The Future of Energy in Western Australia

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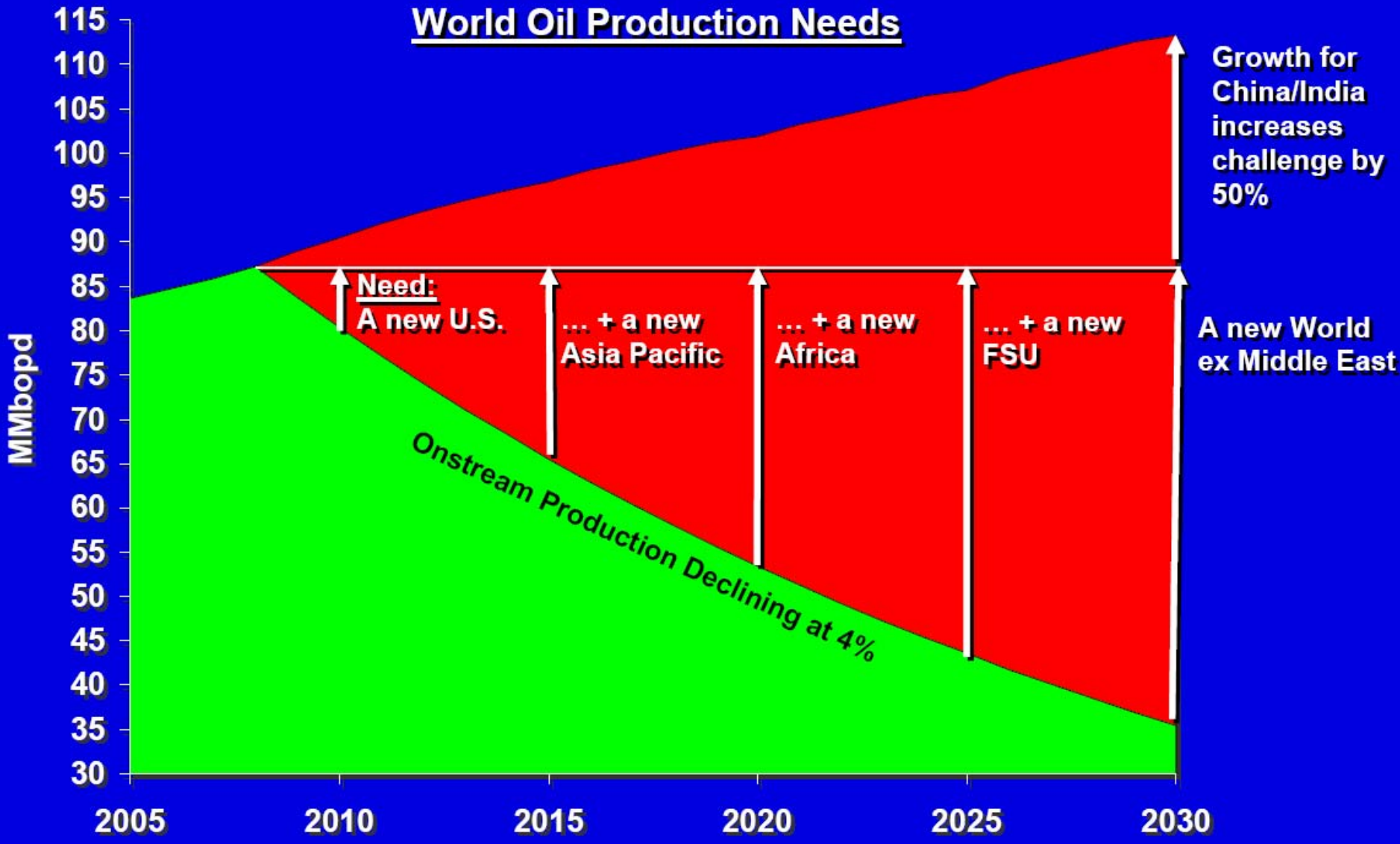
April 2009

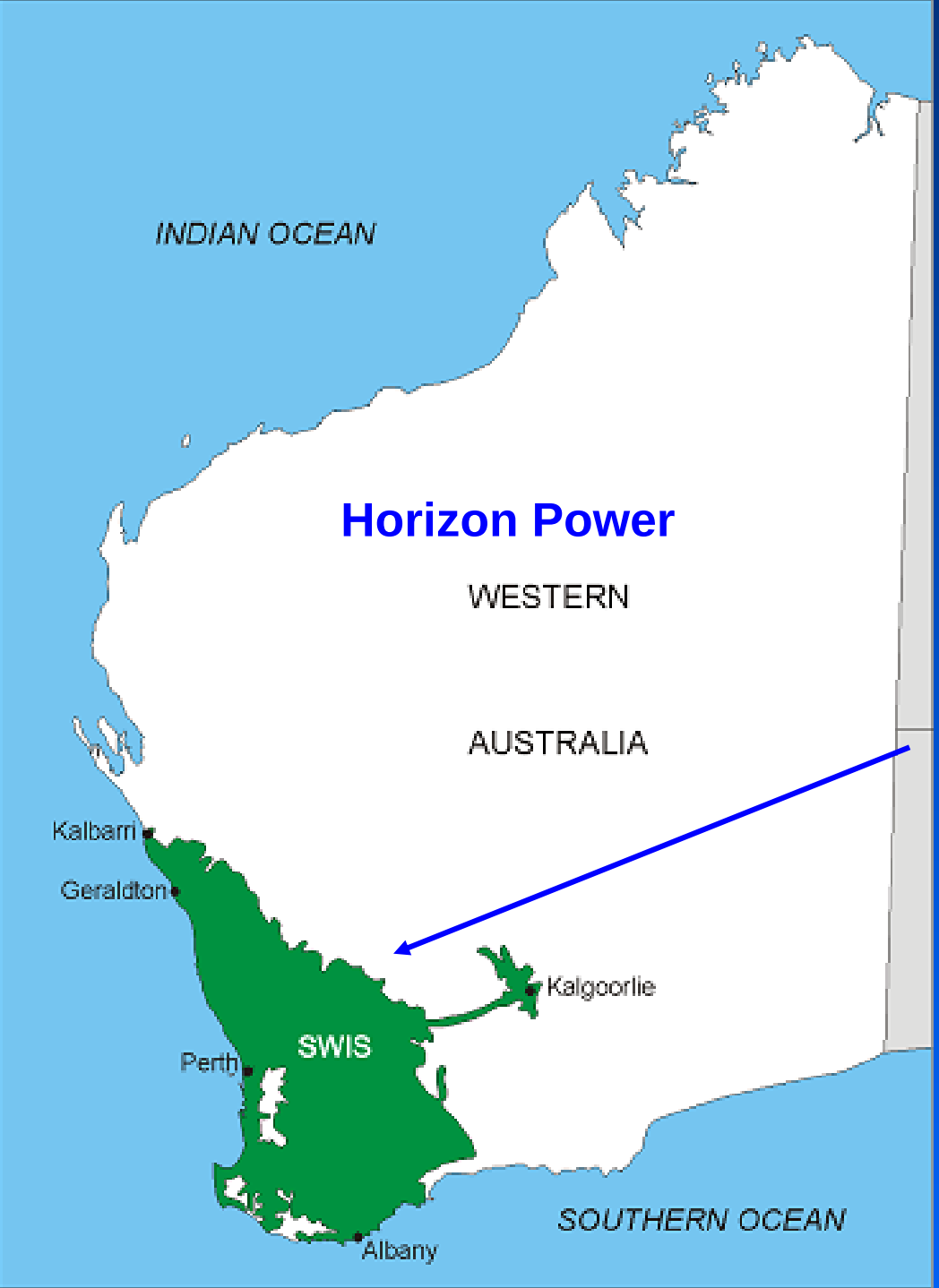
Sections

- Electric Power
- Liquid Fuels
- Convergence through Plug-in Hybrid

What will drive everything.



Source: U.S. Department of Energy data, Perella Weinberg analysis.



