

ESINERGY POLICY SOLUTIONS

PEAK LOAD REDUCTION AND ENERGY SELF-SUFFICIENT PROSUMERS

Digital E-brochure

Interreg
Danube Region



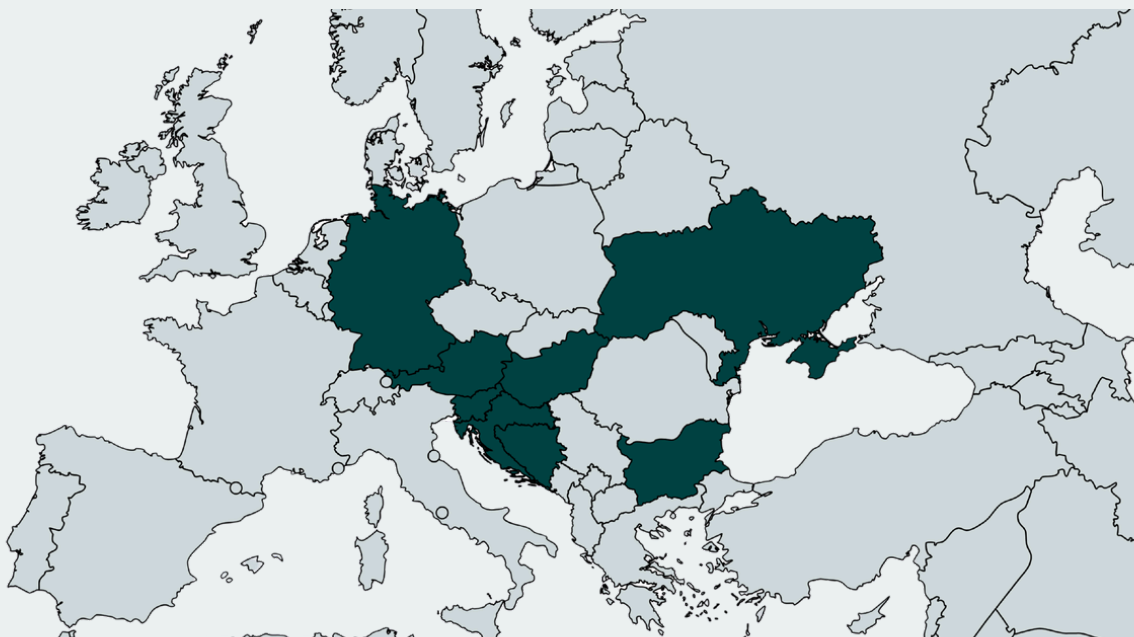
Co-funded by
the European Union


ESINERGY

INTRODUCTION

From pilot actions to structural energy transition

Across the Danube region and neighbouring countries, energy systems are undergoing profound change. Electrification of heating and mobility is accelerating. Renewable energy, especially photovoltaics, is expanding rapidly. At the same time, distribution grids are facing increasing pressure from volatile demand peaks and simultaneous injection of solar electricity.



These developments create a structural challenge: how to maintain grid stability, affordability and energy security while advancing decarbonisation. The ESINERGY project was developed in response to this challenge. Rather than focusing on theoretical models, the partnership implemented concrete pilot actions in eight countries: **Austria, Bosnia and Herzegovina, Bulgaria, Germany, Croatia, Hungary, Slovenia and Ukraine**. Each pilot addressed the same core question:

How can public buildings and municipalities reduce peak loads while increasing renewable integration and strengthening energy self-sufficiency?

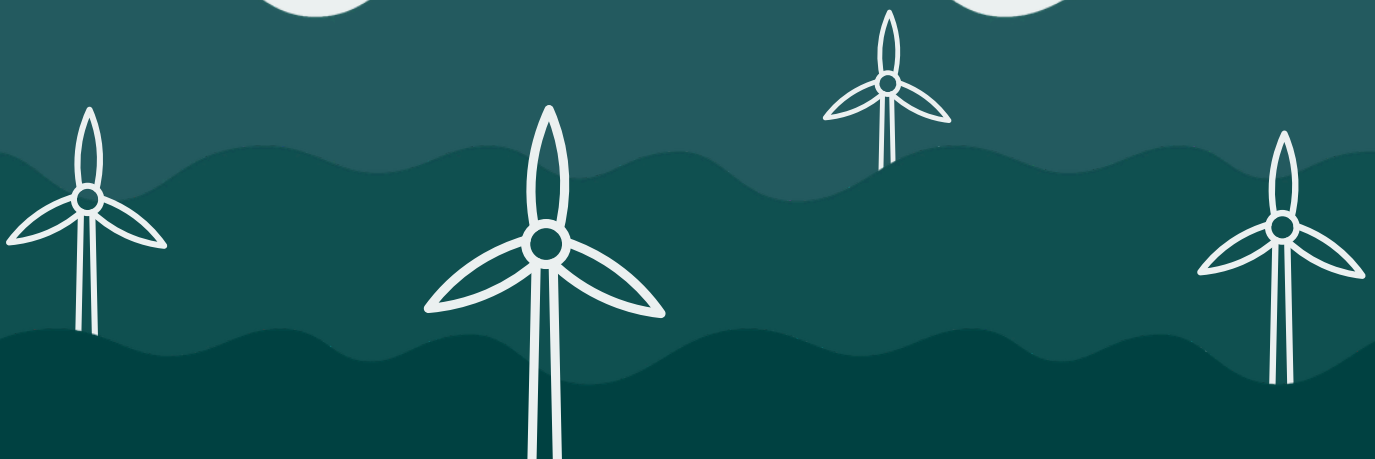
The solutions varied according to national contexts. From battery storage systems and smart energy management, to smart charging and aggregation, to renewable-based heating with heat pumps and photovoltaic systems. Yet a common logic emerged – peak load reduction is not a single technology. It is a coordinated combination of governance, digitalisation, financing and technical design.

Through structured stakeholder engagement, joint transnational workshops and systematic evaluation of pilot results, the partnership translated practical experience into policy brief (pilot solutions). These policy briefs do not only describe installations. They provide scalable frameworks, including:

- Technical requirements
- Steps for replication
- Governance and regulatory recommendations
- Transferability and scaling pathways

What makes ESINERGY distinctive is its transnational dimension. The solutions were not developed in isolation. Each country cooperated with partners from other countries to jointly reflect on feasibility, barriers and policy implications. As a result, the project contributes not only to local improvements, but to a broader European debate on flexible, prosumer-oriented energy systems.

The experience clearly shows that public buildings (e.g. hospitals, schools, administrative facilities) can move from passive energy consumers to active participants in a resilient and decentralised energy system.



AUSTRIA

Battery-based flexibility and energy community model

Pilot location: Weiz, business campus

1. The challenge: peak load as a system risk

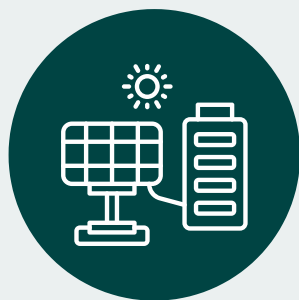
Electricity systems in Austria are under increasing pressure. Rising demand, expanding photovoltaic (PV) generation and the growth of electric mobility are concentrating electricity consumption in shorter time windows. The result is higher peak loads, growing grid congestion and rising infrastructure costs.

Peak load is no longer a local technical issue. It directly affects grid stability, energy prices and the speed of the energy transition. Without flexibility, renewable energy cannot expand without triggering expensive grid reinforcements.

The Austrian pilot in Weiz addressed this problem by integrating a vanadium redox-flow battery storage system into an energy community with existing photovoltaic generation. The aim was not simply to install storage, but to demonstrate how locally produced renewable electricity can be stored and used intelligently during peak demand periods.

Key message:

Peak load reduction is a strategic tool for grid stability, affordability and renewable integration.



