Global District Energy in Cities Initiative

DEVELOPMENT OF DISTRICT HEATING PROJECTS IN DEVELOPING COUNTRIES
SMART THERMAL GRID
ENERGY MAPPING

DISTRICT ENERGY IN CITIES

A GLOBAL INITIATIVE TO UNLOCK THE POTENTIAL OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

UN environment

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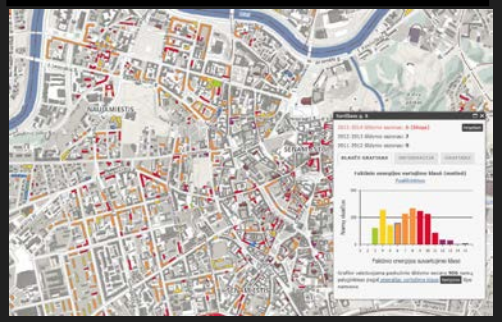
ANNEX



- Development of district heating projects in developing countries from "**Green Field**" stage;
- District Heating and **Smart Thermal Grid**;
- District Energy and City level **Energy Mapping**. Encouraging Customers and Technologies for Energy Efficiency

DEVELOPMENT OF DISTRICT HEATING PROJECTS IN DEVELOPING COUNTRIES FROM "GREEN FIELD" STAGE

- Why District Heating in **Developing Countries**?
- **Methodology and principles** for District Energy development in "Green Field" areas. **Temuco** city case;
- **Technical - Economical** results;
- **Tomorrows Temuco** has been invented today: Temuco city after District Heating implementation;

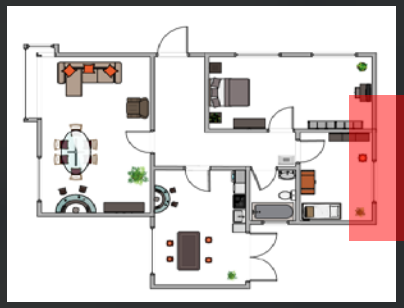
WHY DISTRICT HEATING IN DEVELOPING COUNTRIES?

- The effects of **Air pollution** on **human health** have been well researched within internationally;
- The **Great Smog of London** of 5-9th December 1952 , was a severe air-pollution event, reducing visibility and even penetrating indoor areas, caused **10'000 people die** and >100'000 were made ill;

- **Temuco** has the **third-worst** air quality in Chile. It is estimated that **93%** of the particulate matter in the winter months is caused by burning firewood in woodstoves in single homes;
- Inefficient burning of firewood produces contaminants such as **formaldehyde, methane, black carbon** which cause **effects on health**. In Temuco the current high levels of air pollution cause between **400-500 premature deaths** per year;

