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CrowdFlex

Discovery Show & Tell

Virtual Energy System
Powered by National Grid ESO

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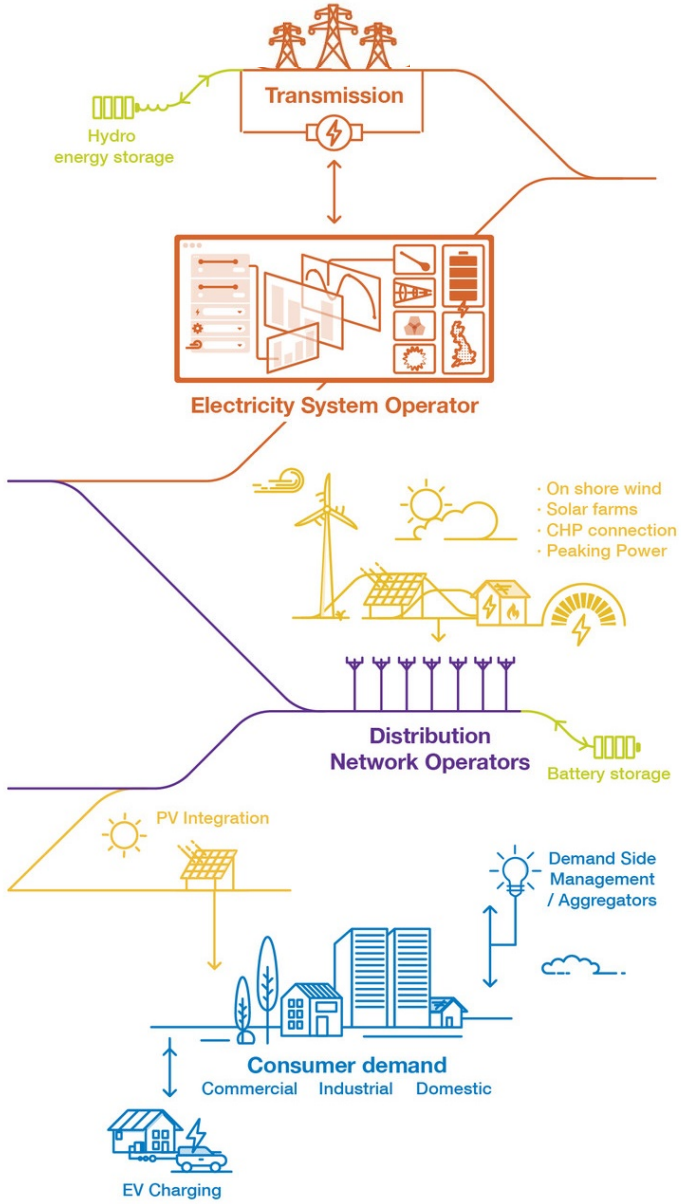
Problem to address

Challenge

- More **renewable generation** which is **non-dispatchable**
- More **electric vehicles** and **heatpumps** which **increase demand**
- So **flexibility** must shift from **supply-side to demand-side**
- A **smart, flexible and reliable** energy system is needed

Opportunity

- **Domestic consumers** offer a nascent, but large **flexibility resource**
- Currently largely **untapped**, due to **limited understanding** and existing **market design**
- Crowdflex explores novel **stochastic flexibility services**, reflecting the **statistical and distributed** assets
- Could enable **lower cost and lower carbon** system operation and reduce capacity and network **investment costs**



CrowdFlex aims to establish domestic flexibility as a reliable energy and grid management service

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CrowdFlex – Project Overview

Objectives

1. to understand and align **ESO/DNO requirements** for flexibility services and consider interaction with the **statistical nature** of domestic flexibility
2. to identify the **technology capability** and **consumer behaviour** parameters to explore in a **real-world trial**
3. to understand how the **statistical nature** of flexibility can be developed into **reliable modelling** of domestic demand and flexibility

Discovery: **feasibility** study (complete)
Alpha: **design** of trial/model (pending funding)
Beta: **delivery and testing** of trial/model (pending funding)

Core Technologies

- Domestic assets & automation: **EVs, heatpumps, white goods**
- **Smart metering**
- **Consumer segmentation** analysis
- **Statistical modelling** methods

