Charging Futures

Reforming electricity charging together

Forum

Access and Forward Looking Charges Webinar

The webinar will begin shortly

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Access and Forward Looking Charges Webinar

12 March 2020

nationalgridESO

Charging Futures

Morning Agenda

Time	Agenda Item	Speaker
10:00 – 10:05	Webinar Introduction	Rob Marshall, ESO
10:05 – 10:15	Access & Forward Looking Charges SCR in the context of wider reforms	Frances Warburton, Ofgem
10:15 – 10:50	Access & Forward Looking Charges: Shortlisting	Jon Parker, Ofgem
10:50 – 11:00	Break	
11:00 – 12:00	Access & Forward Looking Charges: Modelling	Lewis Heather, CEPA
12:00 – 12:15	Q&A Panel	Andrew Self, Ofgem Jon Parker, Ofgem Amy Freund, Ofgem Lewis Heather, CEPA

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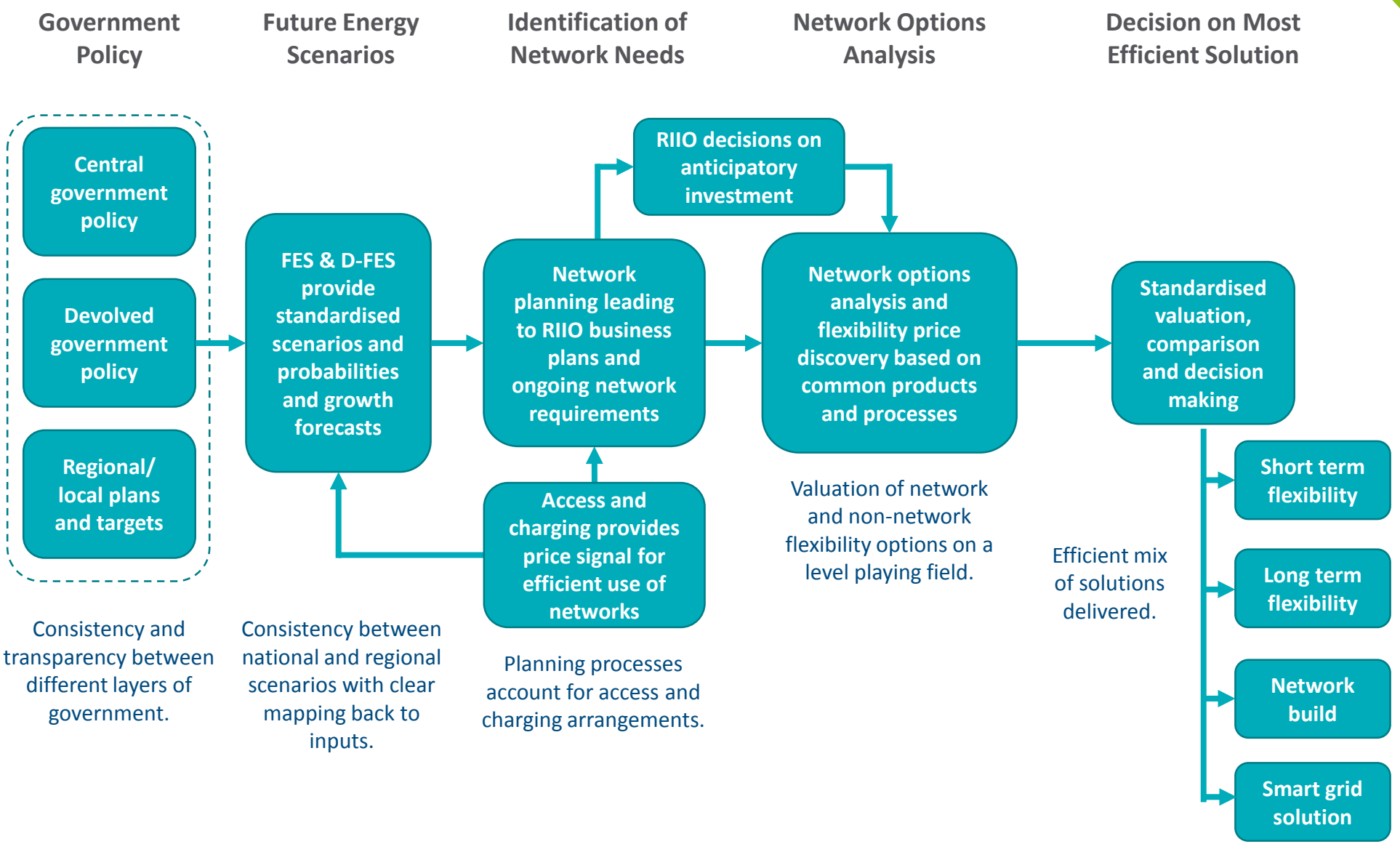
Access and forward looking charges SCR in the context of wider reforms

Frances Warburton

Ofgem

Networks interaction with flexibility



Charging Futures

Future Charging and Access programme

The energy system transformation will create challenges and opportunities for our electricity networks. We are considering how electricity network access and charging should be reformed to address these changes and existing issues:

Access and forward looking charging reform (Access SCR). We want to get better value out of electricity networks by using them more efficiently and flexibly. If we do this, the system will be able to accommodate more electric vehicles and other new technology at lowest cost.

The **Targeted Charging Review (TCR).** This seeks to remove some of distortions which are sending the wrong signals and costing consumers money, and to allocate residual charges in a fairer way.

Mostly Ofgem - led

The **Balancing Services Charges Task Force.** The Electricity System Operator is now leading a second task force to consider how balancing services charges should be structured, given the conclusion of the first task force that it is a cost recovery charge. This will take into account our decision under TCR.