2. The core solution: battery-supported PV as active flexibility

The Austrian solution is based on a simple but powerful principle: store renewable electricity when available and use it when demand peaks. Instead of drawing electricity from the grid during high-demand hours, the battery system releases previously stored PV electricity. This transforms PV from passive generation into an active flexibility resource.

The pilot showed that decentralized storage can:

- Actively reduce peak loads
- Increase renewable self-consumption
- Improve grid stability
- Lower energy costs
- Reduce CO₂ emissions

However, the most important insight is not the battery itself. It is the organisational and regulatory framework required for storage and flexibility to function reliably and be scalable.

3. Structured implementation: governance before hardware

The Austrian experience confirms that peak load reduction is not achieved through a single investment. It requires a structured process.

First, a strategic decision must define peak load reduction as a policy priority. This ensures alignment with energy and climate strategies and provides political backing.

Second, responsibilities must be clearly assigned. Energy units, finance departments, legal teams and facility management must coordinate from the outset. Early dialogue with the Distribution System Operator (DSO) is essential to clarify grid connection rules and storage operation conditions.

Third, technical design must remain flexible and future-proof. Storage capacity, smart metering and control systems should allow expansion and interoperability. Financial models must compare own investment, leasing or energy service contracts.

Continuous monitoring of peak reduction, cost savings and CO₂ impacts ensures transparency and long-term support.

Key message:

Technology alone does not reduce peak load. Governance, financing, regulation and stakeholder coordination determine success.



4. Stakeholder engagement: early and systematic

Peak load reduction affects multiple actors. The Austrian pilot involved DSOs, municipalities, regulators, technology providers and prosumers from the beginning.

Early engagement achieved several outcomes:

- Regulatory barriers were identified before procurement
- Grid compatibility was ensured
- Political legitimacy was secured
- User acceptance increased

Structured consultations, technical workshops and public information sessions built trust and created shared ownership.

This approach ensures that solutions are scalable and transferable, not limited to one pilot configuration.

5. Communication: making flexibility visible

Communication in Weiz focused on visible, positive impacts rather than technical complexity.

Instead of emphasizing battery specifications, messaging highlighted:

- Lower energy costs
- Local renewable use
- Reduced grid stress
- Contribution to climate goals

Local press, public events and digital storytelling helped translate system-level flexibility into everyday benefits.


Visible solutions increase public trust and accelerate replication.

6. Transferability and scaling potential

The Austrian pilot confirms that battery-supported PV systems are scalable when enabling conditions are in place.

These conditions include regulatory clarity for storage operation, tariff structures that reward load shifting, digital monitoring systems and long-term political commitment.

A phased approach is recommended:

- Start with one site.
 - Expand to multiple public buildings or business zones.
 - Integrate into regional energy strategies.
- 

HUNGARY

Smart energy community for coordinated flexibility

Pilot location: Lenti, first Lentiszombathely, later the whole town

1. The context: why flexibility is essential in Hungary

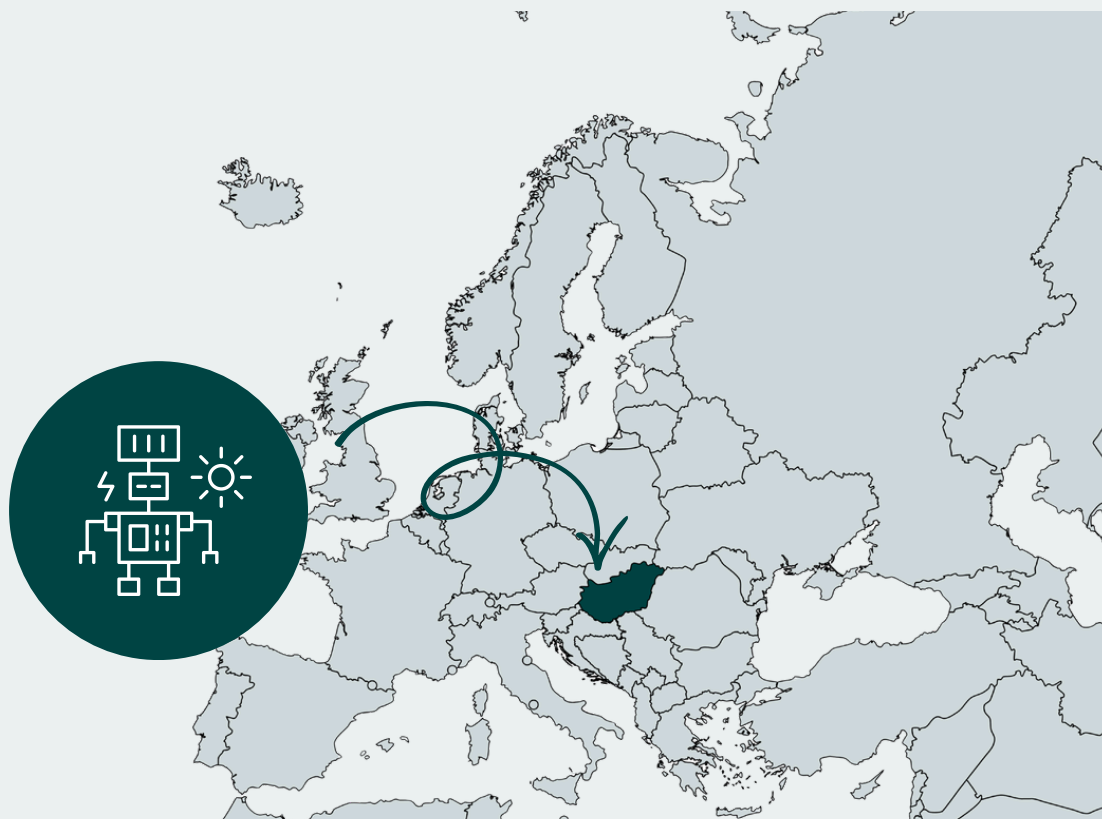
Electricity demand patterns in Hungary are changing. Photovoltaic systems are expanding rapidly, while electrification of heating, cooling and mobility is increasing local peak loads. As a result, distribution grids are exposed to higher stress, particularly during concentrated demand periods.

In many municipalities, renewable electricity is produced at midday but not fully consumed locally. At the same time, peak demand in the evening still depends heavily on grid supply. This imbalance creates grid congestion, rising costs and inefficient use of renewable energy.

The Hungarian pilot in Lenti addresses this systemic challenge through a smart energy community model. The focus is not on one technology, but on coordinating photovoltaic generation, flexible consumption, storage options and digital energy management into one integrated approach.

Key message:

Flexibility is the missing link between renewable energy expansion and grid stability.



2. The core solution: coordinated smart energy management

The Hungarian pilot demonstrates that peak load reduction can be achieved by aligning renewable production with controllable demand.

Instead of exporting surplus PV electricity to the grid and importing electricity during peak hours, the system manages energy flows locally. Flexible loads such as heating, cooling, charging infrastructure and other controllable systems are coordinated through digital control.

The solution combines:

- Photovoltaic systems
- Controllable electricity consumption
- Battery storage potential
- Smart metering and digital energy management

The key principle is simple: shift consumption in time and use locally produced renewable electricity when it is available.

This transforms traditional consumers into more active participants in the energy system and increases the value of local renewable generation.

3. From pilot to replicable model

The Hungarian experience confirms that successful peak load reduction is based on governance and coordination, not only hardware.

The first step is defining the problem clearly: reducing peak loads and increasing renewable self-consumption, rather than installing a specific technology.

Governance must be established early. Municipal leadership, technical experts, financial planners and legal advisors must align objectives and responsibilities. Early dialogue with the Distribution System Operator (DSO) ensures compliance with grid conditions and prevents delays.

Feasibility assessments should include renewable potential, grid constraints, storage options and regulatory frameworks. Financial planning must consider long-term sustainability and cost-benefit analysis.

Continuous monitoring of energy flows, peak reduction and CO₂ savings ensures transparency and long-term credibility.

