Interreg CENTRAL EUROPE

Co-funded by the European Union

JETforCE

# JETforCE

# JUST ENERGY TRANSITION FOR CENTRAL EUROPE

## Work Package 1 - Transnational cooperation to develop tools and enhance capacities for Just Energy Transition

## Activity 1.2 - Handbook

## Knowledge sharing and transnational learning to set JETforCE scenario

Final Version

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# LIST OF ABBREVIATIONS

AI – Artificial Intelligence

AP - Associated Partners

CE - Central Europe

CES - Citizen Energy Communities

DA – Digital Ambassador

EC - European Commission

EU – European Union

GHGs – Greenhouse Gases

IoT – Internet of Things

JETA – Just Energy Transition Alliance

JETforCE - Just Energy Transition for Central Europe

JTF – Just Transition Fund

JTM – Just Transition Mechanism

NGOs – Non-Governmental Organisations

PP – Project Partners

REC - Renewable Energy Communities

RES - Renewable Energy Sources

R&D – Research and Development

SMEs – Small Medium Enterprises

TM – Transition Management

TJTP - Territorial Just Transition Plan

VET – Vocational Education and Training

WP – Work Package

# INTRODUCTION

Following transnational exchanges involving project partners (PP), associated partners (AP), local Just Energy Transition Alliance (JETA) and thematic experts, the purpose of this handbook is to merge knowledge to consolidate key definitions, concepts and assumptions. The handbook offers a theoretical framework and feeds into all the subsequent activities and outputs of the project.

The handbook also provides an overview of the challenges faced today in Interreg Central Europe regions while pursuing a just energy transition, along with the measures adopted to face such challenges. The measures contained in national and regional just energy transition plans mainly refer to incentives and investments for green energy production, establishment of energy communities and citizen engagement initiatives. The handbook reviews best practices and state of the art evidence from Interreg Central Europe regions. Also, it provides an analysis of the requirements for public authorities and energy actors to achieve a just energy transition, such as skills, technical resources, capacities and tools.

# 1. BACKGROUND ON THE PROJECT

## 1.1 Project Objectives

Just Energy Transition for Central Europe (JETforCE) is an Interreg Central Europe Project[1] that addresses the need for energy transition in the Interreg Central Europe regions, without disproportionate negative socio-economic impacts on vulnerable territories or demographics. JETforCE harnesses digitalisation as a means to co-design and co-implement a Just Energy Transition in Interreg Central Europe regions. The project yields positive impacts on Interreg Central Europe regions and citizens, with fairer policies and technologies, better digital skills, environmental benefits and behavioural changes already in the project lifetime.

JETforCE improves local and regional energy planning, equipping public authorities and stakeholders with the capacity and digital solutions necessary to develop a Just Energy Transition framework that:

1) Actively engages citizens, including the most vulnerable.

2) Evaluates technologies for energy efficiency and renewable energy through a socio-economic lens.

Specifically, the project develops the two digital tools described below and enhances the capacity of partners (PP), associated partners (AP) and stakeholders to apply them. The solutions are simple, user friendly, thus supporting wide uptake. They are scalable to heterogeneous territorial types. The project outputs will benefit a wide range of stakeholders, such as local, regional, national authorities, sectoral agencies, public service providers, NGOs and interest groups, industry and SMEs, citizens and digital ambassadors.

**Tool 1 - Challenge Mapping:** is a youth led framework (app and connected database, using block-chain technology), where a challenge reporting data structure assesses climate transition initiatives in a given area and identifies potentially adverse effects on vulnerable communities. In JETforCE, we adapt this experimental tool to Interreg Central Europe regions and extend it to all citizens. We activate Digital Ambassadors (AD), who help bridge the digital inclusion gap. The Digital Challenge Mapping is a digital, bottom-up tool, with block chain technology, where citizens identify local climate challenges.

[1] https://www.interreg-central.eu/

**Tool 2 - Technology Evaluation:** is a brand-new software that we co-create to analyse cost/benefits of existing and proposed technologies for green energy production, distribution and use. The evaluation can be applied to most recent technologies e.g., IOT, big data, smart meters and thermostats, optimised process control. Questions guide decision makers through indicators on potential impact on socio-procedural justice, energy indicators and costs.

Weighted answers serve as decision making support for investments. This brand-new software analyses and compares performance of energy transition technologies actually implemented and ideal scenarios, through a cost-benefit analysis. Benefits are related to energy and socio-economic indicators.

## 1.2 EU Policy and Initiatives on Just Energy Transition

The JETforCE project is well aligned to EU policies and strategies such as European Green Deal[2], Territorial Agenda 2030[3], European digital transformation strategy[4] and European skills agenda for sustainable competitiveness, social fairness and resilience[5]. JETforCE is also aligned to the Just Transition Mechanism (JTM)[6], that is specifically designed to support territories most affected by transition towards climate neutrality.

The JETforCE project will also work in synergy with previous and ongoing EU projects and initiatives. Examples are EU projects outputs from the Interreg programming period 2014-2020. These include projects in Interreg Central Europe regions, such as ENES-CE[7] dealing with citizen engagement in energy planning, TOGETHER[8] targeting citizen involvement in public building energy management (EAV and SIEA are project partners) and CityEnGov[9] supporting the development of sustainable structures and tools to coordinate energy related initiatives (WEIZ is a project partner). Interreg Europe has funded further projects relevant to JETforCE. The project REBUS[10] focuses on improving the capacity of local authorities in promoting energy efficiency in public buildings (BORA and EIfI-Tech were project partners). Additionally, the project SUPPORT[11] develops local policy instruments to implement energy policies (IRENA is the lead partner of the project).

Under the Horizon 2020 Programme, the project REEEM[12] focuses on the role of technologies for energy efficient economies, while the project CROWDTHERMAL[13] addresses community-based development schemes for geothermal energy. Under the renewed Horizon Europe Programme, the project AdJUST[14] aims at achieving a change in societal understanding of the distributive repercussions of the transition to climate

2 https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

3 https://ec.europa.eu/regional_policy/en/information/publications/brochures/2021/territorial-agenda-2030-a-future-for-all-places

4 https://eufordigital.eu/

5 https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1196

6https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en

7 https://programme2014-20.interreg-central.eu/Content.Node/ENES-CE.html

8 https://programme2014-20.interreg-central.eu/Content.Node/TOGETHER.html

9 https://programme2014-20.interreg-central.eu/Content.Node/CitiEnGov.html

10 https://projects2014-2020.interregeurope.eu/rebus/

11 https://projects2014-2020.interregeurope.eu/support/

12 https://www.reeem.org/#:~:text=REEEM%20AIMS%20to%20gain%20a,the%20Strategic%20Energy%20Technology%20Plan.

13 https://www.crowdthermalproject.eu/

14https://www.cmcc.it/projects/adjust-advancing-the-understanding-of-challenges-policy-options-and-measures-to-achieve-a-just-eu-energy-transition

neutrality, and to identify effective and actively supported policy interventions to accompany climate action so that no one is left behind.

Most recent projects can refer to projects funded under the 2020 Green Deal call, such as PHEONIX[15] and REAL DEAL[16], on the topics of citizen deliberation, participation and deliberative democracy. In 2022 further projects funded by the Horizon Europe call "Fostering a just transition in Europe" began and will help to gain a better understanding of the distributional repercussions of the transition to climate neutrality.

To conclude, Just Energy Transition is a newer concept, prioritised in the 2021-2027 EU programming period. Therefore, projects in this field are still few and none focuses specifically on Interreg Central Europe regions. Moreover, none of the financed initiatives proposes a strategy integrating digitalisation into citizens engagement and an evaluation of solutions for a Just Energy Transition.

15 https://phoenix-horizon.eu/
16 https://www.realdeal.eu/

## 1.3 Work Packages (WPs)

WP 1 focused on transnational cooperation to develop digital tools and to enhance stakeholders' capacity to apply such tools. To co-develop, and enhance capacity in applying, transnational tools for Just Energy Transition that engage all citizens digitally in policy co-creation and evaluate green digitalisation opportunities through a just energy transition lens.

WP1 set up and consolidated local Just Energy Transition Alliances (JETAs). JETAs represent local energy ecosystems that support PP and AP throughout implementation, providing input to the various phases. Each JETA launched a call to select one Digital Ambassador (DA). The DA bridges the local gap between citizens and technologies, ensuring that all citizens can have direct or indirect access to JETforCE digital solutions.

At a later stage, WP1 involved PP, AP and JETA in transnational exchanges for knowledge sharing and mutual learning to set the JETforCE scenario. These exchanges resulted in the development of this handbook, which feeds into all the subsequent activities and outputs of the projects.

WP1, developed two digital tools, respectively Challenge Mapping and Technology Evaluation. The conclusive activity in WP1 was to enhance the capacity of PP, AP and JETA to implement JETforCE's digital tools through an online kit containing resources and guidelines.

WP2 designed and implemented transnational pilots to test and validate the two digital tools for just energy transition in order to turn them into solutions. WP3 ensured that the digital tools were taken up, scaled up and integrated into policy in Interreg Central Europe regions.

# 2. PROJECT PARTNERS AND REGIONS

## 2.1 Hungary - BORA 94 Borsod-Abaúj-Zemplén County Development Agency Nonprofit LLC

BORA 94 is a non-profit company, 100% owned by the Borsod-Abaúj-Zemplén County Self-Government, playing a key role in territorial development at county-level since 1994. The agency is an umbrella organisation, having established strategic partnerships with public and private actors (e.g., public authorities, professional organisations, NGOs, research institutes, enterprises, etc.) on local, national, and international levels. Overall, BORA 94 has over 20 years of experience in strategic planning (including methods and tools), capacity building, facilitating public-private cooperation, communication and awareness raising.

Besides dealing with both internal and external preparation and implementation of EU funded projects, BORA 94's main competences include the elaboration of development strategies and concepts for the region and beyond, preparation of cost-benefit analyses, feasibility studies, marketing plans, providing funding advice for SMEs. As such, BORA 94 can indirectly influence local programming and planning, as well as the policymaking process. It can also highly contribute to the implementation of current strategic priorities, such as the green and digital transition of lagging behind areas. In the consortium, BORA 94 represents a heavy industrial, densely populated area (Borsod-Abaúj-Zemplén County, B-A-Z County).

## 2.2 Germany - European Institute for Innovation - Technology (EIfI-Tech)

EIfI-Tech is a pan European nonprofit organisation acting as a stimulator for economic activity through its regional, national and transnational work. EIfI-Tech focuses on technological developments, with the main areas of activity being energy, education, sustainability, transport and mobility. EIfI-Tech works with Quadruple Helix actors (i.e., national/EU agencies, learning institutions, private sector and people) and is dynamic across the energy sector, particularly concerning activities in applied research, feasibility, testing, development, demonstration and deployment. EIfI-Tech combines thematic expertise with high-level skills on engagement, training and capacity-building and long-term experience in transnational cooperation.

## 2.3 Austria - International Association for the Advancement of Innovative Approaches to Global Challenges (IAAI)

IAAI is a youth-focused, UN accredited, not-for-profit civil society organisation. IAAI's overall goal is to empower everyone everywhere to engage in collaborative action for the local and global common good, with culture, technology and social innovation and in alignment with the UN Sustainable Development Goals. To achieve this goal, IAAI organises awareness raising, capacity building and citizen and youth engagement programmes. It promotes climate-friendly lifestyles and citizen science supporting digital tools. IAAI has a strong data and impact driven approach to citizen engagement, as a pre-requisite for innovative climate action incentive mechanisms.

