

Oemof
Workshop Week

E-Lands MVS

Martha Hoffmann

Session 5

RLI, 19.09.2019

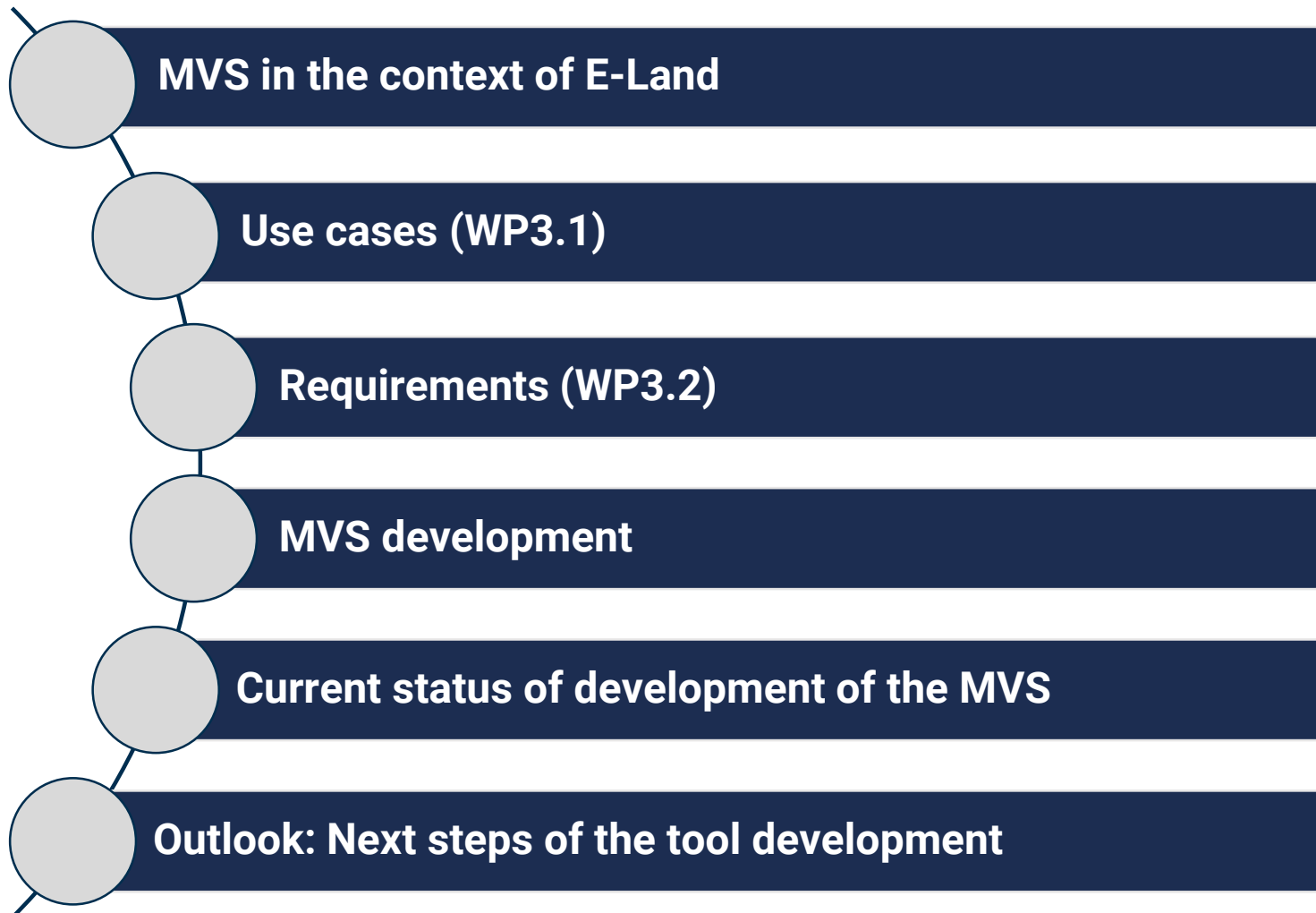


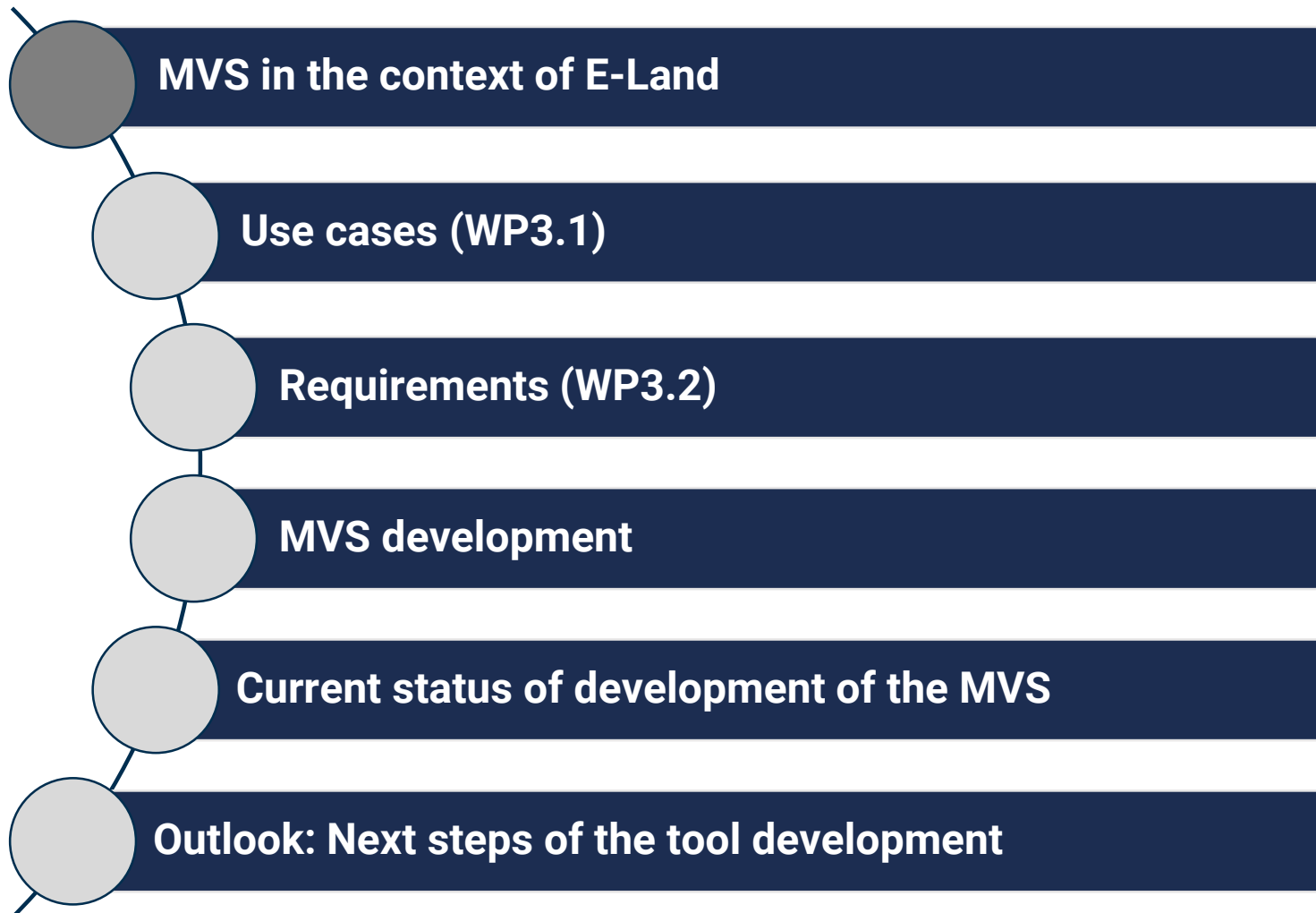
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Getting to know the Multi-Vector Simulator (MVS)