Key message:

Peak load reduction succeeds when governance, regulation and digitalisation evolve together.



4. Stakeholder engagement as a core component

The Lenti pilot highlights that no single actor can deliver flexibility alone.

Effective implementation requires coordinated involvement of:

- Distribution System Operators
- Regulators and competent authorities
- Municipalities and public authorities
- Technology providers and system integrators
- Energy agencies
- Financial institutions
- Aggregators and prosumer associations

Structured workshops, bilateral consultations and demonstration events enabled trust-building and joint problem-solving. Early engagement helped identify regulatory barriers, clarify technical standards and secure political support.

Systematic stakeholder engagement ensures that the solution can be transferred across regions and adapted to different regulatory conditions.

5. Communication: translating complexity into benefits

Communication in Hungary focused on practical advantages rather than technical terminology.

Messages emphasised:

- Lower energy costs
- Increased use of local renewable energy
- Reduced grid stress
- Contribution to climate targets

Public events, municipal channels and digital communication tools helped explain how smart energy management benefits local communities. When flexibility becomes visible and understandable, acceptance increases and scaling becomes easier.



6. Transferability and scaling potential

Transferability does not depend on copying the exact pilot configuration. It depends on replicating enabling conditions and scaling logic.

Key enabling conditions include regulatory clarity, tariff systems that reward self-consumption, digital infrastructure (smart meters and energy management systems) and strong political commitment.

A gradual scaling approach is recommended:

- Start with one site to test technology and governance.
- Expand to multiple sites and integrate storage and demand coordination.
- Embed flexibility into regional and national energy strategies.

7. Policy implications

To move from pilot to system-level deployment, coordinated action is required. At organisational level, municipalities must integrate peak load management into energy and climate strategies and allocate stable budgets for smart energy systems.

At national level, subsidy schemes should support integrated systems (RES + storage + smart management), not isolated components. Regulatory clarity for flexibility markets and energy communities is essential.

At EU level, alignment with the European Green Deal, RED III and Electricity Market Design reform ensures that flexibility solutions receive long-term policy backing.



SLOVENIA

Smart charging and bidirectional flexibility

Pilot location: martjanci, Smart House

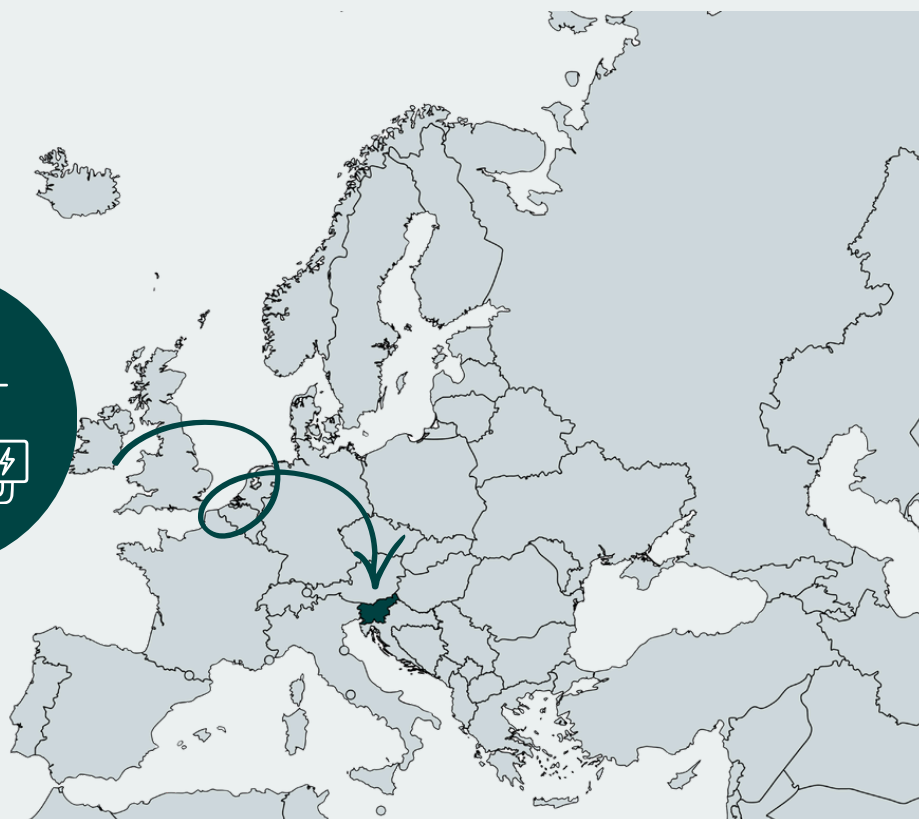
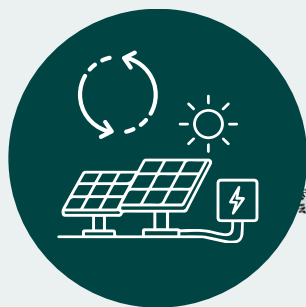
1. Why reducing peak load is a strategic priority

Electricity systems in Slovenia are under growing pressure. Peak loads are increasing, electric vehicles are expanding rapidly and photovoltaic (PV) systems are producing more variable electricity. Without flexibility, local grids become congested, renewable energy is curtailed and electricity costs rise. The Slovenian pilot demonstrates that peak load reduction is not a technical niche issue. It is a strategic enabler of the energy transition. By connecting photovoltaic generation, battery storage, buildings and electric vehicle charging into one coordinated system, the pilot shows how existing renewable assets can be used more intelligently.

Rather than treating electric vehicles as passive consumers, the solution explores their role as active flexibility resources. Through smart and bidirectional charging, electric vehicles can absorb surplus PV electricity and later discharge energy back to the building during peak demand. This reduces grid stress, increases self-consumption and improves energy independence.

Key message:

Reducing peak load through integrated flexibility is essential for grid stability, renewable integration and affordable electrification.



2. The core solution: smart charging linked with PV and storage

The Slovenian solution focuses on smart energy management, not on installing a single technology. The principle is simple but powerful: align renewable production with flexible demand using digital control.

A smart charging system connected to photovoltaic panels and battery storage allows electricity to be consumed, stored or shifted according to real-time grid and production conditions. Instead of exporting excess PV electricity at midday and relying on grid electricity in the evening, the building actively balances its own energy flows.

This approach is particularly relevant for existing PV systems whose support schemes have expired. It creates new business and operational models that keep renewable assets economically and systemically valuable. The solution reduces simultaneous electricity demand and smooths load curves.

Grid operators benefit from postponed infrastructure upgrades. Users benefit from lower electricity costs. CO₂ emissions decrease because fossil-based peak electricity is replaced by local renewable energy. Most importantly, the approach is modular and replicable. It can be applied in public buildings, SMEs, farms, residential blocks and future energy communities across Slovenia and beyond.

3. Structured implementation – a process, not a pilot

Replication does not mean copying hardware. It means replicating the process. Successful implementation requires strong governance, early alignment with grid operators and regulators, flexible technical design and clear internal responsibilities.

The Slovenian experience shows that organisations must first define the peak load problem and policy objective. Flexibility should be the goal, not a specific technology. Governance must be established across energy, finance, legal and management departments before technical work begins. Feasibility studies should assess renewable potential, grid conditions, storage options and regulatory constraints. Early dialogue with the Distribution System Operator (DSO) is essential, especially when bidirectional charging (V2B/V2G) is involved.

The technical setup must be future-proof. Interoperability, cybersecurity, data access and upgrade potential are as important as hardware capacity. Financing must be supported by a clear cost-benefit analysis showing avoided grid investments, lower energy costs and emission reductions. Continuous monitoring and performance evaluation ensure long-term reliability.

Key message:

The highest system value comes from modular, closed-loop systems that link PV, storage, buildings and smart charging into one energy logic.

4. Stakeholder engagement and communication

Peak load reduction succeeds when stakeholder engagement is systematic and continuous.

