



IBPSA Project 1

IBPSA Project 1
BIM/GIS and Modelica Framework for building and
community energy system design and operation
TASK 3: Application and Dissemination
ST 3.1 District Energy DESTEST

Dirk Saelens

Rome expert meeting – Status presentation – 2019.08.31

Development of DESTEST

Aim is to:

1. Develop typical or representative DES configurations
 - that can be used for testing different DES simulation environments (intermodel comparison, ...)
 - that can be used for testing different DES implementations and approaches (f.i. central vs decentral storage)
2. Develop a test framework for testing models in a DES environment
(f.i. substations, pipes, heatpumps ...)

Activities

- Main activities
 - 3 Coordination meetings (May, July, August)
 - Many subgroup meetings
 - Finalization of common exercise 1
 - Preparation of next common exercises / reporting
- Papers for BS2019
 - Towards a DESTEST: a District Energy Simulation Test Developed in IBPSA Project 1, Dirk Saelens et al
 - The influence of input data uncertainty on the district energy demand, Ina De Jaeger et al

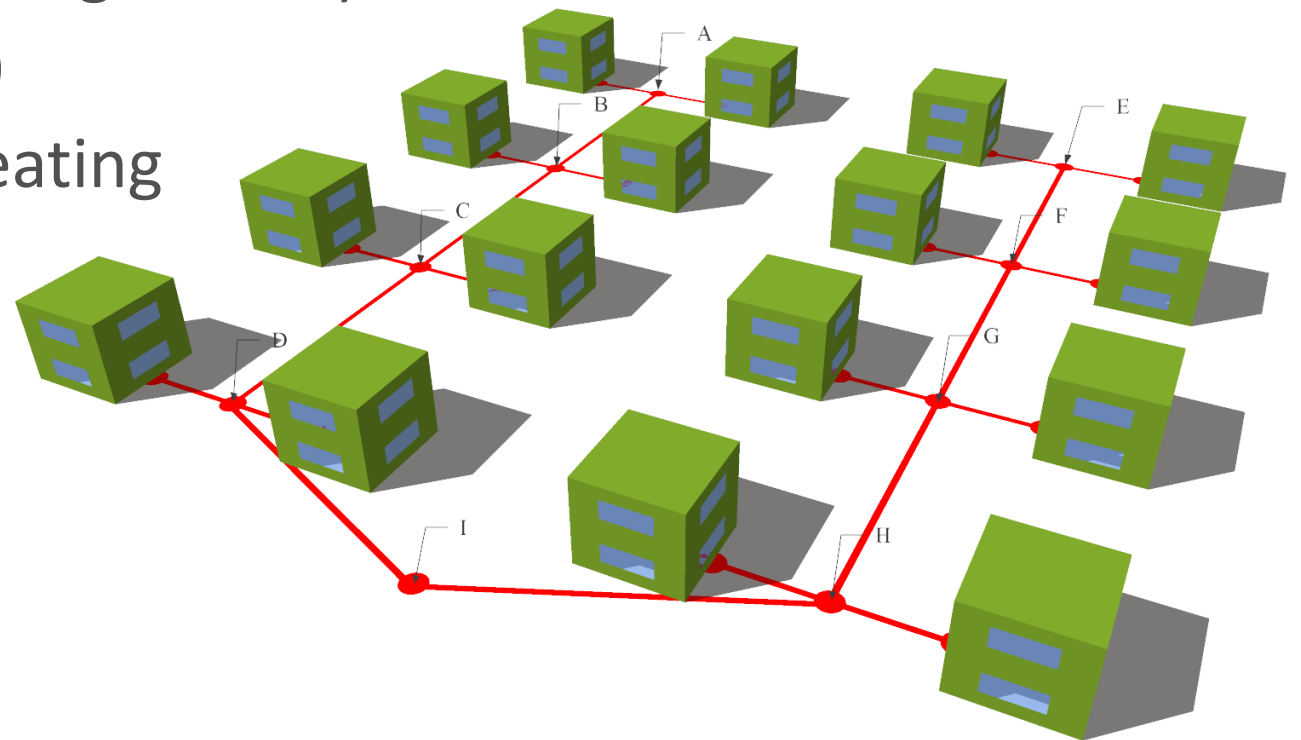
Development of DESTEST

- Two tracks are working in parallel
 - Focus on **building** models: Ina De Jaeger
 - Focus on **network and energy system** models: Felix Bunning
- Common Exercises
 - Start with description of (very) simple neighborhood of buildings
 - Use this information to design thermal network(s)
 - Gradually increase the complexity

Building group

Start simple: 16 identical buildings

- Single-family dwelling of 1980
- Thermal performance based on TABULA project for Belgium
- Two-zone model (day zone and night zone)
- Standard occupant (ISO 13790)
- Only heat demand for space heating



