E-Mobility integration

Project V2G-Strategy

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Core research questions

- Economical assessment of various charging and discharging strategies
- Impact of high penetration rate of electric vehicles (EVs) on low and medium voltage grids
- Efficient integration of electric vehicles (EVs) in an (Austrian) electricity System

Content

- 1. Classification of charging/discharging concepts for e-mobility
- 2. Analysed applications/use cases
- 3. Methodology used within the project
- 3. Results
  - Participation of EVs in positive frequency reserves markets in Austrian control zone
  - Impact of various charging strategies on low voltage grids
- 4. Recommendations for an efficient integration of EVs in an (Austrian) electricity system

1. Classification of Use cases for e-mobility

Use cases for e-mobility are subdivided into two main categories:

- Applications, which refer to the mobile lifetime of batteries and consists of different charging (G2V) and discharging (G2V) strategies that are subdivided into the following:
  - Uncontrolled charging strategy
  - Controlled charging/discharging concepts: These strategies are based on schedules that define the charging and discharging times of vehicles for a certain period of time.
  - Intelligent charging/discharging strategies: These concepts, due to real-time energy system information (market and grid), make feasible the defining of a schedule from different particular target functions, which fit for each system status.
- Applications, which takes into account the reusing of batteries after their automotive retirement.

2. Analysed applications in details

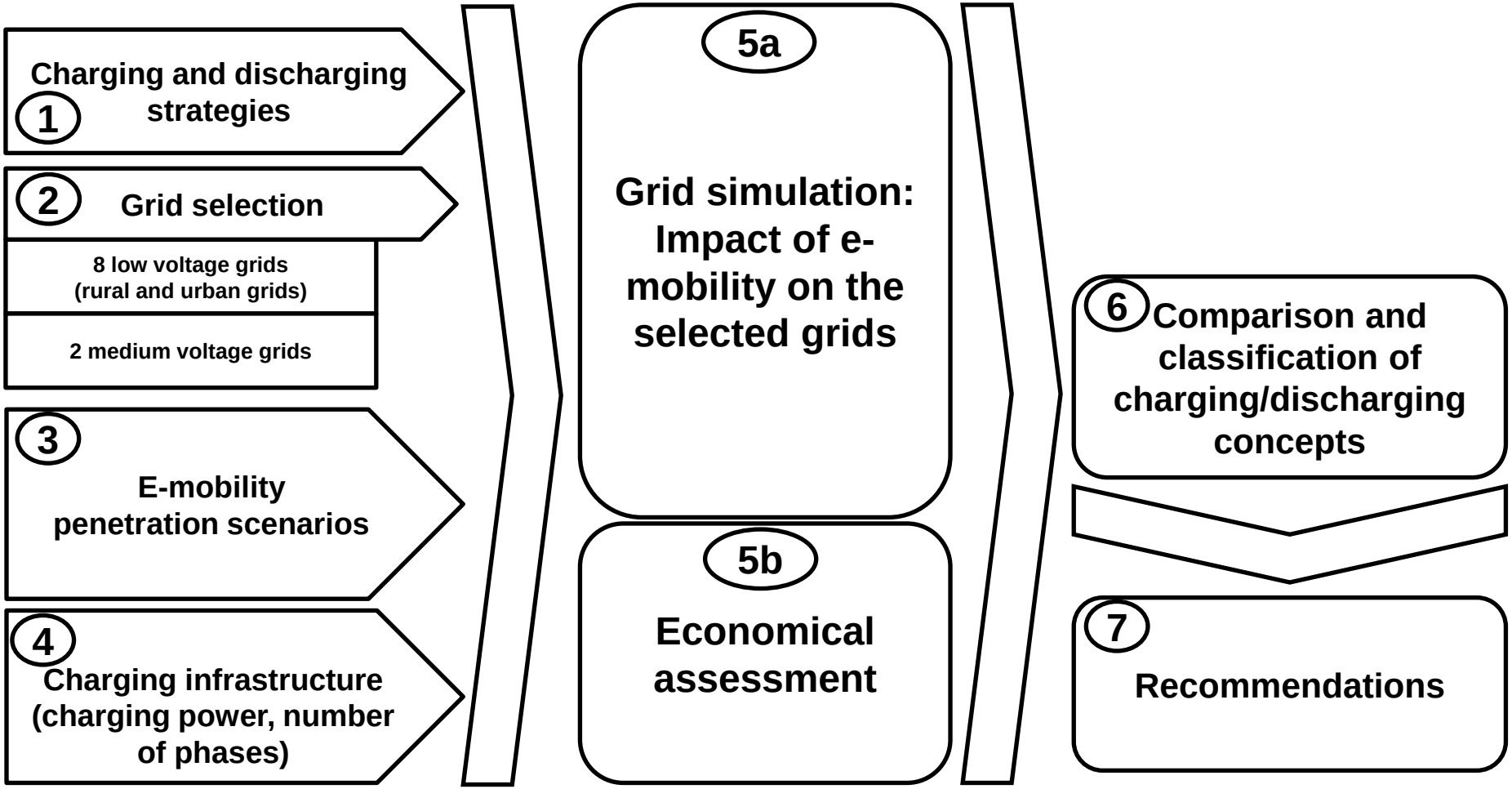
Use cases

- Uncontrolled charging (stage 1)

- Controlled charging (stage 2a, 2b, 2c)
  - Market based charging/discharging strategy:
    - Cost minimising charging (stage 2a)
    - Participation of EVs in manual and automatic frequency reserve markets: Charging and discharging

  - Generation- and load-based charging/discharging strategy (stage 2b, 2c)
    - Shifting the charging times according to the consumption profiles
    - charging from PV generated electricity at home
    - Integration of Evs in balancing groups