Distribution System Operators ensure grid compatibility. Regulators clarify legal frameworks for flexibility services and bidirectional charging.

Municipalities provide political backing and integrate the solution into energy and mobility strategies. Technology providers ensure interoperability and cybersecurity. Energy agencies mediate and support replication.

Communication must focus on visible benefits rather than technical complexity. In the Slovenian pilot, short videos, online interviews, public events and visual materials helped explain how smart charging improves everyday life. When people understand lower costs, cleaner energy and greater independence, acceptance increases.

Early and transparent communication reduces resistance and accelerates scaling.

5. Transferability and scaling logic

Transferability depends on enabling conditions: regulatory clarity for V2G/V2B, appropriate tariff design, digitalisation (smart meters and BEMS), sufficient grid capacity and political commitment.

A stepwise approach is most effective:

- Start small – implement smart charging in a single building.
- Expand regionally – combine charging with PV, storage and coordinated demand.
- Integrate strategically – embed flexibility into regional and national energy and mobility strategies.

The potential impact is substantial. According to the projections, if 10% of solar power plant owners in Slovenia adopted V2B systems, grid load during peak demand could be reduced by more than 50 MW. Transitioning to V2G systems could provide additional grid support of up to 4.2 MW during peak periods (see Potential Impact section).



CROATIA

Battery-Based Flexibility in Public Buildings

1. The challenge: rising peak loads and grid pressure

Electricity systems across Europe are facing increasing pressure. Electricity demand is rising, photovoltaic (PV) systems are expanding and electrification of transport and heating is accelerating. These developments lead to higher peak loads, grid congestion and rising infrastructure costs.

In Croatia, these challenges are visible at local level, especially in public buildings and municipalities that are expanding renewable energy production but lack flexibility mechanisms.

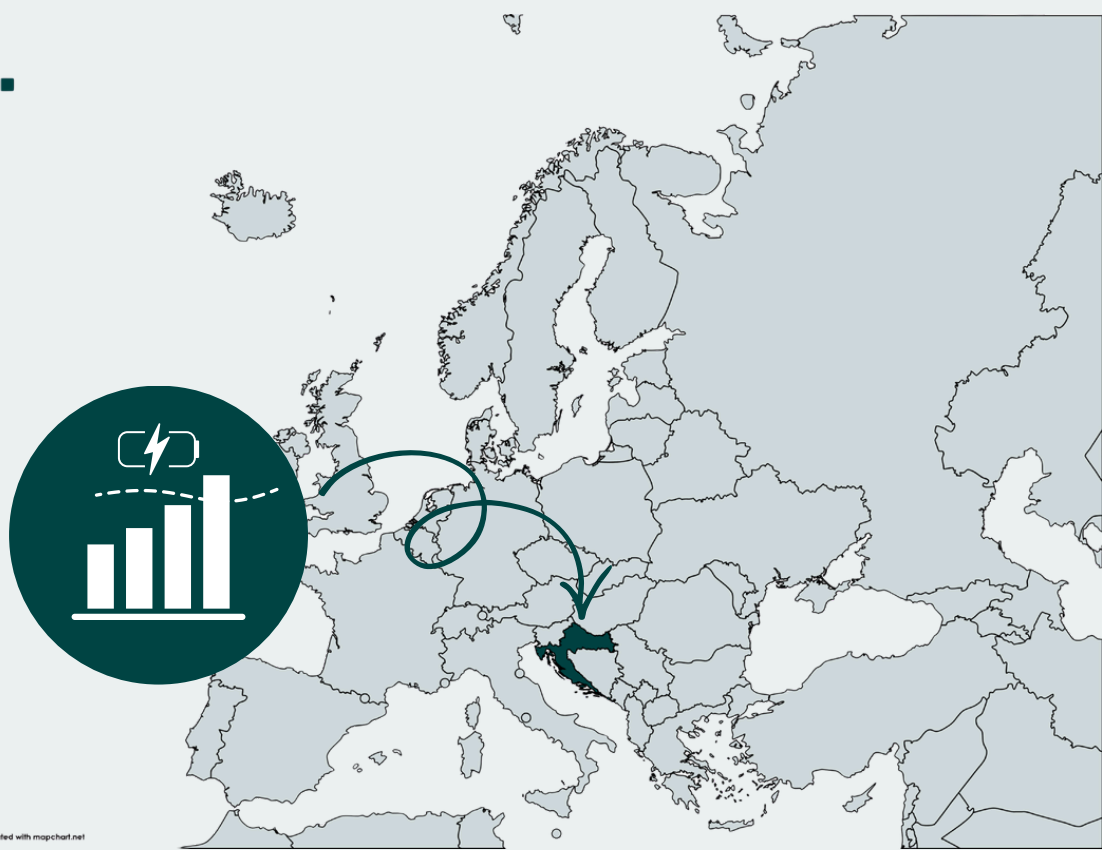
The Croatian pilot within the ESINERGY project addressed this challenge by testing a flexibility-based approach in a public administrative building in Međimurje County. The pilot combined:

- Battery energy storage
- Smart metering upgrade
- Existing photovoltaic (PV) system

The objective was clear: store locally produced renewable electricity and use it during peak demand periods instead of relying on grid electricity.

Key message:

Battery storage combined with smart energy management is a practical and effective tool for peak load reduction.



2. The core solution: local generation and storage and smart control

The Croatian solution is based on a replicable concept, not a one-off installation. The principle is to combine local renewable generation, storage and smart control to actively manage peak demand.

When solar production is high, surplus electricity is stored in the battery system. During peak demand periods, the battery supplies the building, reducing the maximum load drawn from the grid.

This approach delivers multiple co-benefits:

- Peak load reduction and lower stress on distribution grids
- Higher renewable energy integration through increased on-site use
- Avoided or delayed grid reinforcement investments
- Electricity cost savings
- CO₂ emission reductions
- Improved building-level resilience and flexibility

The Croatian pilot shows that flexibility solutions are not theoretical. They are operational, measurable and transferable.

3. Implementation: a process, not just equipment

The Croatian experience clearly shows that peak load reduction is an organisational and policy process, not only a technical installation.

Successful implementation requires:

- Early political and senior management support
- Clear integration into local or regional energy and climate strategies
- Early consultation with the Distribution System Operator (DSO)
- Clear internal governance and assigned responsibilities

Technical planning must be combined with regulatory checks, procurement preparation and long-term maintenance planning. Battery storage should not be treated as a stand-alone investment, but as part of a broader energy management framework.

Monitoring, data analysis and performance indicators are essential to demonstrate impact and support scaling.

Key message:

Do not treat storage as a purely technical project. Treat it as a strategic flexibility instrument embedded in policy and governance.



4. Stakeholder engagement and communication

The Croatian pilot involved a wide range of stakeholders: DSOs, regulators, municipalities, energy agencies, technology providers, financial actors and community representatives.

Early engagement helped to:

- Identify regulatory barriers
- Align technical design with grid requirements
- Secure political and organisational support
- Increase public acceptance

Communication focused on visible benefits rather than technical complexity. Workshops, public demonstrations, digital channels and visual materials were used to translate flexibility into everyday language.

Public events and live demonstrations proved particularly effective, allowing direct dialogue and building trust.

5. Conditions for success and barriers

Storage-based flexibility solutions are replicable when key enabling conditions are in place:

- Clear regulatory frameworks for storage and grid connection
- Appropriate tariff design rewarding flexibility
- Smart metering and digital monitoring systems
- Political commitment and budget allocation

Typical barriers include high upfront costs, regulatory uncertainty, limited internal technical capacity and interoperability issues. These can be mitigated through public funding schemes, early DSO dialogue, standardised technical solutions and internal capacity building.



