The use of measurement for public lighting in Croatia

Policy background

The programme for renovation of public lighting has been an **alternative policy measure** in both periods 2014-2020 and 2021-2030 as per NEEAPs and NECP, respectively in Croatia. Public lighting accounts for about 3% of the total electricity consumption in Croatia (including at peak time). The programme represents a combination of **financial support** (grants in period 2014-2016 from the Environmental Protection and Energy Efficiency Fund – EPEEF, soft loans from European Structural and Investment – ESI funds in period 2017-2020) and stimulation of **ESCO market** through promotion and regulation (Regulation on contracting energy services in the public sector, Official Gazette nr. 11/15). The result is a significant number of public lighting renovation projects implemented by local authorities, either with financial support, or through the ESCO model.

According to Croatian legislation, all energy efficiency projects that are implemented with financial support from the State need to be recorded in the **System for measurement and verification of energy savings (SMiV)**. The data on implemented projects are entered into SMiV dominantly by the subsidy providers (e.g. EPEEF). At the same time, the Ordinance on energy management system in the public sector (Official Gazette nr. 18/15, 06/16) establishes the **Energy Management Information System (EMIS)**, led by Croatian Real-estate Agency, that is used for monitoring of energy consumption in the public sector. EMIS gathers, *inter alia*, data on electricity consumption for public lighting directly from the electricity distribution system operator.

This way, measured data on electricity consumption before and after the energy efficiency project implementation are available from EMIS, and savings based on metered data may be compared with calculated savings using Bottom-Up (BU) engineering methods prescribed in the Ordinance on monitoring, measurement and verification of energy savings (Official Gazette nr. 98/21, 30/22).

Technical aspects

Annex II of the Ordinance on energy management system in the public sector (Official Gazette nr. 18/15, 06/16) prescribes the procedure for taking over remote meters' data into EMIS system as well as data from energy bills. **Metering devices used for billing** are relevant for public lighting. There were 22,282 metering points in EMIS for

public lighting (as of May 2021). Data on electricity consumption are available from 2017 – see figure below.

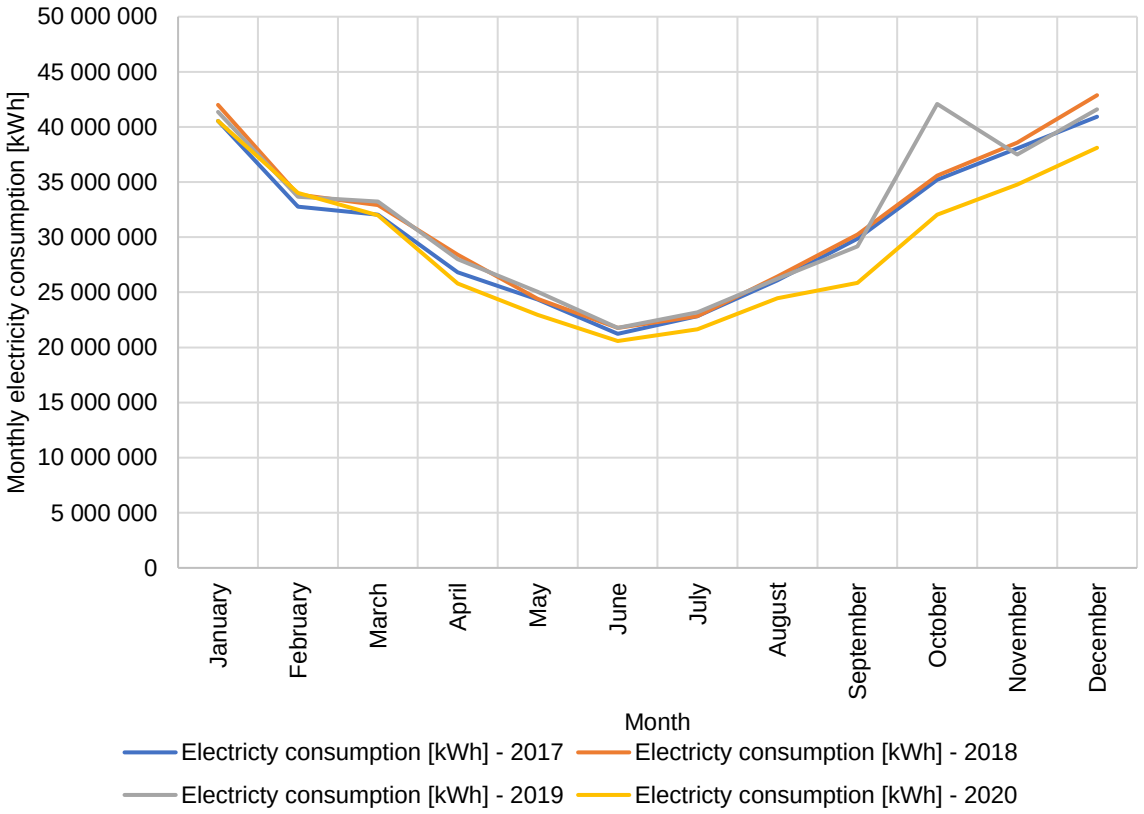

Figure 1 – Monthly electricity consumption for public lighting in Croatia from 2017 to 2020

