on Ways and Means stated that "the credit is intended to enhance the development of technology to utilize the specified renewable energy sources and to promote competition between renewable energy sources and conventional energy sources."[3] The House Committee on Ways and Means further stated that the purpose of the original expiration date (June 30, 1999) was "to provide the committee with the opportunity to assess the effectiveness of the credit in encouraging the utilization of renewable energy sources."[4]

[2] The definition of agricultural livestock waste nutrients subsumes poultry waste, so the Act repealed, prospectively, poultry waste facilities as a separate category of qualified facility.

[3] House of Representatives, Rept.102-474, Part 6, "Comprehensive National Energy Policy Act," H.R. 776, p. 42.

[4] *Ibid.*

II. DISCUSSION OF ISSUES

Value of the production tax credit

Electricity produced from renewable resources

For a taxpayer with a positive tax liability, the electricity production credit is equivalent to a subsidy that pays the taxpayer for each kilowatt-hour of electricity produced in addition to the price at which the producer sells the electricity. That is, a tax credit that reduced a taxpayer's tax liability and therefore increases the taxpayer's bottom line produces a benefit to the taxpayer similar to a direct subsidy that is paid to the taxpayer to improve the taxpayer's top line.[5] Measured at a rate per kilowatt-hour, the direct subsidy equivalent of the electricity production tax credit is c/(1-t), where c is the credit rate per kilowatt-hour and t is the taxpayer's marginal tax rate.[6] If the taxpayer is a corporate taxpayer with a marginal tax rate of 35 percent, the subsidy equivalent of the 1.5 cents-per-kilowatt-hour base credit amount is approximately 2.3 cents per kilowatt-hour of electricity produced. The subsidy equivalent amount of the 2005 level of the credit (1.9 cents per kilowatt-hour) is approximately 2.9 cents per kilowatt-hour. For producers of electricity from qualifying renewable sources this "subsidy" would be in addition to the wholesale price they receive from the sale of power. Data on wholesale prices are not readily available. However, the Department of Energy reports data on retail prices. The Department of

[5] Under general income tax principles, such a subsidy paid to the taxpayer would be includable in taxable income as part of revenue. For the purposes of the subsequent discussion, it is assumed that such a subsidy is part of the taxpayer's taxable income.

[6] To see that c/(1-t) is the direct subsidy equivalent of the electricity production tax credit, the analysis will focus on marginal after-tax profit. As such, the analysis can disregard all fixed costs of production at a qualifying facility. Let R denote the revenue per kilowatt-hour from the sale of electricity and let X be the variable cost expense of generating one kilowatt-hour of electricity. Let c be the credit rate per kilowatt-hour of electricity produced. Finally let t be the taxpayer's marginal tax rate.

If the taxpayer qualifies to claim the electricity production tax credit, the taxpayer's after-tax profit per kilowatt-hour of electricity production is given by equation (1).

$$(1)\quad (R-X) \bullet (1-t) + c = \text{marginal after-tax profit.}$$

Now assume that instead of a tax credit the taxpayer is paid a subsidy, S, per kilowatt-hour of electricity produced. The taxpayer's marginal after-tax profit per kilowatt-hour of electricity production under this scenario is given by equation (2).

$$(2)\quad (S+R-X) \bullet (1-t) = \text{marginal after-tax profit.}$$

If one asks what value of S yields the same marginal after-tax profit as the electricity production tax credit, c, by equating equations (1) and (2), one finds that the subsidy equivalent to the production tax credit is:

$$S = c/(1-t)$$

Energy reports that the national average retail price of electricity for 2004 was 7.57 cents per kilowatt-hour, with the average for residential customers of 8.94 cents per kilowatt-hour and the average for industrial customers of 5.11 cents per kilowatt-hour.[7] Thus, the tax credit for production of electricity is equivalent to a subsidy equal to nearly 37 percent of the average retail price of electricity. As electricity prices vary by region, the rate of subsidy is higher in some parts of the country and lower in other parts of the country.