BOSNIA AND HERZEGOVINA

PV and battery flexibility model

1. Why peak load reduction is becoming urgent

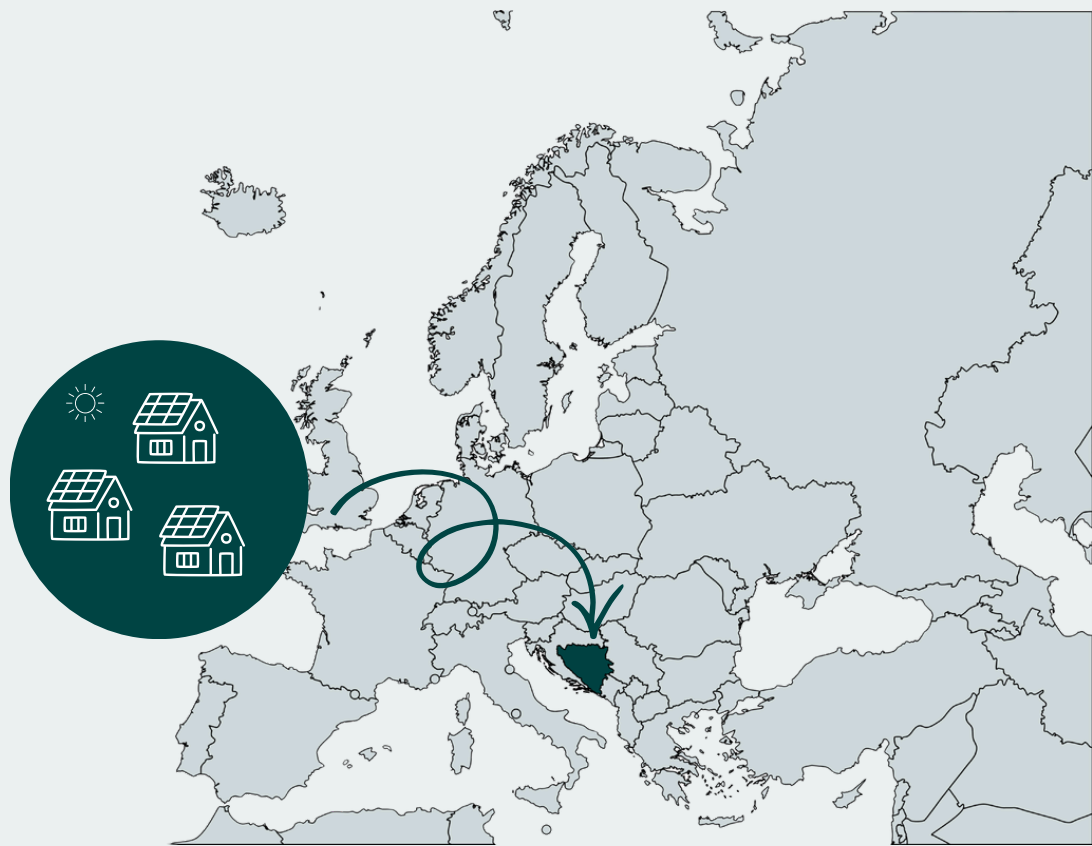
Bosnia and Herzegovina is facing increasing pressure on its electricity system. Electricity demand is rising due to electric heating, economic growth and the expected expansion of electric mobility. At the same time, renewable energy production is becoming more decentralised and variable. These trends create higher peak loads at local level, especially in low- and medium-voltage grids. Without flexibility solutions, grid constraints may slow down renewable energy uptake and increase system costs.

The ESINERGY pilot in Goražde addressed this challenge through a practical, real-life installation. A 10-kW photovoltaic system was combined with a 10-kWh battery storage system on a high-consumption public building operated by Elektro distribucija Goražde.

The objective was not only to produce renewable electricity, but to shift electricity consumption away from peak hours, reduce stress on the local grid and increase local energy resilience.

Key message:

Reducing peak load through PV and battery flexibility is technically feasible and strategically necessary for Bosnia and Herzegovina.



2. The core solution: decentralised flexibility at building level

The Bosnian pilot demonstrates a replicable concept – combine photovoltaic generation with battery energy storage to align renewable production with local demand.

When solar production is high, electricity is stored. When peak demand occurs, typically in late afternoon and evening, the battery discharges and reduces the building's grid dependency.

This approach provides system-level benefits even at small scale. The value lies not in one installation, but in creating a repeatable process that enables many small and medium-sized systems to collectively reduce peak loads.

Key co-benefits include:

- Peak load reduction and lower stress on distribution grids
- Avoided or postponed grid reinforcement
- Increased renewable energy self-consumption
- Cost savings through improved flexibility
- CO₂ emission reductions
- Greater energy resilience and independence

The pilot confirms that distributed storage can support decarbonisation and energy security goals simultaneously.

3. Governance and implementation: the real success factor

The pilot confirms that the main challenges are not technological, but regulatory and organisational.

Successful implementation requires:

- Clear governance and role allocation
- Early grid coordination with the Distribution System Operator (DSO)
- Streamlined permitting procedures
- Stable funding and long-term operation planning
- Integration into municipal and national energy strategies

Peak load reduction must be embedded into energy and climate strategies, SECAPs and national frameworks. It cannot remain an isolated pilot action.

Key message:

The success of flexibility solutions depends more on governance, regulation and planning than on the technology itself.



4. Stakeholder engagement

Effective implementation in Goražde required coordinated involvement of:

- Distribution System Operators (DSOs) and utilities
- Regulators and inspection authorities
- Municipalities and local authorities
- Technology providers and installers
- Energy agencies and technical experts
- Financial institutions
- NGOs and civil society actors

Stakeholders were engaged through bilateral consultations, coordination meetings, procurement processes and public dialogue. This ensured legal certainty, technical feasibility and institutional ownership. Early and broad involvement helped avoid delays, secure political support and increase public acceptance.

5. Communication and awareness

Communication was treated as a core success factor, not an add-on. The solution was presented as a modern, reliable public investment contributing to:

- Lower energy costs
- Reduced emissions
- Increased energy independence
- Improved grid stability

Social media, public events, institutional websites and visual materials were used to explain the concept in simple language.

The key transferable lesson is clear:

Communicate benefits early and repeatedly. Combine digital outreach with face-to-face dialogue. Make results visible.

6. Barriers and enabling conditions

Key barriers included high upfront investment costs (especially for batteries), complex permitting, outdated tariff structures that don't reward flexibility, and limited operational capacity. These can be addressed through targeted subsidies, simplified permitting, tariff reform, smart metering, and training.

Scaling requires full transposition of EU energy directives, clear rules for prosumers and grid access, flexible tariff models, digital management standards, and stable political and financial commitment.

