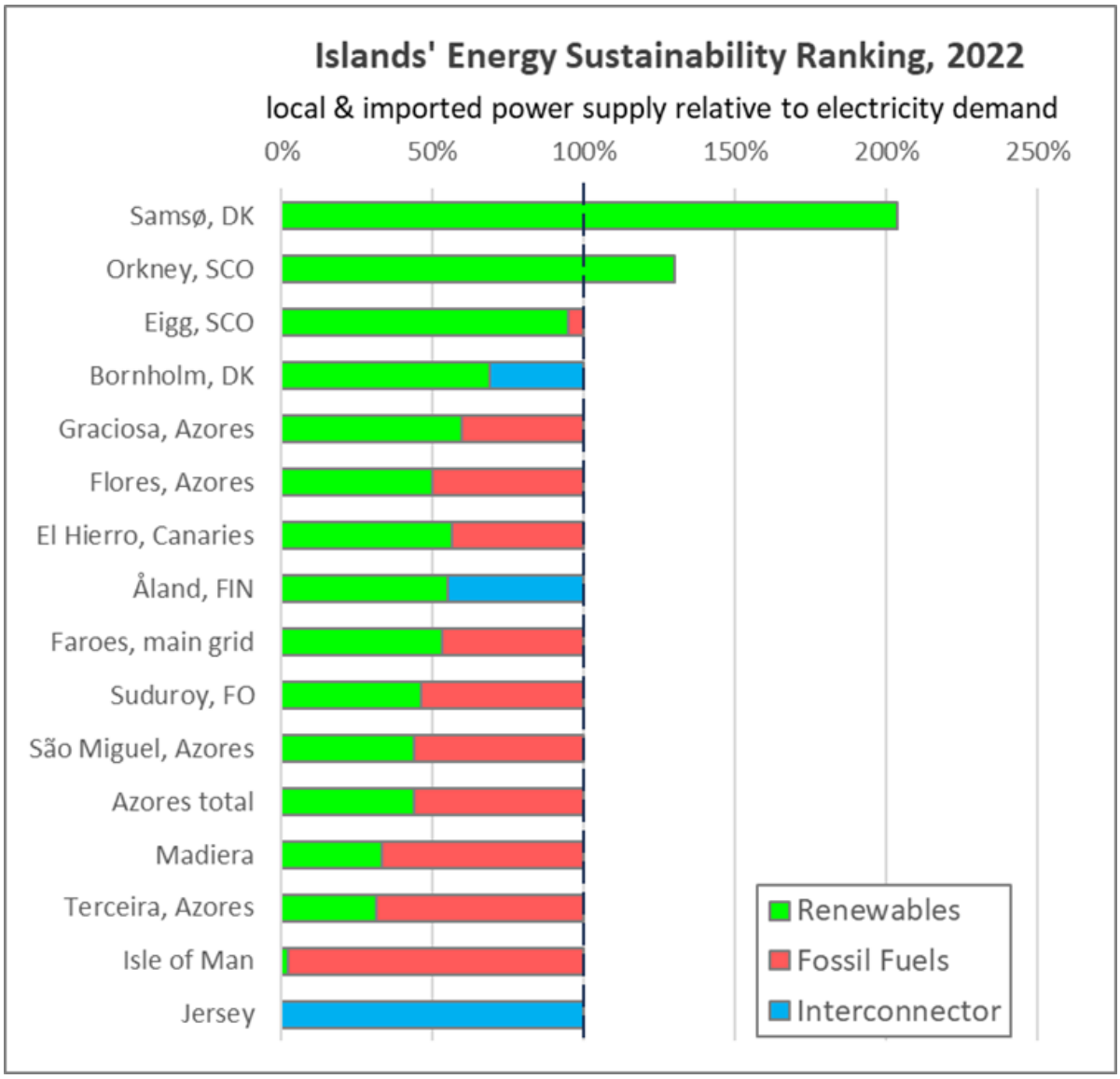
Power and Sustainability on the Isle of Man

The Isle of Man has some of the best prospects for renewable energy in the world, representing huge untapped value to Manx society and of great benefit to the environment. So what is holding us back? This article presents information to facilitate discussions on how we can gain most benefit with the transition to low-carbon energy.



