



MORE-CONNECT 1ST TRAINING MODULE

DYNAMIC ENERGY SIMULATION

Duration: 4 hours

Type: class room lectures

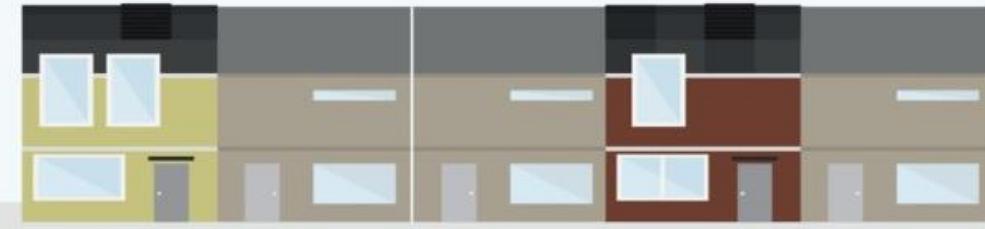
Dr.sc.ing. Anatolijs Borodiņecs

M.sc.ing. Renars Millers



INTRODUCTION

MORE—CONNECT



- Precise building energy simulation allows correct evaluation of energy savings and calculation of payback time. Currently widely used steady state energy calculation tools in Latvia don't consider air-tightness, occupant schedule, wind specifics, massivity of building constructions, Floating COP values of heating/cooling equipment etc. For large office buildings and buildings with large windows area and mechanical cooling systems the dynamic energy simulation tools are the most appropriate approach to make precise energy consumption estimation especially for summer time.
- This module is focused on building energy analysis using such dynamic energy simulation software as IDA-ICE, RIUSKA etc. In scope of this module the participants will learn on 3D building model import using IFC format, creation of building 3D model, definition of materials properties and climatic conditions. Each participant will receive IDA-ICE three-months educational license.
- During the lectures the comparison of energy calculation using steady tool and dynamic energy calculation for MORE-CONENCT case building will be analyzed.
- After completing this module individuals will be able to create own building model, to define boundary conditions and to make simplified building dynamic energy simulation.

OVERVIEW

MORE—CONNECT

<https://www.buildingenergystoftwaretools.com/>

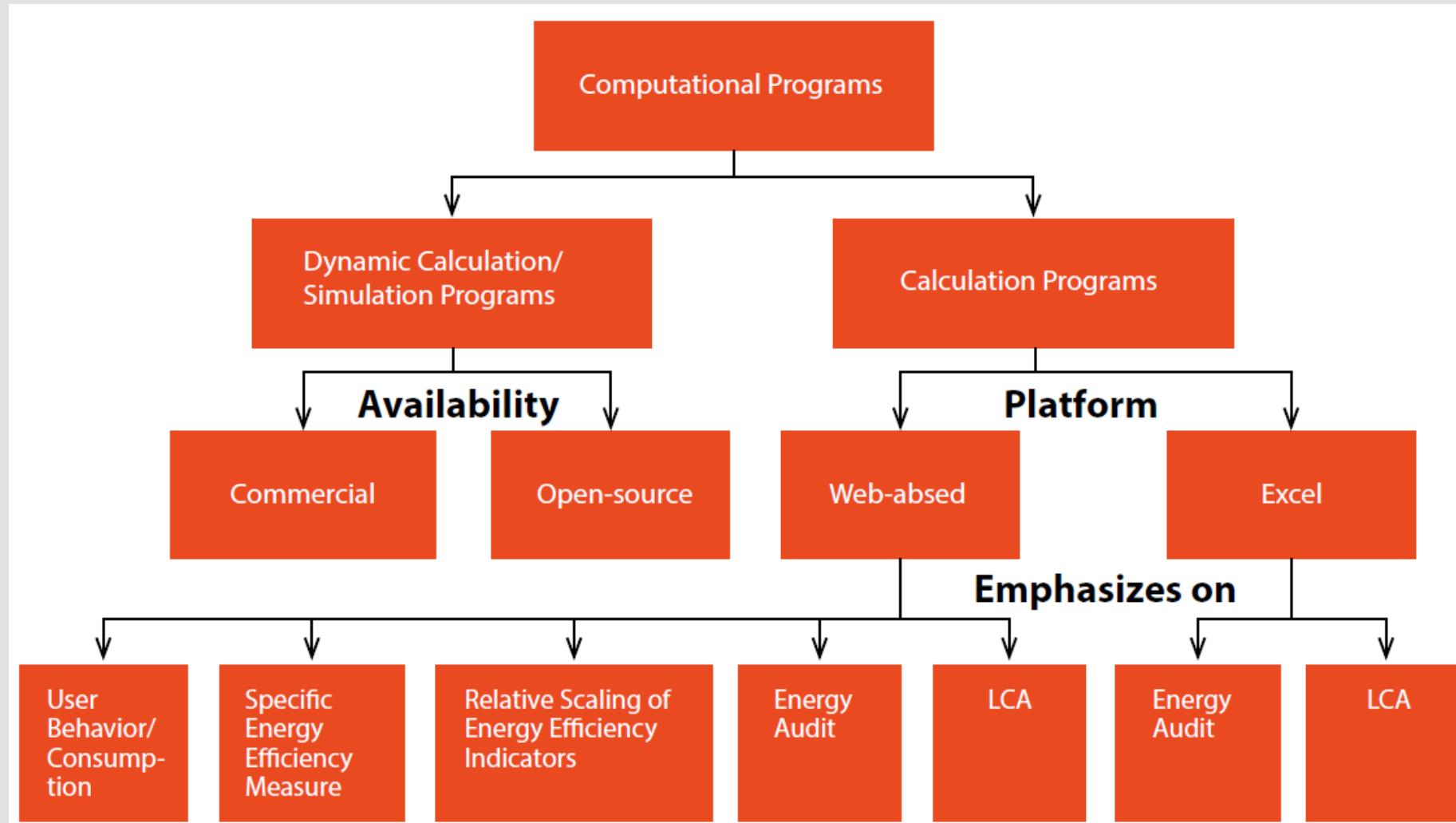
https://www.buildingenergystoftwaretools.com/software-listing?keywords=&field_catagory_tid%5B%5D=201&field_platform_tid=All&field_price_tid=All&field_last_updated_value%5Bvalue%5D%5Byear%5D=2010&field_language_tid=All&keys=&sort_by=field_rating_rating&sort_order=DESC&items_per_page=40