NG ESO-led

Access and Forward Looking Charges: Shortlisting

Jon Parker
Ofgem

Structure of today's session

We will:

- Provide a background briefing of our Access SCR.
- Seek your feedback on:
  - Our shortlisting of options for in depth development and assessment
  - CEPA/TNEI's approach to modelling to support our Impact Assessment

Charging Futures

What are access arrangements and forward-looking charges?

Access arrangements - the nature of users' access to the electricity networks (for example, when users can import/export electricity and how much) and how these rights are allocated.

Forward-looking charges – the type of ongoing electricity network charges which signal to users how their actions can ether increase or decrease network costs in the future.

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Background to the Access SCR

Objective of Access Significant Code Review (SCR): We want to ensure electricity networks are used efficiently and flexibly, reflecting users' needs and allowing consumers to benefit from new technologies and services while avoiding unnecessary costs on energy bills in general.

We launched the Access SCR in December 2018. The scope is

- Review of the definition and choice of transmission and distribution access rights
- Review of distribution connection charging boundary
- Wide-ranging review of Distribution Use of System (DUoS) network charges
- Focussed review of Transmission Network Use of System (TNUoS) charges

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Our approach

Assessing against our guiding principles throughout:

1. Supporting **efficient system development**

2. Reflecting **energy as an essential service**

3. **Practicality & proportionality** of implementation

Until now, our focus has been on developing and assessing a longlist of options – informed by a range of evidence and input from stakeholders. Our working papers outlined our thinking.

Going forward, we are now focusing on assessing a shortlist of options. This assessment will be based against our guiding principles.

We have commissioned CEPA-TNEI to undertake modelling to assess the potential quantitative impacts of the shortlist of options. This will support our further qualitative assessment of the shortlisted options

We intend to publish our consultation on our draft impact assessment and SCR decision in autumn 2020.

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Timeline and how to engage

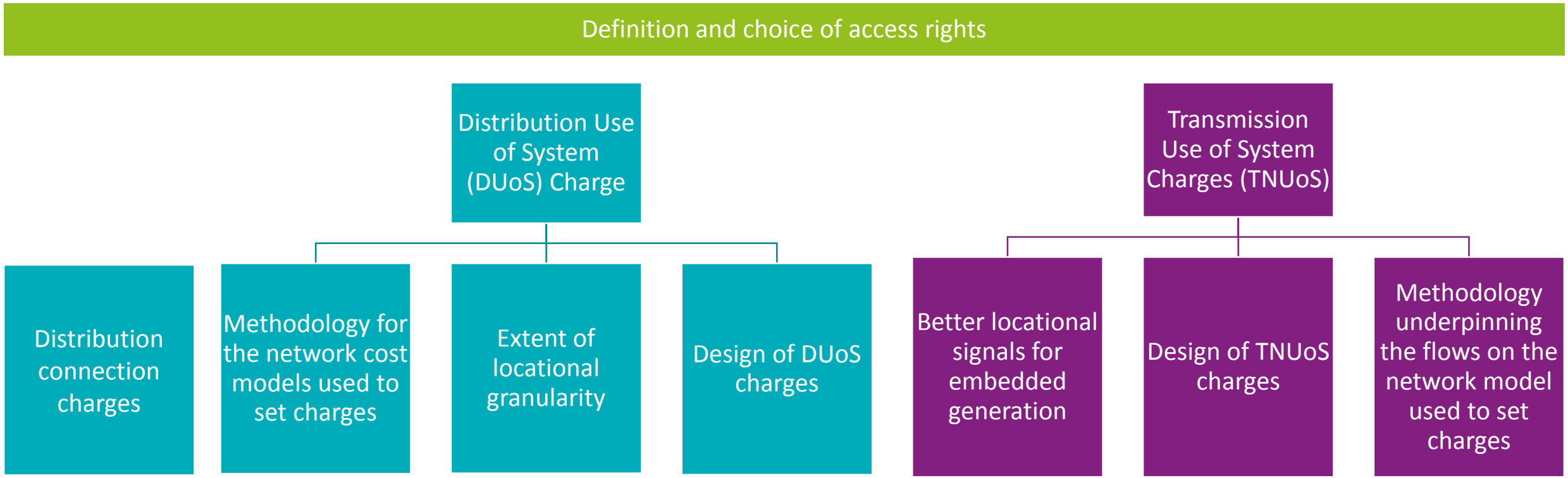
- We will continue to work with our Delivery Group and Challenge Group and will be bringing emerging analysis to a future Forum ahead of consultation
- To keep up to date with all our work on Future Charging and Access - get added to the Charging Futures distribution list at http://www.chargingfutures.com/sign-up/sign-up-and-future-events/

Charging Futures

Overview of our options shortlisting

Overview

- We need to shortlist options to allow for more in depth assessment. To do this we have undertaken a principally qualitative assessment of the longlist against our guiding principles
- We published an open letter on Monday setting out our options shortlist and our high-level reasoning for not taking forward some options. It's structured as follows:



Improving the definition and choice of access rights

Shortlisted reforms	Not shortlisting
> Improved definition and choice of access for larger users: • Improved options for curtailable access rights (non-firm) • Introducing option for time-profiled access rights • Ability to share access between users in the same local area • Clarifying distribution users' access rights to the transmission network	> Some sub-options for choice of access for larger users: • Financially firm/connect and manage at distribution level • Wider shared access • Either fully standardised or fully bespoke choices > Defining and introducing choice of access for small users

Potential reforms to the upfront charges for connecting to the distribution networks