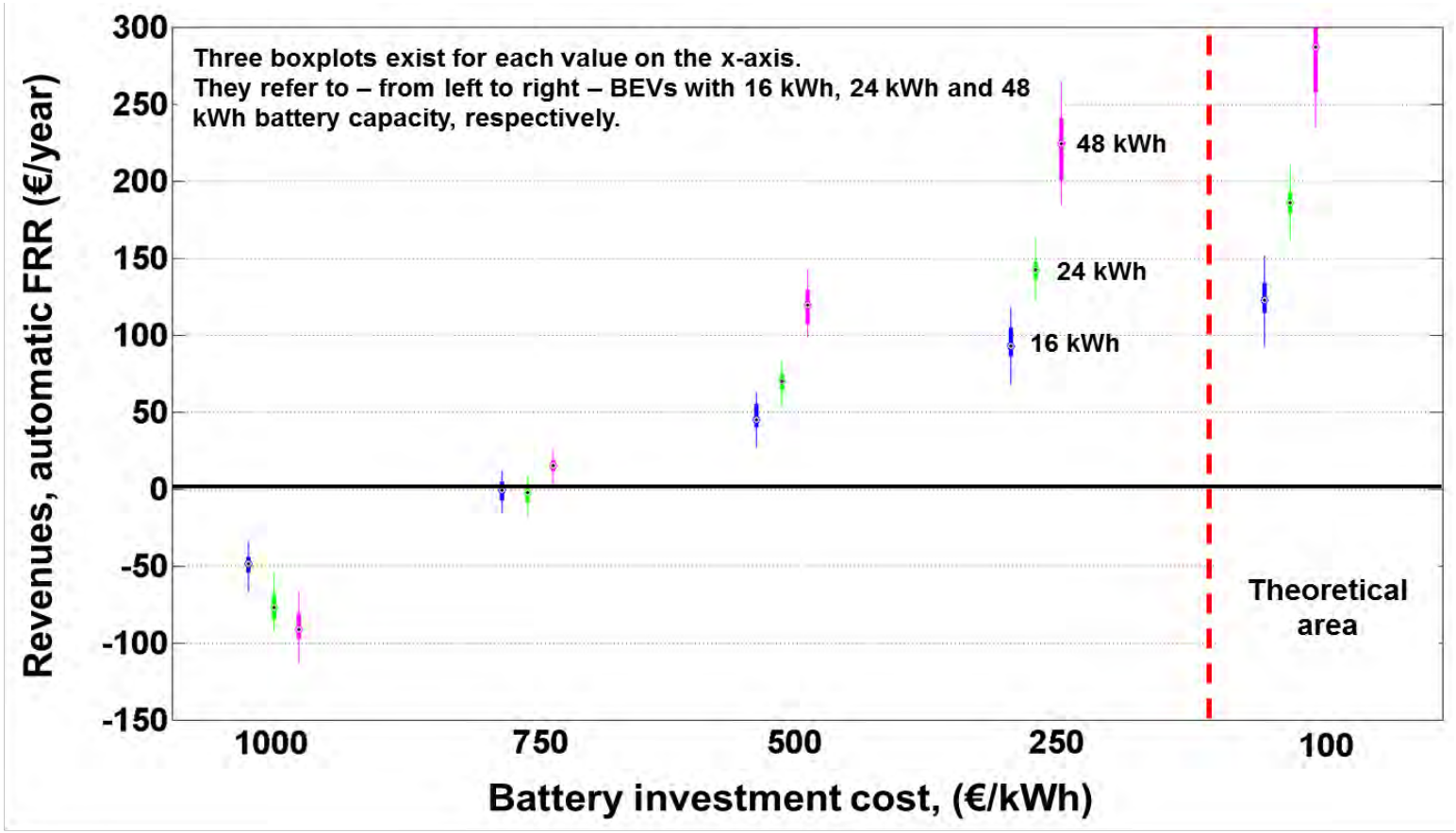
3. Methodology used within the project



3. Results

Participation of EVs in frequency reserve markets

- Participation in positive <u>automatic</u> FRR market

