AUSTRIAN ENERGY AGENCY

# Austrian Energy Agency

## Modelling the development of vehicle fleets with alternative propulsion technologies

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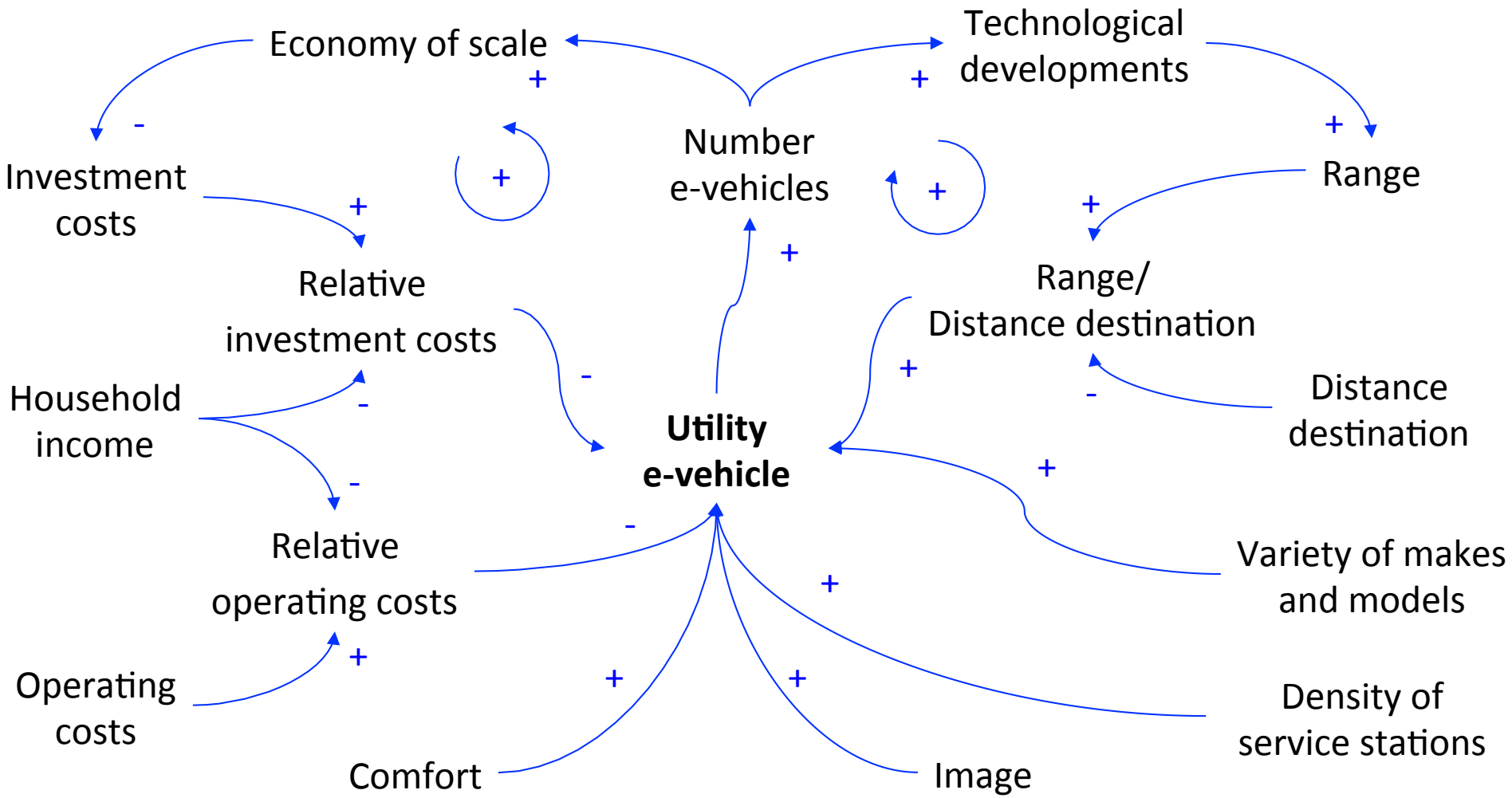
# Background (1/2)

- Currently the electrification of power trains is an important topic.
- Decision makers hope that BEV and PHEV will be able to solve the problems of climate change and peak oil while maintaining today's level of motorised individual mobility.
- The Austrian Climate and Energy Fund has invested substantial resources into e-mobility related research and demonstration projects.
- The budget was 40 Mio. € in 2008 and 60 Mio. € in 2009 and 2010.

# Background (2/2)

- Up to date five e-mobility model regions have been funded by the Austrian Climate and Energy Fund: Vorarlberg, Salzburg, Vienna, Graz and Eisenstadt.
- Nevertheless some experts still have doubts and worry about rebound effects and the cannibalisation of public transport.
- A simulation model for the development of vehicle fleets with alternative propulsion technologies was created by the Austrian Energy Agency.

# Qualitative Analysis of the utility of e-vehicles



# Quantitative modelling of the car fleet developments (1/4)

- SERAPIS (Simulating the Emergence of Relevant Alternative Propulsion technologies in the car and motorcycle fleet Including energy Supply) is a dynamic fleet model.
- SERAPIS relies on stock flow modelling and is programmed in the Systems Dynamics software environment Vensim® (www.vensim.com).
- A multinomial LOGIT model is used to calculate the propulsion technologies chosen for the vehicles to be replaced in each time step.

