Climate change

The need for power storage and alternatives to carbon reduction

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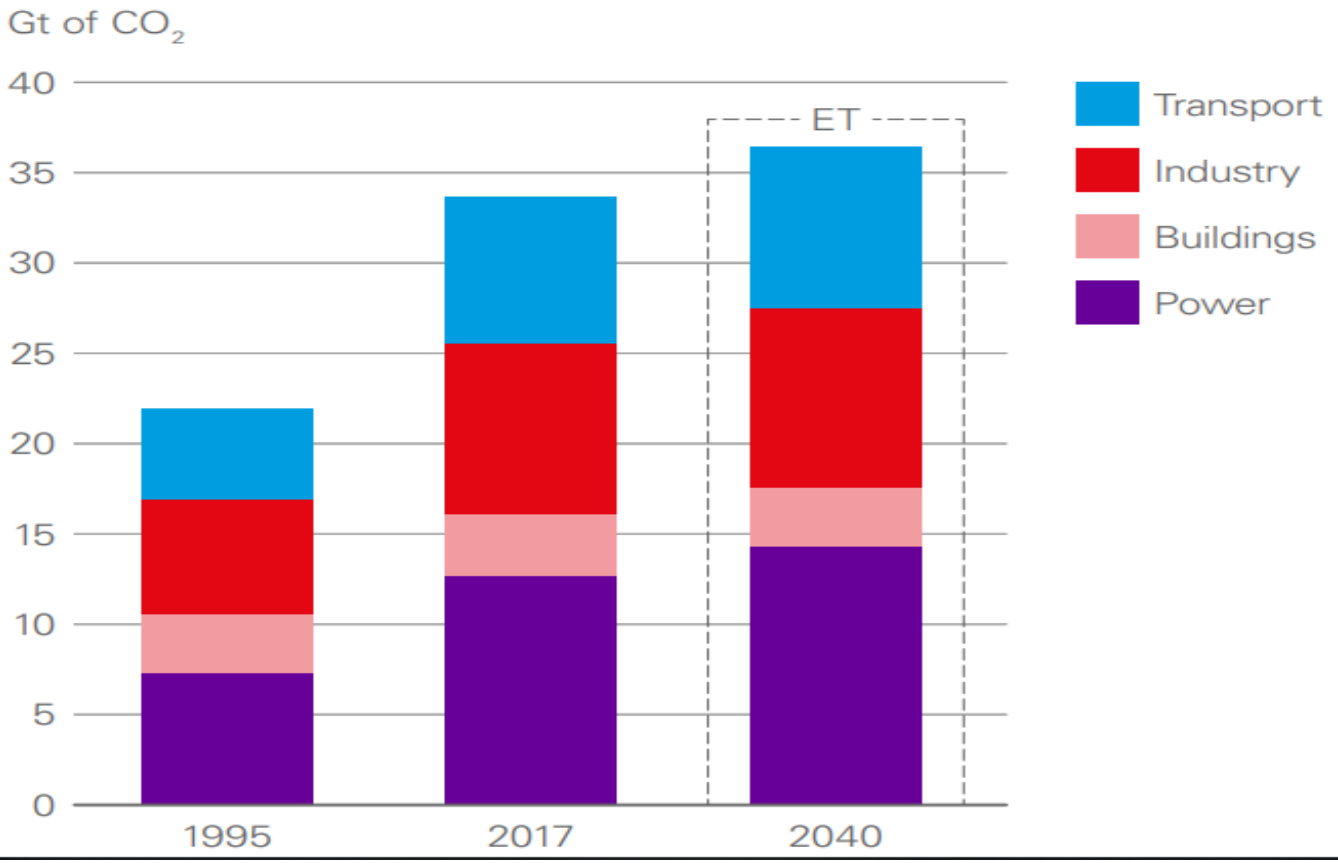
Introduction

- Climate change is here to stay and no longer deniable.
- UK, IMO and EU moving towards zero carbon by 2050.
- US, India, China and Australia maintain right to use fossil fuels and believe market forces will effect change.
- No global coordination, will result in wasted investments.
- Climate does not respect borders.
- Todays children will change all that.