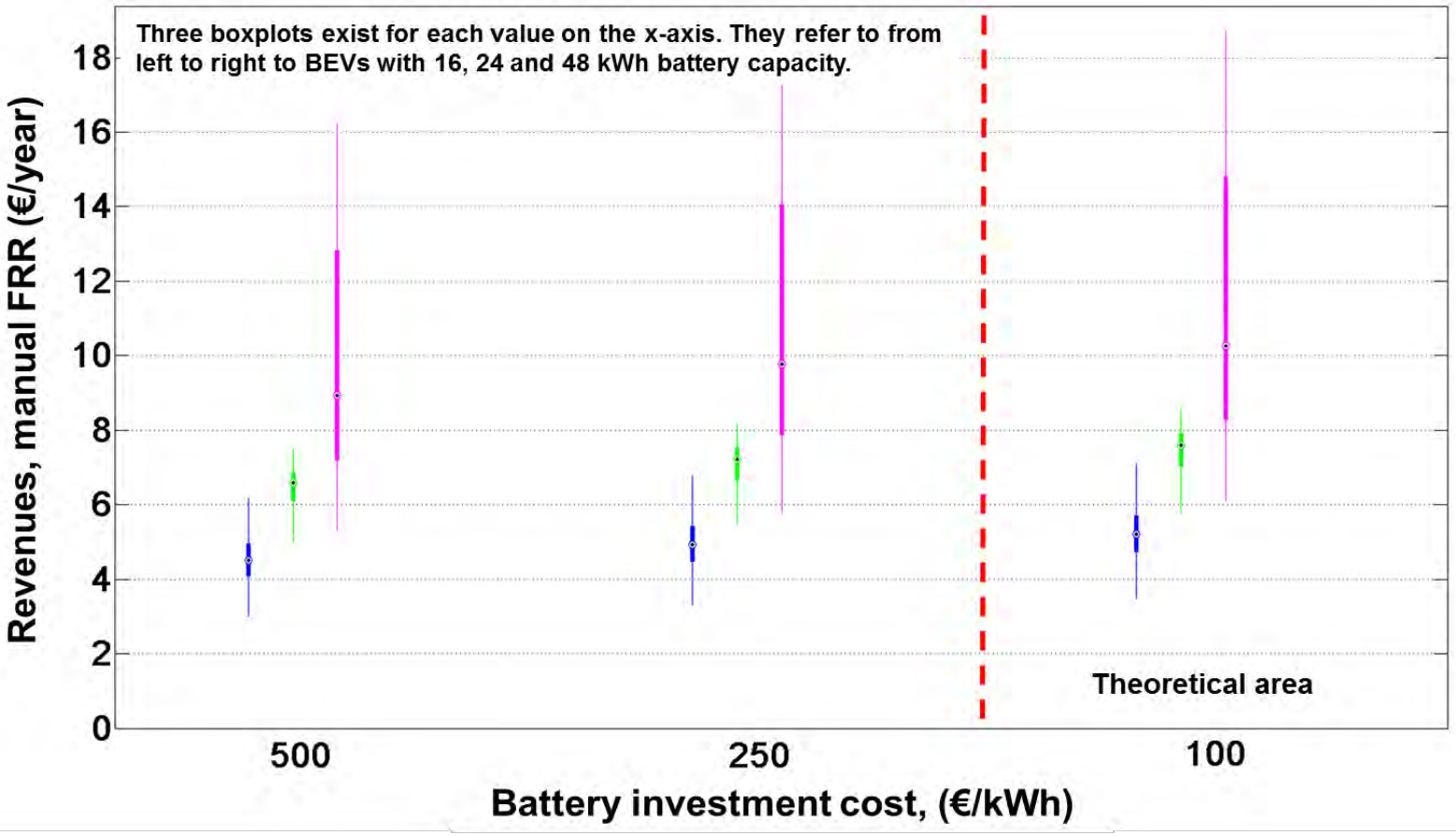


- Revenues between 45 and 119 € per vehicles and year

3. Results

Participation in frequency reserve markets

