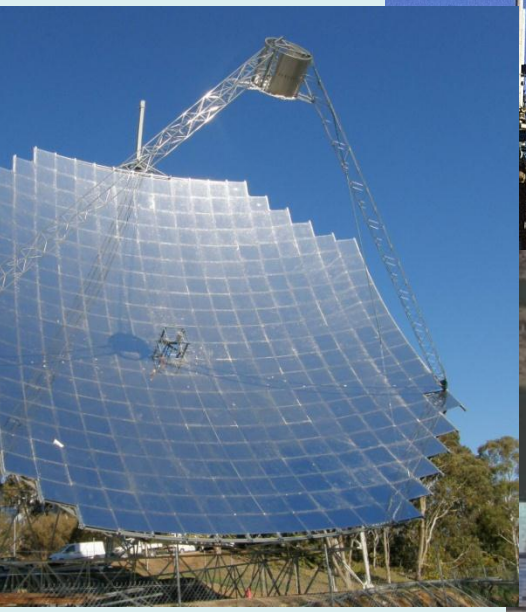
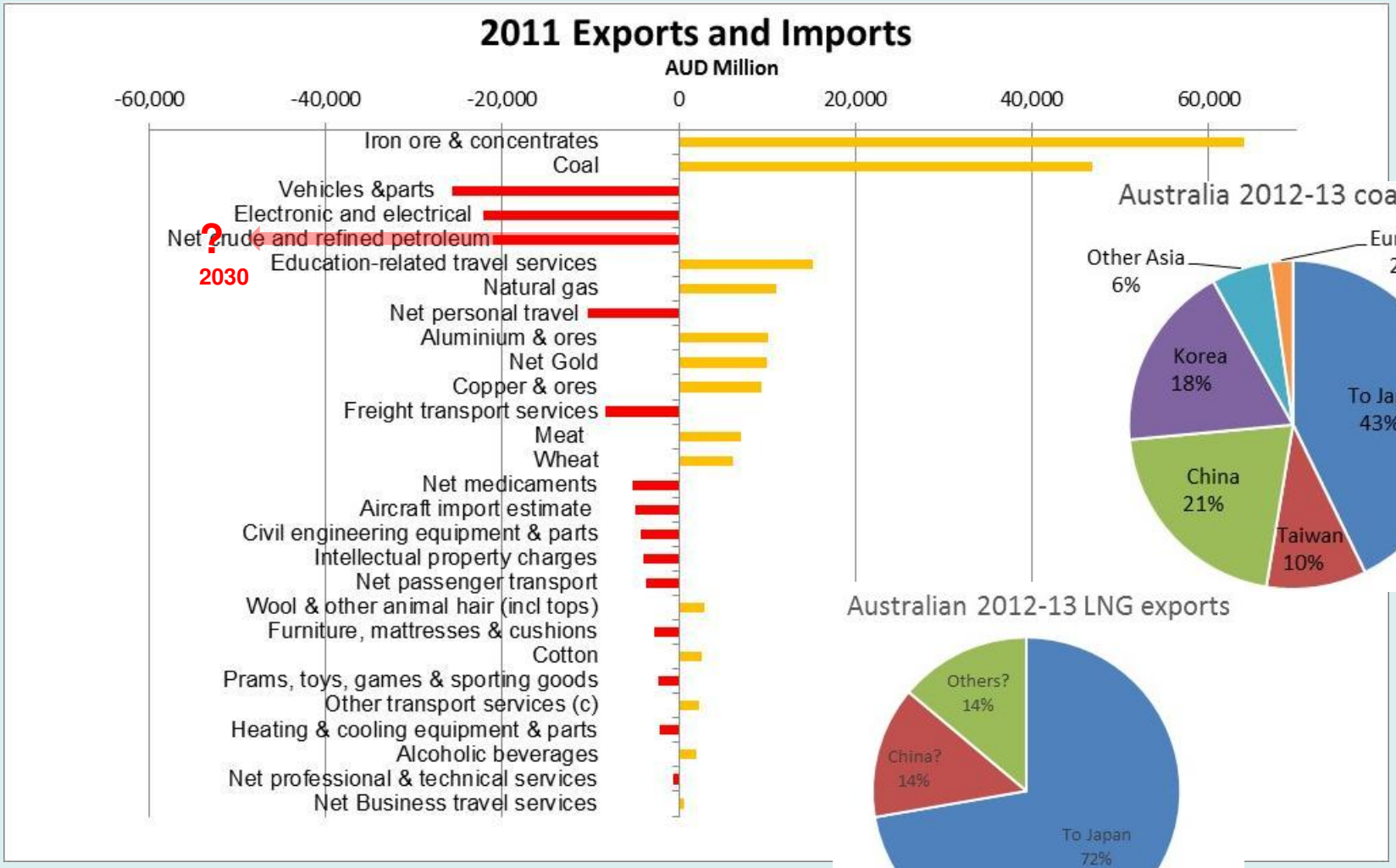
Concentrating Solar Fuels for export