Contributions to buildings

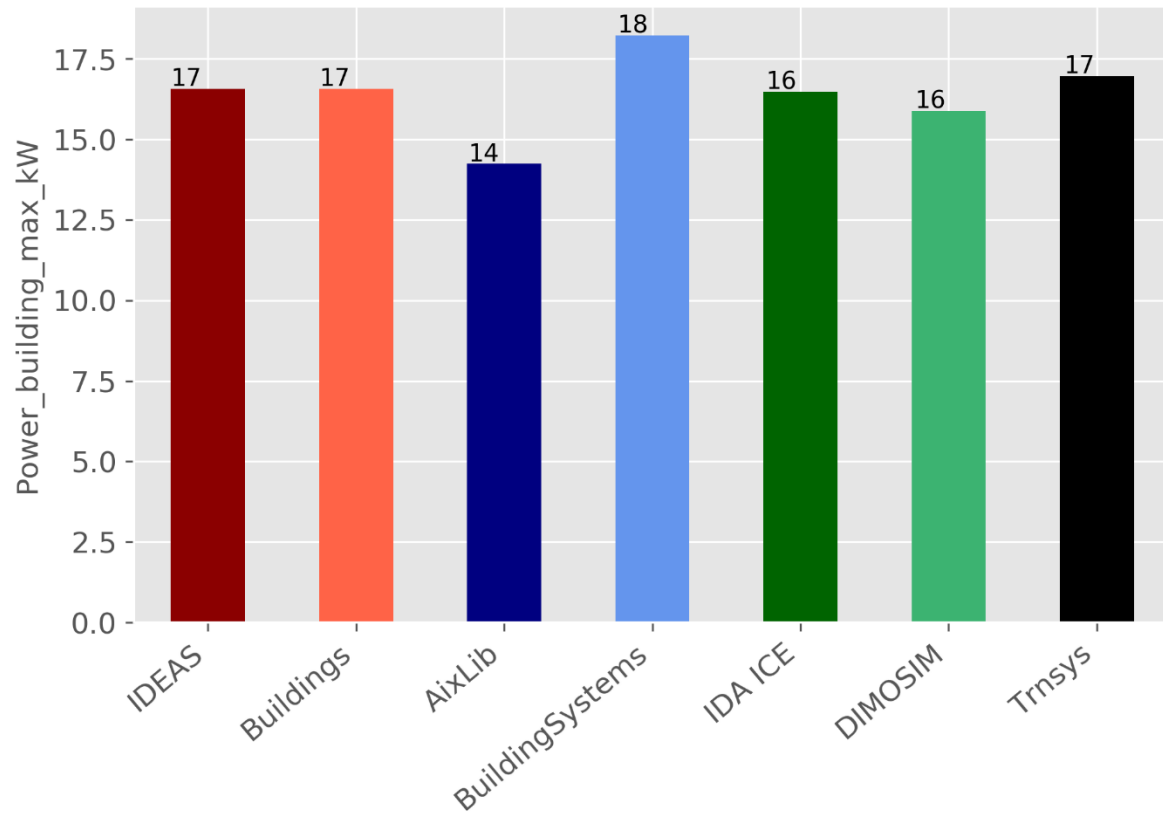
FIRST COMMON EXERCISE

Modelling environment	Modeler	Affiliation of participant
Modelica IDEAS	Ina De Jaeger	KU Leuven / VITO / EnergyVille
Modelica Buildings	Alessandro Maccarini	Aalborg University
Modelica AixLib	Michael Mans	RWTH Aachen
Modelica BuildingSystems	Haris Shamsi	UCD Dublin
IDA ICE	Øystein Rønneseth, Igor Sartori	Sintef Norway
DIMOSIM	Enora Garreau	CSTB
Trnsys	Enora Garreau	CSTB

