TYNDP-2014 2030 Scenarios Building

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Reliable Sustainable Connected

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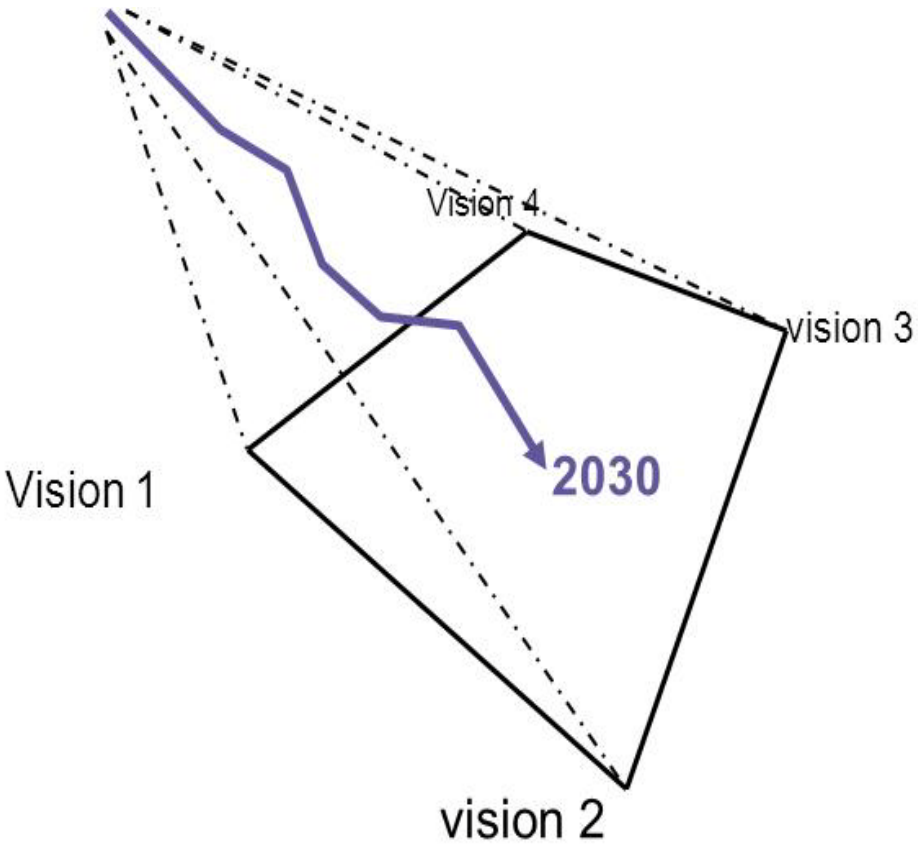
Introduction of the 4 Visions

2030 Visions: a bridge between the European energy targets for 2020 and 2050



Objectives for the visions:

- Look beyond 2020.
- Differ enough from each other
- The visions are not forecasts (no probability attached to the visions).

THE PATHWAY REALISED IN THE FUTURE FALLS WITH A HIGH LEVEL OF CERTAINTY IN THE RANGE DESCRIBED BY THE FOUR DESCRIBED VISIONS

2030 Visions: a bridge between the European energy targets for 2020 and 2050

Vision 3: "Green transition"

Vision 4: "Green revolution"

Vision 1: "Slow progress"

Vision 2: "Money rules"

Vision 3: "Green Transition"

- Favourable economic and financial conditions
- Reinforced national energy politics
- Parallel national R&D research schemes
- High CO_2 prices and low primary energy prices (IEA – WEO 2010 450 scenario)

Vision 4: "Green Revolution"

- Favourable economic and financial conditions
- European energy policy
- European R&D research scheme
- High CO_2 prices and low primary energy prices (IEA – WEO 2010 450 scenario)

Vision 1: "Slow Progress"

- Less favourable economic and financial conditions
- Reinforced national energy politics
- Parallel national R&D research schemes
- Low CO_2 prices and high primary energy prices (IEA – WEO 2010 current policies scenario)

