

Renewable Power in the 21st Century

There are More than Enough Renewable Energy Sources to Meet Our Needs

- Renewable energy sources are available in all parts of globe, close to where energy is needed. They can therefore be used efficiently and with lower transportation and distribution losses, and also lower costs and risks.
- For example, 2005 world electric power consumption was 18.24 PWh/yr.
 - ⇒ More than 100 times this amount could be commercially produced from solar PV systems from the world's rooftops and unused land
 - ⇒ More than 20 times this amount could be commercially produced by wind farms in windy non-urban areas
- Conventional energy resources on the other hand are limited
 - ⇒ Peak oil production will be reached early in this century
 - ⇒ There is only an estimated 40 years production of easily accessible uranium
 - ⇒ Even coal must be extracted from deeper and more expensive sources
 - ⇒ Fossil fuels (especially oil and gas) and uranium are only found at commercially exploitable levels in a few areas of the world
- The issue is not “are there enough renewable power sources?”, but how can we access and use them at reasonable cost in a market that takes all the (external) social and environmental costs of energy sources into account.

Renewable Power Sources can be Quickly Installed and Produce Power Immediately and on Time

- Renewable energy technologies like wind and solar are modular and can be installed rapidly. Germany installed 20,000 MW of wind in 10 years, and 1000 MW of solar in one year.
- Deployment rates are limited only by the capacity to manufacture and install them, materials availability, and policies to support them.
- Renewable energy power plants will produce energy within months of putting a shovel in the ground – usually on schedule and on budget. Temporary materials shortages or a lack of manufacturing capacity to meet an expanding market are the only limiting factors.
- Nuclear power experiences chronic overruns of time and cost. Each of Ontario's nuclear reactors cost up to 250% more than estimated - accumulating a debt of \$14 billion. Refurbishment and repairs also cost 100-200% more than estimated and were offline for longer than expected.
- New nuclear plants fare no better. The Olkiluoto-3 reactor in Finland is 37 months behind schedule after 42 months' construction and some 50% over budget.
- Coal plants that use carbon capture and storage (CCS) will not be available commercially for many years. Building times for CCS plants have not yet been estimated.

Renewable Energy Sources Are Offline Less Frequently

When it comes to being reliable, renewable energy technologies score higher than alternatives on several counts:

	Wind	Nuclear	Coal
Percent unavailable because of breakdown or repair:	0-2 % on shore 0-5% off shore	10-25%	6%
Time to get back on line after shutdown:	0 – immediate start up	1 week or more	2-3 days
Flexibility during times of rapid changes in demand:	Easily controlled	Inflexible – must run	Somewhat flexible
Impact of one unit going off line:	Small – many units	Very high – unstable grid	High

Renewable Power Sources can meet Base Load Power Demands just as well as Nuclear or Fossil Fuel Plants

There are many techniques available now and under development that will allow variable renewable energy sources like solar and wind to meet any energy need at any time, including providing base load power:

1. Interconnected geographically-dispersed wind farms and solar power systems guarantee a base load contribution
2. Controllable renewable energy sources like hydro can be used to smooth out wind and solar
3. Demand can be managed based on (weather) forecasted production from wind and solar power plants
4. Energy can be stored before it is produced (hydro, biomass) or after it is produced (wind and solar)
5. Electric vehicles connected to the grid electricity can supply power back to the grid as needed
6. The outputs of standardized renewable power sources “friendly” to grid operators can be controlled when necessary

For more information see the CanREA fact sheet “Six ways of providing base load power from wind”

Renewable Power Systems are Owned Locally not Globally

Because they use no fuel and can be of any size, wind, solar and hydro power generators can be owned and operated by local businesses, cooperatives or municipalities. This leads to more energy autonomy - energy sources are more easily controlled by those who use them and less likely owned by a few companies or countries.

Renewable energy technologies are also more compatible with the societal trends of the 21st century:

- Electric/plug in hybrid vehicles that exchange power with the grid
- Buildings that have their own power and heating systems and produce as much energy as they use in a year (net zero)
- Sustainable communities that use shared multi-use energy systems and practice smart growth and urban design
- “Smart Grids” controlling decentralized power users and generators

Maintaining a centralized nuclear or fossil fuel power system to serve large generators forecloses many of these options and the plants are more likely to be controlled by global companies or countries.

Renewable Energy will be the Cornerstone of a New Green Economy

Renewable energy provides jobs in all sectors, in all regions, across all trades and professions, and in both rural and urban areas. Renewable energy business can be small and large, private or community owned and operated. Worker migration and community boom and bust impacts are much lower than for nuclear and coal power plants that are built in just a few locations – usually far from population areas.

Germany employs 40,000 people in the solar industry alone, and an estimated 140,000 jobs in renewable energy. The new US administration under President Obama has made renewable energy one of the main planks in his economic stimulus and job package.

Choosing Renewable Power Reduces Global Conflicts, Crises, and Impacts Due to Energy

While renewable resources are not entirely free of environmental and social issues like land use conflicts, noise, and “Not in My Back Yard” resistance, these issues are usually local and can be resolved through strict siting criteria, encouraging local ownership, and using inclusive transparent approval systems.

On the other hand, continuing to rely on fossil fuels and nuclear power could perpetuate global conflicts:

- Transporting and processing nuclear materials increases the likelihood of nuclear weapon development
- Obtaining access to diminishing oil and gas supplies will add to global conflicts
- Use of nuclear, coal, oil or gas for power will increase demand for scarce water supplies in many countries
- Relying on fuels that must be transported and imported worsens energy security

Renewable power sources also have lower environmental impacts than other power sources.

