International Tax Incentives for Renewable Energy: Lessons for Public Policy

DRAFT REPORT

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TABLE OF CONTENTS

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1 Introduction and Summary

Throughout the world, tax incentives have supported public policies designed to stimulate the development of renewable energy markets and industries. Tax incentives are often complementary to other types of renewable energy incentive programs. They are powerful and highly flexible policy tools that can be targeted to encourage specific renewable energy technologies and to impact selected renewable energy market participants, especially when used in combination with other policy tools.

The objective of this paper is to identify the types of tax incentives currently in use worldwide and to learn from the tax incentive policies of the 29 countries and 35 states specifically examined here. In Section 2 we briefly discuss some of the advantages of tax incentive policies, while in Section 3 we summarize ten types of tax incentives in use worldwide to support renewable energy. Section 4 highlights the prevalence of these specific tax incentive types. Section 5 offers lessons based on international experience with these tax incentive programs, and we provide some concluding remarks in Section 6.

To summarize the results that follow, we find that common international renewable energy tax incentives include:

- **Investment tax incentives: large-scale applications**: Provide income tax deductions or credits for some fraction of the capital investment made in renewable energy projects.
- **Investment tax incentives: customer-sited applications:** Tax deductions or credits are offered for some fraction of the costs of renewable energy systems or equipment installed on residences and businesses.
- **Production tax incentives**: Provide income tax deductions or credits at a set rate per kilowatt-hour produced by renewable energy facilities.
- **Property tax reductions:** Owners of land or real property used for renewable energy production facilities can have their property taxes reduced or eliminated.
- **Value-added tax (VAT) reductions**: Exempts producers of renewable energy from taxes on up to 100 percent of the value added by an enterprise between purchase of inputs and sale of outputs.
- **Excise (sales) tax reductions**: Exempts renewable energy equipment purchasers from up to 100 percent of excise (sales) tax for the purchase of renewable energy or related equipment.
- **Import duty reductions:** Reduces or eliminates import duties on imported equipment and materials used for renewable energy production facilities.

- **Accelerated depreciation**: Allows investors in renewable energy facilities to depreciate plant and equipment at a faster rate than typically allowed, thereby reducing stated income for purposes of income taxes.
- **Research, development, demonstration, and equipment manufacturing tax credits:** Tax credits are offered for up to 100 percent of the money invested by a corporation in renewable energy technology development, including the manufacturing processes
- **Tax holidays:** Reduces or eliminates income, VAT, or property taxes for a temporary period of up to 10 years
- **Taxes on conventional fuels**: Some countries tax the consumption of non-renewable energy (this is most often a fossil fuels or carbon tax). The absence of this tax on renewable energy can act as an incentive to consumers to use or buy renewable energy (e.g. instead of energy from fossil fuels).

The design of tax incentives deserves considerable attention. The flexibility of tax incentives allows them to be targeted to specific technologies and investor groups. They can be made strong in the early stages of renewable industry development and gradually phased out as the domestic renewable industry matures and becomes self-sustaining. There can be complex interactions with other government policies and market conditions that can either support or obstruct desired outcomes.

In general, international experience has shown that successful renewable energy tax incentives:

- Must be of sufficient size, scope, and length to be effective in influencing renewable energy investment and consumption decisions
- Should be tailored according to the stage of renewable energy industry development in a country
- Must be carefully designed to account for interactions with other government policies and energy market conditions
- May require other supportive policy initiatives to create and sustain a healthy renewable energy sector

2 Why Use Tax Incentives to Promote Renewable Energy?

2.1 Targeting Specific Needs

Tax incentives have often proven effective in encouraging private sector development of renewable energy resources. They can be designed to influence both investment decisions (supply) and consumption decisions (demand):

- Investment decisions of renewable energy investors and producers can be directly influenced by investment tax credits, production tax incentives, value-added tax reductions, property tax reductions, accelerated depreciation, import duty reductions, etc. All of these incentives – and others – can increase the after-tax

cash flow and earnings of companies engaged in developing and operating renewable energy plants and facilities.

- Residential and commercial consumption decisions for renewable energy can be directly influenced by consumer-focused investment tax incentives, sales or excise tax reductions, value-added tax reductions, import duty reductions for renewable energy equipment installed on residences and commercial buildings, taxes on conventional energy resources, etc. Many of these incentives reduce the effective up-front cost of renewable energy. This cost reduction will increase the demand for renewable energy from what it would be without the tax incentives.

In addition, tax incentives can be specifically targeted to encourage local renewable energy manufacturing capability. Tax incentives are clearly highly flexible in regard to the types of technologies and the class of investors and consumers they can be awarded to. In fact, tax incentives observed internationally range from targeting single renewable technologies to targeting all technologies; and targeting only residential customers located in a particular geographic area to targeting all homes, businesses and corporations nationwide. Some are focused on equipment installation, while others are focused on equipment manufacturing. Some programs last only one to two years, while others have already operated for more than a decade with no expiration date.

2.2 Creating Tax Parity or Encouragement for Renewable Energy

Conventional fuels have long received significant tax incentives and public subsidies, distorting direct cost comparisons with renewable energy even before accounting for environmental degradation. For example, tax credits are often given for the exploration, development, and depletion of natural gas and oil. The U.S. Department of Energy estimates that natural gas, oil, and coal received $2.3 billion in US federal tax credits and subsidies in 1999. By the same accounting, renewable resources (other than ethanol) received $15 million in federal tax credits in that year (10). In other words, total 1999 tax credits and subsidies were more than 150 times greater for natural gas, oil, and coal than for renewable energy. Some OECD countries continue to significantly subsidize the production costs of coal, by as much as 50 percent (9). While such tax disparities differ by country and year, and are strongly affected by the definition of a tax subsidy, conventional fuels have historically received more favorable tax treatment than renewable energy sources, at least in some countries.

Tax parity issues in countries with income taxes also argue for the use of renewable energy tax incentives. Renewable energy technologies often have little or no fuel costs, but are more capital-intensive than conventional (fossil fuel-fired) electricity generation technologies. Conventional generation technologies typically have greater fuel costs, but these fuel costs may often be expensed for tax purposes, reducing the exposure of conventional generators to income taxes. The lower amount of capital costs per unit of production for conventional technologies also results in lower excise taxes for inputs and lower property taxes. As a result, renewable technologies often have to bear a higher tax

burden on a dollar-per-kilowatt-hour basis than conventional technologies, placing them at a distinct tax disadvantage and making true cost comparison difficult (3).

