Electricity Ten Year Statement (ETYS) Webinar

19th Feb 2020

With:
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Chomba Tumelo
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James Whiteford

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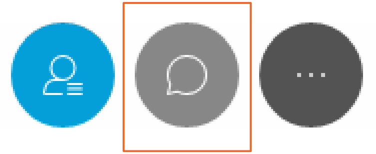
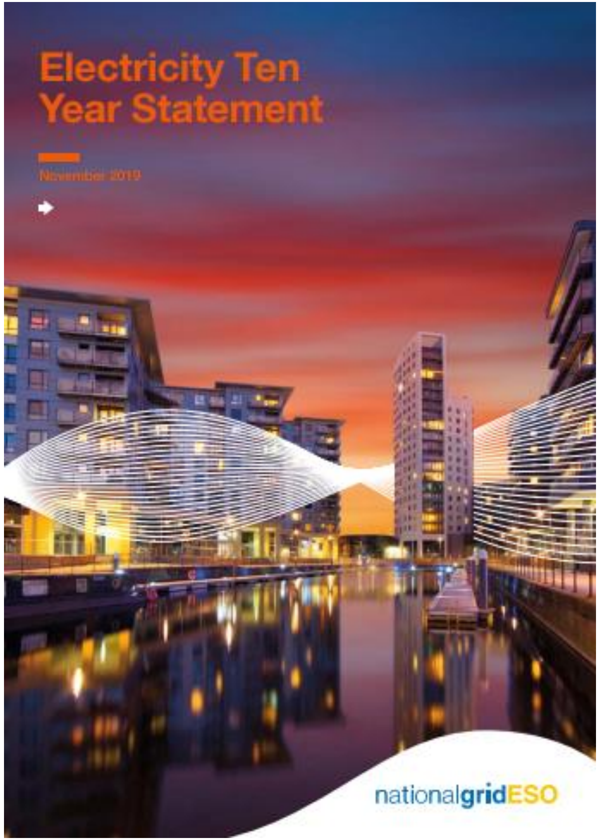
Housekeeping

- All participants will be muted
- Please ask questions via the ‘chat’ option in WebEx
- Q&A session after presentation



Purpose

- Explain why we are exploring probabilistic analysis
- Discuss our probabilistic analysis techniques and some emerging results published in ETYS Chapter 4
- Ask for your views, questions and ideas on how we can improve this analysis



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Electricity Ten Year Statement (ETYS)

ETYS and ESO documents

System Operability Framework
How the changing energy landscape will impact the operability of the electricity system.

Future Energy Scenarios
July
A range of credible pathways for the future of energy from today to 2050. Scenarios are unconstrained by network issues.

Electricity Ten Year Statement
November
The likely future transmission requirements on the electricity system.

Network Options Assessment
January
The options available to meet reinforcement requirements on the electricity system.

ETYS 2019

Contents

Why?

Drivers for developing Year-round probabilistic assessment

With:
Mostafa Nick

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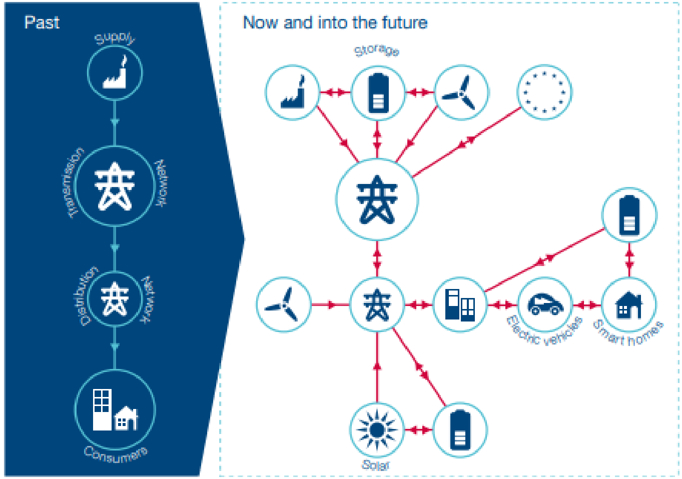
Future challenges and opportunities

System needs are changing

- The system is increasingly more complex to operate due to the growth in uncertainty and intermittent resources (wind, interconnector, solar, etc.)