Shortlisted reforms	Not shortlisting
> Reducing the extent to which distribution users pay for reinforcement through connection charges – a "shallower" or "shallow" connection charging boundary > Allowing alternative payment terms for connection charges e.g. to allow payment over time (including while maintaining the current "shallowish" boundary) > Introducing liabilities and securities arrangements	> Some sub-options for a shallower/shallow connection charging boundary: • Introduce a cap on the extent of reinforcement costs that can be recovered through connection charges • Introduce a standard connection charge • Recover some extension asset costs through use of system charges

DUoS: Methodology for the network cost models used to set charges

Shortlisted reforms	Not shortlisting
> Charges based on forecasts of where incremental reinforcement needed to the Extra High Voltage (EHV) network > "Ultra long-run" cost model, which could be applied at all voltage levels (or from primary substation) > Supplementing an ultra-long-run model with discounts based on an indicator of spare capacity on EHV networks > Charges/credits calculated based users' estimated contribution to upstream network costs > Charges and credits reflect dominant flows (where practical)	> Short-run marginal cost model > Charges based on forecasts of incremental reinforcement needed to the High Voltage (HV) and Low Voltage (LV) networks > Supplementing an ultra-long-run model with discounts based on an indicator of spare capacity on HV/LV networks > Amending the network models to assess users' contribution to downstream network flows as well as upstream flows

DUoS: Extent of locational granularity

Shortlisted reforms	Not shortlisting
> Split DNO areas into more granular "zones" for charging purposes, based on primary substations, or groupings of primaries. Locational variation could be through: • How costs vary for the EHV networks in different areas • Adjusting charges/credits according to whether dominant network flows are caused by demand or generation > Having different time bands for time-of-use charges to reflect locational variation in network peak times Options to reduce volatility in charges for users connected at EHV, for example by moving from nodal to zonal charges	> Other options for greater locational granularity, including: • Charges varying by secondary substations • Varying charges by primary substations according to estimates of varying cost for the HV/LV network below each primary substation • Varying charges by primary substations according to estimates of varying spare capacity for the HV/LV network below each primary substation

DUoS: Design of DUoS charges

Shortlisted reforms	Not shortlisting
> Charges based on more accurate time of use bands, e.g. seasonal > Charges based on agreed capacity rights Hybrid options of the two	> Charges based on users' maximum actual entry/exit capacity during certain periods > Dynamic charging or rebates, with high charge or rebate periods based on real-time network conditions

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TNUoS Charges

Methodology underpinning the flows on the network model used to set charges

We have not removed any reference node options from our shortlist

- We are holding an online workshop on 19 March 2020 to share our work to date on the reference node
- We are still considering whether options for change merit in-depth assessment

Locational signals through TNUoS charges – distribution-connected generation

We have not removed any TNUoS for distribution-connected options from our shortlist

- We are still reviewing whether - and how - small distribution-connected generation should or could pay similar, or identical locational TNUoS charges to larger generators

Design of TNUoS demand charges

Shortlisted reforms	Not shortlisting
> Charges based on more accurate time of use bands, e.g. seasonal	> Charges based on users' maximum actual entry/exit capacity during certain periods
> Charges based on agreed capacity rights	> Dynamic charging or rebates, with high charge or rebate periods based on real-time network conditions
> Hybrid options of the two	

Overview

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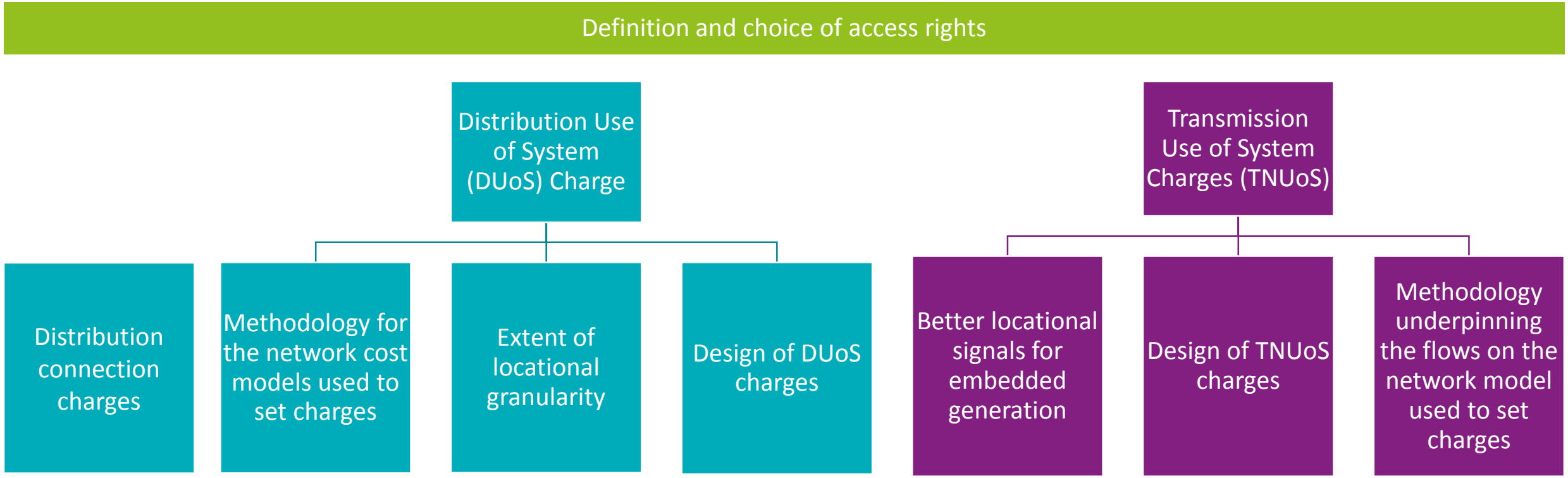