METHODOLOGY AND PRINCIPLES FOR DISTRICT ENERGY DEVELOPMENT IN "GREEN FIELD" AREAS

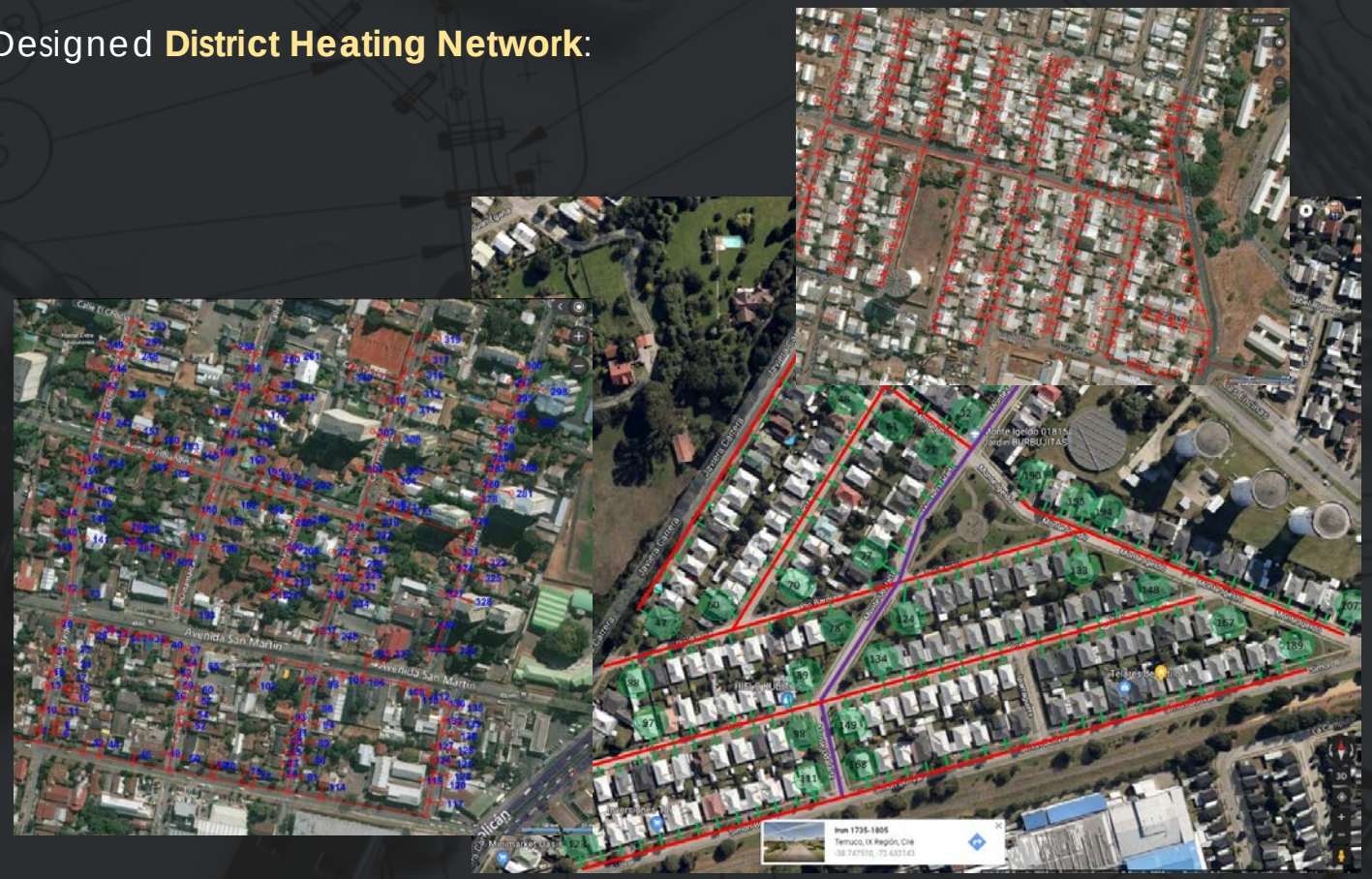
- There are no Methodologies for **District Heating** rehabilitation as there is **no District Heating before**;
- The **Bottom-Up** approach has been used:
  - Identified the **typical housing** in Temuco;
  - Calculated **energy demand** for heating and hot water;



$E_{Heating,\ Hot\ water}$

METHODOLOGY AND PRINCIPLES FOR DISTRICT ENERGY DEVELOPMENT IN "GREEN FIELD" AREAS

- Designed **District Heating Network**:



METHODOLOGY AND PRINCIPLES FOR DISTRICT ENERGY DEVELOPMENT IN "GREEN FIELD" AREAS

- Designed **Power Plants**: for the base load Biofuel and for the peak load Gas.
- Analysed optimal proportion between Biofuel-Gas power distribution;
- Identified principal areas for power generation in a city;

TECHNICAL - ECONOMICAL RESULTS

- Designed **4th Generation Low temperature District Heating**;
- Total installed capacity - 380 MW;
- Investments and operation:

No.	Name	Thousand Eur
1	Power Generation CAPEX	329' 500
2	Power Generation OPEX	14' 300
3	District Heating Network, Heat Substations CAPEX	276' 800
4	District Heating Network, Heat Substations OPEX	4' 300

- Total costs:

No.	Fuel diversification	Interest rate, %	Eur/kWh
1	Wood Pellets/Gas (67/33)	2%	0,143
2	Wood Pellets/Gas (67/33)	0,5%	0,137
3	Biomass/Gas (85/15);	2%	0,098
4	Biomass/Gas (85/15);	0,5%	0,091