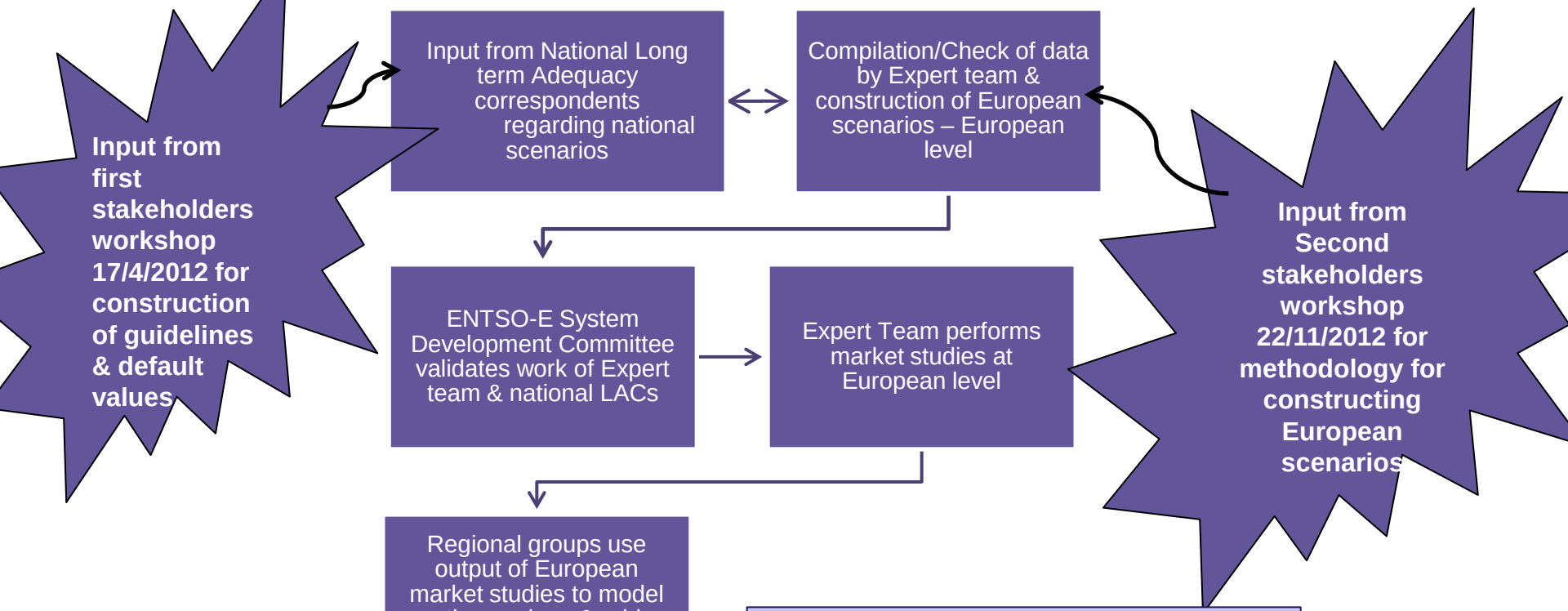
Vision 2: "Money Rules"

- Less favourable economic and financial conditions
- European energy policy
- European R&D research scheme
- Low CO_2 prices and high primary energy prices (IEA – WEO 2010 current policies scenario)

Delay of Energy Roadmap 2050

Construction process for 2030 visions

- a dedicated ENTSO-E TSO Expert Team
  - **Consistency checks of Visions 1 “Slow Progress” and 3 “Green Transition”**
  - **Quantification of the two European top down 2030 Visions 2 “Money Rules” and 4 “Green Revolution”**



Inputs request for visions:
4th Dec 2012 – 7th Jan 2013

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Market modelling for long-term grid development

Inputs

- Multiple scenarios with hypotheses regarding
  - Demand profile
  - Generator characteristics
  - Other generation profile
  - Wind and Solar Profiles
  - Transfer Capacities
  - Reserve
  - Exchanges to Rest of World profile
  - Fuel and CO_2 prices

Modelling

- Chronological Unit Commitment Economic Dispatch model
- Hourly model
- Each country is a single market node
- Minimise the system cost (fuel bill/operating costs) subject to constraints such as must-run, reserve, generator capabilities.

