Smart strategies for the transition in coal intensive regions

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Research & Innovation strategy in the field of energy for Jiu Valley / West (RO42) target region, Romania

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TRACER website: www.tracer-h2020.eu

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Abbreviations

ADR Vest	West Regional Development Agency
CF	Cohesion Fund
CRIT	Coal Regions in Transition Platform
DG	Directorate General
DHCS	District Heating & Cooling Systems
EC	European Commission
EDP	Entrepreneurial Discovery Process
EE	Energy Efficiency
EIB	European Investment Bank
EIS	European Innovation Scoreboard
ERA	European Research Area
ERDF	European Regional Development Fund
ESF+	European Social Fund Plus
ESIF	European Structural and Investments Funds
HD	Hunedoara County
ICT	Information and Communication Technology
INECP	Integrated National Energy and Climate Plan
ITI	Integrated Territorial Instrument
ITS	Intelligent Transport Systems
JTF	Just Transition Fund
KEP	Knowledge Exchange Platform
MEEMA	Ministry of Economy, Energy and Business Environment
MIPE	Ministry of European Investments and Projects (former MEF)
PM	Particulate Matter
PNRR	Recovery and Resilience National Plan
R&D	Research and Development
R&I	Research and Innovation
RIS3	Research and Innovation Smart Specialisation Strategy
S3	Smart Specialisation Strategy
SRSP	Structural Reform Support Programme
SRSS	Structural Reform Support Service within the European Commission
START	Secretariat's Technical Assistance to Regions in Transition
TJTP	Territorial Just Transition Plan
TVET	Technical and Vocational Education and Training
UPET	University of Petrosani

Executive summary

The EU-funded TRACER project (www.tracer-h2020.eu) aims to support, throughout its 3-year duration, nine coal-intensive regions, which are at different stages of their energy transition, to shape or fine-tune their Research and Innovation (R&I) strategies and exchange previous experiences in order to facilitate transition towards sustainable energy systems.

The TRACER project, coordinated by WIP Renewable Energies – Germany, facilitated the mobilisation of a wide range of stakeholders in all nine European regions, including Jiu Valley micro-region, to discuss and agree on a shared vision and priorities for coal transition.

Several TRACER reports were delivered until now covering thorough analyses of the current situations, in terms of energy, environment and social aspects, and 2030-2050 transition projections in all 9 coal intensive regions, together with best practices assessment globally.

TRACER R&I Strategies were based on the European Union's "Smart Specialisation Strategy" (S3) approach and the Entrepreneurial Discovery Process (EDP) focused on each of the 9 coal-intensive regions, while for the energy technologies were considered the R&I priorities of the EU's SET Plan.

This current Report represents the **Research & Innovation Strategy in the field of Energy for Jiu Valley micro-region** – a document endorsed by all key R&I stakeholders, which was harmonised and integrated with the following national, regional (NUTS2/RO42 and NUTS3/RO423) and local policy frameworks:

1. The 2021-2030 Integrated National Energy and Climate Plan (MEEMA, 2020);
2. Romania's National Recovery and Resilience Plan – PNRR (MIPE, 2021);
3. R&I Smart Specialisation Strategy - RIS3 2021-2027 (ADR Vest, 2021) for Vest Region (RO42);
4. Territorial Just Transition Plan (TJTP) for Hunedoara County (Grupul de lucru PTTJ Hunedoara, 2021), NUTS3 region, with the financial and technical support of EC – DG Reform, through SRSP (Structural Reform Support Programme), for the Government of Romania (Ministry of Investments and European Projects - MIPE) (AARC Consortium, 2021);
5. EC (DG Ener - CRIT) assistance services (EC-CRIT, 2020) accessed in 2019, by all 6 Jiu Valley's Mayors through START (Secretariat's Technical Assistance to Regions in Transition);
6. "Strategy for the transition from coal of Jiu Valley" for the period 2021-2030 (MIPE, 2021), developed with the financial and technical support of the EC – DG Reform, through SRSS (Structural Reform Support Service within the European Commission) under the Ministry of European Investments and Projects (MIPE) coordination.

