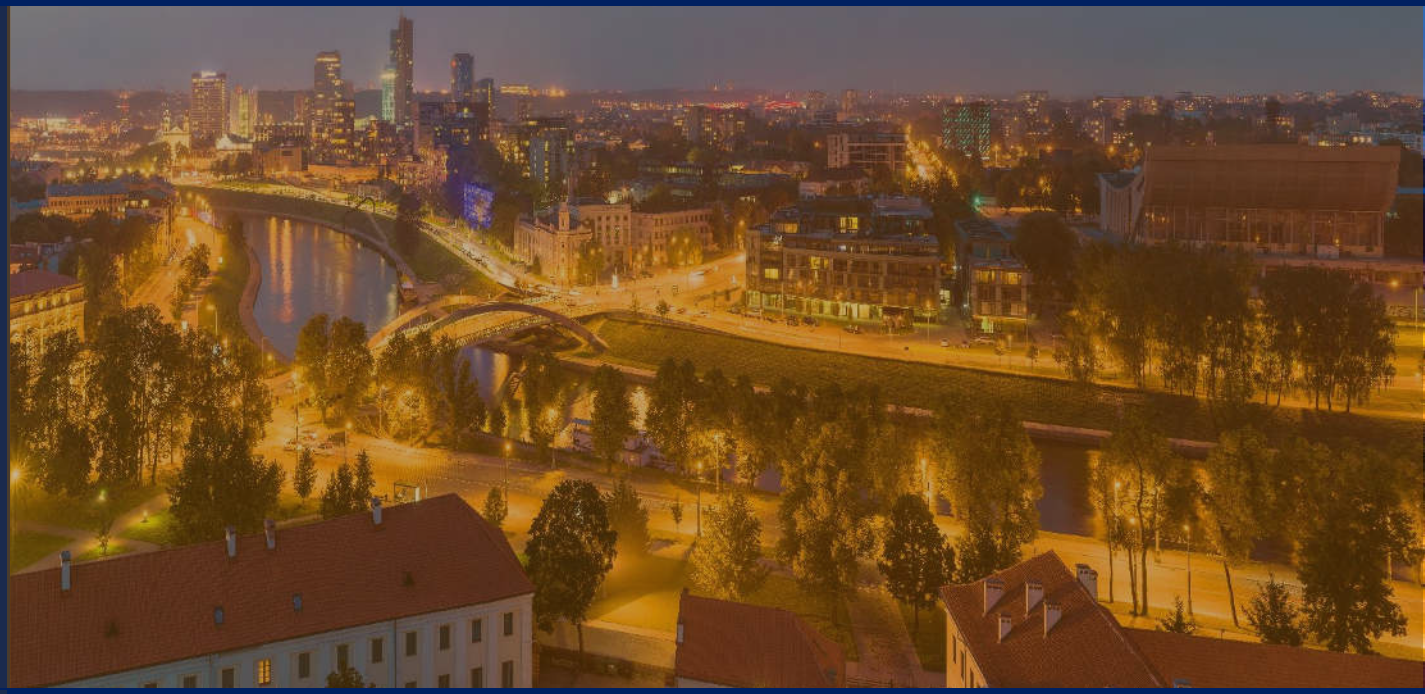
COMBINED TECHNICAL AND POLICY APPROACHES TO BUILDING EFFICIENCY AND DISTRICT ENERGY IN VILNIUS, LITHUANIA



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2016

- There are **45 champion cities** for district energy use around the world and **Vilnius is one of them**.

Prehistory

?

GROUP HEAT SUBSTATIONS: to Reconstruct or Demolish?

Prehistory

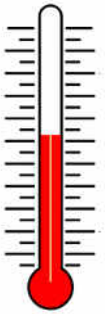
?

Four pipe system or Two pipe system?

ENERGY MANAGEMENT

William Edwards Deming (1900–1993), an American engineer, statistician, professor, author, lecturer, and management consultant

YOU CAN'T MANAGE WHAT YOU CAN'T MEASURE



Thermometer without a scale:

- How to Manage room temperature?
- Is it cold or warm?
- Increase or decrease room temperature for satisfaction?

Disadvantages of the main energy consumption evaluation methods

DISADVANTAGES OF THE MAIN ENERGY CONSUMPTION EVALUATION METHODS

- Building **energy consumption rating** is a measure of comparison by which can be **evaluated energy consumption** efficiency or energy consumption level of a new or old building.

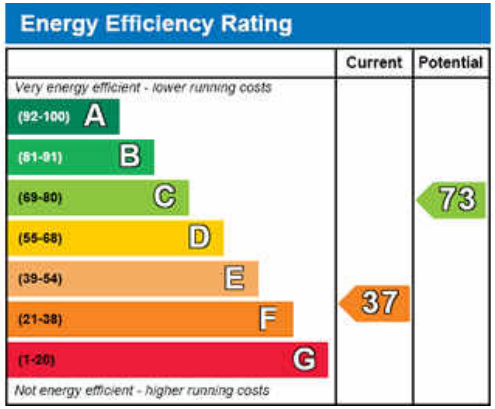
- Heat **energy** consumption in buildings **can be evaluated** by the help of:
  - Energy performance **certificate**;
  - Energy **audit**;
  - According to **bills** for heating;
  - Other scientific **methodologies**;

Disadvantages of the main energy consumption evaluation methods

ENERGY PERFORMANCE CERTIFICATES

Regulation:

- Directive 2010/31/EU of the European Parliament and of the Council on the **Energy performance of buildings**;
- Local legal state deeds: Buildings Technical Regulation "**Energy performance of buildings. Energy performance certification",** Environmental Ministry of LR, 20-12-2005, etc.;
- **Objectives** – that every person without special education would be able to understand about energy consumption performance of his building. This certificate presents **energy performance class**.
- All buildings are divided into **7 classes** from **A** to **G**
- (A – best, G – worst).



Disadvantages of the main energy consumption evaluation methods

ADVANTAGES:

- **Better than a nothing** (first step forward);

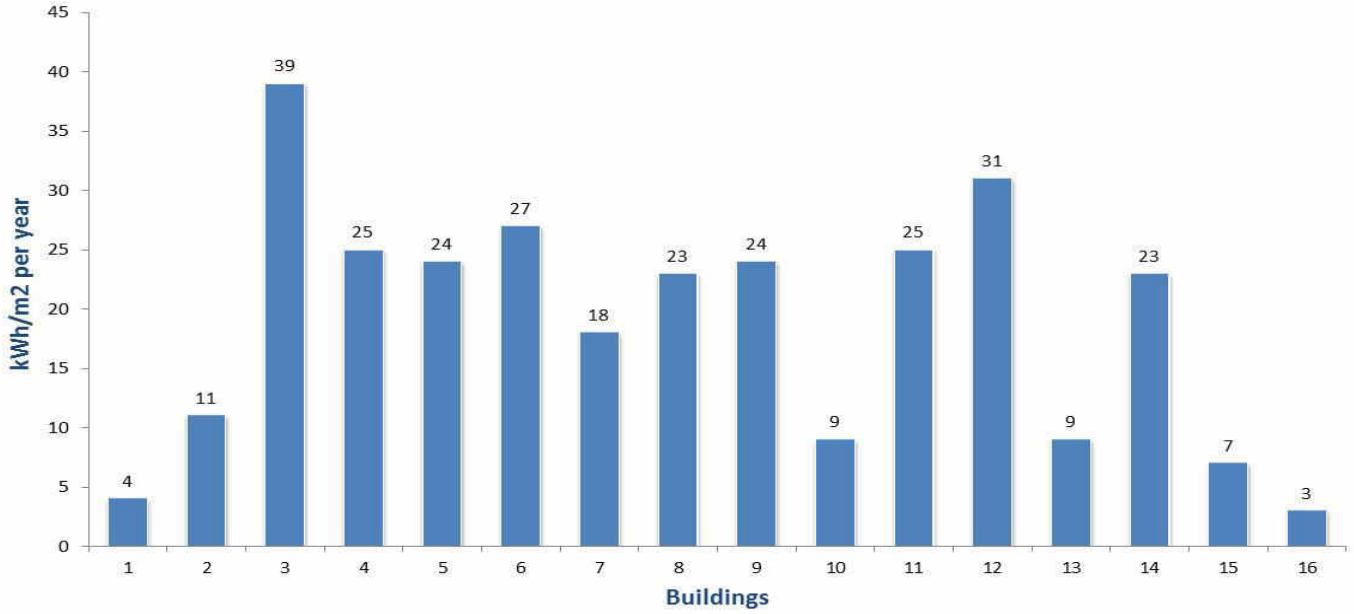
DISADVANTAGES:

- Calculated energy amount is only **theoretical**, for calculations are taken theoretical values and coefficients;
- Time costs – requires to **visit an object**, requires technical **documentation** (for old buildings that makes the problem);
- Despite certificate is performed, the building **actually can consume**

  absolutely **different amount of energy;**
- There are cases than a building according to reconstruction Investment plan, which requires energy performance certificate, **consumes 30 % less energy almost now**. **What shows such Investment plan**?

Disadvantages of the main energy consumption evaluation methods

- Performed study of **A+ energy performance class** buildings shows that buildings can **consume much more energy** than A+ class defines it, because A+ class **shows only energy performance potential** and the actual consumption depends upon quality of building construction materials, construction works, engineering HVAC equipment types and characteristics, qualification of facility management services, etc.
- Fig. shows **how different is** actual **energy consumption** in analyzed **A+ class buildings**



Disadvantages of the main energy consumption evaluation methods

ENERGY AUDIT

Regulation:

- Order to perform audits – order of Economy Minister of LR, 29-04-2008, "**Methodology to perform energy** and cold water **audits** in public buildings";

- **Objectives** – to evaluate state of building constructions and engineering systems, to define measures for energy/water consumption decrement. Etc.;

- **Audit performance takes stages:**
  - Data collection;
  - Metering of energetic parameters;
  - Technical analysis of energy, cold water consumption;
  - Formation of energy and water balances;
  - Recalculation of actual energy costs for a standard climatic year conditions;
  - Energy and water saving measures;
  - Economical evaluation, preparation of report, etc.