- Participation in positive manual FRR market

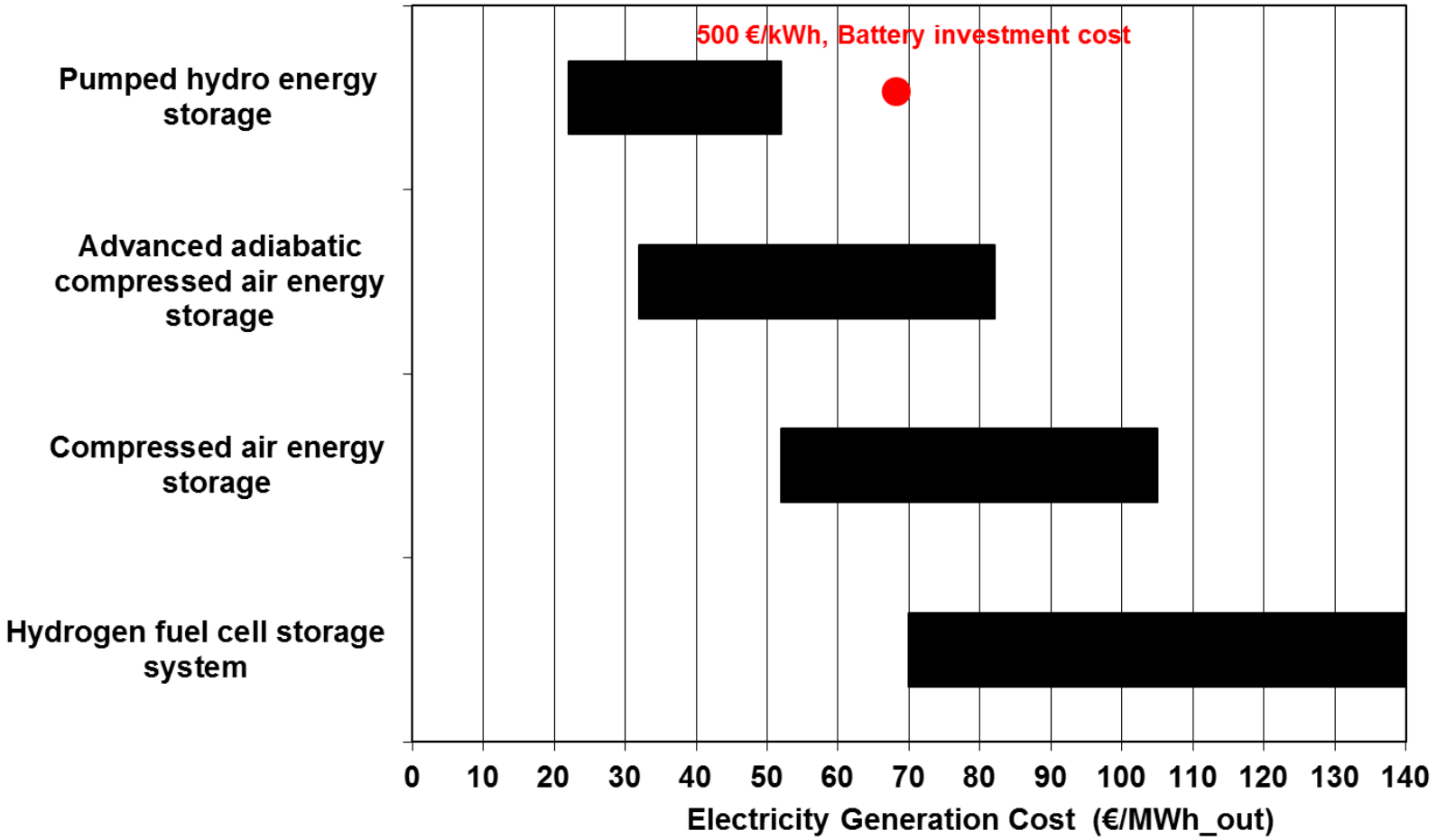


- Revenues are between 4 and 9 € per vehicle and year (Battery investment cost = 500 €/kWh).