BULGARIA

Battery-based flexibility for SMEs

1. Why peak load reduction matters in Bulgaria

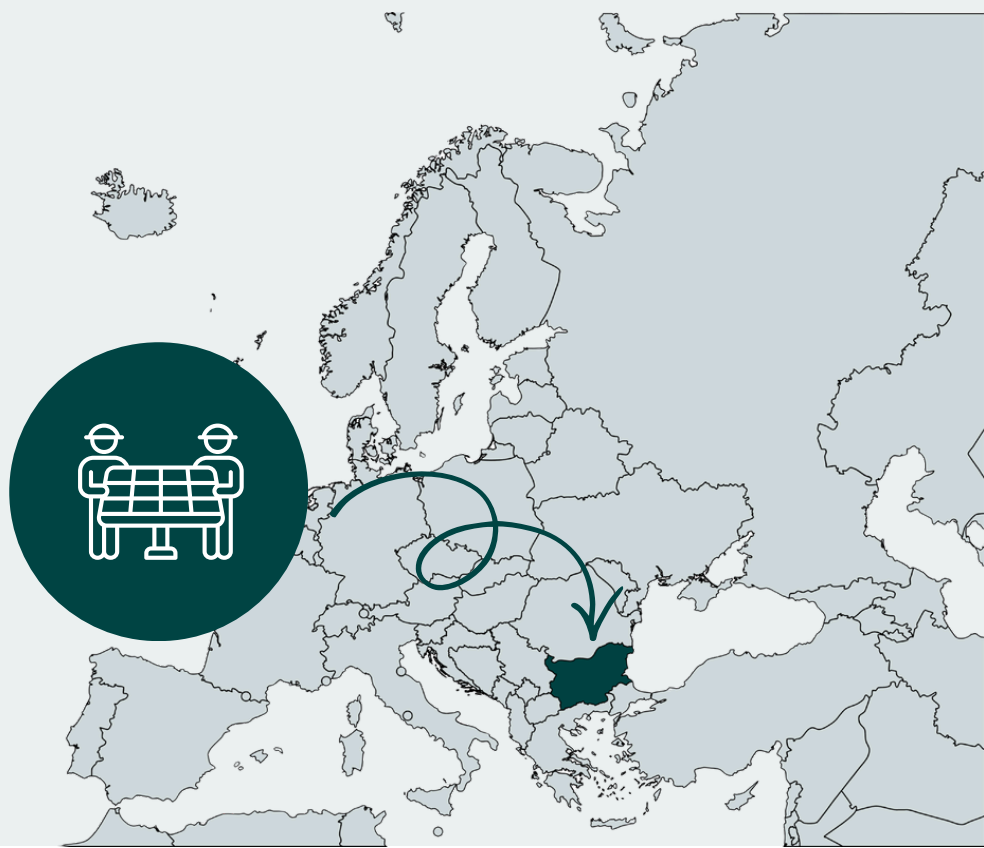
Electricity demand is rising across Bulgaria. Renewable energy capacity is expanding. Electrification of heating, cooling and mobility is accelerating. These changes create higher peak loads and increasing pressure on local distribution grids.

Peak demand does not occur all day. It appears during specific hours, typically in the morning or evening, when many users consume electricity at the same time. These short periods of high demand stress the grid, increase electricity costs and require expensive infrastructure upgrades.

The Bulgarian pilot demonstrates that peak load reduction can be achieved at local level through battery-based energy flexibility. It shows that even small organisations can actively manage their electricity demand instead of passively drawing power from the grid.

Key message:

Energy flexibility is not only for large utilities. It is realistic and affordable for SMEs and public organisations.



2. The Core concept: store smart, use smart

The Bulgarian pilot was implemented in a small enterprise with energy-intensive production. The solution combined photovoltaic (PV) generation with battery storage installed behind the meter.

The operating logic is simple. Electricity is stored when renewable production is high or demand is low. It is then released during peak consumption hours. This shifts electricity use over time and reduces peak load drawn from the grid. The battery is not the goal in itself. The goal is strategic operation of flexibility assets to smooth consumption curves and align demand with renewable production.

This approach delivers multiple benefits at once: higher renewable self-consumption, lower grid stress, reduced electricity costs and lower CO₂ emissions.

3. Implementation: flexibility as an organisational process

The Bulgarian experience confirms that peak load reduction is not just about installing equipment. It requires structured implementation.

Successful projects start with clear definition of the flexibility measure and early screening of regulatory and grid requirements. Governance and responsibilities must be defined from the beginning. Energy managers, finance units and legal departments must coordinate.

Technical design must be based on real consumption and production data. One-size-fits-all solutions do not work. Maintenance and operational responsibilities must be secured before commissioning. Monitoring and adaptation during operation are essential. Flexibility systems must be actively managed to deliver their full value.

Key message:

Treat flexibility as a long-term energy management strategy, not as a one-off technical upgrade.



4. Stakeholder engagement and communication

The pilot shows that technology alone is not enough. Early and structured stakeholder engagement is critical.

Distribution System Operators ensure grid compatibility. Regulators provide the legal framework. Municipalities support integration into local energy strategies. Technology providers deliver design and digital control. Energy agencies facilitate capacity building and replication.

Communication was a core implementation step. The solution was presented in simple language, focusing on cost savings, energy independence, grid stability and climate benefits. Visible demonstration proved more effective than technical explanations.

When flexibility is understandable and visible, acceptance grows quickly.

5. Transferability conditions

Energy flexibility solutions can be transferred across regions when enabling conditions are aligned.

Clear regulatory frameworks for behind-the-meter storage, time-varying tariffs that reward load shifting, digital metering and organisational readiness are key prerequisites. Upfront investment costs and regulatory uncertainty remain barriers, but they can be addressed through targeted funding schemes and standardised guidance.

Flexibility should be embedded in municipal energy plans, SECAPs and national strategies to move from pilot to mainstream adoption.



GERMANY

Integrated flexibility and smart energy management

1. The Strategic context: why Germany needs demand-side flexibility

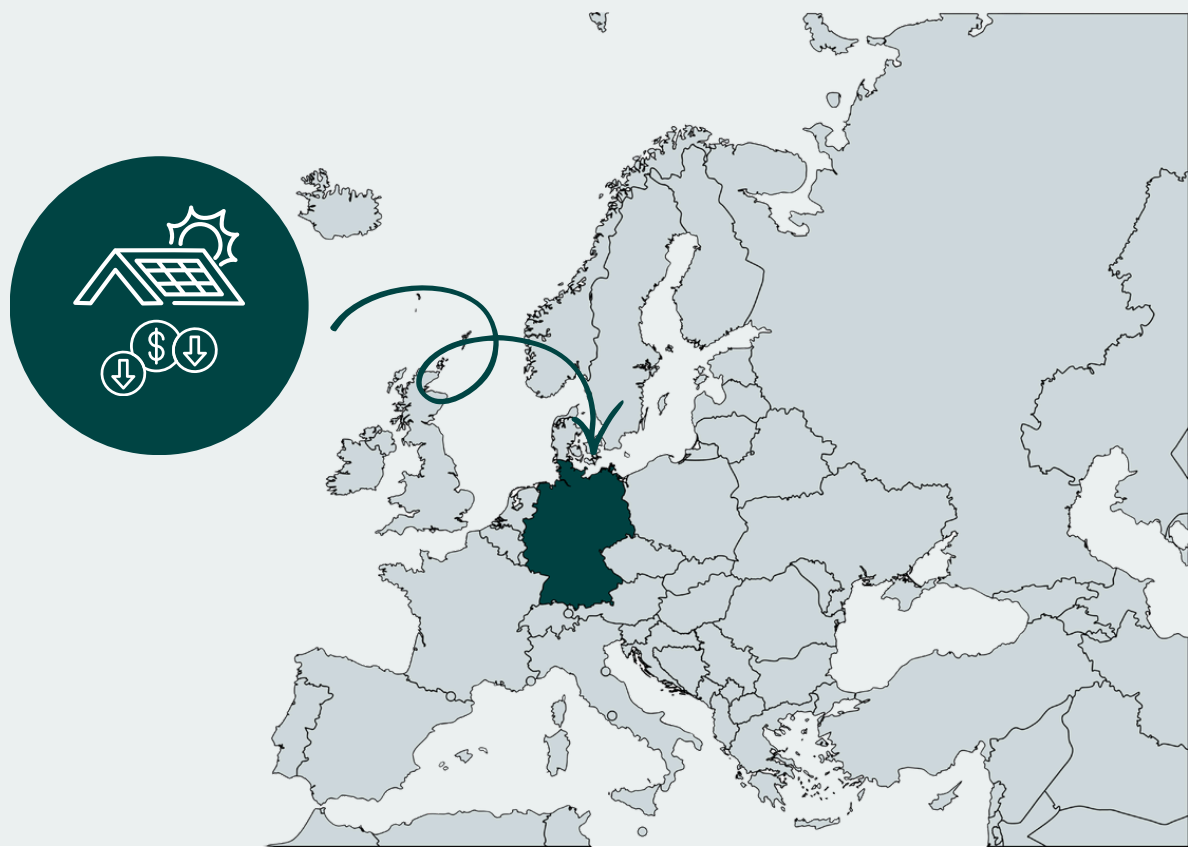
Germany has one of the highest shares of renewable energy in Europe. At the same time, electricity demand is rising due to electrification of heating, industry and mobility. These parallel trends create increasing stress on distribution grids, especially during peak demand periods.

