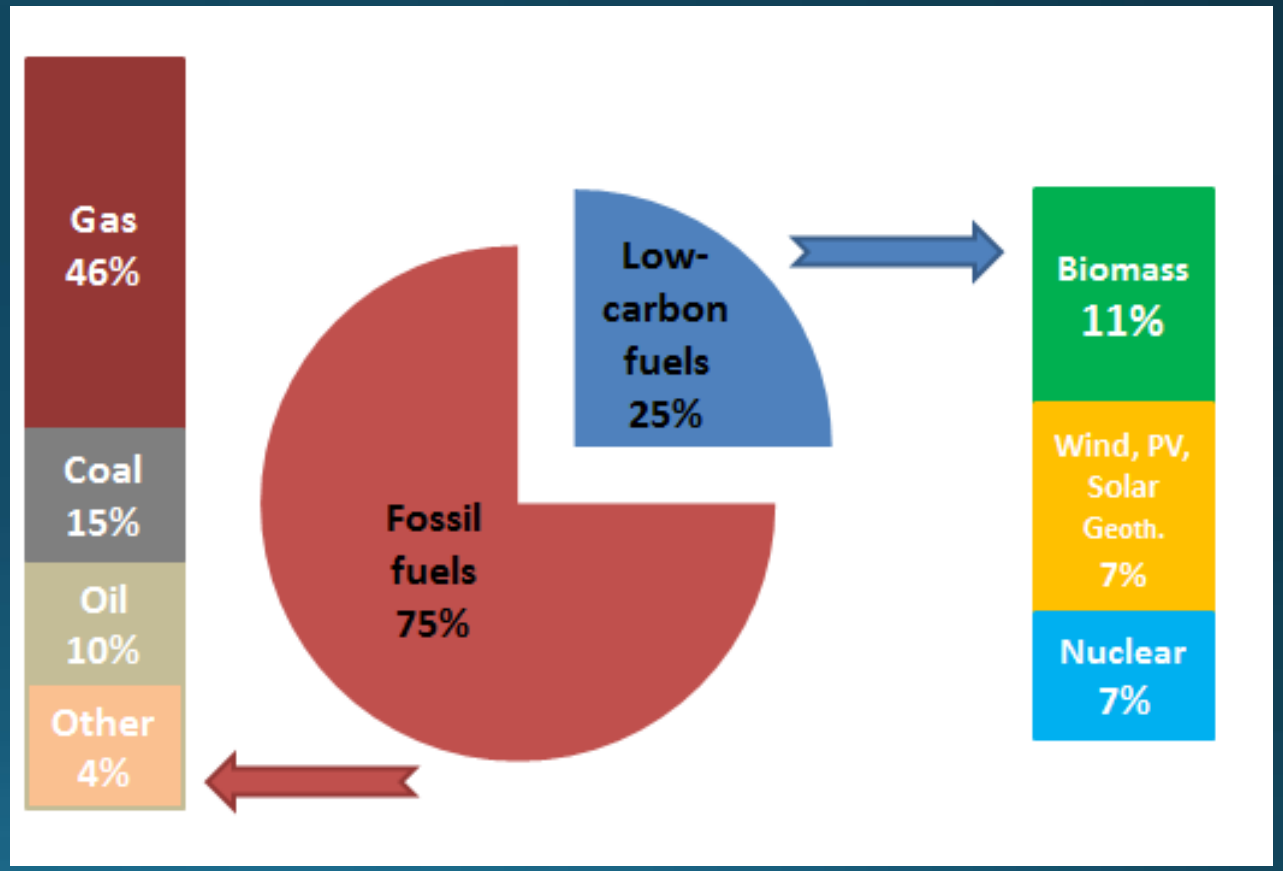
Passive house POLITEHNICA

Introduction

- Heating and cooling consume 50% (684 Mtoe of primary energy) of the EU's energy.
- Space heating accounts for more than 80% of heating and cooling consumption in colder climates.
- Renewables accounted for 18% of the primary energy supply for heating and cooling in 2012, while fossil fuels accounted for 75%.



Challenges

- In the building sector, the global number of households will grow by 67%.
- Global final energy demand in buildings increases by 60% from 2007 to 2050.
- Global energy-related greenhouse gas emissions will more than double by 2050 (8.1 Gt of CO_2 to 15.2 Gt CO_2).
- Increased oil demand will heighten concerns over the security of supplies.

Tools and solution

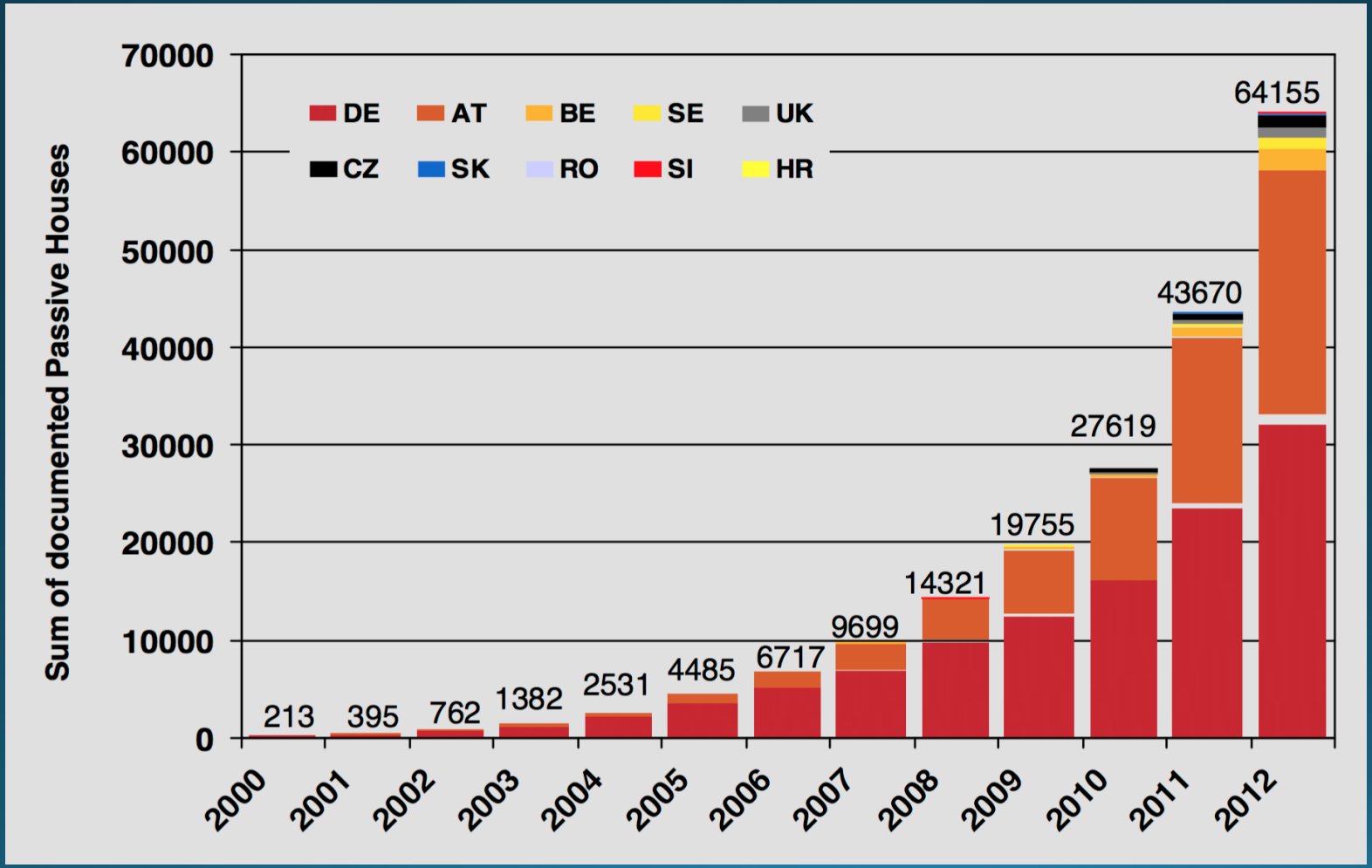
- Smart grids, smart metering, smart homes and buildings, self-generation and thermal and electrical and chemical storage need to be promoted.
- Research, innovation and demonstration actions.
- Developing a toolbox of measures to facilitate renovation in multi-apartment buildings.
- Promoting renewable energy through a comprehensive approach to speed up the replacement of obsolete fossil fuel boilers with efficient renewable heating.

Passive house

Performance Characteristics:

- Annual heating and cooling demand $\leq 15\ \mathrm{kWh/m^2yr}$
- Total primary energy consumption (primary energy for heating, hot water and electricity) $\leq 120\ \mathrm{kWh/m^2yr}$
- Air changes $\leq 0{,}6\ 1/\mathrm{h}$ at 50 pascal pressure, measured by blower-door test

How many Passive House buildings exist in which European country?



