Renewable Energy Sector Guide

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Introduction

This guide is designed to provide the armed forces community with a general overview of the renewable energy industry. It provides advice to the serving military community and veterans, including spouses/partners, with options to consider in their next career.

As Mission Renewable develops its understanding of specific renewable technologies, industry-specific guides will be produced. These guides will offer a detailed insight into the opportunities for service leavers in their respective industries. If you are a veteran working in industry who is passionate about developing pathways for service leavers, then we want to hear from you. Please contact us via the Mission Renewable team email. Your experiences will be invaluable in helping others as we progress with the development of industry-specific guides.

This guide is produced by ***Mission Renewable*** for ***Career Transition Partnership (CTP)***.

Mission Renewable is an Armed Forces engagement initiative for the UK Renewable Sector. It is a Community Interest Company (non-profit) launched in 2022 to harness the opportunity for skills migration from the veteran community into jobs in the renewable energy sector.

MISSION RENEWABLE
ARMED FORCES ENGAGEMENT FOR THE UK RENEWABLE INDUSTRY

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Forewords

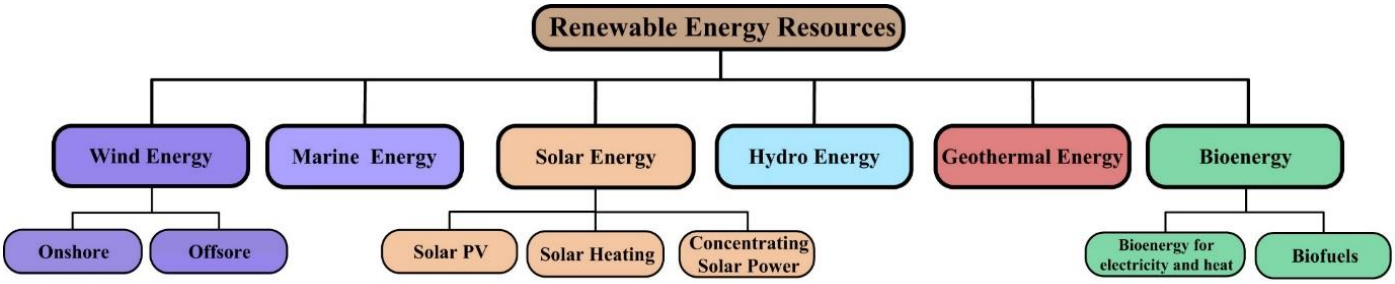
"There are industries and employers who are known for their strong links to the Armed Forces over the years, but it is Renewables that will be the huge growth area for veterans, service leavers and their families. They have prospects in a growing industry that are bright and will allow them to support their families for years to come. This guide has been produced to support those considering careers in the renewable energy sector, and we are hugely grateful to veterans, industry partners and MoD for their assistance.
Read, ask questions, network – and through community, when you are successful, help others up behind you."
James Cameron, CEO, Mission Renewable

"The renewable energy sector is expanding rapidly throughout the country and we urgently need people with the right level of skills and expertise to fulfil the wide variety of roles we have on offer. Women and men who come to us from a military background have a wealth of experience and talent which puts them in pole position for new careers in clean energy"
Melanie Onn, Deputy CEO, RenewableUK

"The renewable energy industry is expanding to become a key part of the government's plans to reach net zero and maintain energy security. There are many different jobs available, and there will be more and more in the future. This guide is designed to help you, the veteran or spouse/partner, find a way into the industry and secure a job. It is clearly laid out, and easily readable. Using it we hope will make your journey into the industry easier and quicker. Good luck!"
Lieutenant General Richard Nugee, Non-Executive Director for Climate Change and Sustainability – MOD; formerly Chief of the Defence People, MOD

What Is Renewable Energy?

Renewable energy can be defined as energy derived from natural sources that are replenished at a higher rate than it is consumed, I.e., an energy source that cannot be depleted by its use. Several energy sources meet these criteria, and they are detailed in the diagram below:

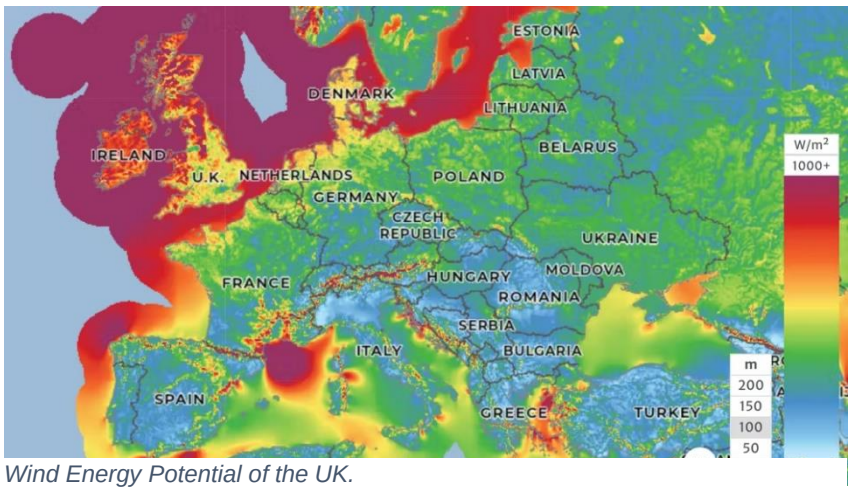


Note: Both the nuclear energy industry and the hydrogen industry are potential employment destinations for those who have served in the armed forces, but they are not listed in the technologies above. However, we will still explore these energy sources in this guide.

Why is Renewable Energy important for the UK?

Climate change driven by the production of greenhouse gases is having a disastrous effect on our planet. Environmental crises are being experienced across the globe, and they have become commonplace in today's news. To combat the impact of climate change, world leaders have made pledges to reduce the number of greenhouse gases that are currently emitted into the atmosphere. In 2021 the COP 26 International Climate Change Conference took place in Glasgow. World Leaders made commitments to attempt to limit the global temperature increase to 1.5 C and reach net zero by 2050. The UK government knows that maximising the country's full renewable energy potential is an essential tool in reaching the 2050 net zero goal. As you can see from the illustration below, the UK's climate, topography and vast stretches of coastline provide the ideal conditions for producing energy via renewable sources such as wind and hydropower.

At the time of writing in 2022, the invasion of Ukraine by the Russian State is having a profound effect on global energy markets, driving up the cost of resources such as Oil and Gas. Energy security is now at the top of the priority list for global leaders as they look to reduce their dependence on other nations for their energy resources. Energy independence will be an essential capability and the UK government understands that renewable energy is the key to reaching this goal.



Wind Energy Potential of the UK.

Why is the Renewable Energy Sector important for Service Leavers?

For the reasons detailed above, the UK government is committed to growing existing renewable energy technology. It has outlined plans to support future projects that will enhance the nation's energy independence and take us closer to reaching net zero. A skills gap already exists across the renewable energy industry, which is likely to grow as new projects are commissioned. Approximately 14,500 service leavers leave the UK military each year. This means there is a pool of highly trained, and highly motivated individuals with many relevant skills who can exploit this growing gap in the industry. Furthermore, the renewable energy sector has several opportunities that should make it an attractive option for service leavers of all skills and backgrounds. A non-exhaustive list of these can be found below:

Key benefits for service leavers

Skills Transfer – This is a skills-based industry. Companies spend significant proportions of their budgets to train their workforce and develop skills and further technical qualifications. Service leavers tend to have soft skills such as effective communication, problem-solving, and the ability to work in teams. Therefore, with specific trade training, service leavers can offer renewable companies a well-rounded package that few other candidates will be able to match.