Increase competition

- Promote network competition
- Procure long-term products from wider pool of solutions.

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Moving to a new planning process

Please submit any questions via WebEx chat.

We will assess a wider range of system needs across the year

Procure solutions from wider pool of participants.

Outline future energy scenarios (FES) → **Assess system needs (ETYS)** → **Identify solutions** → **Recommend most efficient solution (NOA)**

System Operability Framework (SOF)

Request solutions for system needs

Tenders for solutions for voltage, stability, and **thermal** constraint solutions

Market participants, DNOs and TOs can all compete

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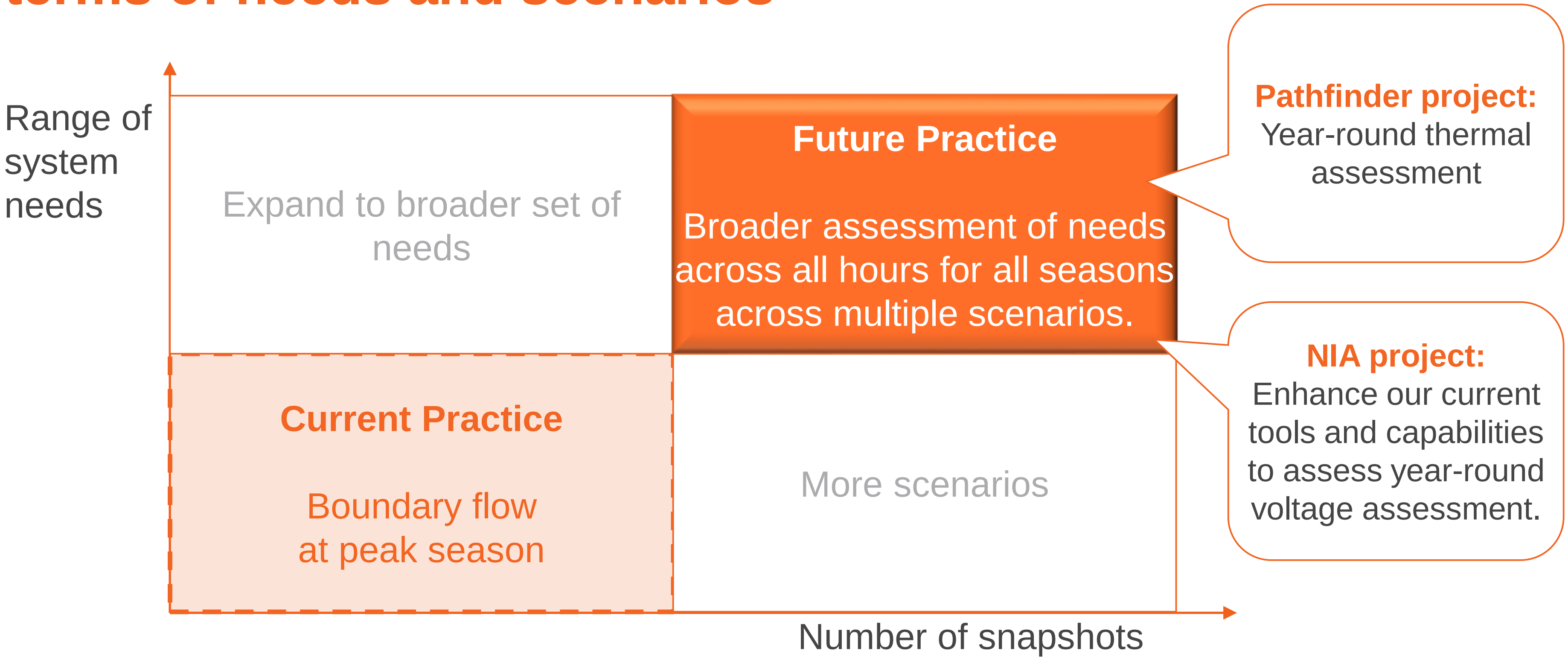
Our ambition is to broaden our current assessment in terms of needs and scenarios



We’re taking a learning by doing approach, through our pathfinders

Assess need → Develop processes → Run tenders → Learn → Embed

Year-round probabilistic thermal assessment pathfinder

Progress so far:

- Thermal year-round probabilistic case study to investigate the concept and assess the viability of using probabilistic tools for thermal studies. Results published for 2019.
- For the ETYS 2019, published in November, we used the year-round probabilistic tool and techniques to assess the credibility of the network assumptions used in the boundary analysis.
- To develop our capability, we are currently evaluating boundaries on which to perform further year-round.