For Jiu Valley micro-region, the R&I Strategy in the field of energy is aiming to define key innovative sectors and priority R&I areas for energy - environment and related fields, which was integrated (see **Annex 1**) in all 4 (four) development pillars inside the Strategy for the transition from coal of Jiu Valley, for the period 2021-2030 (MIPE, 2021), in brief Jiu Valley Transition Strategy.

Starting from screening

- previous Jiu Valley analyses performed in TRACER deliverables,
- the current status of the R&I field at national and regional levels (NUTS2/RO42 and NUTS3/RO423),
- 2021-2027 support policy documents at UE, national and regional (RO42) level in the field of energy and environment,

and based on

- the micro-region energy transition projections on mid / 2030 - long term / 2050, and
- Jiu Valley common vision for 2030-2050 generated after an unprecedented stakeholder consultation process (EDP),

the following **10 R&I objectives** have been defined, in order **to consolidate Jiu Valley micro-region R&I ecosystem**:

a. Cultivating the culture of innovation by encouraging co-creation activities and developing knowledge hubs, living-labs etc.

b. Enhancing the involvement of young people by promoting open science and increasing R&I activities attractiveness

c. Creating opportunities for up-skilling / re-skilling programs in high-tech 4.0 industry and strengthen basic competences in ICT and foreign languages

d. Encouraging the creativity and entrepreneurship in innovation by making the most of the natural and cultural heritage of Jiu Valley

e. Supporting the growth and competitiveness of the innovative business environment for high value-added production/services diversification

f. Improving access to R&I funding opportunities especially for SMEs for innovation through digitalisation and carbon-neutral processes and/or products

g. Deepening the cooperation between R&I entities – businesses – public administrations for promoting ready to market R&I products/services

h. Updating and opening access to the R&I infrastructure

i. Supporting the connection and integration of Jiu Valley R&I key players in global value chains and business networks

j. Addressing national and regional policies priorities and challenges in R&I

6 Jiu Valley R&I priority areas were set-up, with its related key actions and technologies/systems/services, aligned with the SET Plan - Strategic Energy Technology Plan (EC, 2021), the Energy Union's and the regional (RO42, RO423) R&I priorities, and routed in the local needs and strength:

- R&I.I. Renewable and alternative sources and bioenergy generation
- R&I.II. Urban regeneration
- R&I.III. Energy storage
- R&I.IV. Environmental protection
- R&I.V. Competitive and innovative manufacturing and processing industries
- R&I.VI. Innovative technologies and services for consumers (public, private, energy communities, individual prosumers)

Finally, in order to secure a sustainable energy transition in Jiu Valley micro-region, the R&I Strategy recommend:

- A unique governance structure "**Jiu Valley ITI Association**" already created to be validated for evaluating and monitoring both Transition and R&I Strategies implementation,
- A generous funding landscape - if properly managed and planned will generate a number of opportunities to support the implementation of sustainable energy systems.

1. Introduction

According to the **EC Country Report** Romania's weak research and innovation performance hampers the transition towards a knowledge-based economy. The country continues to have one of the lowest levels of public and private expenditure on research and development in the EU, negatively affecting scientific quality and the diffusion of technology amongst firms. Increasing R&D investment and quality and supporting innovative firms remain important challenges. Otherwise, regional initiatives to enhance growth exist, but risk is being hampered by a lack of a robust national innovation and entrepreneurship ecosystem; and, without a sufficient level of public R&D funding, the economic competitiveness, research and innovation and smart specialisation strategies cannot achieve their stated objectives. Unfortunately, without a significant increase in the public R&D budget plus related regulatory measures to increase R&D quality and innovation, little progress is expected (EC, 2020).

Romania had a GERD (gross domestic expenditure on R&D as a percentage of GDP) of around 0.5% during 2012-18, and 0.48% in 2019, of which the greatest proportion came from the business sector (EUROSTAT, 2019). Among all 8 euro-regions of Romania, Vest (RO42) Region with a GERD of 0.39% was listed, according to the EC (EUROSTAT, 2019), on the 2nd place after Bucuresti-Ilfov (1.08%).