Energy transition league table for 2022. The chart shows how far islands have reached in generating enough renewable electricity to meet local demand. Where a green bar crosses the dashed 100% line is the point that an island in theory produces enough renewable power to be self-sufficient. It is worth noting that all the islands except Orkneys have cheaper electricity than the Isle of Man. Further information is available here.

Background

On the Isle of Man we currently produce an average of 8.2 tonnes[1] of carbon dioxide (CO_2) per person each year, 80% of which comes from using gas and oil for electricity, heating and transport.

Although one of the highest in the world (four times the global average), our emissions can be reduced to one-fifth by changing to renewable sources of energy such as local wind and solar. In which case, we will no longer need to import fuel. Assuming heating and transport are fully electrified, this would represent an annual saving of £210 million, equivalent to nearly £2,500 per person per year.

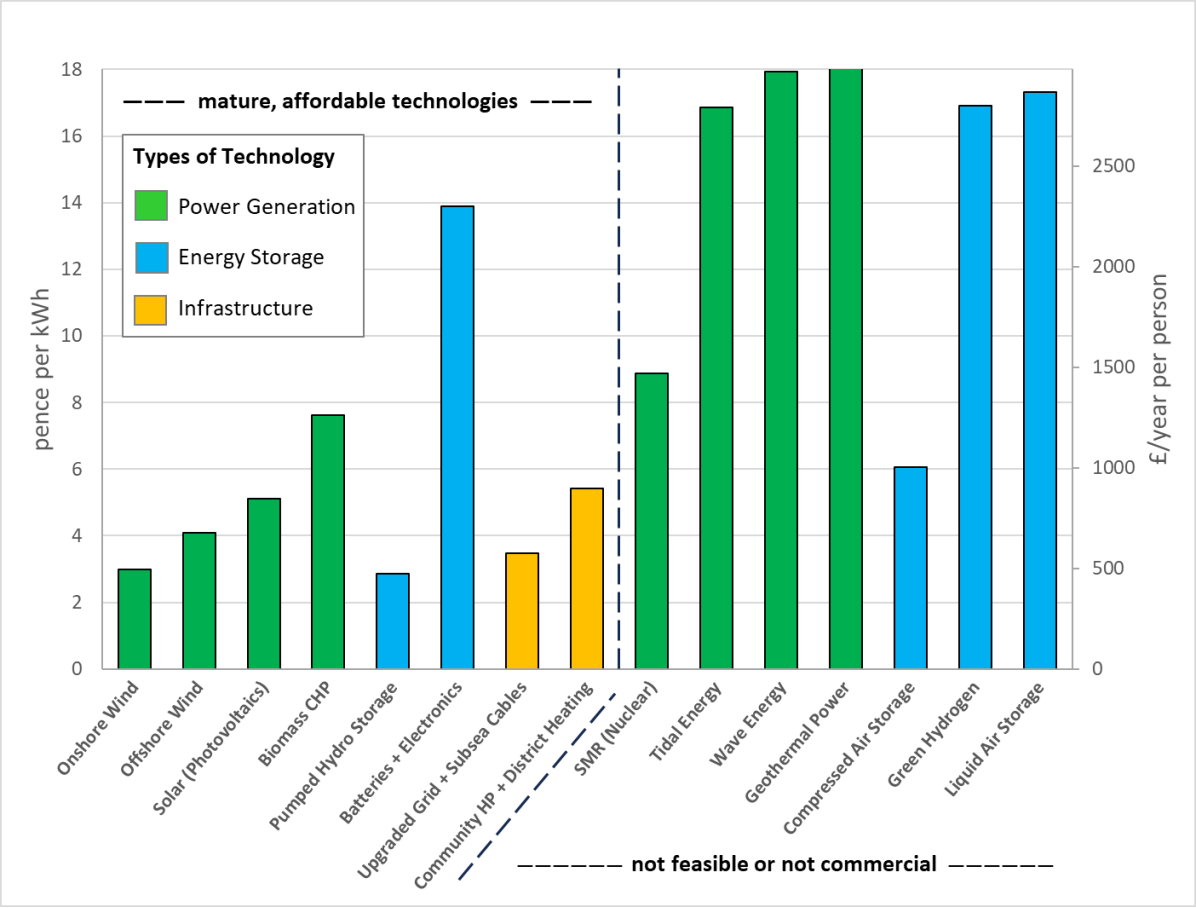


Figure 1. Options to generate renewable power, store energy and utilise power on the Isle of Man. The costs are before-profit averages assuming the investments are spread over 20 years, shown both as per kWh (kilowatt hour) and as per person per year. The energy storage costs are based on 3 GWh storage. The technologies to the right of the dotted line are currently not viable, either for economic reasons or technical reasons.

Our economy and jobs depend on making the shift from gas and oil fairly rapidly because most international businesses are committed to switch entirely to low-carbon power within the next several years.