Top tip – Make your skills obvious by putting them at the top of your CV. Hiring managers do not have the time to read through your experiences and try and pick out the relevant skills and experiences, so do the work for them.

Salary – Annual wage across the industry tends to be above the UK national average, however, this is to be expected due to the industry's highly skilled workforce. An example of this could be an Offshore Wind Electrical technician who could reasonably expect to start on a salary between £30,000 - £60,000 depending on technical experience.

Global Industry – Skills and experiences gained will be valued throughout the world. Opportunities for working abroad exist, as several of the larger renewable companies have projects in Europe, Asia, and America.

Role Variety – There is a large variety of jobs available across the renewable energy industries. Crucially, there is a comparable role in renewable energy industries for most positions in the military. There are examples below of positions that are currently in demand across the industries:

- HSE
- Electrical Technicians
- Mechanical Technicians
- Stakeholder Management
- Environmental Consent
- Logistics
- Stores
- Project Management
- Operations Management

These roles also offer a variety of working patterns, ranging from 9-5 office work to monthly shift rotations offshore. **Top Tip** – When looking at a specific industry, don't focus just on immediately visible technology - e.g., a wind farm. Remember that there are lots of companies from several industries that have worked together to reach that end goal. The job you are looking for could be with the supplier, not the company that is operating the technology.

The Different Types of Renewable Energy Industries in the UK

Offshore Wind

What is it?

Offshore wind power or offshore wind energy is the energy taken from the force of the winds out at sea, transformed into electricity and supplied to the electricity network onshore. It is constantly renewable and offers an infinite energy source that is relatively cost-effective to exploit. The UK is already a world leader in offshore wind power production and has committed to funding and resourcing further growth in the industry.

How does it work?

Fixed offshore wind farms are strategically positioned in the windiest and shallowest locations off the UK coastline. They can be made up of hundreds of wind turbines, which use the wind to spin blades creating kinetic energy, a generator inside the turbine then converts this kinetic energy into electrical energy. The electrical energy is then fed into a transformer which increases the voltage so that it can be used by the national grid.

What are the advantages of offshore wind?

- Topography – As the UK is an island nation, it has a large area of coastline with shallow seabeds that are essential for the construction of offshore wind farms. Due to the shape of the UK, the population centres are centred at comparatively short distances from the coast. Therefore, less energy is lost through transmission and distribution as the energy travels from the wind farms to the areas where it is needed most.
- Climate – The UK experiences above-average wind speeds in comparison to the rest of Europe. These wind speeds tend to be even faster and more consistent offshore. Therefore, combining both climate and topography, the UK is perfectly placed to exploit the benefits of offshore wind.
- Distance from local populations – Offshore wind farms tend to be out of sight, and too far away to generate noise that could frustrate residents.
- Cost efficiency – Due to investment in technology and increasing availability, offshore wind is now a more cost-efficient energy source than many fossil-fuel-driven alternatives.

What are the disadvantages of offshore wind?

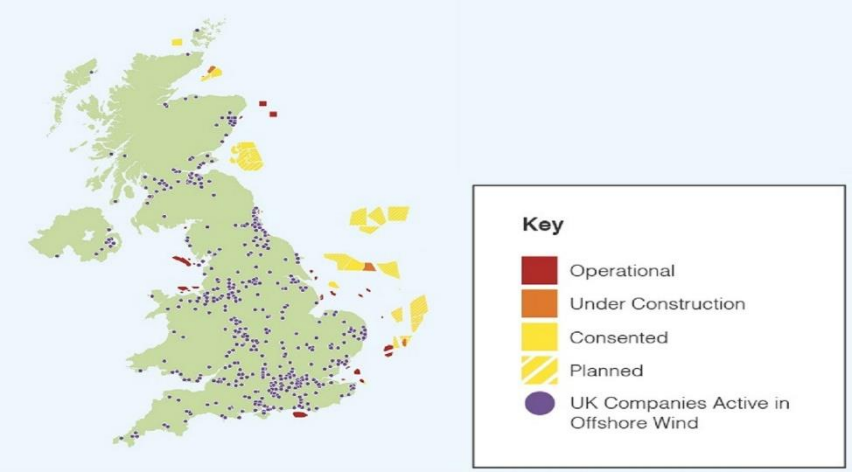
- Impact on birds and marine life – Wind farm developers work closely with environmental groups to monitor the impact that wind turbines can have on local wildlife. Practices to mitigate this are in place, however, research into how wind farms affect habitat loss, and disturb flying patterns is still ongoing.
- Weather – Despite providing an infinite power supply, the wind speed is not constant. During periods of low wind, the energy generation potential of wind farms is significantly reduced. This lack of consistency presents a challenge that wind turbine producers are constantly attempting to overcome via improvements in turbine technology.

Current energy production?

In Q1 of 2022, this was the largest producer of renewable energy in the UK, accounting for 14.9% of total electrical energy produced.

Where are the offshore wind farms located?

The illustration below shows that offshore wind farms tend to be positioned off the East coast of the UK in the North Sea. A point to note is the HQs for the wind farms don't necessarily have to be positioned close to the coast, this is important when looking for a job role in relation to location. I.e. you don't have to live by the coast to work in this industry.



Offshore wind locations - 2021

Key Projects in the industry

- Hornsea Project 1 - https://hornseaprojectone.co.uk/
- Triton Knoll - https://www.tritonknoll.co.uk/
- East Anglia One -https://www.scottishpowerrenewables.com/pages/east_anglia_one.asp
- Walney Extension - https://orsted.co.uk/energy-solutions/offshore-wind/our-wind-farms/walney-extension
- London Array - https://londonarray.com/

Future projects and development of offshore wind

Currently, offshore wind farms are restricted by water depth as the wind turbines have to be fixed to the seabed. Floating wind turbine technology is now becoming available which will negate this limitation, allowing wind farms to be positioned at greater depths, further away from the coastline. As the windfarms move further away from the coast, they will access a faster and more constant wind speed, thereby improving the energy production capacity and predictability.

The UK government has the ambition to deliver 50 Gigawatt (GW) by 2030 of offshore wind, including 5GW of pioneering floating wind. To reach this goal, several new projects have been commissioned:

- Doggerbank Project - https://doggerbank.com/
- Hornsea Project 2 - https://hornseaprojects.co.uk/hornsea-project-two
- Hornsea Project 3 - https://hornseaproject3.co.uk/

Onshore Wind

What is it?

Onshore wind energy is the power that's generated by wind turbines located on land and driven by the natural movement of the air. You'll often see onshore wind farms in rural areas, as they're usually constructed in less-populated areas where buildings and obstacles don't interrupt the air. We have been capturing the power of the wind since the 1880s when it was used to grind corn and drive pumps, but the opening of the UK's first commercial windfarm in 1991 heralded a new era of energy production.

How does it work?

The process of converting kinetic into electrical energy is the same as the process in offshore wind. The major differences occur during the planning and construction phases of an onshore wind farm, which are significantly cheaper and quicker to build.

What are the advantages of onshore wind?

- Speed of Installation and maintenance – Depending on the scale, onshore wind farms can be constructed in months and are relatively easy and cheap to maintain.
- Cost-effective – As previously mentioned, offshore wind is becoming more cost-effective, but onshore is still significantly cheaper and remains one of the least expensive forms of energy.
- Environmental impact – The construction of onshore wind farms is less intensive and requires fewer resources in comparison to offshore wind. The land below the turbines can still be farmed and the impact of the turbines on the local habitat is easier to monitor.
- Scale – Onshore wind is scalable, and it is possible to purchase a single wind turbine that can be used to generate power for a single property or place of work. This makes it significantly more flexible than other forms of renewable energy.

