

Energy Security; a must to have!



Can we really re-achieve this position, with our financial,
societal and personal stress levels intact?

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AEMO's (The Australian Energy Market Operator) **CHALLENGE** in a Few Words Cobbled Together by Oz Editor 24/07/24

'The challenges posed by intermittent wind and solar for electricity generation have been reconfirmed by the AEMO, but climate extremists still seem unable to grasp the message'.

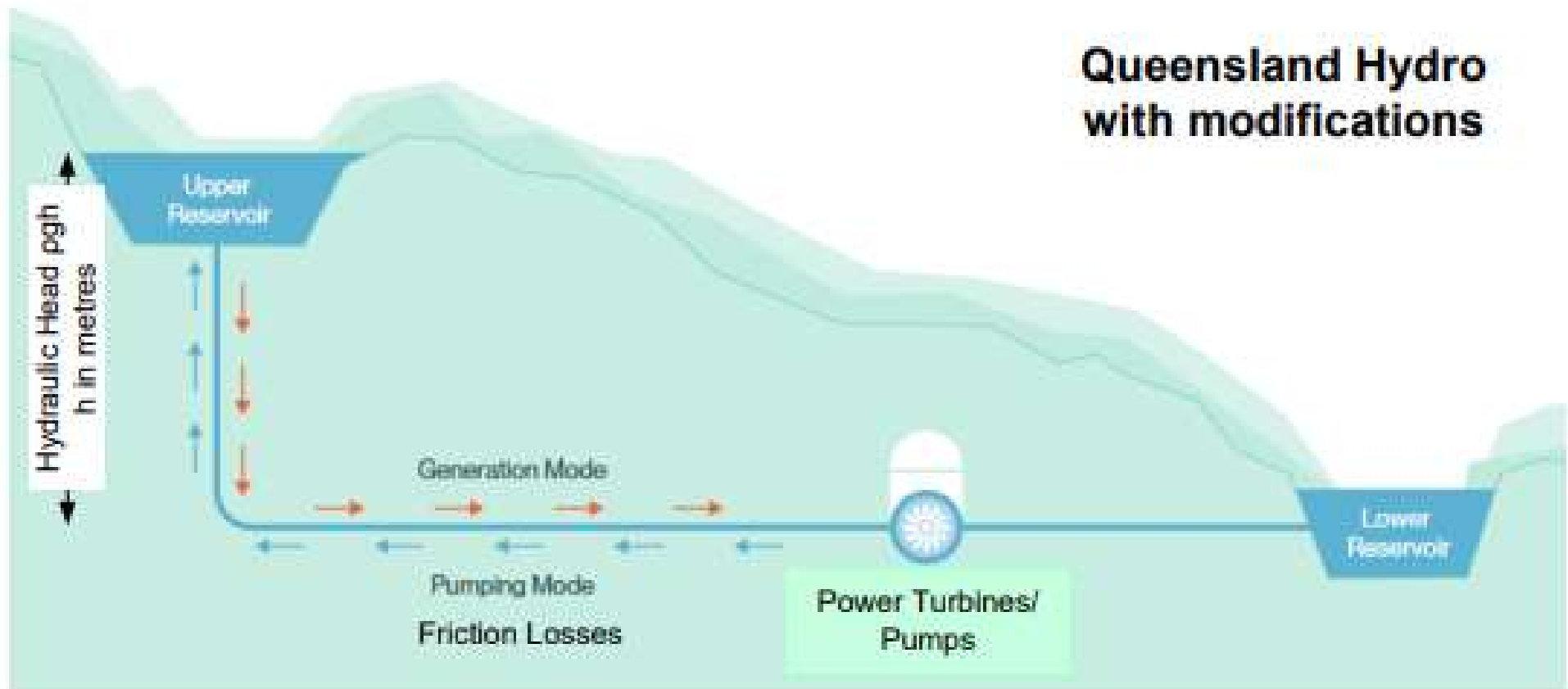
'In a welcome statement, AEMO said what has always been obvious: flexible gas-powered generation is "the ultimate backstop for the national electricity market during periods of reduced renewable generation" '.

So, is it a fact that the Government is trying to **lead** Australians off gas and with little **competence** to go with more renewables as the saviour to the pending energy crisis?



