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## Onshore Renewables & Storage Series

# Hybrid Renewables Explainer

***Thought Leadership***

- Part 1—Definition and market
- **Part 2—Enablers and barriers**
- Part 3—Valuation approaches
- Part 4—Drivers, ITPEnergised hybrid experience and net zero
- Part 5—Visual summary

### *Introduction*

This mini-series takes a closer look at hybrid renewables and how, among a number of solutions, it has the potential to support the Paris Agreement, the UN Sustainable Development Goals (SDGs), a growing world ambition to achieve net zero in our lifetime and to outperform current Environment and Social Governance (ESG) value propositions. This series is written for boards and investment committees of funds, utilities, developers, policy makers and network companies who would like to:

1. Increase returns in lower wind energy yield years;
2. Increase returns when project grid charges are anticipated to start rising;
3. Increase the number and variety of returns by maximising your grid connection as route to market;
4. Increase returns with more valuable flatter generation profiles to offtakers / internal retail position;
5. Reduce lifetime cost of energy at a system level, increase self-balancing and reduce costs of balancing;
6. Develop a platform capable of incubating innovation that cuts across silos from pilots to scale;
7. Diversify risk at the point of connection;
8. Defer investments in grid infrastructure;
9. Introduce option value into the portfolio, at least cost, even at the development stage; and
10. Outperform your current ESG proposition with higher renewable energy density for given land use.

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### *Enablers*

The potential advantages of hybrid renewable schemes are documented[1] but continue to evolve as markets and regulations progress towards enabling a net zero future. Some of the enablers, presented by asset lifecycle for clarity, are presented in **Table 2 below**:

| Enabler | Description |
|---|---|
| 1. Development up until financial investment decision (FID) | |
| Conceptual | Aligns to achieving net zero greenhouse gas emissions, targets now enshrined in European Climate Law and UK Law.<br><br>The scheme has the potential to become more of a grid asset, more self-balancing and/ or able to provide grid ancillary services such as balancing with storage.<br><br>Environmental, Sustainability and Governance (ESG) adherence - ability to serve production facilities with green credentials, resilience, flexibility and to meet board level and investor goals of more sustainable energy in their electricity supply and supply chains, such as the RE100. There is a general trend for datacentre colocation providers and fortune 500 companies to act responsibly to safeguard our planet - ITPEnergised has a strong track record in developing and helping to deliver engaging ESG programmes for clients. Please read more in our ESG series **here**.<br><br>Ability to better serve remote island communities as alternative fossil fuel generation and fuel transportation costs are high.<br><br>As well as wind, solar, various forms of storage (hydrogen, flywheel, lithium ion) there may the potential to add on further technologies as heat and transport sectors electrify e.g. heat pumps and EV charging. |
| Offtake | Firmer and flatter output for physical offtake / private wire / backup. This may favour the supply of green electricity to industrial customers and vertically integrated utilities with a retail position as the costs of balancing and ancillary services rise. |
| Permitting | Potential to reduce costs of permitting as the same activities may apply to two or more technologies although wind may take longer than solar. |

[1] Renewable Hybrid Power Plants, Exploring the Benefits and Market Opportunities, WindEurope, July 2019, https://windeurope.org/wp-content/uploads/files/policy/position-papers/WindEurope-renewable-hybrid-power-plants-benefits-and-market-opportunities.pdf

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| Enabler | Description |
|---|---|
| Subsidies | In a subsidy environment the renewable generation may attract subsidies with any storage component potentially qualifying for capacity market which will help further enhance the HRPP economics. In a no subsidy environment a HRPP may offer a route to market, subject to site specific, market and regulatory conditions. |
| Capex | Defer investments in grid reinforcements.<br>The grid connection is paid for once which may, for example, be up to 15%[2] of a ground mounted solar farm's cost.<br>The potential for capex savings for the renewable generation being added will be subject to EPC economies of scale; there may be a trade-off analysis required on specific cost savings for larger renewable generation versus the potential for more curtailment.<br>Energy density increases and land acquisition costs are spread over more annual electricity production (AEP). |
| Levelised cost of electricity (LCOE) | If a boundary condition is drawn to include the costs of grid balancing services and the renewable generation at a more system wide level, then logically, a hybrid power plant should decrease ancillary service and balancing costs over the lifetime of the renewable asset. If the costs of balancing increased exponentially, rather than linearly, with increasing renewables at a certain tipping point in a countries plant mix the potential LCOE is proportionally lowered exponentially. |
| Grid Connection | Currently in GB, National Grid and the other TSOs, approaches transmission connected hybrid connection schemes on the basis of total capacity (MW) only, and that the connection is Grid Code compliant. At a distribution level, DNOs tend to have a similar approach, but it has been known to differ on one or two cases with more hurdles to pass. Both TSOs and DNOs are likely to assess the generation type to provide a probability weighting to grid connection load factor as a consideration to impact on the network. What happens behind the grid connection point is up to the developer. This may include areas such as incorporation of an overarching hybrid controller and communication between the units, the market and rulesets for economic dispatch, the minimum depth of discharge on schemes with battery storage, the degree of interlocking between generation units, the DC loading of solar PV and configuration of invertors to convert to AC, and fiscal metering to enable reconciliation and billing for a number of stacked revenue streams. |

[2] Utility-Scale Solar Photovoltaic Power Plants, A Project Developers Guide IFC, 2015, https://www.ifc.org/wps/wcm/connect/a1b3dbd3-983e-4ee3-a67b-cdc29ef900cb/IFC+Solar+Report_Web+_08+05.pdf?MOD=AJPERES&CVID=kZePDPG