Peak loads are not constant; they occur during specific hours when consumption exceeds the grid's optimal capacity. Managing these peaks is more cost-effective than continuously expanding infrastructure.

The German pilot demonstrates that peak load reduction through coordinated flexibility measures is a realistic and scalable response. Instead of focusing only on new generation capacity, the pilot addresses how electricity is consumed and managed.

Key message:

Managing demand intelligently is as important as expanding renewable generation.



2. The core solution: integrated flexibility approach

The German pilot combines renewable energy production with smart load management and storage integration. The concept focuses on aligning consumption with renewable availability while reducing peak demand from the grid.

Rather than treating buildings or facilities as passive consumers, the solution turns them into active energy participants. Through digital monitoring, smart control systems and coordinated flexibility measures, electricity consumption is shifted away from peak hours.

This integrated approach supports:

- Peak load reduction
- Increased renewable self-consumption
- Lower grid dependency
- Improved cost efficiency
- Reduced CO₂ emissions

The system does not rely on one single technology. Its strength lies in coordination between generation, storage and controllable loads.

3. From demonstration to system change

The German pilot confirms that flexibility is not a niche measure. It can be embedded into broader energy and climate strategies.

Scaling the approach across multiple buildings, business parks or municipalities would multiply its impact. Even moderate replication can significantly reduce aggregated peak loads and delay grid reinforcement investments.

The pathway to scaling is gradual. First, implement flexibility in one building or facility. Second, expand to similar sites. Third, integrate demand-side management into regional planning and energy strategies.

When flexibility becomes standard practice, it strengthens the entire electricity system.



4. Implementation framework: governance before technology

The experience shows that successful peak load reduction requires more than equipment installation.

Clear governance structures must be established at the beginning.

Responsibilities for monitoring, optimisation and maintenance must be defined.

Early coordination with the Distribution System Operator ensures grid compatibility and regulatory compliance.

Technical design must ensure interoperability, cybersecurity and real-time data exchange. Monitoring systems must be reliable and user-friendly.

Financial planning should consider long-term operational savings, avoided grid costs and potential funding opportunities.

Flexibility systems must be actively managed and continuously optimised to deliver their full value.

Key message:

The effectiveness of flexibility depends on data quality, coordination and long-term operation.

5. Stakeholder engagement

The German pilot involved close cooperation between:

- Distribution System Operators
- Municipal authorities
- Technical service providers
- Energy managers
- Regulatory bodies

Early engagement ensured that technical, regulatory and operational questions were addressed before implementation.

Structured dialogue improved acceptance and created a shared understanding of flexibility as a system benefit, not just a local measure.

Without stakeholder alignment, flexibility cannot move beyond pilot scale.



6. Communication and awareness

Communication was a central success factor.

The pilot was presented in clear and simple terms, focusing on benefits rather than technical complexity. Workshops, site visits and digital communication channels helped explain how flexibility improves energy resilience and reduces costs.

Visible demonstration and transparent data sharing strengthened trust and supported replication.

Communication was continuous, not limited to the installation phase.

7. Transferability conditions

The German experience shows that flexibility solutions can be transferred when regulatory clarity, digital infrastructure and organisational readiness are aligned.

Key enabling conditions include smart metering, digital control systems, supportive tariff structures and clear regulatory frameworks for storage and load management.

Barriers such as complex permitting procedures, high upfront costs and limited technical capacity can be addressed through coordinated policy support and funding instruments.

Flexibility must be integrated into energy planning frameworks rather than treated as an isolated innovation.



UKRAINE

Renewable-based heating for critical infrastructure: Integrated heat pump & PV system in Khotyn hospital

1. Executive context: energy security under pressure

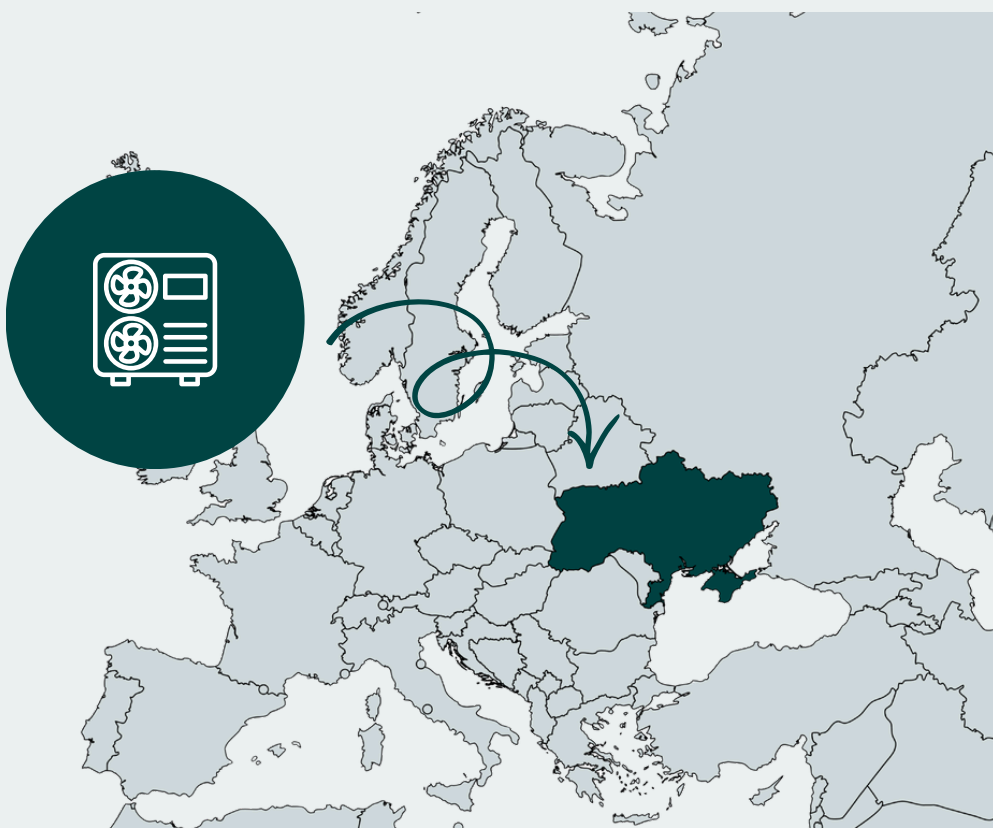
Ukraine is under increasing pressure to secure its electricity system. Rising demand, electrification of heating and the integration of renewable energy sources are occurring in parallel with significant energy security risks. In this context, **peak load reduction, grid stability, affordability and energy independence are not only climate goals – they are national resilience priorities.**

The ESINERGY pilot in Khotyn municipal hospital **demonstrates a scalable solution for reducing peak loads while increasing energy self-sufficiency.** The approach integrates a 75 kW air-to-water heat pump with a 140 kW photovoltaic (PV) system, replacing fossil-fuel heating with renewable-based electricity.

This solution shows that public buildings can reduce peak electricity demand, lower energy costs and strengthen resilience, even under wartime and crisis conditions.

Key message:

Renewable-based heating combined with local electricity generation strengthens grid stability and energy independence.



2. The core solution: heating as a flexibility asset

The solution integrates **air-to-water heat pumps** with on-site PV systems in public buildings. Instead of relying on gas-based heating during peak demand periods, thermal energy is produced using locally generated renewable electricity.

Heat pumps typically operate with a Coefficient of Performance (COP) between 2.8 and 3.5. This means they can deliver up to three times more useful heat than the electricity they consume. When combined with PV systems, they absorb locally produced electricity during high solar generation periods, reducing grid stress.

This shifts energy demand away from fossil fuels and aligns electricity consumption with renewable production. The building becomes an active prosumer, balancing its own generation and consumption. The concept is modular and scalable. It can be replicated in hospitals, schools, administrative buildings and other large public energy consumers.

