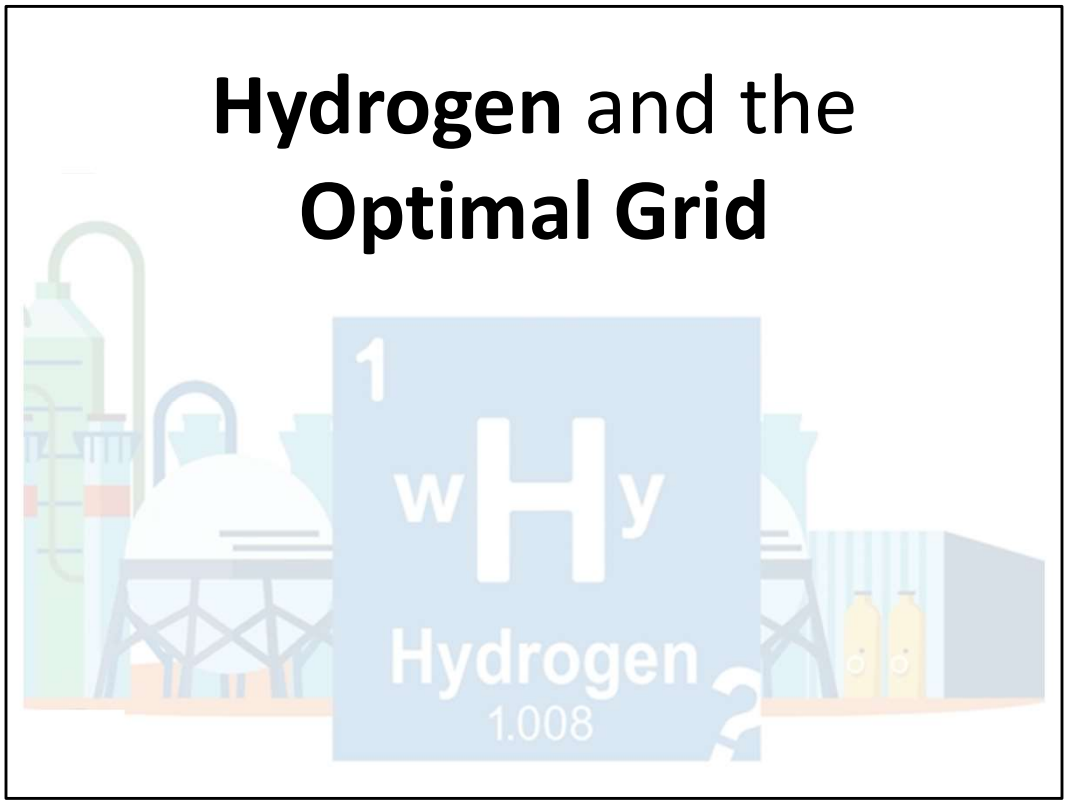


Title says:

But, why hydrogen?

Whenever I say the word “hydrogen”, I get three counter arguments thrown straight at me:
It is inefficient
It is expensive
It is a beast to contain

True?
1. You can’t generalise about a flexible and versatile phenomenon (rubber band).
2. Efficiency and cost is never in any technology or any part of the system, it is always in the system itself.
-> Next slide.

Another hydrogen denying simple comment “Physics” implies inefficiency but is nonsensical. Physical laws also depend on the system that we have defined.
An example: Metal ball and a feather, which one reaches the ground first?
Vacuum tube, again, which one?
Different systems, different laws.

Fun fact for you: Did you know that we can’t fly a rocket into outer space? It will run out of fuel before we have come even half way. It can’t be done.
Still happens many times a year. How? Hydrogen and us being clever! Lesson perhaps, big things may come from hydrogen and us being clever ...

Electricity

- With every added share of RE the price of electricity goes up!

Pause. Does this make sense to you?
The price of electricity creates ripples across our entire society. It goes up, everything gets dearer and harder. For businesses and people alike.

