Stephen Browning and Energy – Big Picture and Fast Action.

Looking at the information from various sources in 2020 and 2021 I see that

"We have a need, a need for Speed" With serious Pragmatism.

Which is also clearly emphasised by the IPCC Working Group 1 Sixth Climate Assessment Report issued in August 2021. Hence my associated strategy for Green Methane (Biocoal, Biomass and Trash feed with easy CO2 sequestration) with High Efficiency Hybrid Energy Production plant to use it. To avoid the dreadful Thermal energy loss we get with Coventional Thermal Generation Condensing Turbines.

The challenges we face are
Resources, Environmental Impact (Including Climate and other factors), Poverty, Disease (and you'll probably add some more).
With the 'Taboo' Elephant in the room being Homo Sapien Population.
You cant now let everyone go anywhere, as Hominins have been able to do for most of the 6 million years of their existence!! To get out of the way of hostile Climate changes.
And Homo Sapiens for most of the 300000 years since we 'branched'.
And the planet can do worse things to us (en masse) than we to it.....

So, as regards the immediate issue of Resources and Climate, noting the former is getting dramatically worse and the latter is getting volatile.
The Heat anomaly (4 degrees) over Siberia is increasing the risk of Permafrost melting causing Methane release to Atmosphere.

Definitely horses for courses - one size don't fit all but we have to hit the biggest Energy Resource and Emissions issue hard - the Chinese Coal burn.
Their 14th Five year plan shows their emissions increasing in this decade. Thus we aren't going to wean them off that Coal fast enough - but we can convert the way they use it...

And are the UK and other High Latitude Cloudy Areas the best place for Sun? The insolation maps (CSP and PV) certainly show where the Solar Generation resources should be.

Especially for Agriphotovoltaics in Arid and Semi Arid Sunny areas. PV on stilts which improves Land Fertility by Shading and whose power can further assist Agriculture

I have a note lower down on the better use of PV.

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Electricity delivery is Unique as an Energy vector. There are no appropriate analogies.
It requires that you get it to the Right Place at the Right Time and that will be (Laws of Conservation of Energy) at the Exact Rate (Power) required.
Thus tight matching of Generation Power to Expected Demand Power is required.
While maintaining Security (MW flow limits), Stability and Voltage (MVAr provision) at all points.
While covering for any one of the large number of Credible faults occurring at any instant.

But the Infrastructure to get it from the best sources to the sinks is considerable and can strain Resource Provision and Environmental Impact. And affect Poverty and possibly Disease. LCOE is a meaningless metric for Comparison of the 'Worth' to the Customer of each type of Generation.
And the Statements that a Power Plant produces Energy as used by x million homes is unhelpful. It is the rate of Delivery, Power at Time, which matters

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We need to concentrate effort on more efficient materials for Energy conversion and storage – 10 to the Power 60 potential substances from the existing Elements (CoGx 2021 Conference - Research Stage). Also an earlier post on advanced Photosynthesis and Photoelectric materials. And I have documents re the 'lightning' battery (tortured glass). Also on R&D into HVDC technology to support Hypergrids; albeit bearing in mind the Resources issue. See below re the issues with existing HVDC installations.

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Throwing Wind and Solar in the air and on the roofs without a proper overall strategy for Energy Production plant mix aint too clever.

And we have the need for a seismic shift in Customer behaviour

As regards the latter the UK Smart Meter project didn't recognise this fully, although there is a data route to enable better Customer Interaction (Data Communications Company Elective services). Which requirement did go in to the consultations – the need for a flexible approach to data content on the interface. And we now have the extra need to observe and manage PV and EV charge/discharge effectively - upstream Distribution and Transmission Security and G to D Matching.
With the large Customer connections (Domestic Single phase 14kW or 24kW upwards) being more heavily utilised and operating bi-directional. Noting that other Countries have various limits on smaller Premises connection Capacity. 3kW Single phase up to 24kW 3 phase in parts of the EU.

The GB National Grid System Operator Assessment of the cost of Net Zero, based on the existing Committee for Climate Change direction for just Renewables and Hydrogen, is between £2.5Trillion and £3Trillion to 2050. UK only using 1.22% of World Energy!! We need a more pragmatic approach.

We have the need and the technology to do integrated Resource and Infrastructure modelling; separate simulations coupled by iteration. I see recognition of that issue in the IEA Smart Grids Network reports. It is only the limitations of our ability to configure and program such Complex simulations that's limits modelling scope.

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In the existing plant mix, each tranche was justified with high load factors at the start of its life.