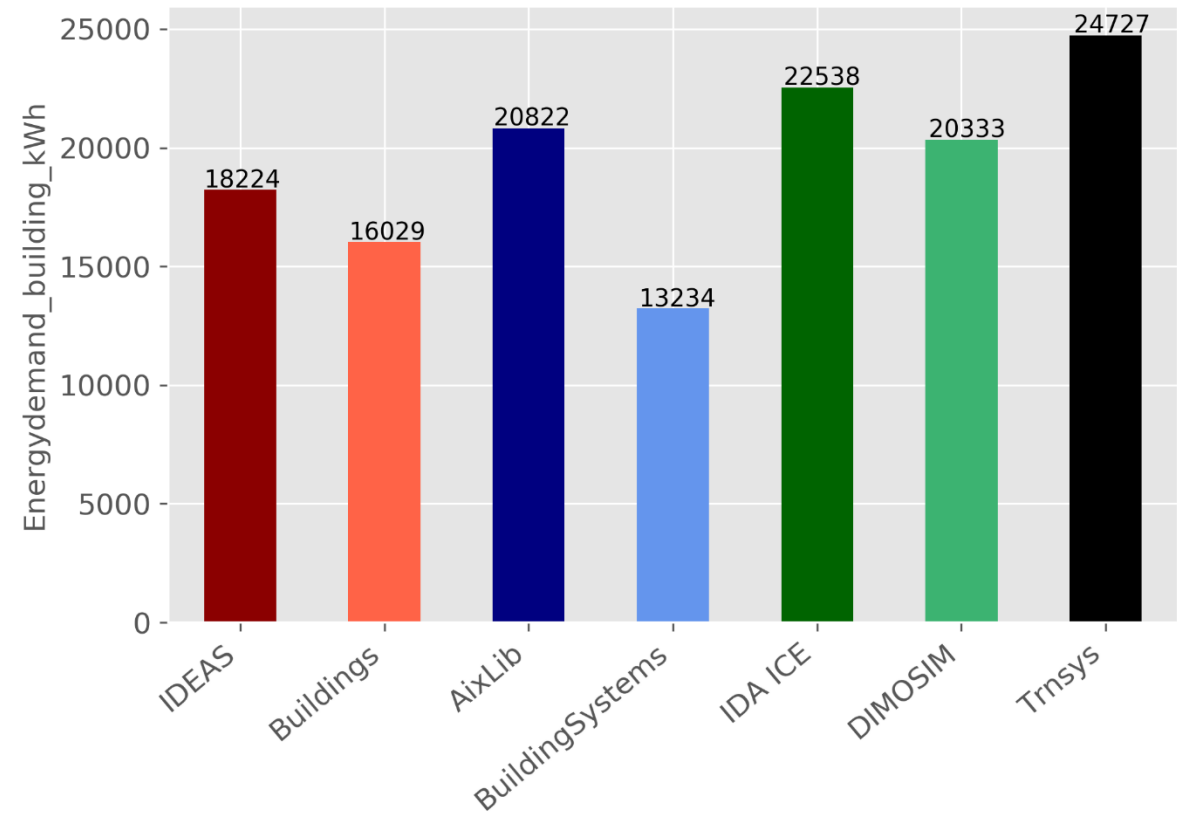
Peak power & energy demand

FIRST COMMON EXERCISE

Peak power

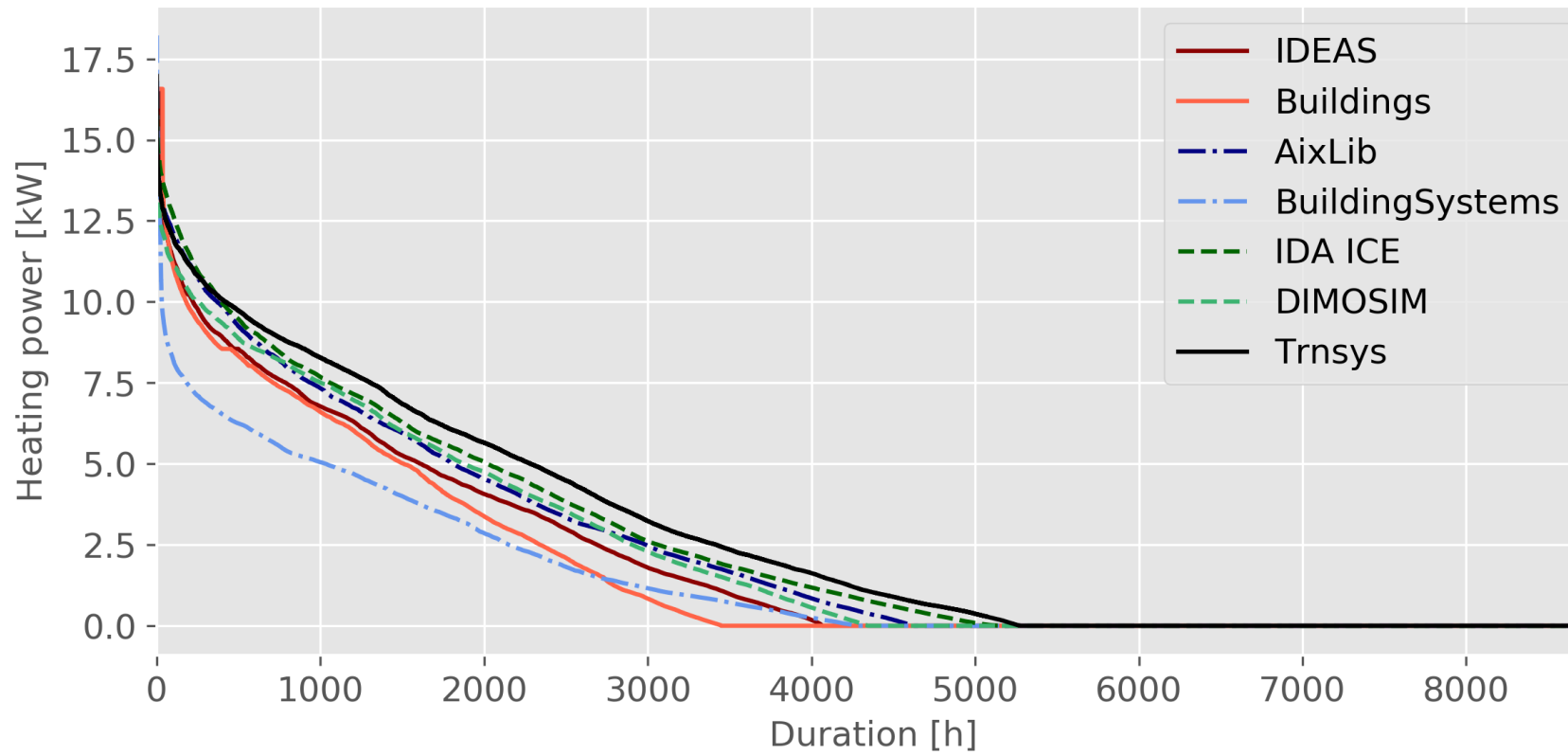


Annual energy demand



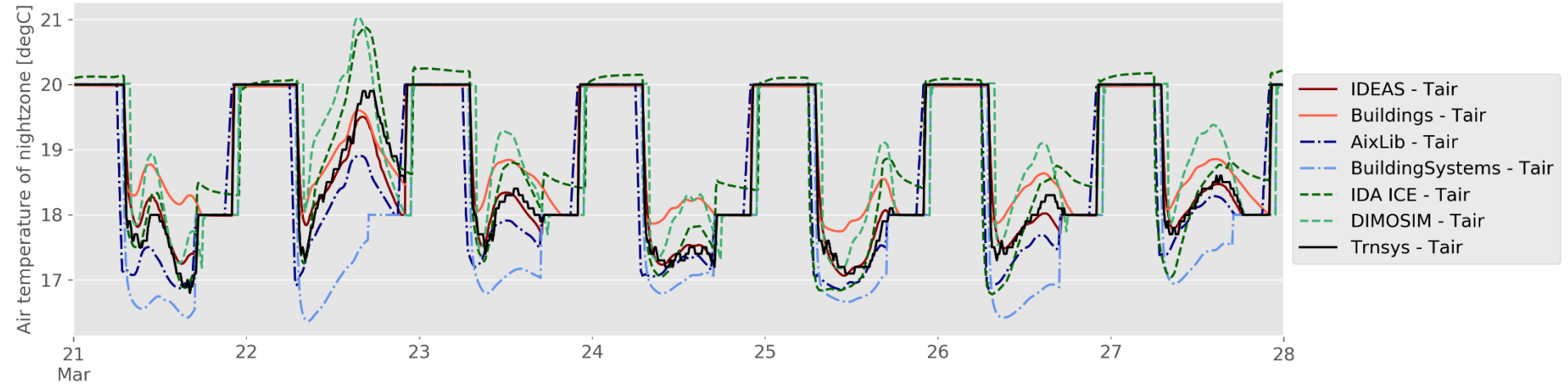
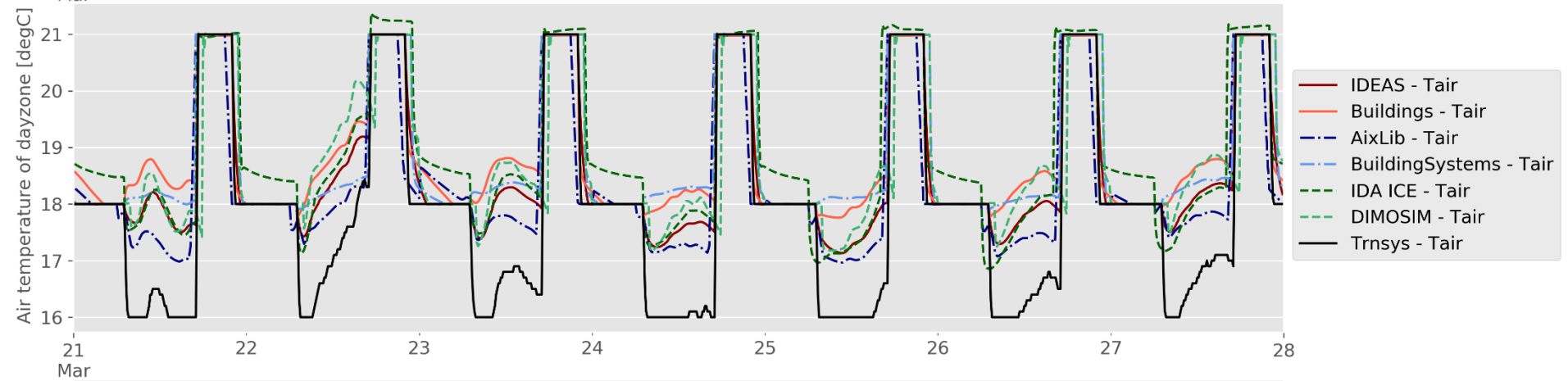
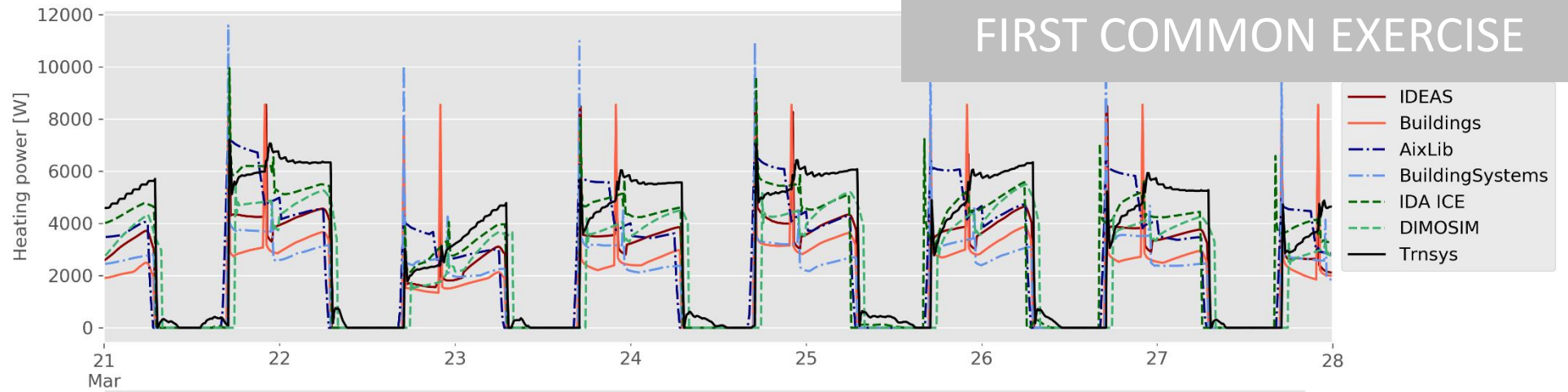
Load duration curve

FIRST COMMON EXERCISE



Profiles: March

FIRST COMMON EXERCISE



Gradually increasing in complexity

- Single-family dwelling of 1980
 - Thermal performance based on TABULA project for Belgium
 - Also include renovation (light and heavy)
 - Two-zone model (day zone and night zone)
 - Only heat demand for space heating
 - Standard occupant (ISO 13790)
 - Stochastic occupants (16 different profiles)