From the perspective of a local resident, imagine knowing every time you switched on the kettle that the electricity was being supplied from a clean Manx source. Experience from other islands shows that people become proud of using their own renewable energy.

[1] This figure does not include indirect emissions associated with purchased goods and off-island transport.

Although there is some concern with the visual impact of wind turbines and solar panels, an area of less than 2% of Manx land and sea would provide all the power we need.

Autonomy and revenue

BP and ENBW are paying £231 million rent per year to the UK Crown Estate to investigate setting up the Mona and Morgan offshore wind farms. This illustrates the value of wind in the Irish Sea region. All the investments will be paid by the two companies who then aim to recoup the cost over many years by selling the electricity, typically at a price of 4-6p per kWh (Figure 2). Customers on the Isle of Man pay 32p per kWh for electricity generated from gas, so you can see that there is plenty of room for price reductions with a free source of energy such as wind.

Another reason to invest in renewable energy is national security. Recent events have shown that countries who depend on imported gas, oil and electricity are worryingly exposed to events beyond their control. With the invasion of Ukraine by Russia, energy prices sky-rocketed and have remained volatile ever since (Figure 2). Modern economies require huge amounts of energy and, as individuals, none of us can contemplate not having heat, electricity or transport. This means we will pay what it takes to meet our current needs for gas and oil.