# Quantitative modelling of the car fleet developments (2/4)

- SERAPIS differentiates between
  - electric, hybrid & internal combustion engine for cars &
  - electric and internal combustion for motorcycles.
- The calculation of electricity consumption and supply requirements is included in SERAPIS.
- SERAPIS has been used in a series of studies, e.g.
  - a pre-feasibility study for the Austrian Federal Ministry for Transport, Innovation and Technology,
  - an evaluation of the Austrian Energy Strategy or
  - a study concerning visions of electricity consumption until 2050 for the Austrian electricity industry.

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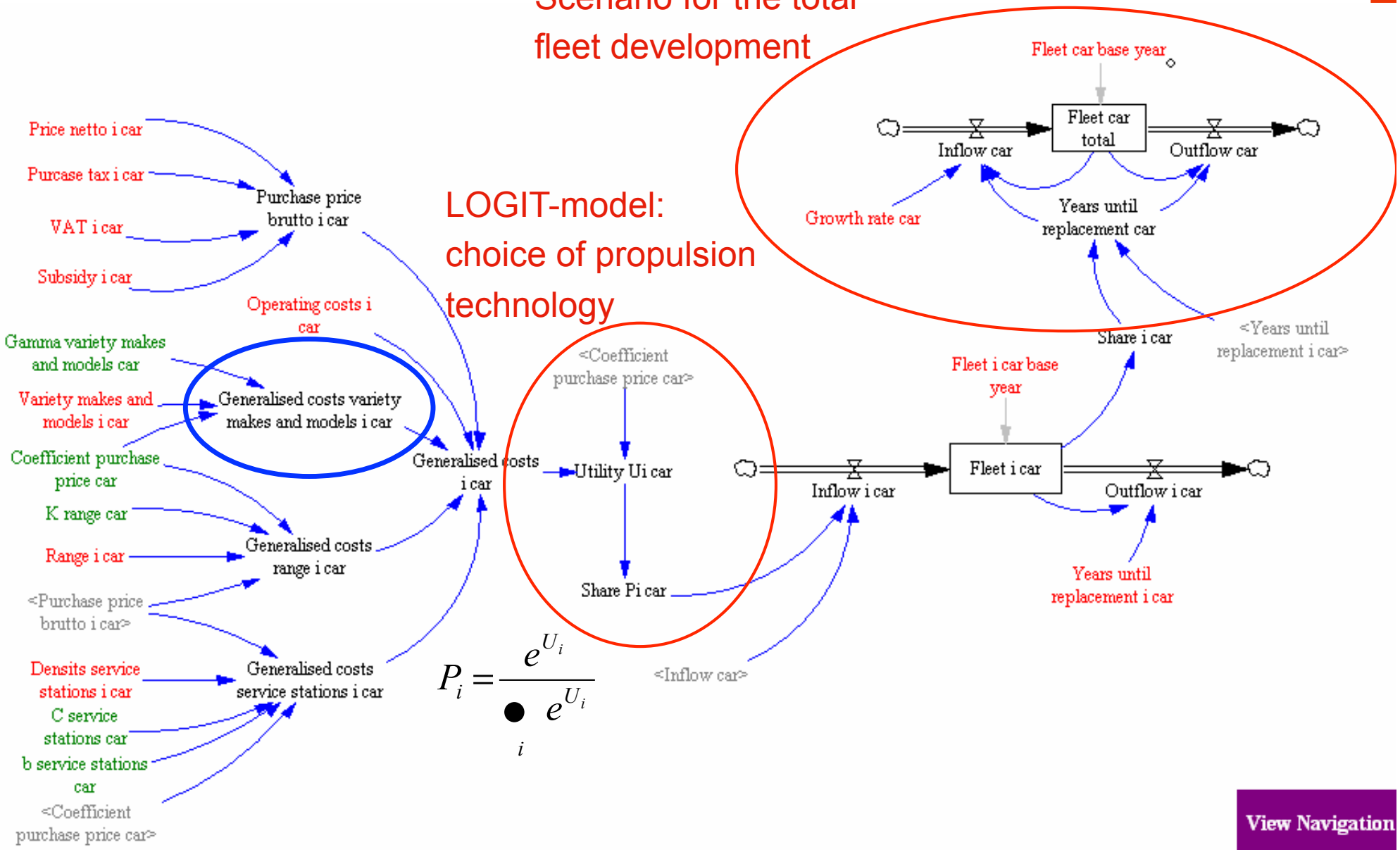
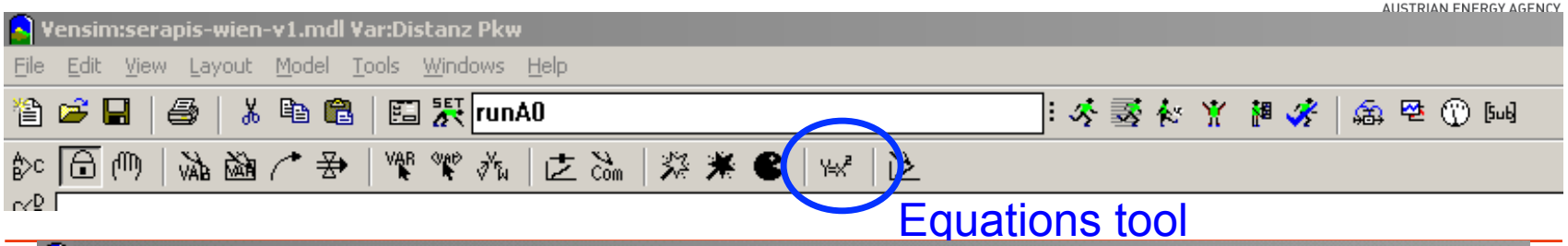
# Scenario for the total fleet development

