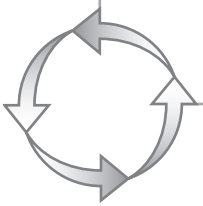
Renewable Energy in Nontechnical Language

by Ann Chambers



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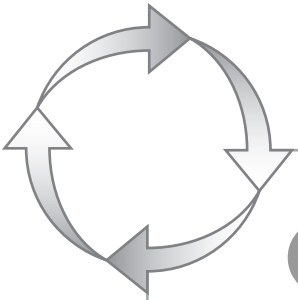

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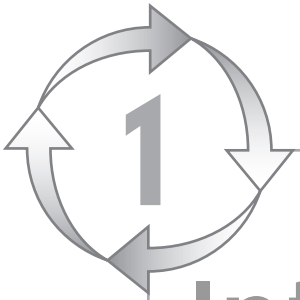

Introduction

Renewable energy sources are those that will replenish themselves—the tide, water flowing downhill in a river, the wind, and the sun. As the technologies to use these natural energy resources evolve, the expense of using renewable energy to generate electricity is coming more in line with the traditional fuels. Emissions constrictions on fossil fuels, research and development efforts, and government subsidies are bringing this niche market toward the mainstream in the United States. Government subsidies also help bring the costs more in line.

Renewables are also gaining ground in the marketing arena. They supply what is often referred to as *green power*, and the U.S. public has been embracing green-power programs offered by utilities as a way to please environmentally conscious customers (Figs. 1–1 and 1–2).

Developing Asia

Support for the construction of large-scale hydroelectric dams remains strong in many countries of developing Asia. Large-scale hydropower projects in China, India, Malaysia, and Vietnam, among others in the region, are expected to provide most of the predicted 4.3% annual growth in renewable energy consumption worldwide.

There are more modest efforts to increase nonhydroelectric renewable energy use, primarily wind and solar, in China, India, and other developing Asian countries. The projects are often aimed at reaching small, rural communities that would otherwise not have access to electricity through the national grid.

In China, work progresses more or less on schedule on the 18,200 MW Three Gorges Dam project, the largest hydroelectric project in the world. The dam is being built on China's Yangtze River. It is scheduled to be fully operational by 2009. The Three Gorges Dam project has encountered problems with accusations of corruption, and there have been difficulties in relocating the estimated 1.13 million residents who will have to move before the dam's reservoir can be flooded. Since 1993, more than 350,000 residents have been relocated. Beyond the expansion of large-scale hydropower, several other projects are underway to develop China's other renewable resources, notably, wind and solar.

Vietnam also proposes expanding its large-scale hydroelectric power over the next several years. In 2001, Vietnam's National Assembly approved construction of the 3,600 MW Son La hydropower project to be constructed on the Da River, about 200 miles west of Hanoi. The project is the subject of some dispute, even among members of the National Assembly, because it has been sited for an area known to have frequent seismic disturbances, and is opposed by human rights activists because it would require the relocation of up to 700,000 people, mostly of ethnic minorities. Estimates for the cost of constructing Son La, which is scheduled for completion in 2016, have run as high as U.S. $5.1 billion. Proponents of the project have argued that it is needed to help improve Vietnam's electricity fuel mix, reduce flood damage, and improve irrigation in the Red River Delta.

The off-grid market has been growing at 15% to 20% annually and the grid-connected PV markets have jumped to a 30% annual growth rate.

Electric Power Research Institute (EPRI) studied PV systems in 2002, finding that many grid-connected systems are being built despite having a higher cost than conventional power.

Eight innovative PV leaders were studied including the following.

- **Sacramento Municipal Utility District (SMUD).** For more than a decade, SMUD has supported PV in its service territory, including its PV Pioneer I, a program allowing residential customers to pay a small additional monthly cost to support a SMUD-owned PV system.
- **Shea Homes.** This home developer is building 100 single-family homes, each with a 1.2 kW PV system as a standard feature.
- **Niagara Mohawk.** The utility installed a 101 kW PV system with battery storage at a utility feeder to provide whole-building uninterruptible power supply.
- **Gardner, Massachusetts.** Installation of 30 2.2 kW residential PV systems and five commercial systems in Gardner is concentrated on a 13.8 kV feeder.
- **Arizona Public Service (APS).** EPRI studied APS's ground-mount systems.
- **Mauna Lani Hotel.** The hotel has horizontally mounted PV panels on the building roof, providing 80 kW of power while reducing building heat gain.
- **Stelle, Illinois.** One-third of the homes in this small community have installed PV systems.
- **Guerilla Solar.** A small residential PV system that was connected to the grid without any permitting or utility involvement because the homeowner decided that working with the utility would be too troublesome.

Case Study: Fun in the Sun

The Pacific Wheel at Pacific Park is the world's first solar-powered Ferris wheel. An innovative and eye-catching use of solar power, it rises nine stories above the Santa Monica Pier deck. Since its construction in 1998, its revolving lights have become a familiar nighttime sight on the Southern California coast. It's one of the few attractions in the area that is not dependent on conventional electricity (Fig. 2–5).

