Bronllys Well Being Park (CLT) Ltd

Feasibility Study into Energy

October 2020

For more information visit www.bronllyswellbeingpark.org

Address: Bronllys Well Being Park Office
Bronllys Hospital, Brecon, LD3 0LU
info@bronllyswellbeingpark.org Tel: 01874 712630

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Introduction

"Never doubt that a small group of thoughtful, committed, citizens can change the world. Indeed, it is the only thing that ever has."
— Margaret Mead

Human activity is changing nature at a rate never seen before. Forests are being torn down to make way for industrial farming. Oceans are being drained of fish and aquatic life. Rivers are being poisoned by toxic chemicals. One million animal and plant species are threatened with extinction. (1)

We all depend on nature. It provides us with clean water and the air we breathe. Healthy ecosystems contribute hugely to a stable climate and are vital for our mental wellbeing, too. The problem is now so severe that experts are warning that the loss of plant and animal species we're seeing today poses a serious risk for global food security (2)

It is not too late to fix this. But if we humans don't trade our individualistic, patriarchal control model, which is a model of domination and power over nature, for one of humility and wisdom and the knowledge that we are a part of nature (3), if we don't change our path, the extinction crisis will have consequences for all of us, threatening food and water security, exacerbating climate change, and even putting us at greater risk of pandemics.

Social renewal is also the result of human action. Time and again it is the grassroots movements that change the world, ordinary people and community groups willing to change the status quo.

Although a growing belief may tell us that all we need is a lot of passion, a lot of commitment, many good intentions, a mixture of rebels, disruptors and challengers and voila, change will happen. It will not. We need a clear platform for change, sustainability of the change and a clear strategy or the energy of rebels, disruptors, mavericks and challengers will be lost.

The Future Generations Act is a platform for Wales and its communities. Citizens and communities who are serious about changing the paradigm can find guidance and a common goal. In these times of turmoil, more than ever before, it has become crucial to revisit values and ethics that define us as humans.

In her foreword to the recently published Future Generations Act report, Sophie Howe, commissioner for the Act, speaks of the 'frustrated ambassadors': ordinary people who, without much noise, change the paradigm day by day, gradually;

- silent and efficient change, instead of loud and inefficient contrarians;
- organised but nearly invisible employee-activists instead of disorganised, loose cannon rebels;
- driven backstage champions working on semi-invisible community models instead of loud and noisy big corporate ambassadors with a stack of power points.

The paradigm of individualism may well be the flaw in our species. (3) We need to relearn how to live relationally rather than competitively and change the paradigm of Them vs. Us.

The lack of connection sickens us and reconnection restores us. *A healthy relationship to oneself, others, one's community, planet, and spirit is the pearl of great price. It is the seat of our happiness; it is the only thing that gives and sustains our fulfilment.* (3)

The Future Generations Act sets out five ways of working (known as 'the Sustainable Development Principle') for use in communities and public bodies to achieve their vision.

They are: long-term, prevention, integration, collaboration and involvement. We owe it to our Future Generations, to our children and grandchildren, to work on it now, together!

We won't have a society if we destroy the environment.

Margaret Mead

Summary

Our primary sources of energy, fossil fuels, are running out, and burning them causes pollution (greenhouse gas emissions) — a leading cause of global warming. Due to global warming the world is getting hotter and could get 1.5˚C hotter as soon as 2030. That's only a decade from now, well within the lifespan of most people alive today.

Extracting fossil fuels through mining and drilling have serious consequences for our environment and health. That's why new forms of clean energy are emerging to help us reduce our dependence on "dirty energy" sources.

At a 2016 United Nations Climate Change Conference, nearly 50 countries agreed to exclusively use renewable energy by 2050. And roughly a fifth of the world's electrical power production now comes from renewable sources. (4)

The UK, Germany, Sweden, and Iceland are leading the way in renewable energy. Germany set a record in 2017 for fulfilling about 85% of its electricity needs with solar.

Decarbonising energy is driving a global shift in the energy world and is key to Wales achieving its carbon budgets. There is a huge opportunity to use its own natural resources to provide low carbon energy which will retain value within the local economy.

Source: Energy Generation in Wales in 5 Minutes

Time is quickly running out for the world to avoid catastrophic climate change. Four years ago, nations pledged to limit global warming to 1.5–2 °C above pre-industrial levels as part of the Paris climate accord, but they are largely failing to meet their commitments — and emissions of carbon dioxide and other greenhouse gases continue to escalate.

The good news is that countries are rapidly adding renewables to their energy mix, but they are also burning increasing amounts of coal, oil and natural gas. That puts billions of people

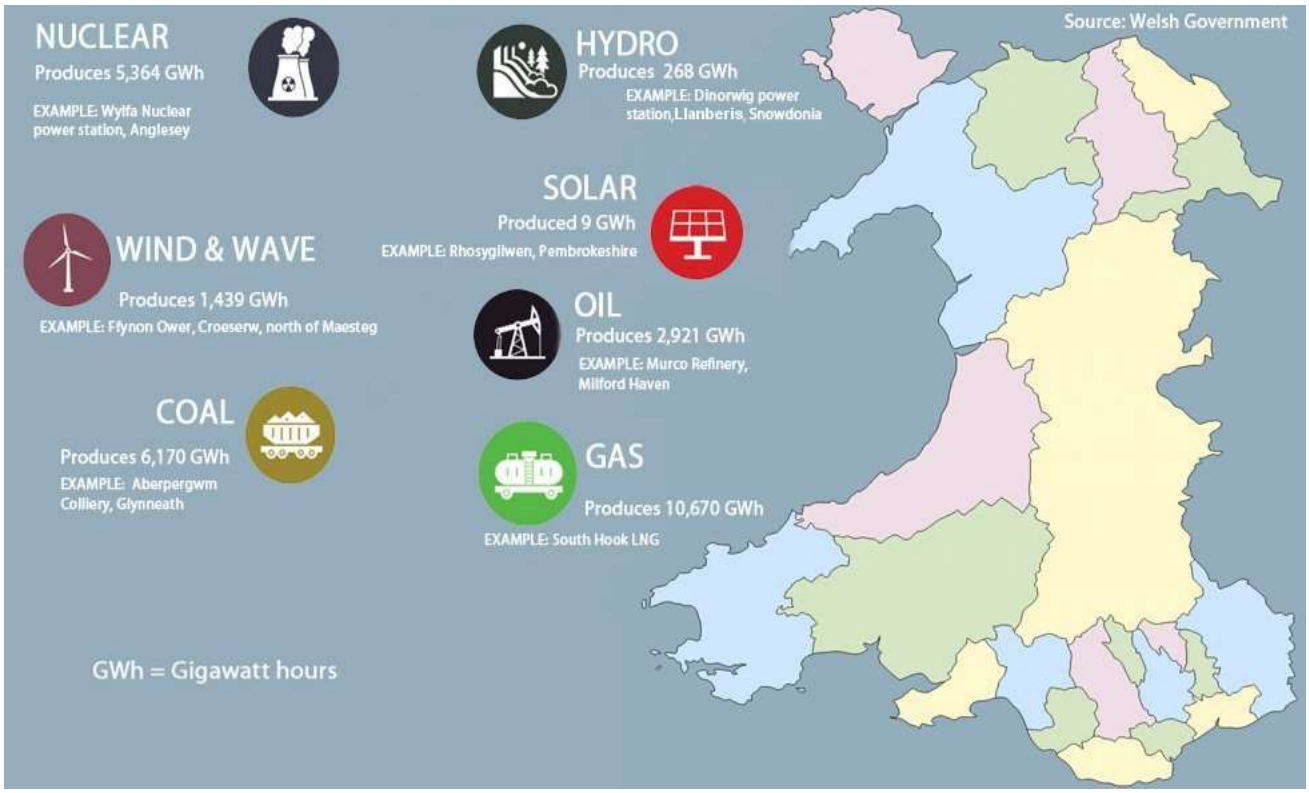
at risk, particularly some of the most vulnerable, who have contributed the least to the problem. (4)

It is clear that community energy organisations can and must play an integral role in the energy system transition and that better support is required to ensure that these organisations can participate in an inclusive and proactive way. Policy makers, regulators and the wider energy market should be looking to community energy as a means of delivering appropriate and impactful change at the local level, stimulating low carbon projects and initiatives which will benefit UK communities and the energy system for years to come. (5)

The state of our Earth is in serious jeopardy, and has been for a while. We've inflicted irreversible damage on our environment, and although we may not be in immediate danger, there's no doubt our children will be.