## LOGIT-model: choice of propulsion technology

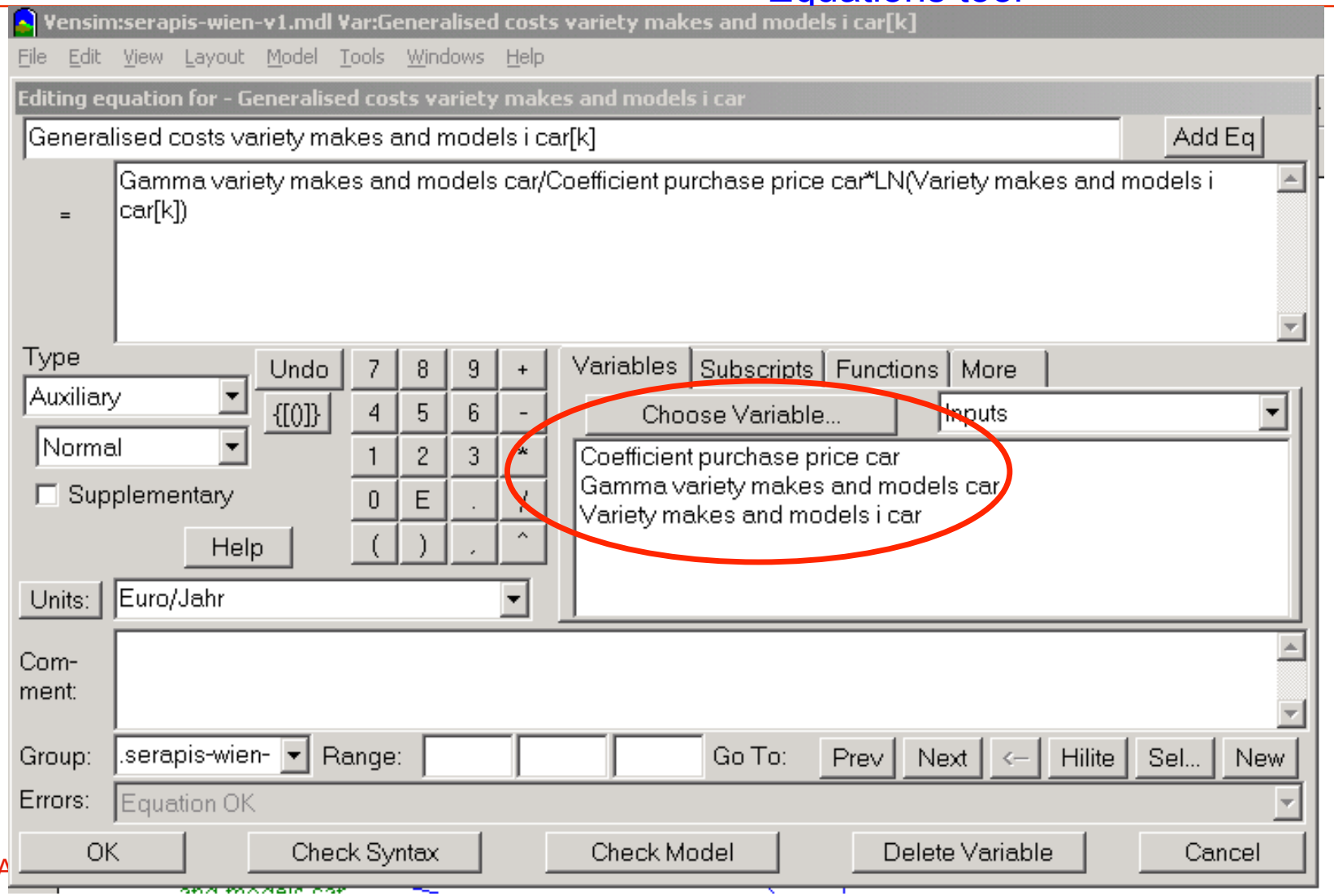



View Navigation

# Vensim®




Equations tool



# Study “E-mobility rollout in Austria”: Scenario definition

- Scenario A0: practically no supportive actions.
- Scenario A5: support for the build-up of the service station network and research into e-propulsion.
- Scenario A7: in addition to A5 decrease of purchase tax for hybrid cars and increase for ICE cars.
- Scenario A1: in addition to A7 direct purchase subsidies of 5 % for hybrid vehicles and of 10 % for battery electric vehicles.
- Scenario A8: in addition to A1 operating costs for ICE cars are increasing at a rate of 5 % p.a.