2.3 Relation to Other Incentives

Although tax incentives are useful tools, tax incentives alone may be insufficient to support the development of a healthy renewable energy sector. In most countries, tax incentives are supplemental to other policies. Countries often combine them with policy tools such as renewable energy production quotas (renewable portfolio standards), feed-in tariffs, government-administered auctions for renewable energy, preferred grid access, grants, low interest loans, funding for research and development, and equipment rebates...

3 Ten Tax Incentives for Renewable Energy

A variety of tax incentives have been used to help stimulate the development and growth of renewable energy around the world. In general, these incentives consist of tax deductions or tax credits.

By eliminating part or all of a tax, tax incentives directly reduce the cost to producers and consumers of renewable energy and the equipment used in its production. They are immediate in impact and straightforward to understand and administer.

Tax incentives should not be confused with an outright payment for investing in or producing renewable energy. They can only be used to reduce the amount of taxes owed by a renewable energy company, investor, or consumer. Since companies, investors, and consumers of renewable energy have varying degrees of tax liability, it is possible that some recipients of tax incentives will be unable to fully use them. If the taxes owed are insufficient to use all of the tax incentive, the incentives effectiveness as a policy tool to encourage investment in renewable energy will be reduced. This can be a critical limitation to the use of tax incentives in some circumstances, and is one reason that tax incentive programs are often supplemental to other types of renewable energy policies.

Below we briefly discuss the design and use of ten different types of tax incentives used to support renewable energy internationally.

3.1.1 Investment Tax Incentives: Large-Scale Applications

Investment tax incentives provide income tax deductions or credits for some portion of the capital investment made in land, fixtures, and equipment for renewable energy. Income tax deductions reduce taxable income, while tax credits directly offset taxes due. These tax incentives, when applied to large-scale renewable energy applications, are available to corporations and not to individuals who invest in renewable energy systems for their homes. Sometimes there are investment size minimums and maximums to

qualify for the tax credit. For example, qualifying investments in a single project in Ireland are limited to 7.5 million pounds or 50 percent of the project costs (whichever is less). Many governments offering investment tax incentives for large-scale renewable applications require certification of the renewable energy equipment for safety and performance to qualify for the tax incentive program. The following table provides summary information about countries and U.S. states that have renewable energy investment tax incentives in place.

A frequent objection to investment tax incentives is that they reward the installation of renewable energy facilities, but not the production of electricity from those facilities. In California during the 1980s, for example, companies rushed to install wind turbines to capture the associated investment tax incentives, in some cases leading to inefficient turbines being installed in poor locations. More recently, some countries and US states have used production-based tax incentives to more appropriately reward performance, at least for large renewable energy systems. As described below, however, investment tax incentives remain a favored incentive, especially for customer-sited, smaller renewable energy facilities.

Table 1.1
Investment Tax Incentives: Large Scale Applications

Country/State	Tax Credit or Tax Deduction	Percent (%)	Renewable Technologies
Country			
Belgium	Deduction	13.5	All
Canada	Deduction	100	Wind, hydro, photovoltaic
Czech Republic	Deduction	Na	All (hydro under 1 MW)
Ireland	Deduction	18	Wind, hydro, solar, biomass
Korea	Credit	5	Energy efficiency
Netherlands	Deduction	13	All
Spain	Deduction	10	Solar, biomass
United States	Credit	10	Solar, geothermal
State			
Hawaii	Credit	20-35	Wind, solar
Montana	Credit	35	All
North Carolina	Credit	35	All
North Dakota	Credit	15	Solar, wind, geothermal
Oregon	Credit	35	All
Texas	Deduction	10	Solar
Utah	Credit	10	Solar, wind, biomass, hydro

3.1.2 Investment Tax Incentives: Customer-Sited Applications

Investment tax incentives also often apply to smaller, customer-sited applications of renewable energy. These incentives are typically awarded for renewable energy systems or equipment installed onsite to supply residential or commercial buildings. Often, the cost of installing the equipment (in addition to the equipment cost itself) is included in

the calculation of the tax incentive. Since installation costs for these systems can be a significant percentage of the total costs, including installation in the tax credit provides a stronger incentive to consumers and businesses to purchase these systems. Though some states and countries have considered applying production-based tax incentives for these smaller systems, it is generally recognized that the administrative costs of tracking production are significant; as a result, most income tax incentives offered for customer-sited systems have remained investment-based. Tax incentives are offered for the purchase of renewable energy systems and equipment by many states and countries. Table 1.2 below provides a summary.

As an alternative to tax incentives for the purchase of renewable energy systems for homes and offices, many state and local governments and utilities in the United States offer rebates. Consumers apply for rebates at the time of purchase of equipment and systems. The rebates are typically paid for with public benefit funds (PBF) collected as a fee on consumer purchases of electricity from utilities. Unlike tax credits, the benefits of rebates are equal for people of all income (and income tax) levels, including public sector entities that do not pay taxes. A large number of state governments in the US offer such rebates.

Table 1.2
Investment Tax Incentives: Customer-Sited Applications

Country/ State	Sector	Incentive Type	Amount	Renewable Technologies
Country				
Austria	Residential	Deduction	Up to 25%	Solar, biomass
Czech Republic	Residential, commercial	Deduction	Up to 100%	All
France	Residential	Credit	15%	All
Greece	Residential, commercial	Credit	Up to 75%	Solar
Portugal	Residential	Credit	Up to 30%	All
Spain	Residential, commercial	Credit	10%	Solar, biomass
United States	Commercial, industrial	Credit	Up to 30%	All
State				
Arizona	Residential	Credit	Up to 25%	Solar, wind
California	Residential, commercial	Credit	7.5%	Solar PV & wind < 200 kW
Hawaii	Residential, commercial	Credit	Up to 35%	Solar, wind
Idaho	Residential	Deduction	Up to 100%	Solar, wind, geothermal
Iowa	Commercial, industrial	Credit	Up to 30%	PV, wind
Massachusetts	Residential	Credit	15%	Solar, wind
Montana	Residential	Credit	$500	All
New York	Residential	Credit	Up to 25%	Solar PV and fuel cells
North Carolina	Residential, commercial	Credit	Up to 35%	Solar, wind, biomass, hydro
North Dakota	Commercial, industrial	Credit	15%	Solar, wind, geothermal
Ohio	Commercial, industrial	Credit	Up to 100%	Solar, wind, biomass, waste
Oregon	Residential	Credit	15%	All
Rhode Island	Residential	Credit	25%	Solar, wind
Utah	Residential	Credit	15%	Solar, wind, geothermal
US Territory				
Puerto Rico	Residential	Deduction	Up to 50%	Solar (30%), wind (50%)

3.2 Production Tax Incentives

Production tax incentives provide income tax deductions or credits at a set rate per kilowatt-hour produced by a renewable energy facility. In the United States, the Oak Ridge National Laboratory estimated that the federal 10-year, production tax credit of 1.5 cents/kwh could lower the levelized life cycle cost of wind power by about 25 percent (8).

