IBPSA Project 1

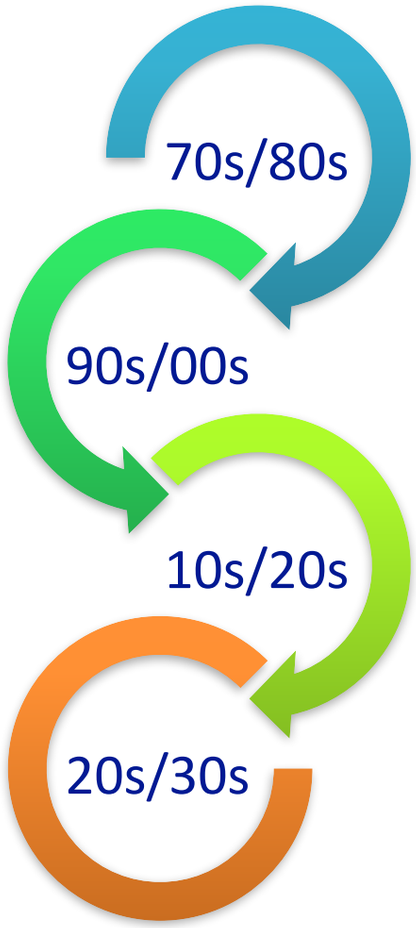
BIM/GIS and Modelica Framework
for
building and community energy system
design and operation

