Access to Energy

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EDITORIAL

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Gigatech Solutions for Gigaton Problems: Floating Solar Practice and Potential

We know how to build PV power plant, we know how to float structures on water, what else is there in FPV?,as opposed to ii) Its not about dumping solar PV into water, its all about floating them…..

These two statements succinctly capture the two ends of the spectrum and the *water* in between that is associated with the practice and potential of floating PV. These two diverse views– aggressive and conservative respectively, were discussed and deliberated upon by the participants of the Deep Dive Workshop organized by the Asian Development Bank during ASIA Clean Energy Forum 4- 8 June 2018 in Manila, Philippines. It was attended by Solar Energy Research Institute of Singapore, Trina Solar, WEnergy, Ministry of Power Bangladesh, Ciel et Terre, International Solar Alliance, Ecogy Cleantech, JE Access, Sustainable Marine Energy, Transcendergy LLC, ITP India and ADB.

Though nascent, the floating PV market is expected to grow rapidly due to certain key advantages including avoided land-use, enhanced energy yields, and providing complementarity with hydropower production in terms of hybrid operation and reduced evaporation. From the first FPV project in 2007 in a vineyard in the US, the sector has seen an exponential growth both in terms of number of projects and the installed capacities, the largest one being 40 MW in China and 150 MW under commissioning, also in China. Further, the experts are already speaking about the frontiers of FPV including offshore installations, flexible PV (on sails of a boat), OPV (Organic solar cells/ PV), and thermal storage as compared to battery-based storage, indicating the confidence and optimism about FPV.

However, the evidence-based results from test-beds and detailed techno-commercial feasibility studies cautioned against the aggressive approach associated with technology and designs aspects of FPV. For instance –does the use of bi-facial PV modules really enhance the yield due to reflection of light from water? don't HDPE floats covering the entire back of the PV module act as deterrent to achieving additional cooling effect due to water? can (big) bird-droppings be ignored on FPV? don't cables and anchors rupture due to constant rocking in water? and doesn't moisture ingress in cables cause insulation faults?

Apart from technical, there are commercial, regulatory and environmental safeguards issues that need duediligence as part of comprehensive planning for an FPV project. The suitability of water bodies and water rights are issues that need to be studied in detail as all types of water bodies cannot be utilized for FPV. There are strategic uses and applications served by the water bodies such as drinking water supply, irrigation, transport, fisheries, tourism that cannot be adversely impacted by an FPV project. A detailed surface analysis combined with a bathymetric survey (bottom topography) would indicate the maximum size of FPV that a water body can sustain. Further, if an FPV is to be hybridized with existing hydro power plant that has a long term signed PPA, an amendment to this PPA to include FPV could become a challenging task. It is also important to note that the useful life of FPV may not be the same as ground mounted PV. The LCOE calculations and hence the bankability of an FPV project would have to be assessed realistically. For Asian countries, it is also worth looking at small scale distributed FPV installations to provide power to ruraland off-grid communities.

It would therefore be prudent for every country to prepare a roadmap for FPV development considering technical, regulatory, legal and commercial aspects. Selecting the 'low-hanging fruits' such as abandoned coal mines that are now filled with water and stagnant water bodies could in the meanwhile kick-start the FPV sector in any country.