This type of incentive has gained increased favor, especially in support of large-scale renewable energy facilities, because it encourages efficient renewable energy production rather than large investments of capital (a potential outcome of high investment-based tax incentives. Production tax incentives help to avoid this. They help to ensure a key objective of renewable tax incentive policy: long-term and efficient production of renewable energy. Countries and states presently offering production tax incentives are listed in Table 2 below.

Table 2
Production Tax Incentives for Renewable Energy

Country/State	Amount per Kilowatt-hour	Renewable Technologies
Country		
Finland	€ 0.6 9	Wind, hydro, wood, biogas
Sweden	SEK 0.181	Wind
United States	$0.015	Solar, wind, biomass, waste
State		
New Mexico	$0.01 for the first 400 million Kwh	Solar, wind, biomass
Oklahoma	$0.0075	Solar, wind, hydro, geothermal

3.3 Property Tax Reductions

Property tax reductions can eliminate up to 100 percent of the property taxes on land and fixed assets used for renewable energy production facilities. Property tax reductions can be an especially important incentive for capital-intensive technologies such as wind turbines and solar energy because property taxes often contribute to a higher per-kilowatt-hour tax burden for capital-intensive renewable energy technologies than for less capital intensive conventional energy technologies. Property tax reductions can therefore help to create more tax parity with conventional electricity technologies.

Table 3
Property Tax Reductions

Country/State	Amount (%)	Limit (yrs.)	Renewable Technologies
Country			
Czech Republic	100	5	Solar, wind, hydro, geothermal, biomass
Italy	36		Solar, wind, hydro, geothermal, biomass
Norway	100		Small hydro
State			
California	100		Active solar systems
Connecticut	Varies		Solar, wind, hydro
Illinois	Varies	15	Solar, wind, hydro
Indiana	100		Solar, wind, hydro, geothermal
Iowa	100	5	Solar, wind
Kansas	100		Solar, wind, biomass, hydro, geothermal
Louisiana	100		Solar
Maryland	Varies	3	Solar, geothermal
Massachusetts	100	20	Solar, wind, hydro
Minnesota	100		Solar PV and wind equipment
Montana	100		Solar, wind, hydro, geothermal
Nevada	50	10	Solar, wind, biomass, waste
New Hampshire	Varies		Solar, wind, wood heat
New York	100	15	Solar, wind, biomass
North Carolina	Same as conventional		Solar
North Dakota	100	5	Solar, wind, geothermal
Ohio	100		Solar, wind, biomass, waste
Oregon	100		Solar, wind, hydro, geothermal, biomass
Rhode Island	Same as conventional		Solar, wind
South Dakota	50 to 100	3	Solar, geothermal, wind, biomass
Tennessee	67		Wind
Texas	100		Solar, wind, biomass
Virginia	Varies		Solar
West Virginia	5%		Wind
Wisconsin	100		Solar, wind

3.4 Value-Added Tax Reductions

Many countries do not have income taxes, but have value-added taxes (VAT) instead. Value-added tax incentives typically shelter producers of renewable energy from taxes on up to 100 percent of the value added between the purchase of inputs and the sale of outputs. Typically, countries providing value added tax incentives simply reduce the rate of the value added tax applied to the production of renewable energy and the domestic manufacturing of renewable energy parts, equipment, and systems. Alternatively, some countries collect the full tax, but refund a portion of the tax applied to renewable energy production and equipment.

The incidence of value-added tax can particularly hurt development of renewable energy if a value added tax is charged on capital inputs to the production process, rather than on the output of electricity. As described in section 2, renewable energy technologies are

often more capital intensive than conventional generation technologies, so they will tend to pay a larger proportion of value added tax when the tax is levied on capital equipment.

The issue of value-added tax is compounded when there are value-added taxes paid on renewable energy production inputs, but not collected on outputs. In many countries, businesses pay value-added tax on the inputs they purchase and they collect value-added taxes on the outputs they sell. At the end of the tax collection period they net out what they paid from what they collected and send a check for the difference to the taxing authority. If there is no value-added tax collected on sales and the price is fixed, the renewable energy producer has no way to recover the value added tax it paid for inputs. Its cash flow and earnings are reduced.

Table 4 presents examples of countries with VAT reductions. Portugal previously offered reduced value-added tax for renewable energy, but recently withdrew that incentive in order to harmonize with European Union tax policy.

Table 4
Value Added Tax Reductions

Country	Value-Added Tax Reductions (%)	Renewable Technologies
China	17 reduced to 6, 8.5, 13	Small hydro (6%), wind (8.5%), biogas (13%)
Czech Republic	22 reduced to 5	Solar, wind, hydro, biomass
Italy	20 reduced to 10	Parts for solar, wind, biomass, geothermal
United Kingdom	17.5 reduced to 5	Solar panels

3.5 Excise (Sales) Tax Reductions

Excise tax reductions allow consumers to avoid paying up to 100 percent of sales tax for the purchase of renewable energy, related equipment, or fuel. The use of sales tax reductions impacts the demand for renewable energy and equipment. Some countries tax electricity consumption, but provide an exemption for electricity produced by renewable technologies. Others exempt the purchase of renewable energy plant and equipment from sales taxes.

Less common than tax reductions, tax rebates are refunds of a specific share of an excise tax. Consumers apply for tax rebates at the time of purchase of equipment and systems. As with investment tax credits, sales tax exemptions may be most effective when linked to technology and performance standards (8).