WP 1.1- Modelica Library for Design and Operation

May 6, 2020

Michael Wetter

Work Package 1.1 Goal

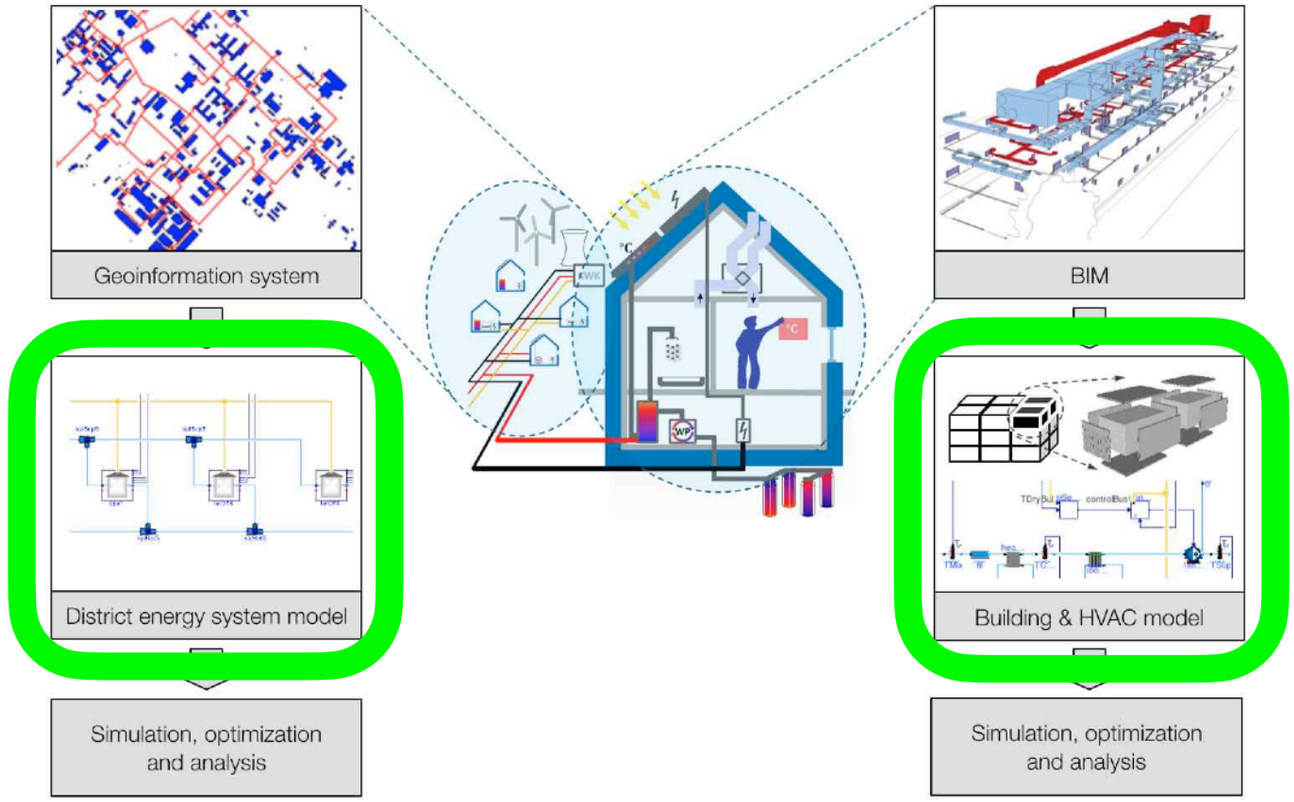


Simulation

Modeling

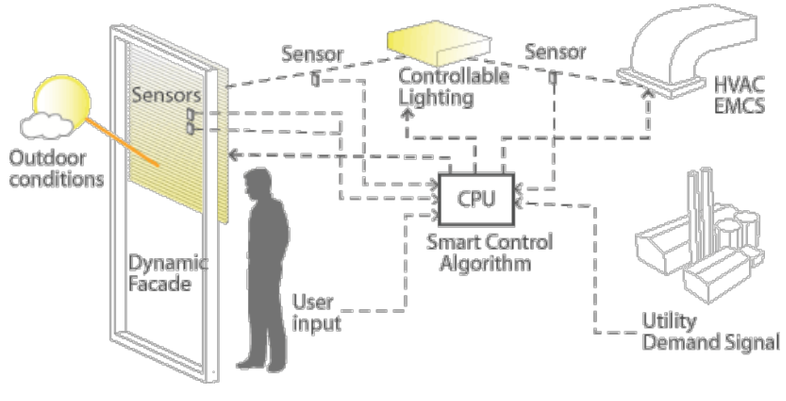