- Office building

ADDITION 1

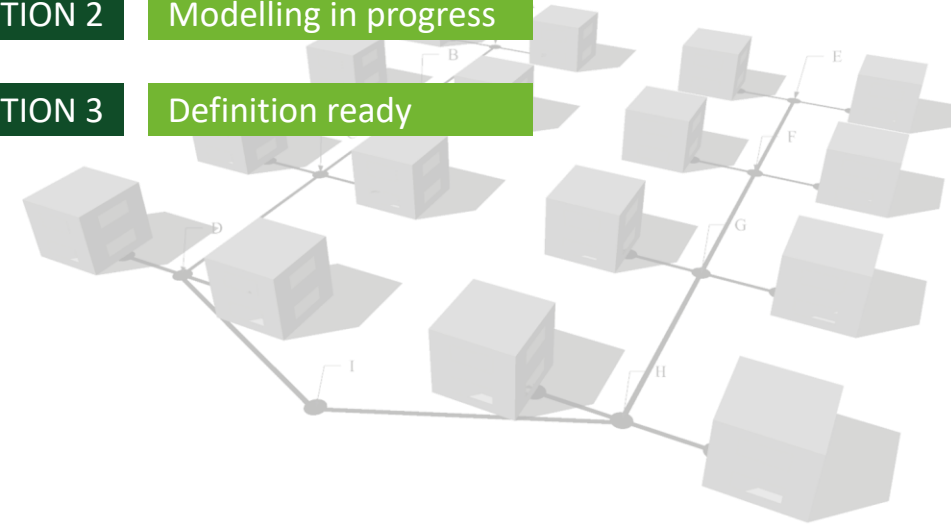
Definition ready

ADDITION 2

Modelling in progress

ADDITION 3

Definition ready



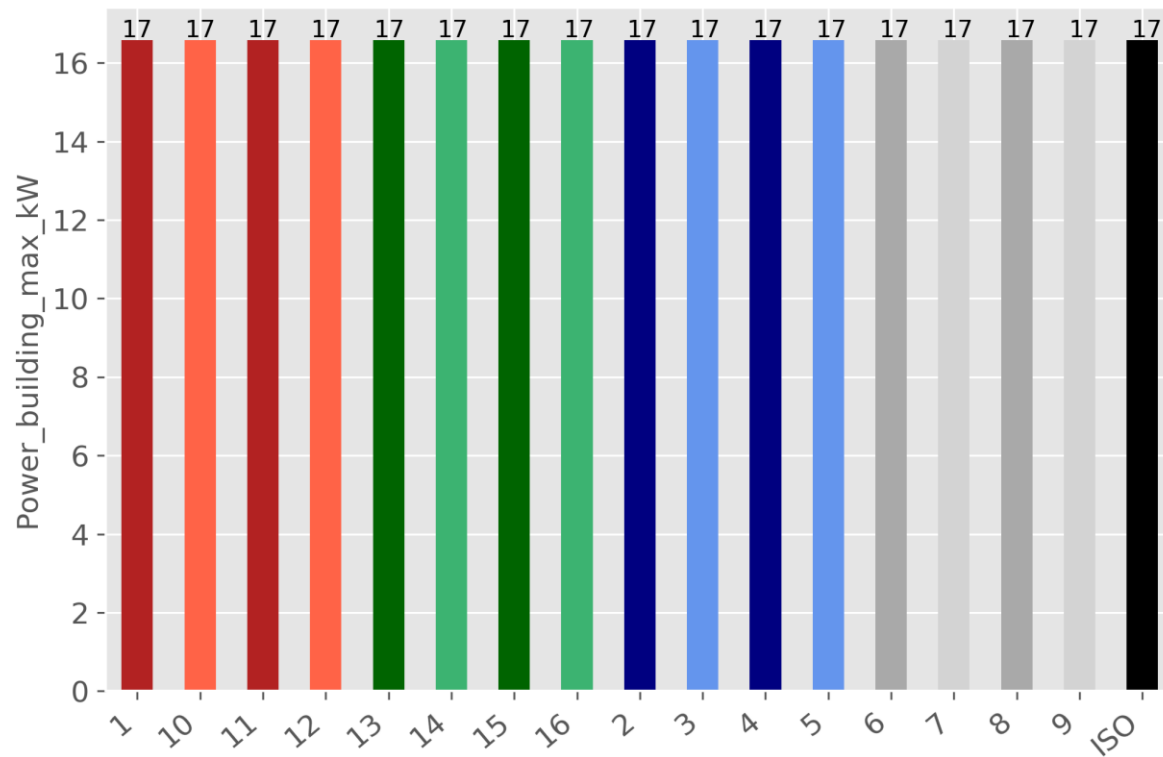
Peak power & energy demand

SECOND COMMON EXERCISE

Results from IDEAS library for all occupant profiles

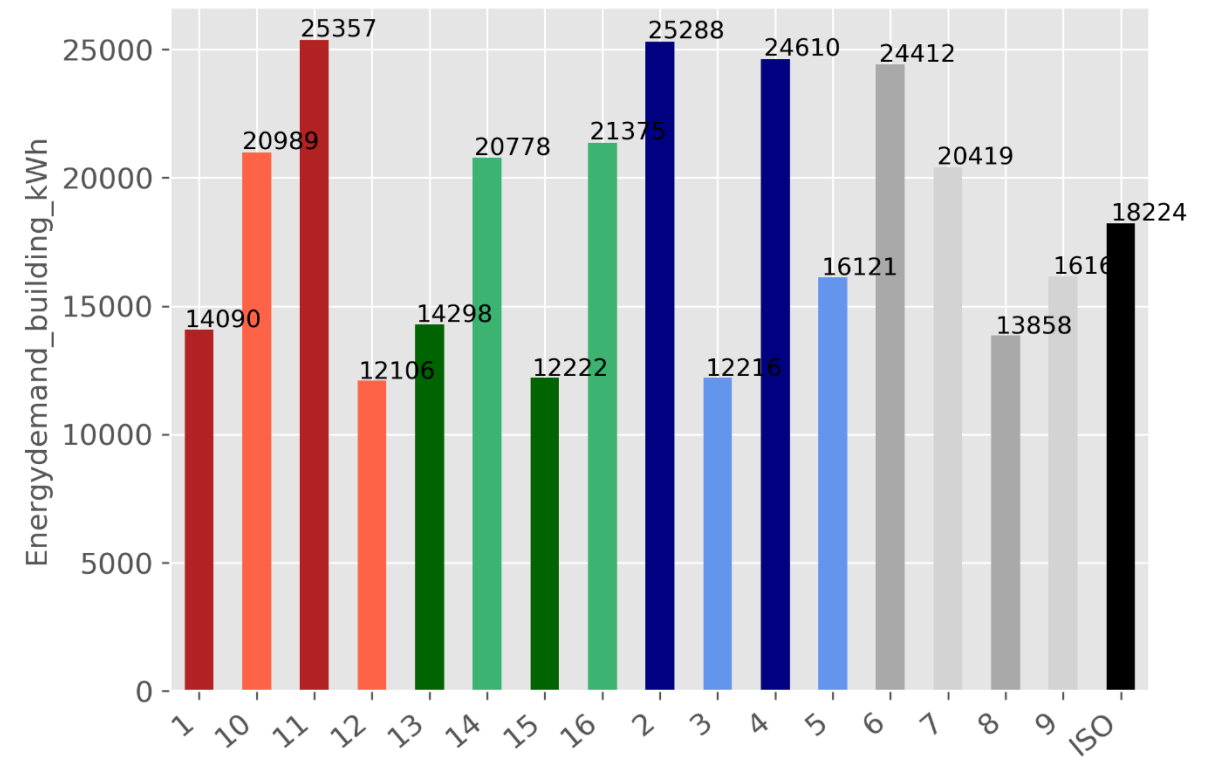
Peak power

Results for different occupants
(IDEAS, SFD, 1, 1980s)