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

Agenda



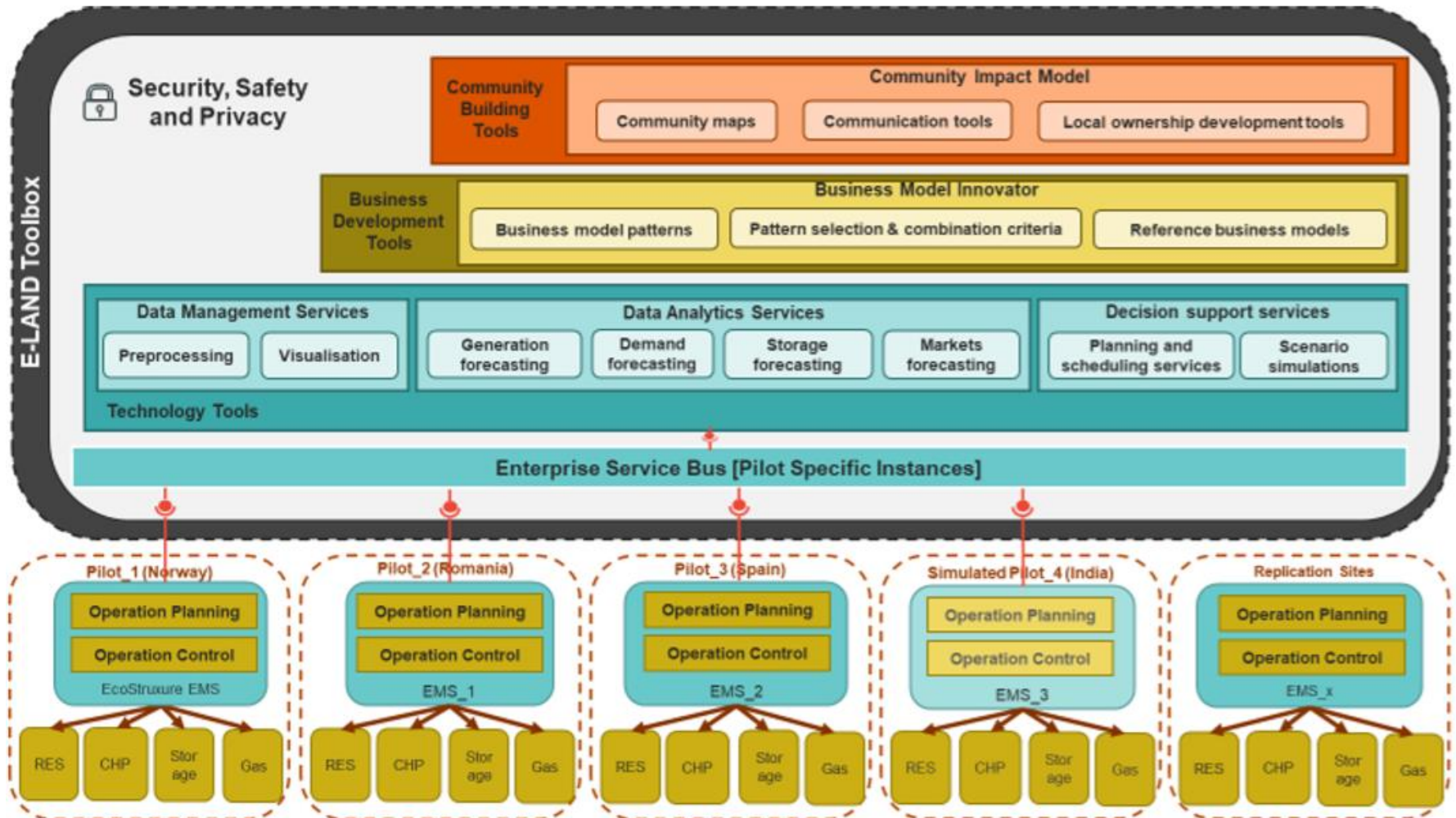


Challenges addressed by E-Land

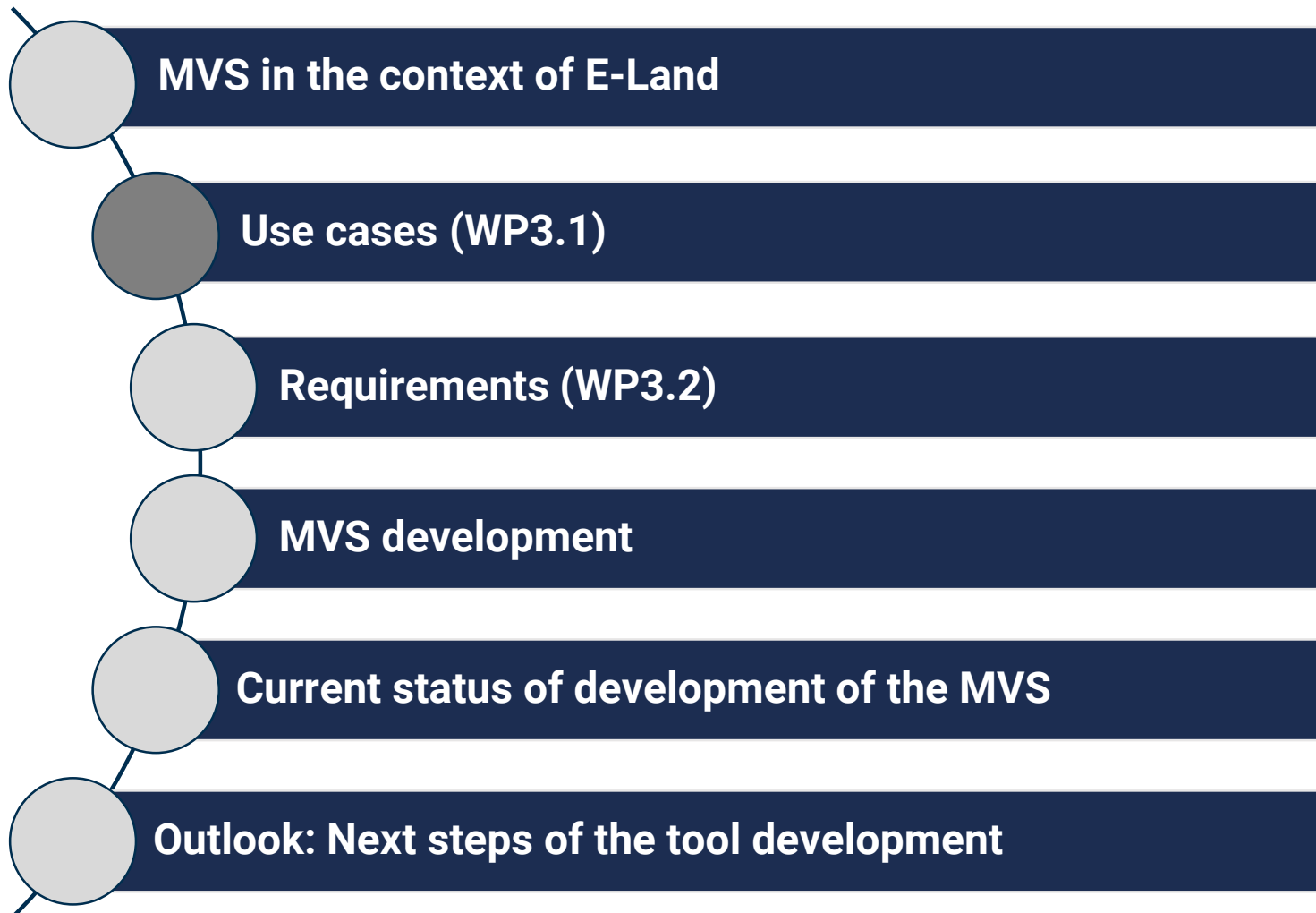
- ▶ Sector-coupling of electricity, gas and heat
 - ▶ ...can improve overall system efficiency
 - ▶ ...can provide flexibility and storage
 - ▶ ...can increase system autonomy
- ▶ Energy sectors should be analyzed, planned and operated in an integrated manner
