Oemof
Workshop Week

E-Lands MVS

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Session 5

RLI, 19.09.2019

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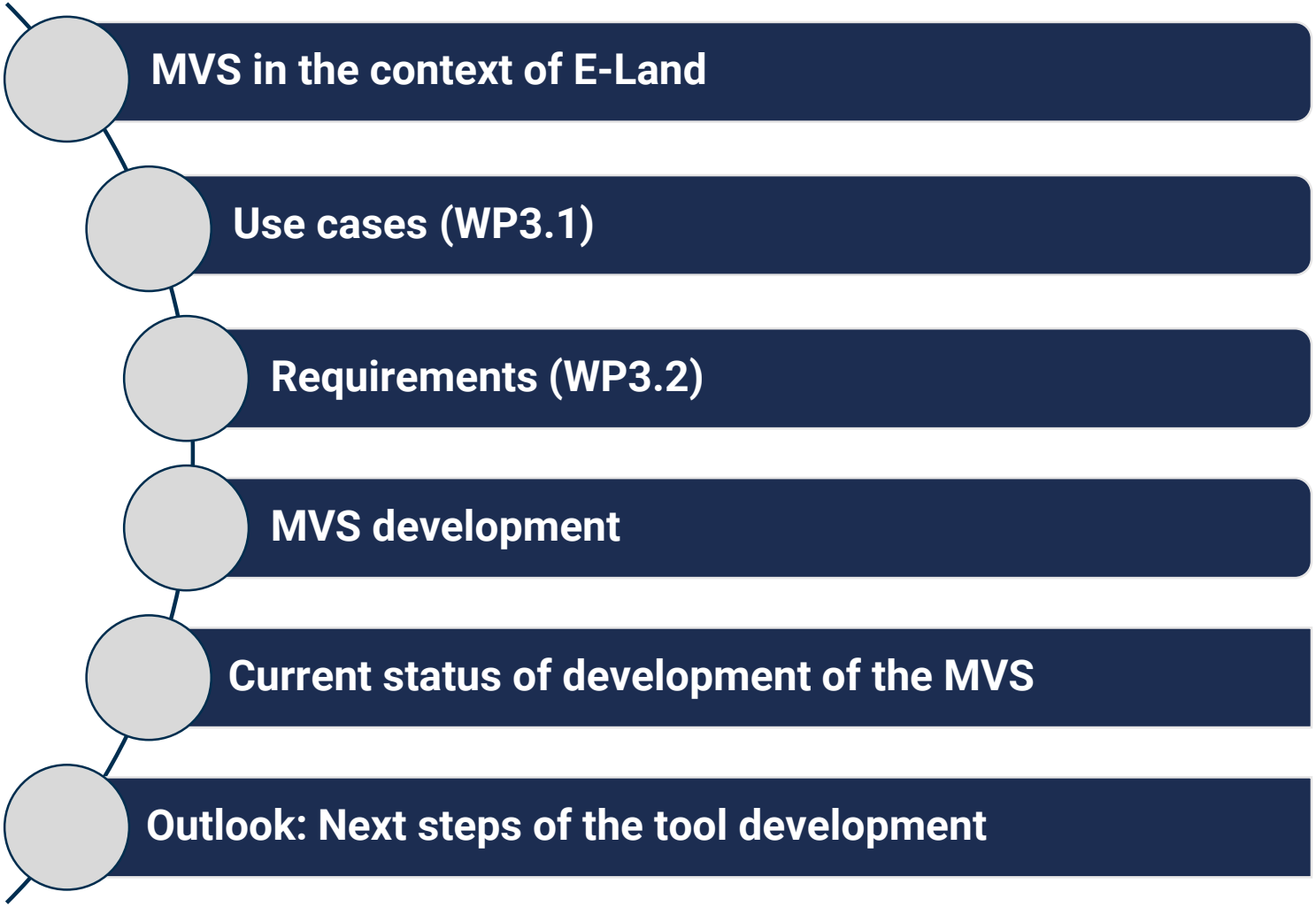
Getting to know the Multi-Vector Simulator (MVS)

All workshop contents at: https://github.com/smartie2076/oemof_workshop

Agenda


MVS in the context of E-Land
Use cases (WP3.1)
Requirements (WP3.2)
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Current status of development of the MVS
Outlook: Next steps of the tool development

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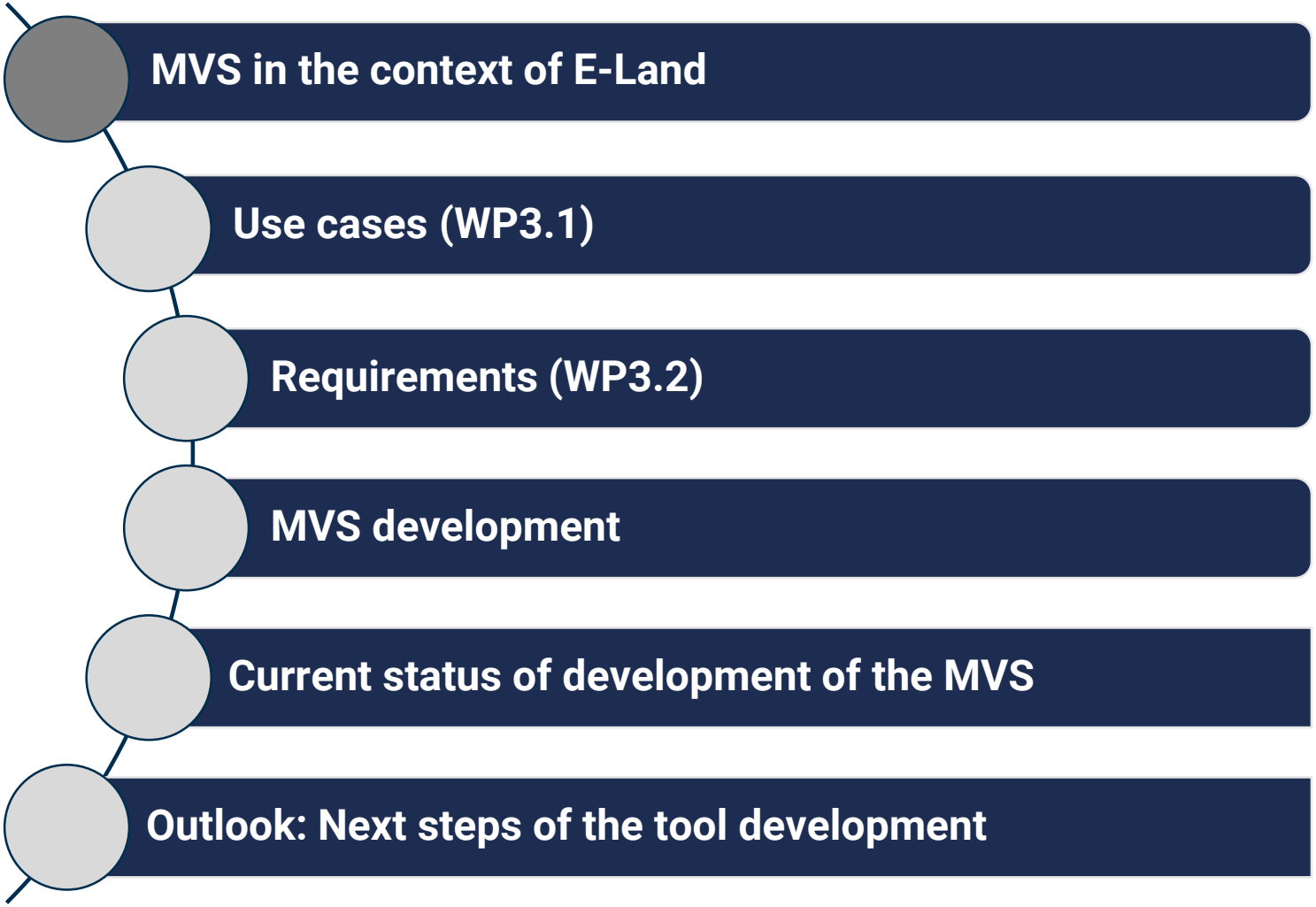
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Challenges addressed by E-Land

