

Meeting Our Needs with Renewable Energy

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Canadian Renewable Energy Alliance (CanREA)



Photo: David Dodge, Pembina Institute

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What my presentation will cover

- A Global Transition to Renewable energy has already begun
- The key role of energy efficiency and conservation
- Why renewable energy is the best option to meet our energy needs
- Illustrations from Alberta and Ontario

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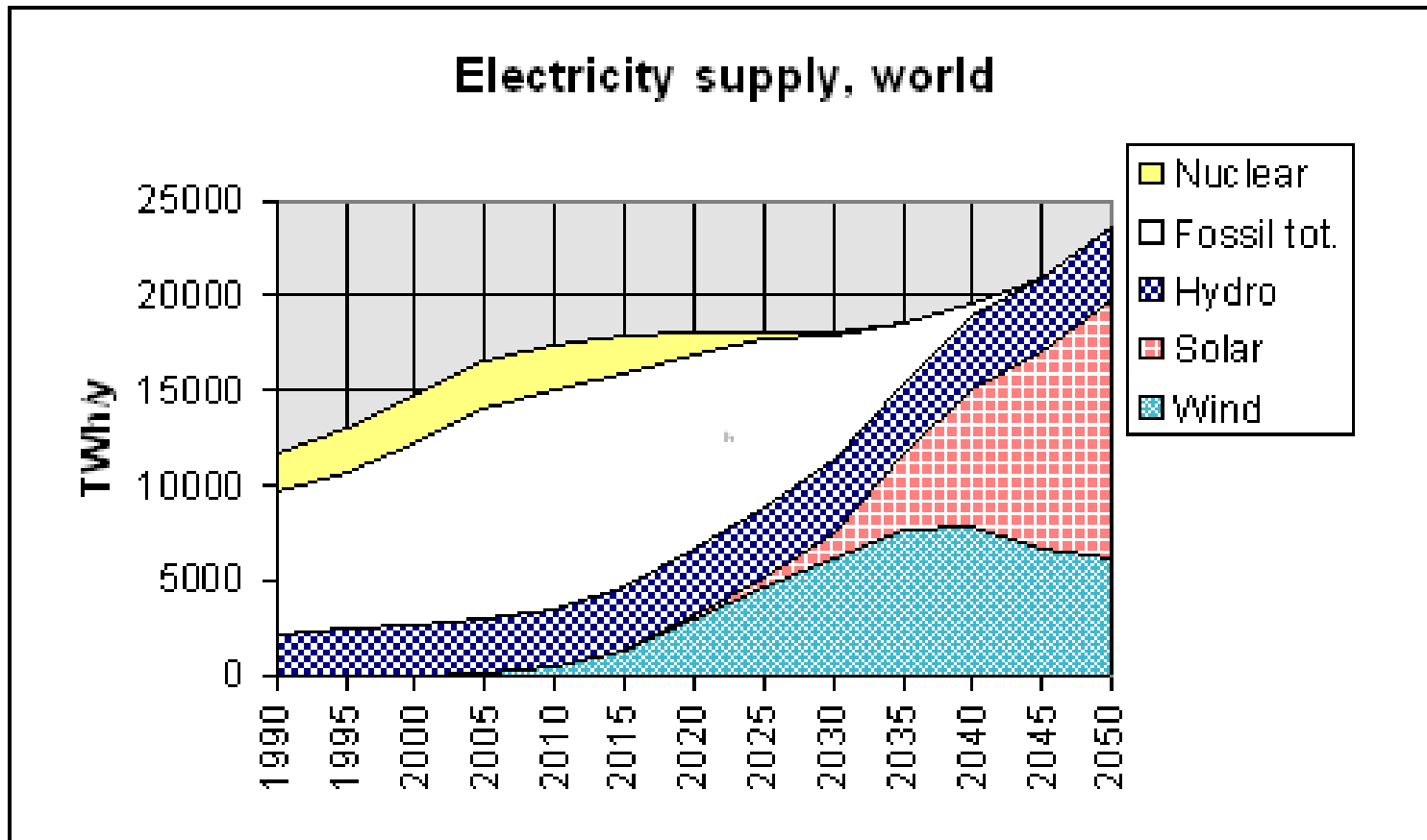
What is CanREA?

- An alliance of 16 Canadian civil society organizations that promote a global transition to renewable energy
 - Members in 8 Provinces
 - Published a Model National Canadian Renewable Energy Strategy in 2006
 - Published a critique of Canadian renewable energy policy in March 2008
 - Proposed a federal economic stimulus package for a green economy in January 2009
- For more see www.canrea.ca

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The Transition to Renewable Energy



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The Transition to Renewable Energy

European Renewable Energy Council (EREC):

