

# **BIM & Simulation**

Building Energy Simulation  
in  
modern BIM planning processes

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# What is BIM ?

*Digital representation of physical and functional characteristics of a facility*  
([buildingsmart.org](http://buildingsmart.org))

Means:

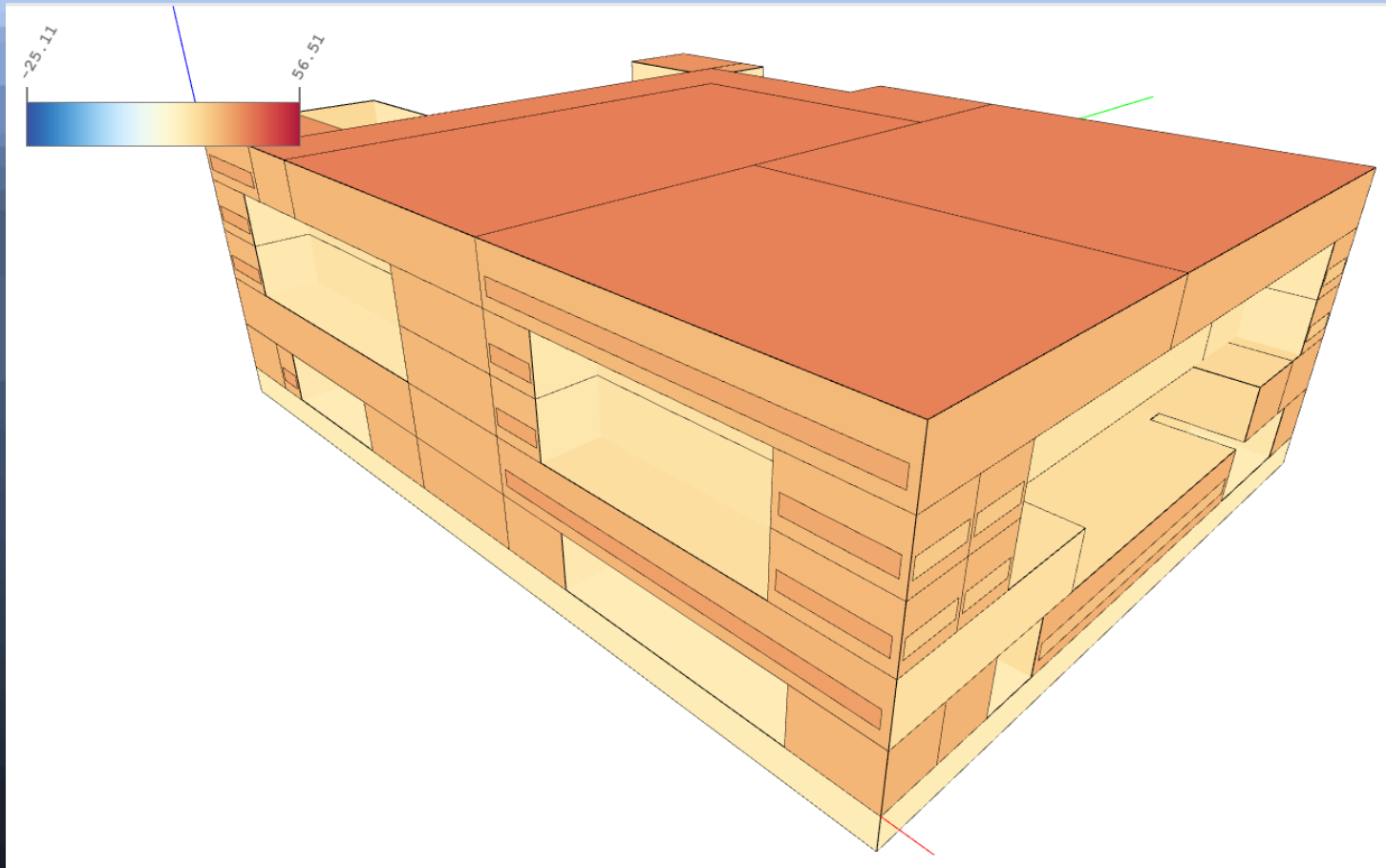
Design of buildings with integrated planning of technical equipment (HVAC, Renewable Energy & Smart Technologies, ICT) and usage

# Increased complexity as a challenge

Dr. Günther Ofner, Director of Flughafen Wien AG, Planning Day 2016 in Velden, on lessons learned from SKYLINK:

- Complexity must be assessed correctly
- assign sufficient time for project development
- critical part: HVAC systems
- *no construction start before completion of plans*
- *no changes of plans during construction*

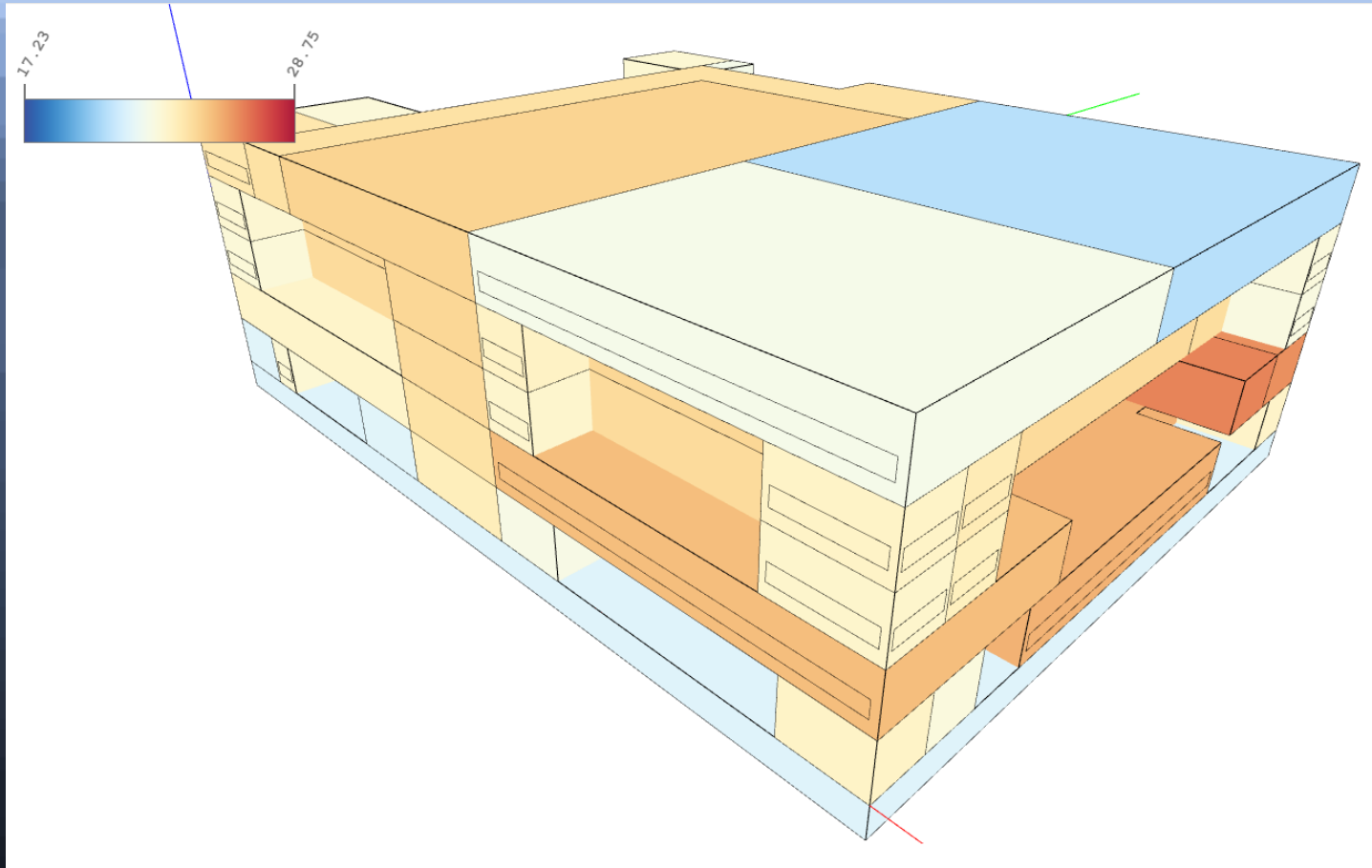
# BIM approach: build virtually first, then physically (1)



e.g.: simulation of hospital

surface temperatures 18.06. 12:00

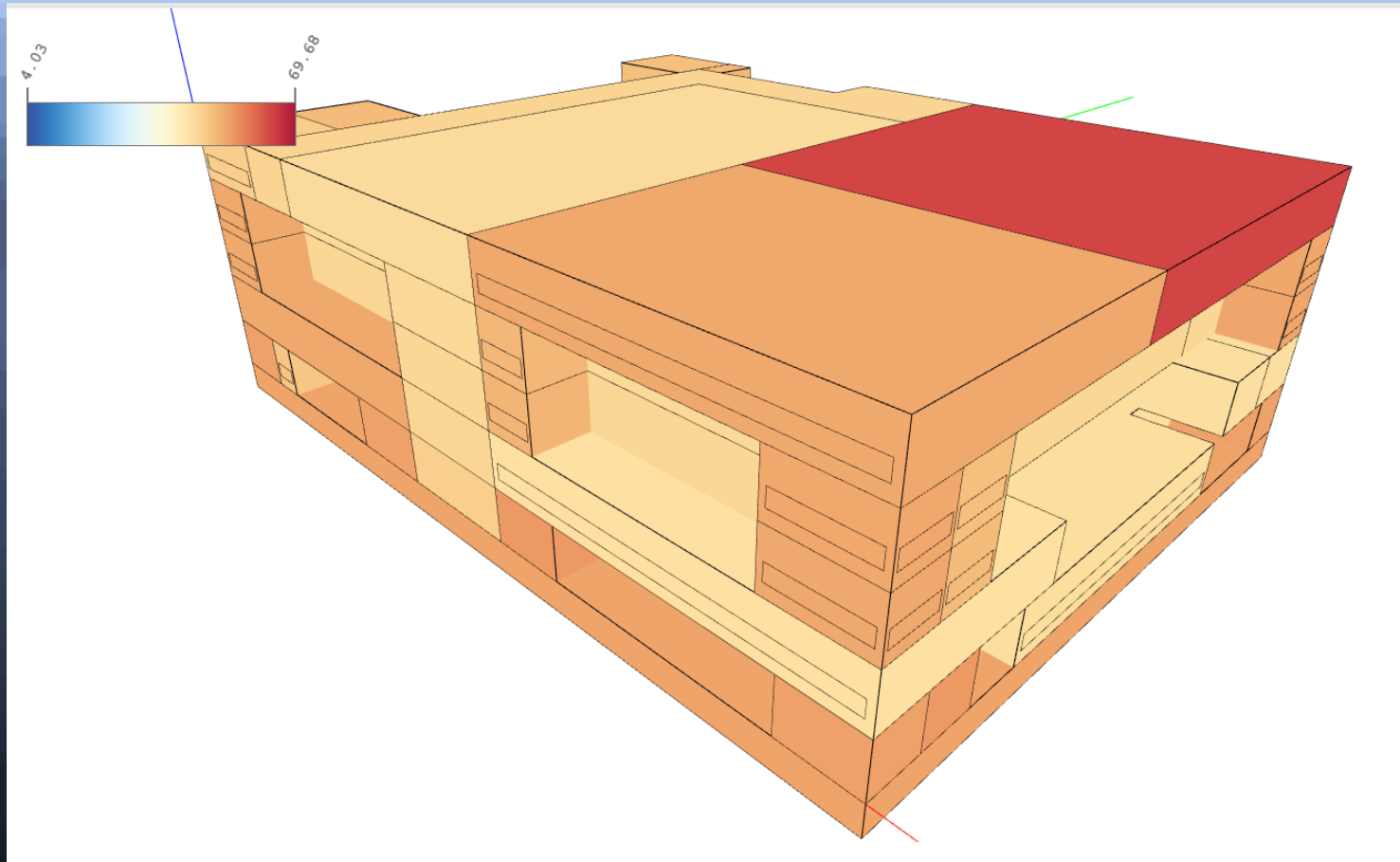
# BIM approach: build virtually first, then physically (2)