Methodology

Year-round probabilistic assessment vs single-snapshot

With:
Mostafa Nick

Boundary assessment methodology

❑ Single snapshot worst-case scenario

- **Dispatch** generation at peak demand considering as per **SQSS**,
- **Scale generation and demand** either side of the boundary according to SQSS rules,
- Peak capability is scaled to represent other seasons

❑ Year-round Probabilistic

- Dispatch hourly generation using **Economic Dispatch** based on expected weather, price, availability,
- Assess boundary limit for all snapshots **across the year**,
- Perform statistical and data mining analysis of results,

Please submit any questions via WebEx chat.

Year-round probabilistic planning methodology: summary view

Step 1: data input
Background generation data

Background generation
- Location
- Fuel type
- Technical parameters

Step 1: Input data
Historical information and their future forecas

Forecasted information
- Bid and offer or short run marginal cost
- Plant availability
- Interconnector flow

Monte-Carlo simulator
Market simulator

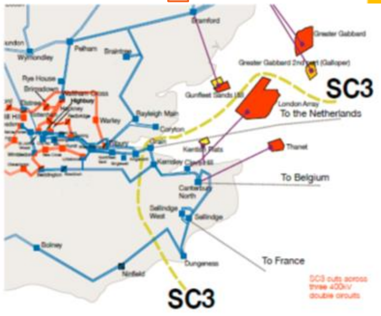
Historical information
- Wind speed
- Solar radiation
- Demand profile
- Hydro and pumped storage

Step 1: Data input
Network data

Background network
- Boundaries info
- Branches info
- Grid info (including list of credible contingencies)

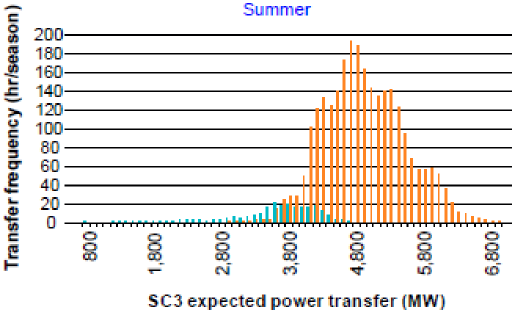
Power system analysis

Step 2: generate hourly generation and demand snapshots based on Economic Dispatch for a range of snapshots



Statistical information of expected boundary power transfers and circuit loadings

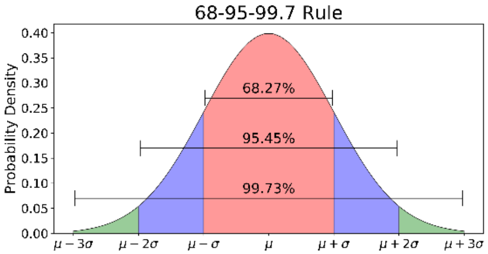
Step 3: Network analysis & data mining



Year-round probabilistic planning

Monte Carlo Simulation

- ✓ Using Monte Carlo method to sample data from distributions
- ✓ 10 years hourly historical data



Market dispatch

Year-round Probabilistic Economic Dispatch

$$\text{minimize} \quad F(X) = \sum_i f_0(x_i \omega_i)$$

$$\text{subject to: } f_i(x_i \omega_i) \leq 0, i = 1, \dots, m$$

- ✓ Minimize cost (bid/offer or SRMC)
- ✓ Planned outages
- ✓ Minimum and maximum limit of generation units
- ✓ Nuclear plants as base load (if not on outage)
- ✓ Historical wind, solar, hydro, and demand profiles

Power system analysis

Security-constrained load flow

- ✓ Currently it is based on DC load flow
- ✓ Base case + set of contingencies
- ✓ 6hr rating for contingency
- ✓ WHVDC re-dispatch based on B6 flow
- ✓ Planned update: Automated QB tapping and FACTS devices