What are the disadvantages of onshore wind?

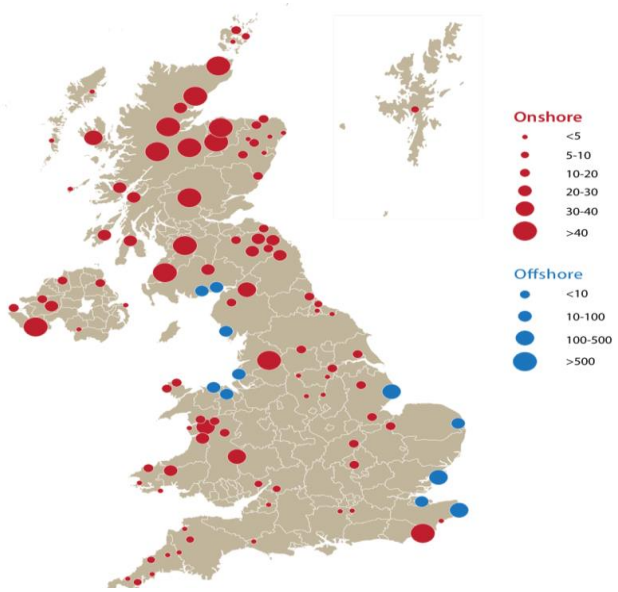
- Changing wind speeds – Wind speed is less consistent and changes direction more often whilst travelling over land. The wind speed in general is lower due to increased friction with the ground.
- Lower power generation – Onshore turbines tend to produce less power than their offshore equivalents due to restrictions on blade size which can limit the 'tip height' of the turbine. In the UK, the average onshore wind turbine produces 2.5 to 3 megawatts (MW), in comparison to the offshore average of 3.6 MW.
- Effects on the local population – It is common for people to complain about the visual and noise impact of onshore wind farms. Due to their requirement to be built away from large urban settlements, they are often constructed in some of the most picturesque areas of our landscape.

Current energy production?

In Q1 of 2022, this was the second largest producer of renewable energy in the UK, accounting for 13.9% of the total electrical energy produced. Onshore wind was the initial renewable energy source of choice, only being overtaken by offshore wind in 2020 in terms of total power output.

Where are onshore wind farms located?

The illustration below was created in 2010, so there has been an increase in both onshore and offshore wind locations since its production. However, it is useful as it shows the key distribution of onshore wind farms and how they tend to be positioned in the mountainous areas of the UK, particularly in Scotland. This has been recognised by the Scottish Government and they have a pipeline of new projects in the initial planning phase of development.



Onshore & Offshore wind locations - 2010

Key Projects in the industry

- Clyde Wind Farm - https://www.sserenewables.com/onshore-wind/great-britain/clyde/
- Whitelle Wind Farm - https://www.whiteleewindfarm.co.uk/
- Kigallioch Wind Farm - https://www.scottishpowerrenewables.com/pages/kilgallioch.aspx
- Pen-y-cymoedd - https://group.vattenfall.com/uk/what-we-do/our-projects/pen-y-cymoedd
- Stronelairg - https://www.sserenewables.com/onshore-wind/great-britain/stronelairg/

Future projects and development of onshore wind

Repowering has become a crucial goal for several of the older wind farms in the UK. This involves the replacement of old wind turbines with new, highly efficient models that are both more powerful and cheaper to maintain than their old counterparts. The new turbines have been proven to double the total generating capacity of a wind farm, and triple the electricity output as they can produce more power per unit of capacity. These targets can be achieved whilst requiring fewer turbines, 27% on average. It is expected that more than 20GW of onshore wind farms in the UK will be repowered over the next 10 years.

As well as repowering, Renewable UK conducted research that showed that the total capacity of onshore wind could double to 30GW by 2030. The report was based on the total number of operational wind farms, under construction, consented, submitted into the planning system, or being developed for submission into planning. It is expected that 30GW could power 19.5 million UK homes a year. A link to the report: https://www.renewableuk.com/news/535255/UKs-total-onshore-wind-project-pipeline-reaches-up-to-30-gigawatts-by-2030.htm

Biomass Power

What is it?

Biomass power is created by burning plant-based fuels to turn turbines and generate electricity. This can include wood pellets and wood chips, bioenergy crops or even agricultural and domestic waste. These sources of fuel are often the by-products of other industrial activities and would normally be wasted. It is also common for energy-dense plants and trees to be grown primarily for burning in biomass power plants. There are ongoing debates on the sustainability of biomass power; however, it provides an energy source that is not dependent on the weather. This flexibility makes it a viable alternative to fossil fuels, and it will be a key technology as the UK government strives for net zero.

How does it work?

A biomass power plant generates electricity via the heat produced from the combustion of organic materials. The process begins with the harvesting of the natural fuels mentioned above, this can also include biogas that is generated as the result of waste fermentation. The heat that is produced from burning the fuels is used to turn water into steam, the steam is then used to turn a turbine which generates electricity.

What are the advantages of biomass power?

- Abundant resources – The organic materials used in the process are widely available and can even come from our waste that would normally be sent to landfill.
- Predictable energy source – Because we have control of the fuel, the power plants can be turned on or off depending on how much energy is being produced by other renewable sources.
- Cost-effective – Burning biomass is cheaper than burning fossil fuels.
- Converting old technology – Old coal-powered plants can be changed into biomass power plants without needing to completely remove all the infrastructure. This can have a significant benefit in terms of reducing construction costs, resource use and the impact on the local environment.

What are the disadvantages of biomass power?

- Generates greenhouse gases – Unlike other renewable resources, the burning of biomass generates harmful gases that are contributing to global warming. The trees grown for the fuel can take in the carbon dioxide that is produced by the burning process, but this can be carbon neutral at best.
- Efficiency – Biomass is not as fuel efficient as fossil fuels, so you require more biofuel to produce enough power to support national energy demand.
- Biodiversity – Removing natural forests to grow trees purely as a fuel source can strip the land of nutrients and prevents diversity of growth for both plant and animal species.

Current energy production?

In Q1 of 2022 Bio Energy accounted for 11.6% of the total electrical energy that was produced, making it the third largest renewable energy source at that time. However, due to the climate in the UK, it is expected that biomass will be called on less during Q2 & Q3 as solar PV contributes more to the national grid during these periods.

Where are the biomass power stations located?

There are currently 78 biomass power plants spread throughout the UK. The illustration below shows the distribution of biomass power plants, with the different sizes in yellow circles replicating power capacity. As you can see from the large circle in the centre, the Drax Biomass Power Plant has significant capacity in comparison to other biomass power stations.

Biomass power plant locations in the UK - 2022

Key Projects in the industry

- Drax Power station - https://www.drax.com/about-us/our-sites-and-businesses/drax-power-station/
- Ferrybridge Multifuel - https://www.power-technology.com/projects/ferrybridge-multifuel-1-fm1-project/
- Stevens Croft Power Plant - https://www.eonenergy.com/About-eon/our-company/generation/our-current-portfolio/biomass/stevens-croft

Future projects and development of biomass power

Bioenergy with carbon capture, use and storage (BECCS) has been outlined as the future pathway for biomass power plants in the UK. This technique generates power via the traditional method. However, carbon capture technology uses a solvent to absorb the carbon dioxide that would normally be emitted into the atmosphere, and it is then transported for geological storage. This in turn reduces the carbon footprint of this energy production method and makes the entire process carbon negative. The Drax Power Station is currently attempting to implement this technology: https://www.drax.com/about-us/our-projects/bioenergy-carbon-capture-use-and-storage-beccs/

Solar Photovoltaics (PV)

What is it?

