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| **Broadband Competence Office, Česká republika** |
| Analysis of some value-added services from the point of view of municipal management |
| **Energy** |

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# 1. Introduction

## 1.1 The importance of energy management for the municipality

Proper management of municipal energy is a key factor in terms of financial stability, operational efficiency and environmental responsibility. Electricity consumption forms a significant part of the operating costs of municipalities, especially in the areas of power supply of public lighting and operation of municipal buildings. Smart power and production management is a way to:

* systematically reduce costs (especially through more efficient consumption and energy savings),
* actively contribute to climate and emissions targets
* To increase comfort, safety and public control over energy management.

The two basic areas that have the greatest potential for savings and development for municipalities today are **Smart Grid** (smart energy management) and **Smart Lighting** (smart public lighting).

## 1.2 The role of digitalisation and high-speed networks (VHCN)

The development of digital technologies and especially the construction of modern digital infrastructure (optical networks, high-speed wireless technologies such as LoRaWAN, NB-IoT or 5G) is a prerequisite for the successful implementation of smart solutions in the energy sector and public lighting.

**Key benefits of digitization and VHCN in this context:**

* Possibility of remote and automated measurement of energy consumption and production.
* Online point-by-point lighting control, dynamic control according to movement and needs.
* Collect, transmit and evaluate data in real time for quick reactions and predictions.
* Access to open data, greater transparency, more efficient planning of renewals and investments.

**Practical example:**

In this analysis, we will work a lot with an example, which is the City of **Písek.**It has been using its own LoRaWAN network for data transmission from lighting sensors and for smart grid pilot projects for a long time, thus ensuring high reliability and efficiency of operation. In order to take full advantage of more advanced functions, it will also be essential for cities in the future to connect to optical networks and possible integration of 5G where high data throughput is needed.

## Aim of the analysis

The aim of this analysis is **to provide municipalities with clear, objective and practical information on the possibilities of using smart technologies in the field of energy management and public lighting** — i.e. in particular:

* **To identify the current possibilities** of using the **Smart Grid** and **Smart Lighting concepts**  in Czech municipalities.
* **To show the benefits of modernization** using digitization and high-speed communication networks (VHCN).
* **To practically describe** what technological elements can be introduced directly in the conditions of the municipality, and where the greatest benefits and barriers are today.
* **To add specific examples** of implementation in the Czech Republic (especially Písek) and abroad – indicating what is already common practice in Písek and what is still planned or implemented elsewhere.
* **To contribute to better decisions** by municipalities of all sizes, with regard to financial efficiency, legislative framework and technical preparedness.

This thesis is designed for the practical needs of Czech municipalities, allows comparison and inspiration and at the same time offers recommendations with respect to the specific size, needs and budget possibilities of each self-government.

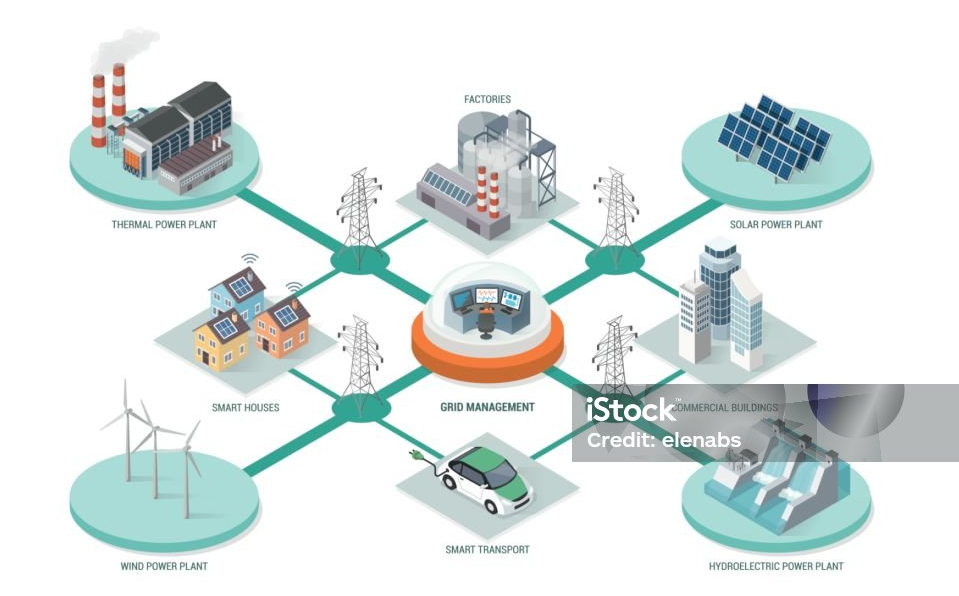
# 2. Initial situation in Czech municipalities

## 2.1 Current practices in energy management

Most Czech municipalities still rely on traditional management models in the energy sector – regular manual consumption readings, routine inspections of lighting or boiler rooms and classic energy purchases. The basic goal is to **reduce energy costs**, often only by random savings (replacing light bulbs with LEDs, insulation). Centrally coordinated or data-driven **energy management** is still the domain of larger cities and advanced municipalities.

