A specialist energy consultancy

The Death of Moore's Law

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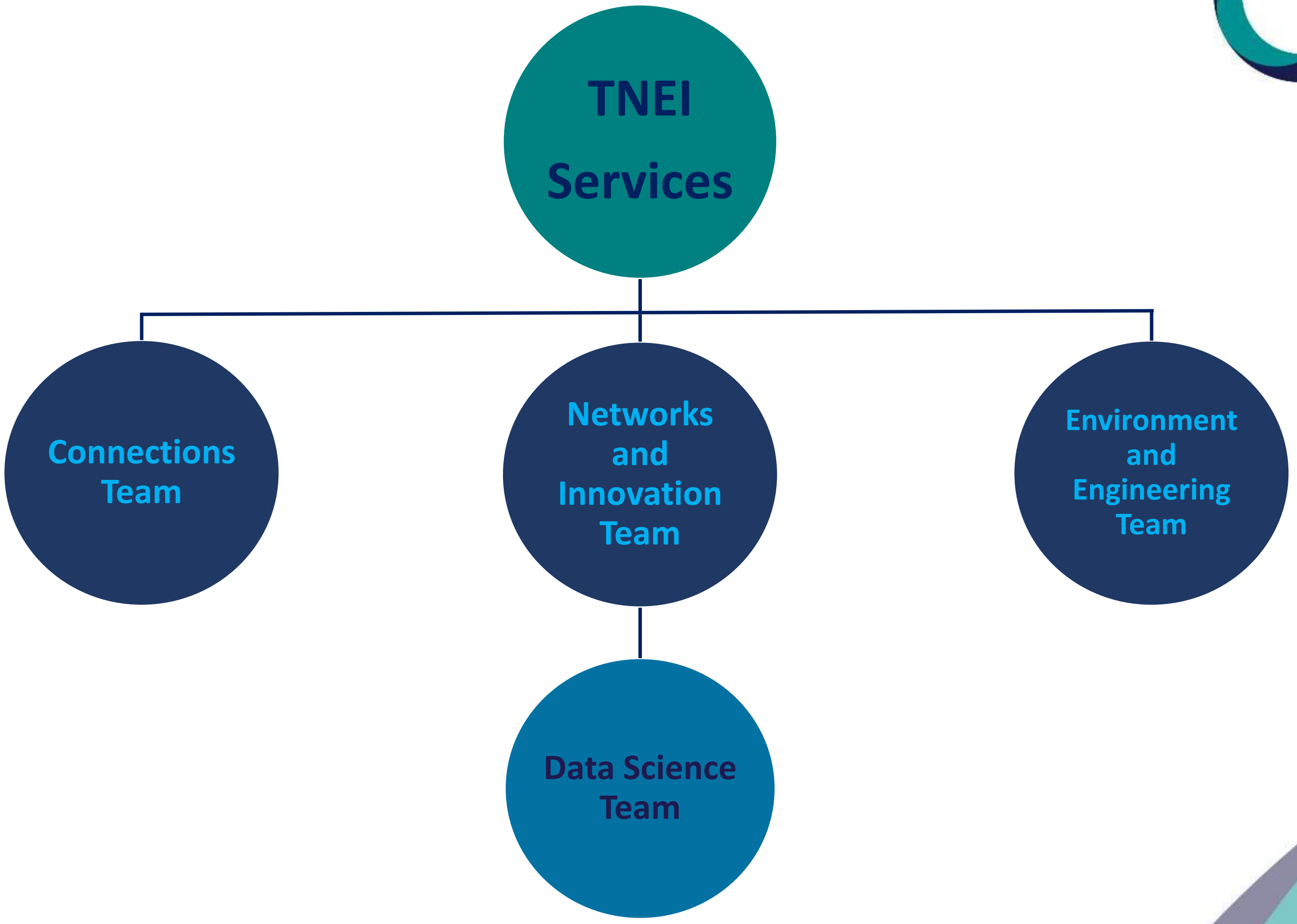
Introduction – Who are TNEI?



Introduction – Who am I?

Max McFarlane

- MEng. - Electronic and Electrical Engineering with International Study from the University of Strathclyde
- Technical Consultant at TNEI Services (Data Science Team)
- Technical Lead at CIGRE UK NGN

Introduction – Why are we here?

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What about renewables?

- The COVID-19 pandemic signals **the beginning of a new era**
- Potential consequences we do not fully understand
- Presents the opportunity for a “green recovery”

What tools do we need?