South West Interconnected System

Verve Energy - generation

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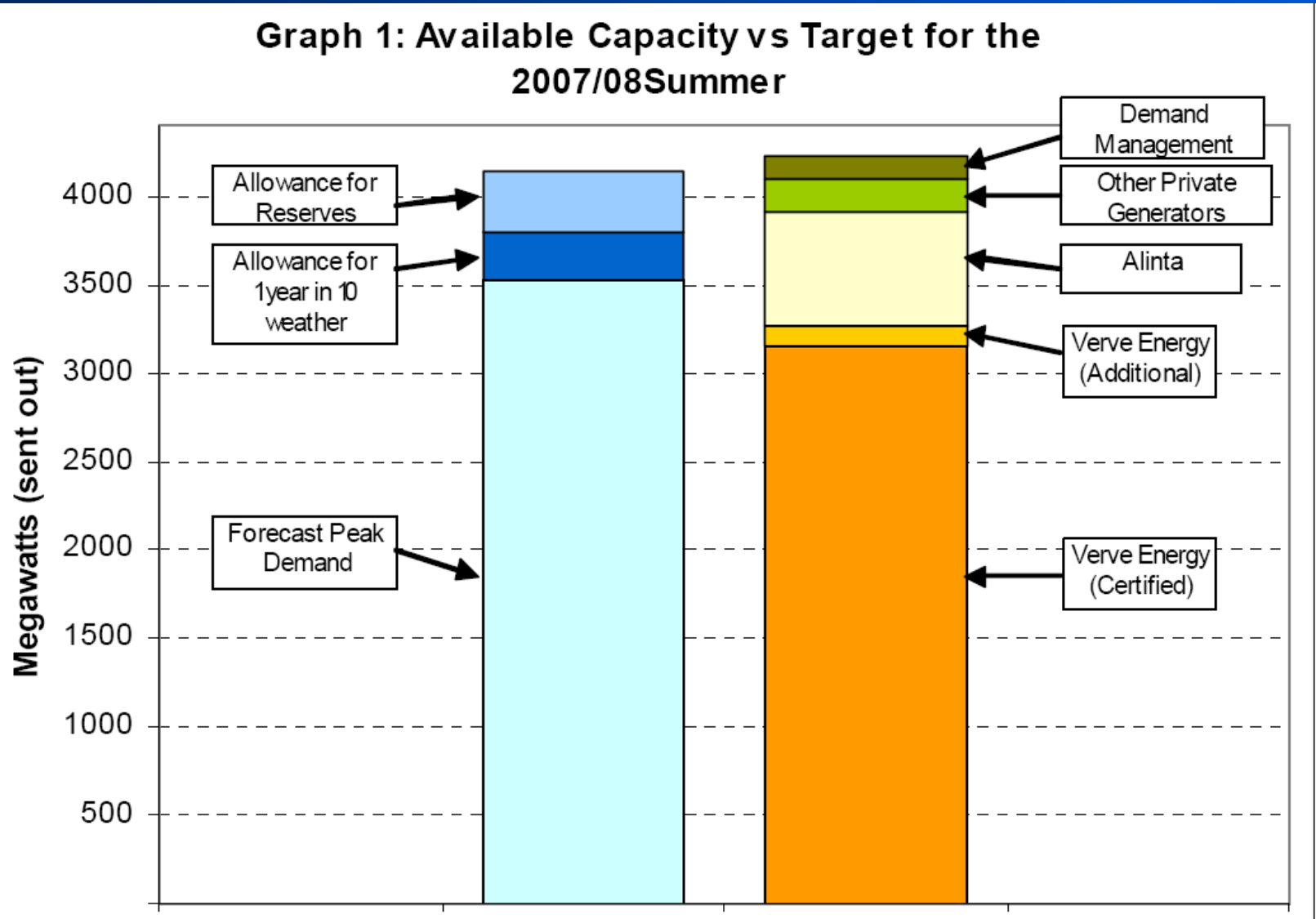
Western Power - distribution

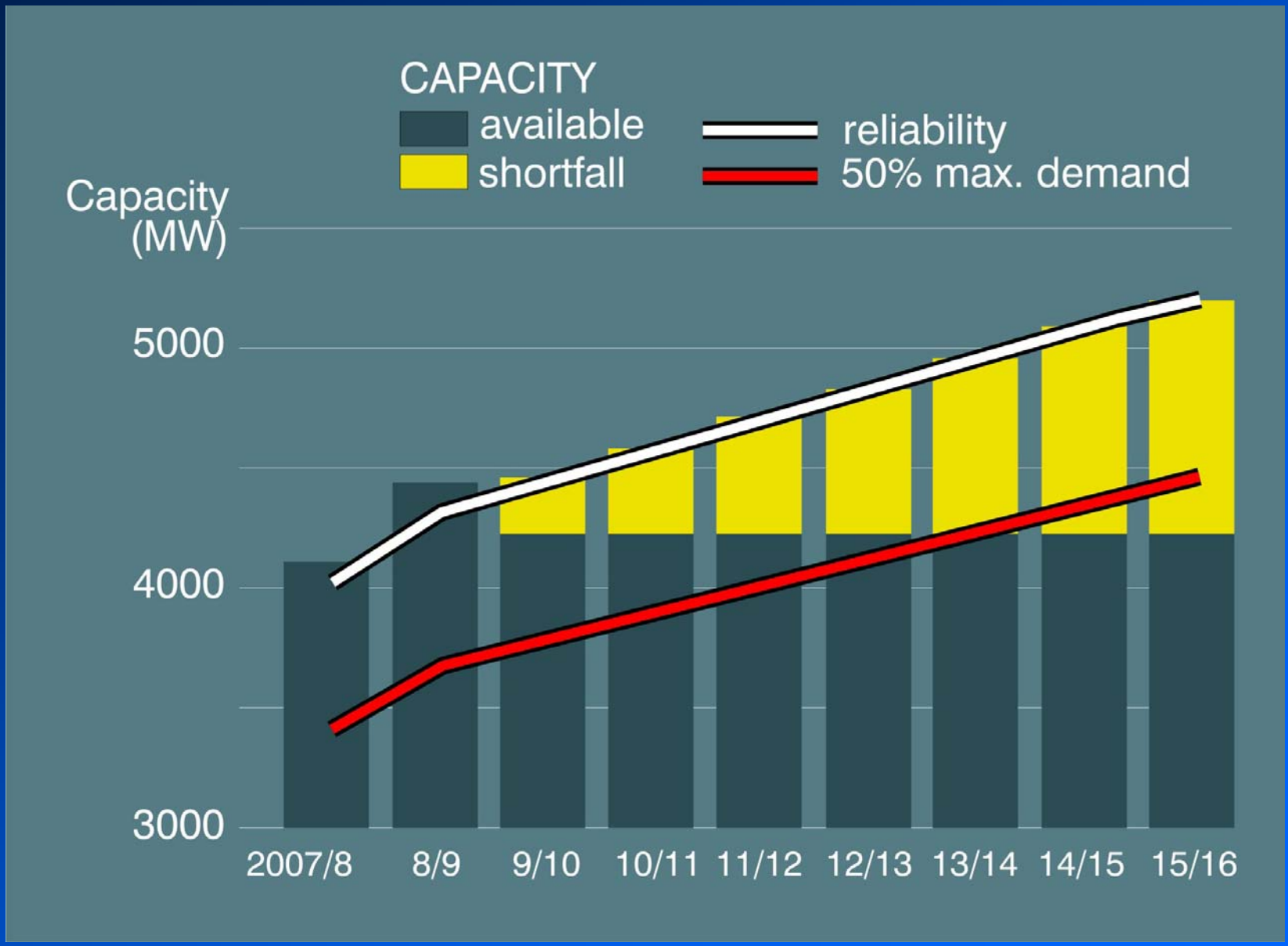
↓

Synergy - retail

Western Australia Generation by Source



SWIS Demand Growth to 2016

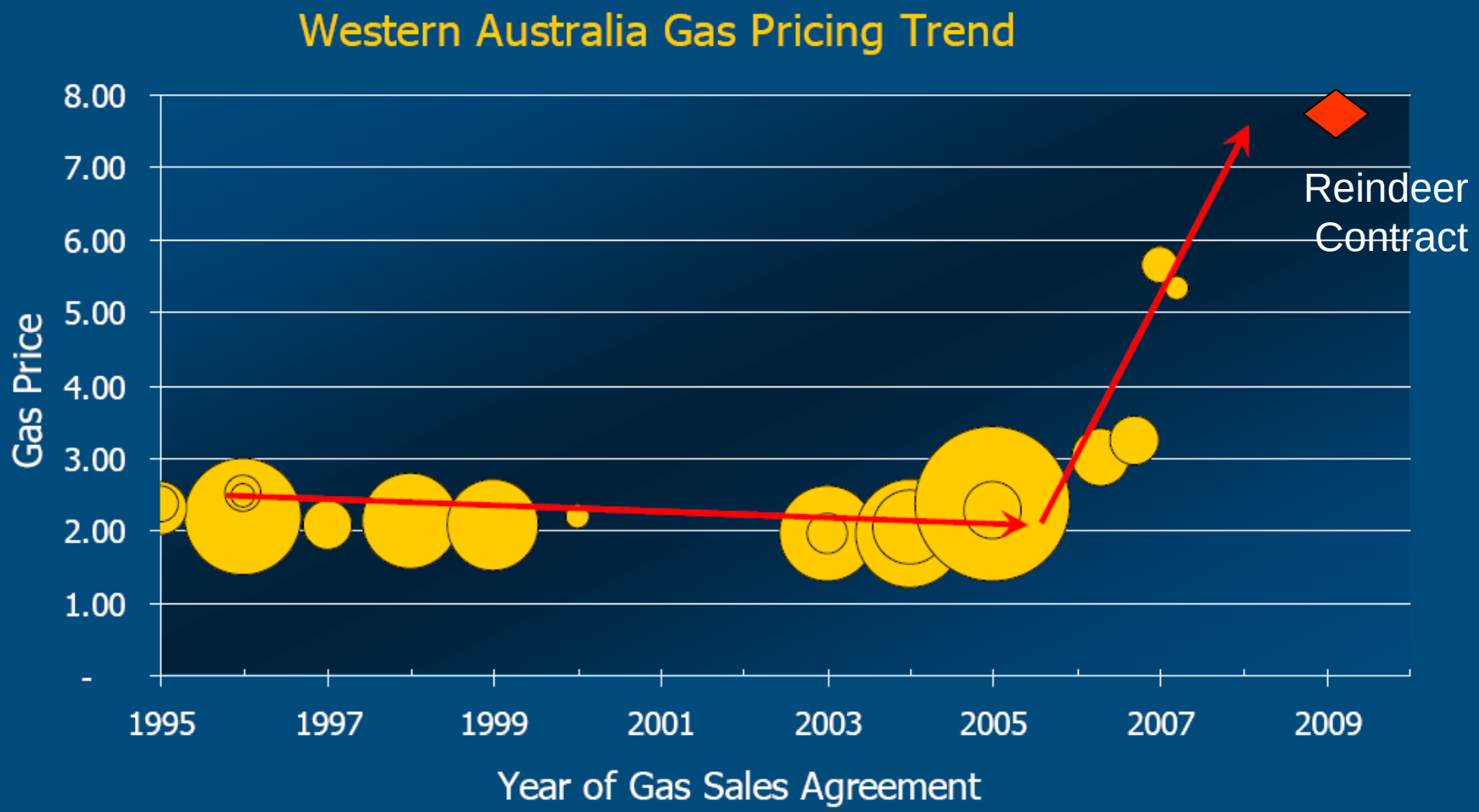


Demand growth is expected to average 120 MW per annum

The Gas Price Issue

- Gas has been cheap in WA for the last 20 years.
- Gas turbine power stations have been cheap to build.
- The long term, cheap gas contracts from the North West Shelf are running out in the next few years.
- The gas producers are using global warming as an excuse to foist high-priced gas on the people of WA.