e.g.: simulation of hospital

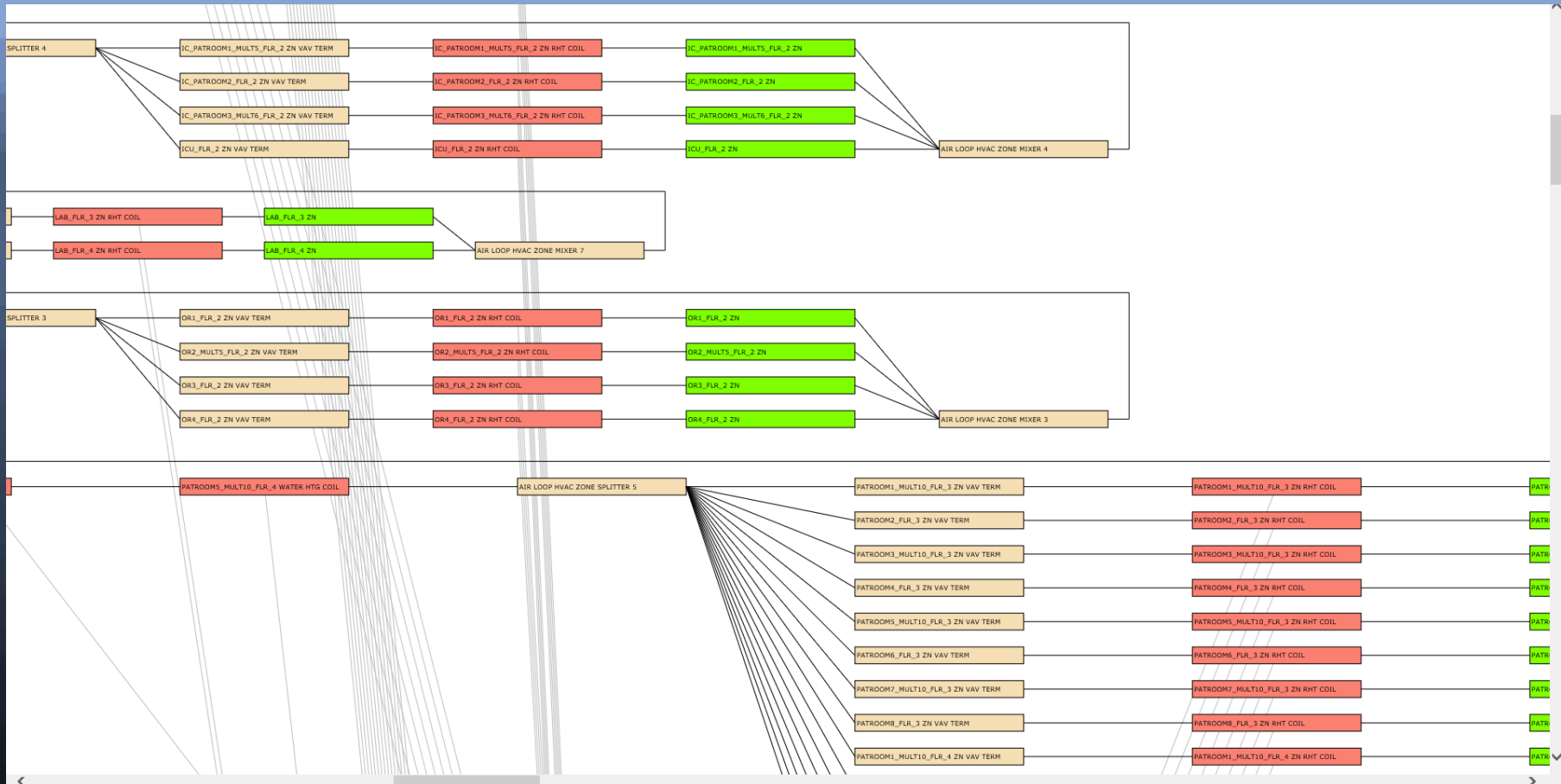
room temperatures 18.06. 12:00

# BIM approach: build virtually first, then physically (3)



e.g.: simulation of hospital relative indoor air humidity 18.06. 12:00

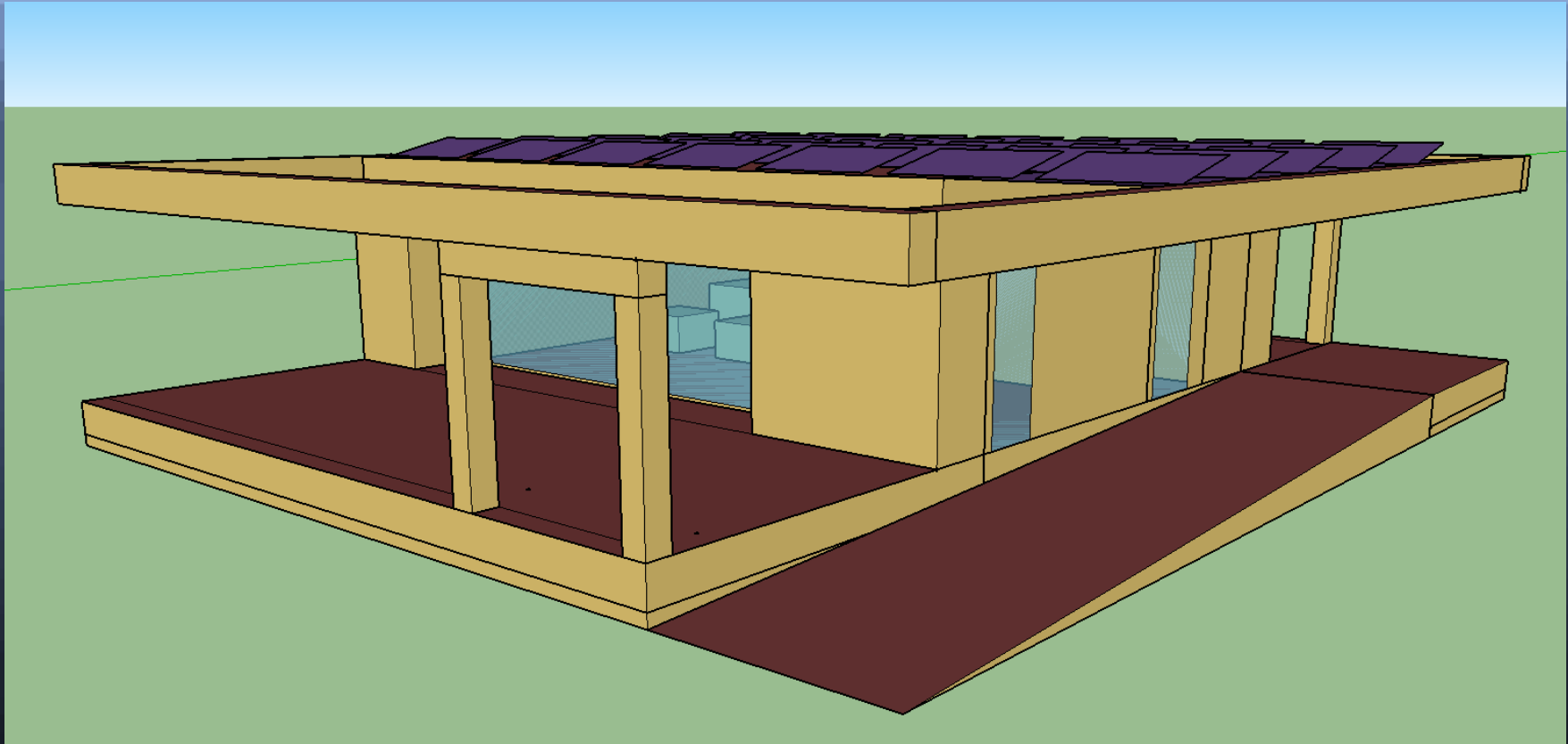
# BIM approach: build virtually first, then physically (4)



e.g.: simulation of hospital

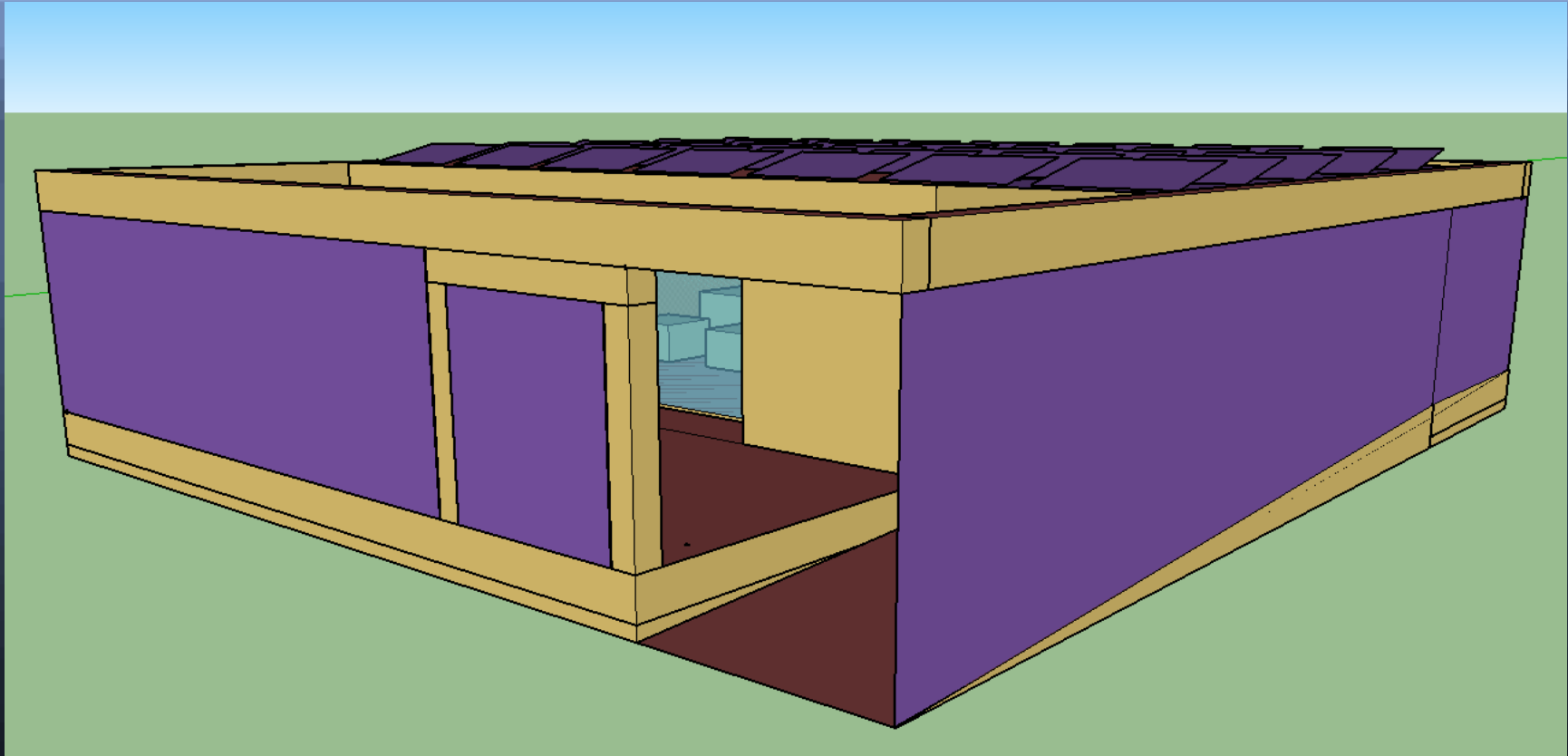
extract from HVAC diagram

# Case example: Energy+ House



example: computer reconstruction LISI HOUSE (University of Tech., Vienna)