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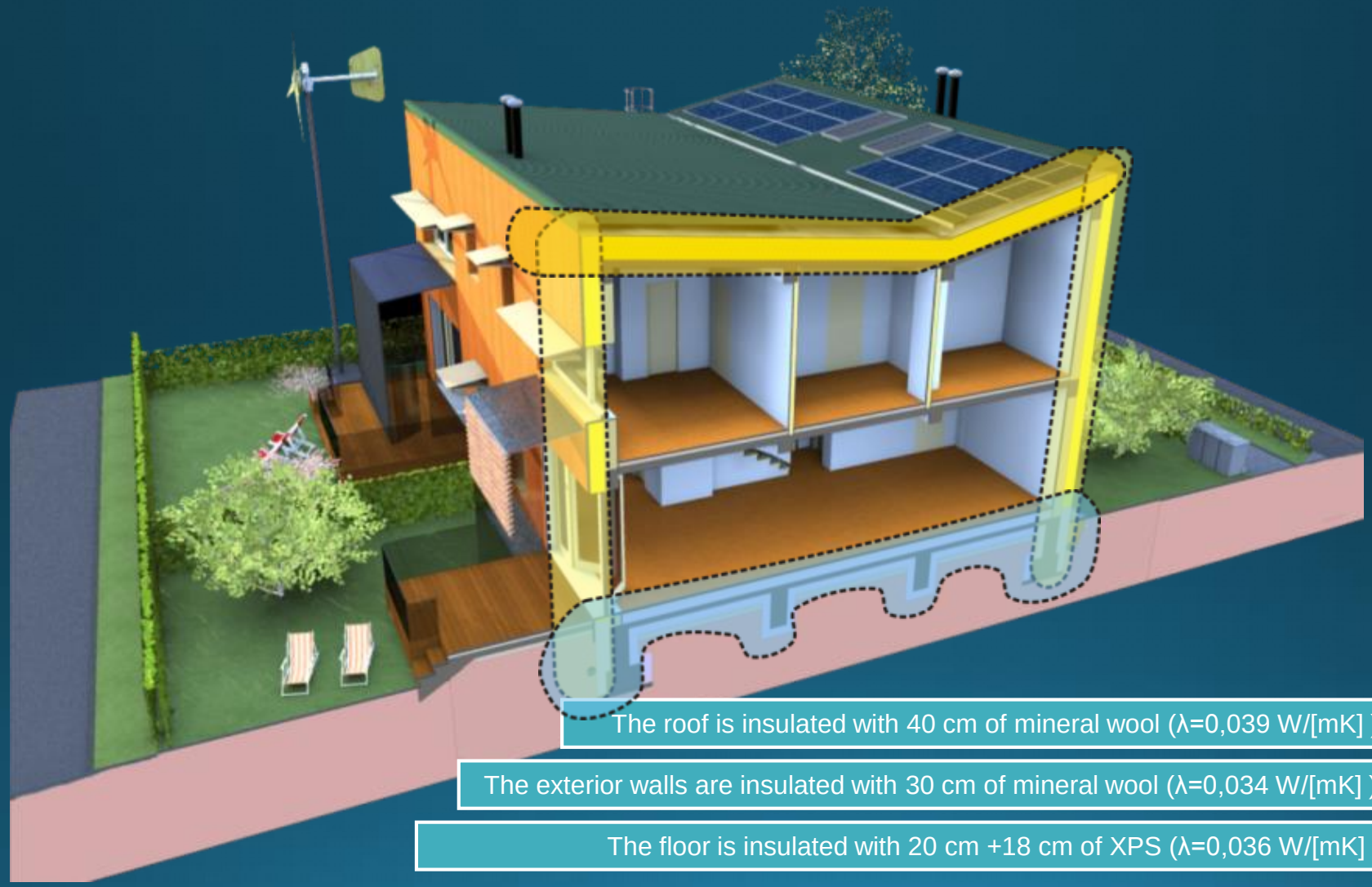

The roof is insulated with 40 cm of mineral wool (λ=0,039 W/[mK])

The exterior walls are insulated with 30 cm of mineral wool (λ=0,034 W/[mK])

The floor is insulated with 20 cm +18 cm of XPS (λ=0,036 W/[mK])

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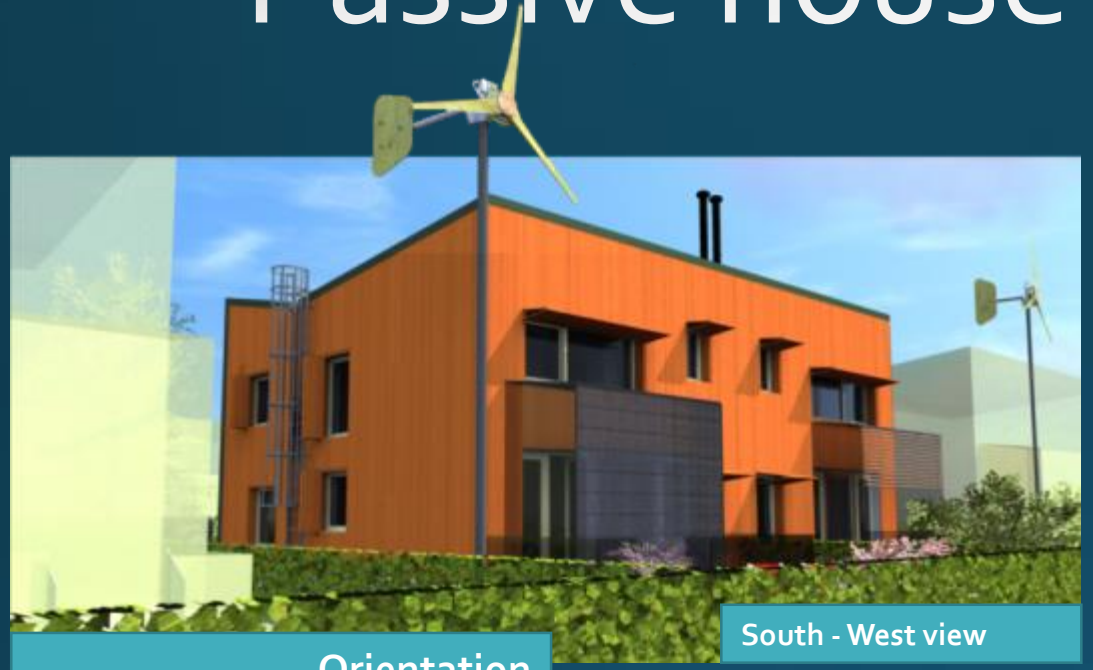

South - West view

Orientation

	A_w/A_f
Northern façade : Surface area Af= 62,20 m² Open surface area(doors & windows) Aw = 4,59 m²	0,07
Eastern (Western) : Surface area Af= 86,72 m² Open surface area(doors & windows) Aw = 11,31 m²	0,13
Southern façade: Surface area Af= 62,20 m² Open surface area(doors & windows) Aw = 17,94 m²	0,29

North facade

North east view

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Materials

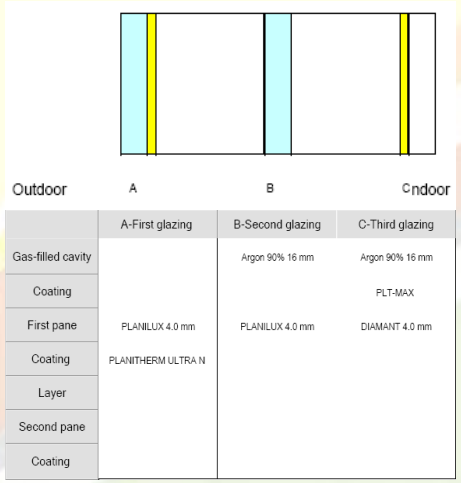
A passive house requires high quality windows that offer high efficiency and thermal comfort.

Window frame - Window frame are insulated U_w = 0,73 W/(m²K) according to PHPP (Passive house package planning)

(REHAU GENEO PHI Darmstadt certified frames)

Triple glazed windows U_g = 0,6 W/(m²K), (2 two low-e layers and the empty space is filled with Argon 90%)

(SAINT GOBAIN GLASS)



	A-First glazing	B-Second glazing	C-Third glazing
Gas-filled cavity		Argon 90% 16 mm	Argon 90% 16 mm
Coating			PLT-MAX
First pane	PLANILUX 4.0 mm	PLANILUX 4.0 mm	DIAMANT 4.0 mm
Coating	PLANITHERM ULTRA N		
Layer			
Second pane			
Coating			

Manufacturing sizes

Nominal thickness :	44.0	mm
Weight :	30.0	kg/m²

UV factor

Transmittance :	19	%

Light factors D65 2°

Transmittance :	72	%
Outdoor reflectance :	14	%
Indoor reflectance :	15	%

Energy factors EN 410

Transmittance :	45	%
Outdoor reflectance :	27	%
Absorbtance A1 :	18	%
Absorbtance A2 :	5	%
Absorbtance A3 :	5	%
Solar factor g :	0.52	
Shading coefficient SC :	0.60	

Thermal transmission

Ug :	0.6	W/(m².K)

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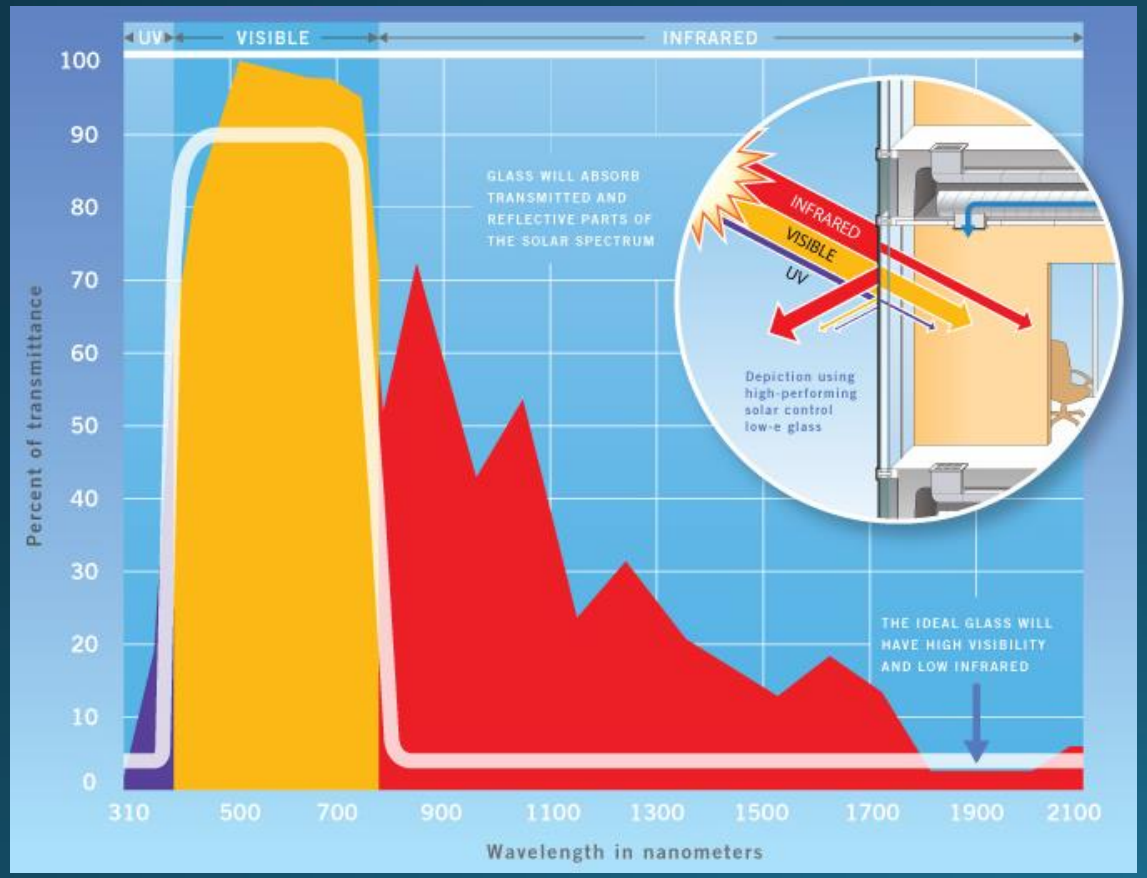

- Low-e coatings have been developed to minimize the amount of ultraviolet and infrared light that can pass through glass without compromising the amount of visible light that is transmitted.
- Radiant energy is one of the important ways heat transfer occurs with windows.
- Reducing the emissivity of one or more of the window glass surfaces improves a window's insulating properties.