Reducing the use of fossil fuels will improve the quality of our air, reduce our dependence on foreign oil, and create thousands of new jobs through green energy.

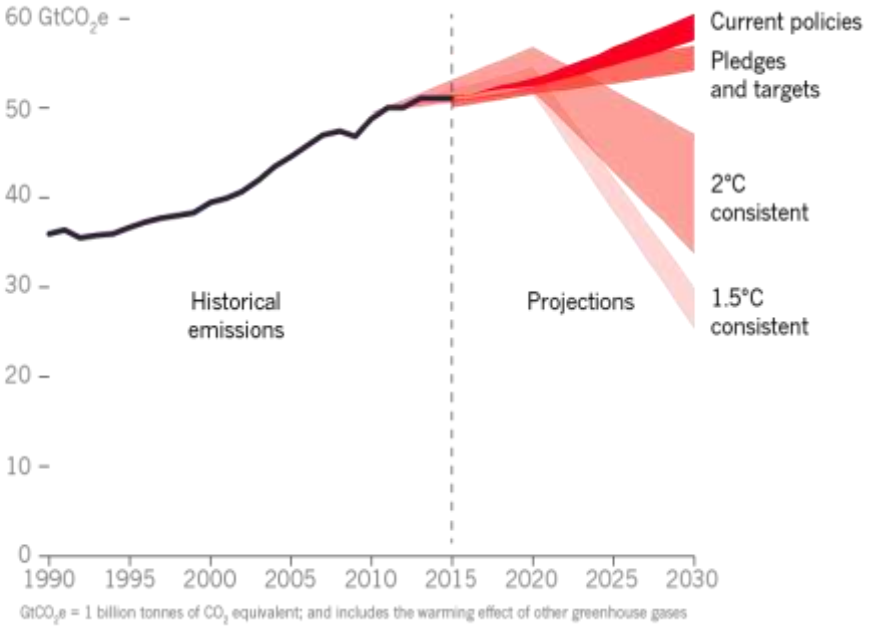
The state of the planet shouldn't rest on our shoulders alone. We need to make small changes **together,** and commit to be kinder to our Earth — after all, we have **no other** planet.



3.0 Global State of Progress regarding Climate Targets

DO OR DIE

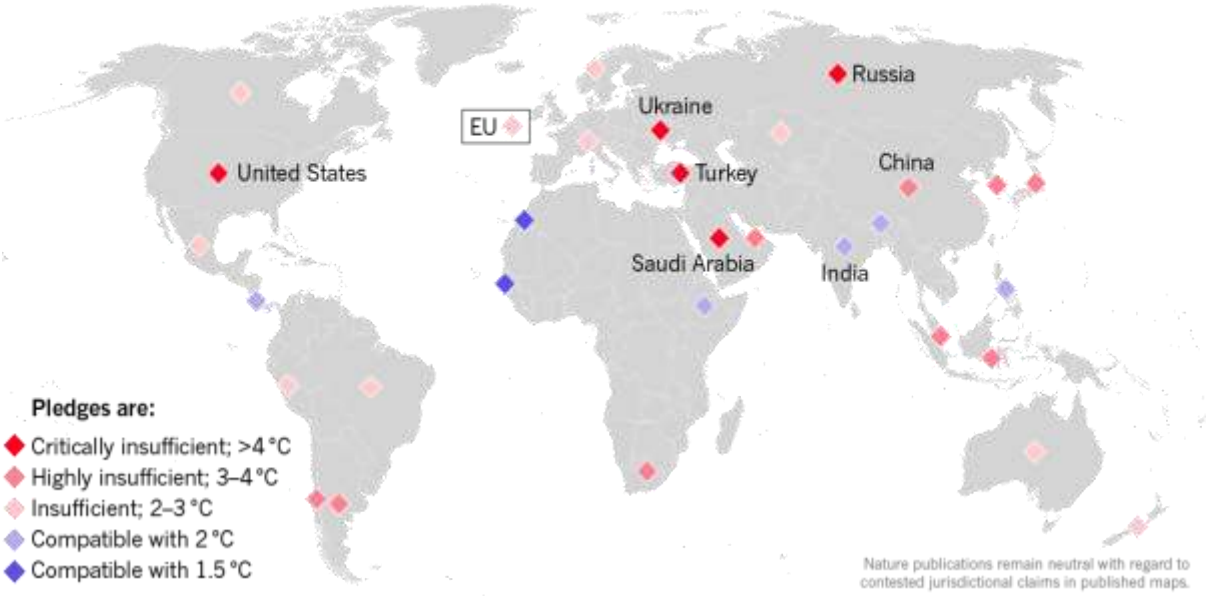
For the world to meet the Paris target of limiting global warming to 1.5°C, nations would have to slash their CO_2 emissions to zero by 2050, according to the Intergovernmental Panel on Climate Change. Even staying below 2°C of warming would require massive cuts. In reality, emissions are still rising under existing policies and environmental pledges.



Source: Climate Action Tracker

NATIONAL COMMITMENTS

Climate Action Tracker (CAT), a consortium of scientists and policy specialists, has rated countries on the basis of their policies and emissions pledges, and has estimated the amount of warming that is compatible with those actions. The CAT rates a nation's commitments against what it judges to be a fair-share plan to reduce emissions.



Source: Climate Action Tracker

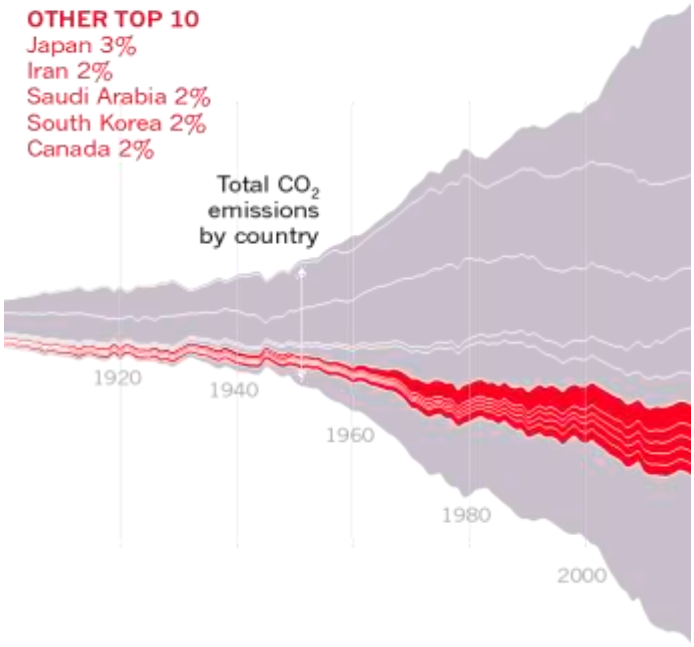
European Union: The 28 EU nations account for more than one-fifth of CO_2 emissions over time, but their collective annual emissions have dropped by more than 20% since 1990. Some estimates suggest the EU is on track to meet its Paris targets. Coal use is dropping but remains a major source of emissions.