Western Australian Experience



Step change in domestic gas prices realised notwithstanding huge reserves base

From Santos presentation June, 2007 – Reindeer contract added

The Reindeer Contract

- Supply from 2011 at $7.80 per gj.
- From 2014 the price is indexed to the oil price.
- One third of reserves are committed to Sino Iron, the rest can go into the domestic market.
- Sino Iron only got seven years of supply for a 25 year plus project.

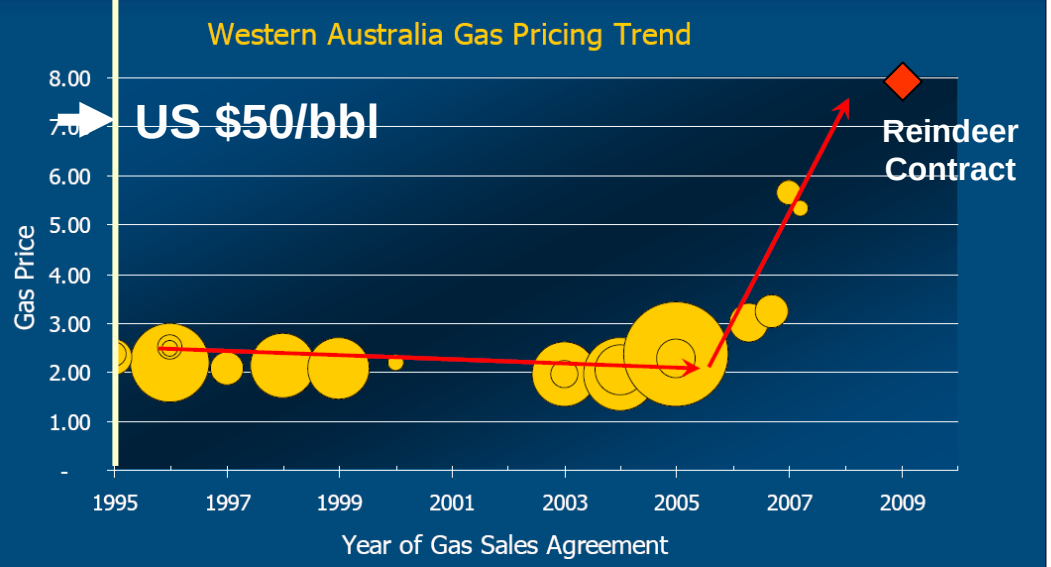
US $150/bbl

US $100/bbl

Likely mid-decade
Gas price
~ $20/gj

This price was achieved on an LNG contract in 2008.

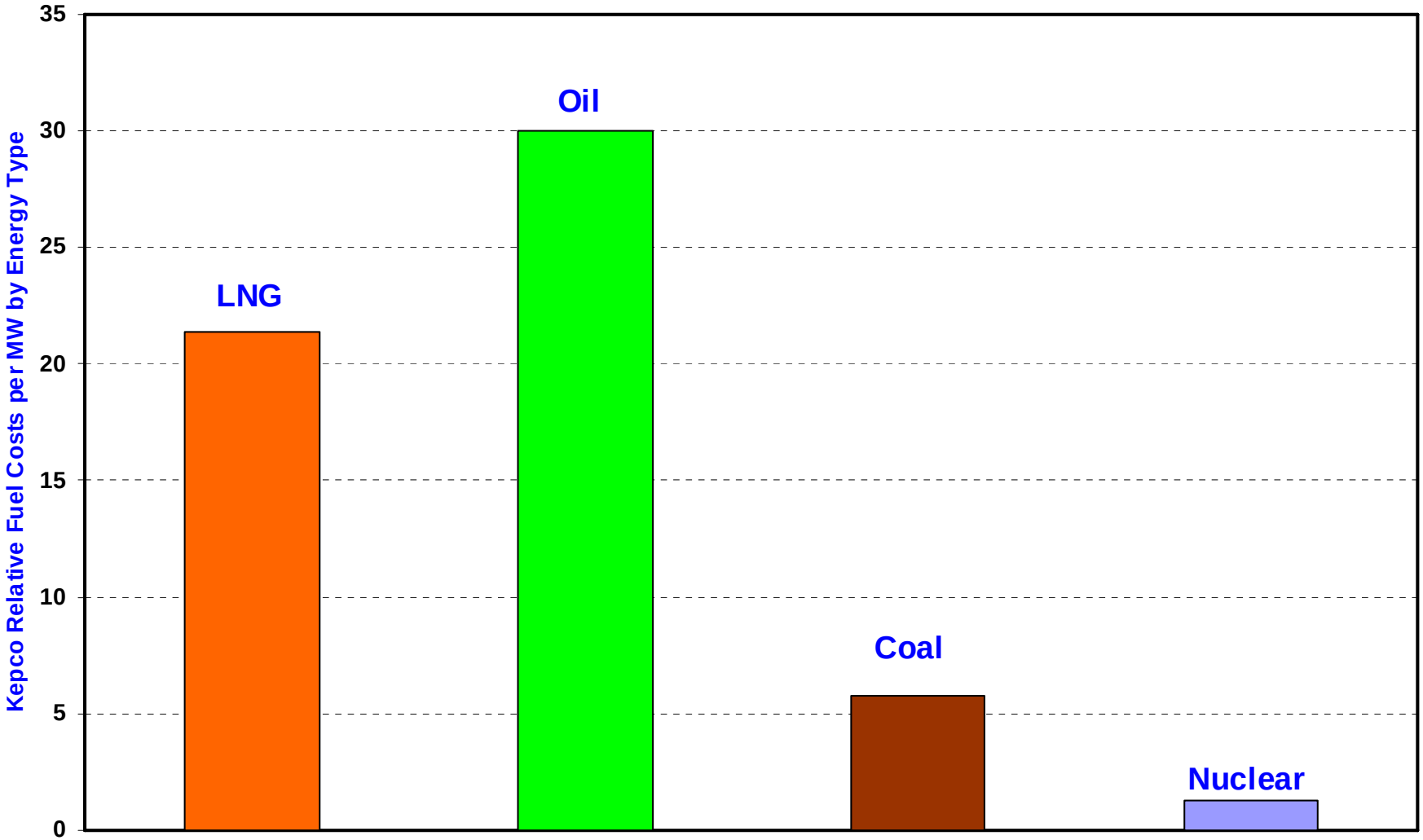
Western Australian Experience



Step change in domestic gas prices realised notwithstanding huge reserves base

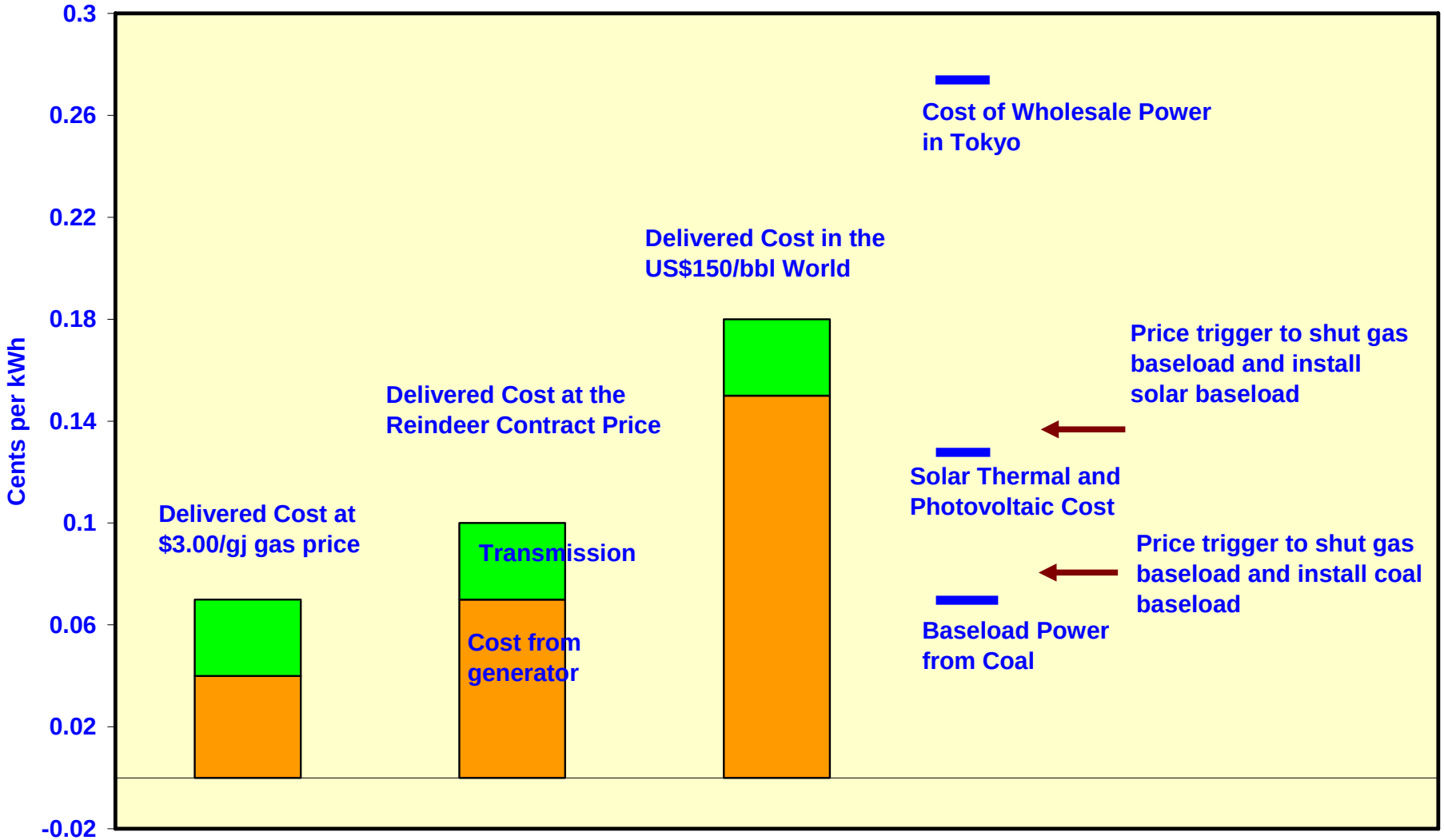
A future that should be avoided.

