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Assessing our Sustainable Energy Options: Key Issues, Uncertainties, Priorities and Potential Choices

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Australia & Climate Change Diplomacy: Towards a Post-Kyoto Regime

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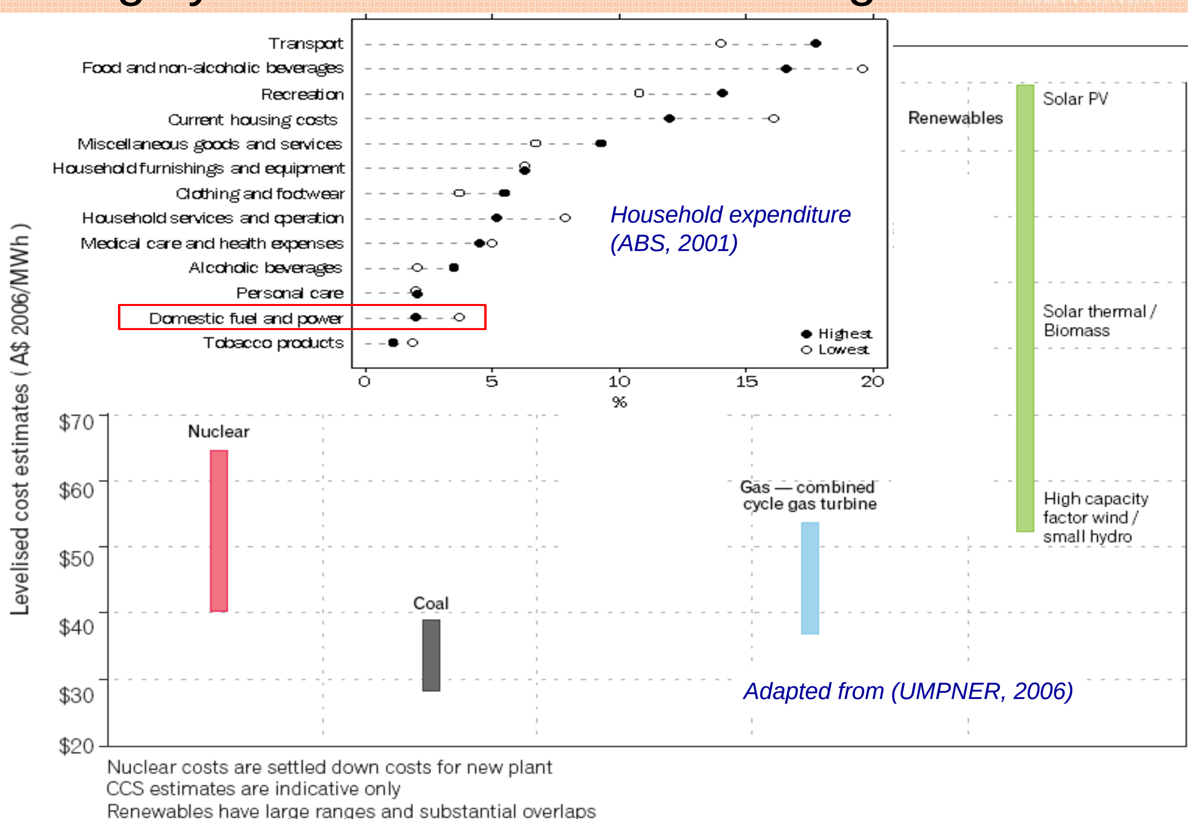
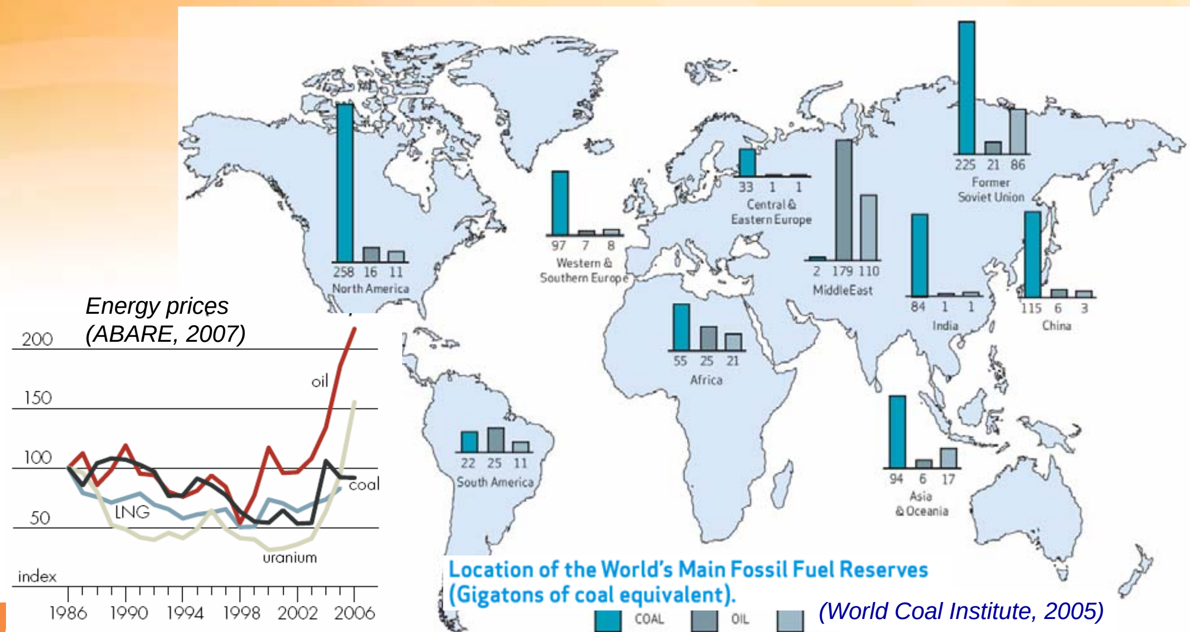
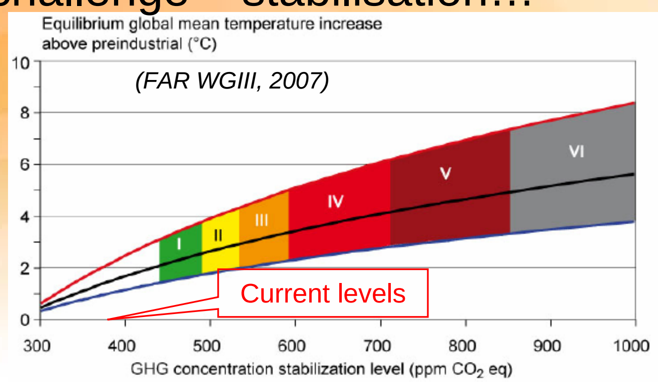
A largely fossil-fuelled world …. for good reason