TECHNICAL - ECONOMICAL RESULTS

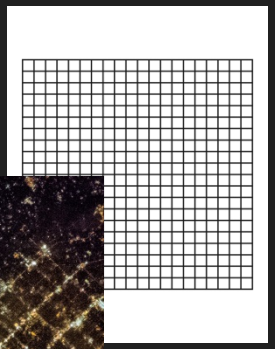
- One family building customer average annual payments before District Heating with Wood stoves and after District Heating implementation:

No.	Fuel diversification	Wood Stoves, Eur/year	District Heating, Eur/year*
1	Wood Pellets/Gas (67/33), 2%	400-1'000	1'500
2	Wood Pellets/Gas (67/33), 0,5%	400-1'000	1'400
3	Biomass/Gas (85/15), 2%	400-1'000	1'000
4	Biomass/Gas (85/15), 0,5%	400-1'000	900

- As low income small buildings (57 m^2) makes 40% of residential buildings share and high income (140 m^2) only 5%, the billing should be adjusted from average payment per building to according to metering methodology (fixed costs per 1m^2 + variable costs according to heat metering data).

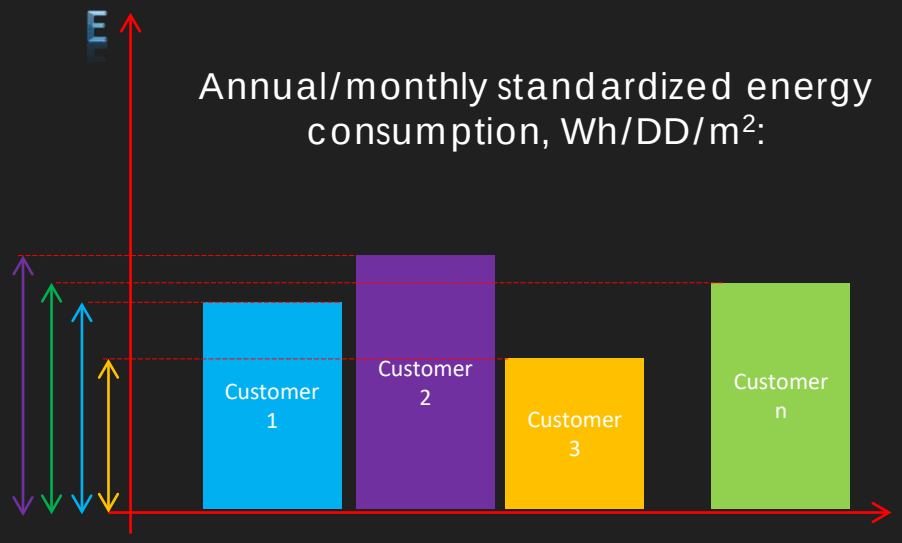
DISTRICT HEATING AND SMART THERMAL GRID

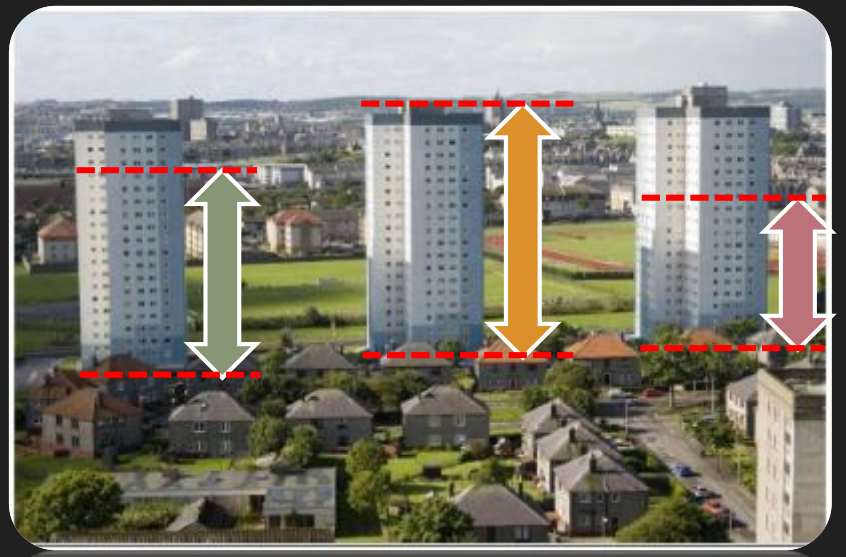
- **GRID** refers to a something resembling a framework of crisscrossed parallel bars, as in rigidity or organization (the city's streets form a grid)



