



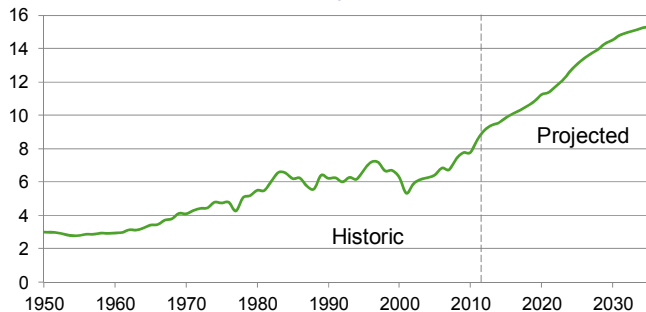
# U.S. Renewable Energy

# factsheets

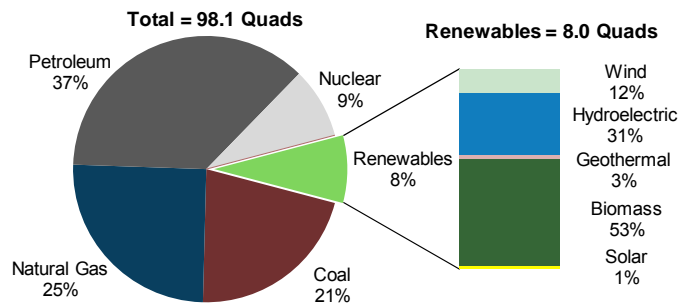
## Patterns of Use

While energy is essential to modern society, most primary sources used today are unsustainable. About 83% of the nation's energy comes from fossil fuels, 9% is derived from nuclear, and 8% comes from renewable sources.<sup>1</sup> Given the environmental impacts associated with the current fuel mix – global climate change, acid rain, large freshwater usage, hazardous air pollution, and radioactive waste – renewable energy has great potential to meet the demand for power with a much smaller environmental footprint. Renewables could also play a significant role in alleviating other pressing problems such as energy security by providing a distributed, diversified energy infrastructure. Wind is the fastest growing renewable source, but contributes only 0.9% of total energy used in the U.S.<sup>1</sup> The examples below demonstrate the potential and progress of renewable energy in the U.S.

U.S. Renewable Energy Consumption: Historic and Projected (Quads)<sup>1,6</sup>



U.S. Total and Renewable Energy Consumption by Source, 2010<sup>1</sup>



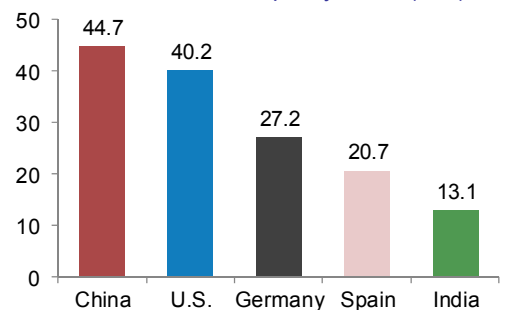
## Major Renewable Sources

### Wind



- Areas with good wind resources have the potential to supply 20% of U.S. electricity consumption.<sup>4</sup>
- U.S. installed wind capacity grew 15% in 2010, to 40 GW.<sup>5</sup> Future estimates range from 66 to roughly 300 GW by 2030.<sup>4,6</sup>
- Based on the average U.S. electricity fuel mix, 1 MWh of wind energy displaces about 1,200 tons of CO<sub>2</sub>. U.S. wind capacity installed through 2008 will reduce CO<sub>2</sub> by about 44 million tons annually. With 300 GW of installed wind energy (20% of U.S. electricity by 2030) 825 million tons of CO<sub>2</sub> emissions could be avoided annually in 2030.<sup>7</sup>
- While wind turbines emit no emissions in producing electricity, they are not without environmental and social concerns such as bat and bird kills, land use, noise pollution, and aesthetics.

Installed Wind Capacity, 2010 (GW)<sup>2</sup>



### Solar



- Assuming intermediate efficiency, solar photovoltaic (PV) modules covering 0.4% of U.S. land area could supply all of the nation's electricity – 1.2-6.2 acres per GWh per year.<sup>8</sup>
- The cost to manufacture PV modules, currently the single largest piece of system cost, fell 70% from 1975 to 2002.<sup>9</sup>
- In 2009, the Commercial & Government sectors installed 282.3 MW, the Industrial sector installed 43.4 MW, and the Residential sector installed 221.2 MW of photovoltaic power.<sup>10</sup> While solar PV modules produce no emissions during operation, they are not without environmental impact. Toxic substances, e.g., cadmium and arsenic, are used in manufacturing PV technologies.

