Flexible connections: an introduction for investors

A joint webinar from SSEN and Everoze

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OBJECTIVE: to brief investors and project analysts conducting due diligence on GB projects with flexible connections.

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- What they are
- Why you'll see more of them

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Scottish & Southern Electricity Networks

3 Implications for investors

- Everoze reflections

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2 Case study: flexible connections

- Modelling & simulations approach
- Modelling & simulations results

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Gary Huskinson
Flexible Solutions Designer

1 Flexible Connections

- What they are
- Why you're going to see more of them

Flexible Connections - What & Why?

- Network at full capacity
- Connect quicker ahead of reinforcement
- Customers have an option
- Alternative to reinforcement

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Flexible Connections - Types

- ANM
- SGANM
- Timed
- Shared Capacity
- Demand Management

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Story so Far

✓93

Flexible connections connected to date

DG capacity across our licence areas.

✓412.5 MWs

✓90

Saved connecting customers over 90 years (yes, years!)

Cost of reinforcement saved by the customer

✓£58M

✓70

✓1GW

Connections in the pipeline. Totalling over 1GW of new flexible generation

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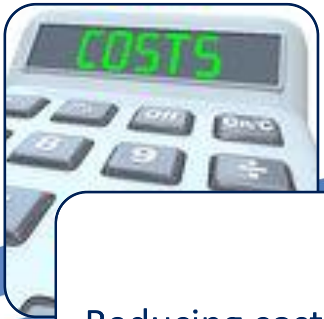
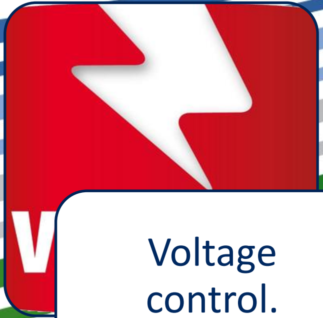
Future



Reducing costs for customers

Increasing optionality visibility to customers

Storage and demand flexible connections



Voltage control. Providing options to **<u>all</u>** customers

Reducing timescales

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Why We Will See More

- Networks are becoming more constrained as more DER Connects
- Need for cheaper, quicker connections is apparent
- Use what we have more intelligently, efficiently and only reinforce where needed
- Transmission and Distribution drivers (SWAN)

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2 Case study: flexible connections

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Modelling & simulation approach

We modelled:

20 MVA solar farm in three modelling cases

1. Fixed capacity connection (with high reinforcement costs);
2. Flexible grid connection;
3. Flexible grid connection, with co-located battery storage.

Connected via:

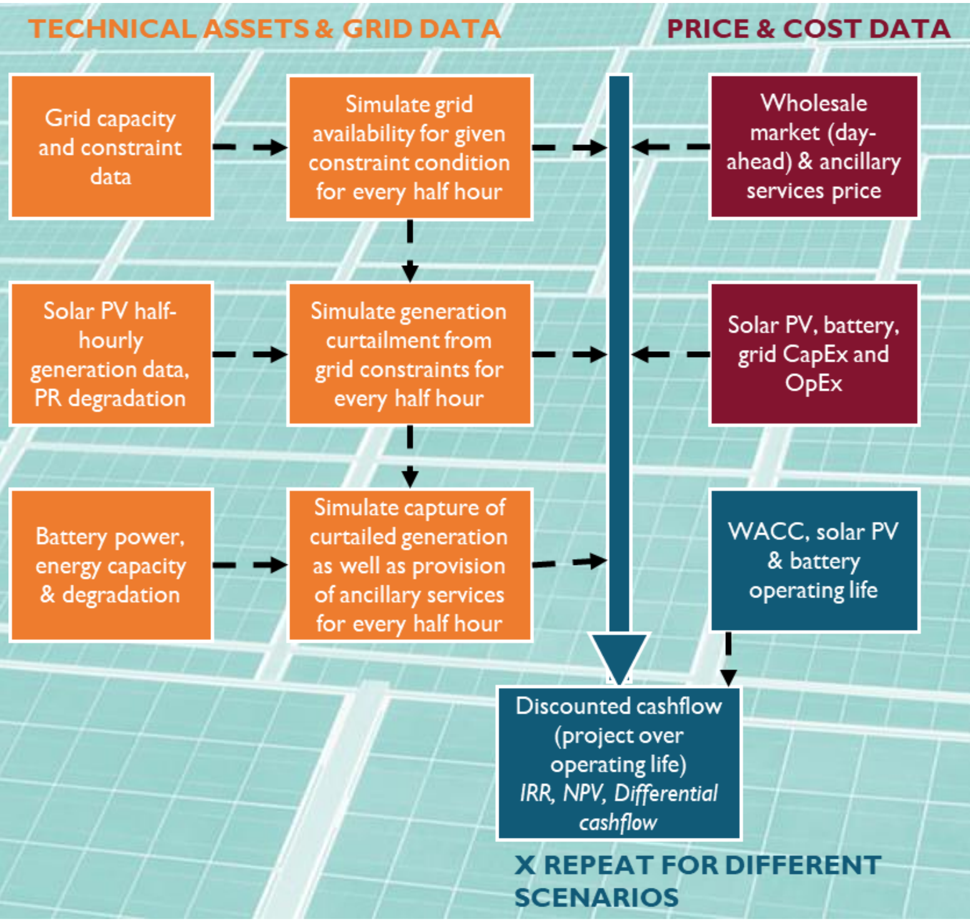
Flexible connection with seasonal profile

