Oemof
Workshop Week

Component Models
oemof v0.3.1

Sarah Berendes

Session 3

RLI, 17.09.2019

Agenda

Introduction

Basic Components

Components

Custom Components

Current Development

Discussion

Intro: Components (Models)
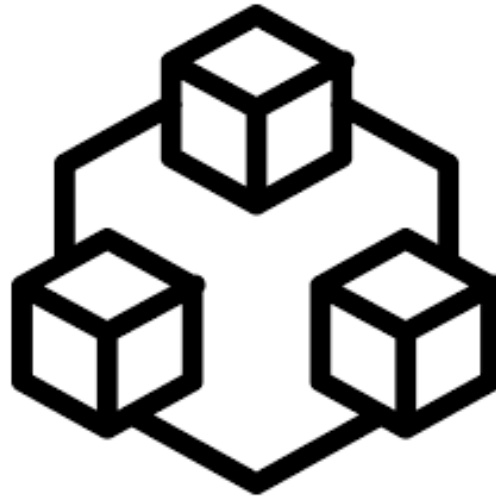
We define all technologies (e.g. power plants), energy carriers (e.g. diesel) and demands (e.g. electricity demand) of the physical energy system as components. A component model describes an abstract representation of a component in the physical system.
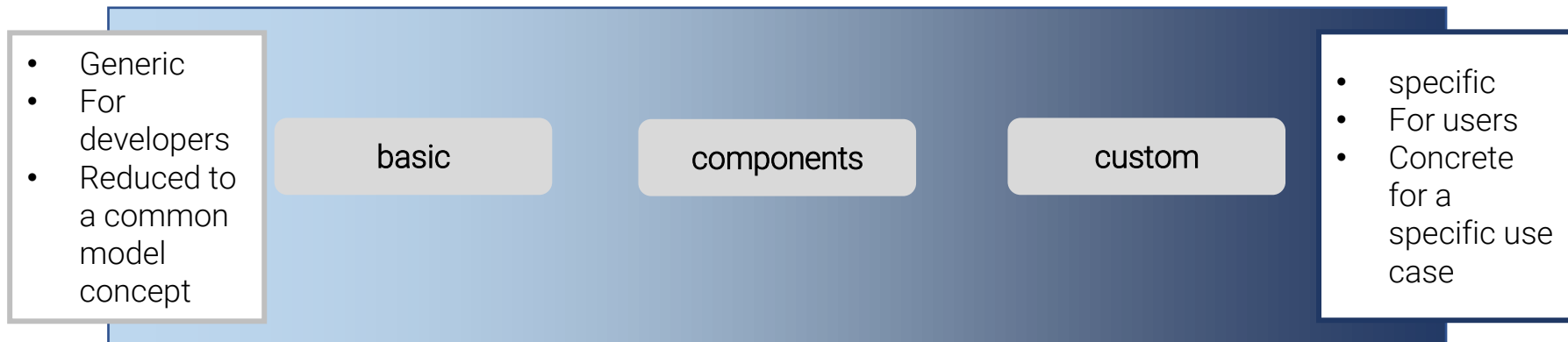
Intro: oemof Characteristics

