2014

Renewable Energy

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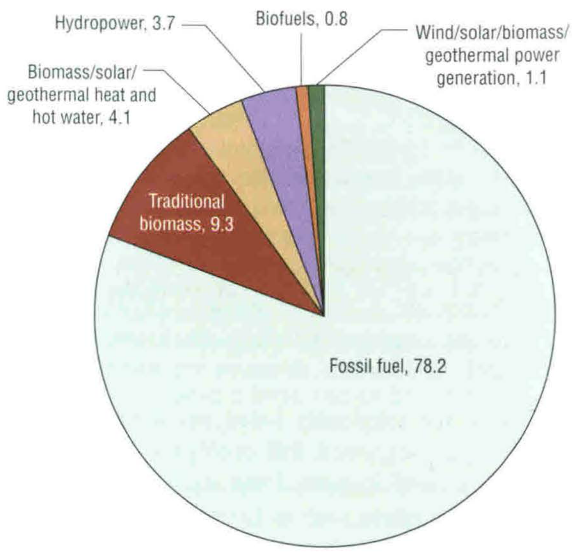
Recommended Citation
Finley-Brook, Mary. "Renewable Energy." In *Achieving Sustainability: Visions, Principles, and Practices*, edited by Debra Rowe, 644-52. Vol. 2. Gale, 2014.

Renewable Energy

Renewable energy installations are expanding around the globe. Although there is excellent potential for achieving sustainability with multiple types of renewable energy, no energy source is a panacea. There are place-specific costs and benefits from every energy type, and the scale of production influences impacts. Industrial-scale renewable energy sources usually merge into existing energy grids and may often be connected to broader economic and political initiatives, such as regional integration, development of new growth poles to stimulate economic expansion in areas without infrastructure, job creation, or trade expansion. With the exception of desert solar projects or initiatives in remote areas, most large-scale renewable energy projects tie onto existing electrical grids and infrastructures rather than transforming prevailing systems. To achieve energy sustainability broader changes are likely necessary. Renewable energy projects of all sizes are increasingly paired with efforts to promote energy conservation, improve efficiency, reduce greenhouse gas (GHG) emissions, increase energy access for the marginalized, and provide other social and ecological co-benefits.

The United Nations International Year for Sustainable Energy for All in 2012 brought attention to the fact that the lack of electricity among the poorest sectors of society increases inequality and impedes progress toward other quality-of-life improvements. Approximately 4.7 billion people live without electricity; 2.7 billion rely on wood, charcoal, and dung to supply their energy needs, leading to serious environmental impacts (e.g., destruction of forests) and health repercussions including respiratory infections, lung cancer, asthma, and more (Sovacool and Dworkin 2012). Energy access through renewable sources has the potential to bring multiple benefits to developing countries, such as improvements in health care, education, ecosystem health, employment, and communication. For example, electricity has been documented to improve standards of living with storage of perishable food or medicines or by extending the hours that educational facilities can remain open. While small-scale renewable energy systems can be



SOURCE: Based on data from REN21 (Renewable Energy Policy Network for the 21st Century). 2013. *Renewables 2013: Global Status Report*. Paris, France: United Nations Environmental Program.

Figure 1. Global energy supply by source in 2011. *(Reproduced by permission of Gale, a part of Cengage Learning.)*

