Oemof
Workshop Week

Basics

Martha Hoffmann

Session I

RLI, 16.09.2019

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Aim of this session

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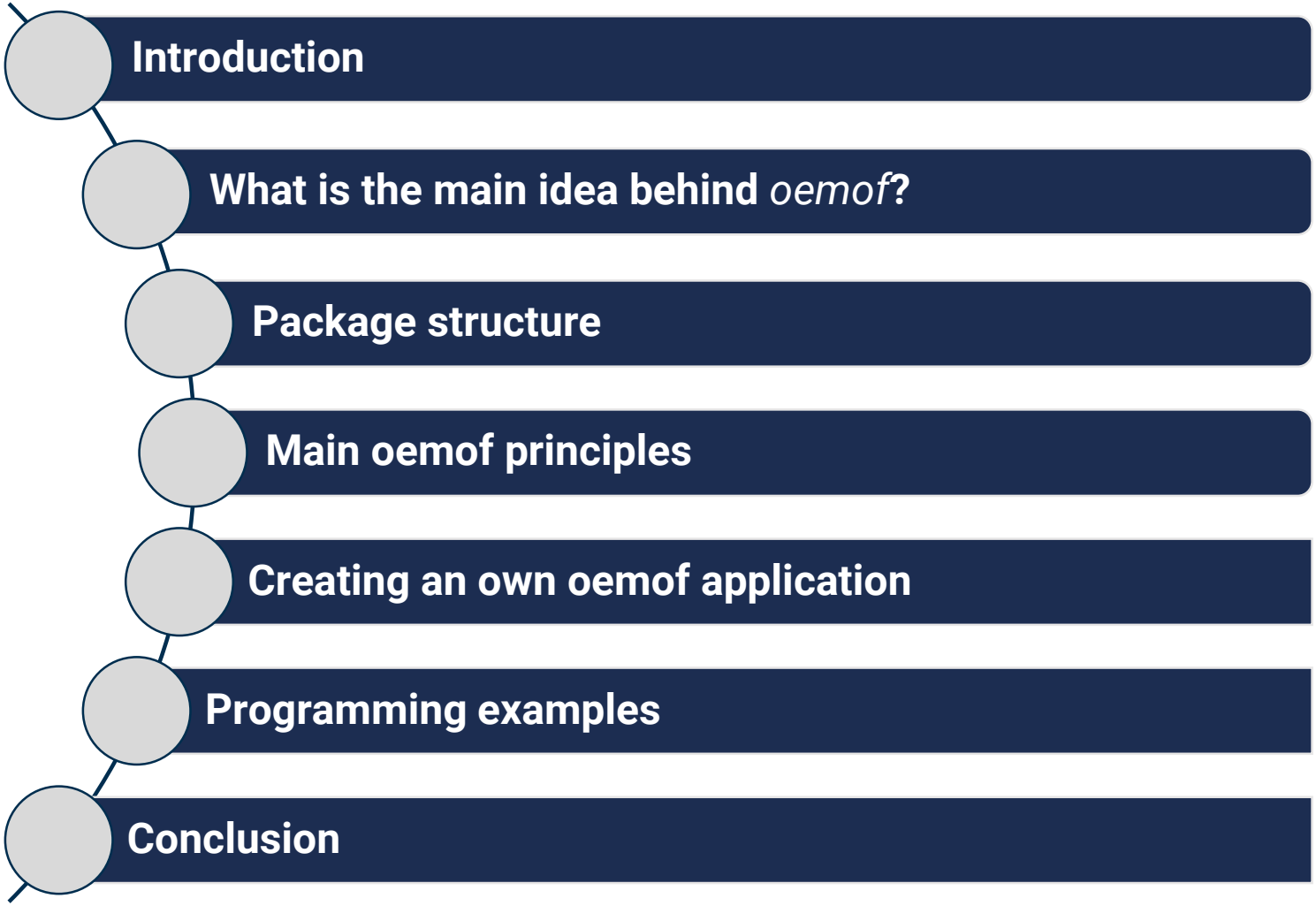
Theoretical and practical introduction to using oemof

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

Agenda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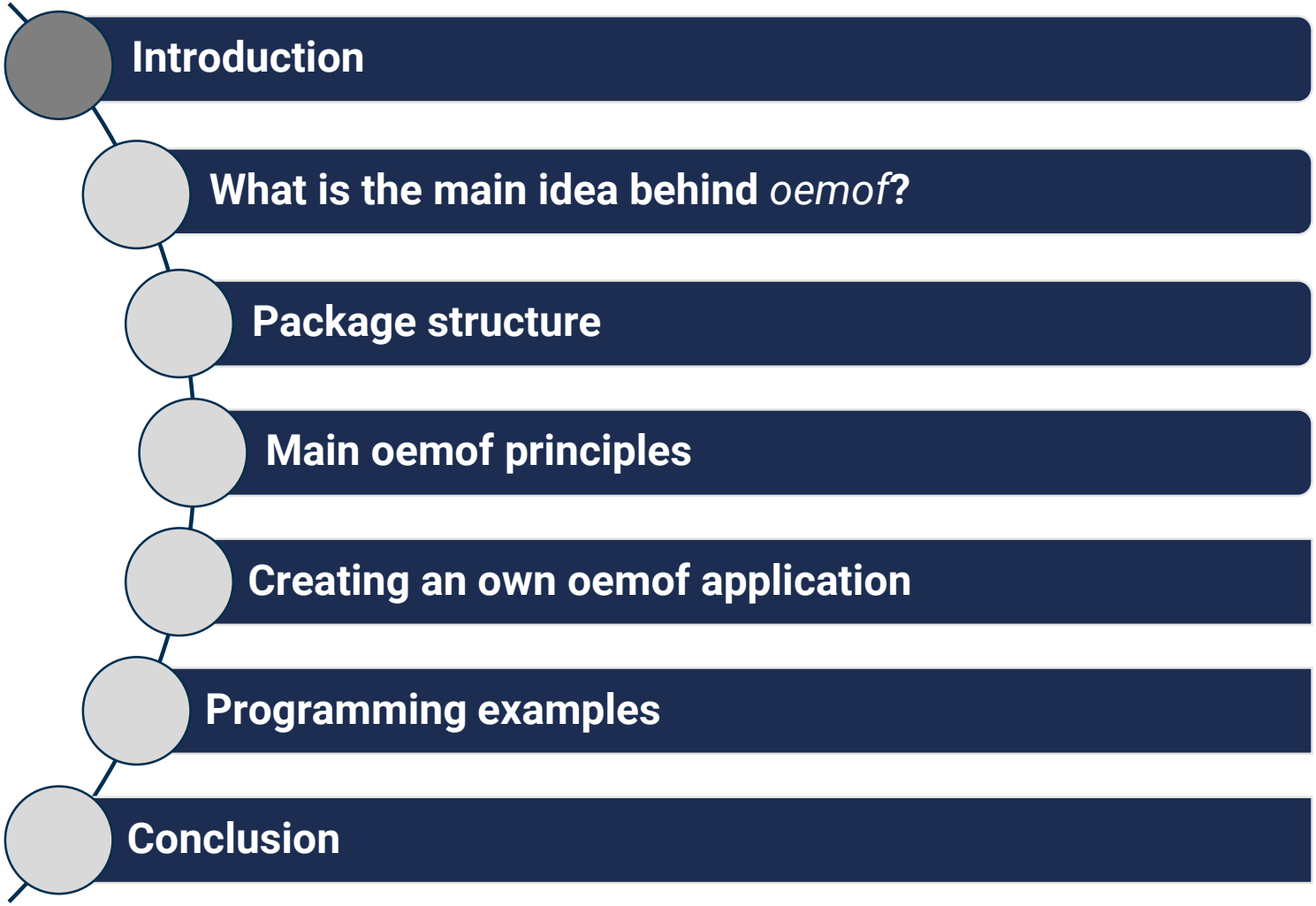
Agenda