Table 5
Excise Tax Reductions for Renewable Energy

Country/State	Amount of Reduction	Renewable Technologies
Country		
Czech Republic	100%	Bio-fuels
Italy	28%	Bio-fuels
United States	100 %	Solar, wind equipment
State		
Arizona	100%	Solar, wind equipment
Florida	100%	Solar equipment
Idaho	100% for > 25 kW	Solar, wind, geothermal, biomass equipment
Iowa	100%	Wind equipment
Maryland	100%	Wood, biomass as fuel
Massachusetts	100%	Solar, wind equipment
Minnesota	100%	Wind equipment
Nevada	100%	Solar, wind, hydro, geothermal equipment
New Jersey	100%	Solar and wind equipment
New Mexico	100%	Biomass equipment & materials
North Dakota	100%	Wind > 100 kW & hydrogen equipment
Ohio	100%	Solar, wind, hydro, waste equipment
Rhode Island	100%	Solar, wind equipment
Utah	100% for > 20 kW	Solar, hydro, geothermal, biomass equipment
Vermont	100%	Solar, biomass equipment
Washington	100%	Solar, wind, biomass equipment
Wyoming	100%	Solar, hydro, geothermal, biomass equipment
U.S. Territory		
Puerto Rico	100% for farm use	Solar, hydro, geothermal equipment

3.6 Import Duty Reductions:

Import duty reductions reduce import duties on parts and equipment used for renewable energy production facilities. This type of incentive is particularly useful in the early stages of a renewable energy industry, before a host country has its own equipment manufacturing facilities and the technical knowledge to compete in the world market. Import duties can vary by technology depending upon the status of domestic manufacturing. Import duties must also be compatible with World Trade Organization (WTO) rules, however.

Depending upon a country's goals, the import duty on whole systems versus an import duty on components will influence the extent to which the import duty encourages or discourages technology transfer and local manufacturing of renewable energy equipment. Renewable industries usually begin by manufacturing parts for renewable energy equipment and eventually move on to more complex components and subsystems, finally manufacturing complete renewable energy systems. For countries interested in developing their own manufacturing sectors, import duty is generally lower for component parts than for importing whole generating systems. This encourages some

local manufacturing of parts and components, and dissuades (to some degree) the import of complete systems from overseas markets.

Table 6
Import Duty Reductions for Renewable Energy Parts & Equipment

Country	Amount of Reduction (Percent)	Renewable Technologies
Bangladesh	100%	Solar, wind
China	Wind: 82% parts, 65% turbines, PV: 30%	Wind, PV, biogas
Czech Republic	Up to 100%	All renewables
Finland	85% when duties exceed 3.7% of VAT	Bio-fuels
India	Varies	Wind turbine parts
Jamaica	83%	All renewables
Philippines	100 %	Small hydro

3.7 Accelerated Depreciation

Depreciation is a non-cash expense that is meant to approximate the decline in value over time that capital assets experience as wear and age take their toll. The non-cash expense reduces income as calculated for income tax purposes. Power plants are commonly depreciated over a 20 to 30-year period, which is the estimated life of the asset. Accelerated depreciation enables investors in renewable energy facilities to depreciate plant, fixtures and equipment at a faster rate than typically allowed; often 15 years or less, thereby substantially reducing stated income for income tax calculations during those years and thereby reducing income taxes.

Accelerated depreciation can be a very strong renewable energy investment incentive. Compared to some other tax incentives, the benefits of accelerated depreciation are 'front-loaded". Net present value is highly time sensitive, weighting income received in the first 5 years of a project much more heavily than income received in later years. Because accelerated depreciation more heavily shields income from taxes in the earliest years of an investment, it has a large impact on net present value calculations used for investment decisions. Accelerated depreciation is an especially effective incentive for capital-intensive industries like renewable energy that require large up-front capital investments.

Table 7
Accelerated Depreciation for Renewable Energy Facilities

Country	Amount	Length	Technologies
Belgium	10%/yr.	One-half of std.	All renewables
Canada	Up to 30%/yr.	Varies	All renewables
India	100% /yr.	1 year	Wind
Luxembourg	Up to 60%/year	Varies	All renewables
Portugal	25%/yr.	4 years	Solar
United States	20% or more/yr.	5 years	Solar, wind, geothermal

3.8 Research, Development, Demonstration, and Equipment Manufacturing Tax Incentives

RD&D and equipment manufacturing tax incentives are intended to create local technological innovation and build domestic businesses. They often hope to enable higher risk, major RD&D projects that represent significant technical advances and/or cost reductions. The first priority of RD&D programs is often to target issues unique to the domestic market. However, RD&D tax credit programs also support efforts to build the capacity for local businesses to compete in international export markets.

Many countries and states offer renewable energy RD&D *funding*, not tax credits. It is one of the most common forms of programmatic support for renewable energy across nations. Direct funding allows for much greater governmental influence on the nature of research conducted, the size of the projects, and the quality of the research. However, renewable energy RD&D budgets more are susceptible to being cut. On the plus side for RD&D tax credits, many innovative technologies have originated in the private sector, without government management or oversight. These types of tax credits recognize the benefit of those private sector research investments.

In countries where the renewable equipment manufacturing industry is not well developed, investment in RD&D is unlikely to occur without some form of public support. The effectiveness of tax credits to stimulate RD&D requires that the industry is large enough and profitable enough that the tax credits will result in an adequate volume of useful research. If the industry is in its infancy, and therefore significant income taxes are not being paid, other forms of government support for RD&D may be more appropriate. In this case, government-administered funding of industry RD&D programs may be more effective than either RD&D tax credits or government RD&D programs.

Countries that offer RD&D tax credits to all industries include Canada, Japan, France, the United States, and the United Kingdom. However, these RD&D tax credits are not driven by government policy toward renewables. In our sample, only South Korea offers an RD&D tax credit specific to renewable energy.

Table 8.1
Tax Credits for RD&D

Country	Amount	Renewable Technologies
RD&D Tax Credits to Renewable Energy		
South Korea	10%	Eleven renewable technologies
RD&D Tax Credits to All Industries		
Canada	35% up to C$2 million	All
France	50% of increase over 2 yr. avg.	All
Japan	20% of RD&D annual increase	All
United Kingdom	150% for small businesses	All
United States	20%	All

Related to industrial RD&D, some state and provincial governments have targeted renewable energy equipment manufacturing as a desirable industry to promote for expansion and development. For example, New Mexico and Michigan have explicit strategies to attract and develop this industry, offering targeted tax and other incentives. Table 8.2 provides an overview of tax incentives for renewable energy equipment manufacturers.