SUPPLY AND **DEMAND SIDE MANAGEMENT**

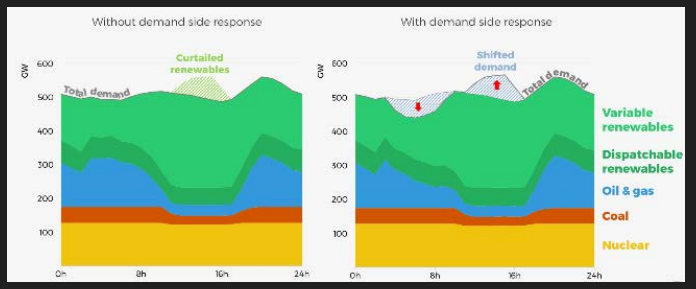
- For every consumer is defined **Standardized Energy Consumption** (eliminated influence of inside/outside temperatures, number of heating days, heating area, etc.);

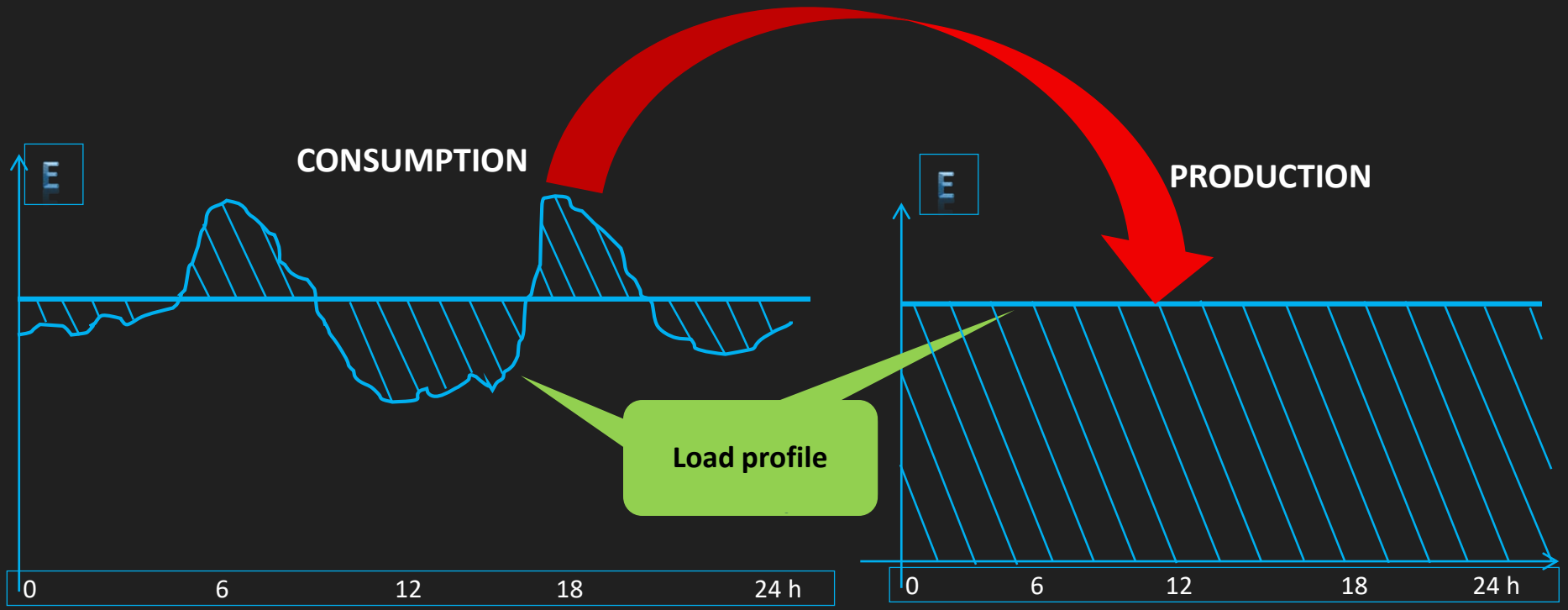




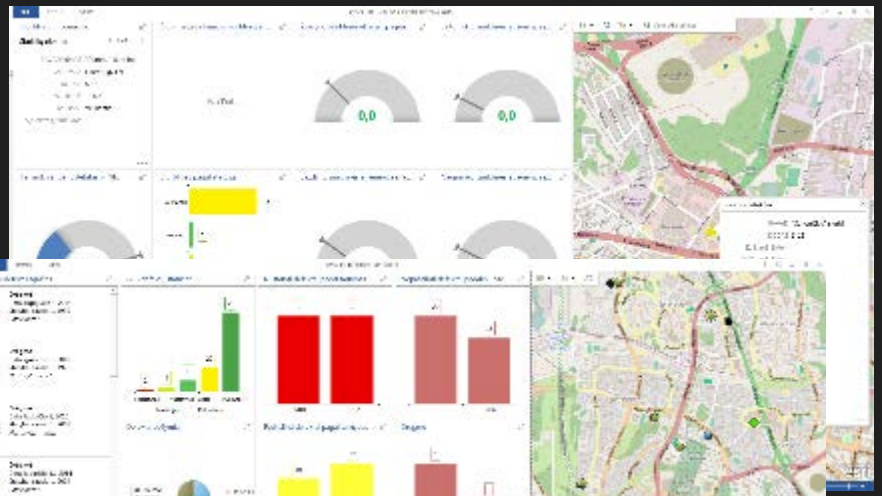
CHANGING LOAD PATTERN

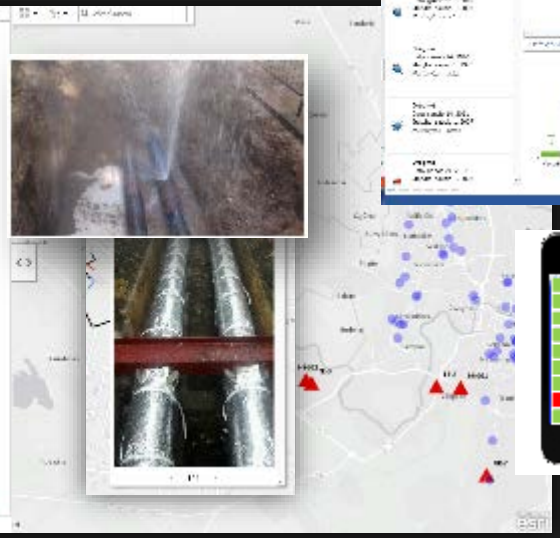
- **Load shift** to a "flat";
- Plant schedule **optimization**;
- Load **forecasting**;