Outputs

- National Balances
- Market Node Marginal costs
- Hourly generation pattern for each generator
- System/Fuel cost
- Fuel consumption by fuel type
- CO_2 emissions

Building of the Bottom-up Visions (“Slow Progress” & “Green Transition”)

Methodology for data collection

- **In order to improve the scenarios for future grid development needs, stakeholders were consulted regarding probable tendencies towards 2030 (workshop 17/4/2012). The inputs were used to establish default values and general common framework**

- **National data (data for vision 1 “Slow Progress” and 3 “Green Transition”) provided by Long-term Adequacy Correspondent (LAC) should be coherent with the general common framework set by ENTSO-E => consistency checks**

- **The top-down approach for visions 2 “Money Rules” & 4 “Green Revolution” requires that they are established at a centralized European level with visions 1 and 3 data as a starting point**

Vision 1 “Slow Progress” : input based on stakeholders workshop 17/4/2012

Demand

- the yearly growth rate of electricity demand in vision 1 should take into account the following:
  - **The yearly change rate of electricity demand between 2010 and 2030 should be between +0.5%/year and -0.5%/year** although rates between +1%/year and -1%/year are still acceptable.
  - A minimum level of electric vehicles (between 5 and 15%). **Proposed default penetration level is 5% of passenger vehicles.**
  - A change in electricity consumption due to a minimum level of heat pumps (between 1 and 10%). **Proposed default penetration level is 1% of households.**
- No additional peak shaving**. Proposed default value is thus 0% of peak load**
- *DEVIATIONS* : LACs should explain in a comment why deviations from the given guideline are acceptable.

Similarly supply data for Vision 1 and demand/supply data for Vision 3 are bounded according to stakeholders inputs (hidden slides)

Consistency checks to assess compliance with general common framework set using stakeholders inputs

- **2 consistency checks for EU2020 at National level**
- **21 consistency checks for national Vision 1 "Slow Progress" & 3 "Green Transition":**
    - **13 consistency checks at National level**
    - **8 consistency checks at ENTSO-E & EU level**

Examples on consistency checks at EU level:

Consistency check 1 (Vision 1): the yearly growth rate of electricity demand between 2010 and 2030 should be between +0,5%/year and -0.5%/year although growth rates between +1%/year and -1%/year are still acceptable

Consistency check 2 (Vision 1) & Consistency check 6 (vision 3): the minimum penetration levels of electric vehicle and heat pumps put forward by stakeholders