An alternative way to assess the value of the credit to the taxpayer should be to think of the credit as part of the taxpayer's stream of receipts across the life of the taxpayer's investment in the renewable energy project. In this view, the value of the credit to the taxpayer is equal to the value of the payment the taxpayer would have to receive annually per kilowatt-hour of electricity produced over the life of the project to produce a revenue stream that is equal in present value to the revenue produced by the credit over the life of the project (recognizing that generally the credit only produces revenue for the first ten years of the project and nothing thereafter). Assuming that a qualifying investment in a renewable energy production facility has a 20-year life, the 1.9 cents per kilowatt-hour production tax credit claimable by the taxpayer for the first ten years, but not thereafter, is equivalent to a cash subsidy of 1.66 cents per kilowatt-hour payable on all production throughout the 20-year life of the investment.[8] In this view of the value of the tax credit, the tax credit is equivalent to a subsidy equal to 22 percent of the average retail price of electricity.

Refined coal

The same calculations as those described above can be applied to calculate a revenue subsidy equivalent of the $5.481 per ton credit applicable to refined coal. This credit amount is equivalent to an increase in revenues of $8.43 per ton of coal to a taxpayer producing refined coal.

Investment in renewable energy electricity production capacity

Are investments in renewable resource electric generation facilities competitive?

As with any investment decision, a potential investor in a renewable resource electric generation facility compares expected revenues to expected costs. A taxpayer will invest in a

[7] Energy Information Administration, *Monthly Energy Review*, March 2005, Table 9.9. The reported average retail prices include any State and local sales or excise taxes applicable to electricity within various jurisdictions.

[8] This value is determined, as in the previous computation, assuming the taxpayer is a corporate taxpayer with a marginal tax rate of 35 percent. The present calculation also assumes that production of electricity is equal in all years of the facility's assumed 20-year life. The stream of cash receipts is discounted at a real interest rate of three percent. A real discount rate of three percent may be conservative. From the investor's perspective it would be more appropriate to use the investor's real cost of capital, which generally would exceed three percent. Under discount rates greater than three percent the cash equivalent 20-year subsidy calculated here would exceed 1.66 cents per kilowatt-hour.

facility to produce electricity from renewable resources if the return from the investment is better than, or comparable to, returns that the taxpayer can expect from alternative investments of comparable risk. Because of the different technologies involved, the expected capital and operating costs of different generation facilities may vary substantially by type of facility. In addition, because any generation facility sells electricity into a market in which the demand for, and price of, electricity can vary by time of day or season, different generation facilities may receive different levels of revenue per unit of power produced.

A taxpayer contemplating an investment in a renewable resource electric generation facility is in competition with other providers of electricity. The revenues the taxpayer can expect from the sale of electricity into the grid generally will be determined by the price received for the lowest-cost source of electricity, absent regulatory intervention.[9] In some parts of the country electricity produced from combined cycle natural gas turbines are considered to be the low-cost provider of incremental increases in electricity production. In other parts of the country, coal-fired power plants may be the low-cost provider of incremental increases in electricity production. The Department of Energy has estimated "levelized costs" of new conventional and renewable generation facilities in the absence of the production tax credit.[10]

[9] See the discussion below relating to existing State renewable energy programs.

[10] The "levelized cost" is the cost per kilowatt-hour of electricity produced accounting for all capital costs, including the return to investors, fuel costs, and operating and maintenance costs. The "levelized cost" further assumes capacity utilization rates that vary by facility type. For example, coal-fired facilities generally have a higher capacity utilization rate than do wind facilities, as the wind does not always blow sufficiently for the wind facility to produce near its rated capacity. The projections of levelized costs also assume technological improvements occur between the present and the year of the projection, 2010.

While the Department of Energy calculations do not assume the availability of the production tax credit for 2010, in calculating the costs of geothermal and solar facilities the Department of Energy analysis assumes that investors may claim the investment tax credit allowed under sec. 48 for such facilities. Energy Information Administration, Department of Energy, *Annual Energy Outlook 2005*.

Table 2.–Levelized Costs of New Conventional and Renewable Generation, Department of Energy

Conventional Source	**Cost in Cents Per Kilowatt-Hour[1]**
Combined cycle (natural gas).....	4.7
Combustion turbine (natural gas).....	7.0
Coal	4.3
Renewable Source	
Geothermal.....	4.4
Photovoltaic	21.0
Solar thermal.....	12.6
Open-loop biomass	5.1
Wind.....	4.8

[1] Projected 2010 costs per kilowatt-hour in 2003 cents per kilowatt-hour under the Energy Information Administration reference case.

Source: Energy Information Administration, *Annual Energy Outlook 2005*.