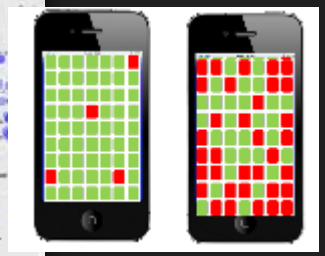




SMART MANAGEMENT SOLUTIONS







DISTRICT ENERGY AND CITY LEVEL ENERGY MAPPING. ENCOURAGING CUSTOMERS AND TECHNOLOGIES FOR ENERGY EFFICIENCY

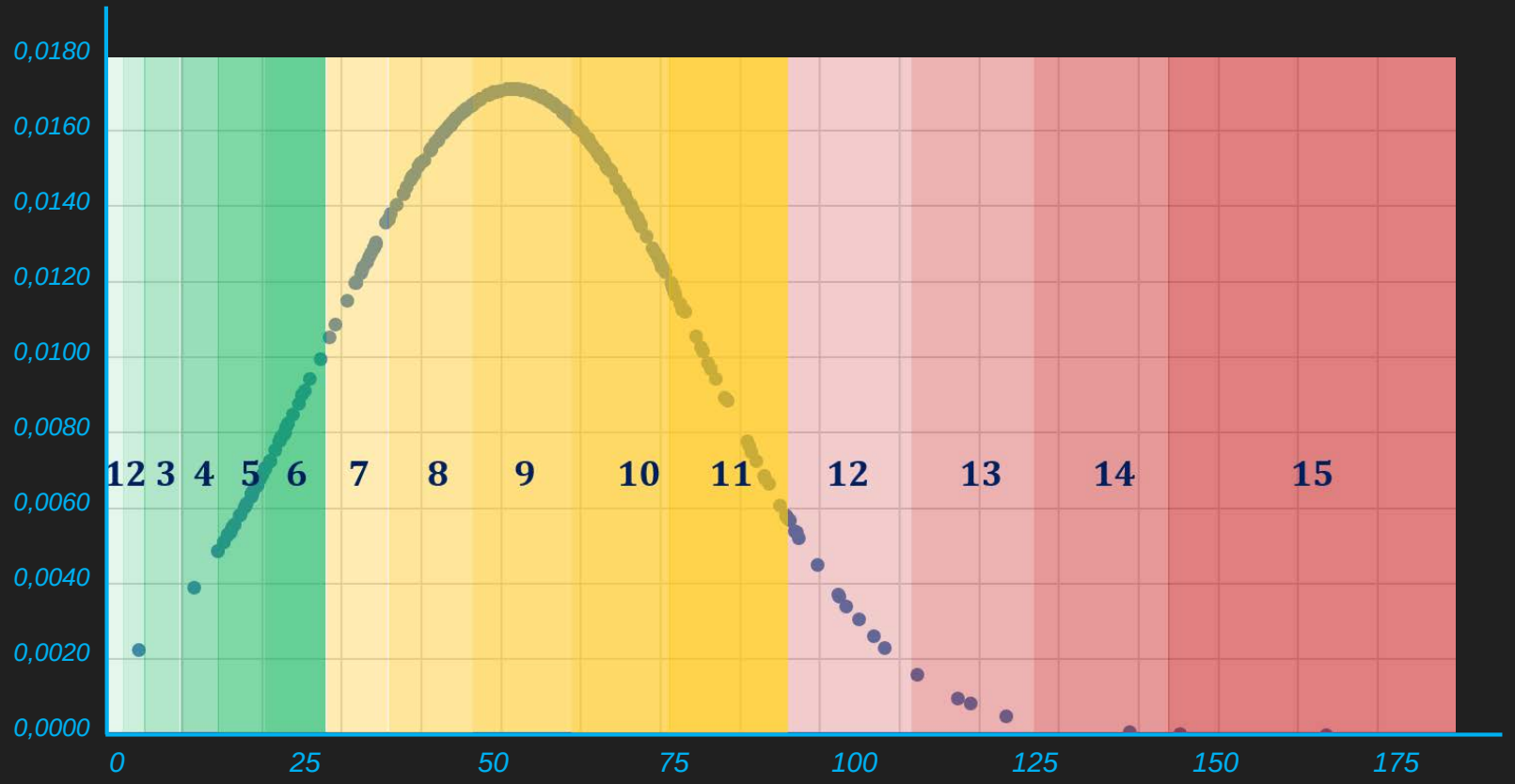
- **Vilnius City case**

VIDEO 1

- **Local Governments** often need more detailed information on the current and future geographical distribution of energy use at the neighbourhood and building levels, as well as on local heat and energy assets and distribution structures.
- This can be achieved through an **Energy Mapping** process that analyses the local conditions, such as sources of **excess heat**, **renewable** heat assets (geothermal and solar), and concentrations of **heat or cooling demand**.
- Taking into account the principles of **Energy Mapping** and some specifics of every country and city, the **Energy Mapping** methodology has been developed and adopted for Cities;
- For the evaluation of actual energy consumption performance the separate evaluation criterion showing actual consumption of a building and being comparable between others has been developed (**Energy Performance Class for District Heating Customers (EP^{Class})**);

- **Energy maps** for district energy can contain, among other variables, data on:
- **Existing and projected energy** consumption by sector, **fuel source** or neighbourhood; the resulting **emissions** and pollution and an understanding of the load profile;
- Present and future **building density** and **type** (residential, commercial, etc.);
- Sources of surplus or **industrial heat** supply;
- **Large energy consumers** and buildings with potential excess heating or cooling capacity (e.g., buildings for events such as a stadium or arena)
- Current networks and potential **network routes**;
- Potential **anchor loads** and their energy consumption;
- **Barriers and opportunities** particular to the location related to local energy sources, distribution, transport, land use, development density and character;
- **Socio-economic** indicators to identify fuel-poor areas that could benefit.