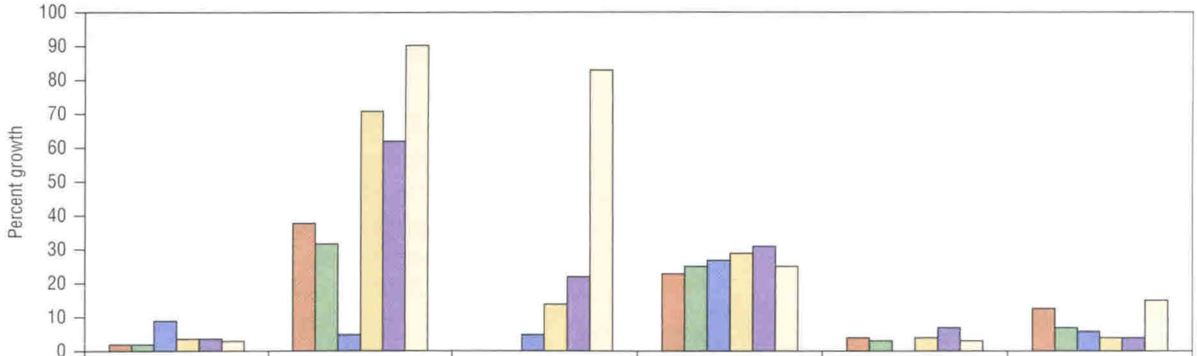
utilized in a wide range of situations, they have often had the most transformative results when (1) they provide electricity to households and communities where existing energy grids do not reach because of cost, steep terrain, or remoteness; and (2) community-based institutions collaboratively manage energy projects.

Although many renewable energy technologies, including biomass, wind power, and tidal power, have existed for centuries, there are new developments and applications emerging regularly. For example, the first solar plane flew across the United States in 2013 and was scheduled make a flight around the globe, and nanotechnology has improved renewable energy storage. However, limited commitments to research and development (R&D) in past decades have meant that today's alternative energy advances are behind where they might have been. Another key impediment is the higher cost of electricity from many renewable energy applications than from widely available fossil fuels such as coal and natural gas. This price disparity is due to the much larger subsidies for fossil fuels and present practices that do not factor negative health and environmental impacts from fossil fuels into costs. Furthermore, some types of renewables, including wind and solar, are intermittent, meaning that there are times when energy is not produced and reliance on stored energy or other sources is necessary. The use of complementary technologies, such as the pairing of solar panels and wind turbines, advances in the quality and cost-effectiveness of energy storage, and smart grid technologies help address this limitation.

Renewable Energy Usage

Although global renewable energy installations (excluding hydropower) more than quadrupled between 2000 and 2010 (NREL 2011), Figure 1 demonstrates that in 2011, 78 percent of global energy still came from fossil fuels. In 2011 wind, solar, biomass, and geothermal power generation combined supplied only slightly more than 1 percent of the world's energy.

Figure 2, demonstrating annual increases of different renewables at a global scale, shows significant growth in solar photovoltaics (PV), concentrating solar power (CSP), and wind energy. Wind energy increased by a factor of eleven between 2000 and 2010, while solar PV increased by a factor of twenty-eight in the same time period. Nonetheless, Figure 2 also highlights the lack of linear growth from 2005 to 2010. It also depicts the relatively slow expansion of hydropower and biomass energy along with small increases in geothermal production.



	Hydro	Solar PV	CSP	Wind	Geothermal	Biomass
2005	2	38	0	23	4	13
2006	2	32	0	25	3	7
2007	9	5	5	27	0	6
2008	4	71	14	29	4	4
2009	4	62	22	31	7	4
2010	3	90	83	25	3	15

SOURCE: Based on data from NREL (National Renewable Energy Laboratory). 2011. *2010 Renewable Energy Data Book*. United States Department of Energy.

Figure 2. Global renewables percent increase by year (2005–2010). (PV = photovoltaic; CSP = concentrating solar power) *(Reproduced by permission of Gale, a part of Cengage Learning.)*

Country	Renewable Energy Capacity Excluding Hydro (Gigawatt)	Renewable Energy Capacity Including Hydro (Gigawatt)
China	90	319
United States	86	164
Germany	71	76
Spain	31	48
Italy	29	47

SOURCE: Based on data from REN21 (Renewable Energy Policy Network for the 21st Century). 2013. *Renewables 2013: Global Status Report*. Paris, France: United Nations Environmental Program.

