Renewable Energy for Base Load ‘Power’

by

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Power v Energy

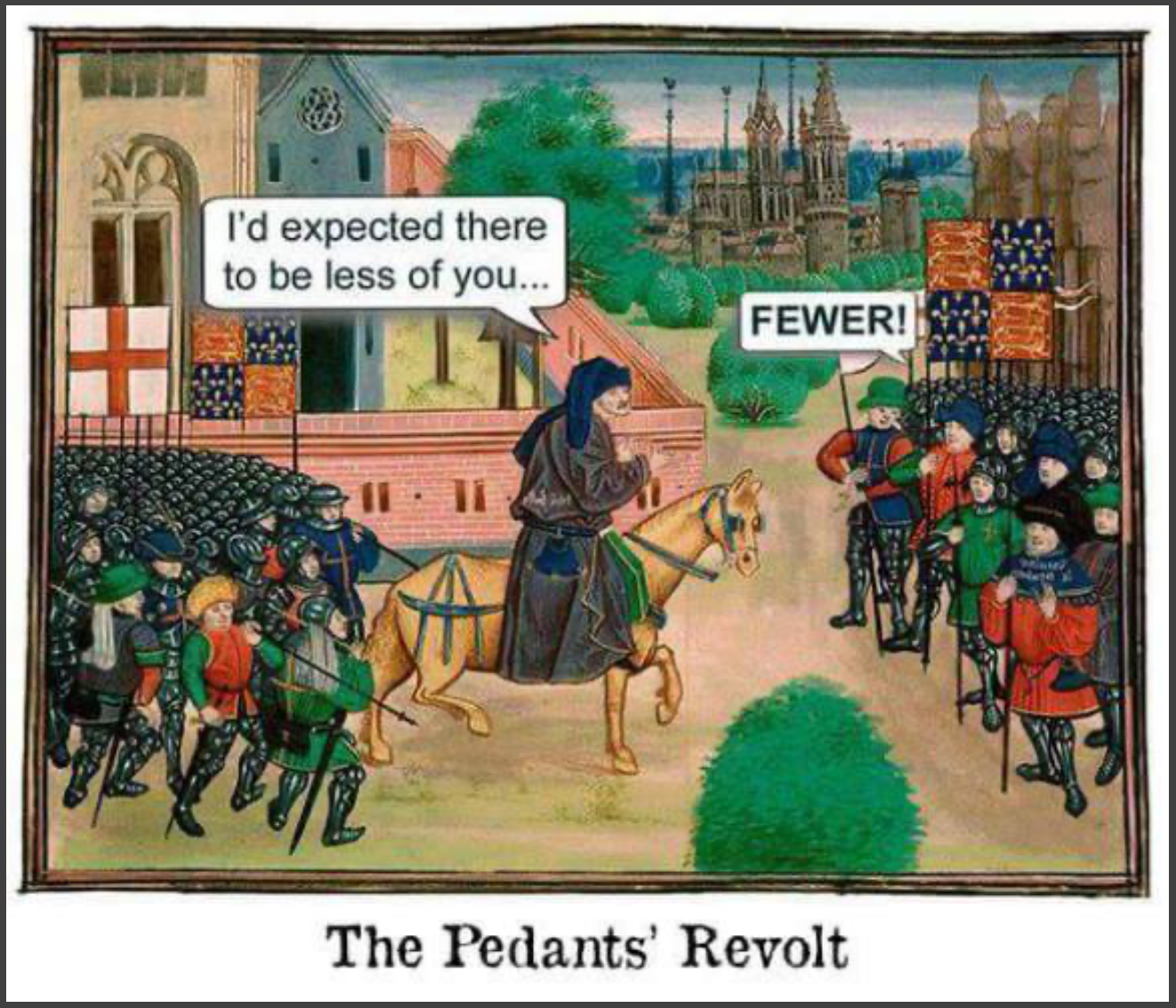
- Power stations generating Electricity have traditionally been categorised by their POWER output
- POWER is measured in Kilo Watts (KW) or Mega Watts (MW)
- Thus Loy Yang A is 2,200 MW

Power v Energy

- The largest wind farm in Victoria is the McArthur Wind Farm with 140 turbines generating a total POWER output of 420 MW.
- Great. A simple calculation 2200/420 and we see that we only need 5.25 McArthurs and we can retire Loy Yang A.
- This WRONG, WRONG WRONG. Wrong by a country mile.