Introduction
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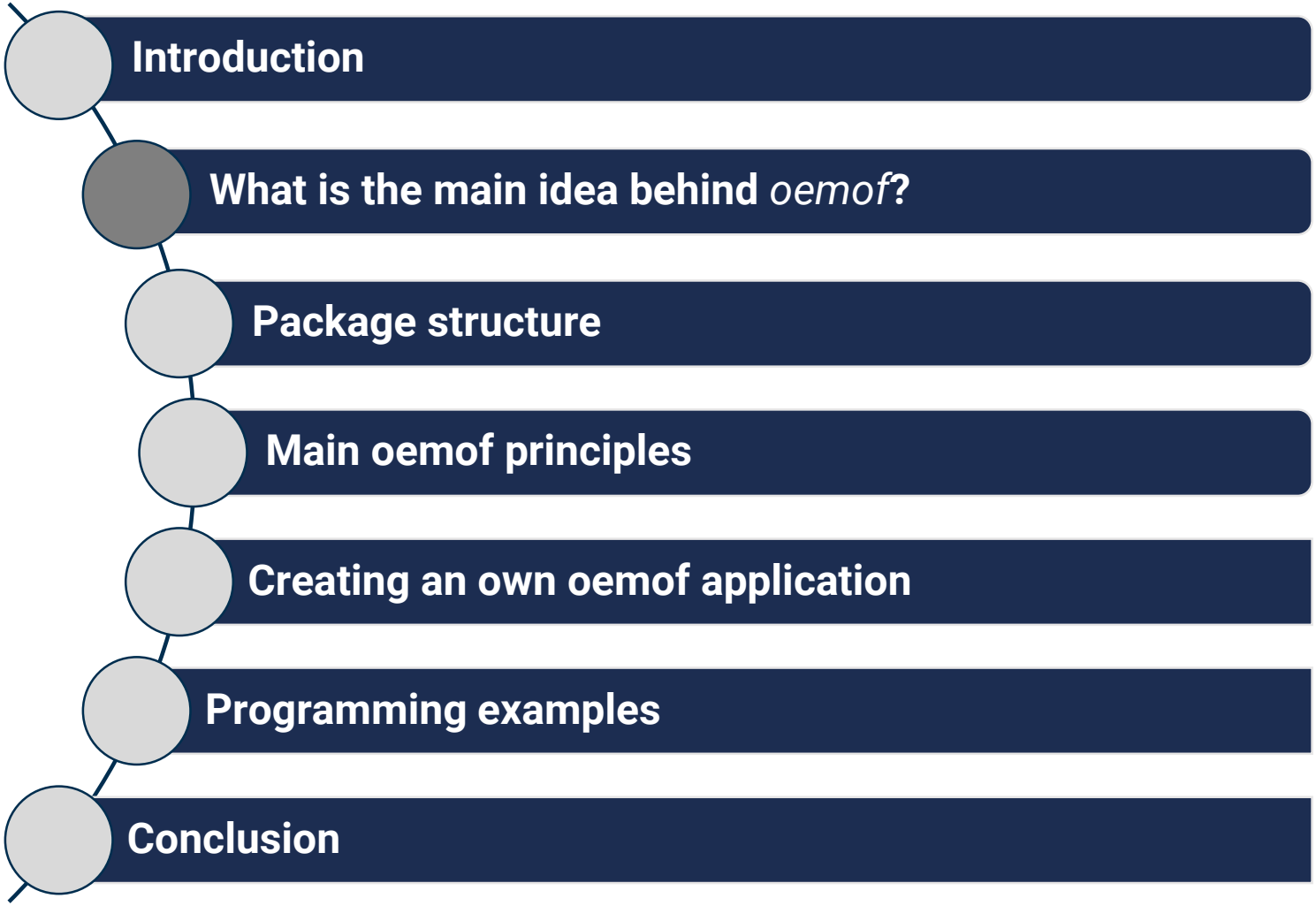
Motivation for open source tools

Open source software is crucial to …

- meet scientific standards in software based research
- foster bottom-up approaches by reducing barriers associated with high license cost of proprietary software tools
- improve research quality & completeness & knowledge pooling due to collaborative modelling

Agenda


Introduction
What is the main idea behind *oemof*?
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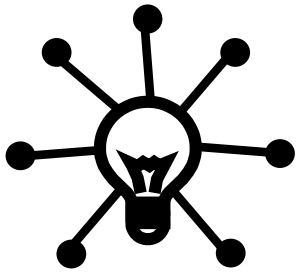
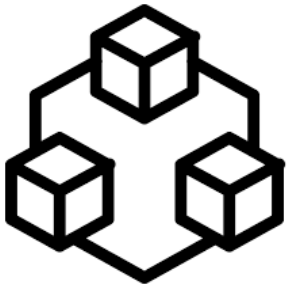
What is the main idea behind *oemof*?

- Collaborative, public development
- Recycling and expansion of existing models
- Modular structure with defined interfaces to correlate other approaches/packages
- Improved review process by the community



collaborative



modular

open source

What is the main idea behind *oemof*?

oemof ['ø:mɔf]

open **e**nergy **mo**delling **f**ramework

- Community-driven open-Source modelling framework initiated by:

ZNES
ZENTRUM FÜR NACHHALTIGE ENERGIESYSTEME
HOCHSCHULE | EUROPA-UNIVERSITÄT FLENSBURG

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OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

- Python package/library specifically developed for energy system modelling
- Model individual requirements/aspects in research projects, dissertations, Bachelor/-Master thesis
- Official website: http://oemof.org

Oemof projects at RLI

- Research projects
  - Publicly funded by EU,
  - BMWI, BMWF
- Research studies
- Contract work
  - Model development
  - Workshops
  - Web-applications
- General oemof uses: https://oemof.org/projects/

oemof ['ø:mɔf]
open energy modeling framework

KOPERNIKUS PROJEKTE
ENavi
Die Zukunft unserer Energie

oemof_heat ['ø:mɔf_'hēt]

