Electricity Supply in 20C and 21C

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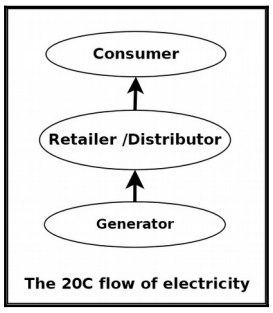
In the debate about energy supply a lot of jargon is used. It is not clear from listening to politicians, commentators and others if they really understand the jargon they are using. Here we try to explain two of the major terms and their relationship to electricity generation and demand. The explanation is given in two scenarios, namely how it worked in 20th Century and how it will work in 21st Century.

20th Century : Electricity Generation Utility Controlled

The standard setup for electricity supply in the 20th Century (20C) is to have baseload supplied by nuclear or coalfired powerplants and anything above it like peak demand, supplied by gas or diesel fired powerplants. The baseload demand used to be quite static therefore nuclear or coalfired powerplants were ideal to deliver electricity at a reasonable price. An additional reason for this simplicity was the centralised electricity generation.

During the 20C electricity demand was met by the despatchable electricity generated by a combination of baseload and peakload generation, as shown in figure 1. The term baseload was very relevant in 20C and even in the first few years of 21C.



This diagram shows the Classic 20C flow of electricity from generator via retailer to customer.

*21st Century : Customer Demand Control*ed.

Now in the 21st century (21C) the scenario has changed and continues to change, it has lost its static simplicity of the 20C. In the current public energy debate the focus is often on baseload while it should be on the demand for electricity. The 20C way is basically telling the consumers that they should use electricity in a pattern that suits the generators. But it should be the other way around the generators should supply the electricity the consumers want and need. Consumer electricity demand from grid in the 21C has changed, because many have become *prosumers*. A prosumer is both a consumer and a producer, and in this case of electricity. The prosumer generates electricity with their solar-PV panels. This means that when they produce their own electricity they will not draw from the grid. All this generation is done "behind the meter" (BTM) out the reach of the public generator. Figure 2 shows the consumer demand curves for 2017, 2022 and 2027 [1]. The graph indicates that by 2022 the consumer demand for electricity in the middle of the day is significant less than what baseload powerplants produces, and by 2027 it is

1 A full set of these curves is what is in jargon called the "**duckcurve**". Modelling has been done amongst others by Renew Economy (2019 a, b).

estimated that no baseload power is needed at all during about 1 hour around midday. The first suggestion could be, produce less baseload electricity. Well, that is a problem because nuclear and coalfired powerplants [2] can physically not slow down enough and later ramp up again for the amounts and in the time frames required. Logically the best way to deal with this problem is to close any nuclear or coalfired baseload producing powerplant. This is likely to cause some political problems for governments. Eloquently described on Sustainable Energy Now's website (SEN, 2019) "… *This scenario does not consider any commercial solar installations, which will accelerate the impact. Without government intervention, the situation will inevitably arise that coal-fired generation will only be needed during certain periods (therefore raising consumer costs), or Government will need to legislate against consumer-generated solar electricity (causing political unrest). Governments will need to respond nimbly*. …"

