



## **MODULE 2**

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## **MODULE 2 Innovations**

- **Transitional Fuel Strategy**
- **Renewable Energy Sources**
- **Energy Demand Prediction Models**
- **Energy Innovation**

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## **Transitional Fuel Strategy**

### **What Does the Term "Transitional Energy" Mean?**

A global transition to alternative energy sources would be very detrimental to many political and business interests. Companies and nations that depend on fossil fuels for their financial viability might not want to or openly refuse to embrace a shift to a new energy strategy. Additionally, there is not enough infrastructure to support a supply of energy that is entirely renewable.

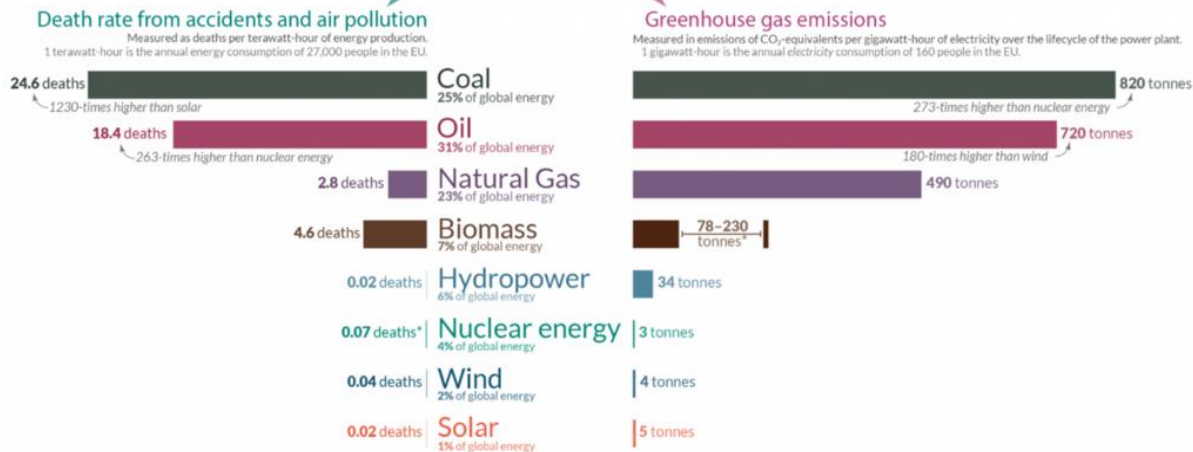
The larger objective of lowering carbon emissions, greenhouse gas emissions, and the increase in global temperatures is a component of the present energy transition strategy. The Paris Agreement's main objective is to keep global warming below 2°C, ideally below 1.5°C.

The good news is that a global agreement has been reached admitting the need for action to stop the negative effects of inaction on climate change. We are well behind schedule, which is terrible news. The necessity for quick action to prevent further and irreparable harm to the earth is emphasised by the Intergovernmental Panel on Climate Change (IPCC). To address climate change, more diversified energy options like solar power, smart grids, etc. are required.

### **Fossil fuels are to blame for carbon emissions.**

The main source of carbon emissions is the combustion of fossil fuels for energy. To prevent further increases in global temperatures, this energy company must decline. We are aware, however, that we cannot abruptly stop using fossil fuels. Tomorrow's shift from dirty, fossil fuel-based energy will take some time.

## What are the safest and cleanest sources of energy?



### A Transition Fuel to Combat Climate Change: LNG

Meanwhile, experts claim that liquefied natural gas (LNG) offers itself as a "transition fuel". They believe LNG can meet the need for gas while bridging the gap between conventional fossil fuels and renewable energy. Even though LNG emits fewer emissions and has a lower carbon intensity than coal or petroleum, it is still a fossil fuel. Even while LNG isn't perfect, it's a better choice than conventional, unclean fossil fuels.

This is particularly important for Asia because the continent relies heavily on coal to power its developing economies. Between fossil fuels and renewable energy, LNG can act as a bridge and a positive step. With only a modest improvement, there is a worry that nations would get complacent. In strategy for energy transformation, LNG must be seen as a transition rather than a panacea.

## **Renewable Energy's Share of Total Power Production**

Even though renewable energy now makes up a portion of the energy mix and power grids in the majority of nations, it is still unable to meet the energy demands of developed societies. Positively, the world's capacity for renewable energy is now rising. The idea of a future fuelled by renewable energy technologies is also winning over political and corporate interests. But sooner rather than later, societies will have to wean themselves off of fossil fuels.

