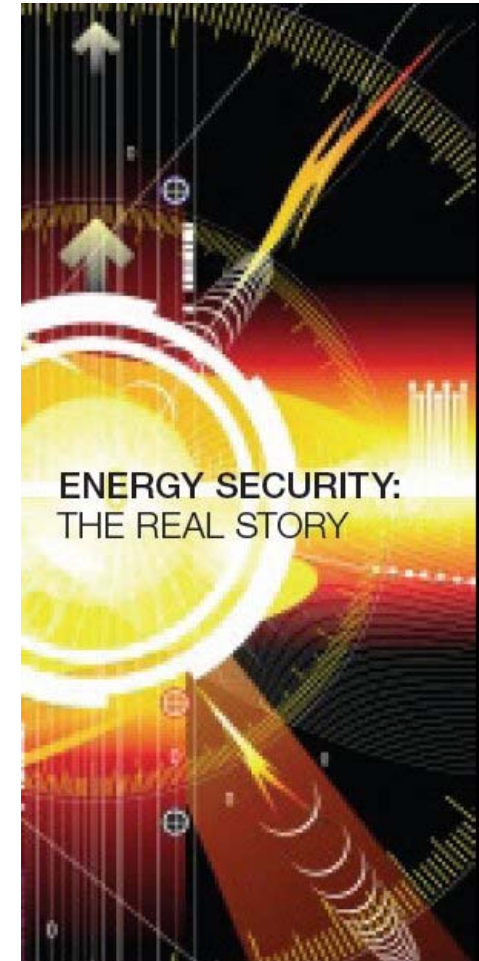


Energy Security: The Real Story

Australia's Options

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Energy security – what does it mean to each one of us?

- **If there is war or blockade of Australia can we continue to operate efficiently? What would we do?**
- **If oil runs out (unlikely) or becomes prohibitively expensive (much more likely) what will we do?**
- **If we suffer a major natural disaster (like Burma or the Asian tsunami) what would we do?**
- **Will the lights stay on – whatever happens?**
- **Will the energy costs stay low?**
- **Can we continue to travel?**

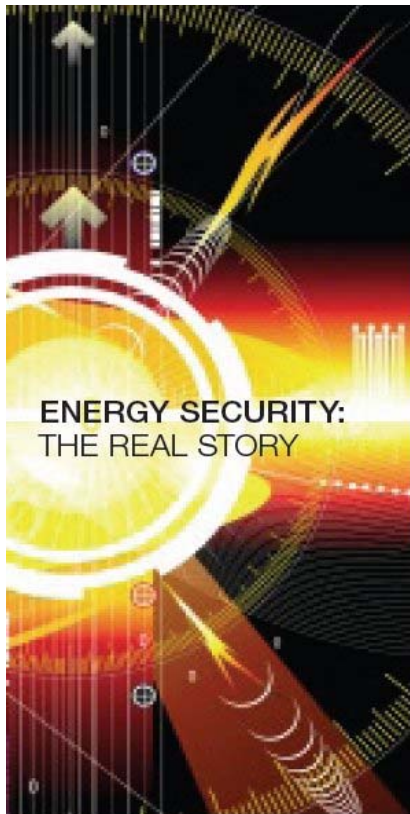


What questions must we answer?

- **What technology scenarios can take Australia to 2020, 2050 and beyond, given climate change imperatives, foreshadowed emissions targets and energy security?**
- **How can such reductions rationally be achieved while still retaining the energy security that people demand? What technologies do we need?**
- **What R&D is needed – or do we just buy the technology from others?**
- **What are the policy drivers? What are the regulatory instruments? How can market forces be harnessed?**
- **What is Australia's role in promoting relevant technologies to others?**



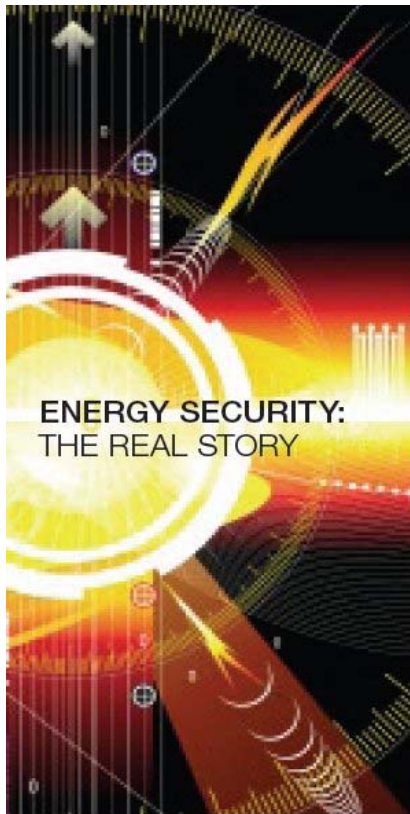
What technologies do we need for real energy security?