Borodinecs.A., Rodriguez-Gabriel A., Tatarchenko O., and etc. Handbook on Buildings Renovation in Central Baltic Region – ISBN - 978-9934-507-39-7 – Riga: Riga Technical University

Tool	Applications	Expertise requirement	Load Calculation	Retrofit Analysis	Freely available
BV2	Annual energy use, durational diagram	HVAC systems	yes	yes	
IDA-ICE	Energy performance, thermal comfort, indoor air quality	HVAC systems	yes		
IDA-ESBO	Building design optimization to evaluate energy consumption and comfort	HVAC systems	yes		
RIUSKA	Energy calculation, heat loss calculation, system comparison, dimensioning, 3D modeling	Engineering background	yes	yes	
VIP-Energy	Energy performance, code compliance, economic and environmental calculations	Basic energy flows and building construction			
ParaSol	Energy demand and peak loads for heating / cooling for different glazing and shading devices.	solar radiation, solar shading, windows, energy performance indicators	yes		yes
DEROB-LTH	Influence of solar insolation and shading devices on the energy balance in the building	influence of different design parameters on the thermal behavior of a buildings			
EnergyPlus	EnergyPlus models heating, cooling, lighting, ventilation, other energy flows, and water use.	Engineering background	yes	yes	yes
DOF-Energy	Evaluates energy consumption and heat loss distribution of the buildings	HVAC and building design			
CELLAR	Calculates the heat loss to the ground from a rectangular building with a foundation of the cellar type with constant insulation thickness at the floor and the wall. Both the heat loss variation during the year, including the peak effect and the accumulated heat loss during the heating season, are calculated.	Engineering background helpful for analysis			
HEAT3	HEAT3 can be used for analyses of thermal bridges, heat transfer through corners of a window, heat loss from a house to the ground	Engineering background			
Unorm	UNorm calculates U-values, temperatures, heat flows, and Ψ - or X-values in 2- and 3-dimensional thermal bridges. The program divides the thermal bridge into small cells.	knowledge of thermal transfer, thermal conductivities, and boundary conditions			Yes
ISOVER Energi	Calculates: U-value, for constructions with and without thermal bridges; total heat loss for buildings; and energy demand for buildings.	Building constructions and installations, and of building regulations are necessary.	yes		
BSIM	Building simulation, energy, daylight, thermal and moisture analysis, indoor climate	Building design and how buildings behave thermally in order create the building model	yes		