<sup>1</sup> U.S. DOE, Energy Information Administration (EIA) (2011) *Monthly Energy Review September 2011*.

<sup>2</sup> Global Wind Energy Council (2009) *Global Installed Wind Capacity*.

<sup>3</sup> EERE (2008) *Annual Report on US Wind Power Installation, Cost, and Performance Trends 2007*.

<sup>4</sup> U.S. Department of Energy (2008) *20% Wind by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply*.

<sup>5</sup> American Wind Energy Association (2011) *Market Reports*.

<sup>6</sup> U.S. EIA (2011) *Annual Energy Outlook 2011*.

<sup>7</sup> AWEA (2009) *Wind Energy Basics*.

<sup>8</sup> National Renewable Energy Lab (2004) *PV FAQ s- How much land will PV need to supply our electricity?*

<sup>9</sup> Nemet, G.F. (2006) "Beyond the Learning Curve: factors influencing cost reductions in photovoltaics," *Energy Policy* 34, 3218–3232.

<sup>10</sup> EIA (2011) *Annual Energy Review 2010*.

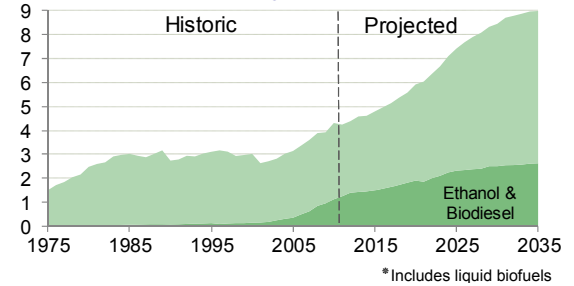
**BTU = British Thermal Unit**  
One BTU is the amount of energy required to raise the temperature of one pound of water by one degree Fahrenheit.  
**Quad = 1 quadrillion (10<sup>15</sup>) BTUs**  
One quadrillion BTUs is equivalent to the annual energy consumption of ten million U.S. households.

## Biomass



- Wood – mostly as pulp, paper and paperboard industry waste products – accounts for 46% of total biomass energy consumption.<sup>10</sup>
- Waste – municipal solid waste, landfill gas, sludge, tires and agricultural by-products – accounts for another 11%.<sup>10</sup>
- Biomass has low net CO<sub>2</sub> emissions - when converted to energy, it releases only the CO<sub>2</sub> it had previously removed from the atmosphere, plus emissions from processing, but it requires 124 acres of land to generate 1 GWh of energy per year.<sup>11</sup>
- U.S. ethanol production is projected to reach 66 million gallons per day in 2035.<sup>6</sup>

U.S. Biomass Consumption: Historic and Projected\* (Quads)<sup>1,6,10</sup>

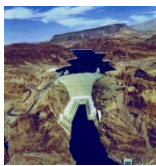


## Geothermal



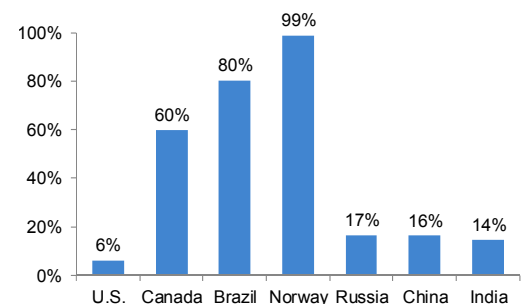
- Hydrothermal resources, namely steam and hot water, are available only in the western U.S., Alaska, and Hawaii, yet geothermal energy can be tapped almost anywhere with heat pumps that extract heat from the soil or air.<sup>12</sup>
- Geothermal electricity displaces 4.1 million metric tons of CO<sub>2</sub> per year. Some facilities produce solid waste such as salts and minerals that must be disposed of in approved sites, but some byproducts can be recovered and recycled.<sup>13</sup>
- Electricity generated from geothermal power plants is projected to increase from 18 billion kWh in 2010 to 28 billion kWh in 2035.<sup>6</sup>

## Hydroelectric



- Net electricity generation from conventional hydropower peaked in 1997 at 356 billion kWh. In 2010 generation was 257 billion kWh, 28% lower than in 1997.<sup>1</sup>
- Hydroelectric power generation is projected to stabilize at approximately 300 billion kWh per year through 2035.<sup>6</sup>
- While electricity generated from hydropower is virtually emission free, plants that are flooded by the dam emit methane and CO<sub>2</sub> at a level that some have claimed causes more damage than a conventional power plant.<sup>15</sup> Other environmental concerns include fish injury and mortality, habitat degradation, and water quality impairment. “Fish-friendly” turbines and smaller dams help mitigate some of these problems.