Annual energy demand

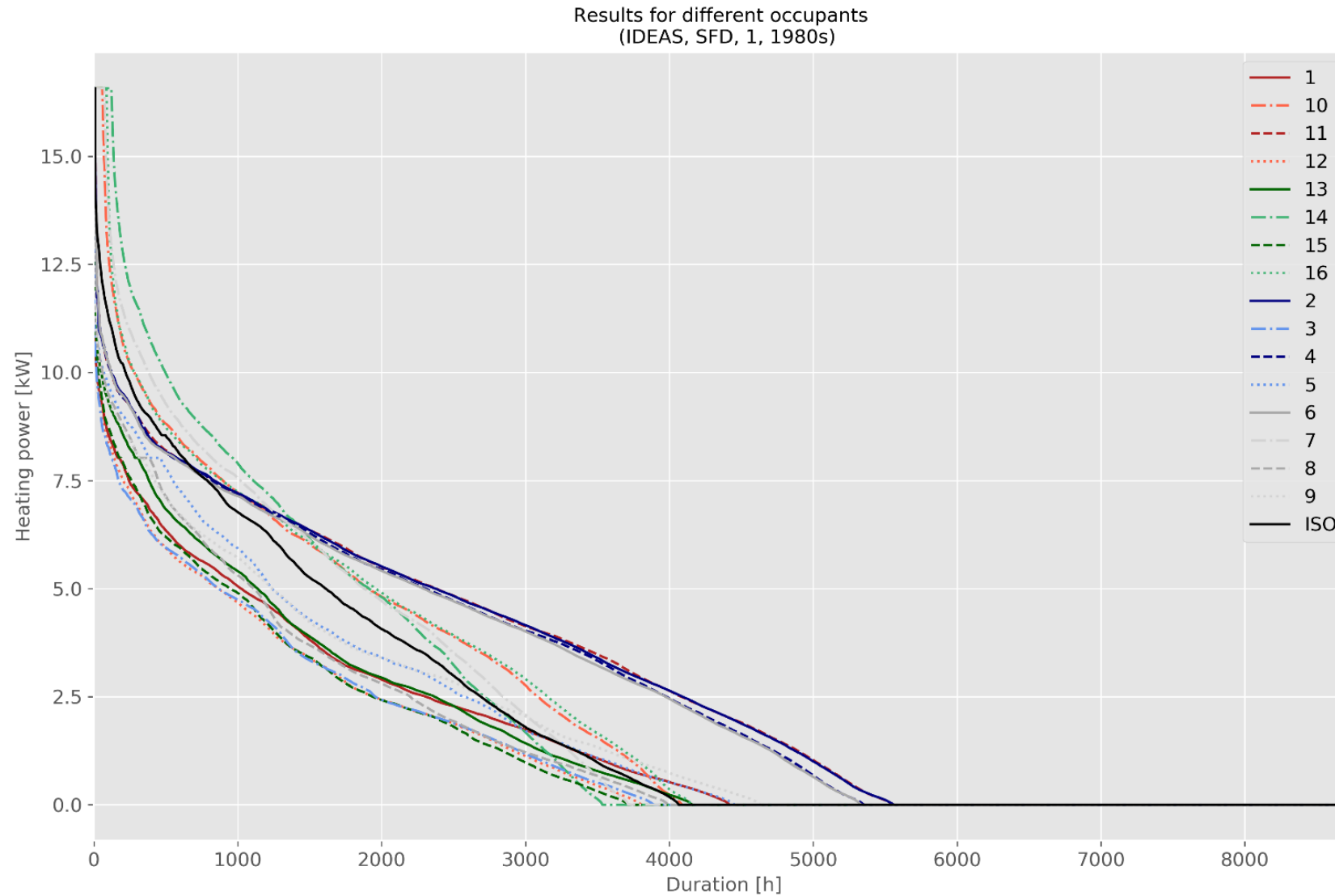
Results for different occupants
(IDEAS, SFD, 1, 1980s)



Load duration curve

SECOND COMMON EXERCISE

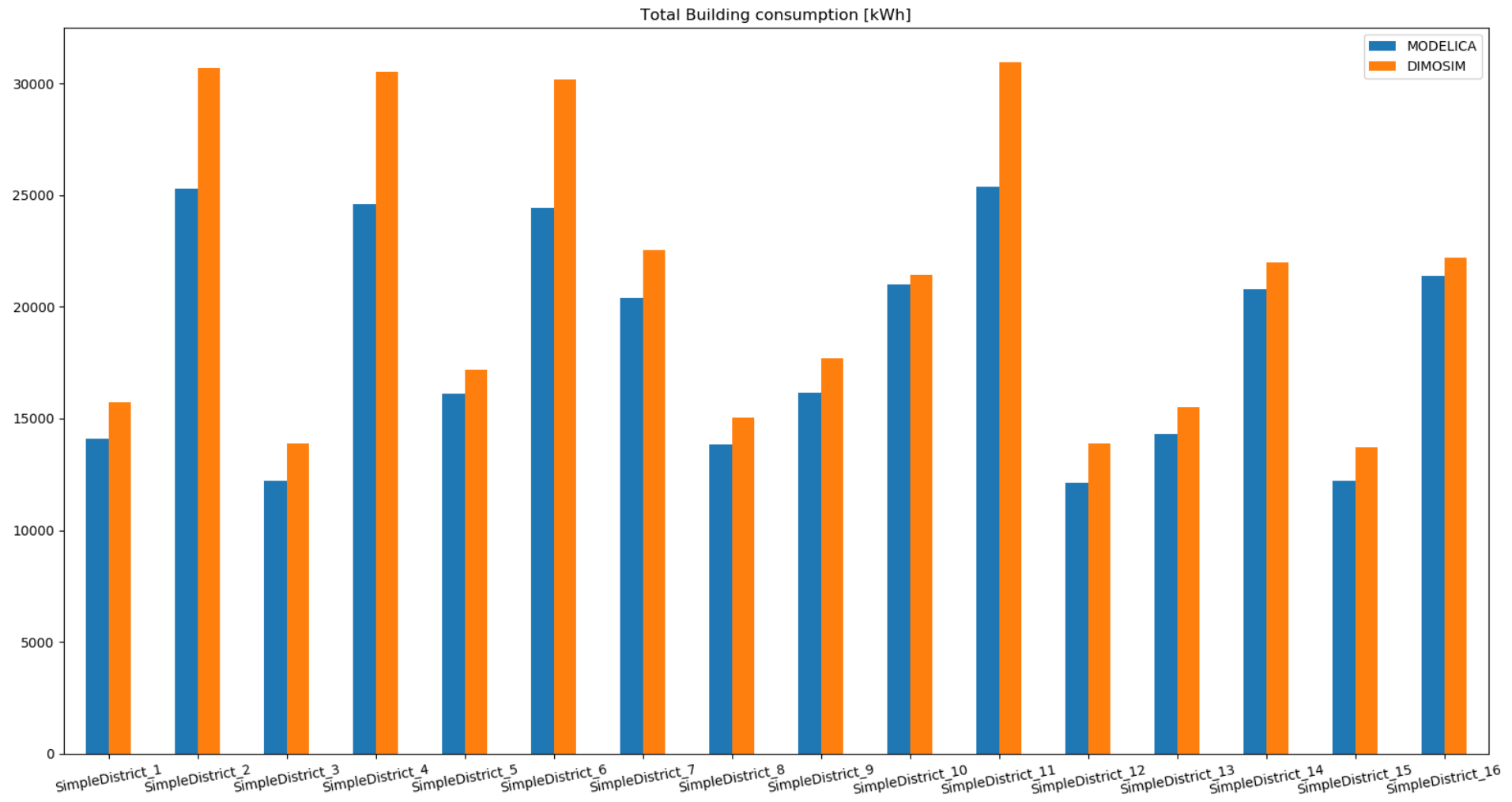
Results from IDEAS library for all occupant profiles