Indian Offshore Wind: Ambitions, Opportunities and Challenges

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Associate Director
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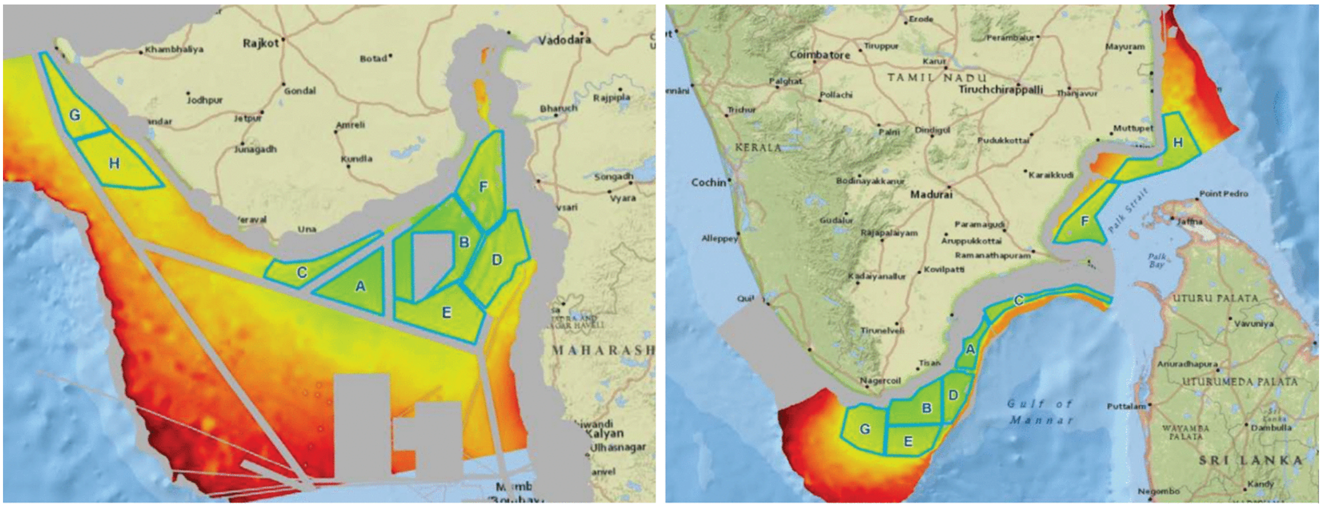
India's announcement of ambitious target of installing 227 GW of renewable energy by 2022 attracted attention worldwide. According to the IEA (2017), China, USA and India shall account for two thirds of the global renewable energy expansion by 2022. Five out of the ten biggest solar photovoltaic power projects being developed across the globe are situated in India, and the largest facility – the 2225 MW Bhadla Industrial Solar Park – is scheduled to become fully operational soon. The credit for India, which is looking well-placed to meet its ambitious targets, can be accorded to timely government action. So far, solar and onshore wind energy have been the focal point of the recent growth, however, the major constraints faced by onshore renewables in India is the availability of land and electrical grid.

India has a coastline longer than 7500 km and some coastal waters offer sites that are well suited to offshore wind projects, including areas with attractive wind energy resources which can reach up to an annual average of 10 m/s. India's offshore winds are an abundant, unexploited, indigenous energy resource that could complement other forms of generation in the future energy mix and help attain energy security.



Source: FOWIND

India is progressing with an offshore wind regime designed to attract wide interest from developers and the supply chain. In October 2015, the Ministry of New and Renewable Energy (MNRE) released the National Offshore Wind Energy Policy and started investigation of two potential projects: one in Gujarat and another in Tamil Nadu, where the most attractive wind speeds are found. With support from the EU and the British Governments, the Indian Government is surveying the offshore wind resource, assessing offshore site conditions and developing a policy framework to support both projects and the local supply chain.

Offshore Wind pre-feasibility studies for the states of Gujarat and Tamil Nadu have been undertaken by the European Union funded project, FOWIND. This project has used numerical models to assess the offshore wind conditions in both states and incorporated technical and constraints to suggest zones for development that have the best potential. The project proposed eight offshore wind development zones (Zone A-H) in each state.

The zones in the waters of Gujarat (left) and Tamil Nadu (right) proposed by the FOWIND project are shown in the figure above. Green offers the most attractive conditions, whereas red is least favourable.

The National Institute of Wind Energy (NIWE), an autonomous body formed under MNRE, is actively managing the regime and is the nodal agency for the sector. For precise wind quality measurements, NIWE installed and commissioned LiDAR offshore in the Gulf of Kambhat, Gujarat, in November 2017. Procurement of another LiDAR for the Gulf of Mannar, Tamil Nadu is under process and expected to be operational in late-2018. In April 2018, NIWE invited Expression of Interest (EoI) for the country's first 1 GW offshore wind project. As the nodal agency, NIWE will be the single point organisation for obtaining/facilitating the clearances for the development of the project. The EoI received keen response from the industry, both Global and Indian firms – 35 applications have since been shortlisted for the next stage of the competition.

