TIMEPAC Academy

Session 7

Reporting, monitoring and verification of energy savings

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Energy efficiency measures for buildings

Heating system and heat consumption:

- ✓ Change of energy source (introduction of RES)
- ✓ Replacement of old boilers/heat pumps
- ✓ Insulation of heating pipes
- ✓ Hydraulic adjustment
- ✓ Improved and continuous heating control and setting of heating parameters
- ✓ Energy monitoring and management system
- ✓ User motivation, energy book keeping, controlling
- ✓ Insulation and window replacement (combination of financial instruments and grants)

Water saving measures

Electricity and power consumption:

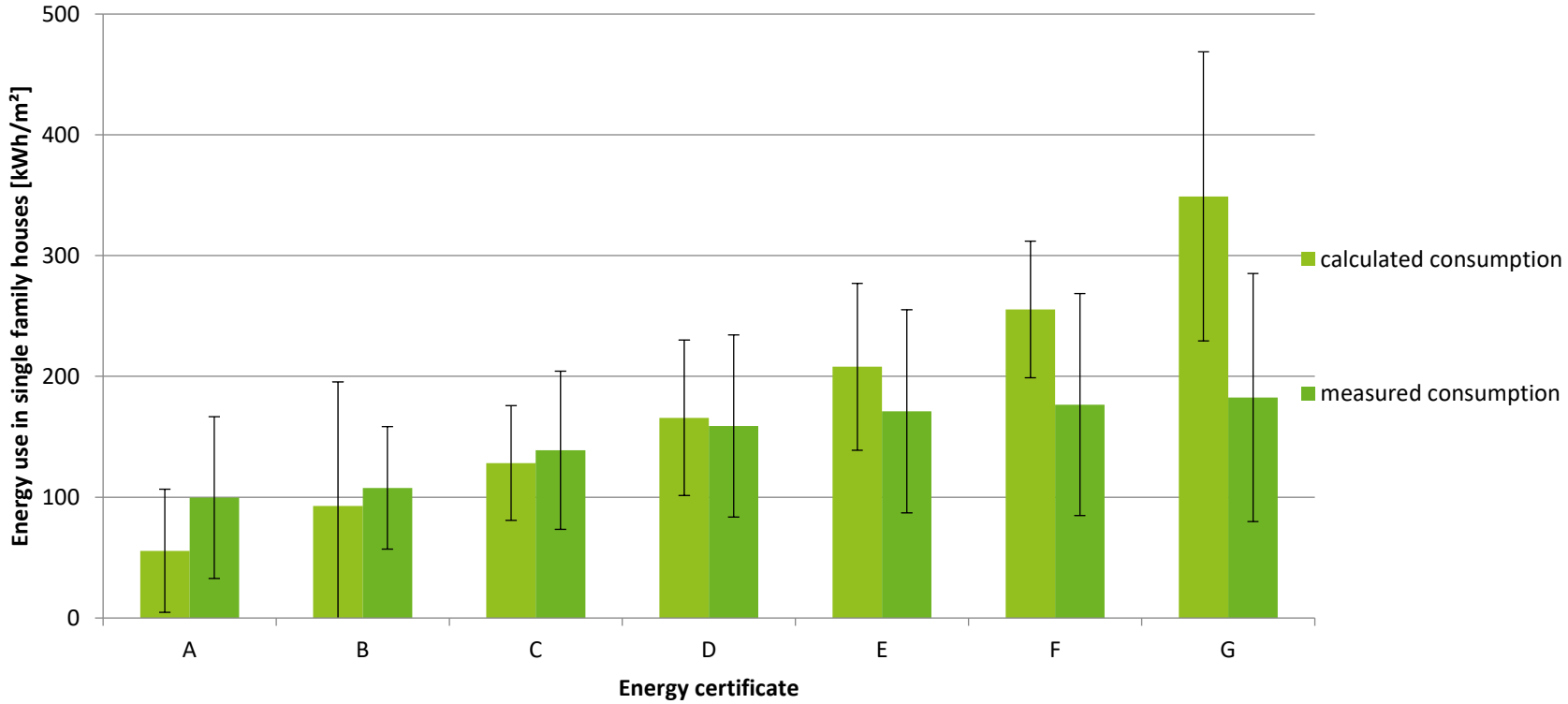
- ✓ Lamp replacement
- ✓ Lighting control
- ✓ Efficiency equipment (refrigerators, freezers,...)
- ✓ Reduce electric heating
- ✓ Energy efficient pumps

Ventilation and air conditioning:

- ✓ Heat recovery system
- ✓ Insulation of air ducts
- ✓ Improved control systems, continuous adjustment of control parameters
- ✓ Re-commissioning, maintenance, introduction of energy bookkeeping

Problem of performance gap

- Calculated and measured energy use in 135.311 houses in Denmark[1]



[1]Data from: SBI 2016:09, Forskellen mellem målt og beregnet energiforbrug til opvarmning af parcelhuse

Definition and purposes of Measurement and Verification Protocol

- **Measurement and Verification (M&V)** is the process of planning, measuring collecting and analysing data to verify and report energy savings within a facility or facilities resulting from the implementation of energy efficiency measures