## 2.4 Italy - Metropolitan City of Bologna

The Metropolitan City of Bologna is an intermediate public authority with responsibilities on policies for economic development, tourism, infrastructures, transport, environment and strategic planning at local level. The Metropolitan City of Bologna has an area of around 3,700 km2 with 54 municipalities and over 1 million inhabitants. Bologna is the capital and largest city of the Emilia Romagna Region, the third most prominent Italian region by number of firms that have invested in green technologies. Bologna boasts significant research centres in the realm of environment and climate change (e.g., ENEA, CNR). It is Italy's second most significant location for innovative tech start-ups, and the Italian city with the highest number of invention patents in ratio to the number of companies. The Metropolitan City of Bologna represents a large metropolitan area.

## 2.5 Germany - Bautzen Innovation Centre (TGZ)

TGZ has four key strategic objectives: support of start-ups (incubator), knowledge and technology transfer/innovation support, regional economic development and energy advisory services. From 2012 to 2023, TGZ ran the Bautzen District Energy Agency, combining innovation and experience with energy. Moreover, since 2021, they run the local EU information center, Europe Direct. The Energy Agency has supported the use of renewables and the increase of energy efficiency in the district. In this role, TGZ disposes of established contacts with citizens, enterprises and the 57 municipalities of the area, having supported them to save energy and to develop concepts for a future-oriented energy supply. TGZ also works with the Regional Planning Association, responsible for new areas for windmills and for lignite areas. The Bautzen district is located in a lignite and mining area, which faces a huge structural change until 2030-2038. The district is one of the territories that would be the most severely affected by the phasing-out of coal mining and by the transition to a climate neutral and circular economy (under the Just Transition Fund).

## 2.6 Slovenia - Local Energy Agency Spodnje Podravje (LEASP)

LEASP is an energy manager of more than 20 municipalities in the Podravje region. Main activities of LEASP as an energy manager are: developing local energy concepts, supporting local authorities in development of energy strategies, energy management and bookkeeping, preparing initiatives and trainings on RES and EE, energy auditing of the buildings and lightning systems, developing feasibility studies for investments in public sector (energy renovation of buildings, public lightning systems, implementation of renewables) and energy certification. The mandate of LEASP is to enhance regional sustainable energy development, by developing projects and studies and by helping municipalities and investors to find the financial sources for projects and investments, control implementation and transfer energy technologies from universities and companies (especially from other EU countries), find sustainable and economically feasible measures to decrease energy consumption, increase energy efficiency and implement renewables. LEASP represents a small municipality in a rural area.

## 2.7 Croatia - Istrian Regional Energy Agency Ltd. (IRENA)

IRENA was founded in 2009 by the Istrian Region to provide advisory service to public and private actors, households and citizens on energy issues. IRENA represents a quality link in the functioning of all energy-related stakeholders within the Istrian Region. IRENA is active in the promotion of energy efficiency (EE), renewable energy sources (RES) use and cogeneration, use of innovative materials and technologies in energy saving, experienced in fields related to energy refurbishment, preparation, development and implementation of projects related to EE/RES. IRENA represents a coastal region and one of the former coal regions in Croatia.

## 2.8 Czech Republic - Energy Agency Vysočiny (EAV)

EAV is a non-profit organisation working in energy management, energy services and waste management with a special focus on Vysočina Region, where EAV is well known. EAV has vast experience in consultancy in energy management, energy savings, monitoring of energy consumption and waste management both for private and public sectors. EAV also oversees energy audits, energy certificates, expert studies, analyses and expert reports of different public and private buildings not only in the Vysočina region but also in the whole Czech Republic. EAV cooperates with regional and local authorities, institutions, organisations, schools and entrepreneurs. EAV represents the capital of a rural region, dominated by hills and forests.

## 2.9 Slovakia - Slovak Innovation and Energy Agency (SIEA)

SIEA, founded in 1999 as a professional allowance agency directed by the Ministry of Economy of the Slovak Republic, is the centre of competence for energy efficiency, energy innovations and renewable energy sources (RES). SIEA acts as an implementation agency for Structural Funds. SIEA as the national energy agency understands deeply the Slovak energy market and its participants – the decision makers, companies, professionals, associations and all those involved in energy and energy efficiency. The main areas of experience are: the energy planning, ranging from energy audits up to regional and state conceptions; the development of legal framework; the monitoring of energy efficiency; the transfer and promotion of energy efficiency solutions via networking with the major stakeholders (municipalities); the direct consulting support in project implementation; and the financial engineering, with a special emphasis on trainings and information seminars for professionals, as well as for the general public. SIEA represents a mountain region with low population density.

## 2.10 Poland - Lodzkie Region

The Lodzkie Region is located in central Poland with an area of over 1.8km$^2$ inhabited by approx. 2.5 million people. The Regional Self-Government is responsible for shaping a sustainable development policy of the region by defining and implementing the strategies, out of which the Regional Development Strategy and the Regional Innovation Strategy underpin the economic development of the region in the most significant way. The Lodzkie Board is the managing authority for regional operational programmes financed by ERDF and ESF+. This allows for the policies outlined for the regional development to be directly implemented through envisaged projects, investments and other measures. In December 2022, the European Commission approved the regional program and TJTP for the Lodzkie Region, thereby the region also received support from the Just Transition Fund. At this point, interested entities can already apply for support under announced calls for applications for various activities. Lodzkie, as one of Polish coal regions, is facing an important process of energy transition. The region is a seat to a mining complex (Bełchatów Lignite Mine and Bełchatów Power Plant) producing 20% of electricity in the country and employing 14,000 people.

## 2.11 Italy - Fondazione YUNUS, Italia

Fondazione YUNUS Italia is a non-profit organisation that works as the first and only centre in Italy dedicated to studying and replicating microcredit programmes based on the Grameen Bank methodology. Since 2017, Fondazione YUNUS Italia works as a business incubator facilitating access to credit, with specific reference to microcredit for micro and small enterprises. Fondazione YUNUS Italia, as a member of the European Microfinance Network, has built a solid network of financial and non-financial partners in Italy and EU. Additionally, Fondazione YUNUS Italia operates in the field of financial education, collaborating with civil society organisations for educational interventions and employment support.

Finally, to respond to the new needs of non-financial social reporting, some of which made more urgent by the 2016 Italian Reform of the Third Sector, Fondazione YUNUS Italia carries out studies for social impact assessment.

Fondazione YUNUS Italia implements the following activities: study and feasibility analysis of entrepreneurial projects to achieve business planning; provision of financial education courses and expertise; and carrying out studies for social impact assessments and analysis, with particular reference to social innovation.

## 2.12 Austria - Weizer Energy and Innovation Centre (WEIZ)

WEIZ, as a regional contact point for energy and innovation, is an important driving force for the economic structural change in the region of Eastern Styria, especially for the municipality of Weiz. WEIZ has a strong expertise in the areas of joint use of electricity, research-related implementation projects and wood in vehicle construction. WEIZ has specific competences in thermal storages, biomass district heating networks and all issues concerning renewable energy systems. Since 1998, WEIZ has developed various R&D and innovation projects at the regional, national and international level. Project fields include, among other topics, energy innovations in the areas of cross-building communal power supply, the development and promotion of regional energy analysis and saving concepts (SECAP), wood in vehicle construction and stakeholder participation. WEIZ represents an historical centre in a mountain area.

# 3. JUST ENERGY TRANSITION IN INTERREG CENTRAL EUROPE REGIONS

## 3.1 JETforCE Definitions and Concepts

### 3.1.1 European Green Deal and Just Transition Mechanism

Energy transition refers to the shift from fossil fuels and other non-renewable energy sources to cleaner and more sustainable alternatives. The primary goal is to mitigate the impact of climate change, reduce greenhouse gases (GHGs), and promote environmental sustainability. To achieve the above mentioned, in 2019 the EU Commission (EC) adopted the European Green Deal[2].

The **European Green Deal** is a response to environmental challenges. It is a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of GHGs in 2050 and where economic growth is decoupled from resource use. At the same time, this transition must be just and inclusive. The European Green Deal put people first, and pay attention to the regions, industries and workers who will face the greatest challenges.

Since it will bring substantial change, active public participation and confidence in the transition is paramount if policies are to work and be accepted. Hence, no person and no place must be left behind.

According to the EC, a "Just" Energy Transition must ensure that the transition towards a climate-neutral economy happens in a fair way, to alleviate the socio-economic impact of the transition for regions, industries and workers. Such regions can refer to those regions that are still significantly reliant on non-renewable energy production, such as coal mining regions. In order to achieve these objectives, the EC has established the so called **Just Transition Mechanism (JTM)**[6], whose pillars are the Just Transition Fund (JTF)[17] and the Just Transition Platform[18]. The JTM is expected to mobilise around €55 billion in the period 2021–2027 to support regions, sectors and workers most-affected by the transition.

The **Just Transition Fund (JTF)**[12] is equipped with €19.2 billion and is expected to mobilise around €25.4 billion in investments with national co-financing and voluntary transfers from other funds. The JTF will alleviate the socio-economic costs triggered by climate transition, supporting the economic diversification and reconversion of the territories concerned. This means backing productive investments in small and medium-sized enterprises (SMEs), the creation of new firms, research and innovation, environmental rehabilitation, clean energy, up- and reskilling of workers, job-search assistance and active inclusion of jobseekers' programmes, as well as the transformation of existing carbon-intensive installations when these investments lead to substantial emission cuts and job protection.

The JTF is established by the JTF Regulation[19] and governed by the Common Provisions Regulation. It is implemented under shared management, under the overall framework of cohesion policy. As part of their Cohesion Policy programmes, Member States must also prepare strategic **Territorial Just Transition Plans (TJTPs).** Once the programmes including the TJTPs are adopted, national or regional authorities are responsible for selecting the projects to be funded. Specific questions on application procedures may be addressed directly to the managing authorities.

The **Just Transition Platform** assists EU countries and regions with the just transition. It consists of a single access point and helpdesk. It provides comprehensive technical and advisory support. Authorities and beneficiaries can access it to find all they need to know about the funds, including opportunities, relevant regulatory updates or sector specific initiatives. Member States can get access by preparing TJTPs that cover the period up to 2030, identifying the territories that should get the most support. The plans should also set out ways to best address social, economic and environmental challenges.

17https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism/just-transition-funding-sources_en

18 https://ec.europa.eu/regional_policy/funding/just-transition-fund/just-transition-platform_en

19 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R1056

JET is a complex process that requires collaboration among governments, industries, communities and individuals to ensure a successful and sustainable shift towards decarbonisation and, ultimately, an environmentally friendly energy system. Hence, citizens' engagement becomes a key element to achieve a deliberative democracy and participatory policymaking.

In this regard, the EC is running a citizen engagement project, called the "Citizens' Voice for Climate Transition", which is part of the European Green Deal calls. Its goal is to analyse the environmental, social and economic transitions needed to achieve the European Green Deal objectives in different domains:

- Technological and behavioural changes mandated by EU initiatives and policies.
- Social justice mechanisms across different geographical and social contexts necessary to keep the process fair.
- Engagement of citizens across the EU to generate public buy-in.

### 3.1.2 Reflexive Governance and Transition Management for a Just Energy Transition

Since long-term infrastructure sectors have identified their own governance, i.e., the capacity to shape and transform itself, as a major concern[20]. As a response, the notion of reflexive governance was proposed to tackle challenges such as the transition to clean and/or decentralised energy production[21]. Reflexive governance becomes concerned with its own conditions, perspectives, expectations, knowledge, strategies and dynamics, in order to avoid the assumption of full knowledge in advance[22]. Reflexive governance implies the acknowledgment of participation, deliberation, probing and collective learning as key elements for inducing and navigating complex processes of socio-technical change[23].

This dynamic and polycentric model of governance may lead to more effective and sustainable provision of public services[24]. Reflexive governance is widely applied in the context of sustainability as it aims to solve socio-ecological vulnerabilities. To contrast environmental degradation, reflexive governance proposes renewed forms of analysis and design of environmental policy and planning[25,] as well as collaborative climate risk management[2627].

