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IBPSA Modelica Working Group

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Approved Proposal

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January 25, 2023

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## 1 Abstract

IBPSA Project 1 is executed from August 2017 to August 2022. IBPSA Project 1 created the Modelica IBPSA Library (<https://github.com/ibpsa/modelica-ibpsa>) which is used as the core of various Modelica libraries for building and district energy systems. This document proposes a continuation of Work Package 1.1 “Modelica Library Development” of the IBPSA Project 1 after Project 1 finishes in August 2022.

The continuation is proposed through a newly formed IBPSA *Working Group* that maintains and further develops the library. Organizationally, the Working Group will be part of the IBPSA Projects Committee. We propose to form a Working Group rather than a new Project because the continuation is expected to be indefinite as long as there are substantial contributions and usage of the developed code.

## 2 Proposal

### Purpose and Scope

To further develop and maintain the library, we propose that IBPSA forms a new Working Group called “Modelica Working Group.” The purpose and scope of the Working Group includes the following:

- (i) Maintain and further develop the Modelica IBPSA Library. The Working Group shall follow state of the art principles that ensure that models are reviewed, validated and well documented. The development shall respond to the requirements of 3rd party libraries that integrate the Modelica IBPSA Library as its core library. The Modelica IBPSA Library shall remain available under the existing BSD license.

- (ii) Coordinate the needs of the IBPSA community with the Modelica Association and with Modelica modeling and simulation environment developers.

## Meetings

Besides virtual meetings, the Working Group expects to meet in person during the International IBPSA Conferences, and during some regional IBPSA Conferences. To minimize travel, meetings will preferably be co-located with the regional IBPSA conferences that also host the IBPSA Board off-year meetings, or with Modelica Conferences.

## Duties of IBPSA

IBPSA will administer the funds of the project. If the Working Group receives 3rd party sponsorship, 10% of the received funds will remain with IBPSA to compensate for overheads, and the other 90% can be used by the Working Group to cover expenses at the discretion of the Chair of the Working Group. When the Working Group terminates, all remaining funds will be owned by IBPSA.

As the IBPSA Project 1 has excess funds of about US-\$13,000 that will flow to IBPSA when Project 1 finishes, IBPSA will provide initial funds to the Working Group of US-\$4,000.

If the Working Group's funds are depleted, upon approval by the IBPSA Board or its designated delegate,

- IBPSA shall contribute funding to cover expenses for in-person coordination meetings, such as for rooms and food.
- IBPSA shall contribute funding to use services for continuous integration testing such as github, travis or similar.

## Duties of the Working Group Chair

The Working Group Chair will provide an annual progress report to the IBPSA Board.

## Intellectual Property

All workshops, software and documentation will be open accessible to anyone.

To ensure open collaboration among the participants, all code will be released as open-source using the BSD 3-Clause License as stated at <https://github.com/ibpsa/modelica-ibpsa/blob/master/IBPSA/legal.html>.

IBPSA will be the copyright owner. The liberal nature of the license allows others to implement the code in their software and distribute it to others at no cost. Hence, IBPSA ownership of the copyright will allow others to reuse and distribute the software.

## Start Date and Initial Members

The proposed start date of the Working Group is August 1, 2022.

The proposed initial slate is

- Michael Wetter (LBNL, USA)
- Saranya Anbarasu (Penn State, USA)
- David Blum (LBNL, USA)
- Yash Shukla (CEPT University, Ahmedabad, India)
- Massimo Cimmino (Polytechnique Montreal, Canada)
- Mingzhe Liu (Penn State, USA)
- Kathryn Hinkelman (Penn State, USA)
- Jelger Jansen (KU Leuven, Belgium)
- Filip Jorissen (KU Leuven, Belgium)
- Klaas de Jonge (Ghent University, Belgium)
- Chengnan Shi (Penn State, USA)
- Christian Vering (RWTH Aachen, Germany)
- Christoph Nytsch-Geusen (UdK Berlin, Germany)
- Alessandro Maccarini (Aalborg University, Denmark)
- Hongxiang (Casper) Fu (LBNL, USA)
- Wangda Zuo (Penn State, USA)

## Notes

1. In early 2022, the cost for continuous integration service is US-\$ 69 per month.
2. As Modelica is an open standard for a modeling language, with various commercial and open-source modeling and simulation environments, forming an IBPSA “Modelica Committee” would not impact IBPSA’s position to stay tool and vendor neutral.