Dr Keith Lovegrove
Head – Solar Thermal, IT Power Group
http://www.itpowergroup.com



How Australia pays for all that manufactured stuff from China, cars from Japan and most of our oil



The future for Oil

- Oil is the biggest single primary energy source
- Conventional (easy) oil appears to have peaked
- 70% of world energy cashflow is around oil
- Liquid fuels have unbeatable energy density and convenience of use
- Energy cost of moving energy around ½ globe by tanker is about 2%

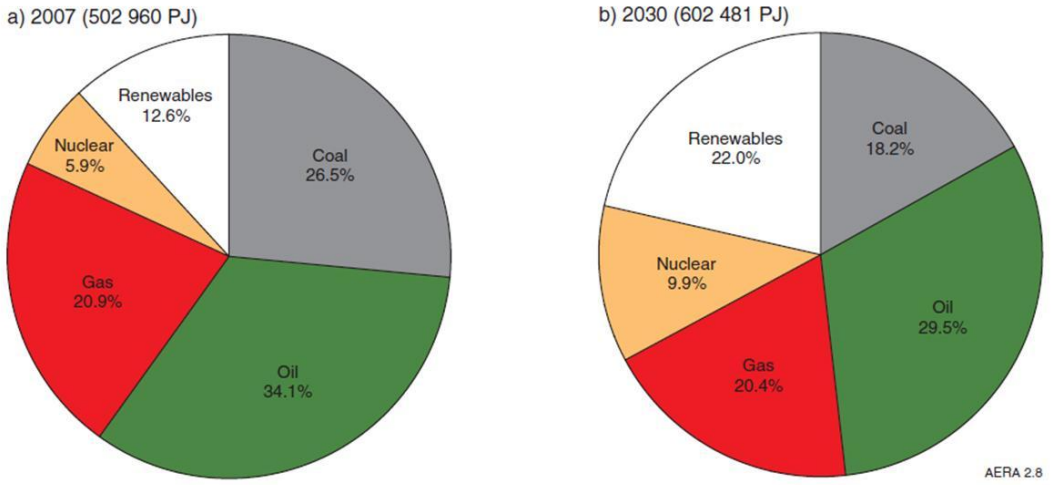
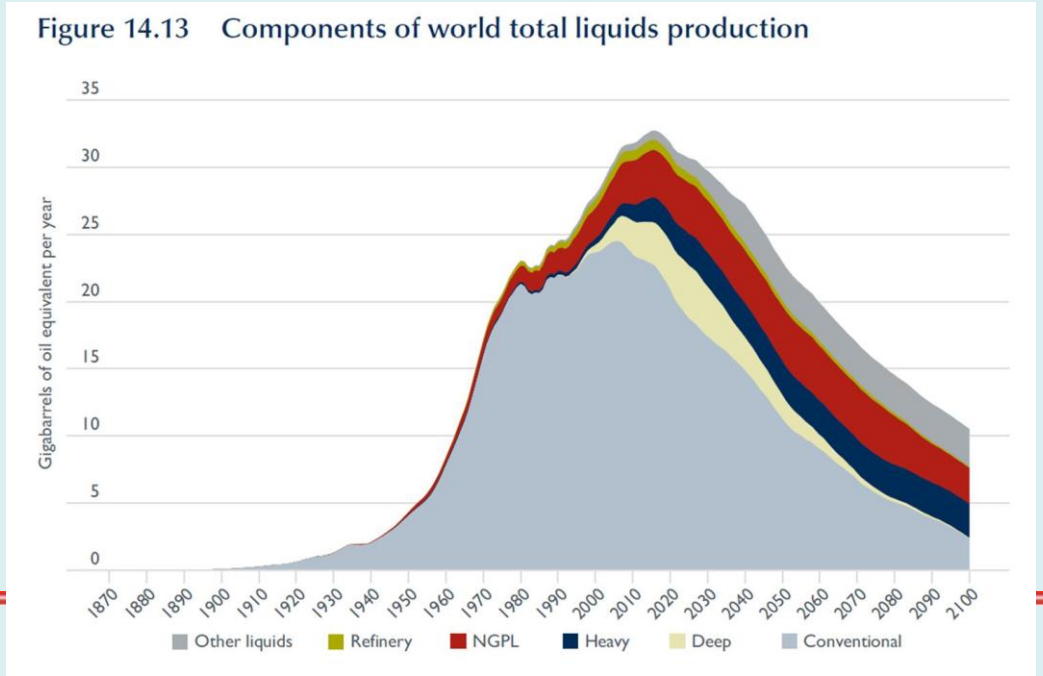