Approaching the problem

Developing outcomes

- Conducted ~17 **interviews** to capture **user needs for ESO/DSOs procuring** flexibility:
  - SO challenges, respective current services and appetite for domestic flexibility
  - Key features to be investigated in a trial
- Undertook quantitative **consumer segmentation work** to identify high flexibility potential characteristics and researched **customer engagement needs**
- Conducted ~5 **interviews with ESO** to understand **user needs for aggregators modelling** flexibility:
  - reviewed approaches for **stochastic forecasting** of generation and demand

Additional activities

- **Engagement** with **relevant projects:** EQUINOX, BiTraDER, DRS Trial, SIF Flexible Heat, and BEIS Heatpump Ready
- **Dissemination/feedback** meetings with key **organisations**: BEIS, Ofgem, and Citizens Advice

Partners

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Additional engagement

Department for Business, Energy & Industrial Strategy

ofgem

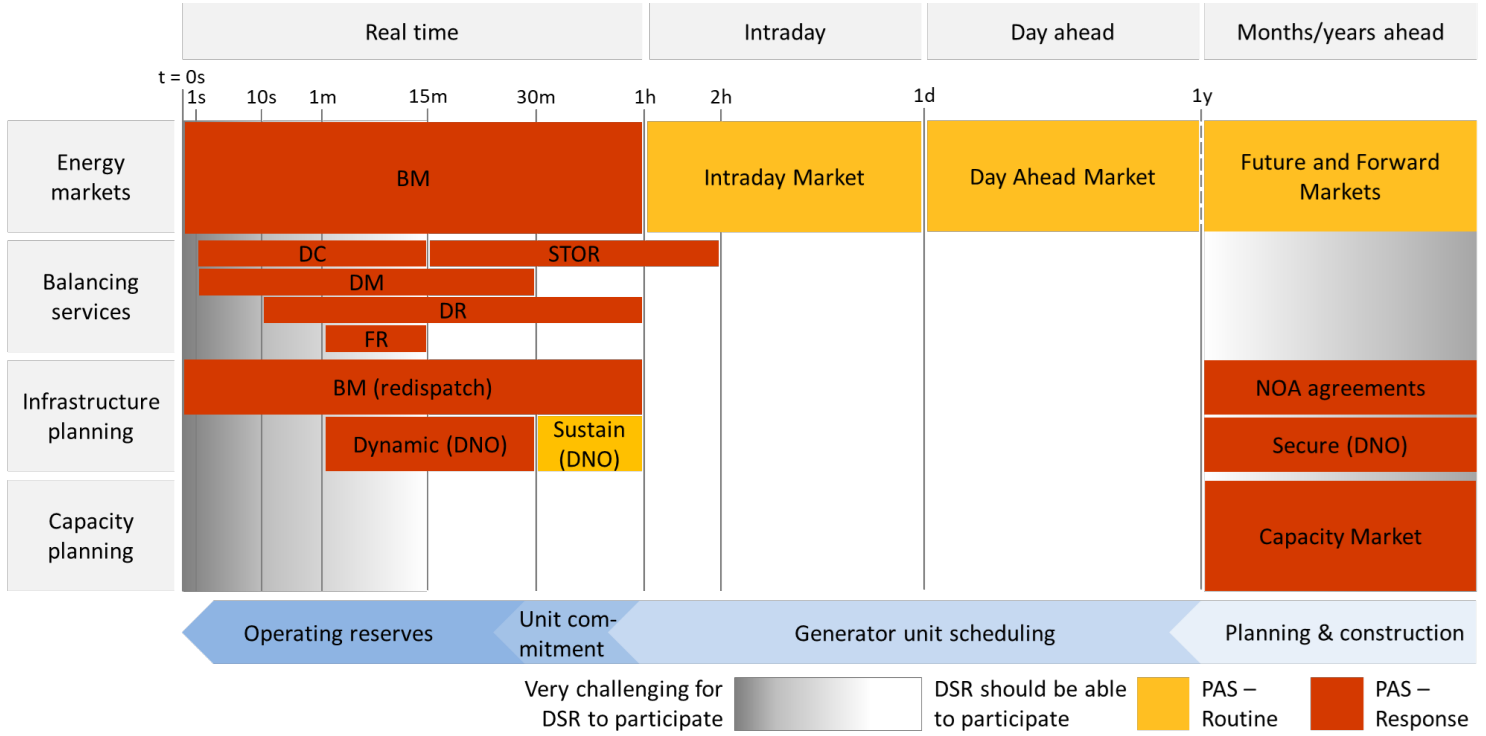
citizens advice

Understanding ESO/DSO requirements

Current system challenges are addressed through various **energy markets & flexibility services**