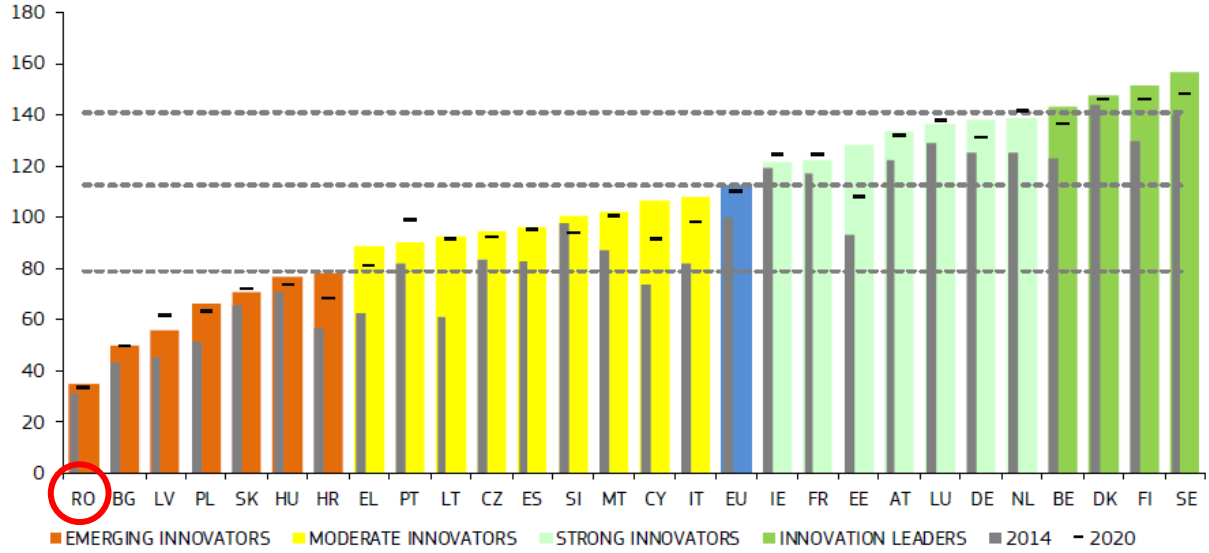


Figure 1: Performance of EU Member States' innovation systems [*Source: European Innovation Scoreboard 2021*]

Romania was a Modest-Innovator according to the 2019 **European Innovation Scoreboard**. Seven out of its eight regions, including Vest (RO42) are classified as Modest-Innovators, while the capital region Bucharest - Ilfov (RO32) is a Moderate-Innovator, regional performance differences being high. Vest Region (RO42) is keeping a similar rank in terms of innovation index, according to the EIS-RIS 2021 (EC, 2021) for 2019 and 2020, but in 2021 it drops to 3rd place after regions (RO32) Bucuresti-Ilfov and (RO11) Nord-Vest. Innovation performance has increased over time and according to EIS 2021 **Romania is listed as an Emerging-Innovator**, Vest Region (RO42) being also an Emerging-Innovator. According to EIS 2021 Romania's strength are in: Sales impacts, Digitalisation and Environmental sustainability; top-3 indicators including:

- Medium and high-tech goods exports
- Broadband penetration
- Venture capital expenditures

Vest Region presents relative strengths (e.g. Employment knowledge-intensive activities) and weaknesses (e.g. Business process innovators).