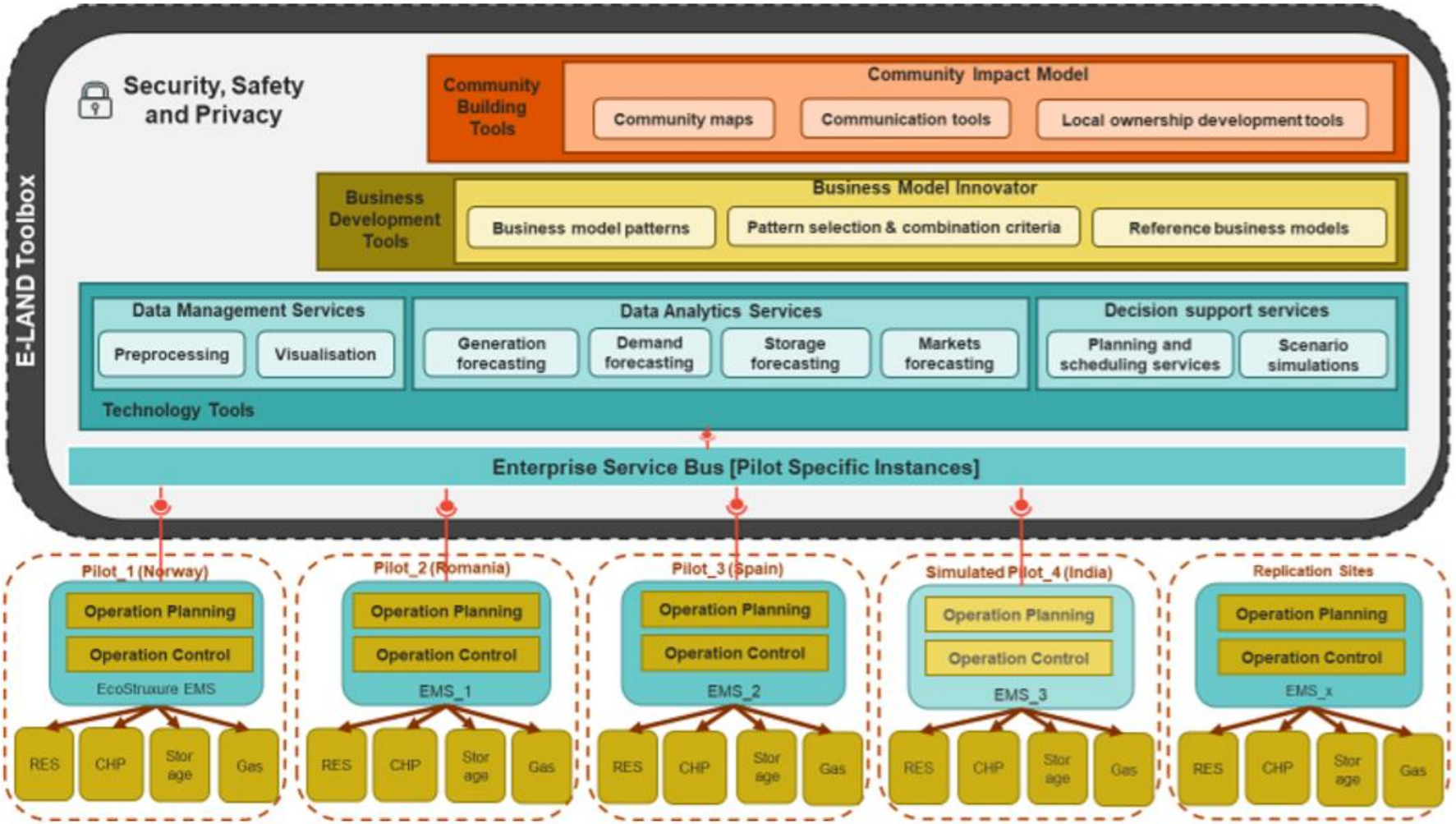
- Sector-coupling of electricity, gas and heat
  - …can improve overall system efficiency
  - …can provide flexibility and storage
  - …can increase system autonomy
- Energy sectors should be analyzed, planned and operated in an integrated manner
- Integrated perspective from business, societal, systems, operations and planning perspective

The E-Land Toolbox

- Framework, which can couple and co-optimize sector-coupled systems
- Multiple layers with different focusses:
  - Community engagement
  - Business models
  - Technical layer, including decision-making support tools

  → Layers integrated over the Enterprise Service Bus ESB)

The E-Land Toolbox



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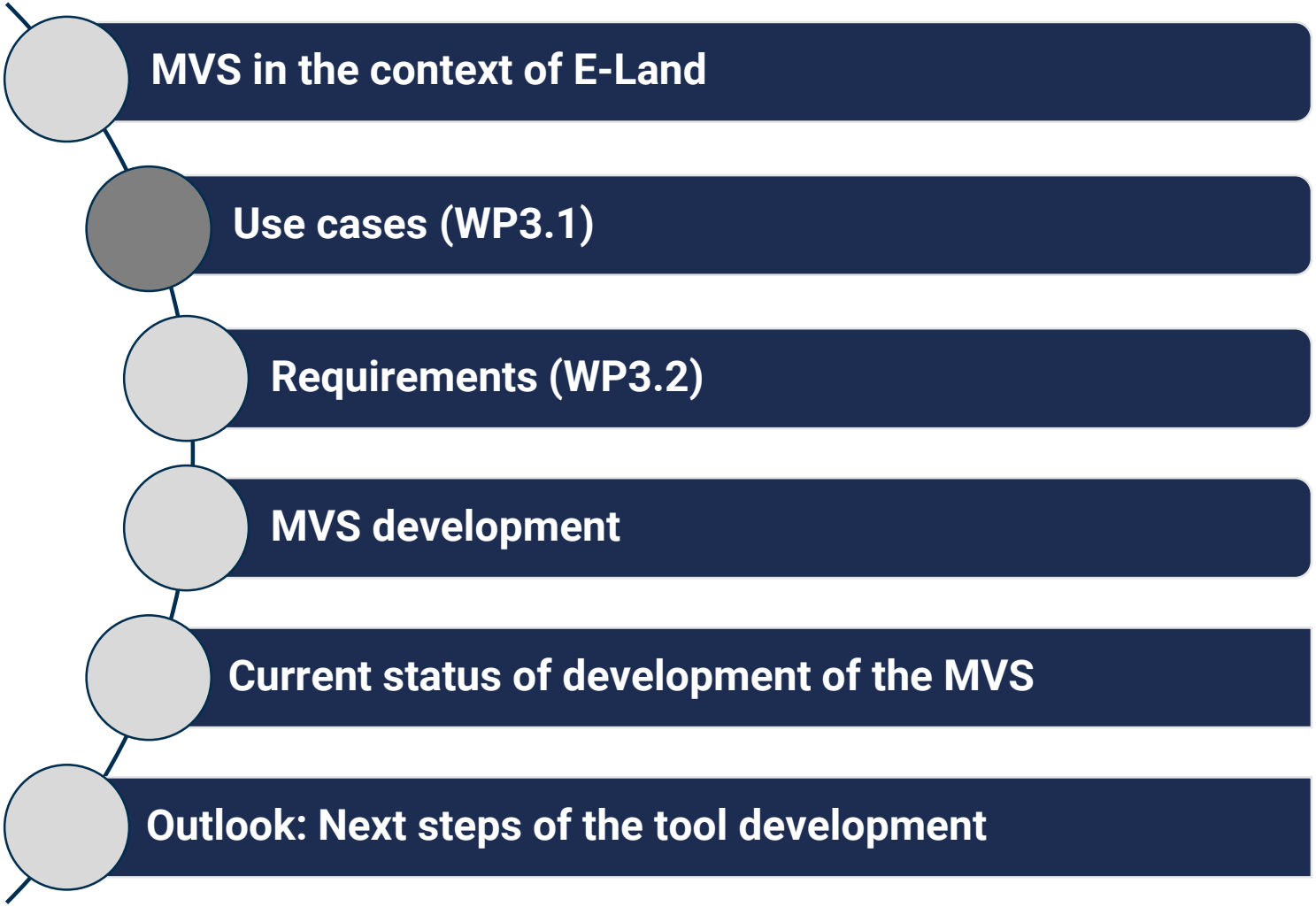
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Use case definition (WP3.1)

- High-Level Use Case (HLUC)
  - Generic concepts describing involved actors but not processes
- Primary Use Case (PUC)
  - UC defined with clear boundaries
  - Necessary to fullfill to adress HLUC
- Secondary Use Case (SUC)
  - More granular, less abstract description of core functionalities