Johannes Leak, The Australian

Pumped Hydro; a real option for a renewable future?



Kidston: 250 MWe, max generation head 223m, min generation head 167m, claimed efficiency 80%
Snowy 2: 2000 MWe, 680m (static head difference), Tantangara upper dam – Talbingo lower dam ⁴

NEWS: Pioneer-Burdekin Pumped-Hydro Scheme for the **Axe** (if the LNP wins) ABC News 13 & 14 June 2024

- Announced 5,000 MW Pumped Hydro, by Premier Palaszczuk 2022;
- Costed at \$12bn, and coupled with 2000 MW Borumba Dam P-H.
- Deputy Premier Cameron Dick, “Without pumped hydro, the whole architecture of renewable energy collapses — that's the bottom line for David Crisafulli”,
- Part of the Energy Hub scheme of Palaszczuk/Mills govts,
- The LNP to Axe Burdekin P-H and may axe Borumba Dam P-H,
‘IF ELECTED’.

Pumped Hydro; Good or Bad for tropical Qld?

- Pumped-Hydro features _ Ref: Pumped Hydro Australia
- >80% max efficiency (*but can be a lot lower - MC*), ENERGY LOSSES (water losses),
- DROUGHT, EVAPORATION, DAM LEAKAGE, THEFT, water rejection and disposal because of contamination (*e.g. the dissolution of sulphides and other minerals in pit-bottoms and tailings*), organic sludge buildup,
- *The increase of the mass (and loss of efficiency) of the turbines by the deposition of bacterial detritus – Tasmania Hydro, (any others?),* and
- Gradual deposition of dust and mud through factors climatic in and around the reservoirs (some reservoirs are major methane sources), also
- Environmental & social (cultural) opposition and most importantly the loss of arable land.

Our Deputy Premier is Right

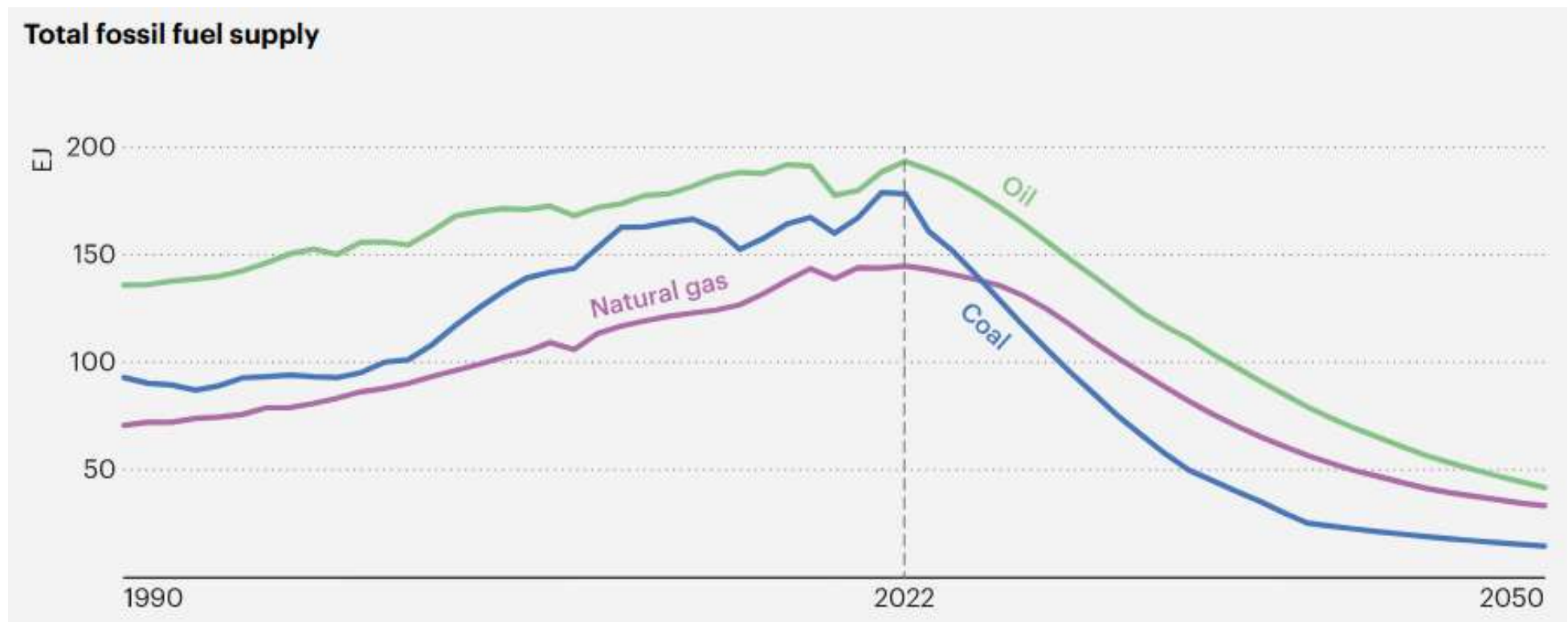
Deputy Premier Cameron Dick, “Without pumped hydro, the whole architecture of renewable energy collapses”.