Tool integration

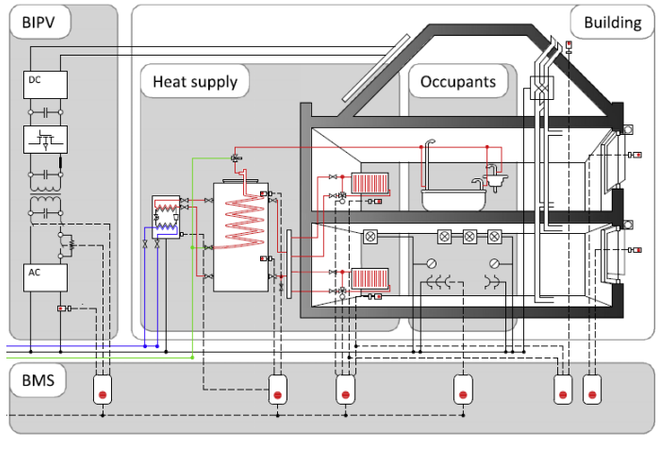
Autonomous modeling

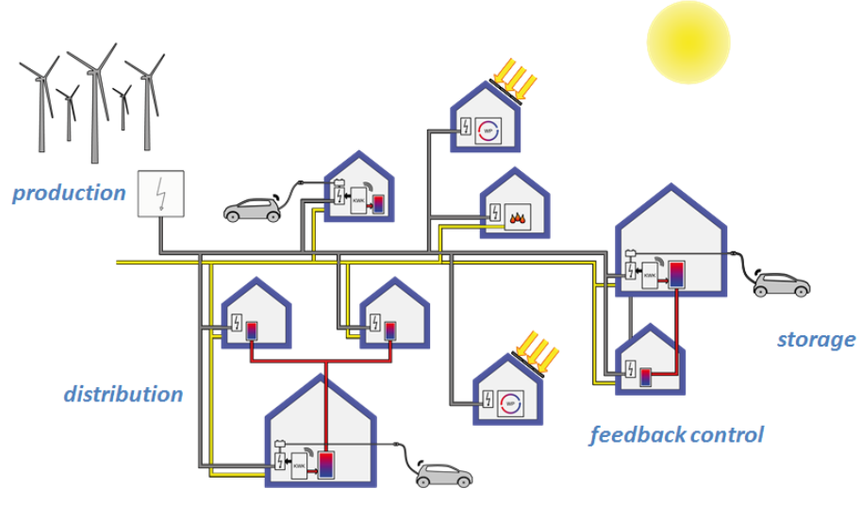


Develop Modelica library applicable for system-level autonomous modeling.