Access and Forward Looking Charges: Modelling

Lewis Heather
CEPA

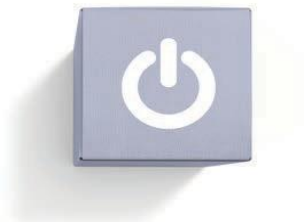
Access and Forward Looking SCR

Impact Assessment Modelling Approach

12/03/2020

Agenda

- Project scope
- Summary of high-level approach
  - Menti discussion on high-level approach
- Behavioural response approach
  - Menti discussion on behavioural response approach
- Final questions/comments

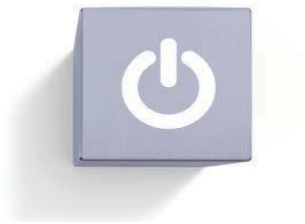


Project scope

Project scope

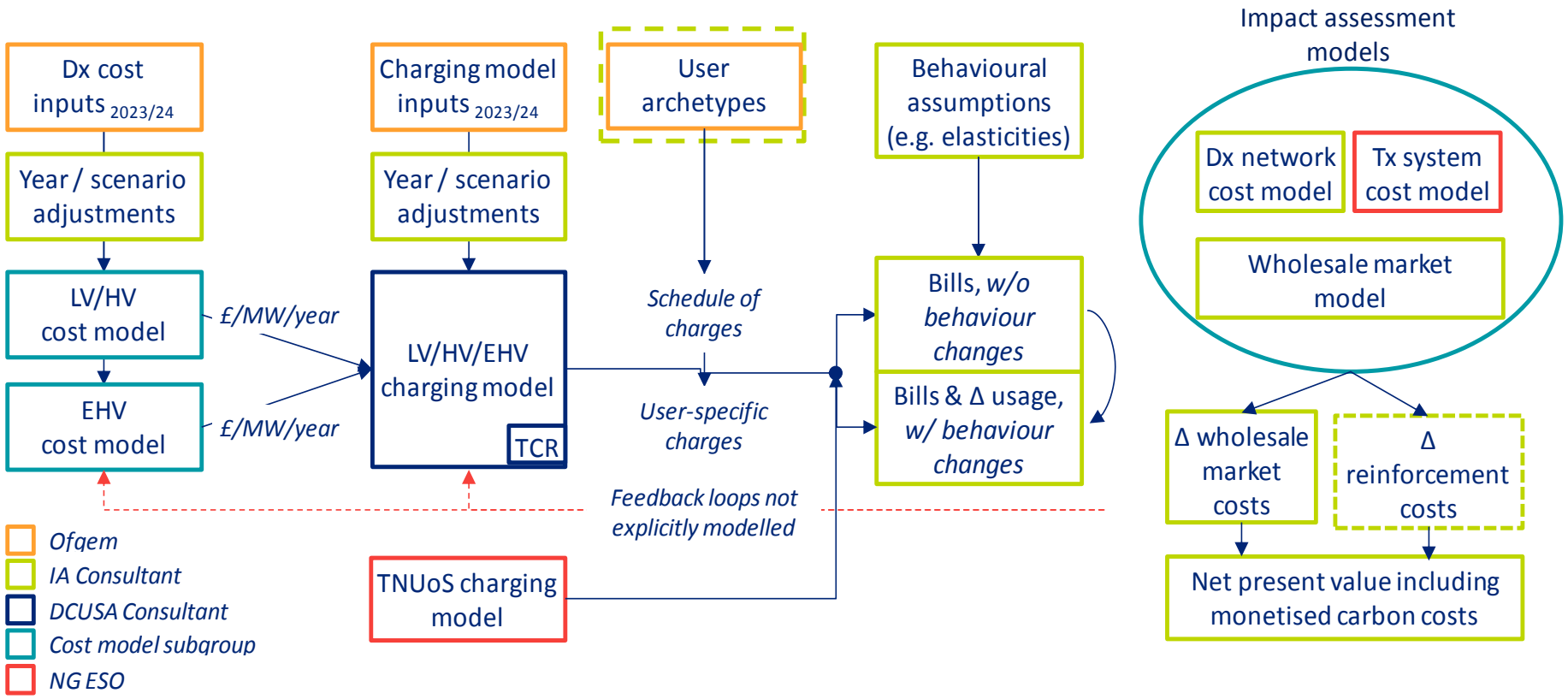
- The scope of the project is to carry out an impact assessment of Ofgem's shortlisted options
- This will combine several models built under this contract with outputs from models owned/developed by others:
  - DUoS charges
  - TNUoS charges

- Given the complexity and range of options, we will adopt the 'specification development principles' applied for modelling of distribution use of system charges. I.e.:
  - *Simplifying* assumptions will be required
  - Focus will be on *impactful* charging options and elements
  - *Transparent* where possible noting trade-off with complexity
  - *Replicable* where possible noting trade-off with complexity
  - *Consolidation* of options/user archetypes to streamline modelling where reasonable



Summary of high-level approach

Overview of IA approach



*Note that transmission reinforcement costs are no longer being modelled by the ESO. They will be estimated based on a sub-set of key constraint boundaries within the market model