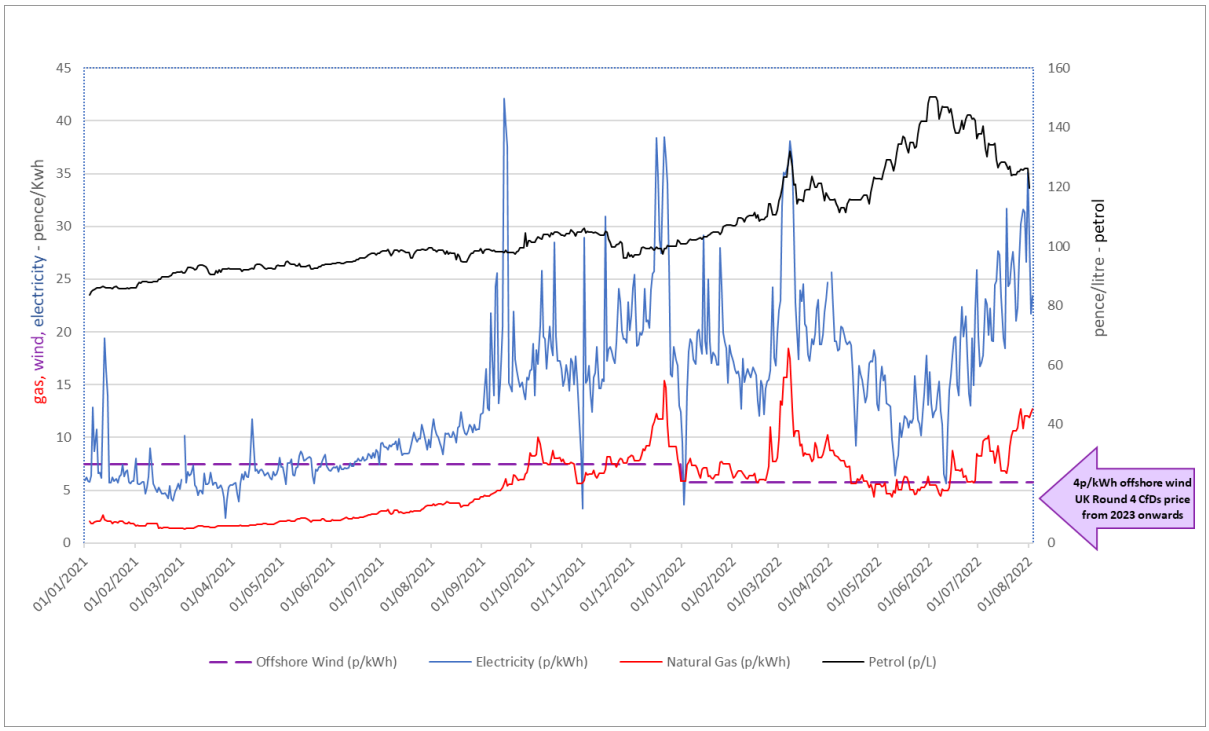


Figure 2. It has been a turbulent time for gas, oil and electricity. This graph shows wholesale gas, wholesale electricity and petrol pump prices for the period 2021-2022, compared to the UK fixed price contracts for offshore wind (CfD = contract for differences). Looking further back, the oil price shocks of 1973, 1979, 1990 and 2008 show that it is wise not to rely on fossil fuels, the reason many islands are switching to renewable energy (Figure 3) and also why the wind industry started in the first place.

Best location in Europe?

The Isle of Man is lagging behind when it comes to the transition from fossil fuels to renewable energy (Figure 3). This surprises international experts as the Island has enviable natural resources which should make the transition not only achievable but also profitable.

The natural advantage we have in the Isle of Man is a huge amount of wind energy plus the perfect geography to utilise it. In fact, the Island's terrain and its central location in the Irish Sea makes it one of the best locations in Europe to establish a hub for renewable energy.

Denmark is leading the race to develop the world's first "green energy island hub" on Bornholm in the Baltic Sea, where electricity from offshore wind will be collected, stored and transmitted to surrounding countries. This represents a significant source of revenue and jobs. The economic model is simple – companies will pay to develop the resource and national consumers will pay for the power.

Figure 3. Chart showing islands' 2030 plans for self-sufficiency in renewable power relative to current electricity demand. The 100% dashed line represents the current electricity demand on each island.

Offshore wind farms require specialised facilities and infrastructure such as above-sea transformers and subsea cables in order to transmit the electricity to national markets. In the case of the Irish Sea, the market is both the UK and Ireland. The idea of an energy hub is to save money by sharing the facilities and infrastructure costs. An existing island is ideal for this, particularly when it is centrally located and surrounded by shallow waters with outstandiing wind conditions like the Isle of Man.

However, it is not just the wind that offers us the opportunity to power a new, sustainable economy but also Manx mountains and water. The main issue with wind and solar energies is that their

strength fluctuates so the supply of generated electricity does not match the demand. Even worse, this variability can cause the frequency and voltage of the electricity on the grid to become unstable, ultimately leading to a black-out if the issue is not dealt with. This is the reason that MUA is proposing to build only a relatively small amount of renewable energy on the Island, relying instead on a subsea cable (an interconnector) to the UK to import most of the power, actually quite an easy way to keep the grid stable. The problem is that market prices for electricity are high and unpredictable (Figure 2). A more cost-effective solution would be to install on-Island energy storage so that surplus power can be kept for when it is needed.