The following approach is used to **calculate energy savings from metered data**:

- Comparison of metered data has been done for each metering point,
- Differences are calculated for each month (comparison of metered data for e.g. January of one year, with January of next year),
- Electricity consumption reduction is determined on a yearly basis by comparing one year with the previous one (e.g. 2018 in comparison with 2017, 2019 in comparison with 2018, etc),
- Analysis is performed only for those metering points where all data sets are available,
- The threshold for electricity consumption reduction that may be considered a result of energy efficiency improvement is 8%[1] - if lower, that is not taken into account, as reduction may be attributed to burn out or other failures of lamps, which is not considered energy efficiency,
- An increase of electricity consumption is attributed to the spread of the public lighting network and an increase in the number of lamps in the system,

[1] This limit has been set based on the engineering experience and analysis of specific cases.

- Due to the additional elimination of possible errors during measurement, savings are calculated if there are positive deviations for the specified month and the two following months. This eliminates the phenomenon where part of the consumption is registered in the following month due to a different time calculation (the reading is not made at the end of the month but in the middle, which means that the consumption is lower than expected).

Experiences

The calculation of energy savings has been done for all metering points in EMIS and results are presented for each city/municipality. The annual savings are shown in the table below:

Month	Energy saving **[kWh] - 2018**	Energy saving **[kWh] - 2019**	Energy saving **[kWh] - 2020**
January	1.540.263	2.221.487	2.868.614
February	1.225.897	1.810.492	2.322.563
March	1.266.668	1.839.600	2.538.948
April	989.671	2.284.448	2.402.776
May	916.101	1.362.361	1.998.527
June	817.070	1.273.192	1.627.541
July	978.588	1.430.231	1.812.163
August	1.211.024	1.627.483	1.972.356
September	1.381.213	1.851.625	2.443.931
October	1.573.407	2.321.195	3.278.632
November	1.629.598	2.599.618	2.671.996
December	1.987.809	2.903.954	3.204.267
Total	**15.517.309**	**23.525.686**	**29.142.314**

EMIS and gathered metered data enabled the evaluation of effects of energy efficiency projects in public lighting systems that were not recorded via SMIV.

It also enabled a comparison of savings calculated by using bottom-up methods and based on metered data from EMIS. This comparison was made for 35 projects from SMIV, for which metered data were also available in EMIS. To make this kind of analysis, the data on annual savings from SMiV needed to be 'distributed' per month depending on when the project was finalised (i.e. in SMIV full amount of energy savings is attributed to a year, even if the project was finalised e.g. at the end of October, and savings started to be generated in November).The analysis showed that SMIV savings (bottom-up method) are in general higher than savings determined based on metered data from EMIS – the average difference is approx. 20%.