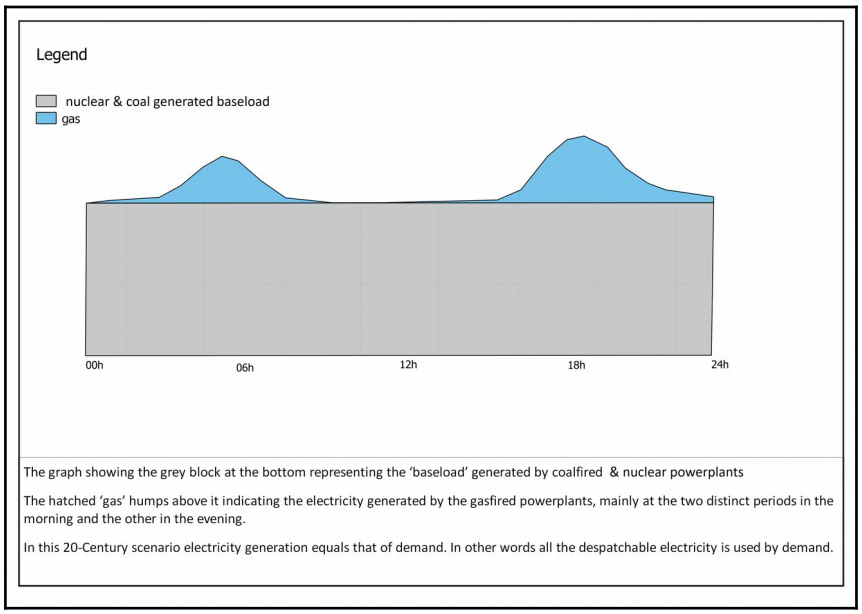
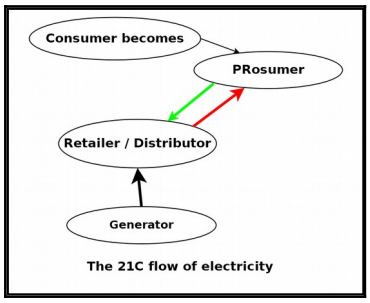


Fig. 1. 20C electricity supply curves.

From the descriptions above it is clear that 'baseload' is now an outdated concept and this is recognised amongst others by the Australian Energy Market Operator (AEMO), AGL Energy, the Chinese government and many other governments. It is likely that the baseload problem will grow with the installation of BTM battery backup, when the time periods no baseload power is required widens.



Here the diagram that shows the electricity flow in the 21C.

2 Ramping up and down is an inherent impossibility for brown-coal- , hyper critical (so called 'clean coal' plants) or other types of coalfired power plants. Starting or shutting down coalfired powerplants may take more than 12 hours. Nuclear powerplants have the same ramping problems and their startups and shutdowns take even longer.

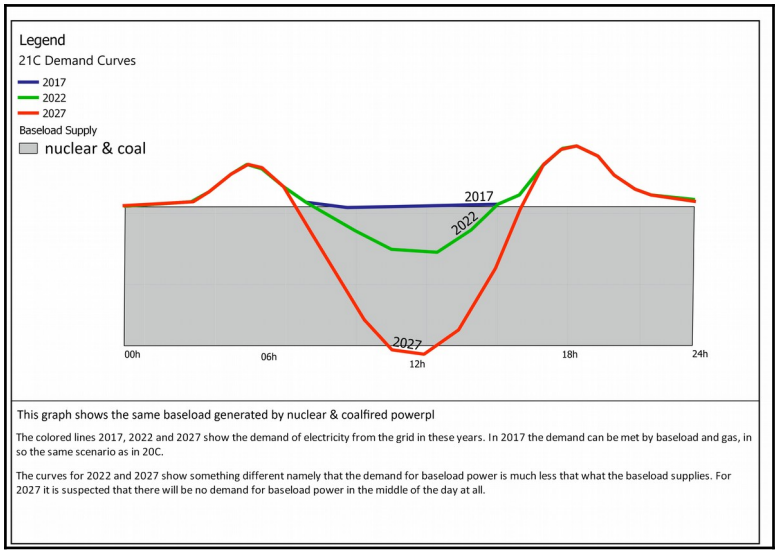


Fig 2. 21C Baseload supply and Duckcurves

On a separate note most nuclear powerplants need copious amounts of water to operate, as is shown in table 1. At a time when clean water is at a premium the use of large amounts of water unnecessarily is not socially permissible.

Energy production Type	**Water requirement (liter/MW h)**
Oil extraction	10 – 40
Oil refining	80 – 150
Coal integrated gasification combined cycle	950
Natural gas combined cycle power plant	200 – 3.000
Nuclear plant closed loop cooling	950
Geothermal power plant in close loop tower	1.900 – 4.200
Enhanced oil recovery (EOR)	7.600
Nuclear power plant open loop cooling	94.000 – 27.700

Table 1. Water usage by energy production; copied from Amaroux (2014).

References

Amouroux, J. et al., 2014. Carbon dioxide: A new material for energy storage. *Progress in Natural Science: Materials International.*

Renew, 2019a. Renew Economy : Ramping and duck curves. *https://reneweconomy.com.au/ramping-and-duck-curves-67877/*.

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