- validated
- well documented
- state-of-the-art physics and dynamics



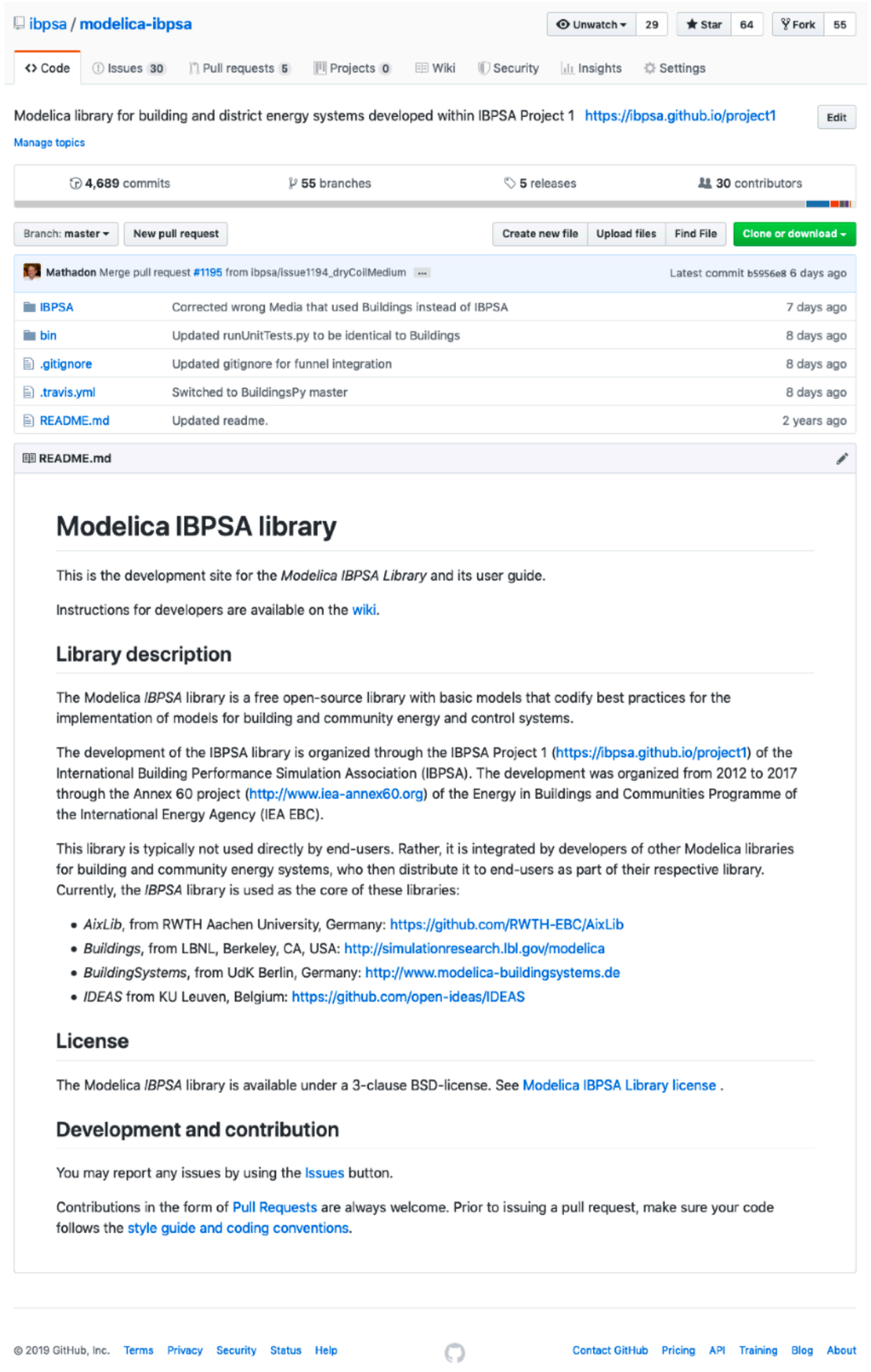




From controls to buildings and communities

Work Package 1.1 Approach

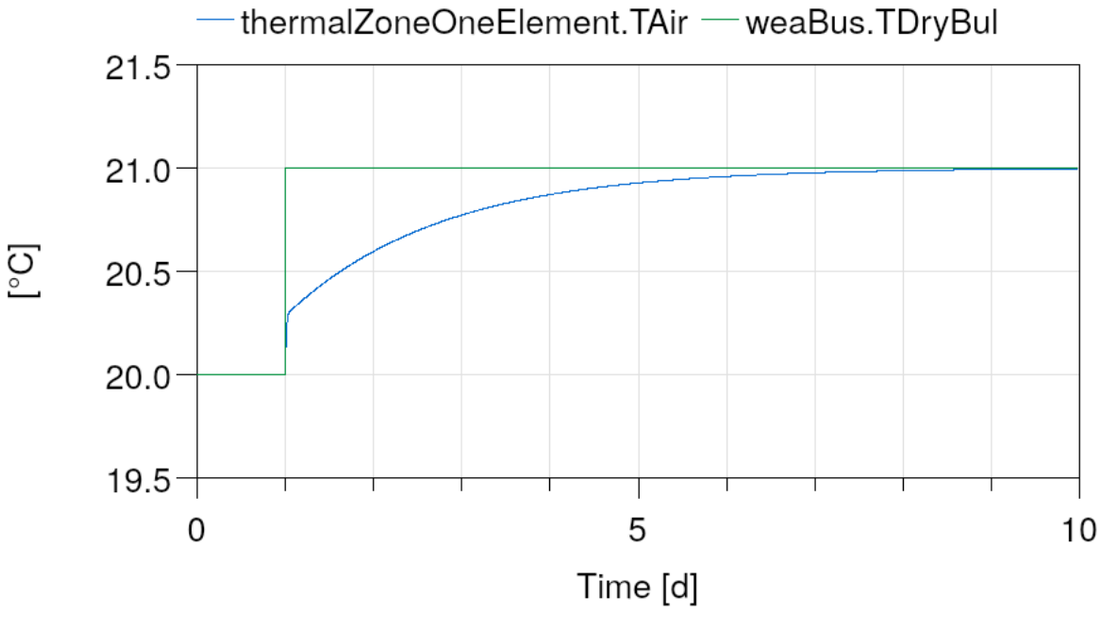
1. Development organized using github.
2. Continuous integration testing, 500 tests for Dymola and JModelica.
3. Workflow and coding guidelines at https://github.com/ibpsa/modelica-ibpsa/wiki.
4. Tools to merge to AixLib, Buildings, BuildingSystems and IDEAS libraries.



Progress in last half year

BoundaryConditions

- Weather data reader now allows for *exact* steady-state simulations
- In progress: Participation in new BESTEST for weather data processing



Fluid

- Pressure independent damper: Correction of actuator position in final review
- In progress: Partially wet coil

ThermalZones.ReducedOrder

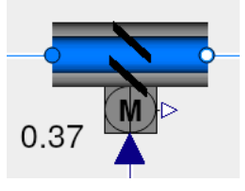
- Added option to model trace substances (e.g., CO2)