Study Results

Selected Case Study

With:
Chomba Tumelo

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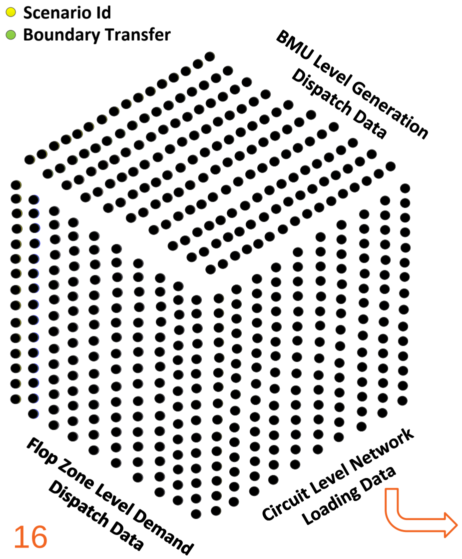
Year-round probabilistic planning – Data Mining

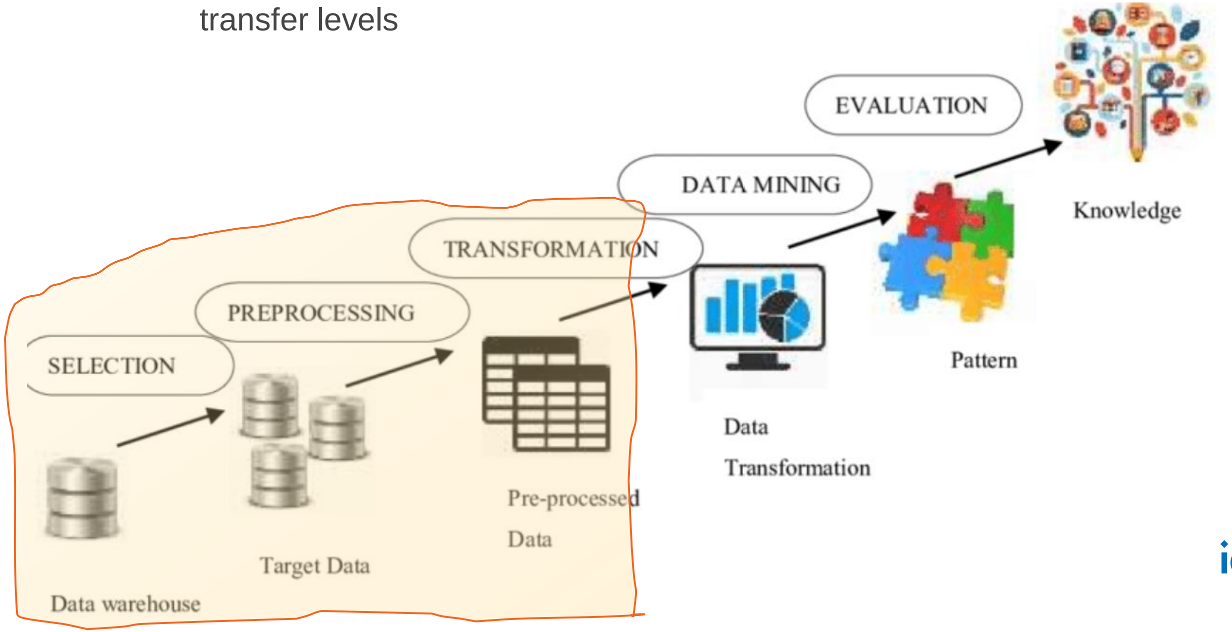
Data mining

- ✓ Output from Monte Carlo generated market dispatch and power system analysis data produces a multi-dimensional data space

Data transformation

- ✓ Algorithms to used sorted data to identify relationships between BMUs, demand flop zones and circuit loading
- ✓ Done for all snapshots (scenario Ids) represented by various boundary transfer levels