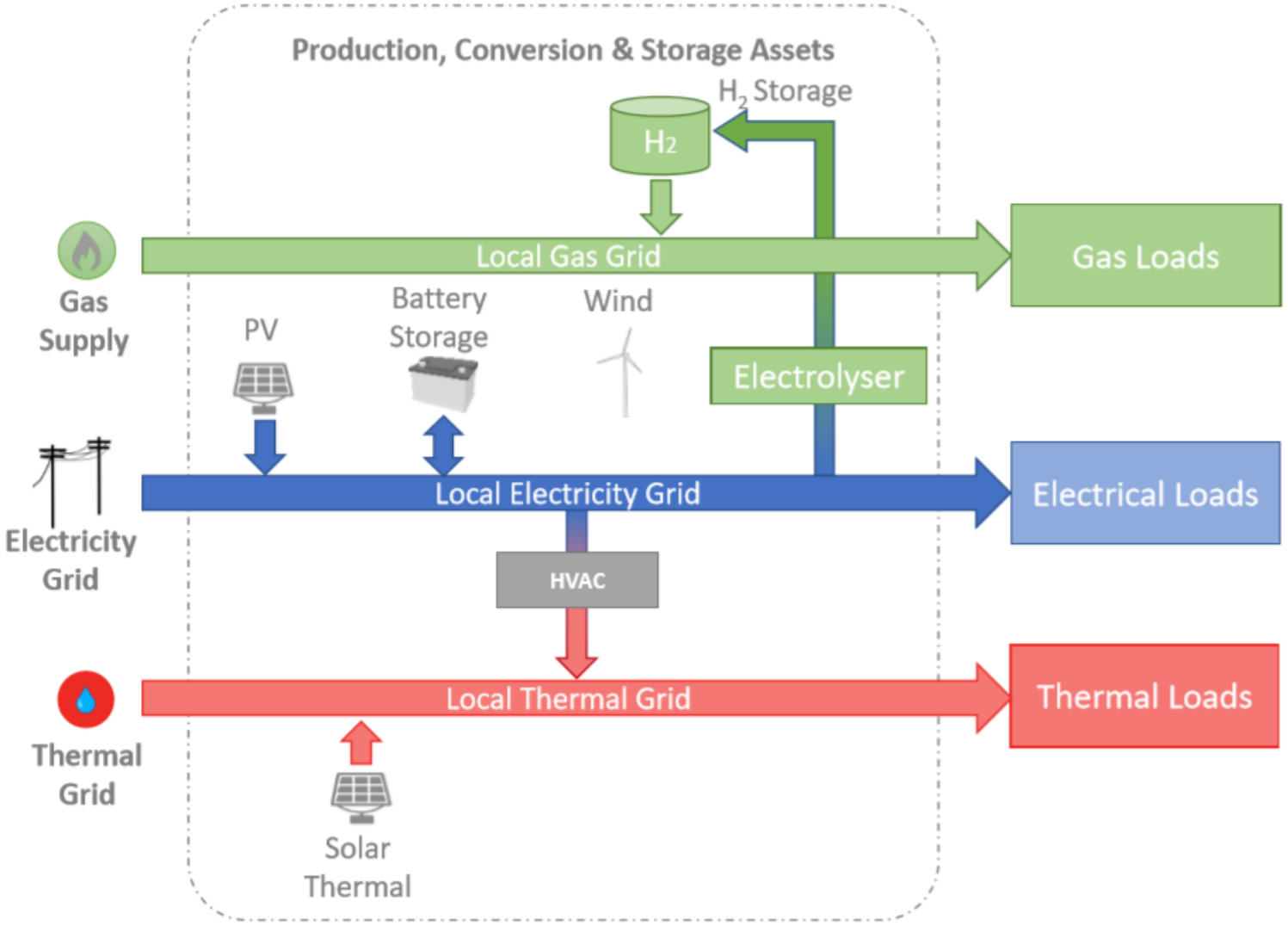
High-Level Use Cases

- "Energy Management System (EMS) integration with DER and BMS":
  - Integration of various systems
  - Modelling interoperability of ES
- Optimization of operation of LES
  - Optimal (day-to-day) operation
- Optimal sizing of a Local Energy System
  - New investments into assets (energy production, storage)

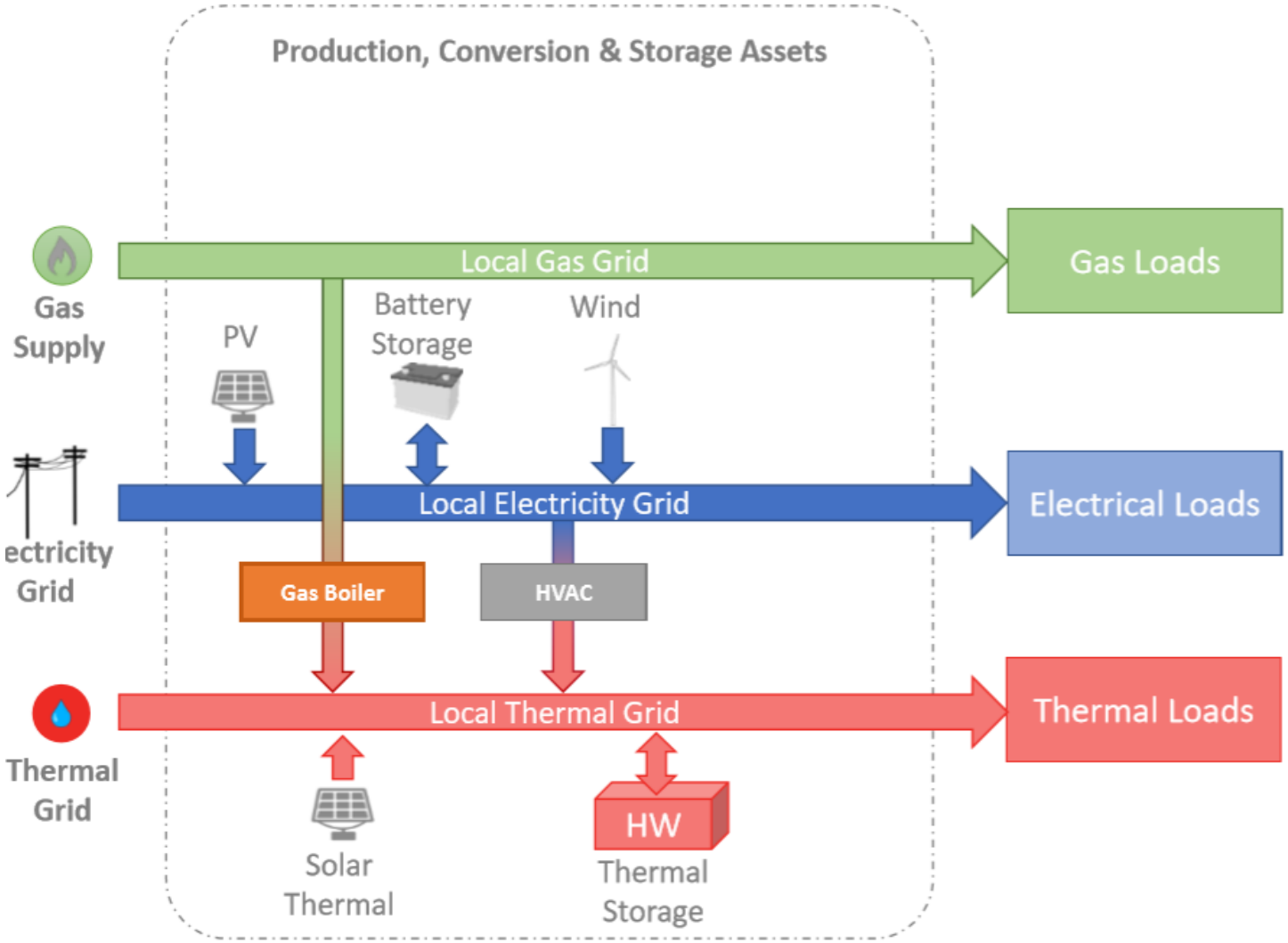
Primary Use Cases (PUCs) and the pilots

#	Name	ES	RO	NO	India
1	Provide commercial functionality to a multi-vector LES	✓			✓
2	Shift Building loads using Demand Side Management	✓	✓	✓	✓
3	Shift Harbor loads using Demand Side Management			✓	
4	Optimal scheduling of thermal and electrical storage		✓	✓	✓
5	Optimal scheduling of electrical storage and hydrogen storage	✓			✓
6	Storing excess generation in thermal network		✓	✓	
7	Optimal management of EV and FCEVs in a LES	✓			✓
8	Multi-vector Optimization of assets' sizing in a LES	✓	✓	✓	
9	Optimal sizing of electric parts of a LES	✓	✓	✓	✓