### **What are the Three Ways we can Speed Up the Transition to Renewable Energy?**

The energy transition's pace must be considered. The sooner renewable energy is made widely available, the lower the likelihood that the earth will suffer from irreparable harm. Three steps are suggested by the World Economic Forum to direct and hasten the switch to renewable energy.

- **The Opportunity for Energy Efficiency**

Aside from the fact that it is heavily dependent on fossil fuels, one of the biggest issues with our current energy grid is how inefficient it is. According to the International Energy Agency (IEA), by maximising energy use, we can reduce emissions by more than 40%.

We will be nearly halfway to our carbon reduction targets if consumers and governments just use the most energy-efficient goods and transportation options available. Without even altering our energy supply, emissions can be decreased through the use of electric vehicles, energy-saving appliances and lighting, and legislative efforts to promote or compel energy efficiency.

- **Energy efficiency and renewable energy integration for flexibility and resilience**

The amount of emissions reductions required can be reduced by an additional 50% by switching from fossil fuels to renewable energy. Together with the energy efficiency plan, this accounts for 90% of the objective. Heavier investment in clean energy to scale it and

reduce costs would encourage shifts in consumer behaviour, facilitating the transition. In other words, customers are crucial to the strategy for the energy transition. Making the switch from filthy to clean, renewable energy would accelerate development.

- **Unleashing Potential Through Collaboration**

Teamwork is necessary to meet the final 10% of our emissions objective. Without international cooperation, achieving ambitious goals is difficult. Nothing more than everyone's shared interest in maintaining the health of the earth is required for this.

To accomplish this global objective, international collaboration and climate agreements like the Paris Agreement are required. Deals can only go so far, though; the next stage is action and keeping your word. Despite falling behind schedule, there is still time to stop global warming. In the end, an energy transition strategy cannot exist without continued international cooperation.

## **Renewable Energy Sources**

### **Renewable energy: what is it?**

Renewable energy comes from natural sources that replace themselves more quickly than they are used up. Examples of such sources that are continuously replenished are the sun and the wind. There are many different types of renewable energy available to us. On the other hand, non-renewable fossil fuels like coal, oil, and gas require hundreds of millions of years to create. When fossil fuels are used to create energy, they emit dangerous greenhouse gases like carbon dioxide.

More emissions are produced by burning fossil fuels than by producing electricity from renewable sources. The key to solving the climate catastrophe is switching from fossil fuels, which now produce the majority of emissions, to renewable energy.

Renewables are now cheaper in most countries and generate three times more jobs than fossil fuels.

### **What kind of energy isn't renewable?**

Because they are not limitless, fossil fuels are not a renewable source of energy. Additionally, they cause our atmosphere to lose carbon dioxide, which accelerates global warming and climate change.

Although it is complicated, burning wood instead of coal is slightly better. On the one hand, if it originates from responsibly managed forests, wood is a renewable resource. By-products from the wood processing sector are used to make wood pellets and compressed briquettes, which might be considered waste recycling.

Additionally, compressed biomass fuels are more energising than logs. On the other hand, burning wood (whether it be unprocessed wood or garbage) causes airborne particulate emissions.

### **Dirty Energy**

Oil, gas, and coal are examples of fossil fuels that are considered non-renewable or "dirty" energy. There are a finite number of non-renewable energy sources. When we fill up at the pump, we are utilising a limited resource that has been refined from ancient crude oil.

Non-renewable energy sources are also often located in particular regions of the world, thus some countries have a greater abundance of them than others. In contrast, all nations have access to sunlight and wind. By lowering a nation's reliance



on exports from countries with abundant fossil fuel resources, promoting renewable energy can also enhance national security.

The environment and human health may be endangered by numerous non-renewable energy sources.

For instance, coal power plants pollute the air, fracking technologies can lead to earthquakes and water pollution. On top of that, every one of these actions contributes to global warming.

### **Future of renewable energy sources**

The demand for energy to power our homes, businesses, and communities grows along with the global population. Maintaining a sustainable energy level and preventing climate change need innovation and expansion of renewable energy sources.

The International Energy Agency (IEA) predicts that by 2024, 30% of the world's electricity would come from renewable sources, up from the current 26% share. The IEA's executive director, Fatih Birol, stated that "renewable energy is at a critical juncture right now."

The UK achieved a brand-new incredible renewable energy milestone in 2020. For the first time, the nation celebrated two months of only using renewable energy on Wednesday, June 10.

This is a fantastic move in favour of renewable energy. It is anticipated that as electricity demand rises in the future, the number of renewable energy sources will keep growing. This will result in lower renewable energy costs, which are fantastic for the environment and economical for us.