Table 8.2
Tax Credits for Renewable Energy Equipment Manufacturing

Country/State	Credit or Deduction	Tax Avoided	Amount	Renewable Technologies
State				
Montana	credit	Property	35%	Wind
Michigan	credit	Income	Varies with growth	Solar, wind
New Mexico	credit	Income	5% of equipment	All
North Carolina	credit	Income	25% of construction	Solar, hydro, biomass
Oklahoma	credit	Income	$6.25/ft.^{2} rotor built	Small wind
Texas	credit	Franchise	100%	Solar
Washington	credit	B&O	40%	Solar PV
Province				
Manitoba, Canada	credit	Income	10%	All

3.9 Tax Holidays

Tax holidays are time-limited exemptions from selected taxes, which may include excise, property, income, and value-added tax. They are typically offered as an initial investment incentive, with the expectation that after the exemption expires, the renewable energy company will begin paying taxes at the normal rate. Like accelerated depreciation and other forms of tax exemptions, tax reductions, and tax rebates, the benefits of this measure are "front-loaded." Benefits are largest in the initial period, often strongly impacting the net present value of a renewable energy project as described in section 3.7.

Table 9
Tax Holidays for Renewable Energy

Country/Province	Tax Avoided	Length	Renewable Technologies
Country			
Czech Republic	Income, property	5 years	Small hydro, heating systems
India	Income	5 years	Wind, biomass
Philippines	Income	7 years	Small hydro, others by application
Province			
Ontario, Canada	Corporate, property	10 years	All

3.10 Taxes on Conventional Fuels

Most countries tax fossil fuels in some manner. Taxing fossil fuels or the emission of pollutants and greenhouse gases is an indirect tax incentive to purchase renewable energy, to the extent that renewable energy sources are exempt from paying the tax on conventional fuels. Taxes may vary with the amount of emissions or be assessed at a flat rate per unit of fuel consumed.

Countries in the European Union are leading the way in enacting laws that increase taxes on the use of fossil fuels. This has been controversial, particularly because of concerns about the taxes negatively impacting competitiveness in global markets. The United Kingdom sought to make the "Climate Change Levy" revenue neutral to businesses by reducing their insurance premiums at the same time. The Kyoto Protocol was framed in 1997. Since 1997, countries that have increased taxes on oil and petroleum products include the Czech Republic, Finland, Germany, Hungary, New Zealand, Norway, Spain, Sweden, and the United Kingdom. Denmark had instituted a carbon dioxide tax prior to 1997. Paradoxically, some European countries tax oil products heavily referencing the Kyoto Accord, but tax coal lightly or not at all.

Table 10
Countries Increasing Taxes on Conventional Fuels Since 1997

Country	Amount of Tax	Fuels or Emissions Taxed
Austria	€ 0.21 to 1.42/kg	Light oil
Czech Republic	CZK 472/tonne	Light oil
Denmark	€ 6.8/Gigajoule	Carbon dioxide
Finland	€ 16.54 to 56.80/tonne	Carbon
France	€ 42.52 to 80.54/kl (TIPP)	Heavy and light oil
Netherlands	€ 0.0639/kWh	Elec.; renewables partly exempt
Germany	€ 0.06125/litre oil, gas € 0.55/kWh	Fossil fuels, electricity
Hungary	€ 16/tonne oil and 25% VAT	Fossil fuels, electricity
Italy	Coal: ITL 5.084/ton, Oil: ITL1.286/ton	Carbon dioxide
Luxembourg	€ 18.59/kl	Light oil
New Zealand	NZ$15 /ton beginning in 2007	Carbon dioxide
Norway	NOK 104 per tonne	Carbon dioxide
Spain	€ 0.029/kWh	Elec.; renewables partly exempt
Sweden	36.5 öre/kg emitted	Carbon dioxide
Switzerland	Varies; CHF 210 per tonne maximum	Carbon dioxide
United Kingdom	£0.43/kWh (elec.); £0.15/kWh (gas); £1.17/kg (coal)	Business use of electricity, natural gas, coal, oil products

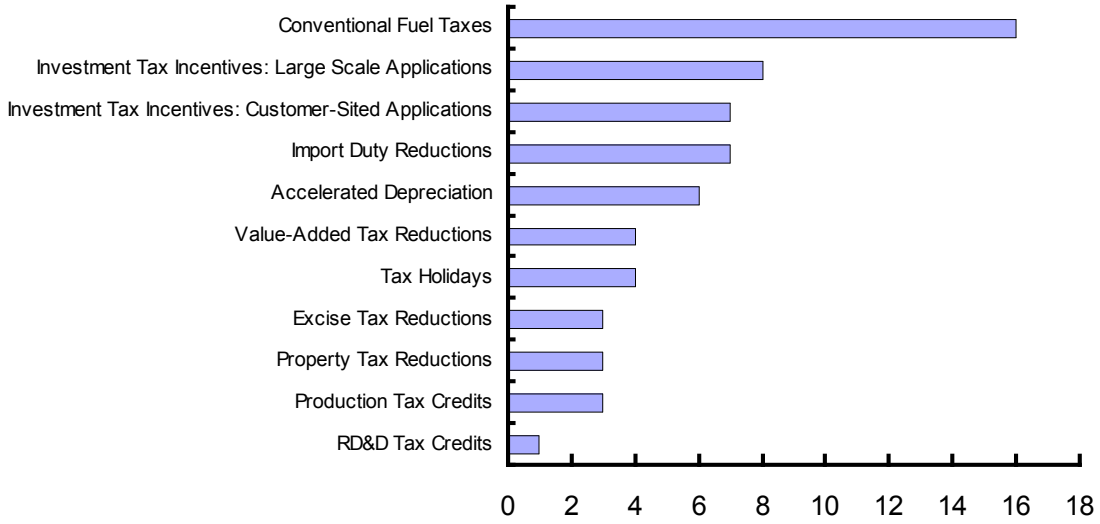
4 Policy Preferences for Renewable Energy Tax Incentives

This section considers the preferences of countries and states for particular renewable energy tax incentive policies. The information on renewable energy tax incentives used in this paper is drawn from four databases, two focused on the European Union, one on

world renewable polices, and one on the United States (6), (18), (14), (5). It is not intended to be a comprehensive representation of world renewable tax incentives.[1] The information covers 29 countries and 35 U.S. states. It represents the types and mix of renewable energy tax incentives found around the world. Given that each country and state government chooses its own tax incentives, some insight on renewable energy tax incentive preferences can be gained.