Most islands with a high amount of renewable energy (Figure 3) are investing in two types of energy storage - batteries, to keep the local grid stable, and in facilities known as pumped hydro storage to match power supply to demand. If the Isle of Man possessed sufficient energy storage, it would also profit by trading electricity with the UK and Ireland. When there is little wind or sun around the British Isles and electricity demand is high, the price of electricity can be astronomical. This is when stored power could be sold at large profit. In the opposite case, when the supply of renewable energy outstrips demand, electricity can be imported for next to nothing and stored for future sale.

The mountains on the Isle of Man offer a significant opportunity to establish our own pumped hydro storage facilities. These can be built partly or wholly underground to reduce the surface footprint. In addition, a large set of batteries and electronics, plus a rotating device known as a synchronous condenser, are needed to avoid any grid instabilities from fluctuations in wind and solar power. A real example of how such facilities work is shown in Figure 4.

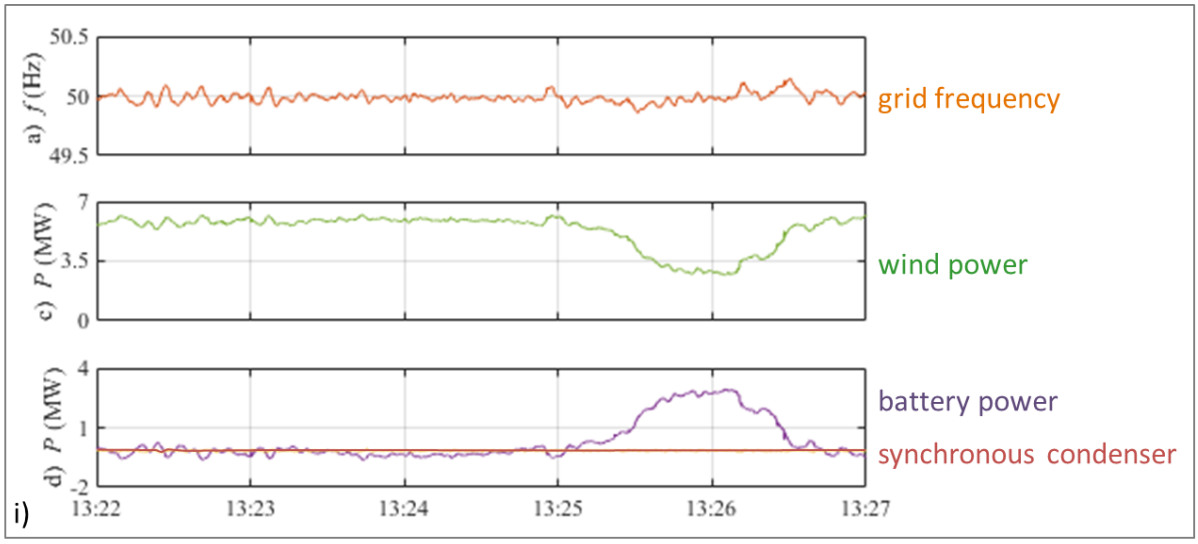


Figure 4. The island of Suðuroy on the Faroes runs mostly on wind power (6.3 MW) and hydro power (3.3 MW) plus some minor solar (0.3 MW). (i) 5 minutes of electronic data at the power control centre showing how, when wind power drops off (green line), the batteries almost immediately kick in (purple line), mirroring the trough with a peak and exactly matching electricity demand to keep the frequency of the grid stable (orange line). Modern pumped hydro schemes are able to do the same but over longer periods (minutes to days). The synchronous condenser has a similar effect to the large turbines of a power station, by smoothing the power over shorter periods (fractions of milliseconds), even before the batteries can react (within a few milliseconds).

Figure 4 continues on the next page.