Fig. 2–5 The Pacific Wheel in California Runs on Solar Power (photo courtesy of Shell Solar)

The 130-foot wheel generates more than 71,000 kWh of PV power from the sun's rays. On cloudy days, the wheel relies on conventional power.

Mounted on top of the park's loading area are 650 PV modules. The modules generate electricity to power the wheel.

brand name, energy expertise, marketing machine, and investment capital to the wind industry. The company sees synergies with other divisions, including plastics, transportation, and power control.

The GE wind division has 900 kW and 1.5 MW systems available and is working with a prototype 3.2 MW system.

> *We are working to drive further improvements and cost savings for our wind turbine products.*
>
> *Steven Zwolinski,*
> *head of GE's Wind Energy*

Energy major Shell also entered the U.S. wind market in 2002 with Shell Wind Energy. Shell bought an 80 MW wind plant in Texas and a 41 MW facility in California. It also has a 50 MW project in Wyoming and jumped into the development or operation of another 1000 MW of wind power in the United States and Europe.

The European Wind Energy Association (EWEA) claims wind power can produce 10% of worldwide energy supply by 2020, even if electricity consumption increases substantially. Denmark and Germany's Schleswig-Holstein are already approaching this 10% figure.

Christophe Bourillon, EWEA executive director, attributes the surge in wind power's popularity to concern about climate change, worries about fossil fuel supplies, and the need to sustain an ever-increasing population.

> *Our association has set targets for Europe alone of 40,000 MW of wind capacity by the year 2010 and 100,000 MW by the year 2020. Wind energy can reduce the amount of greenhouse gases released into the atmosphere, preserve valuable fossil fuel reserves for specialized uses, and help poorer rural countries develop without resorting to polluting technology.*
>
> *Christophe Bourillon,*
> *executive director, EWEA*

Table 3–7
Largest Offshore Wind Installations

Site	Country	On-line	Capacity (MW)
Vindeby	Denmark	1991	4.95
Lely	Holland	1994	2.0
Tuno Knob	Denmark	1995	5.0
Dronten	Holland	1996	11.4
Gotland	Sweden	1997	2.5
Blyth Offshore	United Kingdom	2000	3.8
Middelgrunden	Denmark	2001	40
Uttgrunden	Sweden	2001	10.5
Yttre Stengrund	Sweden	2001	10
Horns Rev	Denmark	2002	80
Large Planned Offshore Projects			
Scheldt River	Holland		100
Ijmuiden	Holland		100
Laeso	Denmark		150
Omo Stalgrunde	Denmark		150
Gedset Rev	Denmark		15
Rodsand	Denmark		600
Lillgrund Bank	Sweden		48
Barsebank	Sweden		750
Kish Bank	Ireland		250+
Arklow Bank	Ireland		500

Source: British Wind Energy Association

EPI's biomass gasifier add-on for coal-fired boilers is a unique system that combines the production of green, renewable energy with effective NO_x reduction in a single unit. The normal problems and disadvantages inherent with directly co-firing biomass in coal boilers, such as excessive wear on pulverizers, fouling and slagging of tubes, ash contamination, etc., are completely eliminated or minimized through the use of EPI's gasifier.

Pat Travis,
business development manager, EPI

Biopower basics

The energy stored in biomass (organic matter) is called bioenergy. Bioenergy can be used to provide heat, make fuels, and generate electricity. Wood, which people have used to cook and keep warm for thousands of years, continues to be the largest biomass resource. Today there are also many other types of biomass we can use to produce energy. These biomass resources include residues from the agriculture and forest industries, landfill gas, aquatic plants, and wastes produced by cities and factories (Fig. 4–5).

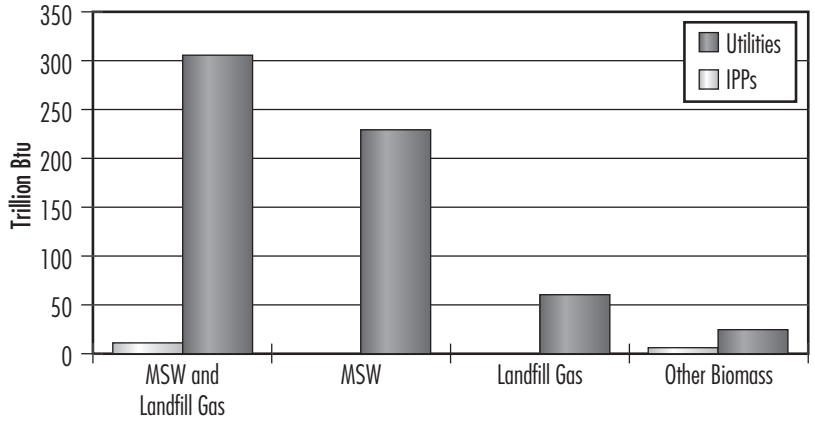

Fig. 4–5 Waste Energy Use in Electric Power Generation (source: DOE)