Figure 2.8 Outlook for world primary energy demand, IEA 450 scenario

Source: IEA 2009b



Oil – the economic equation

- Un-conventional oil costs more and has higher GHG
- Australia's oil trade balance is worsening
- What will oil prices do?

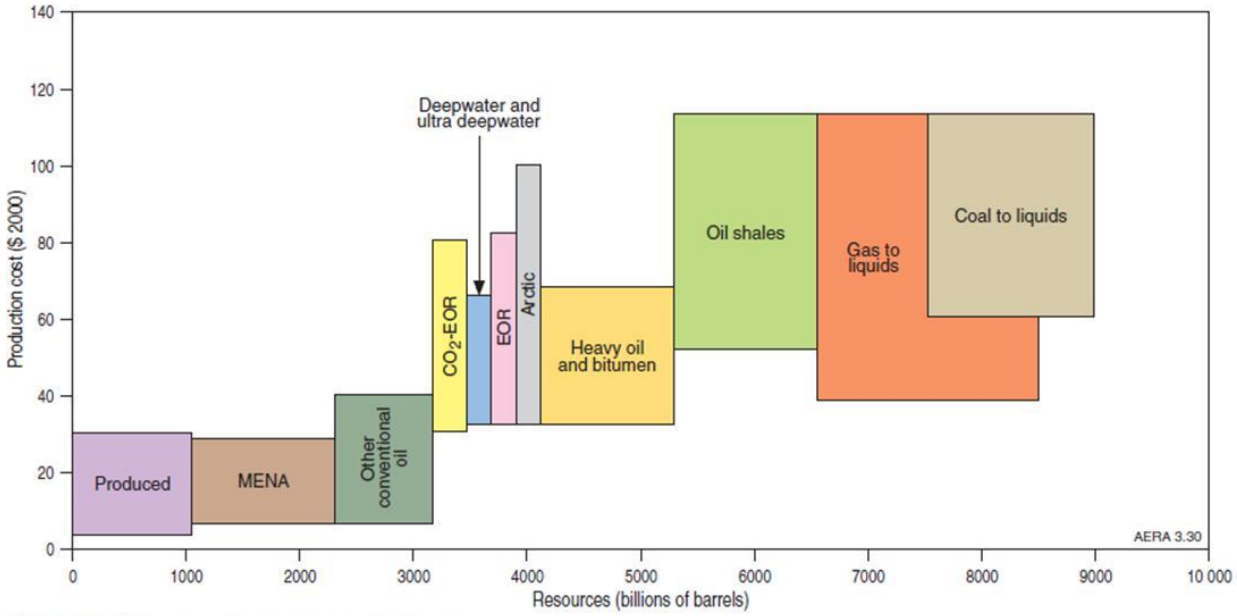


Figure 3.30 Long term oil supply cost curve
MENA – Middle East and North Africa
: IEA 2008