Korea Electric Power Corporation January to September 2008



LNG was 15% of production and 48% of fuel costs – 17x nuclear, 3x coal.

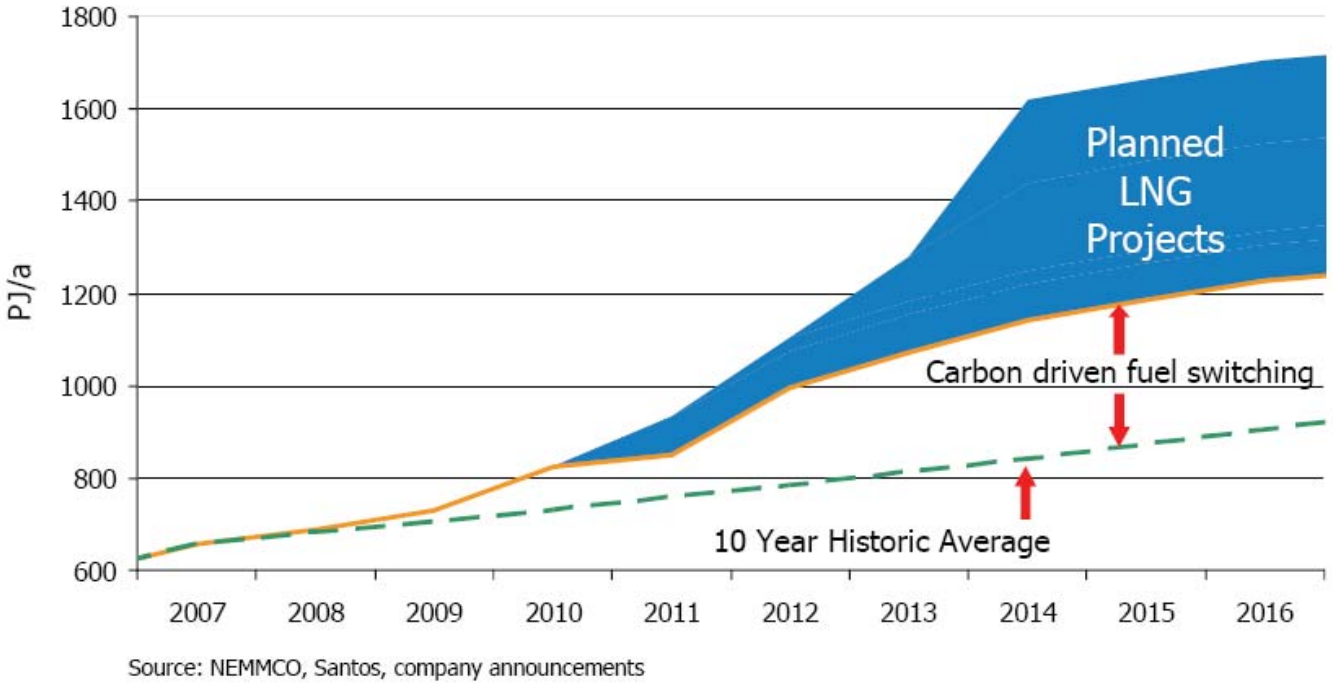
The global warming hoax is being used to triple the cost of WA's power to the Tokyo level.



Salivating at the prospect using the global warming scare to rip off east coast consumers too.

Demand for Eastern Australia gas

Demand will more than double within 10 years...



Source: NEMMCO, Santos, company announcements

...driven by government carbon policy and LNG export

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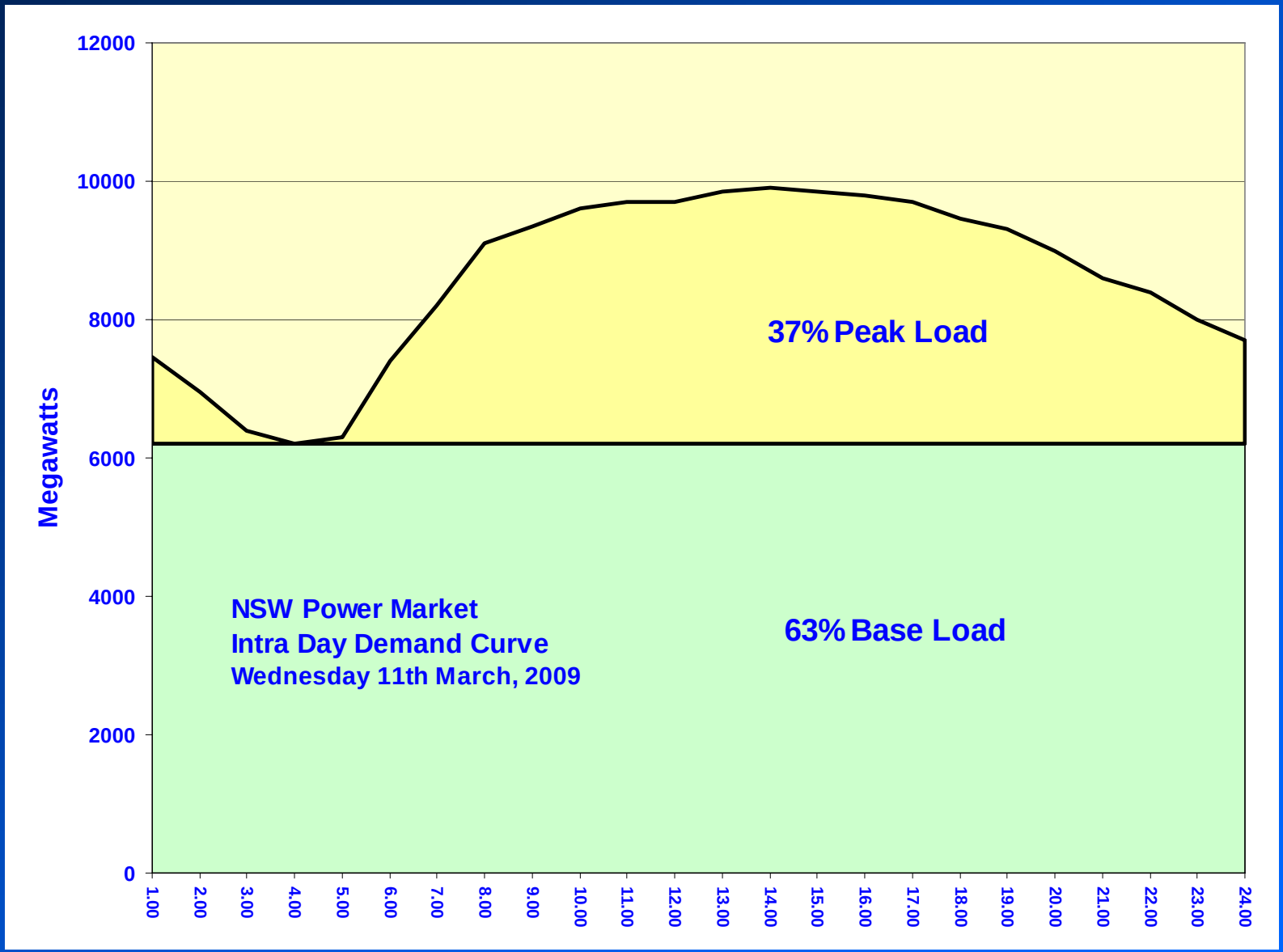
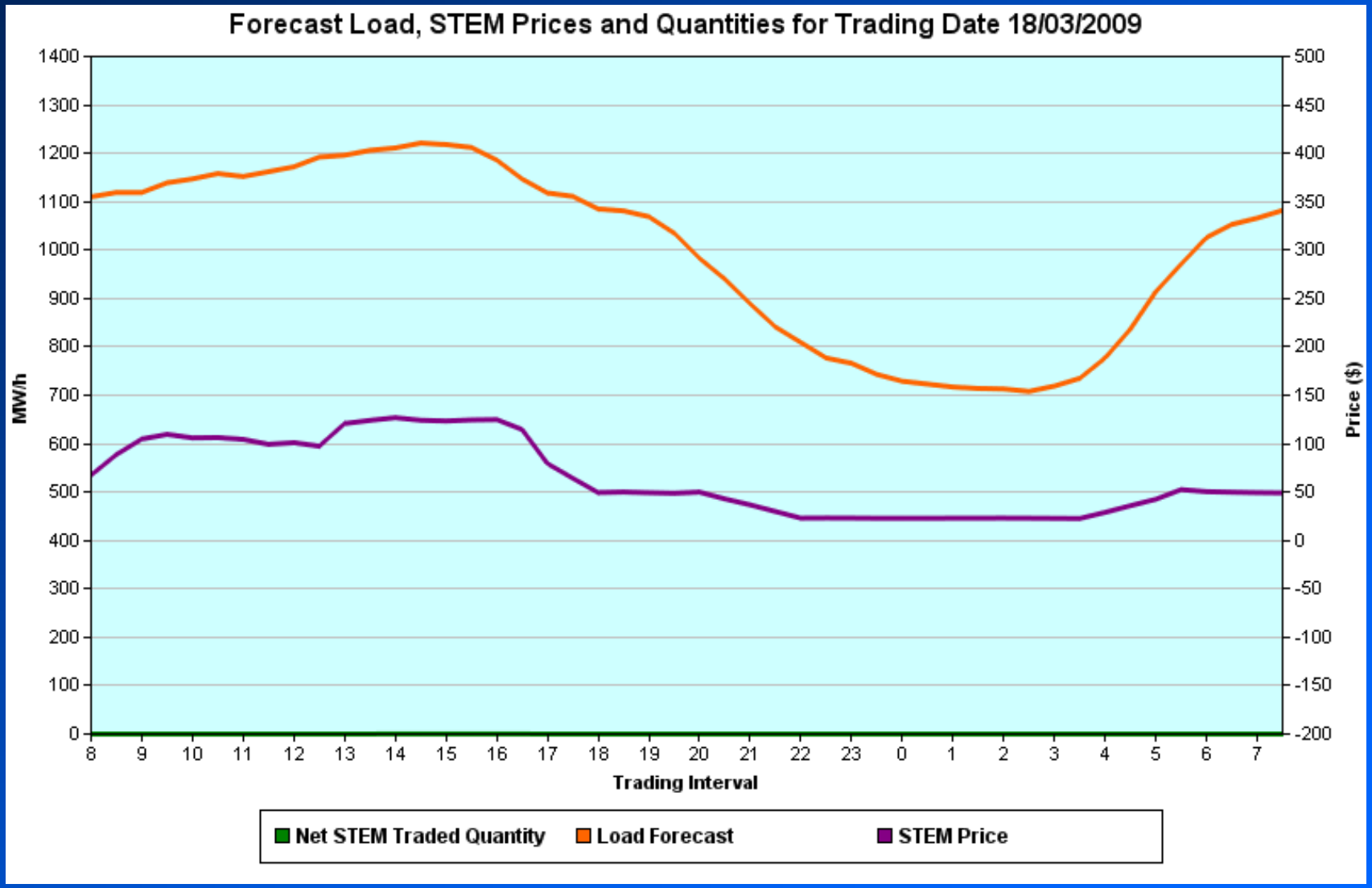
Santos