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

WINDNODE

open_BEA

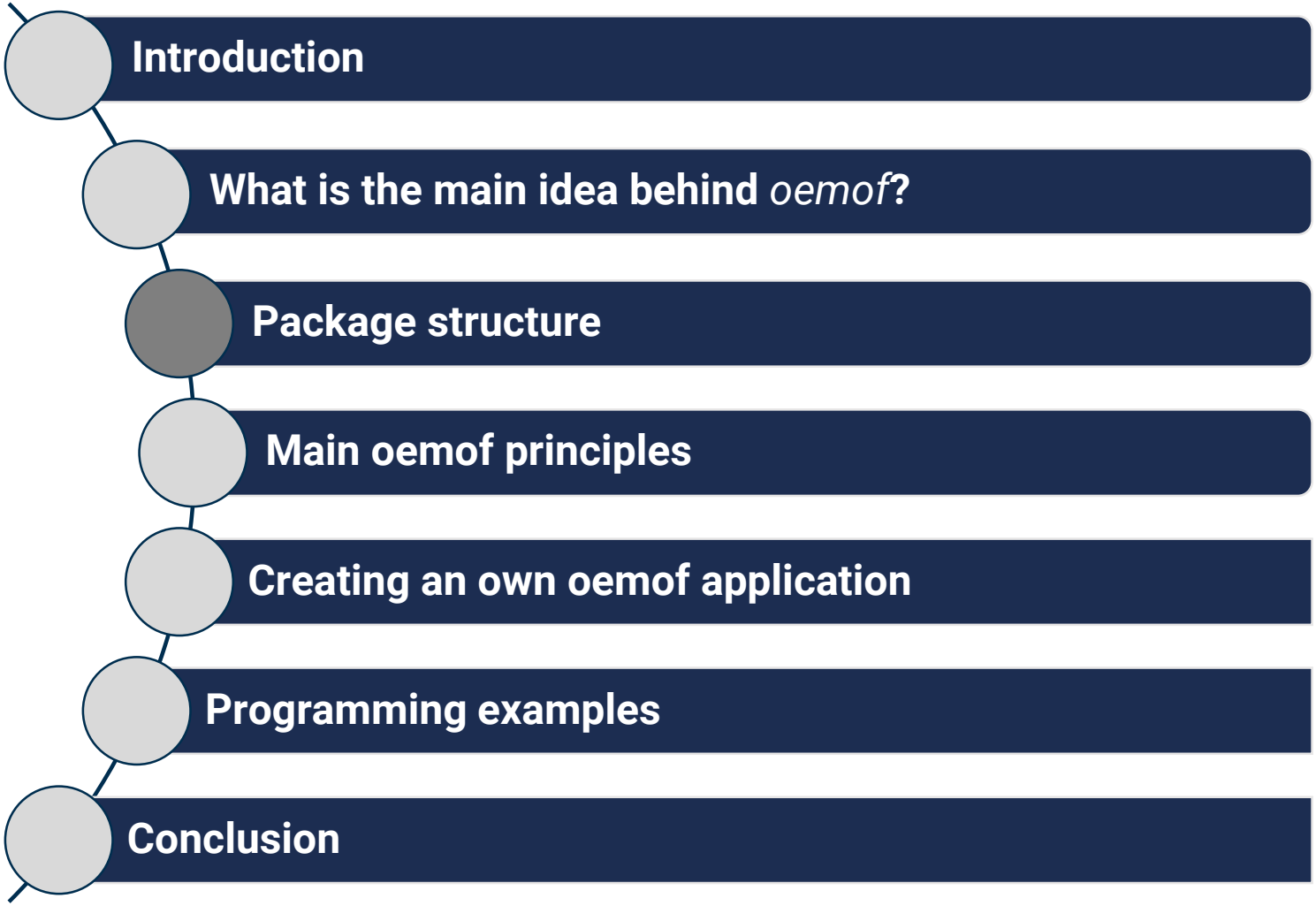
open_MODEX

Horizon 2020
European Union Funding for Research & Innovation

E-LAND

GRECO

Agenda


Introduction
What is the main idea behind *oemof*?
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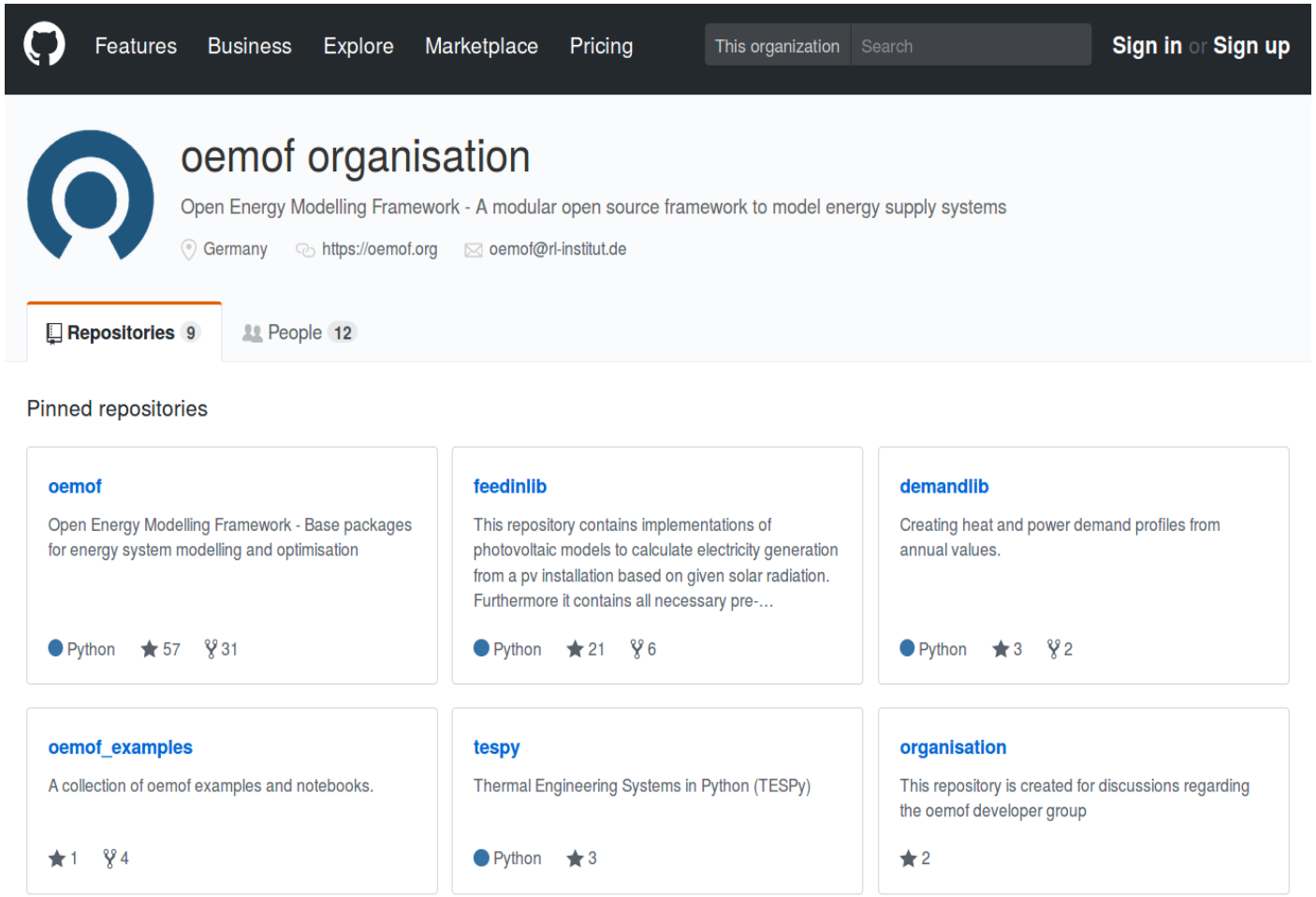
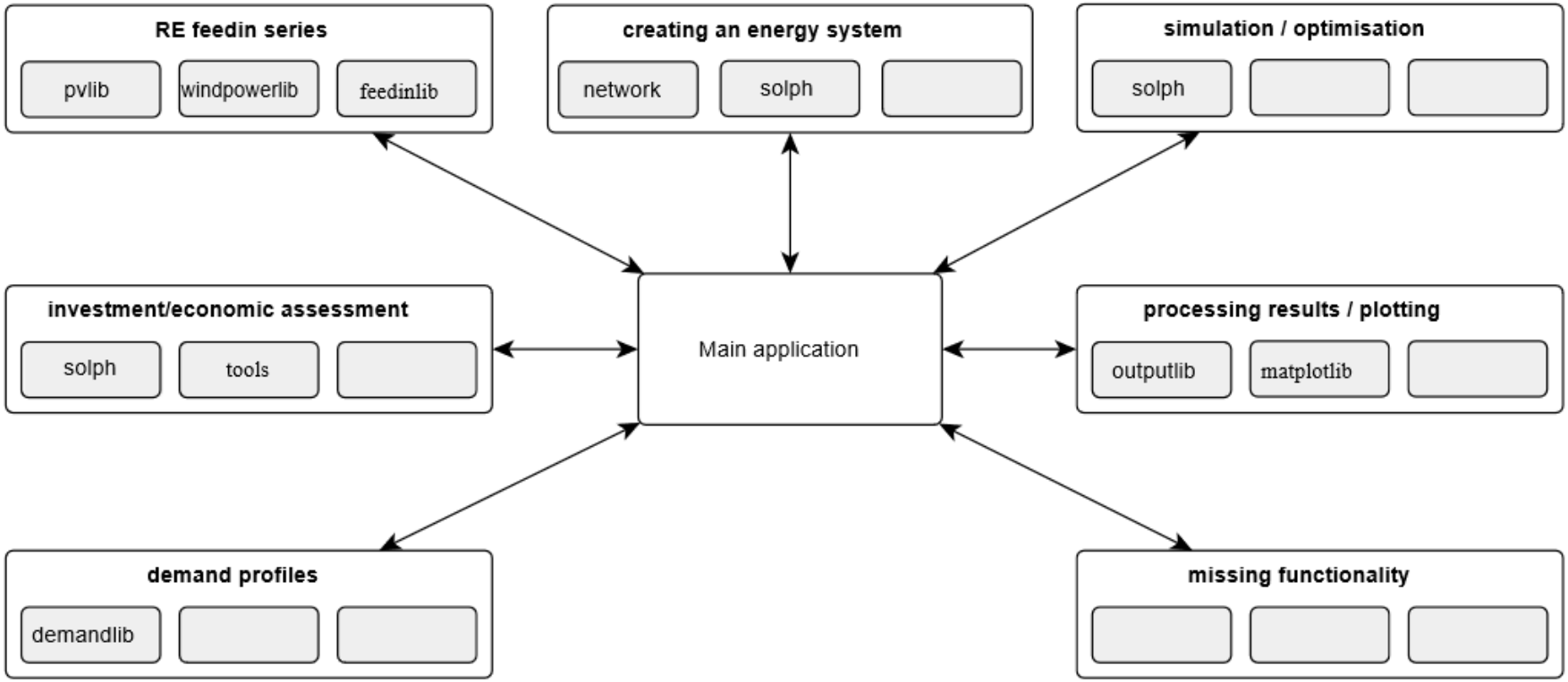
Github reprositories of oemof