# Case example: Energy+ House

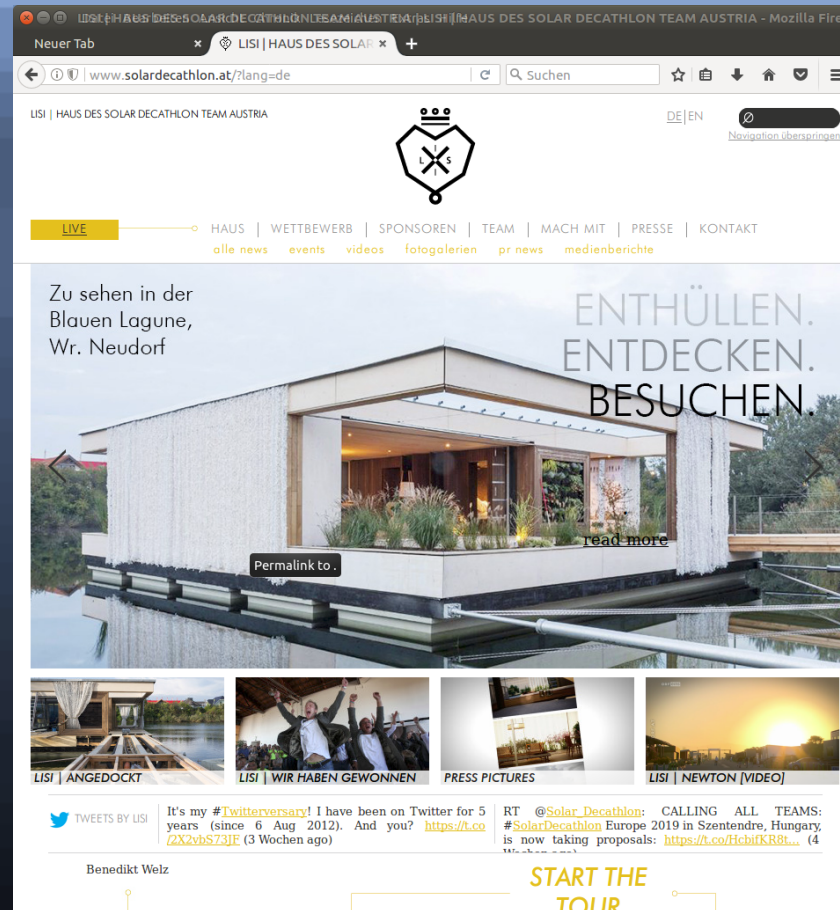


example: computer reconstruction

LISI HOUSE (UT Vienna)

# Case example: Energy+ House

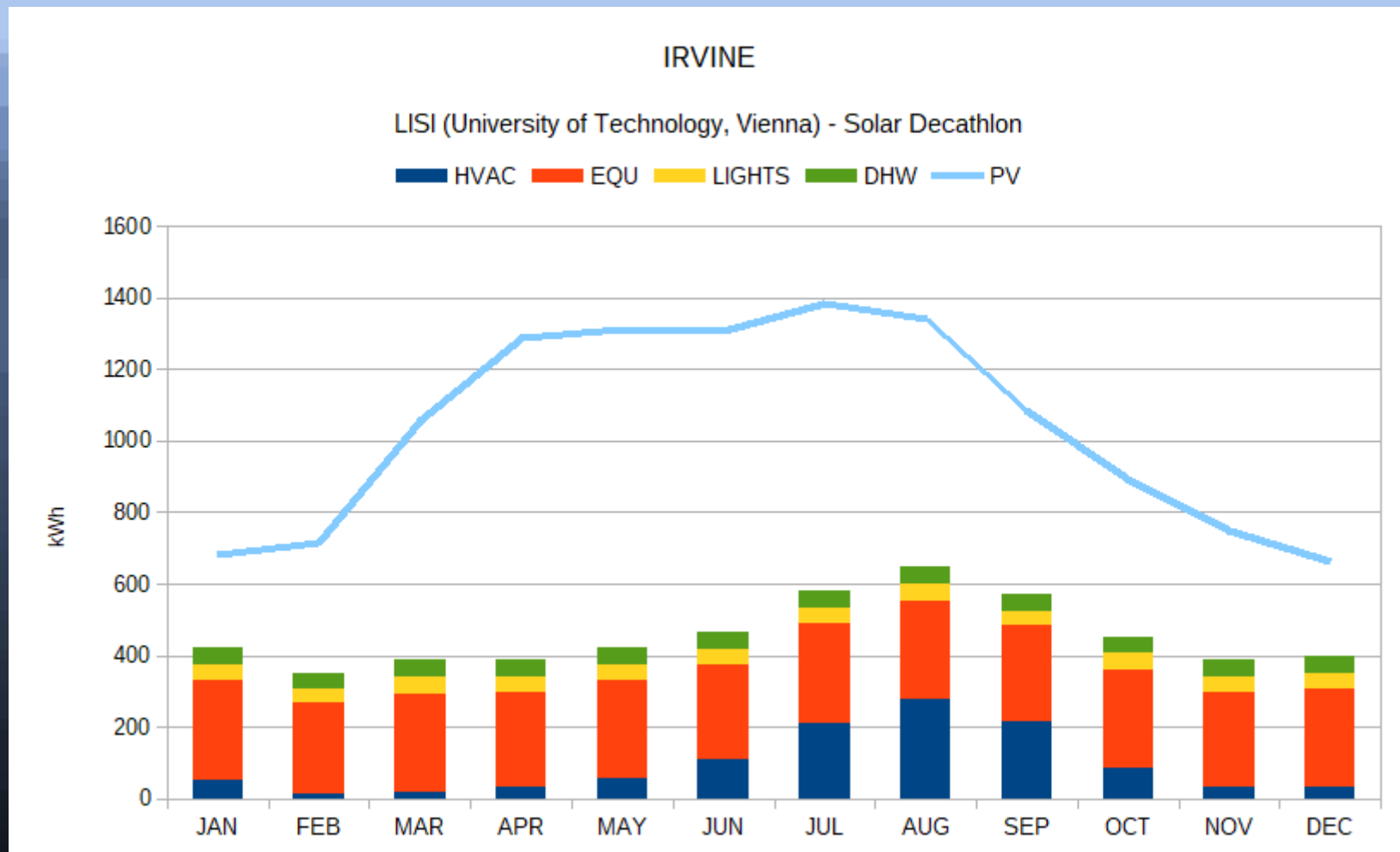
official website: [www.solardecathlon.at](http://www.solardecathlon.at)



example: LISI HOUSE (UT Vienna)

SolarDecathlon 2013 (USA) 1st prize

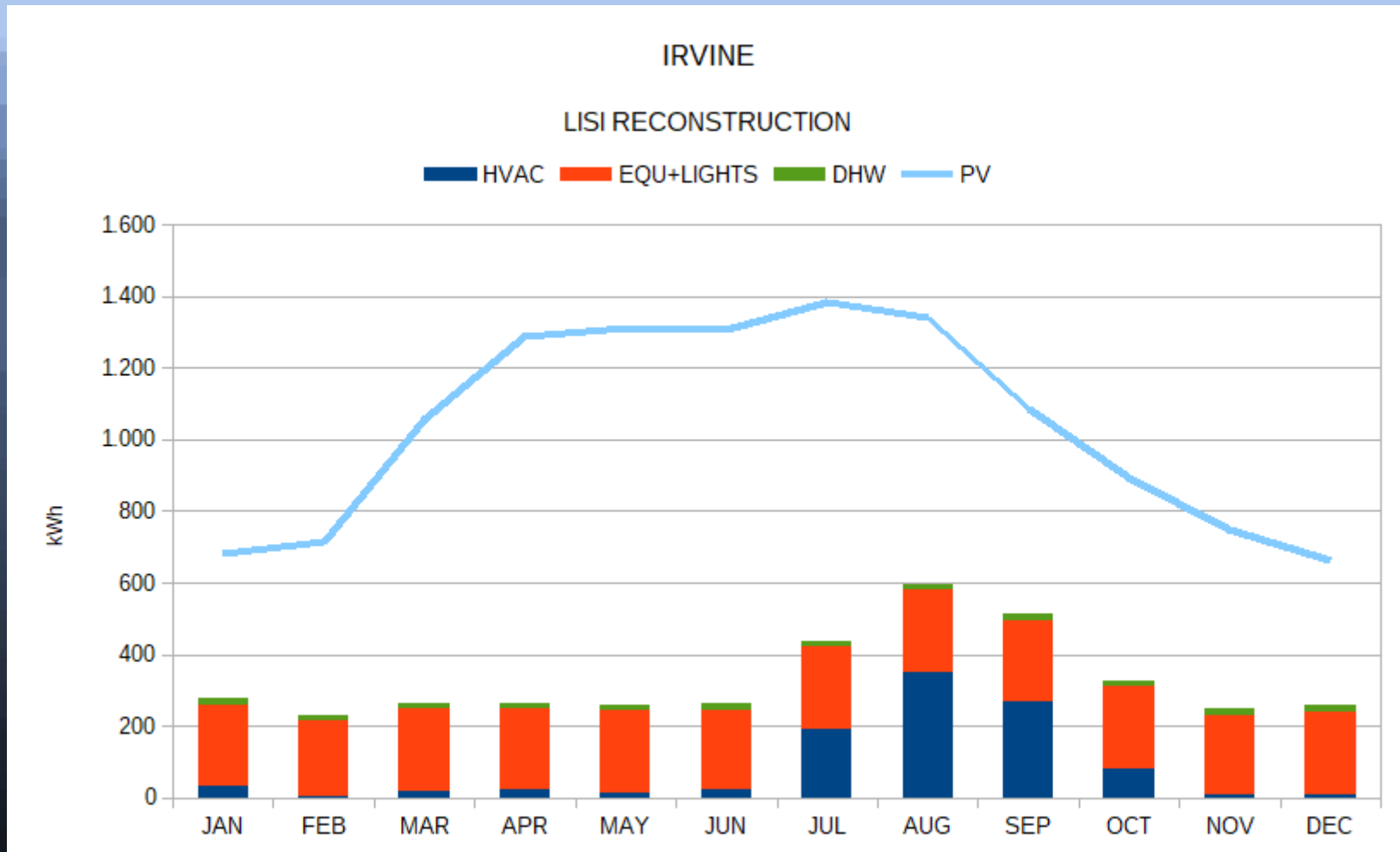
# Case example: Energy+ House



example: LISI HOUSE (UT Vienna)

simulation TRNSYS etc.