Media

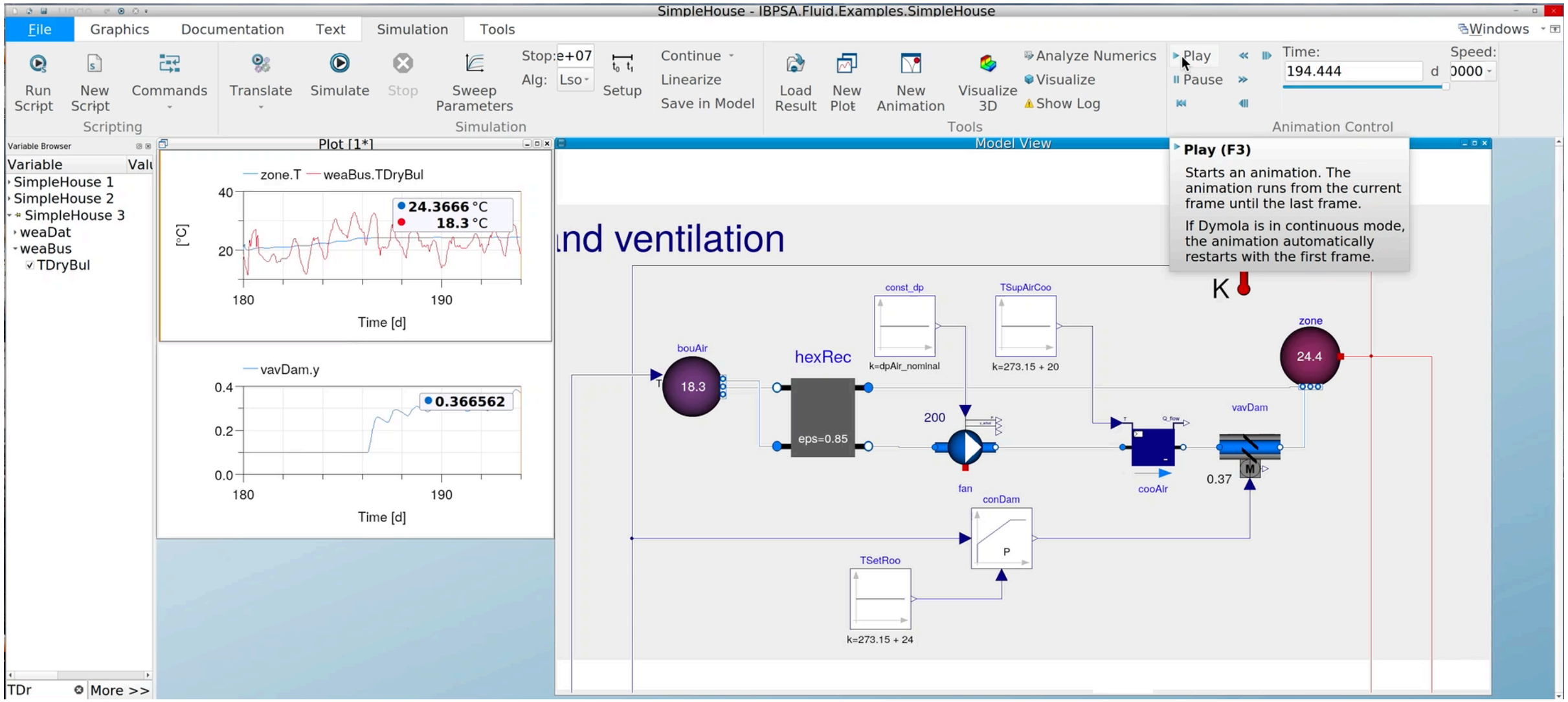
- Implement simplified steam model (no condensation)
- In progress: Implementation of R134a, R290, R410A, R744, and R32

General

- Added dynamic icons
- Updated regression testing to Dymola 2020x
- Tested with MSL 4.0.0 beta