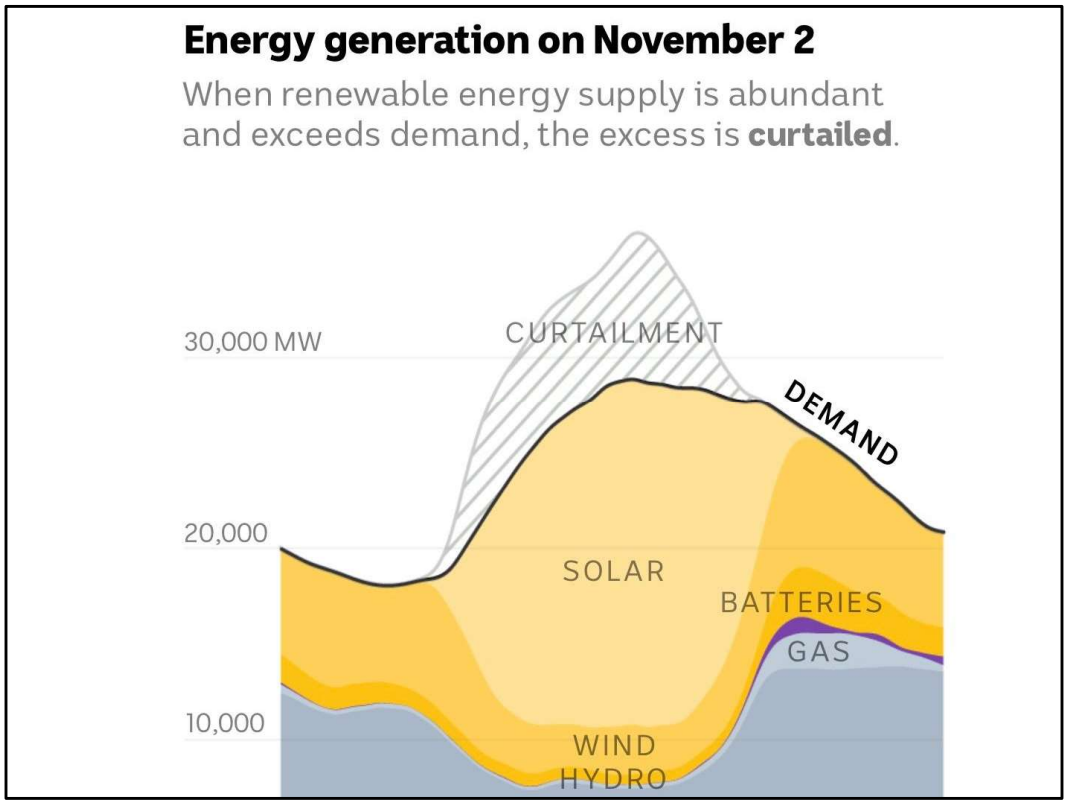
Global phenomenon.
You see it often reported in media as “Network constraints”.

If you add RE to our legacy grids, you will introduce three problems.
Congestion, instability and timing problems.

Congestion means curtailment. We will immediately get a higher price of electricity.
And then we have to compensate for all three problems by upgrading and expanding our grid. This raises the price of electricity PLUS it will increase our taxes.

This is what you would call an “inverse investment”. Every dollar into this project means that you have to pay more now and even more in the future.
When was the last time someone invited you to join an inverse investment project?

They are pretty rare.
But, it is happening here, right before our eyes.
Perhaps that is the reason no one talks about it?