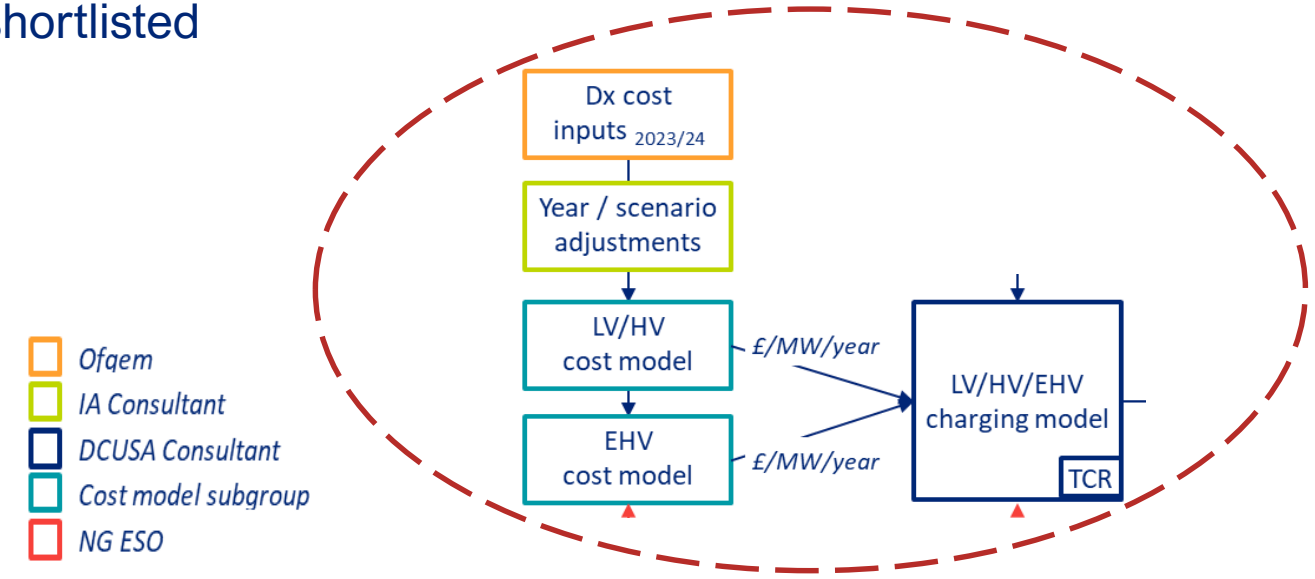
Summary of high-level approach

LV/HV and EHV cost models

- *Being developed by Cost Model subgroup (not under this project)*
- Used to calculate the unit costs at different network locations and under alternative cost concepts
- We will adjust inputs to cost models to reflect scenario definitions and spot year

Outputs

- Unit costs at different network locations, under alternative cost concepts
- Final outputs will depend on modelling of the options that Ofgem have shortlisted



Charging models

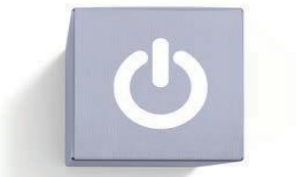
The Charging models are not being developed under this contract but will provide outputs which are used in analysis

Distribution Use of System

- *Development contracted by DCUSA*
- *Models EHV, HV and LV network charges*
- *Includes 500 locations/primaries per DNO*
- *Allow for definition of a range of user archetypes based on consumption and capacity assumptions*
- *Allows for analysis of (static) distributional impacts of charging options*
- *Provides outputs for market and network reinforcement analysis*

Transmission Use of System

- *Owned by National Grid ESO*
- *Models options which include changes to TNUoS charges*
- *Allows for analysis of (static) distributional impacts of TNUoS charging options*
- *Currently models 2023/24 TNUoS charges*
  - *Some form of extrapolation may be needed*
- *Provides outputs for market and network reinforcement analysis*

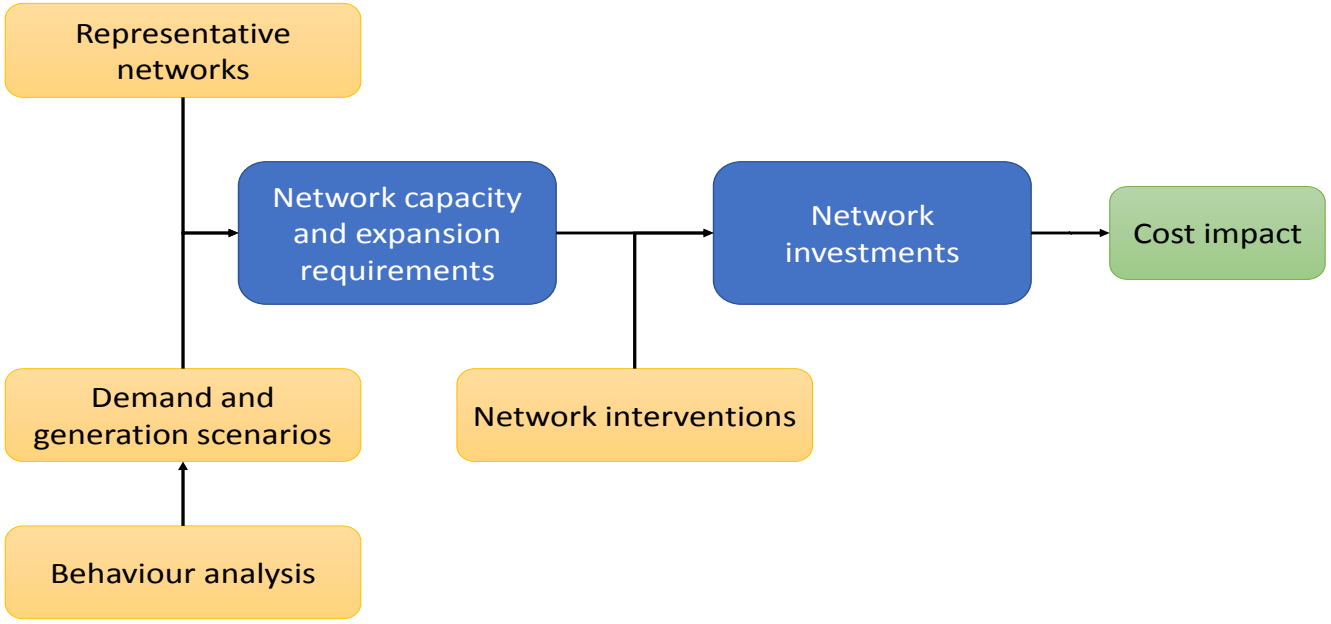


Distribution reinforcement model

We are developing an excel based model for estimating distribution network reinforcement costs. The model will follow a four step process:

1. Model baseline network capacity under relevant scenario (exogenous)
2. Calculate network capacity requirements
3. Identify need for reinforcement
4. Optimise solutions to meet capacity needs at lowest cost

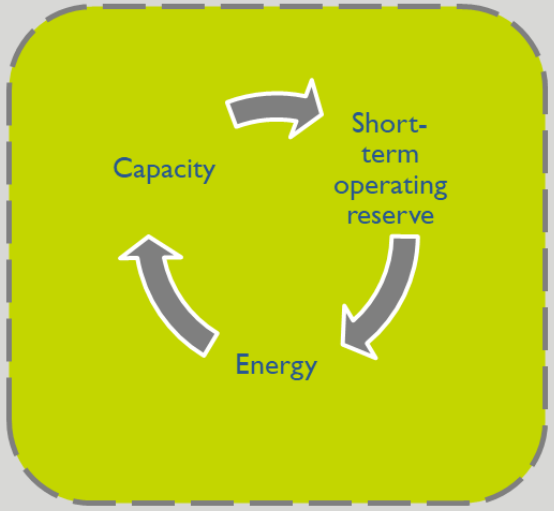
We are in the process of requesting data from DNOs to populate the model



Wholesale Market model

Input assumptions

- Technology (capex, performance, learning rates)
- Fuel & carbon prices
- DUoS charges
- TNUoS charges
- Behavioural assumptions



Technologies covered in the model

1. Peaking plants
- OCGT
- Gas (embedded & transmission connected
- Diesel

2. DSR

3. Solar PV

4. Storage
- Hydro pump
- Lithium ion
- Flow batteries
- other

5. CCGT

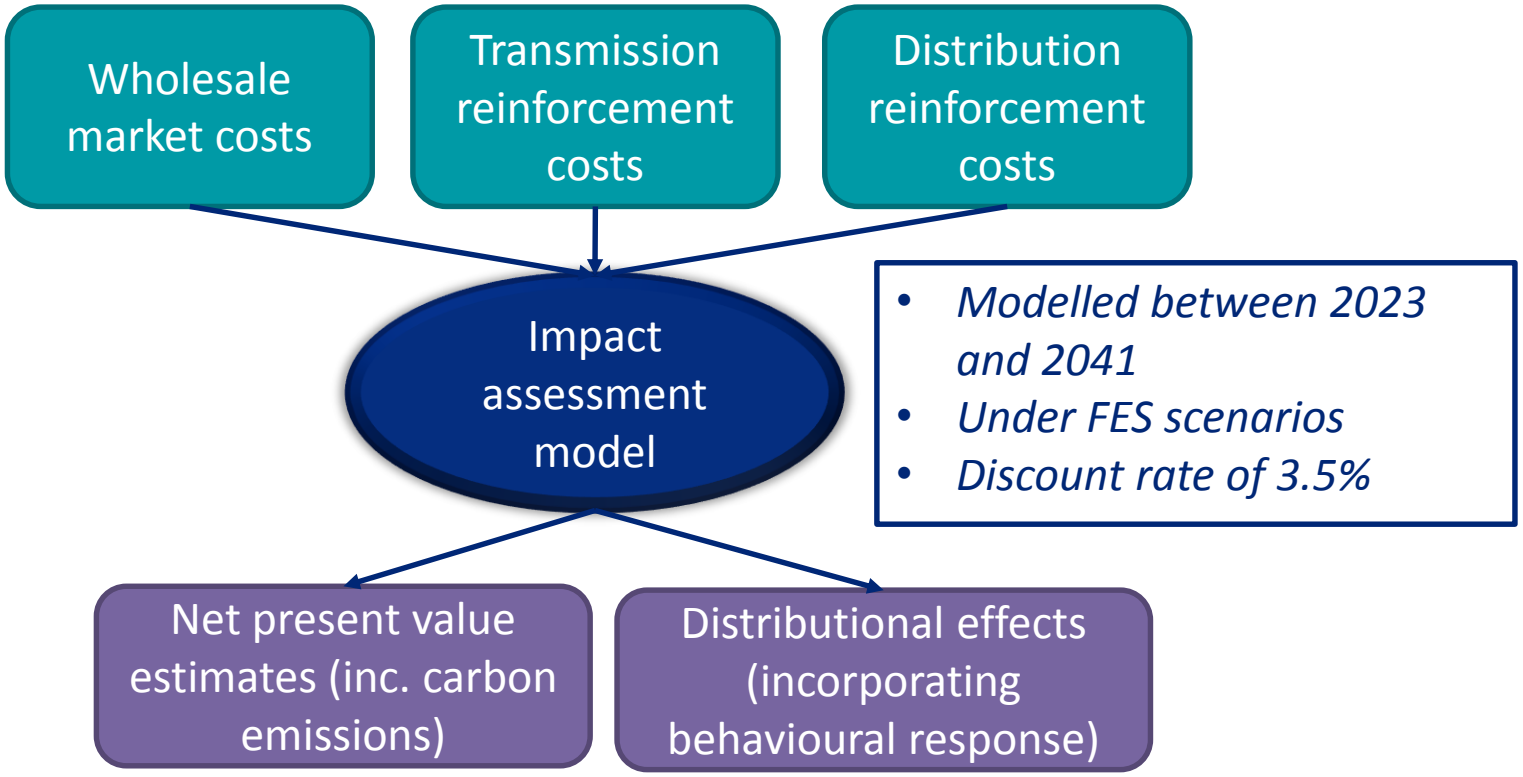
6. Coal

7. Wind

Market outcomes

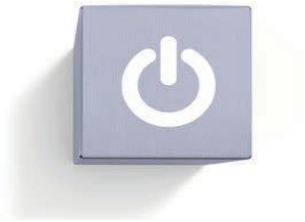
- System marginal prices
- Hourly dispatch
- Hourly reserve prices
- Plant-level revenues
- Indication of potential impacts on investment outlook
- Carbon emissions