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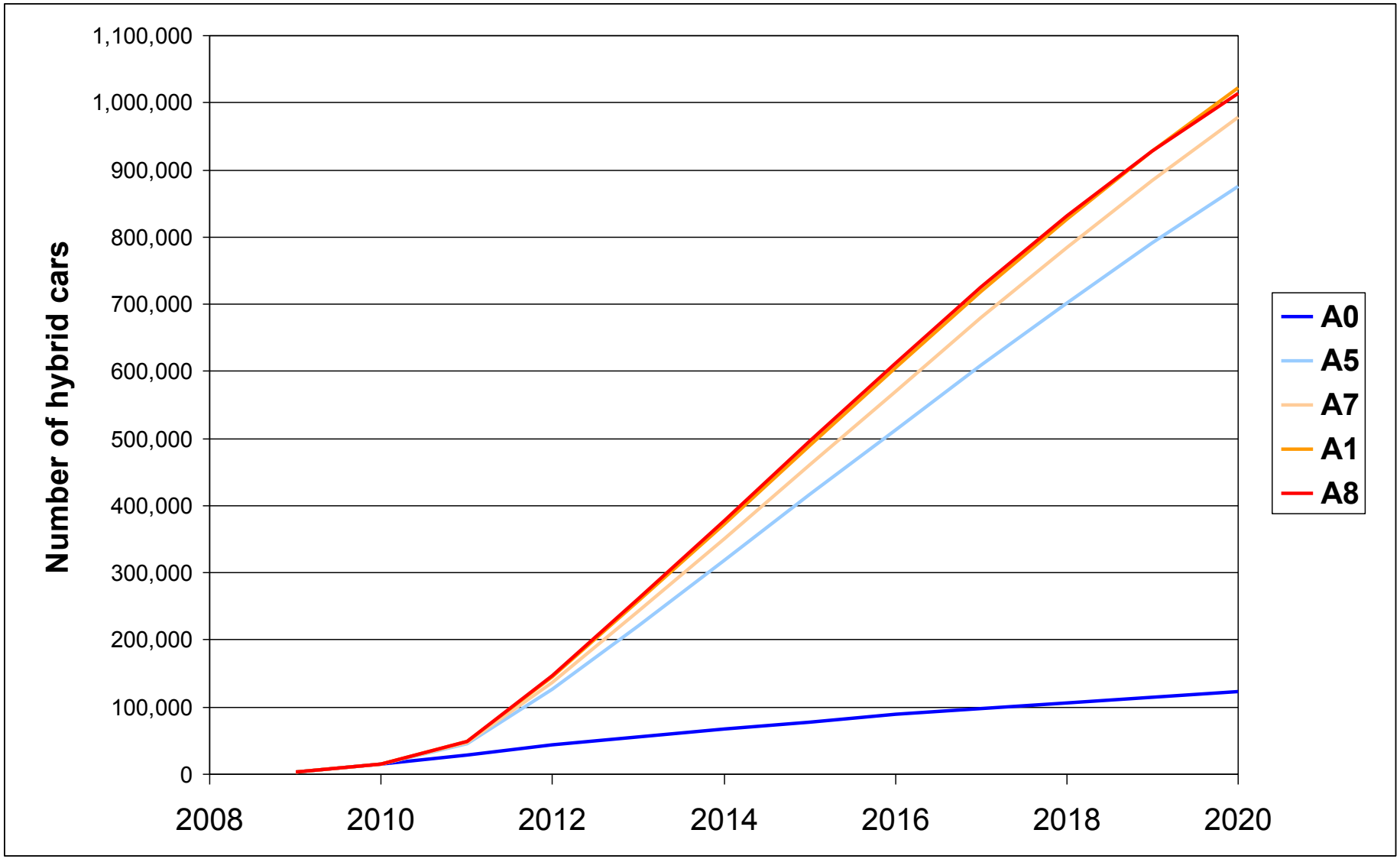
# Study “E-mobility rollout in Austria”
# Result hybrid cars



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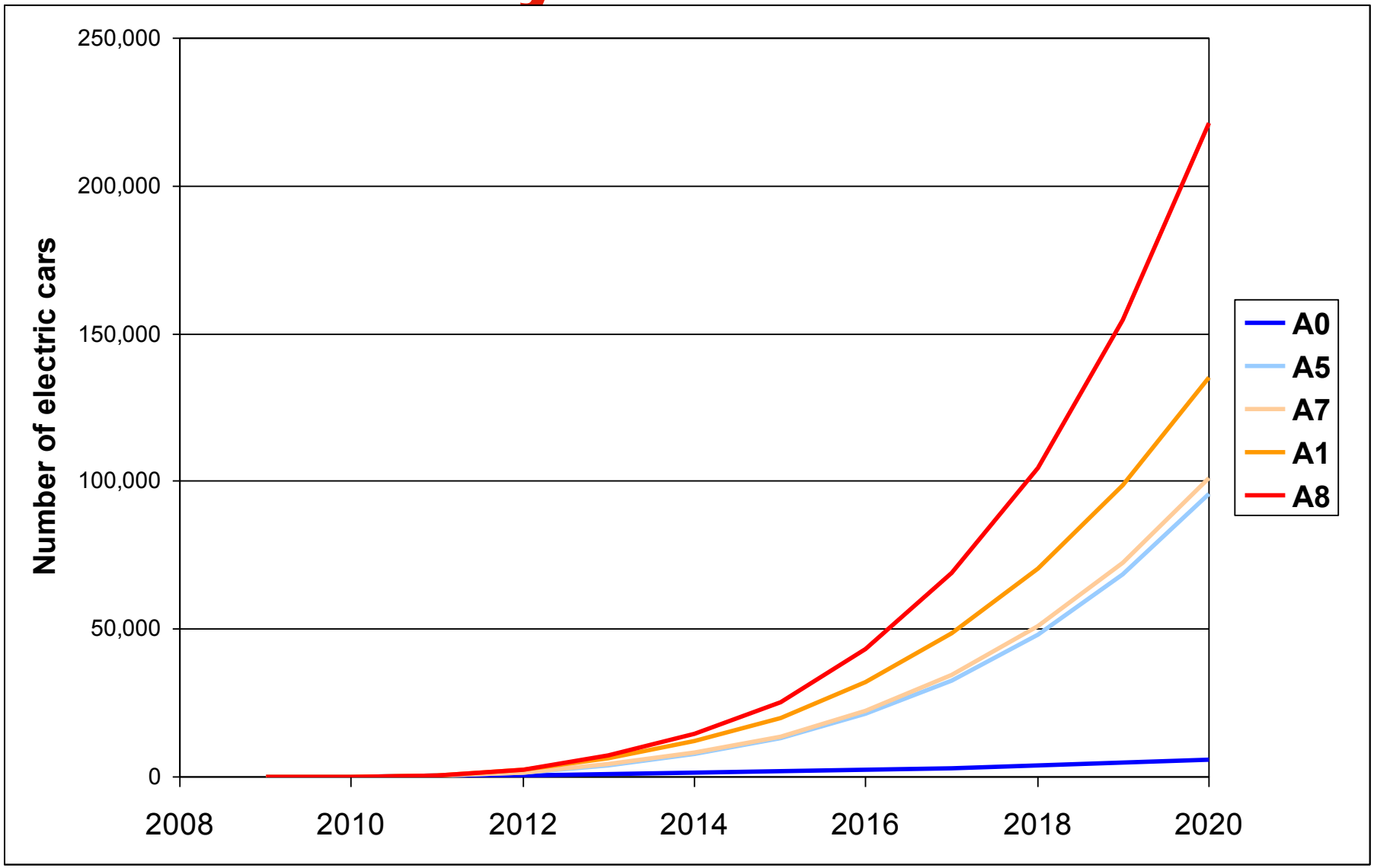
# Study “E-mobility rollout in Austria”
# Result battery electric cars