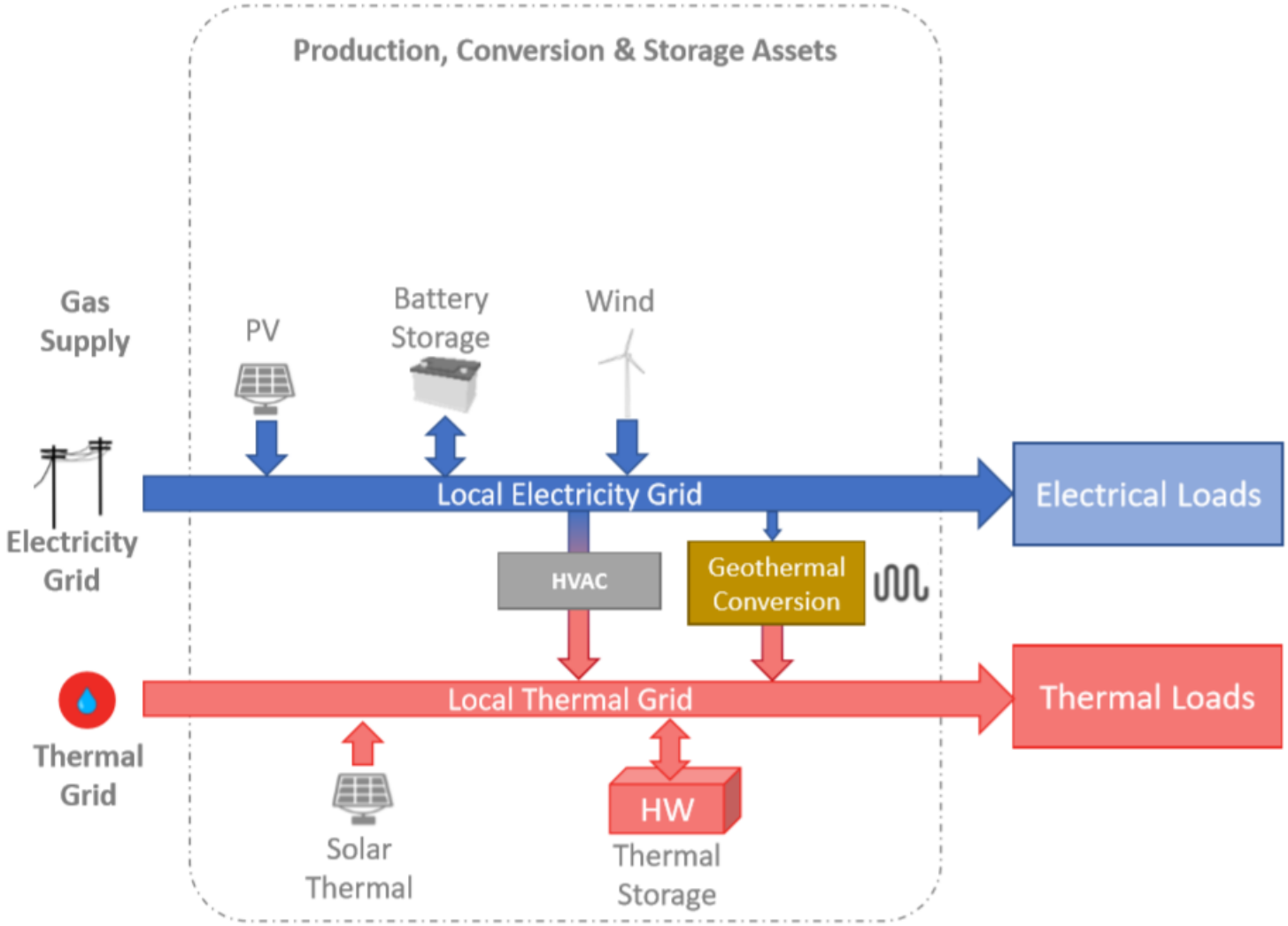
Walqa Technology Park, Spain



UVTgv University Campus, Romania



Port of Borg, Norway



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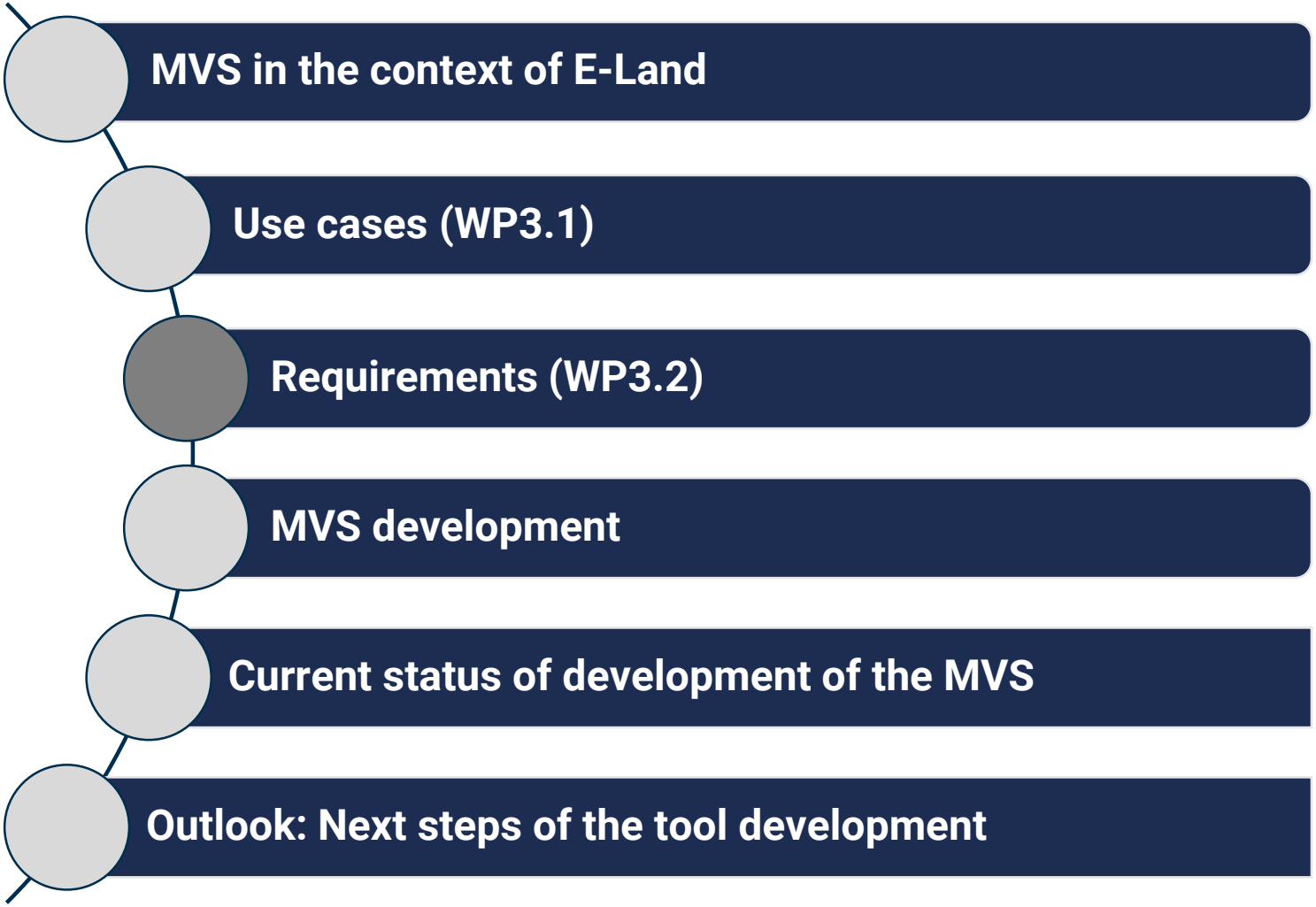
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Functional requirements