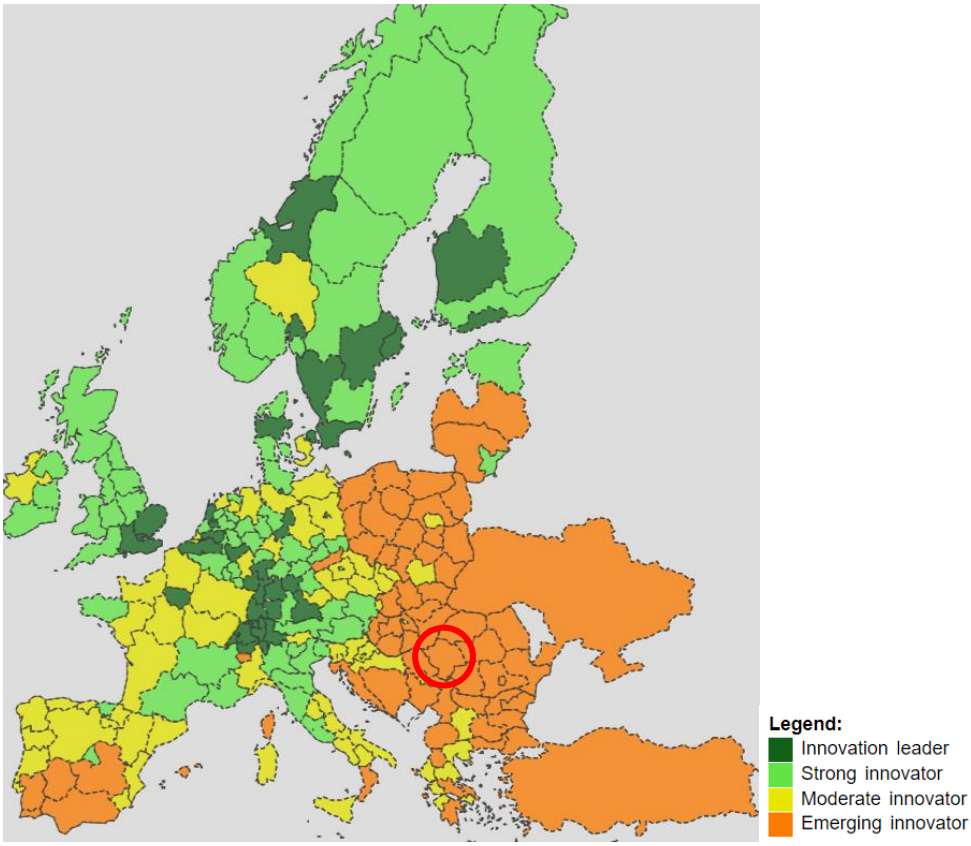


Figure 2: Regional Innovation Scoreboard [*Source: European Innovation Scoreboard 2021*]

For the programming period **2014-2020, in Romania**, the **Smart Specialisation Strategies** (S3) has been implemented both at national and at regional level. At national level, the National Research and Innovation Strategy (assimilated as S3) included four national S3 priorities:

(i) Bioeconomy
(ii) ICT
(iii) Space and security
(iv) Energy, environment and climate change, eco-nano-technologies and advanced materials

The Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI), a public institution subordinated to the Ministry of Education and Research is developing, for the next programming period 2021-2027, the **National Strategy for Research, Innovation and Smart Specialization 2021-2027 (SNCISI)** for NUTS0 level. So, **Romania do not yet have the strategic document setting the national priorities on smart specialisation and research-innovation, and neither the new mechanisms for S3 governance at national level in the period 2021-2027.** According to EIS 2021 Romania's strength are in: Sales impacts, Digitalisation and Environmental sustainability; top-3 indicators including:

- Medium and high-tech goods exports
- Broadband penetration
- Venture capital expenditures

Instead, at regional level (NUTS2), ADR Vest (West Regional Development Agency) developed **RIS3 2021-2027 report** (ADR Vest, 2021) **for Vest Region (RO42)**.

Based on the analysis of socio-economic development indicators, the demand for qualified human resources, the innovation and adaptation capacity at the level of the most prosperous sectors, the following **6 smart specialisation areas are in the loop for 2021-2027 in Vest**

Region (RO42), covering 42% of the region business environment, 57% of the active workforce and 50% of the total turnover:

(i) Agriculture and food industry
(ii) ICT and automotive
(iii) Energy efficiency and sustainable construction
(iv) Manufacturing and processing industry
(v) Health and quality of life
(vi) Cultural and creative industries

More information and analysis related to the regional profile and specialisation at NUTS2, NUTS3 and Jiu Valley micro-region levels will be provided in **Chapter 2.1**.

Even if the national & regional figures and EC assessment are not optimistic in terms of R&I, the Jiu Valley micro-region takes over the regional model and is keen to contribute to and synchronize with ADR Vest effort to boost the public and private R&I potential, currently under-exploited in the region.