Table 1. Top countries in renewable energy capacity in 2012. *(Reproduced by permission of Gale, a part of Cengage Learning.)*

Outside of Europe and North America, recent data on renewable energy production by country are often lacking. Existing statistics, including those that are five years old or more, may be unreliable given the speed with which change has occurred in renewable energy production. Another confounding factor is the lack of data standardization, meaning multiple sources may not agree or may use different measures or criteria. Nonetheless, some general conclusions are possible. For example, the five countries with the greatest renewable energy capacity (see Table 1), including China and the United States, are not those that have the greatest percentage of renewable energy in their total energy mix. Moreover, countries with high percentages of renewables in their energy mix often rely heavily on hydroelectric power. To clarify trends toward nontraditional renewable sources, some lists remove dams when citing renewable technologies. Other sources may subtract traditional biomass (such as wood and dung burned as fuel).

Site-Specific Cost-Benefit Trade-offs

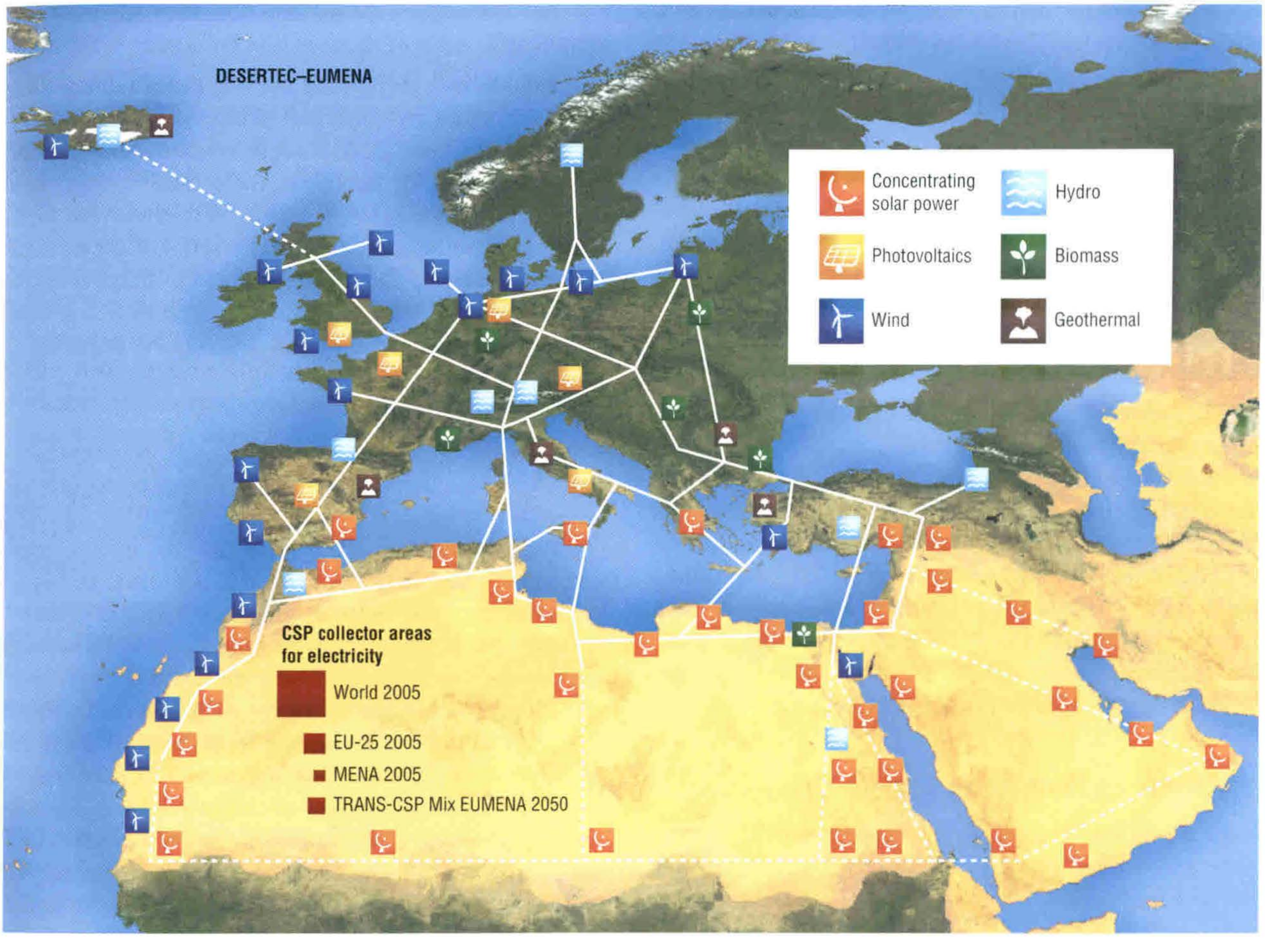
Reductions of GHG emissions and air pollution are core justifications for the transition to renewables (Ochs and Makhijani 2012). An often overlooked benefit is that renewable energy projects can provide the basis for reformulating social and ecological relationships (Alanne and Saari 2006; Rae and Bradley 2012). Projects lead to education and training while strengthening participatory institutions to manage and sustainably utilize natural resources. Decentralized systems—such as community solar models in Europe—can be designed, with appropriate utility regulations, for decentralized ownership that reduces risks regarding access to energy and price increases. Simultaneously, the global focus on promoting sustainable and green energy has led to broader understanding of potential trade-offs between GHG reductions and other aspects of environmental and social well-being.

