IBPSA Project 1

WP 3.2 Application

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Goals of WP3.2

Goal 1: To demonstrate capabilities enabled by the use of Modelica for the design and operation of building and district energy systems

Goal 2: To develop user-friendly tools and interfaces to facilitate the use of Modelica

Outcome

Outcome 1: Collection of application case studies

Outcome 2: Python-based tool for automatic generation of Modelica models from 3D urban building models

Collection of case studies

Participants fill in a “case study template” available at https://github.com/ibpsa/project1/tree/master/wp_3_2_app

Template for description of application case studies – IBPSA Project 1 WP3.2

1. Title and authors

-Provide a title for the application case study

.....

-Name the authors that are responsible for the case study

Name/Institution/Country.....
Name/Institution/Country.....
.....

2. General Description:

-Formulate a general outline of the case study by including: objective, description of HVAC/district system and main results (if already available)

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3. Diagram and picture

-Include at least two pictures for your case study:

1. One diagram showing the layout of the HVAC/district system
2. One picture of Modelica model

4. Thermal zone modeling

-How many buildings have you modelled?

.....

-How many thermal zones per building have you modelled? How many in total?

.....

-What’s the complexity of the thermal zone model (Low order / High order)?

.....

-(only for district simulations) Are network and buildings coupled or decoupled?

☐ Coupled
☐ Decoupled

5. Modelica libraries and tools:

-Which Modelica library have you used? (Keep in mind that IBPSA library is for developers, not for users)

☐ AixLib
☐ Buildings
☐ BuildingSystems
☐ IDEAS

List of case studies

	Title	Institute	Scale	Status	
				Template received	Case study uploaded to website
1	Quantifying uncertainty propagation for the district energy demand	KU Leuven	District	✓	✓
2	MPC-oriented models of a small district with geothermal heat pumps	University of Southern Denmark	District	✓	✓
3	Single-zone model of a university building with hydronic heating and CO2-driven ventilation	University of Southern Denmark	Building	✓	✓
4	Dimensioning of IBPSA plug flow pipes for Vejle Nord LiveLab using Dymola FMI and Python	University of Southern Denmark	District	✓	✓
5	Multi-Infrastructure Modeling of Smart and Connected Communities	University of Colorado Boulder	District	✓	✓
6	Equation-Based Object-Oriented Modeling and Simulation for Data Center Cooling	University of Colorado Boulder	Building	✓	✓
7	Comprehensive Pliant Permissive Priority Optimization (C3PO)	University of Colorado Boulder	District	✓	✓
8	Modeling Air-to-Air and Finned-Tube Heat Exchangers	University of Colorado Boulder	Component	✓	✓
9	Feasibility study of DHC system in Køge (Denmark)	Aalborg University	District	✓	✓
10	Erdeis II – Local DHC provided with a LTN for residential buildings	RWTH Aachen	District	✓	✓
11	Feasibility study of DHC system in Toronto (Canada)	LBNL	District	✓	
12	Co-simulation for building energy modeling with active integrated envelopes	Yale University	Building		

New case studies

Uploading case studies on IBPSA Project 1 website

IBPSA Project 1

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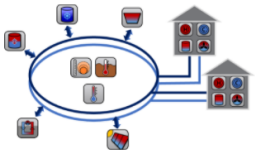
List of case studies

On this page, a number of case studies that emerged from IBPSA Project 1 participants are listed. The case studies deal with different applications ranging from HVAC systems in buildings to district heating networks. The aim is to demonstrate capabilities that are enabled through the use of Modelica.

Comprehensive Pliant Permissive Priority Optimization (C3PO)

by University of Colorado at Boulder (USA)

Read more



Erdeis II – Local DHC provided with a LTN for residential buildings and a geothermal ice storage

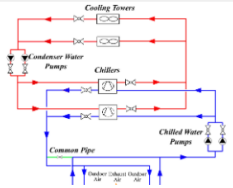
by RWTH Aachen University (Germany)

Read more

5G district heating and cooling system in Køge Nord

by Aalborg University (Denmark)

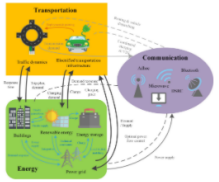
Read more



Equation-Based Object-Oriented Modeling and Simulation for Data Center Cooling: A Case Study

by University of Colorado at Boulder (USA)

Read more



Multi-Infrastructure Modeling of Smart and Connected Communities

by University of Colorado at Boulder (USA)

Read more

Quantifying uncertainty propagation for the district energy demand using realistic variations on input data