Disadvantages of the main energy consumption evaluation methods

Advantages:

- **Detailed information** about a building and its engineering systems, actual **energy**/water consumption, potential **investments**;
- Proper for reconstruction Investment project;

Disadvantages:

- Huge **time costs**;
- **Price** – huge time costs leads to high price;
- Can be **performed only during heating season** (must be performed metering of temperature, humidity, etc. for not less than two weeks);
- Preparing a report is collected and presented a lot of detailed information about a building, which is required only for an energy audit;
- **Impossible** to perform **in a wide scale** – for all city or
- for all country (or it will take few years);

Disadvantages of the main energy consumption evaluation methods

BILLS FOR HEATING

Advantages :

- Energy is divided proportionally for every flat;

Disadvantages :

- Energy for heating is defined subtracting normative amount for circulation and hot water preparation according to in flats declared amount of hot water;

- **Normative heat amount for circulation** is applied for all buildings,
- but in separate building can differ;

- **Amount of declared hot water** differ from total consumed hot
- water amount in a building, so subtracted heat amount is not precise;

- In accordance with the above-presented the energy amount of kWh/m^2 presented in a bill is **not precise**. This amount of energy **can't be compared with other buildings**, it is influenced by **different** heating seasons **temperatures** and **durations**.

Methodology for actual energy consumption evaluation

Solution?

Methodology for actual energy consumption evaluation

To compare energy consumption of different buildings, various influencing factors must be eliminated:

- Heating Areas;
- Hot water consumption;
- Number of days;
- Outside temperature;
- Wind speed ???
- Outside air humidity ???
- Other ???

Methodology for actual energy consumption evaluation

EVALUATION OF ENERGY FOR HEATING

- After influencing **factors** were **eliminated**, finally we got a heat amount to increase **1 m^2** of premises temperature by **1^o C** per **1 day**;
- According to such criterion can be compared different types of buildings by different heating seasons;

Methodology for actual energy consumption evaluation

Must be defined the separate evaluation criterion, showing actual consumption in a building and which would be comparable;

Solution – Actual Energy Consumption Class (AECC);

Evaluation principles:

- Defined **actual** energy amount for **hot water circulation** and **hot water heating** (not according to declared hot water, not according to normative amount of circulation);
- From total energy amount is subtracted actual energy for hot water heating and circulation. **The actual energy amount for heating is get**;
- **Eliminated influence of** different heating seasons **durations** and **temperatures**;
- The result can be **compared** between **different buildings** between **different climatic** conditions and heating seasons;
- Buildings are divided into **15 classes**. **1** – most effective, **15** – worst.

Methodology for actual energy consumption evaluation

ACTUAL ENERGY CONSUMPTION CLASS

No.	Building	AECC
1		1
2		2
3		3
4		4
5		5
6		6
7		7
8	Gedimino av. 100, Vilnius	8
9		9
10		10
11		11
12		12
13		13
14		14
15		15

Best

Worst

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Methodology for actual energy consumption evaluation

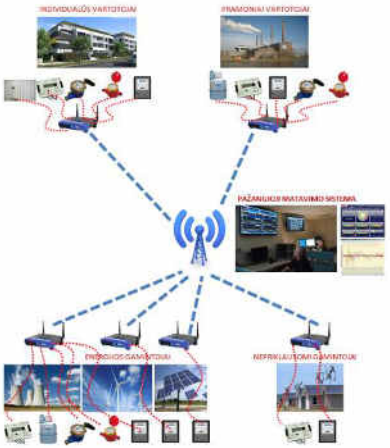
ADVANTAGES OF ACTUAL ENERGY CONSUMPTION CLASS

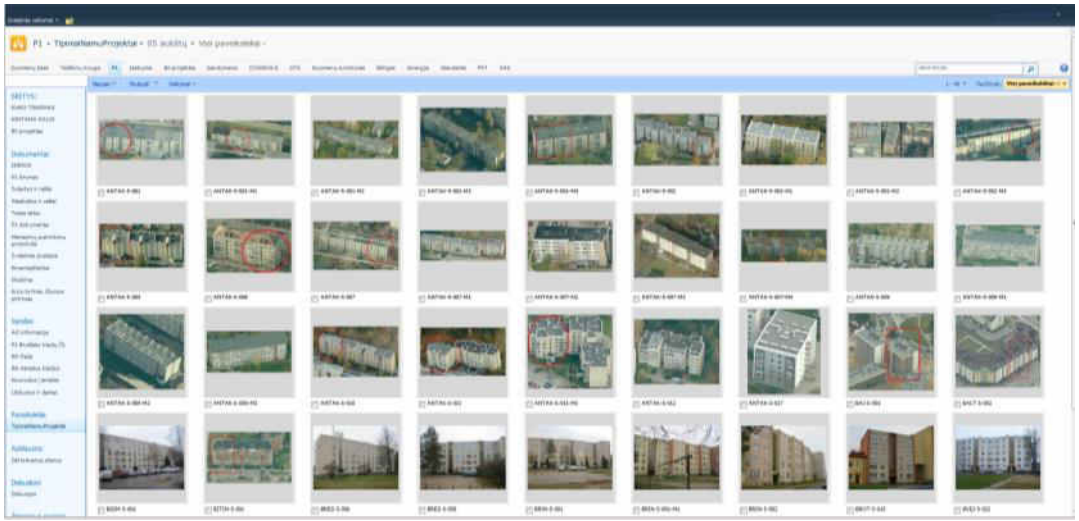
- All **different buildings can be compared** – from smallest to largest;
- Can be compared buildings of the same type. Different types of buildings consumes different amount of energy. Can be analyzed, does a new building consumes too much of energy due to a bad maintenance or does an old building consumes too small amount of energy it should to use, does the **consumption** of building **corresponds to** consumption of **such type of buildings**.

Methodology for actual energy consumption evaluation

Development of AECC was possible due to: **Wireless distant Smart data collection & monitoring system ENCO, CRM, COGNOS** and other developed intellectual systems

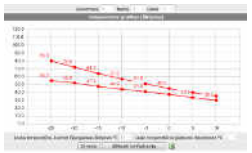
- **Buildings** under analysis are divided into **groups** according to the **same project types**: more than **330** projects and **740** modifications.





Compare a different types during different heating seasons

- By the help of smart intellectual systems **we know** about our buildings **everything** – from construction type to heating system regime and energy consumption



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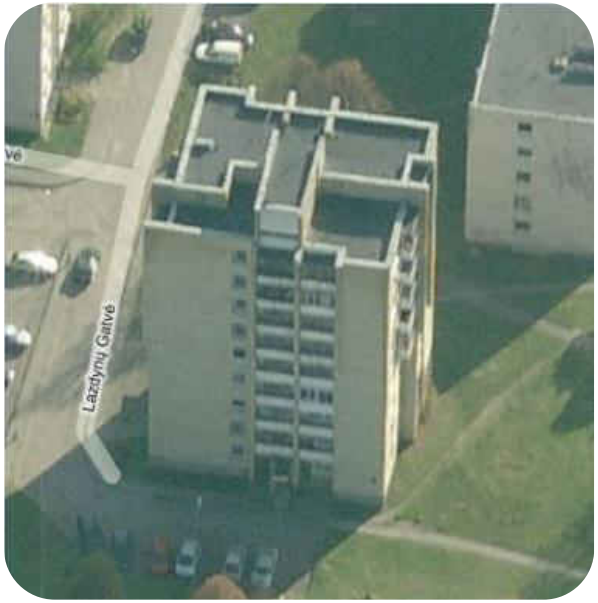
Methodology for actual energy consumption evaluation

- Vilnius according to typical projects:

Total: **330** typical projects and **740** additional modifications of these types



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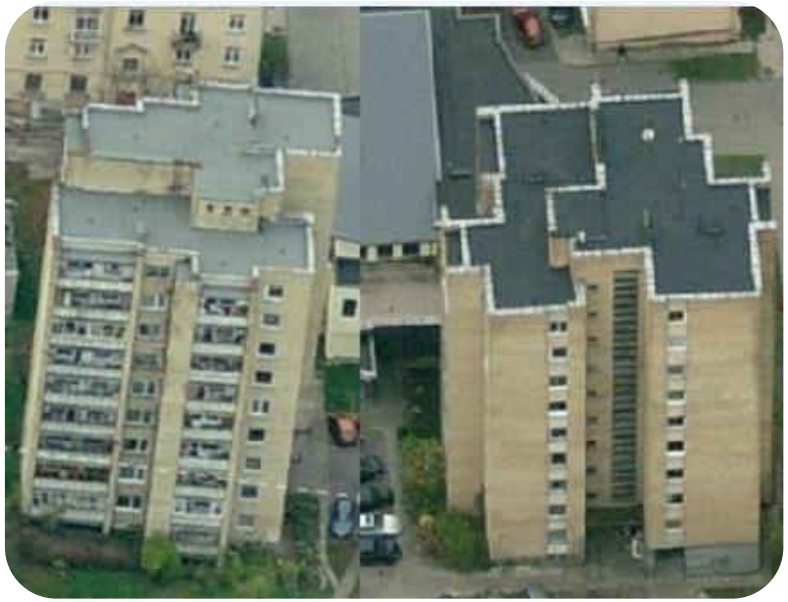

