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Debunking Renewable Energy Myths and Reframing Australian Energy Futures

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The only feasible solution to climate crisis and energy insecurity that doesn't increase the threat of nuclear war is

Sustainable energy = the efficient use of renewable energy

Why Sustainable Energy?

- To mitigate climate change
- To ensure energy security and to increase energy independence
- To cap fuel and electricity prices
- To cut local pollution of air, water and soil
- To create local employment and community engagement

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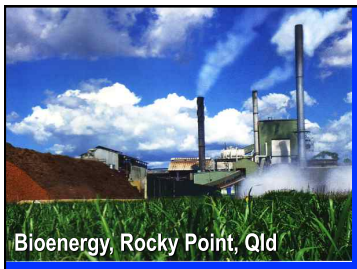
How can Renewable Energy replace Fossil Fuels?

Energy end-use at present	Future renewable energy contribution
Electricity **Currently mostly coal**	Electricity emits 35% of Australia's GHG emissions. Could be supplied entirely by renewables within a few decades.
Transport **Currently mostly oil**	14% of Australia's GHG emissions. Electric vehicles for urban transport; inter-city high-speed rail; biofuels for rural vehicles & some air travel.
Heat (non-electrical) **Currently mostly gas**	About 17% of Australia's GHG emissions Low temperature heating & cooling from solar & heat pumps; high temperature heat from renewable electricity

Electricity will play a greater role in heating/cooling and transport.
This presentation focuses on electricity.


Bioenergy, Rocky Point, Qld

Sustainable Electricity = Renewables + Demand Reduction

Energy efficiency
Energy conservation
Smart grid
Passive solar design
Wind
Biomass
Solar heat
Solar PV
Concentrated solar thermal
Hydro
Wave?
Geothermal electricity?


Wind, Albany, WA


Solar-efficient homes, Christie Walk, Adelaide


CST with thermal storage


PV solar tiles, Sydney

Regions with Strong Renewable Energy Targets

Country/state	2012 Renewable Electricity	Target
Denmark	30% from wind; some electricity & district heating from agri. residues	100% renewable electricity and heat by 2035; 100% transport 2050
Germany	About 21% from renewables.	80% renewable electricity by 2050
Scotland	35% from renewables including hydro	100% renewable electricity by 2020
South Australia	27% from wind + 4% from solar = 31%	33% renewable electricity by 2020
China	Biggest wind capacity and solar hot water; biggest PV manufacture	15% of all primary energy from 'low-carbon' by 2020
California	About 24% in total from hydro, geothermal, wind, biomass, etc	33% renewable electricity by 2020

Renewable Energy is under Attack by Vested Interests and Governments in Oz

- Review of Renewable Energy Target by biased committee – **Imminent**
- Review of alleged health impacts of wind farms – **Announced**
- Funding for Australian Renewable Energy Agency (ARENA) cut by $800 million – **Done**
- Profitable Clean Energy Finance Corporation to be closed – **Announced**
- State governments have cut feed-in tariffs for residential RE – **Done**
- Anti-renewable energy myths spread by politicians & others – **Continuous**

Attacks on Renewable Energy are Part of Attacks on all Climate Action

- Carbon price to be terminated – **Announced**
- Climate Commission (advised public) shut down – **Done**
- Climate Change Authority (advises government) to be shut down – **Announced**

Any one of these measures against climate action and renewable energy could possibly be explained by ignorance or incompetence.

The whole set can only be explained by a deliberate campaign strategy.

Vested Interests (Fossil & Nuclear) spread False Myths about Renewable Energy

- Myth: 'Base-load power stations are necessary and renewable energy (RE) cannot provide them'
- Myth: 'RE is too variable or intermittent to make the predominant contribution to grid electricity supply'
- Myth: 'Coal-fired power stations must run continuously as backup'
- Myth: 'RE is too expensive'
- Myth: 'RE is too diffuse to run an industrial society'
- Myth: 'RE is not ready to replace fossil fuels'
- Myth: 'RE is responsible for the big increases in electricity prices in recent years'

Why the attacks?