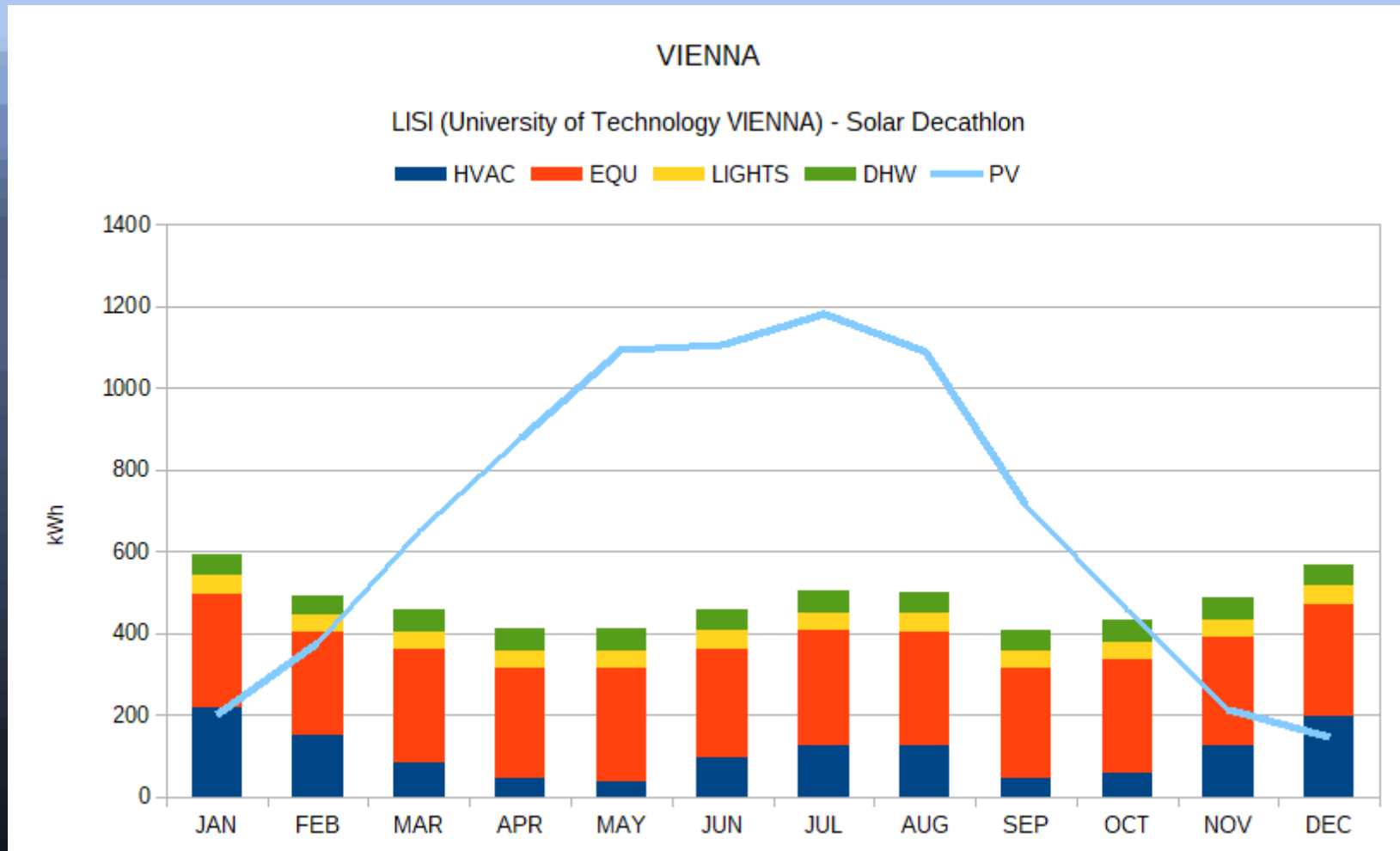
# Case example: Energy+ House



example: LISI HOUSE reconstruction

EnergyPlus simulation

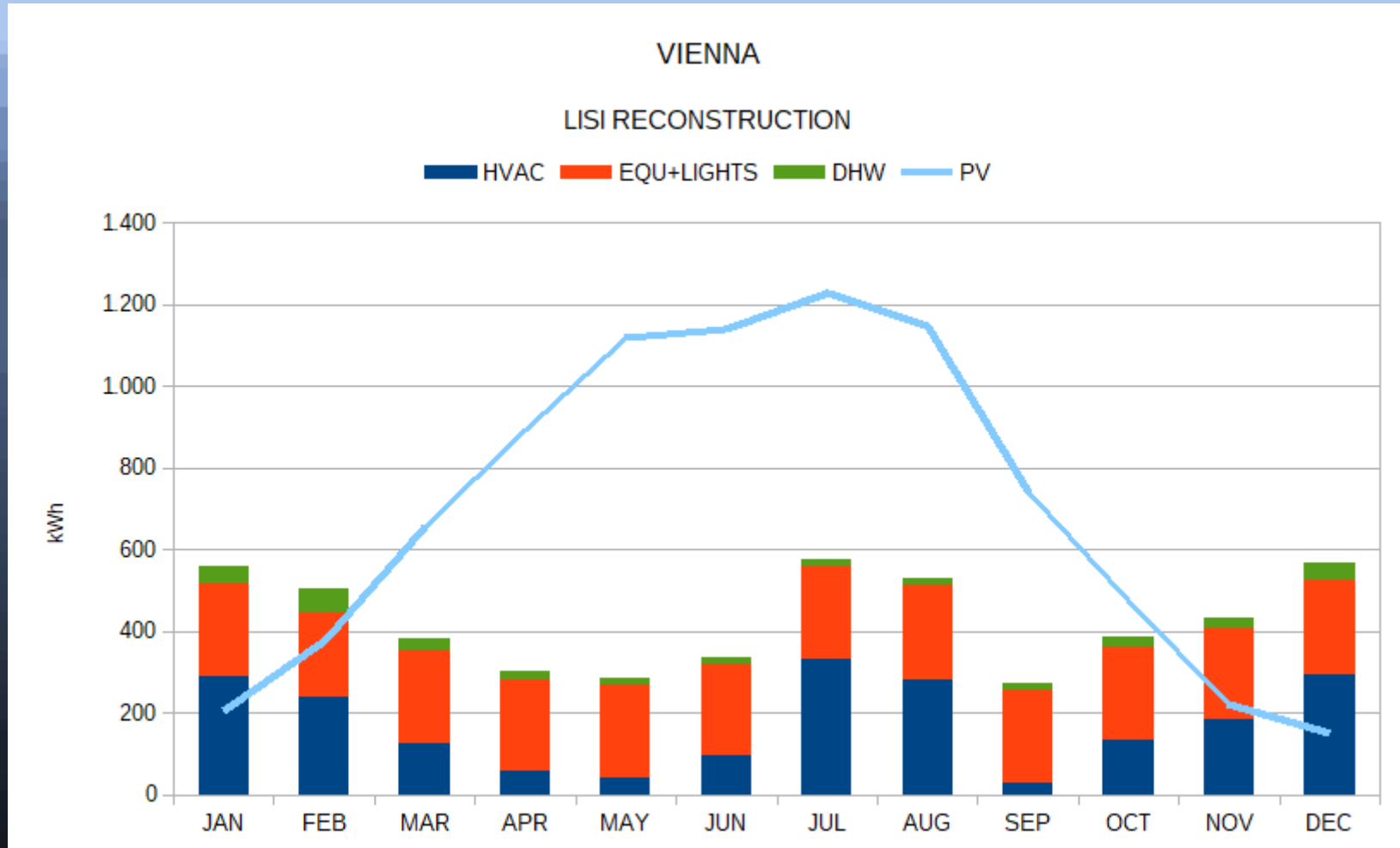
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example: LISI HOUSE (UT Vienna)

simulation TRNSYS etc.

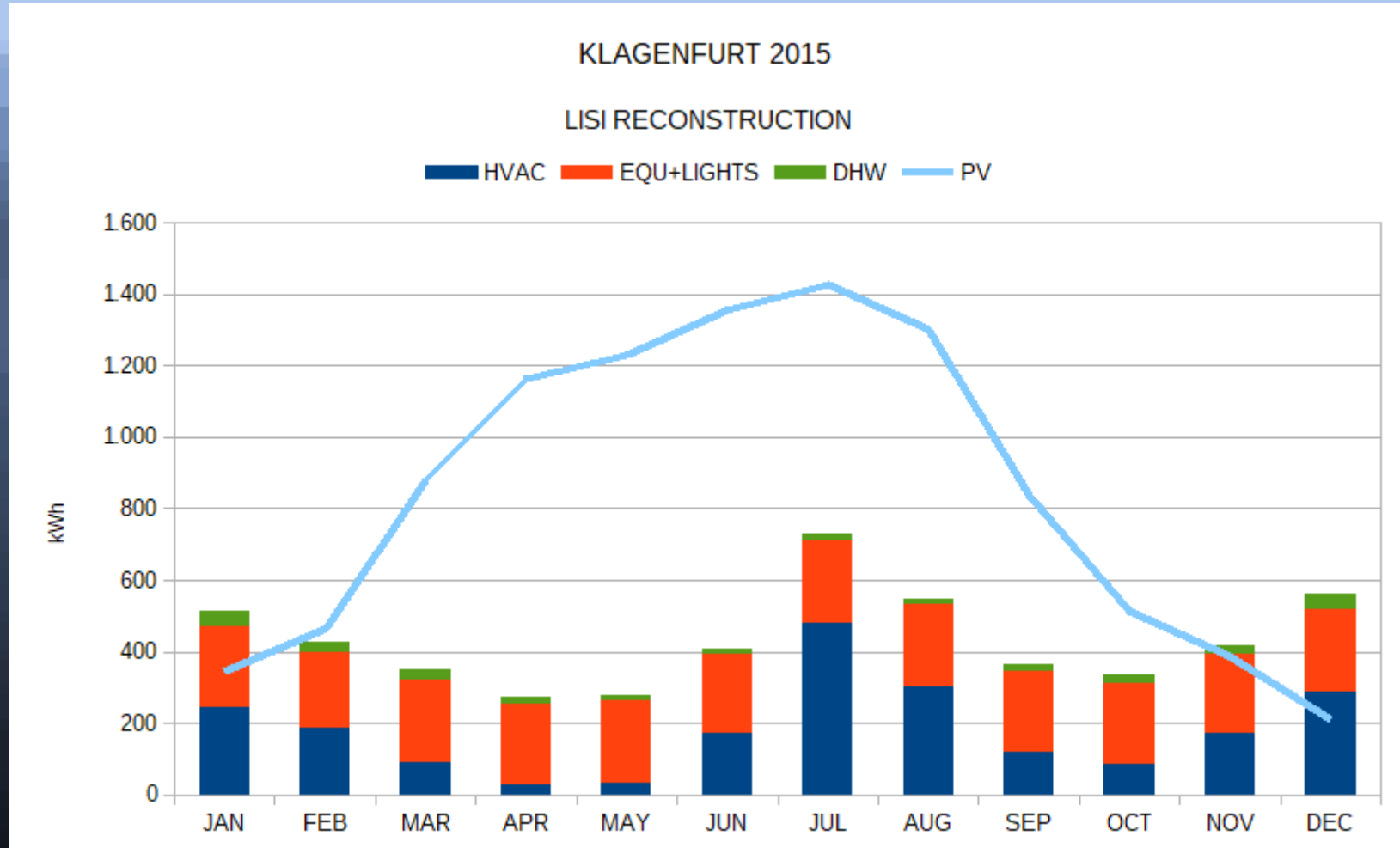
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example: LISI HOUSE reconstruction