## **Source of Renewable Energy**

### **Solar Energy**

The most plentiful source of energy is solar energy, which may even be used under cloudy conditions. The rate at which the Earth absorbs solar energy is around 10,000 times higher than the rate at which people use energy.

For a wide range of applications, solar systems can provide heat, cooling, natural lighting, power, and fuels. Solar technologies can use photovoltaic panels or solar radiation-concentrating mirrors to turn sunlight into electrical energy.

Although not all nations have the same access to solar energy, direct solar energy can nevertheless make a major contribution to any nation's energy mix.

Solar panels are now not only accessible but frequently the cheapest source of electricity because of a sharp decline in the cost of solar panel production over the past ten years. Solar panels come in a range of colours based on the type of material used in their manufacture and have an average lifespan of 30 years.

### **Wind Energy**

Using enormous wind turbines that are installed on land (onshore), in salt water, or freshwater, wind energy captures the kinetic energy of flowing air (offshore). Although wind energy has been used for thousands of years, onshore and offshore wind energy technologies have advanced recently to maximise the amount of electricity produced, using higher turbines and bigger rotor diameters.

Even though average wind speeds vary greatly from place to place, most locations of the world have the potential for considerable wind energy deployment. The potential for wind energy is more than global power production.

Strong winds can be found in many locations around the world, but often distant areas are the greatest for producing wind energy. Offshore wind energy has a lot of potentials.

### **Geothermal Energy**

Geothermal energy makes use of the thermal energy that is available from the Earth's interior. Geothermal reservoirs can be heated using wells or other methods.

Hydrothermal reservoirs are those that are naturally sufficiently hot and permeable, whereas enhanced geothermal systems are those that are naturally adequately hot but improved by hydraulic stimulation.

Different temperature fluids can be used to produce electricity once they reach the surface. Since it has been in use for more than a century, the technology for producing energy from hydrothermal reservoirs is established, dependable, and mature.

### **Hydropower**

The energy of water flowing from higher elevations to lower elevations is captured by hydropower. It can be produced by rivers and reservoirs. Run-of-river hydropower facilities rely on the river's available flow, whereas reservoir hydropower plants use water that has been stored in a reservoir.

In addition to supplying energy, hydropower reservoirs frequently serve as sources of drinking water, irrigation water, flood and drought control, navigation services, and energy.

The largest renewable energy source in the electricity sector at the moment is hydropower. It depends on relatively consistent rainfall patterns, which can be adversely affected by droughts brought on by climate change or by changes to ecosystems that affect rainfall patterns.

Hydropower infrastructure also has the potential to negatively affect ecosystems. Because of this, many people view small-scale hydro as a more environmentally benign choice that is well suited for distant populations.

### **Ocean Energy**

Ocean energy comes from processes that use the kinetic and thermal energy of the ocean's waves and currents to generate heat or electricity.

The development of ocean energy systems is still in its infancy, and several waves and tidal current prototypes are being investigated. Theoretically, ocean energy could easily provide all of the world's energy needs.

### **Bioenergy**

Bioenergy is made from various organic resources, known as biomass, including wood, charcoal, dung, and other manures for the production of heat and power, as well as crops for the creation of liquid biofuels. The majority of biomass is utilised by impoverished populations in developing nations in rural regions for cooking, lighting, and space heating.

Dedicated plants or trees, agricultural and forestry waste products, and diverse organic waste streams are all used in modern biomass systems.

When biomass is used for energy, greenhouse gas emissions are produced, although at a lesser rate than when fossil fuels like coal, oil, or gas are burned. However, given potential adverse environmental effects connected to significant expansions in forest and bioenergy plantations,

and the ensuing deforestation and land-use change, bioenergy should only be employed in limited applications.

### **Hydropower Electricity**

Although wind energy is anticipated to overtake hydropower as the country's leading renewable energy source shortly. Hydropower uses water to generate electricity by turning the turbine blades of a generator, often fast-moving water in a large river or quickly falling water from a high point.

Mega-dams, often known as huge hydropower facilities, are frequently regarded as non-renewable energy sources both domestically and outside. Mega-dams alter and reduce natural flows, limiting access for populations of animals and people who depend on such rivers. Carefully maintained small hydroelectric facilities, with installed capacities under around 40 megawatts, tend not to harm the environment as much because they only divert a portion of the flow.

### **Biomass Energy**

Crops, scrap wood, and trees all include biomass, which is organic material derived from plants and animals. Burning biomass releases chemical energy as heat, which can be used to power a steam turbine to produce electricity.