Impact Assessment model



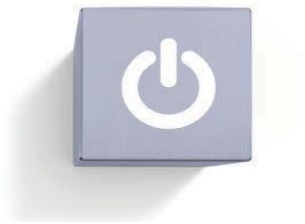
Modelling of generation capacity

- One important consideration is the modelling of generation capacity in the model. At a high-level, there are two options for this:
  1. **Endogenous generation capacity expansion**
     - Allow the model to determine the level of generation of different types based on price signals (and incorporating impact of charging options).
  2. **Exogenous generation capacity expansion based on FES**
     - Align level of generation capacity with FES scenario outputs.
     - Calculate impacts of charging options on revenues of different types of generation capacity to understand potential impacts on investment and/or the need for policy support.



Modelling of generation capacity

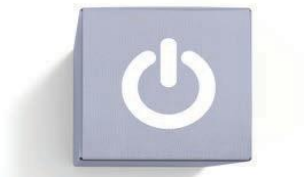
- **Option 1: Endogenous generation capacity expansion**
  - Including both timescales within one model is rarely done in modelling and brings a number of complexities
  - This risks significant divergence from the FES and potential challenges with the robustness of results
  - It may also necessitate/imply policy choices that are beyond the scope of this exercise
- **Option 2: Exogenous generation capacity expansion based on FES**
  - Aligns with FES which are transparent and tested with stakeholders
  - Does not require the development of explicit assumptions regarding policy outlook to 2040
  - But does not implicitly capture technology investment
    - See next slide for how we would propose to incorporate potential impacts under this approach



Modelling of generation capacity

Option 2: Exogenous generation capacity expansion based on FES

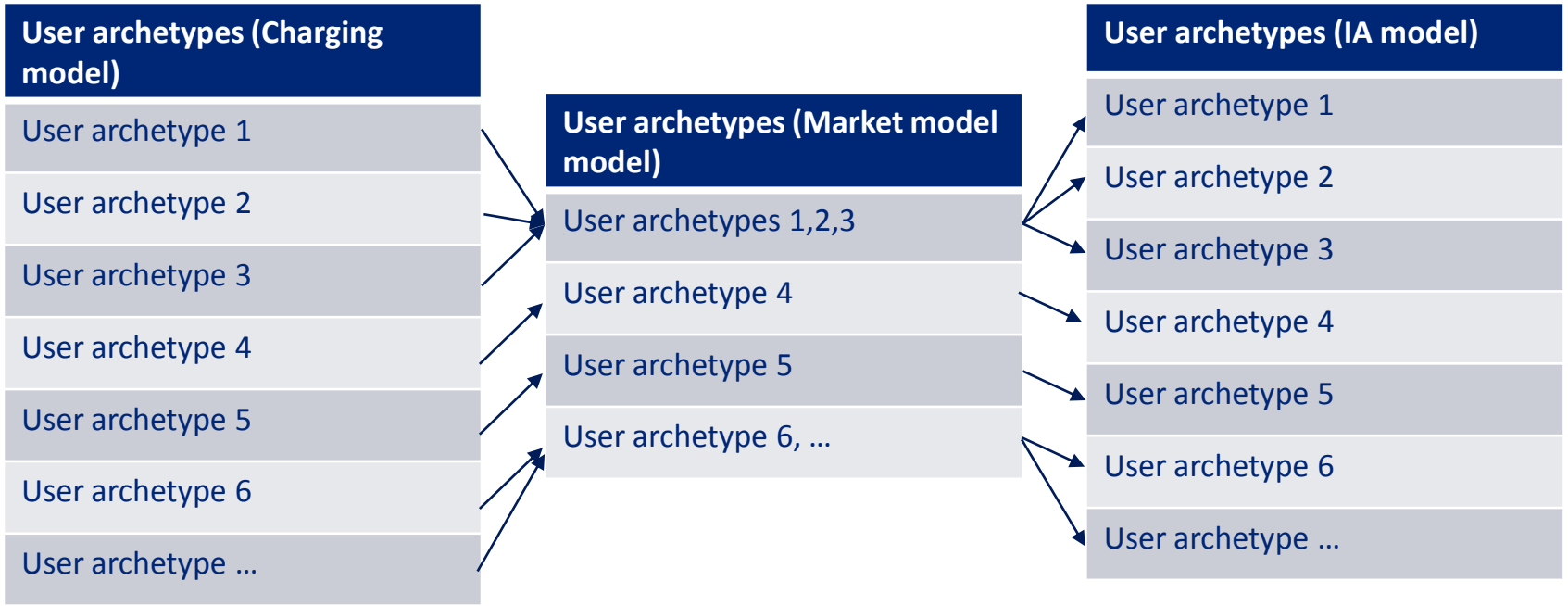
- Under an exogenous generation capacity approach, we would consider implications for capacity investment in the following way:
  - Incorporate impacts of charging options into generator cost functions
  - Calculate revenues for generation types under each charging option and incorporating generator cost function
  - Sum revenues across modelling period (i.e. to 2040)
  - Compare technology revenues between options and against status quo
  - Identify ‘revenue gap/benefit’ for different technology types
  - Revenue gap can be interpreted in two ways:
    1. *The additional level of policy support that would be needed to reduce risk of under-investment relative to status quo*
    2. *The additional risk of under-investment in the case that policy support levels do not adapt*