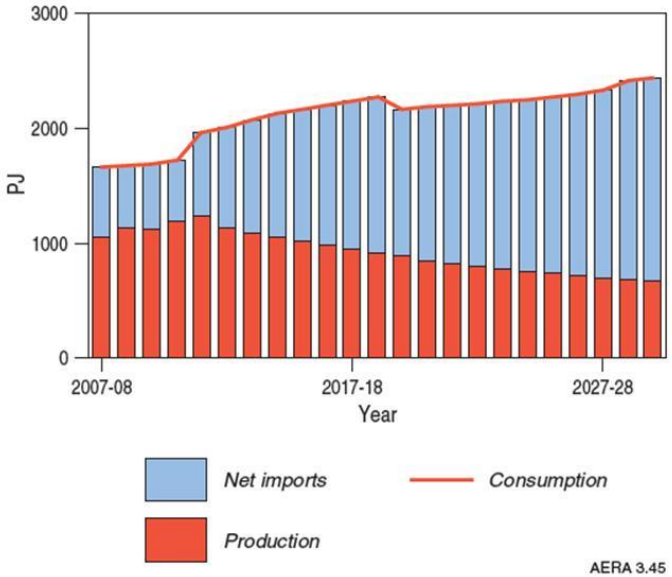
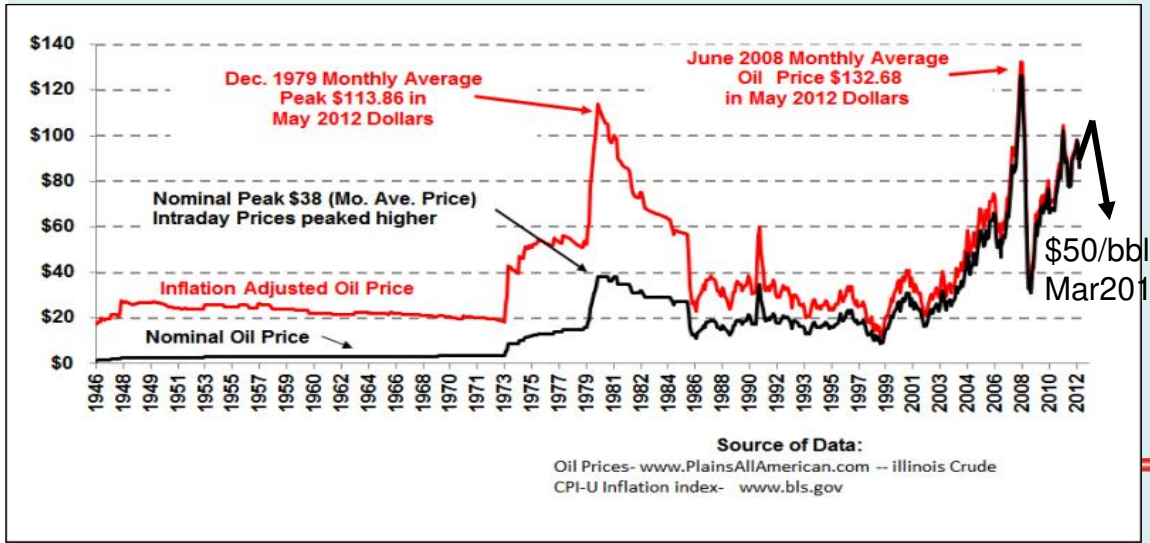
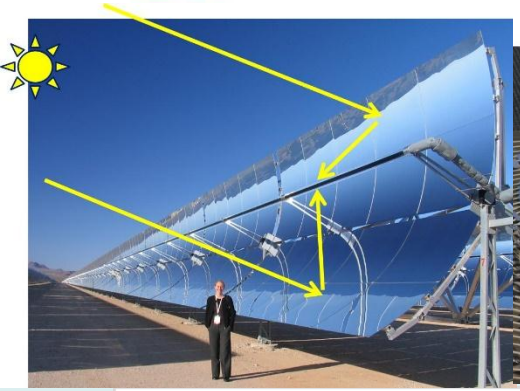
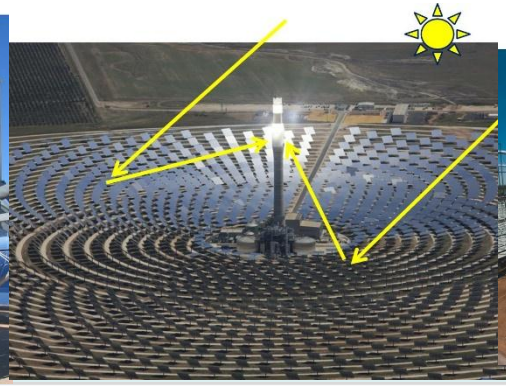