- WP 3.2 described in detail the tasks the MVS has to perform
  - Automatic generation of LES
  - Solving LES
  - Manual set-up of LES (custom components)
  - Optimization results
  - Integrated assets of production/conversion
  - Setting the optimization goal
  - Specific energy cost models
  - Load profiles
  - Data processing for asset parameters
  - Introducable constraints

Non-Functional requirements

- Additional requirements set for MVS in WP 3.2
  - Preprocessing of model input
  - Postprocessing of model results
  - Communication between MVS/ESB
  - Time-step lenghts
  - Interface for technical parameter setting
  - Interface for economic parameter setting

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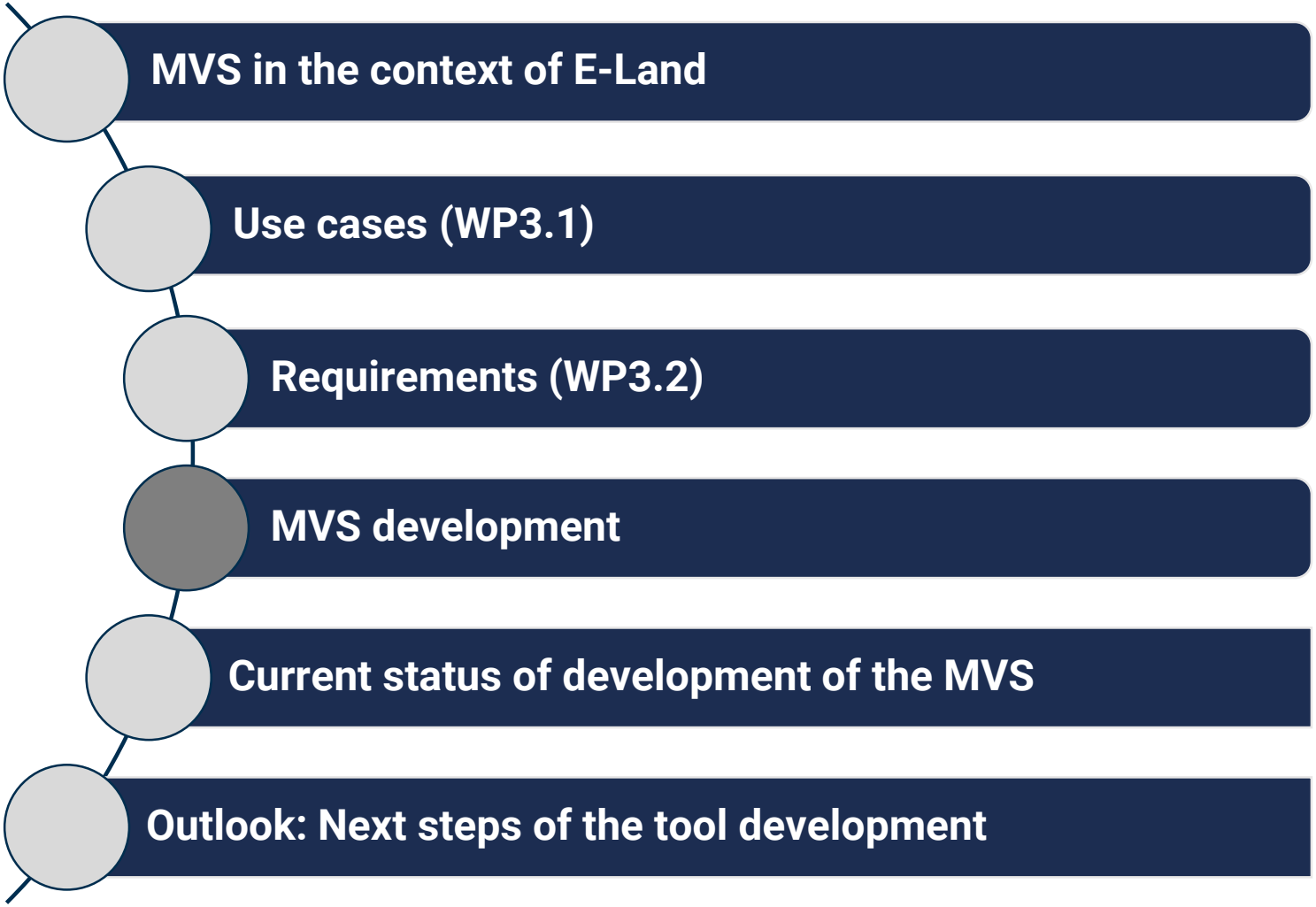
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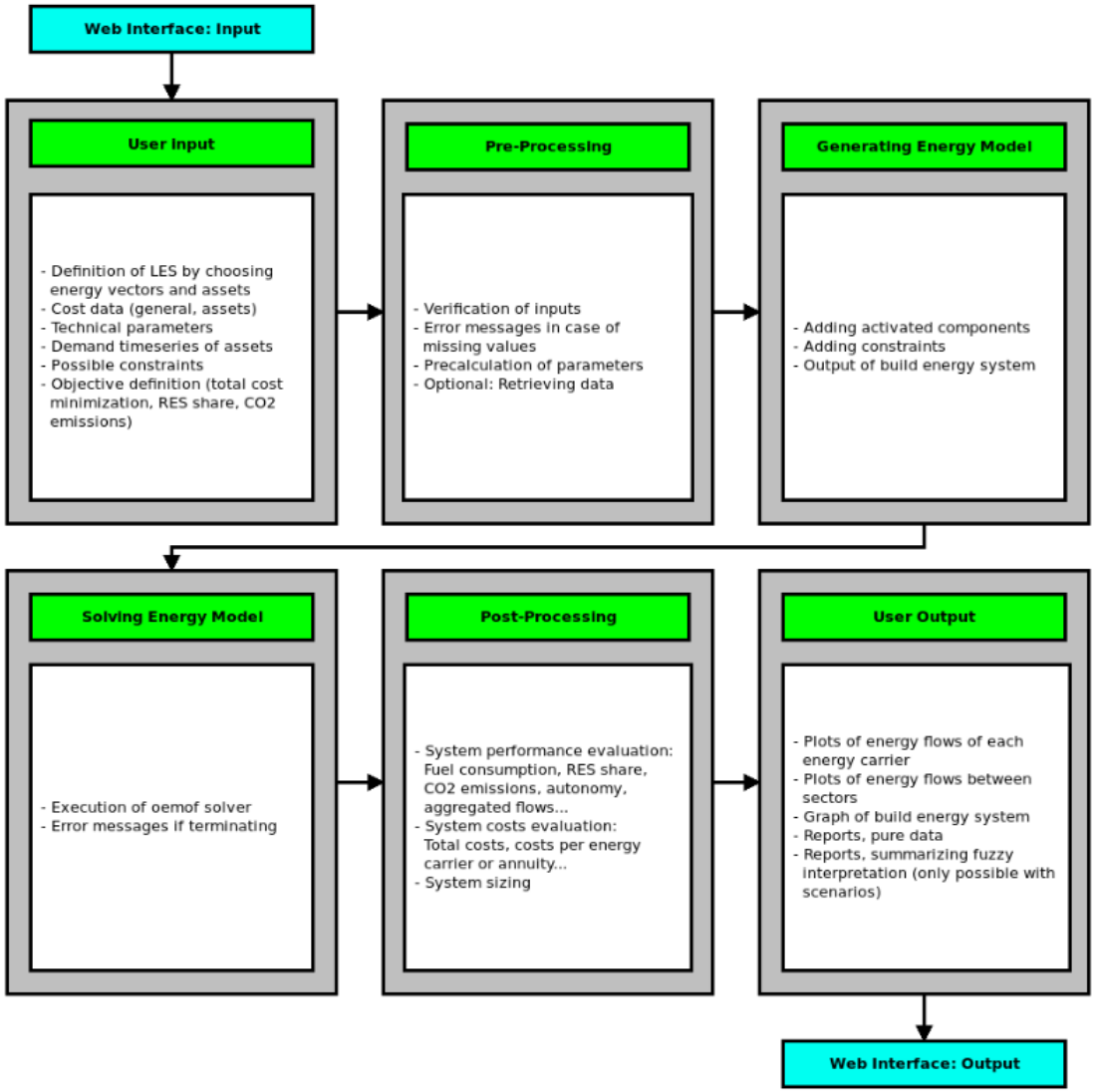
General MVS modular structure