EnergyPlus simulation

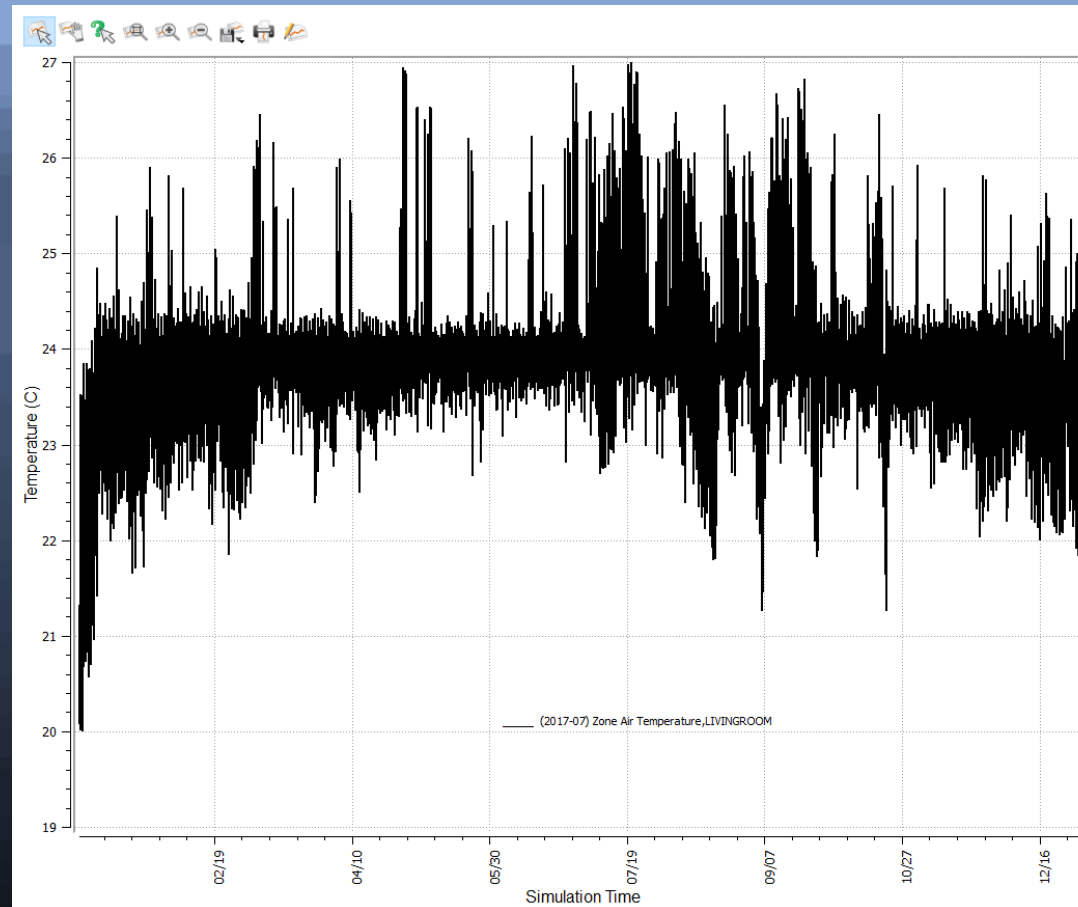
# Case example: Energy+ House



example: LISI HOUSE reconstruction

EnergyPlus simulation

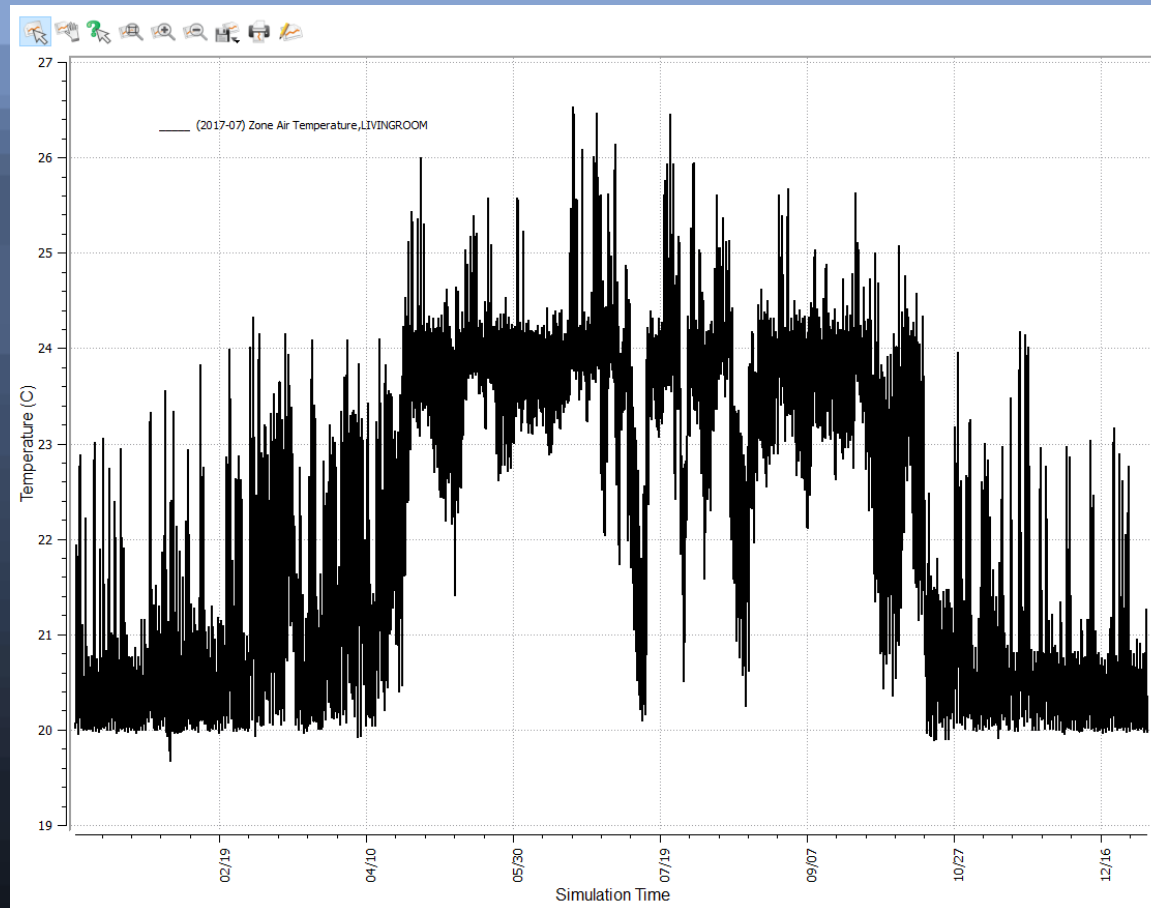
# Case example: Energy+ House



example: LISI HOUSE reconstruction

temperature livingroom IRVINE