EXAMPLE OF STATISTICAL ANALYSIS AND ENERGY PERFORMANCE CLASS FOR DISTRICT HEATING CUSTOMERS



EXAMPLE OF ENERGY PERFORMANCE CLASS FOR DISTRICT HEATING CUSTOMERS

Best

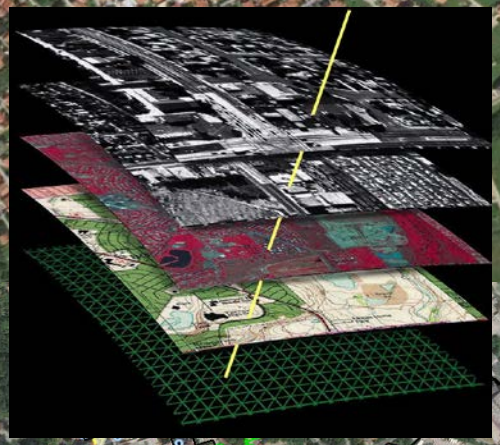
EP^{Class}	Description
0	Zero energy consumption building
1	Low energy consumption
2	Low energy consumption
3	Low energy consumption
4	Low energy consumption
5	Low energy consumption
6	Low energy consumption
7	Average energy consumption
8	Average energy consumption
9	Average energy consumption
10	Average energy consumption
11	Average energy consumption
12	High energy consumption
13	High energy consumption
14	High energy consumption
15	High energy consumption

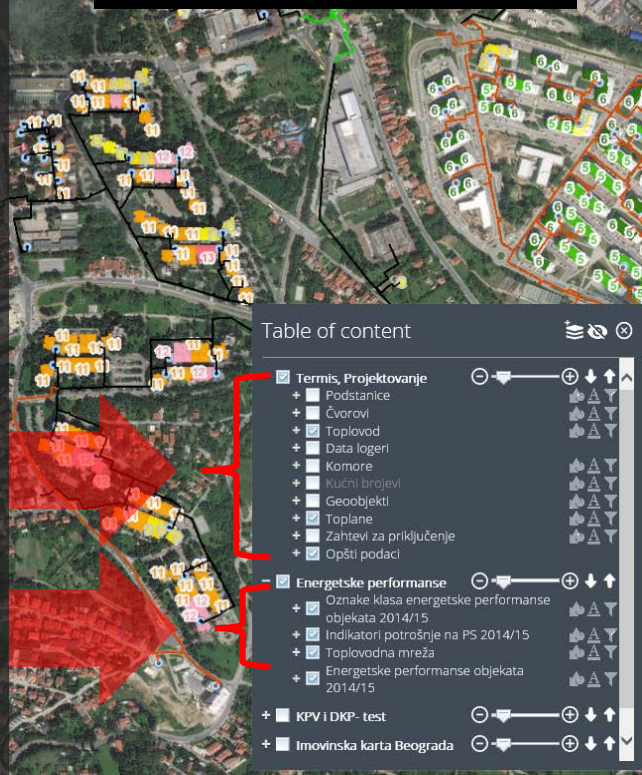
Worst

TRANSFERRING KNOWLEDGE OF APPLYING DIGITAL DATA ON A GIS PLATFORM LAYERS

Belgrade case:

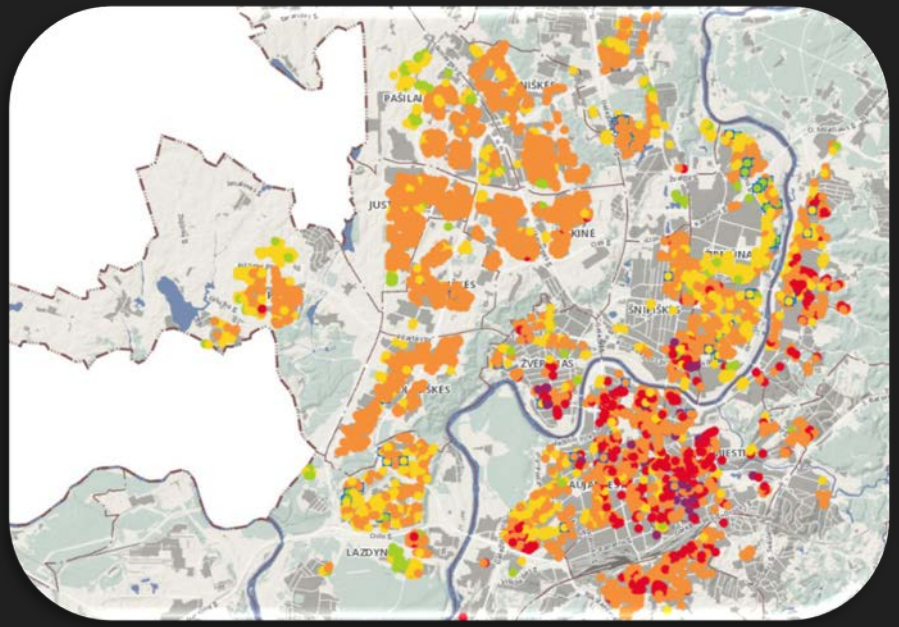
- Energy Map for **Belgrade** area has been created.
- Based on a data the **layers on a GIS platform** have been created:
  - District heating **pipe network** and related data;
  - **Energy Performance** of Final Customers (in Colours and Numbers);