In an independent analysis, the California Energy Commission derived estimated levelized costs for new conventional and selected renewable generation facilities.[11] Table 3, below, reproduces the estimates of the California Energy Commission. The estimates of levelized costs are comparable for solar and geothermal facilities. However, while the reported estimates for wind are close in magnitude (4.8 cents per kilowatt-hour in the Department of Energy analysis and 4.93 cents per kilowatt-hour in the California Energy Commission analysis), they are not directly comparable. The California Energy Commission calculation reduces the capital and operation and maintenance costs of a wind facility by an investor's ability to claim

[11] The estimates of the California Energy Commission make different assumptions than those of the Department of Energy with respect to such factors as the price of natural gas, the useful life of certain facilities, and capacity utilization factors. The California Energy Commission estimates also assume that all such facilities would be located in California. Like the Department of Energy analysis, the California Energy Commission assumes investors in geothermal and solar generation facilities would claim the investment tax credit for such facilities allowed under sec. 48 of the Code. California Energy Commission, *Final Staff Report: Comparative Cost of California Central Station Electricity Generation Technologies,* (Prepared in support of the "Electricity and Natural Gas Report" under the Integrated Energy Policy Report Proceeding Docket 02-IEP-01), June 5, 2003.

the production credit under section 45.[12] The Department of Energy analysis does not reduce capital and operation and maintenance costs in its reference case. Other differences include the quality of the wind resource (national siting for the Department of Energy, California siting for The California Energy Commission), the year in which the facility is placed in service (2010 for the Department of Energy, 2003 for the California Energy Commission), the available technology embedded and cost of equipment when the facility is placed in service, and access to the transmission system.

Table 3.–Levelized Costs of New A Conventional and Renewable Generation, California Energy Commission

Conventional Source	**Cost in Cents Per Kilowatt-Hour[1]**
Combined cycle (natural gas).....	5.18
Simple cycle (natural gas).....	15.71
Renewable Source	
Wind.....	4.93
Hydropower	6.04
Solar thermal (parabolic trough).....	21.53
Solar thermal (parabolic trough ..... with thermally enhanced storage)	17.36
Geothermal (flash)[2]	4.52
Geothermal (binary)[2].....	7.37

[1] Costs per kilowatt-hour are reported in 2002 dollars.

[2] A "flash" facility is one at which steam can be extracted from the geothermal resource to directly turn a turbine. At a "binary" facility the heat is extracted from the hot water pumped from the geothermal resource and is used to heat water or another liquid to its boiling point to produce steam to turn a turbine.

Source: California Energy Commission, *Final Staff Report*, p.2.

[12] *Ibid,* p. 8 and p. R-3.

The production performance of renewable resource facilities is often very site specific, for example depending upon the seasonality of wind, the average amount of daylight, or the ability to obtain a steady supply of open-loop biomass material. With these caveats in mind, the Department of Energy and the California Energy Commission estimates in Tables 2 and 3, above, suggest that in some locations wind and geothermal facilities may be cost-competitive with conventional facilities.[13] However, this does not necessarily mean all such facilities are profitable investments in the absence of the production tax credit or other market intervention.

While the Department of Energy and the California Energy Commission have estimated costs, they have not estimated the likely revenues from the sale of electricity generated by such facilities. The market for electricity pays premiums for the ability of a producer to provide power at certain times of peak demand (by day and by season). The market may also pay more for power that can be counted on as part of base-load capacity. As a weather-dependent source, investors in wind facilities may receive less favorable pricing for electricity than do investors in conventional generation or geothermal or open-loop biomass. However, as calculated above, the production tax credit is equivalent to a significant increase in revenues for the producer. If investors in wind facilities (1.9 cents per kilowatt-hour credit for ten years of production), geothermal facilities (1.9 cents per kilowatt-hour credit for five years of production), and open-loop biomass facilities (0.9 cents per kilowatt-hour credit for five years of production) can expect to contract for prices close to those of natural gas facilities or coal facilities, the existence of the production tax credit may make investments in renewable resource electric generation facilities attractive to potential investors.