McArthur Wind Farm

We now have to get pedantic



Power v Energy

- We don't want POWER from our generators. We want ENERGY.
- ENERGY is POWER provided for a period of TIME. ie. POWER X TIME
- The units of ENERGY are Kilo Watt Hours (KWh) or Mega Watt Hours (MWh)

Power v Energy

- During the time that Loy Yang A is working at 100% capacity we receive into the grid 2,200 MWh of ENERGY every hour.
- So the average rate at which energy is delivered is 2,200 MWh per hour (MWh/h)
- Sadly generators do not all work at 100% all the time

Power v Energy

- All coal fired generators run, on average, at about 90% full POWER, as do Gas and Oil burning Generators and Nuclear generators.

- This 90% has the odd name: the CAPACITY FACTOR.

- If all generators had the same CAPACITY FACTOR then ranking them in terms of POWER would be just as good as ranking them in terms of ENERGY and all would be fine.

Power v Energy

- I think you hear a large BUT coming.
- BUT
- Let us look at the CAPACITY FACTORS for various means of ENERGY generation.

Capacity Factors

- Coal, Gas, Oil, Nuclear 90%
- Photovoltaic 29%
- Wind Farm - off shore 47%
- Wind Farm – on shore 32%
- Hydroelectric dam 45%

Power v Energy

- So, using the relevant CAPACTY FACTORS to convert POWER to average ENERGY per hour we get….
- Loy Yang A 90% of 2200 = 1,980 MWh/h
- McArthur wind farm 32% of 420 = 134 MWh/h
  –
- Thus to supply the same ENERGY as the Loy Yang A generator we would need not 5.25 but 14.7 McArthur wind farms. HOWEVER

Storage

- Because the wind does not blow all the time we need to attach a storage system
- Batteries perhaps or pumped hydro
- Victoria is currently building the biggest battery in the Southern Hemisphere

Victoria's Big Battery

- The Victorian Big Battery is a 300 MW grid-scale battery storage project in Geelong, Australia which will store enough energy in reserve to power over one million Victorian homes for 1/2 an hour.
- POWER = 300MW
- CAPACITY FACTOR = 50%
- Average ENERGY = 150 MWh/h

Victoria's Big Battery

- Let us assume two consecutive windless days (48 Hrs) and calculate how many Big Batteries we would need to replace the Loy Yang A power station

- (1980/150) X 48 = 634

Renewables

- We can retire the Loy Yang A coal burning power station and maintain our electricity supply by replace it with
- 14.7 Wind farms the size of the McArthur wind farm
- PLUS
- 634 Big Batteries
- QED

- And now a short film
- Lots of sense but a dodgy conclusion
- From: https://www.youtube.com/watch?app=desktop&v=RqppRC37OgI


PragerU
What's Wrong with Wind and Solar?