Dynamic icons

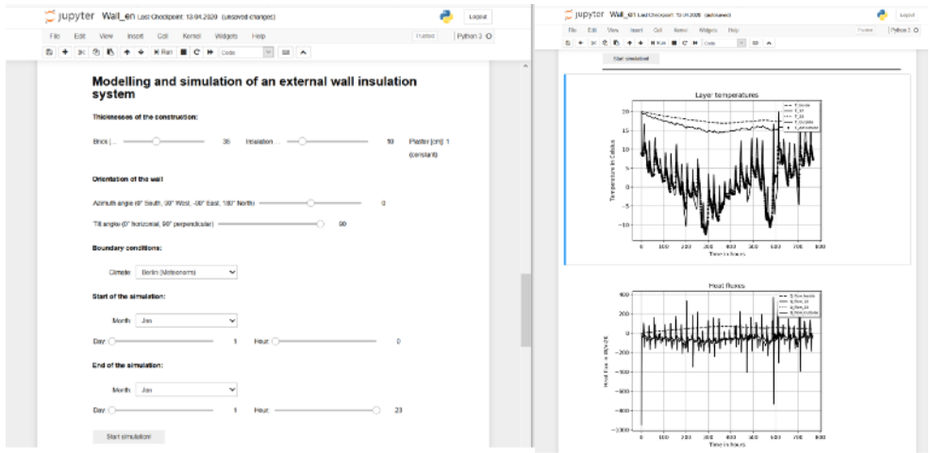


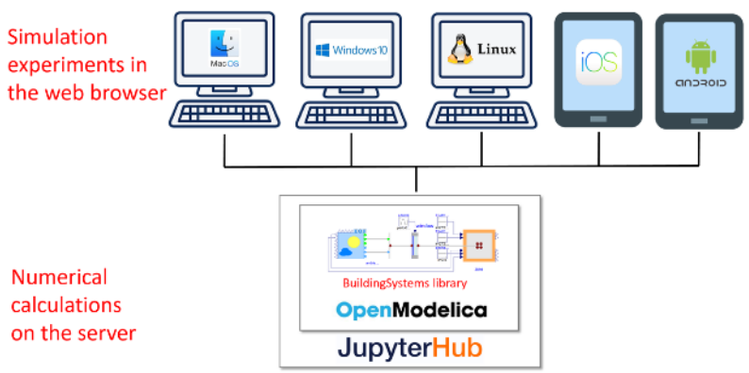
Updates from user-facing libraries

BuildingSystems

Jupyter notebooks based on OpenModelica

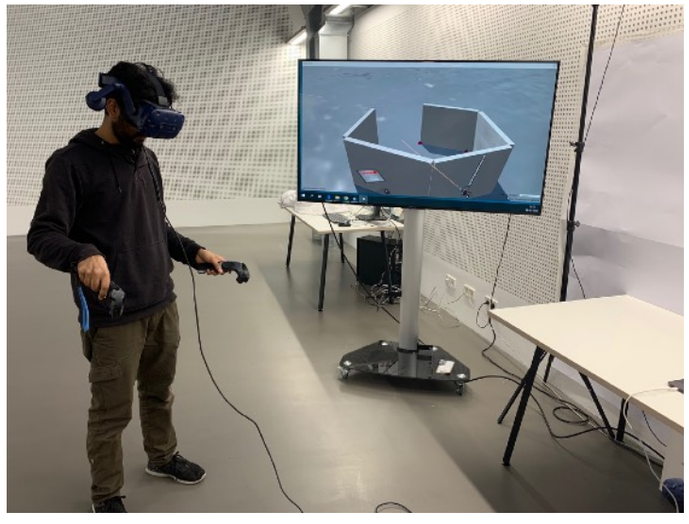
- Development of interactive Jupyter notebooks about building physics and building technology problems
- Usage of simulation models of the BuildingSystems library for student exercises
- Server-client approach for multi-user usage based on JupyterHub and OpenModelica as simulation engine

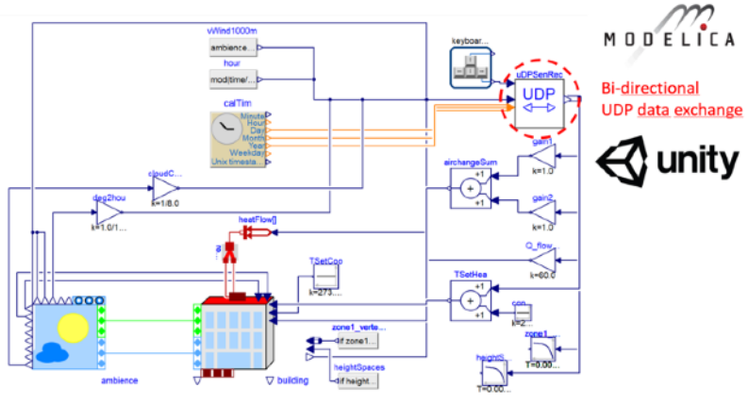




Virtual Reality building energy simulation environment

- Defining building models and performing simulation experiments within an interactive VR environment
- VR environment based on Unity and the multi-zone building model of the BuildingSystems library
- Real time data exchange between the VR environment and the Modelica building models