Modularity and generalization have been key principles behind oemof

Intro: oemof Package Structure

Package Structure: oemof.solph
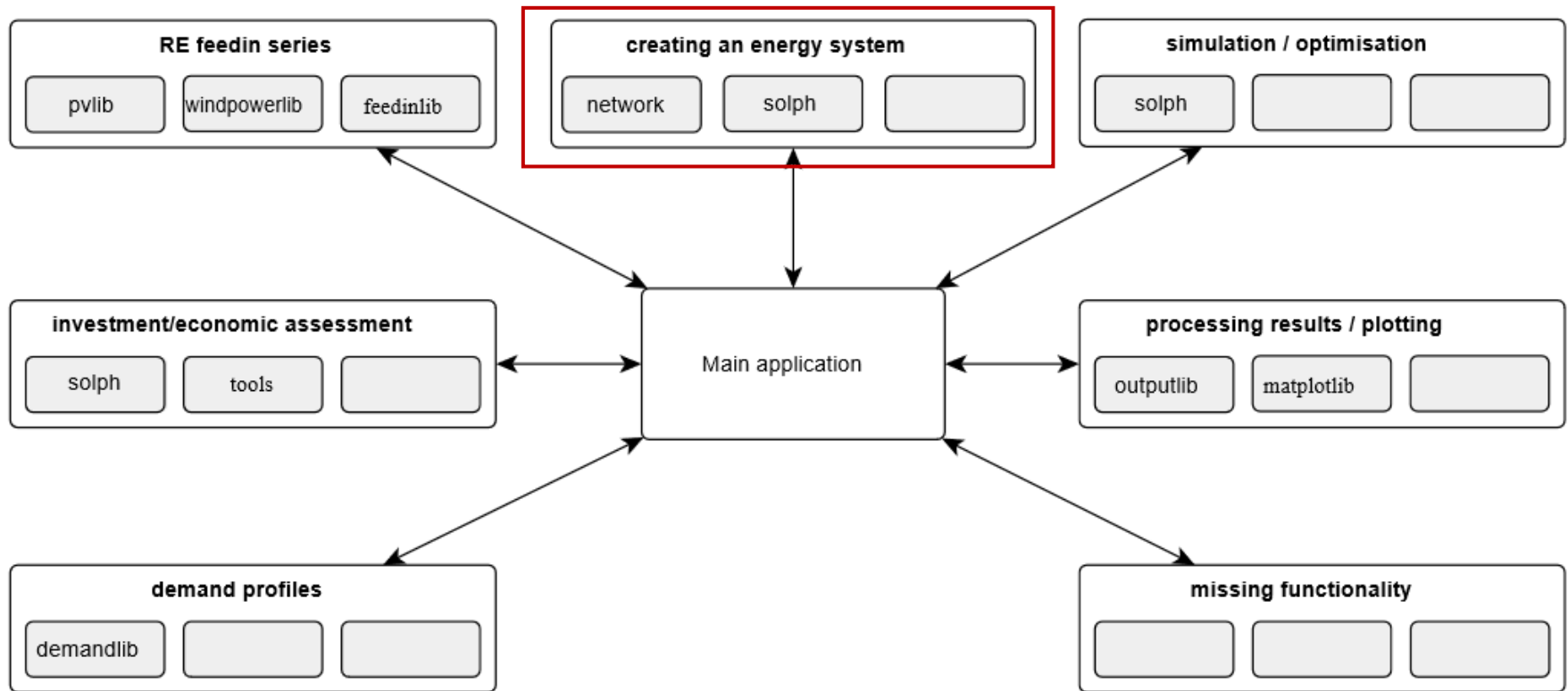
Relevant modules that contain components:

▶ network (basic components)

▶ components

▶ custom

Generic					specific
For developers					For users
Reduced to a common model concept	basic	components	custom		Concrete for a specific use case

Reminder: oemof Modelling Principles

- ▶ (Mixed Integer) Linear Programming + Graph Theory

- ▶ Models composed of Nodes and Edges
  - ▸ Node / Bus or Component (oemof)
  - ▸ Edge / Flow

- ▶ 2 Components can't be directly connected, Bus required in between

- ▶ Bus balance (example)

- ▶ Parameterization mainly done within Flows

Overview Basic Components

Sink

Source

Transfomer

Class: oemof.solph.network

API-Documentation:
https://oemof.readthedocs.io/en/stable/api/oemof.solph.html#module-oemof.solph.network

Note! See example and further information here:

https://github.com/smartie2076/oemof_workshop/tree/master/Day_2_Components_Oemof/3_3_oemof_component_models_oemof_solph.ipynb

Overview Components

GenericStorage

GenericCHP

ExtractionTurbineCHP

OffSetTransformer

Class: oemof.solph.components

API-Documentation:
https://oemof.readthedocs.io/en/stable/api/oemof.solph.html#module-oemof.solph.components

Components.GenericStorage

| Description	Model class to model basic characteristics of (energy) storages
Input(s)/Output(s)	n/m
Bases	Transformer
Balance	Linear
Parameterization (not complete)	nominal_storage_capacity, initial_storage_level, balanced, loss_rate, inflow_conversion_factor, outflow_conversion_factor, min_storage_level, max_storage_level
Examples	Battery Energy System, Pumped Hydro Storage, etc

Components.GenericCHP

Description	Component GenericCHP to model combined heat and power plants.
Input(s)/Output(s)	n/m
Bases	Transformer
Balance	Mixed Integer Linear
Parameterization (not complete)	fuel_input, électrical_output, heat_output, beta (power loss index) back_pressure
Examples	Combined Cycle, Back pressure turbines

Components.ExtractionTurbineCHP

Description	Model combined heat and power plant with extraction turbine
Input(s)/Output(s)	n/m
Bases	Transformer
Balance	Linear
Parameterization (not complete)	conversion_factor, conversion_factor_full_condensation (no tapped flow extraction)
Examples	Simplified CHP model, Extraction Turbine