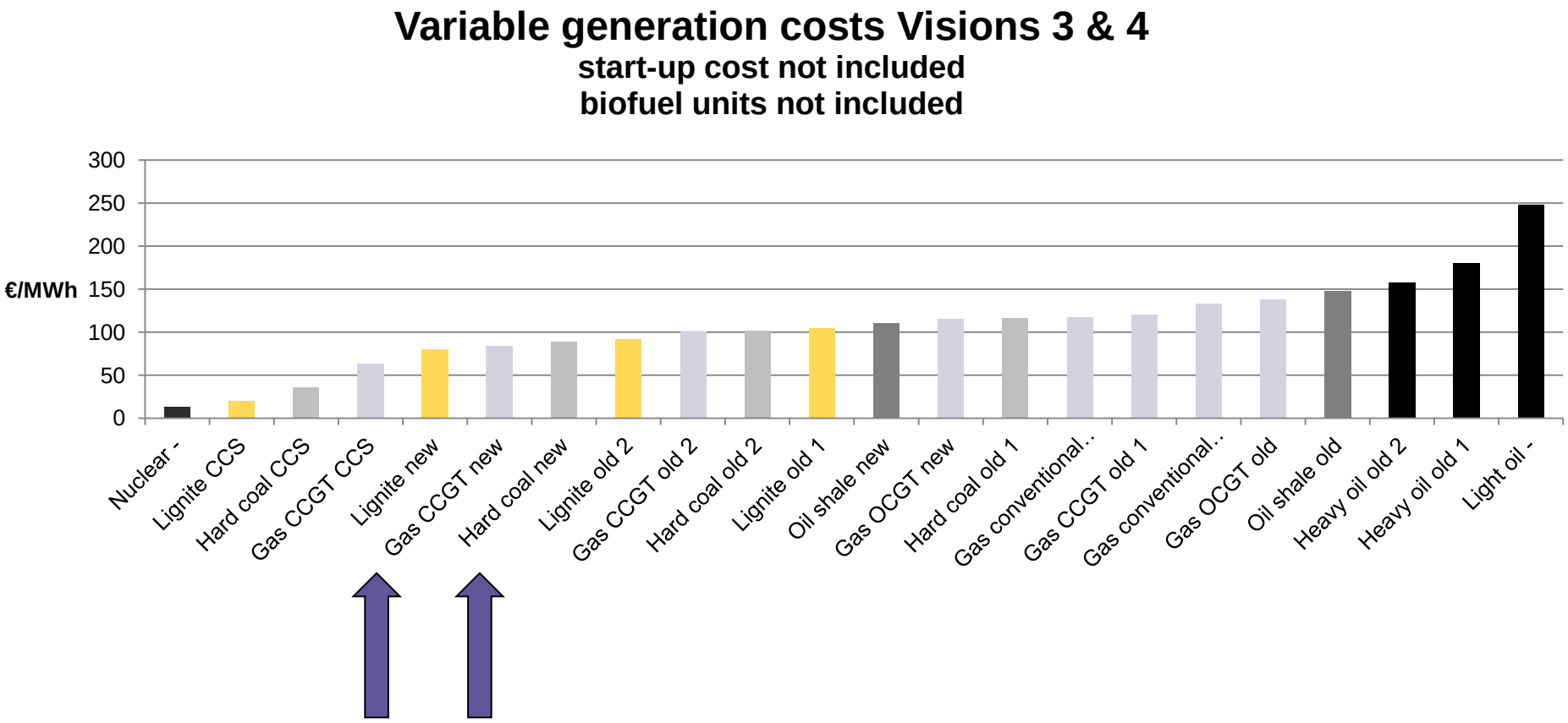
Consistency check 11 (Vision 1) & Consistency check 16 (vision 3): values per type of RES checked at European level

Construction of the Top-down Visions (“Money Rules” & “Green Revolution”)

Philosophy: Construction of the European Top-Down visions 2 “Money Rules” & 4 “Green Revolution”

- Similar to data collection, in order to improve the scenarios for future grid development needs, stakeholders were consulted regarding the construction methodology (workshop 22/11/2012). The inputs were used to establish default values and general common framework
- From Vision 1 “Slow Progress” to Vision 2 “Money Rules” and from Vision 3 “Green Transition” to Vision 4 “Green Revolution” the objective is to optimize thermal generation capacities taking into account the probable increase of market-oriented transmission interconnection capacities (GTCs – Grid Transfer Capacities) all over Europe
- Reduction of expensive thermal generation units (economically unviable) is performed in a iterative (in case of danger on security of supply) and systematic way

Information on Vision 4: Merit Order



High CO_2 prices (93 €/ton) result in a swap in merit order for gas and goal units when compared with Visions 1 & 2 (31 €/ton)

Methodology: Step-by-step construction

- Step 1: Hydro & Load Modification
  - Data Derivation (start with data for visions 1 & 3 + additional parameters for scenarios building)
  - Market Simulations
- Step 2: One step GTC Increases
  - Market Simulations & Adequacy Analyses
- Step 3: On step Thermal Capacity Reduction
  - Market Simulations & Adequacy Analyses

Step 1: Hydro and load data modification (Vision 4)