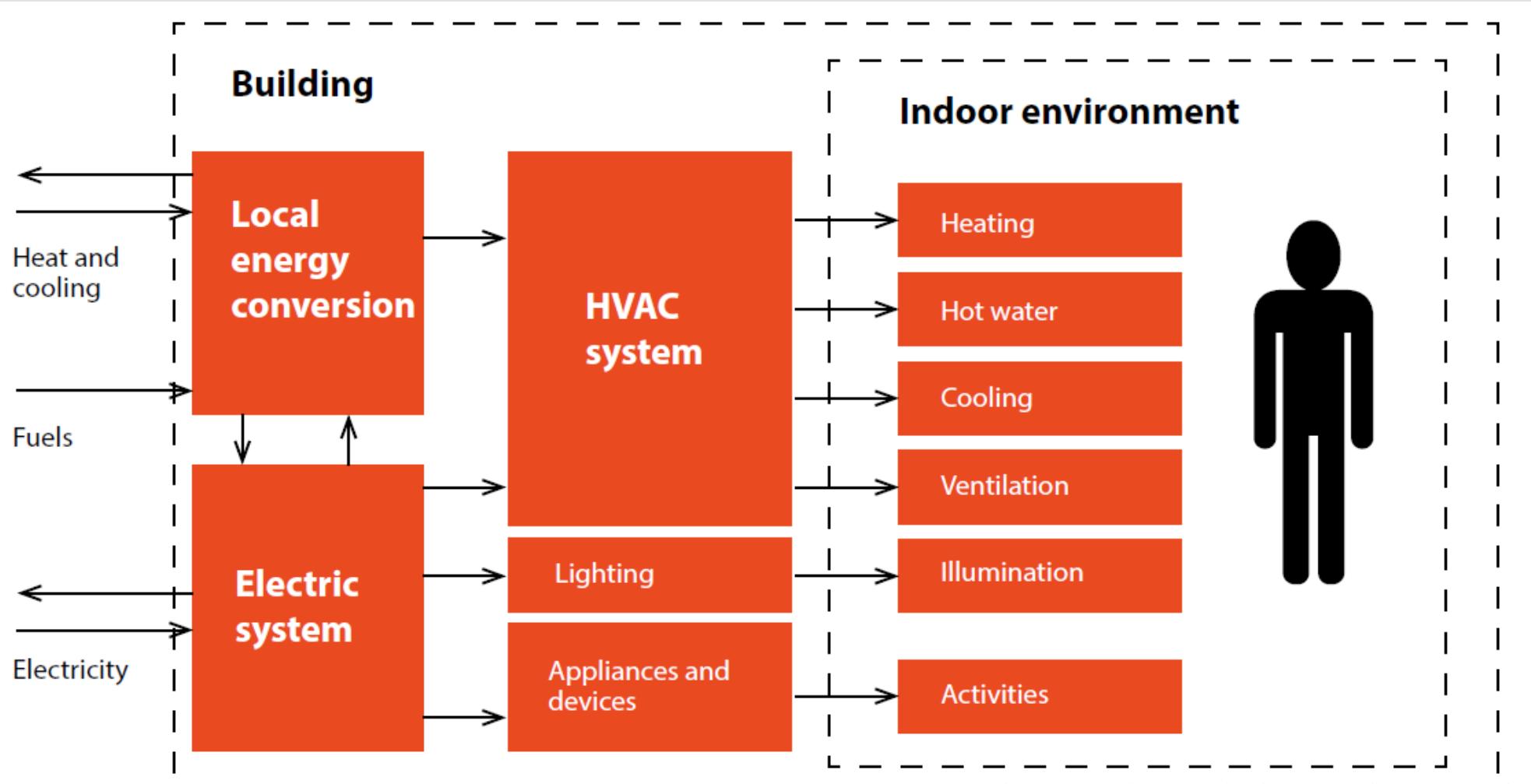
CLASSIFICATION OF COMPUTATIONAL PROGRAMS

MORE—CONNECT



PARAMETERS CONSIDERED IN SIMULATION PROGRAMS

MORE—CONNECT

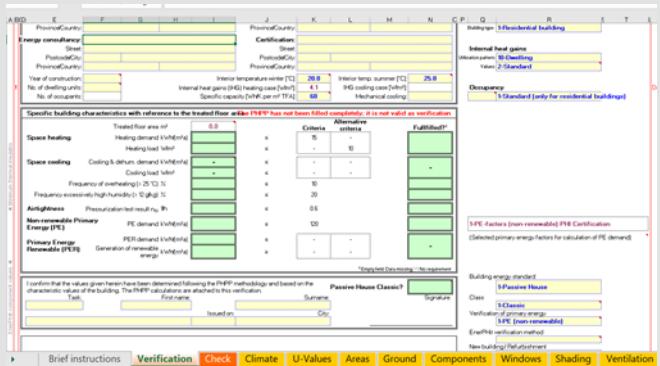


CALCULATION PROGRAMS

MORE—CONNECT

EXCELL based

- Passive House Planning Package, PHPP;
- Latvian energy calculation tool «EFA» ;