Modular structure of the MVS

- mvs_eland_tool
  - A_initialization
  - B0_data_input
  - C0_data_processing
  - D0_modelling_and_optimization
  - E0_evaluation
  - F0_output

- Tool still under development. Can be found in: https://github.com/smartie2076/mvs_eland

Possible components of the MVS

- PV Generation
- Wind Generation
- Electricity Storage Systems
- Gas Boilers
- HVAC Systems
- Solar Thermal Generation
- Hot Water Thermal Storage
- Hydrogen-based Storage Systems
- Geothermal Conversion
- LNG Storage Systems
- Electrolyser

- Additionally: External energy providers, project data, general economic data

A lot of information to input and process

User input: Excel file

- As an intermediary, an Microsoft Excel file is used for user input:
  - All project parameters
  - Information concerning energy sectors
  - Technical and economic parameters of assets
  - Demand profiles (via .csv-files)

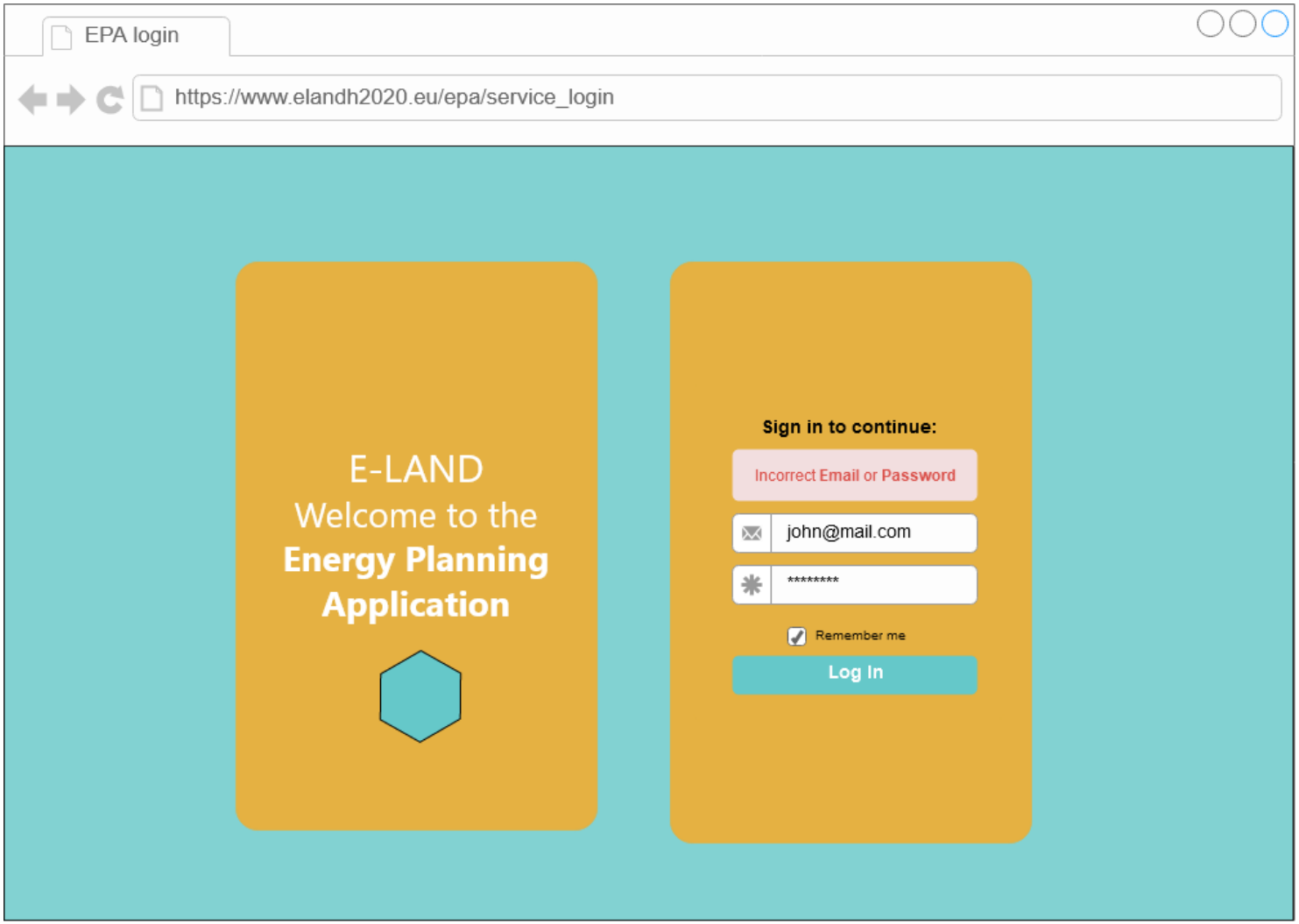
- Excel Template: https://github.com/smartie2076/mvs_eland/blob/master/inputs/test_input_file_v1.xlsx

User Input: Web application

- E-Land collegues ICOM from Greece develop interactive web-application
  - Data input
  - Execution of MVS (stored on server)
  - Postprocessing and vizualization

- Data exchange format with MVS: JSON
- Standalone usage of the MVS from the toolbox will be continued
- This process has just kicked-off

User Input: Web application



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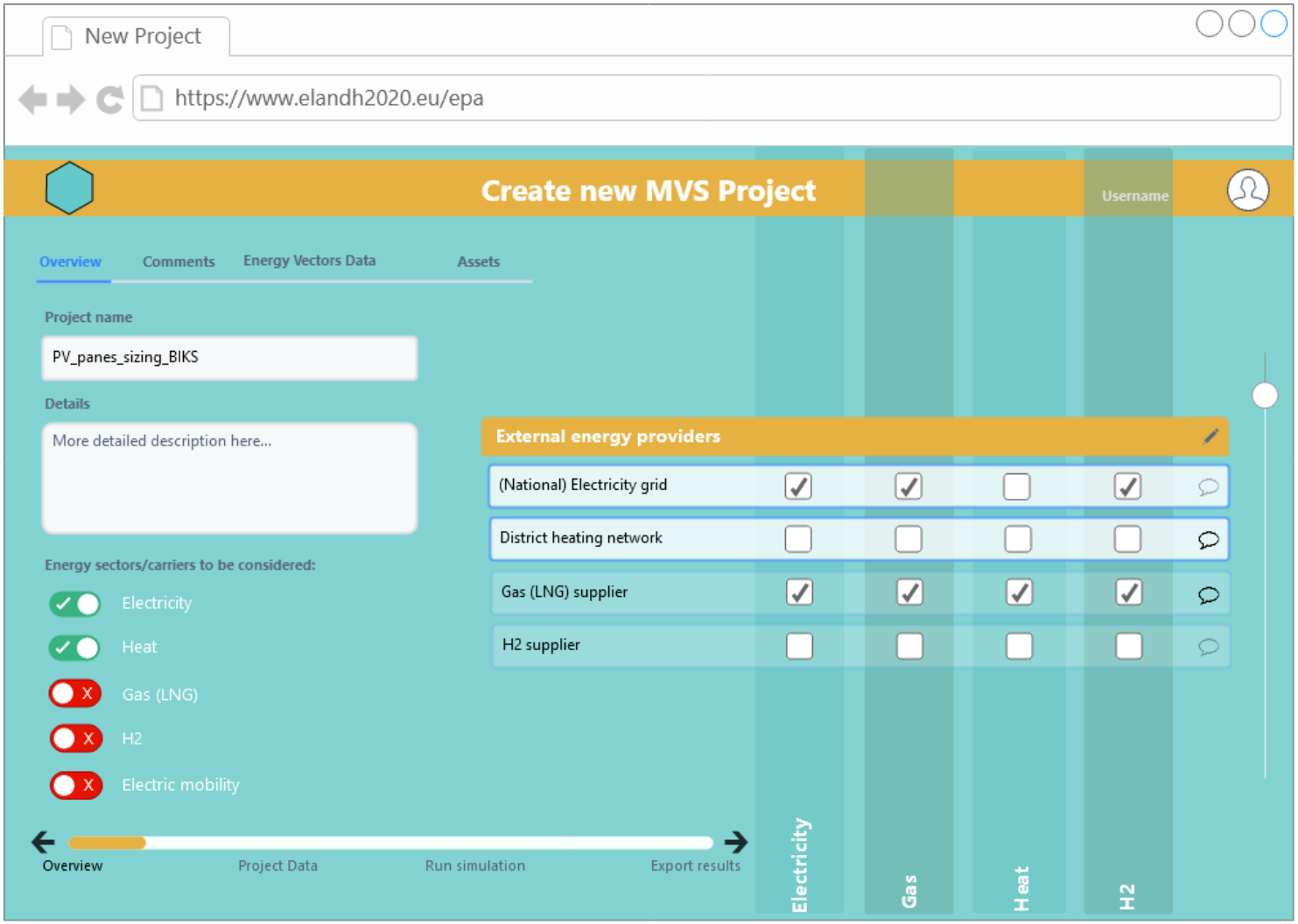