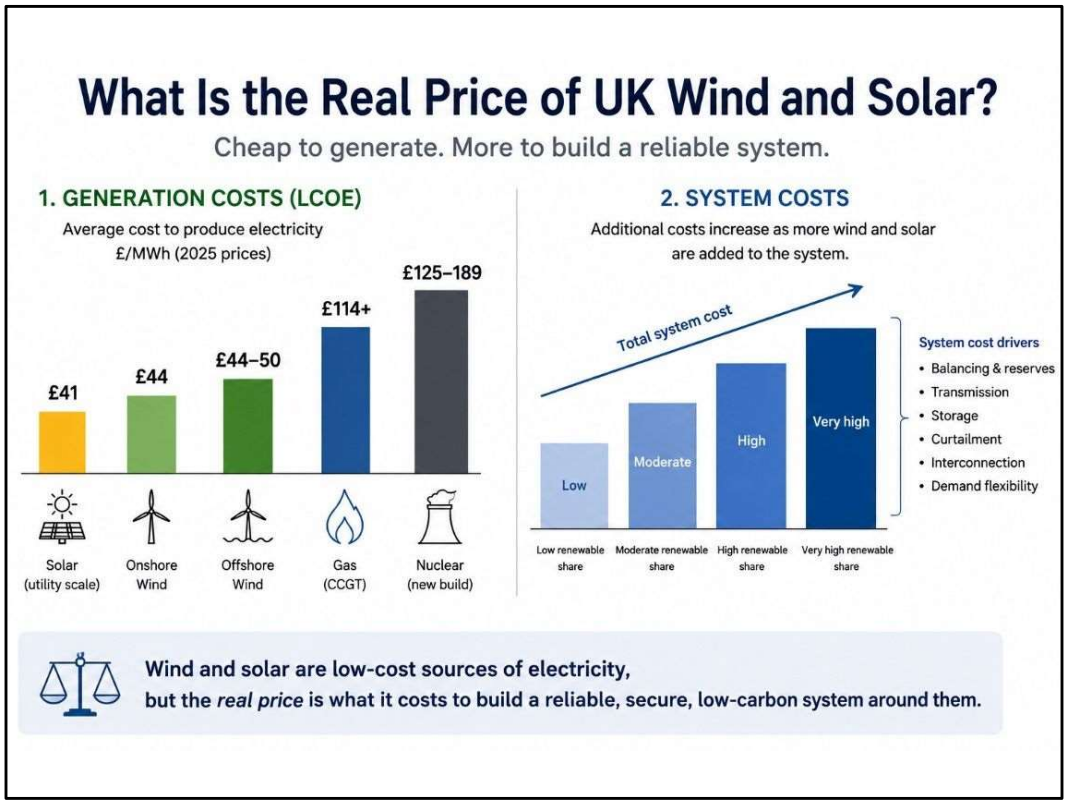


Graphic representation.

Shows the NEM. We have a lot of solar in Australia. 35% to 65% curtailment.
https://www.pv-magazine-australia.com/2025/07/14/aemo-forecasts-increased-solar-curtailment-in-nem/

Scotland has the same problem with wind, 37% curtailment.
https://www.theferret.scot/why-are-scottish-wind-farms-paid-billions-to-switch-off/

“This means that only 63% of the energy which could have been generated made it to the grid.”
https://felicitymartin.substack.com/p/why-we-dont-need-more-wind-turbines



And this is how Tom Baxter in the UK described the phenomenon on LinkedIn on the 17 May.

LI article (Australia focussed) by Ernst Zimmer: https://www.linkedin.com/pulse/missing-half-energy-price-story-ernst-zimmer-f7nxc/

Grid A

- Becomes more expensive and unreliable the more renewable energy we put into it.
- With every addition of RE, the transition becomes slower.
- Can never become 100% RE

Grid B

- Becomes less expensive and more reliable the more renewable energy we put into it.
  - Will become 100% RE
  - Speeds up the transition as every step forward becomes easier and cheaper.