User archetype and behavioural response approach

User archetypes

- We will model impacts across a number of user archetypes
- User archetypes will be aggregated in some models where behavioural responses and tariffs are expected to be similar
- However, the charging model and IA model will be designed to estimate impacts on the full range of user archetypes (data allowing)
- Where full dynamic modelling in the market model is not possible, we may only provide distributional analysis from the Charging model



User archetypes

- We are considering aggregation of consumers in the market model based on our behavioural literature review – e.g. load shifting characteristics.
- Note that the IA model can disaggregate impacts for different users based on different consumption levels
- Some initial thoughts on user archetypes for market model are below:

Domestic classes	Commercial classes	Industrial classes
Domestic – aggregated	Commercial – small	Industrial – EHV-connected without onsite generation / demand management
Domestic – Solar PV	Commercial – LV	Industrial – EHV-connected with peak generation / demand management
Domestic – Solar PV with storage	Commercial – LV with onsite generation/storage	T-connected with peak generation / demand management
Domestic – Electric Vehicles (V2G, smart charging and engaged only)	Commercial – Light industrial HV-connected	T-connected without onsite generation / demand management
Domestic – Heat Pumps	Commercial – Light industrial HV-connected with onsite generation/storage	

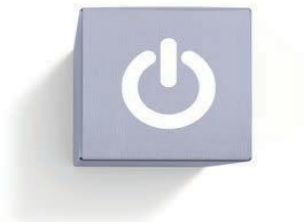
Ofgem is updating its domestic user archetypes. This work may feed into those which we include in our modelling where relevant.

Behavioural modelling

- Behavioural responses will be incorporated into our modelling to estimate the aggregate and distributional impact after taking into account how market participants will respond.
- We are considering changes to behaviour such as load shifting/peak shaving.
- We are exploring the behavioural literature to set assumptions on the level of deviation from some initial baselines:
  - Domestic consumers:
    - Have inflexible demand
    - Do not disconnect or change location based on signals
  - Non-domestic consumers:
    - Respond rationally to price signals
    - May change location (considering option to allow market model to optimise location of large consumers)
  - Generation
    - Respond rationally to price signals
    - May change location (considering option to allow market model to optimise location of capacity)

Behavioural modelling

- There is a mixed depth of literature in relation to potential behavioural response
- We intend to develop assumed levels (0-3) of behavioural response for each consumer archetype, considering how they may respond to changes to £/MW and £/MWh signals
- We would consider the potential extent of behavioural response from consumers in the following ways:
  - *How can consumption be shifted from one period to the other?*
  - *What capacity requirements are needed?*
  - *Will (large scale) generation deviate from rational response to signals?*
  - *Where to locate and consume?*
  - *How will automation impact on behavioural responses?*
- To do this, we would combine evidence from the literature, trials and judgement
- We would justify these assumed levels of response and test them with stakeholders



Behavioural modelling

Example of behavioural response matrix

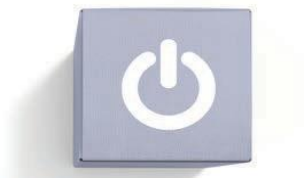
- We will assume that non-domestic consumers respond rationally to price signals unless there is sufficiently strong evidence to suggest a material non-rational response
- 0 = no behavioural change, 3 = maximum behavioural change

where scores (1-3) are mapped to percentage changes based on our analysis

- We will start from the assumption that domestic consumers have inflexible demand

Stylized example behavioural response matrix for domestic consumers

Consumer archetype	**Load shifting** *Assumed strength of response*	**Peak requirements** *Assumed strength of response*	**Location** *Assumed strength of response*
Domestic – low consumption	1	1	0
Domestic – Electric Vehicles	3	2	0
…	…		…



Behavioural modelling

Differentiating between charging options

- The behavioural response score assigned to each user archetype will remain constant across options – i.e. assume that relative change in response between archetypes is constant
- However, the percentage change in response assigned to each score may change depending on characteristics of the option (such as strength of signal)
- Under some options, the behavioural response may not be 'switched on'. I.e.

Stylized example mapping of behavioural response

Behavioural response score (load-shifting)	**Option package 1 (% change)**	**Option package 2 (% change)**	**Option package 3 (% change) – *Behavioural response not 'switched on'***
0	0	0	0
1	5	2.5	0
2	10	5	0
3	20	10	0

Behavioural modelling

Evidence vs judgement

- There will inevitably several gaps/limitations in the behavioural literature and it is not in scope to carry out independent behavioural studies/trials
- Where literature exists it will differ in the following ways:
  - Country of study and relevant context
  - Recency of study
  - Strength of signal provided
  - Number of participants and statistical significance
  - Number of studies considering similar trends
- This suggests a spectrum of options for behavioural response assumptions:

Requiring strong evidence base:

- Statistically significant
- Multiple studies
- Recent
- UK based

Accepting weaker evidence base:

- Small studies
- Single cases
- Different contexts
- Intuition

Strength of behavioural response is also a candidate for sensitivity analysis

Q & A Session

Andrew Self, Ofgem
Jon Parker, Ofgem
Amy Freund, Ofgem
Lewis Heather, CEPA

What's next?

Written comments on access shortlisting sent to futurechargingandaccess@ofgem.gov.uk by 6 April 2020

Join us at 2pm for an overview on the Targeted Charging Review SCR