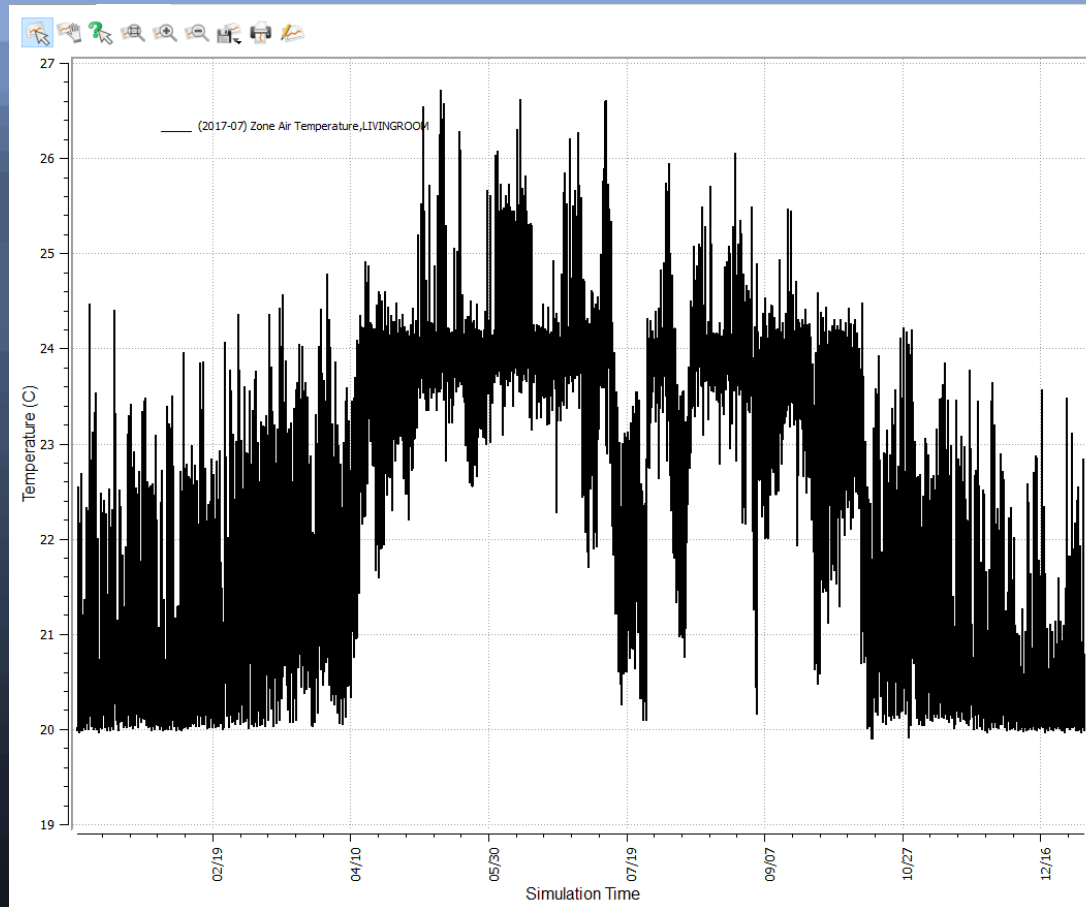
# Case example: Energy+ House



example: LISI HOUSE reconstruction

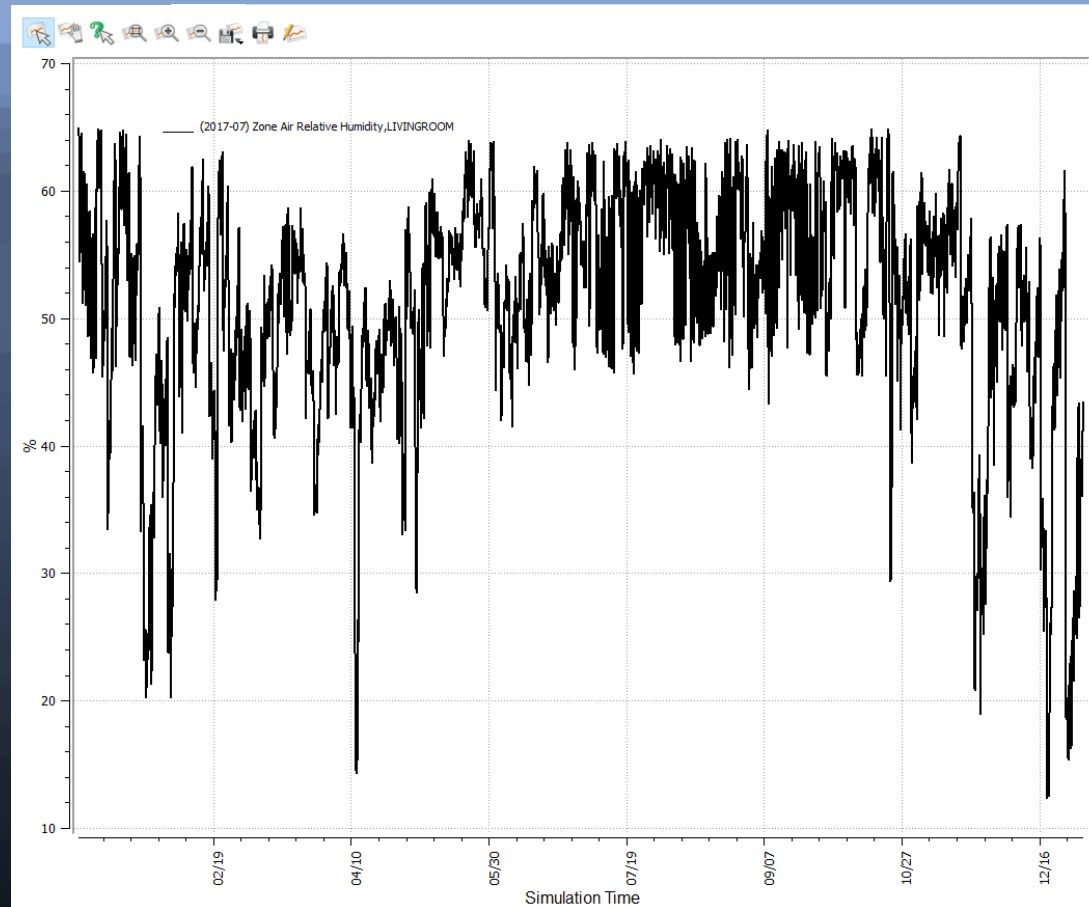
temperature livingroom VIENNA

# Case example: Energy+ House



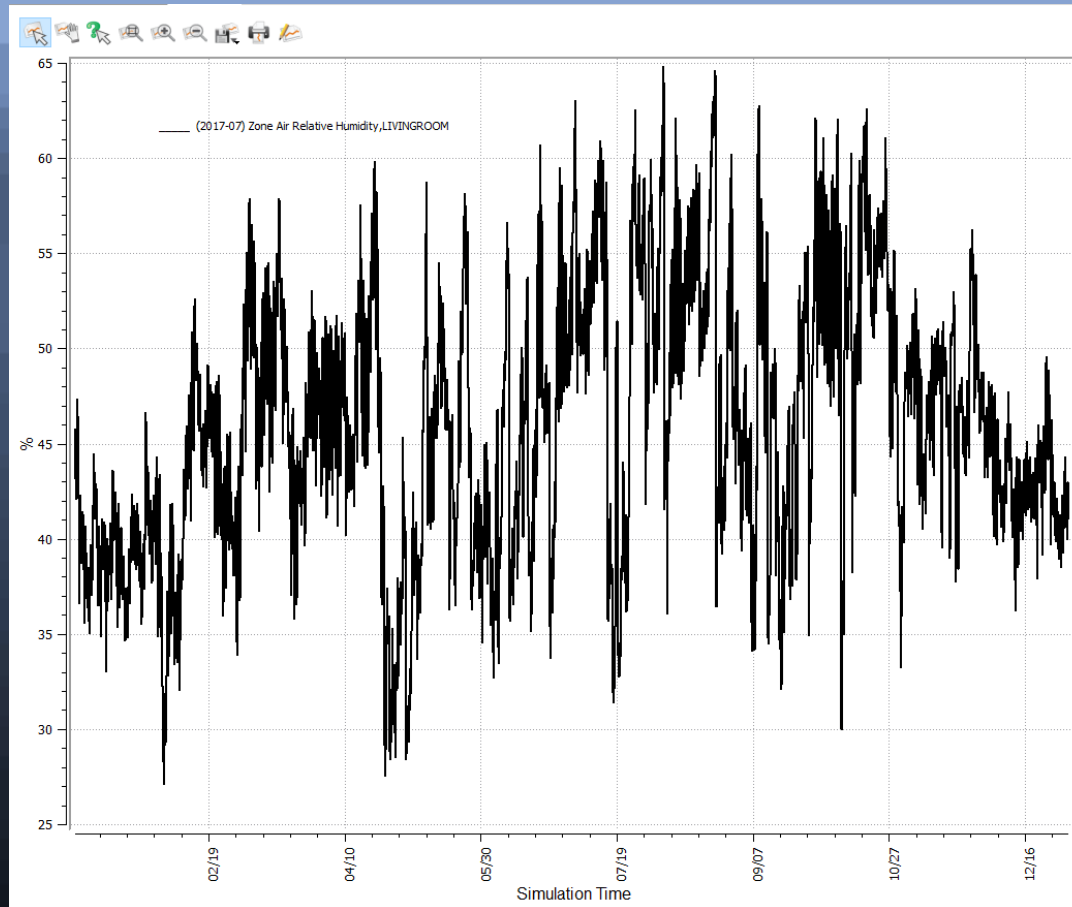
example: LISI HOUSe reconstruction    temperature livingroom KLAGENFURT