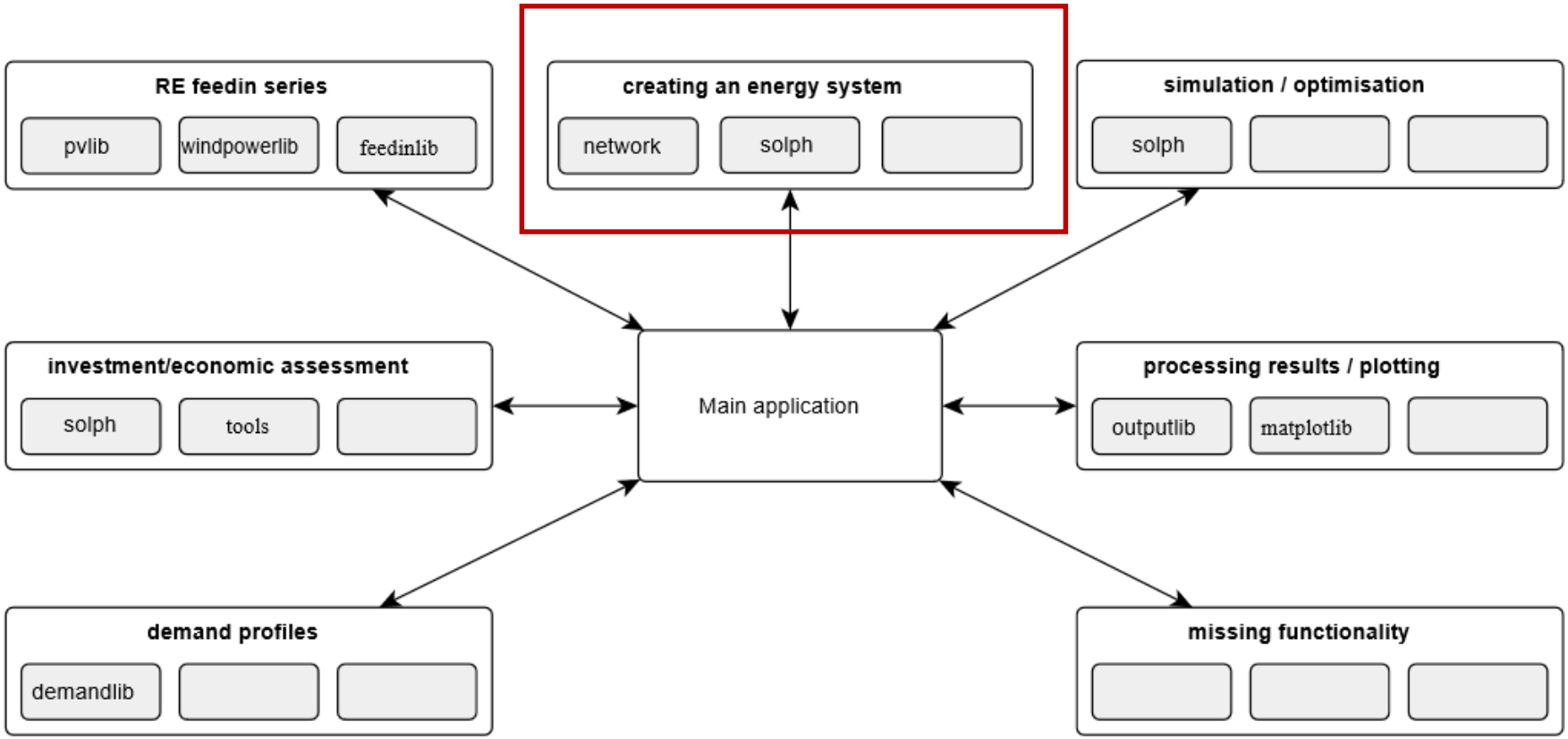
- Oemof toolbox on github: https://github.com/oemof