Energy security concerns growing, regional issues with oil & gas but plentiful coal … and we are unlikely to run out of fossil fuels….



….before global warming concerns dominate. The challenge – stabilisation…



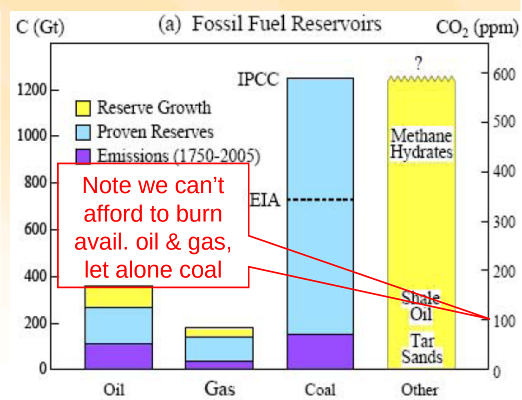
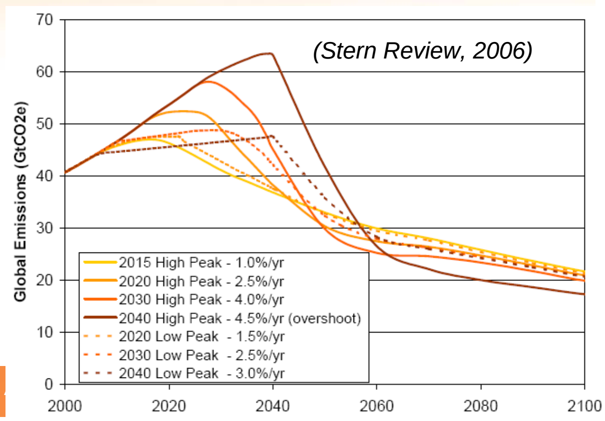