Termination of eligibility for the production tax credit and investment risk

Different types of renewable energy electricity production facilities require different amounts of lead time from site selection to local permitting and acquisition of key components for the facility through to completion of construction. While analysts generally agree that the construction period required to bring a wind turbine on line is less than the development of a geothermal field and production facility, when all aspects of project development are considered it can take more than one year to initiate and complete a wind project. As described in Part I.B. above, after initially providing a period of greater than five years to place credit-eligible investments in service, the Congress has extended the place-in-service date requirement for potentially qualifying facilities on three occasions, each of which occurred after the expiration date provided under prior law. Each extension provided a place-in-service period of less than three years. As a consequence, since 1999 the investment climate for potentially qualifying projects has been more uncertain than previously. Increased uncertainty regarding whether an

[13] In a 1999 survey of the existing literature relating to the costs of renewable resources for electricity generation, the analysts concluded that "[c]current cost estimates are close to the average cost of generation from conventional sources." However, while unclear, it appears these analysts may have reached this conclusion assuming that the production tax credit offset capital and operating costs of wind facilities. James McVeigh, Dallas Burtraw, Joel Darmstadter, and Karen Palmer, "Winner, Loser, or Innocent Victim? Has Renewable Energy Preformed As Expected?" Resources for the Future, Discussion Paper 99-28, June 1999, p.11.

investment will be credit eligible may discourage some taxpayers from exploring the development of qualifying facilities.

Growth of production of electricity from renewable resource electric generation facilities

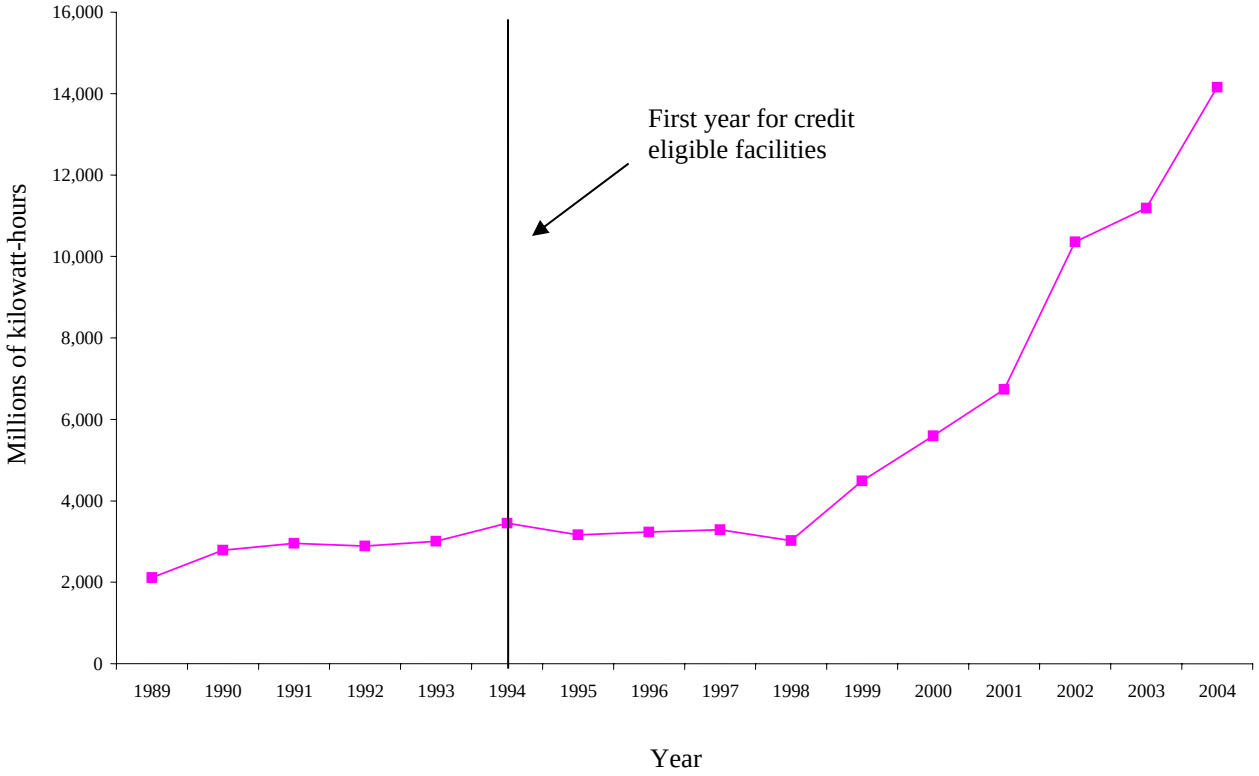
The production credit for electricity from qualified facilities has been available to taxpayers since 1993 (applicable to facilities placed in service after 1993), but until the passage of the AJCA the credit was available only with respect to wind facilities, closed-loop biomass facilities, and poultry waste facilities. In practice, investors have only found it profitable to invest in wind facilities. Since 1993, the year before qualified wind facilities became eligible for the credit, the annual production of electricity from wind has more than quadrupled.[14] See Figure 1 below. Figure 1 reveals that the most rapid growth did not occur in the first five years after the credit was created, but over the past six years.[15] Over the past decade technological gains have been made in the design and efficiency of wind turbines. Figure 1 suggests that the credit was not solely responsible for the growth in production of electricity from wind, but it is not possible from available data to identify the extent to which the credit, technological improvements, the price of alternative production sources (*e.g.*, fossil fuel facilities), State regulation, or other factors contributed to the growth of wind power. Nevertheless, even with this significant growth, wind power accounted for less than four-tenths of one percent of total net generation of electricity in the United States in 2004.[16]

