



# Aurora's power modelling methodology

March 2020

# Our forecasts use Aurora's proprietary European power market model

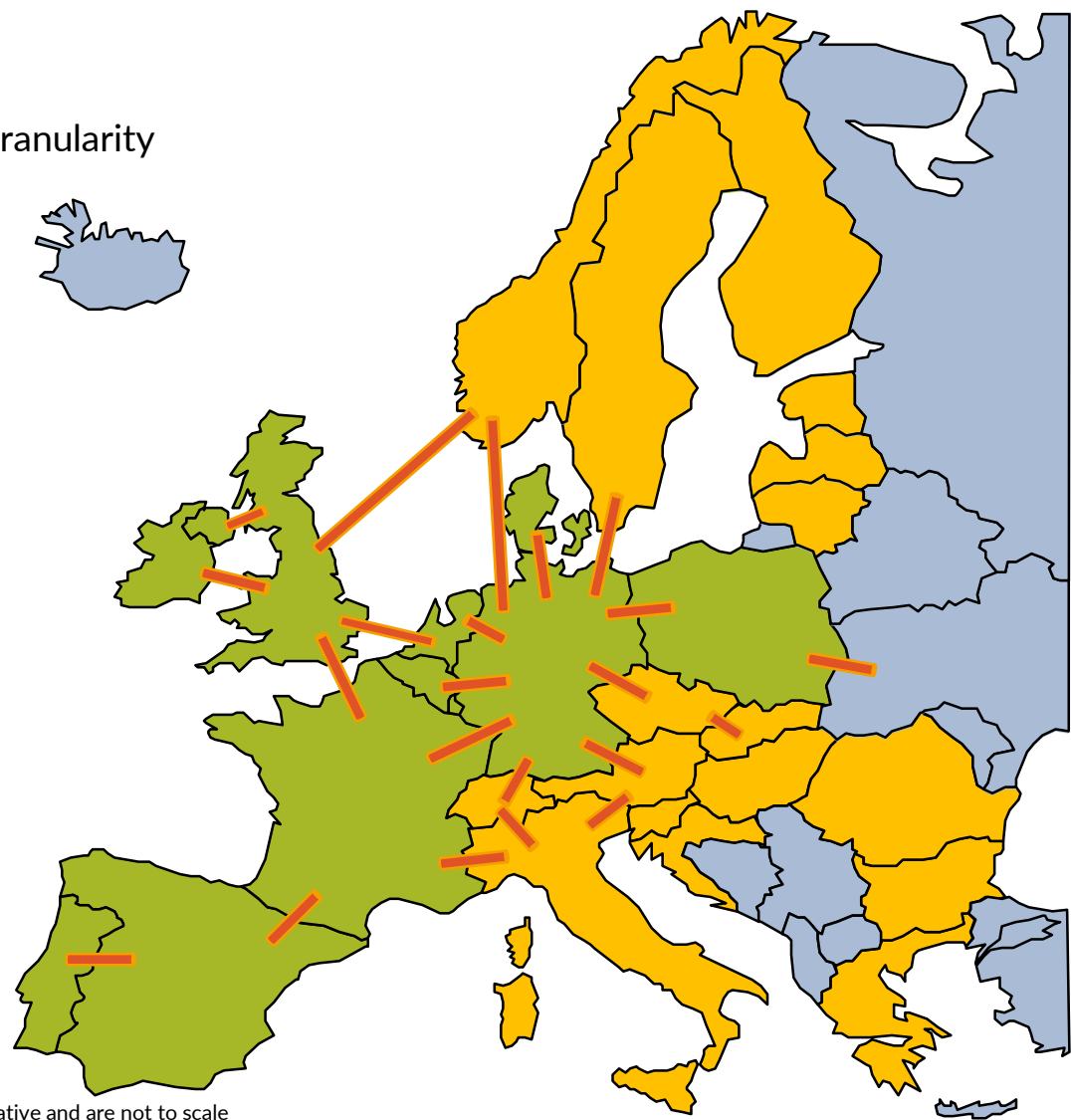
Plant aggregation

Individual plant

Not currently modelled

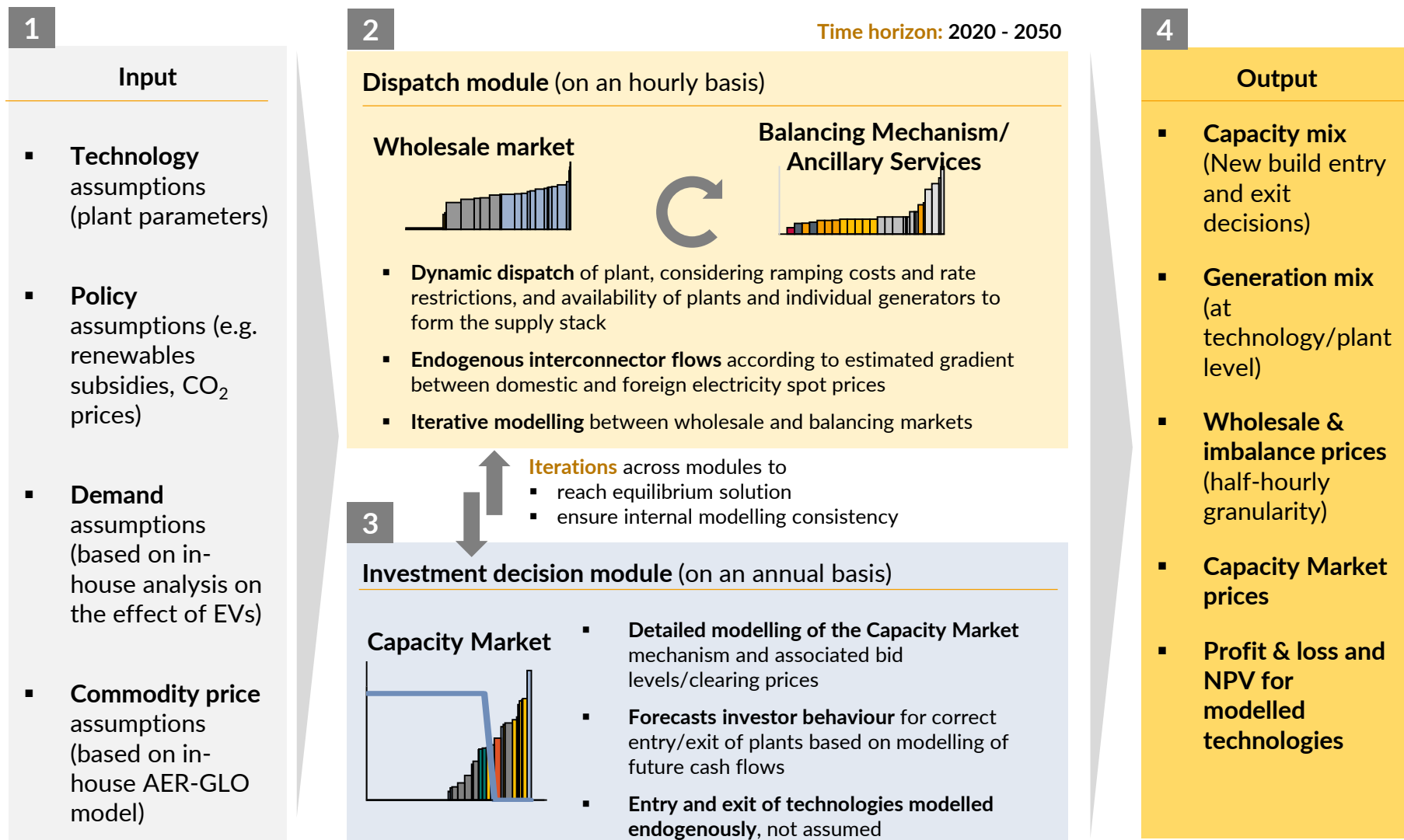
Modelling granularity

- Aurora's EU model currently covers 15 regions
  - 10 regions are modelled at the level of individual plants
  - 5 regions aggregate plants into technology classes
- Even in aggregated regions, a single technology class may contain several discrete technologies (e.g. high/mid/low merits CCGT)
- Bi-directional interconnector flows are determined by power price differentials between countries accounting for ramping restrictions, imperfect market integration and flow rate change costs