The production of biofuel is an example of this transition. Enthusiasm for rapid movement away from fossil fuels led to the early development of some types of biofuels that contributed to different releases of GHG, such as from land-use transition from forests to palm oil, but that upon close scrutiny did not reduce emissions overall (Silva Lora et al. 2011). At the same time, there were concerns about social problems, such as increasing food prices and loss of access to land and resources for marginalized populations. Simultaneously, ecological concerns linked to water contamination, deforestation, or habitat loss emerged in some areas. These realities led to better standards for the production of biofuels in many locations and to the development of independent third-party certification.

Although there are always risks of violations or gaps in verification procedures, there have been lessons learned from forest certification programs established since the mid-1990s. Furthermore, there has been unprecedented pressure from European countries to create the most rigorous certification standards and procedures in existence. Nevertheless, biofuels provide an example of the complexity of achieving sustainability, in that each type of fuel (e.g., from corn, sugar, algae, or grass) has varying social and ecological impacts in each locality. Although some critics oppose biofuel production in general, sustainability analysis and certification standards must account for specifics in each location. Being able to assess biofuels for sustainability is increasingly important as industrial-scale adaptation to renewable energies in commercial fleets, jets, and other major GHG-emitting transportation sectors increases.

In addition to variations in appropriate technology based on location and application, scale can play an important role. Many large-scale solar and wind projects have been criticized for negative impacts on biodiversity. Similarly, the ecological implications of hydroelectric dams often depend on the degree to which impeding the river's flow or flooding a reservoir is necessary, with large dams creating the most significant landscape change. The world's largest dams, namely the Three Gorges in China and the Itaipu, shared between Brazil and Paraguay, involved the flooding of 244 and 521 square miles (632 and 1,350 sq km), respectively. Although other gigantic dams are under construction, there has also been movement toward less intrusive run-of-river projects, dams with low heads, and dams designed to be more fish-friendly. However, critics of large dams often remain skeptical of new technologies or protocols that claim to prevent the devastation of fish populations or protect biodiversity.

The scale of a project is an important factor in efficiency and cost-effectiveness. Some existing renewable energy projects can be deemed megaprojects, such as the 780-megawatt (MW) Roscoe wind farm facility in Texas,



SOURCE: Based on data from DESERTEC Foundation. 2009. *Clean Power from Deserts: The DESERTEC Concept for Energy, Water and Climate Security*, 4th Edition. Bonn, Germany: Protext Verlag.

Map 1. DESERTEC's proposed renewable energy projects and transmission lines. *(Reproduced by permission of Gale, a part of Cengage Learning.)*

spanning nearly 100,000 acres (40,469 ha). That facility, however, is soon to be surpassed by China's Jiuquan wind project, with a proposed 20,000-MW capacity. The massive scale of the regional project DESERTEC is unprecedented: DESERTEC's renewable energy and grid infrastructure will stretch across Europe, the Middle East, and North Africa (EUMENA) and is proposed as being able to supply 15 percent of Europe's energy needs by 2050.