United States: US emissions surged in 2018, but they have been declining generally over the past decade because coal use has fallen, in favour of natural gas and renewables. However, President Donald Trump is rolled back provisions to curb greenhouse-gas pollution and pulled the country out of the Paris accord.

China: Where China goes, the world goes. The country is the largest source of CO_2 and its emissions are growing while other big emitters are turning the corner. CAT says China is on track to see its emissions peak by 2030 — in line with its Paris pledges — but that is not consistent with keeping global warming below 2 °C.

India: India has contributed much less to global warming than have other large countries, on a per capita basis. Although its energy use and coal consumption are growing rapidly, the country is also emerging as a leader in renewable energy.

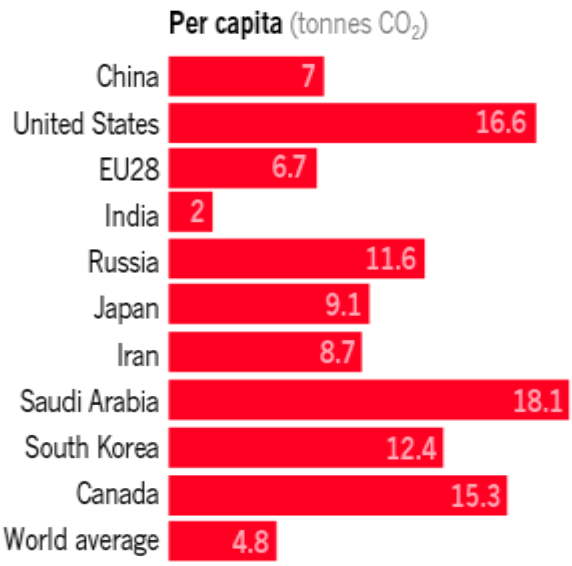
Russia: The collapse of industry after the break-up of the Soviet Union caused CO_2 emissions to plunge, but they have been rising since. Russia has invested little in renewables such as solar and wind and the CAT gives Russia its lowest rating. (4)

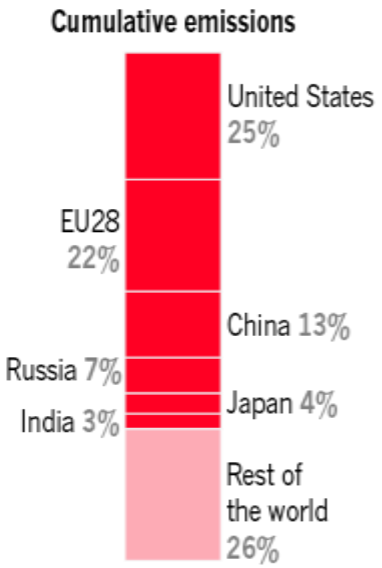


Source: Global Carbon Project

FAIRNESS

Current emissions are only one way of looking at the problem. Although China is now the largest producer of CO_2, it is responsible for just 13% of all emissions over time. Its per capita emissions are rising quickly, but the US leads in per capita and total emissions.

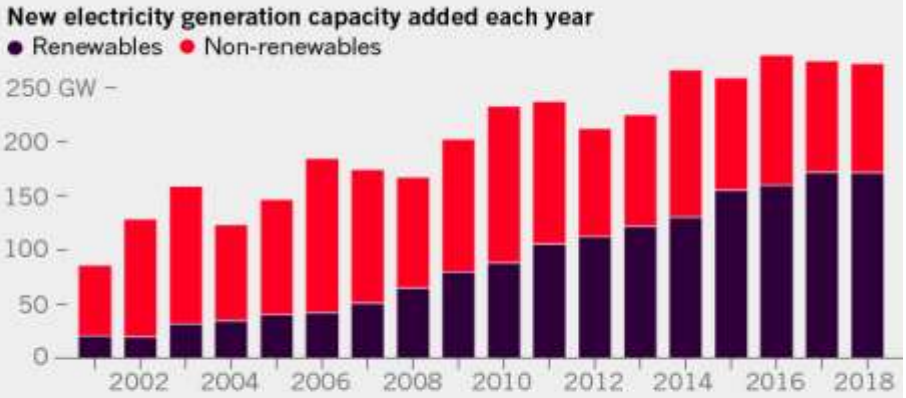


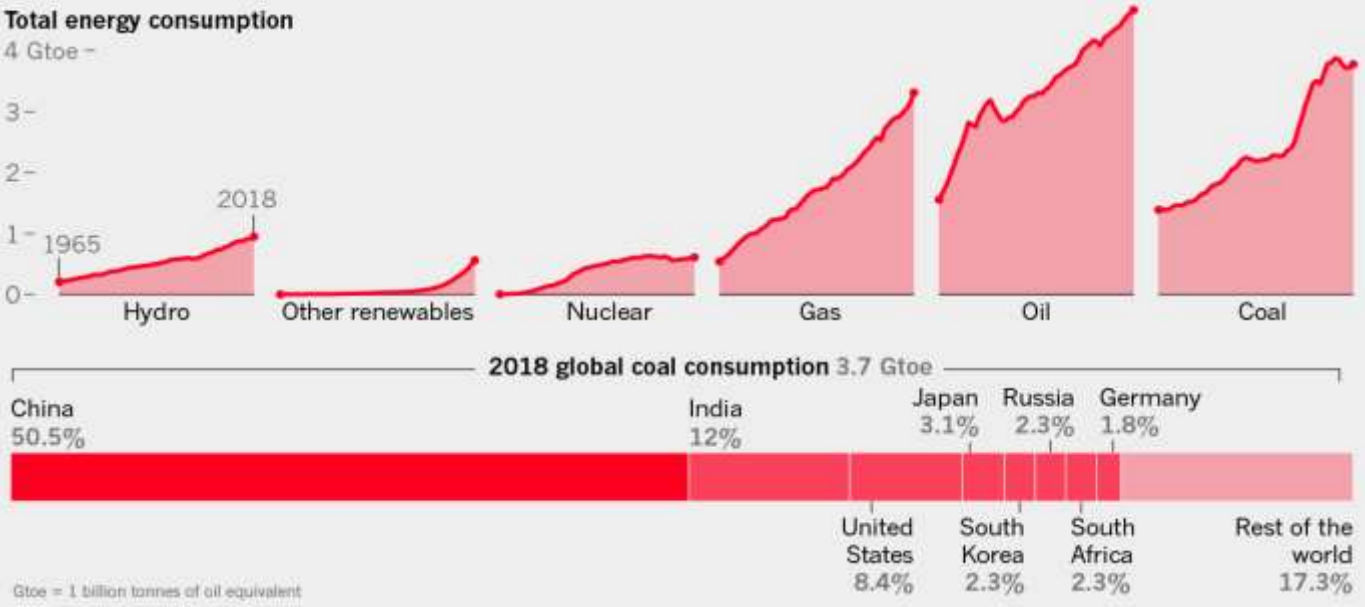


Source: Global Carbon Project

FUELLING THE WORLD

In the past decade, the world has added more renewable energy capacity for generating electricity than it has added from coal and gas. Most of the new renewable energy comes from solar and wind power — with China leading the way. But electricity is just one part of energy use, and consumption of fossil fuels continues to grow rapidly. China accounts for more than half of the global use of coal, the fuel that produces the most CO_2.





Source: Global Carbon Project

3.1 Where does mid Wales fit in?

Mid Wales is well placed to deliver on Wales' ambition to capture the opportunities associated with the low carbon economy and clean growth.