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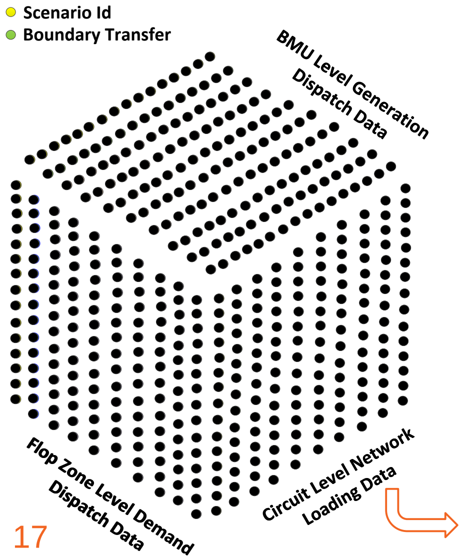
Year-round probabilistic planning – Data Mining

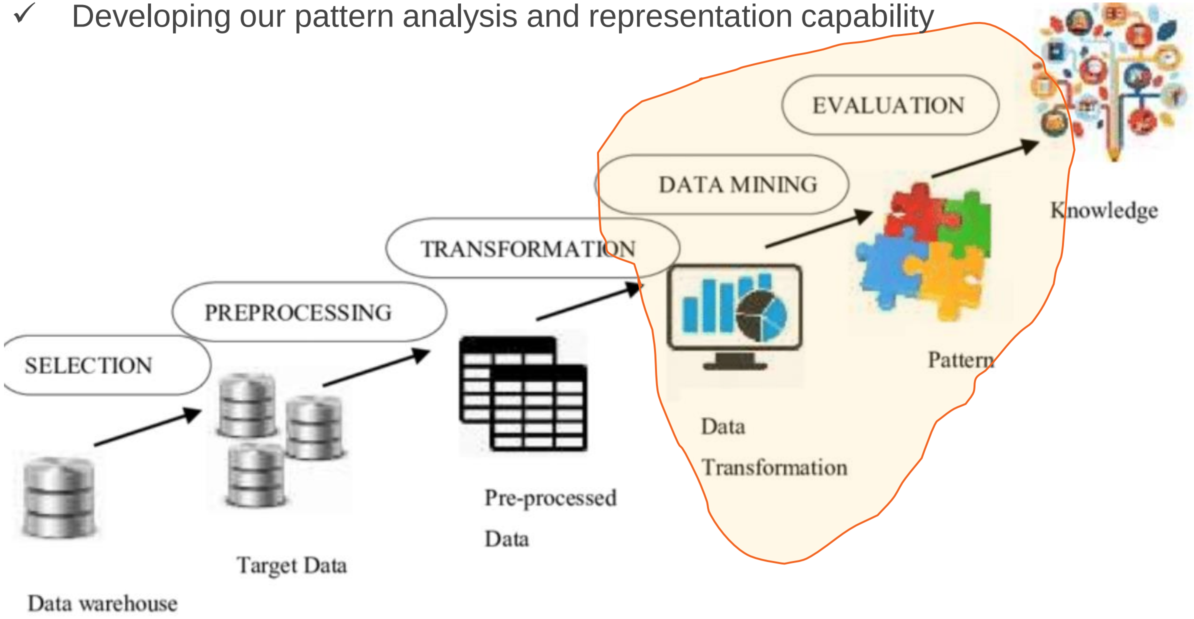
Data mining

- ✓ Output from Monte Carlo generated market dispatch and power system analysis data produces a multi-dimensional data space



Pattern analysis and representation

- ✓ Currently produce probability distribution plots of acceptable and unacceptable power transfers across a boundary
- ✓ Currently produce GB map of average dispatch conditions at given boundary power transfer (both acceptable and unacceptable) conditions
- ✓ Allows us to better understand network requirements
- ✓ Developing our pattern analysis and representation capability



