

Flexible Interconnection – Curtailment Analysis Overview

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Flexible Interconnection Curtailment Analysis: Overview

- › Curtailment Assessments – Overview and Value Case
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 - › *Value Case: Utilities and DER Developers*
- › Typical Study Methodology
 - › *Time-series Study Fundamentals*
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 - › *Study Scope and Assumptions*
- › Study Outputs: Key Metrics and Illustration of Findings
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 - › *Presentation Style*
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 - › *Review of Study Delivery Models*
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Curtailment Analysis – Overview and Value Case

- › Why is Curtailment Analysis Required?
 - › *Flexible Interconnection will result in the occasional curtailment of DER sites. DER site curtailment will vary from case-to-case and is influenced by a variety of factors. There is a need to understand the levels of curtailment DER will experience*
- › What does Curtailment Analysis Deliver?
 - › *Estimation of the curtailment (undelivered energy production) that DER sites experiences due to Flexible Interconnections*

Distribution Utility Value Case

- **Supporting System Planning:** Determine the grid hosting capacity that can be released via Flexible Interconnection
- **Supporting Customers:** Provide an essential service to interconnecting DER customers: *curtailment estimates*

DER Developer Value Case

- **Site Development Business Case:** Understanding value case of Flexible Interconnection and impact on site business case

Typical Study Methodology

Method: Simple Arithmetic

- Simplified Calculation-based approximation of network power-flows
- Typically easy-to-follow methodology for stakeholders to review and understand
- Quick implementation timescales
- Applicable in cases of thermal constraints, radial networks (or simplified voltage studies)
- Insufficient for more complex network topologies or constraint cases

Method: Complex Load-Flow Simulation

- Automated load-flow studies providing full solution of network operation in each time-step
- Suitable for cases of meshed/parallel networks, voltage constraints and reactive power considerations
- Delivers more 'accurate' modelling of network behaviour
- More complex to implement, validate and 'black box' element to study

› Study Scoping and Key Assumptions

- › *Resolution of study: half-hourly, hourly or another resolution?*
- › *Study Cases: reflecting network today, or into the future?*
- › *Is study of DER growth required? What about Load growth?*
- › *What about network topology? How does abnormal running affect curtailment?*

Model Network Operation



Observe Parameters and Identify Constraint Conditions

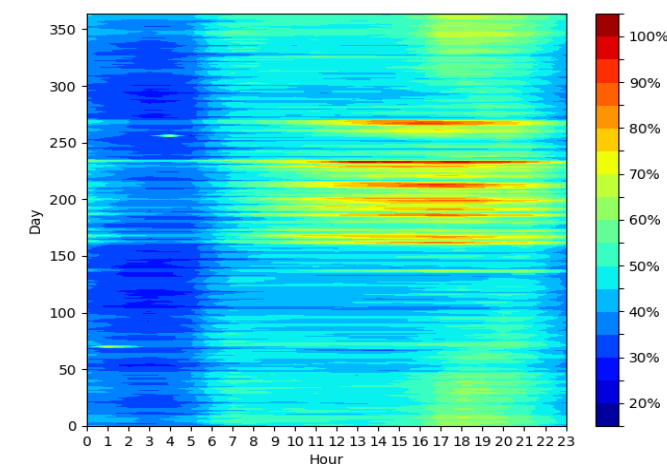
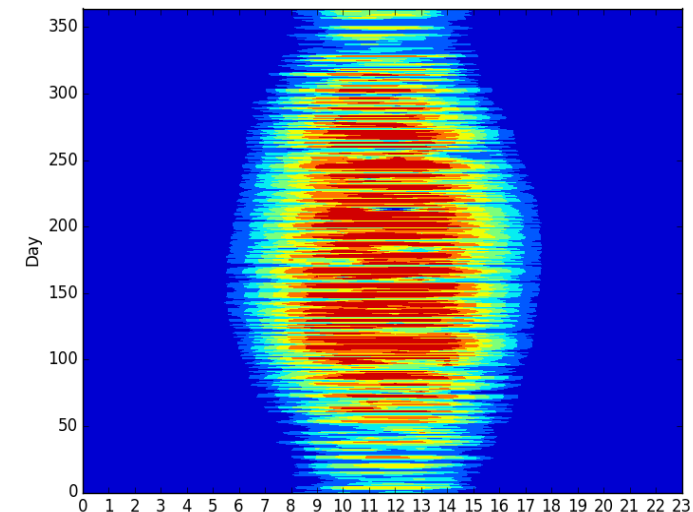