With the announcement of this first offshore wind project, the government is moving positively to develop this sector and intends to replicate the success of India's onshore wind power sector. This would aid towards attaining energy security and help achieve the country's National Action Plan for Climate Change (NAPCC) targets. To provide confidence to the industry, MNRE has announced medium and long-term targets for offshore wind power capacity additions in India; 5 GW by 2022 and 30 GW by 2030.

The target figures may appear moderate in comparison to India's onshore wind target of 60 GW and solar target of 100 GW by 2022, but are still very challenging for this new sector, especially considering the difficulties in installation of large wind power turbines in open seas. India has made a committed start on its journey towards an offshore wind industry that has the potential to generate significant amounts of low-carbon, affordable and predictable power accompanied with jobs, foreign direct investment and new supply chain opportunities.

Important steps are being taken to fill in the existing, broad policy framework, and planning for the first project is underway. India's initial projects will be critical: technological and commercial success coupled with public support will add momentum and confidence to the offshore wind programme. Following the first projects, a sustained programme of larger projects would drive the development of the local supply chain; generating jobs, taxes and exports. It will also see the cost of electricity from offshore wind reduce as technology improves, the local supply chain drives down capital and operational costs, and growing investor confidence pushes down the cost of finance. The European offshore wind market has seen similar trend in recent years and cost reductions have been dramatic.

The key to a successful offshore wind programme will be the available wind energy resource which, in some areas, could be at the lower end of the scale for economic viability and tends to be highly seasonal. In the future, floating wind technologies could boost the extractable energy resource by opening up sites deeper than the 40–50 m limit of fixed foundations. The southern waters off Tamil Nadu, for example, offer mean wind speeds >9 m/s but as water depth increases rapidly from the shore large areas of this resource can only be exploited by floating turbines.

India has now kicked off its offshore wind sector and its future looks promising.

Energy Efficiency Opportunities in MSME Sector

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Small industries worldwide are important players in the economy. They provide employment opportunities to a large number of people, create value addition to products manufactured by large industries and provide opportunities for vertical and horizontal integration of industries. They are interdependent in nature and so many a times exist in clusters of similar industries. Small industries, thus, are the backbone of many economies.

In India, MSMEs employ about 80 million people and provided 8% of the GDP. Upto 40% of exports from India come from these MSME units.

There are a large number of MSME units which are unable to take advantage of the schemes of Government of India (GoI), mainly because they are not registered. MSME units do not come under the ambit of Companies Act and unless registered are not bound to report important economy data. MSMEs also do not have the resources to employ experts in the area of operations and depend upon the skill of the entrepreneur for most technical and management matters. It is in this overall context that the MSMEs operate in the country.

Energy Efficiency, among others is one area in which small industries need expertise for more innovative and economical operations. Many sectors within the MSME units are energy intensive and thus need expertise of this nature to be able to perform better on these avenues.

Energy Intensive industries

A number MSMEs fall within the energy intensive sector. Some examples of these units are gray iron foundries, tool making, brass making and ceramic industries. These provide important input material for large units based in the country.

Gray Iron foundries and tool making industries in the country are spread all over, while brass making and ceramic industries are concentrated in a couple of places namely, in and around Gujarat.

Energy efficiency presents a big opportunity to work with these small industries. In most cases the furnaces need improvement, while in some cases the process flow needs some changes to bring in energy efficiency.

Interventions

A number of interventions have been undertaken in the Indian MSME sector to bring about energy efficiency. The Bureau of Energy Efficiency, under the Ministry of Power, GoI has undertaken many initiatives with World Bank, UNIDO and EESL in this area. The BEE started work in 25 MSME clusters by undertaking a cluster wise survey in these places. Later on, different agencies undertook work in expanding these interventions according to their area of expertise.

The project with the World Bank focused on providing finance for innovative projects. Similarly, the UNIDO project provided technical expertise and the EESL project is working on providing demonstration support in similar projects.