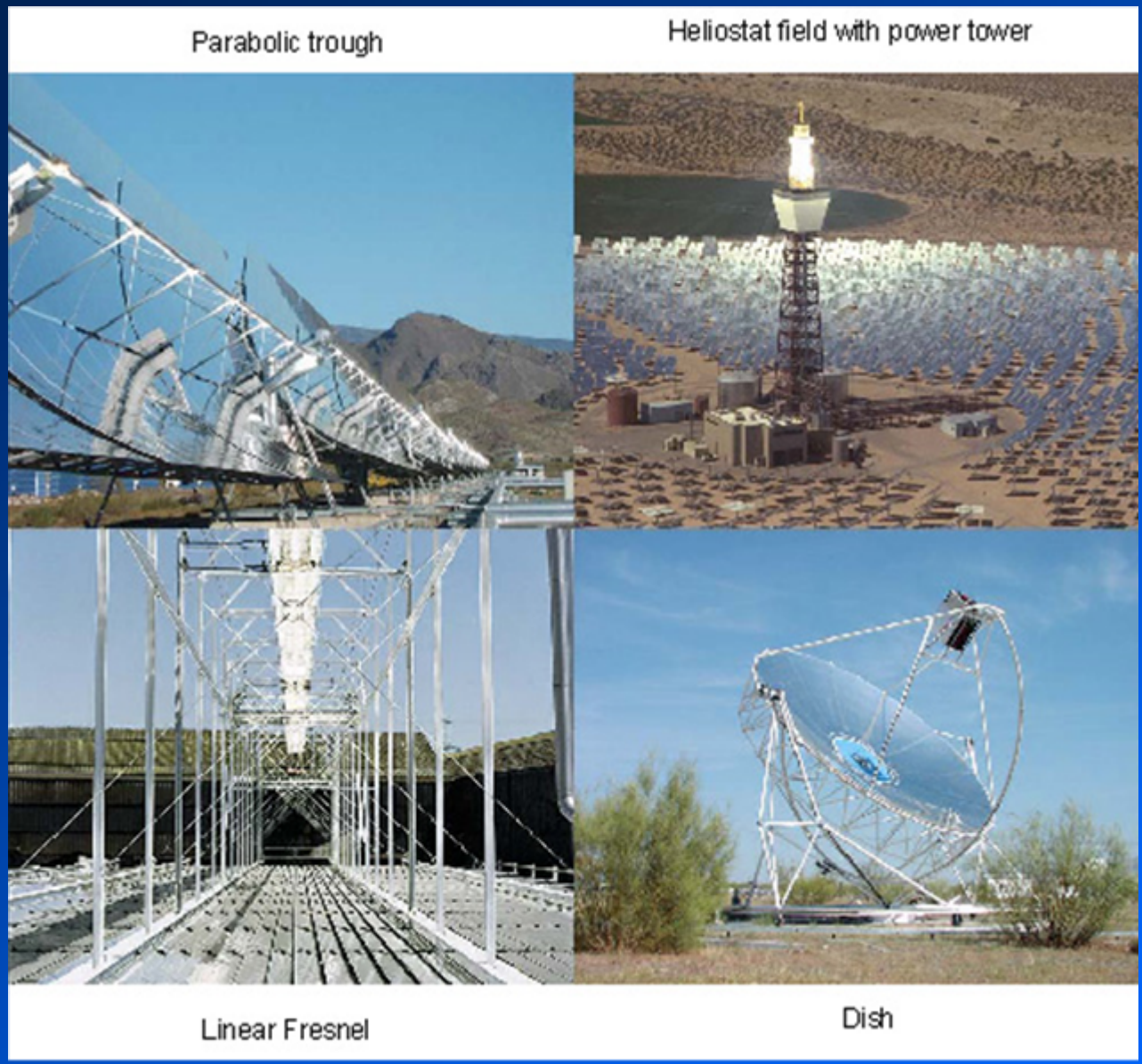
What a Peak Load Curve looks like



The SWIS System Load Demand and Price Curves



Types of Solar Thermal Power

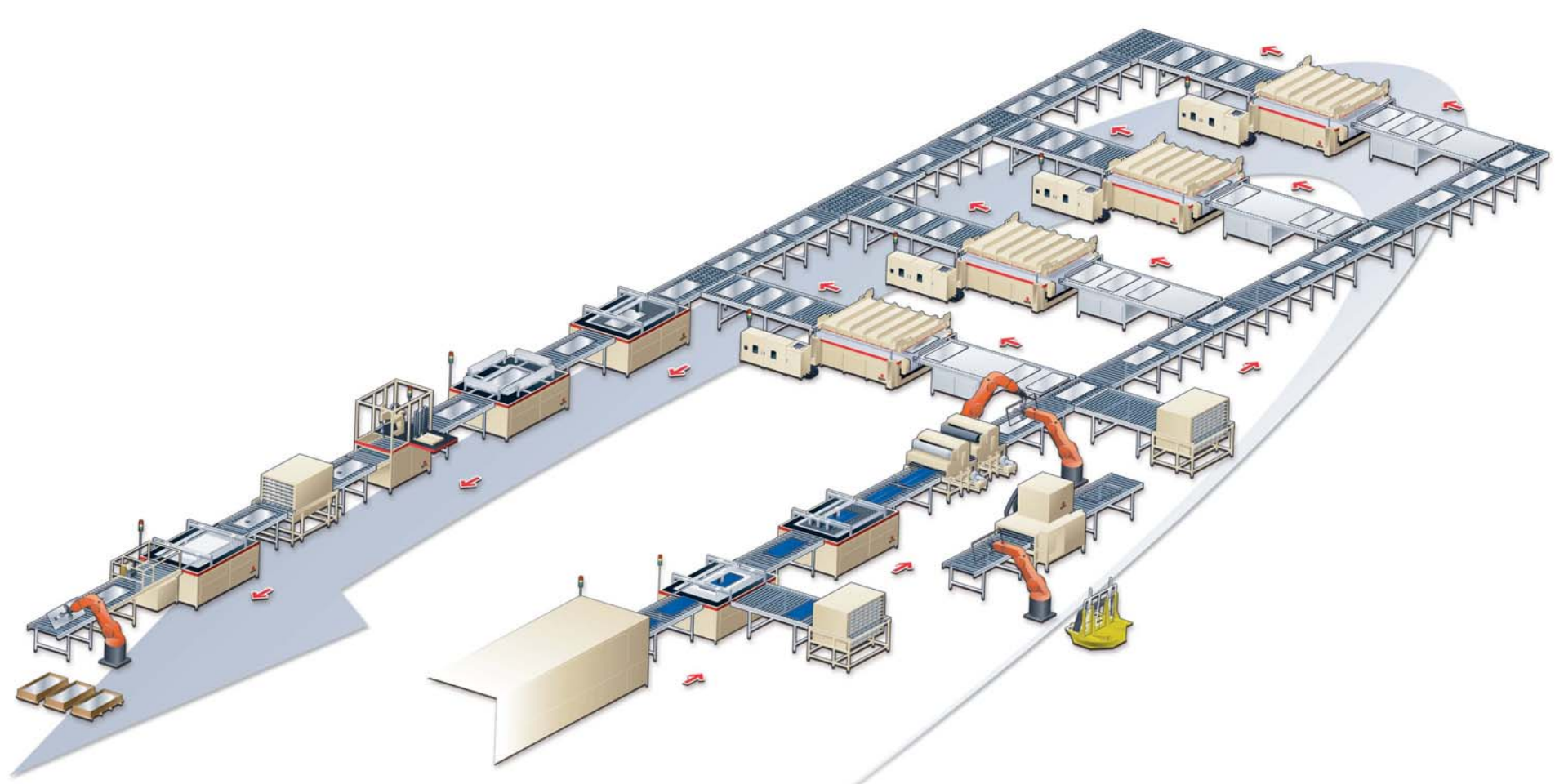


Power Tower has lowest capital and operating costs.