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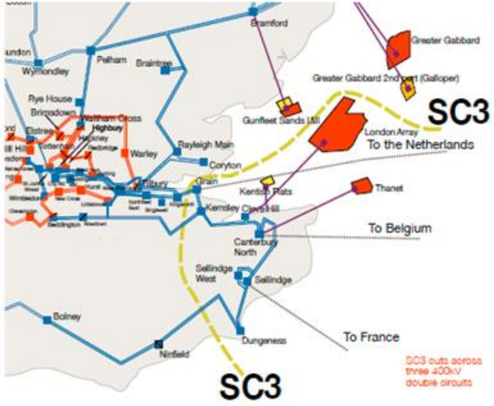
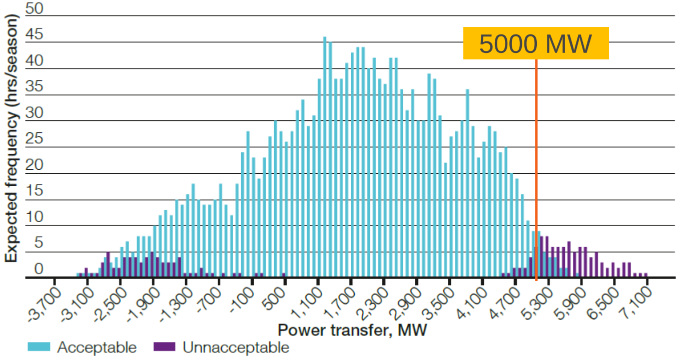
Example Result from ETYS Chapter 4

SC3 Winter Boundary Analysis



Data mining output

- ✓ The distribution plot helps identify boundary import and export limitations
- ✓ Identify complex requirements at a power transfer point
- ✓ The regional dispatch maps help identify acceptable and unacceptable dispatch conditions



SC3 Winter Boundary Analysis

- ✓ Output from Monte Carlo generated around 2,840 scenarios market dispatch snapshot and 85,200 power system analysis network loading data

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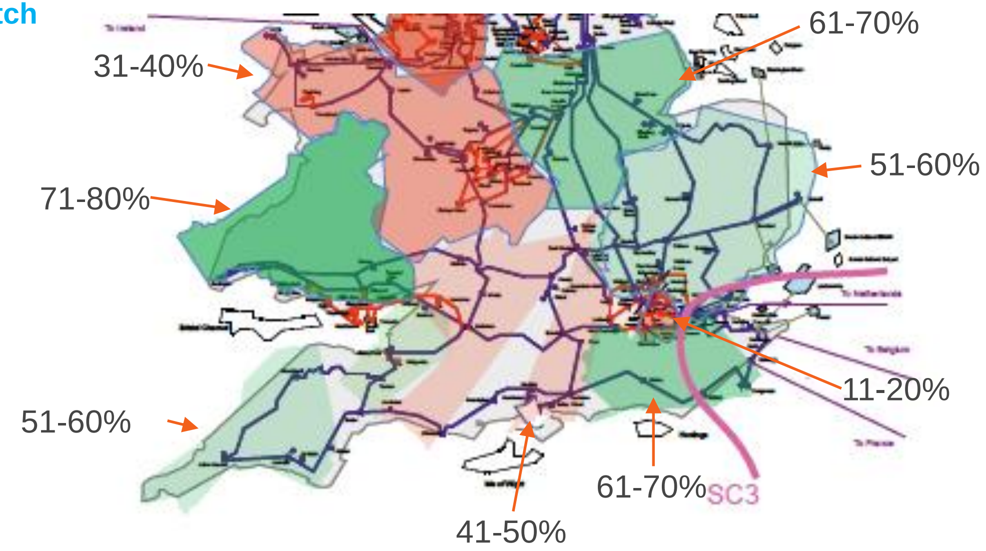
Example Result from ETYS Chapter 4

Pattern analysis output – identification of acceptable and unacceptable dispatch patterns at a constant power flow

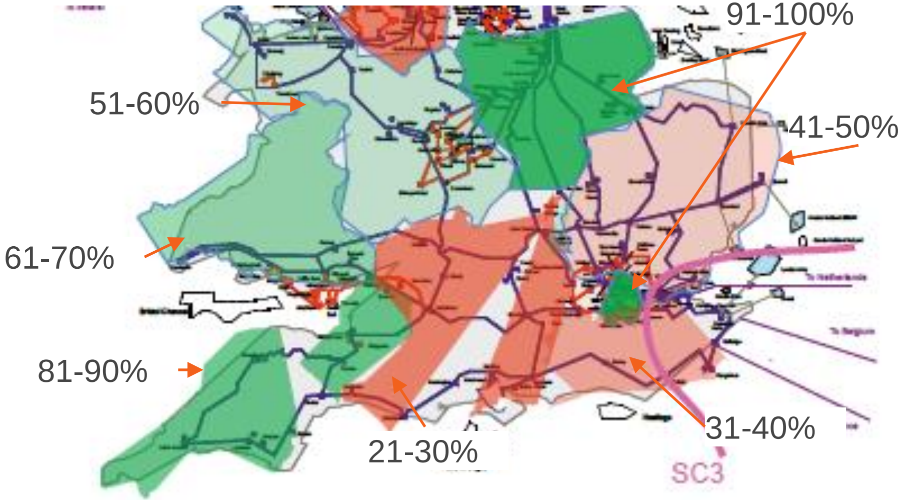
Average Acceptable dispatch scenario at 5000 MW