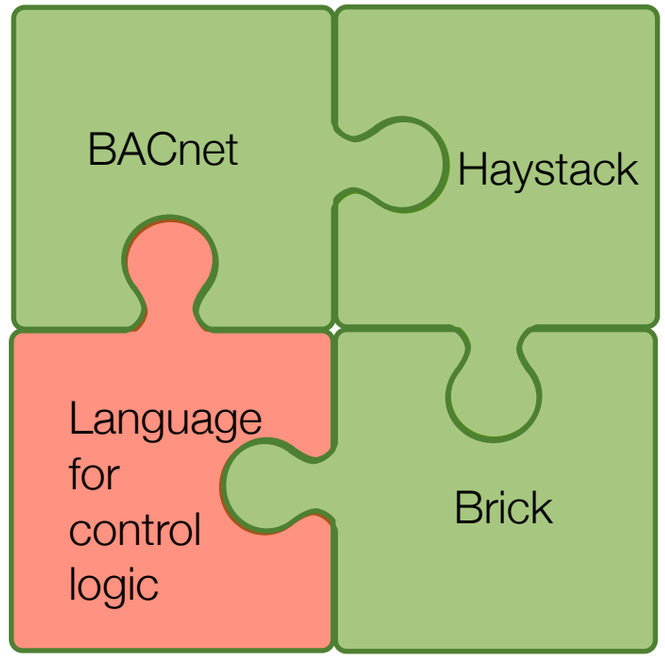




Buildings

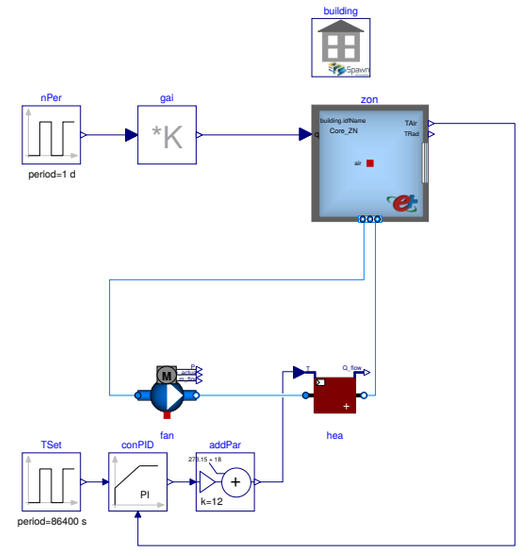
OpenBuildingControl

- Work started on making Buildings.Controls.OBC.CDL an ASHRAE standard
- In progress: Update of control sequences for
  - VAV (ASHRAE Guideline 36)
  - boiler & chiller plants (ASHRAE RP 1711)
  - radiant systems



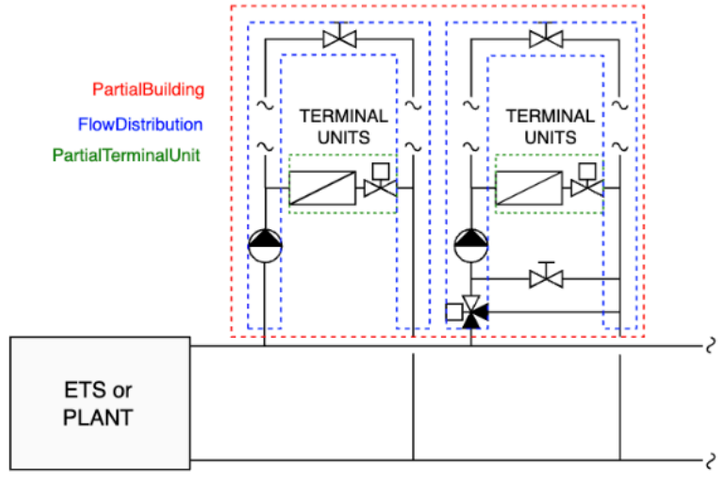
Spawn of EnergyPlus (branch issue1129_energyPlus_zone)

- Beta release in summer/fall 2020
- Can model multiple buildings, read E+ output variables to Modelica
- Next: Writing to E+ schedules and actuators, adding radiant systems