Package structure



Package structure



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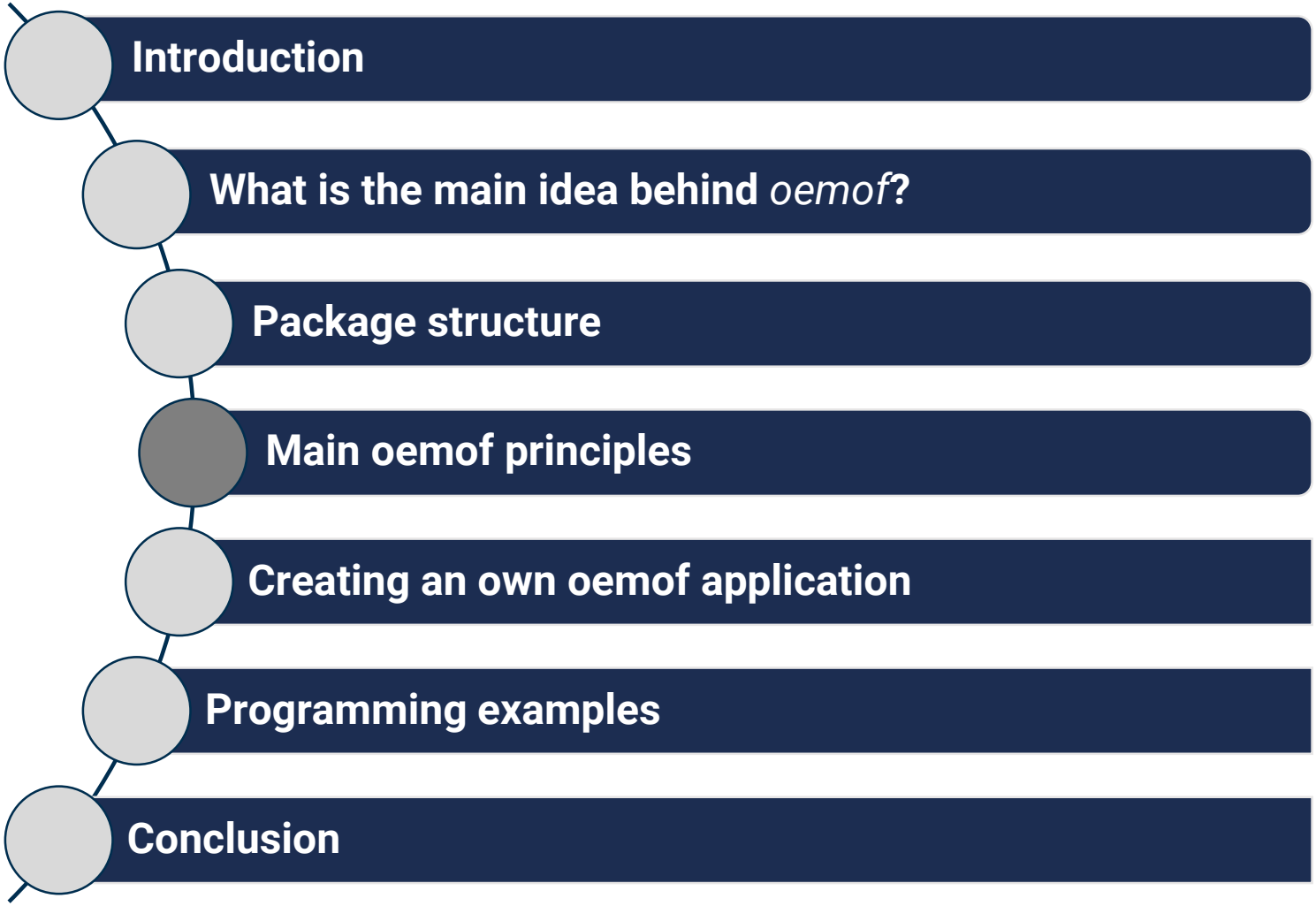
Introduction
What is the main idea behind *oemof*?
Package structure
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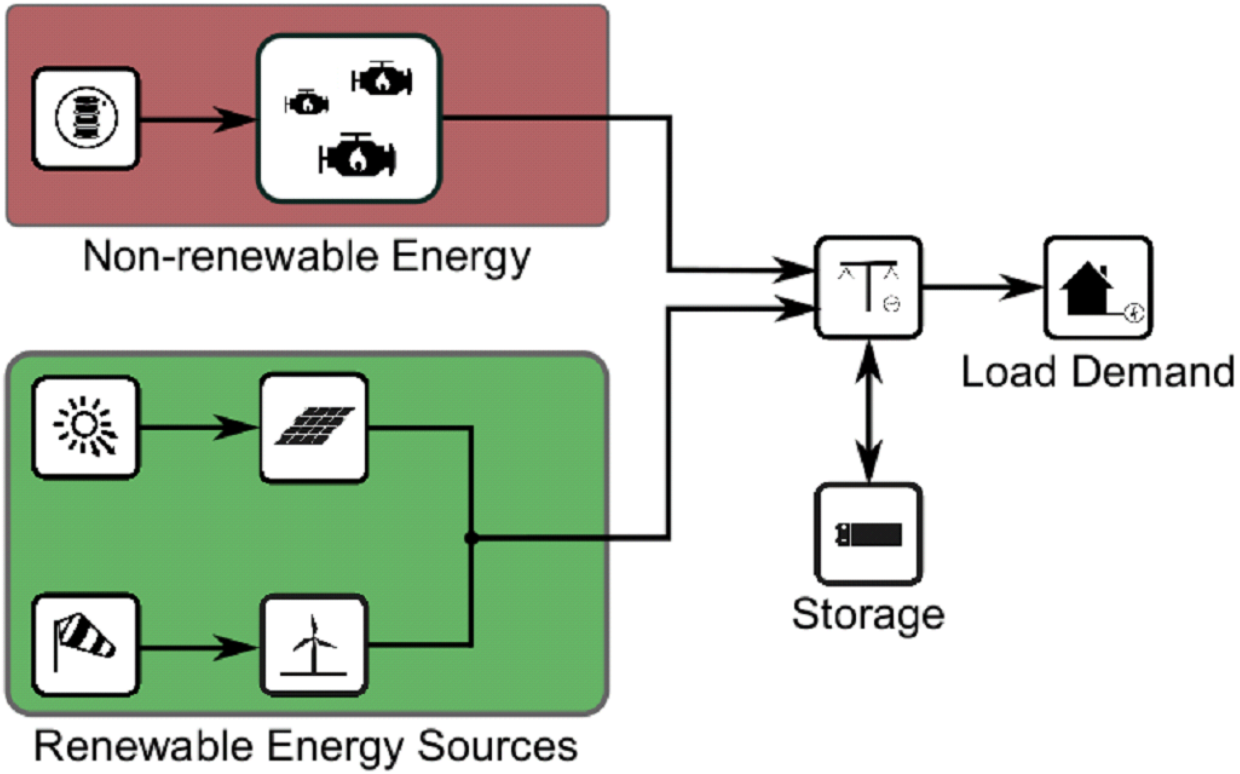
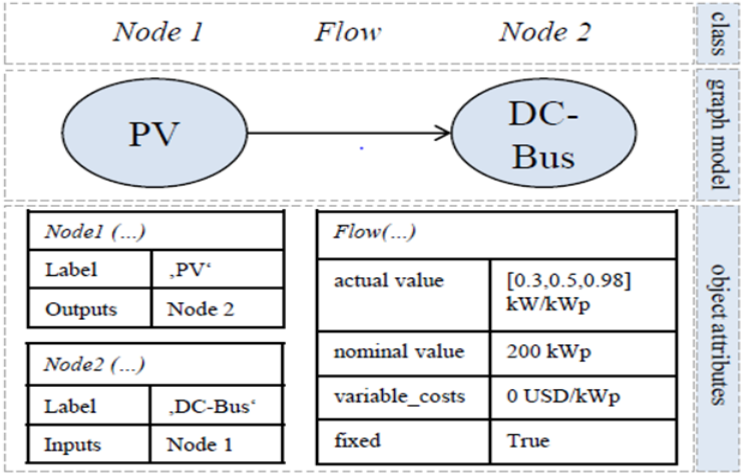
Actual energy system to be simulated



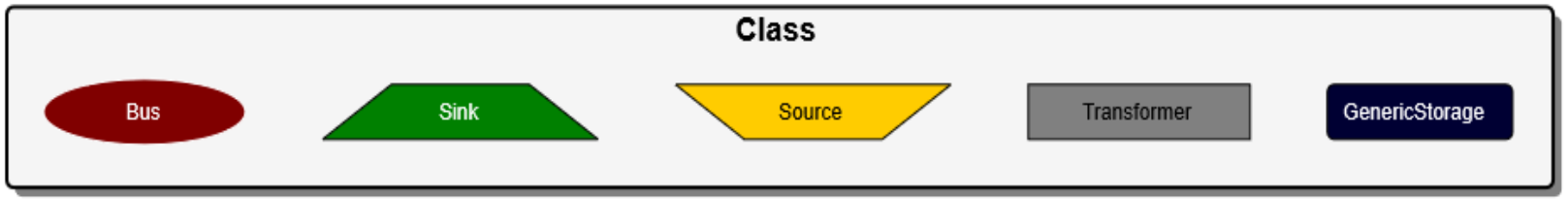
Source/Caption:

Available oemof components

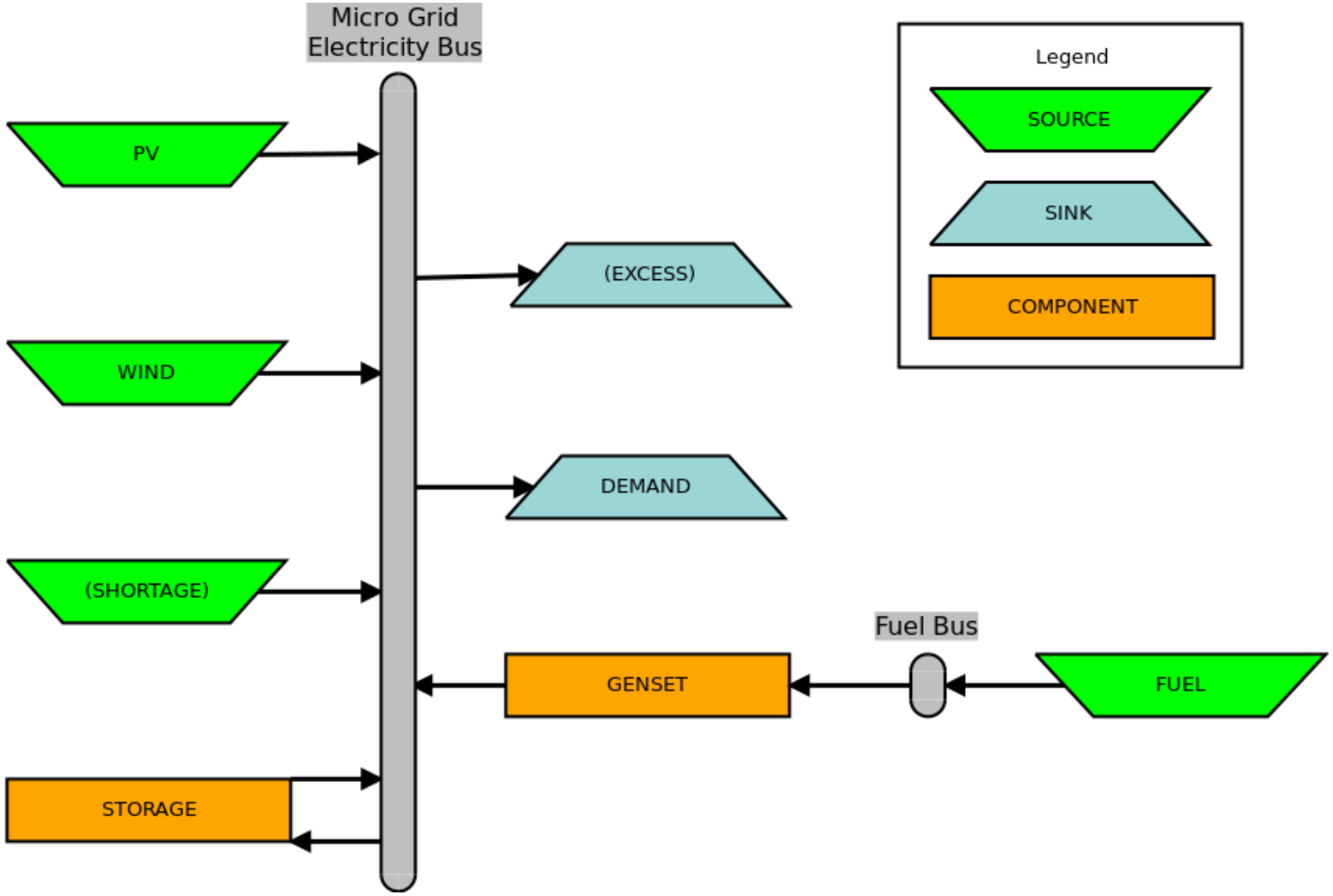
- Graph-based modelling:
  - Energy system build by Nodes, which are uni-laterally connected with Flows



- Main node classes / components:



Simplified, oemof-compatible system



Optimizing with oemof – Objective value

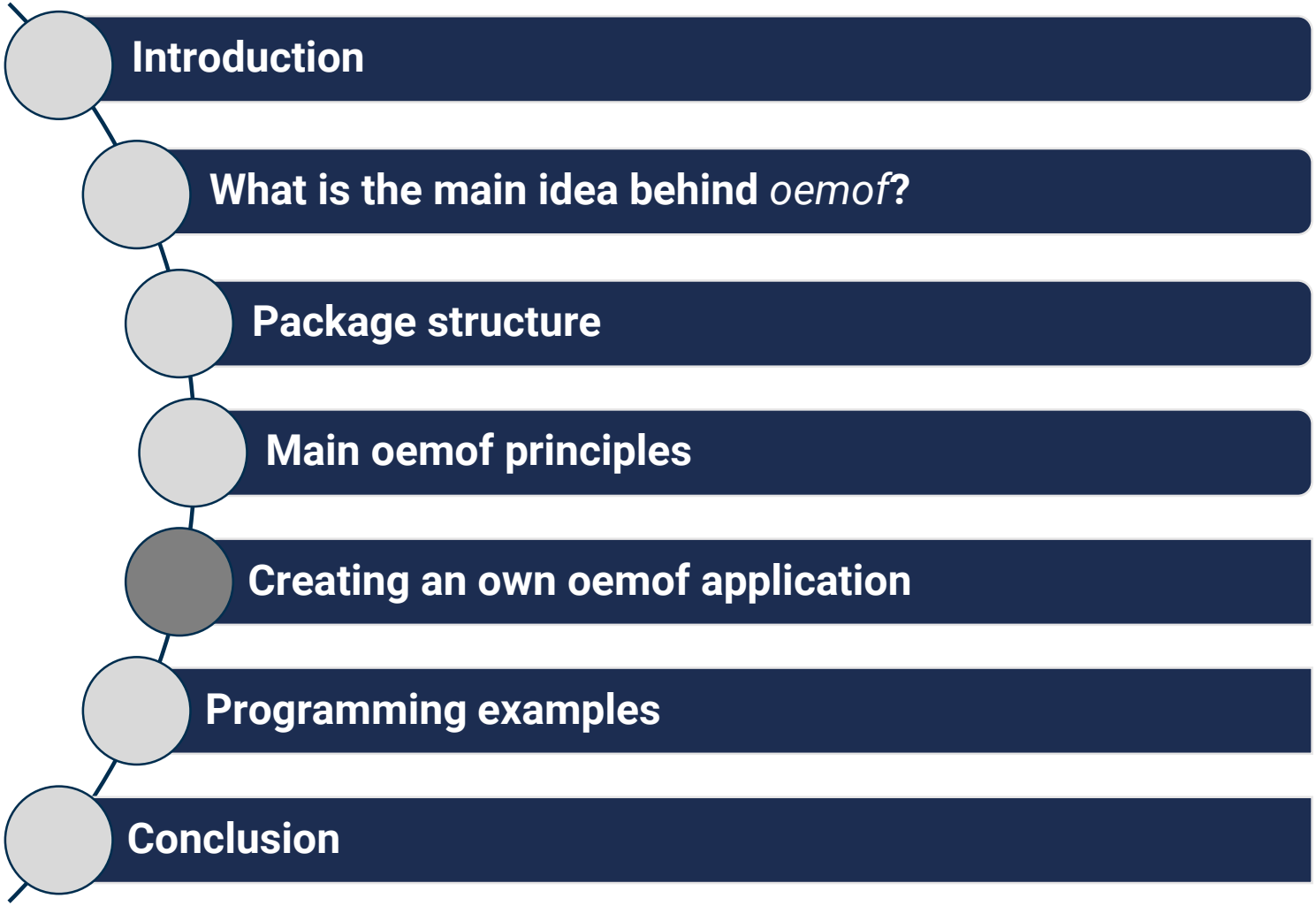
- Oemof generates a linear equation system describing the energy system model
- Solves for the minimal objective value (total costs)
- Target function:

$$min \sum_{i} \left(Capex(i) * CRF(i) + Opex_{fix}(i) \right) * P_{inst}(i) + \sum_{i} \sum_{t} Opex_{var}(i) * E_{gen}(i,t)$$

$$i \in \{WEA, PV, BHKW, Speicher\}$$
$$t \in \{1...8760\}$$

Capex	Capital expenditure	EUR/kW
CRF	Capital recovery factor	-
$Opex_{fix}$	Fixed operational expenditure	EUR/(kW*a)
$Opex_{var}$	Variable operational expenditure	EUR/kWh
P_{inst}	Capacity of component	kW
E_{gen}	Generated electricity per timestep	kWh
i	Index of system components	-
t	Index of time steps	-

