Gas turbine electricity generating plant, Pulrose, Isle of Man

ENERGY SUPPLY ON THE ISLE OF MAN – WHERE NEXT?

Since primitive humans first discovered how to make fire, societies have depended on energy sources of one kind or another. In this essay I'm going to look at energy utilisation on the Isle of Man from earliest settlement to the present day, and ask – where next?

The island was colonised some time before 6500 BC, by hunter-gatherers and fishermen. At this time, most of the island was covered in trees, including the tops of the main hills. Over the centuries, these were systematically stripped for timber to build houses, boats, furniture and for wood and charcoal for cooking, until 300 years ago the island was virtually treeless. Since the early 1700s, however, there has been much forestry and non-forestry replanting on hillsides, in glens, around farms, country houses, roadsides and town parks.

In addition to wood, early Manx inhabitants cut peat for use in home heating and cooking. Peat is partially decomposed vegetable matter and, when dried, is more energy dense and burns longer and hotter than wood. Peat cuts, or turbaries, can be found in various parts of the island. One of the best known is the Ballaugh Curraghs. When the practice of peat cutting was discontinued, the ditches in the area filled with water and bogs were formed.

From the 18th century onward, as the island and the UK began to industrialise, increasing quantities of coal were imported from Whitehaven and other ports on the Cumbrian coast, initially for the lime kilns and mines, then later for the railways and steamships. Between 1836 and 1898 gasworks were built at Douglas, Castletown, Port St Mary, Ramsey and Peel to generate gas from coal. The gas was mainly used for lighting streets and the homes of the wealthy, and the lighting produced in this way was far superior to the tallow candles and oil lamps in use previously.

Electricity was the next form of energy to be widely used. The electric motor was invented in 1832, the electric light bulb in 1878, the Manx Electric Railway opened in 1893 and the Snaefell Mountain Railway in 1895. These and other railways carried goods and increasing numbers of tourists around the island. The electricity was initially generated by the railways' own coal fired power stations at Derby Castle, Laxey, the Bungalow and Ballaglass, and some of the electricity was used as a public supply for the neighbouring communities.

The first successful oil well was drilled in 1859 in Pennsylvania, USA, and soon afterwards, oil products in the form of petrol and diesel began to be imported into the island. At first these products were used to fuel private automobiles owned by wealthy people, then the TT Races which began in 1907, but gradually their use spread to include increasing numbers of the general population.

At the present time, each year the Isle of Man imports some 25 million litres each of petrol and diesel (1), a similar amount each of kerosene and gasoil (heating oils), 110 million cubic metres of natural gas (to heat homes and generate electricity at the Pulrose power station), and smaller quantities of other fuels such as coal and aviation fuel. When you come over the Snaefell mountain road and see the lights of Douglas spread out below you, have you ever wondered where the energy comes from to power it all? Mostly, it comes from natural gas.

Importing all of these energy products has allowed an unprecedented increase in quality of living and the size of the island's population. People need energy products to heat and light their homes and businesses, cook, transport themselves around the island and power electrical devices such as washing machines, TVs and computers. The population has grown from a few hundred hunter-gatherers using wood as an energy source in 6500 BC, to 27,000 in the late 1700s before the Industrial Revolution, to around 84,000 today.

Which begs the question, where next? The island could not support its current population without massive and continuing inputs of energy. Currently, most of this energy comes from fossil fuels. However, these are finite and at some point will either run out, or become so scarce and expensive that it is uneconomical to extract them. Extraction of North Sea oil and gas peaked around the year 2000 and has been in decline ever since, and the UK is increasingly dependent on imported energy.

The most obvious candidate to replace imported fossil fuels is wind energy. The UK is ahead of us here: from the island on a clear day you can see the 57 turbines of the Burbo Bank Wind Farm in Liverpool Bay. These generate up to 348 megawatts (MW) of electricity on a windy day, at maximum output. However, because not all days are windy, the average the energy output over long periods is around 35% of maximum capacity.

It's possible to make a rough estimate of how many wind turbines would have to be erected on and around the island to provide enough energy to replace all of the fossil fuels which are currently imported. Let's take petrol first. There are already a large number of electric cars on the island. If all the remaining petrol cars were switched to electric, how many wind turbines would it take to power them?

The total quantity of unleaded petrol sold each year on the island is around 25 million litres (1). The energy density of petrol is 34 megajoules (MJ) per litre. The energy produced by one 8 MW turbine in 1 year (similar to the ones you can see in Liverpool Bay) is around 88,000,000 MJ. Therefore, running all the petrol cars on the island would require the energy of around 10 wind turbines.

