Wind Energy Developments: Incentives In Selected Countries

by Louise Guey-Lee[1]

Abstract

Incentives have long been viewed as a means of supporting technological developments until a new technology becomes cost-competitive. Wind-based electricity is not yet generally competitive with alternate sources of electricity such as fossil fuels. Thus, it is dependent on nonmarket support for development to take place.[2, 3] *Four countries—the United States, Germany, Denmark and India—had 76 percent of the world's wind generating capacity in 1997. This article briefly examines the development of wind energy in each country. It demonstrates that when sufficient support has been available, wind capacity expanded. Also, when support has been withdrawn, wind energy development has slowed markedly.*

Introduction

This paper discusses developments in wind energy for the countries with significant wind capacity. After a brief overview of world capacity, it examines development trends, beginning with the United States—the number one country in wind electric generation capacity until 1997.

World Capacity

The United States possessed 95 percent of the world's installed wind capacity in the early 1980's.[4] By 1990, however, Denmark, Germany, the Netherlands, and India had also developed significant capacity, and the U.S. share of the world capacity dropped to 75 percent. During the 1990's, European and Asian countries have continued to expand wind energy capacity. In contrast, development of U.S. capacity has been slow, with retirements since 1992 more than offsetting new additions through the end of 1997 (Table 1). By then, worldwide capacity amounted to 7,202 megawatts, up about 1,000 megawatts from 1996 and the U.S. share dropped to 22 percent (Table 2). This capacity was distributed as follows: Europe 4,453 megawatts, North America (including Canada and Mexico) 1,645 megawatts, Asia 1,044 megawatts, South and Central America 32 megawatts, Middle East and Africa 24 megawatts, and the Caribbean 4 megawatts. Growth between 1996 and 1997 was strongest in the European countries: Germany (394 megawatts), Denmark (204 megawatts) and Spain (157 megawatts).

Table 1. U.S. Wind Net Summer Capability 1990-1997

Year	Capability (megawatts)
1990	1,405
1991	1,653
1992	1,823
1993	1,813
1994	1,745
1995	1,731
1996	1,677
1997	1,620

Source: Energy Information Administration, *Electric Power Annual 1997, Volume II*, DOE/EIA-0348(97)/2 (Washington, DC, October 1998).

United States

Early History

The U.S. central station wind industry had its start in the wake of the world oil crises of 1973-74 and 1978-79.

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[2] International Energy Agency, *Key Issues in Developing Renewables* (Paris, France 1997), p. 14. Current delivered cost of wind energy in IEA countries ranges 4 to 10 cents / kilowatthour despite decreases in capital costs of 30-50 percent over the preceding decade.

[3] International Energy Agency, *Renewable Energy Policy in IEA Countries, Volume I: Overview* (Paris, France 1997), p.33.

[4] General trends for the early years are taken from U.S. Dept. of Energy, Wind Energy Program, unpublished data.

Table 2. Wind Electric Capacity Worldwide, 1996 and 1997
(Megawatts)

Country	Year	
	1996	1997
Europe		
Germany	1,545	1,939
Denmark	857	1,061
Spain	249	406
Netherlands	299	336
United Kingdom	270	330
Sweden	105	108
Italy	71	100
Ireland	11	46
Greece	29	29
Portugal	20	20
Austria	3	20
Finland	8	12
France	10	10
Belgium	7	7
Czech Republic	7	7
Russia	5	5
Ukraine	1	5
Norway	4	4
Poland	1	3
Luxembourg	2	2
Switzerland	2	2
Latvia	1	1
Total	**3,507**	**4,453**
North America		
United States	1,677	1,620
Canada	21	23
Mexico	2	2
Total	**1,700**	**1,645**
Asia		
India	816	845
China	79	166
Japan	14	18
Australia	10	11
New Zealand	4	4
Total	**923**	**1,044**
South and Central America		
Costa Rica	20	20
Argentina	3	9
Brazil	3	3
Total	**26**	**32**
Middle East and Africa		
Iran	9	9
Israel	6	6
Egypt	5	5
Jordan	1	1
Africa	3	3
Total	**24**	**24**
Caribbean	**4**	**4**
Total World	**6,184**	**7,202**

Sources: United States: Energy Information Administration, *Electric Power Annual 1997, Volume II*, DOE/EIA-0348(97)/2 (Washington, DC, October 1998) and Rest of the World: Windicator, *Wind Power Monthly* (January 1998), p. 50.