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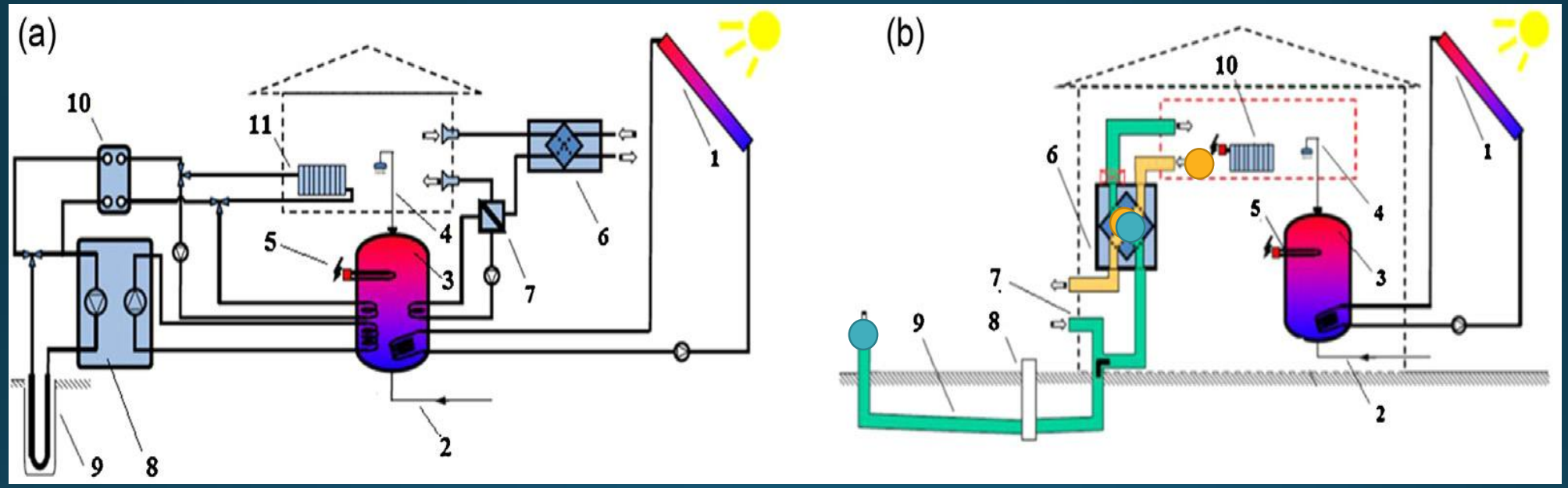


Thermal installations of the passive houses POLITEHNICA

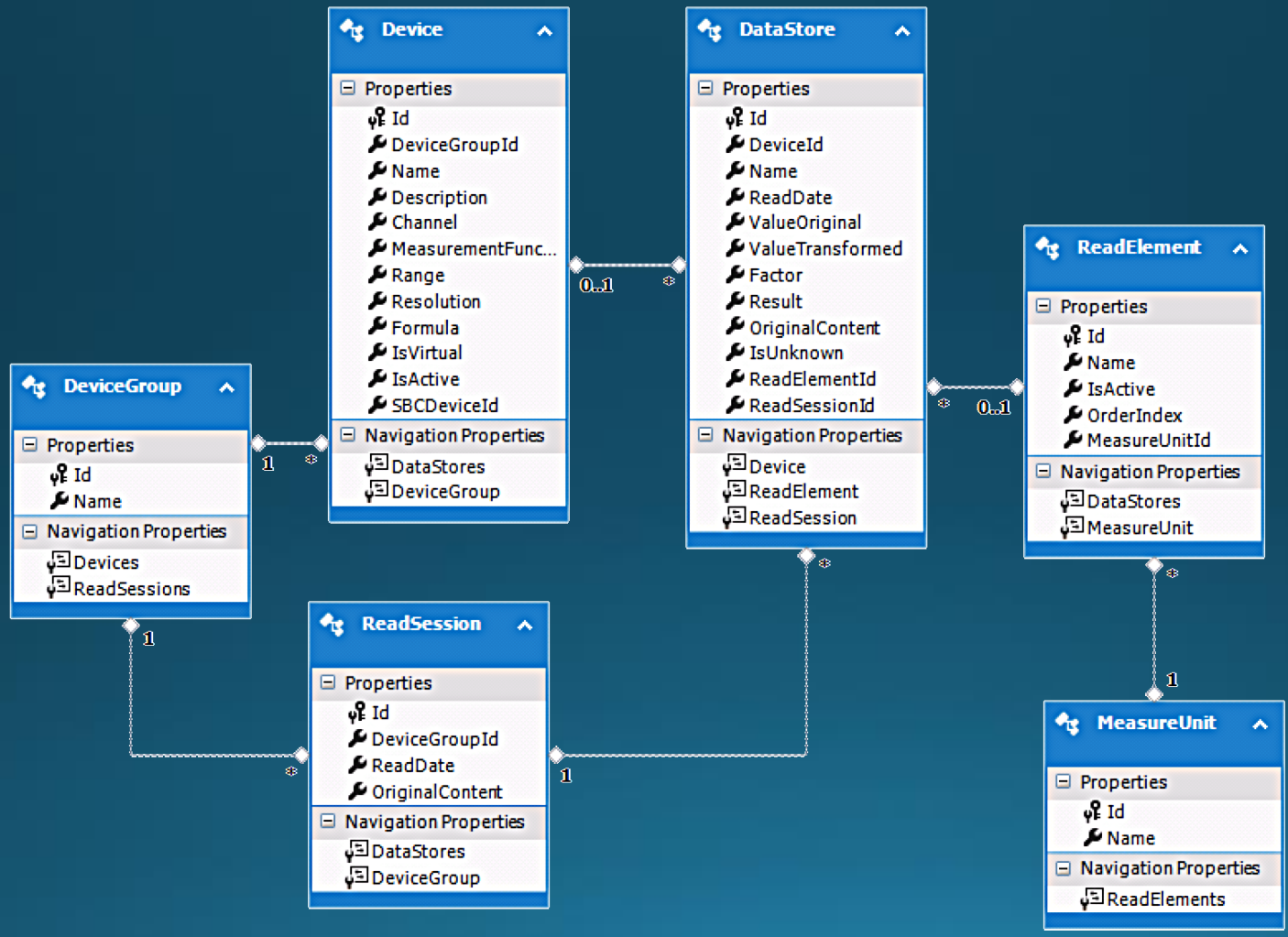
(a) Western passive house	**(b) Eastern passive house**
(1) solar collector; (2) cold water inlet, (3) hot water tank, (4) domestic hot water outlet, (5) electric resistance heater, (6) heat recovery unit (HRU), (7) water-air heat exchanger, (8) pumps station, (9) geothermal heat exchanger, (10) passive cooling heat exchanger, (11) hydronic radiant panel.	(1) – Solar Collector, (2) – Cold Water Inlet, (3) – Hot Water Tank, (4) – Domestic Hot Water Outlet, (5) Electric Resistance Heater, (6) – Heat Recovery Unit (MVHX), (7) – EAHX By-Pass, (8) – Condensate Drain Well, (9) – Earth to Air Heat Exchanger (EAHX), (10) – Electric Radiant Panel

