This supplementary material contains more details on the models used in the paper, following the ODD protocol [1].

Appendix A. Model 1: ODD protocol

Appendix A.1. Overview: Process overview and schedule

Fig.A.1 illustrates the overview of processes in the agent-based model. The actions of the aggregator are based on the USEF framework [2].

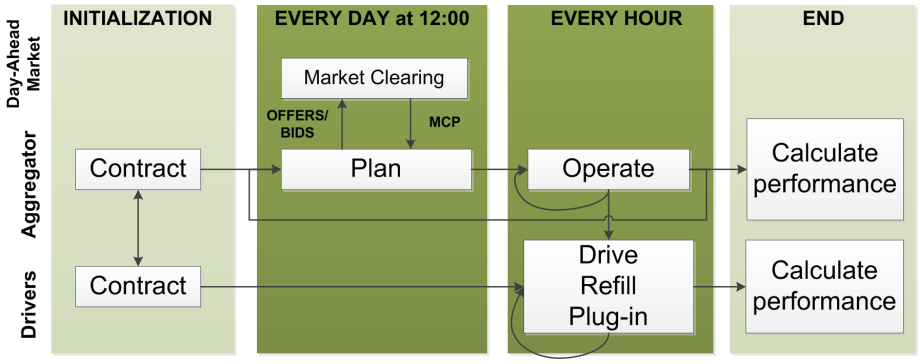

Figure A.1: Process overview per agent type

Appendix A.2. Details: Input parameters and data

Appendix A.2.1. Day-ahead market prices

To calculate day-ahead market prices, we use the prices calculated from [3]. The prices used are those from the High-Wind scenario, with the installed capacities as is indicated in Table A.1.

- Mid-Wind (MW): Scenario in which there is a moderate increase in wind capacity, which replaces the entire capacity of hard coal.
- High-Wind (HW): Scenario in which new wind capacity replaces both hard coal and lignite consuming power plants.
- High-Wind High-Carbon (HWHC): Scenario that consists of the same energy mix as the HW scenario, but with an increased carbon allowance price as well.

The different energy mixes in the scenarios are illustrated in Fig.A.2, and the resulting price-duration curves calculated for each scenario are shown in Fig. A.3.