So what do we have as alternatives?

Photovoltaic (PV) and batteries

Batteries are (and will be increasingly) useful in getting over short-term failures in the power grid, but will not support medium and long-term power demand!

Fossil Fuel Supply, where are we going? IEA



SCOPE of Energy Security Factors

A Review covering the depth of 'energy security factors' that must be addressed severally and as systems, to understand where Australia stands re ENERGY.

Some of the factors that must be considered to regain energy security:

- Raw energy sources resources, level of development, acceptance and costs,
- The processing of the raw energy sources into useable forms of energy, (remembering the 1st and 2nd Laws of Thermodynamics),
- The transport (and reticulation) and storage of such processed energy sources,
- The management of energy wastes from energy collection, processing, use (conversion) and residuals (e.g. ash, nitrogen oxides and waste heat), and

The cost of energy SHOULD be such that the local power and gas users (flick-the-switch or turn-the-tap users) are NOT afraid to turn them on. AMEO's Role?

Certainties, Beliefs and Energy

There is climate change (we started with a 'big-bang' and we will finish with another 'big-bang' or a wack by an oversize comet); they are a certainty,

GHGs are certainly a climate change factor, but are not the only factor (the World happily chuffs through massive climate cycles thanks to the sun, variations in our earth's orbit, and the moon/sun interaction re tides etc),

We do utilise fossil fuels (FFs). However, all FFs are finite energy resources. Even if we do use such fuels at the present rate, but we are not going to exhaust those fuels for a long time, and

Australia has a relatively small carbon footprint and therefore does not seriously jeopardise the world with its fossil fuel production and use.

Discussion Points – The ‘remaining Fossil Fuels’

- There is an awful lot of coal and carbonaceous shale,
- Condensate and gas shale resources are immense (e.g. Beetaloo), BUT
- On-shore, good quality liquid hydrocarbons are getting rarer,
- Off-shore, high quality natural gas resources are there, if more challenging,
- Methane Hydrates are plentiful but are very difficult to ‘mine’ under the sea.
- There is an ever-growing **URGENT** demand for bitumen for roads, and

Many gas resources offer RENEWABLES co-production scenarios, this being a useful Fossil Fuel extender under some circumstances.

Nuclear Power and Energy

- Nuclear Power generation could be plentiful, especially if the third nuclear cycle (U-233 from Thorium-232) is to be exploited,
- Nuclear Energy as heat will likely have limited direct uses in urban and industrial applications, including transport,
- **Nuclear energy can complement renewable power generation**, as the base-load source, including energy supply during diurnal, seasonal and climatic variations in renewables supply, and
- **Detlef Sulzer** has taken you through a detailed review of nuclear energy in a previous Mining Monday. Q. Are HWSMRs possible?
- Decay Heat Hazard, causing much of the Fukushima disaster.

Hydrogen and the Hydrogen Economy

To bring back of 'old memories', my great Hydrogen & the HE presentation:

<https://engineersaustralia.tandfonline.com/doi/full/10.1080/14488388.2022.2046325>

Can Hydrogen replace fossil fuels like Natural Gas (CNG, LNG) & LPG?-

NO

But HYDROGEN still has roles in ammonia and petroleum production, and possibly roles in metal smelting.