- Hypothetical connection in one of SSEN's current Active Network Management (ANM) zones in its network.
- Seasonal curtailment (Summer) with annual average availability between 97.5% and 90% depending on certain conditions.
- Temporal variation of curtailment events during the day, varying from 8am to mid-day to evening-peak demand periods.

And applied:

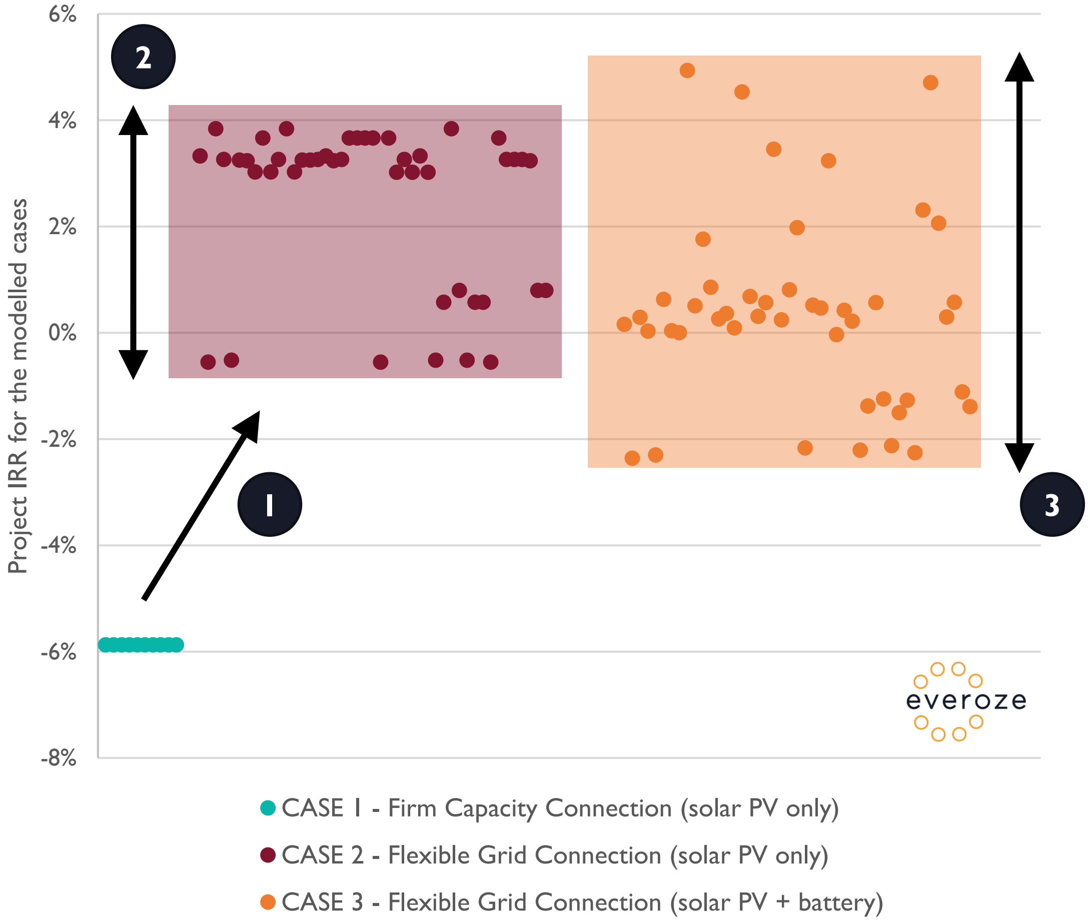
Discounted cashflow architecture

- Energy and FFR price data informed by publicly available data.
- Asset cost data informed by Everoze project experience, and grid costs informed by SSEN for the appropriate network zone.