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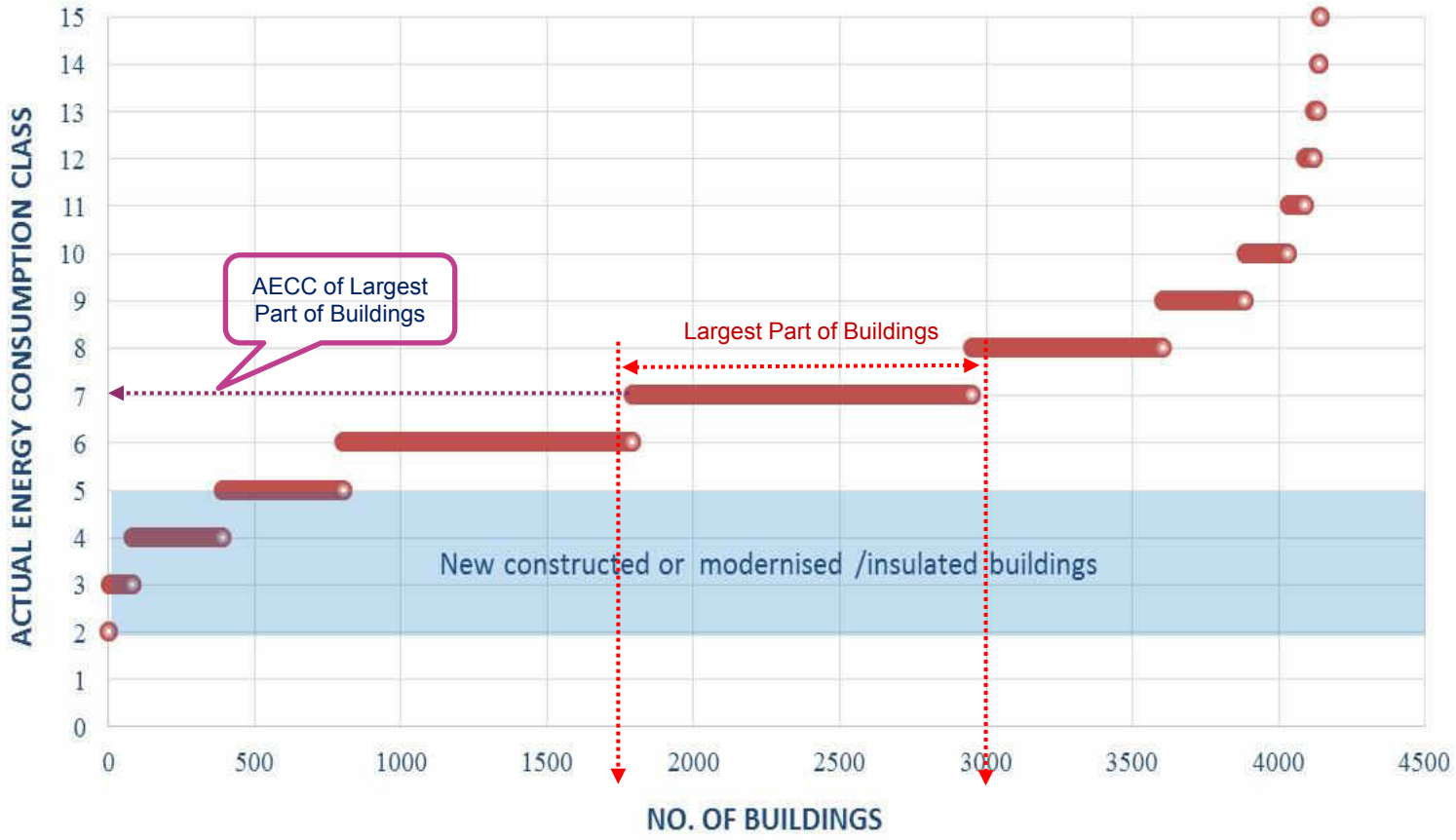
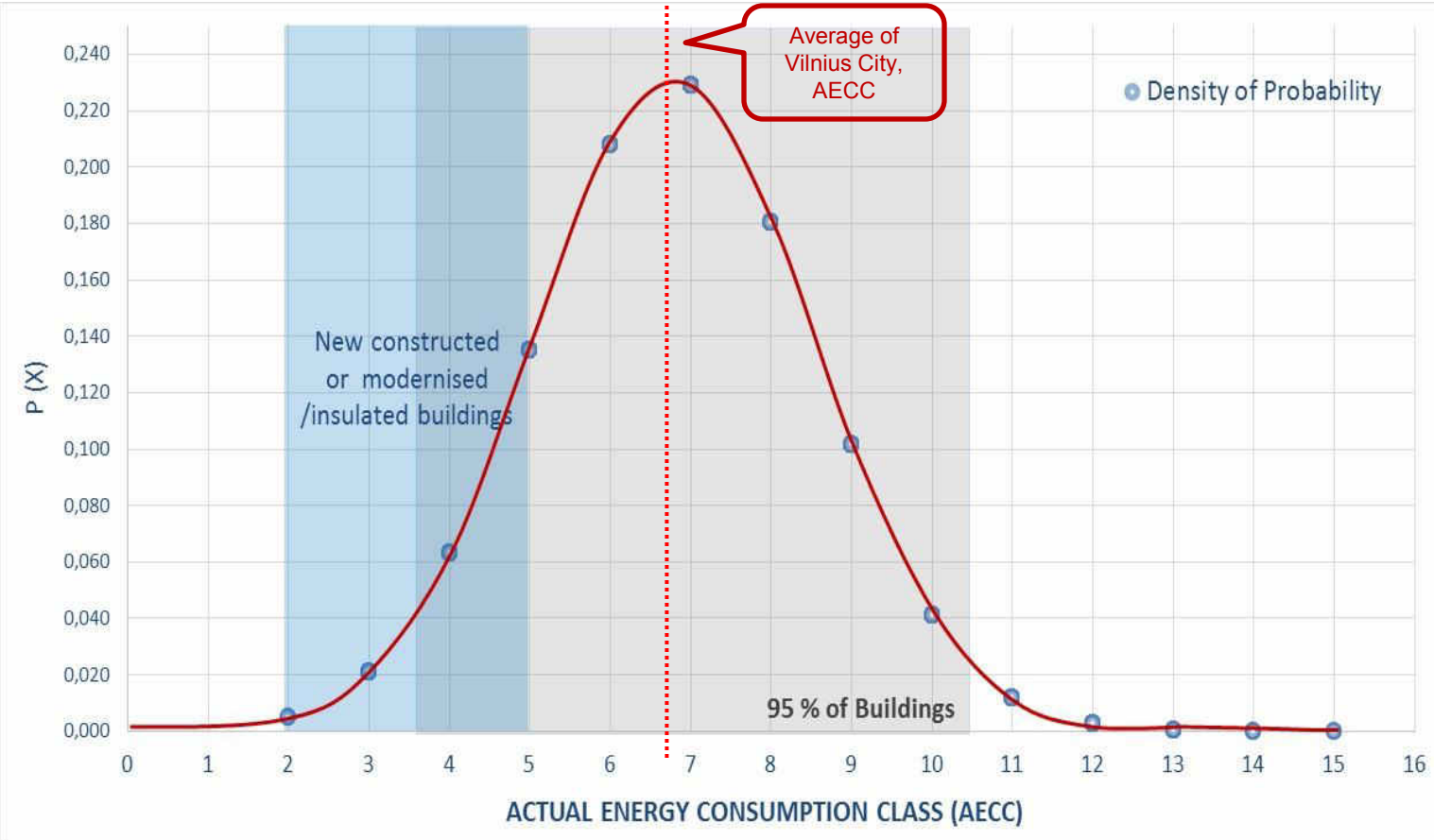
Methodology for actual energy consumption evaluation