- **Why do we need M&V protocol?** Savings cannot be directly measured since they represent the absence of energy consumption and/or demand

- **Can the existing EPC be used for verification of energy savings?** No, existing EPC is a static document and can‘t be used for verification of energy savings

Overview of the M&V design and reporting process

Step 1: Determine Goals for M&V Efforts	*Baseline Period*
Step 2: Select IPMVP Option(s) and Approaches	
Step 3: Document Baseline Data	
Step 4: Develop M&V Plan	
Step 5: Set-up Metering and Ongoing Data Collection Processes	
Step 6: Monitor for Changes in Site Conditions	*Installation Period*
Step 7: Confirm Operational Verification	
Step 8: Ongoing Data Collection	*Reporting Period*
Step 9: Determine Savings for Period	
Step 10: M&V Report for Period	
Step 11: Track Energy Performance and Savings	

[1]Efficiency Valuation Organisation. (2022). EVO 10000 - 1: International Performance Measurement and Verification Protocol (IPMVP) – Core Concepts.

Baseline period – the trickiest part of the M&V

- Every **improvement process starts** from a **known performance level** against which a clear target and time frame for improvement is given
- Available **data must be processed to represent a baseline data set** that determines past energy performance (usually over the last year or two) against which future improvements will be assessed – **tricky part of energy performance certification, auditing and M&V**
- **Baseline period is often a year** but can be any period depending on specific M&V needs - **the baseline period should be without interruptions or unusual operating conditions**
- **Collect relevant energy and context data** (operational non-energy data) from the baseline period – this data is the basis for the definition of initial/reference set of KPIs
- **Starting point for the dynamic EPC!**

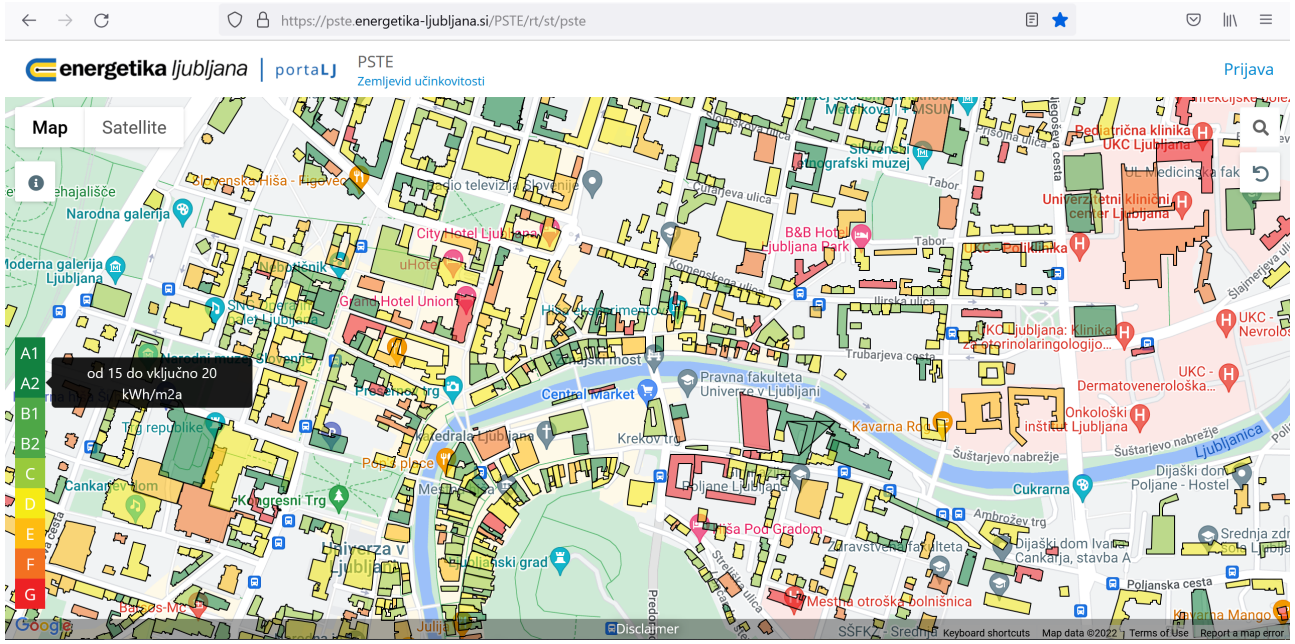
Problem of metered energy consumption and EPBD

