



# Implementation of new consumer model in RAPSim to allow energy management system integration



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# Basics and Motivation

- Rising worldwide electricity demand
- Action necessary
- Energy management systems
  - Increasing efficiency
  - Reduction of energy consumed
  - Increase of comfort
- Introduction of Smart Grids
  - Coordinated power transfer reduces grid utilization
  - Reduction of accruing losses
  - Bidirectional communication consumer-provider
- Smart Grid simulation programs useful
  - Analyzation
  - Planning
  - Examples: GridLab-D, RAPSIm (open source)

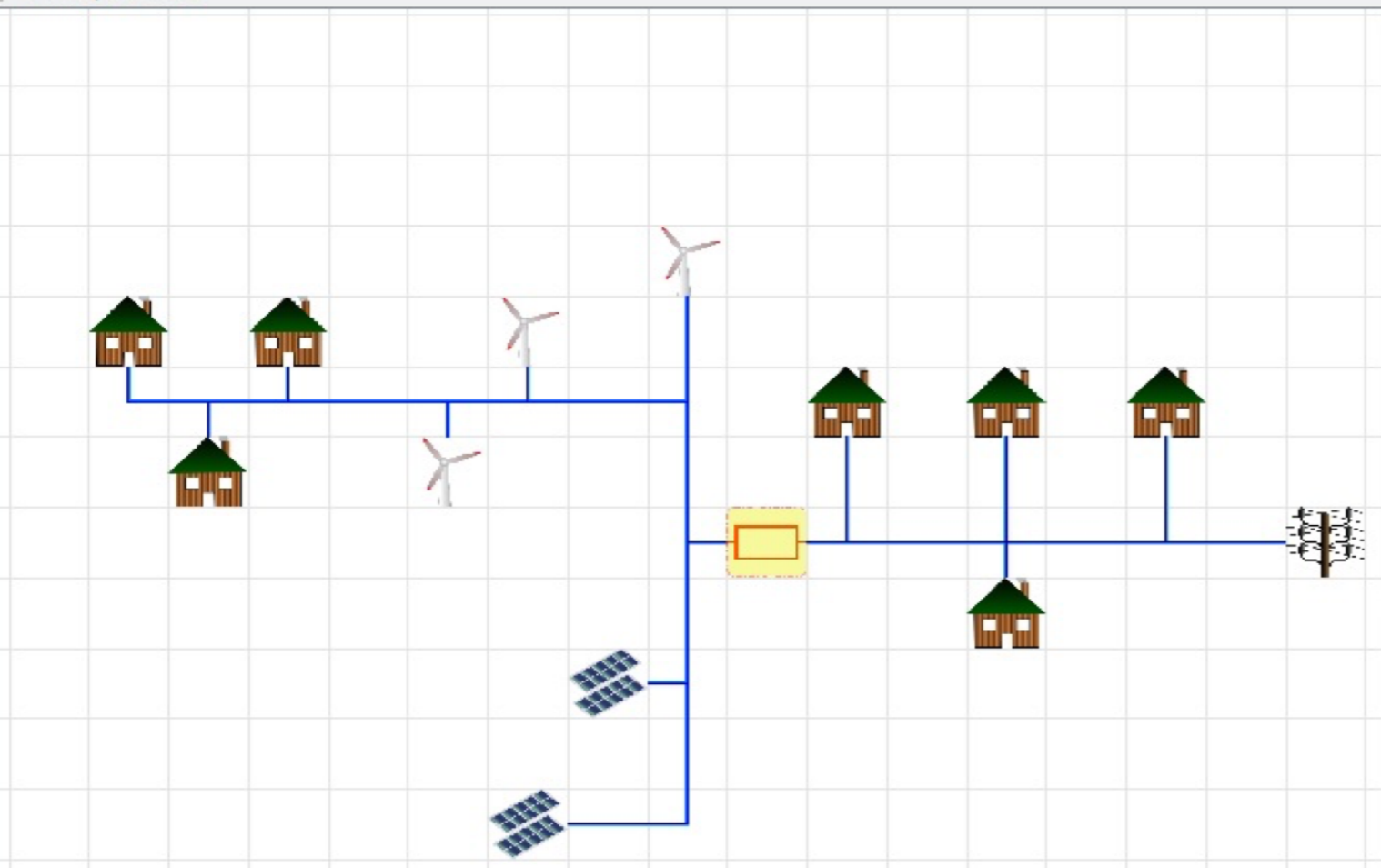


- Developed at Alpen Adria University Klagenfurt (M. Pöchacker)
- Framework for Micro-grid simulation
- Grid structure and participants fully customizable
- On – or off grid scenarios
- Complex weather models
- Simulation data saved to external file
- Java based
- Open source <https://sourceforge.net/projects/rapsim/>