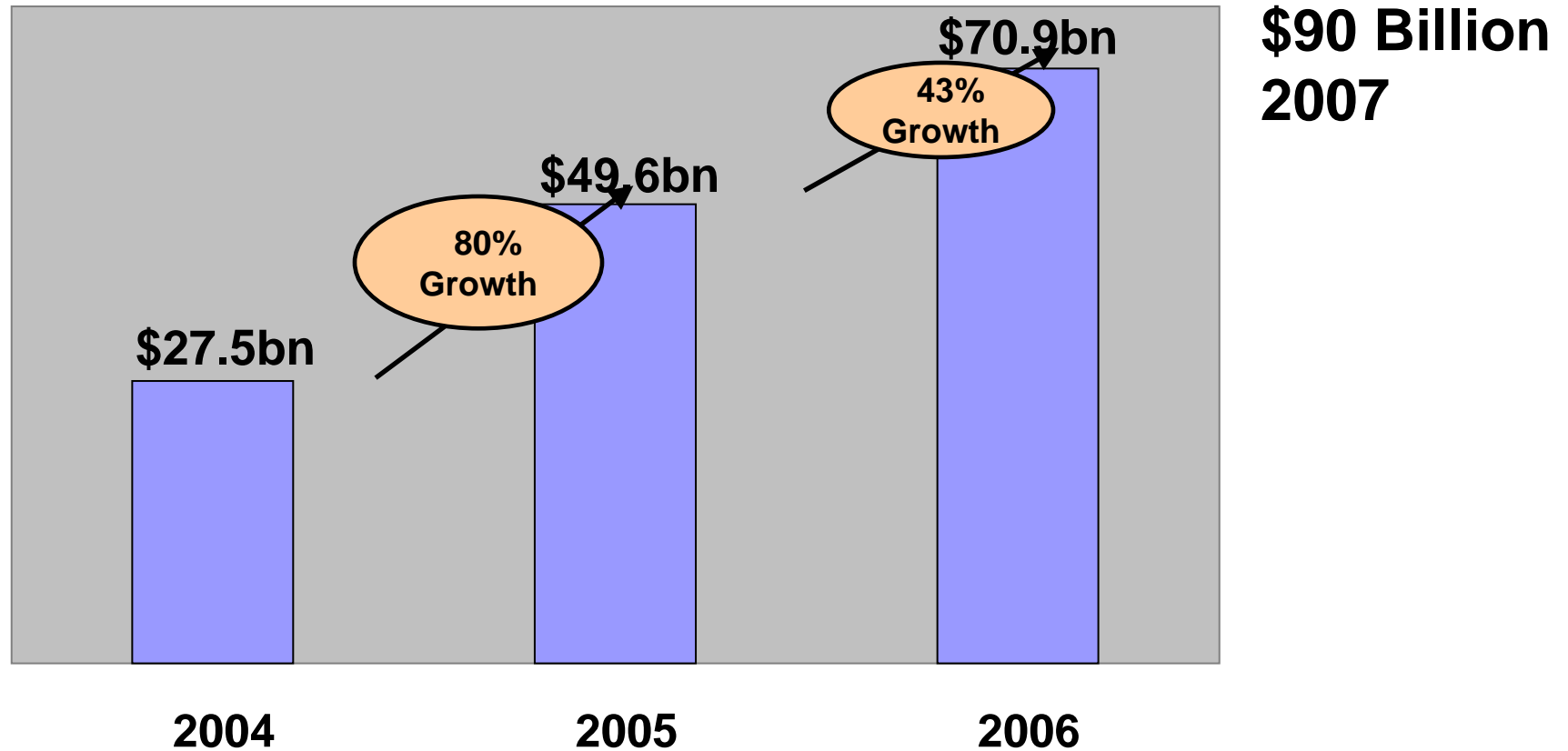
- Renewable Energy could supply 30% of the world's energy by 2030 - all global energy needs by 2090

Renewable Energy Network for 21st Century (REN 21).

By 2050 Renewable energy could supply:

- 85% of Canada's electricity
- 65% of Canada's heating and cooling

GLOBAL INVESTMENT IN RENEWABLE ENERGY



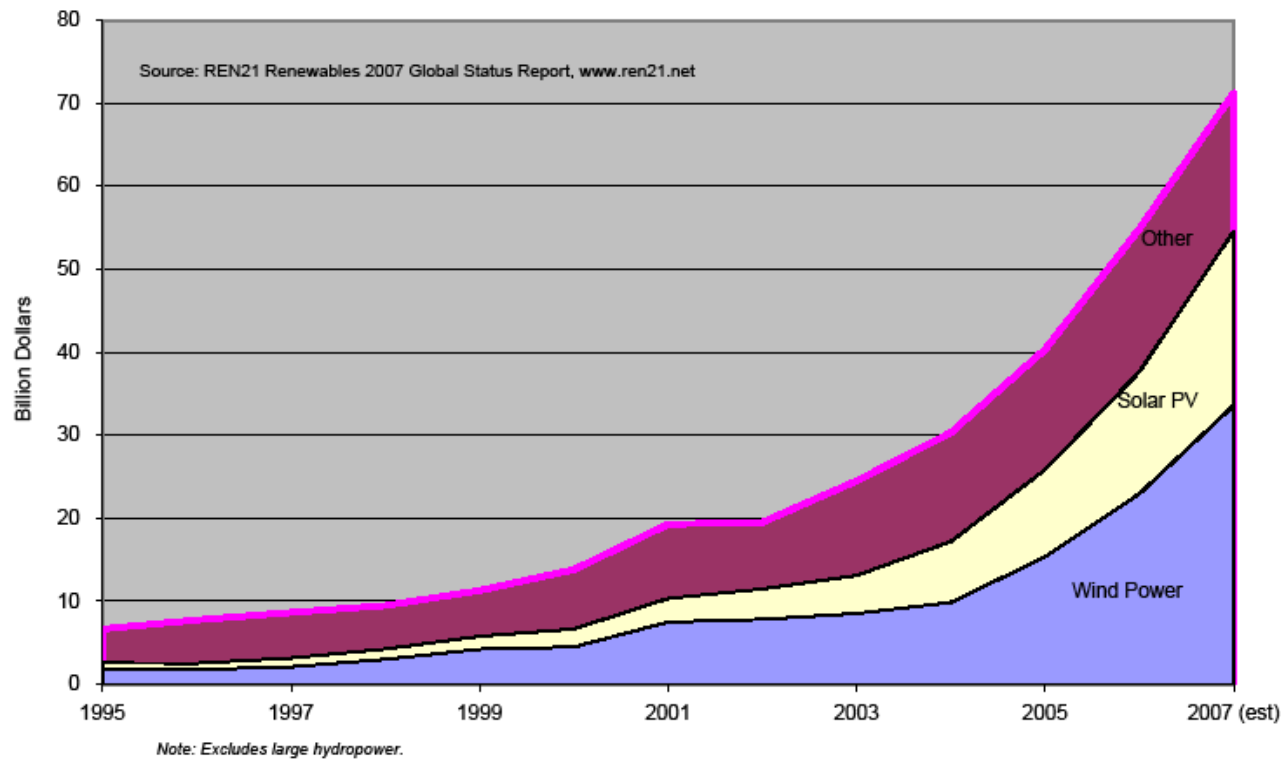
Source: New Energy Finance

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GLOBAL INVESTMENT 1995-2007

Figure 11. Annual Investment in New Renewable Energy Capacity, 1995-2007



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Global Investment in Renewable Energy

- Wind and solar the world's fastest growing energy investments
- Germany and Spain the leaders
- United States catching up - \$26 billion in new spending under Obama
- Canada lagging far behind – **13 times** less investment per capita than the US

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International Renewable Energy Agency (IRENA):

- Established January 2009 to foster global renewable energy transition
- Political will to promote large scale deployment in all sectors at a global level
- 75 countries full signatories
- United States an observer at founding conference
- Canada did not even attend

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Energy Efficiency

The key to the Renewable Energy Transition is a new commitment to energy efficiency

- California has held energy demand constant with energy efficiency for over 20 years
- US to spend \$25 billion over next 2 years

The potential is huge:

- The Canada Green Building Council says building energy use can be cut by 50% by 2015
- Buildings that use 90% less energy (Factor 9) and produce as much energy than they use (net zero) are already realities
- Top vehicle efficiency now down to <3 litres/100km



Why renewable energy is the best option to meet our energy needs



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There is More than Enough Renewable Energy to Meet our Needs

- More than 100 times the world's annual power consumption could be commercially produced from solar PV systems
- More than 20 times this amount could be commercially produced by wind farms



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Renewable Energy is Reliable

	Wind	Nuclear	Coal
Percent unavailable because of breakdown or repair:	< 2 % on shore < 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

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Quickly Installed/Produces Immediately

- Renewable energy technologies are modular and can be installed rapidly
- Limited only by materials and the capacity to manufacture and install them
- Will produce energy within months and on schedule and on budget
- Nuclear experiences chronic overruns of time and cost – Finland reactor: 3 years behind and 50% over budget



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Renewable Energies have Lower Environmental Impacts

	Wind	Solar	Nuclear	Coal + CCS
Life-cycle GHG emissions gms CO₂/kWh	3-7	20-50	10-70	250-400*
Water consumption US gal/kWh	0.005		0.4 – 0.7	0.5
Waste production	none	none	High and low level radiation and waste	Mining tailings and toxic wastes removed in CCS
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 gms CO₂/kWh. Adding CCS results in a 15-25% efficiency loss



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Renewable Energy is the Cornerstone of a New Green Economy

Germany employs 40,000 people in the solar industry, and 140,000 jobs in renewable energy.

- Jobs in all sectors
- Jobs in all regions -
Lowers migration/long distance travel for work
- Economic opportunities of all sizes
- US following fast !!



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Wind and Solar Energy sources can Provide Base Load Power

1. 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
4. Energy can be stored during high wind and solar periods and released as needed.

1. Geographic Distribution

Interconnecting wind farms over a 850 km x 850 km area in US Mid-west:

- 33% of annual wind production could be counted on towards base load with the same reliability as a coal power plant.
- Because generation was also closer to demand, grid distribution losses cut from 7% to less than 2%.

In Spain

- Interconnecting wind farms nearly eliminates variability
- A day in March 2008, 40% of Spain's power was coming from wind

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2. Coordinating with Hydro

Nine Canyon wind project in Washington State

- The output from a new 63 MW wind farm was successfully integrated with 65 MW of hydro.
- Combination has same reliability as coal plants
- Additional cost of coordinating wind and hydro estimated to be only 0.09 cents/kWh.