## 3 Background

### IBPSA Project 1

IBPSA Project 1 “BIM/GIS and Modelica Framework for building and community energy system design and operation” (<https://ibpsa.github.io/project1>) is being conducted from August 2017 to August 2022. Project 1 has 29 organizational participants, 2 sponsoring participants, and 55 individual participants, with an estimated contribution of about 150 person-years. Project 1 is a continuation of IEA EBC Annex 60 “New generation computational tools for building and community energy systems based on the Modelica and Functional Mockup Interface standards” (<https://www.iea-annex60.org/>) that was conducted from 2012 to 2017. Both projects were lead by Michael Wetter (LBNL, Berkeley, CA, USA) and Christoph van Treeck (RWTH Aachen, Aachen, Germany) as co-operating agents.

Project 1 has 6 work packages. One of it is Work Package 1.1: “Modelica IBPSA Library,” led by Michael Wetter, and described below. The continuation of this work package is subject of this proposal.

## Project 1 - Work Package 1.1 “Modelica IBPSA Library”

Work Package 1.1 has been developing the Modelica IBPSA Library, previously called Modelica Annex60 Library [WFG+15]. The library consists of close to 1000 models and functions. It is available open-source under an IBPSA-approved BSD license, developed at <https://github.com/ibpsa/modelica-ibpsa>, and used as the core of the following four Modelica libraries:

- AixLib, from RWTH Aachen University, Germany, (<https://github.com/RWTH-EBC/AixLib>),
- Buildings, from LBNL, Berkeley, CA, USA, (<http://simulationresearch.lbl.gov/modelica>),
- BuildingSystems, from UdK Berlin, Germany, (<http://www.modelica-buildingsystems.de/>), and
- IDEAS, from KU Leuven, Belgium, (<https://github.com/open-ideas/IDEAS>).

Through these libraries, models of the Modelica IBPSA Library are also used in derivative software, such as in BOPTEST ([BAH+21], <https://github.com/ibpsa/project1-boptest>), Spawn of EnergyPlus ([WBG+20], <https://lbl-srg.github.io/soep/>), URBANopt for District Energy Systems (<https://docs.urbanopt.net/workflows/des.html>), Electricity de France’s BuildSysPro Library (<https://github.com/EDF-Lab/BuildSysPro>) and PennState Smart and Connected Communities (SCC) Library (<https://sites.psu.edu/sbslab/tools/smart-and-connected-communities-scc-library/>) and Net Zero Energy Community (NZEC) Library (<https://sites.psu.edu/sbslab/tools/net-zero-energy-community-nzec-library/>).

The Modelica IBPSA Library is being tested with the three Modelica tools OpenModelica, OPTIMICA/IMPACT and Dymola.

## About Modelica

Modelica is an open standard for a language that has been developed for modeling of engineered systems. It has been developed as a tool-independent language that allows sharing models among users, authoring and simulating these models in different modeling and simulation environments, and avoiding that users depend on a single simulation tool developer. The evolution of the Modelica Language is governed by the Modelica Association (<https://modelica.org/>), a non-profit organization with members from Europe, USA, Canada and Asia. The Modelica Association develops also the Modelica Standard Library, and other open standards that are related to simulation, such as the Functional Mock-Up Interface (FMI) Standard, the System Structure and Parameterization (SSP) Standard, and the Distributed Co-Simulation Protocol (DCP) Standard.

Modelica is free to use. Various tool providers offer modeling and simulation environments, both free and commercial, see <https://modelica.org/tools.html>.

## References

- [BAH+21] David Blum, Javier Arroyo, Sen Huang, Ján Dragoňa, Filip Jorissen, Harald Taxt Walnum, Yan Chen, Kyle Benne, Dragana Vrabie, Michael Wetter, and Lieve Helsen. Building optimization testing framework (BOPTEST) for simulation-based benchmarking of control strategies in buildings. *Journal of Building Performance Simulation*, 14(5):586–610, September 2021. URL: <https://doi.org/10.1080/19401493.2021.1986574>, doi:10.1080/19401493.2021.1986574.
- [WBG+20] Michael Wetter, Kyle Benne, Antoine Gautier, Thierry S. Nouidui, Agnes Ramle, Amir Roth, Hubertus Tummescheit, Stuart Mentzer, and Christian Winther. Lifting the garage door

on Spawn, an open-source BEM-controls engine. In *Proc. of Building Performance Modeling Conference and SimBuild*, 518–525. Chicago, IL, USA, September 2020. URL: <https://simulationresearch.lbl.gov/wetter/download/2020-simBuild-spawn.pdf>.

- [WFG+15] Michael Wetter, Marcus Fuchs, Pavel Grozman, Lieve Helsen, Filip Jorissen, Moritz Lauster, Dirk Müller, Christoph Nytsch-Geusen, Damien Picard, Per Sahlin, and Matthis Thorade. IEA EBC Annex 60 Modelica Library – an international collaboration to develop a free open-source model library for buildings and community energy systems. In *14-th IBPSA Conference*, 395–402. International Building Performance Simulation Association, December 2015. URL: <http://www.iea-annex60.org/downloads/p2414.pdf>.