Including Low Carbon Nuclear at 100% Utilisation. But the lifetime costs which were assessed at the design stage probably did not including decommissioning. And some of the Magnox had a second funding 'source' for the spent fuel.
UK AGRs (mid 60's projects) would have been compared to deep mined Coal as neither use of cheaper Manufactured gas (late 60's- but only local production) nor North Sea Natural gas (1975 - which would be restricted from Power Generation use anyway up to 1991) could be foreseen.
It was recognised that the delay of the last stage 1 AGR, Dungeness B (finally commissioned 1984), meant it will never actually save as against Coal - and certainly not Gas.
Noting also the need for diversity of Primary Fuel Input - as evidenced by the 1972/3 miners strike, the Oil Price shocks, then the 1985 miners strike.
Hence the 1960's Strategy for Coal, Oil and Nuclear.

The CEGB did build a 5MW Wind Turbine in 1975 and put up 3 commercial 320kW machines at Carmarthen Bay in 1982.

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Sequential trading then Operator action from unbundling (privatisation) is not using the plant most effectively.

And separate, sequential handing of Generation applications and Transmission and Distribution improvements results in a chronically inefficient approach to T&D provision.
Offshore Wind farms, each with separate connections (Dogger - long wires - struggling to develop), while main Transmission and Interconnectors end up with routes 'crossing' same!!
ESO Ten Year Statement Appendix C – Google NGESO ETYS then look for a link to Appendices. Scroll the Appendix C pdf up and down through the years.
There should have been an integrated plan when Round 3 Offshore Wind was announced; offshore Busbar through the sites and connections to land. But that would mean allocating Generation and Transmission Party payments on each circuit. But we seem to have the situation where each asset is assigned to Transmission or Generation or Demand for charging?.....

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As regards UHV DC for Hypergrids to couple remote Variable Renewable Resources.

I note the issues with configuring UHV High Power Transmission. The 8GW circuits in China, connecting Large Coal and Renewable Generation in the West to the South and East, cannot be operated to full output, or losing one would 'take a Province 'out'!!!

So we need fast R&D to further develop the Technology necessary for fully Meshed DC Grids with smaller parallel circuits and multibusbar substations with DC Circuit breakers, to allow Flexible Electricity transport with big swings in Power flow from Variable renewable resources.

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GB True customer demand can be derived from the published BMRA and NGESO Generation data.
With not just Metered Generation and Interconnector Imports but also Estimated Actual output from Non Metered Generation, Interconnector Export and Pumped Storage Pumping now being published. True (Potential) demand is what the Operator Top Down Demand+Weather Analysis to Forecasting Models use.
So, we can get a decent view of our existing view of load curve, with its relatively high base load level over days then weeks. We have relatively high Trough to Peak ratios compared to the 70's (Economy 7 in non Gas areas and Server farms as we have lost Industry?)
And then superimpose Output by fuel type to get a better idea of the distortions from sequential trading .
Then think about imposing he big variable EV load - tens of GW 'each way' - G2V V2G. With the other 'heavyweight' storage!!

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As regards Hydrogen

You cannot move Hydrogen (CV 12.8MJ/cum) around with the same (reciprocating?) compressors as we do with Methane (CV 39.3MJ/cum or see your bills) at 70 or 90 bar.
Or as was done at 34 bar with Town (Manufactured) Gas over Networks to East Anglia and across the South Coast. Manufactured Gas was H2 rich (60%) but with additional gases to bring it up to 17MJ/cum.

The only project to build a (Centrifugal) H2 compressor was sponsored by NREL in the US and didn't even make it to Prototype stage.

I also found the paper which shows that increasing the level of H2 mixed in with High Pressure Methane causes a serious non linear increase in Compressor Demand.
Same issue I assume applies to storing H2 at pressure in tanks or tankers.

As against the ability to Liquify Methane (inc BioNG)

So, the argument for H2 is to make it locally, use it locally.
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As regards PV, panels in Higher, Cloudy, Latitudes do not give the Best Output and use of the Resource. .

UK PV just 900kWh/Installed capacity kWp/year - Southern Italy 1450. North Africa and other Sunny areas must be higher.

So, Put raised PV Installations to give shading over large areas of Sunny Marginal Land. Plus Seawater Greenhouses. Use Power Output for Local use and driving Desalination, Irrigation, Panel cooling (for best efficiency).....

With land improved and thus more usable for Food and Energy Crops (Fast growing Biomass).

Export Biomass to more Populous Countries near to Trash Landfill. Install Gasifier-Methanators (BGL-HiCoM) at those locations to ‘eat’ Biocoal (priming) but mainly Biomass and Trash. That produces Low/Negative Carbon CH4 and High pressure Easily Sequestrated CO2. Produce Electrolytic H2 adjacent and combine with the CO2 (Sabatier) for e-methane and e-methanol. The latter process already proposed for Shipping.

In the long run set up BGL-HiCom and Electrolysis plants near the Sunny Biomass production. More and More PV with e-methane production for local generation - operate plants daytime and overnight and ship/pipe e-methane and e-methanol.

As an aside it has also been shown that shading improves Pastoral Farming. The livestock grows better. But then we do need Robotic Poo collectors in the fields to feed same to the farms Anaerobic Digestors. As is already done in Robotic Milking Parlours.