[14] Energy Information Administration, *Monthly Energy Review*, March 2005, Table 7.2a.

[15] As noted above, the tax credit for production from wind facilities was enacted in 1992, effective for facilities placed in service after 1993. The Energy Information Administration reports that in 1998, six years after the credit was enacted effective for new facilities in 1994 and thereafter, the production of electricity from wind was 3,026 million kilowatt-hours compared to a production of 3,006 million kilowatt-hours in 1993. *Ibid.*

[16] *Ibid.*

Figure 1.–Electricity Generation from Wind, 1989-2004
(millions of kilowatt-hours)



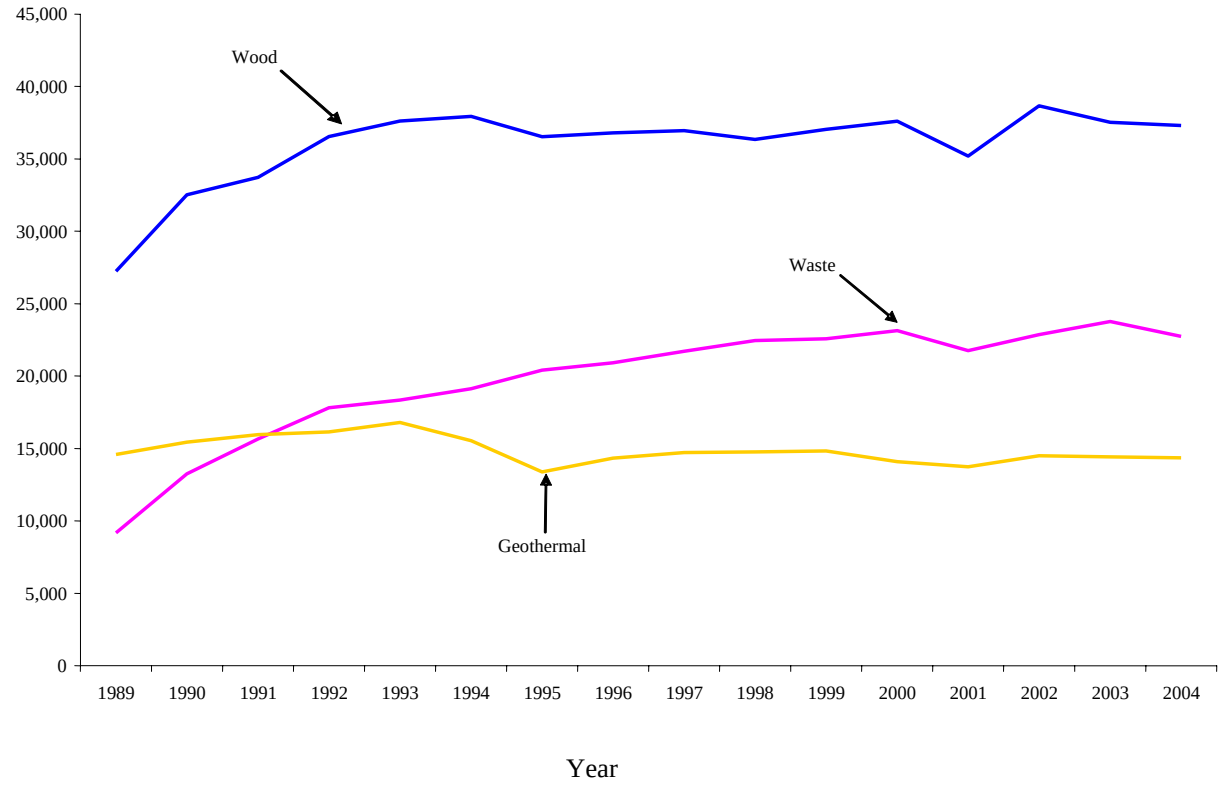
Source: Energy Information Administration.