**Typical current approaches:**

* Manual readings of electricity and gas meters.
* Manual monitoring and evaluation of consumption in city buildings.
* Renewal of public lighting only on the basis of failures, without prediction.
* Energy purchase according to public contracts, usually once a year.
* Public lighting typically operates inthe mode of "all on/off" according to time, without dynamic control.



**Where is the change:**

There are exceptions — many cities are already testing or implementing **Smart Energy elements**:

* **Automated data collection** (meters with remote reading, central power management systems)
* **Intelligent control of public lighting** (remote control, intensity regulation according to movement or traffic, fault monitoring)

**Example Písek:**

Písek is a leader in the Czech Republic in the automation of data collection from public lighting (LoRaWAN system) and electronic control of light points.

**On the other hand, advanced elements such as local electricity storage, RES production management with the support of data infrastructure or V2G (vehicle-to-grid) have not yet been implemented here.** These elements are more likely to be found in larger cities or abroad (for example, Brno is piloting smart storage, Amsterdam is developing V2G implementations).

## 2.2 Expansion of VHCN in municipalities

The deployment of high-speed networks (VHCN) is very uneven in the Czech Republic.

**Large cities (Prague, Brno, Ostrava)** have almost complete coverage of optical networks and are ready for the development of smart technologies. **Smaller cities and rural communities** often have to rely on wireless networks or combined solutions, which limits the range of smart solution deployments.

**Current situation:**

* On average, the availability of VHCN in the Czech Republic is at the level of about 50% of municipalities, with significantly higher coverage in cities with more than 10,000 inhabitants.
* A common "bridging" solution is the deployment  **of LoRaWAN**, NB-IoT and other low-power wireless networks that enable basic smart monitoring.
* The development of fast optical infrastructure is taking place in waves, supported by European and state subsidies (Next Generation EU programmes, National Recovery Plan).

**Example Písek:**

The city has built its own backbone optical network and hybrid LoRaWAN infrastructure, enabling the widespread deployment of sensors in real-time mode even without large investments in cabling.

## 2.3 Barriers and limitations to development

The main obstacles to the development of Smart Grid and Smart Lighting in Czech municipalities are as follows:

* **Financial demands of initial investments** – the return on investment is often longer, a small municipality has a limited budget and less motivation.
* **Lack of technical expertise** – there is a lack of experts to manage smart networks, even during normal operation.
* **Outdated infrastructure** – the absence of fibre-optic networks or the possibility of connecting to RES makes advanced solutions more expensive or impossible.
* **Legislative restrictions and complex procurement procedures** – especially when selecting suppliers or managing sensitive data.
* **Fear of technological dependence on one supplier** – a "closed" system can later hinder development or increase prices.

**Note on the example:**

Písek has overcome some obstacles (such as high initial investments or maintenance of its own LoRaWAN) thanks to active involvement in pilot programs, the use of subsidies and cooperation with universities. It is more difficult to deploy solutions where they need cooperation with other entities – for example, renewable energy with overflows to the grid, large-capacity battery storage, etc.

**Example from abroad:**

In Western Europe, long-term public-private partnerships, open standards and combinations of multiple networks (fibre, IoT, 5G) often address the barriers.

Amsterdam, for example , uses a strong open data infrastructure, while in Germany, cities such as **Wetzlar** are deploying open communication standards for shared management.

# 3. Possibilities and benefits of smart energy management

## 3.1 Overview of digital solutions for the municipality

In the field of municipal energy and public lighting, there is a wide range of digital and automated solutions.

**Main types of technologies and measures:**

* **Smart Grid Systems:** Smart metering, consumption management, production monitoring from RES, predictive maintenance and automated network management.
* **Energy control room for the municipality:** Centralized monitoring and optimization of consumption and production in real time.
* **Smart Public Lighting online.**
  + Remote control of light points, intensity control as needed, fault and consumption monitoring.
  + Sensors for detecting movement, pollution, meteorological conditions, etc.
  + Integration with other smart elements (camera systems, air quality measurement).

Building image content, sky, skyscraper, bold blue

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**Example Písek:**

* **Yes:** Smart public lighting, LoRaWAN network, data collection from light points, possibility of dynamic intensity control.
* **No:** A full-fledged Smart Grid with V2G, accumulation and predictive optimization – these elements have not yet been implemented in Písek (but we can find them, for example, in Brno, Amsterdam, Vienna).