Hydrogen Net Zero Emissions (NZE) Guide

IEA Sept 2023

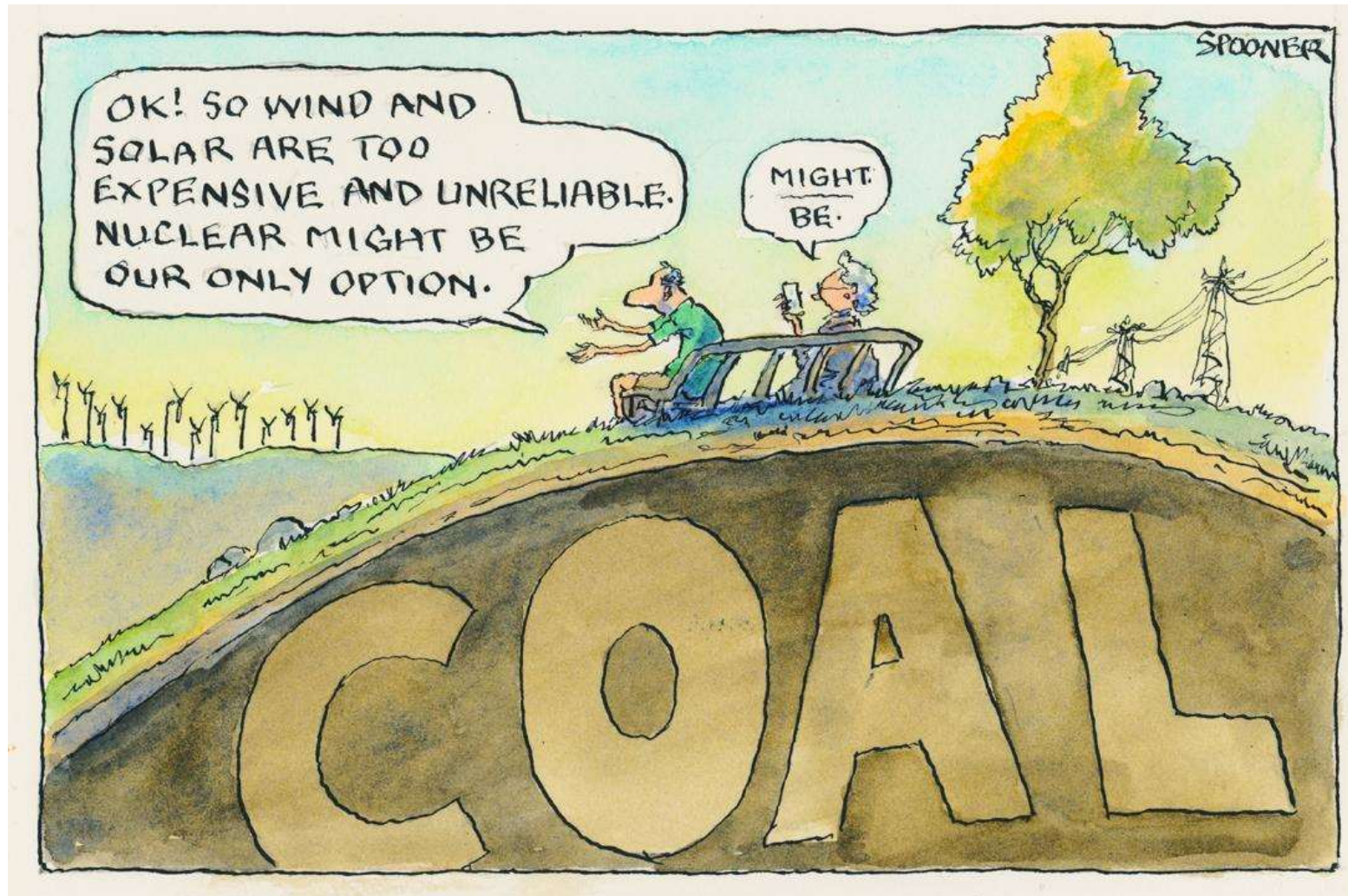
Milestones	2022	2030	2035	2050
Total hydrogen demand	95	150	215	430
Refining (Mt H ₂)	42	35	26	10
Industry (Mt H ₂)	53	71	92	139
Transport (Mt H ₂ -eq, including hydrogen-based fuels)	0	16	40	193
Power generation (Mt H ₂ -eq, including hydrogen-based fuels)	0	22	48	74
Other (Mt H ₂)	0	6	10	14
Share of total electricity generation	0%	1%	1%	1%
Low-emissions hydrogen production (Mt H₂)	1	70	150	420
From low-emissions electricity	0	51	116	327
From fossil fuels with CCUS	1	18	34	89
Cumulative installed electrolysis capacity (GW electric input)	1	590	1 340	3 300
Cumulative CO₂ storage for hydrogen production (Mt CO₂)	11	215	410	1 050
Hydrogen pipelines (km)	5 000	19 000	44 000	209 000
Underground hydrogen storage capacity (TWh)	0.5	70	240	1 200