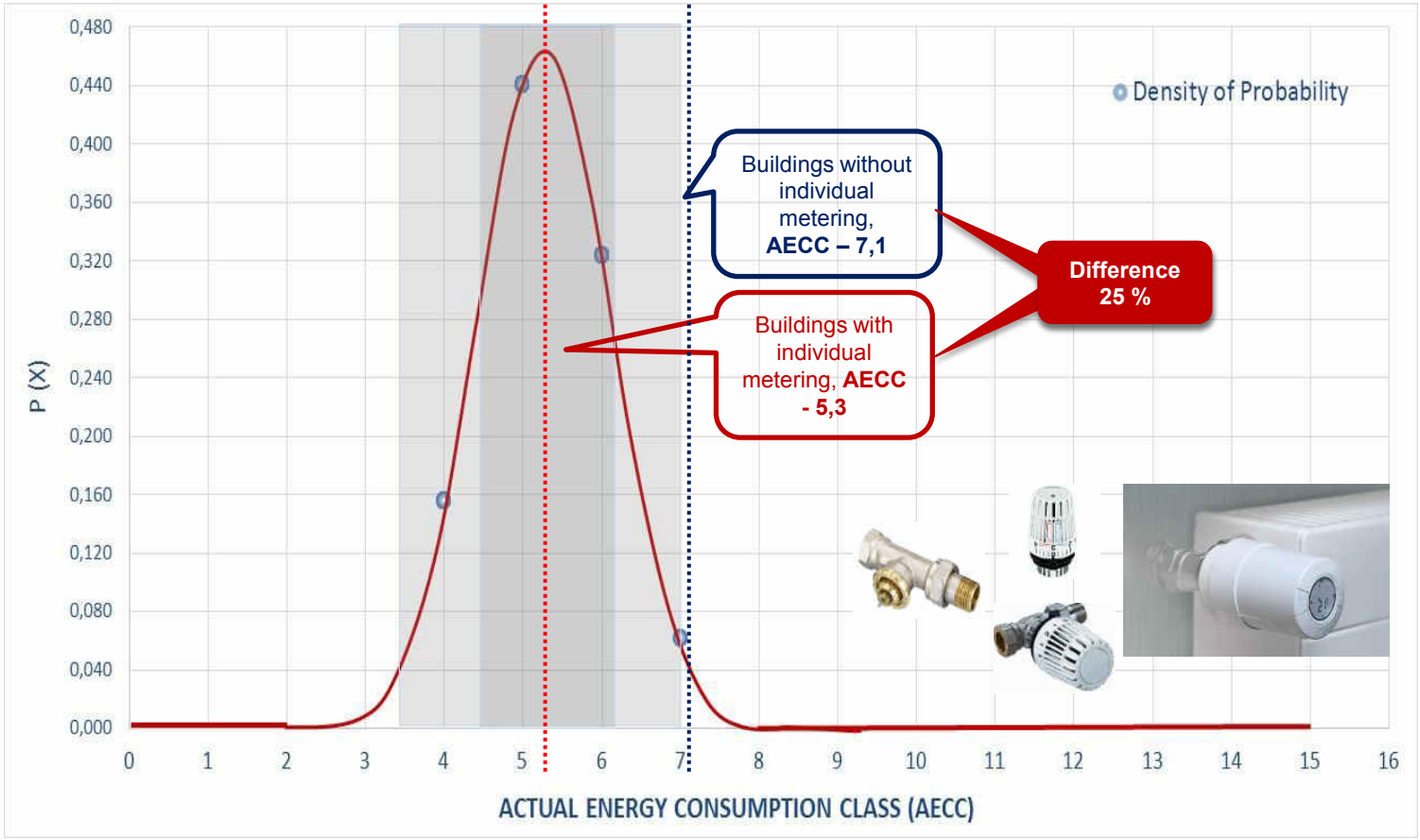
ACTUAL ENERGY CONSUMPTION IN BUILDINGS



Methodology for actual energy consumption evaluation



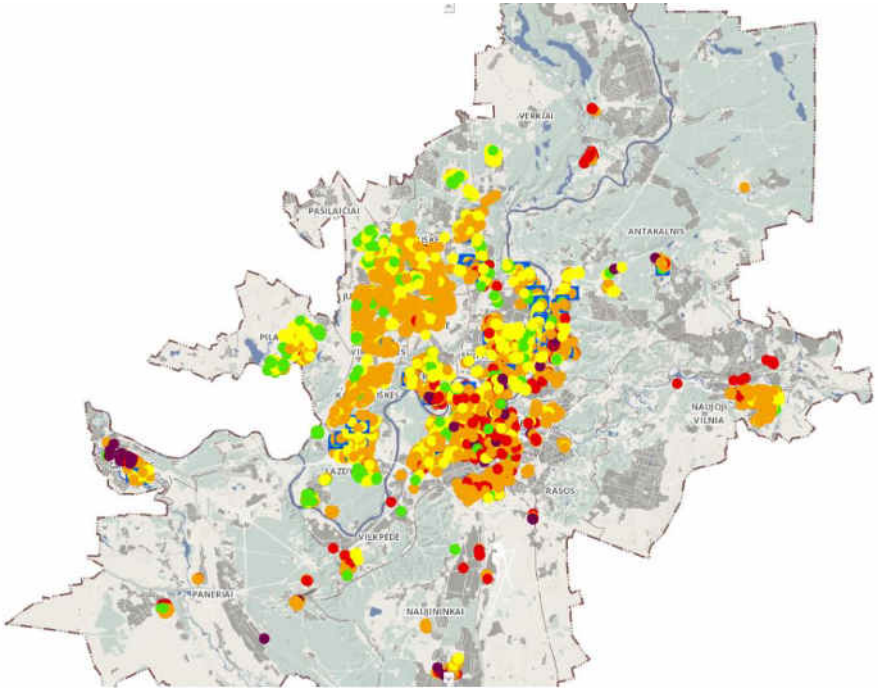
Methodology for actual energy consumption evaluation



Interactive Actual Energy Consumption Class (AECC) map

INTERACTIVE ACTUAL ENERGY CONSUMPTION CLASS MAP

http://www.vilnius.lt/vmap/t1.php?layershow=siluma

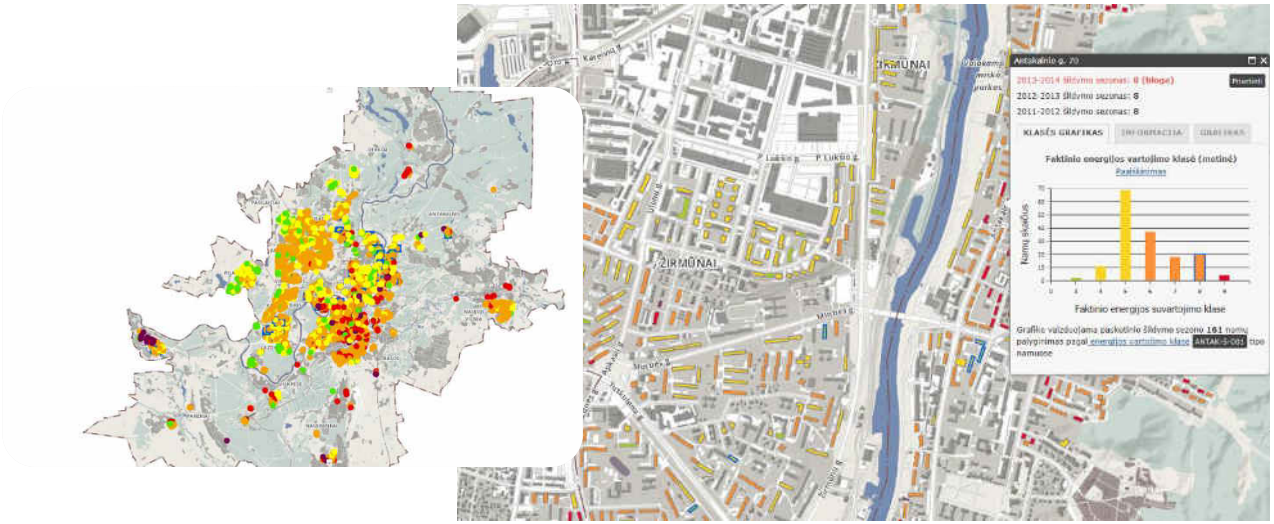


Interactive Actual Energy Consumption Class (AECC) map

ENERGY MANAGEMENT & ENERGY EFFICIENCY

Energy Mapping:

- **Interactive Online Actual Energy Consumption Class map** - assessment of unified actual energy consumption for every building, comparison with the same buildings and different heating seasons. Interactive Online AECC map Development for other Cities, Analytics.



Interactive Actual Energy Consumption Class (AECC) map

Interactive Actual Energy Consumption Class Map on Vilnius city municipality page:

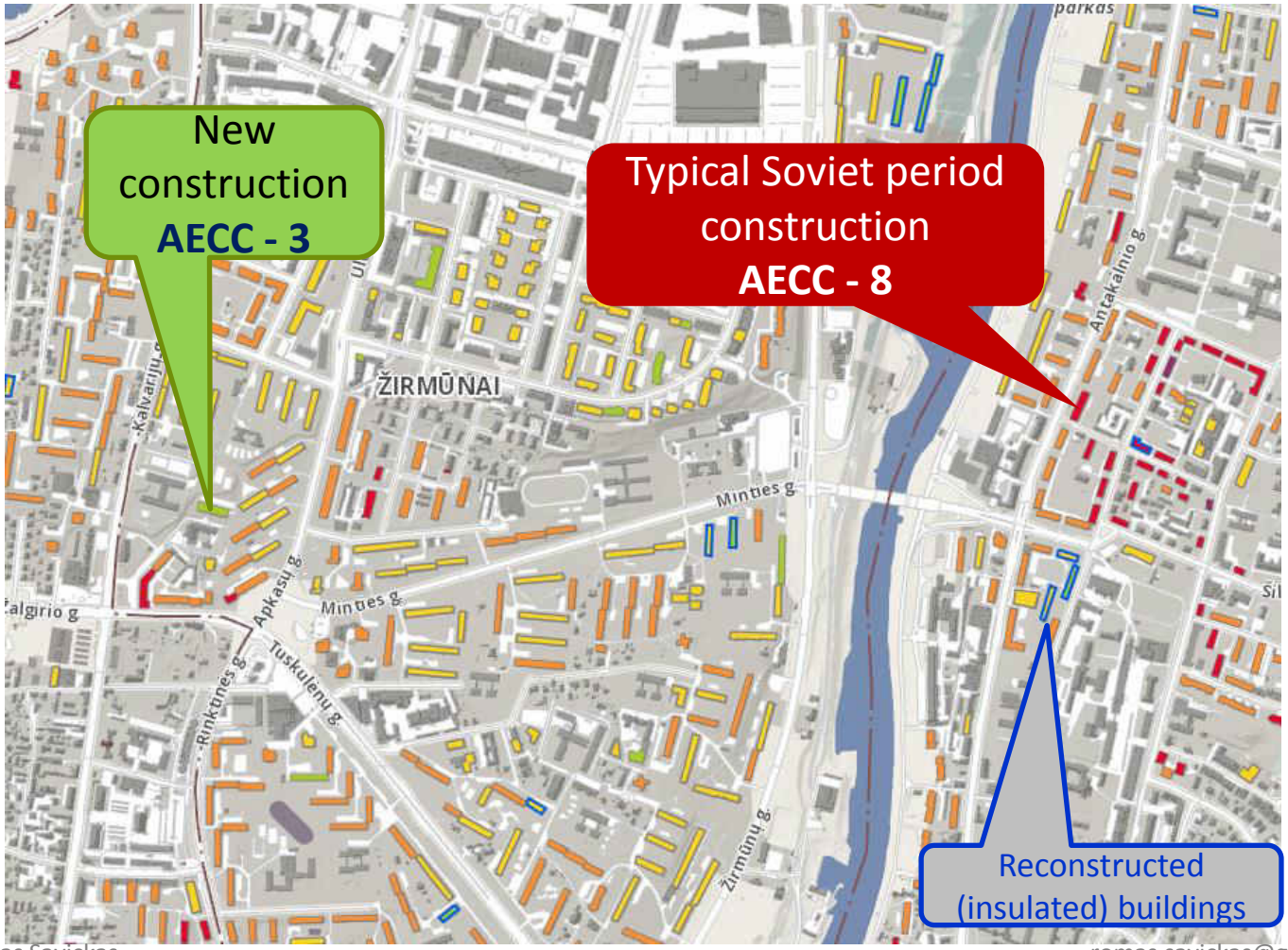
http://www.vilnius.lt/vmap/t1.php?layershow=siluma