## 3.2 Link to VHCN infrastructure

Smart solutions in the energy sector and public lighting are directly dependent on high-quality and reliable digital infrastructure – especially **VHCN** (optical networks, high-quality wireless) or IoT networks (LoRaWAN, NB-IoT):

* **Fast and reliable communication** allows you to collect large amounts of data in real time (e.g. network status, faults, current energy consumption/production).
* **Interchangeability and expandability** of individual systems as needed (connection to the energy control room, integration of RES, etc.).
* **Security and data management** – higher standards of fiber optic networks and secure IoT make it possible to protect sensitive information.

**Example Písek:**

The city uses LoRaWAN and a fiber optic network to transmit data from light points, allowing for detailed monitoring and dynamic control.

**Elsewhere:** Cities with a developed optical network (Prague, Brno) or experimenting with 5G (Pilsen, Ostrava) can also connect more demanding Smart Grid applications (including real-time storage control and prediction).

## 3.3 Main benefits for the municipal budget

The implementation of digital solutions brings specific financial benefits to municipalities:

* **Reduce electricity costs:**
  + Savings due to consumption optimization (dynamic lighting, efficient heating, etc.),
  + Better negotiating position when purchasing electricity (monitoring of actual consumption, prediction of peaks).
* **Lower maintenance costs:**
  + Monitoring and predictive fault reporting minimizes call-outs and accidents.
  + Effective planning of lighting or infrastructure renewal.
* **Better investment allocation:**
  + Accurate data makes it easier to make decisions about priorities.

**Example Písek:**

Savings from smart public lighting are in **the order of tens of percent** compared to the original values - thanks to LED technology and detailed control.

**Elsewhere:** Cities with a fully integrated Smart Grid (e.g. Eindhoven, Amsterdam) can reduce their consumption by up to **40% per year for lighting** and another 10-15% in buildings.

## 3.4 Direct and indirect energy savings

* **Direct savings:** More efficient power management (less losses, regulation at peak times), use of LEDs in lighting, shorter lighting time.
* **Indirect savings:**
  + Better maintenance planning, extending equipment life,
  + Reduction of energy losses in the network,
  + Better awareness of the population and active involvement (measurement and management of consumption).

**Example Písek:**

By introducing LEDs and smart control, the city has reduced annual electricity consumption for lighting by about **35%** (according to official presentations).

**Elsewhere:**   
In cities with advanced Smart Grid management, predictive management of savings of up to **15-20%** on utilities through operational optimization.

## 3.5 Environmental and operational benefits

* **Reduction of CO₂ emissions:**
  + Less energy consumed means a direct impact on the municipality's carbon footprint.
* **A better public environment:**
  + Real-time lighting that reacts to traffic improves safety and comfort (e.g. darkening at night, increasing intensity when moving).
* **Better quality of service:**
  + Faster response to faults (automatic notifications),
  + Ability to evaluate data for planning other city services.

**Example Písek:**

The savings have resulted in a reduction in CO₂ emissions by several tens of tons per year, better service and flexibility in maintenance, which also increases the satisfaction of the residents.

**Elsewhere:**   
In Amsterdam, for example, the combination of Smart Lighting and Smart Grid has resulted in savings  **in street safety** and less light pollution.

# 4. Risks and potential disadvantages of implementation

## 4.1 Investment intensity

The introduction of smart technologies means an initial investment for the municipality, which is usually several times higher than a conventional reconstruction of lighting or basic digitization of operations.

A large part of the costs is associated with the management ofthe new infrastructure (sensors, control units, quality connections, software) and possibly the modification of the network to the Smart Grid standard.

**Risks and disadvantages:**

* Investment intensity is felt to be higher, especially in smaller municipalities; The payback period usually takes 5-10 years, depending on the extent of the modernization.
* Financing often depends on the existence of subsidy titles; Without them, the project is difficult to achieve for many municipalities.
* The total costs are influenced by the type of technology (open vs. proprietary system), the maturity of the existing infrastructure and the bargaining power of the municipality.

Content Image Street Lights, Outdoors, Night, Street

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**Practical example:**

**Písek** reduced its own costs by using European subsidies and cooperation with technology partners (universities, pilot grants).

Some smaller municipalities have not started similar development precisely because of the impossibility of securing pre-financing. Abroad, the PPP model is often used (e.g. in cities in Austria or Germany).

## 4.2 Operational and technological risks

**Main operational threats:**

* **Complexity of systems:** Requires technically trained personnel; operation and maintenance is more complex than traditional systems.
* **Disruptions and dependence on digital infrastructure:** A failure of a connection or key software can limit the function of a larger part of the network.
* **Cyber security:** The risk of network attacks or unwanted traffic manipulation is essential for Smart solutions – especially in cases where critical devices are also connected to the network (e.g. public lighting in connection with city security).
* **Risk of non-compliance:** Requirements for management and storage of operational data, personal data treatment (GDPR).

**Example Písek:**

The city has dedicated IT staff to manage the LoRaWAN network and smart systems, but especially for smaller municipalities, this requirement would mean the need for cooperation (e.g. shared IT support between multiple municipalities).