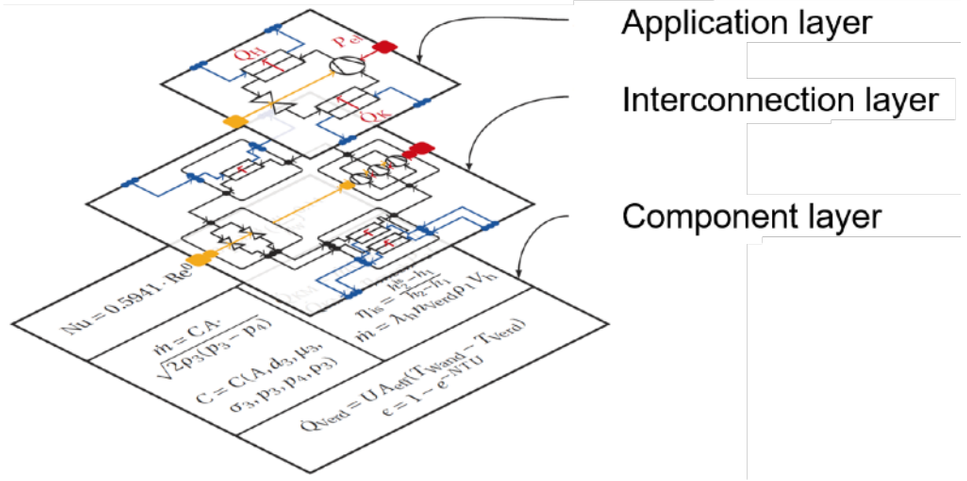


District heating and cooling

- Engine for URBANopt
- Templates for 5th generation DHC

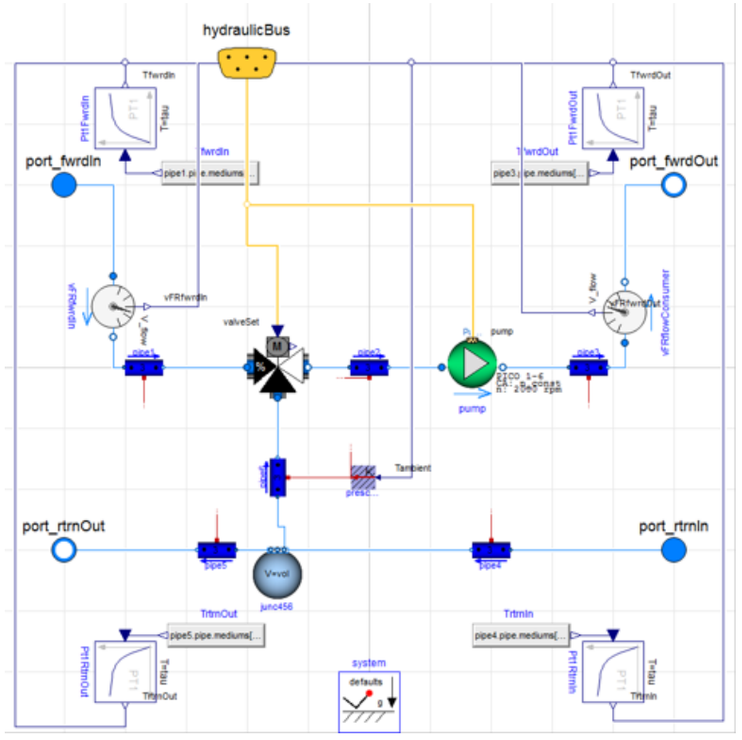


AixLib v0.9.1



New AixLib release on 20.01.20

- The new Heat pump model from v0.7 is now also integrated for FastHVAC
- New modular CHP model for calibration
- New boiler model AixLib.Fluid.BoilerCHP.BoilerNoControl where the input is the part load rate
- New pump model in package AixLib.Fluid.Movers.PumpsPolynomialBased that is based on polynomial functions
- New heat exchanger model AixLib.Fluid.HeatExchangers.DynamicHX with dynamic behavior
- New humidifier model AixLib.Fluid.Humidifiers.GenericHumidifier_u for steam and adiabatic humidification and part load rate as input
- New air medium AixLib.Media.AirIncompressible with constant density for duct work simulations
- Continuous Integration with regression tests to check simulation results



New Toolbox-Homepage including AixLib and Teaser

https://ebc-tools.eonerc.rwth-aachen.de/en