Example Result from ETYS Chapter 4

Pattern analysis output – identification of acceptable and unacceptable dispatch patterns at a constant power flow

Average unacceptable dispatch scenario at 5000 MW



Example Result from ETYS Chapter 4

Future work

- To find solutions to complex requirements we are developing our data mining and the concept of residual requirements
- Solution will be required for a proportion of the time as the remainder of the time the network will be capable of transferring power
- We’re developing our ability to understand and better communicate complex requirements to assess network solutions provided from a wider pool of participants.

Way forward

With:
Chomba Tumelo

Ongoing development and future integration with NOA

- **Our planning standard requires us to secure the network both at the peak conditions as well as across year round conditions**
- **Our probabilistic tools are still under development**
- **We are exploring how to integrate our process with the current Network Options Assessment (NOA) process.**

Development pathway

ETYS 2018

- Case-study for one boundary.
- Present preliminary results in ETYS 2018.

ETYS 2019 benchmark studies

- Further development of our probabilistic tool including its capability to speed-up the process
- All year 1 boundaries studied
- Data mining on results

ETYS 2020

- Initiate developments to integrate pre and post-fault actions (automated and manual).
- Update on development of new voltage assessment tool.
- Develop techniques to calculate dynamic boundary capability.

ETYS 2021

- Proof of concept for a bespoke joint network and market tool for probabilistic thermal analysis
- Proof of concept for integration of probabilistic network analysis into NOA process including ESO optimization actions.

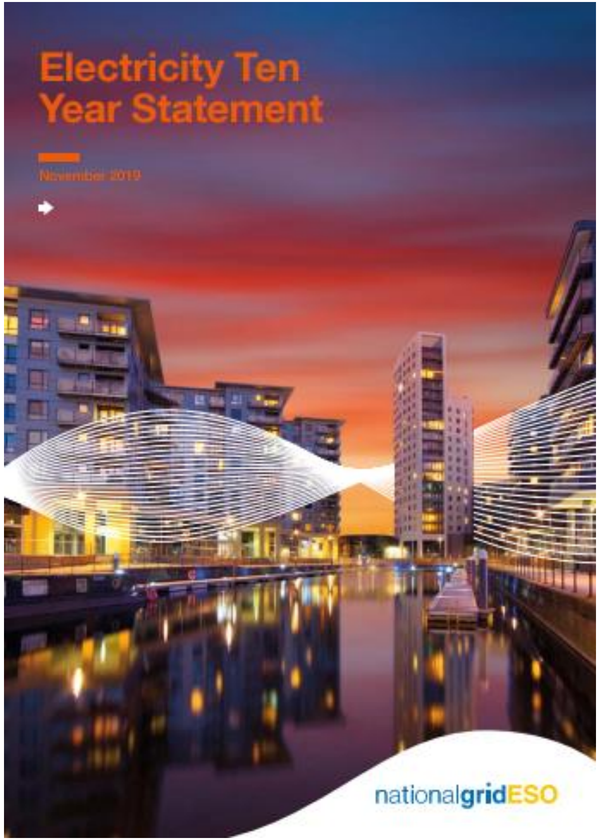
Summary

- Probabilistic analysis techniques can improve our view of system needs across year round conditions

- This will help us describe our system needs better to allow wider market participation

- We are still developing our tools and techniques and we welcome your questions and ideas.

- **Email us at:** transmission.etys@nationalgrideso.com



Q&A session

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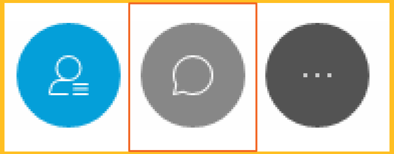

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