Countries and states are separated on the premise that U.S. state government tax incentive choices are influenced by U.S. federal tax incentives and by the nature of the U.S. system of taxation. Figure 1 summarizes the tax incentives of 29 countries.

Figure 1
Number of Countries Utilizing Each Type of Tax Incentive



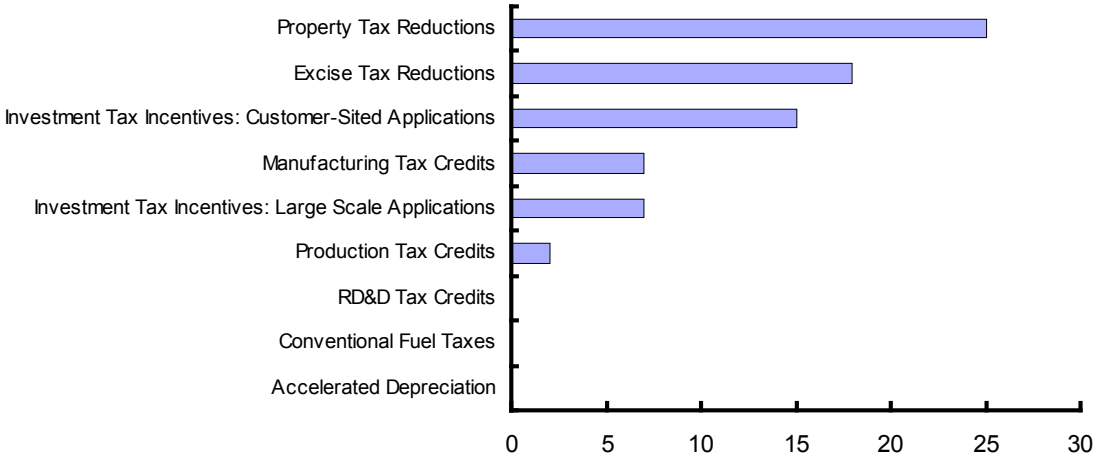
The prevalence and size of conventional fuel taxes is growing. Commitments to the Kyoto accord or global warming concerns are often referenced directly in the tax codes for countries implementing these taxes. Despite the policy advantages of production tax incentives over investment tax incentives, investment tax incentives remain much more common, outnumbering production tax incentives five-to-one. It is still possible, however, that some countries will convert to production tax incentives from the investment tax incentives that have been favored earlier in the development of the renewable energy industry, at least for larger-scale renewable energy applications. Investment tax incentives for smaller, customer-sited renewable energy applications are currently and are expected to remain quite popular. A quarter or less of the countries sampled had import duty reductions, accelerated depreciation, VAT reduction, tax

[1] Information on tax incentives is presented at a summary level. It came from many sources. Although the authors attempted to make the information presented as accurate as possible, it may contain errors, omissions, or be out-of-date. Readers interested in making decisions related to particular incentives are advised to first refer to the latest tax codes and contact the taxing authorities of the relevant countries and states.

holidays, or excise tax reductions. Import duty reductions are most common in countries with developing renewable energy industries.

Figure 2 summarizes nine specific tax incentives offered by 35 U.S. state governments. Two types of tax incentives are not depicted (import duty reductions and value-added tax reductions) because they are not relevant for state government policy based upon jurisdiction and the U.S. tax system.

Figure 2
Number of U.S. State Governments



Utilizing Each Type of Renewable Energy Tax Incentive

Property tax reductions and excise tax reductions are the most common renewable energy tax incentives offered by U.S. state governments. As mentioned in section 3.5, excise taxes on equipment and property taxes can be significant for renewable energy technologies because they tend to be capital-intensive. They can also be a strong contributor to the per kilowatt-hour tax disparity between renewable energy technologies and conventional technologies. Roughly half of the states with renewable energy tax incentives offer investment tax reductions on renewable energy systems for homes and offices. Similar to countries, states continue to prefer investment tax incentives to production tax incentives, though this does appear to be slowing changing with an increasing number of production-based tax incentives for larger-scale renewable energy applications. Seven states offer tax incentives to renewable energy equipment manufacturers, often related to their state economic development efforts. A few directly link the size of the incentive to the amount of equipment manufactured, similar in concept to linking the size of tax incentive to the amount of renewable energy produced (section 3.2).

Figure 3
Number of Countries and States
Utilizing Each Type of Renewable Energy Tax Incentive

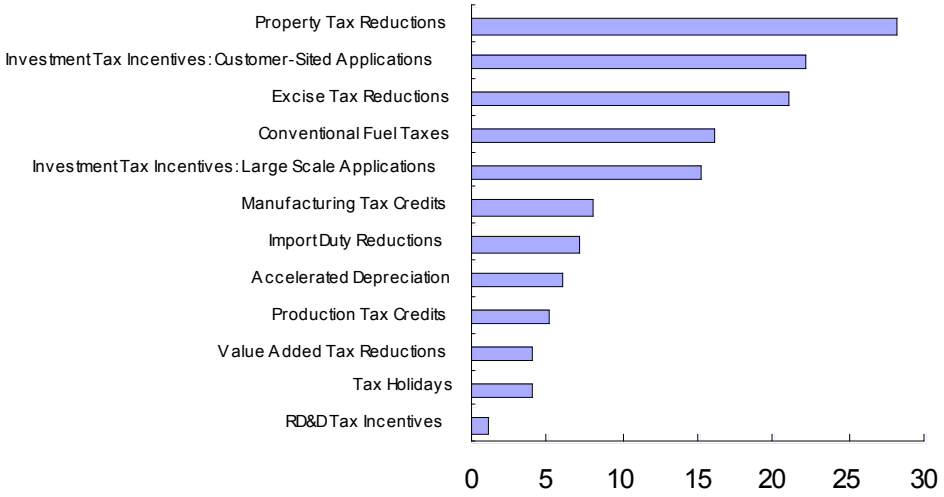


Figure 3 summarizes the combined information for country and state renewable energy tax incentives. Property tax reductions and investment tax incentives for customer-sited applications are the two most prevalent types of tax incentives. Overall, U.S. state governments offer the majority of these two tax incentives. In both Europe and the United States, local governments tend to levy and administer property taxes and excise taxes, therefore no conclusions can be drawn from the fact that countries tend to utilize these tax incentives less than others.