Should our plans change?

Introduction – Why are we here?

LIVE UPDATED 15 HOURS AGO

COP26 latest: Europe to invest €1bn in clean technlogies like green hydrogen

Western nations agree $8.5bn deal to help South Africa decarbonise

Funds to help country, which gets 90% of its electricity from coal plants, transition to renewables

Power Systems of the Future - Race to Net-Zero

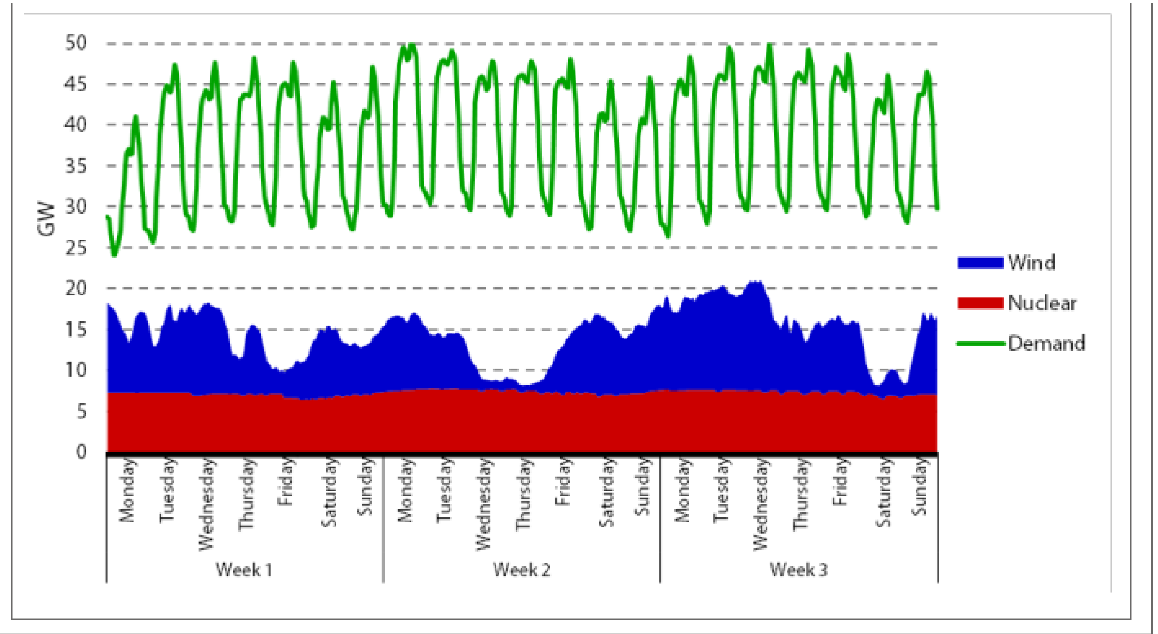
- A net-zero economy requires near-zero emissions from almost every sector
- Variable renewable generation is now the cheapest in the UK
- Intermittency in the power sector requires back-up reserve, currently dominated by gas-based sources

Power Systems of the Future - Flexibility

- Renewables alone is not enough
- A suite of technologies will be required, such as:
  - Generation flexibility.
  - Energy storage
  - Demand-side response
- Intermittency in the power sector requires back-up reserve, dominated by gas-based sources

Power Systems of the Future – Key challenges

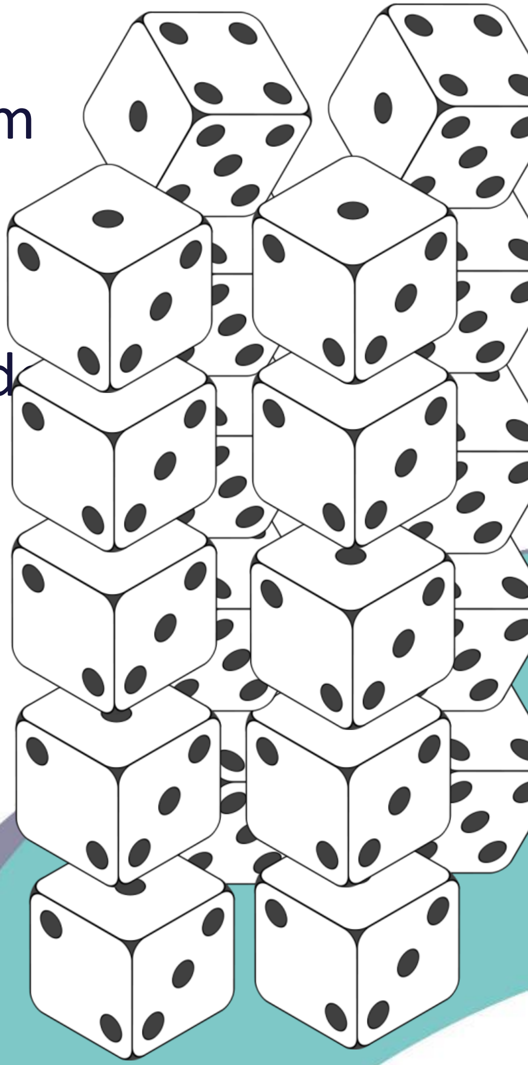
- Meeting peak demand (demand > generation)
- Using available generation (generation > demand)
- Balancing requirements (response, reserve, stability etc.)
- Networks