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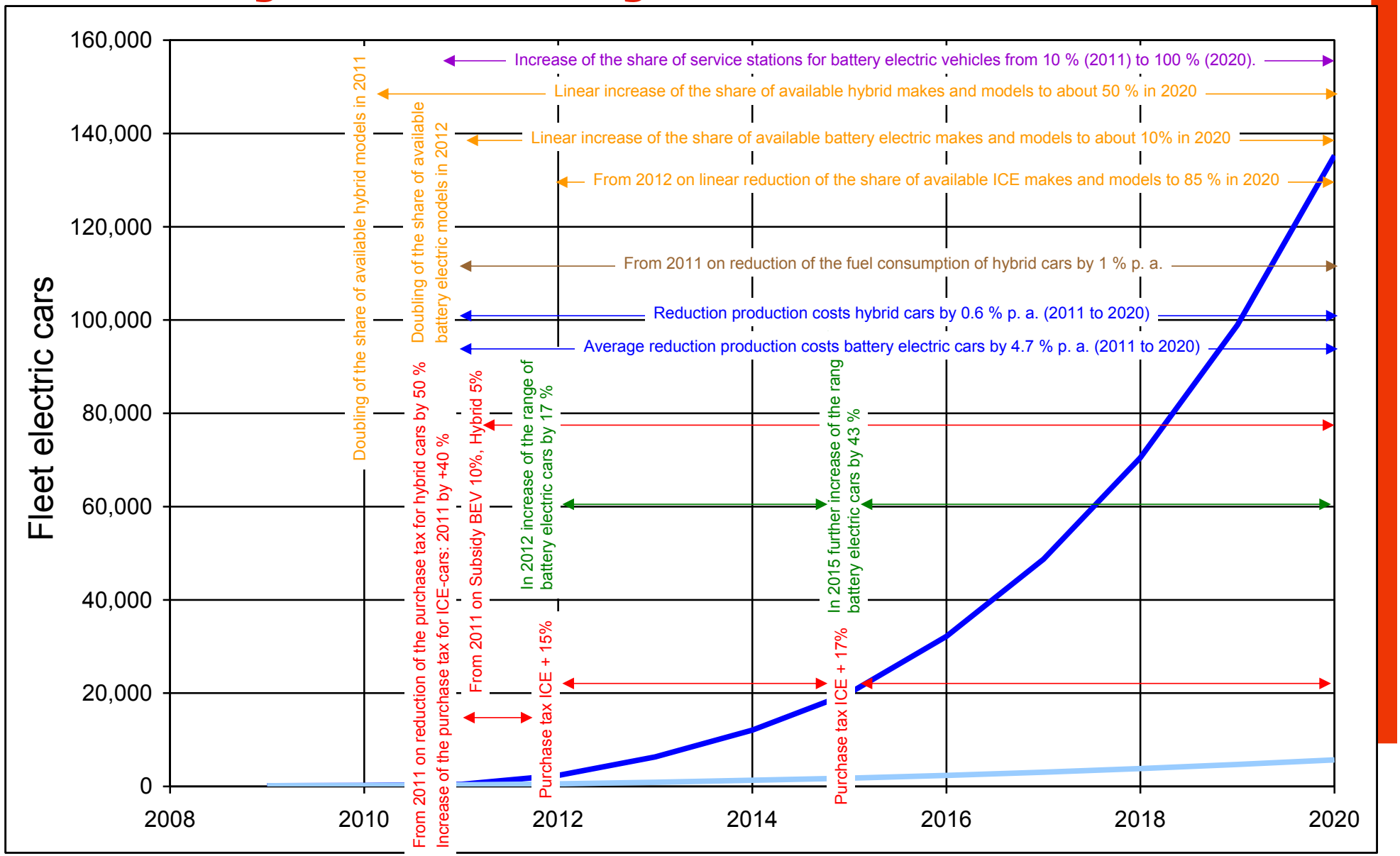
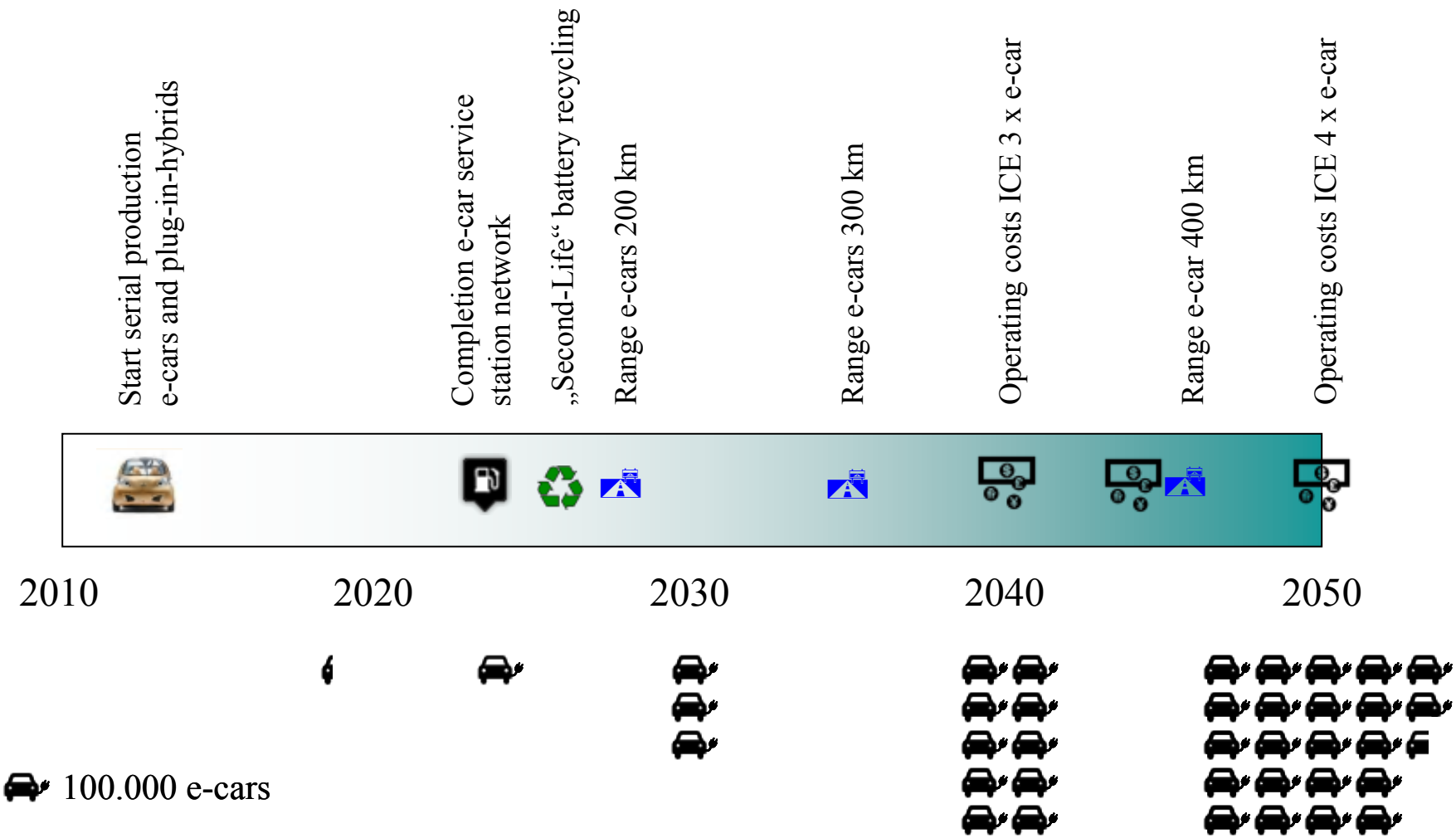
# Study “E-mobility rollout in Austria”



