
Clean Renewable Energy: Faster, Cheaper, Better for the West

**Western Organization of Resource Councils
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Why clean, renewable energy?

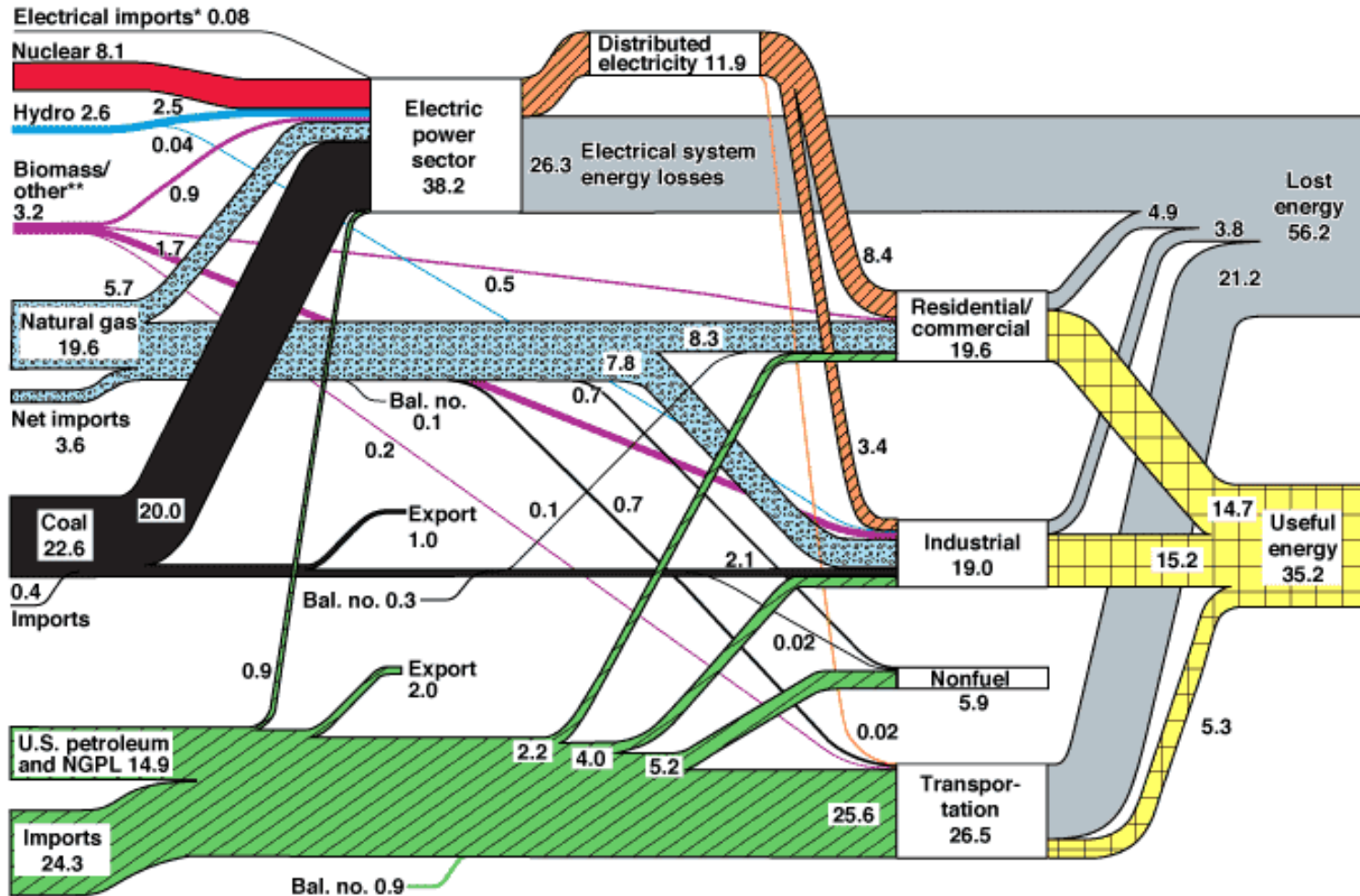
- Clean, renewable energy is the fastest, cheapest, most reliable way to meet our energy needs and hold down prices.
 - Clean, renewable energy reduces demand for natural gas and coal to generate electricity.
 - Clean, renewable fuels and increased efficiency can replace oil.
 - The West has abundant clean energy resources.

Increased efficiency is the cheapest, cleanest source of new energy

- ❑ 58% of energy in the U.S. is wasted, 36% is useful (6% goes to nonfuel uses – plastics, etc)
- ❑ California uses half as much electricity per person as the U.S. average.
- ❑ Cost of 1 kilowatt-hour saved by:
 - Retrofitting residential homes = 3 – 5 cents/kwh
 - Commercial and industrial retrofits = 1 cent/kwh
 - Investments in new buildings – can even be negative – lower construction costs AND lower energy use.

U.S. Energy Flow Trends – 2002

Net Primary Resource Consumption ~97 Quads



Source: Production and end-use data from Energy Information Administration, *Annual Energy Review 2002*.

*Net fossil-fuel electrical imports.