Renewable Electricity threatens Utility Business Models

- 'Merit Order Effect'
  - Wind farms, with very low operating cost, are displacing coal-fired power stations, eg, in South Australia
- 'Death Spiral'
  - Growth in rooftop solar PV and increased energy efficiency is reducing demand for grid electricity
- Result
  - Utilities & big business lobbying federal & state governments to stop growth in RE
  - Government policies try to stop growth of RE
  - False myths disseminated by malicious and lazy media

Mythbusting by Two Methods

- Practical experience: eg, South Australia; Denmark
- Hourly computer simulations of demand and supply by 80−100% renewable electricity in several countries
  - Wright & Hearps (BZE) (2010) : single half-hourly simulation spanning 2 years; RE mix dominated by expensive CST; no PV; east-west transmission link
  - Elliston, MacGill & Diesendorf (2012, 2013, 2014): thousands of hourly simulations spanning 1 year, 2010. Economic optimal RE mix; economic comparison with 4 fossil fuel scenarios with & without CCS
  - AEMO (2013): 4 scenarios; modest contributions from wave and hot rocks (unnecessary)

Practical Experience

- Denmark: 30% of electricity from wind
- South Australia: 27% electricity from wind
- Mini-grids with more than 40% wind energy

Empirical results

- Base-load power stations do not have to be used as back-up. Indeed some can be shut down, partially or totally
- Additional peak-load capacity and energy may be needed as capacity of variable RE is increased
- Gas turbines & diesel generators have low capital cost and, if operated infrequently as flexible back-up, low operating cost

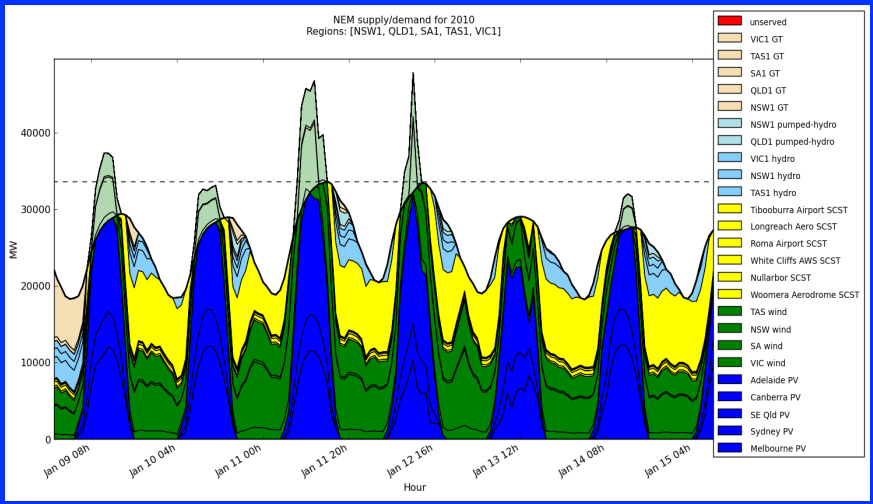
Selected Overseas Scenarios for 80-100% Renewable Energy

Region	Energy use	Authors
Whole planet	All energy	GEA (2012); Jacobson & Delucchi (2011); WBGU (2011); Greenpeace (2012); WWF (2011)
Whole Europe	Electricity (simulations)	Heide (2011); Rasmussen (2012)
Denmark	All energy	Lund & Mathieson (2009)
Germany	Electricity	SRU (2011)
UK	All energy (including simulations) + land use	Zero Carbon Britain (2010; 2013)
USA	Electricity (simulations)	Mai et al (NREL) (2012)

UNSW Simulation Models of 100% Renewable Electricity (RE) in National Electricity Market

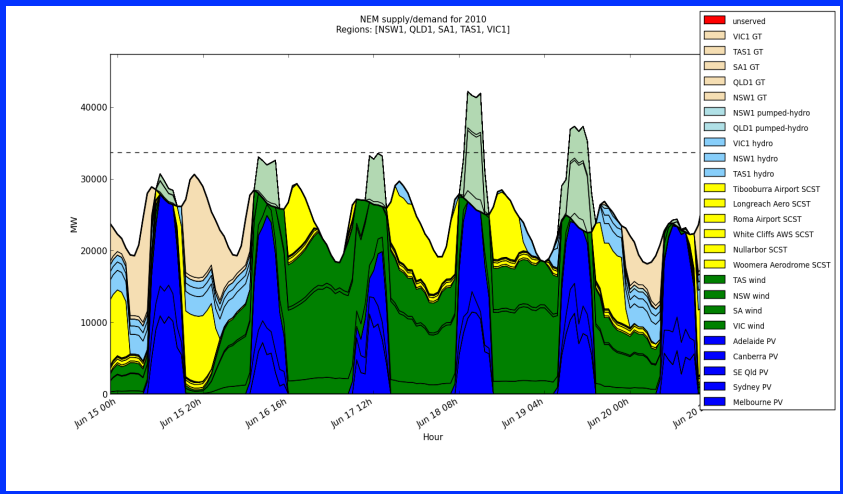
- Hourly data on electricity demand, solar & wind for NEM in 2010
- All commercially available RE technologies; cost projections to 2030 by BREE (2012)
- Simulation model built by Ben Elliston: hourly time-steps through 2010, balancing supply and demand while maintaining reliability
- Simplified transmission model
- Comparison fossil scenarios (see below)