Annual heat demand

SECOND COMMON EXERCISE

Results from IDEAS library & DIMOSIM



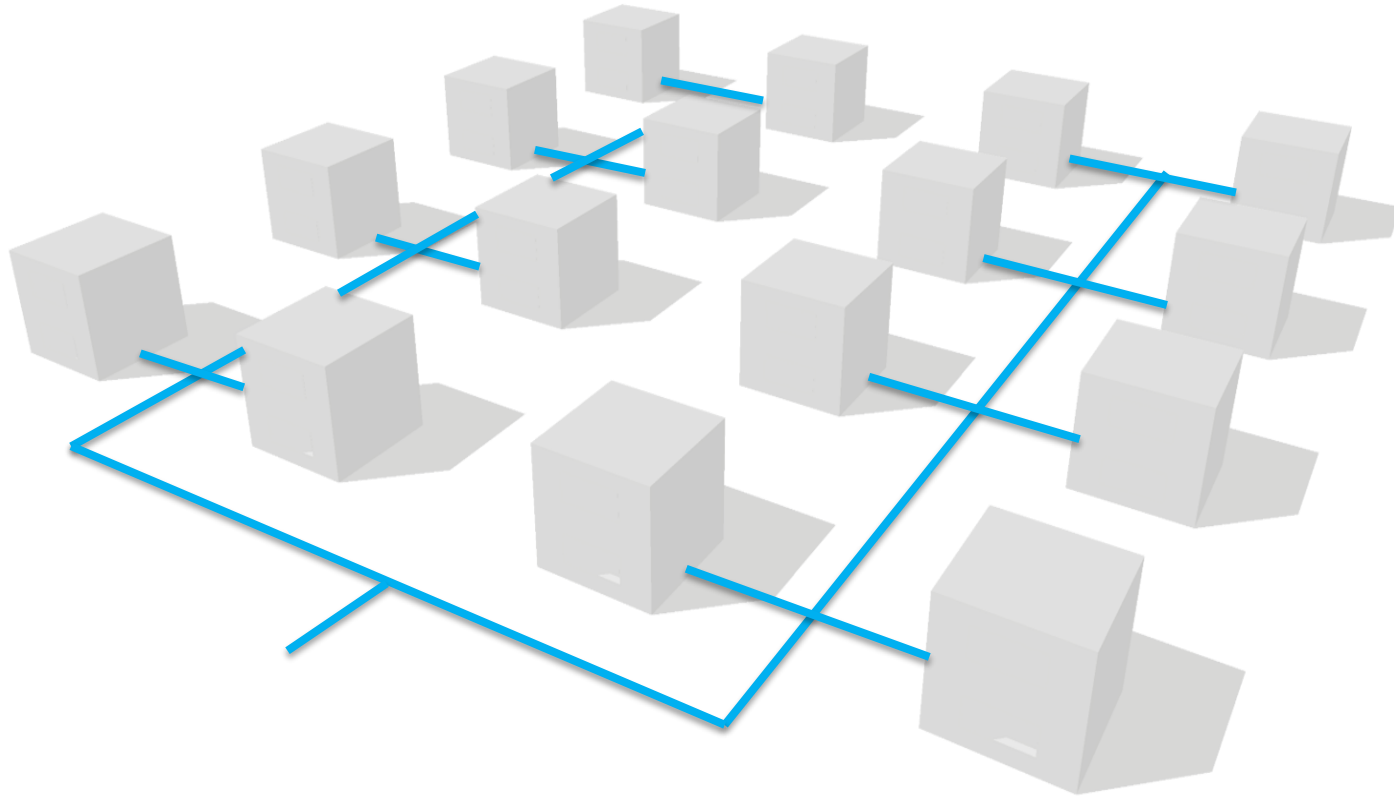
Next steps

- Replace nodes with other loads
 - Automated model generation with TEASER
 - Other types of single-family dwellings
 - Apartment blocks
 - Office buildings
 - Usage of different building standards and countries
 - Scale up ...
- Change network layout, increase of complexity

Scale up to ...



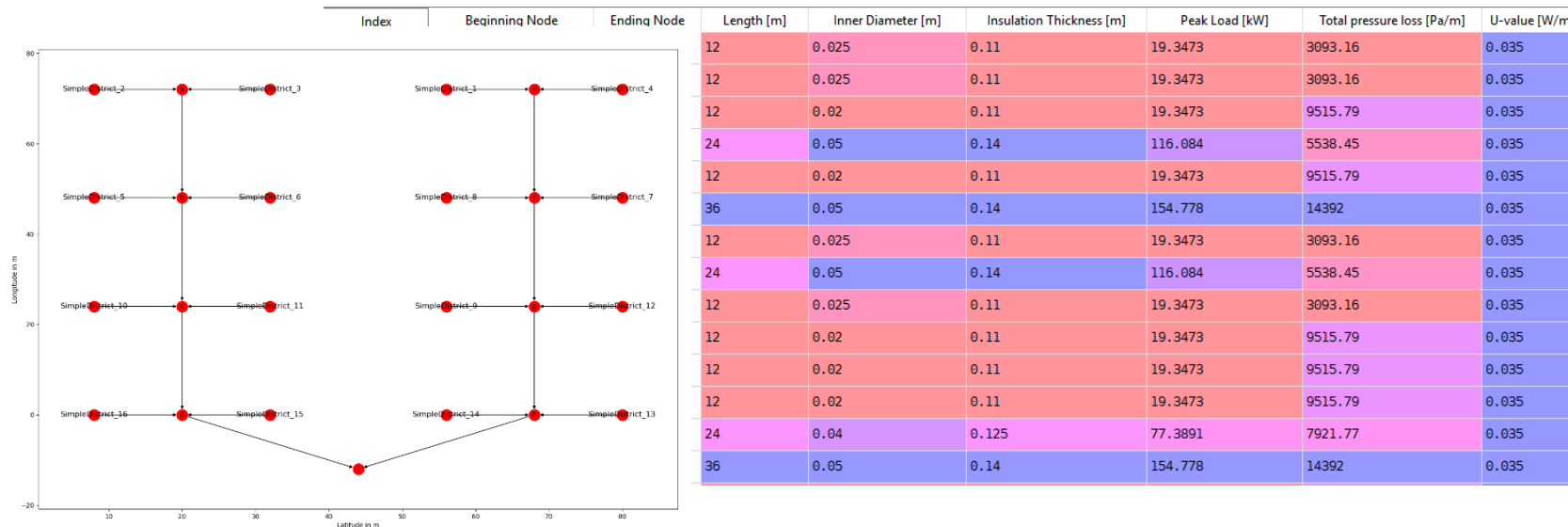
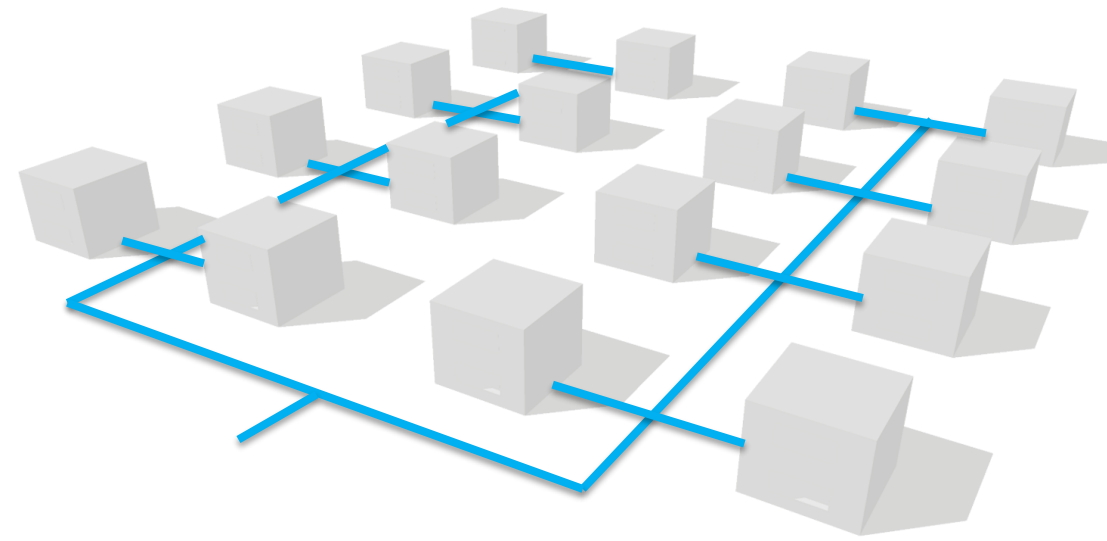
NETWORKS: From building load to district heating system