In order to develop the R&I Strategy in the field of Energy for Jiu Valley (the present report), we need to harmonize and integrate the approach with the national, regional (NUTS2/RO42 and NUTS3/RO423) and local frameworks, already defined in a series of strategic documents:

1. The 2021-2030 Integrated National Energy and Climate Plan (MEEMA, 2020);
2. Romania's National Recovery and Resilience Plan – PNRR (MIPE, 2021);
3. R&I Smart Specialisation Strategy - RIS3 2021-2027 (ADR Vest, 2021) for Vest Region (RO42);
4. Territorial Just Transition Plan (TJTP) for Hunedoara County (Grupul de lucru PTTJ Hunedoara, 2021), NUTS3 region, with the financial and technical support of EC – DG Reform, through SRSP (Structural Reform Support Programme), for the Government of Romania (Ministry of Investments and European Projects - MIPE) (AARC Consortium, 2021);
5. EC (DG Ener - CRIT) assistance services (EC-CRIT, 2020) accessed in 2019, by all 6 Jiu Valley's Mayors through START (Secretariat's Technical Assistance to Regions in Transition);
6. "Strategy for the transition from coal of Jiu Valley" for the period 2021-2030 (MIPE, 2021), developed with the financial and technical support of the EC – DG Reform, through SRSS (Structural Reform Support Service within the European Commission) under the Ministry of European Investments and Projects (MIPE) coordination.

The support framework defined by these 6 strategic documents for the R&I oriented policies and measures in the fields of energy and environment are very briefly summarised in **Chapter 4. Support framework for R&I in Energy and Environment**.

1.1 Development of the Strategy: Overview of the process

According to TRACER Deliverable D2.2 "Best practice report: Smart Specialisation Strategies and SET Plan implementation actions" (TRACER, 2019) the Smart Specialisation Strategy approach (S3) is based on research that suggests that innovation depends on cooperation, which can allow underused knowledge and innovation capacities to be identified and used more effectively. The **S3 approach is therefore based on an inclusive process of stakeholder involvement centred on an "entrepreneurial discovery" process** (EDP).

The JRC considers that **S3 is an interactive process** in which market forces and the private sector are discovering and producing information about new activities, and the government assesses the outcomes and empowers those actors most capable of realizing this potential (EC, JRC, 2021).

The fundamental features of the S3 approach include:

A. extensive **analysis** of the regional (or national) socio-economic situation;
B. an **EDP**, based on a bottom-up approach, where a wide range of stakeholders discuss and reach agreement on priorities and needs;
C. effective **governance** structure;
D. stakeholder's agreement on a **formal strategy and an action plan/roadmap**;
E. well-managed roadmap **implementation process**;
F. sound **monitoring and evaluation** system;
G. **connect** to value chains and business networks.

The planning stage for Jiu Valley micro-region R&I Strategy in the field of energy (current report), referring to S3 features A, B and C, has been already completed on the background of the pandemic years 2020-2021 and other 3 European initiatives rolling-out in parallel with TRACER project implementation:

- EC - DG Reform financial and technical support via SRSS (Structural Reform Support Service within the European Commission) for performing the "Strategy for the transition from coal of Jiu Valley" for the period 2021-2030, under the Ministry of European Funds (currently MIPE) coordination (MIPE, 2021);
- EC - DG Ener, Coal Regions in Transition (CRIT) assistance services accessed in 2019 by all 6 Jiu Valley's Mayors through START (Secretariat's Technical Assistance to Regions in Transition);
- EC - DG Reform financial and technical support for MIPE via SRSP (Structural Reform Support Programme) for the preparation of the Territorial Just Transition Plan for Hunedoara County (NUTS3/RO423) - TJTP HD (Grupul de lucru PTTJ Hunedoara, 2021) and other 5 counties (NUTS3).

Currently Jiu Valley R&I Strategy development process is focused on the performance of the document itself followed by stakeholder's endorsement – S3 feature D.

The entire planning stage (S3 features A, B and C), a quite challenging process, required a deep analysis of the state of play of the regional (RO42 and RO423) and local energy & environment sectors, an ongoing stakeholder's involvement program (EDP), together with the synchronisation of all 4 actions (TRACER, SRSS, START, SRSP) for their complementarity to avoid overlaps.