Or:

- 1. www.vilnius.lt
- 2. Go to: „**Efektyvus vartojimas**“ and to “**Pastatų energinio efektyvumo žemėlapis**“

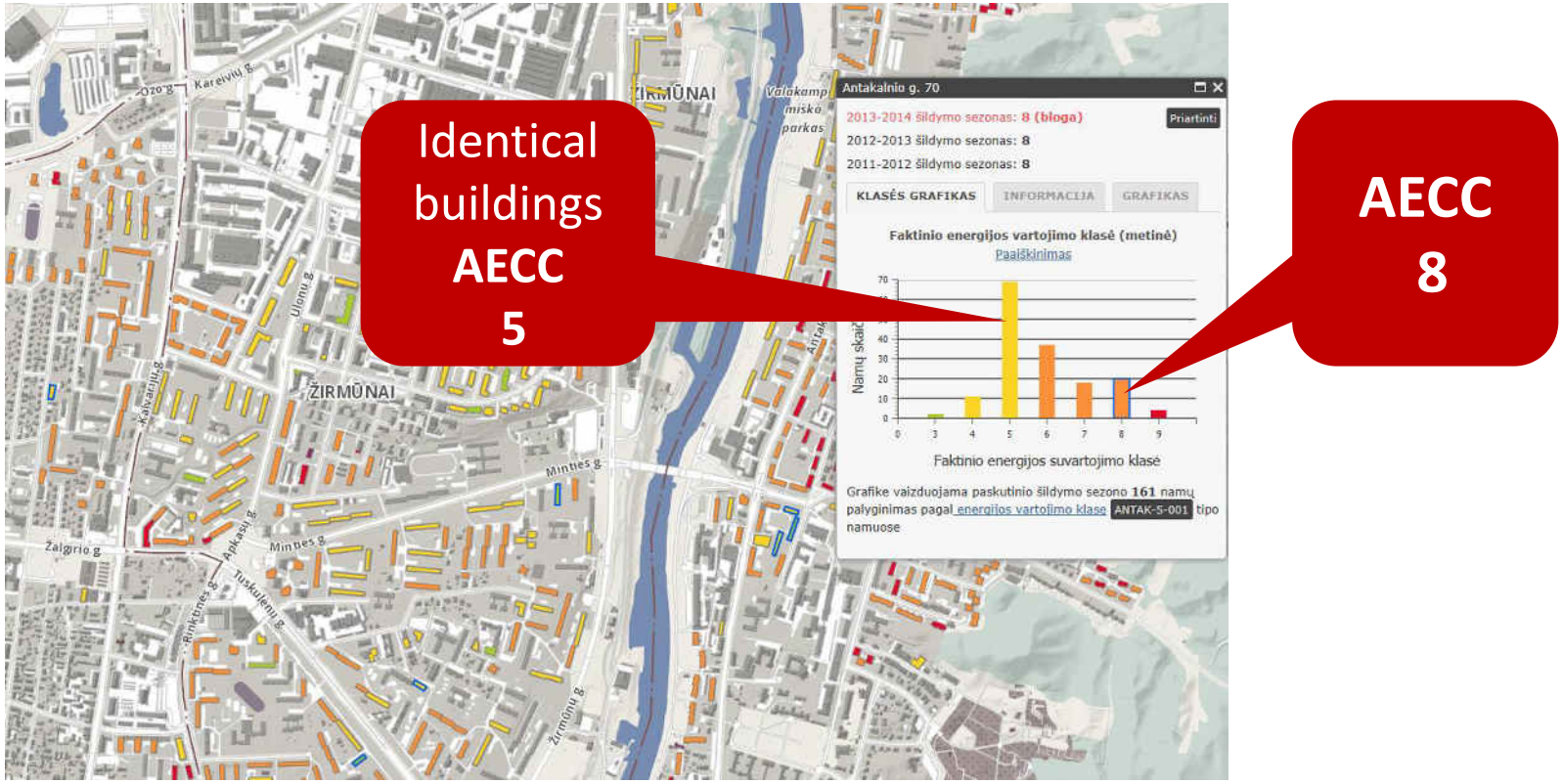
Interactive Actual Energy Consumption Class (AECC) map

- **City plan** – district of multiflat buildings:



Interactive Actual Energy Consumption Class (AECC) map

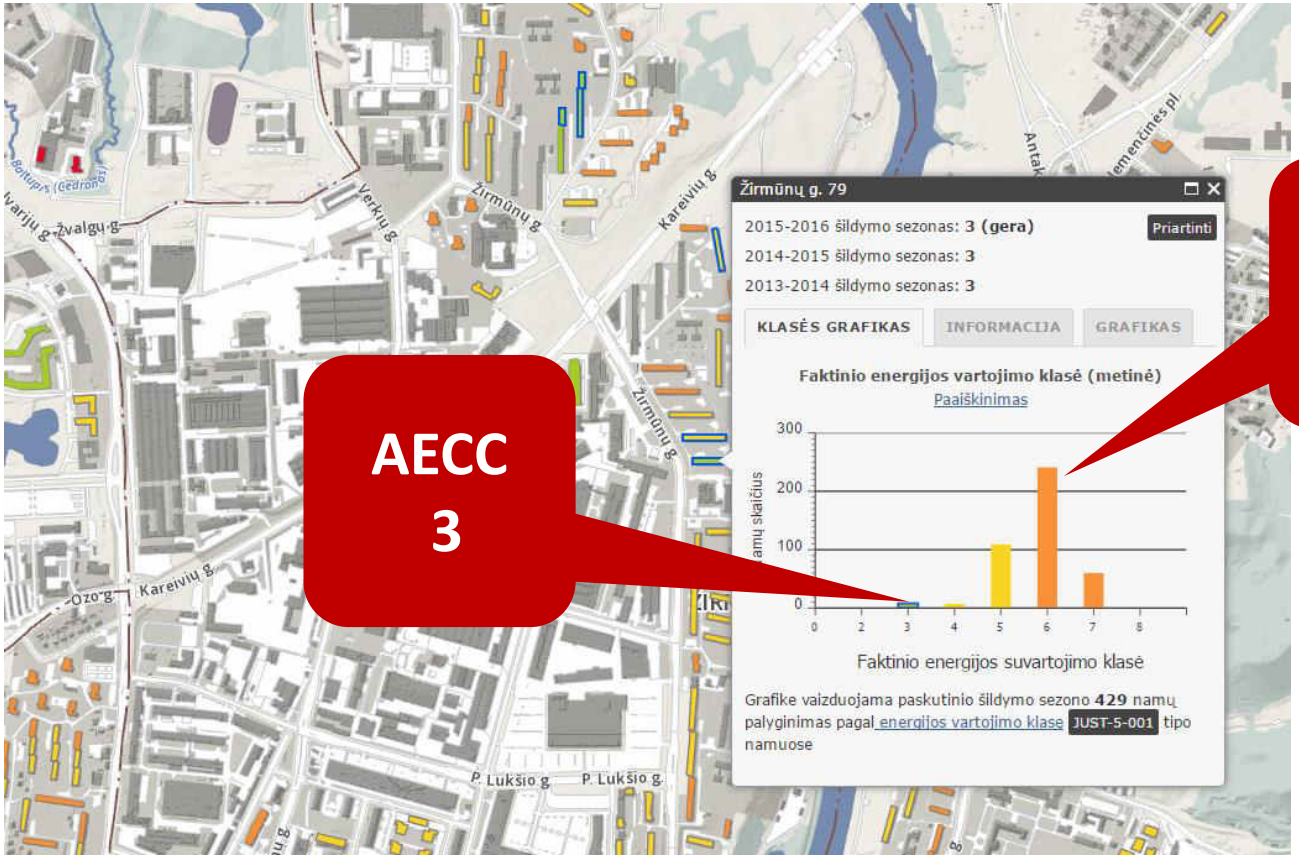
- **Delegate** (return) **responsibility** for a huge **energy bills from heat supply company to a heating systems maintenance company** (or building administrator)



- Selected buildings of **identical project type**
- Selected building has **AECC–8,** then the largest part of **such project type** buildings has **AECC–5**