Solar PV technology uses solar panels to capture sunlight and convert it into electrical energy. The technology can be employed on both an industrial and local scale. Industrial projects such as solar farms are the most popular method for harnessing the power of the sun. These tend to be built on old farmland and use the greatest coverage of solar panels to maximise energy production. Solar PV can also be employed on a smaller scale, via retrofitting panels to the roofs of existing buildings or by including them in the planning and construction of new projects. Solar PV offers a flexible method of harnessing renewable energy, and it is commonly used alongside other technologies, such as onshore wind farms and on top of EV charging stations.

How does it work?

Solar PV technology works by converting sunlight into electricity through solar cells, which make up the surface of a solar panel. The cells are made from thin layers of a 'semiconductor' material (commonly silicon) between layers of glass. Once the sunlight passes through these layers, a direct electrical current (DC) is generated, this then passes through an inverter, which converts it to a 240V alternating current (AC) which can then be used in your home or put into the national grid. The process of exactly how sunlight is converted into the DC can be complex to explain, however, this TED-Ed video provides a clear and easy-to-understand explanation: https://www.youtube.com/watch?v=xKxrkht7CpY&t=76s

What are the advantages of solar PV?

- Accessibility – As previously mentioned, individuals can purchase solar PV technology and use it on a micro-scale.
- Cost Effective – Solar PV is significantly cheaper to both purchase and maintain in comparison with other renewable energy sources. This also adds to its accessibility to individual buyers.
- Operation and Maintenance - There are no moving parts, so solar panels require infrequent servicing and there is a significantly lower chance of the system breaking when compared to other technologies which use equipment such as wind turbines.
- Noise Pollution – Solar PV is completely silent so it can easily be employed in urban centres and on rooftops without disturbing the local population.

What are the disadvantages of solar PV?

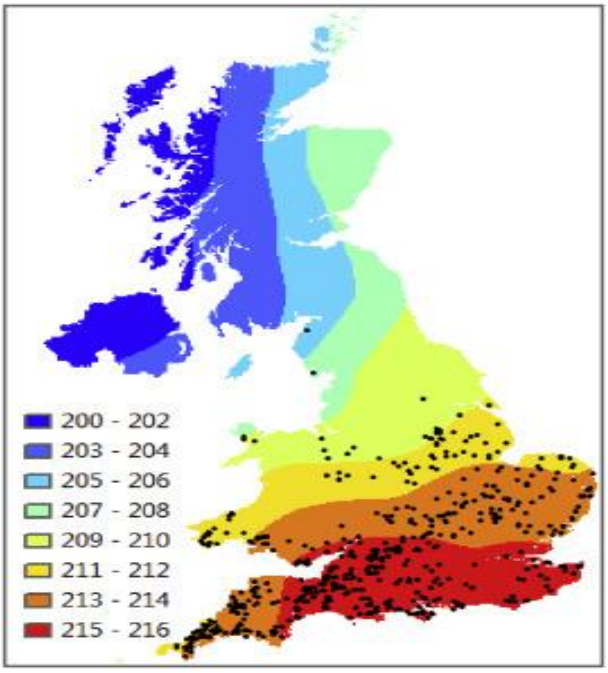
- Climate – Solar PV relies on sunlight to generate electricity, so its output is significantly reduced when there is thick cloud cover and during periods of darkness. Therefore, it remains a seasonal technology in the UK as its output in the summer is significantly more than in the winter, meaning it cannot be relied upon as a constant source of energy.
- Efficiency - Solar panels efficiency levels are relatively low (between 14%-25%). This has an impact on land use, as you need to use a wider area to achieve the same output in comparison to technologies such as onshore wind.
- Fragility – Solar PV panels can be easily damaged, so despite a high degree of reliability, it is still common for them to break.

Current energy production?

In Q1 of 2022 Solar PV accounted for 2.4% of the total electrical energy produced in the UK. However, across the full year in 2021, solar PV accounted for 4.3% of the total energy produced. This shows the impact that weather can have on its total output.

Where are the solar PV farms located?

In 2020 there were just under 500 Solar Farms in the UK. As you can see from the illustration below, most large solar farms are located in the South of England. This is supported by the colour coding which represents solar irradiance which is the power per unit area produced by the sun in the form of electromagnetic radiation. As you can see, the general trend is for this to increase as you travel from North to South.



Solar PV Farms in the UK - Current solar farms (REPD 2015) compared to interpolated average hourly GHI Wh/m^2 (calculated from 5106 recorded irradiation values for 2015).

Key Projects in the industry

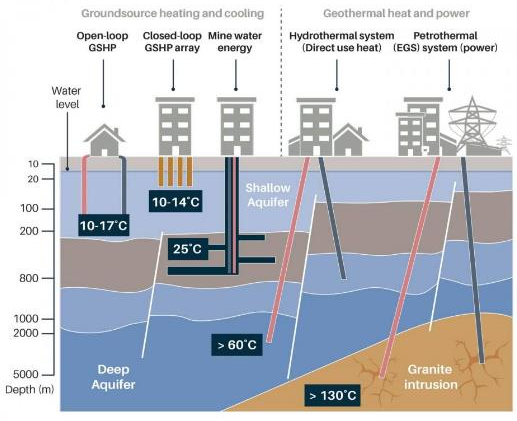
- Shotwick Solar Park - https://britishrenewables.com/portfolio/shotwick
- Lyneham Solar Farm - https://www.publicpowersolutions.co.uk/resources/case-studies/lyneham-solar-farm/
- Owls Hatch Solar Park - https://britishrenewables.com/portfolio/owls-hatch-solar-park
- Wroughton Airfield Solar Farm - https://www.publicpowersolutions.co.uk/resources/case-studies/wroughton-airfield-solar-farm/
- West Raynham Solar Park - https://www.trinasolar.com/us/resources/success-stories/west-raynham-uk

Future projects and development of solar PV

The future development of solar PV farms in the UK has been and will remain a source of controversy. Solar PV is an essential tool for helping reach net zero targets; however, its land use and lack of efficiency in our climate remains a big issue. As our population increases and outside events impact both our energy, and food security, solar PV is pushed into greater conflict with agricultural demand. Other renewable technologies such as onshore wind allow for a better compromise with agriculture as livestock can still graze in fields where turbines have been built. For this reason, solar PV farms remain a contentious issue, and global pressures will have a direct impact on their future development.

In contrast, small-scale, rooftop solar PV is growing in popularity. New sustainable housing initiatives are also in place to ensure that solar panel use is considered when producing new-build properties. These small-scale projects will be key to the future of solar PV, and they offer an ideal starting place for a service leaver interested in working in the solar PV industry.

Ground Sourced Heat & Geothermal Power



What is it?

Ground sourced heat technology – This is designed to harness energy from the top layers of the earth's surface. These top layers are heated up by the sun and maintain a relatively constant temperature which tends to be warmer than the surface in the winter and colder in the summer. This generates a constant energy source that can be used to both heat and cool our homes depending on the time of year. This technology has been growing across the UK, and it is now commonplace for ground source heat pumps to be installed in new property developments.