Grid A

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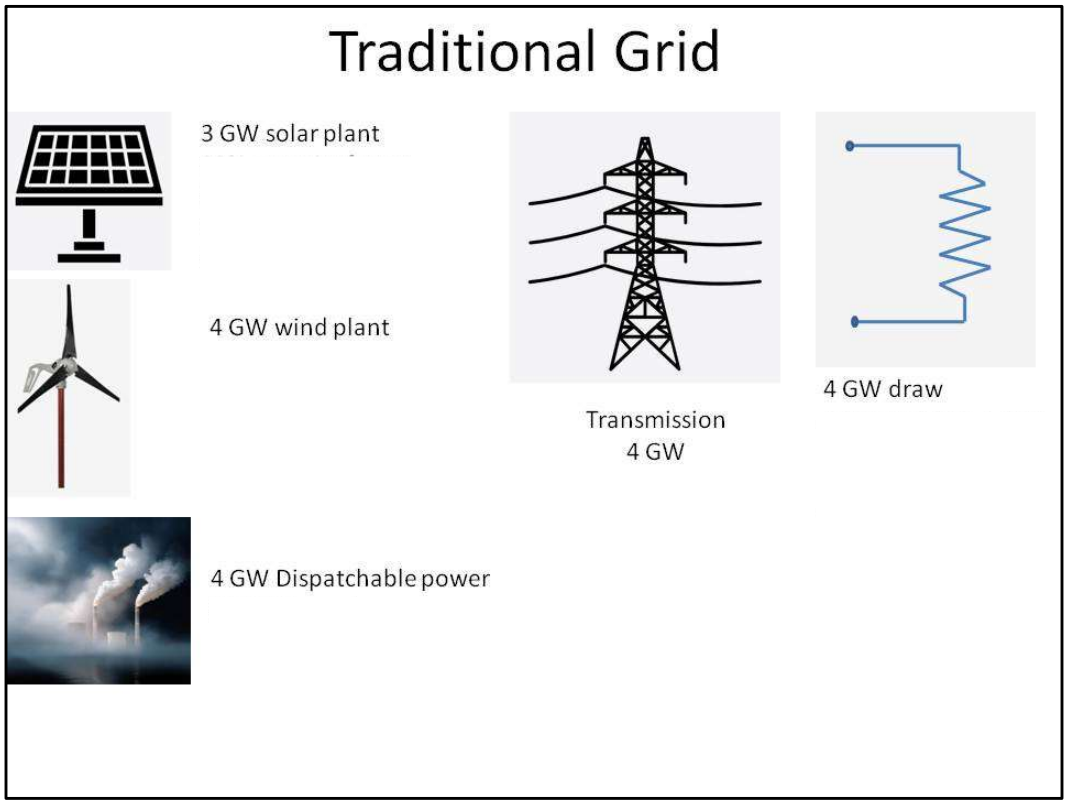
- Speeds up the transition as every step forward becomes easier and cheaper.

Which one do we want?
Do we want the grid that gives us everything we want?
Or do we want the grid that gives us everything we don't want?



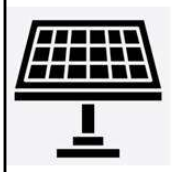
Up the numbers here by a factor six and this picture would reflect the NEM quite well, just a bit more RE.

Now to the interesting part.
RE + storage provides us with an opportunity that we have never had before.
We can now design and implement an Optimal Grid.

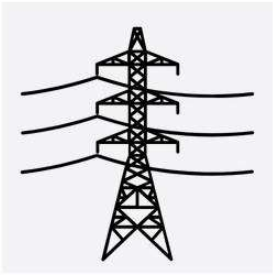
What does that mean. A minimal grid. Minimum generation, transmission, equipment and land.
The smallest and cheapest grid possible.

A grid that caters for average demand, rather than peak demand.