Interactive Actual Energy Consumption Class (AECC) map

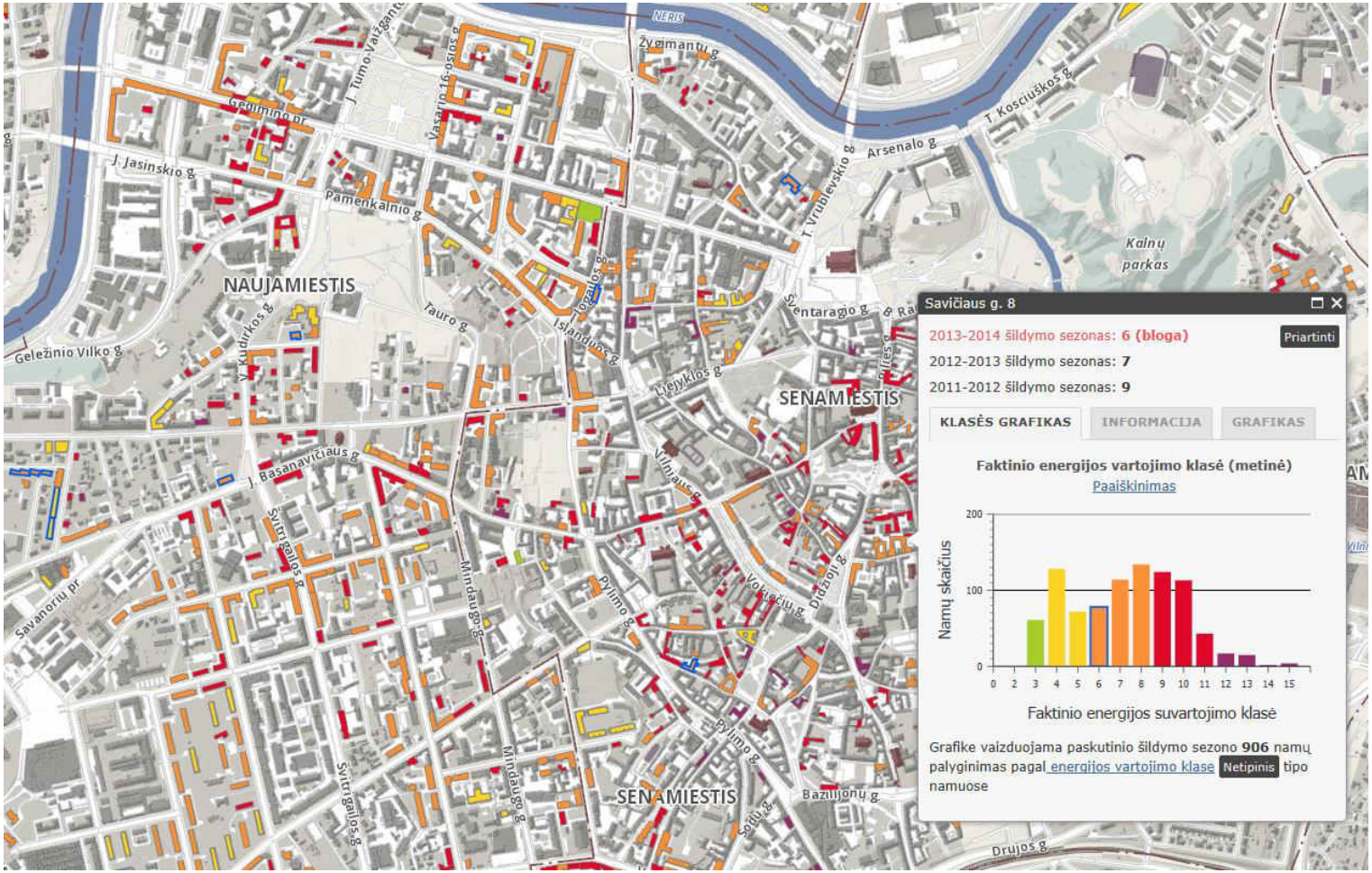
- Reconstructed (**Insulated**) Building and non reconstructed buildings



Selected **RECONSTRUCTED** building: **AECC–3;** Largest part of **such project type** buildings: **AECC–6**

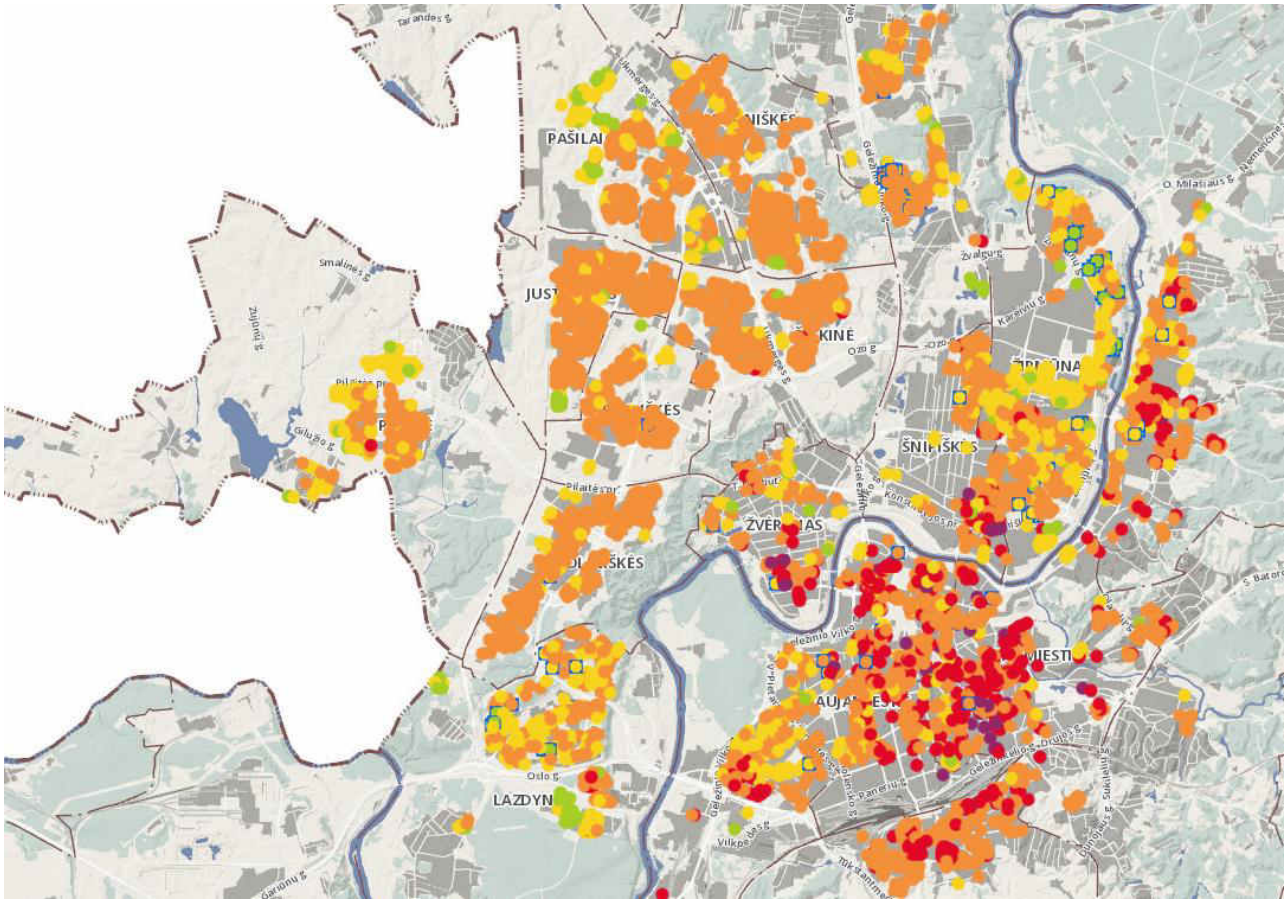
Interactive Actual Energy Consumption Class (AECC) map

- **Old town** view:



Interactive Actual Energy Consumption Class (AECC) map

- **Strategic Energy Efficiency plan** for a whole City (reconstruction (insulation), District heating development, etc.):



Interactive Actual Energy Consumption Class (AECC) map

- **AECC – Winner** of "**EUROCITIES 2014**" for Innovation in Energy:

ENERGISING CITIES
Munich 5-8 November
M YOU
MUNICH LOVES YOU
EUROCITIES 2014

- Short film in YouTube :
- https://www.youtube.com/watch?v=KiVII7hqsl0
- Or find on Google: "Interactive Actual Energy Consumption Map"

Intellectual Energy systems

OTHER

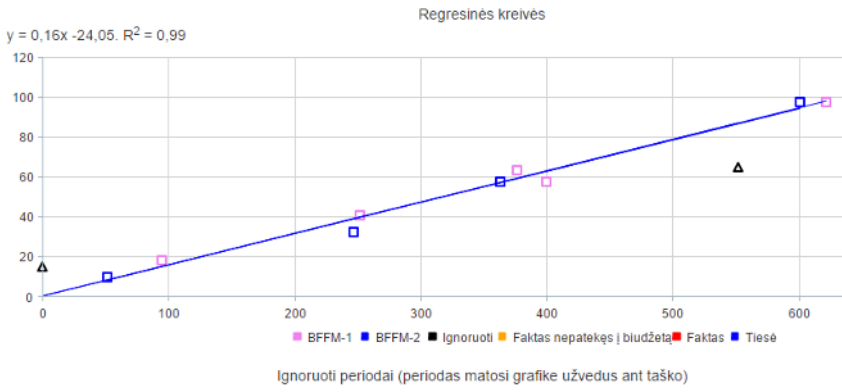
ENERGY CONTROL AND MANAGEMENT SYSTEMS

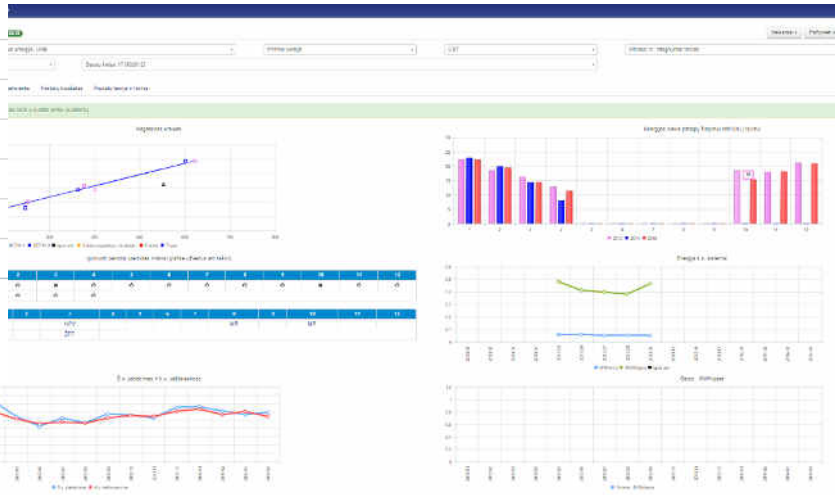
Intellectual Energy systems

ENERGY MANAGEMENT – ENERGY EFFICIENCY – ENERGY SAVINGS

- **Budgeting of Energy Resources** and consumption for the next year in:
  - Buildings
  - District Heating Network
  - Heat Production Source

A set of Degree-Days and other Scientific methodologies). Separately for every building.