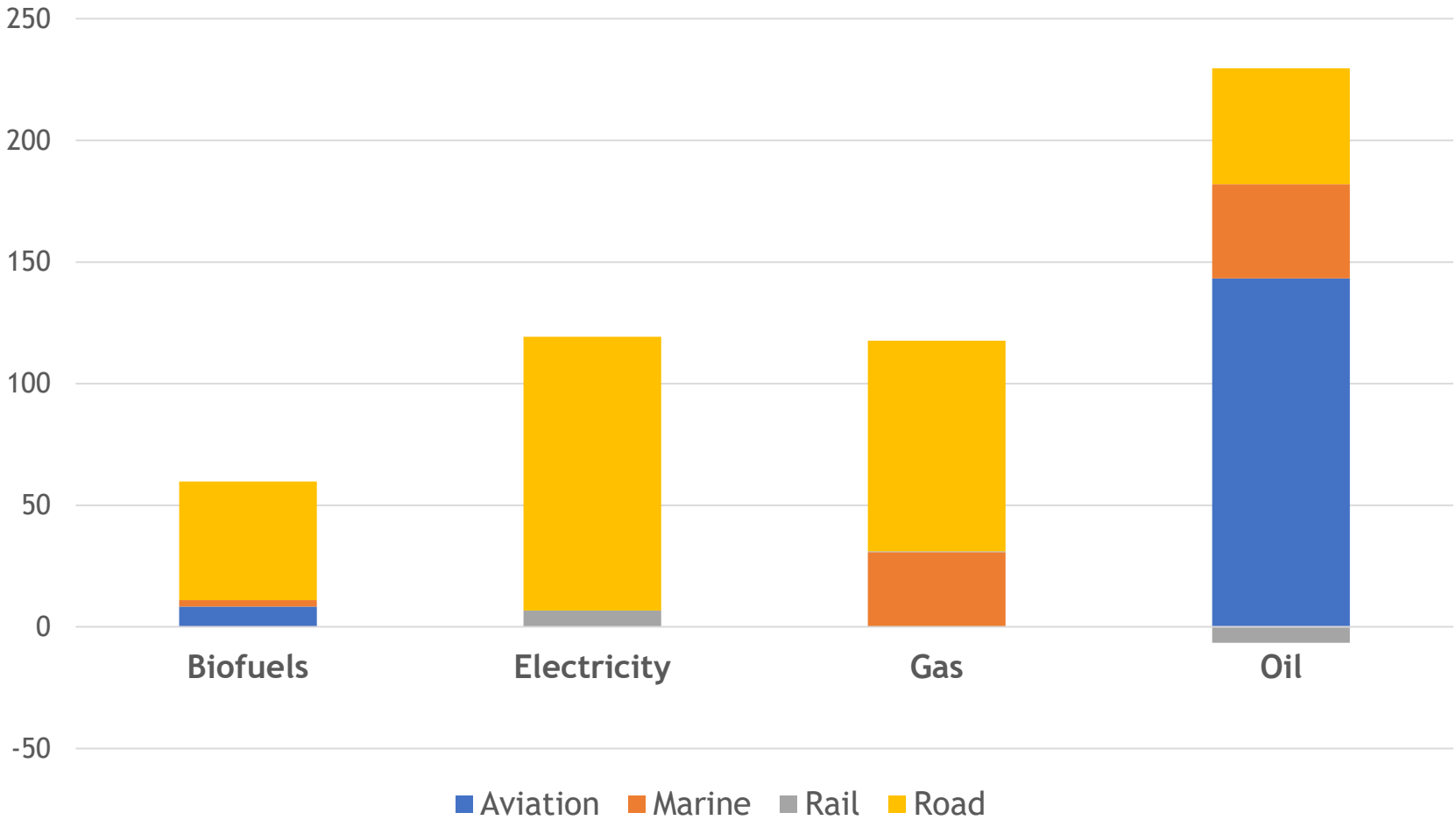
BP Energy Outlook
2019 edition

bp

CO_2 emissions by sector



Transport consumption btoe



Source: BP Outlook 2040-2019

Primary Energy is consumed by Electricity, Transport and Chemicals

- Electricity generation is one of the major producers of carbon emissions.
- Mitigation is taking place in terms of solar and wind power.
- Nuclear fission generators are clean in atmospheric terms, but politically difficult to justify.
- Nuclear fusion is too far in the future to be a practical solution.
- The world is already short of power generation.

Transportation

- This is the next large producer of GHGs.
- Lags behind other efforts to reduce carbon emissions
- Pure Ev's are only a tiny fraction of the vehicle fleet.
- Major drawback is battery design and availability.
- The transfer of power demand from liquid hydrocarbon to electricity.
- Generating capacity demand for a full EV fleet exceeds current availability by a factor or more than 100%.
- UK study shows current generating capacity around 345 Twatt. Power generated by car fleet at 425 Twatt. How will this gap be breached?