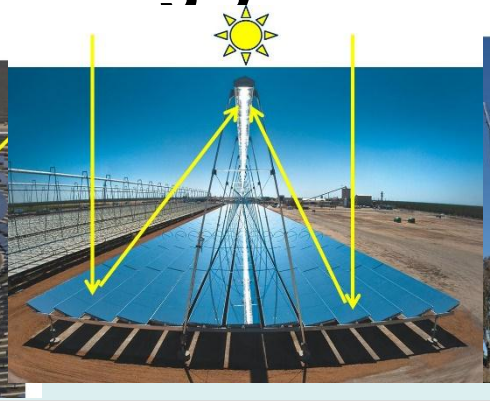
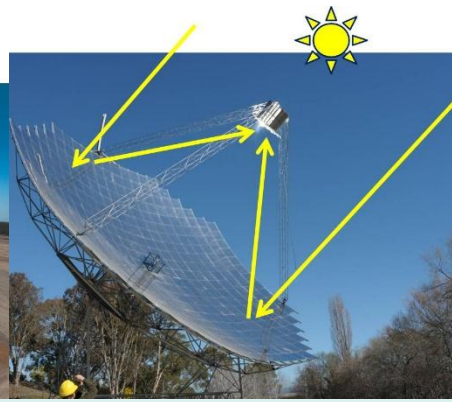
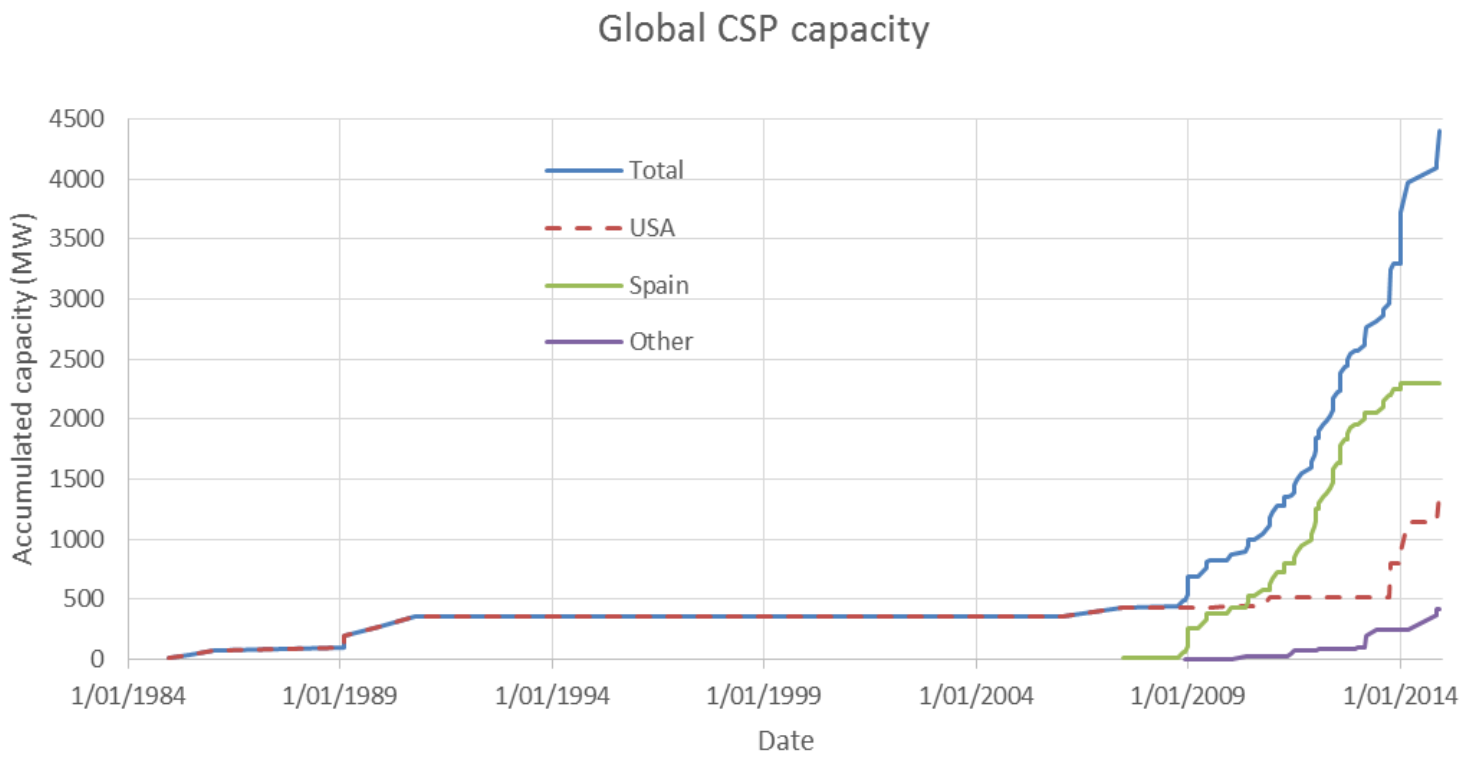