Hydrogen Net Emissions Guide IEA 2022 Extract

Factor (World)	Unit	2022	2050
Hydrogen Pipelines	km	5000	209,000
Cumulative Installed Electrolysis	GW	1	3300
U/G Hydrogen Storage	TWh	0·5	1200
Share of Generation	%	0	1
Low Emissions H ₂ Production	Mt H ₂	0	327
Total H ₂ Demand	Mt H ₂	95	430

Meeting the motility energy demand – the continued role of liquid (and gaseous) gaseous fuels

- Greens demand for switching from gasoline, diesel, LFO, BFO, LPG, Av-gas, and methane (in its various forms, CNG - pipeline, CNG – in cylinders/bottles and importantly for the wellbeing of Australia, LNG), to promote **green electric power - EVs**, but
- On the grapevine: The reliability of EVs is not good, i.e. the availability of EVs is poor, the use of Lithium-ion batteries continues to be hazardous, and having the power grid as the source of energy is challenging an already over stretched power system, but
- Are there existing situations where EVs ‘shine’? Probably, in tightly populated regions with mature power grids with excess capacity.



John Spooner, The Australian

The Ongoing Life of COAL as a Fuel

- John Spooner has it partially right, coal as a source of carbon is not finished (there is plenty to mine), but the easy mine high quality coal is becoming harder to find,
- Lower quality coal is only used with an increase in emissions,
- Environmental concerns will make the using that lower grade coal problematical, and make the international coal flow difficult,
- Coal project developments now carry high political and economic risk; finding investors for fossil fuel development is tough, but
- So could coal be a source of high-grade carbon – possible?

MC's experience with 'demineralised-coal' in the 1980s: Coal to 'Oil'?

CARBON – an increasingly useful material

- Sources: Coal (lignite, torbanite, carbonaceous shale, oil-shale ..), but demineralised coal has not been a great success,
- From the cracking of methane; the hydrogen likely be useful, the carbon,
 - Carbon for specialist uses can be split from methane, with hydrogen being a useful second product,
$$\text{CH}_4(\text{g}) \rightarrow \text{C}_{(\text{s})} + 2\text{H}_2(\text{g}), \Delta H = 74.85 \text{ kJ/mol of CH}_4$$
 - Produced from laser or other high temperature cracking process, and
- Carbon will be needed for making steel (cementite Fe_3C – iron carbide) and Spheroidal Graphitic (SG) cast iron production. Even if the iron ore is smelted using hydrogen and carbon will be required, and
- Are there other advanced uses such as carbon fibres, Buckminster Balls? But advanced carbon products come from PAN (polyacrylonitrile), a complex organic material.