Activities at both the Federal and State level helped launch the industry. The passage of the Public Utility Regulatory Policies Act (PURPA) in 1978 created a market for wind-generated power where none existed before.[5] Other legislation put incentives in place such as lucrative investment tax credits. In the early 1980's, combined Federal and State investment tax credits amounted to 50-55 percent of the investment.[6] These credits were important in helping establish the wind industry by reducing investor tax obligations to the government and effectively lowering the investor's cost by the amount of the tax savings. Research sponsored by California's Mello Act of 1978 portrayed wind energy as a clean, reliable, secure alternative to foreign oil and rising oil prices. So the industry was born.

Research in California identified the Altamont, Tehachapi, and San Gorgonio passes as having the best wind resources. Wind was seen as the ideal complement to California's existing hydro power supply, providing peak power while allowing hydro to be reserved for low wind periods. Using its authority under PURPA, the California Public Utilities Commission decided in favor of relatively high full avoided costs to be paid to qualified facilities (generating electricity from wind and other renewable sources) in Standard Offer 4 contracts guaranteed for ten years. The subsequent boom in investments resulted in the development of 900 megawatts of capacity and lasted through 1985, when the Federal investment tax credits expired and California credits expired shortly thereafter.

The future upon which these incentives had been based, however, did not materialize. First, oil prices took a big slide in 1986 instead of continuing to increase. Second, natural gas prices rose less than projected and improvements in gas generating technology were greater than expected. These two factors meant that when 10-year contracts expired, the basis for future full avoided costs of electricity was much lower than initially anticipated.

Third, improvements in wind generating technology were less than anticipated; thus, the cost of developing wind power remained high. Fourth, the investment tax credits were more effective in getting capacity built rather than assuring the units would be productive. Because of technological problems, some capacity factors were as low as 5 or 10 percent.[7] A number of projects were plagued with costs higher than expected and failed as a result. While investment tax credits were effective in getting capacity built, they did not guarantee reliability and performance. Fifth, environmental groups that were expected to be supportive were instead opposed to development because of problems with visual obstruction, bird kills, and noise pollution. While development continued through the end of the 1980's, these 5 factors greatly slowed the pace of wind energy development, with nearly all new projects being in California.

Recent Trends

By the 1990's, wind energy facilities began to appear in other States such as, Texas, Minnesota, Vermont, Hawaii, and Iowa. Of these additional States, Texas had the most capacity with 43 megawatts in 1997, followed by Minnesota with 25 megawatts. Both Minnesota and Iowa have plans for major expansion which would add roughly 100 megawatts each in 1998, if planned construction is completed. Although production tax credits have been the focus of much attention because of their expiration in June 1999, in recent years, Federal and State support programs have provided a broad level of support ranging from various tax incentives to research grants, shown below.[8, 9]

Investment Tax Credits. Only a handful of States still have these credits. These include Hawaii, Massachusetts, Montana, North Carolina, Oregon and Utah.

Production Tax Credits. This type of credit provides the investor or owner of qualifying property with an annual

[5] Under provisions of PURPA, qualified facilities (QFs) were guaranteed that electric utilities would purchase their output at the utilities' avoided cost, which was the incremental cost that an electric utility would incur to produce or purchase an amount of power equivalent to that purchased from the QFs. Additionally, QF's were guaranteed that electric utilities would provide back up service at prevailing (nondiscriminatory) rates.

[6] R.W. Righter, *Wind Energy in America—A History* (Norman, Oklahoma, 1996).