Simulate *Flexible Interconnection Control* Actions and Log Set-Points

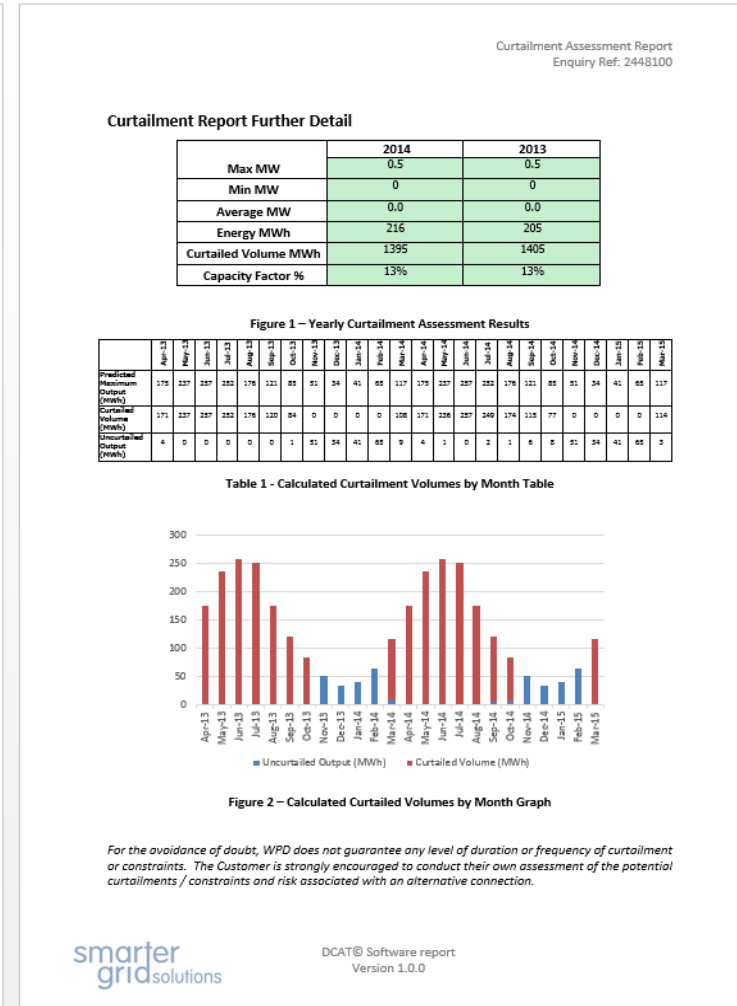
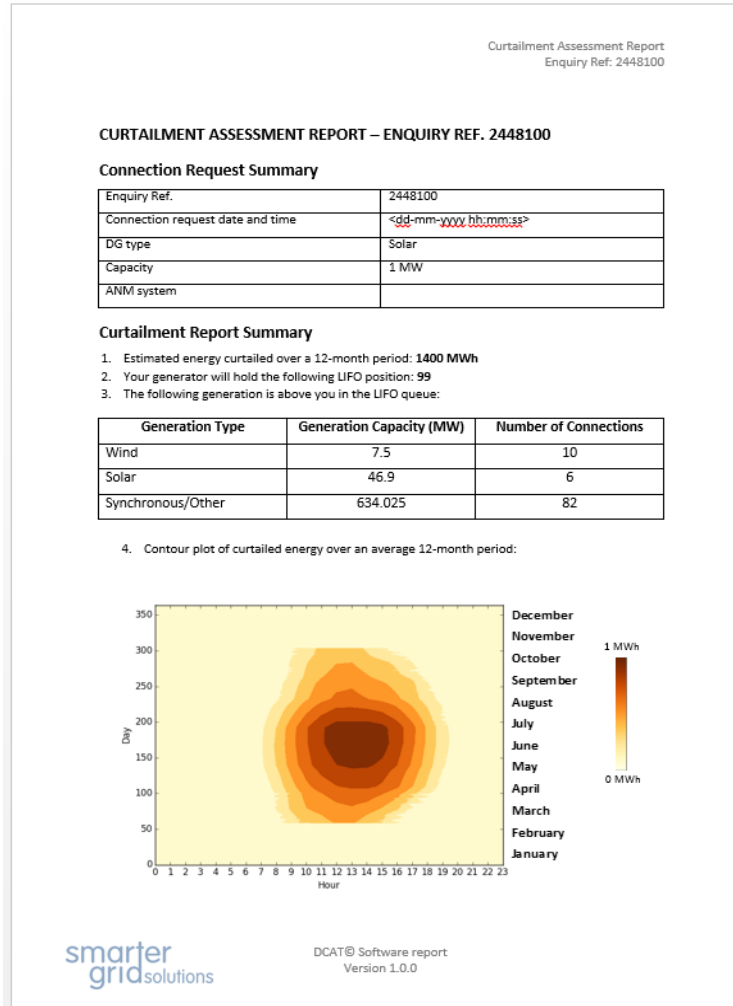
Simplified Time-Series Study Steps

Study Outputs: Key Metrics and Illustration of Findings

- › Key Output Metrics (all **estimates**)
 - › **Annual MWh Production** (Uncurtailed vs Curtailed)
 - › **Capacity/Load Factor** (Uncurtailed and Curtailed)
 - › **Undelivered Production** (MWh or %)
- › Noting different modelling approach for Battery Storage Sites or Schedulable Synchronous generators:
 - › *Present full site export envelope and related curtailment estimate*
- › Presentation of Metrics
 - › *Crucial to present the variation in curtailment:*
 - › *Seasonal, Monthly as well as Annual*
 - › *Intra-day*
 - › *Heatmap-style presentation can quickly illustrate variation across the year*
 - › *Provision of supporting time-series outputs (curtailed vs uncurtailed hourly production) can support in-house analysis by DER Developer*



Study Outputs: Key Metrics and Illustration of Findings



National Grid Electricity Distribution – Example Report for DER Customer

Delivery Models

Developer-Led Delivery Model

- Provision of datasets to the developer to allow their own studies
- Sometimes delivered in addition to utility studies (recognising utility study will not always cover all desired areas)
- Requires sharing time-series data: can be public or via NDA

Utility-Led Delivery Model

- Utility will have full view of network operational characteristics, model etc. Best placed to deliver study
- However there is need to be highly standardised in study scope, outputs etc.
- Recognition this doesn't always meet specific requirements of DER developers

› Data Requirements

- › *Network Model (sufficient information to approximate parameters)*
- › *Time-series historical data (can be loading, demand, or generation export)*
- › *Details of developments (DER type, DER size/location, load growth)*
- › *Understanding of Flexible Interconnection Principles*

› Data Security/Sensitivity Considerations