Trans-Mediterranean Renewable Energy Corporation

Trans-Mediterranean Renewable Energy Corporation (TREC) developed the DESERTEC mega-project (see Map 1) as a means to mitigate climate change while also supplying energy for the EUMENA macro-region through concentrating solar, photovoltaic, wind, wave, biomass, and geothermal production (DESERTEC Foundation 2009). A voluntary organization founded in 2003 by the Club of Rome and the National Energy Research Center of Jordan, TREC has emphasized, since the initial planning of DESERTEC, that the two decades needed for construction would provide ample opportunity to act in a concerted fashion to establish favorable policies for the long-term financial and ecological optimization of renewable energy production. In 2009 the nonprofit DESERTEC Foundation took over TREC's role as the primary promoter of the project and has continued to communicate this long-term vision. Also in 2009, an industrial consortium, Dii GmbH (Desertec industrial initiative, Limited Liability Company), was created between the DESERTEC Foundation and firms interested in developing markets for the megaproject. In 2013 the DESERTEC Foundation website announced its withdrawal from Dii GmbH after disputes over strategies and leadership.

If the project moves forward, DESERTEC's high voltage direct current (HVDC) transmision lines will merge into a super-grid to create sufficient redundancy such that the intermittency of some renewable energy sources would largely cease to be a concern. HVDC lines are expensive, but the foundation expects that with the use of the lowest-cost renewable energy technologies the price of energy from the project can still remain competitive (DESERTEC Foundation 2009). An additional proposed benefit is that water desalinization plants could be run on renewable energy. Solar plants in this cogeneration mode make better use of the energy they produce and become more cost effective.

DESERTEC, an ambitious project with massive needs for financial backing, could potentially be constrained by political instability in the Middle East and North Africa (Irving 2009). Supporters maintain the hope of building successful desert solar pilot projects to demonstrate the potential of the larger project. Meanwhile, it is important that the project remains collaborative: if the focus becomes cheap energy for Europe without sufficient energy development and other co-benefits in partner countries, it could instead become exploitative.

European Renewable Energy Policy

With the 2009 Renewable Energy Directive, Europe made a concerted effort to transition toward renewable energy. Additionally, a broader climate and energy package includes binding legislation to ensure the European Union (EU) meets "20-20-20" targets by 2020:

- A 20 percent reduction in EU greenhouse gas emissions from 1990 levels;
- Raising the share of EU energy consumption produced from renewable resources to 20 percent;
- A 20 percent improvement in the EU's energy efficiency.

In spite of a regionwide commitment to renewables, there are significant national differences in renewable energy production. Eight European countries are producing 15 percent or more of their total energy from renewable sources (see Table 2). Yet there are broad differences in the degree of energy self-sufficiency, with countries such as Denmark producing energy exports, while countries such as Lithuania produce less than 20 percent of their own energy and rely on imports.

Country	Renewable Energy (% of total)	National Energy Self-sufficiency (%)	Renewable Energy Target by 2020 (%)
Latvia	34.7	50.4	40
Sweden	32.1	66.0	50
Austria	26.5	35.0	45
Finland	25.8	49.2	38
Denmark	22.4	116.7	(by 2050) 100
Portugal	22.4	23.3	31
Lithuania	15.1	18.6	23
Estonia	15.0	90.6	25

SOURCE: Based on data from IRENA (International Renewable Energy Agency). 2013. *Doubling the Global Share of Renewable Energy: A Roadmap to 2030*. Abu Dhabi, United Arab Emirates.

Table 2. European countries with 15 percent or more total energy from renewables. *(Reproduced by permission of Gale, a part of Cengage Learning.)*

Germany

Along with Denmark, Germany has an aggressive timeline to transition to renewables, aiming to increase renewable sources to 85 percent by 2050. In 2011 Germany produced 10 percent of its energy from renewable sources, meaning it did not have as high a percentage as any of the countries listed in Table 2 (IRENA 2013). However, following the 2011 Fukushima nuclear disaster in Japan, Germany decided to pursue a rapid phase-out of nuclear energy. The last nuclear plant is scheduled to be disconnected from the grid by the end of 2022 (BMU 2011). This decision will encourage a rapid transition to renewables known as the *Energiewende*, or energy transformation. *Energiewende* builds on Germany's 2000 Renewable Energy Sources Act, which gave small-scale and community projects preferential access to the grid and fixed payments for a period of twenty years in the form of feed-in tariffs.