Since the inception of the credit, other sources of renewable energy, many of which are now eligible under present law, have been more significant sources of renewable energy than wind power. Figure 2, below, reports the annual production of electricity from wood (including wood, black liquor, and other wood waste), waste (including municipal solid waste, landfill gas, sludge waste, tires, agricultural byproducts, and other biomass), and geothermal. These three categories accounted for 1.9 percent of total net generation of electricity in the United States in 2004.[17] Electricity generation from solar power, both solar thermal and photovoltaic sources, has been substantially less, but growing. Electricity generation from solar sources totaled 251 million kilowatt-hours in 1990 and 579 million kilowatt-hours in 2004.[18]

[17] *Ibid.*

[18] *Ibid.*

Figure 2.–Electricity Generation from Other Renewable Sources, 1989-2004 (millions of kilowatt-hours)



Source: Energy Information Administration.

The largest source of electricity generated from renewable resources is hydroelectric power. In 2004, conventional hydroelectric power produced 269, 637 million kilowatt-hours of electricity. This comprised 6.8 percent of total net generation of electricity in the United States in 2004. Since 1975, electricity from conventional hydroelectric power has varied between a peak production of 356,453 million kilowatt-hours in 1997 and a trough of 216,961 million kilowatt-hours in 2001.[19]

Production tax credit and the efficiency of investment decisions

The electricity production tax credit is economically equivalent to an open-ended subsidy, available to any taxpayer with no requirement to make an application to a government agency for the subsidy.[20] If a taxpayer believes that the sum of electricity prices plus the credit

[19] *Ibid.*

[20] Of course, building codes and other regulations may require government approval for a proposed investment in a qualifying facility, but a taxpayer does not require approval before claiming the implicit subsidy offered by the credit.

creates a profitable rate of return, the taxpayer will invest in a qualifying facility. In theory, investors should invest in qualifying facilities up to the point where the return from additional investment in qualifying facilities is no greater than the return on alternative investments. With the tax credit equal for all taxpayers and because qualifying renewable energy sources are not uniformly available at equal cost, the credit is more valuable to investors in certain facilities in certain geographic locations, than for investors with similar facilities in other geographic locations. For example, sustained winds are stronger in some parts of the country than in other parts of the country. Assuming that in neither of two locations would a wind facility be profitable in the absence of a subsidy, and that the cost of construction and operation and access to the electricity grid are equivalent in the two locations, an investment in a qualifying wind facility should be more profitable in the windy location than in the less windy location. One would expect investment to occur in the most profitable locations first. In this sense, the tax credit mechanism is efficient in that potential investors will attempt to exploit the most profitable opportunities to produce electricity from qualifying renewable resources first. As a result, the investors will provide the most amount of qualifying renewable electricity with the least amount of investment.

However, a tax credit is not likely to be a fully efficient subsidy mechanism from the perspective of the government's fisc. The credit amount is invariant for any specific category of qualified facility. While two investments may both be estimated to be profitable enough to merit investment by prospective investors, because of one's access to relatively inexpensive qualified renewable energy resources compared to the other, the one proposed investment is likely to be more profitable than the other proposed investment. By providing the same uniform credit, the government pays more subsidy than is necessary to bring the one investment in a qualified facility on line. For example, there may be some potential qualifying facilities that would be profitable investments in the absence of any subsidy, but they may claim the credit. As several States have enacted "renewables mandates," requiring that electricity providers include a minimum amount of electricity from renewable sources as a condition of sale to consumers, this source of inefficiency (paying for production that will happen regardless of the credit) will grow.[21]

Production tax credit and externalities

A subsidy, such as the credit, can promote economic efficiency when there is a divergence between the private costs of an activity and the social costs of the activity. Such a divergence is called an "externality." Analysts commonly identify pollution as an externality because pollution imposes costs on society in terms of environmental degradation and health costs that are not reflected in the cost of producing the good or service that creates the pollution. By subsidizing non-polluting, or less polluting activities, the tax credit for production of electricity from renewable sources can produce a more economically efficient outcome. To be fully efficient, however, the subsidy should be equated to the incremental social benefit created by displacing a polluting source with a less polluting source. The incremental social benefit is the net change in all types of pollution from the current source of production to the renewable

[21] See discussion below relating to State renewable energy programs.

source of production. With a credit at a uniform rate applicable to multiple technologies, ranging from wind power to burning paper mill residues, it is unlikely that the subsidy provided by the credit will equal the incremental social benefit produced by each separate technology.