20 Voß, J.-P.; Borneman, B. The politics of reflexive governance: Challenges for designing adaptive management and transition management. Ecol. Soc. 2011, 16, 9.

21 Wegrzyn, J.; Gluszak, M.; Telega, A. Infrastructure endowment, financial constraints and willingness to engage in PPPs: The case of Poland. Public Money Manag. 2019, 39, 132–138.

22 Meadowcroft, J. What about the politics? Sustainable development, transition management, and long-term energy transitions. Policy Sci. 2009, 42, 323–340.

23 Voß, J.P.; Smith, A.; Grin, J. Designing long-term policy: Rethinking transition management. Policy Sci. 2009, 42, 275–302.

24 Goldthau, A. Rethinking the governance of energy infrastructure: Scale, decentralization and polycentrism. Energy Res. Soc. Sci. 2014, 1, 134–140.

25 Feindt, P.H.; Weiland, S. Reflexive governance: Exploring the concept and assessing its critical potential for sustainable development. Introduction to the special issue. J. Environ. Policy Plan. 2018, 20, 661–674.

26 Mees, H.; Alexander, M.; Gralepois, M.; Matczak, P.; Mees, H. Typologies of citizen co-production in flood risk governance. Environ. Sci. Policy 2018, 89, 330–339.

27 Westling, E.L.; Sharp, L.; Rychlewski, M.; Carrozza, C. Developing adaptive capacity through reflexivity: Lessons from collaborative research with a UK water utility. Crit. Policy Stud. 2014, 8, 427–446.

The importance of a collaborative approach to environmental risk governance was already recognised by the Aarhus Convention (1999), which established rights to access environmental information and legitimated public participation in environmental decision-making[28].

The model of transition management (TM) represents a suitable tool for the adoption of innovative approaches within complex socio-technical systems such as network infrastructures, natural resources and waste, agriculture and housing[29]. TM aims at "influencing the direction and speed of transitions by coordinating and enabling the processes that occur at different levels in a more systemic and evolutionary way"[30]. Rotmans et al.[31] defined TM in a perspective of incrementalism planning by adopting long-term system thinking, back-casting and forecasting. The objectives of TM are to achieve desirable social goals, to avoid serious pitfalls, i.e., strengthening climate resilience, and to adopt institutional reforms to cope with unfolding patterns of change.

The concept of better regulation[32], adopted by the EC, seems an adequate instrument to adopt the notions of reflexive governance and TM through the implementation of concrete actions. These include:

- Evidence-based policymaking
- Legislative simplification for fit-for-purpose law
- Extensive planning, risk and impact assessment
- Improved stakeholders' consultation and coordination to strengthen mutual capability
- Transparency

28 Koester, V. The Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention). In Making Treaties Work: Human Rights, Environment and Arms Control; Cambridge University Press: Cambridge, UK, 2007

29 Rotmans, J.; Loorbach, D.; Kemp, R. Transition Management: Its Origin, Evolution and Critique. In Proceedings of the Workshop on Politics and Governance in Sustainable Socio-Technical Transitions, Berlin, Germany, 19–21 September 2007.

30 Kemp, R.; Loorbach, D. Transition Management: A Reflexive Governance Approach. In Reflexive Governance for Sustainable Development; Edward Elgar: Cheltenham, UK, 2006.

31 Rotmans, J.; Loorbach, D.; Kemp, R. Transition Management: Its Origin, Evolution and Critique. In Proceedings of the Workshop on Politics and Governance in Sustainable Socio-Technical Transitions, Berlin, Germany, 19–21 September 2007.

32 Decision of the President of the European Commission on the Appointment of Members to the Task Force on Subsidiarity, Proportionality and "Doing Less More E_ciently", C(2018) 406; European Commision: Brussels, Belgium, 2017.

## 3.2 JETforCE Challenges

JET is a complex and multifaceted process. While it aims to address environmental concerns and to promote social equity, it also presents various challenges. Some of the key challenges to achieving a JET are outlined below.

1. **Social Equity and Inclusion**: Ensuring that the benefits and costs of the energy transition are distributed fairly across different social groups and regions can be challenging. Vulnerable and marginalised communities often bear a disproportionate burden of the negative impacts of energy transition policies, such as job losses in fossil fuel industries and increased energy costs.

For instance, **Hungary** will receive around €237 million from the JTF, which will be allocated to the regions of Heves, BAZ and Baranya with the aim of supporting local economies and communities as the energy transition unfolds. However, as it appears through the government's public communication, there is a concrete risk that energy-intensive, polluting industries could receive a large share of the JTF, at the expenses of local communities, SMEs and municipalities.

**2. Economic Disruption:** Transitioning away from fossil fuels can have economic consequences, particularly in regions heavily dependent on fossil fuel industries. Job losses in these industries can lead to economic hardship for workers and communities. Balancing the need for economic growth and stability with the imperative to reduce carbon emissions is a complex task.

**3. Energy Poverty:** While transitioning to RES is important for mitigating climate change, the initial costs of renewable technologies can sometimes lead to higher energy costs for end users/consumers. This can exacerbate energy poverty, where households struggle to afford basic energy services, potentially leading to social inequality and health issues.

Studies show Interreg Central Europe regions as the most vulnerable regions for energy poverty[33]. On average, poorest households in the EU allocate 8.3% of income to energy services. In some Interreg Central Europe regions, this stands at 20%. Concerns about access to affordable energy and transport have increased with Covid-19 and increasing energy prices. Hence, vulnerable citizens risk bearing a disproportionate socio-economic brunt of energy transition investments.

**4. Infrastructure Investment:** Transitioning to a low-carbon energy system requires significant investment in new infrastructure, such as renewable energy facilities, energy storage, and smart grids, P2X and green

[33] Bouzarovski, S. and Herrero, S. 2019. Energy poverty in Central and Eastern Europe. Chapter in book Post-Socialist Urban Infrastructures.

hydrogen developments. Finding the necessary funding and ensuring that infrastructure development is sustainable and accessible is very challenging.

In **Hungary**, more than half of the EU funding for energy and climate projects are currently frozen by the EC due to concerns about the rule of law and fundamental rights (a decision is expected in November 2023).

**5. Technological and Innovation Barriers:** While renewable energy technologies have made significant advancements, there are still technical challenges that need to be addressed. Energy storage, grid integration, and the development of new, efficient technologies are all essential for a successful energy transition; this is especially true of green hydrogen and H2 storage.

**6. Policy and Regulatory Frameworks:** Developing effective policies and regulations that incentivise the adoption of clean energy technologies while also ensuring a JET can be complex. Policy uncertainty and inconsistent regulations will hinder investments and slow down the JET process.

In countries like **Italy**, the bureaucracy necessary to avoid the infiltration of criminal organisations in energy production represents a major obstacle and makes the processes of renewable energy independence and the responsible production of energy by citizens rather slow. In this, the only ones to benefit are the multiutilities which, exploiting their knowledge of the market, can continue to act as intermediaries while maintaining their role.

7. **Lack of Skills and Workforce Transition:** The shift from fossil fuel industries to clean energy sectors will require a new set of skills and training for the workforce. Ensuring that workers have the necessary skills for new job opportunities is crucial for a JET.

**8. Interconnected EU Markets**: Energy systems are interconnected on a global scale, and the transition in one region can have implications for others. Balancing national energy goals with EU climate objectives and trade relationships is challenging.

9. **Political and Public Support:** Public opinion, political will, and support is crucial for driving the energy transition. Resistance from vested interests and lack of public awareness or support can hinder progress.

Although **Hungary** has started its transition towards RES, the process is still quite difficult, slow, and complex, due to several different (both internal and external) political and technical conditions, contradictions, and conflicts of interests. These all result in an inflexible margin of manoeuvre for the government to act. One of the main contradictions is that in most Interreg Central Europe countries, the ability to keep household energy prices low plays a central role in gaining political power. Politicians and the incumbent energy companies have successfully dominated the public discourse. As such, the commonly

held (though questionable) view is that local fossil fuel and conventional energy production will guarantee cheap energy for households, and RES is significantly more expensive.

**10. Environmental Considerations:** While RES are generally more environmentally friendly, they are not without their own environmental impacts, such as habitat disruption, resource extraction, and waste management challenges.

In Poland, the biggest environmental challenge will be the transformation of 10,000 hectares of post-mining areas. It is planned to develop of natural and tourist areas, including the creation of two large lakes through the inflow of water. They are planned to become a big tourist attraction in the central part of Poland. Investments aimed at reducing water scarcity and increasing afforestation will also be an important environmental element during the just energy transition in the Lodzkie region.

Addressing the challenges above requires a comprehensive, holistic approach that considers the economic, social, and environmental aspects of the JET. Collaboration between governments, industries, communities, and civil society is essential to ensure that the JET is both sustainable and just.
Transnational cooperation is also crucial to achieve a JET. First, JET is a common and extremely complex challenge for Interreg Central Europe regions. Joint efforts and knowledge sharing are essential to understand this challenge and its multiple implications in a comprehensive way and to design effective solutions. Second, a strong transnational co-creation, testing and validation process is necessary to ensure the wide applicability of approaches and solutions.

## 3.3 Measures to Achieve a JET

This section analyses the key components of a successful JET. It describes the measures to be implemented in order to address the adverse distributional effects and inequalities resulting from the energy transition, in relation to its impact on vulnerable regions, industries and demographics.

### 3.3.1 Public Policy and Incentives

Enacting supportive policies and regulations at local, national, and EU levels is essential to encourage investments in clean energy technologies and facilitate JET. Examples of public incentives in clean energy technologies and infrastructures are the following:

- **Renewable Energy:** Emphasising the adoption of renewable energy sources such as solar, wind, hydroelectric, geothermal, and biomass.
- **Energy Efficiency:** Encouraging the efficient use of energy through technological advancements and behavioural change to reduce wastage and increase overall energy productivity.
- **Electrification**: Promoting the electrification of various sectors, such as transportation and heating, to transition away from fossil fuel-dependent technologies and reduce emissions.

In **Hungary**, the 2022 Climate Protection Law was the first in Interreg Central European region to set a legally binding climate neutrality target for 2050. The 2021 National Clean Development Strategy describes scenarios to achieve this objective. Hungary is planning to use green hydrogen as a major decarbonization instrument from the early 2030s, reducing up to 40% emissions by 2050, while simultaneously accelerating economic growth. By 2030, Hungary has also set objectives for the minimum share of RES in various sectors: 20% of gross final electricity consumption, 30% in heating and cooling and 14% in transport. Measures include the development of existing district heating networks.

The primary energy production of Hungary has decreased over the past decade, totalling approximately 449 petajoules in 2021. During the same year, Hungary sourced most of its electricity from nuclear power plants (46% of total electricity generation). Fossil fuels, such as natural gas and coal, were the second most-used source of power in the country. However, RES has developed recently, mainly focusing on photovoltaic power plants. The installed capacity of the Hungarian solar power plants has exceeded 4,000 megawatts in 2022. The share of RES in gross final energy consumption increased rapidly since 2017 to reach 13.9% at the end of 2020, exceeding the 13% target that Hungary had for 2020, but below Hungary's 2030 ambition of 21%.

In Hungary, seven sectors account for all GHGs emissions: power, industry, transportation, buildings, agriculture, waste, and land use and forestry. To achieve cost-optimal decarbonization by 2050, each sector

will need to harness new and existing technologies. Reducing power-sector emissions, accounting for 12% of emissions in Hungary, is central to the country's ability to reach net zero. Decarbonisation itself will help to boost demand for electricity by 2.8 times by 2050, and the sector must meet this demand with carbon-neutral solutions. Given the increasing maturity of solar- and wind-power generation technologies and Hungary's significant potential, the power sector could immediately begin scaling up the capacity of renewable power and fully abating emissions by the mid-2030s.