[7] Capacity factor is the ratio of the electrical energy actually produced by a generating unit to the maximum electrical energy that could have been produced at continuous full-power operation during the same period.

[8] See N.A. Rader and R.H. Wiser, Review Draft *Strategies for Wind Energy —A Review and Analysis of State Policy Options*, prepared for the National Wind Coordinating Committee (Washington, DC, March 1998.)

[9] For state level information, see also North Carolina Solar Center, *National Summary Report on State Financial Incentives for Renewable Energy*, prepared for the Interstate Renewable Energy Council (Raleigh, NC, July 1997) and *National Summary Report on State Programs and Regulatory Policies for Renewable Energy* (Raleigh, NC, January 1998). Updated information is found in the Database of State Incentives for Renewable Energy on their website at http://www-solar.mck.ncsu.edu/.

tax credit based on the amount of electricity generated by that facility. By focusing on production, improved project performance is encouraged. Section 1914 of the Energy Policy Act of 1992 (EPACT) created a 10-year, 1.5 cent per kilowatthour credit adjusted for inflation for new plants entering service before June 30, 1999.[10] It has been estimated that this production tax credit can lower life-cycle levelized costs of wind power by about 25 percent.[11] Much of new and planned capacity depends on this credit, which will expire on June 30, 1999, unless proposed legislation passes to extend the tax credit by five years.

Property Tax Reductions. Reductions in property taxes can be used to promote wind development by decreasing the tax burden associated with owning a wind power facility. The tax burden is relatively high compared to fossil energy because of the greater land requirements per unit of output. This policy is an effective incentive in a number of States. For example, it is estimated that in Minnesota, where property taxes are high, property tax exemptions could reduce levelized costs by 1.0 cent per kilowatthour in some cases.[12] The disadvantage of this mechanism is that it produces an incentive for development, not a market per se.

Accelerated Depreciation. Tax depreciation is a non-cash expense meant to approximate the loss of asset value over time, and is defined as the portion of an investment that can be deducted from taxable income in any given year. The Tax Reform Act of 1986, which established the modified accelerated cost recovery system (MACRS), set the current rules for federal tax depreciation. Under MACRS, wind property is currently provided a depreciation life of 5 years, substantially shorter than the 15 to 20 year depreciation lives of non-renewable power supply investments. Faster depreciation results in tax benefits early in a project's life, and is preferred by investors because an after-tax dollar is worth more today than in later years.

Direct Production Incentives. Although similar to a production tax credit, direct production incentives provide cash income directly. At the Federal level, Section 1212 of Energy Policy Act of 1992 (EPACT) provides a "Renewable Energy Production Incentive" (REPI) of 1.5 cents per kilowatthour to non-profit organizations that own wind facilities.

Direct Investment Incentives (Grants). These include programs like the Department of Energy's Turbine Verification Program in which cost sharing with utilities permits early development of wind systems preceding full-scale deployment of turbines. It also includes State monies used for seed grants to conduct resource assessments and feasibility studies.

Government Subsidized Loans. Utility-scale wind system debt interest rates typically are 1 to 2 percent higher than rates for gas-fired projects. Subsidized loans can be provided at below market interest rates, thus reducing loan payments and levelized costs. Although there is no federally subsidized loan program, a number of States including Minnesota have them. While this type of program promotes wind energy, the effect is insufficient to make wind competitive.

"Standard Offer Contracts" for Small and Distributed Projects. During the 1980's, "Standard Offer 4 Contracts," that guaranteed prices 10 years into the future (and saved on transaction costs), were instrumental in the development of wind energy. The guaranteed prices were based on each utility's "full avoided cost" of marginal generation assuming escalating energy prices (which did not materialize). As these contracts have been renewed, the new prices have been much lower and threaten the viability of operating wind generators.