3. Results

- Participation in frequency reserve markets

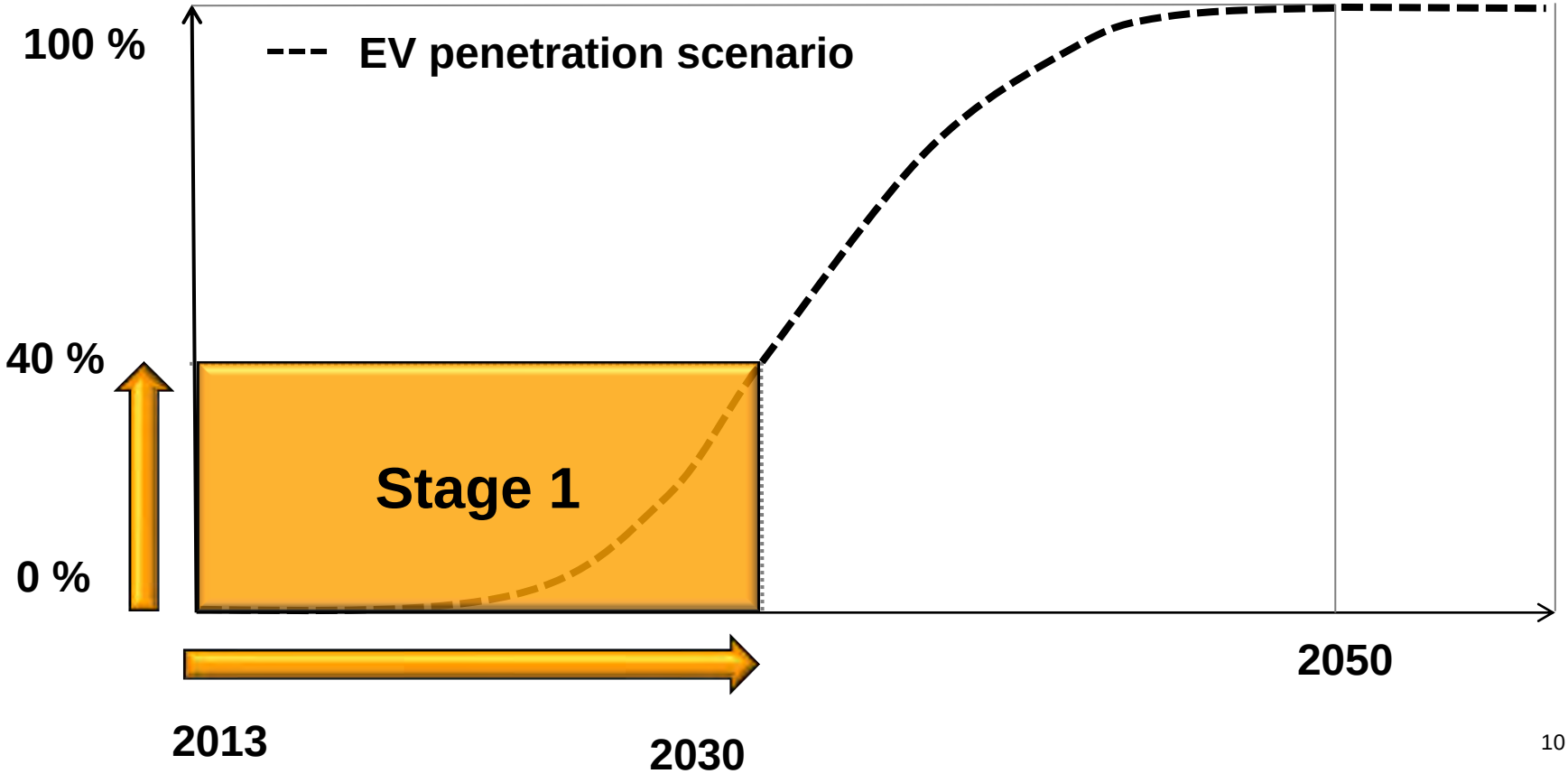
➢ Can the mentioned revenues be realised in APG control zone? A comparison with other competitors