Total renewable electricity generation stood at 653.2 GWh in Mid Wales in 2016, driven by onshore wind and the hydro power generation. The region possesses a large number of individual renewable generation sites (6,010 across Mid Wales), primarily for solar photovoltaics.

Grid capacity in Mid Wales is a significant constraint to future growth. Access to the energy network for domestic customers is restricted whilst the significant cost associated with grid reinforcements has held back further investment.

Mid Wales faces challenges in terms of fuel poverty. 17% and 14% of households in Ceredigion and Powys, respectively, live in fuel poverty with extreme levels of poverty being found in areas such as Llangeitho, Aberystwyth and Cardigan. High levels of fuel poverty are also found particularly in the north of Powys.

The Growing Mid Wales partnership (6) **in their strategic document sets it priorities for Action on Energy as follows:**

Priority	Intervention
Transformational priorities	• Network capacity upgrades and co-investment
High priorities	• Waste to energy/ combined heat & power (CHP)
	• Regional renewable energy regional investment programme
	• Hydrogen economy feasibility study
Supporting priorities	• Low carbon transport programme
	• Rural business and community renewable energy generation programme

A key driver of electricity demand over the longer term at the UK level is the electrification of transport, resulting in increased demand across all current scenarios produced by National Grid. This will present opportunities and challenges related to supporting infrastructure for electric vehicles in rural areas where access and mobility is constrained.

In the longer term, the potential to develop the hydrogen economy is forecast to be a central part of the UK's energy strategy. Energy storage and hydrogen production could offer a real economic benefit in Mid Wales utilising renewable energy generation and the region's water supply to produce hydrogen through electrolysis. Early stage research into the feasibility of the hydrogen economy should be considered to better place Mid Wales and set out the future investment needed to harness the region's natural assets.

The energy world is changing dramatically with an expected greater focus on local and less on big centralised electricity generation – a major paradigm change.

Traditional extraction of finite resources (coal mining) and their processing (oil refining) are well past their peak. Wales is ideally placed to deliver on the clean energy transition.

4.0 What is renewable energy?

Renewable energy is clean energy that comes from natural resources, such as the sun, wind, and water (think: solar, wind, and hydro energy).

4.1 Why is it better?

With renewable energy, there is no need to worry about things like the sun and wind running out like fossil fuels will. Plus, they have far fewer negative consequences for our environment.

4.3 Why do we continue to rely on fossil fuels?

1. Cost of investment

One of the biggest barriers is cost. While renewable energy is 'free' and the maintenance is minimal, building the technology is expensive. Although it is cheaper in the long run, the upfront expense is a road block for investors and politicians. On the other hand, fossil fuels are relatively easy to access and cheap to use.

2. Unreliability

Renewable energy sources aren't always reliable. If a wind turbine relies on wind for its power, or sun for solar panels, what happens when the weather changes? The fact that wind and solar don't produce energy around the clock can be an obstacle for some.

3. Lack of incentive

Without government incentives for investors, the renewable energy market growth is seriously hindered. Tax incentives from the Government could further increase the boost of renewable energy.

4. Lack of education

One of the biggest challenges is getting people to switch from their non-renewable energy sources, especially since many assume it's unreliable and expensive. Lack of education and misinformation around renewable energy still remains one of the largest barriers in green energy production.

5.0 Community Energy (7) (8)

5.1 Key Messages

• 2018 was the toughest year yet for community energy: The sector has been negatively impacted by recent reductions in subsidy support and unclear government strategy.

• The removal of the Feed-in Tariff is already having dramatic impacts: Few new generation projects were developed in 2018, with newly installed generation capacity falling steeply in comparison to previous years.

• Communities are concerned about the future of the sector: With fewer opportunities and greater challenges, many community energy organisations are moving away from energy generation and towards energy efficiency and wider low carbon projects.

• Community energy continues to demonstrate resilience and determination. In response to increasing challenges, communities are developing new business models and exploring innovative new technologies and approaches to low carbon development.

• Community energy across the UK is in need of clear guidance and support. Communities must be supported to access new opportunities and innovations to ensure the long-term growth and additional impact of the sector (5)

5.2 Looking Ahead

2019 was a challenging year for the sector whether there is still optimism for 2020 and beyond is unclear for many in the community energy sector. New opportunities arising from the energy system transition offer new possibilities for community-led energy development even after the Covid pandemic.

5.3 Fossil Fuel electricity generation (7 pp. 36-38)

Fossil fuel generation in Wales has a total capacity of approximately 7.6 GW, including nearly 5.9 GW of gas power, 1.6 GW of coal and 0.1 GW of diesel. Deeside Power station, a Combined Cycle Gas Turbine (CCGT), has been decommissioned, reducing the capacity of fossil fuel electricity generation in Wales by 515 MW. In 2018, gas generation capacity was mainly made up of five large CCGT power stations:

• Pembroke Power Station – 2,269 MW (currently the largest gas power station in the UK)

• Connah's Quay Power Station – 1,380 MW • Severn Power – 850 MW

• Baglan Bay Power Station – 520 MW

• Barry Power station – 235 MW (ceased operations in March 2019)

Wales has around 740 MW of small-scale (>100MW) fossil fuel electrical capacity, which includes diesel generators, CHP projects, open cycle gas turbines and gas reciprocating engine sites. Over the last decade there has been a greater need for smaller, decentralised power stations to provide flexibility services to the network, in order to replace decommissioned centralised power stations and to support the rapid increase in renewable energy generation.

Many of these generating stations operate as 'peaking plants', designed to generate only during periods of peak electricity prices or in response to calls from the UK Electricity System Operator (National Grid ESO) or Distribution Network Operators.

In South Wales there is currently a constraint on the transmission electricity network, preventing controllable generation technologies (e.g. thermal generation, battery storage, fossil fuel and some biomass) from connecting to either the transmission or distribution networks until 2026. It is unclear whether the closure of Aberthaw Power Station in 2020 will help mitigate this constraint or expedite the solution to unlocking capacity sooner.

Future

The Welsh Government has adopted the target recommended by the Committee on Climate Change to reduce carbon emissions from Wales by 95% by 2050. The Welsh Government has also declared an ambition to reach net zero by 2050 and will work with the UKCCC and other stakeholders to understand how this could be achieved.

Reducing carbon emissions from power generation is vital to the achievement of carbon targets; a future energy system powered solely by low carbon energy sources is needed. The closure of Aberthaw Power Station in April 2020 will contribute towards Wales' carbon targets and will mean that power generation in Wales will be coal-free five years ahead of the UK's target of 2025. The reason for the closure is due to several market conditions, including increasing competition from gas power.

While several larger-scale fossil fuel power plants are closing, there is currently an increased interest in connecting smaller, distributed, flexible gas generation sites in Wales. These flexible gas generators are expected to continue to play a role in the wider electricity system, as variable low carbon generation capacity increases.

To what extent and how often flexible gas generation will be called on to operate varies significantly under different future energy scenarios. However, reducing the carbon impacts of these gas generators will need to be considered if Wales' carbon reduction ambitions are

to be achieved. Small backup and on-site fossil fuel electricity generators, which may be located on farms or industrial and commercial properties, are likely to be underestimated within the data.

6.0 Low Carbon Technologies (7) CHP

The UK's main energy demands are three-fold:

Transportation (mostly oil-fuelled),

Electricity (generated from natural gas, nuclear power and renewables)

Heat (chiefly gas)

Of the Welsh local authority areas, Carmarthenshire experienced the greatest renewable energy capacity growth in 2018, due largely to the commissioning of Brechfa Forest West Wind Farm. Denbighshire followed, with a more moderate increase. Three-quarters of Welsh local authority areas saw capacity increases of less than 5 MW.