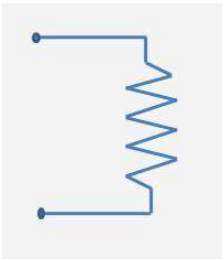
Optimal Grid



3 GW solar plant



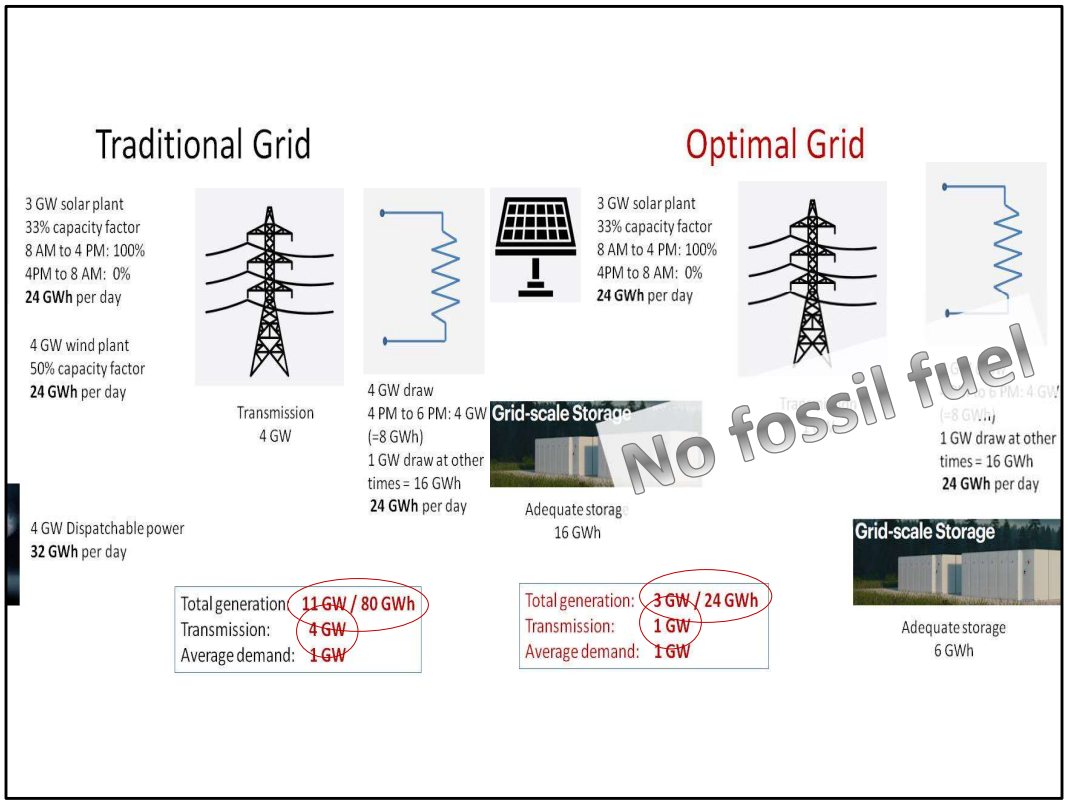
Transmission
1 GW



4 GW draw

Adequate storage
16 GWh

Adequate storage
6 GWh



Even though we have a lower capacity factor in the Optimal Grid, we are still able to meet demand with a lower generation than in the Traditional Grid!

And almost half the transmission, equipment and land!

And NO fossil fuel!

Seasonal variations

Generally 10-15% seasonal variation
510 TWh annual demand, 15%, +- 8% => storage need = 8% x 510 = 80 TWh

Adequate seasonal storage
for the NEM

17 TWhrs

17,000 sq. kms. Li-ion batteries

=

7,000,000 **football fields.**

To counter the waste, to build the optimal grid, how much storage would we need? About 1 month worth.

That's about 1 football field filled with batteries for every four Australians. One next to every house ...

1 GWh LI-ion covers about 1 sq. km.
1 TWh => 1,000 sq. kms.
17 TWh => 17,000 sq. kms.
A Aus rules football field (the playing area only) = 25,000 sq.m. = 0.0025 sq. km.
400 football fields = 1 sq. km. 10,000 x 400 = 4M
4M x1.7 = 7M

Adequate storage in the NEM with Hydrogen

34 TWhrs

= 154 Costco warehouses

Underground

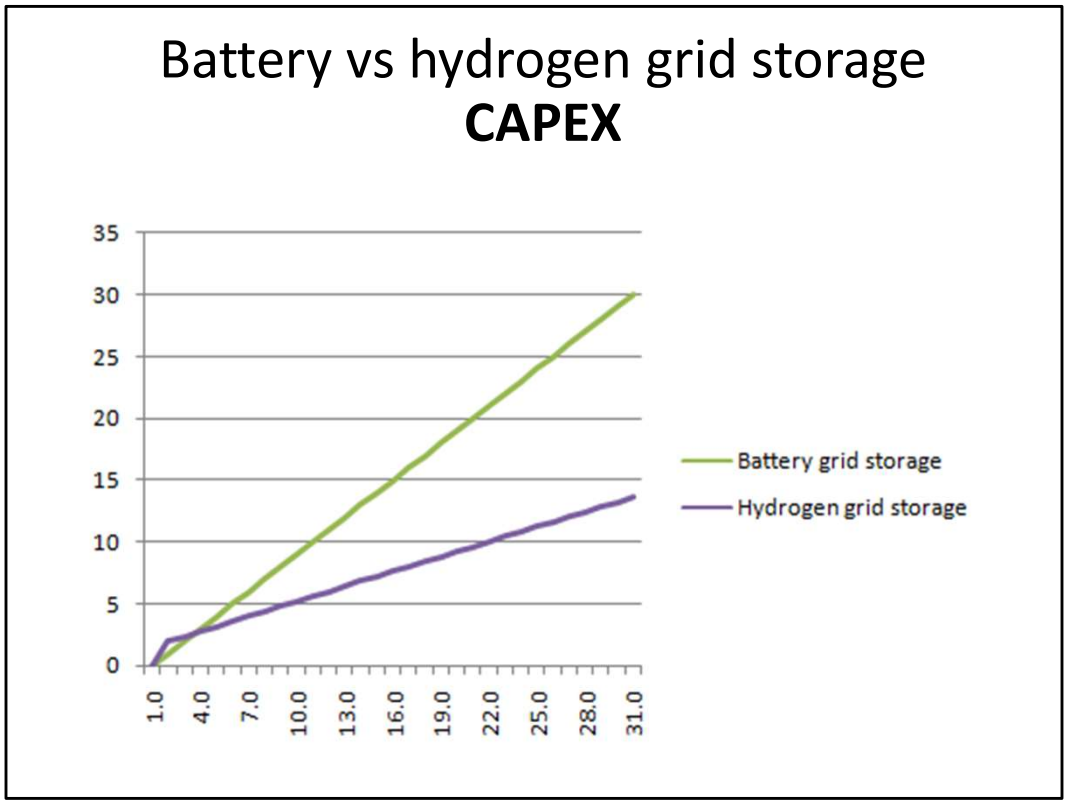
"Costco warehouse" for international reference.