- ▶ Integrated perspective from business,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

- ▶ 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



Agenda



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

- ▶ “Energy Management System (EMS) integration with DER and BMS”:
 - ▶ Integration of various systems
 - ▶ Modelling interoperability of ES

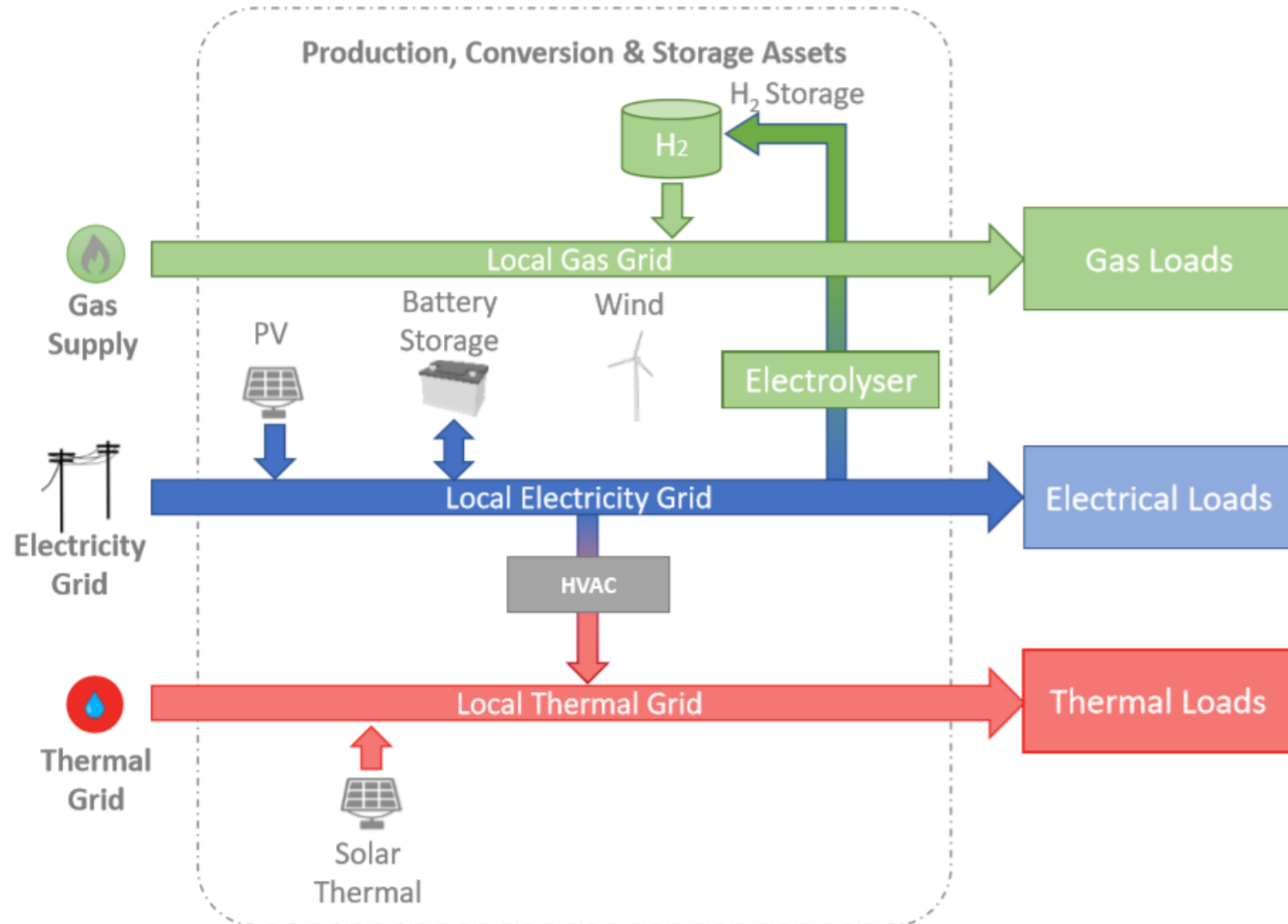
- ▶ Optimization of operation of LES
 - ▶ Optimal (day-to-day) operation