Powys is the local authority area with the greatest installed renewable energy capacity, with 369 MW. However, Neath Port Talbot still has the highest renewable energy generation, with an estimated 1,092 GWh. Ceredigion has the highest percentage of its electricity consumption met by renewable electricity generation. This is due to a combination of its low electricity consumption and its diverse and relatively high amount of renewable energy, including hydropower, onshore wind and biomass electricity and CHP.

6.1 Anaerobic Digestion (7 p. 16)

There are 45 anaerobic digestion (AD) projects installed in Wales, totalling 27 MW of electrical and thermal capacity. No new anaerobic digestion AD projects have been identified as commissioning in 2018.

Analysis

The 27 MW of AD capacity in Wales is made up of 19 MW of electrical capacity and 8 MW of thermal capacity. 16 of the 22 local authority areas host one or more AD plants. Around a quarter of the AD plants are in Powys and account for 6 MW of total capacity. Deployment rates of AD have halted since subsidy tariff rate cuts in 2017, before which there was a period of high growth; between 2014 and 2016, the number of AD projects in Wales trebled.

6.2 Bio Mass Heat (7 p. 17)

Biomass heat projects represent over two-thirds of all renewable heat capacity in Wales, with a total thermal capacity of 443 MW from 3,345 projects. There were 135 new projects commissioned in 2018, adding 45 MW of capacity. Biomass heat deployment over time Geographic distribution of biomass

Analysis

There are five biomass heat projects with a capacity over 1 MW in Wales, the largest of which remains the 23 MW solid biomass boiler at a wood manufacturing plant in Wrexham,

commissioned in 2014. The most recent project, commissioned in 2018, is a 1.25 MW solid biomass boiler in Rhondda Cynon Taf. These five projects make up 12% of Wales' biomass thermal capacity.

Powys is the local authority area with the highest biomass deployment, with a total thermal capacity of just under 132 MW across 928 projects, representing just over a quarter of all biomass heat projects in Wales. Ceredigion and Carmarthenshire are the local authority areas with the next highest capacities, with each hosting around 43 MW.

Biomass heat projects in Wales generated 1,360 GWh of heat, enough to meet the equivalent heat demand of approximately 108,000 homes. However, the deployment of biomass boilers in domestic properties (excluding log burners) is limited, with installations in less than 0.1% of Welsh homes. In 2018, 68% of new installations were in non-domestic properties.

6.3 Biomass Electricity and CHP (7 p. 19)

Technologies within this category include electricity from biomass (including waste wood), biomass CHP plants and biomass gasification plants. There are currently 48 operating projects in Wales of these types, with a total electrical capacity of 131 MWe and thermal capacity of 119 MWth. In 2018, four projects were commissioned, with a total capacity of 10.7 MWe. The biggest was the 10 MWe waste-wood fired gasification plant at Barry Docks in The Vale of Glamorgan.

Analysis

The development of new biomass electricity and CHP in Wales has reduced significantly in recent years, from 20 new projects in 2016 to 4 in 2018. The overall electrical capacity of this category increased by 8% in 2018, following a small decrease in 2017.

At 41.8 MWe, the Margam Green Energy Plant in Neath Port Talbot, commissioned in 2017, is the largest plant in this category to be installed in recent years. The CHP plant at Shotton Paper Mill in Flintshire remains the project with the highest total capacity at 115 MW, due to having the highest thermal capacity at 90 MWth combined with an electrical capacity of 25 MWe.

6.4 Energy from Waste (7 p. 21)

This section includes energy from waste plants that generate energy from municipal or commercial waste and excludes wood-waste only plants which is considered in the biomass electricity chapter on this page. Anaerobic digestion is considered as a separate technology (see page 12). Only one energy from waste plant is now in operation in Wales, with a total electrical capacity of 30 MW.

Analysis

The only energy from waste project in operation is the 30 MW Trident Park energy recovery facility in Cardiff, owned and operated by Viridor. Commissioned in 2015, Trident Park has the capacity to handle 425,000 tonnes of municipal waste a year and diverts at least 95% of residual waste produced in South Wales. The 5 MW Swansea Crymlym Burrows waste incinerator in Neath Port Talbot has been decommissioned.

6.5 Heat Pumps (7 p. 22)

Wales has 56 MW of air, ground and water source heat pumps across 4,928 installations. 488 new projects were commissioned in 2018, adding 5.5 MW of thermal capacity. Heat pump installations currently produce 108 GWh of heat, the equivalent of 0.6% of estimated domestic heat demand in Wales.

Analysis

In 2018, the heat pump installation rate in Wales fell slightly below the recent annual average, with 488 new installations; this is the lowest number of new projects since 2011. The majority of new installations were air source heat pumps, with 403 new projects falling under that category. These now make up 72% of all heat pumps in Wales. However, the largest heat pump installed in 2018 was a 173 kW water source heat pump in Powys.

The deployment rate of installations over 45 kW in capacity fell in 2018, with only five projects compared to seven in 2017. The majority of new installations are small-scale heat pumps below 10 kW capacity. Powys is the local authority area with the highest number of heat pumps, with a total of 882 projects, giving it the highest thermal capacity of 9.7 MW. In 2018, Ceredigion saw the greatest growth in installed capacity and projects, with 0.87 MW being installed across 116 projects.

6.6 Hydro Power (7 p. 24)

Wales has 182 MW of hydropower capacity from 364 projects. Hydropower generates approximately 367 GWh of power annually, enough to power the equivalent of 104,000 Welsh homes. The largest project commissioned in 2018 was the 550 kW Bryn Cowlyd Water Treatment Works Hydroturbine in Conwy.

Analysis

There were only six new projects commissioned in 2018, less than 10% of the deployment rate of 2015 when installation rates peaked at 70 new projects. Total installed hydropower capacity increased by less than 1% between 2017 and 2018. Nearly 80% of the installed capacity in 2018 is due to the 550 kW Bryn Cowlyd project in Conwy, the first project over 500 kW that has commissioned since 2014. No hydropower project over 700 kW has been commissioned in the last 20 years.

The largest hydropower project in Wales, Rheidol Power Station, is in Ceredigion, commissioned in 1964 and has a capacity of approximately 56 MW. Gwynedd remains the local authority area with the greatest number of hydropower projects in Wales, with 141 projects totalling 59 MW. However, due to hosting Rheidol Power Station, Ceredigion has the greatest hydropower capacity with just under 71 MW across 28 projects.

6.7 Landfill Gas (7 p. 26)

There are 24 landfill gas projects in Wales with a total capacity of 31.4 MW. There was no change between 2017 and 2018 in the number and total capacity of landfill gas powered generation plants.

Analysis

Landfill gas in Wales generated 117 GWh of electricity in 2018, enough to power the equivalent of approximately 33,000 Welsh homes. However, the amount of generation from landfill gas has been decreasing each year from a peak in 2014. This is due to waste increasingly being diverted away from landfill, particularly organic waste, and so the amount of methane gas captured from decomposing waste is decreasing.

There remains a spread of landfill gas projects across the local authority areas in Wales. Merthyr Tydfil has the greatest capacity with 6.3 MW, including the 4.3 MW Trecatti 2, the largest landfill gas site in Wales. Wrexham has the highest number of projects and second largest capacity in Wales, with three projects and a total of 4.4 MW capacity.

6.8 Onshore Wind (7 p. 28)

Welsh onshore wind capacity increased by nearly 100 MW in 2018 to 1.1 GW, generating enough electricity to power the equivalent of 55% of Welsh homes. The vast majority of new onshore wind capacity commissioned in 2018 was from two large-scale projects: the 57.4 MW Brechfa Forest West Wind Farm in Carmarthenshire and the 37.6 MW Brenig Wind Farm in Denbighshire.