3. Lowering Demand to Match Supply

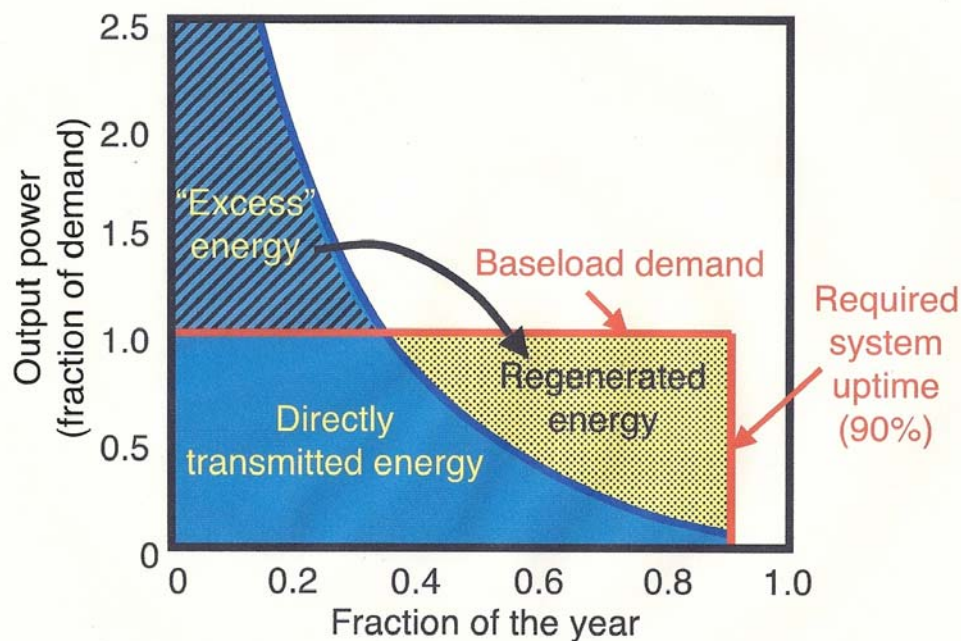
- Most utilities peak manage demand to match supply
- In California grid operators are planning to reduce demand when supply from solar or wind farms drops by:
 - Re-setting customer programmable thermostats to higher or lower temperatures
 - Getting customers to use hot and cold storage
- Customers feel no impact and are rewarded for participating

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4. Storing Renewable Power

Making wind dispatchable with storage:
Think “baseload”