Germany's renewable energy transition is heavily dependent on state subsidies, leading to some criticisms of the costs for the state and questions about long-term sustainability (Bhatti 2013). Yet beyond the provision of renewable energy, there have been economic benefits to thousands of small-scale energy cooperatives and producers. However, the renewables they produce are not always the most cost-effective and the prices paid by state agencies and consumers for energy is more than it is worth in market terms. (It is important to remember that the present market does not fully include the negative costs of utilizing fossil fuels and undervalues the benefits of renewable energies.) The fact that German politicians and consumers are willing to carry this burden is evidence of a moral economy (McGrath 2013). Germany is lauded as an international leader for pursuing a rapid transition to a low-carbon renewable energy future.

Renewable Energy Policy in the United States

Although Germany and the United States had similar energy policies in the 1970s following the energy crisis, there has since been increasing divergence (Laird and Stefes 2009). Ensuring energy security ranks at the top of the US political agenda, but lowering GHG emissions and transitioning to renewable energy sources, have been treated as a lower priority. Unlike European countries, the United States has no federally defined targets for renewables, and individual states have been left to individually set energy standards. Two state policies, Renewable Portfolio Standards and the Mandatory Green Power Option, have been widely implemented but have brought mixed results (Delmas and Montes-Sancho 2011). Although the United States produces 12 percent of its energy with renewable sources, the specific amount ranges widely by state. Although eight states in 2012 produced more than 25 percent of their energy from renewable sources, only Maine reached over a quarter of its total production from renewables once hydropower was subtracted from the state's energy mix.

A segment of US consumers are willing to personally invest in the transition to renewable energy by installing solar home systems (SHS). Nevertheless, growth in industrial solar in the United States greatly surpasses increases in residential and small-scale applications, which make up the backbone of Germany's solar programs. The declining price of solar panels, in part due to imports from China, has made purchasing them more attractive to some; but high installation costs, lack of long-term financing, state utility regulations that deter community-level systems and allow utilities to use mostly fossil fuels instead of efficiency and renewables, and limited state subsidies still deter many American families from installing panels on their properties. It is still easier to connect to a monthly fossil fuel energy bill, where utilities finance the initial costs of a power plant, than to have to pay for a renewable energy system, where building owners have to cover the initial costs. States with higher subsidies or tax rebates, such as California, and locations where solar companies install systems without up-front payments, have experienced rapid growth. At the same time, US electrical companies promote a transition to renewable energy by selling renewable energy certificates (RECs), which allow consumers to voluntarily support private-sector renewable energy projects instead of installing their own system.

Participatory Planning and Implementation of Energy Projects

As with any infrastructure development, there are risks associated with the expansion of renewable energy, particularly for marginalized populations. Without clear standards and procedures for limiting negative social impacts, renewable energy projects can contribute to land grabbing or the loss of local access to natural resources (Scheidel and Sorman 2012). Ecological concerns from the construction of new renewable energy installations include deforestation, water pollution or mismanagement, energy sprawl, and biodiversity loss (Jackson 2011); yet these impacts are still small in comparison to the negative climate change and pollution impacts from fossil fuels. Because of varying livelihood impacts and ecological and landscape valuations, renewable energy initiatives lacking broad public participation in planning stages often face opposition. A lesson from wind project opposition is that outside imposition of projects, particularly without adequate local benefits, can incite protest (Pasqualetti 2011). Local populations are more likely to support projects when changes they request are made, such as moving projects or reducing the number or size of turbines. Affected populations should be involved in defining and implementing complementary programs that increase local benefits. When developers focus exclusively on lowest-cost energy production or funnel profits to private investors or development banks, they stymie the ability of renewable energy projects to create broader positive social and ecological transformations.