# Case example: Energy+ House



example: LISI HOUSE reconstruction    air humidity livingroom IRVINE

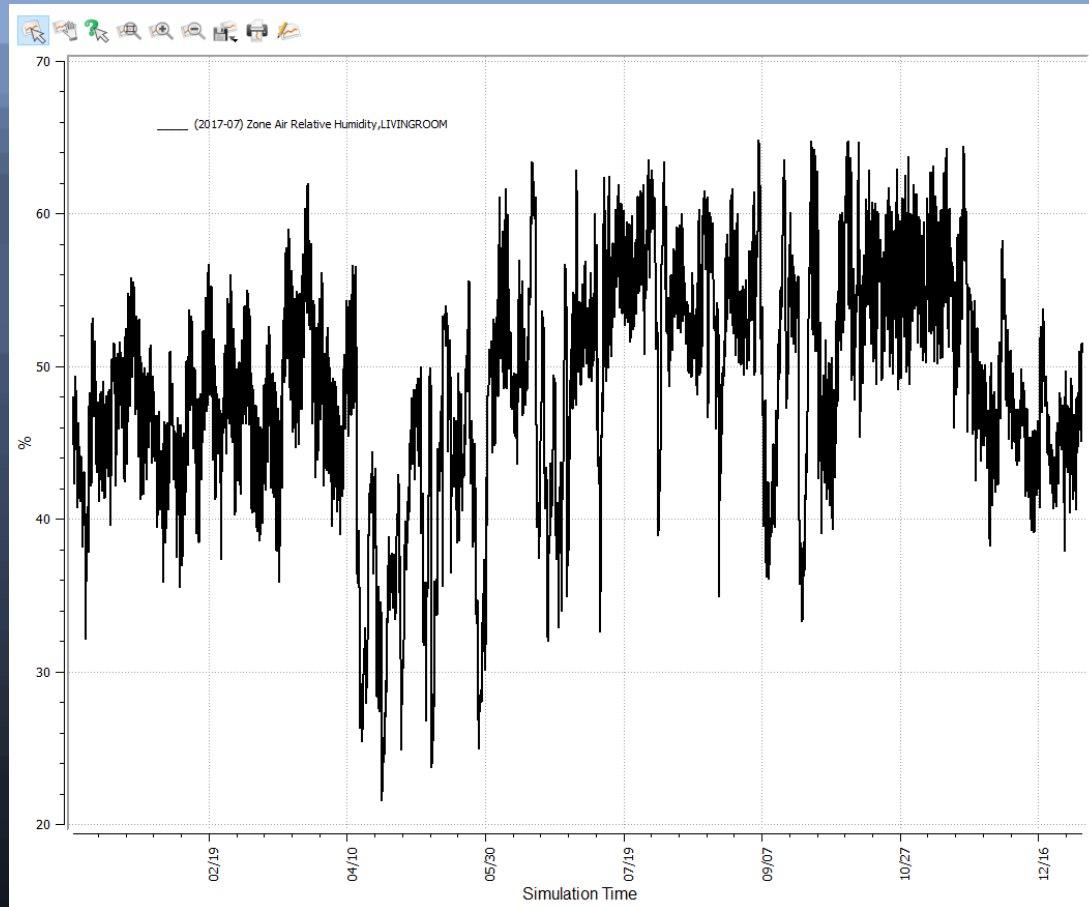
# Case example: Energy+ House



example: LISI HOUSE reconstruction

air humidity livingroom VIENNA

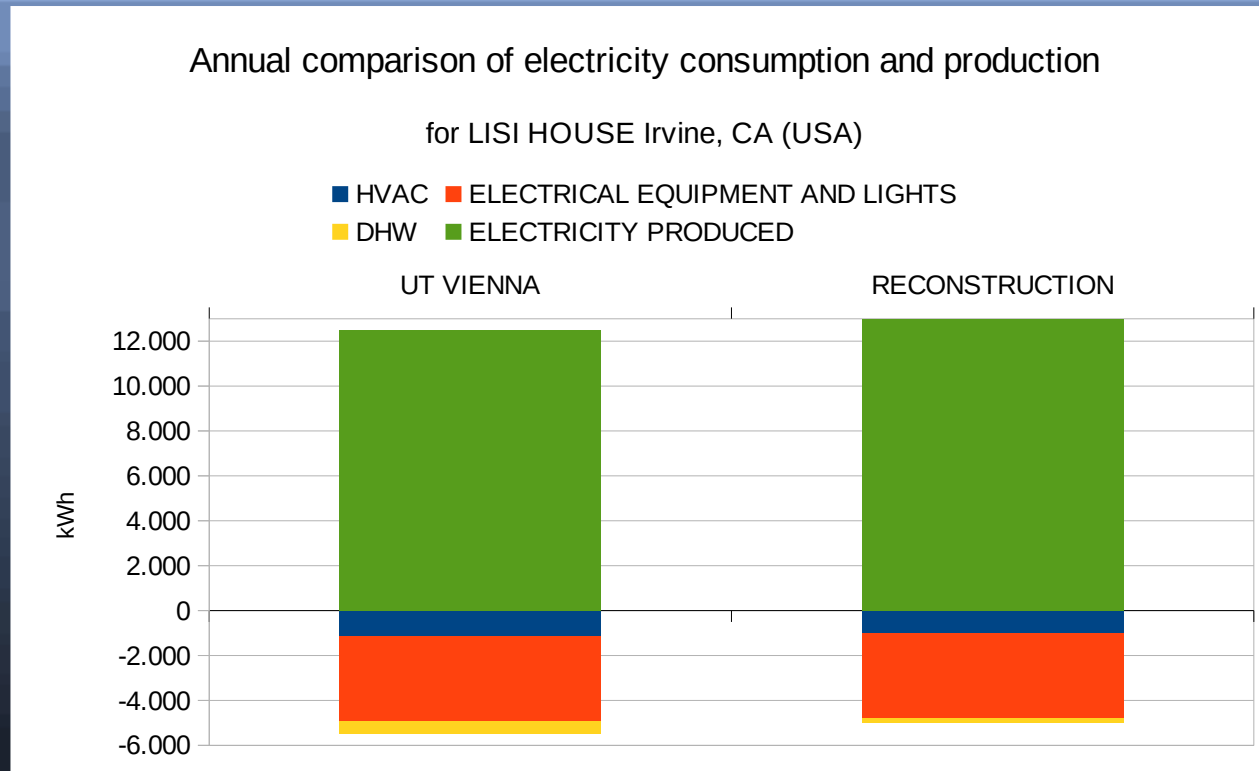
# Case example: Energy+ House



LISI HOUSE reconstruction

air humidity livingroom KLAGENFURT

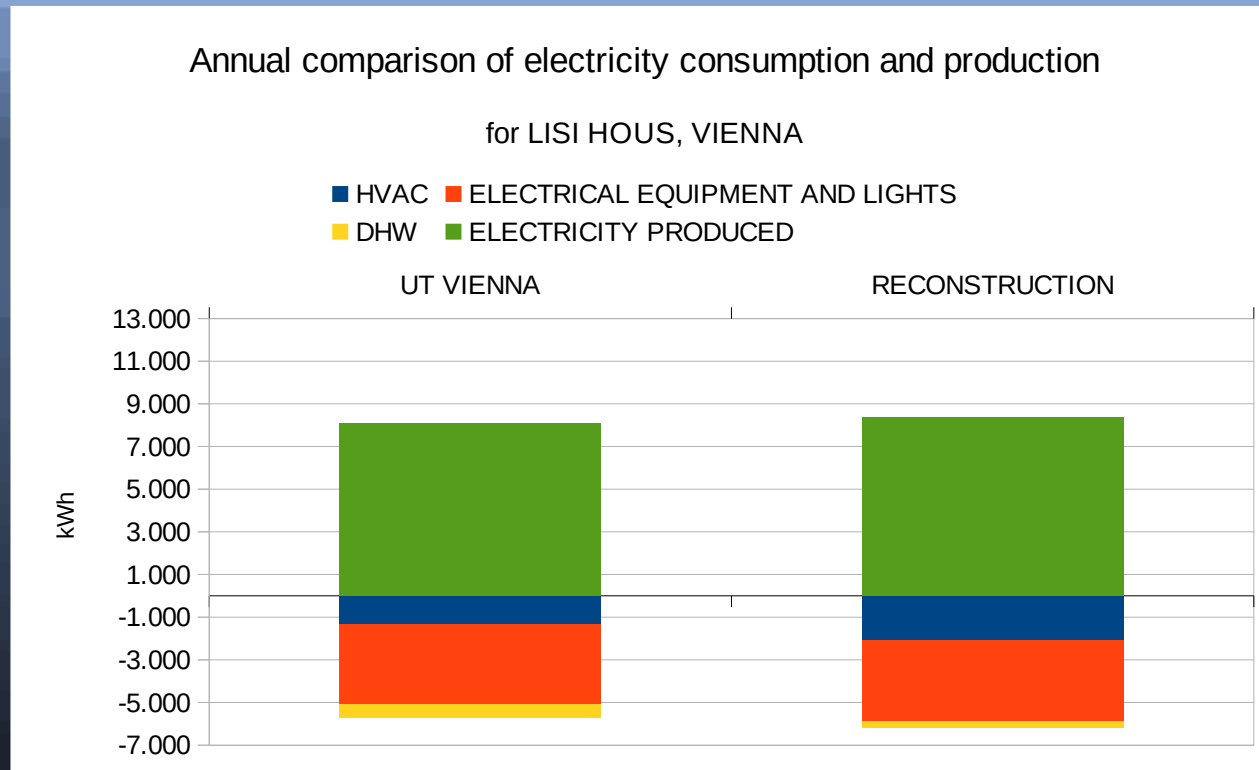
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TRNSYS simulation (UT Vienna)

EnergyPlus simulation

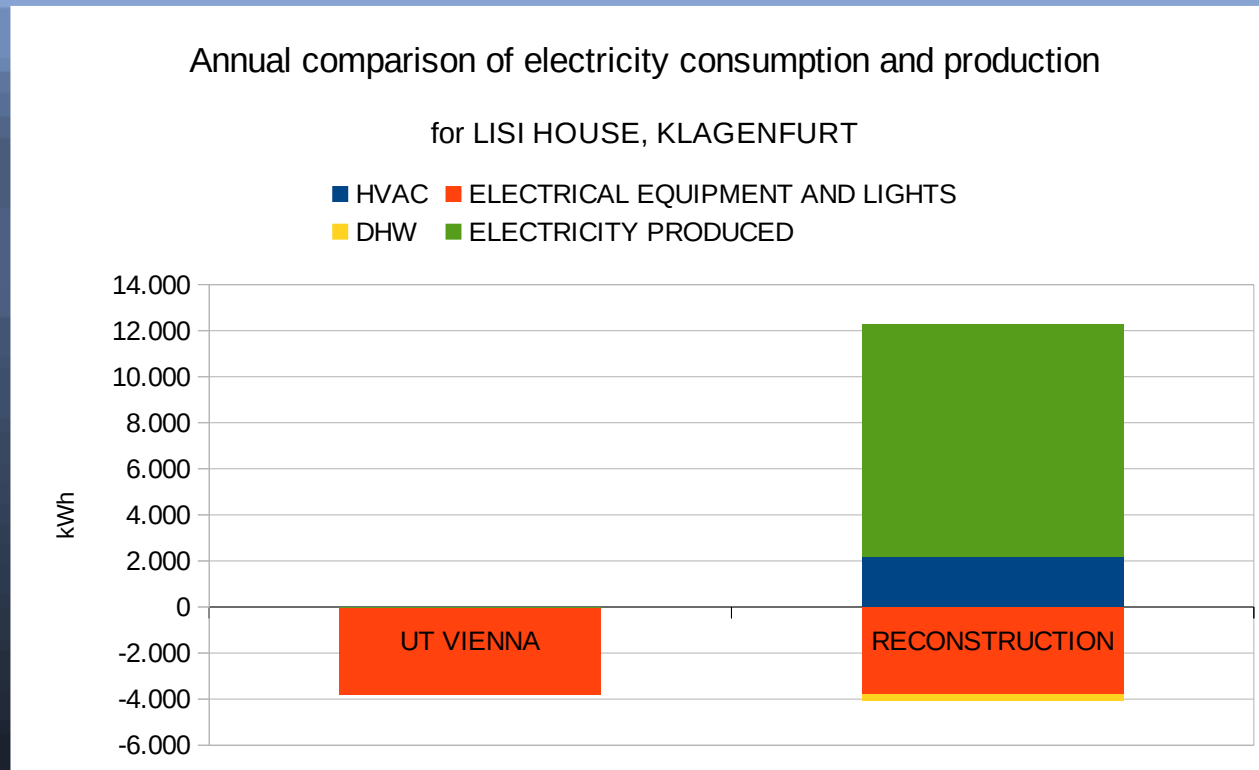
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TRNSYS simulation (UT Vienna)