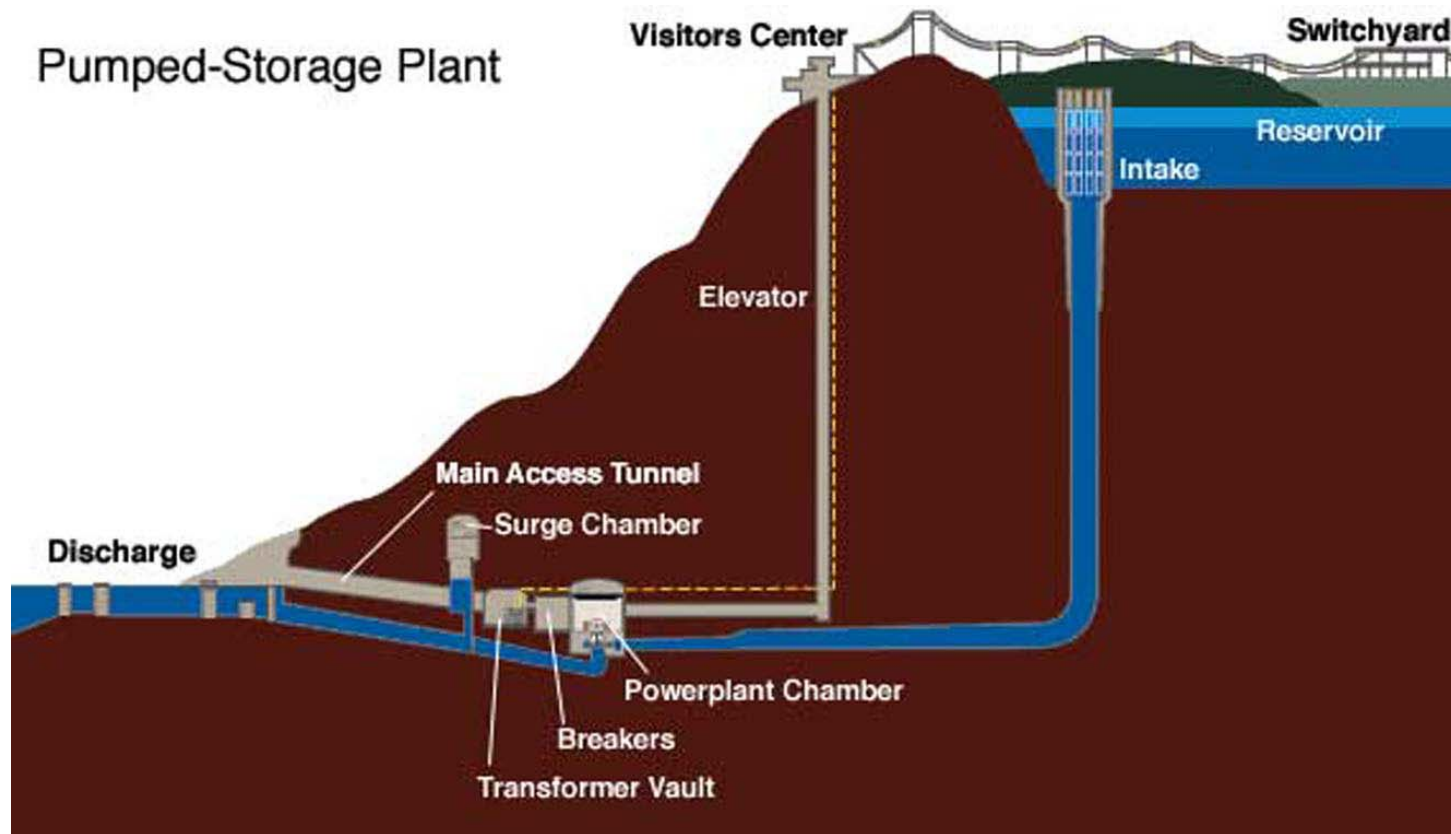


Samir Succar, Princeton Environmental Institute



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Pumped Hydro



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Compressed Air

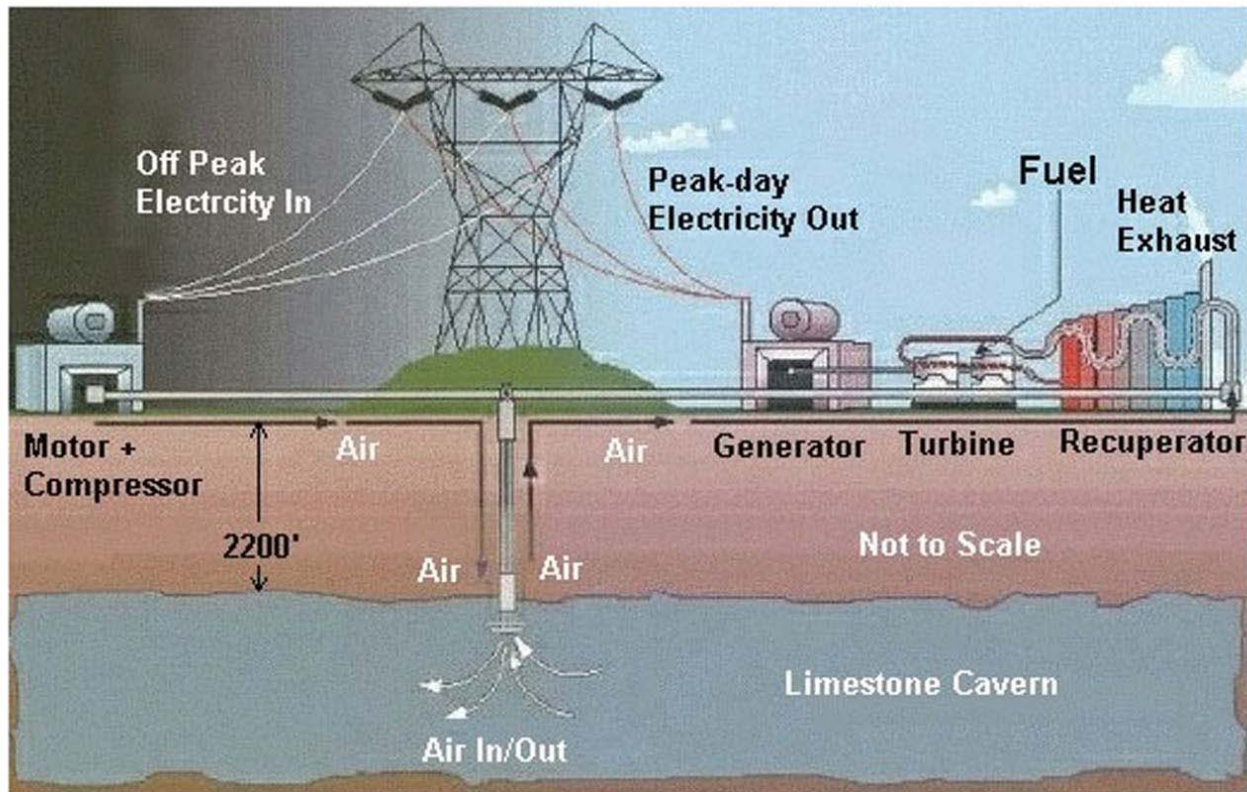
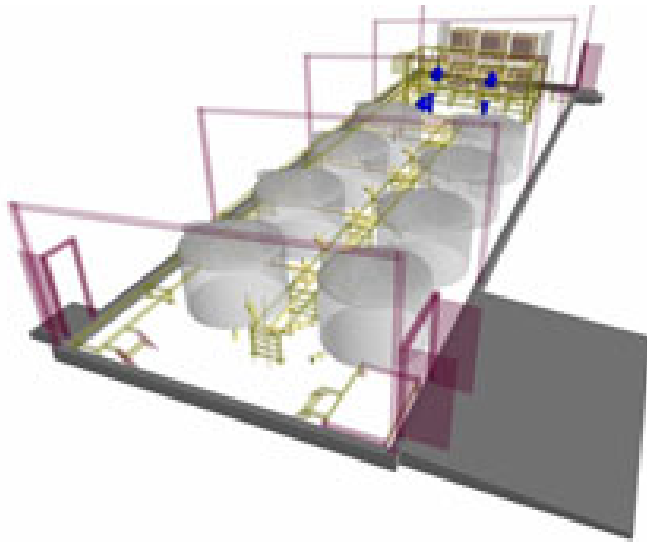