Investment tax credits for larger-scale renewable applications are more widely used by countries than by state governments. More than half of the governments offering tax incentives include investment tax incentives for larger renewable energy applications in the mix. Investment tax incentives of this type can be especially effective in the early stages of industry development. Germany, Denmark, and Japan, countries with well-developed renewable energy sectors, do not offer investment tax incentives. As discussed in section 1.1, investment tax incentives can lead to a focus on capital investment and not productive efficiency if not carefully managed. This suggests two possible explanations: 1) countries believe investment tax incentives are effective and that they can manage to avoid any potential negative consequences; and/or 2) once a tax incentive has been extended to an industry, it can be politically difficult to remove it.

Import duty reductions, accelerated depreciation, production tax incentives, value added tax reductions, tax holidays, and RD&D credits are the least used tax incentives. Because of WTO rules, developed countries with developed equipment manufacturing industries may be restrained in their use of import duties. Four of the six least common incentives can significantly impact the cash flow and income of renewable energy projects (reducing import duties on parts and equipment and RD&D tax credits have the least financial

impact). None of these incentives is inherently inferior to other types of tax incentives in wider use. Some countries and states may benefit from including these incentives in their policy mix.

5 Lessons for Public Policy: Characteristics of Successful Tax Incentives

The experiences of many governments in offering renewable energy tax incentives can provide useful guidance in program design and administration. Section 5 highlights policy advice gained from experiences in implementing renewable energy tax incentives in the United States and around the world.

5.1 Relationship to Other Policy Tools

Tax incentives, although useful, are generally not as effective as other types of renewable energy policy tools. For example, policies such as renewable portfolio standards and renewable energy feed-in tariffs (utility obligation to purchase renewable energy at a fixed price) have been found to provide a stronger stimulus to use of renewable energy, particularly in developing markets. While they are generally not used alone, renewable tax incentives frequent accompany other renewable energy policies. Their design flexibility makes them particularly well-suited to meet needs not covered by other renewable energy policy tools.

5.2 Creating Tax Parity

Countries should, at a minimum, aim for tax parity between energy resources. Renewable technologies should not be taxed at a higher dollar/kilowatt-hour rate than conventional energy sources. While the tax disadvantage for renewables in many countries may not be intentional, it is especially troubling in countries where the negative environmental impacts of conventional electricity generation technologies are not well accounted for in markets or tax systems. Countries interested in tax parity between resources should conduct studies of the incidence of energy taxes on conventional and renewable energy resources. Moreover, if governments believe it is sound public policy to encourage renewable energy, then tax systems can be modified to with more aggressive tax incentives to specifically favor renewable energy.

5.3 Incentive Targeting

Successful renewable energy tax incentives will generally be targeted to specific identified needs that are not adequately being covered by other renewable energy policy approaches, and may vary according to the stage of renewable industry development.

In the early years of establishing a domestic renewables manufacturing industry, for example, tax incentives should generally be more generous and import duties on parts and equipment should be slight. This will help to encourage foreign equipment manufacturers and local firms to develop domestic manufacturing capability. At this early stage of development, tax incentives can also be used to directly encourage the manufacturing and assembly of parts and components locally, or R&D efforts by local renewable energy firms.

As the domestic industry develops and strengthens, the industry will move on to manufacturing more complex components and systems (e.g. wind turbine blades and gear boxes). With the maturation of the industry, tax incentives for local equipment manufacturing may become less important, while tax incentives for the production of electricity from renewable energy installations may increase in importance. Countries may gradually raise import duties for competing systems and equipment to levels similar to other industries, assuming it is compatible with WTO rules. This would provide increased demand for domestically produced renewable energy equipment.

Of course, the long-term objective of offering tax incentives is to develop a healthy renewable energy marketplace; one that is not strongly dependent upon tax incentives and government subsidies to survive. Incorporating a phase-out schedule in tax legislation can help to ease political tensions and the potential for a market crash that may come from abruptly removing a tax incentive after the industry has grown used to it.

5.4 Size and Use of Tax Incentives

The size of the tax incentives can clearly impact their effectiveness. Tax incentives are most effective when:

- **They are large enough to make a renewable resource competitive under circumstances when it otherwise would not be.** This is the classic "but-for" test applied to evaluate the effectiveness of public policy initiatives. If it is impractical to make the tax credit large enough to be effective, then other policy tools are clearly required.

- **The recipients owe sufficient taxes to make the tax incentive fully useful.** Adding flexibility to the features of a tax incentive can increase its value in years when the recipient does not owe sufficient taxes to fully use it. Many companies or projects, for example, earn investment tax credits that they cannot immediately use because they did not earn enough profit in the first year or two of a project to have a tax liability large enough to use the tax credit. Insufficient tax liability can be mitigated in two ways: 1) the tax credit can be designed to allow the recipient to sell the rights to the tax credit to a company or individual who has sufficient tax liability to use it; or 2) the recipient can be allowed to "carry-forward" the tax credit to a future year when there are expectations of higher earnings and higher tax liability.

Flexible design of tax credit programs that allow the recipient to carry forward or sell their unused credits is essential for them to be effective incentives. Canada is an example of a country that has designed flexible tax credits. Recipients of investment tax credits can carry-forward the credit for a period of up to 10 years. In this manner, the recipient can use part of all of the tax credit in any of the first 10 years they choose, at a time when they owe sufficient taxes to benefit from it. In addition, they can "carry-back" the tax credit for up to 3 years, allowing an investor to use a tax credit to pay back taxes owed prior to actually earning the investment tax credit (11). In Oregon and Oklahoma, this issue has been tackled differently: in both states, the tax credit can be sold to other businesses with the taxable income needed to fully use the incentive.