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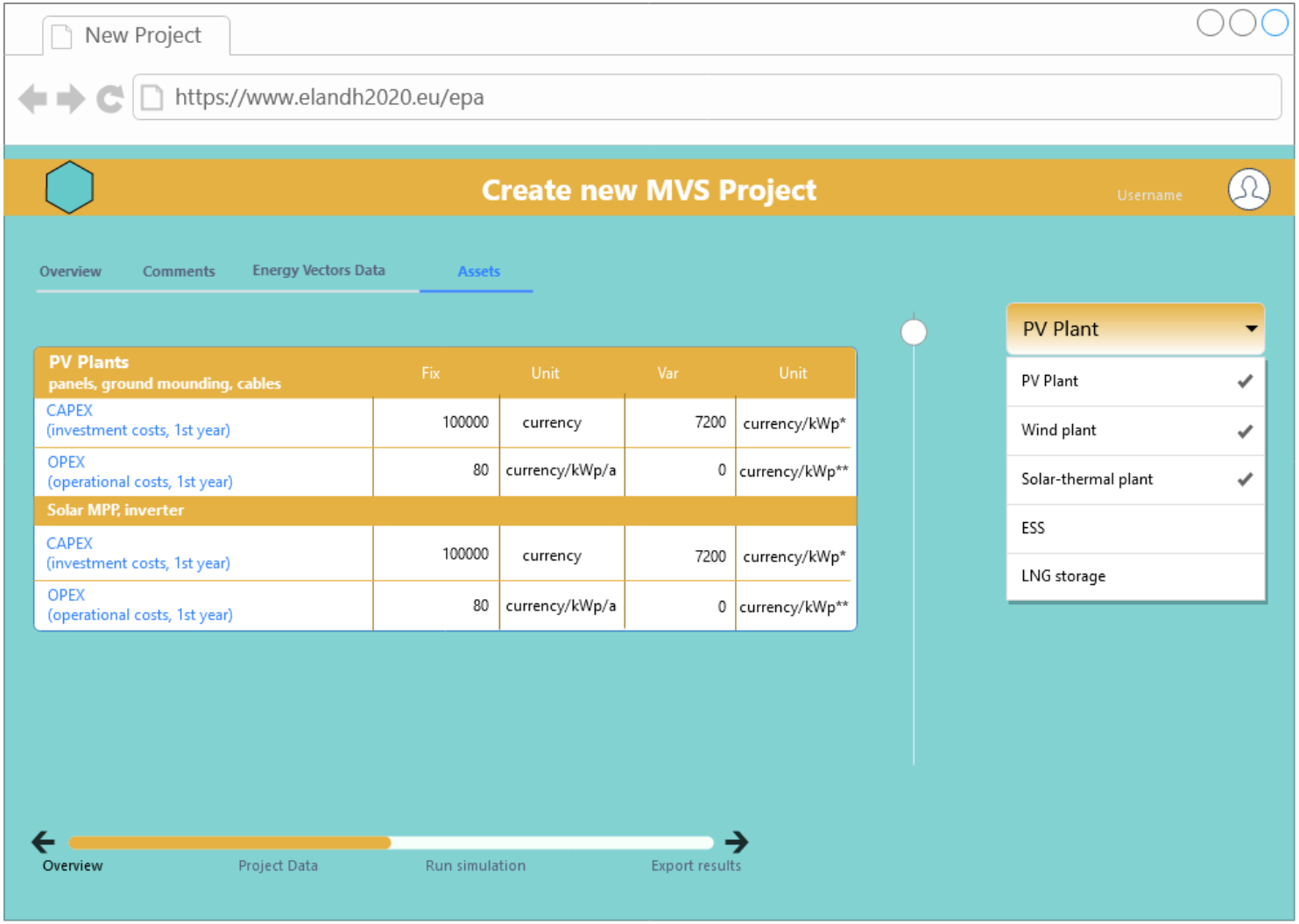