- Participants
 - Felix Bunning
 - Michael Mans
 - Annelies Vandermeulen
 - Bram van de Heijde
 - Konstantin Filonenko
 - Alessandro Maccarini
 - Enora Garreau

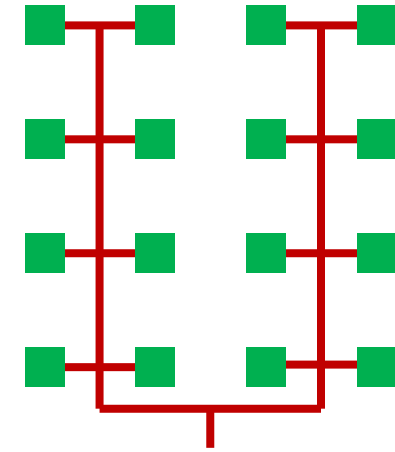
NETWORKS: From building load to district heating system

- Building loads stored on github
- Derive network from loads:
 - Fix topology
 - Python: Automatically generate pipe dimensions, write to csv file



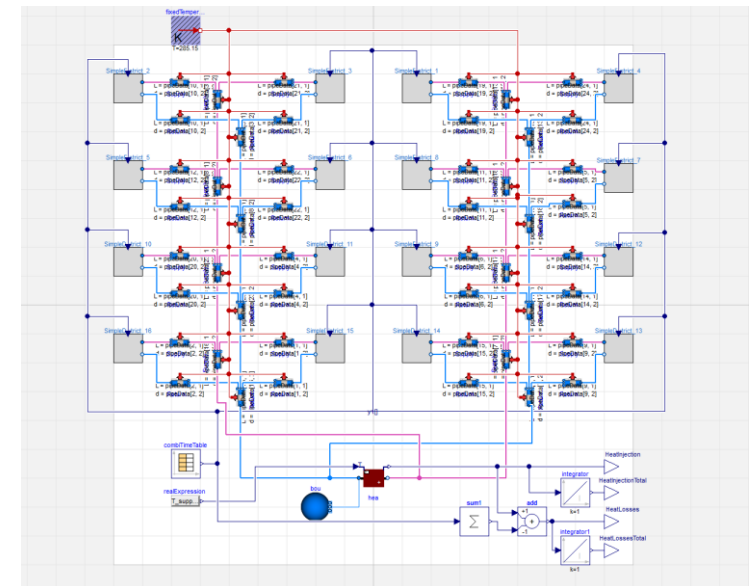
Base for common exercise

- Defined building layout and radial network layout
- Comparison of different KPIs for different models
- Used models:
 - Plug-flow pipe (IBPSA library)
 - Dynamic pipe (Buildings library)
 - Dimosim (CSTB)



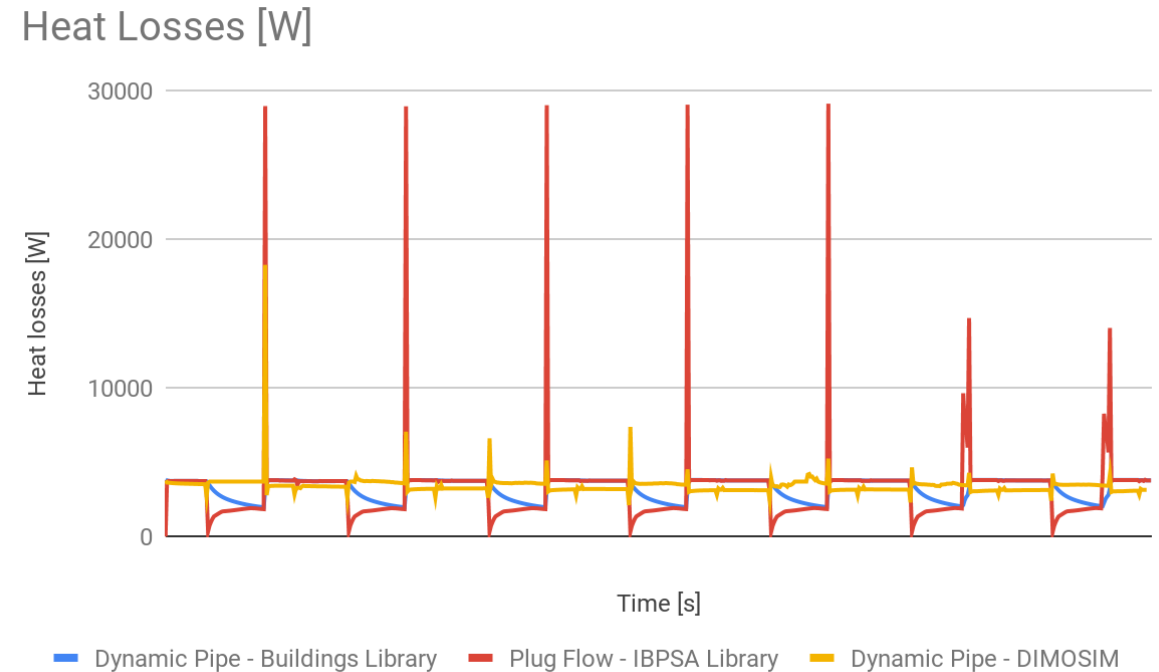
Modelica: automatic parametrization
from csv file