Similar calculations can be done for the other fossil fuels, the details of which are shown in Table 1 below. Here is a summary:

Diesel: 25,000,000 litres, equivalent to 10 turbines
Natural gas: 110,000,000 cubic metres, equivalent to 45 turbines
Heating oils (kerosene and gasoil): because these are supplied by more than one private firm and the details are commercially sensitive, it's difficult to establish the total quantity imported. However, an Office of Fair Trading report in 2010 (2) suggested that the total amount of heating oil used is similar to the total amount of petrol and diesel used, so let's estimate another 21 turbines for these.
Coal was the main fuel on the island in Victorian times, but is only used in relatively small quantities on the island today (3), the total amount being insignificant in comparison to the other fossil fuels.

Aviation fuel can't be replaced by electricity so I am leaving this out of the calculation.

So if we were to replace all of the fossil fuels on the island with renewable energy, we would need to build a total of 86 wind turbines generating an average of 688 megawatts, plus the associated infrastructure for carrying the electric power around the island and storing it on windy days for later use on days when there is little wind.

Are we up to this challenge? The evidence is not encouraging. In 2010, Tynwald (the Manx Parliament) agreed a renewable energy target of 15% of electricity generated from renewable sources by 2015 (4). Following agreement of the motion, the Department of Economic Development sought expressions of interest to design, build and operate a 20 megawatt onshore wind farm. The project was subsequently shelved on grounds of cost. A report in 2013 admitted that the target of 15%

electricity generated from renewable sources by 2015 would not be achieved, and instead recommended that Tynwald should adopt a greenhouse gas emissions target for the Isle of Man of 80% reduction of 1990 levels by 2050. This is far enough in the future that it does not commit the Manx government to any action in the present. The Isle of Man does not currently have any target for renewable energy. A planning application for three private wind turbines of 10 kW each (microscopic in comparison with what's needed) on the Port Erin headland was refused in 2016 mainly on the ground of visual impact (5).

Plans to build tidal generators off the Point of Ayre, Langness Point and Kitterland were announced in 2015. However, in 2018 the companies which were to have built the generators were dissolved.

In 2015, wind farm specialist DONG, now Orsted, was awarded the rights to explore the potential for a wind farm off the east coast of the island. Studies and surveys are still ongoing but no date has so far been set for constructing anything.

In the decades ahead, the Isle of Man has some difficult choices and trade-offs to make regarding energy supply. If we do nothing, fossil fuel energy will gradually become scarcer, more expensive and come from more questionable sources, for example the Siberian oil and gas fields. Let's hope the Russians are as generous to us with their oil and gas as the UK has been. If we don't want the view to be spoiled by onshore wind turbines, we will have to build them offshore at greater cost. If we don't want to spend the additional money, or build wind turbines at all, then it's unlikely we can continue to support the island's current population as fossil energy supplies decline. We should therefore start planning to downsize the population and associated infrastructure such as schools and housing stock. Most importantly, we need to start having a discussion about the choices before us while we still have time to make those choices.

References

(1) Road fuels market monitoring report 2017. Isle of Man Office of Fair Trading.
(2) An investigation into liquid fuel prices in the Isle of Man. Isle of Man Office of Fair Trading, April 2010.
(3) Isle of Man Census Report 2011. Economic Affairs Division, Isle of Man Government Treasury
(4) A Report by the Council of Ministers on the Renewable Energy Target. Isle of Man Government, May 2013.
(5) Planning Application 14/00632/B. Isle of Man Government

TABLE 1

This table summarises the calculations used to determine the energy equivalence of the various energy sources. To make them comparable with each other, I have calculated a common denominator for all of them, namely megajoules per year. It

was difficult to obtain accurate figures for quantities of some fuels used, and these have been estimated.

Type of fuel	**Quantity used on the Isle of Man per year**	**Conversion factor to megajoules**	**Megajoules per year**	**Equivalent number of 8MW wind turbines producing 88 million megajoules per year**
Petrol	25 million litres	34 MJ / litre	850 million	10
Diesel	25 million litres	35 MJ / litre	875 million	10
Natural gas	110 million cubic metres	37 MJ / cubic metre	4,000 million	45
Heating oil (kerosene and gasoil)	50 million litres (estimated)	37 MJ / litre	1,850 million	21
Coal	885 households using 100kg per year each (estimated) = 88,500 kg	30 MJ / kg	2.6 million	Insignificant
TOTAL			**7,577 million**	**86**