Source: CCC Analysis based on Drax (2019) *Electric Insights*.

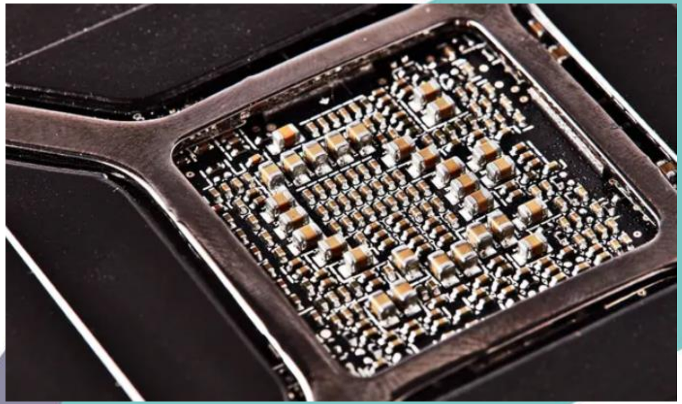
Power Systems of the Future – System Modelling

- Centralised to distributed energy systems compounds system variability
- System planners and network operators must consider a wid scope of potential scenarios
- Modelling becomes much more substantial, and unmanageable with traditional deterministic approaches



The Death of Moore's Law

- The number of transistors that could fit into a silicon chip will doubling every two years – Moore's Law (1960's)
- Based on empirical correlation observed over a particular period in history
- The laws of physics call a halt to the exponential increase (by 2020's or 2030's)



The Death of Moore's Law – A Hardware and Software Problem

- Money has been poured into R&D of hardware
  - Will quantum computing be our silver bullet?
- Moore's law has made programmers relatively lazy
- Software has become bloated and often inefficient

The Death of Moore's Law –
The Birth of Myhrvold's Laws of Software

Myhrvold's Four Laws of Software:

1. Software is like a gas – it will fill its container
2. Software grows until it is limited by Moore's Law
3. Software makes Moore's law possible
4. Software is only limited by human ambition and expectation

Application –

Power System Analysis (Dynamic Studies)

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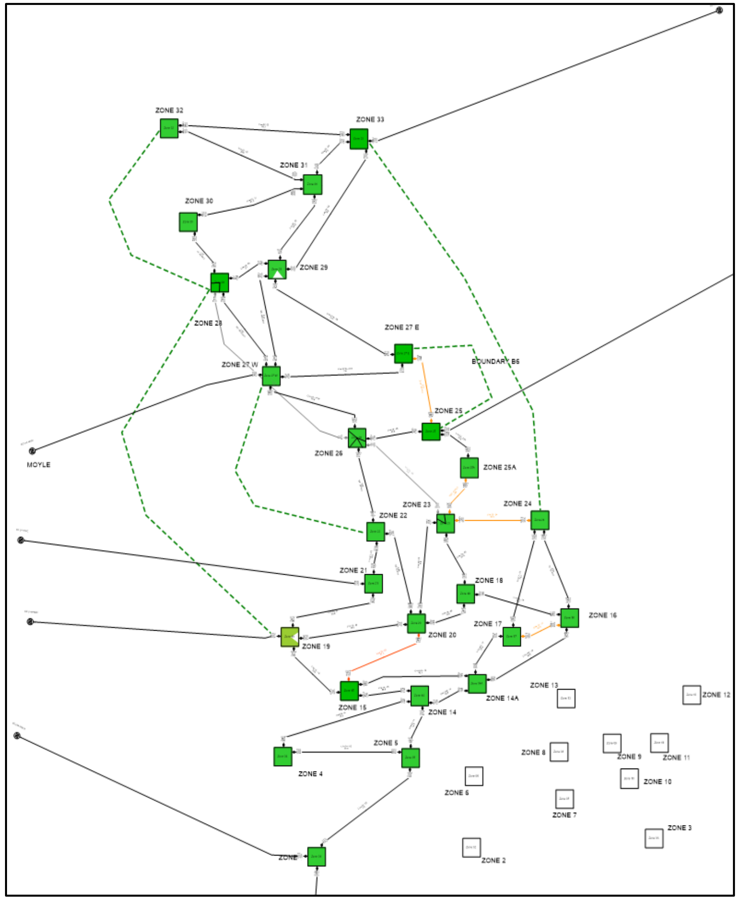