Social and Ecological Co-benefits in Developing Countries

The Global Environment Facility's Small Grant Program (SGP) has created life-changing transformation through renewable energy projects in rural areas organized and managed through community organizations. Since 2001 the SGP has supported dozens of microscale hydro projects and small-scale solar initiatives in the Dominican Republic. These microprojects expand slowly because the goals are broader than simply providing energy. Goals include sustainable livelihoods, promoting public awareness of global environment, community participation, gender focus, innovative financial mechanisms, including cofinancing, and capacity building. Similar initiatives around the world demonstrate clear ties between renewable energy and broader sustainable development objectives as they bring widespread benefits in terms of community well-being, education, and training, and institutional strengthening. In Cuajinicuil, Nicaragua, several nongovernmental organizations (NGOs) joined forces to install an integrated hybrid wind and solar PV microgrid system. The project improved national capacity for local turbine construction and installation; local villagers also received education and training and are now able to manage the energy technologies. A gender-balanced committee manages the system and collects household tariffs to cover project costs and maintenance.

Microgrids can help address national-level or state limitations in developing countries to provide electricity

(Mohn 2012); but investments, usually coming from foreign states, donors, or private investors, are needed to create projects. Capacity building and training are essential. Microgrids are growing in popularity because they are flexible and scalable and yet can affect the lives of a large number of people. To be most effective, microgrid projects need to have a local organizational structure in place to maintain and repair infrastructure, collect user fees, balance loads, and ensure that users do not exceed their allotted amount of electricity. When consumers seek to produce their own energy, microgrids in industrialized countries function similarly (Bronin 2012; Mohn 2012). Collaborative renewable projects can be found in a wide variety of structures ranging from shared "solar gardens" for urban residents living in apartments to pooled biofuel production among rural agricultural cooperatives. Synergistic and complementary initiatives can turn waste from one enterprise into energy for another.

Research, Advocacy, and Education

Top research journals, such as *Renewable Energy*, *Energy Policy*, *Energy for Sustainable Development*, and *Renewable and Sustainable Energy Reviews*, promote the understanding of a wide range of renewable energy topics. In addition to discussing appropriate, feasible, and cost-effective technologies, journals in the field could give more attention to political and institutional impediments to the expansion of renewable energy initiatives, given that social challenges frequently limit project and policy success even when technological applications are successful.

Numerous international organizations support increased and improved use of renewable energy sources. Some have primarily a business or investment interest in the sector, while others focus on education. Thousands of NGOs and civil society organizations promote specific renewable energy projects, provide training, improve efficiencies, share resources, and advocate for policy shifts at various governance scales. The United Nations (UN) has taken a lead role in promoting a global energy transition with its Sustainable Energy for All program, which has three interlinked objectives to achieve by 2030: providing universal access to modern energy services; doubling the global rate of improvement in energy efficiency; and doubling the share of renewable energy in the global energy mix. National and subnational governmental agencies around the world provide important information to consumers within their specific political jurisdiction: localized information is necessary because of policy differences in tax incentives, subsidies, and feed-in tariffs.

The Renewable Energy Policy Network for the 21st Century (REN21) is made up of civil society organizations;

	Donor Gift	Market Creation	Integrated "Sustainable Program"
Actors	One, usually a government or a development donor	Multiple government agencies and/or multilateral donors	Multiple public, private and community stakeholders
Primary goal	Technology diffusion	Market and economic viability	Environmental and social sustainability
Focus	Equipment, often single systems	Multiple fuels or bundling for economies of scale	Energy services, income generation, institutional and social needs and solutions
Implementation	One-time disbursement	Project evaluation at beginning and end	Continuous evaluation and monitoring
Ownership	Given away	Sold to consumers	Cost-sharing and in-kind community contributions
Awareness building	Technical demonstrations	Demonstration of business models	Demonstrations of business, finance, institutional, and social models

SOURCE: Adapted from Sovacool, Benjamin, and Michael Dworkin. 2012. "Overcoming the Global Injustices of Energy Poverty." *Environment: Science and Policy for Sustainable Development* 54 (5): 14–27.

