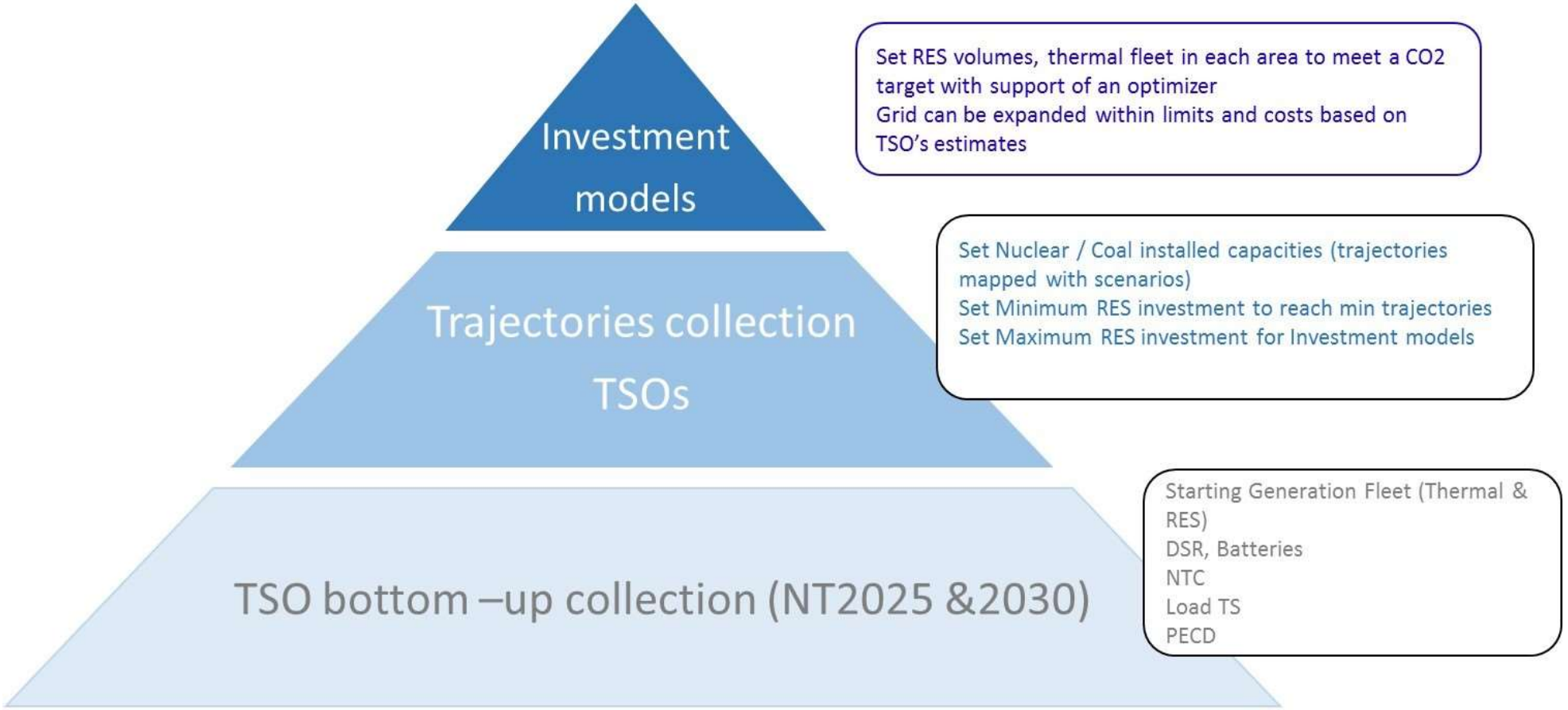
ENTSOs Scenario Building Generation side Methodology

Storyline based scenario

- Scenario are mainly storyline based
- Economic analysis is not done on a total energy model
- The shift in primary energy mix determines the demand for electricity and gas
- The electricity generation mix is then assigned capacity in order to meet demand and the decarbonization target.