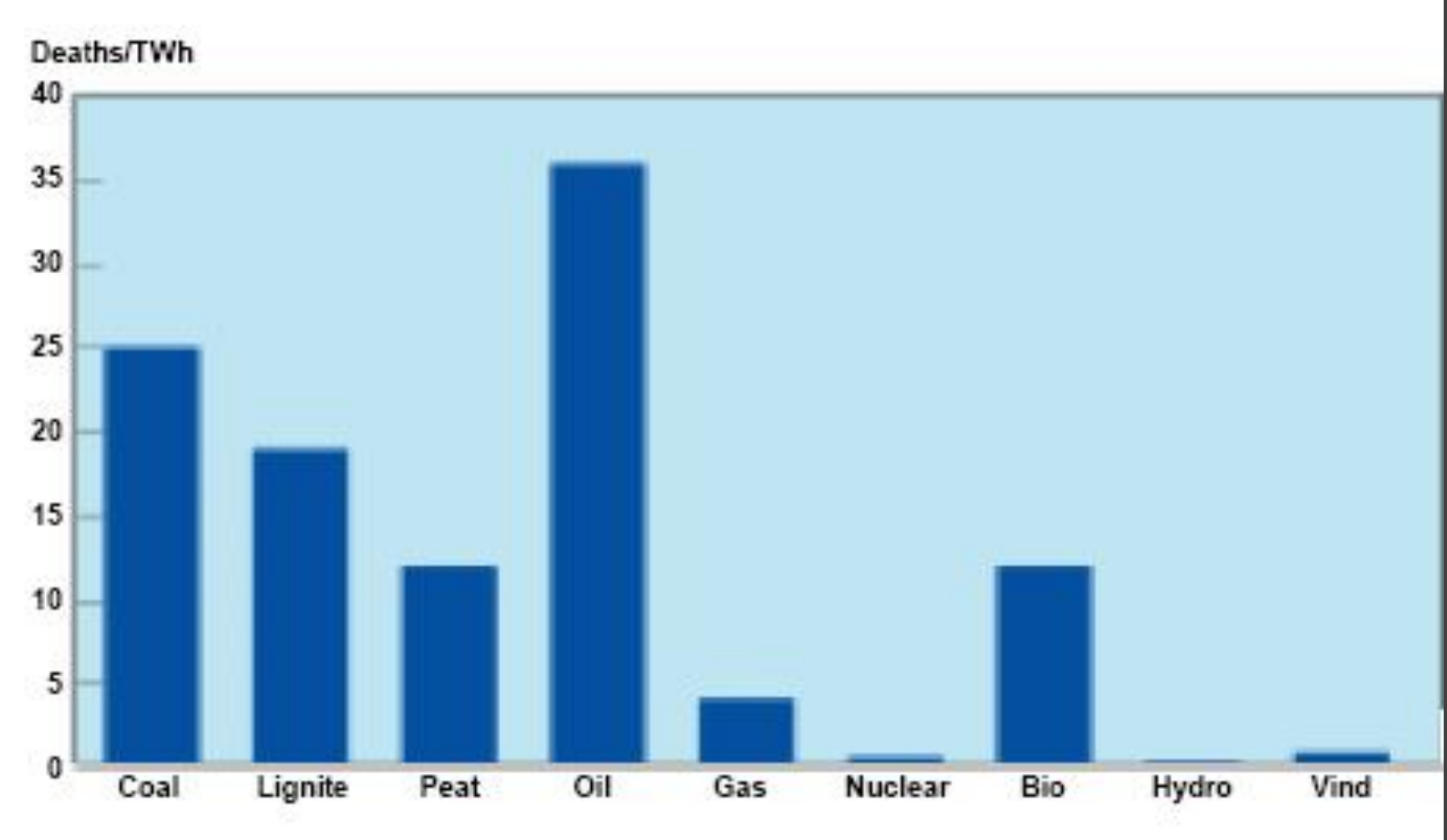
The film

- I would agree with 90% of what he said
- But not his conclusions
- For several reasons we must ween ourselves off the use of fossil fuels
- I know it is unfashionable but, let's consider nuclear power

Firstly, consider this

- How many people die in the Energy Generation process.
- We measure in deaths per Tera Watt Hour (TWh) of electricity generated.
- 1 TWh = 1,000,000 MWh

Deaths per TWh



Uranium or Thorium

- Uranium was chosen for the early nuclear reactors because of the pressure to make nuclear weapons
- Experience gained was use in the first generation of nuclear power stations. All reactors were based on Uranium
- France derives 80% of its electricity from Uranium reactors and sells some electricity to other EU members when the sun does not shine and the wind don't blow

Uranium or Thorium

- But there is another – I would suggest, better – way to go

- Let me introduce you to

- Thorium

Thorium

- Much more abundant than Uranium
- Australia is particularly well endowed. We have more Thorium than any other country in the world.
- Very difficult to turn into weapons grade material

The Liquid Fluoride Thorium Reactor (LFTR)

(pronounced Lift er)

- The LFTR in 5 minutes
- This is Kirk Sorensen
- Brace yourselves: he is a fast talker!
- From: https://www.youtube.com/watch?app=desktop&v=uK367T7h6ZY

Thorium

- A powerful take-home message
- You can hold a life-times energy in the palm of your hand!

The Liquid Fluoride Thorium Reactor (LFTR)

- What about the waste?

- Again Kirk Sorensen
- From: https://www.youtube.com/watch?app=desktop&v=Q3EGOL4J6yI

Thorium

- Thorium reactor are currently being built in China, India and Indonesia
- And the rest of the wolrd is taking note
- Thorium will keep us going for the next thousand years by which time we should have tamed nuclear fusion

For the *very* long term

. . . .

Fusion reactors

- Abundant fuel
- No radioactive waste
- Its how the sun works
- International Thermonuclear Experimental Reactor (ITER) – 90 MW in, 500 MW out - France (20??)

The End