Figure 3.45 Australia's oil supply–demand balance



Concentrating Solar Power growing strongly



Solar Fuels – moving beyond electricity

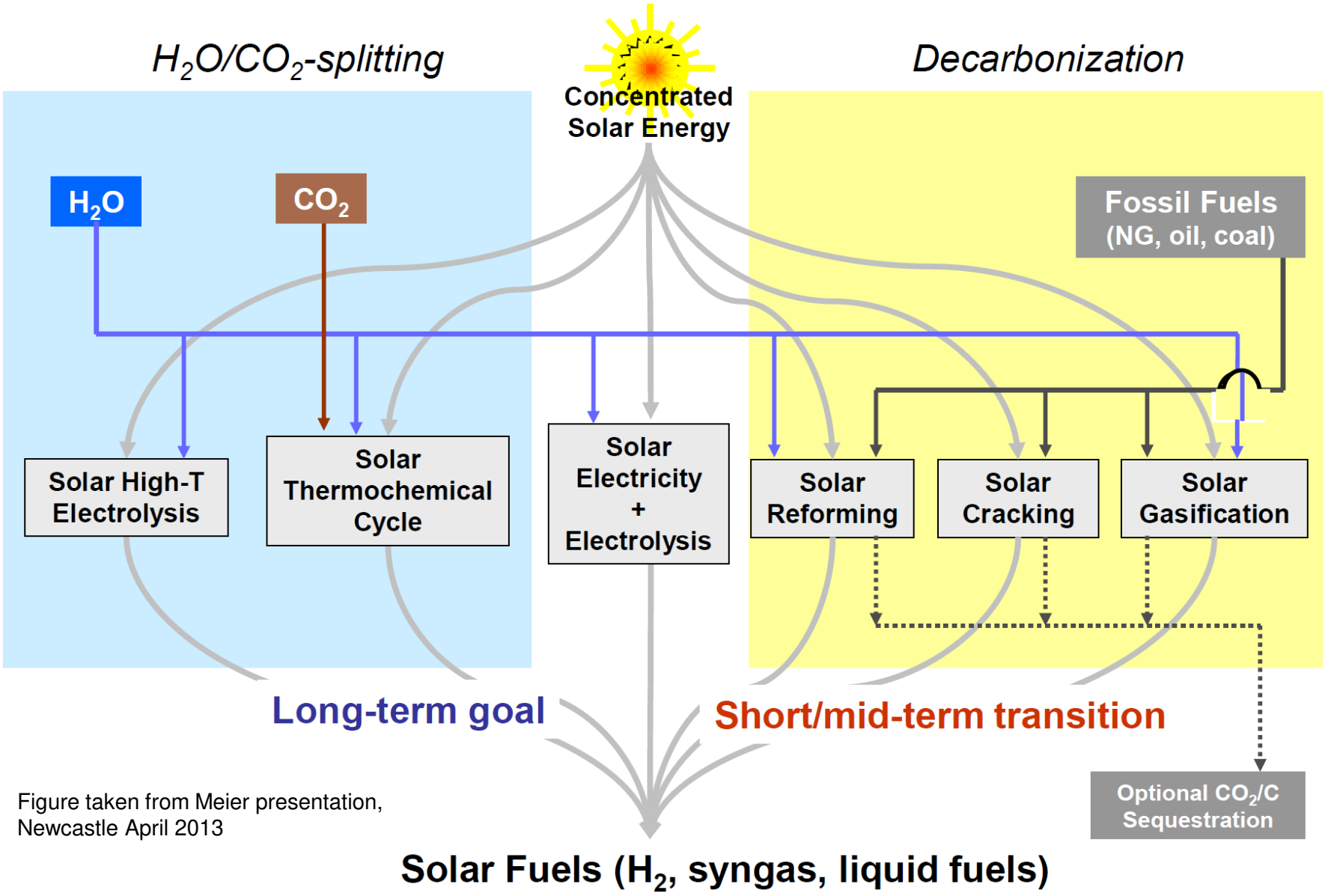


Figure taken from Meier presentation, Newcastle April 2013

Australia's solar chemistry history

- Ammonia cracking at ANU
- Steam reforming of methane at CSIRO
- Plus new work at Uni of Adelaide

Some possible examples (draft numbers)

Process	Input fuel cost	Solar product gas LCOF	Final fuel LCOF	Technology readiness	GHG intensity
Conventional crude oil at **$100/bbl ????**	$16/GJ		$20/GJ	Current technology	High
Solar gasification of brown coal	$1/GJ	$10/GJ	$18/GJ	Medium	High
Solar reforming of natural gas	$10/GJ	$12.4/GJ	$20/GJ	High	Medium
Solar gasification of biomass	$10/GJ	$14/GJ	$22/GJ	Medium	Zero
Solar water splitting	zero	$50/GJ	$58/GJ	Low	Zero

Based on 2020 solar field costs estimated at $107/m^2 for heliostats.