5.5 Administrative Efficiency

Tax incentives are often easier to administer than other programs to bolster renewable energy development because the knowledge, systems and government organizations needed already exist. Agencies collecting tax revenues are typically familiar with tax incentives and tax reduction programs. There may be some advantage to having government agencies related to the energy sector participate in the administration of the renewable tax incentives to ensure that they are well-designed and effective. The programs should also allow for flexibility and modification of programs over time. They should track the details of the participants, costs, and energy produced on a routine basis in order to make appropriate changes.

5.6 Public Sector Participation

The rate of growth in renewable energy production can be increased if there is a way for non-taxed public sector organizations to participate in tax incentive programs. Schools, hospitals, and government agencies may be willing to join in renewable energy tax incentive programs if allowed. Public sector participation can also help to deploy renewable energy systems into rural areas where the number of businesses may be low compared to urban areas.

A design component of a tax incentive that would permit public sector organizations to participate would be one in which such organization are able to assign tax credits to businesses in return for a cash direct payment (or a reduction in the cost of the equipment they are procuring). As noted earlier, some tax incentive policies allow just these transactions to occur.

5.7 Education and Outreach

Education about the tax incentive programs can aid in the success of promoting renewable energy, especially for tax incentives targeted to households and small

businesses. A study of deployment of renewable energy technologies in Egypt, Ghana, and Zimbabwe found that information and awareness of renewable technologies was one of the two biggest barriers to implementation (12). However, the need for greater information on renewable technologies and incentives is not unique to developing countries. In the United States, experience has shown that people who were interested in installing renewable energy systems and equipment in their homes and businesses often did not know about the availability of tax incentives. Informing them about the tax incentives helped them to make the decision to purchase the equipment or systems sooner than they might have otherwise done (1).

Government agencies offering renewable energy tax incentives need to publicize them in order to ensure the tax incentive programs are successful. For example, tax incentives for grid-connected wind projects should be publicized to international project development companies, wind turbine manufacturers, and investors. Tax incentives for renewable energy systems and equipment for homes and offices should be publicized to equipment manufacturers and suppliers, communities, local governments, and the general public. For deployment to homes and businesses, it is useful to include information about the benefits of particular renewable technologies along with the information on residential and commercial tax incentives.

5.8 Credibility and Enforceability

Credibility and enforceability are important in shaping investor and consumer expectations about renewable energy tax incentive programs. Good tax incentive programs are ones where:

- Tax incentive program participants are confident that there is a long-term commitment to the program (e.g. 10 years or more).
- The government does not radically change the program requirements for qualifying for and using the tax incentives
- Requirements for qualifying for tax incentives are carefully enforced, regardless of the phase of the program
- Program participants are treated fairly and uniformly, with no favoritism being given to any individual project or class of program participants
- Once qualification for tax incentives has been verified, the participants are able to claim the benefits according to schedule without problems

5.9 Performance Standards

Tax incentives, especially those that are investment-based, should generally include performance standards in order to ensure that equipment has the quality, support, and capabilities necessary for long-term operation. This may include compliance with safety and operating standards, manufacturer warranties, and industry certifications and testing. Performance standards can be particularly important for investment tax credits as a way

to improve an incentive that by design primarily encourages an initial investment. Some tax incentive programs require detailed technical information, projected energy production, and certification that the equipment installation was done properly. Over time, at least for large renewable energy systems, countries should consider moving to production-based tax incentive policies.

5.10 Technology Neutral

Though tax incentives can and should be targeted in nature, having some tax incentives that are technology neutral in the long-term may be important because many renewable technologies are still evolving. It may not be advisable, for example, to favor one or two renewable technologies over all others based upon today's economics or the latest technological advancement. For example, although wind power has made tremendous strides in cost reduction, wave and tidal power appear to be making significant technological gains today. It is difficult to predict what technological advancements may occur in the future. Limiting the renewable technologies that qualify for tax incentives signals a favored technology mix that may not keep up with changes in the marketplace. Companies with promising new technologies may be encouraged to move elsewhere if tax incentives do not support their technology. In addition, it should be recognized that renewable technologies that do not generate electricity, but directly produce heating, cooling, or other services, could also be important to renewable energy policy and therefore be the targets of tax incentives (e.g. solar water heating and ground-source heat pumps).

5.11 Predictability and Consistency

Investors, banks, and other financial institutions need predictability and consistency to provide the investment capital required to expand the renewable energy sector. Predictability and consistency reduce government costs of administering programs and reduce the risk of investing. Reduced investment risk reduces the costs of renewable energy and helps to develop a stable domestic renewable energy industry. Stability in government policy is very important to investors. The frequent expiration of the US renewable energy production tax credit and the uncertainty surrounding its renewal has caused boom and bust cycles in the US wind industry that has hurt its ability to grow domestically and compete internationally. The American Wind Energy Association (AWEA) states that each time the production tax credit expires, it causes layoffs, stalled projects, and a negative near-term market outlook for wind power (13). The success of Germany and Japan in developing strong renewable energy industries in less than a decade can be attributed to long-term government commitments to supportive policies.

6 Conclusion

Tax incentives for renewable energy are powerful policy tools that can help to drive the market for renewable energy, when combined with other policies. In many countries, renewable energy production is at a tax disadvantage because it is capital-intensive compared to conventional energy production, and many taxes are based on capital investment. Tax incentives can help to offset this disadvantage.

Tax incentives should be part of a coordinated package of policy measures that support the development of the renewable energy industry. The mix of renewable energy tax incentives should be gradually adjusted over time according to the stage of industry development, with some incentives being phased out on a predictable schedule as the domestic market grows and the industry matures. Some countries could benefit by adjusting their mix of tax incentives to better match their stage of renewable industry development.

In pursuit of Kyoto Accord targets, an increasing number of countries have shifted from implementing renewable energy tax incentives and subsidies to implementing taxes on carbon dioxide emissions or increasing taxes upon fossil fuels. Faced with commitments and deadlines, countries are no longer relying solely upon positive incentives for renewable energy, but are increasingly turning to disincentives (taxes) for consumption of energy forms with undesirable characteristics. This is an important shift in both political will and public policy on renewable energy.

Countries that have developed successful renewable energy industries have promoted stable markets, designed flexible long-term tax incentives, and (most importantly for attracting investment) have remained steadfast in their commitment to renewable energy through the years.

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