Geothermal power - As you move closer to the earth's core, the surrounding rock increases in temperature, this phenomenon is described as the geothermal gradient. Deep Geothermal utilises the gradient at depths >500 meters to heat a solution and convert it into steam, this is then captured and used to drive turbines, like those seen in the biomass powerplants.

How does it work?

Ground sourced heat technology – This is usually harnessed via an electrical device called a heat pump, which extracts heat from one place and transfers it to another. These devices are attached to a fluid circulation system, which pumps a solution underground, and uses the ambient temperature of the earth to either heat or cool the solution. It is then pumped back up to ground level for use in domestic appliances such as heaters and air-conditioning units.

Geothermal power – This is a growing technology in the UK which utilises temperatures >160 degrees to generate steam and drive a turbine. To reach these temperatures, there needs to be a geological anomaly, such as a radiologic granite intrusion. These can be found in the UK in areas such as Cornwall, Northern England and Scotland and tend to be 5000m below the earth's surface. Two deep boreholes are drilled - one shallower than the other – and water is pushed into the rock through the shallower borehole, it is heated and turned into steam, which is then captured by the deeper one, creating an engineered geothermal system. The captured steam is then used to turn a turbine at the earth's surface and generate electricity.

What are the advantages of these technologies?

Ground source heat technology

Accessibility – This technology can be employed either in a large-scale project or by individual homeowners.

Efficiency – Ground source heat pumps are three times more efficient than modern gas-powered boilers. Fitting a heat pump could drastically reduce a household's energy bill.

Reliability – The heat source is not greatly affected by seasonal fluctuations in temperature, this, therefore, means you have a reliable and consistent means of heating that can be accessed at any point throughout the year.

Geothermal power

Reliability – In areas where deep geothermal power can be harnessed, the temperatures are constant and are heated by an 'infinite' source. It, therefore, has the potential to generate a constant supply of electricity.

Fuel dependency – There is no fuel required, which removes the dependency on another resource. This also removes the need for mining or other fuel extraction methods.

What are the disadvantages of these technologies?

Ground source heat technology

Installation – Despite its accessibility to the consumer market, the installation costs remain high. Cost is offset by the energy savings made over the lifetime of the technology but remains a major barrier to its wide-scale adoption in the UK. Furthermore, there are restrictions on the type of buildings, local geology, and space which can prevent a heat pump from being fitted to a property.

Carbon neutrality – Heat pumps rely on electricity to run, so their carbon neutrality depends on the source of that electrical energy.

Geothermal power

Location restricted – There are only certain areas in the UK that can generate the temperatures required within reachable depths. This limits the scale that geothermal power can be employed across the country.

Initial Costs – The initial cost for installing the technology required for a geothermal power plant is significantly higher than other renewable and fossil fuel-driven power sources. However, like ground source heat technology, this can be offset over the life of the project.

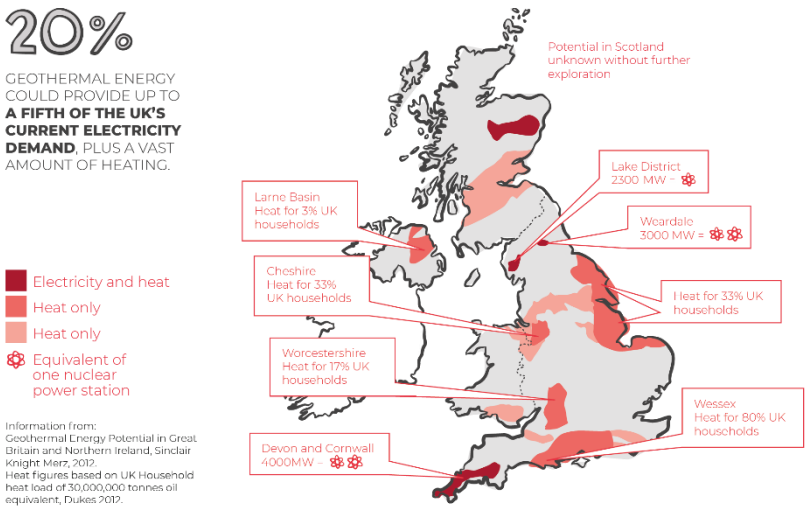
Gases released during drilling – Many greenhouse gases are stored below the surface that can be released during the drilling phases of installation. While these gases are also released into the atmosphere naturally, the rate increases near geothermal power plants. However, these gas emissions are far lower than those associated with fossil fuels.

Current energy production?

Despite their advantages, in 2019 only 2% of households had been fitted with ground source heat technology. Geothermal power does not currently produce any energy in the UK; however, four major projects are under development.

Location of geothermal potential

Ground source heat technology that is driven by the sun can be accessed across the entirety of the UK, this is one of the key advantages of this technology. However, deep geothermal power production is only available in a thew locations in the UK. The illustration below shows areas in which geothermal power could be harnessed, for heat, or heat and electricity.



Geothermal potential in the UK - 2012

Key projects in the industry

- United Downs Geothermal Project - https://geothermalengineering.co.uk/united-downs/
- Eden Geothermal - https://www.edengeothermal.com/

Future projects and development of ground-sourced heat and geothermal

Ground sourced heat continues to grow as a realistic and affordable energy source. The UK Government has outlined plans to instal up to 600,000 heat pumps by the year 2028. The Climate Change Committee (CCC) has suggested that 3.3 million heat pumps need to be installed in existing homes by 2030, rising to eight million by 2035. The scaling up of ground-sourced heat technology is going to be essential to reaching the 2050 net zero target, and this provides an excellent opportunity for service leavers.

Geothermal power is still in its infancy in the UK. The key projects in the industry outlined above are pioneering the race for harnessing deep geothermal energy and they are expecting to produce electrical and heat energy by 2030. This area remains highly specialist, however, it has great potential, and it is important for service leavers to understand that with limitless power, there could be a significant investment and job creation.

Hydro/Marine Power

What is it?

Hydropower is made up of energy produced by four different energy sources: run-of-river, water storage, pumped water storage, and offshore hydropower (wave & tidal). Hydropower is based on the principle of harnessing the kinetic energy from moving water to turn turbines. The only exception to this is wave power, which harnesses the vertical movement of waves to move magnets within generator coils, producing electricity.

How does it work?

In its simplest form, hydropower is driven by the kinetic energy of water that is moving from one place to another. This kinetic energy is harnessed by directing water flow over a turbine which causes it to spin and once connected to a generator, produce electricity. The water flow is driven by gravity (excluding wave), so it has the potential to be an infinite source of energy if there is enough water available. As previously stated, wave power is slightly different to this in the way it generates electricity, but the fundamental principle of harnessing the kinetic energy of water remains the same.

What are the advantages of hydro/marine power?

- Predictability – Hydropower production is highly predictable and can be relied upon to generate a year-round supply of electricity. However, run-of-river hydro is dependent on water flow, so there are areas of the UK where this would not be a viable technology due to regional fluctuations in rainfall.
- Scalability – It is relatively scalable, especially hydropower that is generated by run-of-river, which can be harnessed by small power plants if there is enough water and a steep drop in elevation.
- Long lifecycle - Hydroelectric generators tend to have low maintenance costs in relation to the total energy that they produce. Large power plants have an expected lifespan of 100+ years, making them a realistic economic alternative. The exception to this is both marine and wave power production, which due to the degrading effects of salt water, have a greater need for maintenance.

What are the disadvantages of hydropower?