8% discount rate, 20 year amortisation

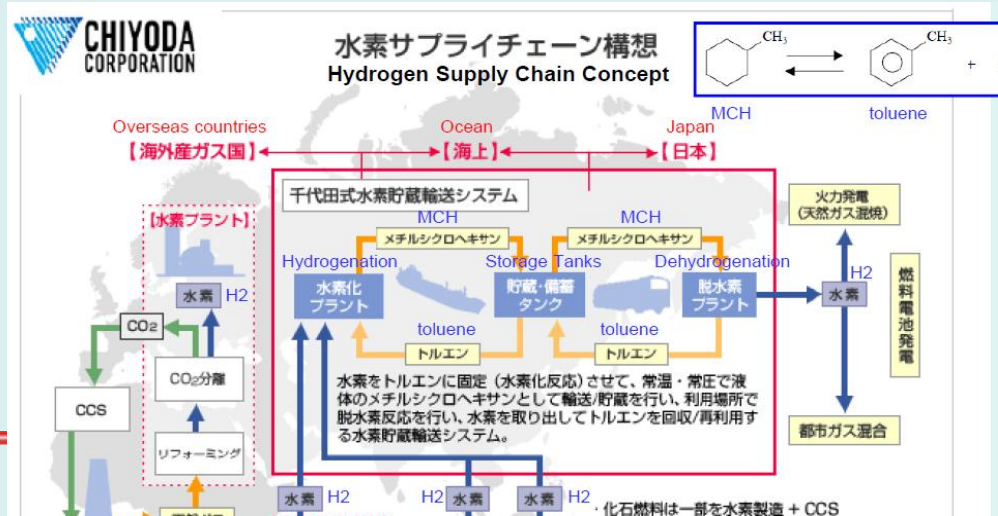
Major policy initiatives towards hydrogen in Japan

- *"In FY 2012, Japan invested approximately $240 million in fuel cell and hydrogen energy programs, ...included:*
  - *$112.77 million in subsidies for residential micro-CHP systems*
  - *$37.71 million for hydrogen infrastructure & vehicle demonstration projects*
  - *$91.71 million for various fuel cell and hydrogen energy R&D projects*
- *In July of 2010, Japan unveiled a plan to sell two million fuel cell electric vehicles by 2025, and install 1,000 hydrogen fueling station to support them.*
- *Japan's 3 major gas companies, Tokyo Gas, Toho Gas, and Osaka Gas, sold 9,250 Ene-Farm fuel cells in 2011 and plan to sell 14,400 units collectively in 2012.*
- *Japan has set a goal of fuel cells powering 2 million homes by 2020."*