3. Implementation pathway: governance matters

The pilot experience shows that **successful peak load reduction depends more on governance and coordination** than on technology alone.

Strategic political approval is required at municipal level. Measures should be integrated into Sustainable Energy and Climate Action Plans (SECAPs) and national decarbonisation frameworks.

Clear roles must be assigned across departments: **energy, procurement, finance, legal and facility management**. Early coordination with Distribution System Operators ensures grid compatibility and safe integration. Financial planning must consider capital expenditure, operational costs and long-term payback. Funding can include municipal budgets, state funds, concessional loans and international instruments.

Monitoring and digital metering are essential to measure peak load reduction, renewable self-consumption and CO₂ savings.

Key message:

Governance, early stakeholder involvement and structured planning determine success.



4. Stakeholder engagement and communication

The pilot applied a structured stakeholder engagement model involving municipalities, national authorities, DSOs, energy agencies, financial institutions, technology providers and NGOs.

Early engagement ensured regulatory compliance, political ownership and institutional alignment. Focus groups, workshops and demonstration events strengthened trust and transparency.

Communication focused on visible benefits: reliable heating supply, lower energy costs, energy independence and reduced emissions. Demonstrating the system in operation proved more effective than technical explanations alone. Positive, human-centred messaging increased public acceptance and political support.

5. Conditions for replication

Successful transfer of the solution requires enabling conditions:

- Clear legal status of public prosumers
- Simplified permitting and procurement procedures
- Supportive tariff and market design
- Political commitment and institutional ownership
- Access to blended financing mechanisms
- Digital monitoring and interoperability

Barriers such as high upfront costs, administrative complexity and limited technical capacity can be mitigated through targeted funding, technical training and standardized documentation.



CROSS-CUTTING LESSONS FROM 8 COUNTRIES

Across Austria, Hungary, Slovenia, Croatia, Bosnia and Herzegovina, Bulgaria, Germany and Ukraine, five structural lessons emerge:

1. Peak load reduction is a governance process.

Flexibility requires coordination between energy, finance, legal and technical departments. Clear internal responsibilities accelerate scaling.

2. Early DSO involvement is decisive.

Grid readiness, connection conditions and operational compatibility must be clarified before procurement.

3. Flexibility must grow together with renewables.

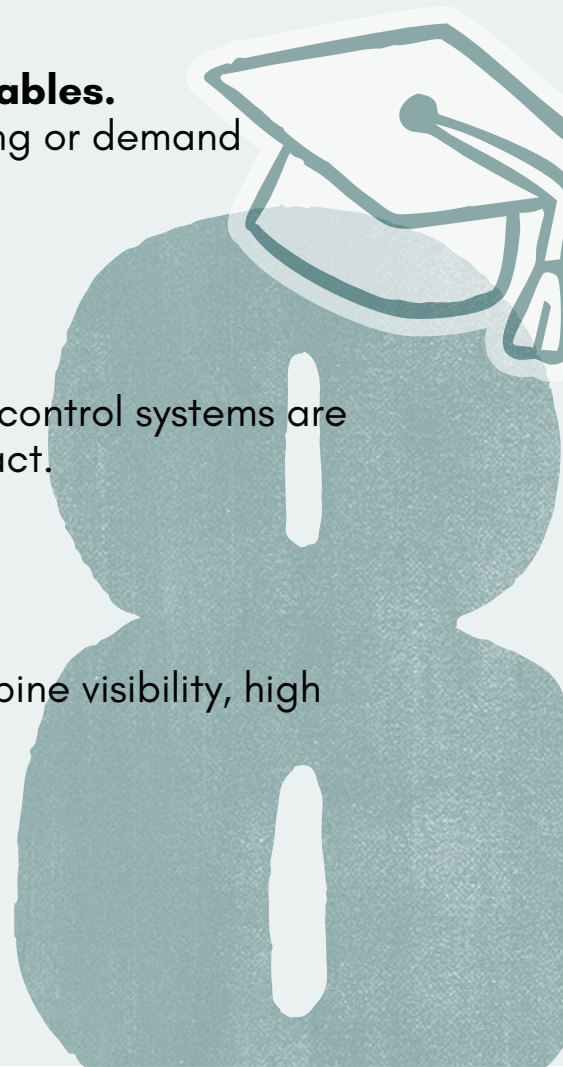
Solar expansion without storage, smart charging or demand coordination increases grid stress.

4. Digitalisation is non-negotiable.

Smart metering, monitoring and interoperable control systems are prerequisites for measurable and scalable impact.

5. Public buildings are ideal starting points.

Hospitals, schools and municipal facilities combine visibility, high energy demand and political legitimacy.



TRANSNATIONAL COMPARATIVE INSIGHTS



A common structural challenge

All eight countries face the same dynamic:

- Rising electricity demand (heat pumps, EVs, electrification),
- Rapid photovoltaic expansion,
- Increasing pressure on distribution grids.

**Renewable energy alone does not ensure stability.
Flexibility is the balancing mechanism.**

Three technical pathways – one strategic goal

Despite different contexts, solutions cluster into three models:

Battery-supported PV systems

(Austria, Croatia)

Store renewable electricity and release it during peak demand.

Clear, measurable impact. Strong replication potential.

Coordinated smart energy management

(Hungary, Bulgaria, Bosnia and Herzegovina)

Align renewable production and controllable demand through digital coordination and structured governance.

Lower hardware intensity, stronger institutional coordination.

Electrification combined with flexibility

(Slovenia, Germany, Ukraine)

Smart charging, aggregation and renewable-based heating integrate electrification with system balancing.

Long-term structural transformation with strong decarbonisation impact.



GOVERNANCE MATURITY DETERMINES SCALING SPEED

Comparative analysis shows:

- Early political endorsement accelerates deployment.
- Dedicated energy management units improve coordination.
- Integration into SECAPs and municipal strategies increases sustainability.
- Fragmented regulatory environments slow replication.

Governance clarity reduces investment hesitation more effectively than subsidies alone.

FINANCIAL LOGIC

Upfront investment cost is the main barrier across all countries. However, economic viability improves when accounting for:

- Avoided grid reinforcement,
- Reduced peak tariffs,
- Lower fossil fuel dependency,
- Long-term operational savings,
- CO₂ reduction value.

Integrated funding (RES + storage + digital control) delivers stronger returns than isolated investments.

DIGITAL INFRASTRUCTURE AS SCALING ACCELERATOR

All pilots confirm:

**Without smart metering, monitoring systems and interoperable control architecture, flexibility cannot be optimised or monetised.
Digital maturity directly correlates with replication speed.**

Across countries, a consistent three-step model emerged:

Step 1 – Pilot demonstration

Test governance, technology and financing at one site.

Step 2 – Regional replication

Expand to multiple buildings through structured coordination.

Step 3 – Strategic integration

Embed flexibility into regional and national energy frameworks.

STRATEGIC POLICY IMPLICATIONS

At municipal level

- Integrate peak load reduction into energy and climate strategies.
- Assign clear operational responsibilities.
- Plan long-term investment frameworks rather than one-off projects.

At national level

- Clarify legal status of public prosumers.
- Support integrated systems (PV + storage + smart control).
- Introduce tariff structures that reward load shifting.
- Simplify permitting and grid connection procedures.

At EU level

- Align renewable expansion with flexibility deployment.
- Support digital infrastructure and interoperability standards.
- Strengthen aggregation and flexibility market frameworks.
- Promote cross-border knowledge exchange.

FINAL STRATEGIC MESSAGE

The ESINERGY pilots confirm that peak load reduction is:

- Technically feasible,
- Economically rational,
- Institutionally manageable,
- Replicable across diverse regulatory contexts.

Flexibility is no longer optional.

It is a structural requirement of a resilient and decarbonised energy system.
The technologies are available.
The governance models are tested.
The policy instruments are identifiable.

The next step is coordinated scaling, from pilot demonstration to structural deployment across the Danube region and beyond.