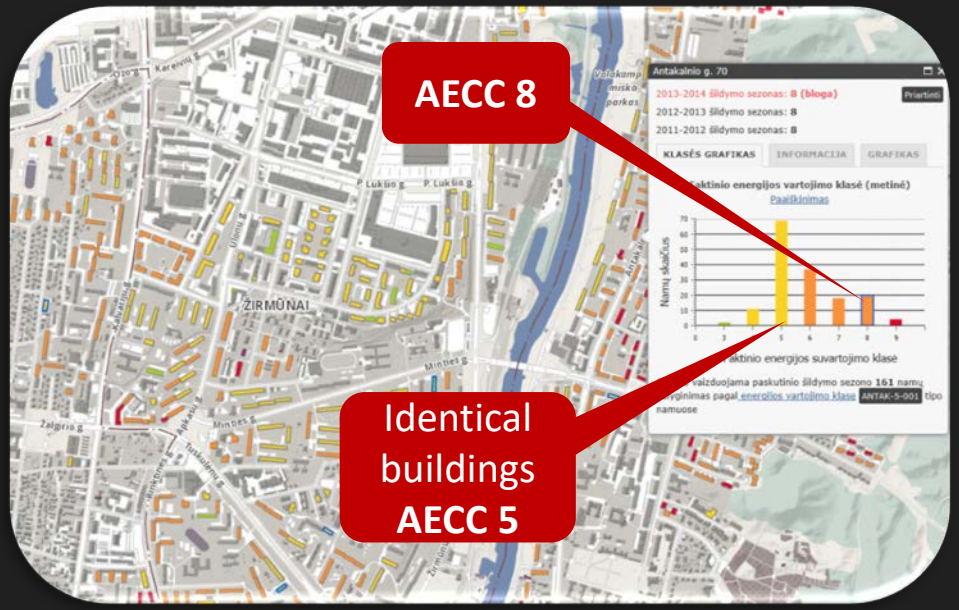




ADVANTAGES OF ENERGY MAPPING AND ENERGY PERFORMANCE CLASS

- **Analytical tools** in Energy Map **encourage customers** for Efficient Energy use.
- Showcases of **Refurbished** buildings.
- **Strategic** City Energy development **plan**.





ADVANTAGES OF ENERGY MAPPING AND ENERGY PERFORMANCE CLASS

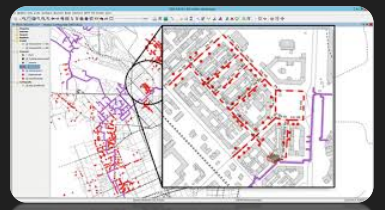
- **Energy Consumption Efficiency** of all different buildings (Final Customers) can be compared between – from smallest to the largest;

- It encourages **Customers to take an active role in Energy Management**;
- As for better Energy Management engineering systems should be upgraded, it will stipulate the **technical progress and upgrade of HVAC systems inside buildings** - from thermostatic valves, balancing valves, heat substations to the heat and hot water metering for a whole building and individual metering for every final customer (flat), switching from square meters based billing to meter based billing, also it can be useful to Manage and balance District Heating Network grid more efficiently, take a decisions on a DH Network pipes replacement.









VIDEO 2

VIDEO 3

NEXT GENERATION ENERGY MAPPING

- **Photogrammetry** can help city buildings transfer into 3D shapes

VIDEO 4

NEXT GENERATION 3D ENERGY MAPPING

- **Panevezys** city map digital transfer into 3D

VIDEO 5

THANK YOU

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