In addition, Hungary could aim to become a net power exporter from the early 2040s. By 2050, solar and wind resources could represent over 85% of total installed capacity; however, the rise of solar power requires a major increase in more flexible sources.

Hungary is using a mix of public and private funding to advance the energy transition. An additional total of €62 billion over the period 2016-2040 is needed to reach the national targets. The cost of reaching net zero carbon emissions by 2050 are estimated at €150 billion. Hungary is planning to use the various funds provided by the EU to advance the energy transition. The EU Recovery and Resilience Facility (RRF) is making available €723.8 billion for the period 2021-27 with specific shares allocated to each EU member state. In 2020, the government issued a euro-denominated sovereign green bond to encourage investors to contribute to financing sustainable projects in Hungary. The green bond was over-subscribed, with investors making offers of almost €7.7 billion for the €1.5 billion 15-year bonds. As an acknowledgement of this EU green bond issuance, Hungary received the Sovereign Green Market Pioneer Award from the Climate Bond Initiative.

In **Germany**, the question of the energy transition is fundamentally shaped by the decision to phase out nuclear energy (already completed) and coal-fired power generation (by 2038). The war in Ukraine has additionally accelerated the transformation process, as until then gas was considered a so-called "bridge technology", i.e., a bridge between conventional electricity and heat generation to renewable energies. As almost everywhere in Europe, the most important technologies of the energy transition are wind power and photovoltaics in the area of electricity generation and heat pumps in the area of heating. Solar thermal energy plays a subordinate role due to the relative lack of intensity in solar radiation in Germany.

With respect to wind power production, the approval and construction of new wind energy plants has been slow in recent years, in many cases because of strict guidelines on the state level. Generally speaking, wind energy production is more prevalent in the north of Germany, as these regions tend to be both stormier and more sparsely inhabited. Consequently, the southern states of Bavaria and Baden-Württemberg rank lowest in terms of wind energy production capacity per capita, with Saxony not far ahead of them. The federal government aims to reach 115 gigawatts of installed wind production capacity by 2030; as of mid-2023, Germany is currently on track to miss this goal, as the installed capacity sits at approximately 60 gigawatts, with an estimated 2.7–3.2 gigawatts to be added in 2023. While this does represent an increase compared to previous years, it falls short of the almost 10 gigawatts still needed to reach the 2030 target.

On the Saxon state level, no new wind turbines have been added in the first six months of 2023. However, the number of approved applications for new developments has seen a recent rise. More significantly, the state intends to significantly increase the land area dedicated to the production of wind energy, from the current 0.3% to 2% in 2027. This is intended to be achieved by allowing for the construction of turbines in forests and by giving municipalities more leeway to designate new areas for wind energy production which were previously off limits.

With respect to solar energy production, the new renewable energy law, in force since 2023, defines ambitious goals for the expansion of Germany's solar energy production capacity; by 2040, solar power production plants should have a combined output of 400 gigawatts, compared to only 66.5 gigawatts at the end of 2022. According to calculations by the Fraunhofer ISE, to reach this target requires the installation of 9 gigawatts in 2023 and an annual 22 gigawatts starting from 2026. This is achievable, but requires a very accommodating legal framework, which the current government intends to deliver in ways outlined in its solar strategy.

Contrary to the difficulties outlined in the above section, the expansion of solar energy production in Saxony is going very well. In the first half of 2023, Saxony added 243.8 additional megawatts of solar power – almost as much as the 245.1 megawatts installed in all of 2022. This reflects a substantial turning of the tide after years of insufficient capacity increases and is mainly driven by the fallout of and legislative reactions to the energy crisis caused by Russia's war in Ukraine. One standout project is "Energiepark Witznitz" near Leipzig, which will be built in a former open pit lignite mine and is set to add an additional 650 megawatts to Saxony's output alone.

A particular challenge for **Germany**, and here also especially for private households, lies in the so-called heat turnaround (*Wärmewende*), i.e., the conversion of heat generation to renewable energies. The federal government, driven by the Green Party as coalition partner, is pushing ahead very strongly here at the legislative level. The goal is that from 2024, as far as possible, every newly installed heating system will run on at least 65% renewable energy.

Existing heating systems can continue to run and be repaired. Although there are to be generous transition periods and exemptions and a strong social compensation through extensive subsidies, this issue unsettles many citizens and is potentially a social upset. The legislative process has been temporarily halted by the ruling of the Federal Constitutional Court. The court has identified concerns here for equal participation, among other things, due to the federal government's haste.

In **Austria**, the federal government is committed to achieve climate neutrality by 2040 also through the gradual decarbonisation of the heat supply. The government is subsidising the switch to climate-friendly alternatives. The public funding is secured until 2025 and is higher than ever before. With a budget of over €1 billion, it is intended to ensure that the exchange of fossil heating systems is made possible for all

households. In addition, €300 million are reserved for boiler replacement for low-income households, who receive up to 100% of the investment in climate-friendly heating systems.

In the Emilia Romagna region of **Italy**, the 2017 Regional Energy Plan sets the Climate and Energy Strategy and objectives of the region until 2030 in terms of strengthening the green economy, energy saving and efficiency, development of renewable energy, interventions on transport, research, innovation and training. The Plan follows the EU objectives by 2030 and 2050 on climate and energy as drivers of development of the regional economy. A monitoring body was also established to monitor the results of the Regional Energy Plan. It involves the main stakeholders (e.g., trade associations, professionals, social and environmental associations, etc).

The specific targets are the following:

- The reduction of climate-changing emissions by 20% by 2020 and 40% by 2030, compared to 1990 levels.
- The increase to 20% by 2020 and to 27% by 2030 of the share of RES consumption.
- The increase in energy efficiency to 20% to 2020 and 27% to 2030.

The Regional Energy Plan's priorities are dedicated to decarbonisation measures where regional intervention can be most effective: mobility, SMEs, residential, tertiary and agriculture. Specifically, the main areas of intervention are the following:

- Energy saving and efficient use of energy in different sectors.
- Electric and thermal energy production from RES.
- Energy rationalisation in the transport sector.
- Cross-cutting aspects.

In **Slovenia**, the 2020 Integrated National Energy and Climate Plan sets the national objectives, which are decarbonisation, energy efficiency, energy security, internal energy market and R&D. Within the dimension of decarbonisation, the main measures refer to GHGs reduction and RES development. The latter is incentivised through the implementation of a new support scheme and promoting investments in promising and commercially viable RES projects (i.e., wind, solar, geothermal, etc.). The Plan establishes the regulation for the construction of large hydropower plants in the country.
With respect to RES integration into the national grid, the Plan specifies the technical criteria, procedures and tariffs. The Plan also sustains self-supply of electricity from RES, including REC, by removing administrative barriers and providing financial incentives. The document also lists all the existing instruments to promote the development of district heating and cooling systems for RES. Some of the main challenges in Slovenia remains the following:

- Identify and prioritise RES that are well-suited to Slovenia's geography and resources. These may include wind (under condition due to environmental protection), solar, hydropower and biomass.

- Support the development of policies and incentives to encourage the adoption of distributed energy storage systems in homes and businesses, which can enhance grid resilience.
- Foster collaboration between utilities, regulators, and technology providers to ensure the successful deployment of smart grids.

Furthermore, **Croatia** has established their 2030 National Energy and Climate Plan. The key objectives are the reduction in GHGs for the Republic of Croatia by the year 2030, the increased share of RES in the gross final energy consumption and improved energy efficiency, expressed as consumption of primary energy and direct consumption of energy. The National Energy and Climate Plan aims at a 36.4% share for renewable energy by 2030 and significant investment across the energy sector – including hydropower, wind farms, solar photovoltaic plants and hydrogen energy. It will also support the production of electric batteries as well as the renovation and expansion of the electricity networks.

Specifically, the main targets refer to decarbonisation, energy efficiency, energy security, efficient internal energy market and R&D/innovation. The plan specifies the measures to achieve each target.

There are four key strategies that address the dimension of decarbonisation:

- The Energy Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050.
- The Long-Term Strategy to Encourage Investment in the Renovation of the National Building Stock of the Republic of Croatia by 2050.
- Draft of the Low Carbon Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050.
- Climate Change Adaptation Strategy in the Republic of Croatia until 2040 with an outlook to 2070.

The key document for the energy efficiency dimension is the “Long-Term Strategy to Encourage Investment in the Renovation of the National Building Stock of the Republic of Croatia by 2050”. The dimensions of energy security and the internal energy market have been elaborated within the framework of the Energy Development Strategy. The national strategies relevant to the dimension of research, innovation and competitiveness are the Strategy of Education, Science and Technology, the Smart Specialisation Strategy of the Republic of Croatia 2016 – 2020, and the Innovation Promotion Strategy of the Republic of Croatia 2014 – 2020.

In **Czech Republic**, the energy policy is guided by the 2015 State Energy Policy, which was expected to be updated in 2023. Key objectives are to phase-out of coal from its energy mix, reduce energy consumption, improve the energy intensity of the economy, and expand nuclear power by about 2,500 MW by 2035, with a goal of reaching 50% of the energy supply.

Czech Republic is preparing for the phase-out of coal from its energy mix. The role of coal in total energy supply declined by 19% from 2009 to 2019, primarily driven by reduced coal-fired power generation that was replaced by natural gas, bioenergy, nuclear and solar photovoltaic.

The 2015 State Energy Policy designates nuclear power as the main source of energy and its share is projected to rise to between 46% and 58% by 2040. Coal-powered energy is planned to fall to 21%, while RES would rise to 25%. Today, RES play a relatively minor role in total energy supply, although their share increased by 71% since 2009, reaching 16% of total final energy consumption in 2019.
**Slovakia** has committed to achieve carbon neutrality by 2050. The current energy mix in the country consists of coal (24%), nuclear (23%), natural gas (29%), RES (13%) and oil (11%). The national energy policy focuses on optimising the energy mix to reduce emissions of GHGs and pollutants while protecting energy security and affordability of energy supply.

The main strategic documents adopted on a national level that aim to achieve the targets is the National Energy and Climate Plan (NECP) that builds on the Slovak Energy Policy (Energetická politika), which is a strategic document defining the energy sector's primary objectives and priorities to 2035 with an outlook to 2050. The plan is based on five pillars: decarbonisation, energy security, energy efficiency, competitiveness and sustainable energy.

Key measures in national energy policy, to be implemented by 2030, are listed below by sector.

- Energy industry:
  - Termination of operation of solid fuel heating plants after 2025.
  - Transformation of power plants using solid fossil fuels after 2023 (Nováky, Vojany).
  - Increasing the share of RES in the energy mix.
  - Mandatory amount of RES in central heat supply systems.

- Energy consumption in industry:
  - Reduction of final energy consumption in industry.
  - Support of hydrogen production from RES.
  - Scheme of economic competition in the field of energy efficiency and emission reduction.
  - Voluntary agreement on energy savings.
  - Expected increase in carbon prices in the EU ETS (a measure at EU level).

- Transportation:
  - Electrification of transport.
  - Infrastructure development for ecological transport.
  - Support of ecological passenger transport.
  - Infrastructure support for alternative fuel vehicles.

- Energy efficiency:
  - Increasing energy efficiency in public buildings; industry, family houses and apartment buildings.

The 2021 Slovak National Recovery and Resilience Plan also indicates the reforms and investments to prepare the country to become more sustainable, resilient and better prepared for the challenges and opportunities offered by the green and digital transitions. Main targets are:

- Green transition.
- Smart, sustainable and inclusive growth.
- Social and territorial cohesion.
- Health and economic, social and institutional resilience.
- Digital transformation.
- Policies for the next generation.