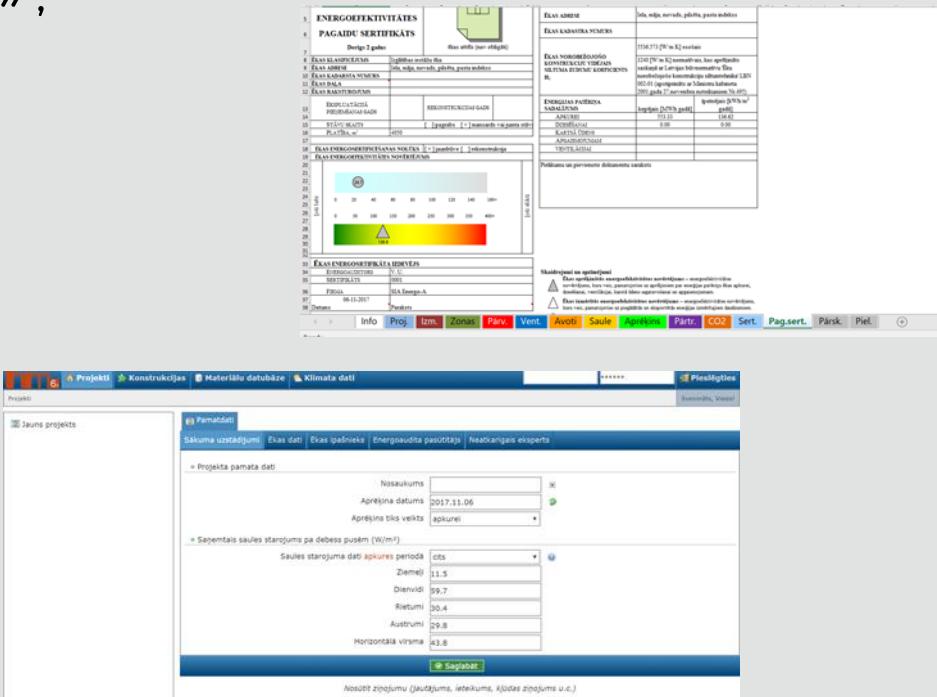


The screenshot shows the PHPP software interface. It includes sections for 'Project Country', 'Certification', 'Building', 'Occupancy', and 'Building energy standard'. There are numerous input fields for space heating, space cooling, ventilation, and energy sources. A large green button at the bottom right is labeled 'Calculate'.

PHPP requires some extra adaptation to prepare final document in accordance to Latvian legislations.

WEB-tool

- Heatmod - <http://www.heatmod.lv>



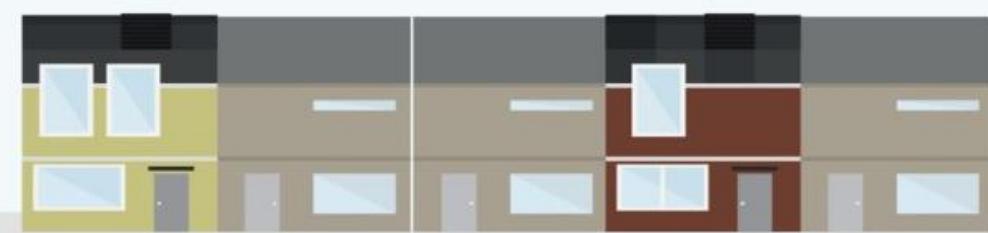
The screenshot shows the Heatmod web-based energy calculation tool. The interface has a navigation bar with tabs: Projekti, Konstrukcijas, Materiālu datubāze, Klimata dati, Pielikumi, Veicināt. The main form is titled 'Jauns projekts' and contains several sections: 'Pamatdati', 'Sākotnējais apjomis', 'Efas dati', 'Efas iegādnieks', 'Energoaudīta pasūtītājs', and 'Neatkarīgais eksperts'. Below these are tables for 'Efas parametri' and 'Efas apjomības parametri'. At the bottom, there is a table for 'Sāpentais saules starojums pa debesīs pusiņā (W/m²)' with data for different months: Ziemēl (11.5), Dzirnavi (9.7), Rietumi (20.4), Austrumi (29.8), and Horizontalā virsma (41.8). A large green button at the bottom right is labeled 'Saglabāt'.

«EFA» is no longer supported by Ministry of Economy. However calculation procedure fulfils major requirements.

All tools are based on EN ISO 13790:2009.