Analysis

In addition to the two new large-scale onshore wind projects, six small-scale projects commissioned in 2018. These eight projects provide an additional 99 MW of new capacity, a similar increase in capacity to the previous year. This represents a 10% increase in total onshore wind capacity, but just a 1% increase in the overall number of projects. With only one project commissioned in 2018, the number of projects installed that were rated under 500 kW was at its lowest since 2004.

Neath Port Talbot remains the local authority area with the highest onshore wind capacity, with 230 MW from only 12 projects, mainly due to 138 MW of the 226 MW Pen y Cymoedd wind farm sited within the authority's area. A similar situation exists in Rhondda Cynon Taf, which hosts the remaining 90 MW of the Pen y Cymoedd wind farm and six other large-scale projects.

6.8.1 Offshore Wind (7 p. 30)

Wales has three offshore wind projects, totalling 726 MW. All three Welsh projects are located off the North Wales coast, in Liverpool Bay.

Analysis

Wales was an early adopter of offshore wind; North Hoyle (60 MW) and Rhyl Flats (90 MW) were both developed under the first offshore wind leasing round from The Crown Estate in 2003 and 2009 respectively. Gwynt y Môr was developed under Round 2 and commissioned in 2015, adding 576 MW to the existing 150 MW of offshore wind already installed in Welsh waters. Gwynt y Môr is currently one of the largest offshore wind farms in the UK.

6.9 Solar Thermal (7 p. 31)

There is now over 13 MW of installed solar thermal capacity, from 4,664 projects. In 2018, 64 new projects were installed, adding 0.18 MW of capacity.

Analysis

The rate of deployment of solar thermal projects continued to decrease in 2018. The number of new installations reduced by 42% in 2018 compared to 2017, with just 64 new projects

being commissioned, the lowest number of new installations since 2005. Only one project greater than 10 kW was commissioned in 2018, which was in Denbighshire.

Powys is the local authority area with the greatest solar thermal capacity and the most projects, with 1.9 MW installed across 671 projects. The local authority areas with the highest number of solar thermal projects tend to be those with housing associations that have installed solar thermal on their housing. For example, Rhondda Cynon Taf has the second greatest number of installations in Wales, of which over 90% are related to social housing.

6.9.1 Solar PV (7 p. 32)

Solar PV capacity in Wales totals 978 MW across 54,560 installations, an increase of 5 MW from last year. Solar PV generated an estimated 909 GWh in 2018, enough to power the equivalent of 18% of Welsh homes. Solar PV capacity in Wales totals 978 MW across 54,560 installations, an increase of 5 MW from last year. Solar PV generated an estimated 909 GWh in 2018, enough to power the equivalent of 18% of Welsh homes.

Analysis

The largest solar PV project to be commissioned in 2018 was a 250 kW commercial rooftop PV project in Flintshire. This is the lowest maximum project size in a decade, representing the challenging situation for large-scale solar PV across the country, as a result of the closure of the Feed-in Tariff and the Renewables Obligation and the lack of Pot 1 Contracts for Difference auctions.

In 2018, the number of solar PV projects commissioned was similar to 2017, with 940 new projects commissioned in 2018 and 916 in the previous year. This represents a dramatic reduction in the installation rate of solar PV projects compared to 2016 and 2015, when over 2,200 and 10,000 were installed respectively.

Wales currently hosts the largest solar farm in the UK, the 72.2 MW Shotwick Solar Park in Flintshire, which commissioned in 2016. Pembrokeshire remains the Welsh local authority area with the highest capacity of solar PV, totalling 190 MW, followed by Carmarthenshire, totalling 108 MW.

6.9.2. Sewage Gas (7 p. 34)

There was no change in the number of sewage gas projects in Wales in 2018. There are six active sites providing a total of 11.2 MW of heat and 9.3 MW of electricity. The most recent sewage gas project to be commissioned remains the Five Fords plant in Wrexham, which opened in 2012 and injects up to 700 standard cubic metres per hour of biomethane into the gas grid.

Analysis

The six active sewage gas plants in Wales are distributed among five local authority areas. Two projects commissioned in 2010, the Cardiff East plant at 4 MWe/5 MWth and the Afan CHP in Neath Port Talbot at 3 MWe/3.3 MWth, account for a third of the total capacity. Cardiff is the local authority area with the largest concentration of sewage gas generation, representing 49% of the total capacity in Wales.

Summary

In her foreword to the Energy Generation in Wales study the Minister for Environment, Energy and Rural Affairs, Lesley Griffith, states that the report provides a complete picture of energy generation in Wales and a consistent measure against the energy targets set in 2017. The target is for Welsh renewables to generate electricity equal to 70% of Wales' consumption by 2030. In 2018 renewable generation is equal to 50% of electricity consumption in Wales.

778 MW of renewable energy capacity is in local ownership, against their target of 1 GW by 2030. It is expected for all new energy projects to include an element of local ownership.

2018 saw the commissioning of Wales's third largest wind farm, Brechfa West, in Carmarthenshire. Brechfa's 28 turbines are sited on the Welsh Government woodland estate and will provide a community benefit fund in excess of £11 million over the wind farm's operational life.

The 'Welcome to Our Woods' community organisation and its partners completed the build of a 27kW hydropower development near Treherbert, Rhondda Cynon Taf. This community aims to use revenue from the scheme to reduce fuel poverty within the area.

Reducing reliance on fossil fuels and continuing to develop and support renewable energy, with local ownership, will help achieve Wales' low carbon vision and maximise the value to Wales.

7.0 Hydrogen: (9) (10)

The Environment (Wales) Act sets a statutory target for at least 80% emissions reduction in Wales by 2050 and a framework of 5 yearly carbon budgets and interim targets for 2020, 2030 and 2040. The interim targets and the first two carbon budgets (2016 to 2020 and 2021 to 2025), must be set in regulation. The Act sets the new approach to decarbonising Wales.

Hydrogen features within proposals in the document for use in transportation and heating systems.

7.1 Strengths

Hydrogen can be used interchangeably in all transportation and heating sytems; joining these up for the first time creates the clean, highly flexible hydrogen economy. Hydrogen, the tiniest molecule that exists, is not found in large quantities on earth. Instead, it is mostly made from fossil fuels ('grey' hydrogen) with the cleaner alternative of using low-carbon electricity to 'zap' water ('green hydrogen') on the rise. 'Grey' hydrogen is used as feedstock in sectors, such as fertilisers and refineries.

Clean hydrogen is expected to play a key role in the decarbonisation of sectors where other alternatives might not be feasible or be more expensive. This includes heavy-duty and long-range transport and energy-intensive industrial processes.

Renewable (‘green’) hydrogen, produced through electrolysis from water using renewable electricity, can provide the mobility sector and industry with emission-free energy and feedstock. It can also provide long-term and large-scale storage, and flexibility to the energy system.

Significantly, renewable hydrogen supports the integration of renewable electricity generation, as it decouples energy production from usage in both location and time, and can balance electricity demand and supply. This, in turn, is also important for electricity grid management, for isolated or stand-alone regions or for specific and local uses, concentrated in a city or restricted area.