- Discovery confirmed there is strong **appetite** within ESO/DSO for domestic flexibility to **play an active role**
- Identified the markets and services **suitable for domestic flexibility**
- Only **most rapid of response services** thought to be **beyond technical capabilities** of domestic assets
- **Balancing via energy markets** can be declared close to time of delivery, location independent (aligned with **PAS-Routine**)
- **System critical** & **operational services** must deliver response when called upon (aligned with **PAS-Response**) and require declaration well ahead of time

The procurement timescales and response times of various energy markets and services available to flexible assets



BM – Balancing Mechanism, DC – Dynamic Containment, DM – Dynamic Moderation, DR – Dynamic Regulation, FR – Fast Response, STOR – Short Term Operating Reserve, NOA – Networks Options Assessment.

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Key dimensions for a Trial

For the **two flexibility categories**, Discovery lays out **parameters required for a large-scale trial** of domestic flexibility

1. **PAS-Routine** type flexibility – e.g. energy markets:
    - Timewise vector of **baseline demand**
    - Timewise vector of projected **flexible capacity**, for each time interval, **through a year**

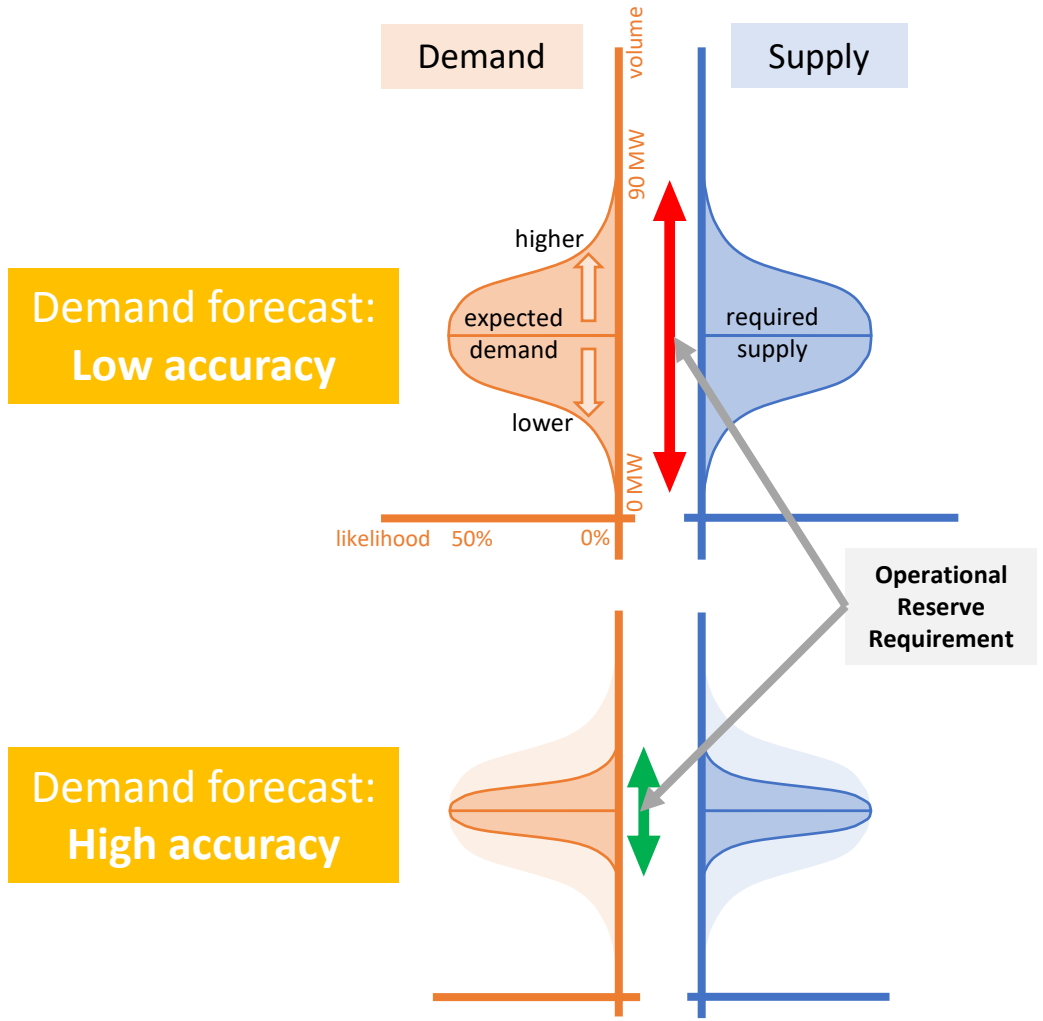
2a. **PAS-Response** type flexibility – system **operational** events e.g. Response, Reserve:
    - Firm response may vary throughout the year, therefore, response should be **tested multiple times** under a **variety of conditions** (season, weather, time of day, concurrent PAS-Routine incentives)
    - A rapid response required, likely procured via an **automated response**