Agenda


Introduction
What is the main idea behind *oemof*?
Package structure
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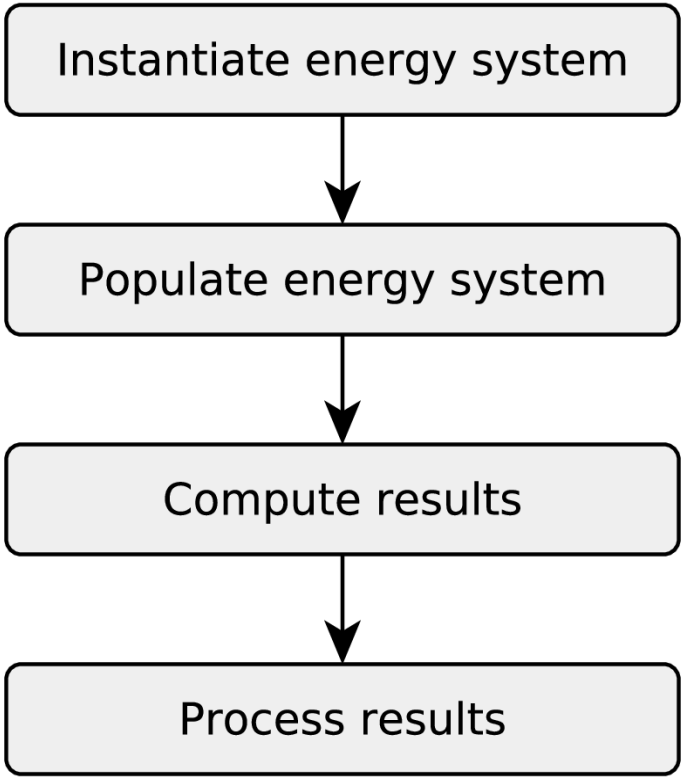
Installation of oemof

- Necessary to install:
  - Python programming environment (eg. pycharm)
  - Package manager (eg. miniconda)
  - Solver (eg. coinor-cbc)
  - Python library oemof

- More information:
  - Slides: Oemof_Workshop_02_Installation.pptx
  - Youtube tutorial for Windows: https://www.youtube.com/watch?v=eFvoM36_szM

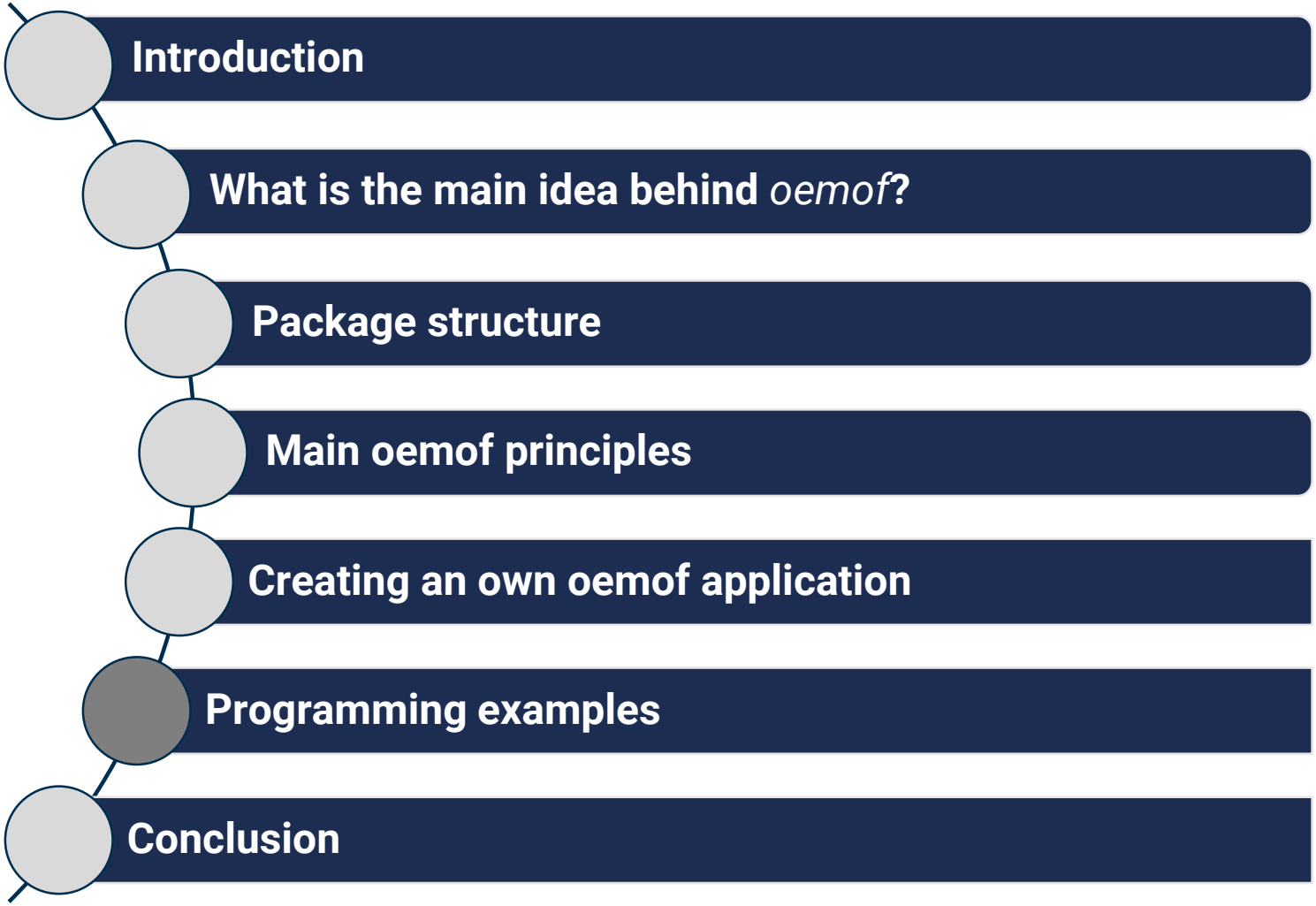
Building an own oemof application



Data requirements of an oemof model

- Economic parameters:
  - Fix and variable cost of the system components
  - For internal processing of costs: WACC, project lifetime)
- Timeseries with values for each timestep:
  - Sources (non-dispatchable generation)
  - Sinks (non-dispatchable demands)
- Technical parameters:
  - Transformer (eg. generator) efficiencies
  - Technical storage parameters

Agenda


Introduction
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Programming examples
Conclusion

Download coding examples

- Download git reprository of this workshop from git: https://github.com/smartie2076/oemof_workshop

- To execute jupyter notebooks:
  - Open terminal, move to folder „/oemof_workshop“
  - Create environment and install requirements

```
pip install -r requirements.txt
```