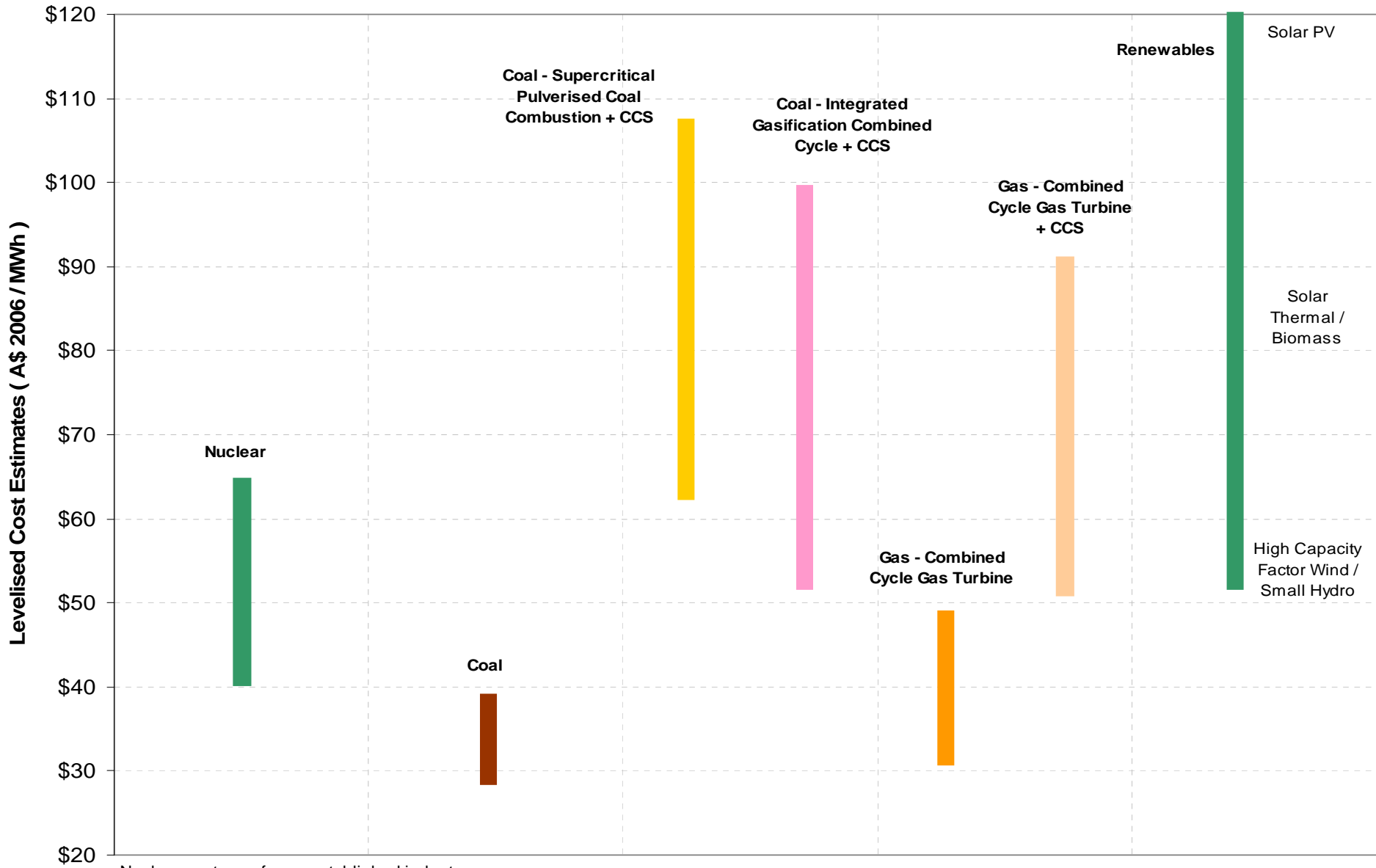
- **Energy conservation?**
- **Clean coal?**
- **Carbon capture and sequestration?**
- **Solar?**
- **Wind?**
- **Geothermal?**
- **Nuclear?**
- **Bioenergy?**
- **Electric vehicles?**
- **Oil replacements?**
- **Hydrogen?**
- **Or all of these?**



And what are the costs and potential of these technologies?



- **Energy conservation** – low to medium
- **Clean coal** - medium to high
- **Carbon capture and sequestration?** - ???
- **Solar** – high but falling steadily
- **Wind** – medium but still falling
- **Geothermal** – the jury is out!
- **Nuclear** – lowest low emission base load
- **Bioenergy** – varies – competes with food
- **Electric vehicles** – great potential!
- **Oil replacements** – inevitable for Australia
- **Hydrogen** – a niche product
- **Or all of these** – certainly!