•http://www.fchea.org/index.php?id=25

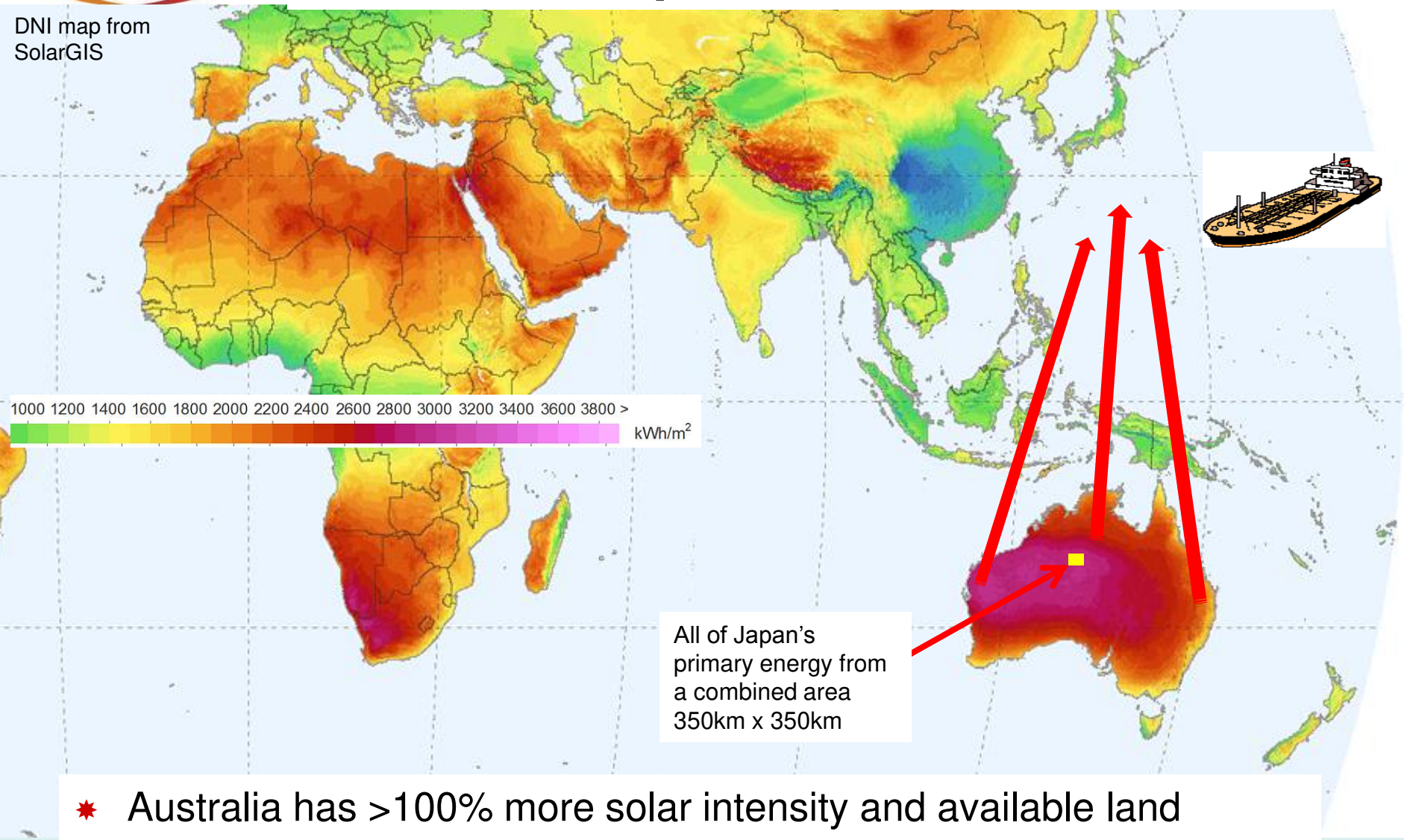
Options for moving (solar) Hydrogen from Australia to Japan by ship

Method
Compressed H_2 gas
Metal hydride
Liquid H_2
Toluene cycle
Methane / LNG
Ammonia
Other?



Figures taken from Kodama presentation, Newcastle April 2013

Australia's 'Desertec' – solar fuels to Japan and others



- Australia has >100% more solar intensity and available land
- Energy cost of tanker transport < 2% for energy dense fluid