Photo Courtesy of CAES Development Company

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Large Scale Battery Banks



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Vehicle to Grid

- Vehicle to grid – 2 way into distribution system
- Austin, TX plans on using the local wind power that is generated at night to charge plug-in hybrid car batteries, and then tap into those same car batteries for extra power during the day time.



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Other Storage Options:

- **Flywheels:** rotating cylinder enclosed within a low pressure or a vacuum
- **Supercapacitors:** two electrodes of opposite polarity separated by an electrolyte
- **Hydrogen Storage:** water -> hydrogen -> fuel cell
- **High Temperature Fluids:** pressurized hot water -> steam turbine

Power Storage Applications

	Wind Farm	Solar Rooftop	Solar Farm	Solar Thermal
Pumped Storage	X			X
Large Scale Batteries	X		X	
Compressed Air	X			
Flywheels		X	X	
Capacitors		X		
Hydrogen	X			
High Temperature Fluids				X



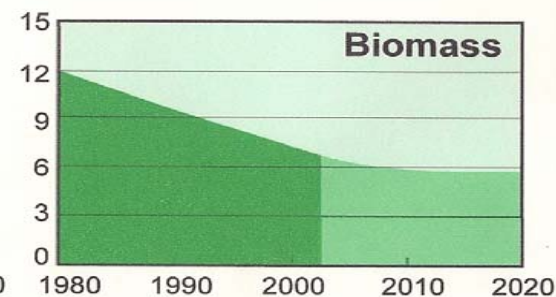
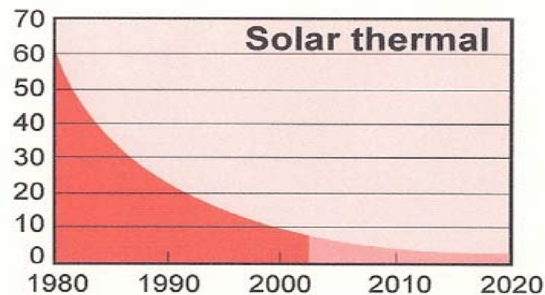
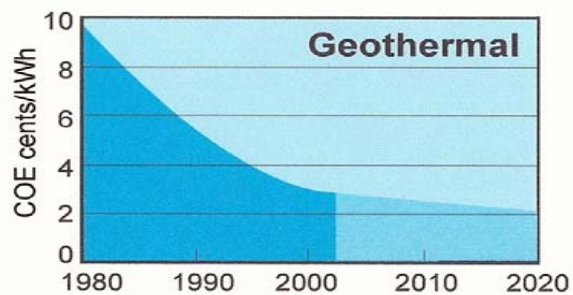
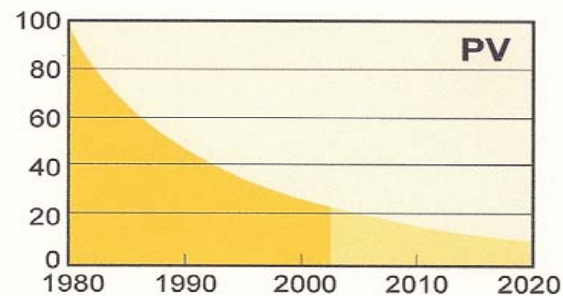
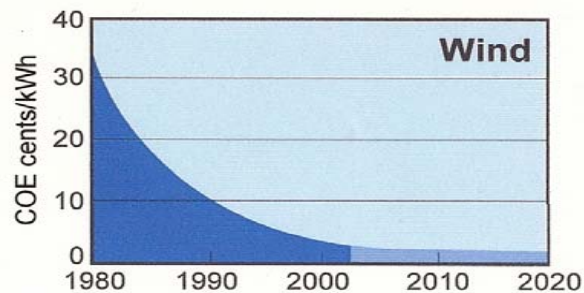
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Renewable Energies are Cost Competitive

- For solar, wind and hydro energy there are no fuel costs
- The cost of using these technologies will decrease over time and will drop in price the more they are used
- The cost of making variable resources like wind produce power at all times is likely to be less than nuclear or coal + CCS

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.