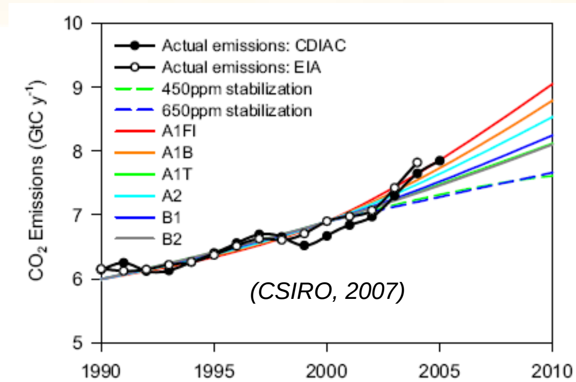
Table SPM.5: Characteristics of post-TAR stabilization scenarios [Table TS 2, 3.10] [a)]

Category	Radiative Forcing (W/m²)	CO_2 Concentration[c)] (ppm)	CO_2-eq Concentration[c)] (ppm)	Global mean temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity[b), c)] (°C)	Peaking year for CO_2 emissions[d)] (year)	Change in global CO_2 emissions in 2050 (% of 2000 emissions)[d)] (%)	No. of assessed scenarios
I	2.5 – 3.0	350 – 400	445 – 490	2.0 – 2.4	2000 - 2015	-85 to -50	6
II	3.0 – 3.5	400 – 440	490 – 535	2.4 – 2.8	2000 - 2020	-60 to -30	18
III	3.5 – 4.0	440 – 485	535 – 590	2.8 – 3.2	2010 - 2030	-30 to +5	21

…. and possible emission trajectories

- Note high 'price' of delay
  - Waiting 20 years to act requires emissions to fall 3-7 times faster to a lower level
- *… current trajectory exceeds the 'worst case' IPCC scenarios from TAR*

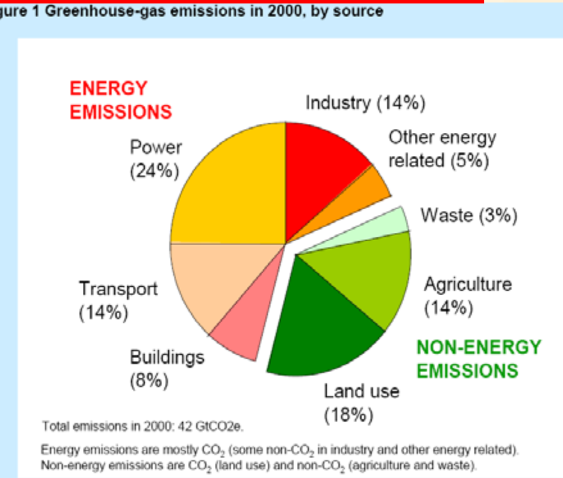




Abatement options *(Stern, 2006)*

- Reducing demand for emissions-intensive goods + services
  - Energy conservation / frugality
- Increased efficiency
  - Particularly end-use efficiency, but also in supply + distribution
  - Can save both money and emissions
- Action on non-energy emissions
  - Land-use, agriculture, waste
  - non-CO2 industrial emissions
- Switching to lower-carbon technologies for power, heat and transport
  - Renewables, Nuclear, Gas Carbon Capture and Storage

Figure 1 Greenhouse-gas emissions in 2000, by source



Source: Prepared by Stern Review, from data drawn from World Resources Institute Climate Analysis Indicators Tool (CAIT) on-line database version 3.0.