Net Metering or Net Billing. Under this system, utility customers are guaranteed a market for their power by being permitted to operate a "reversible meter." When customers use more electricity than they generate, they pay for the additional electricity at retail prices as usual. Conversely, when customers generate more electricity than they use, the electric utility is obliged to purchase the additional electricity. The prices customers receive for their excess electricity varies widely by State and region and between wholesale and retail levels. So far, experience for wind and net metering is limited. Although California has a provision for net metering, it excludes wind as a source. Other States limit the size of eligible projects, so larger wind projects (greater than 50 or 100 kW) cannot participate.

Site Prospecting, Review and Permitting. Programs in California and at the Federal level have been developed to conduct site resource assessments, evaluate

[10] Note: When other financial assistance is provided to a project, the amount of the production tax credit is reduced by a formula documented in Section 1914 of EPACT.

[11] Hadley, Hill, and Perlack, *Report on the Study of the Tax and Rate Treatment of Renewable Energy Projects*, ORNL-6772 (Oak Ridge, TN, December 1993).

[12] J. Bailey and D. Morris, Institute for Local Self Reliance, *Taxing Wind Energy in Minnesota* (January 1995).

transmission issues, conduct bird population studies, settle zoning issues, and streamline permitting processes. This helped to promote the early development of wind energy projects in California. The U.S. Department of Energy Utility Wind Resource Assessment Program performed a similar function in later years.

Renewable Portfolio Standard (RPS). The terms of renewable portfolio standards vary among States, but an RPS generally requires every retail power supplier to provide a certain minimum percentage (or floor) of electricity from specified renewable sources for a given time period. A RPS can operate in tandem with a credit trading system, so suppliers sell credits for extra renewable power they generated or vice versa. If they are short of renewable power they can purchase credits to make up the difference to settle their account.[13] Legislation establishing some sort of renewable portfolio standard has passed in a number of states including Arizona, Maine, Massachusetts, and Nevada.

Renewable Setasides. In California, a recent ruling provides for a 0.7-percent surcharge on electric bills to support renewables during the four-year transition to a competitive market. Wind energy is earmarked to receive $70 million of an estimated $540 million total budgeted.[14, 15] Already, some 300 megawatts of new wind energy projects have won the opportunity to receive California Energy Commission financial incentive funds.[16]

Auctioned Contracts. Increasingly, electric utilities have acquired renewable energy competitively by issuing request for proposals (RFP's), which generator owners can bid on. In effect, the bidder guarantees to provide a given amount of electricity under specified terms for a given price. To date, most of these RFP's were issued as renewable only or technology specific only.

Green Marketing/ Pricing. These are voluntary programs in which customers agree to pay a premium to purchase "environmentally friendly" or "green" electricity. This encourages development of a market for renewable power, wind included. So far, public response has been limited. It is estimated that only 1 to 4 percent of residential consumers will participate in the near future in California's green pricing program.[17] Although there is some difficulty in determining what the premium should be,[18] utilities like Sacramento Municipal Utility District and Traverse City Light and Power have begun to use green pricing to stimulate renewables development. In Sacramento, customers pay an additional $4 per month special premium to have a photovoltaic system installed and operating on their rooftop.

State Mandates. These provisions differ for each State. In Minnesota, the State legislature has required Northern States Power to phase in construction of 425 megawatts of new wind capacity by 2002 as compensation for being allowed to store nuclear waste on site. In Iowa, the Alternative Energy Law (AEL) requires investor-owned utilities to purchase a combined total of 105 megawatts of their generation from renewable and small hydropower sources. The majority of needed capacity will be from wind power and biomass applications.

Research and Development. The United States government has long supported development of wind technology that will be economically competitive as an energy source. The Wind Energy Program, administered by the Department of Energy, is divided into three components: applied research, turbine research, and cooperative research and testing. Funding for 1997 was $29 million.

Germany

Germany has made impressive gains in installed wind capacity since 1991 and is now setting the trend for Europe's future.[19] German capacity is nearly 2,000 megawatts, up from less than 100 megawatts in 1990.[20] In mid-1997, it surpassed the United States as the country with greatest wind capacity. Germany's environmentally friendly atmosphere was largely responsible for 394 megawatts being added in 1997, with more under

[13] See Schaeffer's proposed House of Representatives Bill 655.