Components.OffsetTransformer

Description	Model tansformers with an offset
Input(s)/Output(s)	n/m
Bases	Transformer
Balance	Mixed Integer Linear

input(s) → **OffsetTransformer** → output(s)

input-ouput relation

in

out
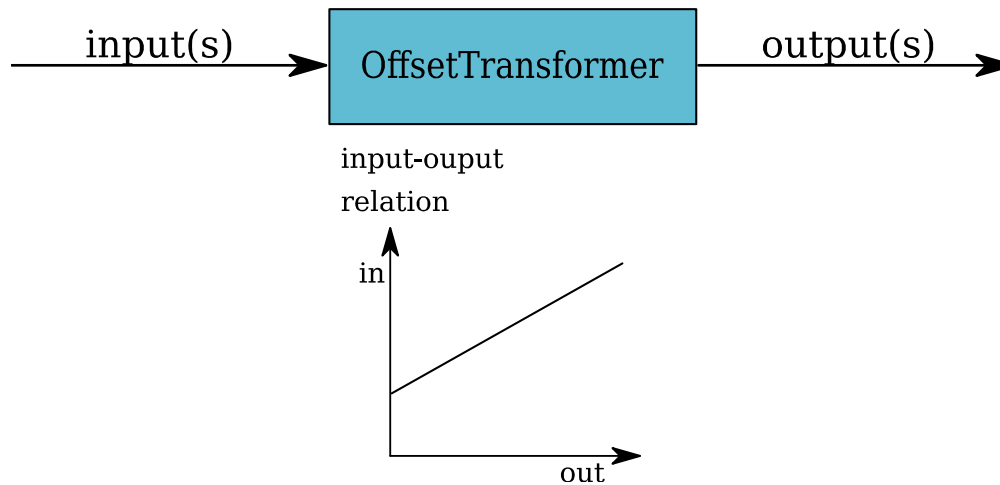
Components.OffsetTransformer

Description	Model tansformers with an offset
Input(s)/Output(s)	n/m
Bases	Transformer
Balance	Mixed Integer Linear
Parameterization (not complete)	coefficients (y-intersection and slope)
Examples	Diesel Generator, CAES

Overview Customs

Link

ElectricalLine

GenericCAES

Class: oemof.solph.custom

API-Documentation:
https://oemof.readthedocs.io/en/sta
ble/api/oemof.solph.html#module-
oemof.solph.customs

Custom.Link

Description	To directly link two nodes Buses
Input(s)/Output(s)	n/m
Bases	Pyomo
Balance	Linear
Parameterization (not complete)	conversion_factors
Examples	Transshipment_link

Note!
- Experimental
- Needs improvment

Custom.ElectricalLine

Description	To do linear optimal power flow calculations based on angle formulation.
Input(s)/Output(s)	either in or out
Bases	Flow
Balance	Mixed Integer Linear
Parameterization (not complete)	reactance
Examples	Grid model

Note!
- connected buses need to be of the type ElectricalBus.
- It does not work together with flows that have set the attr.`nonconvex`
- Input and output of this component are set equal, therefore just use either only the input or the output to parameterize.
- Default attribute min of in/outflows is overwritten by -1 if not set differently by the user

Custom.ElectricalBus

Description	Bus object to be used with Electrical Line for LOPF
Input(s)/Output(s)	n/m
Bases	Bus
Balance	Mixed Integer Linear
Parameterization (not complete)	slack max_voltage_angle min_voltage_angle
Examples	Grid model

Custom.GenericCAES

Description	To model a arvitrary compressed air energy storage
Input(s)/Output(s)	n/m
Bases	Transformer
Balance	Mixed Integer Linear
Parameterization (not complete)	electrical_input, fuel input, electrical_output,
Examples	-

Note!
• Set of equations can be found in Kaldemeyer, C.; Boysen, C.; Tuschy, I.
A Generic Formulation of Compressed Air Energy Storage as Mixed Integer Linear Program – Unit Commitment of Specific Technical Concepts in Arbitrary Market Environments Materials Today: Proceedings 00 (2018)
• experimental

Components- Current Developments

oemof-tabular.facades

provide energy specific access, provide an interface to tabular data sources from that models can be created easily. Map facade to energy systems.

Link: https://github.com/oemof/oemof-tabular/

Project: oemof_heat

Heat components for oemof e.g. heat pump, solar thermal collector, hot water storage, concentrating solar

Link: https://reiner-lemoine-institut.de/en/oemof_heat/

https://github.com/oemof-heat

(planned) Project: oemof_mobility

Discussion

Questions?
Comments?

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!

License

Except where otherwise noted, this work and its content (texts and illustrations) are licensed under the Attribution 4.0 International (CC BY 4.0)

See license text for further information.

Tel: +49 (0)30 1208 434 0

E-Mail: sarah.berendes@rl-institut.de

Web: http://www.rl-institut.de

Twitter: @rl_institut