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Key drivers in assessing our energy options

- *Their ability to contribute to large, rapid and sustained global emission reductions while maintaining energy security*
  - Technical status
    - unproven => mature; niche => widespread
  - Delivered benefits
    - GHG emission reductions, flexibility, dispatchability
  - Present costs where known – + possible future costs
  - Potential scale of deployment
    - possible physical, technical + cost constraints
  - Potential speed of deployment
    - time and effort required to achieve scale
  - Other possible societal outcomes
    - eg. other environmental impacts, **energy security implications**

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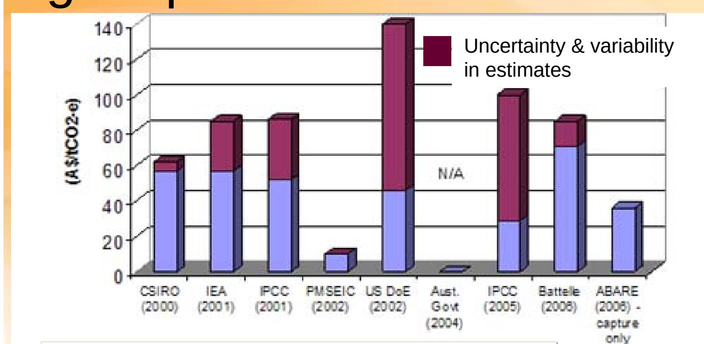
Key perspectives wrt these drivers

- Scientific
  - eg. impact of physical resource limits on potential scales of deployment
- Engineering
  - wrt our ability to develop socio-technical systems; eg. engineering limitations to speed particular technology industries can grow
- Economic
  - in the ‘social welfare’ sense; eg. direct & externality costs of options
- Commercial
  - role of commercial market ‘settings’ in driving individual decision making in areas like technology innovation
- Societal
  - including social expectations and governance required to deliver these including policy, mechanisms, measures and regulation: eg. social acceptability of nuclear power

Our options – technical status

Energy Efficiency	Many off-the-shelf high efficiency equipment + appliances available but not yet widely deployed. Considerable potential for technical progress
Renewables	Mix of very mature (eg. Hydro) established yet continuing to evolve (eg. Wind) and emerging (eg. Hot Rock).
Lower emm fossil-fuel techs	Off-the-shelf CCGT and Cogen plants are widely deployed in some parts of the world – micro cogen technologies still emerging
Nuclear	Established Generation II plants however the Gen III designs proposed for much of the developed world are still being proven up – 'first of kind'
Carbon Capture + Storage	Not yet demonstrated at scale and fully integrated for electricity generation – demonstration projects not yet implemented. Proving 'storage' will take time.

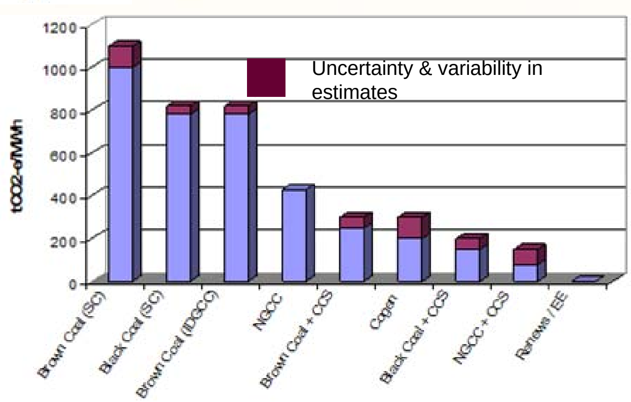
eg. Implications of CCS technical status



Estimates of CCS costs
adapted from various sources (MacGill, 2007)

Study scenario	Approximate period where significant deployment of CCS in electricity generation begins
PMSEIC (2002)	2005
IEA (2004)	2010
DoE (2004)	2020
IPCC (2005) MiniCAM MESSAGE	 2015-20 2040
ABARE (2006)	2015
CO2CRC (2006)	2030
Battelle (2006)	2025

Estimates of CCS emissions
from various sources (MacGill, 2007)