7.2 Weaknesses

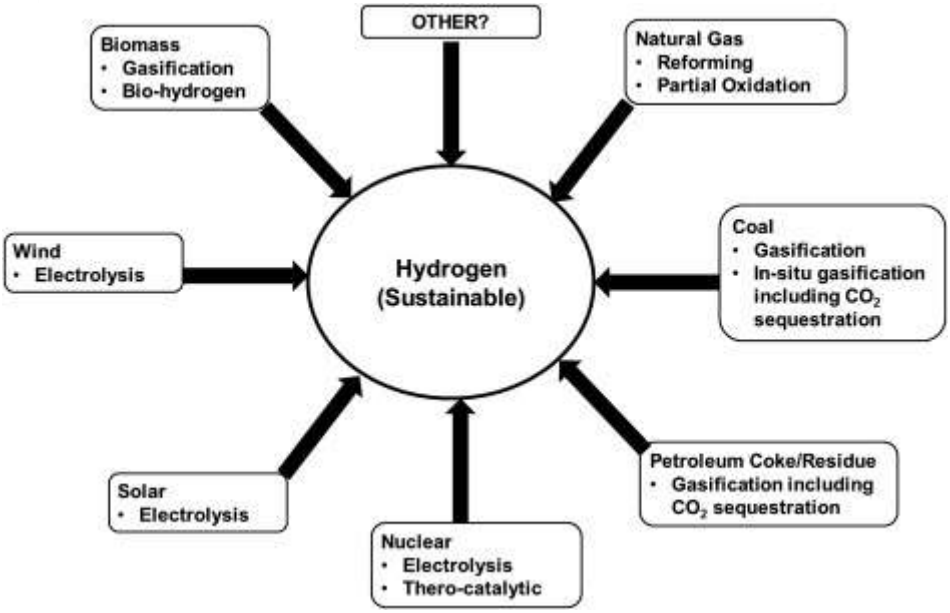
The production of renewable hydrogen is still considerably more expensive than the conventional, highly carbon intensive methods, which do not reflect the associated environmental and climate externalities. The conversion of renewable electricity to hydrogen is currently not as efficient as direct consumption of renewable electricity due to conversion losses associated with the production of hydrogen.

There are barriers to consider, such as lack of production, infrastructure, high cost and low efficiency. It is important to look at the whole value chain in order to advance towards a hydrogen ecosystem at a scale that contributes to meet the 2030 and 2050 climate and energy goals in a timely and cost-effective way.

7.3 Opportunities

From a Welsh perspective, hydrogen might link with many of the opportunities identified in the IWA’s 2018 assessment of the energy transition (11). And whilst the Welsh Government has already identified hydrogen’s potential (10) again, it’s time to start putting the pieces together.

There are a variety of ways in which hydrogen can be generated. The Figure below shows some economically viable options Hydrogen can be generated using a variety of fossil fuel sources, nuclear energy (by either electrolysis or thermochemical cycles), or solar energy (so-called photo electrochemical cells) from biomass, and there can still be some controllable chemical routes which have not yet been tested



To ensure efficient allocation of resources and use of clean hydrogen where it is most valued, strong price signals and functioning markets are needed, together with an enabling framework to ensure the upscaling of renewable hydrogen in order to overcome the current market failure. In addition to massive scale-up, research and innovation are needed to increase the efficiency and the functioning of the whole value chain.

A high number of high-profile businesses have joined to create an alliance for a hydrogen strategy for the UK. They have pledged to invest 1,5bn into Hydrogen projects if the Government takes an approach for a clear strategy. In their letter to the Chancellor of the Exchequer, they lay out the benefits to such an approach (12).

Right alongside the influx of new all-electric vehicles has come a wave of hydrogen-powered transportation options. Big-name car companies like General Motors, Toyota, and Volkswagen are developing and marketing their own hydrogen EVs, some of which could be out in the next few years. UPS is also testing its own hydrogen delivery trucks and hopes to have a fleet operating across California soon.

Proponents of this technology note that hydrogen is more common than lithium by a long shot — it's literally the most abundant element in the universe — and that it produces energy just as cleanly, since the only end products of burning hydrogen are heat and pure water.

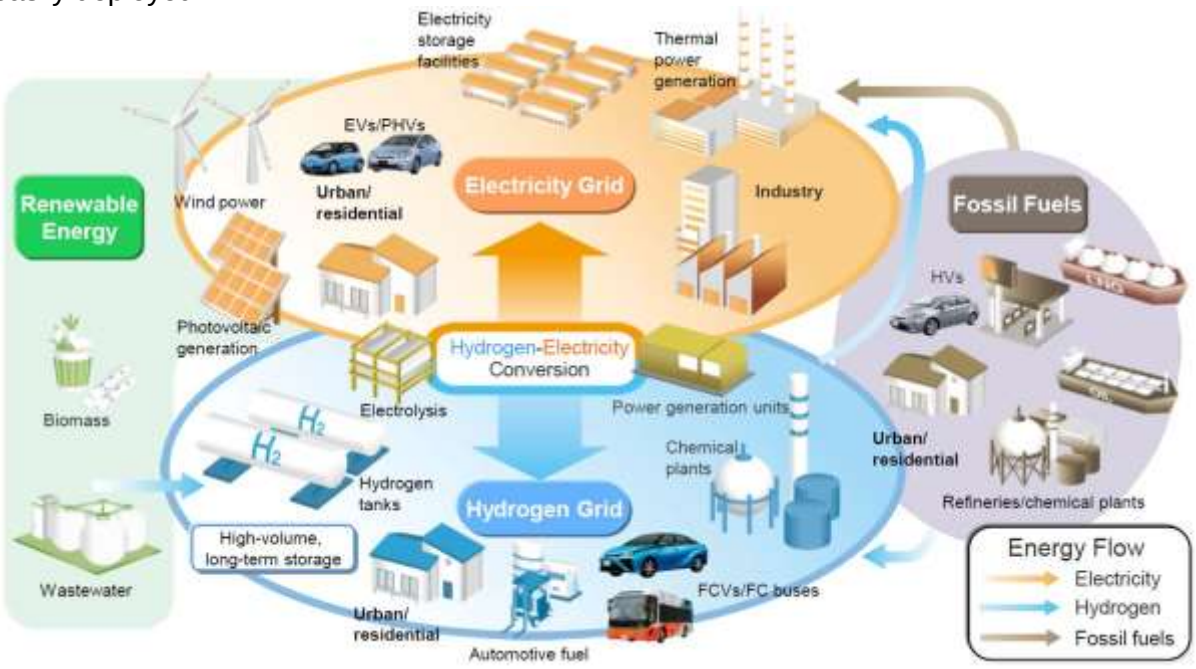
Looking at transportation alone, the problem is simple: the most common element on the planet is actually pretty hard to capture and store in a useful way. The gas has to be pressurized and held in large steel tanks, which take up far more space than an energy-equivalent tank of gasoline.

7.4 Summary

The price of lithium-ion batteries – the key technology for electrifying transport – has declined sharply in recent years after having been developed for widespread use in consumer electronics. Governments in many countries have adopted policies encouraging increased deployment of electric cars, further accelerating the decline in battery prices. At the same time, the power sector now offers growing opportunities for the use of batteries to support the integration of variable renewables such as wind and solar PV into electricity

systems. As such, lithium-ion batteries are now a technology opportunity for the wider energy sector, well beyond just transport.

Electrolysers, devices that split water into hydrogen and oxygen using electrical energy, are a way to produce clean hydrogen from low-carbon electricity. Clean hydrogen and hydrogen-derived fuels could be vital for decarbonising sectors where emissions are proving particularly hard to reduce, such as shipping, aviation, long-haul trucks, and the iron, steel and chemical industries. These are areas where other clean energy technologies cannot be easily deployed.



Source: https://newenergytreasure.com/2014/06/28/hydrogen-production-in-the-new-hydrogen-economy/

The CCC's "Hydrogen in a Low-Carbon Economy" report finds that hydrogen can make an important contribution to long-term decarbonisation if combined with greater energy efficiency, cheap low-carbon power generation, electrified transport and new "hybrid" heat pump systems, which have been successfully tested in the UK.