Nuclear costs are for an established industry
 CCS estimates are indicative only
 Renewables have large ranges and substantial overlaps

Energy conservation

- **Although the security Cinderella, still huge scope for enhanced savings in industry, commerce and domestic sector.**
- **Technologies like advanced variable speed motors, intelligent control and metering, advanced buildings, smart lighting and much more could save 30-40% and more with no functionality loss.**
- **The potential of advanced low carbon footprint metallurgical processes is considerable**
- **But market incentives are needed to accelerate the response!**
- **Emissions trading will stimulate all these technologies.**



Clean coal technologies

- **'Clean coal' technologies development includes:**
 - New combustion systems - oxy-firing, combined cycle gasification, polygeneration, etc
 - And especially carbon capture and sequestration.
- **But - if these technologies prove successful they will add significantly to electricity price (even without carbon trading)**
- **What RD&D, education and training, legislative and regulatory harmonisation will be needed for carbon capture and sequestration?**

Renewables – can they fill the gap?

- **What are the evolutionary trends in renewable energy technologies that should be fostered in Australia?**
- **What renewable energy technologies should Australia exploit? Organic solar PV cells? Second generation algae biodiesel? Concentrating PV? Low cost wind generation? Waves and tides?**

Solar energy

- **The sure answer to energy security! But how to harness it economically?**
- **Improved low cost PV integrated roofing panels will enable new and retrofit homes to be distributed micro generators (2-3kW each).**
- **Solar water heating should be required for new houses.**
- **Research should focus on low cost concentrating systems, both photovoltaic and thermal – huge potential.**
- **Research on very low cost organic PV technologies is needed.**
- **CSIRO and Australian universities are at the forefront!**

Wind energy

- **Good for energy security but highly site specific (eg Tasmanian roaring forties versus downtown Parramatta!)**
- **Lower cost higher power wind systems are needed**
- **Australian skills are good**
- **MRET was critical to early success**

Geothermal energy and hot rocks

- **Huge potential in Australia – again the ‘Lucky Country’**
- **Significant opportunities for exploitation and commercialisation of geothermal power generation in Australia – many under way already**
- **Supply is effectively secure and emissions free**
- **But where are Australia’s hot rock resources? Generally remote from the load!**
- **So very significant investment is needed**

Nuclear energy

- **UMPNER 2006 concluded nuclear power lowest cost LET**
- **Coal less costly but will change with emissions (carbon) trading**
- **Australia has 40% of world's natural uranium but no enrichment facility**
- **Removal of barriers requires better public information plus education and training of engineers, technologists and managers.**
- **Institution building needed over 5 years (eg RD&D, education, regulatory harmonisation)**
- **Australia's present nuclear capabilities limited apart from ANSTO**
- **Political impasse could go as benefits become more apparent and risks seem to be manageable. This will take time**

Bioenergy and biofuels

- **What is the potential for bioenergy and biofuels?**
- **Cost still relatively high – needing subsidies**
- **Competes with food and agricultural land (especially ethanol, but also biodiesel)**
- **Future may lie in low value lignocellulose and even algae (which can absorb CO₂, nitrogen and sun and thrive on poor ground and saline groundwater)**

Transport systems

- **What are the step changes foreshadowed in energy for transportation – road, rail, air and sea?**
- **What technological contributions can Australia make?**
- **What contributions can be made to advanced batteries for electric and hybrid vehicles?**



Transport energy

- **Electric road vehicles** - Transport emissions lowered and long term security (ie freedom from imported oil) increased with take up of electric vehicles, first hybrids then plug in (and feed out) EVs with advanced batteries and superior performance
- **Electric railways** – Already the urban and main line choice, but less practical for remote miners and rural communities
- **Electric ships** – Using compact nuclear power plants, as with submarines

Oil replacement technologies

Energy security and imported oil replacement options for Australia include:

- **Coal to oil (CTL)**
- **Gas to oil (GTL)**
- **Compressed natural gas (CNG)**
- **Liquefied natural gas (LNG)**
- **Coal seam methane (CSM)**
- **Bio-ethanol and biodiesel**
- **Electric vehicles (EVs)**

The Hydrogen Economy

- **How best can Australia prepare for the uptake of hydrogen as an energy carrier?**
- **The National Hydrogen Study has opened this debate!**
- **More research needed in development of the hydrogen economy, including low cost hydrogen storage and advanced hydrogen fuel cells.**

What will be the impact of externalities?

- **What role can rational markets play through internalising perceived values of externalities?**
- **How will internalisation of externalities contribute to long term Australian energy policy formation, having in mind economic realism, sustainability and security imperatives?**



Where will the brains come from?

- Policy makers? Yes – but they need specialised help – but where from?
- The learned Academies (Technological Sciences and Engineering, Science, Humanities and Social Sciences)
- Professional societies (Engineers Australia, Australian Institute of Energy, etc)
- Technology think tanks (eg Sydney University Warren Centre, University of NSW Energy Research, Development and Information Centre (ERDIC), **University of Western Sydney Whitlam Institute**, University of SA Institute of Sustainable Systems and Technologies (ISST), etc)
- National RD&D organisations (CSIRO, Research Universities, CRCs, etc)
- Energy industry associations (eg coal, gas, petroleum, renewables, nuclear, energy utilisation and end use, electricity and gas distribution, etc)
- Others??

So let us all keep thinking!

And that means –

every one of you!

Thank-you for your
kind attention



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