Reduced GB model (SE region)

Boundary Stability Analysis

Current state:

- Yearly studies of winter maximum and summer minimum

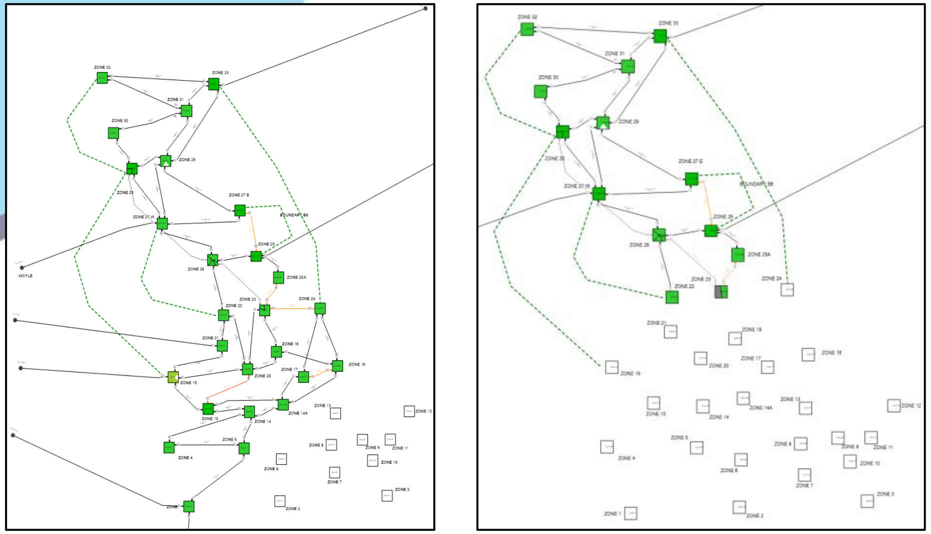
Proposed solution:

- Automated stability identification
- Classification model for boundary stability

Found on the Smart Networks portal

Application –

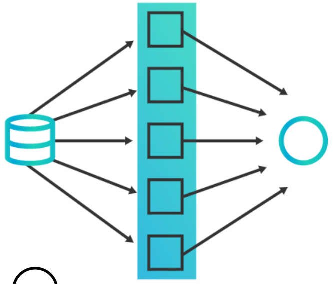
Power System Analysis (Dynamic Studies)