2b. **PAS-Response** type flexibility – system **stress** events e.g. Capacity Market and NOA agreements:
    - **Tests during system stress** events (e.g. cold weather for demand-led peaks, summertime for supply-led stress) to ensure **reliable response**
    - Services may be called via **automated response or manually**, similar to the “Big Turn up/Down” experiments from CrowdFlex: NIA

Statistical modelling of domestic demand

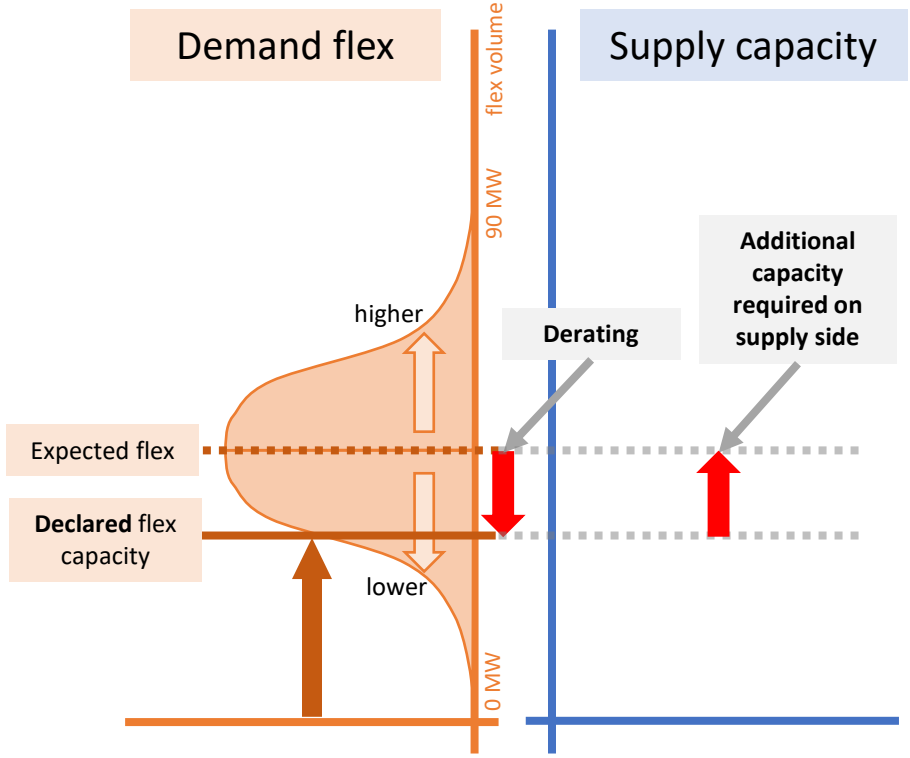
There is value in a data-intensive **understanding, forecasting and modelling** for domestic demand and flexibility