2018.03.23 - 15:45

Start Sim Refresh Attributes Undo

Cloudfactor: 0.5  
Windspeed: 3.0



CustomConsumer @(19|9), Bus=0

Name	Value	Unit
CustomConsumer-Object		
powerConsumption	0.0	W
powerDemand	0.0	W
ConstantDemandModel		
actual used model: ConstantDemandModel		
powerDemand	0.0	W

Consumer with constant power demand

Close refresh

SolarPowerPlant @(14|10), Bus=0

Name	Value	Unit
SolarPowerPlant-Object		
powerProduction	0.0	W
powerProductionOptimal	0.0	W
SolarPeakPowerModel		
actual used model: SolarPeakPowerModel		
efficiency	0.2	% /100
height	0.0	km
latitude	46.6	°
longitude	14.4	°
powerProductionOptimal	0.0	W
squareMeters	0.0	m <sup>2</sup>

1) day of the year by use of clear sky model and 3) by using random cloudiness of the weather thread

Close refresh

RAPSim - Renewable Alternative Powersystems Simulation

2014.01.04 - 04:30

Cloudfactor: 0.494  
Windspeed: 1.614

Stop Sim Refresh Attributes Undo

Idle Time

0.01s 0.1s 1s 10s

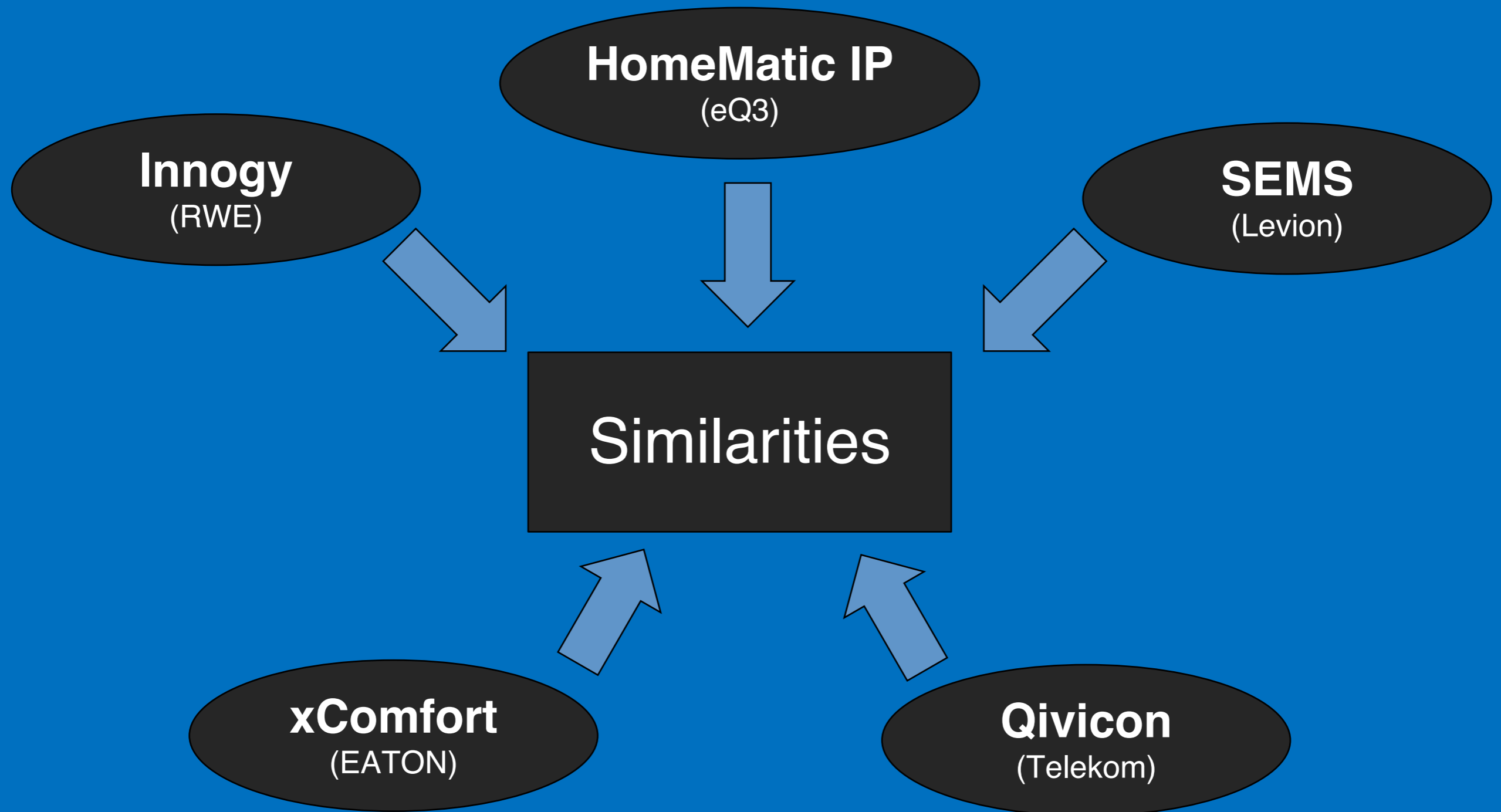
Stop NoDelay Pause Step



# Aim of the research

- Add Home Energy Management System (HEMS) support to RAPSIm