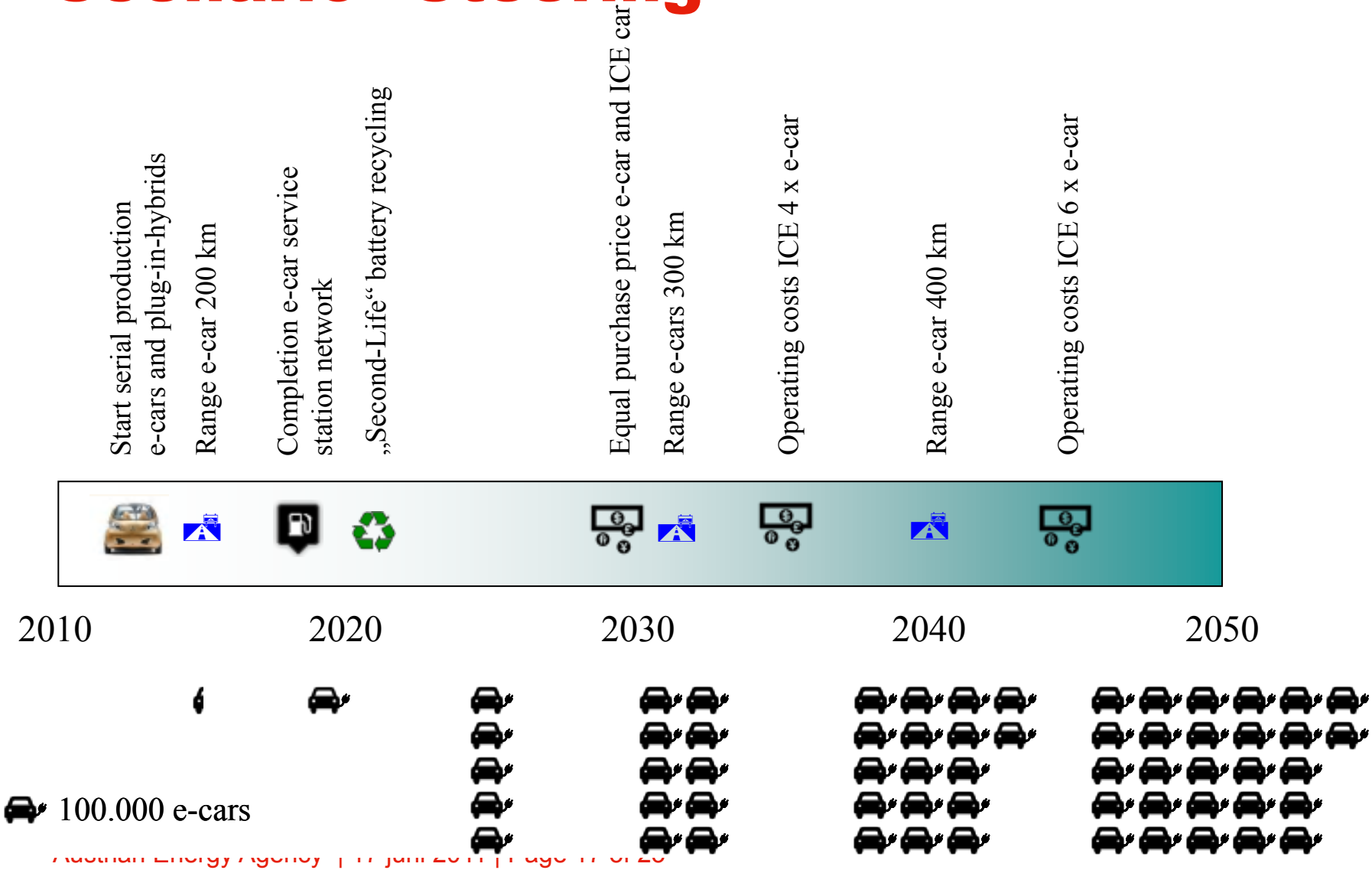
# Study „Visions 2050“ Scenario definition