Opportunities

In the current scenario, a number of development agencies have been interested in energy efficiency in the MSME sector. This interest is based both on climate change agenda as well as economic aspects of energy efficiency. The economic aspects of energy efficiency are usually more attractive to MSME unit than the climate change agenda.

On the one side, MSMEs looking for better productivity in their operations would like to bring in energy efficiency concepts and methods in their working, while on the other, activities that can satisfy this demand can be carried out. Such activities can be like energy audits, development of detailed project reports for various technologies and financing of such interventions. Activities can also include carrying out demonstration projects and developing financial models for greater dissemination of technologies.

Mix of energy sources – Dispatchable Renewable Energy

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Managing Director
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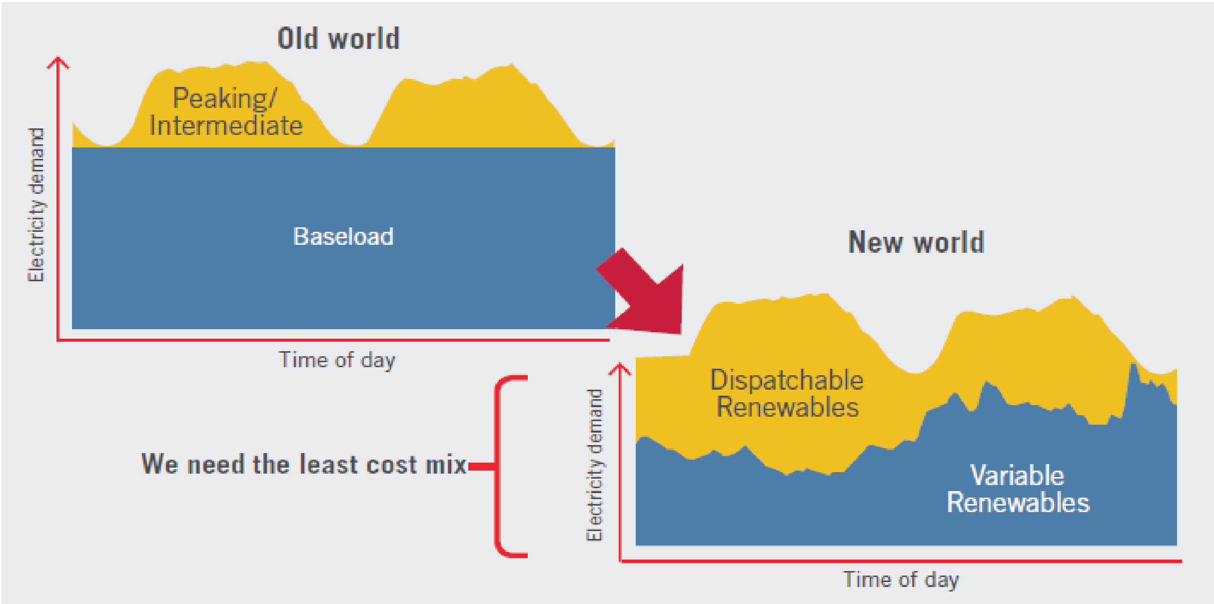
The world is moving towards a low emission electricity system and the need to better understand the various technology combinations for Dispatchable Renewable Electricity generation to contribute to overall system reliability has increased.