- Determination of an appropriate way to integrate those
- Implementation of the functions
- Execution of test simulations
- Next objectives:
  - Analyze impact of HEMS
  - Overview of how to add components

# Selected Energy Management Systems



# Selection of functions suitable for simulation

Basic common functionality:

- Light control
- Heat control
- Smart switches
- Integration of photovoltaic systems
- Integration of battery storages

Little impact, no human habits

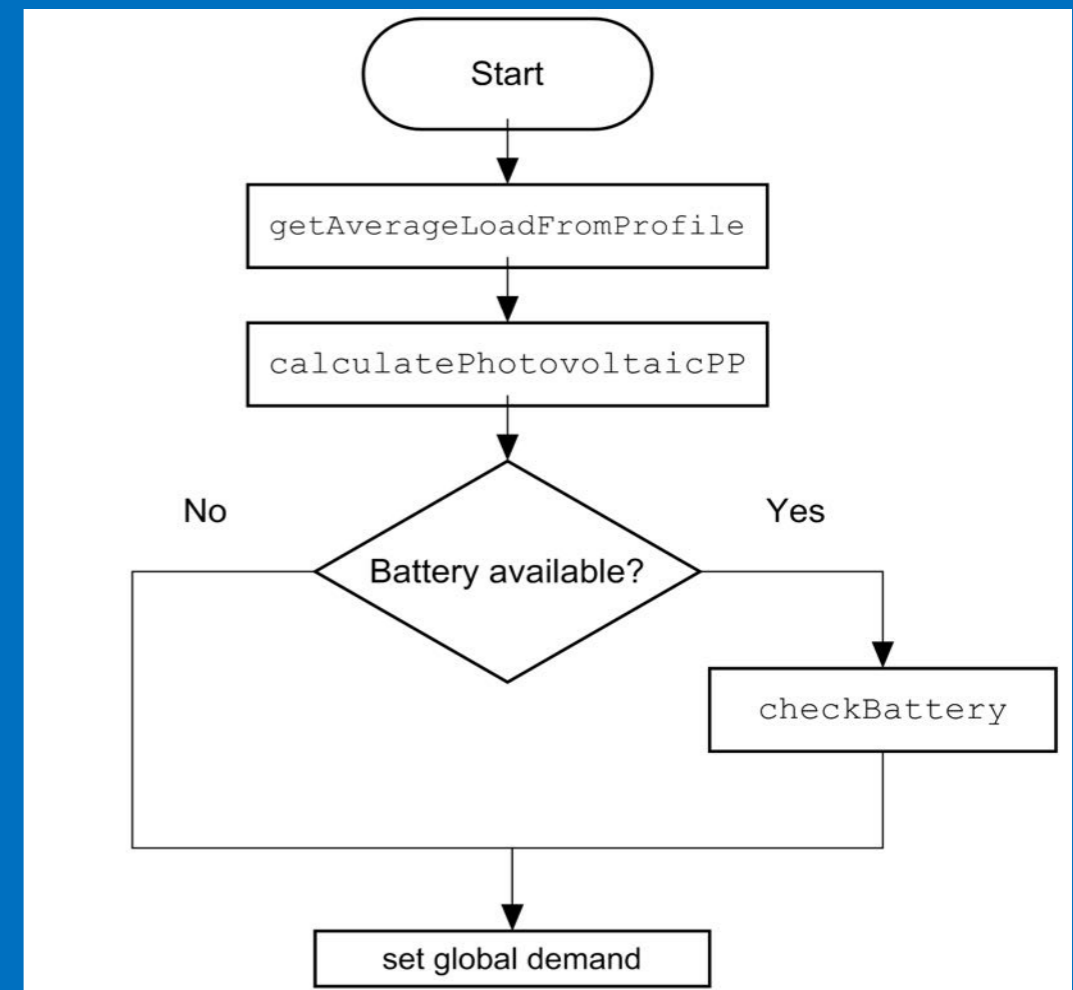
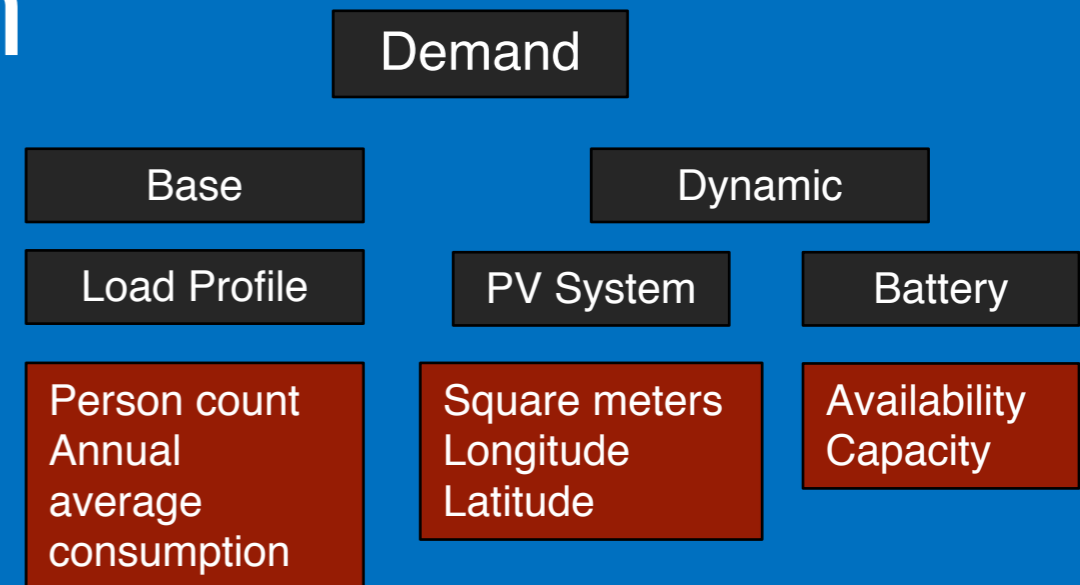