Intellectual Energy systems

ENERGY MANAGEMENT – ENERGY EFFICIENCY – ENERGY SAVINGS

- **Detailed Analytics** of **every Final Customer (Building) Energy consumption** and **Prediction of future** energy/hot water consumption and **activity**.
- Assessment of Customer (Building) Energy consumption **to his historical data** and **comparison** of Energy consumption **with the same buildings**, old town, post Soviet, new construction, etc. buildings.
- **Prediction of bills** for heating/hot water for current month (starting from the first day of a month).
- Customers **Billing Control**: to avoid **mistakes of Faulty Bills**.

Intellectual Energy systems

ENERGY MANAGEMENT – ENERGY EFFICIENCY – ENERGY SAVINGS

Energy Metering:

- **Individual Heat Metering for the every Final Customer**, technical solutions for **Smart metering**, post Soviet buildings heating systems, **Wireless data collection, control and management systems**, Energy Efficiency Directive requirements. Individual metering by heat cost allocators, etc.

- **Customers Energy Metering Control**: identification of heat metering devices failures, energy theft/stealing identification by analytical means and "in Situ".

- **Expertise of Customers Complains**: due to energy billing, energy metering, etc.

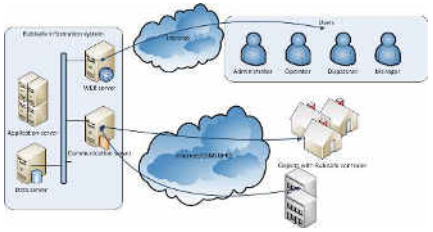
Intellectual Energy systems

ENERGY MANAGEMENT – ENERGY EFFICIENCY – ENERGY SAVINGS

WIRELESS DATA COLLECTION, CONTROL AND MANAGEMENT SYSTEM

Intellectual Energy systems

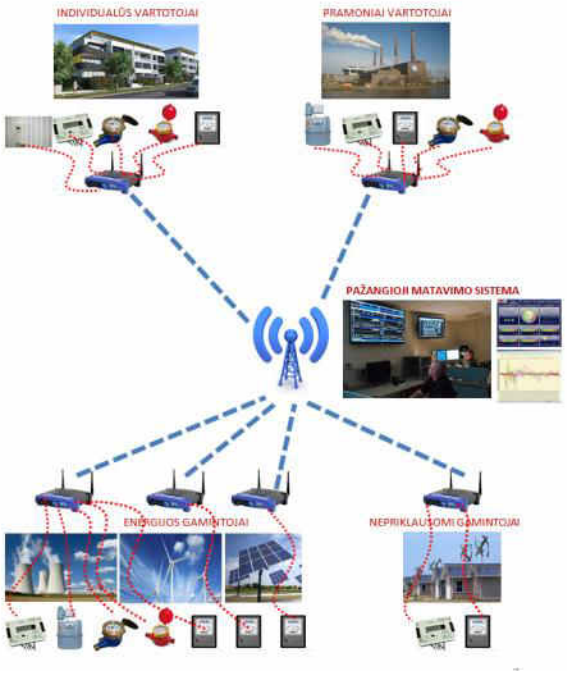
ENERGY MANAGEMENT – ENERGY EFFICIENCY – ENERGY SAVINGS



Wireless data collection, control and management system

Big data collection and transmission for various Utility systems:

- Heat/Hot water, Gas, Electricity and other meters, heat cost allocators, other devices;
- Various devices, installations, equipment: from pressure/temperature in District Heating Network to Power Plant, etc.



Parameters monitoring:

- Information, emergency and warning messages for accidents prevention;

Tools for Analytics

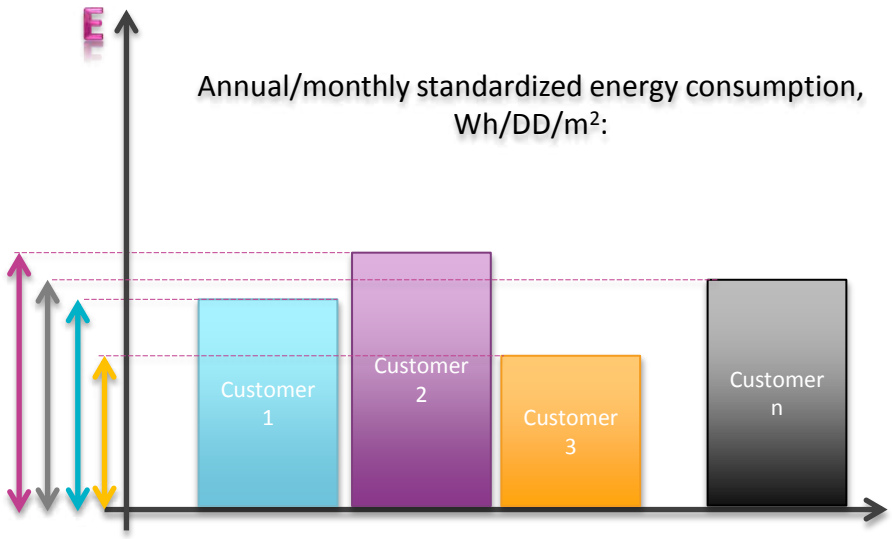
Intellectual Energy systems

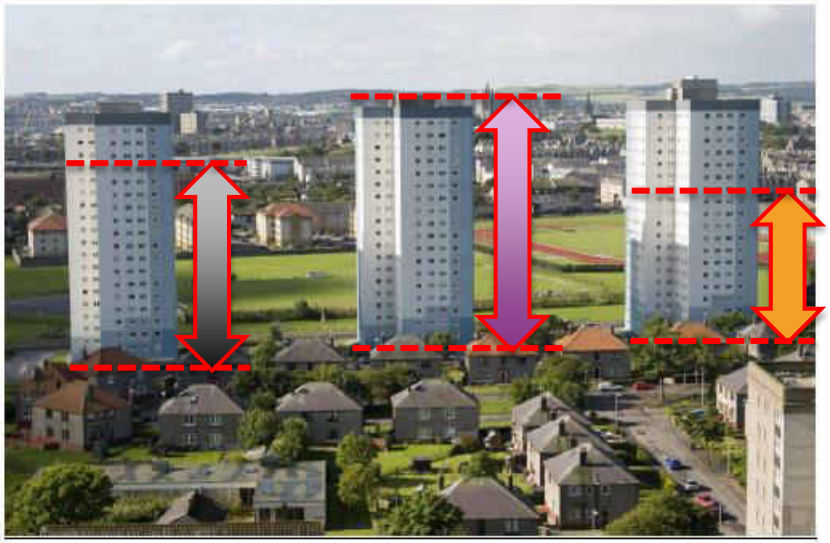
ENERGY MANAGEMENT – ENERGY EFFICIENCY – ENERGY SAVINGS

SMART THERMAL GRID

Intellectual Energy systems

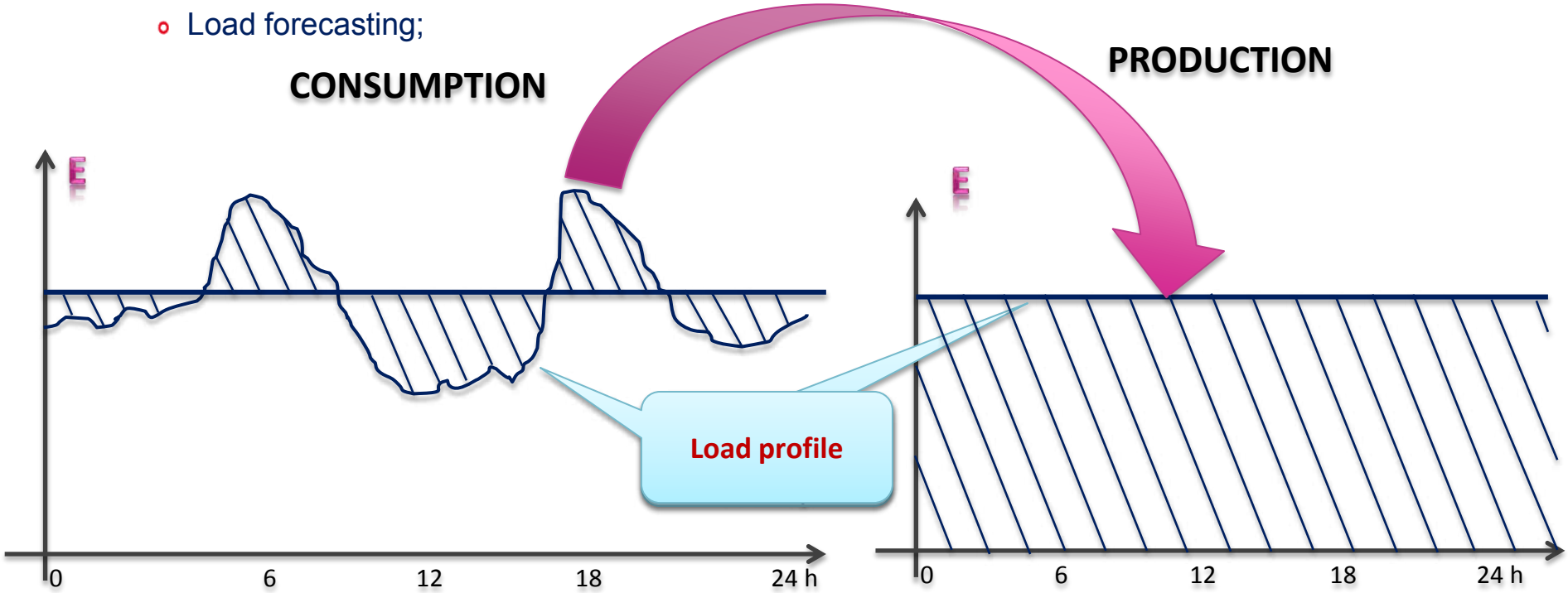
- **CONSUMERS - SUPPLY AND DEMAND SIDE MANAGEMENT**
  - For every consumer is defined **Standardized Energy Consumption** (eliminated influence of different outside temperatures, number of heating days, heating area, etc);