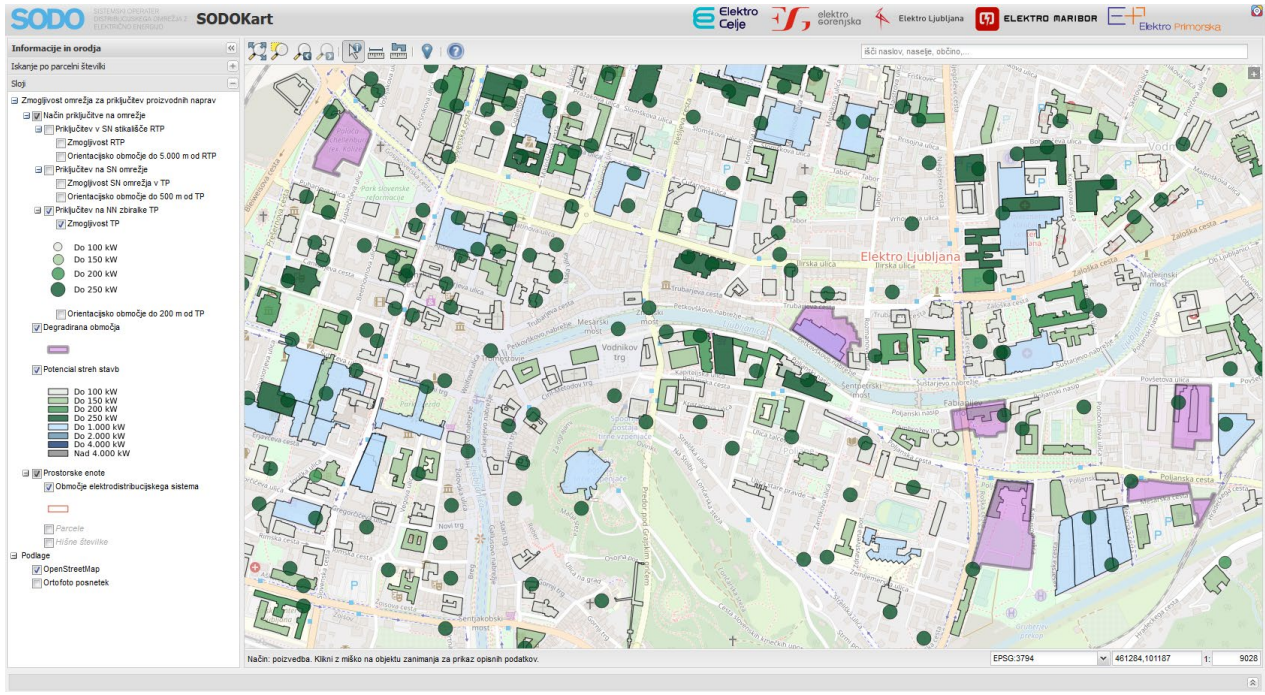
- Article 19 - The database shall allow data to be gathered from all relevant sources related to energy performance certificates, inspections, the building renovation passport, the smart readiness indicator and the calculated or **metered energy consumption** of the buildings covered.

- Annex I - Member States **may use metered energy consumption under typical operating conditions** to verify the correctness of the calculated energy use and enable comparison between calculated and actual performance. **Metered energy consumption** for the purposes of verification and comparison may be based on monthly readings.

- Availability of data, smart meters, privacy…

Metered energy consumption – Interesting insights from Slovenia





Various options of measurement and verification (1/3)

- There are four different options of measurements and verification:
  - **Option A** – Retrofit Isolation: **Key parameter(s) measurements**
  - **Option B** – Retrofit Isolation: **All parameters measurement**
  - Option C – Whole Facility
  - **Option D – Calibrated Simulation (entry point for dynamic EPC)**

IPMVP Option	Definition	How Savings are Calculated	Typical Applications
D. Calibrated Simulation	Savings are determined through simulation of the energy consumption and demand of the whole facility, or of a sub-system in the facility and comparing results with actual energy consumption and demand. Simulation models are demonstrated to adequately model actual energy performance in the facility. This option requires considerable skill in calibrated simulation and experience with the equipment and processes being modeled.	Actual energy consumption and demand and results from simulation model(s). Energy consumption and demand from the simulation, calibrated with hourly, daily or monthly energy data. Energy sub-metering and metered performance data including processes may be used in further model calibration. Non-routine adjustments as required.	Multifaceted energy management programs affecting many systems in a facility but where no meter existed in the baseline period. Energy consumption and demand measurement, after installation of natural gas, electric or other energy meters, is used to calibrate a simulation model.

Dynamic EPC – Verifying performance improvements – New dynamic and context-sensitive indicator – Energy Performance Coefficient

- **Energy Performance Coefficient (EnPC)** which is the ratio of actual (E_{act}) to predicted (E_{pred}) energy consumption (EPC based energy consumption)
- EnPC = E_{act} / E_{pred}
- The purpose of the EnPC is to **identify changes in energy consumption**, and to present that information to the building energy manager in a simple and straightforward way
- **Can be basis for verification of energy savings**

Conclusion

- **Dynamic EPC** has a potential to serve as a tool for verification of energy savings
- Actual energy consumption must be included – **transparent definition of the baseline (reference) consumption (properly calibrated EPC)**
- **Combining activities** – energy performance certification, auditing, inspection, modelling, energy management…
- Presentation of the benefits and limitations of the selected approach as **compared with possible alternatives**

Implementation of advanced projects!

TIMEPAC The new EPC for Europe

If you would like more information, please visit www.timepac.eu or contact us at

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