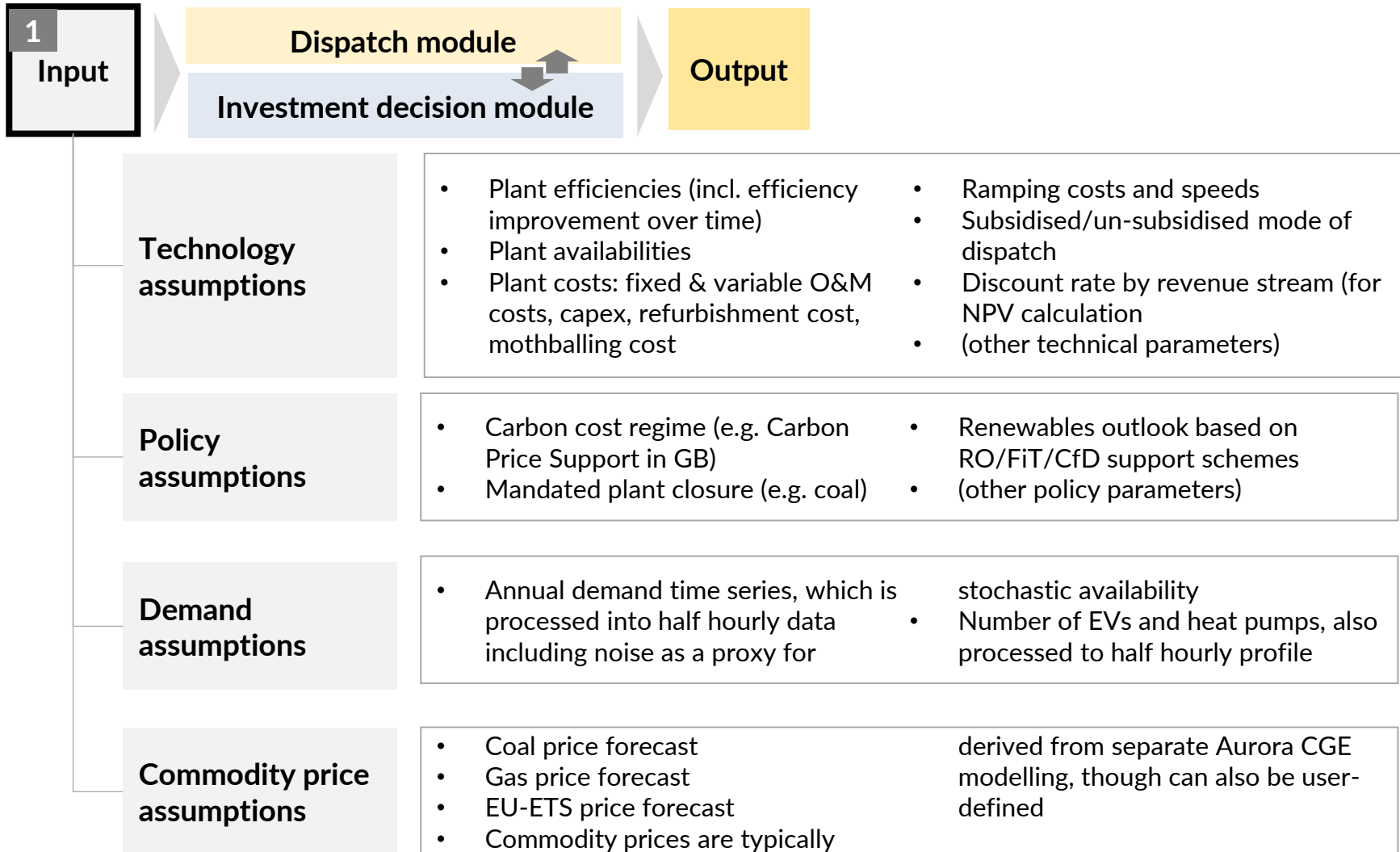
\*Note: sizes and lengths of interconnectors are for visual representation only, illustrative and are not to scale