EnergyPlus simulation

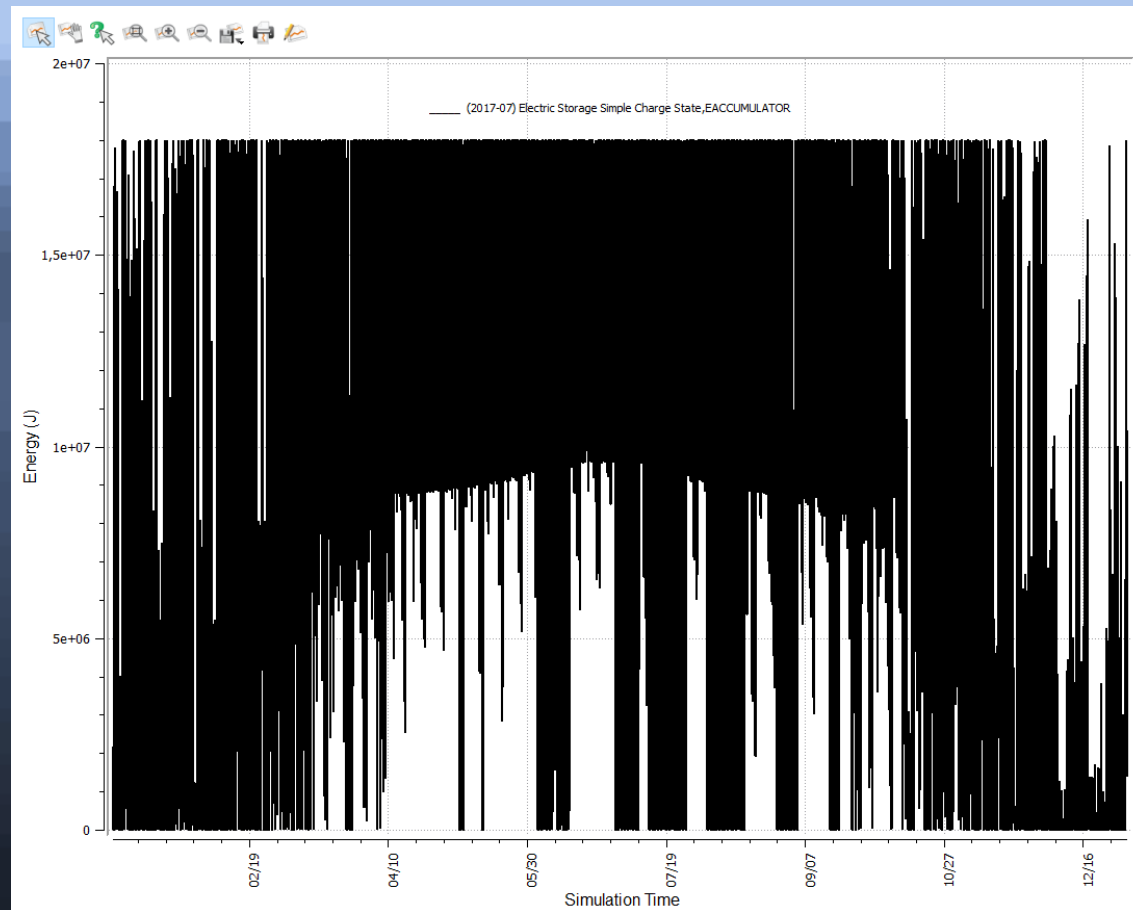
# Case example: Energy+ House



(UT Vienna): no data

EnergyPlus simulation

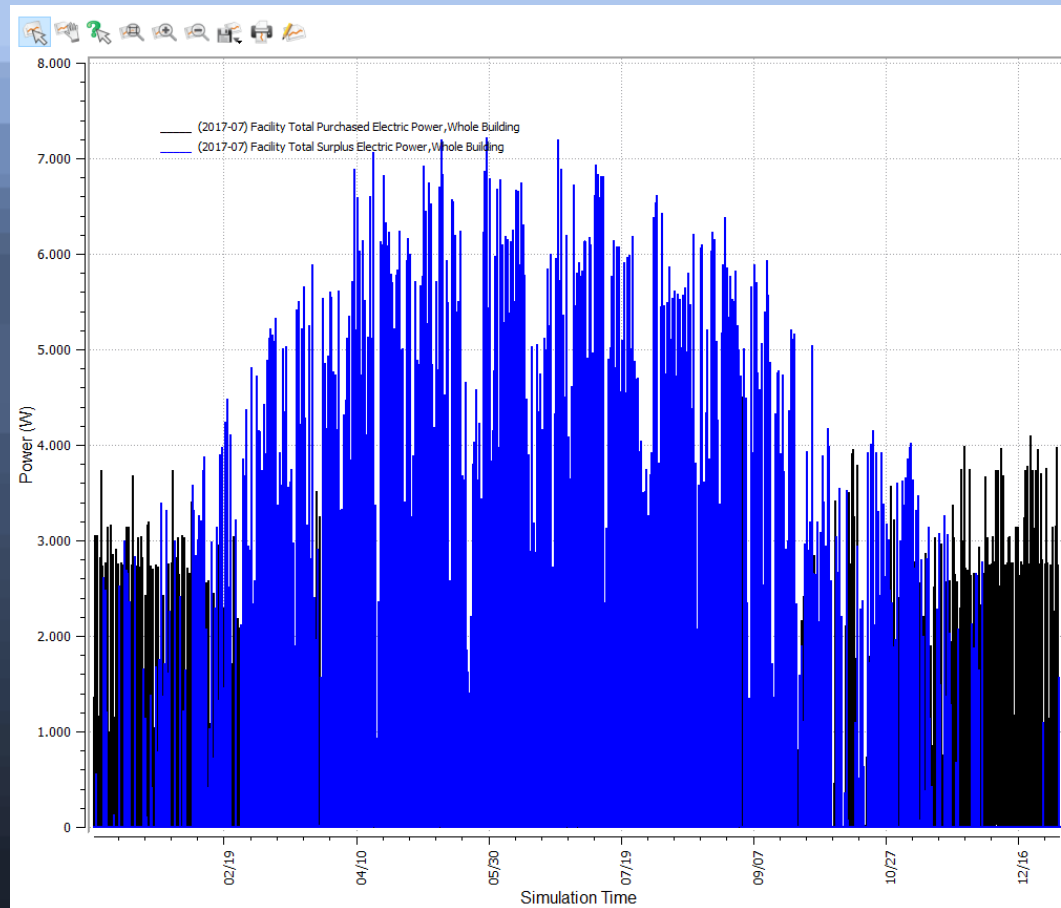
# Case example: Energy+ House



LISI reconstruction

battery load status Klagenfurt

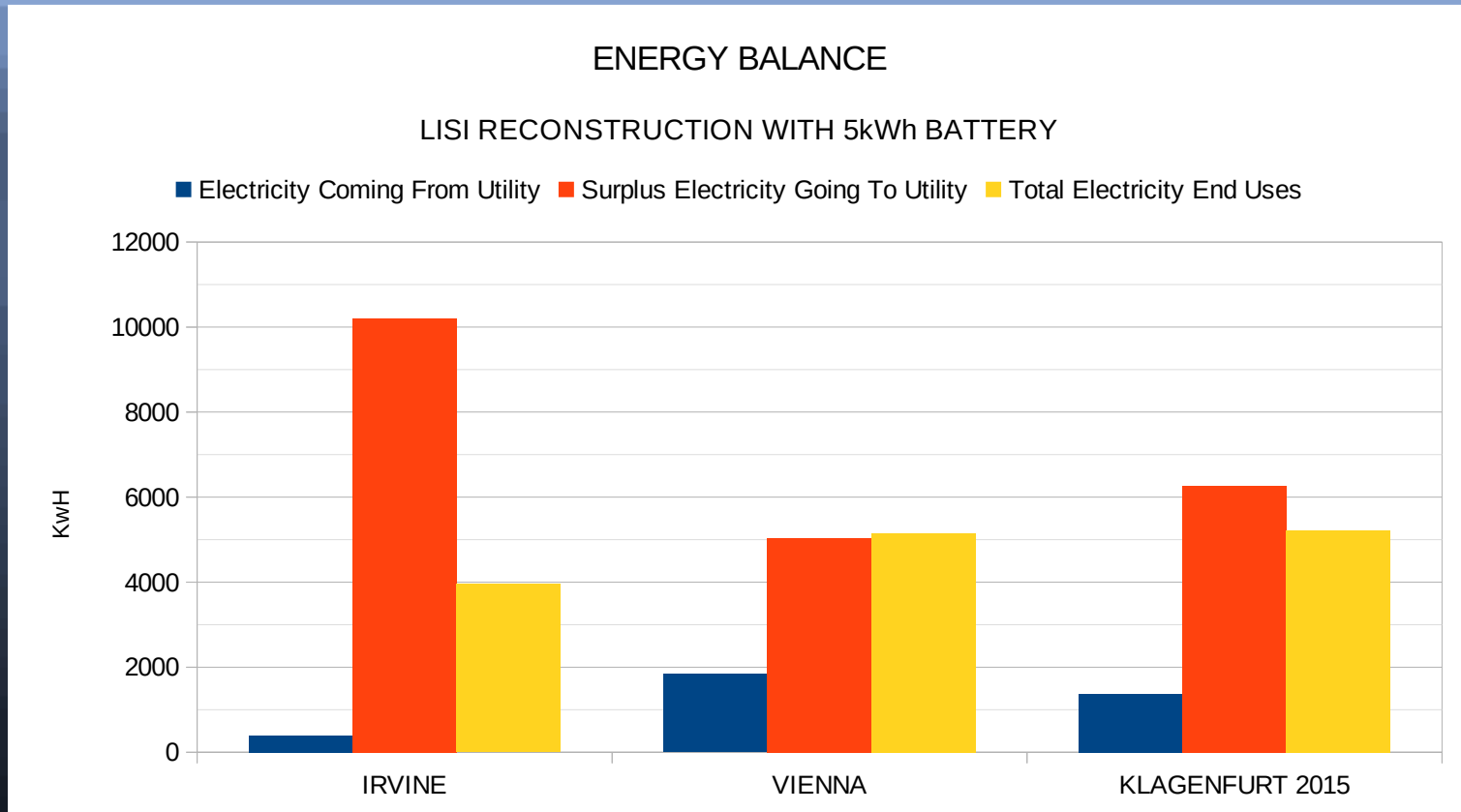
# Case example: Energy+ House



LSI reconstruction

electricity purchased and surpluses Klagenfurt

# Case example: Energy+ House



Energy balance LISI reconstruction

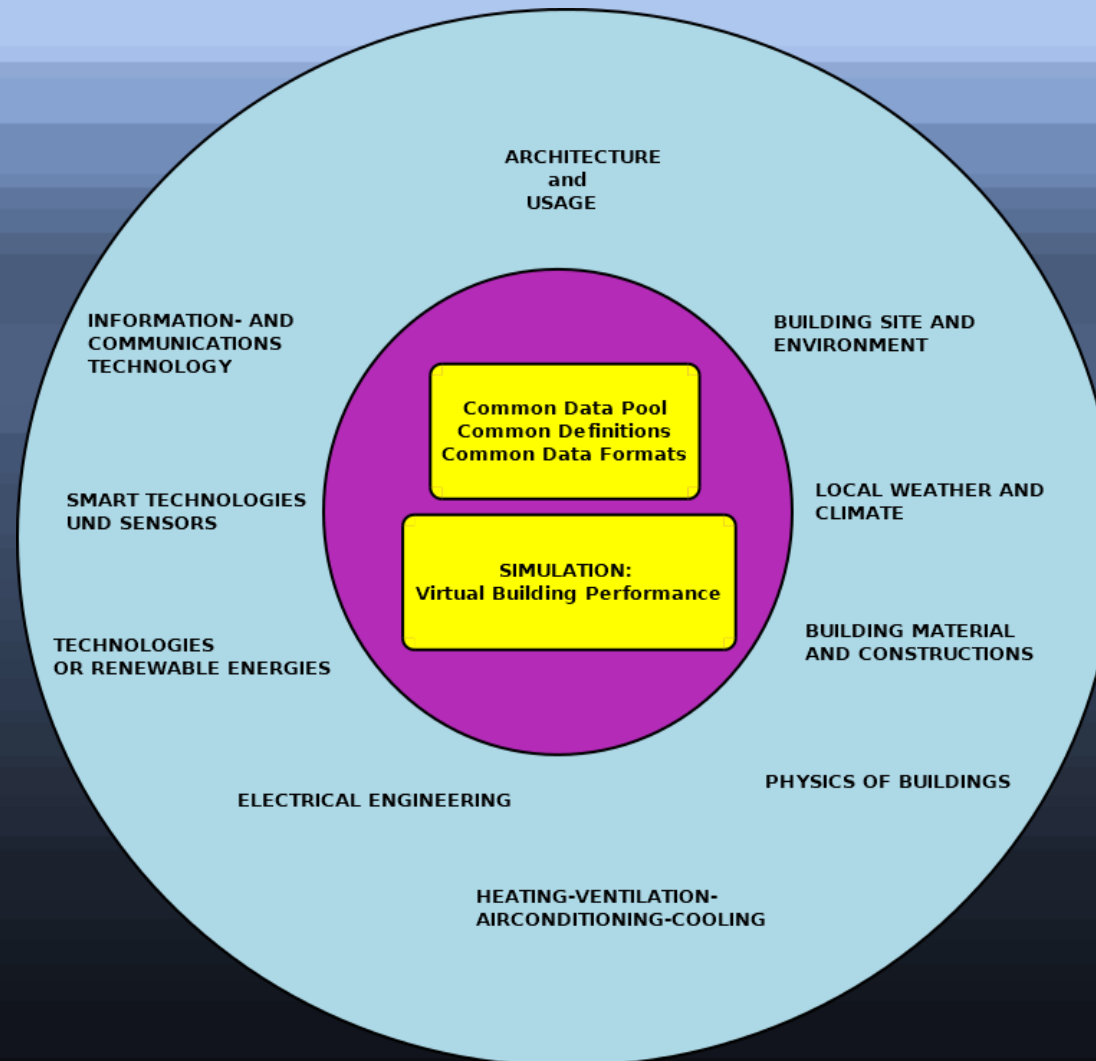
EnergyPlus simulation

# Case example: Energy+ House

## NOTES on computer reconstruction of LISI House (University of Technology, Vienna)

- \* EnergyPlus simulation model (= reconstruction) was developed only on the basis of published data (with incomplete technical details)
- \* missing data were replaced by assumptions:
  - ++ efficiency curves of heat pumps (COPs, capacity curves )
  - ++ usage of electrical equipment
  - ++ consumption of domestic hot water
  - ++ automated shading and controlled natural ventilation
- \* deviating weather data used

# Simulation as a coordination tool



# Simulation as coordination tool

facilitated coordination of interdisciplinary teams  
through

software supported questioning:

- \* what informations and data to collect ?
- \* how to keep consistent technical specifications ?
- \* how do technical subsystems depend on each other ?
- \* what consequences are there in case of changes ?

software supported

- \* common data definitions
- \* common data formats
- \* common data (e.g. in the cloud)

# **BIM & Simulation: future areas of application**

**Shopping Malls**

**airports**

**hospitals**

**Hotels**

**Schools**

**Computing Centers**

**Office Buildings**

**Complex Modernizations**

**Innovative projects with Green Technologies**

# Building Energy Simulation

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