Transportation (2)

- Reliance on Lithium-Ion batteries can only be short term.
- Lithium is called a rare earth. It is rare and difficult to mine.
- The alternatives of Cobalt and Nickel are just as undesirable.
- The working conditions and political stability of these mines will render them ethically unacceptable.
- The Plug in Hybrid (PHEV) has been found to be unreliable in terms of emissions, as the owners rarely bother to plug them in. Thus they can only be viewed as short term solutions.

Chemicals and Agriculture

- These areas are just as bad as carbon emitters.
- It is difficult to conceive homo sapiens as a herbivore, not matter how many vegans try to convince the world.
- Fertilizers and pesticides will continue to be required.
- as well as some of the harder plastics and pharmaceuticals.
- Thus storage for primary chemicals and fertiliser feedstocks will remain.
- PS as well as for alcohols!

Governments, Finance and carbon trading

- The great stumbling block to climate amelioration is finance.
- Governments talk a great talk as to what they would like industry to do.
- However there is a great political reluctance to tell the voters the truth.
- If you want to clean up the air you breathe, then you must pay for it.
- Although a lot of academic research is paid for from public funds, it is the billions required from the private sector to build to scale that is needed.
- Only if an adequate return is guaranteed, will the investment in climate mitigation will be forthcoming.

Governments, Finance and Carbon Trading

- The only current way that has the potential to release these investments, is carbon emissions tax and payment.
- A carbon Trading systems that is properly policed and monitored may be the answer.
- The IMF have calculated that it will take a value of around $50 per tonne of carbon removed to spur investment into such mitigating schemes.
- However to get a global agreement on this, is a long way away.
- We saw the disaster of COP 25 in Madrid to achieve anything and we have low hopes that COP26 will do any better.

Possible and Probable mitigators

- Currently the only real mitigators are wind and solar.
- Plant based bio fuels have been proven to be useless in such mitigation.
- The problem with wind and solar is the intermittent nature of the power generated. This needs full back up from fossils fuelled generators. These will stand idle when enough renewable energy is being produced.
- At times wind and solar combined, over produce, in which case the generators are paid to shut-in capacity. Seems ridiculous doesn't it?

Mitigators (2)

- If this surplus power can be stored then maybe the intermittent gaps can be filled.
- So can this surplus power be stored, assuming that Lithium-ion or cobalt-nickel is not the long term answer?
- We need simple and low cost systems.
- Tidal power and pumped hydro are well known technologies.
- Large tidal power systems exist in France (Rance) and S Korea (Sihwa Lake generates 254MW).
- However these are not infrastructure projects that can be built by private capital. They have long pay-out and low returns. Unless they can be funded by carbon emissions trading.

Mitigators (3)

- There are known technologies to help mitigate carbon emissions.
- Carbon Capture and Sequestration(CCS)- well known tech, can be built quickly and will take our carbon and put it back into the earth from where it came.
- Cryogenic batteries. These take surplus low cost power and use it to liquify air. The stored air can then be released to run a turbine and generate electricity. One scaled up plant is in construction in the UK and another agreed in the USA.
- Other options are fuel cells both liquid using hydrogen and solid oxide using ammonia.

Mitigators (4)