- “Waiting”: reference scenario based on the assumption of a continuation of past trends with some improvements in energy efficiency.
- “Chasing”: characterized by exogenous shocks and knee-jerk political reactions to steeply rising oil prices, policies lagging behind developments, rather than proactively confronting it.
- “Steering”: both nationally and internationally coordinated efforts to curb greenhouse gas (GHG) emissions, to internalize external costs and develop innovative and sustainable low-risk technologies that succeed the fossil-based electricity production.

# Study „Visions 2050“
# Scenario “Chasing”



# Study „Visions 2050“
# Scenario “Steering”



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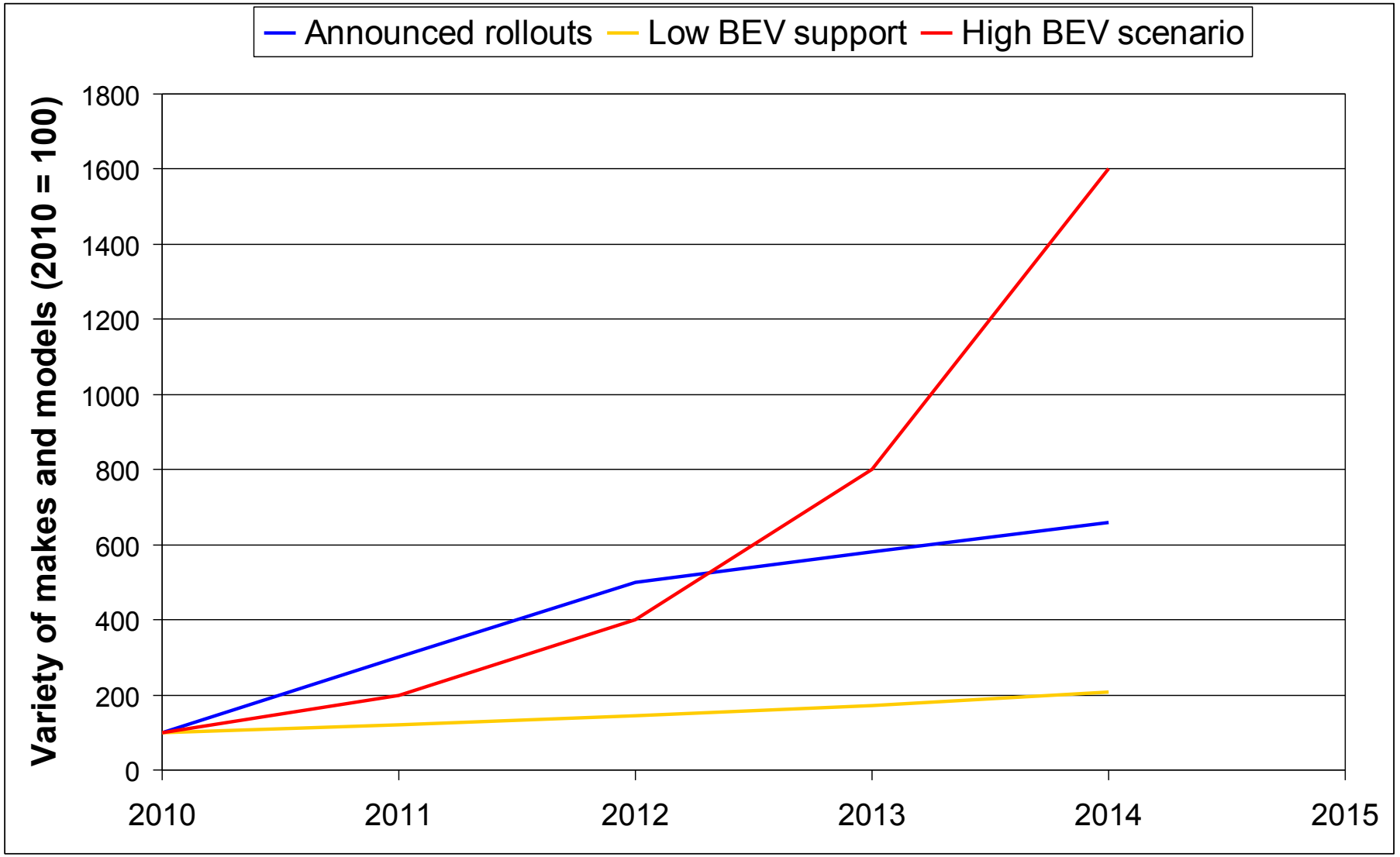
# Validation of the model assumptions – variety makes and models