3. Results

- Impact of charging strategies on low voltage grids: Uncontrolled charging

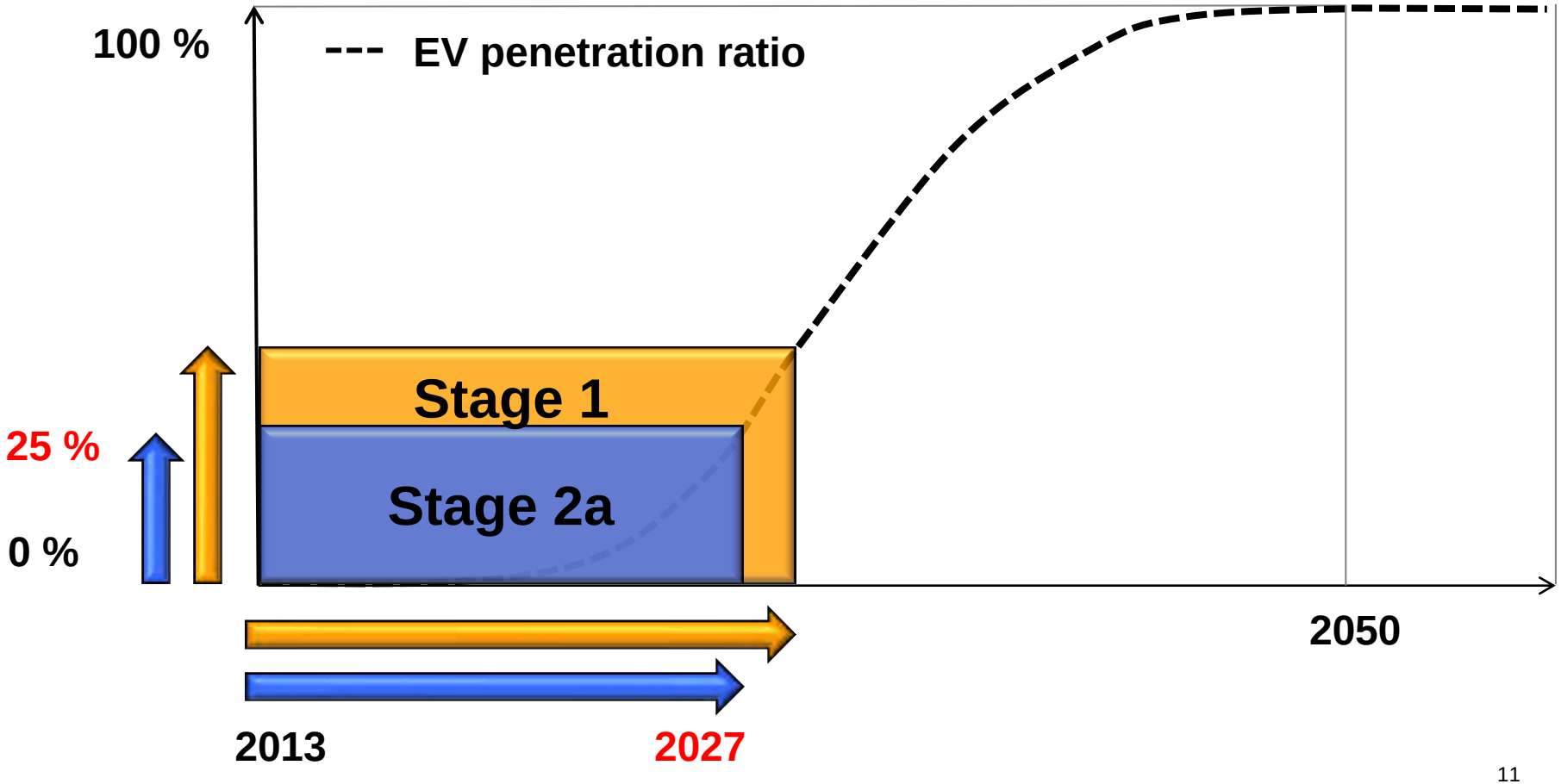
➢ As from 2030 (> 40 % penetration ratio): Comprehensive reinforcement activities within LV-grids due to the continuing of uncontrolled charging concept