Supply and Demand for a Typical Week in Summer 2010 – Optimal Mix of RE



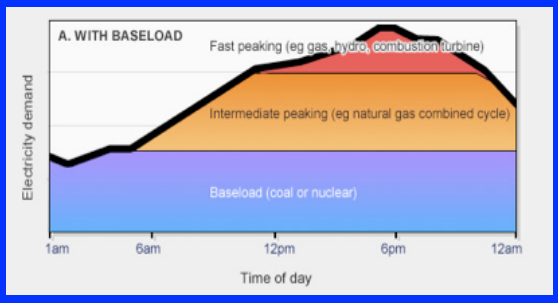
In summer, negligible gas turbine (GT) energy used.

Supply and Demand for a more Challenging Period in Winter 2010 – Optimal Mix of RE

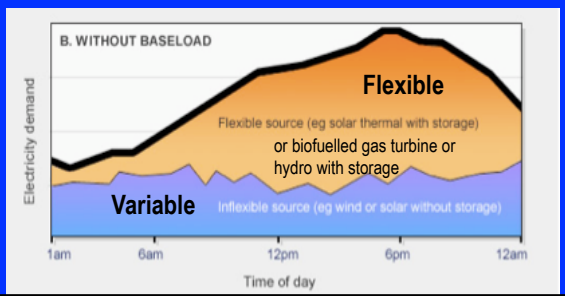


In calm winter evenings following cloudy days, GTs & demand management are important.

Meeting Demand without Baseload Stations



Old concept:
With base-load power stations



New concept:
No base-load power stations

Meeting Demand without Base-load Stations

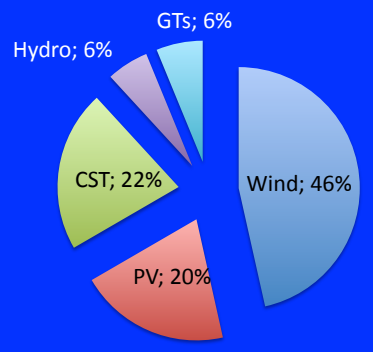
- Renewable electricity supplied by mix of variable plants (wind and PV without storage) and flexible/dispatchable plants (CST with thermal storage, hydro with storage, biofuelled gas turbines)
- Flexible plants (together with improved weather forecasting) balance the fluctuations in power output from inflexible plants
- Demand management in a 'smart grid' can also play an important low-cost role.
- Key parameter is reliability of the whole supply-demand system, not reliability of individual technologies. Reliability criterion satisfied in all simulations: unmet annual energy < 0.002% of annual demand

Additional Ways of Increasing Grid Reliability for Insurance against Rare extended overcast, calm Periods

- Increase geographic dispersion of solar and wind farms
- Introduce smart grids and smart devices to allow consumers and utilities (under contract) to cut peak demands when supply is limited
- Pay for reserve capacity in terms of vehicle-to-grid capacity, mini-hydro and biofuelled gas turbines and diesel generators

100% RE Least-Cost Energy Generation Mix 2030

5% Discount Rate; no extra transmission



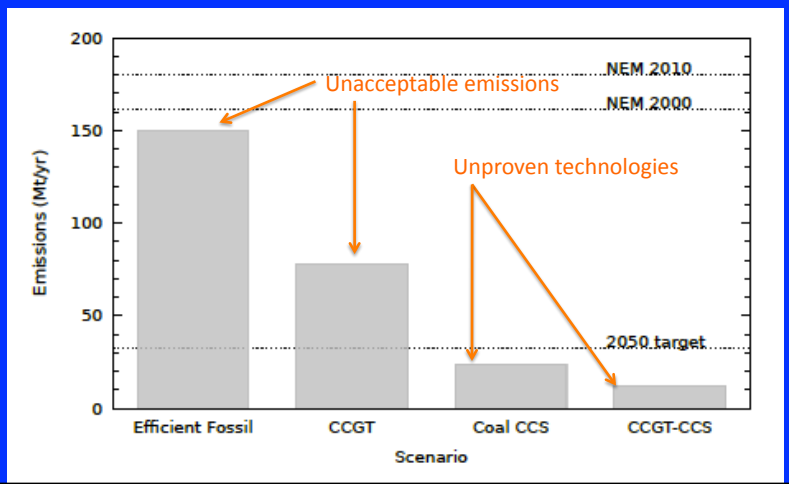
Technology costs projected to 2030 by Bureau of Resources & Energy Economics (BREE 2012). Low costs of the range