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An observation from another source.

It is legitimate to flag up the population issue but the conversation needs to be more reflective than it often has been. Out of the current 7.9bn people on the planet 2 billion are children (under 15). By 2100, the WHO estimates the number of children to be ... 2 billion. The numbers issue Is about us living longer not more kids overloading the space. Some are already arguing that coronavirus is doing what politicians of all hues seek to duck. One take is that longevity isn't the issue, but you do have to change diet, lifestyles, contributory roles, politics and economics.

And from me
I see the point on the Population Age profile. We are indeed getting more successful at 'mending people' while at the same time we are our only major predator?
Apart from the Planet and Cosmos that is – Seismic Activity, Volcanism and Projectiles!!

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As regards (relatively cost inflexible) Nuclear it is necessary to see how the Energy drivers work - including Diverse Resourcing. And the fact there is plenty of Base Customer Demand to accommodate what we have and had. Having committed to any Nuclear strategy you run the plant as hard as you can to cover the considerable 'Committed' Fixed Costs. Up to the time the Regulatory requirements for continued operation are infeasible to carry out. Such as requiring replacement of the Pressure Vessel.

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The issue with Methane is to 'Use it, Don't Lose it (to the atmosphere) - or it 'loses' Us'. (Carbon Cycle diagrams on Wikipedia). With the Heat Anomaly over Siberia (+4degC) increasing the risk of Permafrost melting and more Methane Release. Google 'Exploding Pingos'.

Thus melting the Siberian Tundra releases a major Greenhouse accelerant.
Although the Oceans do capture CO2 by waves trapping bubbles. Thus 77ppm of the CO2 produced since Industrialisation started have actually been Sequestrated by the Oceans.

Making Synthetic Methane from Coal, which is currently being used inefficiently in vast quantities and has the largest Reserves, mixed with Trash and Biomass in the Gasifier-Methanator mechanism which also enables easier CO2 sequestration from the Outlet, is a fast option. Converting the conventional Chinese Coal Generating Stations to CCGT (as with Peterhead and proposed for 2 units at Drax and by simple use of burners to start with), plus added Heat Recovery. But mainly separate High Efficiency CHP+C+ETES units.. The latter producing Electricity with Heat at Various Temperatures (Chinese Energy Demand is mainly Industrial) and also enabling the use of Waste Heat to Generate.

And the plastic in the Oceans could be captured and processed to Liquified CH4 onboard. Powered by a Chinese Floating SMR. Russia have just deployed a floating SMR in the Arctic.

But, as I also say in FPS 22 this is 'get out of Jail for a while'.
For the long run we need seriously better, cleaner, large scale Energy Production and Conversion.

Hence the ideas that Quantum Computing will give an incredible 'Quantum Leap' to our ability to do faster DNA sequencing, understand the nature of 'stuff' and what Synthesised materials would be of most use. Exciting Stuff.

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More as regards Modelling

The only way to get a handle on Future Energy is linked time series analysis (coupled Modelling) of the sources, conversions, outputs and emissions impacts. Coupled Resources and Infrastructure modelling with Iteration between them – a bit more extensive than the ITRC currently propose (DAFNI) and better than each model working on fixed assumptions at its boundary.

Fuel Supply, Conversion and Transport -
Natural Energy- (Sun and Wind conversion, Hydro and Geothermal production),
Combustion - Natural Fossil, Natural Low Carbon (Biomass, Trash, Anaerobic Digestion) and Low Carbon Fossil Conversion (Coal/Trash/Biomass - Syngas/CO then to Synthetic Natural Gas (CH4) + CO2 (latter to easy CCS). H2 production (iterate with Electricity model).

Combine Sequestrated CO2 with H2 (Sabatier) for more CH4. Methane can be moved around through pipes at high pressure; Hydrogen cannot; the compressor does not exist and the attempt to build one (Centrifugal mechanism) didn't even make it to Prototype.

Also alternate Conversion (Syngas/CO to Methanol). Others?

With Emissions and Environmental Impact accounted. Base data and some calculation here, more calculation in the Production Model (e.g Emissions calc from Fuel Heat usage).
Inc Storage and source 'Scarcity' .

Electricity Production - Inputs from Fuel Supply/Conversion and Transport Storage.
Thermal Efficiency data for Combustion plant
Dynamic data restrictions.
direct storage.
Internal Interface to Transmission and Distribution Network modules - security, stability and losses accounting. .

Heat and Cooling Production - Interface with Fuel Supply and Electricity (inc HP and CHP+++), including Heat from Fuel Conversion.

Transport - Light and Heavy, Personal, Business and Public.
Complex Interface with Fuel and Electricity (Any Heat recovery?)

Just 'scratches the surface'; lots more in the formulation of the models and interface data!!

I have dealt with 2 model iteration (Annual Generation-Fuel Allocation Optimisation) but nothing as complex as this - way outside the comfort zone!!