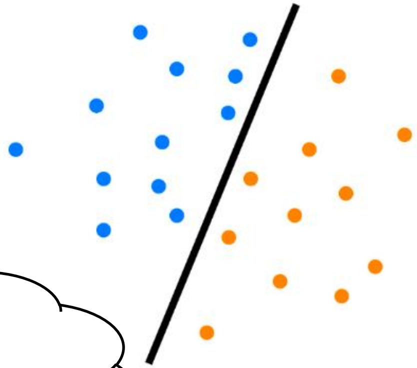
- Dynamic network reduction

Reduce simulation times

- Parallel processing



Maximise potential of hardware



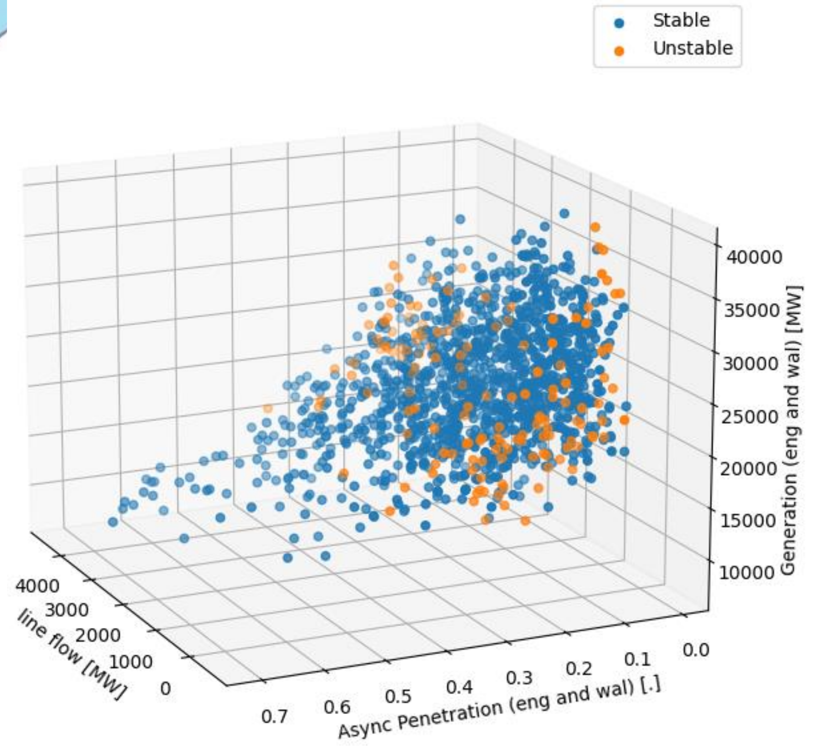
- Active learning

- Binary classification model

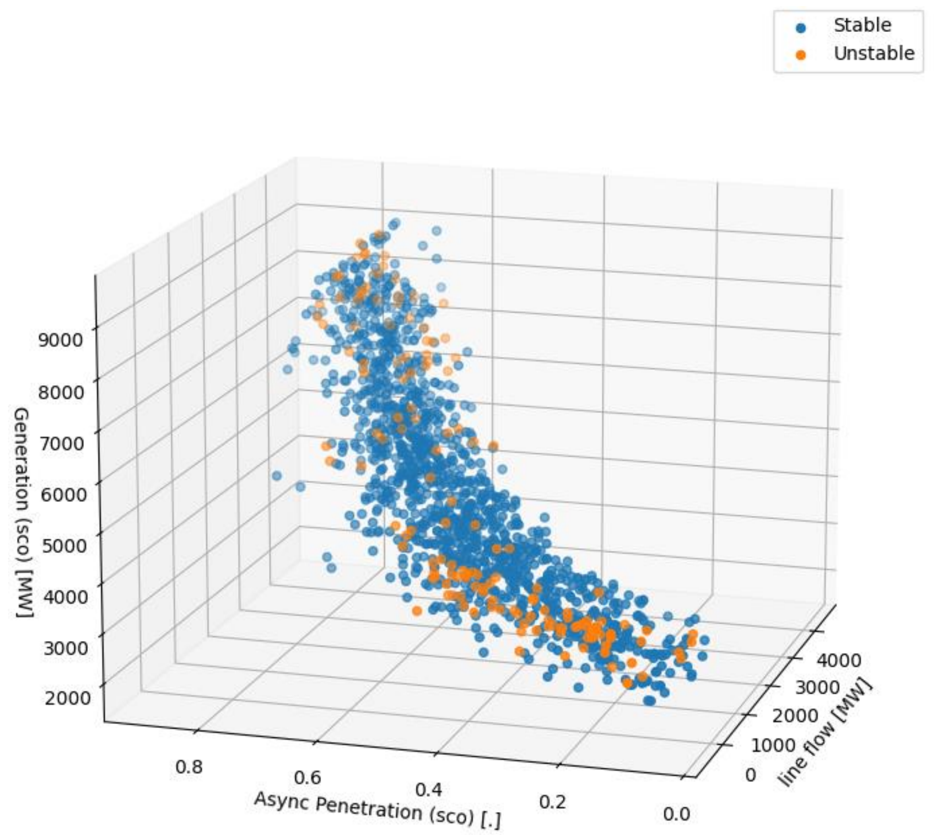
Model the process, cut out simulation time

Application –

Power System Analysis (Dynamic Studies)



Flow across B6 boundary plotted against **total generation** and **asynchronous penetration** in the <u>whole of England and Wales</u>



Flow across B6 boundary plotted against **total generation** and **asynchronous penetration** in the <u>whole of Scotland</u>