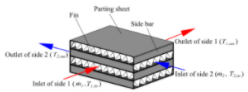
by KU Leuven (Belgium)

Read more

Single-zone model of a university building with hydronic heating and CO2-driven ventilation system

by Southern University of Denmark (Denmark)

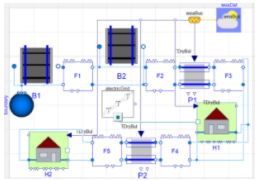
Read more



Modeling Air-to-Air and Finned-Tube Heat Exchangers

by University of Colorado at Boulder (USA)

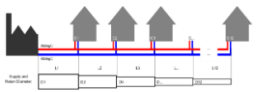
Read more



MPC-oriented models of a small district with geothermal heat pumps

by Southern University of Denmark (Denmark)

Read more



Dimensioning of IBPSA plug flow pipes for Vejle Nord LiveLab using Dymola FMI and Python

by Southern University of Denmark (Denmark)

Read more

Development of a new Python-based tool

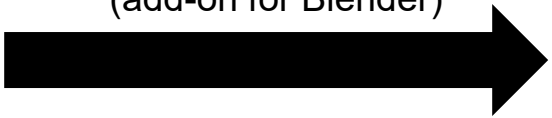
Motivation

It would be useful to have a tool that enables users to **visually**:

- Create 3D urban building forms
- Assign building properties (e.g. U-values)
- Export Modelica models for calculation of heating and cooling loads

BAGEL (**B**lender-based **A**utomatic **G**enerator of **E**nergy **L**oads)

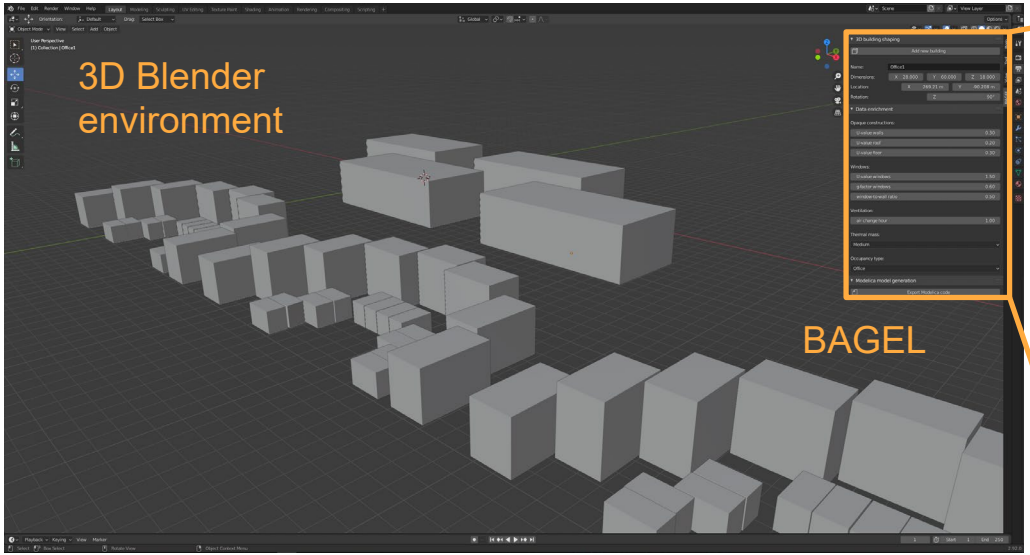
BAGEL
(add-on for Blender)