An off-the-shelf 30 MW per annum thin film photovoltaic production line

-Not much more complicated than a fruit packing line

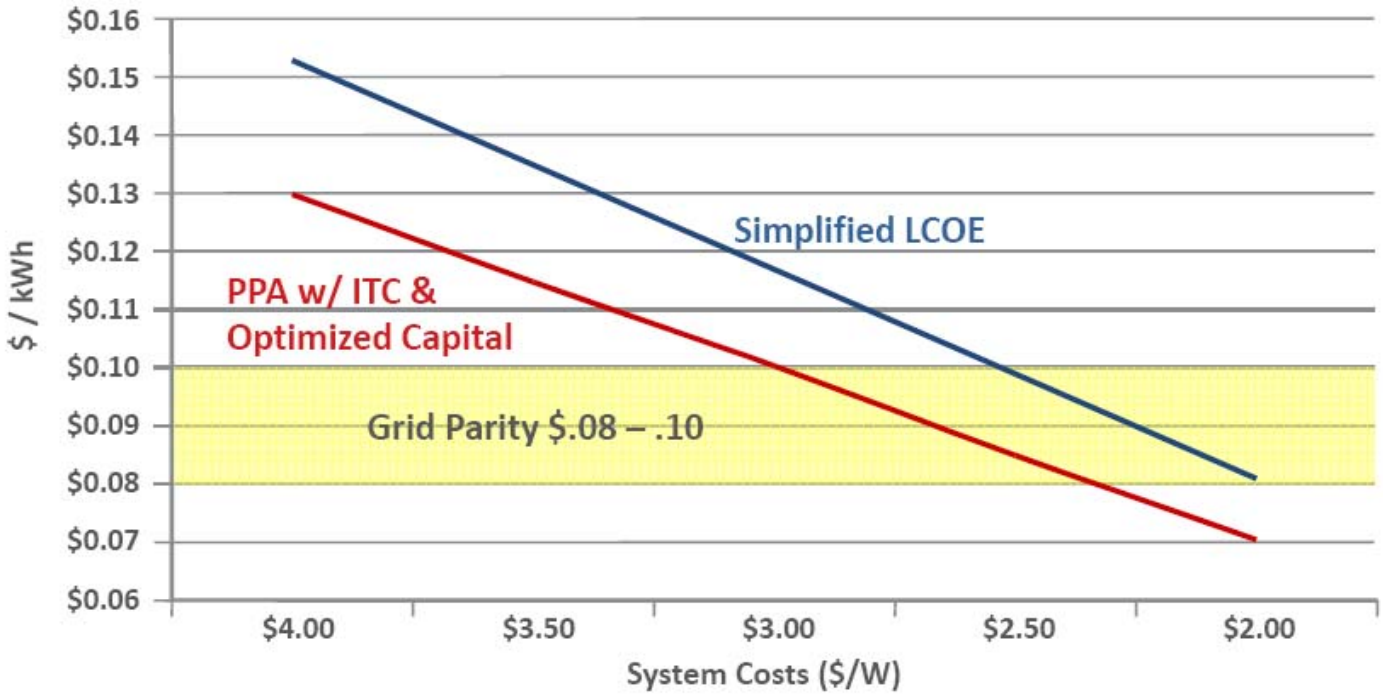
-4 of these would cover WA's 120 MW per annum growth requirement



A projection of grid parity at US$0.09/kWh within two years using thin film photovoltaic

Roadmap to Grid Parity 2010-2012

Levelized Cost of Electricity (LCOE)



Note: Electricity price and O&M costs adjusted for 2.5% inflation escalator, Assumes 1,750 kw/h irradiance

Wind power is idiotic.

- **Based on data from the wind farms in the SWIS, Western Power estimates that for current levels of almost 200 MW of wind capacity, around 60 MW of gas turbine capacity would be required for load following purposes.**

- **Load following is generally achieved by maintaining additional gas turbines in reserve to provide sufficient fast response capability to accommodate the positive and negative changes in wind generator production.**

- **Given the spasmodic operational requirements of the load following plant, it runs at very low efficiency and hence high cost, compared to more regular use.**

Carbon capture is idiotic.

Source	Projected Increase in Cost of Electricity from Addition of CCS
Duke Energy Indiana[10]	68%
MIT Future of Coal Report[11]	61%
Edison Electric Institute[12]	75%
National Energy Technology Laboratory[13]	81%

The cost of power would go up 80%
-putting a lot of people out of work
- we would burn through our coal reserves 80% faster.

Geothermal? Why bother?

- WA hotspots are remote from demand centres – large transmission build cost if nothing else.
- The hotspots are barely lukewarm at best.
- Solar thermal can get to temperatures of 400° (oil) to 550° (steam) with just mirrors.
- Turbines at these temperatures will be much more efficient than ones at 120°.

Photovoltaic required to power an air conditioning unit

- 1,500 watt air conditioning unit
- Operating at 10 hours per day
- 15 kWh
- PV modules rated at 75 watts with an area of 0.72 sq metres and 12% efficiency
- 7 watts per day per watt of rated capacity
- 29 modules required – 2,143 watts rated
- $2.50 per watt installed in a paddock
- $5,400 cost of PV system installed in a paddock or $11,000 installed on roof

Cost of PV for a home

- 6,000 kWh average annual consumption in Perth (Florida is 14,000 kWh)
- 16.4 kWh per day
- 23 sq metres of PV
- $6,000 greenfield capital cost
- $450,000 current median Perth house price
- 1.3% PV system cost as percentage of total house cost

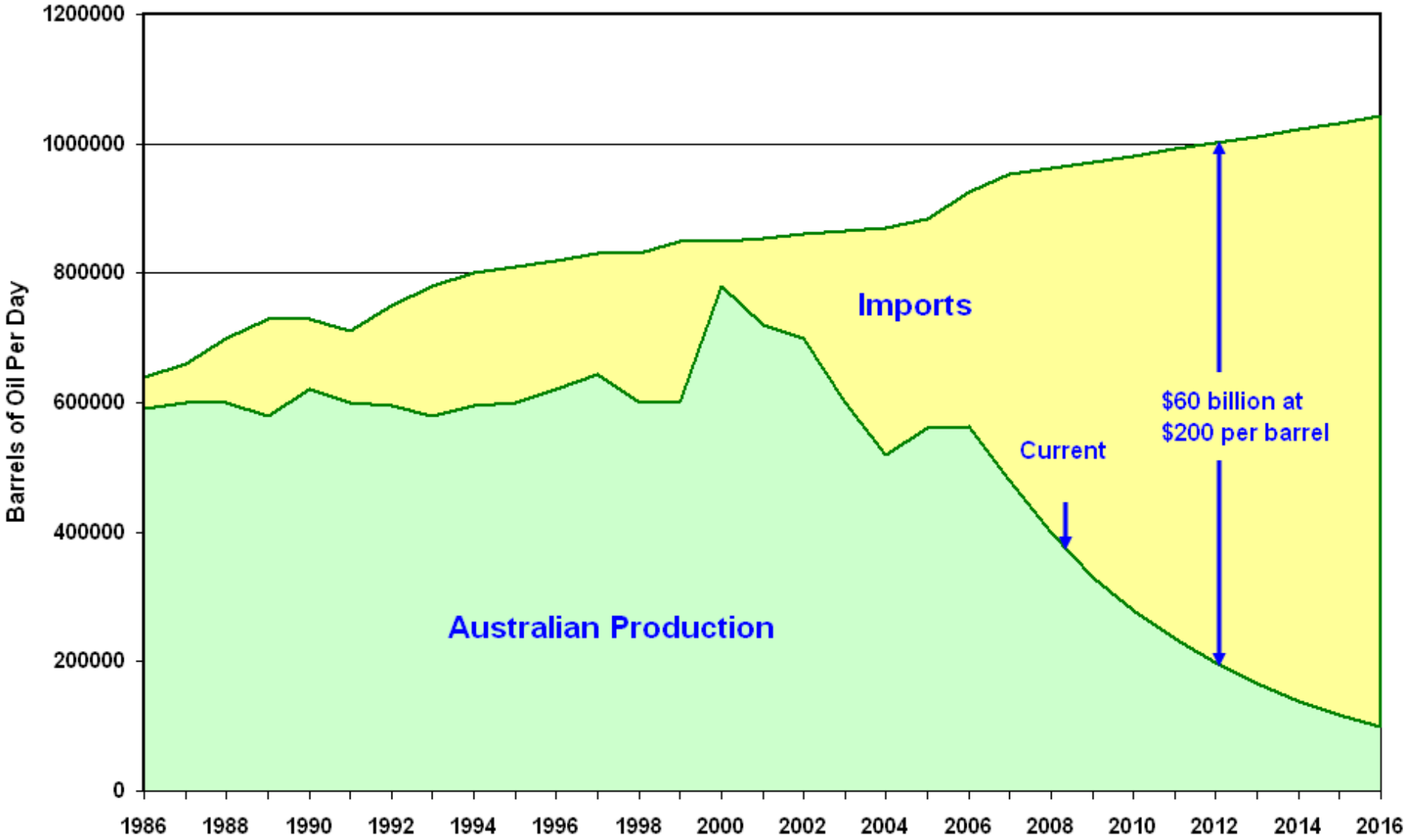
Potential optimum solution for Western Australia

- Increase coal base-load capacity with at least four separate generating companies.
- Plan to say goodbye to gas base-load generation.
- Install thin film photovoltaic for daily peak demand, beginning with the far ends of the distribution system i.e. Wheatbelt towns.
- Solar tower with hot oil storage for the demand shoulders.
- Some gas turbine capacity retained for backup.