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- Current costs – world averages
 - **Wind 6-9 cents/kWh**
 - **Solar 20-30 cents/kWh**
 - **Nuclear 10-22 cents/kWh (including overruns)**
 - **Conventional Coal 4-7 cents /kWh**
- Estimated Future costs
 - **Base load wind 8-12 cents/kWh**
 - **Solar thermal base load 12-20 cents/kWh**
 - **New Nuclear 15-22 cents/kWh**
 - **Coal + Carbon Capture ~ 8-15 cents /kWh**

Commercial Availability

- Wind with storage commercial by 2013
- Competitive Solar by 2015
- New Nuclear – still not proven and 2020+ before first kWh produced
- Coal + carbon capture - un tested and 2020-30 before commercial



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Examples of Provincial Transitions to Renewable Power

Alberta – Greening the Grid

– <http://re.pembina.org>

Ontario – Renewable is Doable

– <http://www.renewableisdoable.com>



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Greening the Grid in Alberta

Pembina Institute - 2009

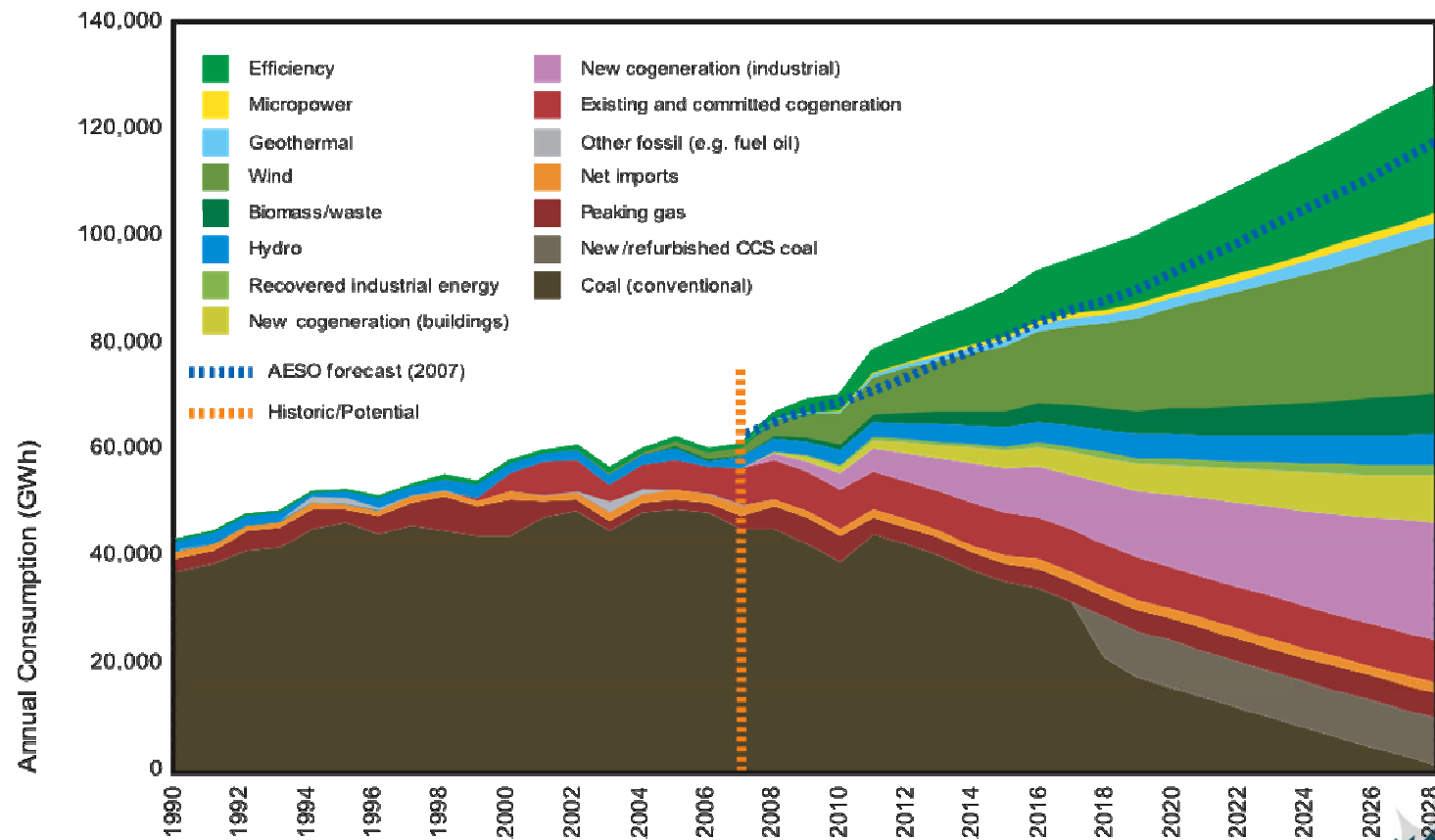
- Alberta's power demand over the next 20 years could be met by **energy efficiency, wind and natural gas cogeneration**, without having to resort to building new coal or nuclear plants.
- If Albertans set their sights higher, the province could generate so much energy from these sources that it could begin to **phase out existing coal generation**.