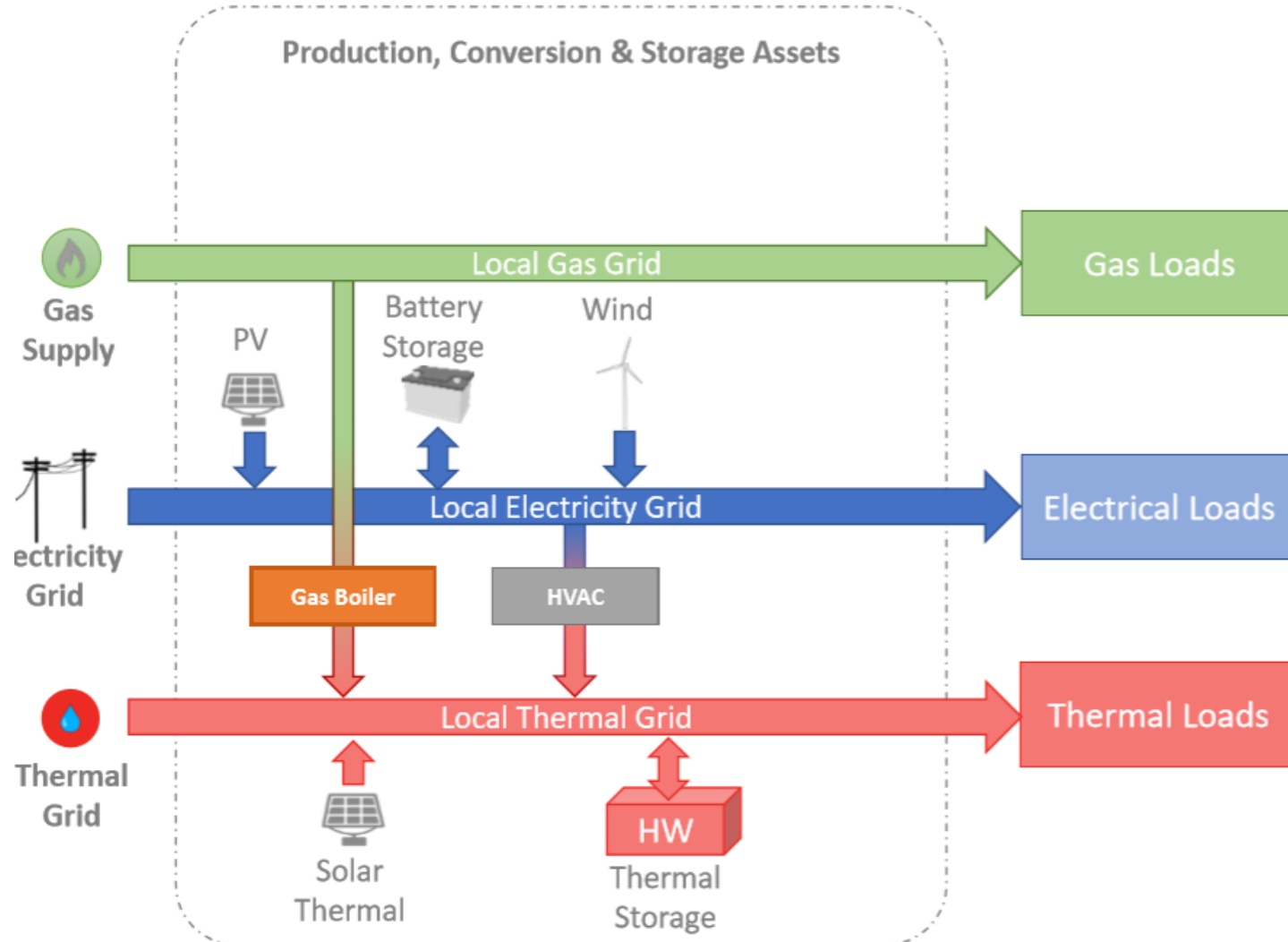
- ▶ Optimal sizing of a Local Energy System
 - ▶ New investments into assets (energy production, storage)

Primary Use Cases (PUCs) and the pilots

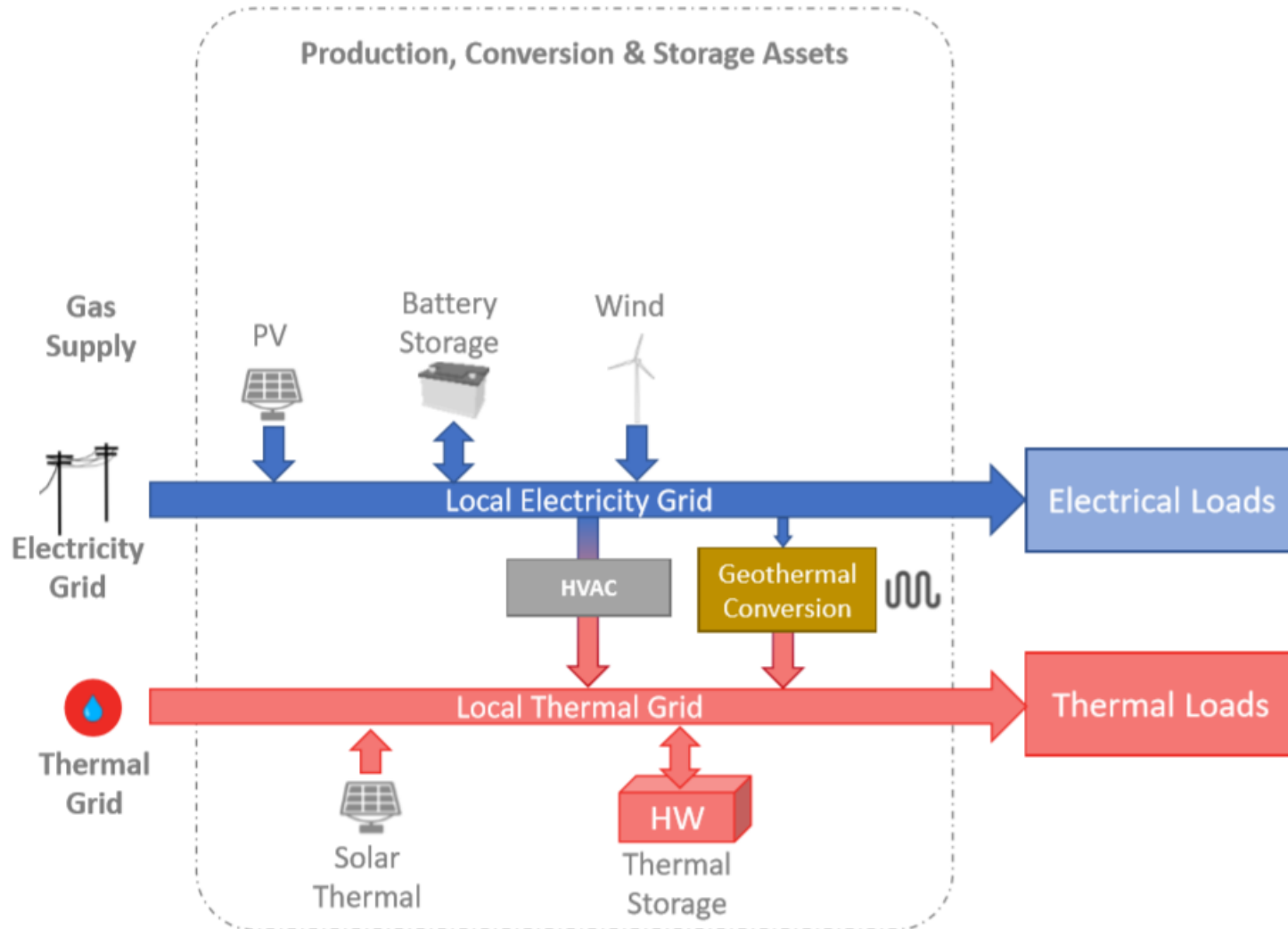
#	Name	ES	RO	NO	India
1	Provide commercial functionality to a multi-vector LES	✓			✓
2	Shift Building loads using Demand Side Management	✓	✓	✓	✓
3	Shift Harbor loads using Demand Side Management			✓	
4	Optimal scheduling of thermal and electrical storage		✓	✓	✓
5	Optimal scheduling of electrical storage 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