Another aim of the 2021 Slovak National Recovery and Resilience Plan refers to energy permits. The objective is to accelerate and simplify the administrative procedures related to the further development of RES – especially with regard to wind energy and geothermal energy, the digitisation of some processes, including the determination of two pilot areas suitable for the development of wind energy.

The reform also includes the necessary increase in qualifications and strengthening of administrative capacities. The goal of the investment aimed at the further development and modernization of the electrification transmission system, and subsequent investments within individual regional distribution systems, is to increase technical capacities for further integration of RES and its acceleration.

In **Poland**, in September 2023, a contract was signed for the design of the first nuclear power plant in the country. It is to be built in the Choczewo municipality in Pomerania. Construction will begin in 2026, and the first unit is to be launched in 2033. This is how a new economic stage began in Poland. This is the first investment of this kind, so it still raises doubts/concerns among local communities regarding the safe operation of such power plants.

The Regional Energy Plan in Lodzkie supports the following activities:

- The development of infrastructure for generating electricity from RES and related storage capacity.
- Improving the energy efficiency of heating/cooling systems.
- Investments in smart mobility, including decarbonisation of the transport sector and its infrastructure.

- Investments in the development and modernisation of gas transmission/distribution infrastructure in order to improve energy efficiency and to introduce RES and low-emission gases into the system.
- The modernisation of the power system towards innovative technologies and solutions.
- Investments in the development of hydrogen technologies and other alternative fuels.

Also, the regional authorities adopted the Anti-Smog Resolution, which aims at reducing excessive fuel consumption by residents. The city of Lódz, the capital of the Lodzkie Region, has also created a programme called "Don't poison yourself!". It offers citizens non-returnable grants to permanently eliminate non-ecological hearths (especially those fire with hard coal and lignite). Activities under the regional programme aimed at increasing energy efficiency will reduce the phenomenon of social exclusion, as they will concern reducing the phenomenon of energy poverty by co-financing investments that will cover people affected by or at risk of energy poverty, e.g., generally less wealthy people, including the elderly, single parents (mostly women), people with disabilities or large families.

### 3.3.2 Innovative Energy Technology and Infrastructure

Public policy and innovation clusters can also incentivise research and investments in new energy technologies and infrastructure, such as:

- **Energy Storage:** Incorporating energy storage technologies, such as batteries and pumped hydro storage, can help mitigate the intermittency of renewable energy sources, like solar and wind, and provide grid stability. Energy storage enables the storage of excess renewable energy for use during periods of high demand.

In **Hungary**, the EC approved a grant of €1.1 billion in state aid for the implementation of an energy storage scheme in Hungary, which aims to support the installation of 800MW (1,600 megawatt-hours) of large-scale electricity storage projects. This will allow the Hungarian electricity system to be more flexible. The measure will be open to companies that are active in Hungary's energy sector. It will also be open to cross-border participation, meaning storage projects in neighbouring EU Member States. Projects will be selected through a competitive bidding process and contracts are expected to be awarded before the end of 2024. All storage technologies will be eligible.

In **Germany**, the BigBattery project aims to develop and expand long-term storage facilities. The project commissioned one of the largest battery storage facilities in Germany and Europe in 2020 (53 MWh storage capacity) and prepares to invest in a 137 MWh BigBattery Oberlausitz at the Boxberg site in 2024.

In **Austria**, the focus in on redox flow batteries, also called liquid batteries, for energy storage. This consists of an electrolyte that is stored in tanks in different oxidation states. Today, their production is still very complex, but redox flow electricity storage is predicted to have great potential as network storage for the energy transition, for example for shifting solar energy for consumption during the night.

In **Croatia**, the reversible hydropower plant Velebit (a pumped-storage plant) is one of the most complex hydropower facilities in Croatia. It has two levels of storage/accumulation, with a capacity of 276 MW in generator and 240 MW motor mode. In addition to electricity production, the importance of Velebit is the possibility of pumping mode, i.e., to storage/accumulate surplus electricity production. The Velebit serves as a large battery to store electricity that is then placed in the system when it is most needed.

In **Slovakia**, there exist various battery energy storage projects, such as:

- Battery storage system in Senec (430 kWh), which serves mainly as price arbitrage, back-up source, optimisation of reserved capacity and reactive power.
- Battery storage system in Bachledova dolina (630 kW/1000 kWh), which serves as a back-up source and compensation of voltage deviations.
- Battery storage system in Dubnica nad Váhom (55 kW/120 kWh li-on storage), which is a pilot installation focused on testing various applications, such as the optimisation of reserved capacity, reactive power, etc.

- **Carbon Capture and Storage (CCS):** Implementing technologies that capture carbon dioxide emissions from industrial processes and power plants and safely store them underground to reduce GHG emissions.

In **Slovakia**, the geological potential for CCS is a rather complicated matter and a subject of further geological exploration. The geological pattern of Slovakia consists of many protected water zones (14.15%) and protected landscape areas (23.3% of the area of Slovakia). The deployment of CCS technology is at its very beginning in Slovakia and can be considered immature.

- **Smart Grid Integration**: Smart grid capabilities should be integrated into energy transition technologies to enable real-time monitoring, control, and optimization of energy distribution and consumption. This will facilitate better coordination between energy producers, consumers, and grid operators. Also, it will facilitate the integration of RES into the existing power infrastructure.

In Saxony, **Germany**, the regional energy and climate policy contains a chapter on “Measures to develop smart energy systems, grids and storage systems at the local level”. Unfortunately, at the moment, this specific section is still in development and not yet in effect. At the national level, the federal government pushes toward enforcing 100% green heat grids by 2045.

The ACON project aims to increase the efficiency of cross-border electricity distribution systems between **Slovakia** and **Czech Republic**. This will support the integration of the electricity markets between the two countries, using of innovative smart grid technologies.

- **Demand Response Capabilities**: Implementing demand response capabilities in energy transition technologies will allow consumers to adjust their energy consumption based on grid conditions and pricing signals. This can help balance energy supply and demand, reducing the need for fossil fuel-based backup power.
- **Internet of Things (IoT) Connectivity:** Utilising IoT sensors and connectivity can enhance energy management and efficiency. IoT-enabled devices can collect and transmit data, enabling real-time monitoring and optimisation of energy use.
- **Data Analytics and Artificial Intelligence:** Data analytics and artificial intelligence (AI) can be employed to process large datasets, identify patterns, and optimise energy systems. AI algorithms can optimise energy distribution, predict energy demand, and optimise energy consumption in buildings and industries.

In **Hungary**, the AI Coalition, initiated by the former Minister of Technology and Industry, aims to establish a national cooperative network of AI developers, market actors, public bodies and research institutes, to define the directions and frameworks for the domestic development and adoption of AI. This resulted in the establishment of the national Artificial Intelligence Strategy for the period 2020-2030.

In **Croatia** the Energy Management Information System (EMIS) is a web application for monitoring and analysing energy and water consumption in public sector buildings. EMIS provides a transparent oversight and control of energy consumption, making itself an inevitable tool for systematic energy management.

- **Hydrogen technology:** Hydrogen is a versatile energy carrier, which can help tackle various critical energy challenges. Clean hydrogen produced with renewable energy, or fossil fuels using carbon capture, can help to decarbonise a range of sectors, where it has proven difficult to reduce emissions. Hydrogen can also support the integration of variable renewables in the electricity system, being one of the few options for storing energy over days, weeks or months.

In **Hungary**, innovative hydrogen technologies are expected to become available after 2030, but before 2040. Up to 2030, Hungary plans to produce 20,000 tonnes (t) per year of hydrogen via steam methane reforming of fossil fuels and 16,000 t per year of hydrogen produced from solar PV.
Hungary has a modest ambition to install 240 megawatts (MW) of electrolyser capacity by 2030, whereas EU countries on average target capacity at gigawatt (GW) scale. In 2022, Hungary has shifted gear and is advancing its hydrogen ambitions by one decade to develop hydrogen for its transport and hard-to-abate sectors. In 2023 the first hydrogen production plant was inaugurated in Kardoskút. The project will enable

the electricity system to store large amounts of surplus electricity from renewable energy sources (solar cells) in the form of hydrogen, up to several hundred megawatts for long periods of time, even months. An existing natural gas storage facility was adapted for the project. The 2.5-megawatt electrolyser was installed in cooperation with four universities and a research institute.

In **Germany**, the current debate is indeed dominated by hydrogen technology. The federal government as well as the state governments are working intensively on corresponding strategies, whereby in addition to the production of hydrogen, the question of distribution networks is also being addressed. A notable organisation supporting hydrogen technology is Wasserstoffnetzwerk Lausitz. Also, in the Industriepark Schwarze Pumpe, which historically has served as a symbol for coal-fired power generation and environmental decay, a hydrogen generation plant is being built. Against the backdrop of the equity issues addressed by the JETforCE project, hydrogen technology plays a subordinate role, as the future use cases will mainly be in industry and possibly long-distance transport.

In **Slovakia**, the Slovak National Hydrogen Association (NVAS) is a joint initiative that aims to support the research and use of new technologies based on hydrogen and fuel cells. It supports the establishment of a legal and regulatory environment to foster hydrogen production in Slovakia. NVAS was responsible for drafting the national Hydrogen Strategy and its objectives.

In Slovakia, the EUstream - H2 Infrastructure – Transmission Repurpose (H2I-TR) IPCEI project aims to repurpose one of the transit pipelines of EUstream's transmission system connecting Ukraine in the east with the Austrian and Czech transmission systems in the west, which would enable a cost-effective way of transporting large volumes of pure hydrogen from/to Ukraine and from North Africa towards consumer centres in Germany, Slovakia as well as in other parts of Europe. The company EUstream is also part of the European Hydrogen Backbone (EHB), an initiative that aims to enable the future transport of hydrogen within the EU.

#### 3.3.2.1 Innovation Clusters

In Emilia Romagna, **Italy**, the 2021 – 2027 Smart Specialisation Strategy identifies the thematic areas that will serve as the reference for all actions the region will put in place to promote innovation, competitiveness and sustainable growth. The Clean, Safe and Affordable Energy thematic area touches on several areas currently undergoing major changes and is also very relevant on a regional scale because of the economic and social impacts it determines.

The focus is on the following topics:

- Energy efficiency.
- RES production (hydropower, solar, biomass, onshore/offshore wind, geothermal).
- Smart energy systems.

- Hydrogen technology.
- Power-to-gas e power-to-X technology.
- Carbon capture and storage technology.

In Emilia Romagna, the *Clust-ERs* are associations of public and private bodies: companies, research centres and training institutions that share skills, ideas and resources to support the competitiveness the regional industrial strategic sectors. The objectives of the clusters are to foster R&D and innovation through a cooperative approach. They are financed by the EU Funds of the Emilia Romagna Region – ERDF ROP 2014-2020. The Energy and Sustainable Development Cluster GREENTECH promotes innovative solutions for environmental sustainability and low carbon economy, such as biomethane, smart energy systems and Carbon Capture and Storage.

In **Croatia**, the following areas have the most significant capacities of both industry and scientific community have been identified in the Croatian Integrated National Energy and Climate Plan for the Republic of Croatia for the period 2021-2030:

- Development of new and improvement of existing primary and secondary equipment for power system (primary equipment: turbines, generators, motors, transformers, switches, power lines and cables; secondary energy equipment: control, measurement, protection, supervision, management).
- New technologies and improvements related to power plants, substations, components and systems related to renewable energy sources.