Figure 4 (ii) Five of seven 0.9 MW wind turbines on Suðuroy. Note the sheep for scale. iii) The Suðuroy synchronous condenser, equivalent to 8 MW of power. iv)-vi) The battery installation (iv), inverters (v) and transformer (vi) at Suðuroy which allow up to 6.3 MW of surplus wind power to be stored and then regenerated when the power is required on the 20 kV electricity grid, i.e. when demand outstrips power production from wind and hydro. SEV, the electricity authority on the Faroes, is now planning to build pumped hydro storage facilities to deal with longer periods of surplus and deficit wind power.

Options for Manx self-sufficiency in green power

Not all renewable energies are suitable for the Isle of Man, either because they are prohibitively expensive or because they are not technically feasible. Tidal, wave and nuclear energy fit in the former category, roughly five times more expensive than wind (Figure 1).

On paper, bio-energy looks interesting, for example, by burning wood in a power station for electricity and/or to produce heat. Unfortunately, there is not nearly enough land on the Isle of Man to produce the fuel from forests or crops whilst there are environmental, price and supply concerns about importing wood, bio-gas or liquids such as bio-diesel or bio-ethanol.

Geothermal energy has gained some publicity and, in the right place, where ground temperatures are high such as Iceland or parts of Italy, it is a valuable source of power. Even in countries like Denmark and Germany, warm water at depth can be used in district heating. Unfortunately, the Isle of Man has the wrong geology – neither the ground temperatures nor the deep water. And even if these were present, boreholes to tap the energy are remarkably expensive and not without risk.

Although emissions from fossil fuels are the main cause of climate change, there has also been discussions on the potential for offshore gas in the Isle of Man. Exploration wells have been drilled in Manx waters, and one such well by BP in block 112/25 showed indications of gas. BP tried their best to get gas to flow from the borehole but with no success. This well is therefore classified as a failure.

Seismic data also show that there is very unlikely to be a gas resource in the vicinity of the well. And even if a new gas discovery was made, it is a long process to test, appraise and develop a field. We would therefore see no return before 2030, when gas is due to be phased out anyway.

It clearly makes sense to develop renewable energy on the Isle of Man as there is no doubt that a massive resource exists. A scenario of how this would be developed over the next several years is shown in Figure 5. However, there is still the question on who should make the investments and manage the projects.