Monitoring system

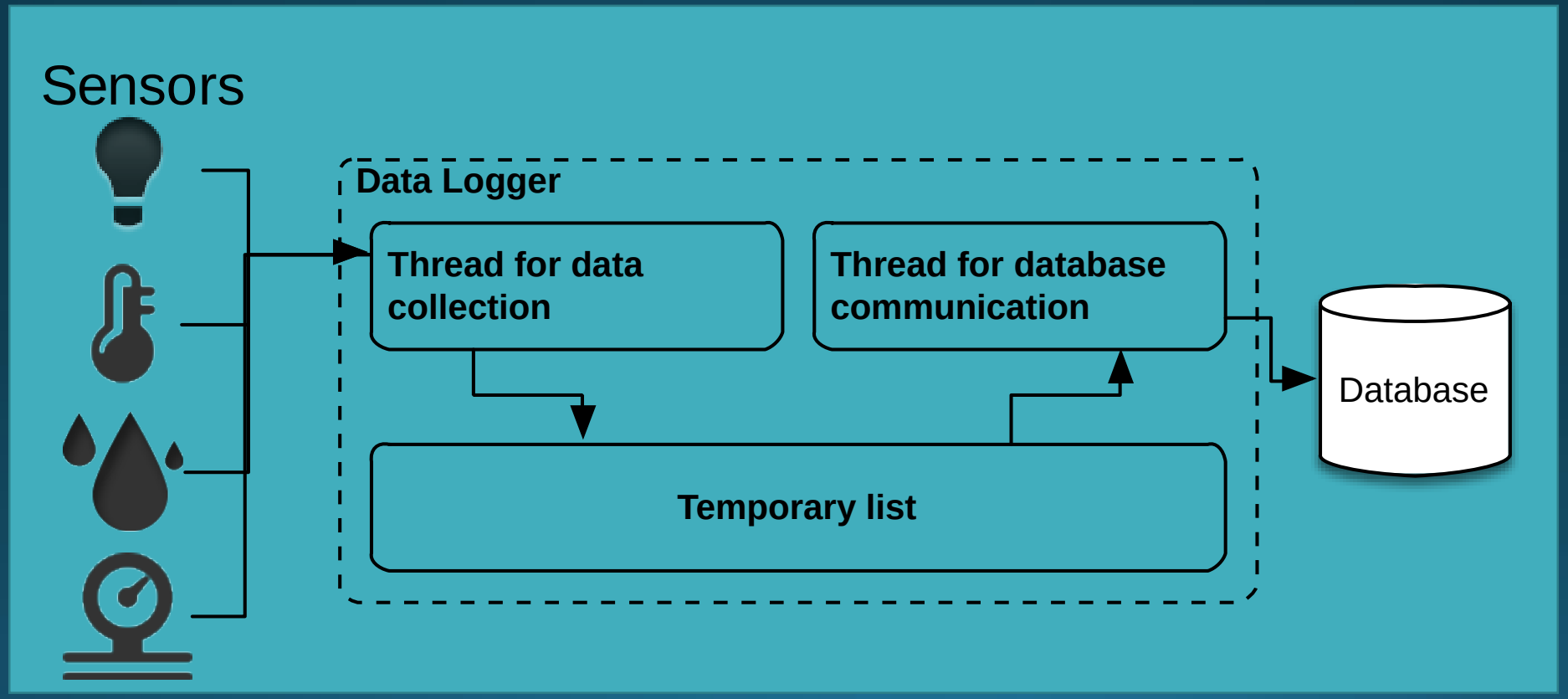
The monitoring system comprises of both hardware infrastructure and software solution, which have been developed based on the requirements presented in the table below.

Reliability	Scalability	Third party app	Time discretization	Maneuver ability
Automatic start and configuration of devices available in the network after system failure or restart.	Handling a growing amount of data.	Access to the monitoring system using web services.	Ability to configure the application to collect data at specified time rate (1,5,10,15,30,60 min)	Data export using well known file format (*.pdf, *.doc,*csv,*xls), based on selection of time rate, sensor and time interval.