→ automated process from building
energy loads to simulation-ready
Modelica model



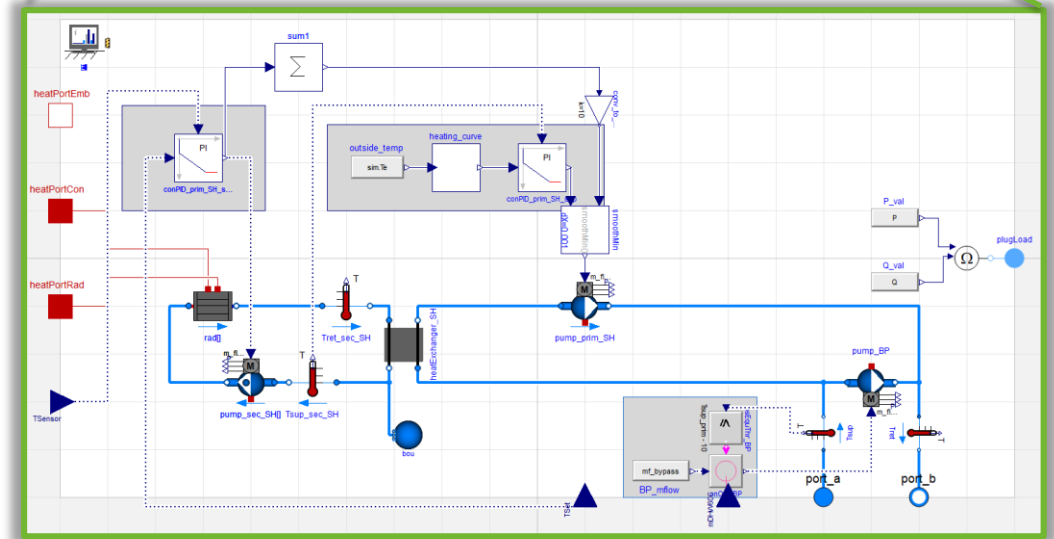
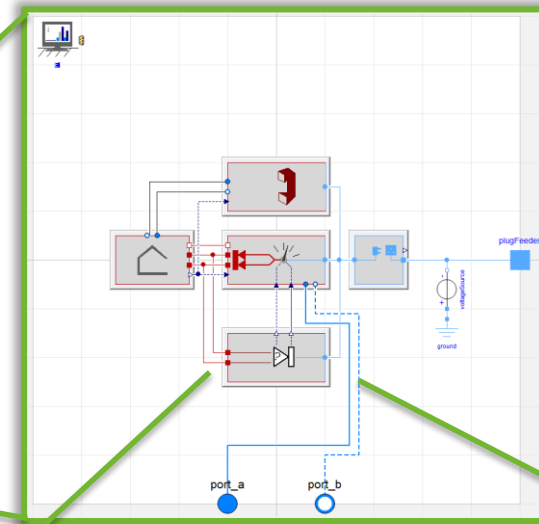
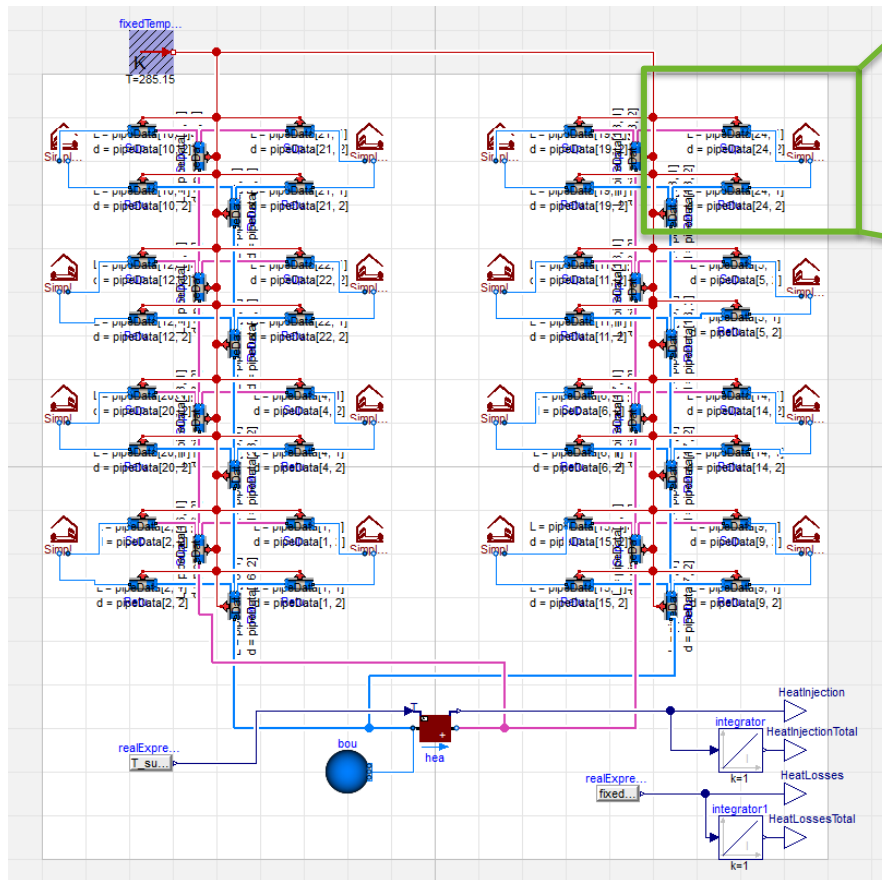
Destest network group

- ~Finished first test case:
 - 16 buildings, heating, branch network
 - Modelica plug-flow pipe, dynamic pipe, Dimosim tested
- Compared KPIs:
 - Heat losses
 - Critical temperatures
 - Pressure losses



Network group meets building group

- Started substation modeling



Destest network group

- Developments for further test cases:
 - Modelica models for different substations
 - Plans for combined heating and cooling
(as soon as building cases for cooling are ready)
- Fixed template for future reporting of test cases
- Set up online spreadsheet for faster communication of results

Plan for breakout sessions

BS 1-1	Topic 1.1 Feedback from past research activities
Joint session	Building and network modeling team, jointly with 1.1
	Modeling of 1000s or 100,000s of buildings, coupled and uncoupled, jointly with 1.1
BS 1-2	Topic 1.2 Feedback from past research activities
Chair: Ina / Felix	Building and network modeling team (continued), without 1.1
	Possibility for free contributions
	Time for free discussion
BS 2-1	Topic 2.1 Discussion on reporting and publications
Chair: Dirk	Review of reporting so far (first case description)
	Outline of future publications
	Outline of content of future reports
	Time for free discussion
BS 2-2	Topic 2.2 WP3.2 presentation of free subjects
Chair: Alessandro	Full template for collecting case studies (15 min)
	CU Boulder - 3 case studies (15 min + 5 Q&A)
	SDU - 4 case studies (20 min + 5 Q&A)
BS 2-3	Topic 2.3 Future steps in the DESTEST development
Joint session	Continued: Modeling of 1000s or 100,000s of buildings, coupled and uncoupled, jointly with 1.1
BS 2-4	Topic 2.4 Defining of Action Plan towards next meeting
Chair Dirk	Next steps and Commitments