CLIMATE DATA

MORE—CONNECT



MONTHLY AVERAGE TEMPERATURES

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
PHPP V9.3	-2.1	-2.7	0.7	7.0	12.3	15.4	19.0	17.8	12.9	7.4	2.8	-0.6
LBN003-15	-4,7	-4,3	-0,6	5,1	11,4	15,4	16,9	16,2	11,9	7,2	2,1	-2,3
СНиП 2.01.01-82	-4,5	-4,2	-1,1	5,2	11,5	15,4	18	16,5	12,2	6,7	1,6	-2,3
СНиП II-A.6-72	-5.0	-4.8	-2	4.6	10.7	14.3	17.1	15.7	11.7	6.2	1.5	-2.6
IDA-ICE (ASHARE IWEC2 2011)	-0.1	-3.0	1.5	6.5	12.3	15.6	17.4	17.8	12.2	7.7	1.8	-1.6

CLIMATE DATA

MORE—CONNECT



25

20

15

10

5

0

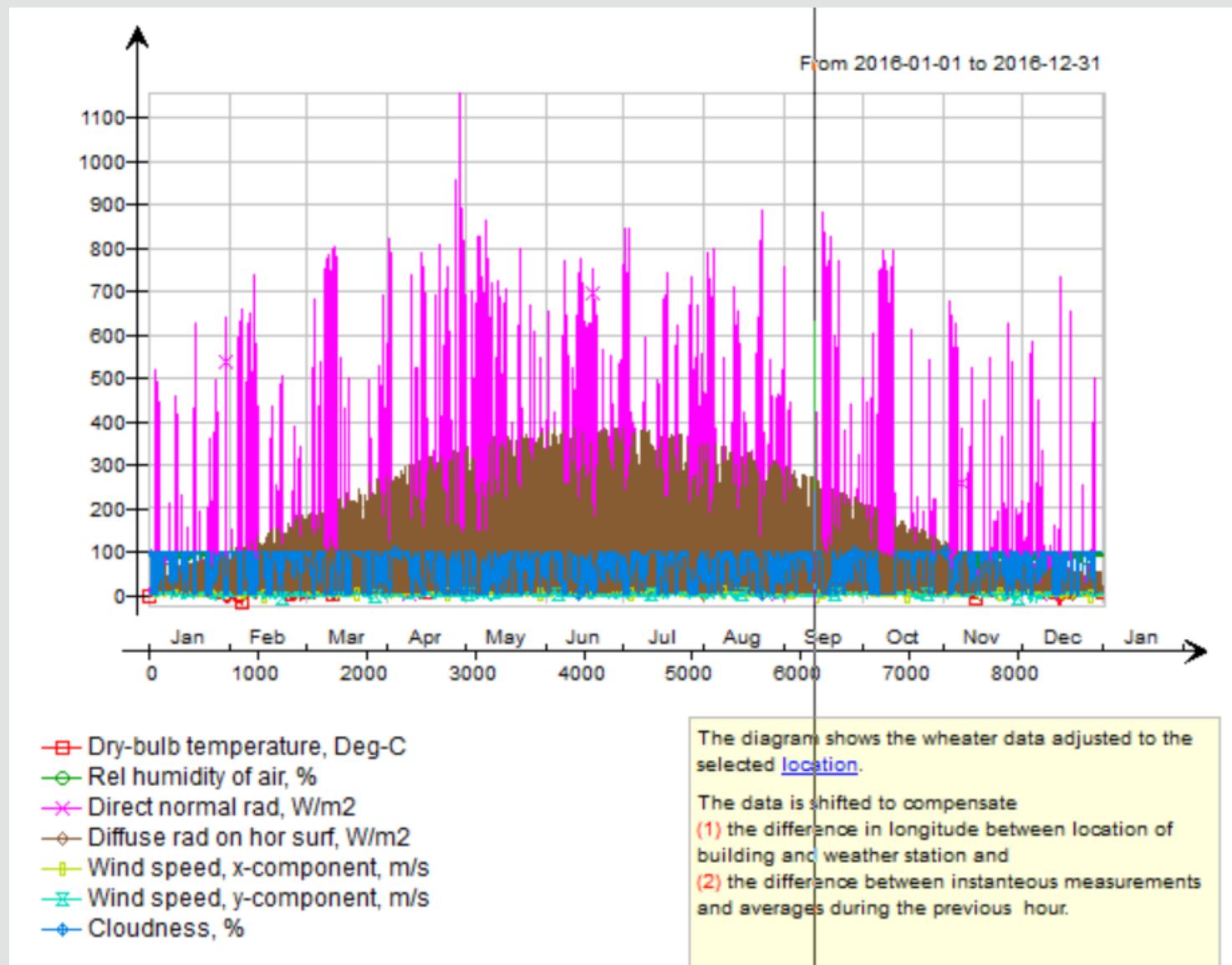
-5

Temperature, °C



HOURLY DATA

MORE—CONNECT



INTERNAL HEAT GAINS

MORE—CONNECT



CONSTANT

TABLE F.3 Approximate Summer Heat Gains from Occupants, Equipment, Lighting, and Envelope