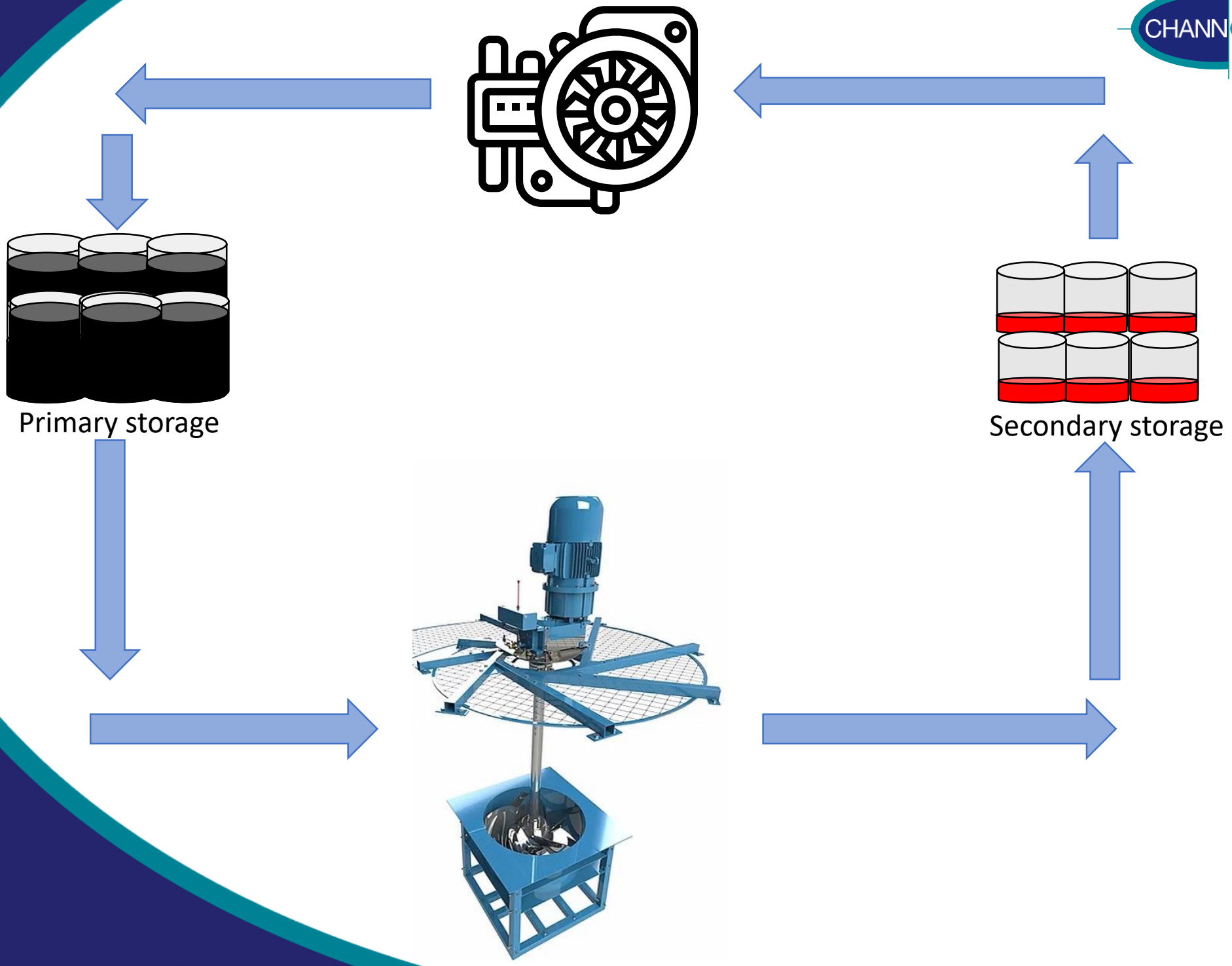
- A simpler solution would be to educate people to turn off unused lights or turn down thermostats by 1 Degree. This could easily result in a 10% reduction in demand.
- Finally what has all this go to do with Stock Expo and tank storage in particular. Well storage terminals can start by generating their own power through solar panels on tank and building roofs and also build wind generators.
- What is a tank terminal? It is an industrial site with permission to store and handle hazardous material.
- Therefore it is an asset to be harnessed in the climate change argument. Terminals currently store energy in liquid form.

Storage terminals-the future

- What will you do with empty tanks in zero carbon world?
- Since you accept that the job of a terminal is to store energy, why not store electricity?
- How can this be done? Well I mentioned cryogenic batteries.
- These might have to develop greenfield sites. This requires planning and environmental permitting.
- Oil terminals have got planning permits and so can offer a redundant tank pit for a cryogenic battery.
- Alternatively if Lithium-ion batteries were the future they could be built on redundant terminal sites.

Storage terminals-pumped hydro

- An alternative would be to use some of the redundant tanks to develop a pumped hydro scheme.
- Cheap or self generated electricity could be used to pump water into the largest tanks and use them as potential energy stores.
- An underground pit would then need to be dug and a fan fitted at the bottom, with a vertical drive shaft to a generator.
- Once called upon to produce electricity for the grid the water would be allowed to flow by gravity through the water generator and then recovered in other tanks.
- The process would then be repeated with the collected water being pumped to the primary reservoirs.


Primary storage
Secondary storage

Other fuels

- As used cooking oil becomes a viable feedstock for next generation biofuels, it might be beneficial if storage terminals built, or franchise building, an esterification unit on a redundant site.
- This would generate rental income just as before.
- Old terminals have tankage that has been written off and on the basis that the world would be awash with spare capacity, rates are going to go much lower than replacement cost would require.

Conclusions

- One thing that is certain, climate change polices are going to force changes to the power generation and oil and gas industries.
- There will continue to be a public clamour for tighter emissions controls.
- If the storage industry is to survive the transition to a zero carbon world, then it will need to think ‘outside the box’.
- It will need to equip itself with new skill sets.
- It will need to understand the transition phase and power economics.
- This means educating itself and hiring the right kind of skills that will almost certainly be needed.
- Finally, Channoil Consulting Ltd already has these skills in house and if anyone wishes to take matters further, please get in touch.
- *Thank you for listening.*

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