In the **Czech Republic**, several clusters and organisations are playing pivotal roles in advancing energy technology and infrastructure:

- The Czech Technology Platform for Energy Security (C-TPES): An organisation aiming to streamline the R&D activities of the energy sector in the Czech Republic. It coordinates among industries, academia, and the public sector to foster energy security innovations.
- The South Moravian Innovation Centre (JIC): Located in Brno, JIC actively supports startups, innovative companies, and R&D projects in multiple domains, including energy. They offer various support programmes, mentoring, and funding opportunities.
- The Energy Cluster of the Czech Republic (ECCR): This cluster focuses specifically on the energy sector. It is a professional association of businesses, institutions, and organisations in the Czech energy sector that actively supports energy research, development, and deployment.
- The Moravian-Silesian Energy Cluster (MSEC): Situated in the Ostrava region, the MSEC emphasises sustainable energy, energy efficiency, and the implementation of new energy solutions.

- The ÚJV Řež Research Centre: UJV Rez is a major research institution in the Czech Republic that deals with nuclear power research and other energy domains. They work closely with industry stakeholders and provide critical insights into energy technologies.
- Research Centers in Universities: Several universities in the Czech Republic have their dedicated research centers focusing on energy technologies. For instance, the Czech Technical University in Prague and Brno University of Technology have significant contributions to energy research.
- Bioenergy Cluster: Focusing on sustainable energy from biomass, this cluster fosters cooperation between businesses, research institutions and public administration. Nanotechnology Industries Association (NIA): Though not exclusive to energy, the push for nanotechnology in energy applications like better solar panels or energy storage is significant. The NIA is involved in various innovative projects, some of which pertain to energy technologies.

In **Poland**, in the region of Lodzkie, the barrier to the development of technological innovations in the area of energy and climate is the relatively low level of innovation in the entire region. Financial support is planned for the creation of business environment institutions, which would initiate cooperation between organisations and research institutes with the business community, thereby commercialising research results and supporting the enterprise sector.

At the moment, in the region of Lodzkie, the Bioenergy for the Region Cluster, coordinated by CBI Pro-Akademia, is an open cooperative initiative bringing together over 80 enterprises, scientific and research institutes, local government units and business environment institutions operating in the field of RES. The Bioenergy for the Region Cluster was awarded the "European Cluster Excellence Initiative Bronze Label Certificate". The aim of the cluster is to promote sustainable bioenergy development in central Poland.

### 3.3.3 Energy Communities

EU Directive 2019/944 defines "Citizen energy communities"[34] (CES) and EU Directive 2018/2001 defines "Renewable energy communities"[35] (REC). The common elements under both definitions are the following.

With respect to the governance:

- Participation must be open and voluntary.
- Households should find it easy to both enter and leave the energy community.

With respect to ownership:

- Participation and effective control by citizens, local authorities and smaller businesses whose primary economic activity is not the energy sector.

With respect to the purpose:

- To generate social and environmental benefits rather than focus on financial profits.

With respect to the activities:

- Generation
- Aggregation
- Energy storage
- Distribution
- Consumption
- Provision of energy related services
- Supply
- Sharing

In **Hungary**, a strong legal framework is needed to facilitate increased penetration of CES and REC. The government amended the Electricity Law in 2021, which provided a legal framework to regulate energy prosumers, energy communities and aggregators. However, detailed rules still need to be developed and implemented to make these new market players functional. CES and REC are only in an experimental pilot phase in Hungary. For instance, a large energy community is being constituted near the Bükk mountain area.

[34] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0944#:~:text=This%20Directive%20aims%20to%20recognise,catalogue%20of%20rights%20and%20obligations.

[35] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001

The Mayor, who leads the initiative, is a JETA member and a DA.

The following initiatives are supporting the development and operation of the energy communities in Hungary:

- GreenDependent Institution and E.ON joint "Energy Neighbourhoods" Programme (national-level continuation of an international project cooperation financed originally by the Intelligent Energy Europe Programme).
- The company Rising.eco, founded in 2021, aims to connect as many solar panels into energy communities as possible. The team's development is a blockchain-based accounting platform that extracts and processes energy consumption and production data for energy communities using a 'behind the meter' tool, EcoBox. The system thus ensures that REC can optimally use and distribute locally generated energy. Their solution could make the energy sector cheaper and more climate-friendly in the future, while contributing to the development of energy self-sufficiency.

In **Germany**, Feldheim is an energy self-sufficient village in Brandenburg. Individual households are connected to a local heat and power supply network which is fed into exclusively from local renewable energy sources (e.g., wind turbines, biogas plants etc.). This supply network is owned and operated by Feldheim Energie GmbH & Co. KG, a limited liability company in which both the inhabitants of Feldheim and the city of Treuenbrietzen hold stock in.

In Germany, Energy Cooperative New Energies East Saxony is active with the aim to give the population in Dresden and the surrounding area the opportunity to participate in the construction of plants for the production of electricity and heat. Emphasis is given to the diversity of renewable energy projects in the portfolio.

The cooperative implements a low entry threshold with certificates that can be purchased starting at €50. Overall, compared to the production of renewable energy with wind turbines, solar power is inherently more inclusive as the threshold for basic participation is minimal and scaling systems is far less complex.

In **Austria**, collective self-consumption was introduced in 2017 as part of an amendment of the national electricity act (ElWOG). The act supports private and commercial collective self-consumption, including electricity sharing. In 2021, a framework for CES and REC was introduced, together with a Coordination Office for Energy Communities, which will ensure that energy communities can be set up and operated easily, becoming an indispensable element of the energy market in Austria. The government will provide up to €4 million to support their establishment.

A pilot for a "renewable energy community business park" is to be created in Weiz. The focus is on the development of innovative operating and tariff models and the integration of a redox flow storage system, which is integrated into a REC and a control energy pool. The storage facility will be installed on the

property of a potential area in combination with a newly constructed building and will be used jointly within the REC. The resulting flexibility is used both to increase self-consumption and on the balancing energy market.

In **Italy**, at the national level, the Energy Community Data Platform (ECDP) ensures an efficient and comprehensive management of energy community data flows by exploiting IoT and Big Data technologies, with the aim of fostering energy-aware use. The platform makes it possible to optimise the overall efficiency of the energy community through the development of customised energy consumption and production plans for each stakeholder in the community, supporting decision-making and forecasting processes. EDCP was adopted by ENEA to achieve efficient management and continuous monitoring of energy flows. EDCP provides a dashboard for monitoring the data flow integration process with advanced flow management functionalities that allow the easy addition of new energy community facilities.

Also in Italy, the NRG2peers platform aims to support the uptake and multiplication of financially, legally and technically viable user-centred residential energy communities. The main aim of NRG2peers is to support the uptake of a next generation of European peer-to-peer energy communities. NRG2peers sets up a gamified platform, supporting residential energy communities, to increase energy efficiency and to integrate a higher share of renewable energy. The NRG2peers platform offer two tools specifically designed to support the creation and improvement of energy community projects in the EU:

- The Readiness Level Indicator Tool: This was developed to help stakeholders define the benefits of adopting peer-to-peer energy sharing strategies and increasing energy flexibility in already defined energy communities. This tool allows them to determine the level of “readiness” of the community and understand what requirements are needed for these strategies to be successfully adopted.
- The NRG2peers Advisory App: This was developed as an online platform through which people involved in existing or potential energy community projects can find useful references, inspiration and interact with each other to exchange experiences.

In Emilia Romagna, Italy, citizen engagement strategies have focused on the theme of renewable energy communities. Emilia Romagna was the first region in Italy to approve a law to support renewable energy communities. The energy plan pushes towards a future no longer characterised by large power plants, but by a common and widespread commitment throughout the territory so that clean energy can be increasingly localised, self-produced and shared. The Emilia Romagna Fund for renewable energy communities is specifically designed to involve economically disadvantaged citizens to combat energy poverty. The Fund consists of a non-repayable grant, with an allocation of €2 million, increased up to €4.6 million, with a financing rate of 80%, plus 10% if there is a bonus (maximum 90%). Emilia Romagna activated a help desk specifically designed to inform citizens on the topic of renewable energy communities. So far, 124 projects have been approved.

In Emilia Romagna, in the Province of Imola, a digital application, called Bryo App, is active for citizens to assess the opportunity to be part of an Energy Community. The tool provides a preliminary evaluation through online surveys and, once completed, share a report with the eligibility results. A school decarbonisation questionnaire is available as well.

In **Slovenia**, proposals for additional measures to promote electricity generation from RES include the promotion of local energy communities. The government is developing an adequate support scheme, technical and human resources to achieve this objective. Under the Renewable Energy Initiative, citizens are encouraged to participate in renewable energy projects, including community-owned energy initiatives and the installation of rooftop solar panels. The concept of local energy communities is gaining momentum in Slovenia. These communities allow citizens, businesses, and municipalities to collaborate in managing and producing energy locally, fostering greater involvement and control over their energy sources and consumption.

In **Croatia**, the existing legal framework need to be complemented by the development of ad-hoc regulation for CES and REC, in accordance with the provisions of EU Directives. If necessary, a national action plan will be developed for their development. National energy policies and measures to achieve the national target of RES power production include capacity building and enhancement for all market players, including CES and RES. These are considered valuable options to be adopted largely on islands that are geographically separated from the rest of the country.

In **Czech Republic**, the process of integrating the EU Directives on CES and RES into national legislation has not been finalised yet and the information available is limited.

In **Slovakia**, the terms “energy community” and “energy producing community from renewable sources” were introduced into the law in 2022. There is an existing cluster specialised on fostering the development of CES and REC, together with local initiatives. The Slovak Innovation and Energy Agency (SIEA) is involved in an Interreg project called REC4EU, supporting the creation of energy communities.

In **Poland**, legislative work is currently underway to integrate EU Directives on CES and REC into Polish energy legislation. Currently, there is no established energy community in the Lodzkie Region. In Poland there are two energy cooperatives in Gdansk and Bydgoszcz. However, the EU is financing the programme “My Electric Current” that aims to incentivise the generation and management of electricity by residents for their own use. Citizens (i.e., prosumers) can finance photovoltaic panels, energy and heat storage, heat pumps and energy management systems. In the process of systemic transformation, distributed and prosumer energy from RES will be developed – including energy clusters and energy cooperatives.

### 3.3.4 Public Awareness and Education

The implementation of digital platforms, information desks and assistance tools can raise awareness and educating the public about the importance of JET, climate change, and sustainable energy practices. Also, these instruments help in sharing with consumers and users the experimentation of new technologies, communication and involvement of the younger generations. An example being Digital Ambassadors (DA) within the JETforCE project, who bridge the gap between citizens and technologies, ensuring that all citizens can have direct or indirect access to JETforCE digital solutions.

In **Hungary**, there is a challenge related to the implementation of a JET. There is the need to pay more attention to the opinion of affected local communities and civil society. Locals and NGOs have been invited to interviews and stakeholder workshops in each interested region, but with significant time constraints, which makes meaningful public participation in the drafting of the plans quite difficult. The concerns and proposals of local communities need to be built into the plans, as it is them who should be the main beneficiaries of the JET plans.

However, there are some good examples for major programmes/projects to face JET challenges and to support marginalised citizens, including groups affected by coal-phase, but mainly thanks to the initiatives and active work of NGOs. They also cooperate closely with citizens and these less fortunate groups to provide help and information to them. Some good examples are:

- Social solar power plants for lagging behind settlements (Hungarian Charity Service of the Order of Malta in cooperation with E.ON Electricity Company).
- Energy Transition Programme (Hungarian Association of Nature Conservationists Friends of the Earth Hungary).
- ENES-CE project, addressing the issue of energy efficiency in Central Europe, where citizens play a pivotal role (from Hungary, the partner was Energy Club).

As a conclusion, we can state that although there are some good initiatives for facing the challenges of the JET in Hungary, however the overall Hungarian population and the government/decision-makers are not yet ready to drastically change their mindsets, lifestyles and regular habits to make the energy transition more just for everyone.