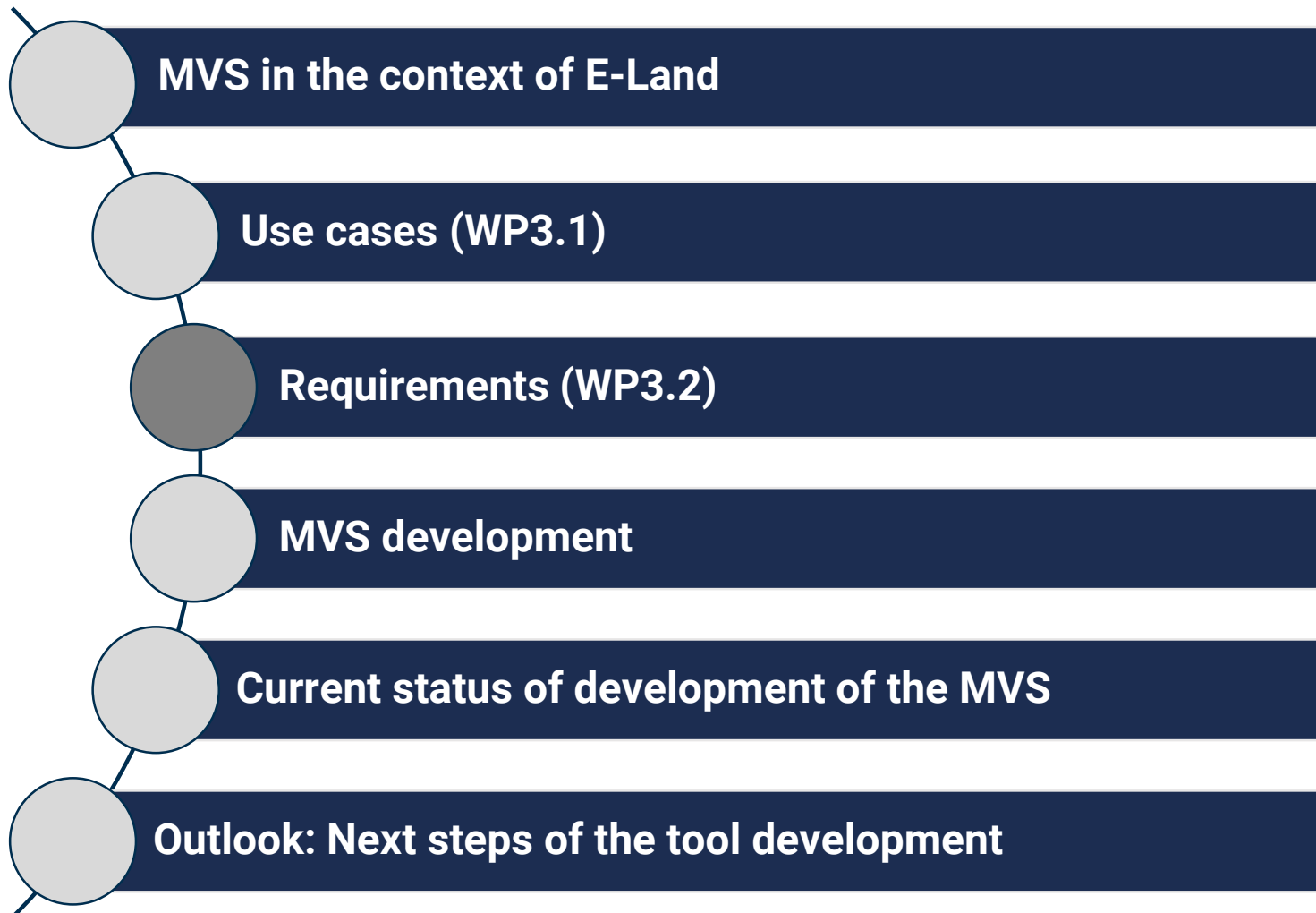




Port of Borg, Norway



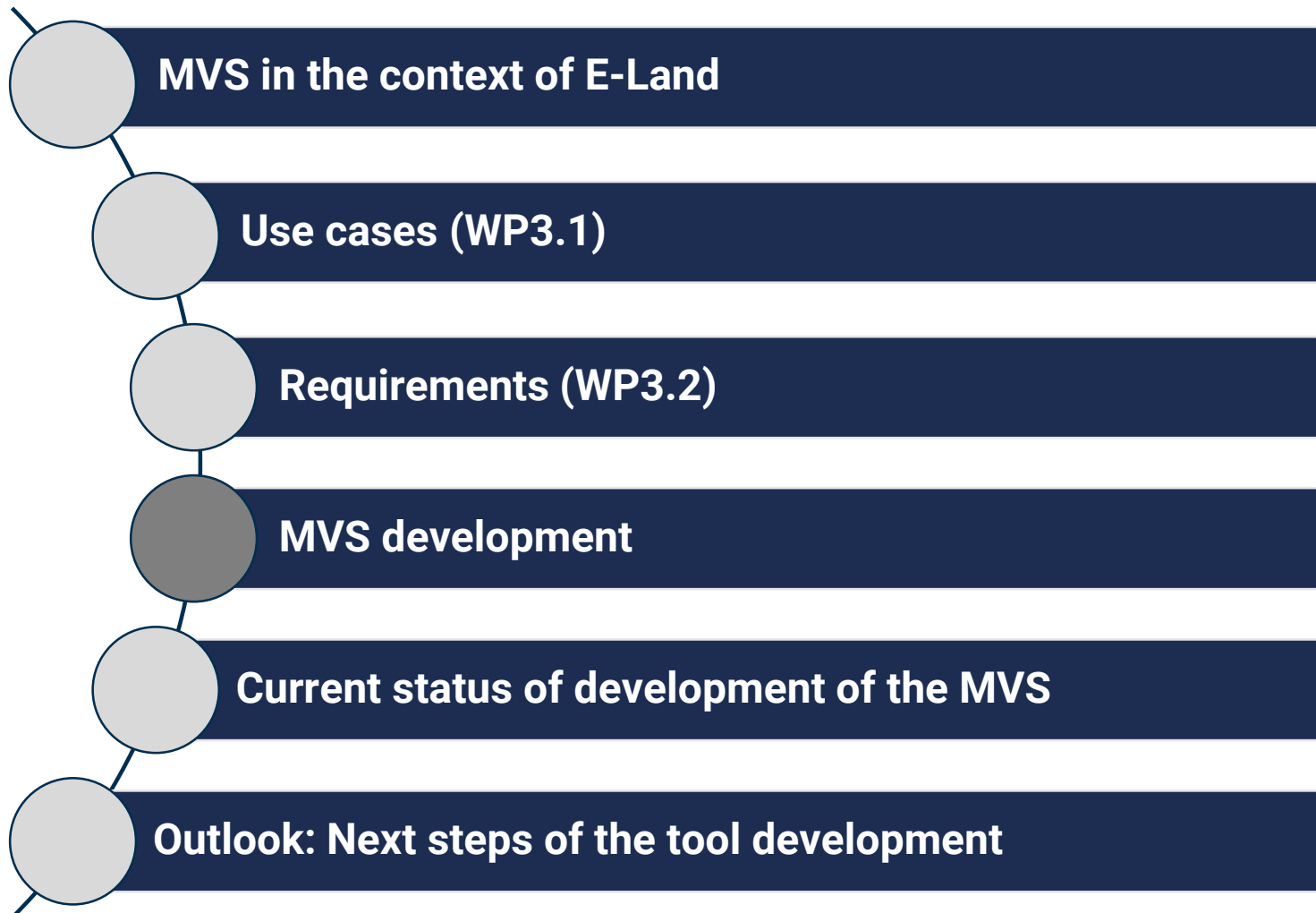
Agenda



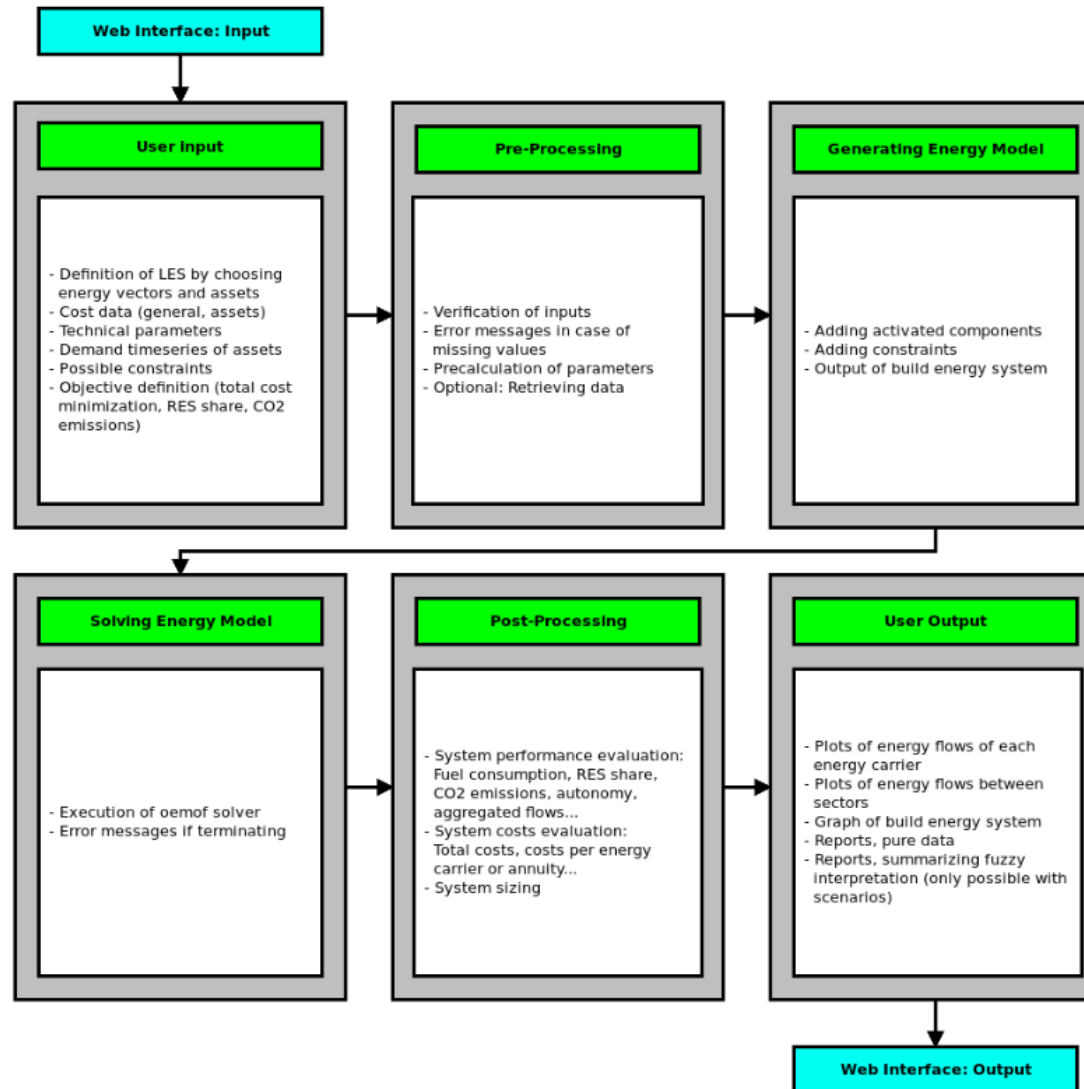
- ▶ WP 3.2 described in detail the tasks the MVS has to perform
 - ▶ Automatic generation of LES
 - ▶ Solving LES
 - ▶ Manual set-up of LES (custom components)
 - ▶ Optimization results
 - ▶ Integrated assets of production/conversion
 - ▶ Setting the optimization goal
 - ▶ Specific energy cost models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

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

Agenda



General MVS modular structure



- ▶ 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

- ▶ E-Land colleagues 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

EPA login

https://www.elandh2020.eu/epa/service_login

E-LAND
Welcome to the
Energy Planning
Application

Sign in to continue:

Incorrect Email or Password

john@mail.com

☒ Remember me

Log In

User Input: Web application

The screenshot shows a web browser window with the URL <https://www.elandh2020.eu/epa>. The page title is "Create new MVS Project". The interface includes a navigation bar with tabs: "Overview" (selected), "Comments", "Energy Vectors Data", and "Assets". A sidebar on the left contains a "Project name" field with the value "PV_panes_sizing_BIKS" and a "Details" text area with the placeholder "More detailed description here...". Below this, a section titled "Energy sectors/carriers to be considered:" lists five options with checkboxes: "Electricity" (checked), "Heat" (checked), "Gas (LNG)" (unchecked), "H2" (unchecked), and "Electric mobility" (unchecked). The main content area features a table of "External energy providers" with columns for "Electricity", "Gas", "Heat", and "H2". The table rows are: "(National) Electricity grid" (checked in all columns), "District heating network" (unchecked in all columns), "Gas (LNG) supplier" (checked in all columns), and "H2 supplier" (unchecked in all columns). At the bottom, a progress bar shows the current step is "Overview", with other steps being "Project Data", "Run simulation", and "Export results".