Figure 3. Typology of renewable energy development paradigms. *(Reproduced by permission of Gale, a part of Cengage Learning.)*

multilateral banks and institutions; industry and state representatives; and scientific, technical and policy experts. REN21 represents a global shift to improve collaboration and communication between public, private, and civil society actors promoting renewable energy, as shown in the right column of Figure 3. Energy development moved through two stages to the current integrated sustainable paradigm. Initially, renewable energy technology was often distributed as a donation, but many projects were unsuccessful in maintaining institutional support and meeting broader social and ecological objects. In the second period, there was a tendency toward overreliance on market forces. Developing markets in conjunction with state and donor support has been effective in promoting renewables, such as with China's Renewable Energy Development Project, which brought portable solar systems to remote locations and also jump-started national solar markets. The third and current paradigm includes private-sector actors but also seeks long-term policy reform, education, and other commentary initiatives, including the development of resilient institutional partnerships with state agencies and civil society.

The UN Foundation Energy Access Practitioner Network is an example of the integrated sustainable paradigm. The network focuses on household and community-level electrification linked to production and well-being by incorporating specific applications for health, agriculture, education, and small business (Mohn 2012). Another related paradigm shift that is necessary to promote long-term sustainability is to move from integrating renewables into existing structures to total system transformation (REN21 2013). As an indication of the need for fundamental change, many advocacy organizations criticize the fact that climate and energy solutions often extend unsustainable practices; this occurs in part because of exclusionary and narrowly focused decision-making and planning processes in which protecting the lowest cost and greatest profit for those with the most political power is the dominant driver, even when this leads to shortsighted and inequitable energy development.

Where Will Renewables Be Tomorrow?

In spite of some market setbacks, including investments in low-cost shale and imbalances in supply and demand in the solar sector, investments in renewables are predicted to grow steadily until 2030, with wind and solar experiencing the largest growth based on power capacity added in gigawatts (Bloomberg New Energy Finance 2013). The projected growth in industrial solar and wind highlights the need for related investment in grid infrastructure, load management, and storage technologies. The traditional solar panel may become a less popular option as concentrated, thin-film, and portable applications become more widely available.

Although other types of renewable technologies are also expected to grow, projections for specific increases by energy type vary widely (IRENA 2013). Fuel cells utilizing hydrogen gas eventually may be employed not just for small passenger cars but also for trucks, buses, tractors, forklifts, and construction equipment. Hydrogen fuel cells could potentially change the way energy is stored, but the cost to produce hydrogen may prevent worldwide commercialization for energy storage. Cost-effective and high-density storage is currently a major impediment, and there are many R&D programs seeking to overcome challenges. Research to improve and expand smart grids and information technologies linked to renewable energy is also on the rise.

Improved cost competitiveness of renewable technologies is expected as the scale of production increases and efficiency improves. Governmental policy trends remain uncertain, but the establishment of stable carbon markets or price premiums for green technologies with lower GHG emissions could make renewables more cost competitive. Carbon taxes on polluting energy sources, such as coal, oil, and hydrofracked natural gas, could have a similar effect. State subsidies may shift from fossil fuels to renewables, and this would facilitate additional private-sector investment. However, other long-term uncertainties are likely to emerge as a result of climate change. Hydroelectric dams may be less productive during droughts or where annual glacial melt is no longer available. Potential for solar, biomass, and biofuel production may also shift to new locations or away from current areas with climatic changes influencing cloud cover, precipitation, and temperature.

The potential for meeting all of our energy needs with present technology for conservation and renewable energies is somewhat disputed, but experts say that we can reach a majority of our energy needs. Outdated regulations must be adjusted, and the true costs and negative impacts of fossil fuel combustion must be acknowledged. The greater usage of renewable energies and reduction of fossil fuel use is of great importance to the well-being of the planet and future generations.

See also Appropriate Technology; Biofuels; Climate Change; Consumption; Energy Conservation; Fossil Fuels; Geothermal Power; Hydropower; Nuclear Power; Solar Power; Tidal Power; Wind Power.

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