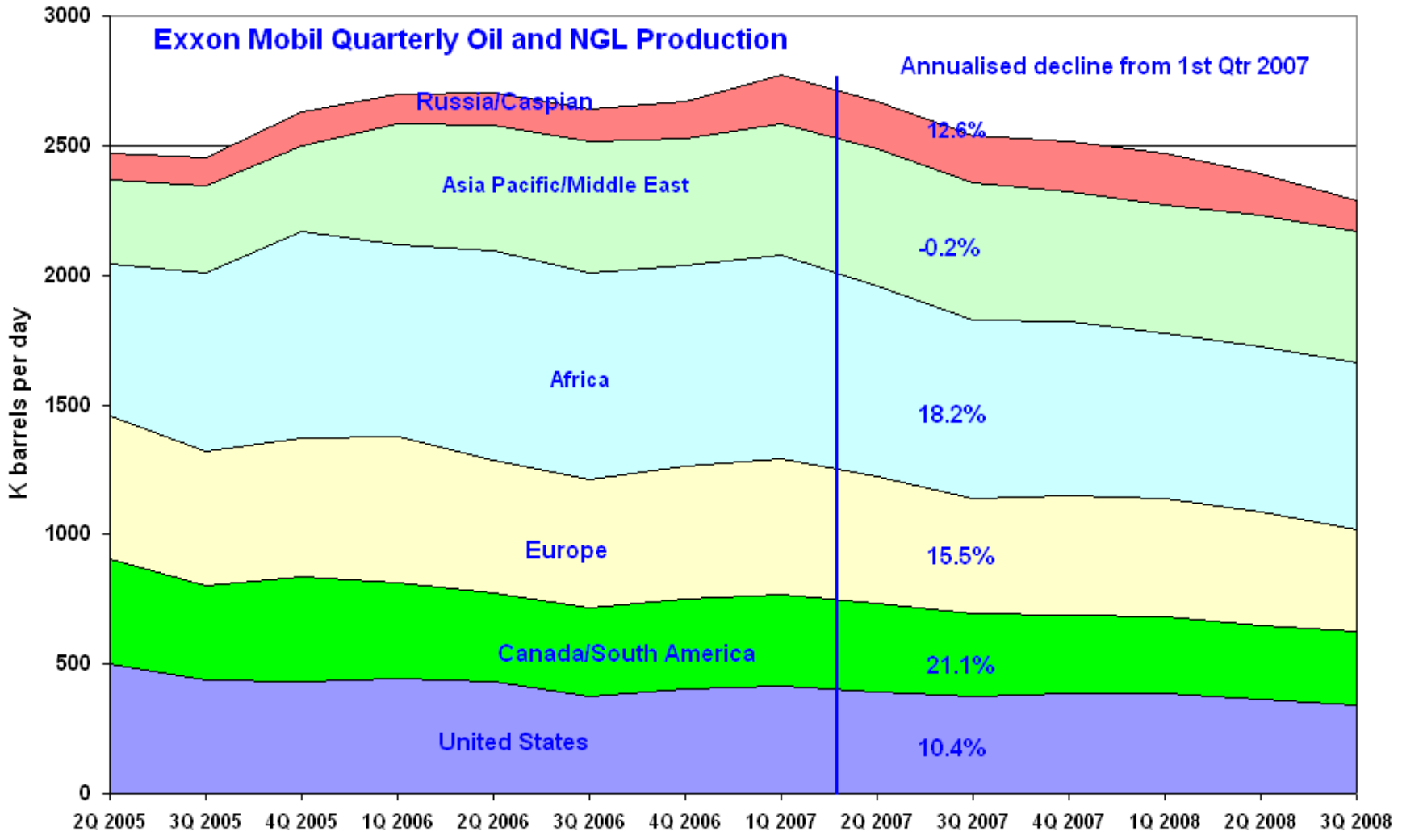
Timeframe

- **Steam turbines have a three year lead time to delivery.**
- **Decisions regarding power supply when the existing gas contracts run out mid-decade need to be made within the next two years.**

The Enormous Oil Trade Deficit Coming



Rapid Exxon Mobil Production Decline



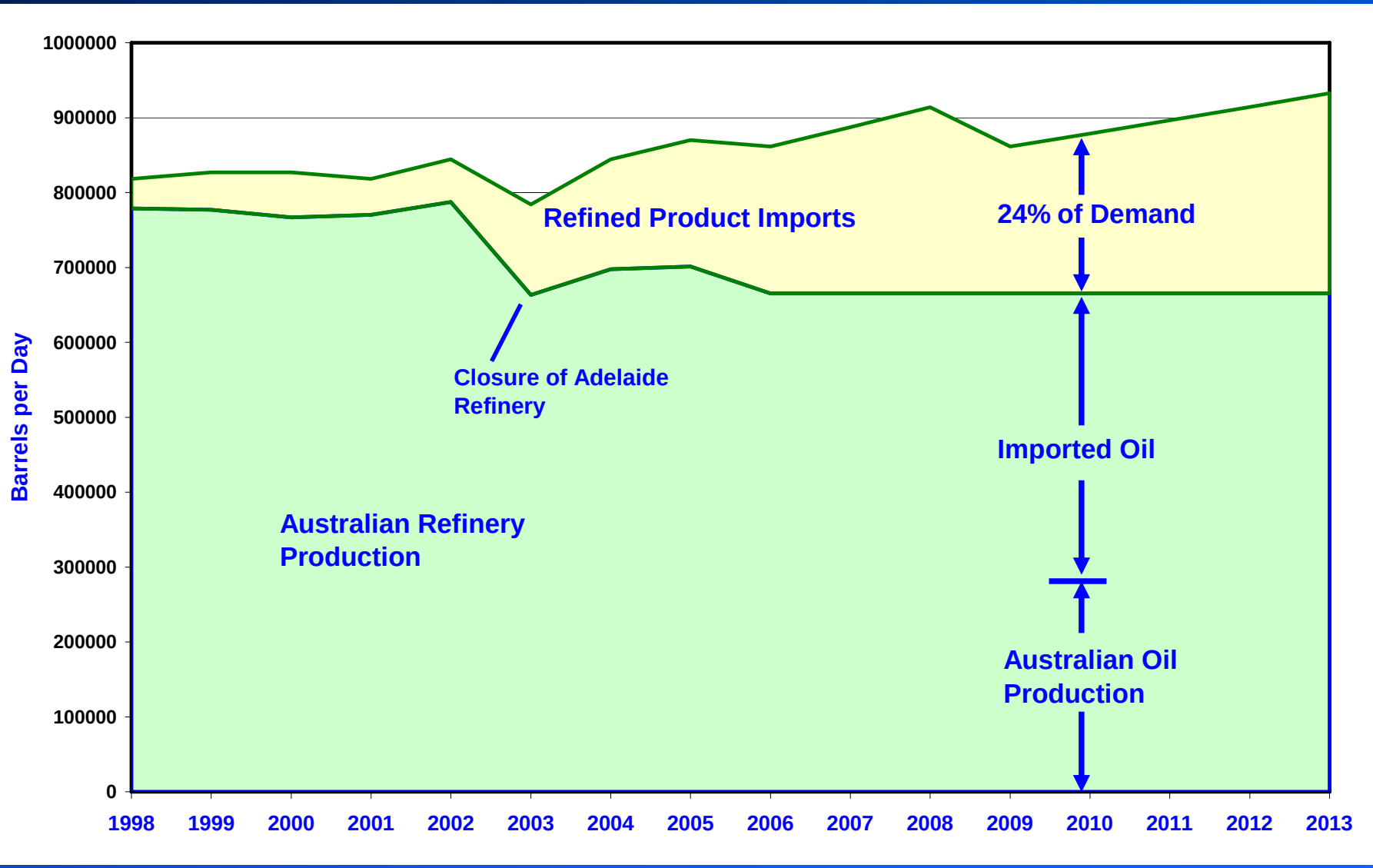
Production does not respond to price – the majors can't produce any more.