- Start-up costs – The initial costs associated with building a large-scale hydroelectric power plant are very high, especially if it relies on artificially created water storage.
- Fledgling technology (marine) – Both tidal and wave power have great potential, but they are relatively new technologies that require more research and investment before they can be scaled up and delivered at a national level.
- Environment – If an artificial catchment area is built to enhance water storage via flooding, then the impact on local ecosystems both upstream and downstream can be catastrophic.

Current energy production?

In Q1 of 2022 hydropower accounted for 2.2% of the total electrical energy produced in the UK. This is below the global average where hydro accounts for 60% of renewable energy, and 15.9% of the total energy produced. This is likely a result of both our topography and our climate. In comparison to other nations, the UK does not have enough large water courses that can supply major hydroelectric power plants, and our climatic conditions favour other renewable alternatives which are cheaper to develop.

Where are the hydropower plants located?

The illustration below shows where hydropower is currently being produced in the UK. The general trend is for hydropower stations to be constructed in mountainous areas which experience higher rates of rainfall and water flow. The exception to this rule is the tidal power projects in the Orkney Islands and a wave power project off the coast of Cornwall. The size of the circles is dictated by electrical power generation, as you can see from the illustration, the Dinorwig Power Station in Wales produces significantly more electricity than any other hydropower project.

Hydro power stations in the UK – 2022

Key projects in the industry

- Dinorwig Power station - https://www.fhc.co.uk/en/power-stations/dinorwig-power-station/
- Orbital 2 Tidal Power Project - https://www.orbitalmarine.com/
- Cruachan Power station - https://www.visitcruachan.co.uk/

Future projects and development of hydropower

The future of land-based hydropower is unclear. However, recent studies that looked into the UK's hydro potential found that it could generate up to 2% of the total energy requirement. This is a modest amount in relation to other renewable technologies. The decision on harnessing this remaining potential will likely depend on the financial costs associated with building new power stations and how these compare with alternative technologies.

The future of marine-based hydropower looks significantly more promising, especially tidal power production. On 24 November 2021, the UK government announced an investment of £20 million to support the development of the tidal energy industry. This industry remains in a proof-of-concept stage, like deep geothermal power, so the jobs in the industry remain highly specialist. However, it has great potential, and service leavers need to follow the progress of this technology as it will likely play a key role in the UK's future energy mix.

Nuclear Power

What is it?

Nuclear energy comes from the binding energy that is stored in the centre of an atom. To release this energy, the atom must be split into smaller atoms in a process called fission. This process is carbon-free and does not contribute greenhouse gases into the atmosphere. This makes it an essential tool as the government attempts to reach net zero.

How does it work?

During the fission reaction, the smaller atoms do not require as much binding energy to keep them together, so the excess energy is released as heat and radiation. This heat is then captured and used to boil water into steam. The steam is then used to turn a turbine, similar to the process seen in deep geothermal and biopower plants. The used fuel from the reaction is then either recycled or put into canisters which are then locked up underground, sealed by rocks and clay.

What are the advantages of nuclear power?

- Efficiency – Nuclear power is significantly more efficient than fossil fuels or biomass power. 5g (equivalent weight to a single piece of paper) of fuel is enough to power the average UK home for a year.
- Low Emissions – Once constructed, nuclear power plants produce almost zero amounts of direct greenhouse gas emissions.
- Reliability – Nuclear power production is not affected by fluctuations in weather. The rate at which a power plant produces electricity can be controlled and production can be increased when other renewable sources are unable to meet demand. This makes it an essential technology in the UK's energy mix.

What are the disadvantages of nuclear power?

- Cost – The production and running costs of a nuclear power plant are very high. This method is more expensive than its fossil fuel equivalents such as coal and gas.
- Waste – The disposal of toxic nuclear waste remains controversial. The burying of this waste underground is classed as safe if it is done in a controlled manner and meets specific industry standards. However, the impact that a leak of this material could have on the surrounding environment is unknown.
- Mining for Fuel – Open pit mining for uranium is a destructive process and has a devastating effect on the local environment. Despite measures being in place, it is common for toxic runoff to filter into the water cycle surrounding the mines and pollutants can be spread far from the original mining location.

Current energy production?

There are currently eight operational power stations in the UK, which accounted for 16.1% of the total electrical energy that was produced in 2020.

Where are the nuclear power plants located?

The illustration below shows both power plant locations and their total capacity for energy production. The illustration shows that the power plants tend to be in rural areas, close to the coast or large bodies of water. This is essential for ensuring the safety of the reactor as large quantities of water are needed for cooling.

Nuclear power station locations and capacity in the UK

Key projects in the industry

- Hinkley Point B - https://www.edfenergy.com/energy/power-stations/hinkley-point-b
- Hunterston B - https://www.edfenergy.com/energy/power-stations/hunterston-b
- Heysham 2 - https://www.edfenergy.com/energy/power-stations/heysham-2
- Torness - https://www.edfenergy.com/energy/power-stations/torness
- Hartlepool - https://www.edfenergy.com/energy/power-stations/hartlepool
- Sizewell B - https://www.edfenergy.com/energy/power-stations/sizewell-b
- Heysham 1 - https://www.edfenergy.com/energy/power-stations/heysham-1
- Dungeness - https://www.edfenergy.com/energy/power-stations/dungeness-b

Future projects and development of nuclear power

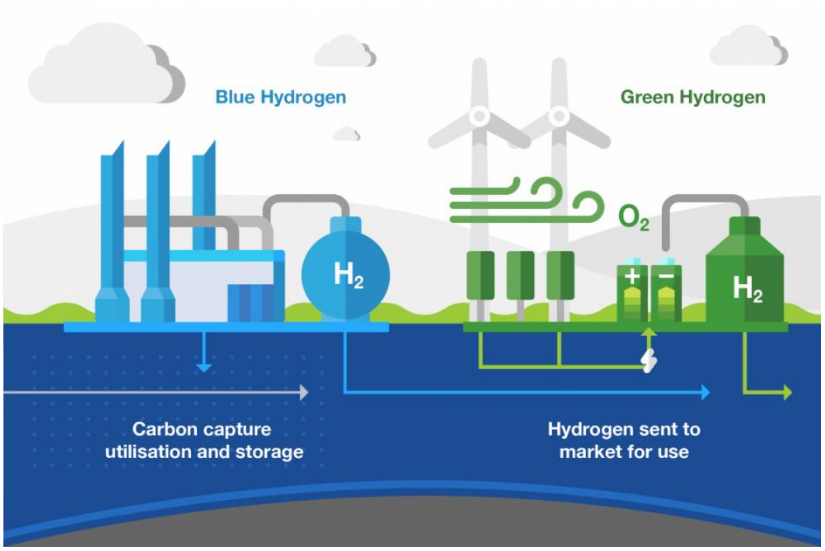
As we progress towards net zero, nuclear power has been identified as an essential technology for reducing our dependence on fossil fuels. However, the nuclear sector is currently in decline. In 2010 the government permitted eight new power plants to be constructed, yet only one of these is currently in production. This is a result of incredibly high production costs and the complexity involved with the development of new sights. As a result, the government is not willing to build power stations themselves, and they have struggled to find companies that are willing to take on the scale of the work.