Some analysts have argued that there is social benefit meriting subsidy in the potential for domestic renewable resources to displace foreign energy sources, principally petroleum. Petroleum-fired electricity generation accounted for approximately 3.0 percent of net electricity generation in the United States in 2004, and the amount of petroleum consumed in electricity production was approximately 3.4 percent of refined petroleum products produced in the United States in 2004.[22] If a credit-eligible facility displaces electricity produced at an unsubsidized facility, market economics dictate that it generally would be the highest cost producer that is displaced. It need not be the case that a petroleum-fired electricity generating facility is the highest-cost producer. In addition, if a petroleum-fired electricity generating facility ceases production, thereby reducing the demand for petroleum, it need not be the case that the reduction in demand for petroleum leads to a reduction in imported petroleum. As the demand for petroleum falls, market economics dictate that it generally would be the highest-cost suppliers that are displaced. The highest-cost suppliers of petroleum may be domestic producers.

State renewable portfolio standards, mandates, or renewable goals and the production tax credit

As of the close of 2003, the Department of Energy had identified 15 States with programs to encourage the development of renewable energy for electricity generation.[23] The Department of Energy analysis divides these programs into three types: renewable portfolio standards; renewable energy mandates; and renewable energy goals. In general, a renewable portfolio standard requires that a specified share of electricity generation (or sales) is attributable to renewable resources. A mandate requires the construction of specified amounts of new renewable-source generation capacity. Goal-based programs are voluntary. Table 4, below, lists those States with such programs as characterized by the Department of Energy analysis.[24]

[22] Energy Information Administration, *Monthly Energy Review*, March 2005.

[23] Thomas Petersik, "State Renewable Requirements and Goals: Status Through 2003," Energy Information Administration, Department of Energy, www.eia.doe/oiaf/analysispaper/rps/index.html, July 21, 2004.

[24] The Department of Energy analysis list two States with two different types of programs.

Table 4.–State Renewable Energy Programs as of December 31, 2003

Renewable Portfolio Standard Program	
Arizona California Connecticut Maine Massachusetts	Nevada New Jersey New Mexico Wisconsin
Mandate Program	
Iowa Minnesota	Texas Wisconsin
Goals Program	
Hawaii Illinois	Minnesota Pennsylvania

Source: Thomas Petersik, "*State Renewable Requirements and Goals*: *Status Through 2003*," Energy Information Administration.

There is variation across the different State programs in terms of the energy resources that qualify as renewable for purposes of the program, the amount of renewable electricity generation the State program hopes to attain, and the mechanics of the program. Regardless of the design of the State program, there is interaction with the production tax credit. The Department of Energy analysis concludes that, of the renewable energy capacity constructed in these States, wind facilities comprised more than 90 percent. In particular, 49 percent of the new capacity consisted of wind facilities constructed as part of the Texas State mandate.[25] Generally, such wind projects would have been eligible for the production tax credit. The interaction of these State programs and the production tax credit may help explain the growth in electricity generated from wind facilities documented in Figure 1, above.

According to the Department of Energy, States use several approaches to pay for the construction and operation of renewable electricity generation facilities brought on line under

[25] Petersik, "State Renewable Energy Requirements and Goals: Status Through 2003."

these programs. Some States pass the costs on to all utility ratepayers in the form of higher rates for all electricity. Other States apply a charge on selected categories of sales. Still other States encourage consumers to voluntarily pay higher prices for electricity from renewable sources. Under any of these approaches, the production tax credit allows the electricity provider to offer the renewable electricity at a lower price than the provider otherwise would charge in order to cover costs. The analysis above suggested this reduction might be on the order of 2.9 cents per kilowatt-hour. The existence of the production tax credit reduces the burden on consumers in those States that have established such programs. Because the production tax credit reduces the revenues of the Federal government, it could be said that taxpayers at large pay more in taxes to reduce the burdens on electric utility customers in those States with such programs.