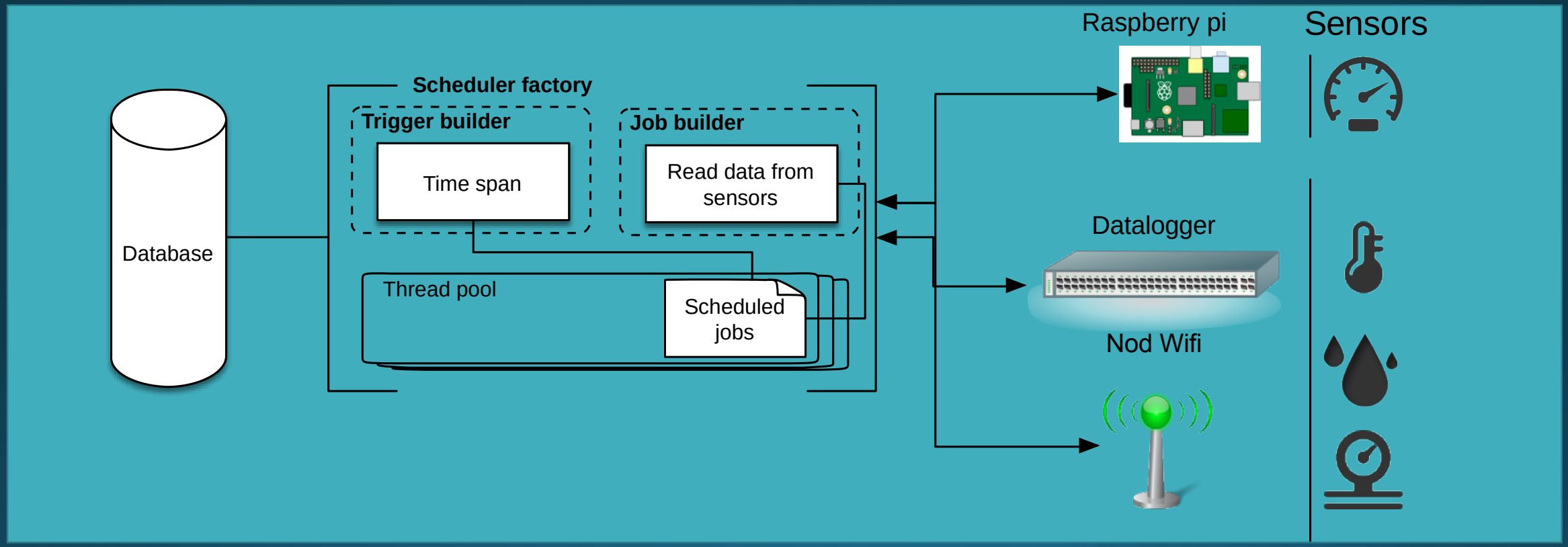
Entity Framework



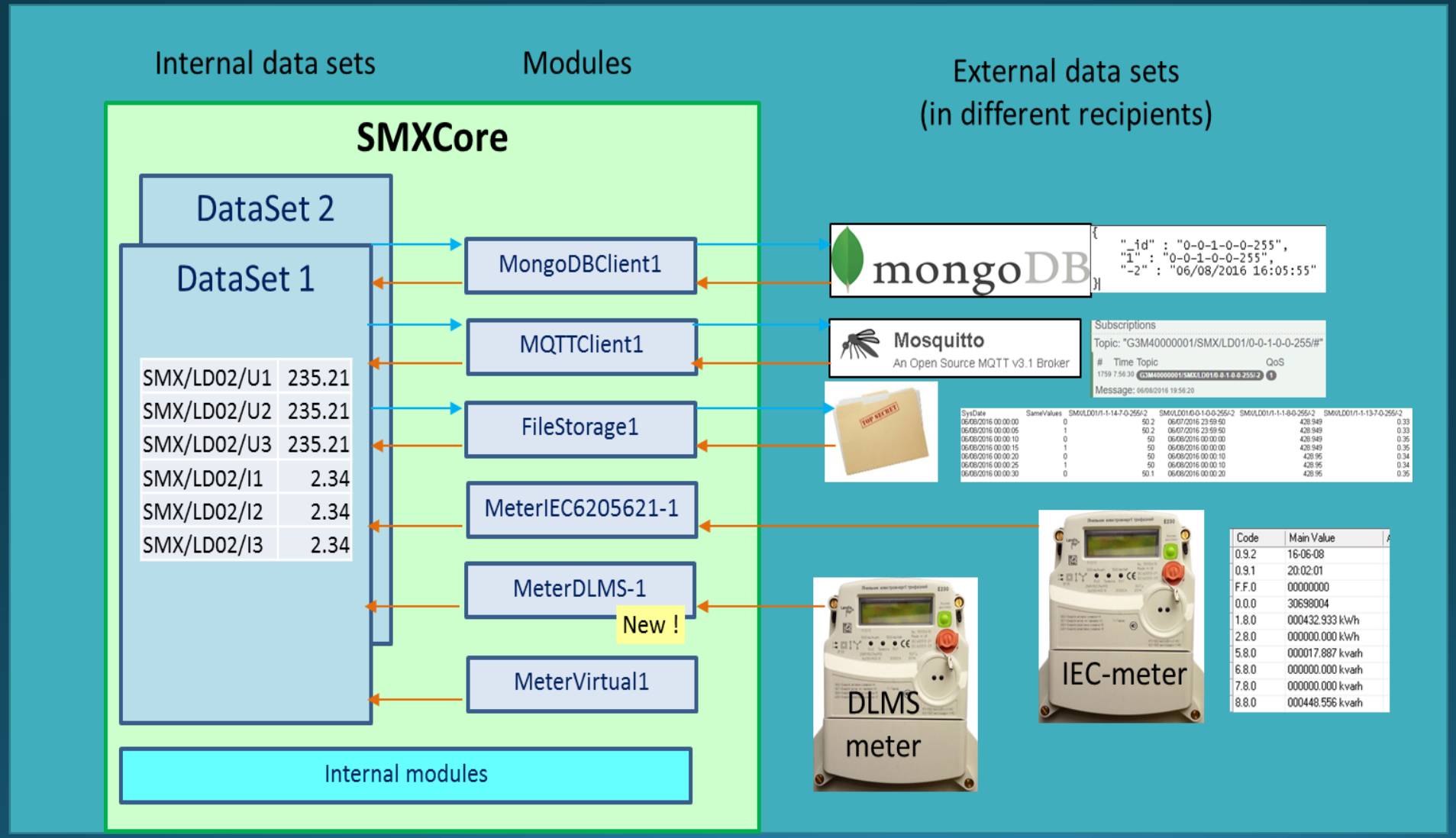
Monitoring system



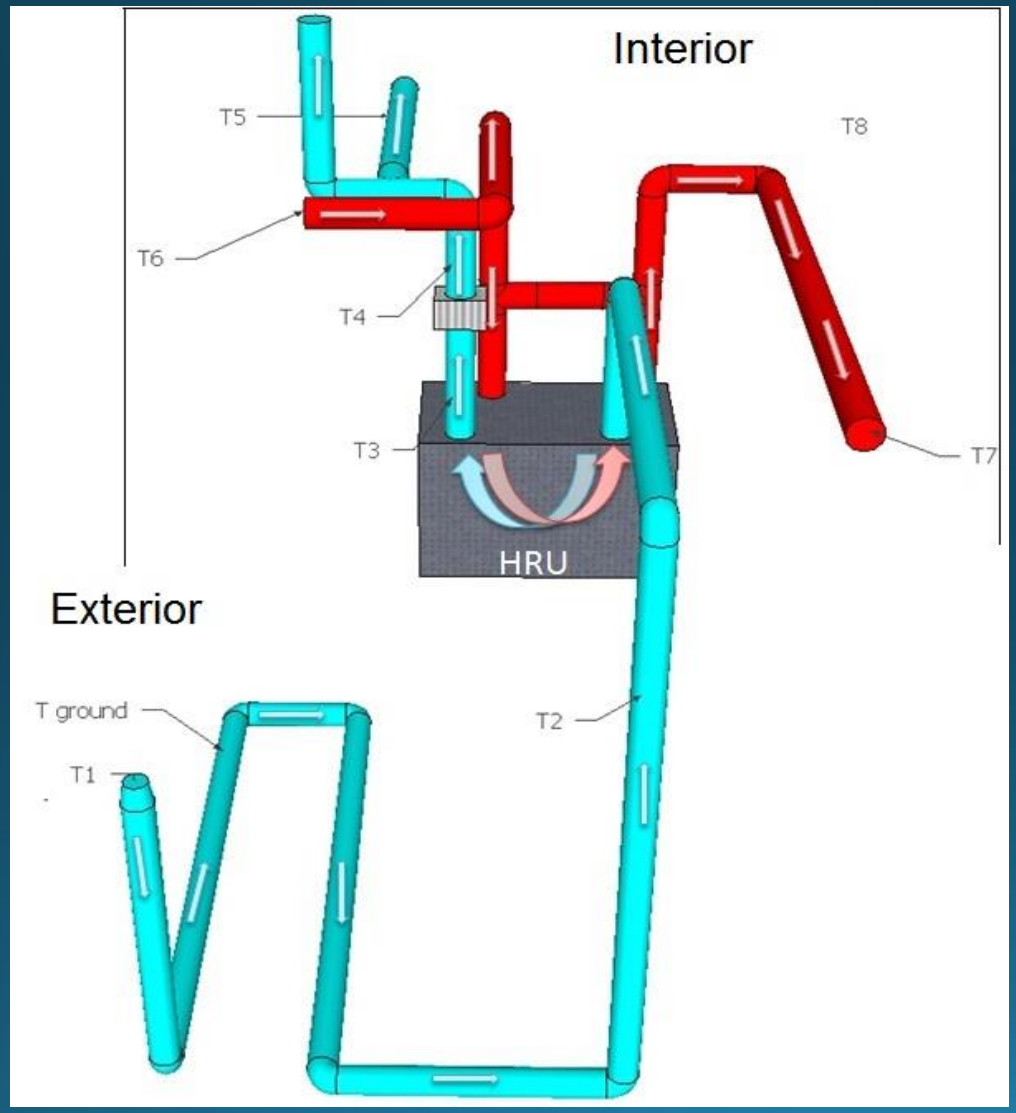
Data collection



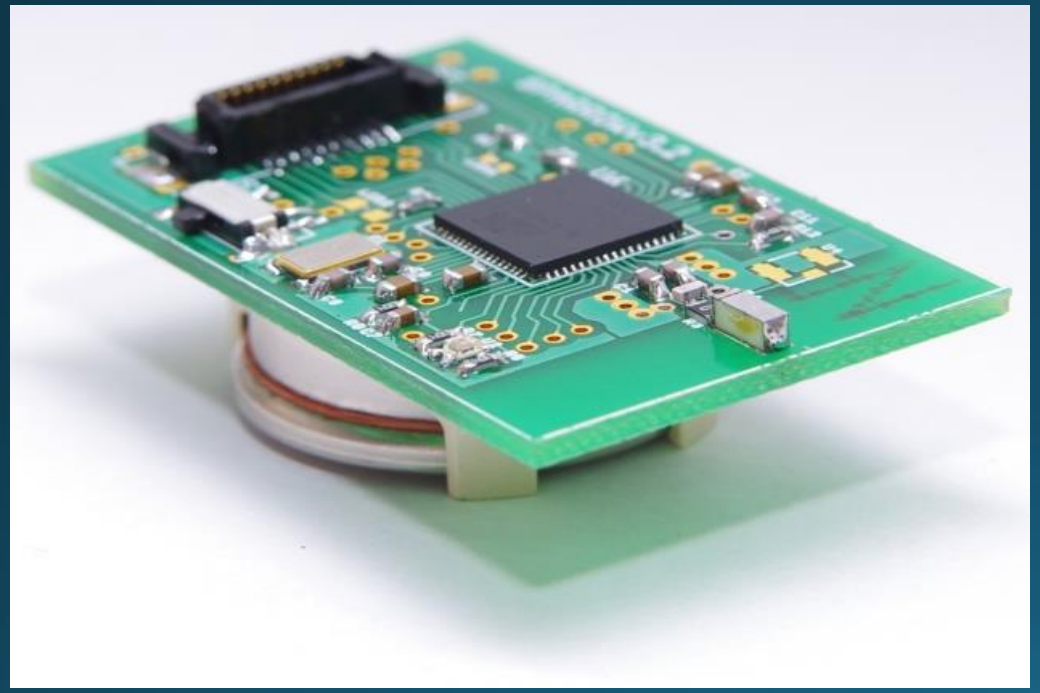
Scheduler for data collection

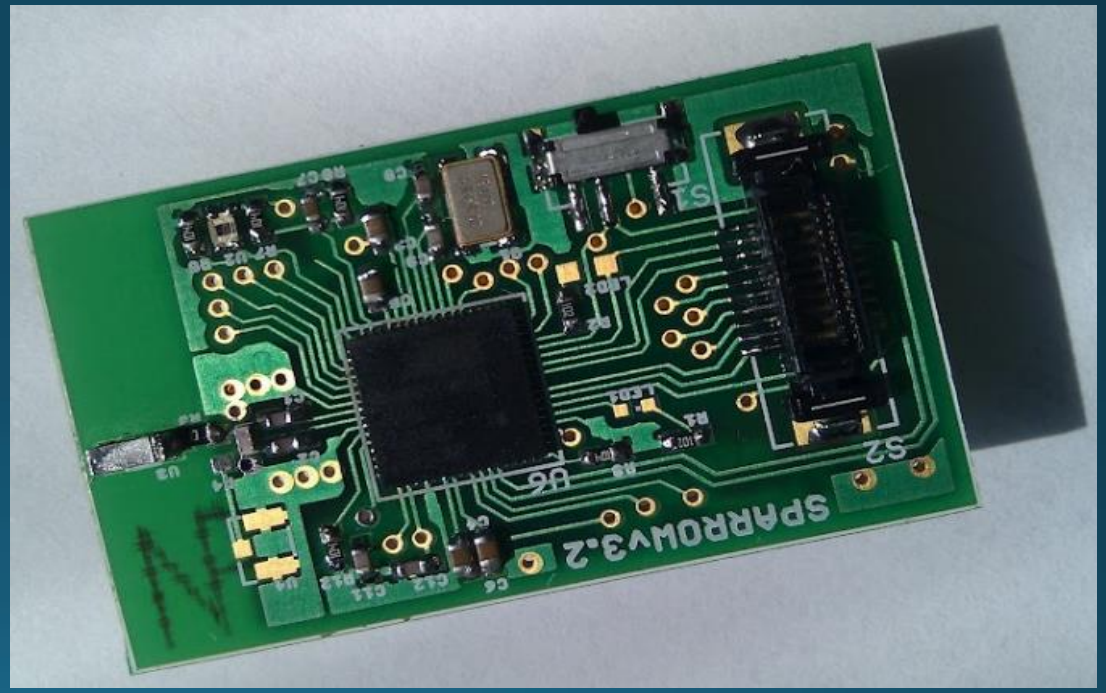