Twin Problems

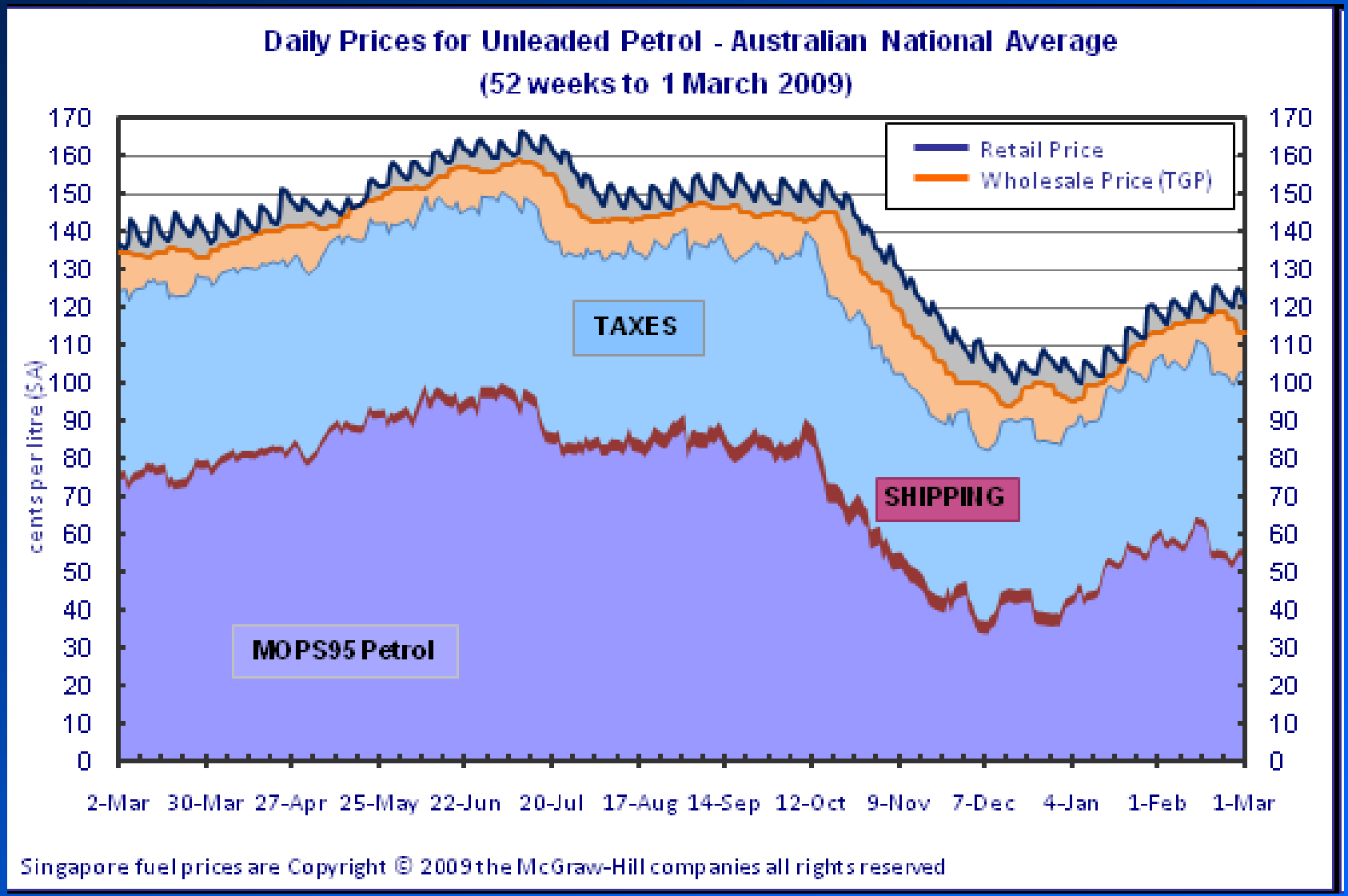
1. After four decades of being largely self sufficient in liquid fuels, Australia is now becoming highly exposed to potential supply disruption, with potentially catastrophic consequences for the economy and national security.

2. The trade deficit is going to balloon out.

A very rude awakening is coming for Australia.



Cost Makeup of Australian Petrol



Solution: Coal to Liquids

- **The breakeven price for CTL projects is about $50 per barrel.**

- **Modelling of a 50,000 bopd plant has the following results at US$100/bbl:**

Capital Cost:	**$4,200 million**
NPV at 10% discount rate:	**$8,850 million**
IRR:	**25%**

- **US$100/bbl is A$0.95 per litre pre taxes.**

CTL is no more expensive than deep water oil.

Coal to Liquids has operating costs and capital costs per barrel, over the life of the project, are similar to that of current deepwater oil and LNG projects around the world:

Country	Project	Project Type	Startup	Capex $ billion	Recoverable m bbls	Capex/ boe
Canada	Fort Hills Project	Tar sands	2011	$30.2	4,700	$6.40
Angola	Pazflor	Deepwater oil	2011	$9.4	750	$12.50
Norway	Snohvit Area	Deepwater LNG	2007	$9.1	1,302	$7.00
Nigeria	OPL 222	Deepwater Oil	2011	$5.4	620	$8.70
US	Wyoming CTL	50,000 bopd CTL	2013	$4.20	665	$6.32

The Virtues of Coal to Liquids

1. CTL will make Australia impervious to oil supply disruptions.

2. CTL will stop an enormous blow out in the trade deficit.

3. The capital cost per annual barrel of capacity at about A$300/barrel will be less than twice the oil price.

4. Backing out 800,000 BOPD of imports by 2012 at US$200/barrel will result in $17 billion of company tax being paid.

Binary Outcome

Either:

Australia continues as is with potential for enormous economic disruption from supply squeezes and a ballooning trade deficit.

Or:

Australia installs CTL capacity, insulates itself from supply disruptions and generates a large amount of company tax in the process.

Indonesian CTL Projects

- **Sasol has announced an intention to build an 80,000 BOPD CTL plant in Indonesia using lignite.**
- **Ultimately they expect to produce 1,000,000 barrels per day.**
- **At that level, they would produce 20 times as much CO2 as the Latrobe Valley power stations.**
- **Why is Australia denying itself liquid fuel supply security when our neighbours are going hell for leather?**

West Australian CTL Potential

- **We have billions of tonnes of lignite in a belt stretching from Esperance to northeast of Kalgoorlie.**
- **The Kalgoorlie region burns 15,000 barrels per day of diesel – an ideal starter size for the technology.**
- **Distributed diesel production would contribute to fuel supply security.**

Convergence through plug-in hybrid

- GM Volt will have a lithium ion battery giving 64 km range
- Also a 1.4 litre petrol engine with 53 kW generator – no mechanical connection to the wheels
- 111 kW (150 hp) electric motor
- 100 litre battery volume, 170 kg weight – will drop with ongoing battery development
- Top speed of 190 kmph
- 45 litre fuel tank
- 3 hour charge time at 240 volt
- The battery will lose 25% of its storage potential over 10 years
- Financially attractive at $1.25 per litre
- Reduce petrol consumption 90% on a typical driving pattern

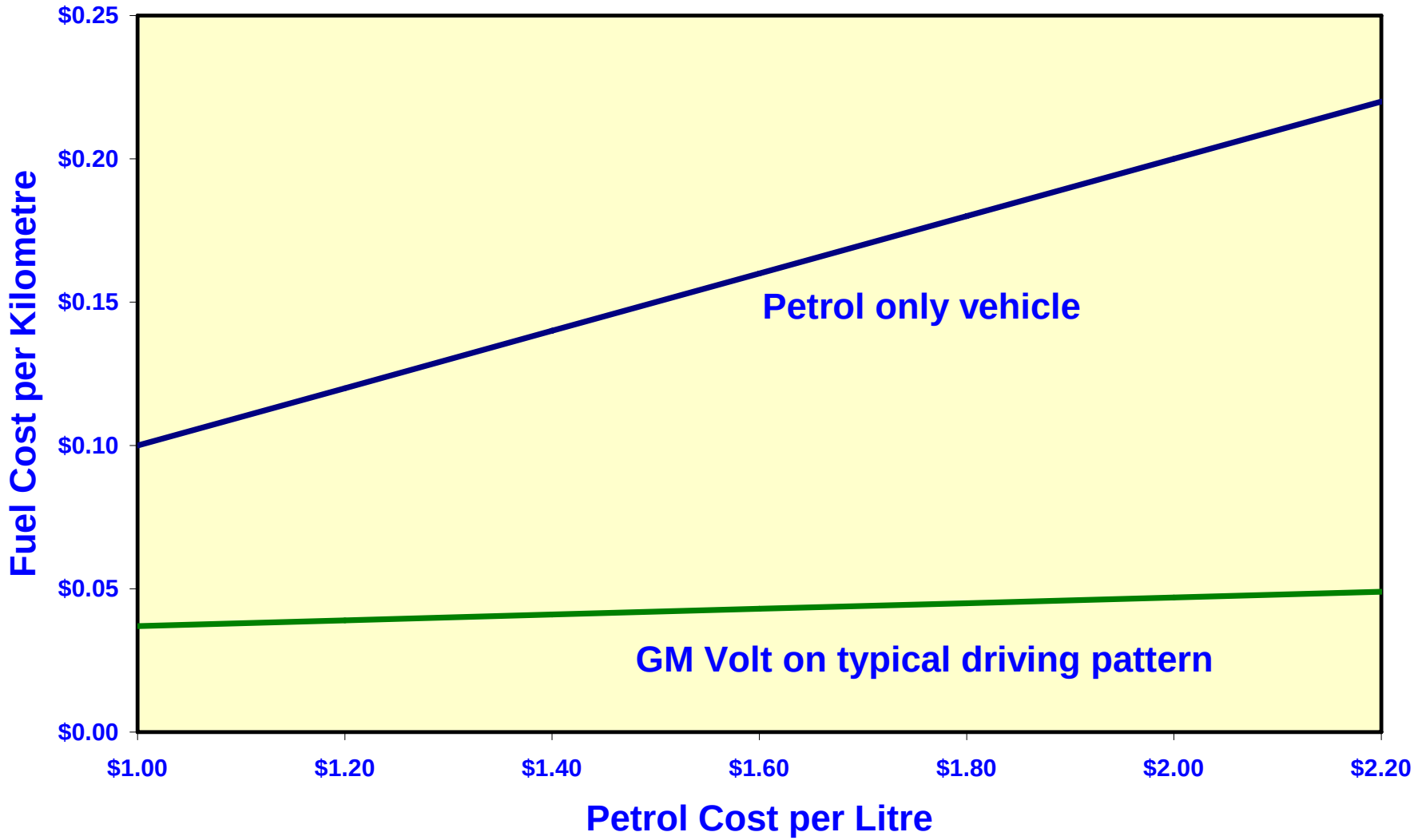
Photograph of GM Volt

When high oil prices return, the electric car drivers will be the only ones accelerating hard and enjoying themselves.

Comparative Costs

- At $0.20 per kWh, electric motoring will cost $0.03 per km as opposed to $0.12 per km with $1.20 petrol
- 20,000 km per annum equates to 8.0 kWh per day
- Recharging a car doing 55 km per day will be about half the cost of running an air conditioner for 10 hours per day
- A photovoltaic system to provide the charge would cost $3,000 – approximately 10% of the vehicle cost
- Half a million vehicles would require another 500 MW of generating capacity

Per Kilometre Comparative Fuel Cost



Summary

- Gas will get priced out of the power market.
- WA should build more coal base-load power and introduce solar peaking.
- Decisions need to be made in the next two years to avoid high power costs next decade.
- The carbon tax needs to be abandoned so that we can install CTL capacity.
- Lithium batteries combined with CTL fuels promise an eternity of low cost motoring.