  - Execute

```
jupyter notebooks
```

Tutorials - Jupyter notebooks

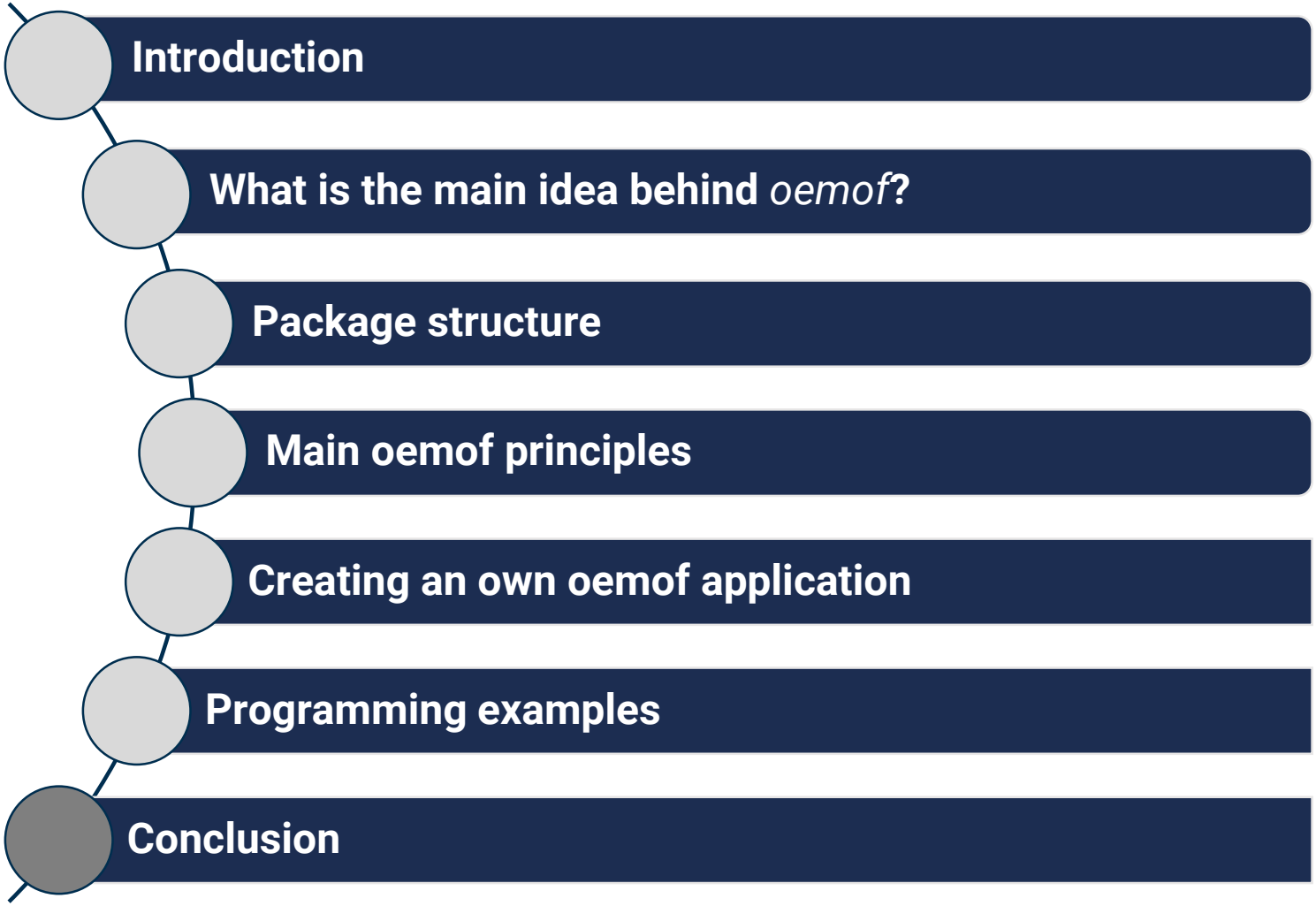
- Dispatch optimization with fixed capacities: ./Day_1_Oemof_Basics/1a_tutorial_dispatch.ipynb
- Investment and dispatch optimization: ./Day_1_Oemof_Basics/2a_tutorial_investment_optimization.ipynb

Tasks - Jupyter notebooks

- Dispatch optimization with fixed capacities: \Day_1_Oemof_Basics\1b_task_dispatch.py
- Investment and dispatch optimization: \Day_1_Oemof_Basics\2b_task_investment_optimization.py

→ Solutions are provided

Agenda


Introduction
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Working with oemof

- Download and use oemof
- Register on and post and discuss issues on: https://forum.openmod-initiative.org/tags/c/qa/oemof
- Indicate or post own projects/coding examples via mail or github
- Find documentation on: http://oemof.readthedocs.io/en/stable/
  - Register errors in documentation via mail or issue or pull request (github)
- Find oemof examples on: https://github.com/oemof/oemof_examples

Helping oemof develop

- Documentation
  - Register or correct spelling and grammar mistakes
  - Re-write sections that are unclear
  - Add missing explainations
- Code
  - Register or fix bugs
  - Fix docstring or code layout
  - Create and submit own components or constraints
  - Add own features or implement requested features
- When developing: Fork/clone oemof reprository: http://github.com/oemof/oemof

Oemof user&developer meetings

- Yearly user&developer meetings

- Half-yearly developer meetings
  - Next meeting: 4. to 6.12.2019, Berlin
  - Register and develop agenda on: https://oemof.org/2019/09/11/oemof-turns-5-anniversary-developer-meeting-in-december-2019/

THANK YOU FOR YOUR ATTENTION !

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How to follow Oemof's activities?

Website: https://oemof.org/
Github: https://github.com/oemof
Or join our mailing list!

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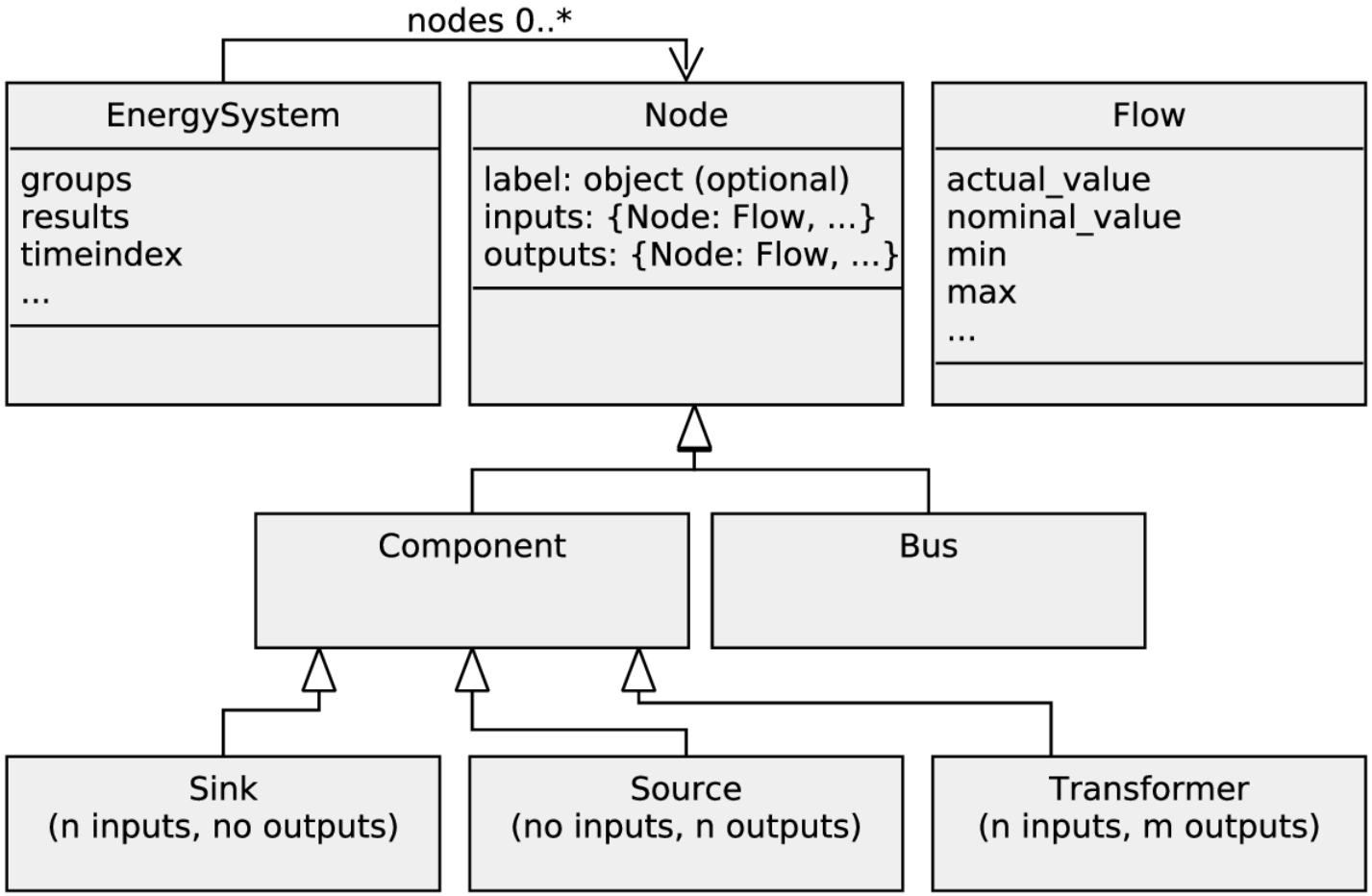
nodes 0..*
EnergySystem
groups
results
timeindex
...
Node
label: object (optional)
inputs: {Node: Flow, ...}
outputs: {Node: Flow, ...}
Flow
actual_value
nominal_value
min
max
...
Component
Bus
Sink
(n inputs, no outputs)
Source
(no inputs, n outputs)
Transformer
(n inputs, m outputs)