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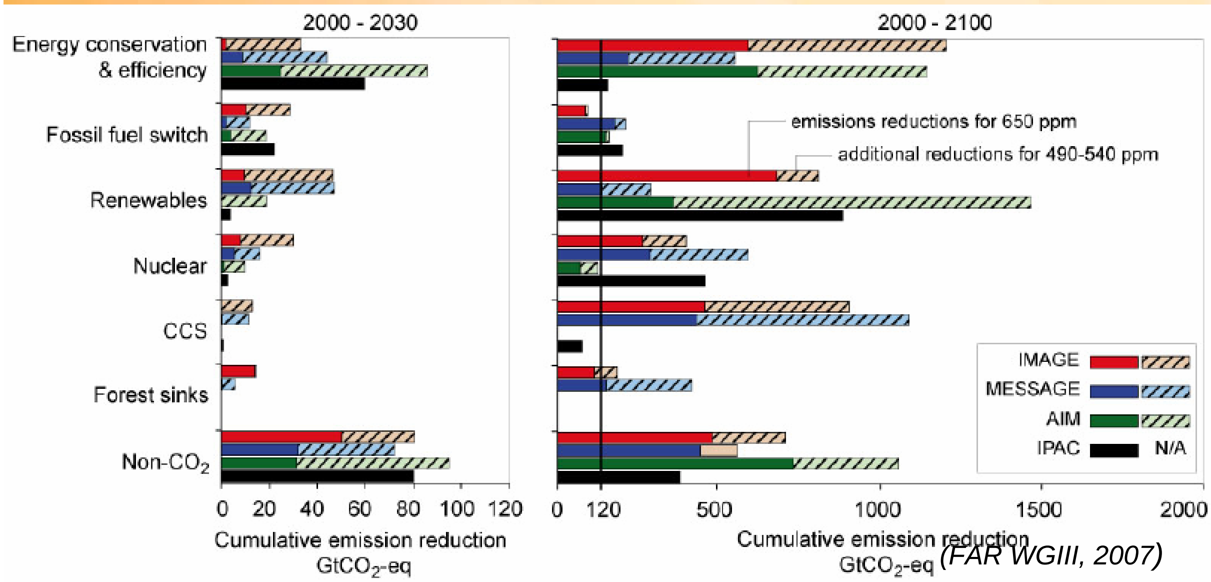
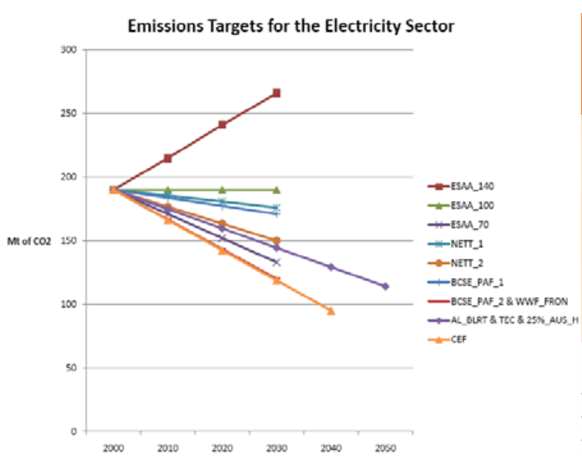
Putting it all together: future energy scenarios have mixed transparency wrt tech. assessment, generally poor incorporation of uncertainty, some agreement



(FAR WGIII, 2007)



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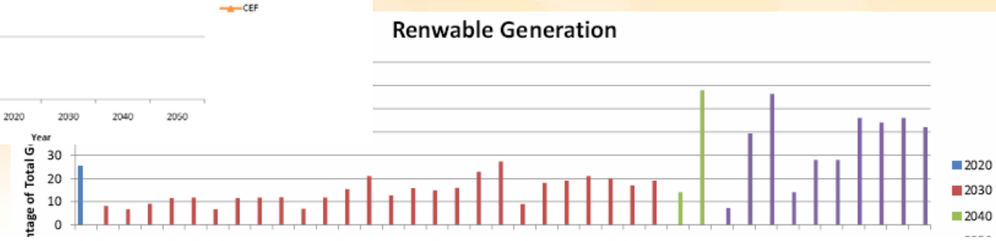
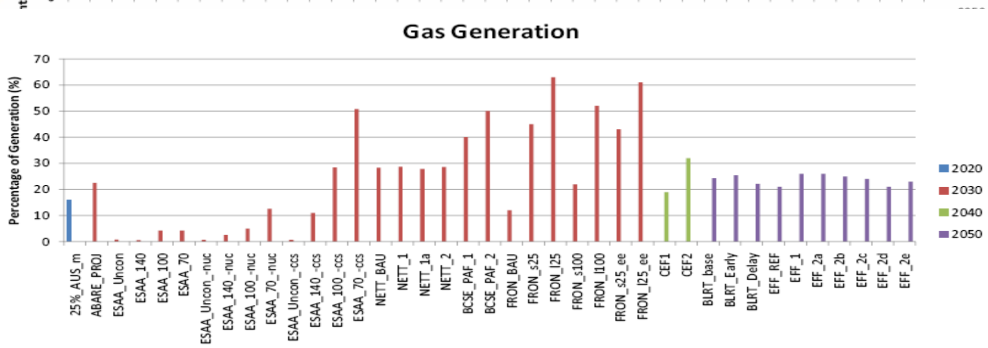
Australian scenarios show wide variations *(Morris, 2007)*