- Discovery identified a high-level **approach for modelling** domestic demand and flexibility
    1. Underlying **demand** (stochastic)
    2. Overlay **flexibility potential** (deterministic limits)
    3. Expected **flexibility outturn** (stochastic)
- Considered **use cases** for modelling forecasts:
    a) Improved **demand-side visibility**
        - Reduce energy imbalance & operational reserve requirements
        - Better utilise existing capacity & network infrastructure, delaying reinforcement
    b) Forecasting **availability for flexibility services**
        - Reduce operational costs (incl. constraints, reserve and energy balancing)
        - Reduce capacity & network reinforcement investment
- Domestic energy modelling can form part of the **Virtual Energy System ecosystem** by integrating with the **Common Framework** (currently under development)



Stochastic delivery of flexibility services

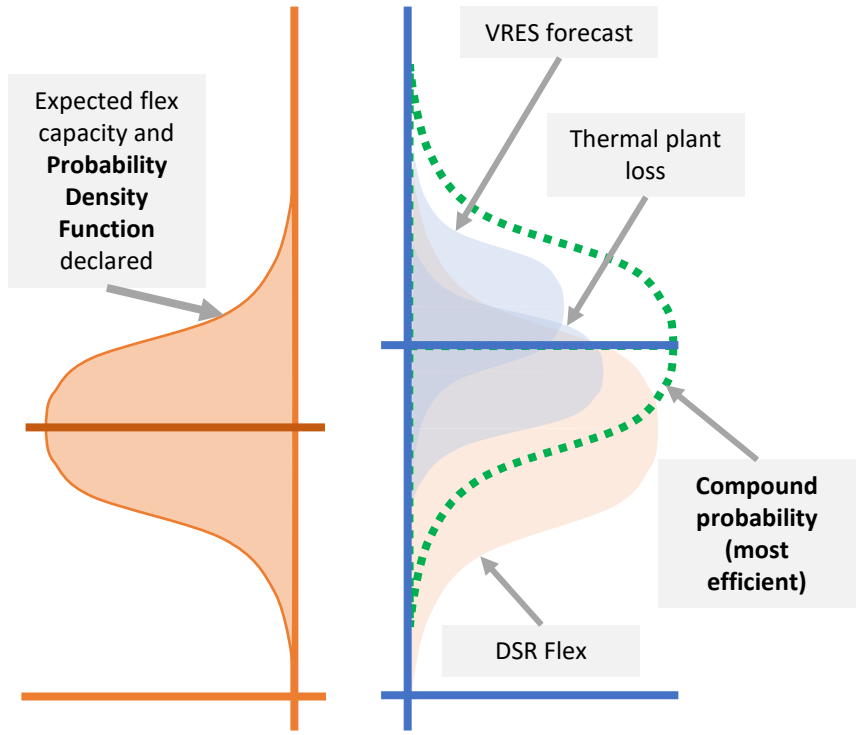
Flexibility: **Deterministic**



Flex capacity must be **derated** to ensure **high confidence in** delivery – this **underutilises and undervalues** demand assets.

This means the ESO must procure **more supply side flexibility** capacity – increasing system operation costs.

Flexibility: **Stochastic**



Declaring the **entire PDF distribution** enables the ESO to **realistically view flex potential** and **offset** any lower delivery confidence with **visibility of other possible system changes.** This enables **more efficient management** of resources – leveraging value and reducing system costs.

- Currently flexibility services procure a **declared firm capacity,** i.e. **deterministic**
- However, domestic flexibility is **inherently stochastic**
- Its capacity is best described by **statistical**, rather than **deterministic methods**
- Procuring flexibility statistically via a PDF, would **eliminate the need to derate capacity**
  - Reducing over procurement
  - Providing system savings for all stakeholders

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Discovery learnings and Alpha plans

1. Statistical Approaches to Services

- Identify current/future **"system needs"** and associated parameters
- Take a **spectrum approach** to flexibility services
  - Investigate **deterministic approaches** for near-term utilisation of domestic assets
  - In parallel, develop **pathways to introduce stochastically** procured services
- Develop approaches for **stacking** multiple flexibility services