For the purpose of generating power, biomass is frequently misrepresented as a clean, renewable fuel and a more environmentally friendly option than coal and other fossil fuels. Recent research reveals that many biomass types, particularly those derived from forests, emit more carbon dioxide than fossil fuels. Additionally, there are negative effects on biodiversity. However, in the correct situations, some types of biomass energy might be a low-carbon choice. An example of a low-carbon energy source is sawdust and chips from sawmills, which would otherwise quickly disintegrate and release carbon.

## **Your Home's Use of Renewable Energy Sources and How we Might Aid**

The benefits of utilising renewable energy in a household environment are compelling:

**Minimize your Energy Expenditures:** Once the costs of establishing a renewable energy system have been covered, you can reduce your reliance on the National Grid and your energy prices. A great gas boiler substitute is air source heat pumps.

**Receive Payment for the Electricity You Produce:** The Feed-in Tariff programme of the UK government compensates you for the electricity you produce, even if you use it.

**Refinance Your Electricity with the Grid:** You can get extra money from the Feed-in Tariff programme if you are producing enough energy to export an excess back into the National Grid.

**Drive an Electric Vehicle:** Did you know that our EV rates are renewable in addition to being cost-effective? View our electric vehicle pricing.

**Minimising Carbon Footprint:** Carbon dioxide and other dangerous pollutants are not released into the atmosphere while using green, renewable energy sources. The Solar panel's page of the Energy Saving Trust states that a typical solar PV system might save 1.5 to 2 tonnes of carbon annually. More information is available in our guide to solar panels.

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### **Energy Demand Prediction Models**

A model that offers a systematic framework for identifying patterns and foreseeing changes in energy requirements, especially when those trends and needs are related to various scenarios of socioeconomic and technological growth. It considers various energy sources (including conventional fuels) at the end-use level across all economic and consuming sectors/subsectors. To establish sustainable energy systems, MAED was created to assist energy analysts and



decision-makers in analysing future energy demand. It is a simulation model based on a bottom-up scenario method that works well for medium- and long-term analysis at the national or regional levels. A thorough investigation of social, economic, and technological issues, reflects fundamental changes in energy consumption.

## **Energy Innovation**

Possibly the most crucial changes the world needs to make right now to lessen both climate change and international conflicts are toward renewable energy and sustainable storage technologies. Even though significant advancements have been made on both counts, a carbon-free energy environment still has to be developed. Fortunately, local tests for global scalability are being conducted on some of the most creative energy technologies.

### **Some Innovations**

Garden windmills that are miniature

When you think about a wind farm, you might picture enormous buildings that are situated in far-off, windy locations, but that is swiftly changing.

principle as large-scale wind farms, but on a much smaller scale. When the wind blows through a set of three outer and three inner vertical blades, spinning mechanical energy is produced, which travels through the generator and is transformed into electrical energy.

The CW1000 model, made of sturdy stainless steel, carbon fibre, and aluminium, can withstand winds up to 134 mph.

The units are modified to have a maximum height of just over 3 metres and produce noise levels that are less than 40 decibels, or roughly the volume of a quiet conversation, to ensure that they are suitable for household use.

The Icelandic company claims that by making wind power available to people everywhere in the world, it intends to decentralise and democratise energy production.

### **Solar Expansion to Cover More Surfaces**

More towns are adopting a prosumer strategy and producing their own power as solar technology spreads and become simpler to use.

Up until now, roof panels have been the most popular home method of capturing and converting light, but Solecco is going a step further by providing solar roof tiles.

These utilise silicon photovoltaic cells to turn sunlight into electricity like roof panels. But rather than using just a few panels, entire roofs may produce solar energy since they have a larger surface area.

By integrating small-scale solar generating into various components of the urban environment, such as smart benches, trash cans, and solar lighting in green spaces, Environmental Street Furniture goes a step further. The incorporation of charging stations and network connectivity, which in turn facilitates social power sharing, creates prospects for powering cities.

### **Using Recycled Plastic**

With current global recycling rates hovering around 18%, it is clear that more has to be done to ensure the abolition of single-use products. For good reason, plastic is a significant focus in the fight against waste. Over seven billion tonnes of plastic were manufactured globally by 2015. To combat this, Greenology is using pyrolysis to convert plastic into energy. Plastic is broken down without combusting by heating garbage at a very high temperature without oxygen.

Biofuels can be made from the bio-oils produced by this technique. The advantages of this novel waste management strategy are twofold: not only can plastic be recycled, reducing the long-term environmental damage caused by single-use plastic; additionally, the production of biofuel provides a source of energy for everything from transportation to the production of electricity.