3. Results

- Impact of charging strategies on low voltage grids: Controlled charging

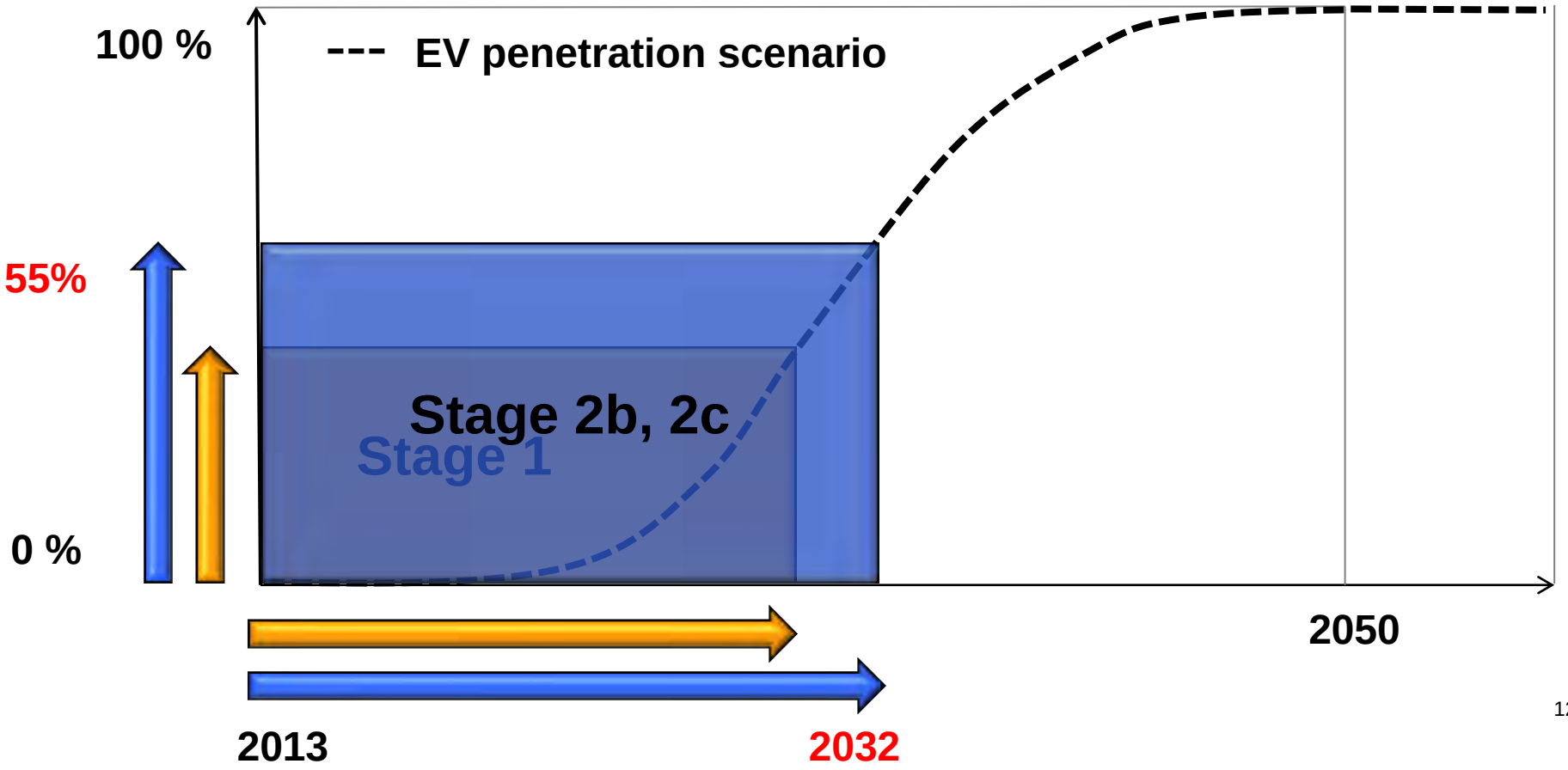
  - Cost minimising charging: High coincidence factor => Decreasing of the penetration ratio