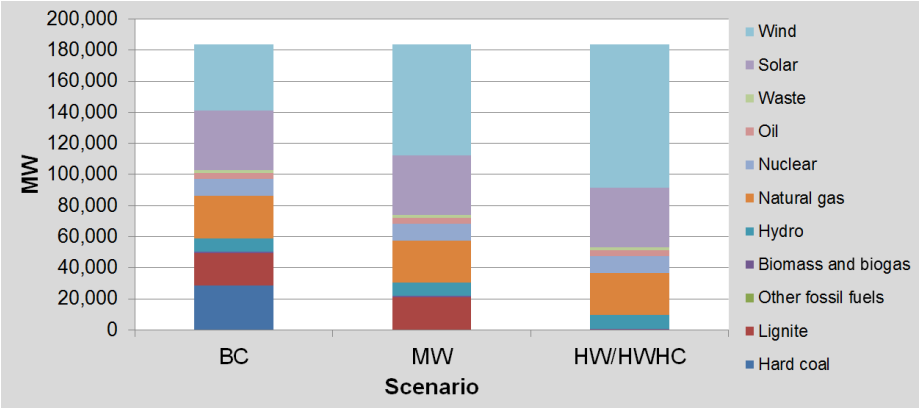

Figure A.2: Installed capacity per fuel type for four scenarios

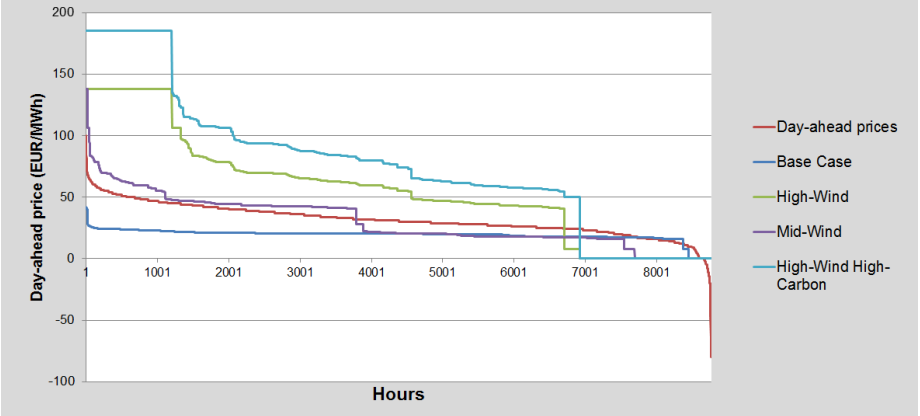

Figure A.3: Price-duration curve for scenarios

Appendix A.2.2. Input parameters for technical and economic data

Appendix A.2.3. Data sources

- Driver agents: driving distance, arrival and departure times [4]
- Power plant data: plants, capacities, fuel types, efficiencies, etc. [5] ()for

Table A.1: Scenario inputs for day-ahead market prices

Scenario	Base Case	Mid-Wind	High-Wind	High-Wind High-Carbon
Wind capacity (GW)	42.7 [23.3%]	71.4 [38.8%]	92.3 [50.2%]	92.3 [50.2%]
Solar capacity (MW)	38.5 [21.0%]	38.5 [21.0%]	38.5 [21.0%]	38.5 [21.0%]
Other (MW)	102.6 [55.8%]	73.9 [40.2%]	53.0 [28.8%]	53.0 [28.8%]
CO_2 allowance price (€/ton)	8.00	8.00	8.00	50.00

Table A.2: Input parameters

Parameter	Value
Hydrogen price (€/kg)	1.5
FCEV efficiency (%)	60
Fuel cell cost (€/kW)	26.9
Fuel cell lifetime (hours)	8000
Higher Heating Value (kg/kWh)	39.4
FCEV preferred operating point for V2G (kW)	10

external day-ahead market model)

- Load, solar, wind generation: time series data [5, 6] (for external day ahead market model)

Appendix B. Model 2: ODD protocol

Appendix B.1. Overview: Process overview and schedule

Every `step`, the main actions of agents are scheduled as shown in Fig. B.4.

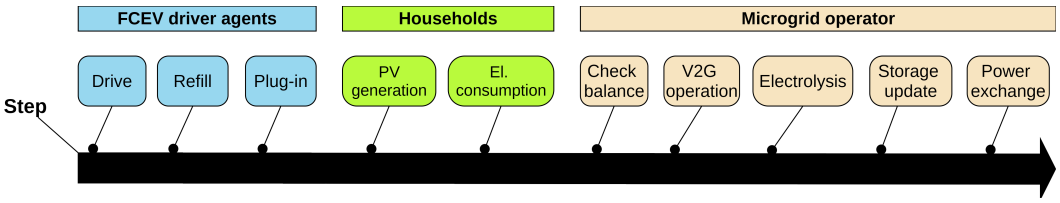

Figure B.4: Schedule of agents in the model

Appendix B.2. Details: Input parameters and data

The input parameters of the technical subsystem, especially the sizing of the PV panels, wind turbines, electrolyzers, and hydrogen storage are the same as our previous work [7]. During initialization, the input data from driving behaviour in the Netherlands is used. Every time step, the generation and consumption data is updated.

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Table B.3: Input data used in agent variables

Agent type	Variable	Units	Source
Driver	driving distance (weekdays/weekends)	km	[4]
Driver	arrival time (weekdays/weekends)	hours	[4]
Driver	departure time (weekdays/weekends)	hours	[4]
Household	Hourly PV generation	kW	[8]
Household	Hourly load profile	kW	[9]
Microgrid operator	Hourly wind speed	m/s	[10]

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