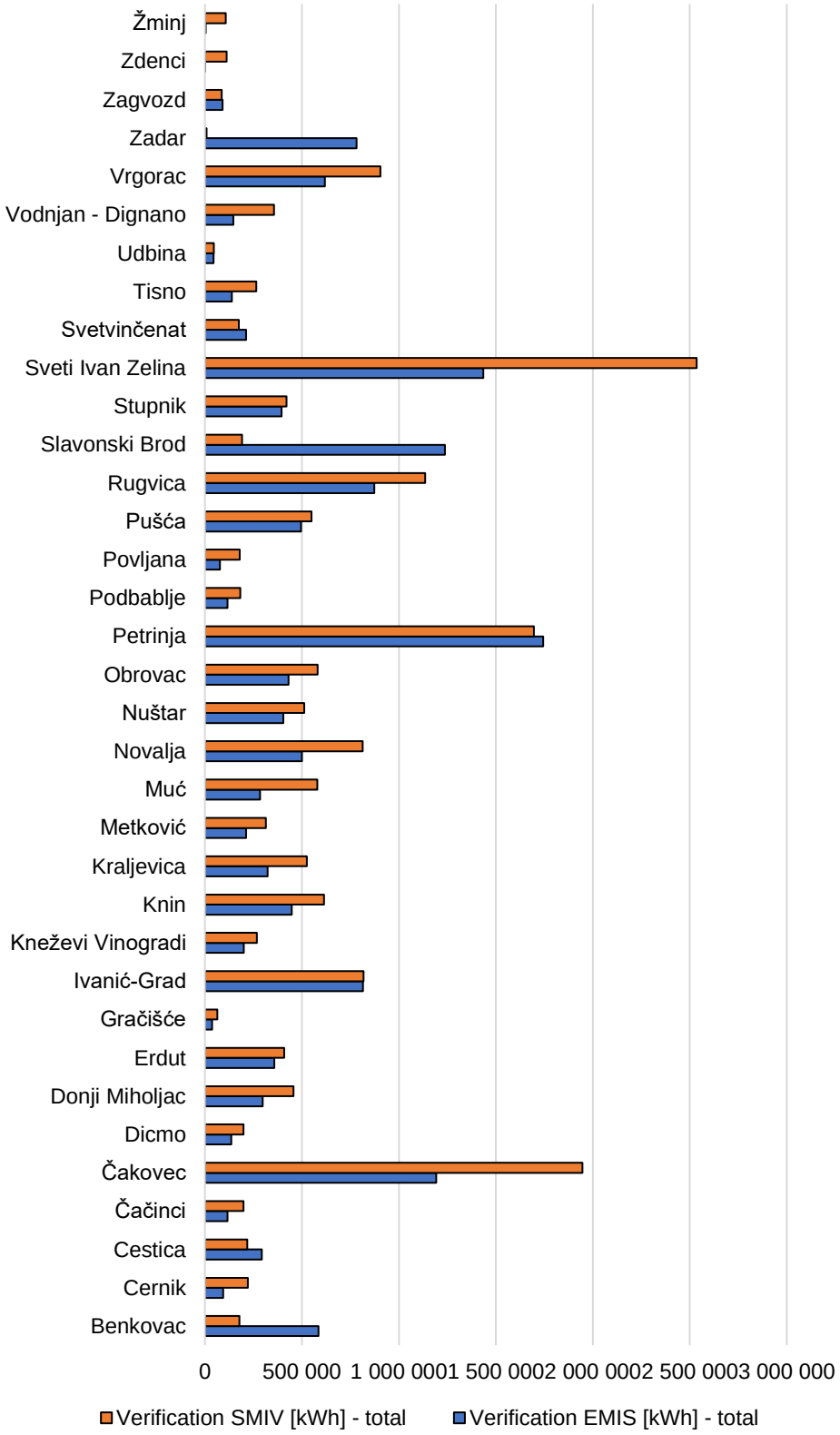

Figure 2 – Comparison of savings from SMIV and EMIS (ISGE)

This exercise was relatively easy, as metered data are taken from existing meters used for billing electricity consumption for public lighting and there is a mandate to gather these data prescribed in legislation.

Energy savings from public lighting projects may be relatively easy to determine from metered data, compared to other cases where the energy consumption can be influenced by more factors (e.g. buildings, complex industrial processes). The approach implemented was based on monthly data and comparison of two same months in two consecutive years.

Further readings

- National Energy and Climate Plan for period 2021-30, available in English here: https://mingor.gov.hr/UserDocsImages/UPRAVA%20ZA%20ENERGETIKU/Strategije,%20planovi%20i%20programi/NECP_Croatia_eng.pdf; measure ENU-8)
- National Energy Efficiency Action Plan for period 2022-24, available in Croatian here: https://mingor.gov.hr/UserDocsImages/UPRAVA%20ZA%20ENERGETIKU/NAPEnU_2022.-2024..pdf, page 14-15 about achieved energy savings in public lighting; measure ENU-8)

Stakeholder interview

Interview with **Ms. Iva Fakin**, assistant director at Croatia government real estate agency, Sustainable energy management and EMIS department

- **How much resources are needed on the side of the public authority to assess the energy savings from metered data?**

To assess the energy saving from metering data via EMIS is fairly straightforward, but the interpretation of the results needs to be handled by experienced person, the one who is familiar with the data and area of expertise. The issue is correct interpretation of metered data. Simple "after minus before" does not take into consideration all influencing factors, and here is where expertise is needed.

- **According to you, what would be the main added value of the use of metered data?**

Main added value of the use of metered data is the insight into deviation from expected consumption (as provided in the energy audit report or project design documentation). Metered data, i.e. data on actual energy consumption, are the key in revealing whether there are deviations, and the basis for further investigations on what caused them. The reasons may be, for example, bad construction work, user

behaviour, building energy management, etc. For that purpose, data and information on influencing factors on energy consumption should be also collected. Another use of metered data is to mitigate errors in calculated (deemed) savings, i.e. to refine existing bottom-up methods.

- **Are the analyses made from the metered data used only to assess energy savings? Or are they used also in an approach of energy management (e.g., to detect unusual deviations in electricity consumption)?**

They are used both to asses energy saving and detect deviations and suspicious consumption (for example water leakage). EMIS has built in alarm module to notify this event.

- **Do you think that a similar approach could be used for other types of energy efficiency programmes (e.g. building renovations, behavioural measures)?**

Metering of energy and water consumption through EMIS is mandatory for all public sector buildings (including public lighting). Currently we are in project to determinate (irresponsible) behavioural impact on consumption of energy and water. Also, we are detecting other causes that negatively impact consumption after renovation: inadequate construction work, poor material quality, bad energy management…

- **Do you think that the use of metered data can help to secure investments in energy efficiency projects?**

It can, but more factors need to be met and taken into consideration. Beside mentioned user behaviour and building energy management, it is needed to measure indoor air quality and it is very important to determinate good baseline consumption before renovation. Metered data help to refine analyses, provide better estimations of savings, hence increase the trust in energy efficiency projects.