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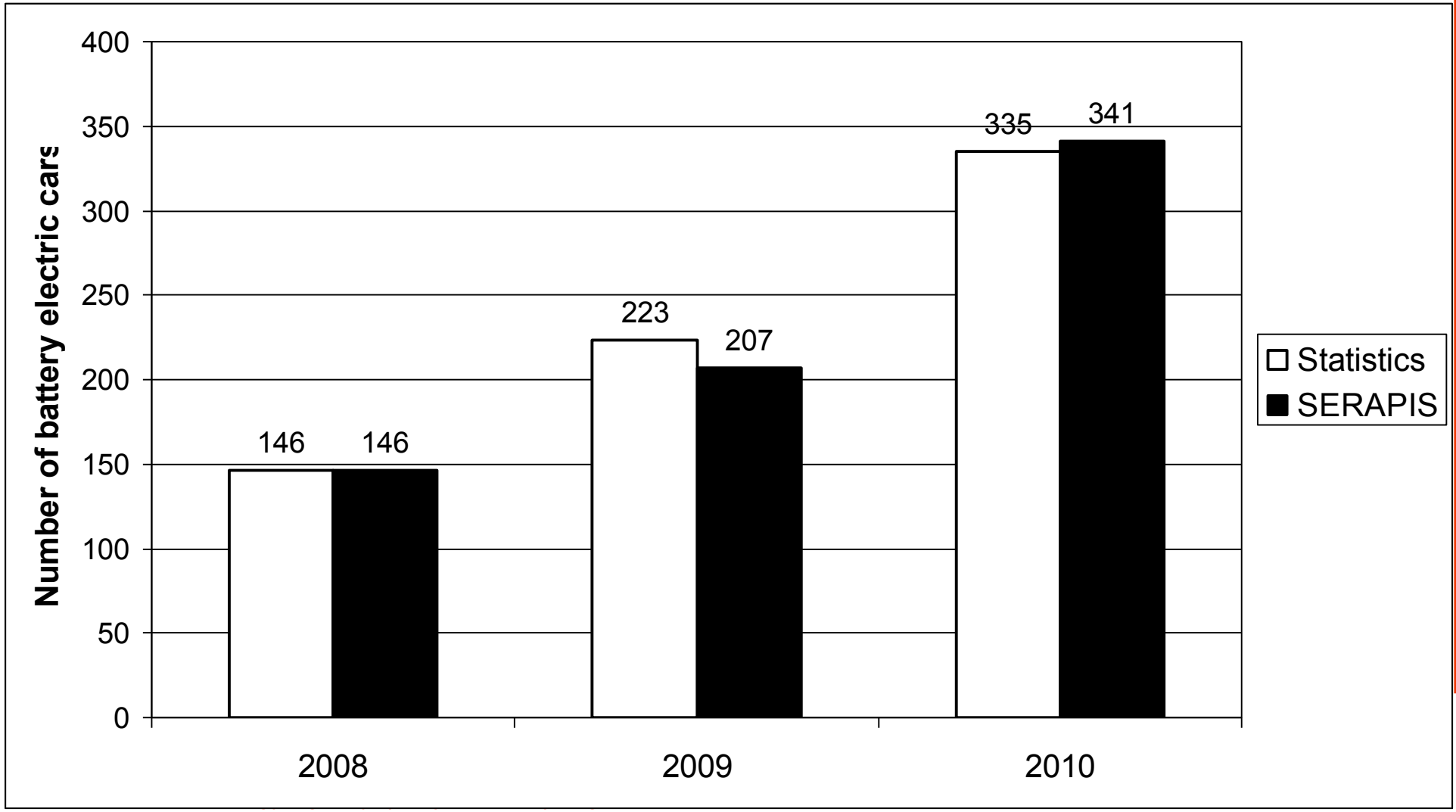
# Validation of the model assumptions – registration statistics



# Conclusions (1)

- SERAPIS is a dynamic state-of-the-art fleet development and propulsion technology choice model developed by the Austrian Energy Agency.
- SERAPIS has been used in a series of different studies on behalf of public authorities, associations and utility companies.
- Recently SERAPIS was modified to model the development of light-duty commercial vehicle fleet rather than private car fleets.

# Conclusions (2/2)

- The case study results have shown that
  - in the short and medium term public support is a precondition for the development of a significant BEV-fleet and
  - that hybrids and BEVs can significantly reduce final energy consumption and improve energy efficiency.
- Unintended side effects like the cannibalisation of PT needs further consideration and investigation.
- A comparison of model results with data from registration statistics indicates that the model structure as well as estimated parameters are appropriate.

# Thank you for your attention!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