**From abroad:**

Some cases in Western Europe have shown that insufficient security testing can become a target for hacker attacks (see the incident with street lights in the USA, 2021).

## 4.3. Dependence on suppliers/technologies

The implementation of smart grids brings the risk  **of vendor lock-in** (dependence on one supplier), especially if the municipality chooses a proprietary solution (closed type of hardware and software):

* **Modernization compatibility issue:** A closed system can increase expansion or integration costs in the future.
* **Risk of supplier outage/unwillingness:** If a company goes out of business or reduces support, the municipality is in a disadvantageous position.
* **Limited choice for upgrades:** Having to stay with only one supplier often makes service more expensive and limits development.

**Example Písek:**

The project in Písek emphasizes the **openness of the solution**  (LoRaWAN = open standard, the possibility to connect multiple types of devices), which reduces the risk in the future.

**Elsewhere (Czech Republic, abroad):**

Some cities (e.g. Litoměřice or even projects in Germany) chose proprietary technologies during their first investments – after some time, they had to replace part of the equipment or run multiple systems in parallel.

# 5. SWOT analysis (energy management using VHCN in the municipality)

## 5.1 Strengths

* **Significant energy and cost savings**

Efficient power management, advanced monitoring and optimization lead to savings on electricity and maintenance.

*Písek has achieved savings on public lighting of about 35% thanks tosmart management.*

* **Improving the comfort and safety of residents**

Dynamic lighting, fast fault detection, higher service levels.

* **Data for decision-making and transparency**

The collection and evaluation of data in real time allows for better investment planning, and open data strengthens public trust.

* **Reduction of emissions and environmental impactsSmart technologies bring a smaller carbon footprint of the municipality.**
* **Flexibility and extensibility of the solution**

Open standards (e.g. LoRaWAN in Písek) allow for further development without dependence on one supplier.

## 5.2 Weaknesses

* **High initial investment costsEspecially for small municipalities, it can be a barrier despite subsidy titles.**
* **Demands on digital infrastructure and technical expertise**

Operations require qualified administrators and a reliable network; smaller municipalities often lack IT capacity.  
*In Písek, operation is provided by a specialized team, smaller municipalities have to deal with support externally or shared.*

* **Complexity of administration and risk of system failure**

Smart grids can be more difficult to recover quickly than traditional management in the event of a major outage.

* **Time lag of return on investment**

The payback period is usually 5-10 years, which may not be in line with the election and budget cycles of municipalities.

## 5.3 Opportunities

* **Subsidy programmes and European funds**

Currently, there is great interest and a wide selection of subsidy titles for digitization and energy modernization (National Recovery Plan, Modernization Fund, OP TAK).

* **Development of community energy and RES**

Possibility of regional electricity production and sharing, smart consumption and accumulation management (pilot in the Czech Republic, more commonly abroad).

* **Integration of other city services**

Once implemented, the infrastructure will allow for the gradual connection of water meters, parking sensors, environmental stations, etc.

* **Involvement in the Smart City ecosystem**

Synergies with other projects (transport, security, public participation).  
*Písek is expanding the smart infrastructure to other services, and in Brno/Vienna this approach is key to long-term sustainability.*

* **Increasing demand for energy independence and security**

Smart grids can be the basis for a city's energy resilience during price shocks and crisis situations.

## 5.4 Threats

* **Risk of vendor lock-in**

Closed systems can increase costs and limit development in the long run.

* **Cyber threats and weak security**

A smart grid is a tempting target for attacks, there is a risk of inoperability or data loss.  
*ENISA and the Ministry of Industry and Trade recommend that cyber protection be given priority attention.*

* **Changes in legislation and policy**

New regulations (e.g. personal data protection, interoperability requirements) may require unexpected investments or changes.

* **Failed integration with existing infrastructure**

When new elements are not compatible with the old system, there is a risk of higher operational risks and inefficiencies.

* **Rejection of new access by staff or members of the publicLack of communication can slow down or block implementation.**

# 6. Possible financial and budgetary models for municipalities

## 6.1 Financing options (grants, own budget, partnerships)

Municipalities have severalbasic ways to finance smart solutions:

* **Subsidies from public sourcesThe most common way is investment subsidies from European or state programs.**  
  Typical programs:
  + **Modernisation Fund, National Recovery Plan, Operational Programme Technologies and Applications for Competitiveness (OP TAK),**
  + Czech state subsidy programmes (e.g. MIT – EFEKT programme, Ministry of Regional Development).

**Advantage:** They reduce risk and shorten the payback.

**Disadvantage:** They require administrative capacity and pre-financing of costs.

* **Municipality's own budget**

Financing directly from savings, sale of assets or transfer from other chapters. Common for smaller projects (first piles, replacement of part of the public lighting).

* **Combined model (subsidy + own funds)**

Frequent in cases where the subsidy does not cover 100% of thecosts – the municipality finances the difference or takes out a loan.