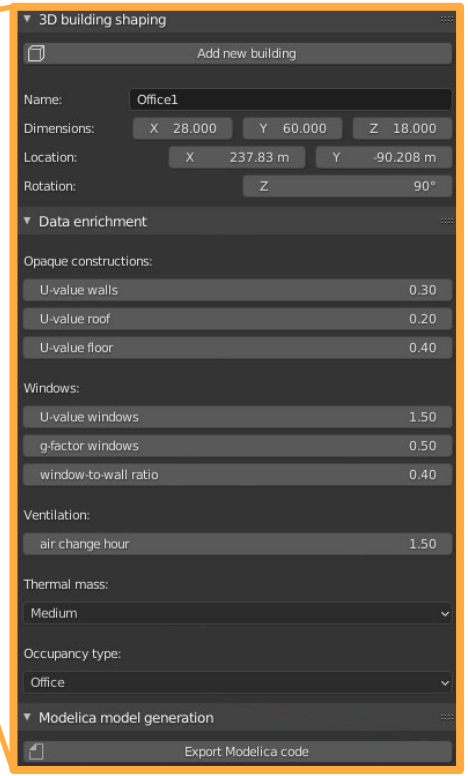


What is Blender? 3D computer graphics modeling software

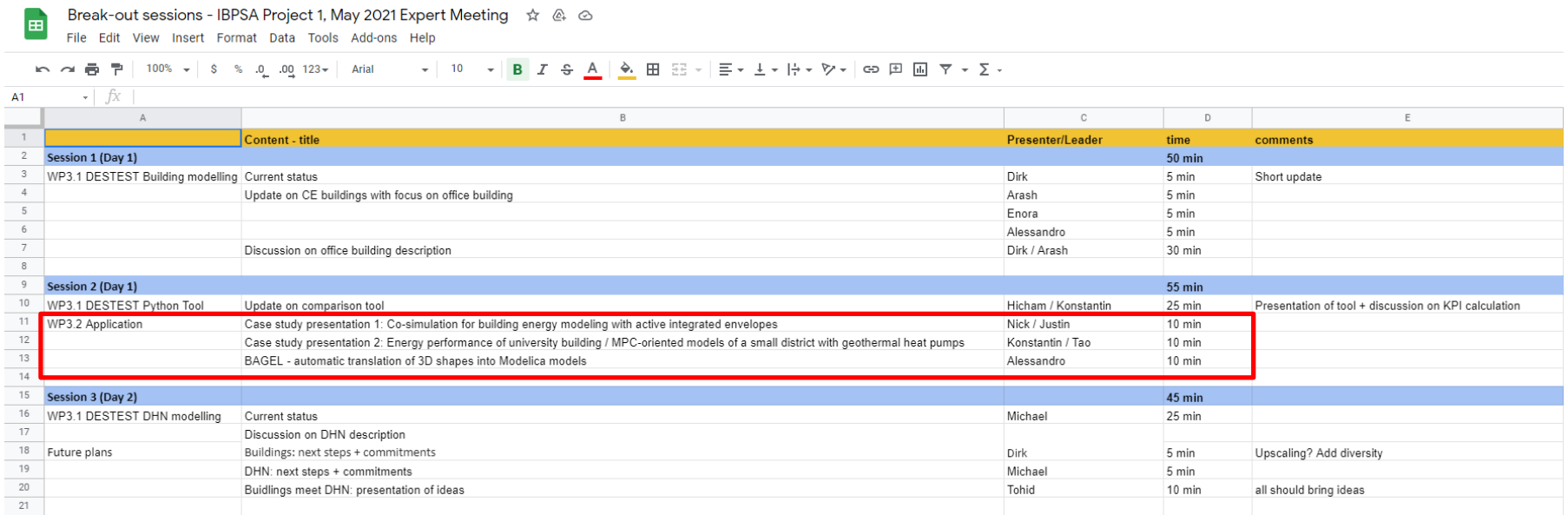
Why Blender? Free and open source / Blender Python API

BAGEL (**B**lender-based **A**utomatic **G**enerator of **E**nergy **L**oads)





Breakout session



Break-out sessions - IBPSA Project 1, May 2021 Expert Meeting

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	A	B	C	D	E
1		**Content - title**	**Presenter/Leader**	**time**	**comments**
2	**Session 1 (Day 1)**			**50 min**	
3	WP3.1 DESTEST Building modelling	Current status	Dirk	5 min	Short update
4		Update on CE buildings with focus on office building	Arash	5 min	
5			Enora	5 min	
6			Alessandro	5 min	
7		Discussion on office building description	Dirk / Arash	30 min	
8					
9	**Session 2 (Day 1)**			**55 min**	
10	WP3.1 DESTEST Python Tool	Update on comparison tool	Hicham / Konstantin	25 min	Presentation of tool + discussion on KPI calculation
11	WP3.2 Application	Case study presentation 1: Co-simulation for building energy modeling with active integrated envelopes	Nick / Justin	10 min	
12		Case study presentation 2: Energy performance of university building / MPC-oriented models of a small district with geothermal heat pumps	Konstantin / Tao	10 min	
13		BAGEL - automatic translation of 3D shapes into Modelica models	Alessandro	10 min	
14					
15	**Session 3 (Day 2)**			**45 min**	
16	WP3.1 DESTEST DHN modelling	Current status	Michael	25 min	
17		Discussion on DHN description			
18	Future plans	Buildings: next steps + commitments	Dirk	5 min	Upscaling? Add diversity
19		DHN: next steps + commitments	Michael	5 min	
20		Buidlings meet DHN: presentation of ideas	Tohid	10 min	all should bring ideas
21					

In addition, short presentation of BAGEL in WP2.1 session to explore synergies