Underground.
We can dig holes, we can bore tunnels.
We wouldn't even see this.

Costco in Ardeer = 16,653 sq m x 10 m = 166,530 cu. m.
A ten m cube holds 40 tonnes at 700 bar = 1.33 MWh
166.5 cubes = 220 GWh
34 TWh => 154 Costco warehouses filled with 700 bar H2

Bunnings is approx. 10,000 sq.m.
About 200 Bunnings warehouses.

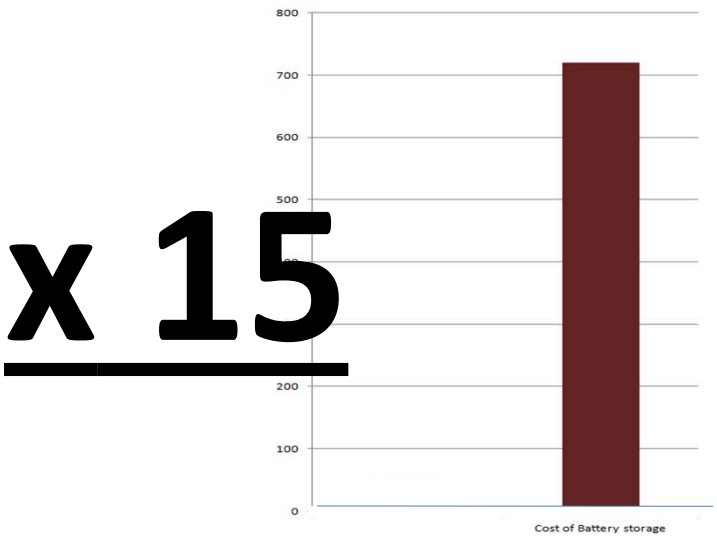
Pilot for 90 tonnes underground H2 storage in Germany:
https://www.hydrogenfuelnews.com/hydrogen-storage-pilot-at-etzel-completes-90-tonnes-underground-filling/



Batteries are simple. If we need twice the storage, we need to double the amount of batteries.
Hydrogen storage however, has three components:
Electrolysers, fuel cells and a tank.
Now to the interesting view, OPEX:

Battery vs hydrogen grid storage

OPEX



x 15

The hydrogen storage will provide electricity competitive with the cheapest generation.

The difference here comes from that when it comes to ongoing costs, we are essentially comparing a 720 hour battery solution with a 16 hour hydrogen solution.

The Optimal Grid will give us:

- ✓ Cheaper price of electricity
- ✓ Lower taxes
- ✓ Accelerated transition to renewable energy
- ✓ Pathway to RE growth,

  RE fuels

  and renewable energy security.

=> Australia enters the journey to RE superpower

And it woun't cost a cent to kick it off ...

Final question:
If renewable energy is worth going for, then surely cheap RE is better?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