* **Public-private partnerships (PPP, ESCO models)**

The partner (typically an energy company or technology supplier) implements the investment and the municipality repays it from future savings or fees (energy services with guaranteed savings).  
**Advantage:** Minimum of own money at the beginning, guarantee of savings.  
**Disadvantage:** Commitments for many years, dependence on one partner.

**Example Písek:**

The Smart Lighting project was financed mainly **from European and state subsidies** (OP Environment, EFEKT program), part of it from its budget. The ESCO model was used, for example, by the city of Brno (pilot energy services in municipal buildings).

## 6.2 Direct and long-term budgetary implications

**a) Investment (short-term, CAPEX):**

* Acquisition of new infrastructure (luminaires, control units, connections, software), installation and transition costs.
* Administrative burden associated with grant applications and project control.

**b) Operational and long-term (OPEX):**

* Reduced energy costs through savings (lower electricity bills).
* Reduction of common repair and service costs (fast fault detection, predictive maintenance).
* Extending the life of the equipment (thanks to more environmentally friendly operation).
* Possibility to reinvest savings in other phases of smart solutions (e.g. expansion to new streets, connection of schools, hospitals, etc.).

**Indirect impacts:**

* Improving the safety and image of the city (attractiveness for investors and residents).
* Simplification of administration thanks to digitization (time savings and lower error rate).
* Emission reduction, compliance with European energy requirements and sustainability.

**Example Písek:**

* After the initial investment in smart public lighting, it recorded annual savings of about 35% compared tothe initial electricity costs.
* Call-outs for breakdowns and accidents have also decreased (time savings, longer service life of luminaires).
* The evaluation for 3 years shows a return on investment of about 8 years (including all side effects, it can be even better in reality).

## 6.3 Sample ROI model

Below is a simple scheme for calculating the return for a municipality the size of Písek (simplified template – indicative numbers):

**Table**



**1. Energy**

* LED luminaires consume about 50-70% less electricity.
* Remote control (dimming, motion/traffic modes, adaptive lighting) allows for further savings.
* Energy savings reach 30-40% compared to the old state (in practice even more).

**2. Routine maintenance and service**

* LEDs have a significantly longer lifespan (10-15 years vs. 1-2 years).
* The system warns in advance of the risk of failure, replacements can be planned more efficiently.
* Savings of service interventions and spare parts, often 30-50%.

**3. Accidents and call-outs**

* Remote diagnostics means quick localization and solving only real problems.
* Fewer sudden, expensive call-outs (emergency interventions, emergency).
* Savings here typically up to 50% compared to the past.

**4. Administration**

* Automated reporting, reporting and intervention planning via software.
* Significant time savings for officials (they can focus on other projects).
* A smaller, but significant saving on the part of human labour.

**Note:**

The model is based on a conservativeestimate, it does not take into account, for example, possible increases in energy prices, direct benefits from subsidy support (reinvestment in development) or the effect of reducing emission fees.

**Key factors influencing ROI:**

* Amount of subsidy, interest costs (loan/PPP/ESCO).
* Actual energy and cost savings achieved.
* The price of el. energy on the market in a given period.
* Maintenance expenses, system operation and any license fees.
* Durability and expansion possibilities of the system.

# 7. Case studies and examples

## 7.1 Czech cities

### 7.1.1 Sand

**Project description:**

The city of Písek is one of the leaders in the Czech Republic in the implementation of smart technologies at the local government level. Smart public lighting and energy management play a key role here. Already in 2015, Písek began to build its own IoT network LoRaWAN, to which it gradually connected more than a thousand light points.

**Technical solutions:**

* Installation of LED lights on approx. 95% of lighting.
* Remote digital control (dimming, energy optimization according to the time of day and movement).
* Collection of data on failures, consumption and operation in real time.
* Possibility of future integration of RES and Smart Grid elements.

**Outcomes:**

* Reduction of electricity consumption for public lighting by about 35%.
* Significantly faster fault identification and more efficient maintenance.
* Annual savings of the city budget in the order of millions of crowns.
* The openness of the system (LoRaWAN) allows easy expansion to other smart elements (parking measurement, air quality sensors).

**Enlightenment:**

* The critical factor was the combination of multiple sources of subsidies.
* Own technical team and cooperation with other partners (research, universities).
* An open platform reduces technology dependency.

### 7.1.2 Ostrava

**Project description:**

Ostrava focused on the modernization of public lighting and comprehensive management of city networks using digital platforms. In 2022, pilot installations using 5G networks for the control of public lighting, traffic and environmental sensors took place here.

**Technical solutions:**

* Dynamic LED lighting with remote management capability.
* The city's platform for traffic monitoring and energy optimization.
* Pilot use of 5G networks for data-intensive smart applications.

**Outcomes:**

* Energy savings and improved safety from flexible light settings.
* Possibility of immediate reaction in case of breakdowns or accidents.