Modelling & simulations results

Flexible connections can boost IRR - but results are project-specific



Graph presents the project IRR for 45 different scenarios modelled for each of the three modelling cases

1. **A flexible connection is substantially more attractive than the reference case:** For the scenarios modelled, the IRR shows that the flexible connection is a much more investable proposition.

2. **The model shows high sensitivity to the specifics of the flexible connection and corresponding constraint characteristics:** Results vary widely based on the position of the project in the ANM stack, as well as timing of grid constraint during the day. The reasons are threefold:
   - Technical: Grid unavailability risk is higher the lower the project is in the ANM stack *(last-in first-off basis)*.
   - Technical: Impact of temporal variation of grid unavailability depends on solar output for the corresponding time of day.
   - Economic: The capture price of energy (£ per kWh generation) varies by time of day.

3. **Co-locating a battery to capture curtailed generation may not always be economically viable:** Returns vary widely depending on i) the timing of grid constraints and the resale value of energy; and ii) the ability to maximise grid connection by providing ancillary services.

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3 Implications for investors

- Everoze reflections

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3-step approach for investors

1. UNDERSTAND THE CONSTRAINT

Assess in the time domain, **not** just as an annual average

- Assess correlation of generation with constraint – and capture price
- Use SSEN analysis

3-step approach for investors

2. TEST IMPACT ON FINANCIAL MODEL

Test uncertainties and upsides, **not** just the base case

- Take a *long term* view on grid & demand assumptions that underpin flexible connections
- Accept that revenue-stacking is the primary uncertainty driver for co-located storage
- Model DSO revenue as possible upside

3-step approach for investors

3. (RE)CONSIDER DESIGN OPTIMISATION

Optimise for IRR,
not for levelized cost of energy

- Redefine the goal of optimisation
- Consider exerting influence in design
- Evaluate options for maximising grid utilisation through storage

3-step approach for investors

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Thanks for listening

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Assumptions

Grid connection and constraint

- 20 MVA export and 4 to 16 MVA import (depending on scenarios) at 0.95 power factor
- Summer time constraints: 97.5%, 92.5% and 90.2% annual average availability due to grid constraints for projects in the 2nd, 3rd and 4th position in the ANM stack *[this assumption as provided by SSEN is specific to the part of the SSEN network considered for modelling, and is indicative only]*
- Timing of constraint: 8am, 10am, 11:30am, 2pm, 4pm & 5pm considered across various scenarios for start of constraint. Model assumes timing of constraint is the same every day for the scenario modelled.
- Same level of constraint is assumed for future years of operation. This may be a conservative assumption in some cases as growth in demand over time may have an effect of reducing ANM curtailment in some instances.

Battery storage

- 19 MW rated power with 88% round-trip efficiency
- Nameplate energy capacity of 19 MWh to 26.6 MWh (considered across various scenarios) with a usable capacity range of 90% of the nameplate capacity
- 15 year operating life with 2% capacity degradation per year

Solar PV

- 20 MVA / 19 MW (24.7 MWp) installed capacity
- 25 year operating life with PR degradation of 0.4% per year
- Generation capacity factor 10% (including electrical and availability losses)

Energy price and ancillary services

- 2018 day-ahead energy price for export revenues (no forward price adjustment used for future years revenues)
- £12 per MW per hour FFR availability price (based on recent monthly FFR tenders; no forward price adjustment used for future years revenues)
- 4 to 16 MW FFR volume (considered across various scenarios) for i) 8 hour availability windows during night time during summer, and ii) all day during winter time
- 5% discount on energy and FFR revenues for supplier fees

Costs

- Grid: £60k connection charge and £38m for grid reinforcements (estimate from SSEN for the hypothetical project in the ANM zone)
- Solar PV: £540k per MWp and £8.5k per MWp per year
- BESS: £421k per MW (including allowance for solar PV co-location cost savings) and £8k per MW per year
- No Devex considered