Intellectual Energy systems

- **CHANGING LOAD PATTERN - SUPPLY AND DEMAND SIDE MANAGEMENT**
  - Load shift to a "flat";
  - Plant schedule optimization;
  - Load forecasting;



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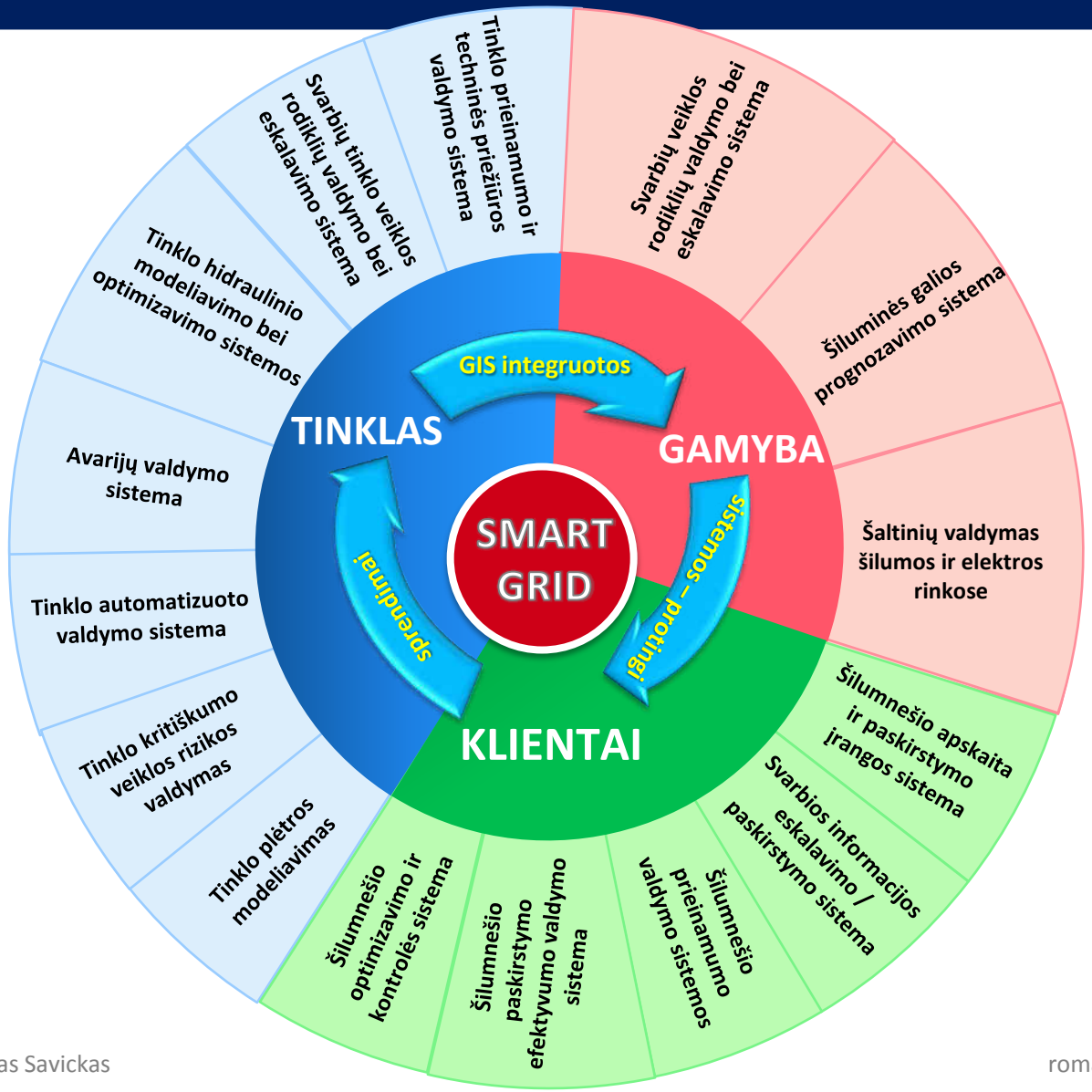

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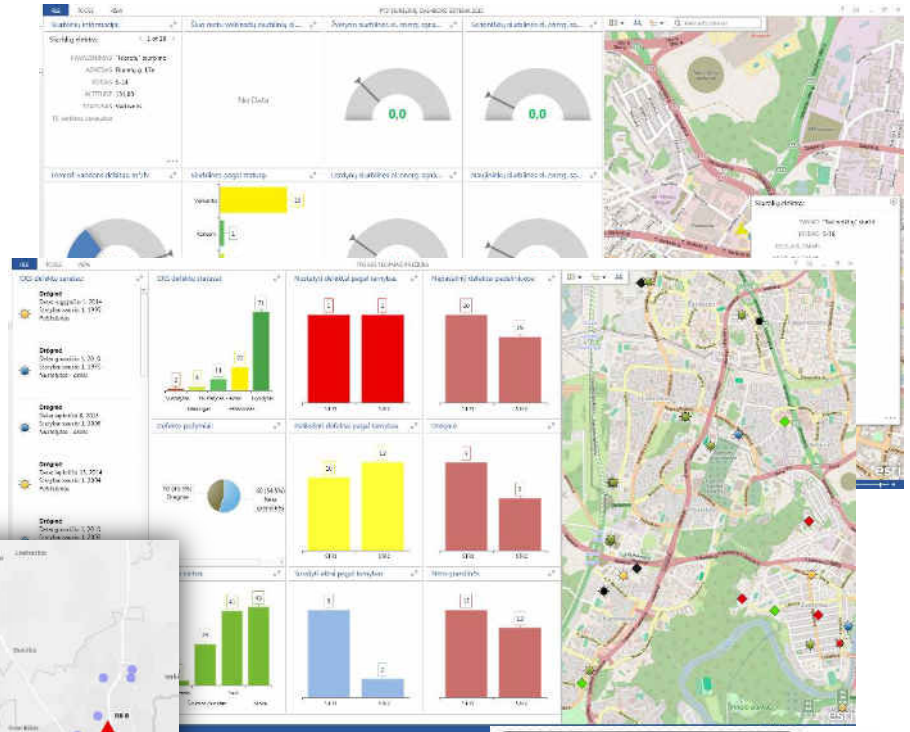
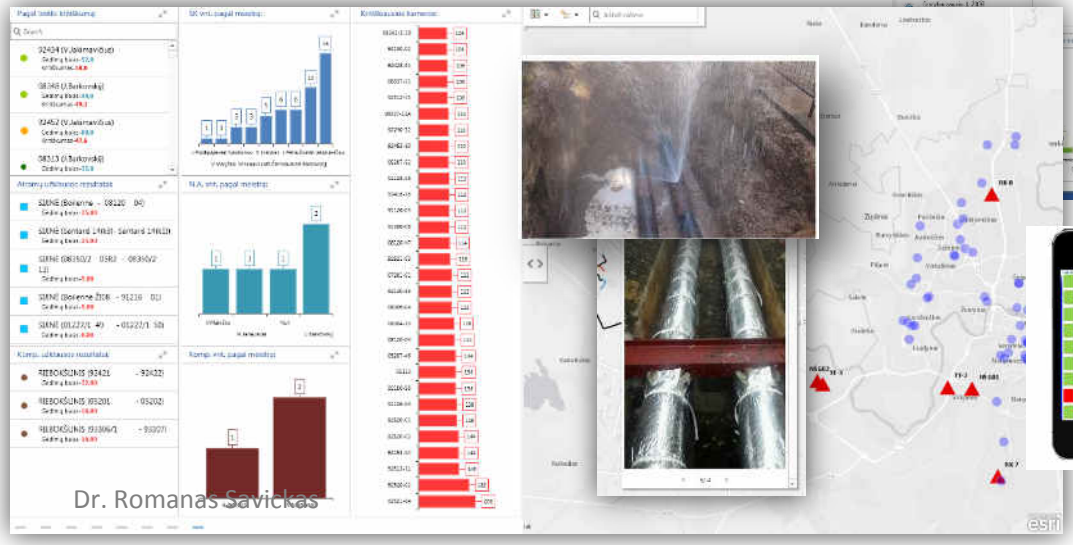
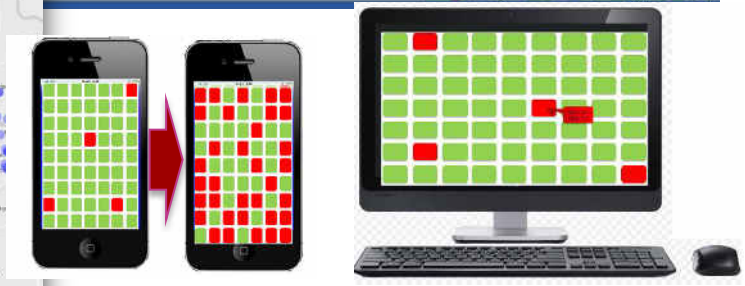
Intellectual Energy systems

- GIS – „Operations Dashboard“ sistema
- GIS – Tinklo siurblių elektros valdymo sistema







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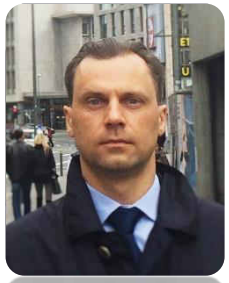
THANK YOU



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