3. Results

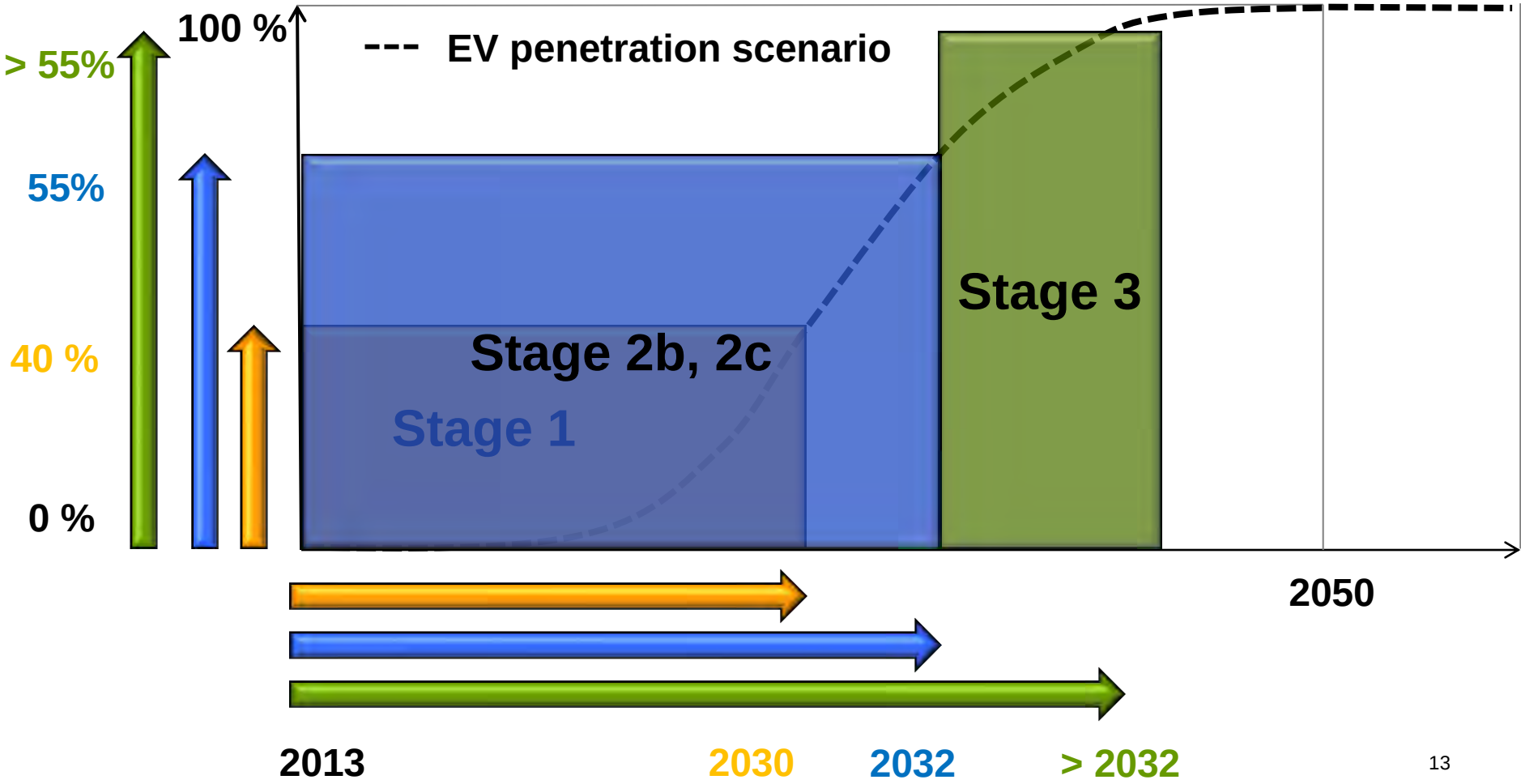
- Impact of charging strategies on low voltage grids: Controlled charging

  - Load-based charging concept: (Charging of vehicles between 00:00 a.m. and 06:00 a.m.): Small increase of charging costs in compare to the cost minimising charging



3. Results

- Impact of charging strategies on low voltage grids: Intelligent charging



4. Recommendations for an efficient integration of EVs in an (Austrian) electricity system

- **Three phases connecting of EVs to low-voltage grids with low charging power is recommended according to an efficient usage of grid reserves**
- **Cost minimising charging is characterised by a high coincidence factor and unnecessary consumption of grid reserves.**
- **Load-/generation-based charging concepts must be realised with a low coincidence factor with the beginning of EV penetration.**
- **However, it is recommended to begin with preparations needed for intelligent charging. The realisation of intelligent charging must be conducted even if appropriate functionalities exist within the grids (e.g. by smart grids)**
- **The V2G concepts cannot be recommended according to the current market conditions and battery degradation costs.**

Thank you for your attention

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