In **Germany**, citizen engagement as a means to make the energy transition more just on a local and regional level has been the subject of methodical investigation for some time. Consequently, there is a fairly large corpus of available material detailing case studies and best practices within this context. Examples include the following publications:

- Energiebeteiligt.de: A collection of case studies on dialogical participation in the context of the energy transition" (2017; Federal Ministry of Education and Research).

- Practical Guide to Citizen Participation: Shaping the energy transition together" (2013; Netzwerk Bürgerbeteiligung / Network Citizen Participation).
- Citizen participation in the energy transition" (2016; Institute for Advanced Sustainability Studies).

In **Austria**, the Interreg Central Europe project TARGET-CE developed the OnePlace platform. This is a collection of energy efficiency materials (best practices, databases of experts and material, strategies and action plans, tools, educational material, financial road maps and 3D cities) to support public authorities, citizens and energy planners in proper energy management and energy savings in public buildings. OnePlace wants to provide a wide spectrum of energy efficiency solutions, collected within a unique repository/hub.

Also in Austria, the so-called Autarky Rate Tool was developed as part of the Store4HUC project. This is a freely accessible online tool that is available to anyone interested in installing electrical storage in combination with RES.

In Emilia Romagna, **Italy**, citizen engagement occurs through instant messaging applications using dedicated channels created by public administrations for the specific issue. The characteristics of the territories often make use this type of relational channels indispensable whenever a dialogue is to be established. In Emilia Romagna, the dialogue was activated through manifestations of public interest, which take place on dedicated pages of public administration websites.

An example being the regional platform/app for citizen participation called *Iopartecipo+*, which aims to connect citizens and public administration. Citizens, companies and associations can actively contribute to regional policymaking. Every policy is implemented through different stages: analysis, planning, implementation and final evaluation. Every "virtual square" is dedicated to a participation process, and it is configured as a public space in which people can share information, discuss ideas and propose solutions.

In Emilia Romagna, citizen engagement strategies on energy transition issues have already been activated in many cases. They envisage the entrustment to private companies with experience in the sector, of the creation of information and training tables, of public events on the subject and of the definition of the path and strategy for disseminating the subject to citizens.

In 2023, Emilia Romagna and regional consumer and user associations established a Memorandum of Understanding to address issues related to the ecological transition with the aim, in particular, of supporting citizens and protecting their rights. The agreement aims at the activation, on the basis of mutual cooperation, of tools aimed at the information, training and active participation of consumers on energy issues, also with reference to the topics of services.

In **Slovenia**, the government, along with various energy-related organisations and stakeholders, has been implementing measures to promote public involvement in decision-making processes and increase awareness of energy issues among citizens. The 2020 Integrated National Energy and Climate Plan aims to speed up the implementation of programmes for informing, raising awareness and training of different target groups on the benefits and practical aspects of the development and use of RES and energy efficiency measures, such as energy management software and smart metering.

Some measures that could be implemented in Slovenia with respect to public awareness and education are the following:

- Involving representatives from diverse social groups, including marginalised communities, in the decision-making process related to energy transition policies and projects.
- Establishing forums for open dialogue and consultation with stakeholders to understand their needs, concerns, and priorities.
- Analysing data to identify vulnerable groups and regions that require targeted interventions.

In **Croatia**, on national and regional level there are several initiatives and platforms which organise and provide adequate raising awareness activities and education. Starting from the national level, the Environmental Protection and Energy Efficiency Fund (EPEEF) is the central point for collecting and investing extra budgetary resources in the programmes and projects on environmental and nature protection, energy efficiency and use of RES. At the regional level, there are six regional energy agencies in Croatia. Their role is to promote and encourage regional sustainable development in the field of energy and environmental protection through the use of RES and the introduction of increased energy efficiency measures, the introduction of good energy management practices, the promotion of sustainable development, and the provision of information and advice.

In Croatia, there is a need for better and proper citizen engagement, together with adequate financing schemes to trigger investments in RES and energy efficiency to mitigate the risk of energy poverty for the most vulnerable groups. The challenge is how to reach vulnerable groups, how to prepare adequate measures to reduce the risk of energy poverty of these groups, and how to ensure adequate and sufficient funds to overcome increased energy costs, particularly for elderly population.

With respect to energy poverty, IRENA participates as project partner in the EU Life Project JUSTEM ("JUStice in Transition and Empowerment against energy poverty"[36]). Also in Croatia, there are two active tools, Innovative Direction in Energy Advising (IDEA)[37] and PowerPoor[38], financed respectively by Erasmus+ and Horizon 2020, to combat energy poverty in the country. The former offers educational platforms for energy awareness, while the latter encourages the use of alternative financing schemes.

[36] https://webgate.ec.europa.eu/life/publicWebsite/project/details/101076151

[37] http://www.project-idea.eu/

[38] https://powerpoor.eu/

**Czech Republic** has been making efforts to address climate change and promote sustainable energy practices. The Ministry of Industry and Trade offers free energy advice through its Energy Consultation and Information Centres (EKIS) and related mobile app. EAV is one of these centres for the Vysočina region. EAV offers energy-saving advice to the general public, businesses, and entrepreneurs. Citizens receive information, recommendations, advice and basic energy calculations in the field of building insulation, heating, cooling, RES etc. Also in Czech Republic, the project EuroNet 50/50 Max aims at raising awareness of public buildings' users, including schools. EAV prepared a set of workshops for students to introduce them how to behave "energy responsible" at schools.

In **Slovakia**, regional authorities lack the professional capacity, which is a prerequisite for systematic energy planning and awareness raising initiatives. Regional energy centres and sustainable energy hubs are two essential and complementary components of the new Regional Energy Planning Information System. This will make it possible to systematise the collection, updating and archiving of data from all sectors. It will also enable to automate established calculation procedures, e.g., for quantifying regional fuel and energy saving potentials across sectors. The outputs of the Regional Energy Planning Information System will be available in the form of factsheets, tables, charts and maps to public administrations (in particular municipalities), academia, the public and the media.

In **Poland**, the Lodzkie Region organised public hearings in partnership with the Association of Polish Green Network Associations and the National Federation of Non-Governmental Organisations. The 2030 Development Strategy of the Lodzkie Region and the Territorial Just Transition Plans (TJTP) for the Lodzkie Region were widely consulted with the inhabitants of the region before their adoption. In 2021, the Lodzkie Region created a Communication Plan of the TJTP which was the result of cooperation with the consulting company PwC Advisory. The document aims to increase the awareness of the inhabitants of the mining region about the energy transformation. An important aspect of providing information to the region's citizens was showing examples of success in transforming other mining regions into emission-free areas. In 2020, the Lodzkie Region organised roundtables to discuss the transformation of mining areas. They consist of representatives of local governments, business community, national authorities, universities, non-governmental organisations, energy companies etc. These local stakeholders play an advisory role in the creation and updating of the TJTP of the Lodzkie Region.

Also in Poland, many Polish cities aspire to the idea of Smart City 3.0. Many of them operate according to the idea of 2.0, but there are also cities that reach higher. Among them are e.g., Warsaw, Wrocław, Łódź, Słupsk, Rzeszów, Lublin, Gdynia and Katowice. These are cities that implement projects using modern technologies, but also look for new ways to involve residents in the implementation of the assumptions of smart cities, they undertake cooperation with start-ups, activities within participatory budgets and develop social consultation systems.

### 3.3.5 Investing in Skills and Jobs

In order to ensure that the energy transition towards a climate-neutral economy happens in a fair and just way, it is critical to alleviate the socio-economic impact of this transition for the most affected regions, industries and workers. Examples are those carbon intensive regions still heavily reliant on coal mining.

There will be the need to support the most affected regions through supporting their transition to low-carbon and climate-resilient economy as well as supporting the creation of new jobs in the green economy. Investing in the creation of new firms, SMEs and start-ups will also be necessary. The most affected industries will need to shift to low-carbon technologies and diversify towards new products and services, based on climate-resilient investments and jobs. The most affected workforce will need to be supported through facilitating new employment opportunities and offering re-skilling opportunities.

In **Hungary**, the phase-out of lignite is a crucial part of the National Climate and Energy Plan. The Ministry for Innovation and Technology, within the LIFE-IP North-HU-Trans Programme, started the implementation of a roadmap for the low-carbon transition of those regions still heavily reliant of lignite. Major objective of the roadmap is economic diversification, through supporting reskilling of the workforce. In Hungary, the regions of Baranya, Borsod-Abaúj-Zemplén and Heves are eligible to receive funding from the JTM. The amount of JTF allocated to Hungary is 250 million EUR. According to estimates, the JTF will be able to save 4 000 jobs in the three most affected regions. Among the beneficiaries of the EU funding seems to be the state-owned Matra coal power plant. The JTF will support the retraining and employment programs for the over 2 000 workers related to the plant. In the frame of the LIFE-IP North-HU-Trans Programme, the Borsod-Abaúj-Zemplén County Chamber of Commerce and Industry provides re-training programme for the Mátra Power Plant workers and mentoring programme for entrepreneurs in the region as well as awareness raising for local citizens.

**Germany** is going to participate in the JTF and the accompanying platforms and mechanisms with eight individual regions, six of which lie within the territory of former East Germany, and one of which is Saxony. A TJTP is being developed by the JTF unit of the Saxon Ministry of Regional Development. The most immediately affected population group are workers related to the lignite mining industry, which is most important for the Lusatian border area between the states of Saxony and Brandenburg, but also plays a diminishing but still significant role in the area surrounding Leipzig. The importance of the Lusatian mining district is reflected in the results of the 2023 Lausitz Monitor, for which only 21 % of respondents stated that they are in favour of an early end to coal mining and power generation in 2030.

The Lusatian mining district is still an important branch of industry for the almost exclusively rural area in which it is situated. A 2019 study by the Leibniz-Institut für Wirtschaftsforschung Halle concluded that the economic prospects of both east German lignite mining areas remain substantially below those of its west German counterparts and the national average, and encouraged further policy initiative, which the JTF can be considered to partially deliver on. On a national level, the 2022 municipal directive specifies higher funding quotas for municipalities in regions which are financially weak and/or affected by structural change.

In 2022, 7.675 Lusatian workers were directly employed by the industry. While the energy transition creates innumerable opportunities for new employment and professional development, these are still often focused on urban centres, which may further encourage existing trends toward depopulation. There are, however, initiatives working to address these imbalances. Of those, the most noteworthy known is the "Qualification Network in Lusatia for Renewable Energies", in which the LEAG mining company, the dominant corporate entity behind coal mining in the region, pushes hard to adapt their business model for the energy transition.

In **Austria**, the Interreg Alpine Space Project "ECOLE", focused on ecological industrial parks, will help to solve problems industrial parks face to become circular Eco-Industrial Parks, which is industries to introduce at all levels the principles of the circular economy. Industrial Parks suffer from an image of polluters, but also from the increasing cost of energy/production inputs and lack of knowledge on integration of circular economy approach. The ECOLE project uses a community approach and establishes a systemic thinking community model that will co-design action plans to implement collected tools in the pilot sites. In three years, industrial parks will become more circular, resilient and sustainable, able to face climate and economic crisis.

In Emilia Romagna, **Italy**, the 2020 Work and Climate Alliance was signed by trade associations, local authorities and their associations, professional orders and colleges, environmental associations, universities and research institutions. The Alliance confirmed the commitment to support the region through the energy transition. The Alliance is based on the principle of public participation and shared public policy planning. It pursues the objectives of social sustainability and inclusion by protecting employment and promoting green jobs, also through the upskilling of the current workforce, with a special focus on youth employment.