**Enlightenment:**

* Close cooperation is required (city-contractors-operators).
* Integrating critical infrastructure into smart management requires a thorough cybersecurity solution.

## 7.2 Foreign examples

### 7.2.1. Amsterdam (Netherlands)

**Project description:**

Amsterdam has long relied on open data, smart grid management and smart lighting. It connects consumption metering, renewables and utilities into an integrated platform.

**Technical solutions:**

* Smart metering of households and public buildings.
* V2G pilots – electric cars as battery storage.
* Controlled dynamic street lighting with adaptive scenarios.

**Outcomes:**

* Energy savings of up to 40% on public lighting.
* Reduction of CO₂ emissions – an annual reduction of more than 2000 tonnes.
* An open platform (open data) allows the involvement of different partners.

**Enlightenment:**

* Cooperation between the municipality and business and citizens is key.
* The development of infrastructure must go hand in hand with the digitization of services.

### 7.2.2. Vienna (Austria)

**Project description:**

Vienna emphasizes the involvement of residents in the planning and operation of smart services. Smart Lighting works in adaptive lighting mode according to the intensity of traffic and pedestrian movement.

**Technical solutions:**

* Real-time intelligent lighting control, LED technology.
* Participatory application for fault reporting and service optimization.
* Extensive use of optical networks and IoT platforms.

**Outcomes:**

* Energy savings of up to 35%.
* Improving the safety and satisfaction of the city's residents.
* Significantly shorter troubleshooting times thanks to digitized messages.

**Enlightenment:**

* Successful digitalisation requires the connection of technology, people and data.
* Openness to innovation and active communication with the public.

**Summary and common lessons learned**

* **Significant financial savings** are achievable in all conditions if investment is made in quality infrastructure and operation is dynamically managed.
* **The openness of technologies** (open standards, LoRaWAN, open data) significantly reduces the risk of vendor lock-in and supports further development.
* **Public participation** and cooperation with professional partners (companies, universities) is critically important for success and long-term sustainability.
* In everycity, cybersecurity and comprehensive data management **need to be** addressed, especially where critical services enter the network.

# 8. Recommendations for effective implementation of smart energy management and public lighting in the municipality

## 8.1 Strategic and organizational recommendations

* **Develop a comprehensive concept of smart solutions at the level of the entire city or municipality**

Include not only energy, but also related areas (water, parking, security). Set clear priorities and schedules, prepare a framework budget and funding options (subsidies, PPP).

* **Build solutions on open standards and technologies (e.g. LoRaWAN, MQTT, IP protocols)**

This minimizes the risk of vendor lock-in, increases extensibility, and opens up the possibility of future integration with other systems.

* **Involve key partners and the public in a timely manner**
  + To address selected technology partners – not only suppliers, but also universities and research and innovation organizations (example Písek, Brno).
  + Communicate with citizens on an ongoing basis – education and participation will make it easier to accept changes.
* **Before starting investments, analyze existing infrastructure and processes in detailPerform an energy audit, ICT audit and evaluate specific needs and limits. This will prevent inefficient spending.**

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## 8.2. Technical and operational recommendations

* **Invest primarily in high-quality digital infrastructure (VHCN or LoRaWAN/IoT network)**  
  This basis is essential for centralized management and further development – without stable networks, reliable smart management cannot be operated.
* **Choose a modular solution of the "pilot-scale" natureStart**

with a pilot project on a limited part of the network (for example, a few streets or a selected urban area), evaluate the results, savings, public reaction, and only then proceed to faster implementation on the entire territory.

* **Pay attention to cybersecurity from the start**

Implement security standards (passwords, encryption, network segmentation, regular updates). Count on staff training. Consider a mandatory backup and disaster recovery plan.

* **Monitor and evaluate traffic based on real data**

Automated data collection and analysis allows you to optimize service settings and plan investments – for example, measure real savings, maintenance needs, and development opportunities.

* **Provide staff training and ongoing support**

Safe and efficient operation requires technically skilled administrators and basic training of service staff (a possible model of shared IT support in smaller municipalities).

## 8.3 Economic and development recommendations

* **Maximize the use of subsidy titles and divide investments into several phases**

Securing subsidies in a timely manner significantly reduces the financial burden itself. Spreading investments facilitates cash flow while enabling continuous learning/operational optimizations.

* **Consider energy solutions in the wider ecosystem of the city/municipality, including the involvement of renewable sources and community energy**

Use existing networks for downstream projects (e.g. smart water/gas metering, parking or waste logistics), which synergistically increases the return on initial investment.

* **Open data where possible and meaningful**

The publication of aggregated and anonymised data promotes transparency and involves citizens or third parties in innovation (e.g. Amsterdam or Brno by involving start-ups).