Big impact, external data available



# How to integrate those functions into RAPSim

- Integration by consumer models
- Already existing ones:
  - Average load curve model
  - Constant demand model
- No change of existing ones, they serve their use
- New generic model:
  - Energy management model
  - Class: `AbstractCustomConsumerModel`





# Creation of a test simulation

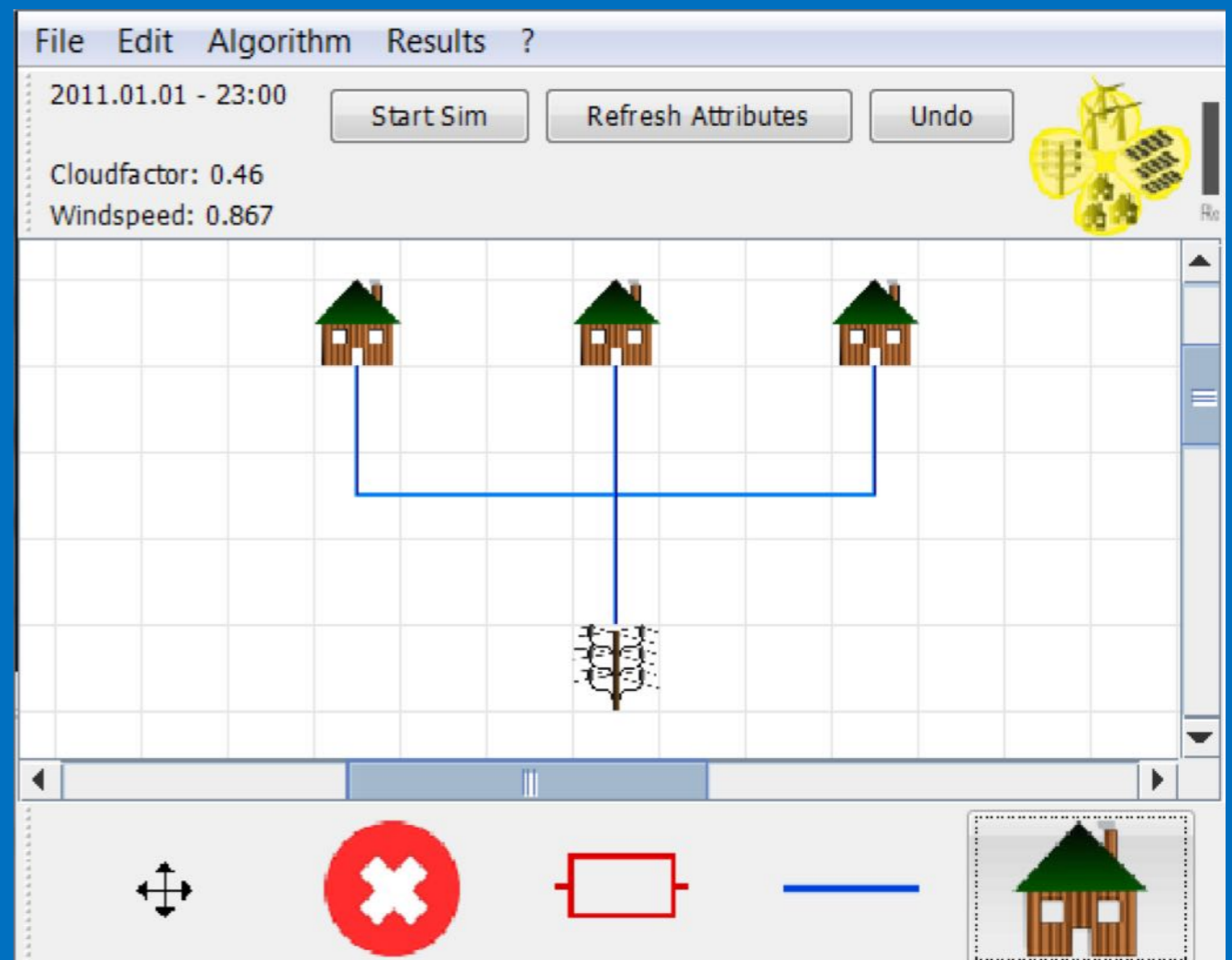
Scenario to compare new component to old ones

Structure:

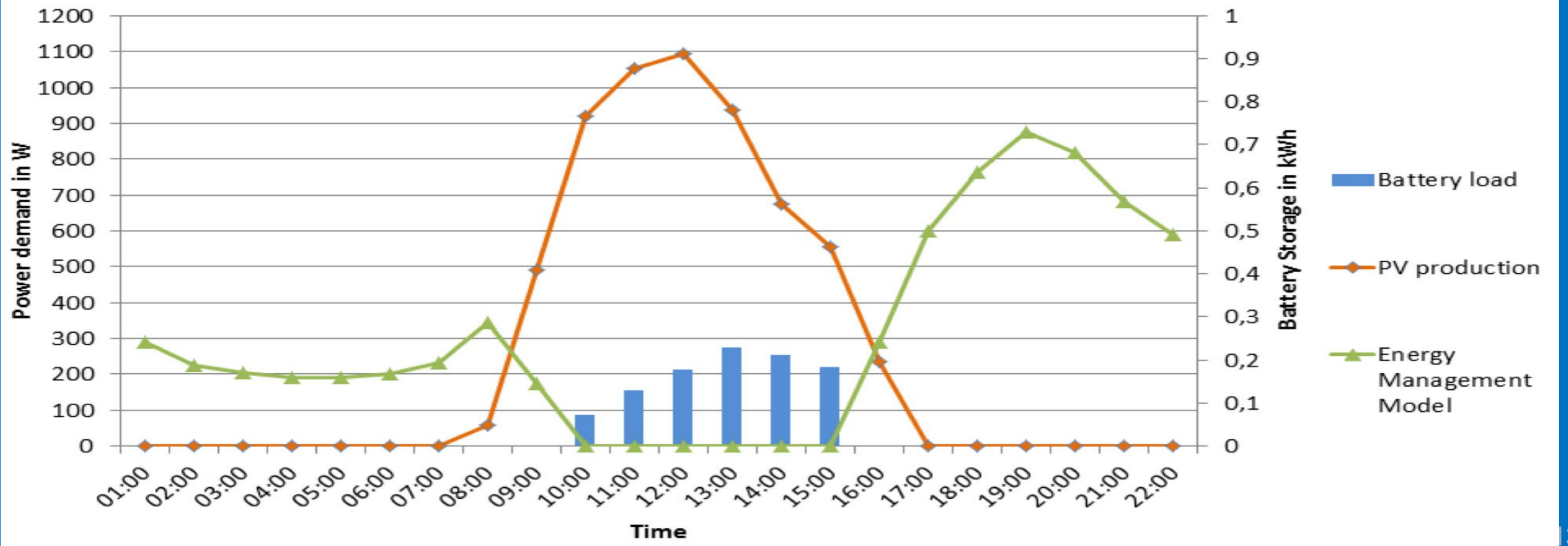
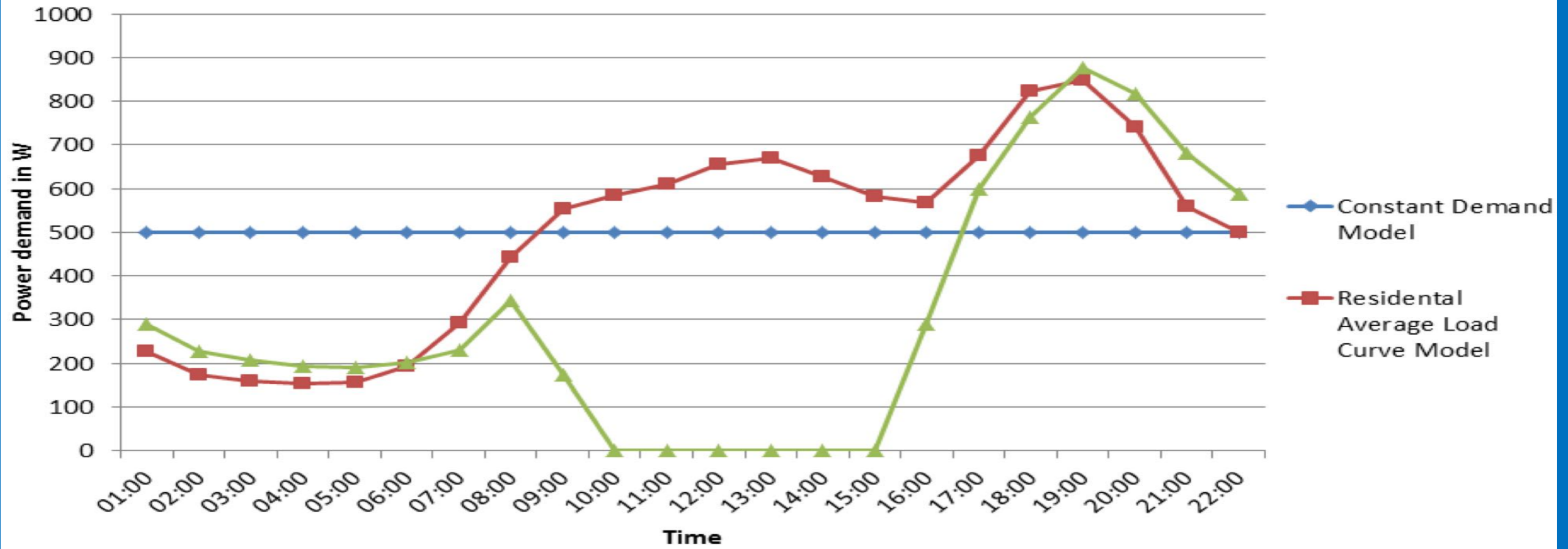
- Constant model
- Average model
- Energy management model
- Public power grid

Executed:

Simple distribution  
algorithm



# Simulation results



# Discussion

What we noticed:

- Involving energy management systems is essential
- Big difference in simulation
- Closer to reality

Changes:

- Integration of energy management systems into RAPSIm
- More dynamic consumer models
- New individual scenarios and settings possible

# Outlook

- Implementation of external interfaces
  - Connecting external devices (HiL\*)
  - Data input by real energy management systems
- Adding further features
  - Simulation of human behavior
  - Complete simulation; replacing load profile
- Scaling to bigger test simulation scenarios

\*HiL... Hardware in the Loop

Thank you for your  
attention