Part A. Internal Heat Sources—People and Equipment								
Function	Area per Person ^a		Sensible Heat Gain (Btu/h ft ² of Floor Area)			Sensible Heat Gain (W/m ² of Floor Area)		
	ft ²	m ²	People ^b	Equipment ^c	Total	People ^b	Equipment ^c	Total
Office, U.S. ^c	180–100	16.7–9.3	1.3–2.3	0.4–1.1	1.7–3.4	4.1–7.3	1.2–3.4	5.3–10.7
Office, Europe ^e			1–1.6	2.2–4.2	3.2–5.8	3–5	7–13.1	10–18.1
School: elementary, U.S.	100–20	9.3–1.9	2.3–11.5	0–0.6	2.3–12.1	7.3–36.3	0–2.0	7.3–38.3
Schools, Europe ^e			3.8–8.0	0–0.6	3.8–8.6	12–25.2	0–2.0	12.0–27.2
School: secondary, college	150–100	13.9–9.3	1.7–2.6	0–0.6	1.7–3.2	5.4–8.2	0–2.0	5.4–10.2
Health care								
Sleeping (hospital)	240	22.3	0.9	0.6 ^e	1.5	2.8	2.0 ^e	4.8
In-patient (clinic)	120	11.1	1.9	Varies	1.9+	6.0	Varies	6.0+
Assembly: fixed seats	15	1.4	14.0	—	14.0	44.2	—	44.2
standing space, concentrated use	15–7	1.4–0.7	21.0–45.0	0–0.5	21.0–45.5	66.3–142.0	0–1.6	66.3–143.6
Restaurant ^f								
Fast food: dining area	15	1.4	17	3.4	20.4	53.6	10.7	64.3
Kitchen, refrigeration				17.1	17.1	54.0	54.0	
Sit-down: dining area	25	2.3	10.2	5.1	15.3	32.2	16.1	48.3
Kitchen, refrigeration				7.2	7.2	22.7	22.7	
Mercantile: street floor	50–30	4.7–2.8	6.3–10.5	3.4	9.7–13.9	19.9–33.1	10.7	30.6–43.8
Other sales floors	60–50	5.6–4.7	5.3–6.3	3.4	8.7–9.7	16.7–19.9	10.7	27.4–30.6
Shopping center, Europe ^e			3.2	0.3–1.3	3.5–4.5	10	1.0–4.0	11.0–14.0
Warehouse	1000–300	92.9–27.9	0.4–1.2	—	0.4–1.2	1.3–3.8	—	1.3–3.8
Hotels, nursing homes	300–200	27.9–18.6	0.8–1.2	3.4	4.2–4.6	2.5–3.8	10.7	13.2–14.5
Apartments ^g	300–200	27.9–18.6	0.8–1.2	See note g	See note g	2.5–3.8	See note g	See note g

Day	Time	Living room and kitchen	Other room
Monday - Friday	07.00 – 17.00	8.0	1.0
	17.00 – 23.00	20.0	1.0
	23.00 – 07.00	2.0	6
	average	9.0	2.67
Saturday - Sunday	07.00 – 17.00	8.0	2.0
	17.00 – 23.00	20.0	4.0
	23.00 – 07.00	2.0	6.0
	average	9.0	3.83
average		9.0	3.0

INTERNAL HEAT GAINS

MORE—CONNECT



VARIABLE

Schedule

Name: House living +

	Monday-Friday	Saturday	Sunday & holidays
0 [8-19], 1 otherwise			
<input type="checkbox"/> Same as Mon-Fri			
<input checked="" type="checkbox"/> Same as Saturday			

OK Save as... Cancel Help Advanced...

Schedule

Name: © House lighting (example)

	Monday-Friday	Saturday	Sunday & holidays
1 [6-8, 15-23], 0 otherwise			
<input checked="" type="checkbox"/> Same as Mon-Fri			
<input checked="" type="checkbox"/> Same as Saturday			

OK Save as... Cancel Help Advanced...

Occupant 1: a group of occupants in RIGA LT(2).Living room 2.4.1

Number of people in group: 1

Schedule: House living +

Activity level: 0.85 MET

Clothing:

- Constant: 0.85 ± 0.25 * CLO
- Schedule: n.a.