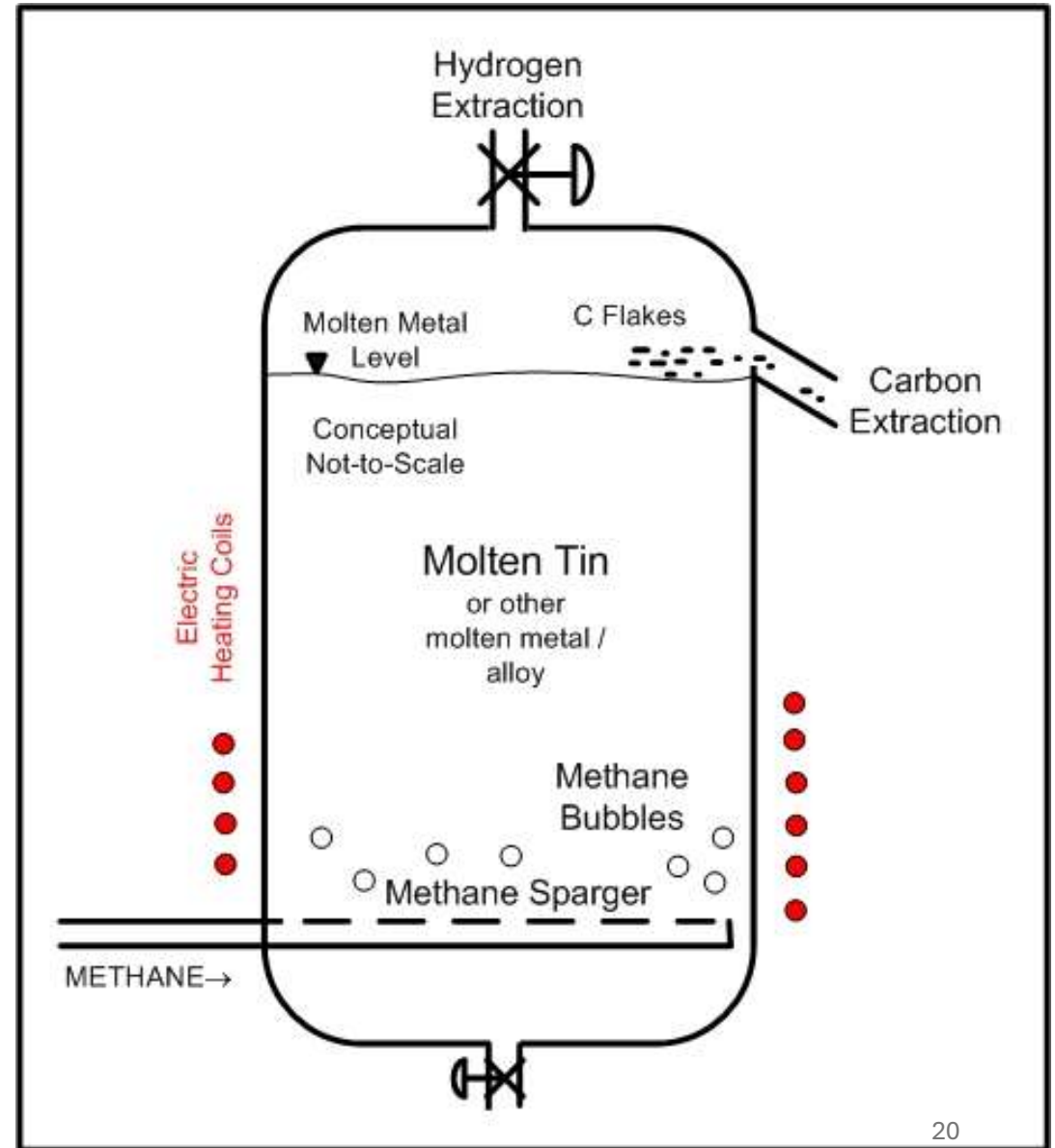
Explaining



A schematic indicating the main features of the methane cracker.

The process will likely be expensive in terms of fuel consumption however the value of the carbon product may meet the high fuel costs. This will depend on which allotrope of carbon is produced, its purity and value.

This is for the future, and will require RD&D.



How it works?

The concept is based on methane bubbling in a molten medium to produce hydrogen and solid carbon

- While methane bubbles are rising, they decompose under the high-temperature effect of the melt (Sn, Bi, Al, etc.),
- H₂ leaves as the effluent gas while carbon particles float at the melt surface, driven by buoyancy forces, so
- Consequently, reactor blockage due to carbon deposition on the reactor walls can be efficiently prevented.