[14] *Wind Energy Weekly* (February 2, 1998), pp. 1-2, and *Wind Power Monthly* (January 1998), pp. 32-37.

[15] Details of the program can be found on the California Energy Commission's website at http://www.energy.ca.gov/renewables.

[16] *Wind Energy Weekly* (July 20, 1998), pp. 1-2.

[17] Lawrence Berkeley National Laboratory (LBL), *Selling Green Power in California: Product, Industry and Market Trends* (Berkeley, California, August 1998).

[18] Advocates suggest a premium of 5-15 percent as a reasonable range.

[19] The current goal of the European Wind Energy Association is to reach 8,000 megawatts of installed capacity by 2000.

[20] Windicator in *Wind Power Monthly* (January 1998), p. 50.

construction in 1998.[21] Most of Germany's development is in small, dispersed projects owned by individuals and private operating pools, not utilities. This development has been encouraged by various mechanisms, several of which are described below.

Electricity Feed Law (EFL). Since 1991, the EFL has obliged electric utilities to purchase renewable energy at guaranteed prices equal to 90 percent of retail price.[22] For wind, this amounts to Deutsche Mark (DM) .1715, or 10.5 cents per kilowatthour in 1997 for the life of the plant—a significant stimulus to development.[23] In the future, as prices come down in Europe's more competitive, liberalized electricity market, the guaranteed price is expected to be lower—about 2 percent less in 1998 for example.[24] This type of decrease is expected to gradually put economic pressure on developers.

In addition, the electric utilities are opposed to the EFL because of the burden it places on them. Efforts to declare the law unconstitutional failed, but the amendment to the EFL recently passed in Germany's Parliament is more favorable for utilities. It provides a cap (some 5 percent) on electric power taken from renewable sources.[25] This is good and bad news for the wind industry—the EFL is still in force, but there is a limit on benefits.

Investment Assistance. The Deutsche Ausgleichsbank grants to wind turbine operators soft loans with average interest rates of 1 to 2 percent below the rates in the capital market.[26] Rates are fixed for the duration of the loan and thus provide easy financing for German wind farms, when compared with the rest of Europe.

Planning Privileges. The German Building Statute Book prohibits erection of buildings and similar structures on open countryside with some exceptions.[27] Facilities for public electricity supply, including wind turbines, are permitted. This facilitates development of wind power, which has large land requirements.

250 Megawatt Program. The goal of the 250 Megawatt Program is to carry out a broad test over several years of the application of wind energy on a commercial scale.[28] As an incentive for their participation in the program, operators of the wind turbine / wind farm receive grants for the successful operation of their facilities. The current benefit is either DM .06 or .08 (about $.03 or $.04) per kilowatthour depending on whether the energy is fed into the grid or used by the owner of the turbine, respectively.

El Dorado. This program provides overseas aid to cooperative ventures between German interested parties and development partners in the Southern Hemisphere. Grants of up to 70 percent of the cost of the project are provided. At the end of 1996, this program supported development of 26 megawatts of capacity.

Research and Development (R&D). The Federal Ministry for Education, Science, Research and Technology spent about DM 5.5 million or $3.2 million on various R&D projects while the Federal Ministry of Economics contributed about DM 1 million or $0.6 million in 1996.

Denmark

Denmark ranks as the world's largest manufacturer and exporter of wind turbines and it is third in installed wind capacity. In the 1980's, before Germany and the Netherlands began wind programs, Denmark had virtually all of the wind capacity outside the United States. By 1990, this amounted to around 300 megawatts. Development has continued through the 1990's and has included two offshore projects. Despite limitations on available land space, total wind capacity was over 1,000 megawatts at the end of 1997.

Currently, about 60 percent of the world's wind turbines are manufactured in Denmark. In the twelve months ending October 1997, Denmark sold 1,021 megawatts of wind turbines.[29] About one-third, or 326 megawatts, went to domestic markets and the remainder were exported. Germany was the most popular destination,

[21] Germany is projected to add 500 megawatts of capacity in 1998. For details, see BTM Consult, APS, *International Wind Energy Development–World Market Update 1997* (Ringkobing, Denmark, March 1998).