[clothing is automatically adapted between limits to obtain comfort]

Object:

Name: Occupant 1

Description:

Open Floor Plan

Equipment 1: a set of equipment units in RIGA LT(2).Living room 2.4.1

Number of units: 1

Schedule: House living +

Emitted heat per unit: 125 W

Energy carrier: Electricity

Energy meter: [Default] Equipment, tenant

Advanced:

Long wave radiation fraction: 0.1

Liquid water emission per unit: 0.0 kg/s

Dry steam emission per unit: 0.0 kg/s

CO2 per unit: 0.0 mg/s

Utilization factor: 1

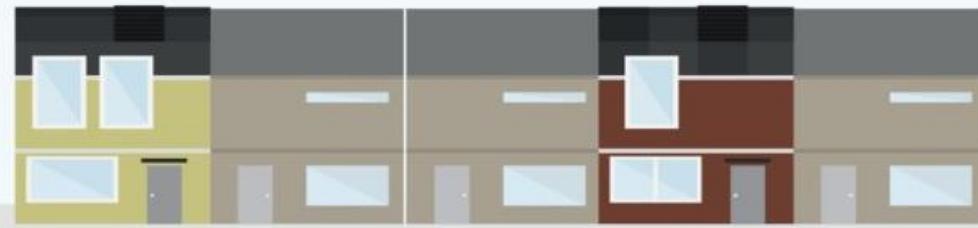
Object:

Name: Equipment 1

Description: operation: 125 W. Energy Saver mode: 20 W. Source ASHRAE RP-1055

USED IN LATVIA DYNAMIC ENERGY SIMULATIONS

MORE—CONNECT

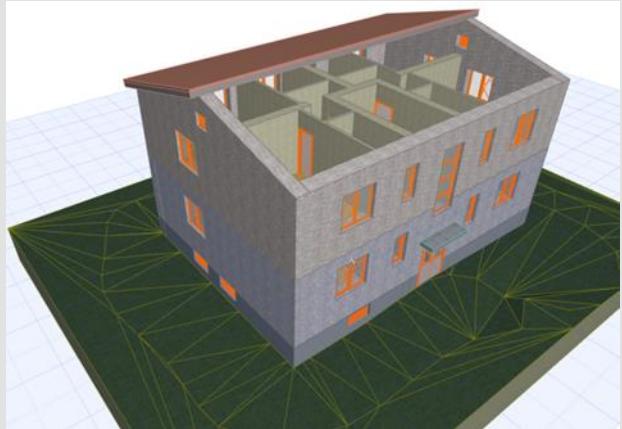


- ArchiCAD EcoDesigner STAR add
Embedded tools
- MagiCAD Comfort & Energy
- IDA- ICE;
- IESVE;
Stand alone software
- RIUSKA

MORE-CONNECT BUILDING

MORE—CONNECT

ARCHICAD ECODESIGNER STAR ADD



Energy Model Review - Thermal Blocks

Thermal Blocks Structures Openings

001 Living Rooms
1.1 Zone
1.2 Zone
1.3 Zone
1.4 Zone
1.5 Zone
2.1 Zone
2.2 Zone
2.3 Zone
2.4 Zone
2.5 Zone
3.1 Zone
3.2 Zone
3.3 Zone
3.4 Zone
3.5 Zone
4.1 Zone
4.2 Zone
4.3 Zone
4.4 Zone
4.5 Zone
002 Attic
003 Basement Facilities
004 Staircase