8.0 Initial Assessment and Energy Recommendations for BWBP by the Green Valleys

The Green Valleys (Wales) (14) is a multi-award-winning Community Interest Company based in the Brecon Beacons, Wales. They inspire and support communities to generate sustainable social, economic and environmental benefits through transition to a low carbon emission future.

The Green Valleys Projects

Energy Community Cooperatives create huge opportunities for citizens and communities to benefit directly from combating climate change. Renewable energy projects developed by local people put communities in control of alternative, changing energy systems. The ECCO project supports the development of new energy cooperatives in Wales and aims to create tools and processes to accelerate the development and capacity of the sector. It is funded by Interreg North West Europe and the Welsh Government.

Woodlands
They have supported the development of numerous community woodland groups. Active management by local people improves woodland habitats, generates wood fuel and other products and provides an activity that supports physical and mental health, social interaction, learning and enjoyment.

Hydro System Design and Advisory Service
They have developed over 50 hydropower projects across Wales. These range from the smallest scale to large projects in complex environments. They provide a range of services from initial assessments and feasibility studies, to securing all licences and managing construction projects. Their clients include homeowners, farmers, government agencies and registered charities.

Energy Recommendations for BWBP (CLT)

There are a number of energy demands and solutions that could be addressed by BWBP. It should be a priority to determine scope of the work.

Energy generation and conservation efforts could possibly be targeted at:

- The PTHB buildings and operations
- The BWBP buildings and operations
- Wider community and transport use

The following outlines some options for the Bronllys Hospital site as an initial assessment. For all these options more detailed appraisal is required. Understanding current energy demand and patterns of use will be essential to assess potential cost benefits.

Generation Options

Solar PV: Huge potential on site due to south facing roofs and constant demand from hospital operations. Large areas potentially are available for ground mounted arrays and canopies above car parking and walkways.

Solar thermal: Also potentially useful due to hot water demands. However, it is likely to be better overall to use roof space for solar PV and have electric emersion heaters.

Hydro: No potential on site

Wind: Exposed location particularly at north end of site, outside of BBNPA so a small turbine may be possible. This could be around 20kW on a 10-12m tower. It is possible that there may be space for 1-3 turbines.

Biomass AD: There would be potential for AD on site and this could take a number of forms. Small AD systems are available and would require proper sizing depending upon potential use. The gas could be burnt directly to provide space heat and hot water on site, distributed via a heating main. Any additional capacity could provide heat to future building developments via an extension to the heat main. This is the most efficient use of the gas produced. Gas could also be burnt to power an electric generating turbine to provide onsite electricity and export excess electricity at times of low demand. A combined heat and power system could generate both.

A key consideration is the ability to reliably source the necessary feedstock for the digester. Most systems utilise at least a proportion of cattle slurry, mixed with other feed such as silage, food waste and other green waste. The correct mix and quality of feed is essential. There may be considerations regarding the transport of feed material onto site and the amount of space required for the plant, tanks and associated facilities.

Biomass timber: A range of commercial scale timber boilers are available that can burn logs, wood pellets or wood chips and provide hot water and space heating via a wet central heating system. This would need to be correctly sized and a robust supply chain of fuel established. A significant amount of storage space would be required to store an appropriate amount of fuel and a fuel reserve.

Heat Pumps: Air or ground source heat pumps could be used for heating. These work best in highly insulated modern buildings and so would be a better solution for new builds than the existing hospital estate. Solar PV or wind would provide electricity to run the heat pumps. Wind would be better as solar PV provides minimal electricity at the times of highest heating demand over winter (and of course nothing after dark). There are large areas of open ground, which could be used for the collectors of ground source heat pumps. Air source heat pumps should be located on south facing exteriors.

Efficiency Options

Existing buildings:

Require survey for energy saving opportunities including insulation to walls/floor/roof, glazing, lighting, heating, catering facilities, office appliances and any specialist services such as laundry.

Building use can be assessed to determine if there are opportunities to reduce the number of buildings and rooms occupied, maximizing use of the most energy efficiency spaces and minimising use of the least efficient.

New builds:

Any new building should be built to the highest insulating standards. Passive House standard results in very low heating demands, thereby lowering operating costs. The hospital site has potential to develop south facing buildings to maximize solar gain through windows and electricity from solar PV.

Case Studies

8.1 Harbury Energy initiative (13) is a local low carbon group serving the village of Harbury in rural Warwickshire. Since they began working in their community in 2010, they have achieved significant beneficial changes for their community buildings, installing PV panels and LED lighting, insulation, energy storage and other carbon reduction.

Harbury Energy Initiative (13) is a village volunteer-run group that aims to save energy, to reduce household costs and to cut carbon within their community. Much of the work to date has focused on our community buildings but they have also helped with reducing the cost of installation of photovoltaic panels on many roofs and have stimulated a number of households to insulate their walls and carry out other improvements to cut carbon.

Harbury e-Wheels provides transport to those in need using 2 electric cars supplied by Electric Zoo, working within a 15-mile radius of Harbury. They do this at no cost to the beneficiary or the agency that refers them. Their aim is to reduce rural isolation and enable local agencies to deliver their services effectively. This combines social benefit with environmental benefit.

8.2 Down to Earth is an award-winning social enterprise based in Swansea with a 14-year track record to support people to bring about positives change in their lives.

Down to Earth uses traditional and sustainable building methods to offer fully accessible and inclusive commercial construction projects to diverse community groups, particularly from 'hard to reach' and disadvantaged backgrounds. Combining learning and well-being.
Using only locally sourced and sustainable/natural building methods, this remarkable, participant-led approach results not only in buildings that are stunning and eco-friendly, but also transforms the participants' understanding of learning. It's a win-win situation.Participants gain accredited outcomes through an inclusive and engaging programme and the organisation/school/community group end up with a beautiful and inspiring building to further develop outdoor learning

SUSTAINABLE CONSTRUCTION (15)

This remarkable approach transforms both the participants and the community involved in the project – whilst simultaneously creating stunning, sustainable buildings. From large scale commercial training spaces to smaller outdoor classrooms, Down to Earth has an excellent track record in accessible, accredited training programmes resulting in remarkable buildings.

(15)

HOW DOWN TO EARTH IMPROVES HEALTH AND WELL-BEING

Imagine tackling depression and anxiety in an Early Intervention in Psychosis programme through young people being outdoors and building a house with natural materials. Or imagine people with traumatic brain injuries receiving neuro-rehabilitation through sustainable woodland management and growing food organically. This is exactly how the organisation works – doing meaningful, peer-based outdoor work which is carefully designed to have a rehabilitative impact.

WHO THEY WORK WITH

They work with the health boards (NHS), statutory bodies and also charities.
They work with the following departments/units in the health boards and we are always interested in developing new partnerships.

- Early Intervention in Psychosis
- Traumatic and Acquired Brain Injury
- Low secure mental health
- Stroke

Swansea University Building/Eco Building Pictures: https://downtoearthproject.org.uk/

Sero Homes/Parc Hadau

Sero Homes is a private company based in Cardiff committed to building zero carbon homes. Their first project is **Parc Hadau,** a development of zero carbon homes in the community at Rhydyfro, Pontardawe

The planning application was approved on the 17th of December by North Port Talbot planning committee. Due to the innovative nature of Parc Hadau, they also secured some funding under the Welsh Government's Innovation Housing Programme fund which will support them with the increased costs associated with the zero carbon and ecological features they propose.

Sero Homes is a match to Bronllys Well Being Park's philosophy.

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Special thanks goes to Gareth Ellis for providing the initial assessment. Mr. Ellis worked across six south Wales local authority areas and with a broad range of community clients to reduce energy consumption from community buildings and currently manages the Interreg ECCO project for The Green Valleys CIC, engaging with European project partners on the development of new energy cooperatives, including TrydaNi.