not generally obvious what assumptions & methods these differences come from





Alternative scenario approach – *WWF Vision for 2050*

- Q: technical feasibility of meeting growing global energy demand using sustainable energy technologies that protect climate.
  - High level qualitative technology assessment
  - focuses on key questions of physical resources, technical capacities & rate of industrial transitions - doesn't assume technology costs or carbon price
  - Uncertainties explicitly modelled

Industrial Energy Efficiency & Conservation Efficient Buildings Efficient vehicles Reduced use of vehicles Aviation and shipping efficiency Re-powering Hydro	***Benefits >> Disbenefits***
Sustainable Biomass Wind power Solar PV Solar Thermal power Solar Thermal Heat Small Hydro Geothermal (heat and power) Tidal, Wave & Ocean Technologies Hydrogen from Renewables Large Hydro (existing plus sustainable) CCS Natural Gas Displacing Coal	***Benefits > Disbenefits***
Unsustainable Biomass Unsustainable Hydro Nuclear	***Benefits < Disbenefits***

Figure 2. WWF grouping of climate solutions technologies based on environmental, social, and economic criteria.

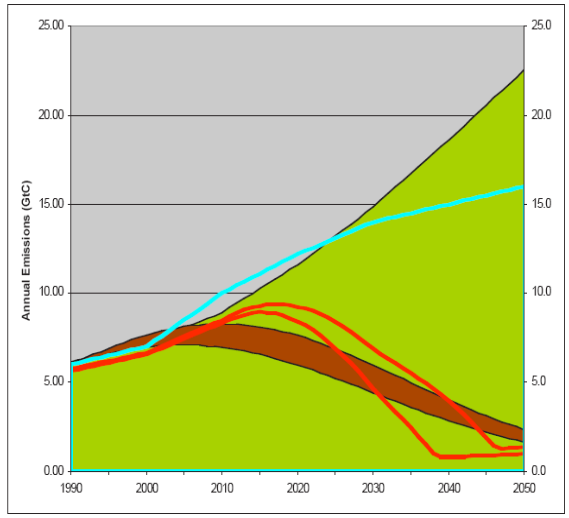


Figure 6. Emissions in the WWF Climate Solutions Model. The diagram shows the range of emissions (the area between red lines) in the scenario presented in this paper. The lower limit of

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General principles to guide policy efforts

- What exists is possible
  - existing off-the-shelf energy efficiency, gas & renewables have demonstrated capabilities in reducing emissions & understood costs.
- What doesn't yet exist may or may not be possible
  - and while these options should be pursued, shouldn't be relied upon – eg. waiting for CCS before taking action high risk
- It takes time to commercialise technologies
  - additional money can shorten but generally can't eliminate such delays
- It takes yet more time to develop industrial, infrastructure and institutional capacities
  - Key to taking technologies from niche applications to widespread deployment.

Possible policy conclusions

- Key policy priorities
  - Widespread deployment of existing options through rapid development of necessary industrial, infrastructure & institutional capabilities
- International and national policy efforts to date
  - Have not come close to scale of challenge we face so few lessons
  - Wider examples of transitions include oil shocks of 1970s, World War II. *Key to such transitions has been very significant Govt. involvement.*
  - Successes to date include Mandatory Energy Performance Standards (MEPS), renewable energy industry development in Europe & beyond
  - Key policy failures to date include EU ETS and NSW GGAS. *ETS still experimental – should it be relied upon as primary measure?*
- CCS and other emerging options
  - need to deploy existing options to buy these time to be proven up (or otherwise) and for necessary capabilities to be established.
  - key for CCS progress is demonstration projects *current delays in Australia & worldwide damaging to CCS prospects*