### **Preserving Heat For A House**

Heating decarbonization is one of the worldwide issues for which there is yet no conclusive solution. With its heat battery technology, Pumped Heat Ltd (PHL) is creating a viable remedy. The company has discovered a way to have its gadgets charge and store electricity at "off-peak" times when electricity is cheapest, and then use this energy to provide heating and hot water for



households as needed. The electricity used to charge these devices will have a carbon content that is close to zero as the grid continues to decarbonize and renewable energy sources become more affordable and widely available.

By using vacuum insulation, the heat battery technology loses 10 times less heat than a typical night storage heater.

A home's heating demands are met immediately by air-sourced heat pumps, which are more frequently used. They use the electricity that is readily available at the moment to heat the water when they receive it, which might be very cold during the winter. Instead of only when there is an excess of electricity, Pumped Heat's storage mechanism guarantees there is always heat available, keeping a constant temperature for hot water or central heating.

According to the company, one advantage of adopting a heat battery system is that it is less expensive than an oil or LPG boiler in a future where the domestic and national output of renewable electricity is only expected to rise.

### **Waste-Powered Aircraft**

Travel and transportation are two of the most fossil fuel-dependent industries in the world, and they are actively looking for alternate, more sustainable ways to power them in the long run.

Velocys seeks to accomplish this via using garbage. Using the Fischer-Tropsch method of gasifying waste, the company is creating environmentally friendly fuels for heavy-duty vehicles and aviation. This entails using a catalytic chemical reaction to transform waste materials—such as trash and woody debris—into clean jet fuel. Synthesis gases—carbon monoxide and hydrogen—are transformed into liquid hydrocarbons that may be utilised as a fuel in the process. This not only reuses waste materials that may have ended up in landfills, but it also creates far cleaner fuels with lower particle matter and harmful pollution emissions.

The globe is focused on more environmentally friendly ways to fuel our lives as we start a new decade of creation, and these ground-breaking responses to pressing environmental problems will keep people thinking creatively.

### **Trains Powered by Solar**

Byron Bay developed and built a solar-powered train that is entirely powered by renewable resources. The train has 100 seats and covers a distance of 3 kilometres. Given that transportation causes some of the highest greenhouse gas emissions in many nations, this technique is regarded as being advantageous in cities with tram systems.

### **Synthetic Photosynthesis**

The method of harnessing and storing solar energy is known as artificial photosynthesis. Additionally, researchers are looking into how water may be transformed into hydrogen and oxygen, which could reduce atmospheric carbon dioxide levels.

### **Tidal Power**

Tidal energy is a reliable source of power. Due to the position, which makes it challenging to transfer energy from the ocean to land, scientists have previously had difficulty using this. Now that it can be used directly, tidal energy has the potential to power up to 20% of the UK.

### **Electricity from Carbon Nanotubes**

Carbon atoms are folded up into single sheet molecules to form carbon nanotubes. These can produce electricity and could be utilised in place of other energy sources in smaller electrical equipment.

### **Trees Made of Solar Energy in 3D.**

Solar panel leaves are attached to wood-based stems in 3D-printed solar energy trees. Since most nations still burn wood for energy, they were developed to replace it with solar energy. These were made to resemble trees so they could be placed in gardens and other natural settings. Heat energy can also be harvested by solar energy trees.

### **Flowing Sunlight**

Solar energy transforms liquid sunshine into a fuel source. This liquid can be utilised in synthetic photosynthesis, which is why scientists have been attempting to exploit it as a sustainable source of energy.

### **Tyre Electric**

Goodyear is developing a novel idea for electric tyres that would charge while being used. They would be propelled by the tire-on-road heat created by friction. Even when stationary, these tyres can still be charging.

### **Glass Lithium Batteries**

These batteries have a much longer lifespan than conventional batteries. They have a capacity that increases with age and have two times the energy density of a typical battery. The batteries function at lower temperatures, charge more quickly than any other variety, and cost less.

### **Networks of Batteries that Supply Energy to Entire Cities**

However, sustainable battery development is required for much more than just automobiles and construction. For instance, the City of Melbourne has started an ambitious project to build a network of neighbourhood-based mid-sized batteries that are connected. The plan is to store energy when there is little demand and release it when there is. The vision, known as Power Melbourne, focuses on both economic growth and achieving carbon-free targets. Research, training, and employment possibilities will be made possible through investments in the clean technology sector.

New jobs will be produced in a variety of clean energy sectors, namely in electricity efficiency, power production, the automobile industry, and grid modernization, according to a recent World Energy Outlook report by the IEA. 75 per cent of the 13.3 million new jobs are expected to be created in these four sectors, which will more than make up for the 3 million jobs that the fossil fuel sector is predicted to lose.