Rolls-Royce is currently in the process of providing a solution to this problem through the development of small modular reactors (SMRs). The small reactors would produce less electricity but come with a more palatable price tag (only 10% of the cost of a large reactor) and could be produced in 3-4 years. This gives the government the option to build several small reactors on a quick time scale. The key point for service leavers is this technology is designed around the small reactors that are used by the Royal Navy on their nuclear submarines. This is a key link to MOD and as SMRs grow in popularity, service leavers will be in a good position to exploit the new job roles that will be created. Further information on SMRs can be found here - https://www.rolls-royce.com/innovation/small-modular-reactors.aspx#/

Blue and Green Hydrogen

Hydrogen is a clean fuel source, that when consumed in a hydrogen fuel cell produces electrical power. Hydrogen can be extracted through several different processes, the most common being thermal extraction and electrolysis. Thermal extraction typically works via a process called steam reforming, where steam reacts with a hydrocarbon (usually natural gas) to produce hydrogen and carbon dioxide. Carbon capture and storage (CCS) technology can be used to capture the carbon dioxide that is produced. The thermal extraction process including CCS is commonly referred to as **blue hydrogen**.

Alternatively, electrolysis can be used to extract hydrogen by passing an electrical current through water which splits the molecules into hydrogen and oxygen. It is possible for the electricity used in this process to be generated by renewable technologies. When combined with renewable technology, the process of electrolysis for hydrogen generation is known as **green hydrogen**. The UK government has recognised the potential of hydrogen for energy production and has developed a Hydrogen Strategy. This strategy has outlined goals to set up 9000 jobs, unlock £4 billion investment, and produce 5GW of low carbon energy by 2030.



Blue and Green Hydrogen will play a key role in the UKs future energy mix

Skills, Qualifications and Training

The renewable energy industry requires technical qualifications for most of its roles. Service Leavers should ensure that they maximise the opportunities provided to them through their resettlement period to gain relevant qualifications and maximise their employment opportunities. Depending on an individual's specific entitlement, there are courses available ranging from 5-day short courses booked through the CTP up to Degree courses that can be paid for using ELCAS credits. There is not a specific course that will guarantee you employment in the industry. However, we have listed several relevant courses below:

CTP

- Engineering based courses
- Domestic Electrical Installation
- 18th Edition Wiring Regulations
- Level 3 Award in Inspection and Testing
- L3 Diploma in Gas Utilisation and ACS Assessments Phase 1
- LCL L3 Certificate in Refrigeration, Air Conditioning & Heat Pump Systems
- NEBOSH General Certificate
- NEBOSH Environmental Management Certificate

ELCAS - For those that are entitled to ELCAS funding, there is a wide selection of level 3 qualifying courses that are relevant to multiple renewable energy industries. A list of relevant courses is too expansive to put in this document, however, we have put together links that you will be able to follow for the relevant courses that ELCAS can offer. The list of service providers that ELCAS uses is constantly changing. Please conduct your research on their website as the links below may miss out on courses that were not available at the time of writing this document.

- Engineering courses
- Electrical courses
- Environmental courses
- Health & Safety
- Marketing
- Project Management
- Accounting & Finance

Other opportunities

Government funded – The UK government currently offers free courses to adults aged 19+ who are looking to retrain and work in a skilled industry. Several free courses apply to the renewable energy industry including electrical engineering, nuclear engineering, and H&S. These provide service leavers with an excellent opportunity to complete both a technical course through the government scheme and use their learning credits to complete an industry-specific course or vice versa. Follow the link for more information - https://nationalcareers.service.gov.uk/find-a-course

Employer-funded - There are many examples where employers have hired veterans and paid for them to complete the requisite courses. This is very dependent on the type of employer, the job market at the time, and the demand for the role. For example, if there is a heightened demand for onshore wind turbine technicians then there is likely to be more scope for courses to be employer funded.

Grant funded - There are many fantastic charities and organisations that offer employment support to veterans. Some offer financial support which can be used to help fund courses, such as the Royal British Legion Employment Grant, or Armed Forces benevolent fund charities. (ABF, RAFBF, RNRMC)

Self-funded - You may be able to financially support your training courses, recognising that a short-term investment may open the door to a rapidly expanding industry, and pay dividends in the long term when you consider potential earnings. Whichever route you take, you will likely have to contribute at least a proportion of training costs from your own resources towards training courses.

What Next?

Many veterans are employed in renewable energy industries and there are a multitude of different routes by which they have got there! One of the challenges of writing this information resource is that there is no singular direction to point you in which gives you a clear pathway through to the separate industries.

What do you need to consider?

- What skills and attributes have you already acquired during your military career?
- What job would you like to do in your second career?
- Are there geographical constraints as to where you want to be working?
- Are there any education or skills gaps that can be addressed by training or courses?
- How will the training be funded? Is it possible to use the Careers Transition Partnership (CTP) to help you? What would be the best use of the ELC scheme to fund any training? Are there other sources of help for training?

The primary soft skills of any forces leaver are quality of character, work ethic, temperament, and flexibility. These should be what makes you an asset to any organisation. It is the day-to-day mechanics of each job which can be learned, for which training and experience each play their part.

What can I do now?

- Get your CV written. Allow others to review it and make suggestions. Think through how to express your experience and training in the armed forces, such that someone in your chosen industry will understand what you bring to their organisation.
- Register on LinkedIn, and/or update your LinkedIn profile.
- Start to speak with people. Establish contact with anyone you know who is already working in the industry.
- Start applying for roles which are advertised – Ensure your CV is relevant to that specific role. A generic CV is unlikely to get you an interview.

Final top tips

- Network, network, network. Use those who can help. Go and talk with (and listen to) people.
- Make the most of resettlement opportunities. Use resettlement courses.
- Responsibility lies with self. But lots of people will help you. Asking for help is not a sign of weakness
- Be persistent in your efforts. Determination and persistence will pay off eventually.

Into The Future

Mission Renewable want to build up a portfolio of people who have transitioned from the armed forces into the renewable energy industry. If you are already in any of the respective industries, please do get in touch with us – we would like to hear your story. When you become successful in finding employment in the renewable energy industry, likewise we would like to hear from you, to hear your story, to learn tips and tricks from you, so that we can, in turn, help others; and encourage you to help those who are following behind you.

We hope that this information source has helped to give you a stepping stone into the renewable energy industry. We wish you every success in your future career.

George Pendreich
Account Manager
Mission Renewable

Appendices

- Appendix 1 – Employment Road Map
- Appendix 2 – Useful Links
- Appendix 3 – List of Sources