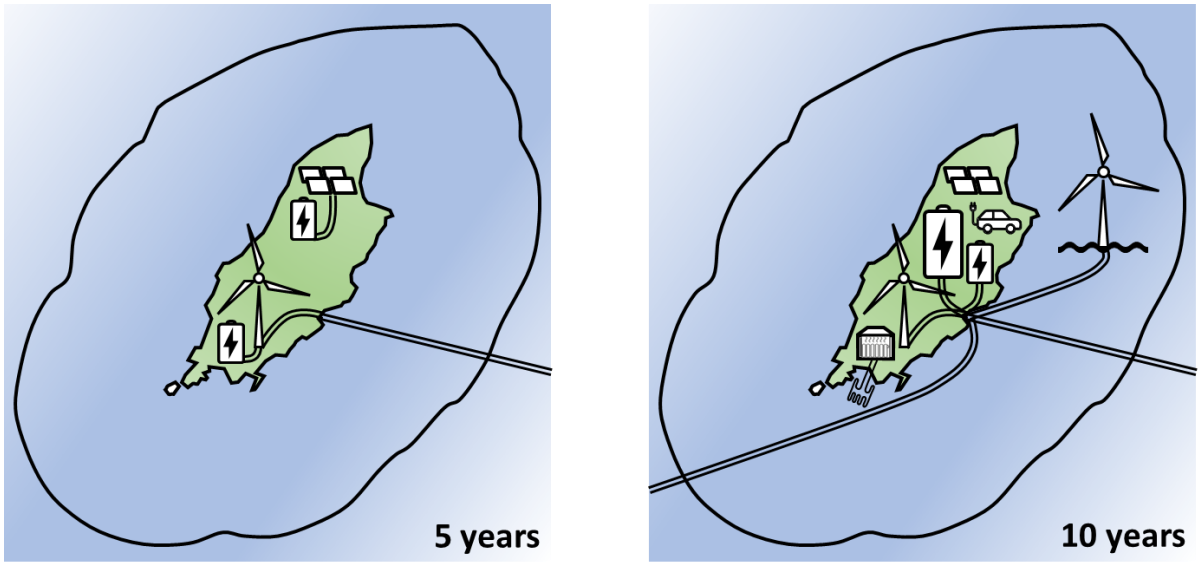


Figure 5. Schematic illustration showing scenarios of how far the Isle of Man could reach in developing home-grown renewable energy over the next several years. Within 5 years – onshore wind farm, solar parks, battery storage, high voltage cable to Douglas and existing interconnector to the UK. Within 10 years – energy self-sufficiency with the additional element of offshore wind, large scale energy storage, synchronous condenser at Pulrose, smart electronics, large interconnectors to UK and Ireland, electric vehicles and district heating from seawater-sourced heat pumps.

Who should pay?

It does not cost Abu Dhabi to develop its own oil resources - companies bid for the privilege to invest as they can profit too. Similarly, nowadays most countries use the private sector to make the up-front investments in wind, solar and hydro power. The same makes sense for the Isle of Man where the commercial potential is huge.

So how does the Government ensure the best outcome for the Isle of Man? We assume that the objectives should be affordable prices, energy security and economic prosperity which, for example should mean that everyone's home is warm and dry.

As the up-front costs for a wind farm, solar park or pumped hydro scheme are high, nowadays most countries invite the private sector to make the developments, often in return for a fixed price for a guaranteed amount of power. In which case, what does the public sector need to do?

First of all, the Isle of Man needs to welcome the private sector by setting clear objectives backed up by appropriate policies and legislation. It is a competitive world but we would gain the attention of commercial companies by presenting a strategy, for example, to make the Island a net exporter of green energy.

Secondly, the Island can make itself "open for business" by making the procedure to apply for licences, planning permissions, grid connections, power contracts and export routes both straightforward and transparent.

Thirdly, to make the strategy realistic, we would need to plan for 1) energy storage facilities, 2) two large subsea interconnectors to UK and Ireland; and 3) modernisation of the Island's electricity transmission network. Both 1) and 2) can be funded and constructed by industry but 3) would involve public sector investment, particularly in facilities to keep the grid stable such as batteries and synchronous condensers (Figure 4), as well as the cables, transformers and equipment to allow for an expected doubling in electricity consumption, once heating and transport is taken into account.

An obvious point is that the Government should not try to do everything itself but should rather facilitate the process. MUA's role would therefore need to change in order to encourage outside investments by providing access to the grid for power generators, promoting agreements to purchase electricity and supporting market arrangements to trade green electricity. Public sector investments would focus on building the facilities needed to transmit, stabilise and distribute the power, including smart electronics and major upgrades to the domestic supply network. Other parts of the system, such as interconnectors, would probably be best achieved through public-private partnerships.

Finally, not to forget why this is critical

Together with the rest of the international community, the original reason for the Isle of Man's commitment to net zero greenhouse gas emissions was to mitigate climate change. From a purely parochial perspective, the Island will suffer if global temperatures continue to rise. For example, if melt water continues to flow from Greenland, the Gulf Stream will stop, rather ironically making the Island significantly colder. Before that happens, many local birds, insects and sea-life are likely to die out, whilst global catastrophes and human migrations will affect everything from food prices to our mental well-being.

The Isle of Man Climate Change Act means that we have no choice but to change how we generate and utilise power. Fortunately, this is a real economic opportunity for the Island, provided we are ambitious and work together. Some people do not like the idea of wind turbines but both the environment and society is under such threat so we need to find a way of dealing with this reticence. Some islands have used community schemes, financial compensation and other direct benefits.

Clearly, consultation is an essential part of the energy transition whilst the benefits need to be shared fairly. Green Talks Live on 28 November 2023 is part of the Energy and Sustainability Centre's efforts to advance the process, which also includes a short briefing and several videos.

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22 November 2023.

Energy and Sustainability Centre IoM

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