HVAC monitoring

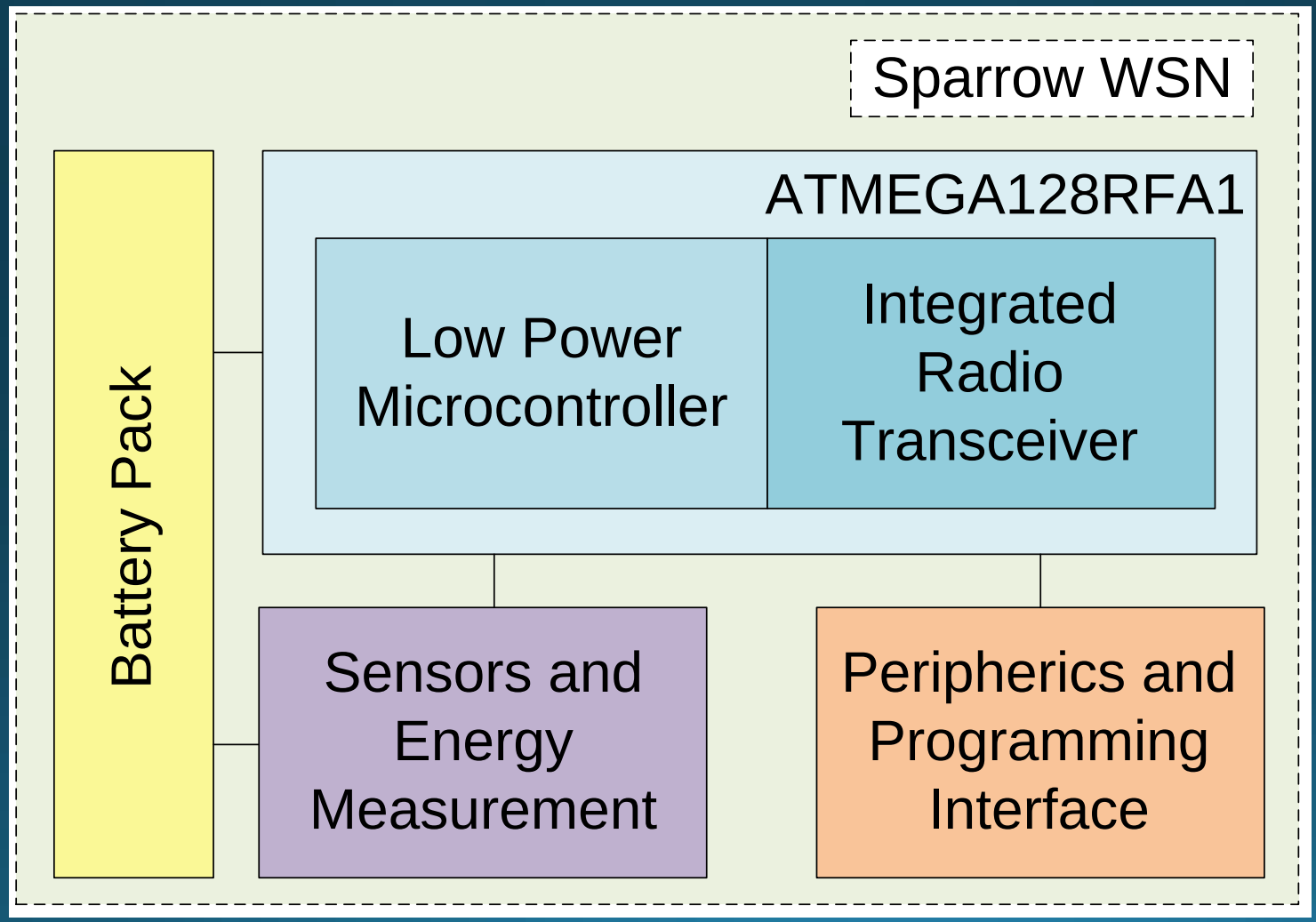


Data collection

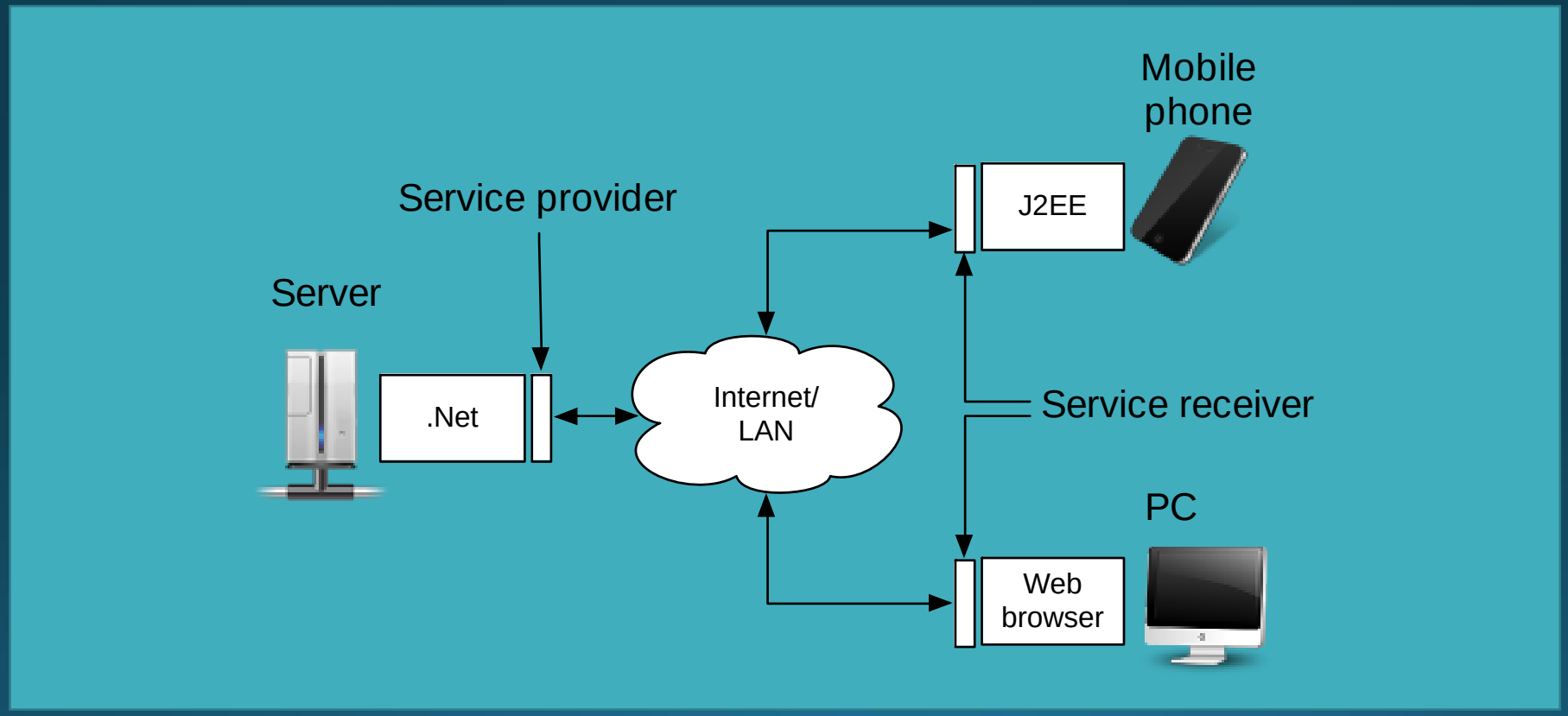




Functional block diagram

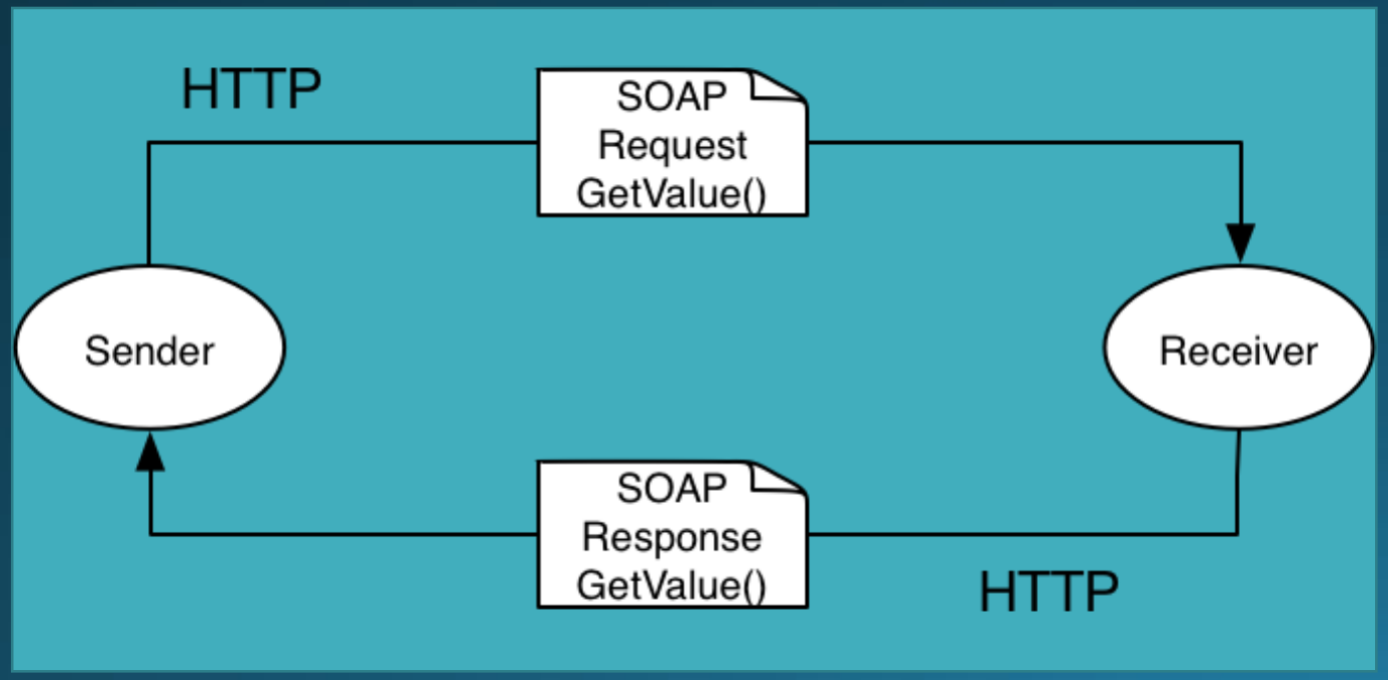


SOA


Mobile
phone
Service provider
J2EE
Server
.Net
Internet/
LAN
Service receiver
PC
Web
browser