Methane Cracking For Hydrogen Production, Malek Msheik et al, 2021, Energies
<https://hal.science/hal-03238224>

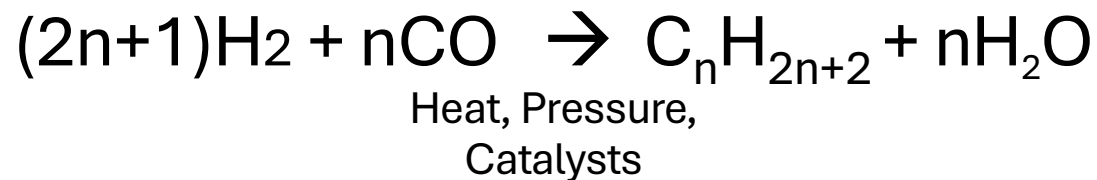
Energy for Power & Energy for Motility

- Power supply for motility, industry, commerce and meeting urban demand, are often competitive and sometimes complementary,
- Motility has been supported by the development of the petroleum industries but now some societies are looking for green energy complemented by new and extended electric power generation and reticulation – new and expanded GRIDS!
- An example of the change is the proposed development of motility based on EVs (cars first, utility vehicles) that are fed electric energy through the transmission and reticulation grids, grids that are stressed already in Australia,
- DISCUSSION ANYONE?

Recreating the Australian Petroleum Industry using unconventional feedstocks

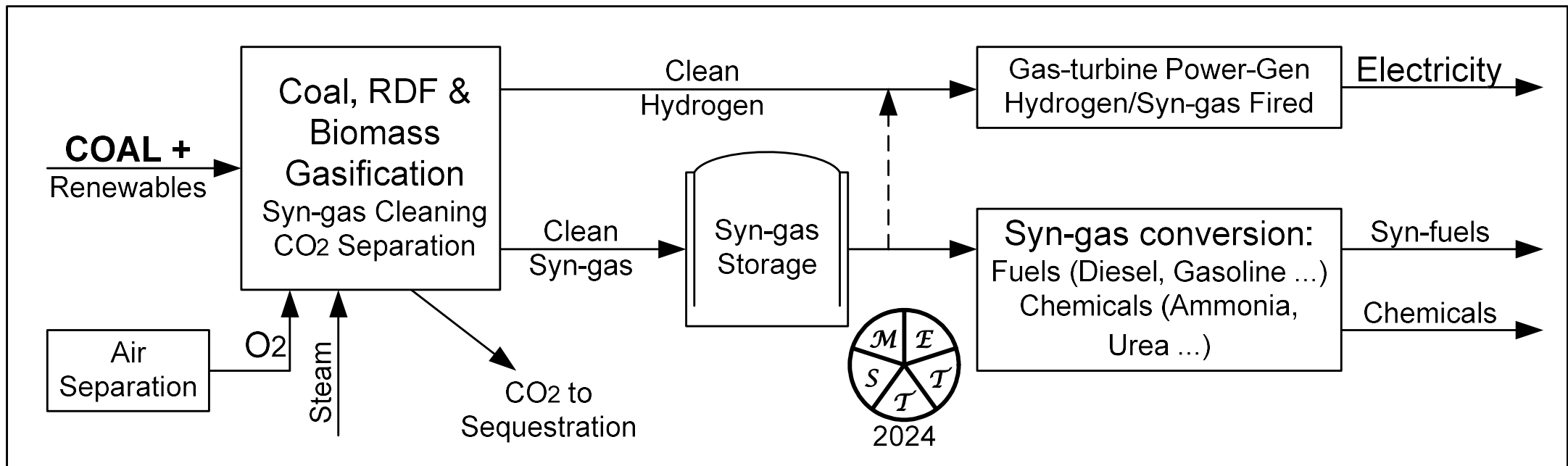
Replacing traditional DIESEL, LFO, M&HFO, **asphalt**, AV-gas varieties etc with **syn-gas** products is possible, but technically challenging and carries some risk.

SYNTHESIS GAS (syn-gas) is Hydrogen & Carbon Monoxide



C_nH_{2n+2} is Petroleum (for Gasoline $n=8$)

Stretching the Fossil Fuels with Renewables



Preventing ENERGY Desperation

- Renewables need ELECTRICITY STORAGE to be feasible; Qld Deputy Premier,
- Pumped Hydro can be an energy storage, but don't count on it being our saviour,
- Batteries should be further researched to increase their capacity, longevity and safety, but batteries will not displace Pumped Hydro as baseload back-up,
- Grid losses must be reduced by new power transmission and reticulation systems, lines and plant, but
- Can a new & positive attitudes be created for accepting nuclear energy to really have energy security?