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Greening the Grid in Alberta

Green Scenario With Coal Phase-out



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Renewable is Doable in Ontario

WWF-Canada, Pembina Institute, Greenpeace, DSF,
CELA and Sierra Club - 2008

Two of Ontario's Nuclear Plants could be replaced by 2020
by deploying 5000 MW more clean energy

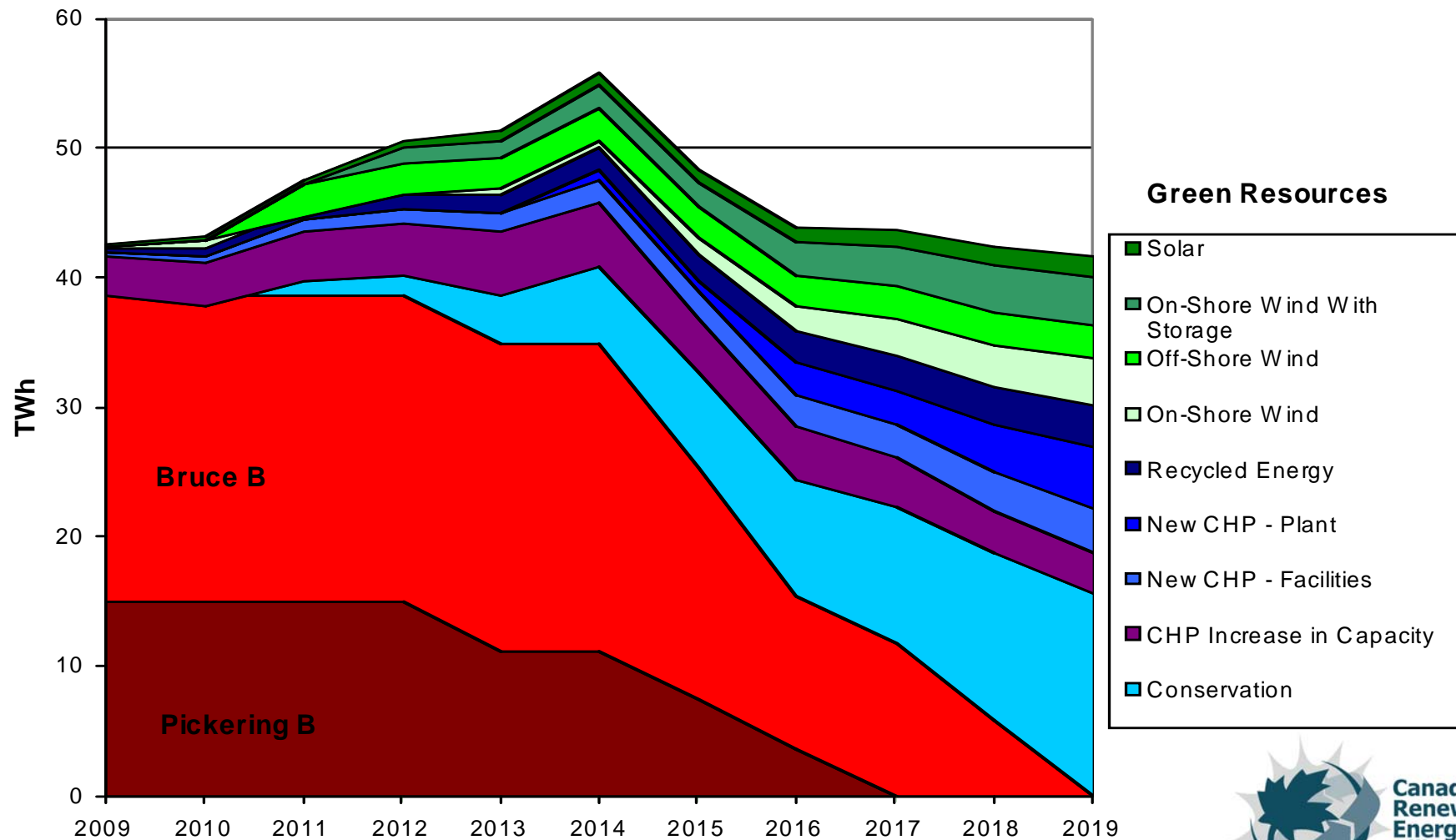
- electricity consumption reduced to 13% below 2008
by 2018 through efficiency and conservation
- 15% of 2018 base load and peak met through new
renewable power
- Natural gas used only for cogeneration + 500 MW
power from recycled energy
- All coal plants could be closed by 2013

All deployment rates within identified potential and well
within building rates seen in other countries



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Renewable is Doable in Ontario



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Conclusions



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Renewable Energy is the Only Real Option for the 21st Century

- More than enough to meet our needs – particularly if coupled with energy efficiency
- Available everywhere close to where it is needed
- Extremely reliable – few unscheduled outages
- Storage and other techniques make it continuously available
- Cost competitive with alternatives
- Will get cheaper over time while alternatives increase –
- Can be installed quickly in small increments
- Low social, environmental and political impacts/conflicts
- High job creation potential in all regions – cornerstone of the new green economy



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Thank You



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