SOA

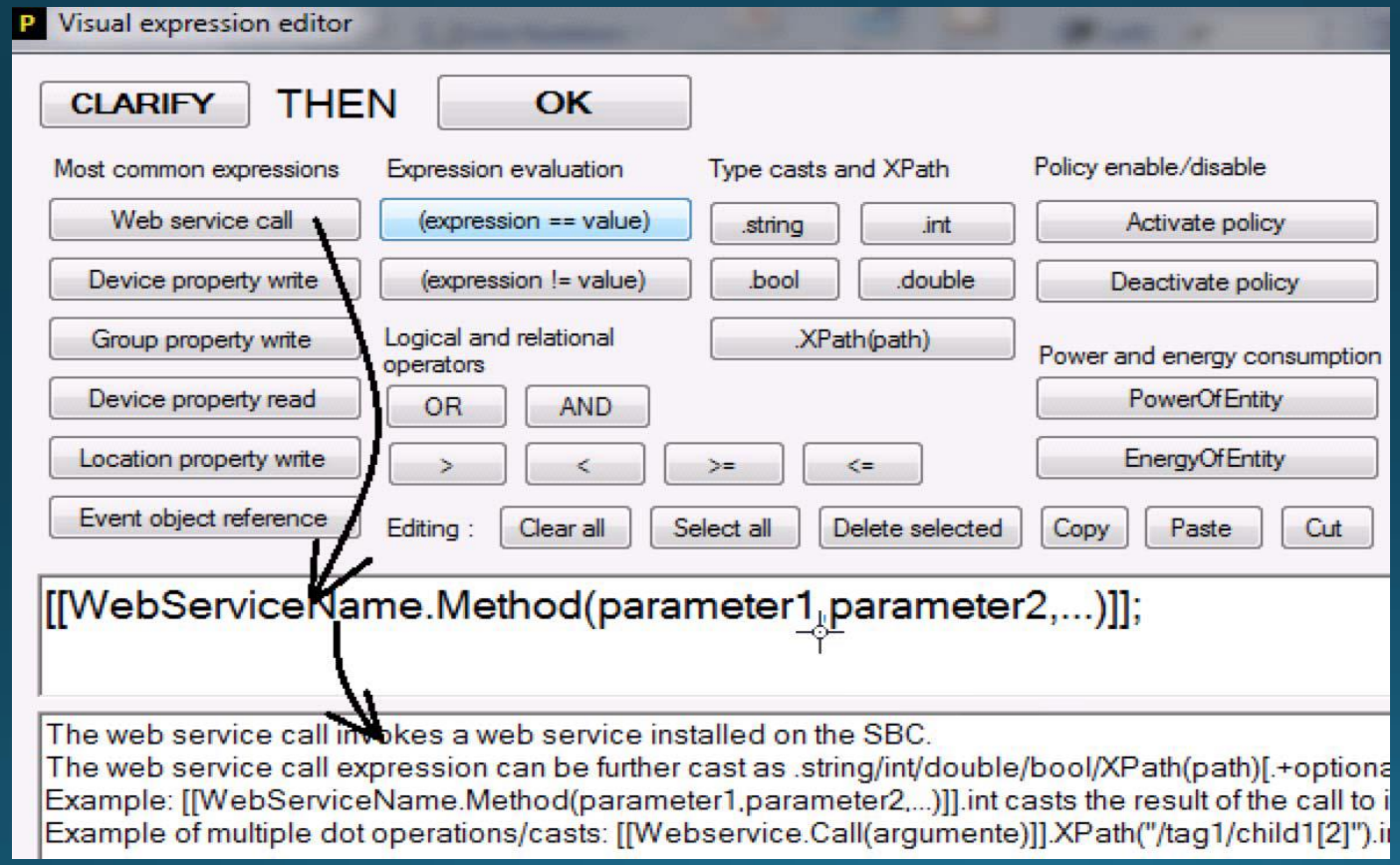
Sender and receiver are using http protocol to access GetValue() method, which returns a list of all the collected data (device name, description, last read value, read date) in the latest session. For third party applications, calling (request) the web service GetValues() will return as a result (response) a structured XML which will parsed by the senders application.



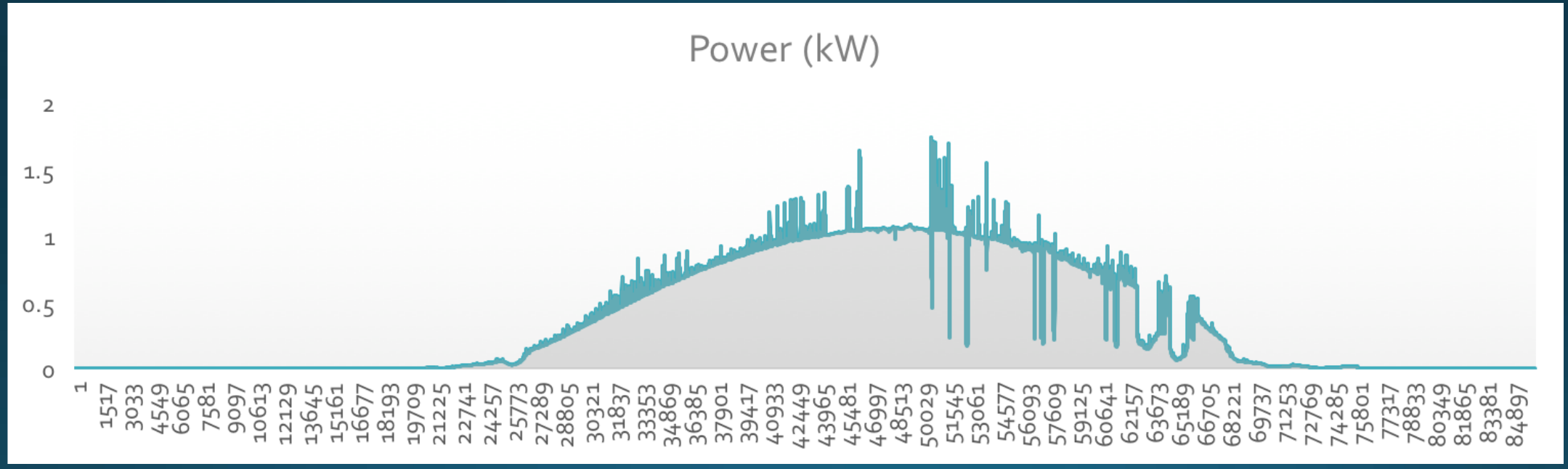

```
HTTP/1.1 200 OK
Content-Type: text/xml; charset=utf-8
Content-Length: length

<?xml version="1.0" encoding="utf-8"?>
<soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchem
  <soap:Body>
    <GetValuesResponse xmlns="http://casapasiva.org/">
      <GetValuesResult>
        <CurrentValue>
          <Device>string</Device>
          <Description>string</Description>
          <Value>double</Value>
          <ReadDate>dateTime</ReadDate>
        </CurrentValue>
        <CurrentValue>
          <Device>string</Device>
          <Description>string</Description>
          <Value>double</Value>
          <ReadDate>dateTime</ReadDate>
        </CurrentValue>
      </GetValuesResult>
    </GetValuesResponse>
  </soap:Body>
</soap:Envelope>
```