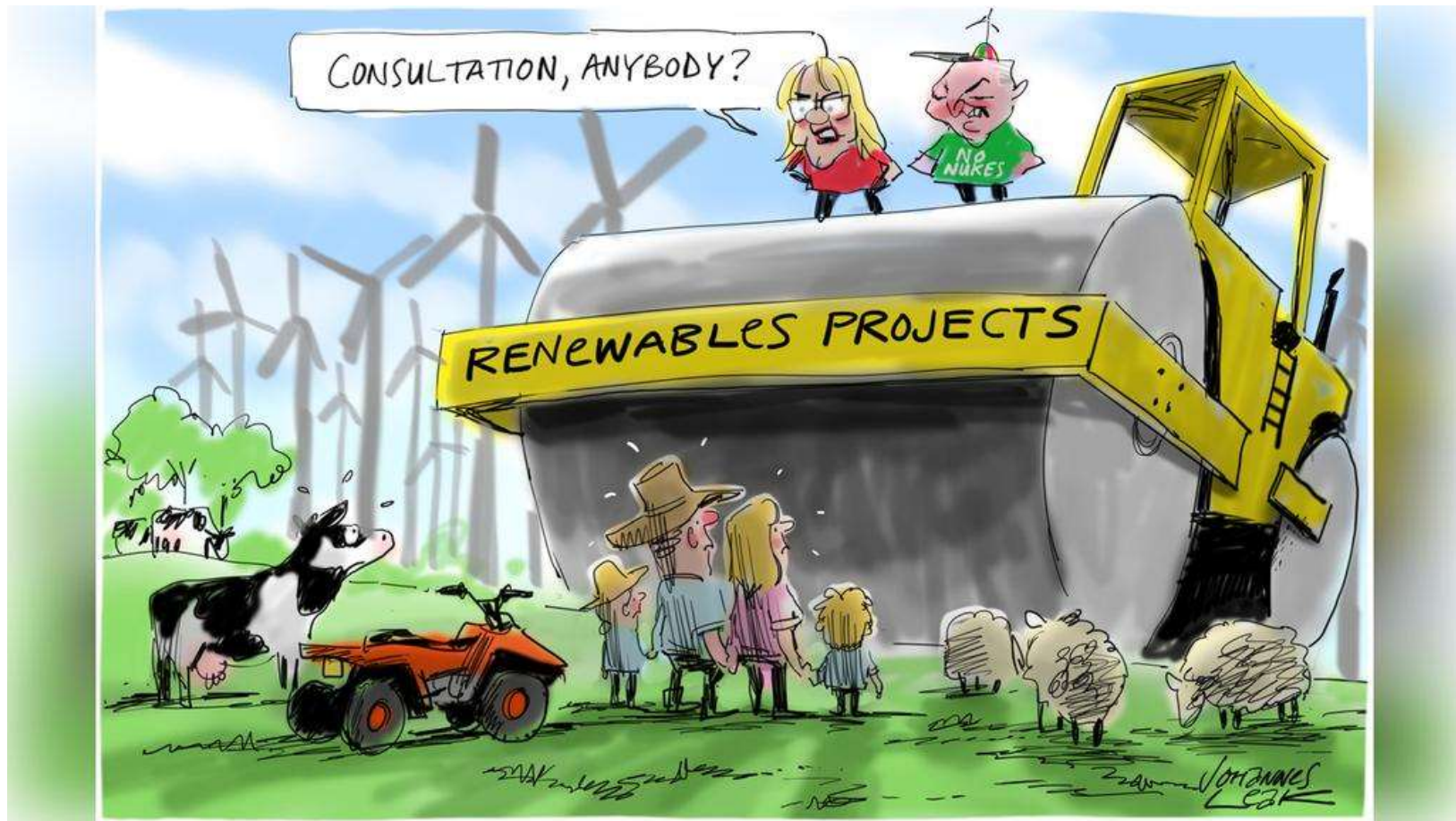
Questions???

Hot off the press: July 26, 2024

**Seeley International slams Australia's IR, anti-gas policies,
Giuseppe Tauriello, The Australian's Business Network**

**'Victorian government's extreme, illogical anti-gas stance
has also come into this — having unintended impacts on
the market. *With customers* going to switch off gas'.**

Our energy future in the hands of those that 'know'!



Thanks to Johannes Leak

**Thanks, and may we all
have a bright energy future!**