UNSW's Four Comparison Scenarios

None in AEMO (2013) study

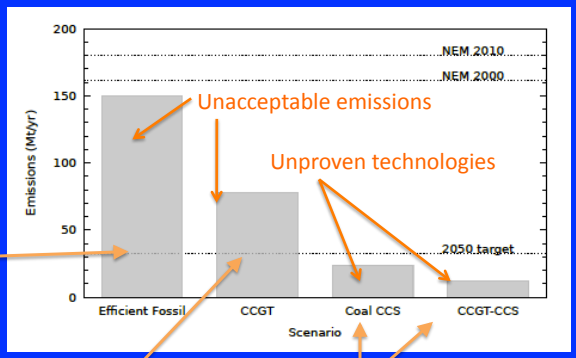
1. Most efficient commercially available fossil power stations (no CCS); GHG emissions still 81% of existing system – **unacceptable!**
2. All gas (no CCS), base-load and peak-load; GHG emissions 40% of existing – **unacceptable!**
3. Base-load coal with CCS **(unproven technology)** + peak-load gas turbines
4. Base-load gas with CCS **(unproven technology)** + peak-load: gas turbines

Annual CO_2 Emissions from 4 Fossil-Fuelled Comparison Scenarios



Annual CO_2 Emissions & Economics of 4 Fossil-Fuelled Comparison Scenarios

CCS is hypothetical carbon capture and storage; CCGT is combined cycle gas turbine



100% RE competes either if CO_2 price is $50-100 per tonne, or fossil subsidies transferred to RE

100% RE competes if domestic gas prices increase to near export prices

100% RE competes almost everywhere

Busted Myths about Renewable Energy (RE)

- **Myth:** 'RE cannot provide base-load power.' Myth is based on false notion that base-load demand must be supplied by base-load power stations – **BUSTED by simulations and elementary logic**
- **Myth:** 'RE is too variable or intermittent to make the predominant contribution to grid electricity supply – **BUSTED by simulations: variable RE's contribute 70%; flexible RE 30%**
- **Myth:** 'Coal-fired power stations must run continuously as backup' – **BUSTED by both experience & simulations**
- **Myth:** 'Renewable energy is too expensive' – **BUSTED by simulations & economic analysis based on conservative projections**
- **Myth:** 'Renewable energy is not ready' – **BUSTED: UNSW simulations use only commercially available technologies**

Conclusion re Reliability and Economics

- 100% renewable electricity (RE) systems meet reliability criteria without base-load power stations
- Coal + CCS could only compete with 100% RE under uncommon combinations of costs: eg, power station close to storage reservoir AND low CO_2 price
- But, low CO_2 price means no economic driver for developing and using CCS in Australia
- Hence, in a climate-constrained world, there may be no future for coal-fired electricity, even if CCS becomes commercially available
- All-gas and gas + CCS can only compete with 100% RE if domestic gas price doesn't rise to near export parity (it is almost there)
- Renewable energy is a good long-term investment

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Recommended Key Renewable Energy Policies

- Increase 2020 Renewable Energy Target; at least keep at 41,000 GWh/yr
- Set new RE target of 120,000 GWh/yr for 2030
- Set targets for energy efficiency and renewable heat, as in Europe
- Set feed-in tariffs to drive big solar, both CST and CPV
- Build transmission highways/spines
- Maintain Clean Energy Finance Corporation
- Remove subsidies to production & use of fossil fuels (at least $10 billion p.a.)
- Support medium-scale renewable energy projects by communities
- Implement really smart meters together with sophisticated demand management

What You Can Do

- Spread the word that 100% renewable electricity is technically and economically feasible based on commercially available technologies
- Publicly and privately refute the myths that are being spread against renewable energy
- Campaign for government policies to expand rapidly renewable energy and energy efficiency programs
- Make your own home more sustainable in terms of energy
- Push your employer, local school, shopping mall, and local community to implement sustainable energy

Further Information

Research papers:

http://www.ies.unsw.edu.au/our-people/associate-professor-mark-diesendorf

New book: *Sustainable Energy Solutions for Climate Change*, UNSW Press and Earthscan, 2014