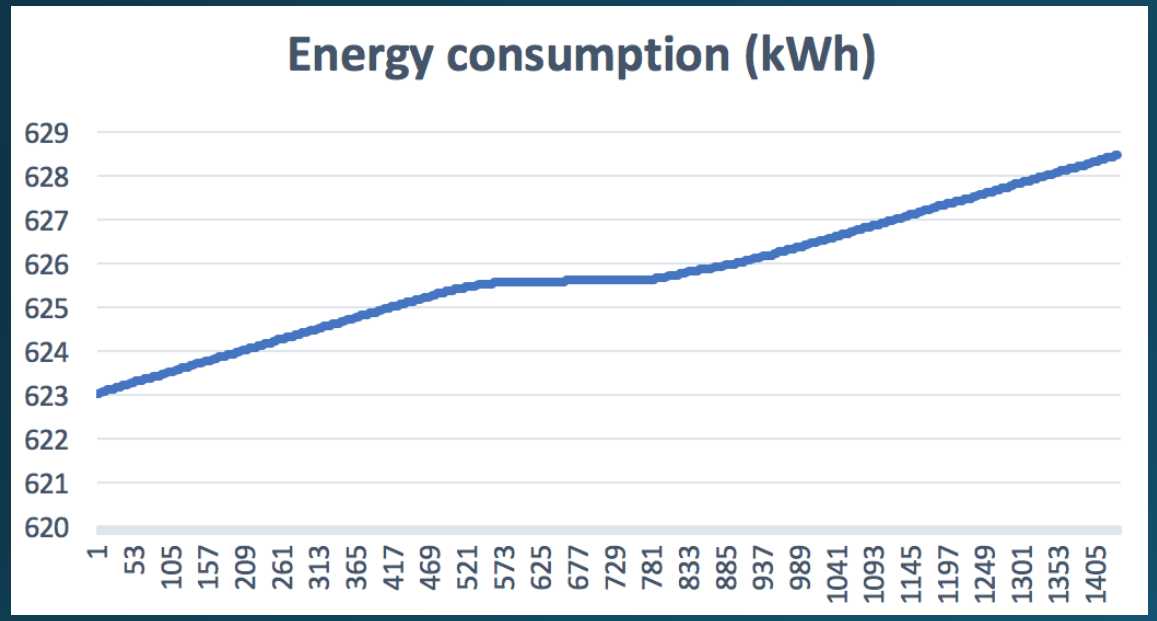
Policy editor



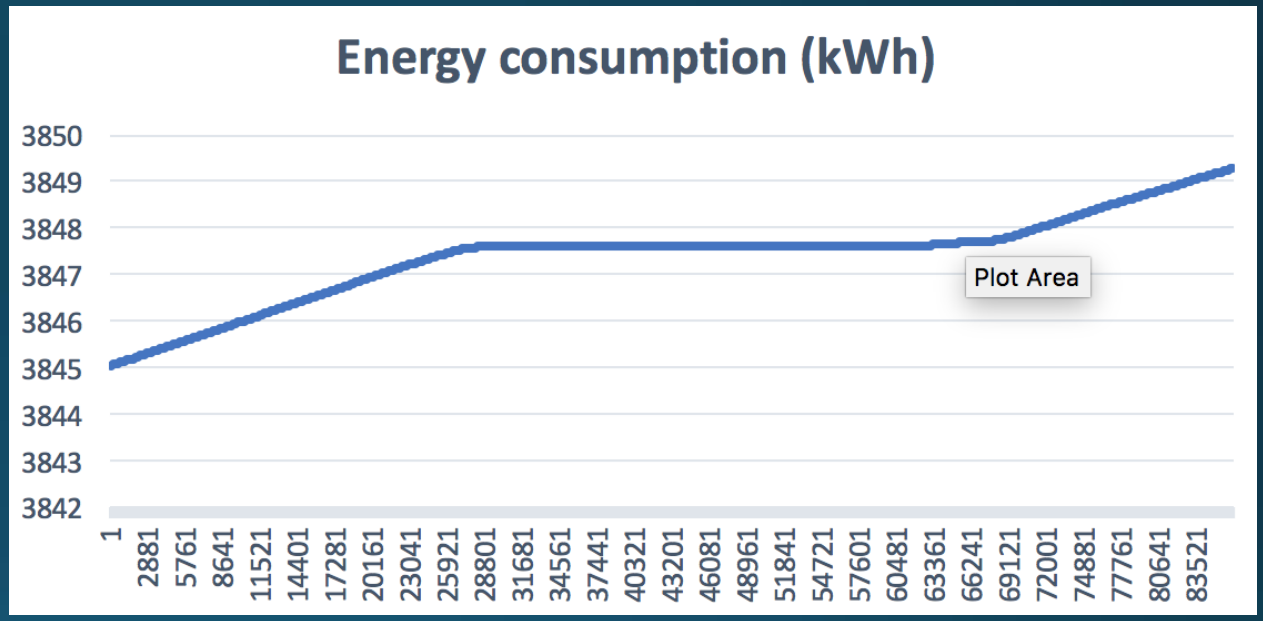
Energy production



Energy consumption



Energy consumption during 21.11.2015



Energy consumption during 31.05.2016

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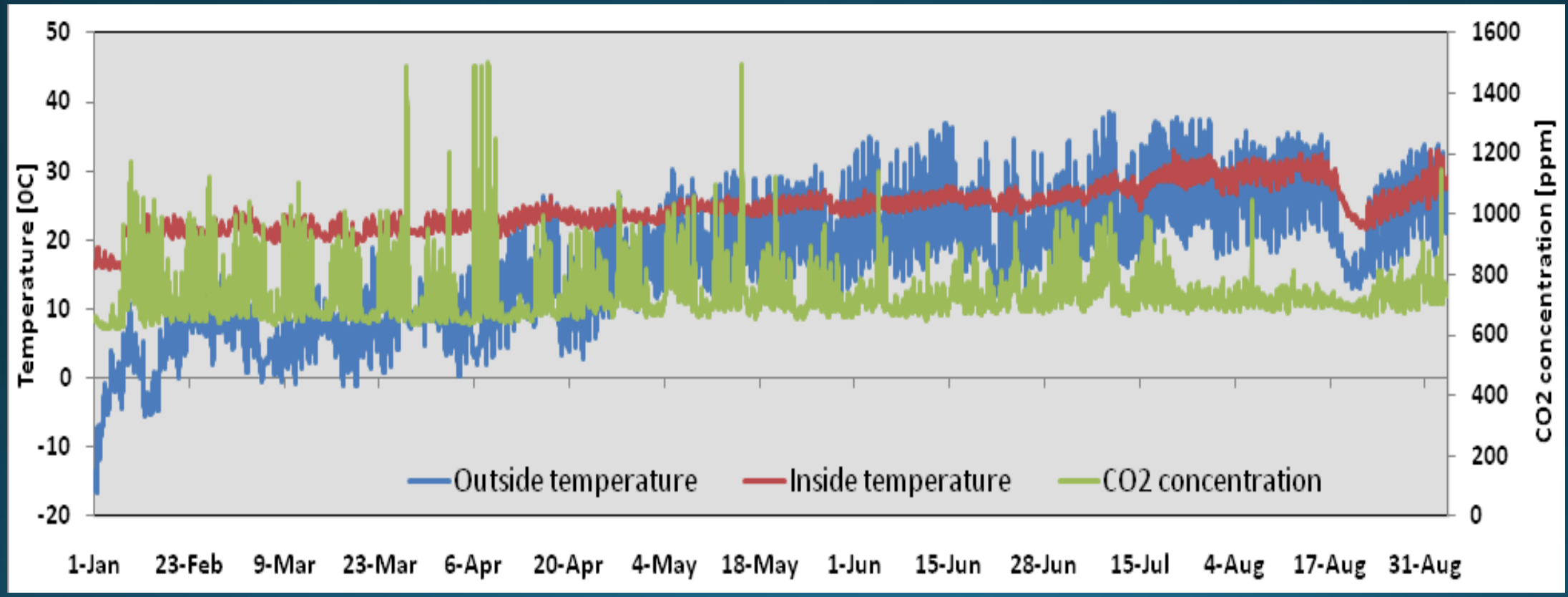
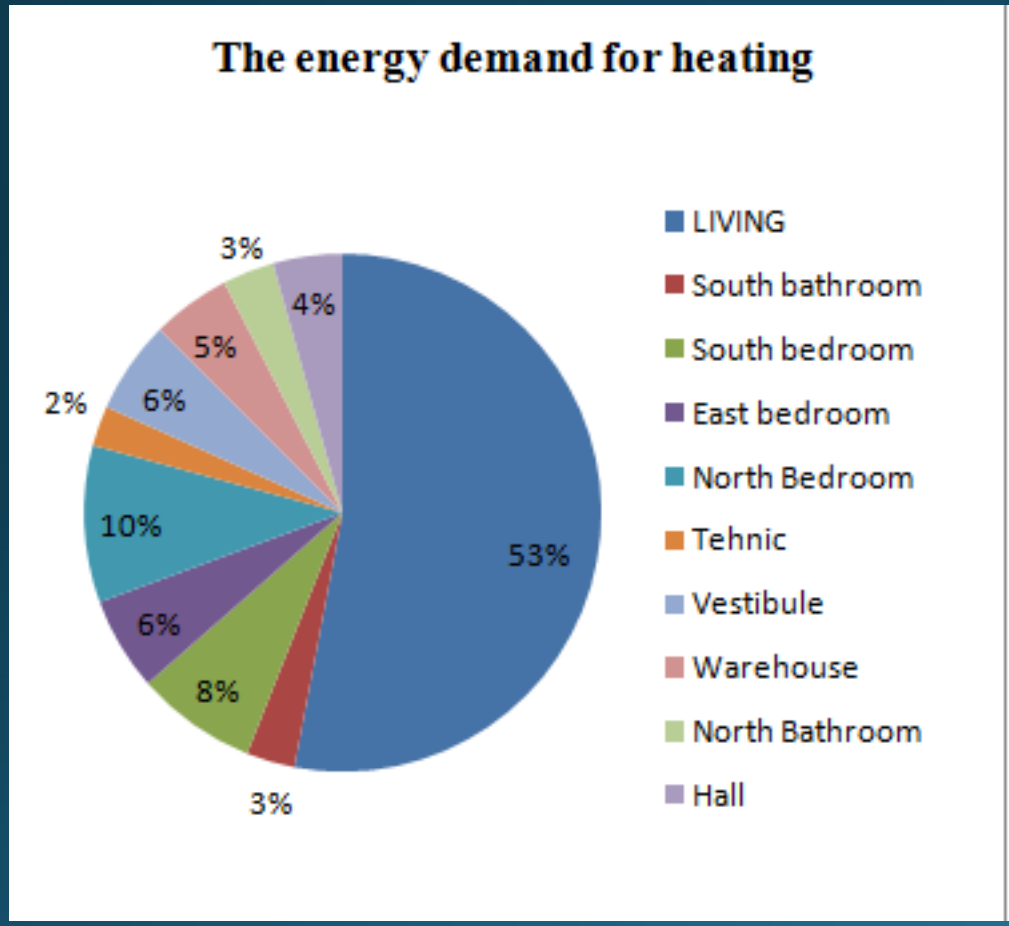
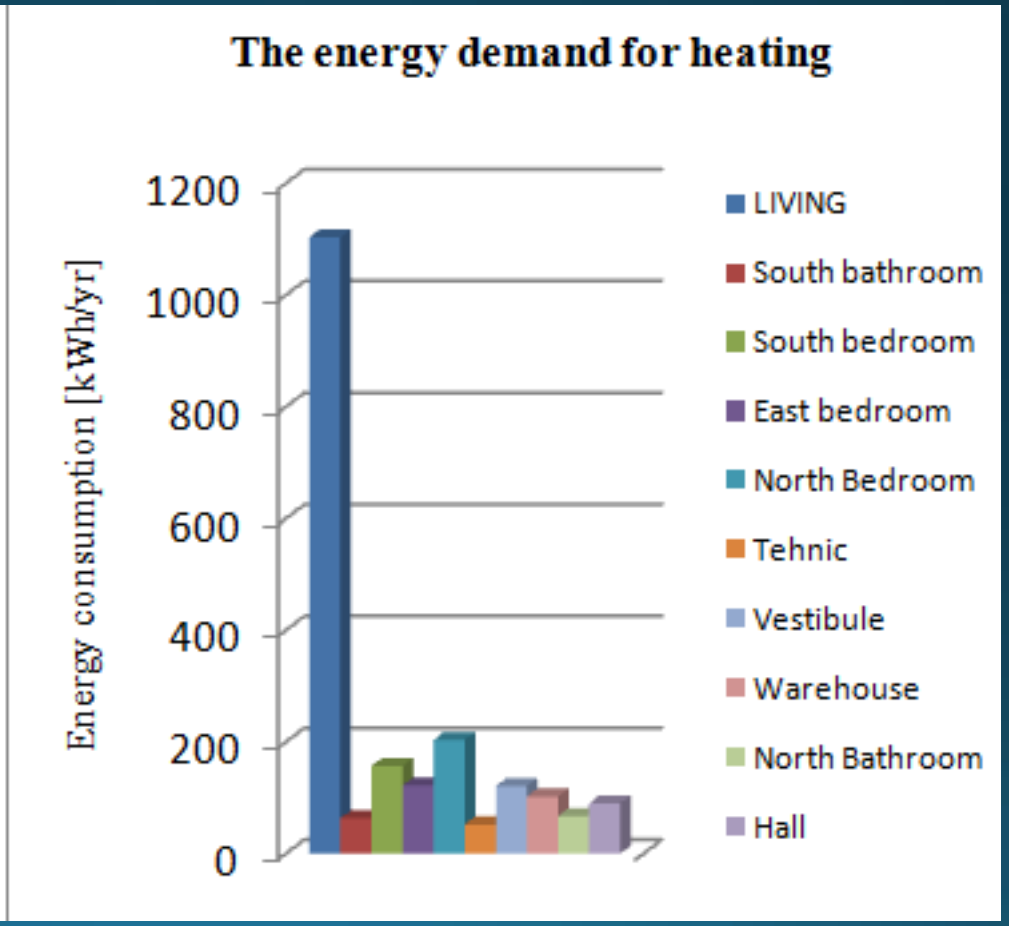


Passive house POLITEHNICA





Passive house POLITEHNICA

Treated Floor Area:	140,0	m^2
	Applied:	**Monthly Method**
Specific Space Heat Demand:	**12**	**kWh/(m^2a)**
Pressurization Test Result:	**0,5**	**h^{-1}**
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	**119**	**kWh/(m^2a)**
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	**75**	**kWh/(m^2a)**
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	**178**	**kWh/(m^2a)**
Heating Load:	**15**	**W/m^2**
Frequency of Overheating:	**0**	**%**
Specific Useful Cooling Energy Demand:		**kWh/(m^2a)**
Cooling Load:	**1**	**W/m^2**

Thank you