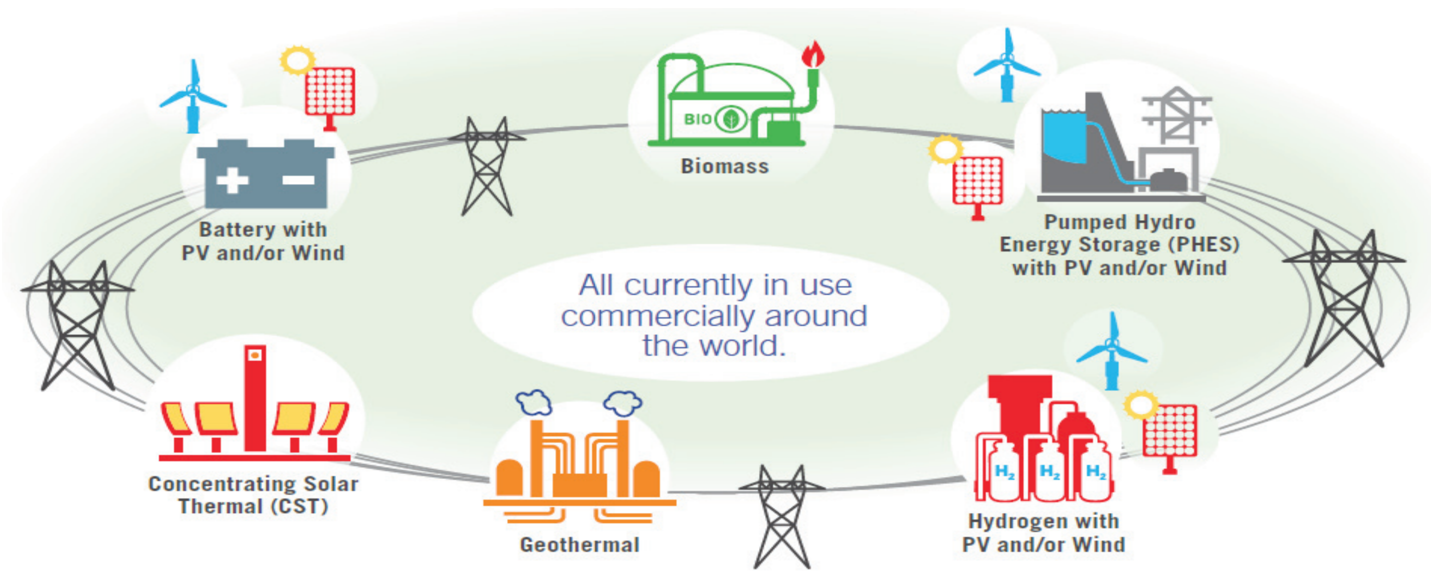
Dispatchable generators are those that can raise or lower power output on command from the system operator or facility owner, however, the rate of response can vary from system to system. Consistent renewable energy sources such as bioenergy and geothermal are inherently dispatchable, while variable renewable energy (VRE) inputs such as wind or solar energy can be converted to dispatchable generation when combined with some form of energy storage like batteries, pumped hydro, hydrogen and molten salt. Such storage could be co-located or based elsewhere in the system with a virtual or contractual ‘connection’.

With variable renewable energy (VRE) generation from wind or photovoltaic (PV) systems now becoming the cheapest electricity per MWh for new build systems, there is a shift from an old world of baseload coal balanced by open cycle gas turbines and hydro, to a new world with increasing levels of VRE balanced by dispatchable renewable generation.