Percentage of Electricity Generation from Hydroelectric Dams (2007)<sup>13</sup>



## Advancing Renewable Energy Encourage Supportive Public Policy

- Renewable Portfolio Standards that mandate certain levels of renewable power are proving successful. For example, Texas installed more than 3,000 MW of renewable energy, exceeding the 2009 mandate three years early.<sup>15</sup> Thirty-seven states and the District of Columbia have renewable portfolio standards or goals in place as of September 2011.<sup>16</sup> State standards are projected to provide support for 76,750 MW of new renewable power by 2050 (excluding hydro).<sup>15</sup>
- Renewable energy growth is driven by important federal incentives (vary by technology): Production Tax Credit earns 1.0-2.1¢/kWh of energy generated; Investment Tax Credit reduces taxes on upfront costs 10-30%; 1603 Cash Grant directly reduces costs 10-30%.<sup>17</sup>
- Tax credits, grants, and other incentives are also offered to the residential, commercial, and industrial sectors for energy efficiency improvements or renewable energy installations, some up to 50% of the cost. See <http://www.dsireusa.org/> for program details.
- Eliminating subsidies for fossil and nuclear energy would encourage renewable energy. Congress has allocated over \$15 billion in tax relief to the oil and gas industries for the 2008-2012 fiscal years.<sup>18</sup> Also, studies estimate that the Price-Anderson Act, which limits the liability of U.S. nuclear power plants in the case of an accident, amounts to a subsidy of \$366 million to \$3.5 billion annually.<sup>19</sup>
- Net metering, which enables customers with generation capacity to sell excess electricity to the grid and eliminates the need for reserve batteries, provides an incentive for installing renewable energy devices. 43 states and D.C. have some form of net metering program.<sup>16</sup>

## Engage the Industrial, Residential, and Commercial Sectors

- Renewable Energy Certificates (RECs) are sold by renewable energy producers in addition to the electricity they produce; for a few cents per kilowatt hour, electricity consumers can purchase RECs to “offset” their usage and help renewable energy become more competitive.
- Over 860 utilities in every state and D.C. offer consumers the option to purchase renewable energy.<sup>20</sup> For a list of “green pricing” programs see <http://www.eere.energy.gov/greenpower>.
- Many companies purchase renewable energy as part of their environmental programs. Intel, Kohl’s, Whole Foods, Starbucks, Johnson & Johnson, and Staples are top 10 users of renewable energy.<sup>21</sup> See <http://www.epa.gov/greenpower/toplists/top50.htm>.

<sup>11</sup> National Renewable Energy Lab (2004) *PV FAQs - How much land will PV need to supply our electricity?*

<sup>12</sup> EERE (2007) “Technologies – Geothermal FAQs.”

<sup>13</sup> EERE (2004) *Buried Treasure. The Environmental, Economic, and Employment Benefits of Geothermal.*

<sup>14</sup> U.S. EIA (2009) *International Energy Annual.*

<sup>15</sup> Union of Concerned Scientists (2009) “State Policies – Fact Sheet – Renewable Electricity Standards at Work in the States.”

<sup>16</sup> DSIRE (September 2011) *RPS Policies Summary Maps – RPS Policies and Net Metering* <http://www.dsireusa.org/summarymaps/index.cfm?ee=1&RE=1>.

<sup>17</sup> DSIRE (2011) *Federal Incentives / Policies for Renewables & Efficiency.*

<sup>18</sup> Joint Committee on Taxation, 109<sup>th</sup> Congress, 2<sup>nd</sup> Session (2009) “Estimates of Federal Tax Expenditures for Fiscal Years 2008-2012.”

<sup>19</sup> Heyes, A. and C. Liston-Heyes. “Liability Capping and Financial Subsidy in North American Nuclear Power.” Department of Economics, University of London, England and Dublin, J.A. and G.S. Rothwell (1990)

<sup>20</sup> “Subsidy to Nuclear Power Through Price Anderson Liability Limit.” *Contemporary Policy Issues*, Vol III, July.

<sup>21</sup> EERE (2006) “Buying Green Power – Can I Buy Green Power in My State?”

<sup>22</sup> EPA (2011) “Green Power Partnership – National Top 50.”

Images courtesy of DOE/NREL and the U.S. Department of Interior.