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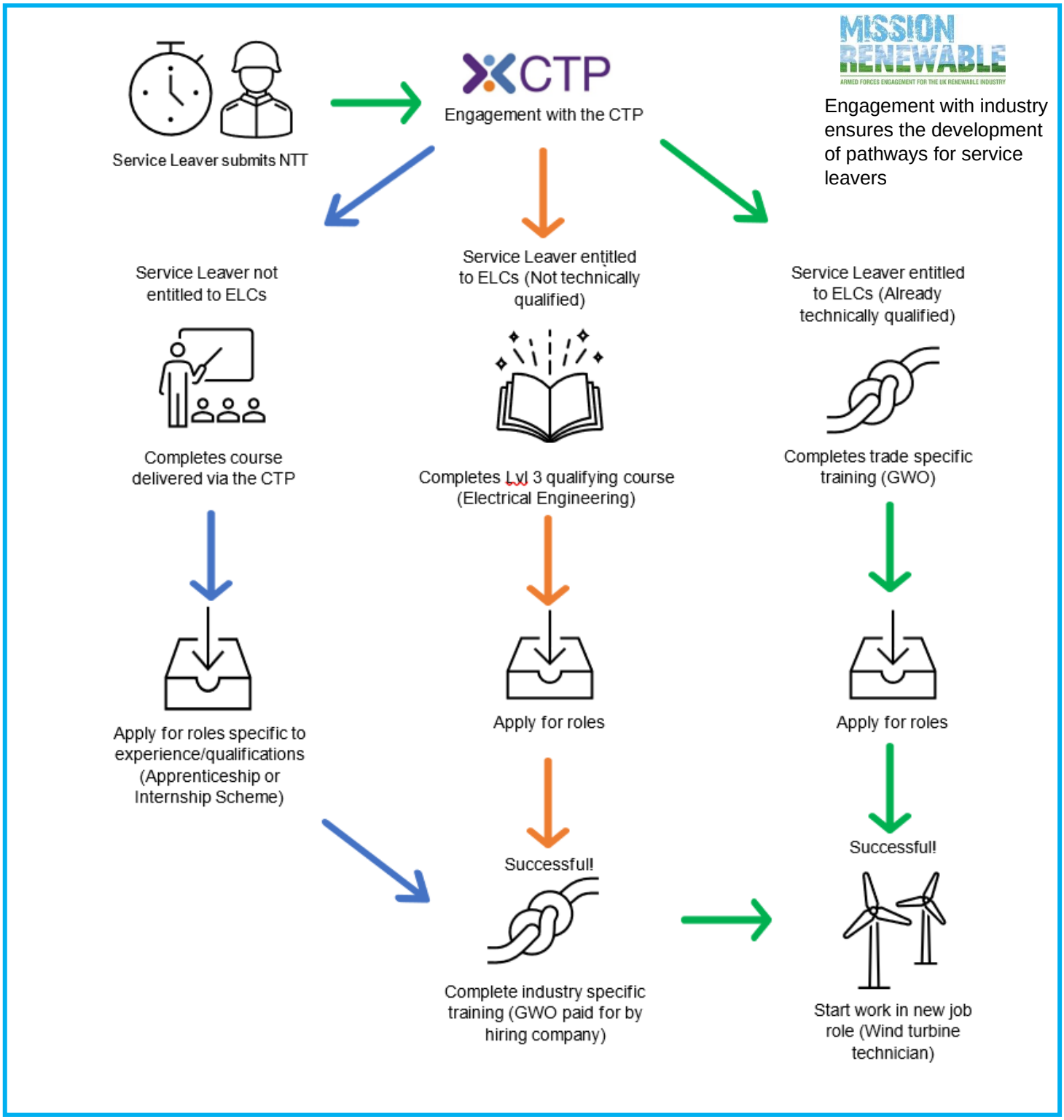
Appendix 1 – Employment Road Map

This road map has been designed to give service leavers an example of how they could transition from the military into a renewable energy industry. The illustration depicts how a service leave could move into a role as a wind turbine technician, working for an offshore wind operation company. Despite this route focusing on a role specific to the wind industry, the fundamental principles are the same across the entirety of the renewable energy sector.



Appendix 2 – Useful Links

General Information

- Mission Renewable (Armed forces engagement initiative with the renewable energy sector) - https://www.missionrenewable.org/
- Career Transition Partnership - https://www.ctp.org.uk/
- ELCAS - https://www.enhancedlearningcredits.com/
- RenewableUK (UK's leading not-for-profit renewable energy trade association) - https://www.renewableuk.com/
- Tri-service resettlement manual (JSP 534) - https://www.gov.uk/government/publications/tri-service-resettlement-manual-jsp-534
- Green Jobs Online - GreenJobs, Environmental Jobs and Renewable Energy Jobs in the UK

Offshore & Onshore Wind

- Vestas - https://www.vestas.com/en
- Equinor - https://www.equinor.com/
- Orsted - https://orsted.co.uk/
- RWE - https://www.rwe.com/en
- EDF Renewables - https://www.edf-re.uk/
- Vattenfall - https://group.vattenfall.com/
- Scottish Power Renewables - https://www.scottishpowerrenewables.com/
- Siemens Gamesa - https://www.siemensgamesa.com/en-int
- GE Renewables - https://www.ge.com/renewableenergy/home

Solar

- Solar Energy Uk (Solar trade association with 276 member companies. Due to the complex landscape of solar, we would recommend starting with this organisation as a starting point to understand the industry.) - https://solarenergyuk.org

Hydro Power

- Orbital Marine Power (UK leader in tidal energy) - https://orbitalmarine.com/
- British Hydropower (Hydro trade association) - https://www.british-hydro.org/

Bioenergy

- Biomass Uk (Biomass Trade Association) - https://www.biomass-uk.org/
- Bioenergy Infrastructure Group - https://bioenergyinfrastructure.co.uk/

Geothermal

- British Geographical survey - https://www.bgs.ac.uk/geology-projects/geothermal-energy/
- Geoscience UK - https://www.geoscience.co.uk/geothermal-in-the-uk
- Geothermal Engineering, United Downs, Cornwall (First Geothermal Power Plant in the UK) - http://geothermalengineering.co.uk/united-downs/

Nuclear

- Energy Security Strategy (Nuclear, what you need to know) - https://www.gov.uk/government/news/nuclear-energy-what-you-need-to-know
- Energy UK - https://www.energy-uk.org.uk/our-work/generation/nuclear-generation.html
- EDF Energy - https://www.edfenergy.com/about/nuclear/future-of-nuclear-power

Hydrogen

- UK Hydrogen Strategy - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf
- Shell Renewables - https://www.shell.co.uk/a-cleaner-energy-future/hydrogen.html
- BP Hydrogen project in Teesside - https://www.bp.com/en/global/corporate/what-we-do/gas-and-low-carbon-energy/h2teesside.html

Appendix 3 - List of Sources

UK Energy Trends 2022 - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1086800/Energy_Trends_June_2022.pdf

Imperial College London - https://www.imperial.ac.uk/stories/future-energy/

National Grid Live Status - https://grid.iamkate.com/

UK Energy in Brief - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1032260/UK_Energy_in_Brief_2021.pdf

UK Net Zero Strategy - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf

Centre for Sustainable Energy - https://www.cse.org.uk/advice/renewable-energy/solar-pv

International Hydropower Association - https://www.hydropower.org/iha/discover-facts-about-hydropower

British Geological Survey - https://www.bgs.ac.uk/geology-projects/geothermal-energy/

Biomass Uk - https://www.biomass-uk.org/

Uk Hydrogen Strategy - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf

National Grid - https://www.nationalgrid.com/stories/energy-explained/what-offshore-wind-power

Wind Europe - https://windeurope.org/newsroom/news/repowered-wind-farms-show-huge-potential-of-replacing-old-turbines/

Carbon Brief - https://www.carbonbrief.org/mapped-how-the-uk-generates-its-electricity/

Renewable Energy World - https://www.renewableenergyworld.com/storage/advantages-and-disadvantages-of-solar-photovoltaic-quick-pros-and-cons-of-solar-pv/#gref

The future scope of large-scale solar in the UK: Site suitability and target analysis, Renewable Energy, Volume 113, 2019 - https://www.sciencedirect.com/science/article/pii/S0960148118310590

Green Match - https://www.greenmatch.co.uk/blog/2019/09/uk-solar-capacity#:~:text=Astonishingly%2C%20the%20solar%20capacity%20in,the%20other%20EU%20member%20states.

Good Energy - https://www.goodenergy.co.uk/how-does-hydroelectricity-work/

Gov.UK - https://www.gov.uk/government/news/uk-government-announces-biggest-investment-into-britains-tidal-power

EDF - https://www.edfenergy.com/about/nuclear/what-is-nuclear-energy

Neccus - https://www.neccus.co.uk/

Eden Geothermal - https://www.edengeothermal.com/about/geothermal-energy/uk-and-cornwall-potential/

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