SONE
Supporters of Nuclear Energy
Newsletter
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Nuclear for shipping, heating and more

There will be no Newsletter next month as I will be away on holiday with grandchildren. At sea in the Channel the chances are that we will pass many huge heavily laden container ships on their way around the world. Though unseen by most people these are responsible for a significant fraction of the world's emissions of CO_2, oxides of nitrogen and sulphur. The potential benefits of employing nuclear energy for shipping are obvious but they have been seriously neglected. The International Maritime Organisation is a notoriously conservative body that has been slow to engaged with the need to suppress atmospheric pollution in international waters.

Nuclear powered submarines have been plying the seas since the USS Nautilus (1955). They have varied in size from 400 to 26,500 tonnes. Like other nuclear naval ships including aircraft carriers their record for radiological accidents is exemplary. Such long experience with naval nuclear powered vessels should be sufficient evidence that nuclear powered cargo and passenger vessels would also be safe in principle. As with land based nuclear technology the barriers seem to be collective fear with its linked increased costs and unscientific regulations. With the reality of global climate change seemingly upon us, any reluctance to consider civil nuclear powered shipping needs to be challenged. The UK is an innovative maritime nation with much relevant experience (including Rolls Royce). There is an opportunity here and SONE is an appropriate body to ask some searching questions. Of course we will be told that IMO complies with UN regulations as laid down by IAEA. We are already challenging that Goliath on land and the same battle needs to be extended onto the high seas where 50 years have already been wasted.

Four nuclear driven cargo ships have been built but they were less successful than expected, largely because their routes and access to ports were restricted to appease local concerns. Speed was very competitive but they were not built to take containers. A recent study summed up the experience gained but it lacked

the urgent approach that climate change now suggests [1]. Anyway there is no reason to delay and today (22nd July) I posted a note to Twitter and Facebook:

> *What about emission-free #nuclearpowered ships? They have been safe for the navy for 60 years, but fear and related overcautious authorities stop their use for passengers and cargo! That is crazy. The accident record and the science suggests "fear environmental change, but not nuclear". Let's go. Let's have fast nuclear cargo and passenger ships with less holiday jets. Titanic luxury with no emissions CO_2 / NO_x / SO_2 (and no icebergs either). Challenge authorities (IMO IAEA UN) to change policy for world benefit, even survival*

There have been more than 50 replies in the first 12 hours, uniformly supportive. These media have their uses especially to connect with younger generations.

The provision of energy without carbon emissions for air transport is difficult. Neither hydrogen nor batteries seems a likely solution though people will try, no doubt. As noted above nuclear-powered ships could be fast and provide transport for some goods currently carried by air. With appropriate advertising and pricing many air travellers might be persuaded to go by sea also, emission free. After all in days gone by, though you got what you paid for, the luxury and relaxation available on a North Atlantic liner was second to none.

Climate change and gas

That climate change is happening is increasingly obvious. Predictions are very uncertain and may not deflect people in their daily habits, but as they see effects themselves they become more inclined to act and to listen to what needs to be done. It is quite uncertain how inhospitable the world environment may become. But, although it will take a long time before measures taken now have any significant beneficial effect, that is no reason not to do what we can in the meantime.

The main problem is energy, and the only viable solution is a switch away from carbon to nuclear power. Other solutions are too weak and unreliable. Other pressing problems such as fresh water supplies and infrastructure resilience are also improved by such a switch.

But how might the energy generated by nuclear be best dispersed to homes and industry? You might suppose that nuclear plants should be sighted near centres of population, so that as many homes as possible, and industry too, could take advantage of the large supply of waste heat available. That should be so, but it is not! In the Cold War when power plants produced fuel for weapons, as well as electricity, they were sited in remote places for security. Later, the authorities

still wanted nuclear plants out of sight and out of mind to reassure public nuclear phobia. Today this may be seen as a mistake. The public need, not only to be reassured about nuclear safety, but also to benefit from a sense of connection to their local power station. It is noticeable in communities such as Dungeness and Sellafield that residents are less concerned about nuclear risks because they know people who work at the site. They have developed a confidence and familiarity not experienced by those further away.

An advantage of Small Modular Reactors is that they could be more widely dispersed. Their footprint is small, needing neither high volume rail connections nor room for coal supplies. For example, Drax and Didcot should be converted to such nuclear plants as soon as possible. Cooling for a small plant is not the major problem sometimes supposed.

In addition to the electricity grid that disperses power directly to homes and industry, the UK also has an extensive gas distribution system. This can be harnessed too.

Gas and heating

The UK consumes about 2500 GWh per day of gas for heating in the winter and 400 GWh per day in the summer. As I learnt on July 7 at a meeting of the Westminster Energy Environment and Transport Forum on the future of gas, there is a plan is to completely decarbonise the natural gas distribution network with an eye too on the additional 1000 GWh per day of gas for electricity generation as well as 1500 GWh per day of carbon fuel for transport. Since 2014 work has been underway in Leeds to convert its network to hydrogen, “the H21 Project” [2]. This development is being extended to East London and the North of England. Currently the hydrogen is to come from methane with Carbon Capture and Storage planned to achieve decarbonisation.

But CCS is not an environmentally safe long term solution. Better by far would be hydrogen produced as an integral part of the load on a nuclear fission plant so allowing steady operation without ramping [3]. Evidently this step needs to be encouraged and developed. Once in place the hydrogen distribution network would be available to re-fuel hydrogen powered transport too.

Land transport

Rail transport when decarbonised by electrification still has to be supplied from nuclear power via the grid. (I always enjoy thinking of Brunel who, all those years ago, understood the benefit of getting the engine off the train, as in his unsuccessful Atmospheric Railway.) Road transport is more difficult. Decarbonised energy for road vehicles requires either batteries or hydrogen

storage. Though the energy in each case can be sourced from nuclear power, there are further problems. The lifetime of batteries is adversely affected when they are charged or discharged rapidly, so "refuelling" is limited in speed. In addition batteries are heavy and their materials not easily sourced. Hydrogen has efficiency losses, and though light itself it needs a heavy pressure vessel for storage. However, no doubt both batteries and hydrogen – and ammonia too – will play a part in the decarbonised era.

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[1] https://doi.org/10.1016/j.jclepro.2017.05.163 Journal of Cleaner Production Volume 169, 15 December 2017, Pages 152-160

[2] https://www.northerngasnetworks.co.uk/wp-content/uploads/2017/04/H21-Report-Interactive-PDF-July-2016.compressed.pdf

[3] https://www.iaea.org/NuclearPower/NEA_Hydrogen/index.html

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