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| Enabler | Description |
|---|---|
| Lending Community | Historically, some of the markets that battery storage has played into have been shallow in nature, reducing appetite to invest. Including storage with conventional renewables can increase appetite to invest with the potential for higher project gearing compared to battery storage on a standalone basis. Most storage projects are financed with between 30-40% leverage. One view from the community is that renewables developers/ owners should think about adding storage given the prediction, by some, of more price cannibalisation with increasing renewables. Storage would allow some ability to move energy into times it is really needed providing a competitive advantage in the marketplace. |
| 2. Construction from FID until Commercial Operations Date (COD) | |
| Construction | Sharing of construction crews |
| | Sharing of foundations for common scope items |
| 3. Operations from COD to lifetime extension / repowering | |
| Opex | O&M costs can be shared as some routine activities can be shared amongst the technologies using the same crews.<br><br>Asset management costs can be shared whether singular hybrid meter or individual generation / storage resource metering is in play.<br><br>If the use of the land has been made through land optioning and lease, this helps to ensure a higher AEP is achieved for the Opex.<br><br>With a flatter / better known generation profile there may be the potential to reduce penalties from being outside of nomination windows in some countries.<br><br>Subject to regulations there may be a potential to socialise fixed costs over a larger generation base provided for by the total hybrid scheme. This may have the potential, for example, to spread any spikes in grid costs over a larger generation base reducing project IRR dilution. One upcoming example is the potential for TNUoS to increase materially in the period 2021/22 for generators.<br><br>For storage in Europe and the UK the double taxation of grid charges is ending reducing the opex burden on the hybrid scheme. For the UK, the Ofgem approved Connection and Use of System Code (CUSC) modification CMP281: “Removal of BSUoS Charges From Energy Taken From the National Grid System by Storage Facilities” means that the double charging of BSUoS on storage assets will come to an end April 2021. |

| Enabler | Description |
|---|---|
| Revenues | Wind and solar can be very negatively correlated, and as expected, this will vary from site to site and from country to country:<br>➢ This can Increase the capacity factor of the site<br>➢ This can provide a more-firm generation profile.<br>➢ This can help PPAs that supply a demand with a firmer profile / have the potential to influence pricing.<br>➢ If wholesale pricing is reduced by material instantaneous wind generation, solar generation offers the potential to enjoy higher merchant pricing when the wind doesn't blow.<br>➢ If governments are encouraging storage this may increase the revenue scheme available for the scheme as a whole, for example the capacity market in the UK and some other countries allows storage to compete with conventional forms of generation in a levelling of the playing field. |
| 4. Valuation | |
| Option Value | Owning a development project with one form of renewables/ storage may provide further upside potential or option value for hybrid conversion, subject to feasibility.<br>Owning an operational project with one form of renewables/ storage may provide further upside potential or option value for hybrid conversion, subject to feasibility.<br>The option value (ROV) of the site should logically increase as any repowering would likely imply higher energy densities of the individual generation/ storage technologies at the time, subject to feasibility.<br>Digital control at time of repowering should be more advanced allowing real time and advanced commercial optimisation. The grid becomes a smart grid serving 21st century prosumers and RE100 companies. |

**Table 2 – Enablers for hybrid renewables**

Given the barriers to entry for wind are typically higher than solar, ex-poste development of an HRPP may favour wind developers for wind-solar and/ or storage schemes. Solar-storage schemes may favour solar developers. An overall control aggregation layer may help to optimise the scheme's revenues and costs.

### *Barriers*

There are some barriers to progressing hybrid renewables, and these need to be identified on a case by case basis. Some of these barriers may be mitigated or worked through or in aggregate may not always support a positive Financial Investment Decision (FID). Some barriers are shown below in **Table 3:**

| Barriers | Description |
|---|---|
| 1. Development up until financial investment decision (FID) | |
| Conceptual | Grid connection treatment and any requirement for additional grid compliance testing for the existing scheme and additional generation / storage.<br>Degree of negative correlation between wind and solar – the closer to 100% negative correlation the lower the potential curtailment, the higher the capacity factor of the hybrid scheme and the better the economics. With a lower negative correlation these attributes express vice versa.<br>Terrain – the hillier the terrain the harder / more expensive it may be to install additional solar panels. This may also require a particular review of shading analysis and impact on energy yield.<br>Consenting – there can be a trade off with the agricultural land use and the space allocation for the additional solar farm - this could be a planning barrier. |
| Offtake | Selection of which generation unit gets curtailed in event of generation exceeding grid connection capacity. |
| Permitting | Ability to maximise synergies during permitting from the local planning authority / statutory stakeholders. |
| Subsidies | Priority of capture of subsidies to maximise hybrid value in the event there could be a conflict. |
| Capex | Ability to recognise and monetise any deferral of grid reinforcements with the developer and network company both mutually benefiting. |
| Financing | For existing projects that are already financed, carrying out a hybrid retrofit will likely require lender consent. |

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| Barriers | Description |
|---|---|
| 2. Construction from FID until commercial operations date (COD) | |
| Construction | Incentives to identify synergies in the EPC contract. |
| 3. Operations from COD to lifetime extension / repowering | |
| Opex | Incentives to identify synergies in O&M and asset management costs. |
| Revenues | Corporate PPA offtaker recognising the value of a more stable generation profile by paying a higher price. |
| Subsidies | The degree to which subsidies are available may impact the configuration of the hybrid renewables scheme. |
| 4. Valuation | |
| Option value | Under certain market / regulatory conditions the hybrid investment may become stranded in part, or as a whole, but this risk may be mitigated depending on how the project is structured and in the selection of route to market. |

**Table 3 – Barriers to hybrid renewables**

The barriers to hybrid renewables will vary from site to site, country to country and continent to continent. ITPEnergised has been working with clients to assess project viability from the onset in a range of applications working out the potential solution space, in response to known constraints.

In the next part of this series, we will provide an overview of potential valuation approaches.