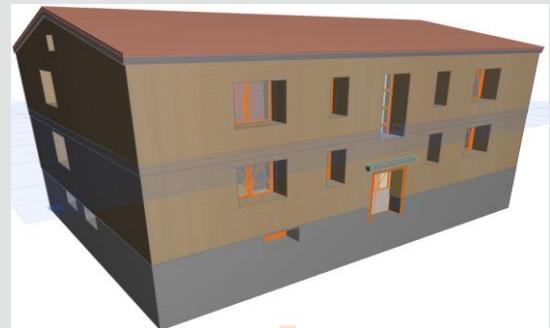
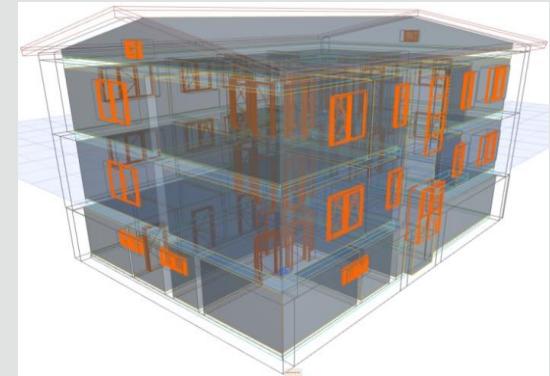
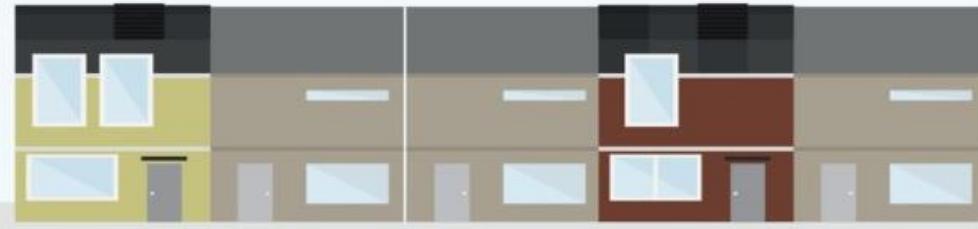
001 Living Rooms
External Structures
Straight Wall - Existing
Straight Wall - E
Internal Structures
Straight Wall - E
Straight Wall - E
002 Attic
003 Basement Facilities
004 Staircase

Show uniform items as a single entry
Total area threshold: 0,00 m²

Thermal Block Properties
001 Living Rooms
Supply Building Systems
System Type System Name
Heating District heating
Ventilation Natural ventilation

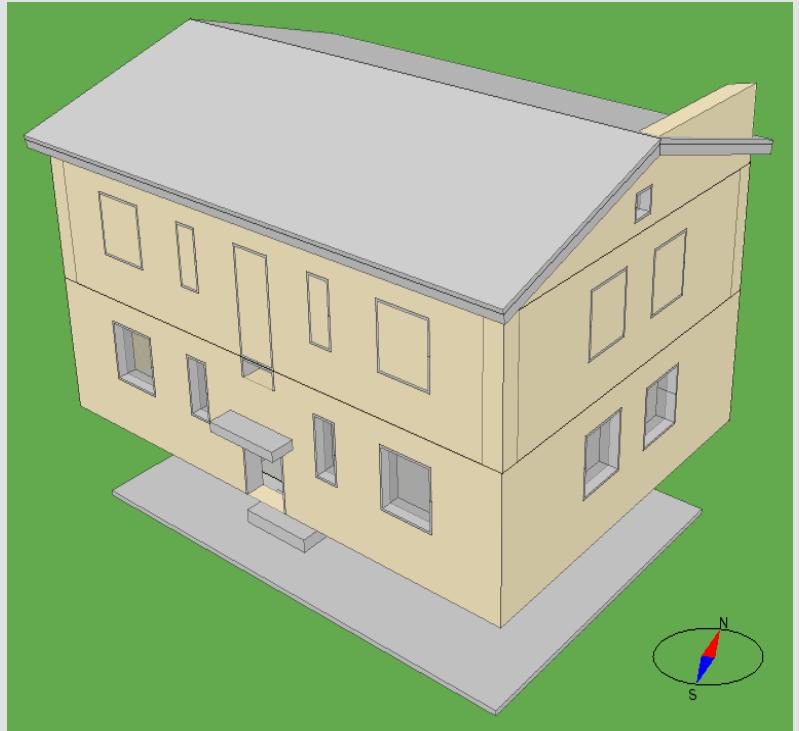
Structure Properties
Type
Orientation
Category
Thermal Block
Name
Area
Thickness
U-value
Infiltration
Solar Absorptance

Opening Properties
Type Window
Orientation SouthWest
Thermal Block 001 Living Rooms
Opaque Area 0,60 m²
Glazed Area 1,55 m²
Total Area 2,06 m²
Opening Catalog...
Total Solar Transmittance 82,00 %
Direct Solar Transmittance 69,00 %
Solar Analysis Open Analysis...
Perimeter 7532 mm
Opaque U-value 2,11 W/m²K
Glazing U-value 2,80 W/m²K
Overall U-value 3,29 W/m²K
Perimeter Psi-value 0,18 W/mK
Infiltration 1,43 l/sm
Shading Device None



.IFC IMPORT FOR IDA-ICE

MORE—CONNECT



PRACTICAL EXERCISE

MORE—CONNECT



To choose renovation package which insure:

- 60% thermal energy reduction;
- 80% thermal energy reduction;

•Initial data:

- Building. IFC model;
- U values:
 - Wall – 0.9'W/(m²K);
 - Roof – 0.75;
 - Floor – 0.8;
 - Windows/door – 1.9