## 8.4 How to use examples of good practice (Písek, abroad)

* **Conceptually inspired:**
  + Písek – emphasis on open infrastructure and combining pilot/subsidy projects.
  + Brno/Vienna – linking the energy sector with other city services, participation of residents.
* **Learn from mistakes:**
  + Avoid closed or proprietary systems – the experience of some cities shows that the price of an easy "all-in-one" solution means higher costs for expansion.
  + Do not underestimate administration and security (personnel, training, operational tools).
* **Evaluate and share results regularly**

This makes it possible to adapt the strategy over the years, find new partners and draw on additional subsidy impulses.

# 9. Conclusion and summary

Smart energy management and modern public lighting represent a clear path for Czech municipalities and cities to **reduce operating costs, increase safety, improve the environment and quality services for residents**.

The study showed that success in these areas is not only a matter of technology, **but above all of strategic planning, openness, collaboration and long-term work with data**.

**Key takeaways and lessons learned**

* **Digitalisation and VHCN** are the basis for modern energy management and utilities. It is necessary to build on a high-quality, safe and open infrastructure.
* **Smart energy management brings real savings** (usually 25-40% inpublic lighting, 10-25% in otherservices) and significant environmental benefits.
* **Open standards and interoperability** must be a priority; they significantly reduce the risk of technological dependency and facilitate further development.
* The main **barriers** are mainly initial funding, staffing, cybersecurity issues and sometimes also resistance to change.
* Successful projects (Písek, Brno, Amsterdam, Vienna) bet on **gradual implementation, active involvement of citizens, interconnection of various areas (energy, transport, environment, security) and long-term work with data**.

**Recommended steps for municipalities and cities**

**Ten commandments for the effective implementation of smart energy management**

1. **Set a concept and goals** – prepare a long-term plan for the digitization of energy and public lighting.
2. **Examine infrastructure and capacities** by analyzing the current state of your network, IT, and HR resources.
3. **Bet on open technologies and standards**, minimize vendor lock-in.
4. **Secure funding and subsidies** – take advantage of available programs and plan your budget wisely.
5. **Start with a pilot project**, evaluate its results and then proceed with scaling.
6. **Involve the public and professional partners** – open communication increases support and reduces resistance to change.
7. **Build a secure and robust network** (VHCN, IoT, LoRaWAN)and you are dealing with security and scalability from the very beginning.
8. **Monitor and evaluate data** – savings, environmental benefits, development needs.
9. **Continuously educate staff** and keep your management and security knowledge up to date.
10. **Regularly review and share experience** – benchmarking (comparison with other municipalities), adaptation to new possibilities and technologies.

**Looking ahead**

The trend of digitization in public services will continue to grow in the Czech Republic and Europe. Smart energy management and Smart Lighting are the gateway to further digitization of cities and municipalities – the Internet of Things, community energy, RES integration, smart transport planning and environmental measures.

Municipalities have the opportunity to use the experience of leaders, grow gradually and safely with regard to their own conditions. Investing in open standards and human capital clearly pays off not only in terms of energy, but also socially.

# 10. Literature, links and sources

**1.1 The importance of energy management for the municipality**

* **Ministry of Industry and Trade of the Czech Republic: Energy Management for Cities and MunicipalitiesOverview of obligations and recommendations for systematic energy management in public administration.**  
  <https://www.mpo-efekt.cz/cz/energeticky-management/>

**1.2 The role of digitalisation and VHCN**

* **European Commission: Towards Smart Cities – Digital Infrastructure (VHCN, IoT, Open Data)**  
  Summary of the role of digital networks in the development of Smart Cities.  
  <https://smart-cities-marketplace.ec.europa.eu/>