2. Trial Design

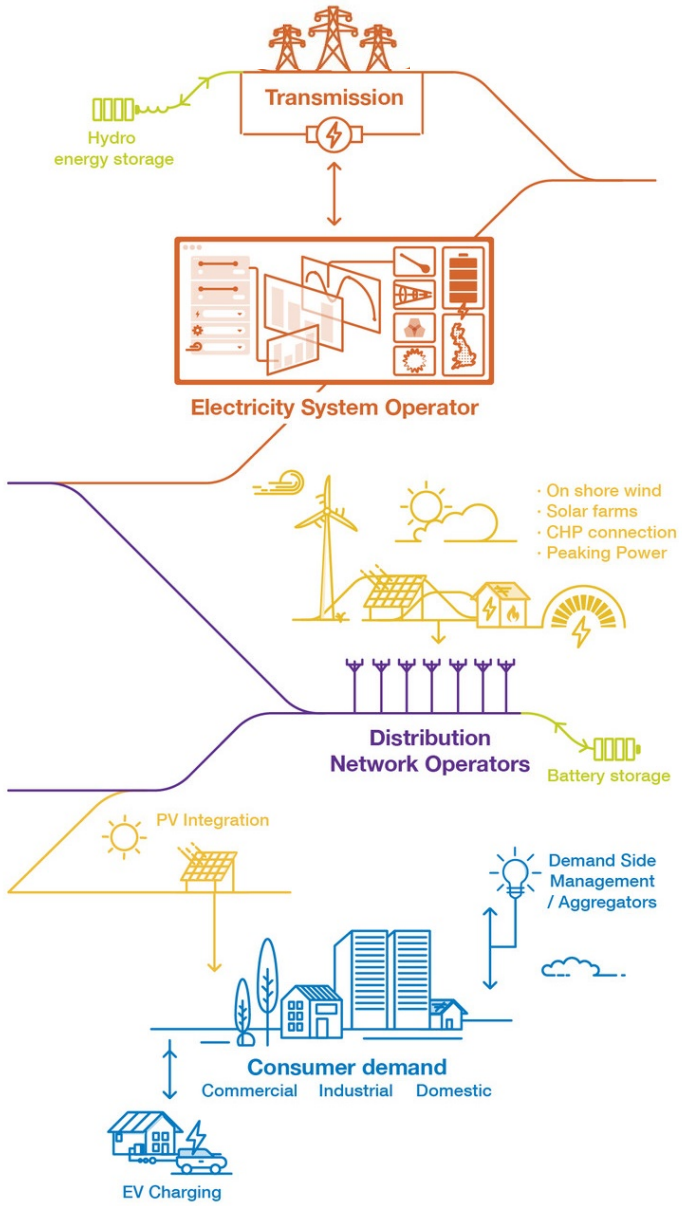
- A future trial must identify **priority domestic flexibility services** to test and:
  - Determine **timewise vector** of: baseline demand, flex potential, flex out-turn (24-7-365)
  - Determine **asset availability/capacity** for system operation & stress events
  - Identify **efficient** financial & information remedies to **incentivise** Routine and Response type services

3. Model Specification

- Identify **data needs & modelling approach** for **statistical demand** and dynamic **flexibility** forecasting techniques
- Align with Common Framework (where possible) for **VirtualES integration**

Stakeholder Engagement

- Engage with **Ofgem/BEIS** to understand potential **regulatory/policy barriers**
- Engage with **industry** players to gather **feedback** and **disseminate** learnings



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Value and potential benefits

CrowdFlex adds value beyond existing projects to date, by focusing on:

- **understanding and evolving ESO/DSO needs,** not just developing asset technical capability
- **testing delivery reliability** and statistical significance, targeting large numbers of participants & events
- **statistical modelling** for the VirtualES ecosystem, in combination with a real-world trial

Learning from CrowdFlex has the potential to:

- **Lower customer bills**
  - through system wide **savings** and **revenues** from services
- **Reduce costs** of system balancing and network reinforcement
  - through **access** to and **confidence** in domestic assets
- Enable **greater market participation** on the demand side
  - through novel **statistical approaches** to flexibility services
- Increase use of **renewable generation** and **lower carbon** emissions
  - through the **demand-side** supporting the energy transition

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Q&A

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