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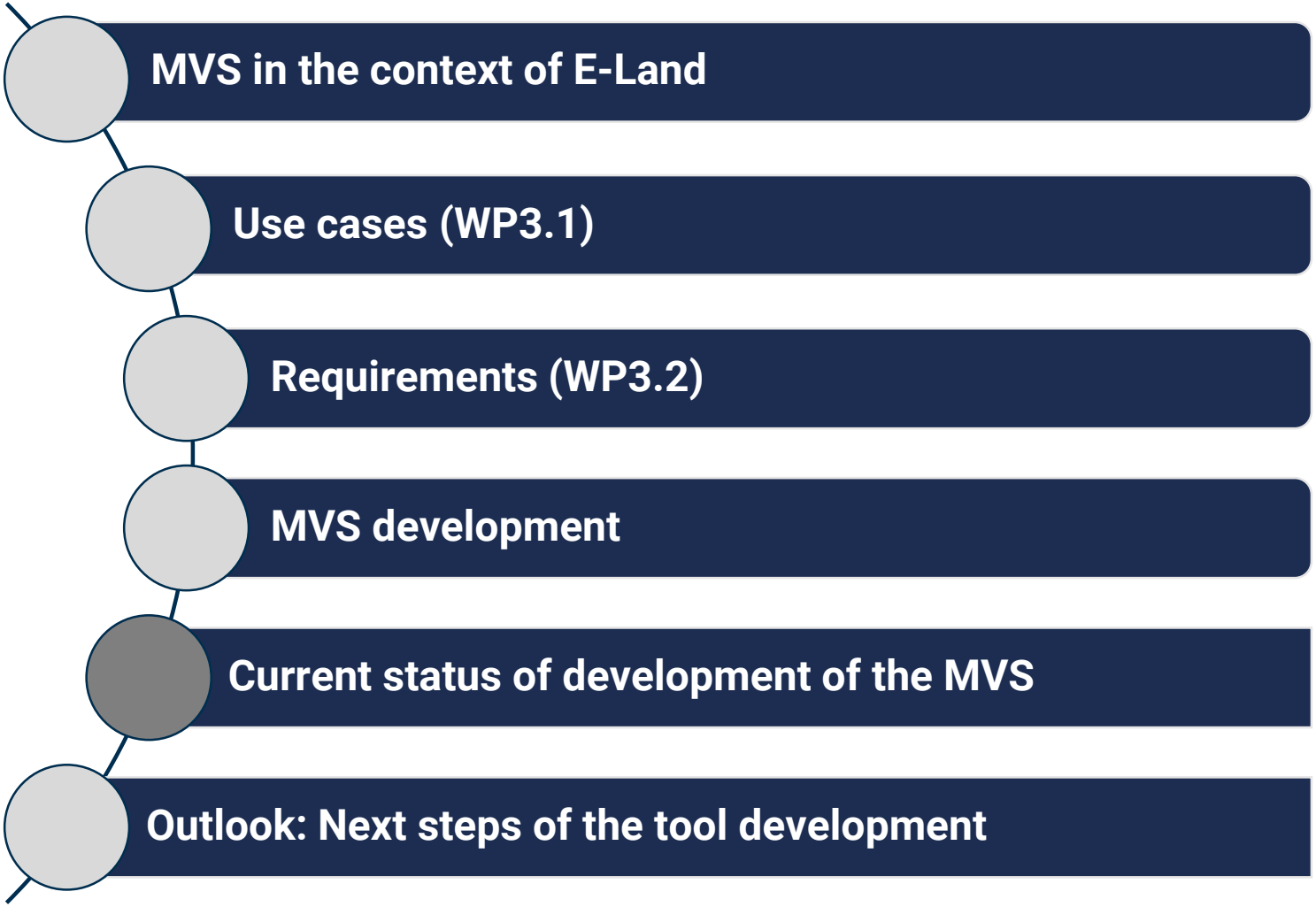
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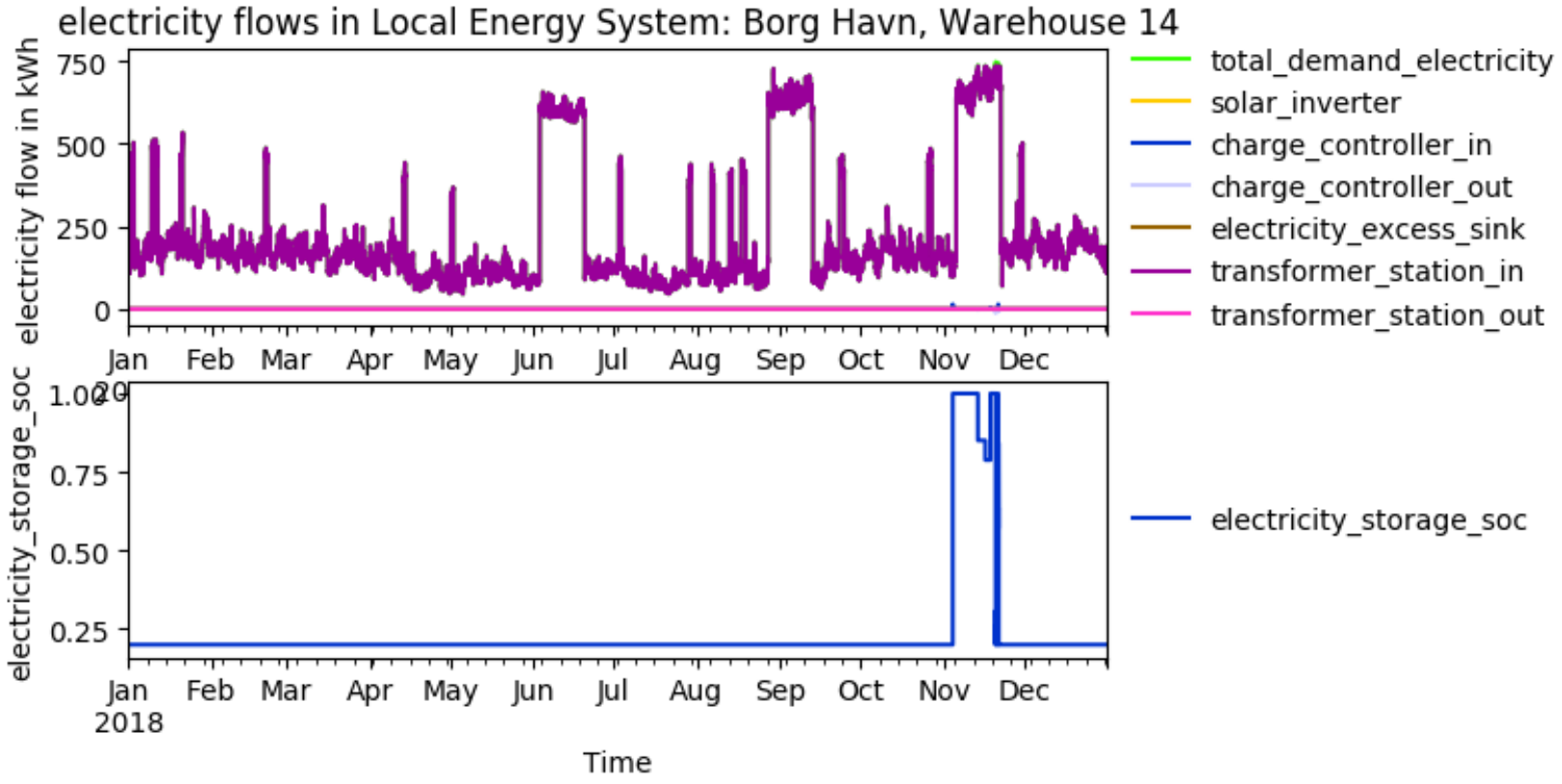
Development status of the MVS

- Adapted to simulate BIKS (1st step)
- Sole electricity system model
- Optimization goal: Decrease peak demand pricing costs by installing PV and storage

BIKS: Current intermediate output



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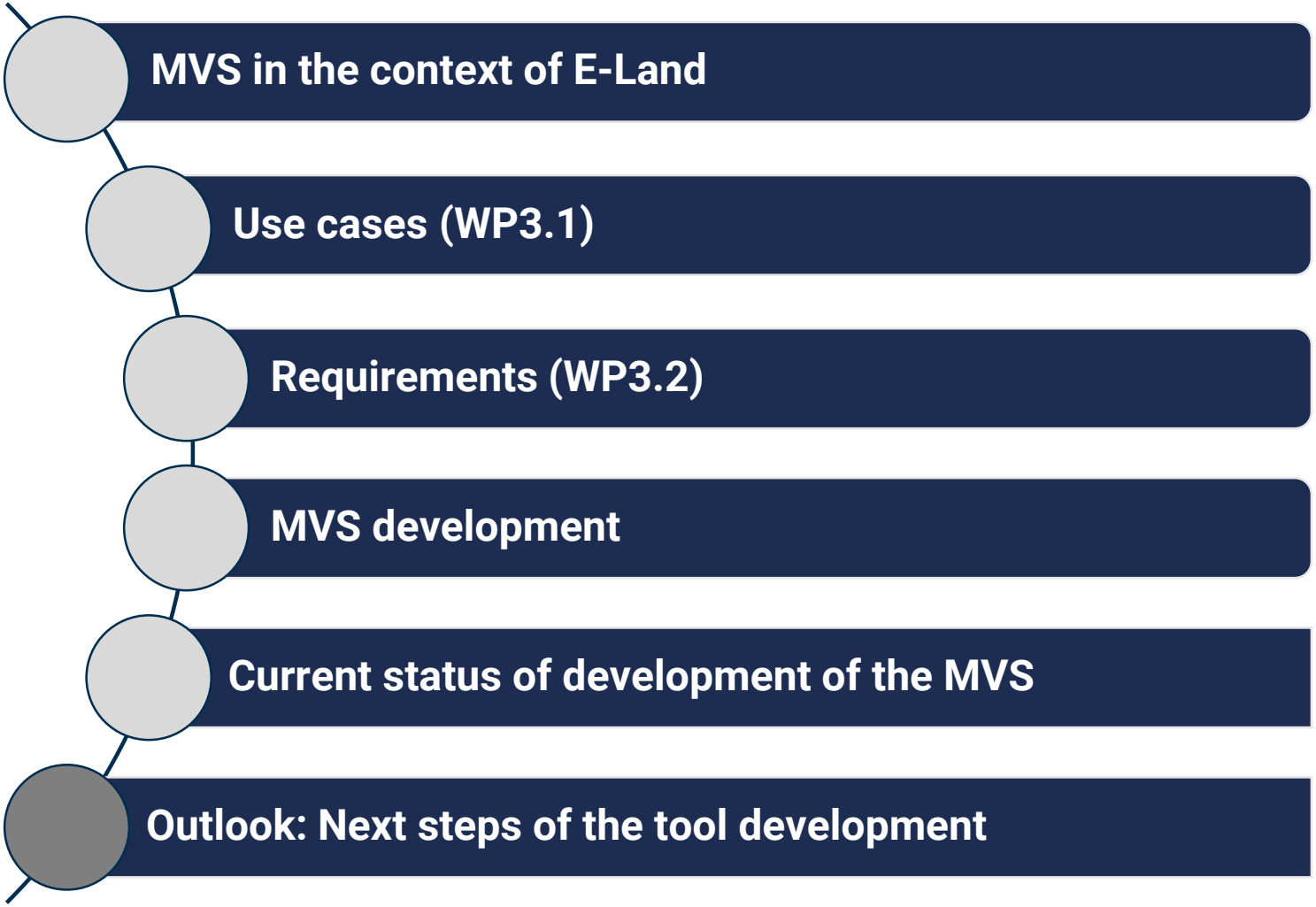
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Next extensions

- Implement multiple transformer stations to mirror peak demand pricing of BIKS
- Add post-processing
  - Graphs
  - Scalar output
  - Key performance indicators (KPI)
- Change input-format to json
- Restructure/clean automatized generation of energy system models
- Clean project parameter dictionary

- Reach out to other pilots and integrate their needs

THANK YOU FOR YOUR ATTENTION !

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