	Wind	Solar	Nuclear	Coal + CCS
Life-cycle GHG emissions grams CO ₂ /kWh	3-7	20-50	20-70	250-400*
Water consumption US gal/kWh	0.005		0.4 – 0.7	0.5
Waste production	Very small - only during manufacture	Minor - only during manufacture	High and low level radiation and waste	Mining tailings and toxic wastes removed during carbon capture
Land Use	High but allows multiple uses. Siting important	High but allows multiple uses. Siting important	Waste disposal issue unsolved	Mining aspects still an issue

* Conventional Coal = 800 – 1000 grams CO₂/kWh. Adding CCS results in a 15-25% efficiency loss

Renewable Power Technologies are Cost Competitive

Current Costs:

Many renewable power sources like wind, hydro, and biomass are cost competitive with current alternatives.

Current costs (including cost overruns) – world averages

- ⇒ Conventional Wind 6-9 cents
- ⇒ Conventional Nuclear 10-13 cents/kWh
- ⇒ Conventional Coal 4-7 cents /kWh

Future Costs:

The cost of “firming up” variable renewable power resources like wind and solar using storage and other options so that they can provide base load power is still expected to be less costly than coal plants using carbon capture and storage or new nuclear capacity.

For example, the cost of coordinating wind or solar system output with hydro power is less than 0.1 cents per kWh. The cost of adding flow battery, compressed air or pumped storage to wind is expected to increase the cost per kWh by only one third. Solar thermal power plants have built in thermal storage capacity.

Aside from maintenance (and in the cases of biomass, production and processing costs), there are no fuel costs associated with renewable technologies. The costs of using renewable energy technologies will decrease over time and will drop in price the more they are used through economies of scale and technology improvements.

At the same time the cost of alternatives that rely on a fuel will continue to rise. Coal with CCS and new generation nuclear with reprocessing will cost far more than current versions of these technologies, and they still both use a fuel that will only become more expensive in the future.

Estimated Future costs

- ⇒ Base load wind with storage = 8-12 cents/kWh
- ⇒ Solar thermal base load = 12-20 cents
- ⇒ New next generation nuclear = 12-22 cents/kWh rising with scarce uranium
- ⇒ Coal + carbon capture = ~ 7-12 cents /kWh rising with increased fuel costs

America's National Renewable Energy Laboratory believes concentrating solar power will be competitive with conventional technology by 2015 at the latest, followed closely by solar PV.

Renewable Power Systems are Commercially Available

Most renewable power energy, even solar PV and solar thermal which are still expensive, are still widely available commercially and are attracting huge global investment. Germany and Spain lead the way while Canada lags far behind. In fact the Canadian company Arise Technologies recently set up a new \$40 million PV manufacturing plant in Germany because there was no market or support in Canada.

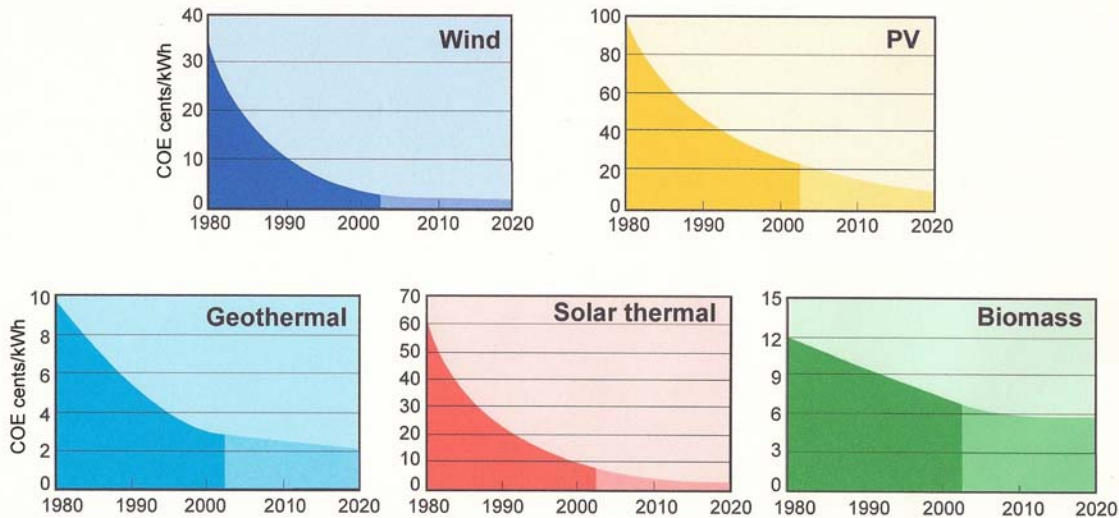
Wind, solar, hydro and biomass power projects already installed around the world have excellent track records and all renewable power technologies aside from wave or tidal are well on the way down the economies of scale cost curve. – see NREL chart below

Technologies to firm up wind and solar like power storage or smart grid management software are less developed but are already being tested worldwide and are expected to be commercially available soon.

There are no real prospects that new nuclear power plants will show how well they work before 2018-20. Coal power generation with carbon capture is still under development. While some components are being tested, and capture of free carbon dioxide from natural gas has been commercialized by Norway in the North Sea, there is not likely to be a full working coal plus CCS plant in operation before 2020.

Renewable Energy Cost Trends

Levelized Cents / kWh in Constant 2000 Dollars



Source: NREL Energy Analysis Office (www.nrel.gov/analysis/docs/cost_curves_2002.ppt).

The costs of renewable energy technologies are declining.

[Source: National Renewable Energy Laboratory Energy Analysis Office]

For more information on the Canadian Renewable Energy Alliance visit www.canrea.ca