**1.3 Practical examples**

* Písek – Smart Písek: <https://smart.pisek.eu/index.html> 1
* Písek – ASB Portal: <https://www.asb-portal.cz/stavebnictvi/technicka-zarizeni-budov/energie/pisek-je-smart-city> [2](https://www.asb-portal.cz/stavebnictvi/technicka-zarizeni-budov/energie/pisek-je-smart-city)
* Písek – CBCSD: <https://www.cbcsd.cz/wp-content/uploads/2017/10/Smart-cities.pdf> [5](https://www.cbcsd.cz/wp-content/uploads/2017/10/Smart-cities.pdf)
* Ostrava – Ostrava Roads: <https://www.okas.cz/o-spolecnosti/archiv-novinek/ostrava-rychle-pokracuje-ve-vymene-verejneho-osvetleni-aby-setrila.html> [4](https://www.okas.cz/o-spolecnosti/archiv-novinek/ostrava-rychle-pokracuje-ve-vymene-verejneho-osvetleni-aby-setrila.html?hledat=%C5%BE%C3%A1dost)
* Ostrava – MMR (5G): <https://mmr.gov.cz/Evropska-unie/Narodni-plan-obnovy/VYZVY-archiv/3-vyzva-Demonstrativni-aplikace-ekosystemu-siti-5G> [7](https://mmr.gov.cz/Evropska-unie/Narodni-plan-obnovy/VYZVY-archiv/3-vyzva-Demonstrativni-aplikace-ekosystemu-siti-5G)
* Amsterdam – Amsterdam Smart City: <https://amsterdamsmartcity.com/channel/energy/project> [8](https://amsterdamsmartcity.com/channel/energy/project)
* Amsterdam - Fleet Europe (V2G): <https://www.fleeteurope.com/fr/maas-smart-mobility-technology-and-innovation/netherlands/news/amsterdam-pilots-v2g-charging> [11](https://www.fleeteurope.com/fr/maas-smart-mobility-technology-and-innovation/netherlands/news/amsterdam-pilots-v2g-charging)
* Amsterdam – Sustainable Cities Collective: <https://www.smartcitiesdive.com/ex/sustainablecitiescollective/amsterdam%E2%80%99s-smart-city-program/8726/> [13](https://www.smartcitiesdive.com/ex/sustainablecitiescollective/amsterdam%E2%80%99s-smart-city-program/8726/)
* Vienna – Smart City Wien: <https://smartcity.wien.gv.at/> 1
* Vienna – Energy Cities: <https://energy-cities.eu/best-practice/smart-citizen-participation-in-vienna/> [10](https://energy-cities.eu/best-practice/smart-citizen-participation-in-vienna/)
* Vienna – GDS Lighting (adaptive lighting): <https://www.gdslighting.com/en/adaptive-lighting-how-it-works-and-why-choose-it/> [9](https://www.gdslighting.com/en/adaptive-lighting-how-it-works-and-why-choose-it/)

**1.4 International context and examples**

* **IEA – Smart Grids and Digitalisation (EN)**  
  An analytical summary of the importance of digitalisation in the energy sector for cities and municipalities.  
  <https://www.iea.org/reports/digitalisation-and-energy>
* **Open & Agile Smart Cities (Network of Cities Implementing Smart Lighting/Smart Grid in the EU)Overview**  
   of case studies and typical implementations in European cities.  
  <https://oascities.org/>

**1.5 Basic and methodological literature**

* **NCEU: Handbook on energy measures for mayorsPractical guidance for mayors and municipalities on how to systematically implement energy-saving measures and manage the energy sector.**  
  [https://www.smocr.cz/Shared/Clanky/7376/nceu-prirucka-k-energetickym-opatrenim-pro-starosty.pdf6](https://www.smocr.cz/Shared/Clanky/7376/nceu-prirucka-k-energetickym-opatrenim-pro-starosty.pdf)
* **Energy Management for EveryoneA practical guide to implementing energy management in municipalities, including process descriptions and practical examples.**  
  [https://biom.cz/upload/6e01d6d4c4835ec93cda508772f3bf6e/prakticka\_prirucka\_energetickeho\_managementu.pdf7](https://biom.cz/upload/6e01d6d4c4835ec93cda508772f3bf6e/prakticka_prirucka_energetickeho_managementu.pdf)

**1.6 Smart public lighting and EPC projects**

* **Smart Public Lighting - Signify**  
  Modern trends, savings and benefits of smart street lighting management, including global statistics.  
  [https://www.signify.com/cs-cz/our-company/blog/showcase/20250509-signifys-smart-public-lighting-inconspicuous-change-that-changes-cities3](https://www.signify.com/cs-cz/our-company/blog/showcase/20250509-signifys-smart-public-lighting-inconspicuous-change-that-changes-cities)
* **Publication of the Ministry of Industry and Trade Effect: Lighting – Methodology of EPC ProjectsMethodological guide for the integration of energy-saving measures in public lighting into projects with guaranteed savings (EPC).**  
  [https://efekt.gov.cz/cz/energeticka-ucinnost-v-praxi/publikace?tema=41b281ae44ee181453a7c2487640aaa25](https://efekt.gov.cz/cz/energeticka-ucinnost-v-praxi/publikace?tema=41b281ae44ee181453a7c2487640aaa2)

**1.7 Community energy and digitalisation**

* **Community energy in the Czech Republic at a crossroadsAn overview of current developments and legislation in community energy in the Czech Republic, including examples of electricity sharing and the role of data centres.**  
  [https://www.businessinfo.cz/clanky/komunitni-energetika-v-cesku-na-rozcesti-podari-se-nastartovat-sdileni-elektriny/ 4](https://www.businessinfo.cz/clanky/komunitni-energetika-v-cesku-na-rozcesti-podari-se-nastartovat-sdileni-elektriny/)
* **IEA – Digitalisation and EnergyAn international analytical summary on digitalisation in the energy sector and its importance for cities and municipalities.**  
  <https://www.iea.org/reports/digitalisation-and-energy>1

**1.8 Academic and professional work**

* **Energy Sustainability and Municipalities – Case Study (Master's Thesis, Masaryk University, Brno)**  
  It contains a literature review, an analysis of RES and energy self-sufficiency of municipalities in the Czech Republic.  
  <https://is.muni.cz/th/wvln1/>