New Project

https://www.elandh2020.eu/epa

Create new MVS Project

Username

Overview Comments Energy Vectors Data Assets

Project name

PV_panes_sizing_BIKS

Details

More detailed description here...

Energy sectors/carriers to be considered:

- ☒ Electricity
- ☒ Heat
- ☐ Gas (LNG)
- ☐ H2
- ☐ Electric mobility

External energy providers

(National) Electricity grid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
District heating network	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gas (LNG) supplier	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
H2 supplier	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overview Project Data Run simulation Export results

Electricity Gas Heat H2

User Input: Web application

New Project

https://www.elandh2020.eu/epa

Create new MVS Project

Username

Overview Comments Energy Vectors Data **Assets**

PV Plants	Fix	Unit	Var	Unit
panels, ground mounding, cables				
CAPEX (investment costs, 1st year)	100000	currency	7200	currency/kWp*
OPEX (operational costs, 1st year)	80	currency/kWp/a	0	currency/kWp**
Solar MPP, inverter				
CAPEX (investment costs, 1st year)	100000	currency	7200	currency/kWp*
OPEX (operational costs, 1st year)	80	currency/kWp/a	0	currency/kWp**

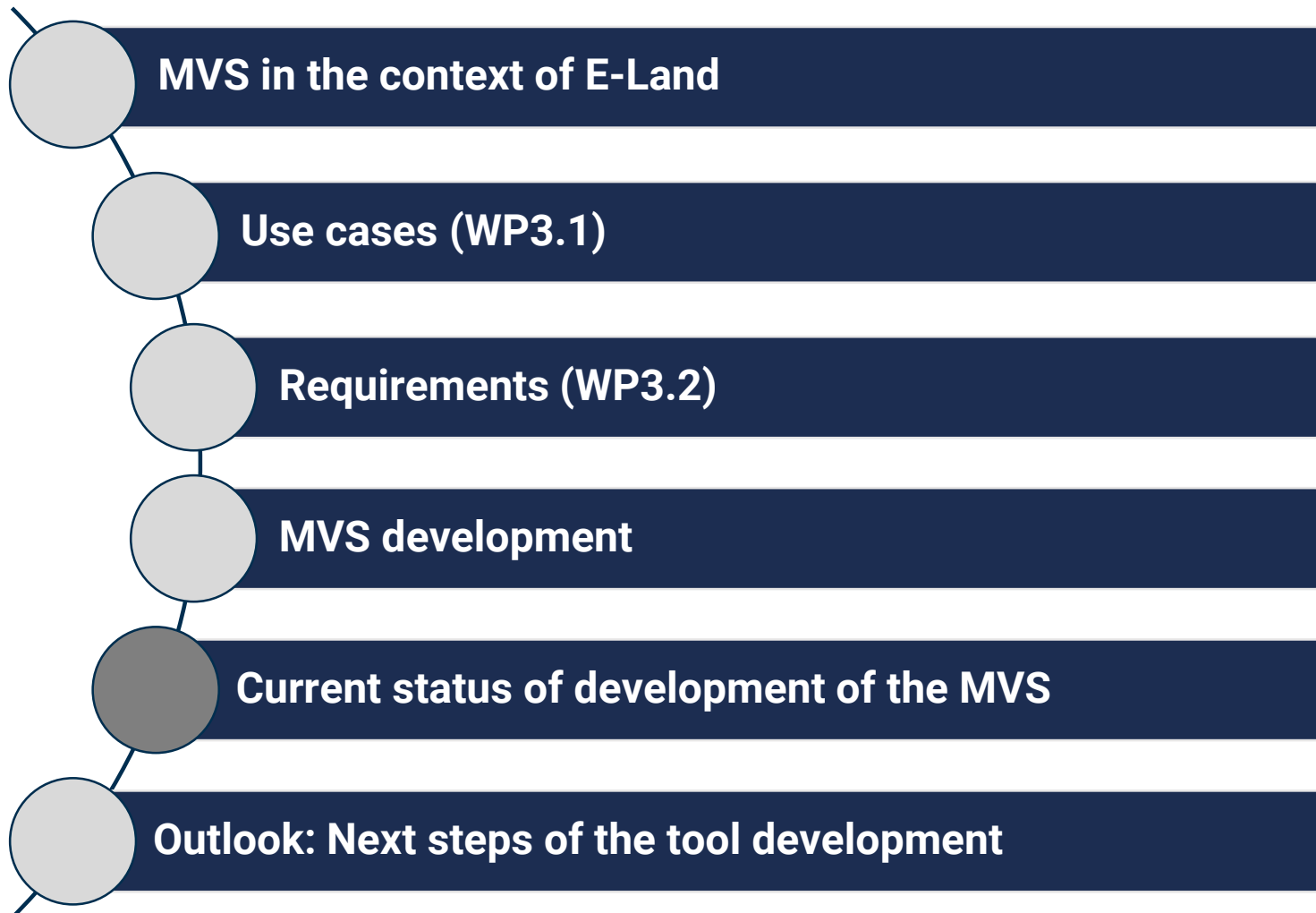
PV Plant

- PV Plant ✓
- Wind plant ✓
- Solar-thermal plant ✓
- ESS
- LNG storage

← Overview Project Data Run simulation Export results →

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 - ▶ A_initialization
 - ▶ B0_data_input
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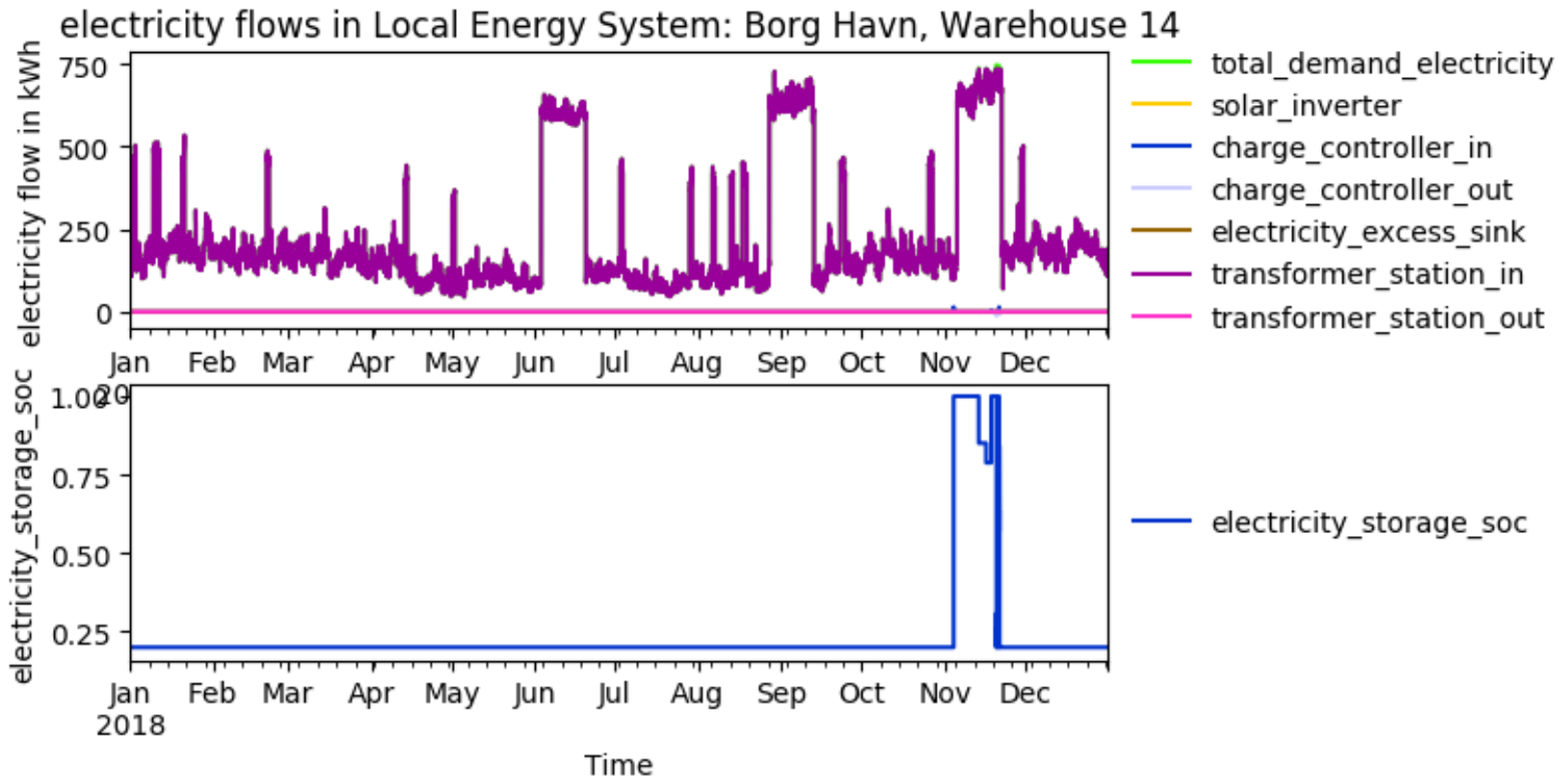
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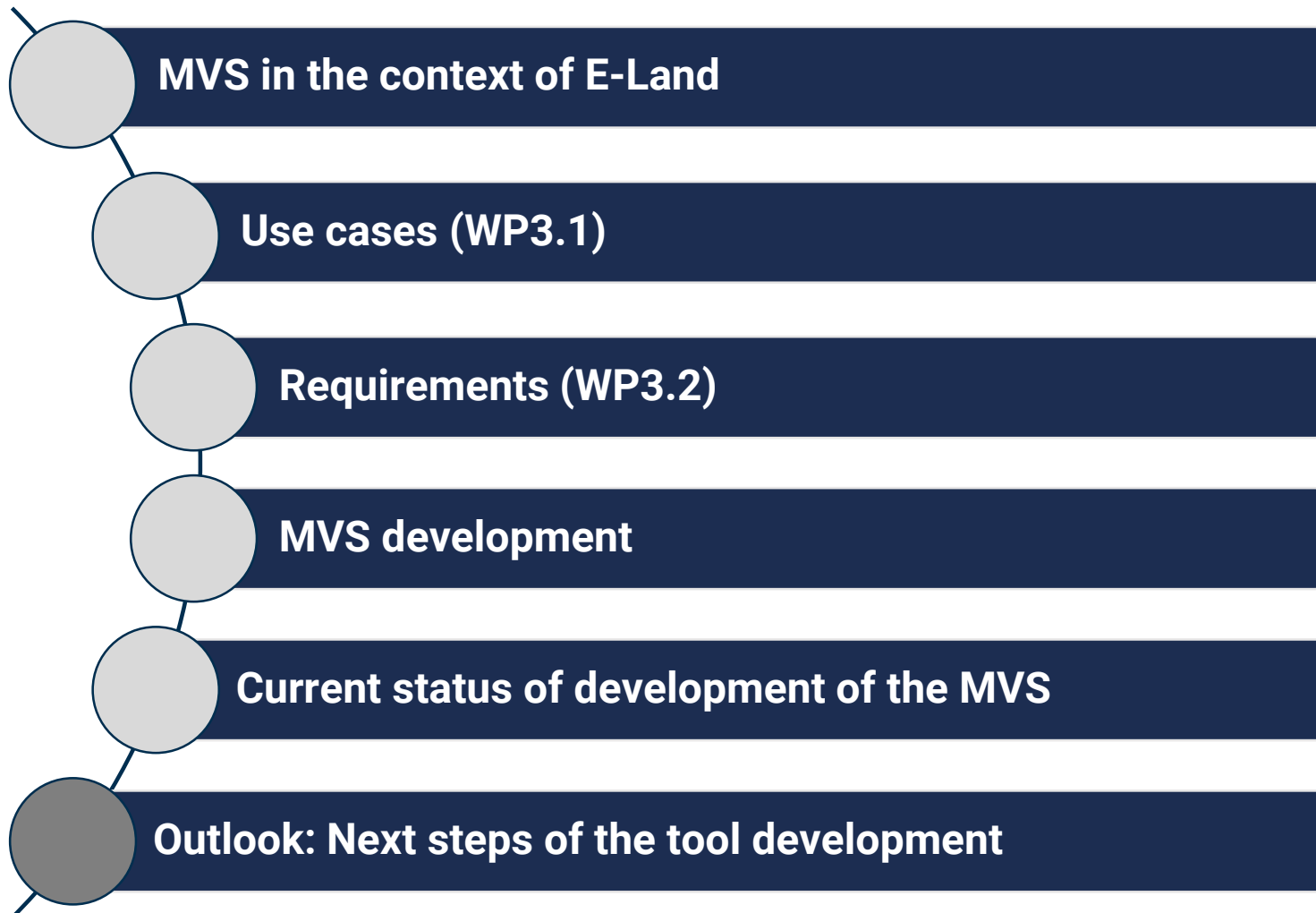
Development status of the MVS

- ▶ 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



Agenda



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 !

How to follow Oemof's activities?

Website: <https://oemof.org/>

Github: <https://github.com/oemof>

Or join our mailing list!



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