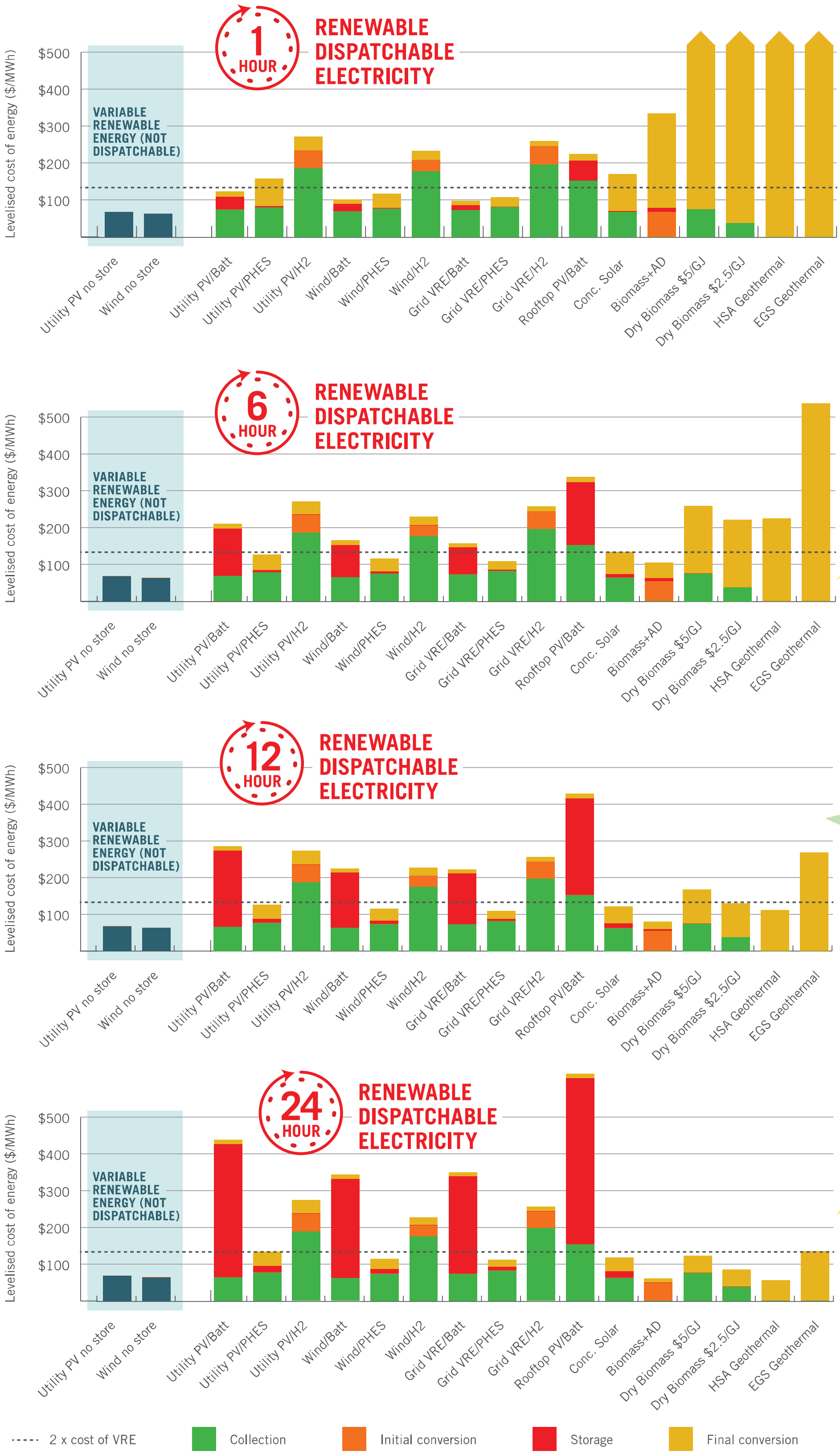
With the changing electricity supply scenario, the current public debate is around issues of electricity system security to avoid large-scale blackouts due to technical issues. Recent studies suggest this is relatively easy to address and only becomes a problem when neglected. A study carried out by our team for Australian Renewable Energy Agency (ARENA) compares commercially available options for providing dispatchable electricity generation from renewable sources. The emphasis of this study is on addressing the provision of electricity when it is most needed (overall reliability), which appears to be the issue that will require the greatest long-term planning and investment. It examines the sensitivity of energy cost to configuration and the applicability of various technologies to different roles.

The study highlights that all the dispatchable renewable options of; PV or wind driven batteries, pumped hydro energy storage (PHES) or hydrogen; concentrating solar thermal; bioenergy and geothermal have a role to play as shown in figure below:



COMPARING COST OF ELECTRICITY

Levelised Cost of Energy (LCOE) for the different combinations at zero, one, six and twelve hours of storage or duration of delivery for systems at 100MWe nominal capacity evaluated with a 6.5% weighted average cost of capital.



Figures show the contributions to LCOE for each of the collection, initial conversion, storage and final conversion subsystems in each case.

For each timescale there are **multiple cost competitive options** below the line representing 2 x the cost of VRE

For each timescale different technologies are seen to offer the **lowest cost energy**

Each technology has timescales and configurations for which it is best suited.

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