- Load data: structural growth rate for Vision 3 was taken into account to construct the base profile for Vision 4 + the necessary addition of profiles for peak shaving, EV and heat pumps specific for Vision 4 (if not specified by LACs default values are used)
- Hydro data: for hydro countries (total installed hydro > 15% of NGC – National Generation Capacity) additional information provided by LACs was taken into account when deriving their hydro capacities for Vision 4 (centralized storage added); for non-hydro countries decentralized storage capacity in Vision 3 is reduced or eliminated according to its relationship with the total amount of additional centralized storage; overall there was more centralized storage added than decentralized storage being eliminated
- For adequacy analysis: a week in the load curve derived as stated above is modified to reflect 1 in 20 worst case (high demand); for hydro the hydro curve derived above was modified to reflect a dry year condition

Step 2: One step GTC increases

- Goal: to allow for possible thermal capacity reduction in the next step with possible GTC increases based on market signals
- Simulations are run independently and a list of possible candidate links for GTC increase was provided by each of the tools
- GTC indicators are calculated independently: marginal costs differences between market nodes (criterion: > 2 €/MWh)
- Reinforcements of existing interconnections plus some new potential ones are considered
- The default increase of GTC in MW are 0.7 and 1.4 GW for small and big countries respectively (according to their annual demand)
- Besides market-oriented criteria the Barcelona rule is also considered (10% NGC requirement)
- <u>For RG studies: the increases in their regions will be replaced by real projects based on more in-depth assessments including system security of supply indicators</u>

Step 3: One step thermal capacity reduction

- Goal: to propose a one step sensible reduction of less economic-viable thermal units after GTC increases
- Market simulations are run independently and results are compared and checked against each other
- Adequacy analyses are performed giving indicators LOLE and ENS
- Other reduction indicators (EFPH and CBA indicator) are provided by through market simulations
- All countries with non-zero LOLE (respectively also ENS) values are exempted from reduction
- The profitability of all new base-load and new mid-merit thermal units is assessed using the CBA indicators (for Vision 4: mark-up on marginal costs is applied to mimic difference between short term variable costs and real market prices in order to recover partially the CAPEX for these units)
- The capacity of the new units with negative CBA indicators or insufficient EFPH (3000 hrs for hard coal, 2000 hrs for the rest) is reduced by a default value of 20%
- Other units hard coal (old) and gas (conventional, CCGT old) are also reduced in capacity according to the 20% default rule
- The actual reduction in volume of these units is adapted taking into account the bio-fuel presence, must-run obligations and unit size
- Another round of adequacy analyses is conducted to confirm that our one step reduction would not jeopardize the generation security of supply

Pros & Cons of current methodology

Pros:

- First time that an overall assessment of the consistency of data is explicitly checked through a number of consistency checks
- Methodology (default values and common framework) consistent and compliant with discussions and inputs from previous stakeholders' workshops
- Methodology allows to take into account country specific characteristics that cannot be translated in optimization criteria.
- Methodology allows to add an European layer on top of national specificities but only in a one step way
- Time and resource constraints from TSOs can be respected (few iterations)

Pros & Cons of current methodology

Cons:

- A new process with one step to form the European layer is not enough:
  - Thermal capacity is reduced sensibly rather than “optimized”
  - Some bottom-up data get carried over to top-down scenarios, e.g. must-run obligations are kept from bottom-up scenarios
  - CCS restricted to limited number of countries even in Vision 4 (how commercialized can it be by 2030 in an optimistic scenario?)
  - Coal plants still dominate in “gas-scenarios” (Visions 3 & 4): unrealistic?
- A new methodology is used with a lot of new default values and indicators:
  - 2 €/MWh might be too low to justify investment for some interconnections
  - 93 €/ton of CO2: unrealistically high? (IEA 450 Scenario, year 2035)
- Limitation on the availability of resources and tools to perform very complex procedure:
  - No global RES optimization

Feedback & Suggestions on Methodology Improvement

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