# The model iterates between dispatch and investment decision to find an equilibrium set of prices and capacities

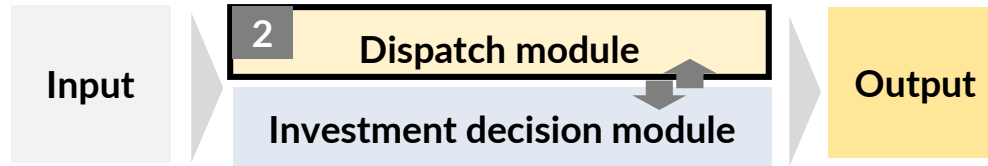


1. See Appendix 1 for further details of the modelling methodology

# Input assumptions include technology, policy, demand and commodity prices

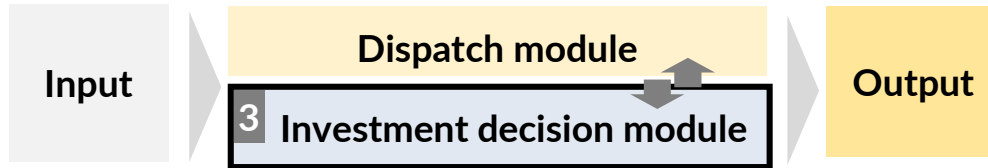


# Based on user-defined inputs, the dispatch model optimizes plant behaviour to minimize costs



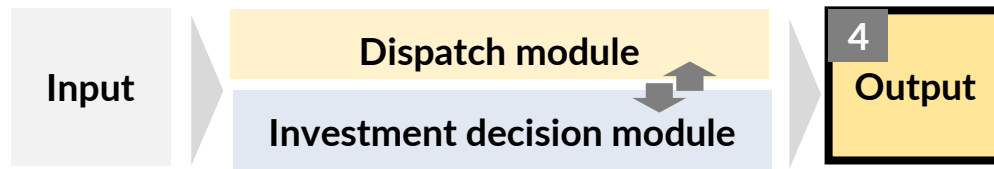
- Regional dispatch is optimized to minimize costs while accounting for:
  - Gross production and demand, including losses
  - Interconnector imports and exports
  - Ramping constraints
  - Loss of load
  - Spilled power
  - Plant availability and outages
  - Any additional user-defined constraints (e.g. emissions)
- Costs include
  - Capex, fixed and variable
  - Ramping
  - Spill and loss of load
  - Mothballing and refurbishment

# Capacity investment decisions are based on plant economics



- In regions like GB which have a Capacity Market:
  - Annual procurement targets are set by the user
  - The model finds the cheapest plants to meet the target de-rated capacity and outputs a Capacity Market price
  - Already existing plants receive 1-year contracts
  - New building plants can receive multi-year contracts
  - Each technology has a specific de-rating factor (i.e. how much can 1MW of each tech count towards the target)
  - The model iterates between the dispatch and investment decision modules until it reaches a consistent, equilibrium set of prices and capacities such that each asset is just able to make its required level of return

# Input assumptions include technology, policy, demand and commodity prices



<p><b>Annual data (plant-level)</b></p>	<ul style="list-style-type: none"> <li>Capacity details</li> <li>Short-run marginal cost</li> <li>Capture price</li> <li>Production (net and gross)</li> <li>Fuel use and CO2 production</li> <li>Fraction of capacity curtailed</li> <li>Wholesale, balancing and capacity market revenues and profits</li> </ul>
<p><b>Annual data (regional level)</b></p>	<ul style="list-style-type: none"> <li>Total capacity</li> <li>Demand and embedded demand</li> <li>Baseload and peakload power price</li> <li>Energy unserved/spill</li> <li>Export and import</li> <li>Fuel and commodity prices and use</li> </ul>
<p><b>Half-hourly data</b></p>	<ul style="list-style-type: none"> <li>Plant short-run marginal cost</li> <li>Marginal plant and system marginal costs</li> <li>Wholesale and balancing prices</li> <li>Capacity margin</li> <li>Gross and net production</li> <li>Curtailement volume</li> <li>Storage and pump production details</li> <li>Energy unserved</li> <li>Transmission data</li> <li>Spread</li> <li>Embedded demand</li> </ul>

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