**Biomass/other includes wood, waste, alcohol, geothermal, solar, and wind.

June 2004
Lawrence Livermore
National Laboratory
<http://eed.llnl.gov/flow>

Windpower: Cheap & Renewable

- Judith Gap Windfarm: 135 Megawatts
 - 90 1.5 MW turbines
 - \$162 million installed (\$1.2 million/MW)
 - Cost of Judith Gap power to NW Energy: 3.2 cents/kwh; + cost to firm it up, 3.8 cents/kwh.
 - Northwestern Energy's cost of supply for residential customers = 5.1 cents per kwh.
 - Xcel green pricing customers now save \$10 month over regular customers because wind is so much cheaper than electricity from natural gas.

Solar Photovoltaic (PV) Electricity

- World's largest solar PV plant to be built in Nevada.
 - 18-megawatt
 - Cost \$115 million
 - Will double to 36 MW, enough for 36,000 homes
- Costs of solar electricity are 2-5 times U.S. residential rates – but
 - costs in California are falling 7% per year
 - costs are falling more dramatically in Japan

Transportation: Renewable Fuels and Efficiency

- Ethanol (alcohol from grain)
 - Blended with gasoline (“E-10” or 10% ethanol)
 - E-85 for Flex-Fuel Vehicles (“FFV’s”)
- Biodiesel (diesel made from vegetable oil)
 - Blended with petroleum diesel (“B2”, “B20”)
 - Used straight = “B100”
- Hybrid cars
 - Today’s hybrids combine power from gas and electric engines
- Coming soon: “Plug-in” hybrids

Ethanol

- 2005 = 3.9 billion gallons, 3% of U.S. gasoline
- Most U.S. ethanol today made from corn
 - Cost: \$1.10/gallon to produce from corn
- Brazil produced 4.1 billion gallons in 2005
 - meets > 25% of its gasoline demand
 - Cost: 55 cents/gal to produce from sugar cane
- Energy out = 1.35 X energy in
- *Coming soon....*

Cellulosic Ethanol

- Made from any plant material (e.g. grass, wood chips, corn husks)
- Enzymes turn cellulose to sugar, which is turned into alcohol.
- Today's cost = about 50% more than ethanol from corn, but with new R&D the cost is falling
- Better energy balance than ethanol from corn
4 to 8X energy out/energy in

E85 4 million FFV's on the road today

- Chrysler minivans
- Ford Taurus, F-150 trucks & Explorers,
- Chevy Impala & SUV's
- Mercedes, Mercury, Nissan, Mazda, Isuzu
- Use E85 for only 1% of their fuel.
- Approx. 600 E85 pumps in the country. Montana:
 - Mal-Function Junction Ethanol Card Stop, Helena
 - EconoMart Phillips 66, West Yellowstone, MT
 - Malmstrom Air For Base, Great Falls
 - Want one in Billings? www.E85fuel.com

Biodiesel

- Diesel made from vegetable oils
 - Byproducts = glycerol, animal feed
- US production 75 million gallons in 2005
 - Only .1 % of U.S. diesel
- Made out of soybeans in the U.S. today
 - In Montana we could use canola, mustard seed, safflower, sunflowers....

Biodiesel: room to grow

- Direct substitute for petroleum diesel; often blended (“B20, B2”)
 - U.S. diesel use = 50 billion gallons per year
 - 20% of U.S. transportation fuel
- Production cost = \$1.50 – 2.50 per gallon
 - Petroleum Diesel = \$1.80/gallon
- B20 available in Montana at:
 - Story Distributing in Belgrade
 - 2 Missoula Cenex stations
 - Yellowstone Park

Adding it all up

- How much renewable energy do we get now?
 - 6% of all energy from renewables, half from hydro
 - electricity – solar, wind, geothermal – about 2% of total U.S. electricity generation
 - 3% of U.S. gasoline production from ethanol 2005
 - .1% of diesel production from biodiesel 2005

How much renewable energy *could* we get?

- Biofuels = 4.3 million bpd @ < \$0.75/gallon by 2025
- 11 million barrels per day by 2050
 - 2005 U.S. oil consumption = 20.6 million bpd
 - US oil imports = 12 million bpd
 - Persian Gulf = 2.5 million bpd
- With improved auto efficiency and urban planning, biofuels could *replace* all US oil use by 2050.
- Shell: Renewable energy will provide 60% of the world's energy by 2060.
- Windpower could supply 20% of U.S. electricity.
 - Could also be used to make hydrogen for fuel cells.

What about hydrogen and fuel cells?

- Theoretically inexhaustible source of energy ($2\text{H}_2 + \text{O}_2 \longrightarrow 2\text{H}_2\text{O}$)
 - When it's burned you get water vapor – no pollution.
- Hydrogen is not necessarily renewable – or cheap
 - H_2 stores energy used to produce it. It isn't clean unless energy used to make it is clean (i.e. wind, not coal)
 - Not practical for transportation without completely new cars, fueling stations -- \$\$\$.
- There's a better way: increased fuel efficiency, biofuels, plug-in hybrids & wind

The Stone Age didn't end because people ran out of stones...

.....they found better ways of doing things.

- Improved technology and economics, and the high price and environmental cost of fossil fuels, have brought us to the era of clean, renewable energy sources.