Scenario Pyramid



Trajectory Collection

- The trajectory collection was a process used to capture the range of scenario each country uses in their NDP.
- The purpose of the trajectories were to set the boundary conditions for the economic model.
- These build out rates were use to frame the upper limits for the Top Down Scenarios

Technology Cost Assumptions

- The technological cost assumption were taken from primes as a reference.
- The cost of some technologies were modified to fulfil the scenarios storyline
  - Distributed Energy
    - Solar discount
    - Solar Battery system discount
  - Global Ambition
    - Offshore Wind Discount
  - National Trends
    - No Discount on any technology

Decarbonisation Target

- The decarbonization target for each scenario was set in reference to the European Commissions Long Term Strategy

Scenario	Long Terms Strategy Scenario	Emissions (Mt CO_2)	Emissions from Model (Mt CO_2)	CO_2 Price
DE2030	Linear approach from 2015 – 2040	501	393	53
DE2040	Average of 1.5° scenarios	47.5	46	100
GA2030	Linear approach from 2015 – 2040	501	411	35
GA2040	Average of 1.5° scenarios	47.5	45	80
NT2030	Baseline	620	411	27
NT2040	Average of 2° scenarios	182	145 – 190	75

Commodity Prices

- The commodity prices for Coal, Oil and Gas were taken from PRIMES.
- The price for Nuclear and Lignite were based on historical data and have very little variations over time.
- Biofuel are country dependent and based on bottom up data.
- The only parameter which was changed was the CO_2 price, resulting in a sensitivity approach
- The CO_2 price was determined by the decarbonization target. If the CO_2 price is highest the model will invest in more renewables as they will more easily remunerate their costs.

Starting point: Ex-ante addition to NT2025 capacities

	Distributed Energy	Global Ambition
	80 % of NT2020 – NT2025 growth Growth Rate Projected to 2040 from 2030 values	50 % of NT2020 – NT2025 growth Growth Rate Projected to 2040 from 2030 values
	50% of 2020-2025 growth Growth Rate Projected to 2040 from 2030 values	80% of 2020-2025 growth Growth Rate Projected to 2040 from 2030 values
	Low Trajectory	NT2030 Value Medium Trajectory at 2040
	Low Trajectory (unless stated by country)	High Trajectory (unless stated by country)
	Low trajectory	

(xxx GW) : Pan european installed capacity / (yy GW) : ex-ante addition on NT2025 capacities

CCS Investment

- CCS is an investment option only in 2040
- CCS investment was done through retrofitting current CCGT and Conventional gas plants with CCS.
- The option was not added to countries which opt out of CCS.

Grid Investment

- Grid investment was included for all scenarios except for the ‘bottom up’ scenario
- The 2030 ‘Top Down’ Scenarios start from the 2025 grid
- The boundary conditions are based on the project submitted to TYNDP 2018 up to 2030
- For the ‘Top Down’ 2040 Scenario, the upper limit for investment between 2030 and 2040 is again the TYNDP 2018 projects up to 2030

DSR – Vehicle to Grid

- Assume % of EVs are available to contribute to V2g and use this as a capacity.
  - 10:00 – 16:00
    - 50% of people can charge at work, should be left with 80% capacity at 16:00.
    - 50% x 20% = 10% of capacity can be used
  - 19:00 – 00:00
    - 70% of people participate at home, should be left with 50% capacity at 00:00.
    - 70% x 50% = 35% of capacity can be used
- Activation price is oil units without (142EUR/MWh) – therefore doesn't affect the RES investment, would only effect profitability of oil plants
- Take into account readiness of infrastructure
  - In 2030 infrastructure can accommodate 25% in DE and 10% in GA
  - In 2040 infrastructure can accommodate 70% in DE and 50% in GA

DE2030: Battery Capacity Available

- Average battery = 31.2 kWh
  - 10% capacity = 3.12 kWh
  - 35% capacity = 11 kWh

Assume DSR will be active for 2 hours on average.

  - Band 1 = 1.56 kW/EV (3.12 * 2 * 25%)
  - Band 2 = 5.5 kW/EV (11 * 2 * 25%)
- Link to a study = 11kW
- Other sources 6.24 kW – 6.6kW (MIT)(new motion)

- The final DSR capacities used are
  - 2030: Lowest of 30% of peak demand and EV capacity based on above methodology
  - 2040: Lowest of 60% of peak demand and EV capacity based on above methodology