[22] C. Flavin and S. Dunn, Worldwatch Institute, *Rising Sun Gathering Winds: Policies to Stabilize the Climate and Strengthen Economies* (Washington, DC, November 1997), p. 49.

[23] *The Solar Letter* (January 30, 1998), pp. 37-38.

[24] Personal communication with Andreas Wagner, German Wind Energy Association, January 1998.

[25] *The Sustainable Energy Industry Journal* (Issue 8, 1998), p. 38.

[26] International Energy Agency, *IEA Wind Energy 1996 Annual Report* (Paris, France, October 1997).

[27] Personal communication with Andreas Wagner, German Wind Energy Association, January 1998.

[28] International Energy Agency, *IEA Wind Energy 1996 Annual Report* (Paris, France, October 1997).

[29] *Wind Power Monthly* (December 1997), p. 23.

followed by Spain, China, and Great Britain. Over the years, the Danish government has demonstrated a great deal of support for its wind industry at home and abroad. Some selected support programs are discussed below.

Windmill Law. This law requires electric utilities to purchase output from private wind turbine owners at 85 percent of the consumer price of electricity plus ecotax relief or about Kroner .62, or 9 cents per kilowatthour.[30] Electric utilities receive Kroner .10 or 1.5 cents per kilowatthour production subsidy for power generated by wind.[31]

Energy 21. In earlier years, Denmark undertook development of wind energy to lessen dependence on imported oil. Now development is tied to its Energy 21 goal of reducing CO_2 emissions by 20 percent by 2005. This translates into an initial 1,500 megawatts of wind capacity on land and later by 2030, 4,000 megawatts offshore.[32] This plan also encourages support at the grass roots level as local planning boards have been asked to include wind in their energy plans.

Export Assistance. The Danish International Development Agency (DANIDA) provides both direct grants and project development loans to qualified importing countries.[33] India is a good example of a developing country receiving assistance. In the beginning, tied grant money was used to develop the first demonstration projects of about 20 megawatts. Joint ventures formed in these projects paved the way for future development using soft loans tied to the purchasing of Danish equipment directly, or setting up a licensing agreement with Danish companies to manufacture locally. Typically, these loans for developing countries bear low interest and have extended payback periods. The exact terms are determined by the importing country's state of development (e.g., least developed, less developed) with the most favorable terms going to the least developed countries, and so on.

Research and Development (R&D). The Danish government has long supported development of technology for its manufacturing industry. During the 1976-1996 period, total R&D funding was about Kroner 350 million ($52million).[34]

Demonstration Projects. These projects received about Kroner 170 million ($25 million) over the same time period.

India

India ranks first in the developing world for installed wind capacity. With nearly 850 megawatts of wind capacity, it ranks fourth in the world after Germany, the United States, and Denmark. Most of this development occurred in 1995 and 1996, when capacity expanded by an average of several hundred megawatts per year. Among the States, Tamil Nadu has the most capacity—approximately 75 percent of India's total in 1996— while Gujarat and Andra Pradesh have most of the remainder. With electricity demand pressing, the government favored wind projects because they had a short gestation period and no air emissions. Efforts were made to develop a domestic manufacturing industry partnered with overseas companies. Denmark, Germany, and the Netherlands were instrumental in providing assistance. Nevertheless, it is reported that the projects have been dogged with poor performance due to the turbines being improperly sized for European-type high wind speed conditions, whereas India's wind speeds are lower. In 1997, the slow economy, tight credit, and change in government resulted in total additions of less than 50 megawatts, despite the number of support mechanisms in place to support development, described below.[35]

Guaranteed Prices. Tamil Nadu and several other State electric boards have agreed to purchase wind power at about 6.4 cents per kilowatthour.[36]

Tax Benefits. These include:

- Five-year tax holidays on income from sales of electricity
- Accelerated depreciation of 100 percent on investment in capital equipment in the first year

[30] *Wind Power Monthly* (January 1998), p. 29.