**Slovenia** has developed TJTP. The plan is focusing on two most affected regions by the just transition process, which are Savinjska-Saleška and Zasavje, where thermal power plant's coal blocks are based, that should be closed by 2033. The JTF will help diversify the local economy by investing in R&D related to innovative industrial processes and production capacity in SMEs. The JTF will support SMEs to develop innovative business models, as well as measures that will help to retain talents in the region and create new job opportunities. The region of Zasavje used to have a coal mine and power plant and is seeking to develop new sectors that will support the restructuring of its economy. The JTF will support 2 400 workers active in the coal sector with lifelong career guidance and training.

The JTF will also invest in decarbonising the region, through the production of various RES, such as solar energy and hydrogen, and energy efficiency measures. Moreover, the JTF will redesign the district heating system and support the transition from the use of coal to alternative clean energy sources for heating, for instance solar energy and heat pumps. Finally, to promote a green transition, the Fund will back the establishment of a Centre for Demonstration and Training in Zero Carbon Technologies that will focus on the research on climate-neutral technologies.

In **Croatia**, the JTF will invest €179 million thanks to the approval of a multi-fund programme under Cohesion Policy. The JTF will support the counties of Istria and Sisak-Moslavina in delivering a just climate transition based on the Territorial Just Transition Plans. Investments will help diversify the economy thanks to reskilling and upskilling activities, the creation of hubs for sustainable technological innovation and new circular business models in the manufacturing sector. The EU-supported investments in Istria are estimated to create 300 direct and 300 indirect jobs, and to reskill 200 people, adapting the local workforce to new green jobs and providing local firms with the skills they need for economic transformation.

Sisak-Moslavina has highly polluting industries which account for a significant share of GHGs emissions. The Fund will support economic diversification by investing in the uptake of innovations by SMEs, including through collaborations with universities, and incentivising new business models, with a particular focus on the ICT industry. Finally, it will also support the reskilling and upskilling of workers in the local chemical and refining industries, thus helping to retain talents in the region.
In **Czech Republic**, the most affected regions by the energy transition are Moravian-Silesian Region, Ústí nad Labem Region and Karlovy Vary Region. The most affected industries are coal mining and coal-based power plants. The expected socio-economic impacts are unemployment, migration, economic slowdown and social challenges. In the regions of Karlovarsky, Ústecky and Moravian-Silesian there is a high concentration of carbon-intensive industries with 21,000 jobs linked to the coal and chemicals industry.

The government has implemented several strategies to support the regions, industries, and workers most affected by the energy transition. The RE:START strategy supports the three coal-dependent regions and provides a platform for multi-sectoral and multi-level planning to build stronger regional economies in a post-coal future. RE:START will allocate about €3.15 billion among the three regions from 2017 until 2030, including €46 million for air quality projects and €83.4 million for sustainable public transports.
The JTF will grant €1.64 billion to support the phase out of coal-fired power plants by 2033 and to ensure a fair transition to climate neutrality. The JTF will also support entrepreneurs and human resources by helping to re- and upskill workers. In Ústí nad Labem region, where 80% of lignite is extracted, the JTF will support investments to transform the economy into one based on RES and a circular economy. In Moravian-Silesian region, the biggest coal-mining region in Czechia, the JTF also addresses environmental challenges related to air pollution and groundwater contamination due to industrial activities.

**Slovakia** will use support from the JTF. The currently allocated amount of €459 million will be based on the TJTP. The allocation of funds from the JTF will take into account the extent to which individual regions will face transformational challenges related to the need to reduce GHGs emissions and social challenges related to job losses resulting from the transformation. The most affected regions are the Trenčín Region, the Košice Region and the Banská Bystrica Region.

The priorities of the TJTP are the following:

- Investments in the creation of new diversified and sustainable jobs; specifically on the territory of former industrial sites.
- Diversification of the local economy by supporting the development of SMEs and start-ups/new businesses.
- Support for research, development and innovation primarily in new economic sectors of the green economy.
- Reconversion of environmental impacts caused by mining activities and coal burning.
- Development of sustainable production and supply of heat in the region.
- Development of sustainable energy in the region using RES.
- Support of energy efficiency and smart energy solutions in the region.
- Support of alternative types of mobility based on the principles of smart mobility.
- Support of lifelong learning, reskilling and support of new opportunities and development especially of young people.
- Labor market support for vulnerable groups affected by the phase-out of coal mining.
- Development of social care services in connection with the gradual termination of coal mining.

In **Poland**, the EC has identified six coal regions, which are the following regions: Lodzkie, Silesia, Lower Silesia, Greater Poland, Lesser Poland and Lubelskie. The expected socio-economic impact of the energy transition refers to decline in GDP and unemployment. The most important social effects of the transformation process are the deterioration of the situation on the labour market resulting from the reduction of jobs in the mining, energy and mining-related sectors and the need to retrain some employees to acquire new professional competences. The most desirable qualifications will include development of modern energy (including RES), logistics, automotive industry, medical and rehabilitation services and digital competences. New skills will be sought, including the development of Industry 4.0, circular economy and mechanical engineering.

At national level, the government is trying to assure workers through the 2021 Social Agreement. In Poland, the Green Transformation Council works on regulatory and strategic initiatives related to the European Green Deal. The purpose of the Council is to provide information related to the European Green Deal that have a direct or indirect impact on businesses.

The Lodzkie region adopted a TJTP, with a target reduction of carbon dioxide emissions by about 80% by 2030. The reduction in lignite extraction in the Lodzkie region by 2030 will result in the sector to become a declining sector. An employment reduction is expected by 2030 in these sectors to the level of 4,500 workers and over 13,000 jobs in mining-related sectors and local SMEs.

The PGE Group will support the re-skilling and up-skilling of the inhabitants of the transformation area by creating new jobs in the renewable energy sector. Lodzkie Region, together with the PGE Group, is already taking steps to minimize the future effects of the transformation on Belchatow power plant and mining employees, including the establishing of the Competence Development Centre in 2021.

## 3.4 Requirements to Achieve JET

This section highlights the requirements needed by public authorities and energy actors in order to implement the measures to achieve a JET. Such requirements can refer to skills, technical resources and capacity, tools, etc.

First of all, public authorities and energy actors need to be capable to develop TJTP in order to access EU funding. Hence, there is a need to critically assess regional economic circumstances and to anticipate future economic trends and needs. Having an effective stakeholders' engagement strategy will be essential to ensure that all parties, including the most vulnerable demographics, have a voice in shaping transition policies. Public authorities will need to plan effective public awareness initiatives to educate the public about the social, economic and environmental benefits of the transition, dealing with doubts and concerns. Public authorities in the most affected regions from the energy transition will need professional competences to establish innovation ecosystems/networks, to sustain the business transition of SMEs and start-ups development. Similarly, public authorities will need to collaborate closely with Vocational Education and Training (VET) institutions at regional level to implement effective reskilling and up-skilling programs for those workers in declining high-polluting industries. Another objective of VET institutions is to retain youth talents in these regions, offering rewarding career opportunities and a good quality of life.

To address all of the above, regions will need to cooperate closely for the transnational exchange of knowledge and best practices. Further capacity building is also needed in the use of digital tools for transparency and accountability. Also, digital tools can support effective stakeholders' engagement strategy, hence the co-design and co-implementation of policy, as well as monitoring and reporting to the wider public, to introduce a systemic approach in the implementation of JET. Such digital tools would need to use latest innovative technologies – for instance, Internet of Things (IoT) and Artificial Intelligent (AI).

# 4. CONCLUSIONS / RECOMMENDATIONS

The energy transition across the Interreg Central Europe regions, also known as the "Energiewende" in German-speaking countries, represents a shift in the region's energy sector towards cleaner, more sustainable, and ultimately decarbonisation energy sources. This handbook demonstrates that Interreg have been actively engaged in this transition to address climate change, reduce GHGs emissions, and decrease the regions dependence on fossil fuels. Indeed, Interreg Central Europe regions are implementing national energy policies following the environmental and climate goals outlined in the European Green Deal.

This handbook indicates how the energy transition will have a much higher socio-economic impact on certain regions, specifically those who are still reliant on high polluting and non-renewable energy production, such as coal mining. To alleviate such negative impact, most regions are developing Territorial Just Transition Plans in order to make use of the Just Transition Fund.

Today some regions seem better equipped to sustain an energy transition that is “just”, being at an advanced stage in the implementation of innovative green technologies and sustainable practices. An example being the delay in the integration of EU Directives on citizens energy communities and renewable energy communities into national legislation in some regions, such as Hungary, Croatia, Czech Republic and Poland. The same holds true with respect to citizens’ engagement and public awareness initiatives. While some regions have already in place digital platforms that allow citizens to have a voice in shaping and co-designing policy, such as Germany and Italy, other regions, such as Hungary, are lagging behind in the implementation of such tools, hindering the possibility to actively involve all stakeholders into the public debate, particularly the most vulnerable to the negative socio-economic impact of the energy transition, and, as a consequence, to achieve an energy transition that is “just”.

A special focus is given here to green energy technologies and sustainable practices to address environmental challenges and reduce carbon emissions. These technologies and initiatives are aimed at promoting cleaner energy sources, improving energy efficiency, and mitigating the impact of climate change. Here are some examples of green technologies and practices implemented in Interreg Central Europe regions.
There are certain green technologies that appear to be more prominent than others, such as wind and solar. These sources play an essential role in reducing carbon emissions and provide for a more decentralised and resilient energy supply. Solar panels and photovoltaic systems have become increasingly popular in regions like Germany, Austria and Hungary to generate electricity. Some regions, such as Germany, Austria and Poland, have invested in wind farms to harness wind energy. In Poland, there are plans to build new capacity of offshore wind farms (5.9 GW by 2030) as basis for limiting the operation of coal-fired power plants.

Indeed, many regions in Central Europe have taken steps to phase out coal-fired power plants. Germany, for example, is actively closing down its coal mines and coal-fired power plants. It should be noted, that this is a complex and difficult process for other regions. For example, Czech Republic and Poland are still heavily reliant on coal and are facing challenges in transitioning to sustainable energy sources. In 2020, the share of RES in Czech Republic was less than 6 percent.

While some regions are phasing out nuclear power plants, such as Germany, or not have any operating nuclear plants, such as Italy, it is worth noticing how national energy policy in Czech Republic and Poland are investing in nuclear power as major decarbonisation tools. Hungary also operates nuclear power plants; however, Hungary is investing in hydrogen and energy storage as main instruments to achieve environmental and climate objectives. A similar strategy is implemented in Germany.

Biomass and biogas are found in many regions, mostly in Germany, Austria and Italy, utilising biomass and biogas technologies to produce renewable energy from organic waste and agricultural residues.
Improving energy efficiency measures and electrification are also key pieces of the energy transition. The majority of Interreg Central European regions are implementing these measures in industries, buildings, and transportation to reduce energy consumption and GHGs emissions.

It's important to note that the progress and specific strategies across all partner regions of the energy transition vary from region to region, in respect to the just energy transition. Nevertheless, the overarching goal of reducing carbon emissions and promoting sustainable energy is shared across all regions. The Interreg Central Europe regions have made significant progress in embracing green technologies and sustainable practices to mitigate the effects of climate change and reduce their carbon footprint. The specific initiatives and technologies may vary from region to region, but the overall commitment to sustainability is evident throughout all Interreg Central Europe regions.

To conclude, Interreg Central European regions require cross-border cooperation and there is evidence that collaboration takes place on energy projects and grid connections to enhance regional energy security and improve the integration of RES. It is clear that administrations across the Interreg Central Europe area are implementing policies and regulations that support the energy transition, such interventions to meet renewable energy targets. Evidence found in this handbook illustrate that in Interreg Central Europe there is investment in R&D to innovate and advance sustainable energy technologies.

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