[31] American Wind Energy Association, *Fact Sheet on International Wind Energy Incentives* (Washington, DC, February 1997).

[32] *Wind Power Monthly* (September 1997), p. 20.

[33] Princeton Economic Research, Inc., Draft *Government Export Assistance Available to European Wind Turbine Manufacturers*, prepared for the National Renewable Energy Laboratory (March 24, 1995).

[34] International Energy Agency, *IEA Wind Energy Annual Report 1996* (Paris, France, October 1997), pp. 40-41.

[35] *Wind Directions* (April 1997), pp. 8-11.

[36] India Renewable Energy Development Agency (IREDA), at website http://www.crest.org/renewables/ireda/wind.html (July 23, 1997).

- Excise duty and sales tax exemptions for wind turbines
- Import duties on a variety of components waived
- Moving toward a production tax incentive to encourage performance.

Project Financing. India Renewable Energy Development Agency (IREDA) was formed in 1987 to provide assistance in obtaining loans from the World Bank, the Asian Development Bank, and the Danish International Development Agency (DANIDA). This included acting as a conduit for World Bank Loans totaling $78 million specifically for wind.

Planning and Resource Assessment. India has a large wind assessment program with over 600 stations in 25 States to provide information about the best sites for development.[37]

Grants/Demonstration Projects. By the end of 1996, some 50 megawatts of demonstration capacity had become operational.[38] This capacity was concentrated in the States of Tamil Nadu and Gujarat.

Closing Comments

The United States is rich in wind resources.[39] The major difference between the United States and the other countries discussed is the price guaranteed for wind energy. U.S. producers, under new contracts, receive around 3 to 4 cents per kilowatthour.[40] In contrast, wind producers in Germany, Denmark, and India are guaranteed 10.5 cents per kilowatthour, 9 cents per kilowatthour, and 6.4 cents per kilowatthour, respectively. U.S. producers, who currently are facing the uncertain world of deregulation and competitive pricing, find investing in wind energy too risky.

In March of 1998, the Administration released its "Comprehensive Electricity Competition Plan" (CECP) with provisions for a renewable portfolio standard, a public benefit fund, and net metering. While wind would benefit from these provisions, if enacted, some of the benefits would be limited. For example, wind energy might be expected to take a major share, but not all, of the energy provided under a renewable portfolio standard. Also, wind projects typically exceed the size limitations (up to 20 kilowatts) for net metering. Further, Congress has yet to approve the CECP, so most of the U.S. wind capacity planned to come on line in the next year or two is either "mandated" as in Minnesota and Iowa or, alternatively, designed to take advantage of the production incentive which is to expire in June 1999, or both.

Future

Although the four countries studied in this article currently have 76 percent of the world's installed wind capacity, there are some interesting developments elsewhere. In 1997, Spain added some 150 megawatts of wind capacity and now surpasses both the Netherlands and the United Kingdom. Also, Spain has near-term plans for an additional 100-200 megawatts of capacity using contracts with premium prices.[41] In Asia, China expanded from 79 to 166 megawatts last year and some of China's projects are being financed using tied aid with Denmark and other mechanisms to continue development of wind energy in a country that is hungry for clean energy.

[37] *Wind Energy Weekly (*September 9, 1996), p. 5.

[38] Ministry of Non-Conventional Energy Sources, Government of India, *Annual Report 1996-1997*, pp. 50-51.

[39] For details, see the Wind Energy Resource Atlas of the United States, at website http://rredc.nrel.gov/wind/pubs/atlas.

[40] The average price of electricity for sales for resale by investor-owned utilities was 3.2 cents per kilowatthour in 1996. See Energy Information Administration, *The Changing Structure of the Electric Power Industry: Selected Issues*, DOE/EIA-0562(98) (Washington, DC, July 1998), p. 23.

[41] *The Solar Letter* (April 25, 1997), pp. 158-159.