The analysis of Jiu Valley socio-economic environment (S3 feature A), with focus on the energy sector and its social-environmental impact, was performed and presented in the following TRACER reports (TRACER, 2019-2021):

- The current role of coal mining and related policies in the TRACER target regions (D3.1);
- Technical concepts for the transition of the energy system into a smart, sustainable and renewable energy system in the TRACER target regions (D3.2);
- The environmental impacts and sustainable reclamation solutions in nine coal regions (D3.3);
- Social challenges and re-skilling need of the workforce solutions in the TRACER target regions (D3.4).

The EDP in Jiu Valley (S3 feature B), according to Regional Report D5.3 (TRACER, 2021), involved face-to-face and virtual meetings / workshops / interviews taking place within the region, where all 4 helix stakeholders categories come together to build working relationships, share ideas/knowledge, and agree on a common vision and priorities rooted in the micro-region's strengths (or "specialisation").

Regarding the governance structure (S3 feature C), an official and complex process is ongoing aiming the establishment of the micro-regional association playing the key role in securing a sustainable future development for Jiu Valley. Additional details related to the "Asociația pentru Dezvoltare Teritorială Integrată Valea Jiului" (Jiu Valley Integrated Territorial Development

Association), are presented in **Chapter 4.1 Multilevel governance structure for R&I policies in Jiu Valley**.

S3 are defined as integrated, place- and evidence-based economic transformation agendas, developed at the national/regional level, through a bottom-up process, in order to support research and technology driven economic development in selected priority areas, relying on local assets and capabilities, but also on external sources of knowledge and integration in global value chains (Szávics P. , 2020).

For Jiu Valley micro-region, the R&I Strategy in the field of energy is aiming to define key innovative sectors and priority R&I areas for energy - environment and related fields (S3 feature D), which will be integrated (see **Annex 1**) in all 4 (four) development pillars inside the Strategy for the transition from coal of Jiu Valley, for the period 2021-2030 (MIPE, 2021), in brief Jiu Valley Transition Strategy. Outcomes of Jiu Valley R&I Strategy will contribute to reaching goals set out in the regional and national strategic documents listed below:

- RIS3 in Vest Region / NUTS2 / RO42 (ADR Vest, 2021)
- Hunedoara TJTP / NUTS3 / RO423 (Grupul de lucru PTTJ Hunedoara, 2021)
- Integrated National Energy and Climate Plan – INECP 2021-2030 (MEEMA, 2020)
- Romania's National Recovery and Resilience Plan – PNRR (MIPE, 2021)

Starting from the common vision defined in the Regional Report D5.3 (TRACER, 2021), as result of the EDP, in **Chapter 4.3** will be presented the R&I priorities areas for energy-environment and related fields.

As Foray mention that “the main goal of a smart specialisation policy is to concentrate resources on the development of those activities that are likely to effectively transform the existing economic structures through R&D and innovation” (Foray D., 2015), one of the big challenges of Jiu Valley micro-region governance structure will be to ensure the necessary qualified human capital.

Addressing Jiu Valley main barriers and challenges regarding the lack of financial competences in R&I funds accession and the reduced administrative capacity, we consider that the willingness, constant and committed engagement of the key local stakeholders, together with a good governance will be the main drivers for effectively developing and implementing the R&I solutions and projects identified during the Strategy (current report) and Roadmap (future TRACER D6.3 Report) elaboration process.

In the same time, for an effective implementation of the R&I Strategy and Roadmap (S3 feature E) developing a sound monitoring and evaluation system (S3 feature F) is a must.

Finally, for Jiu Valley micro-region being connected (S3 feature G) and competitive in the global economy is a must and depends on transnational activities and participation in global value chains.

According to Maurissen (Mariussen et al, 2016), for a region the pre-condition for growth as a well-connected regional innovation ecosystem, is to become a combination of:

- Existing and emerging industrial strengths, represented by the existing industrial capabilities at the core of regional specialisation supported by RIS3;
- Knowledge providers inside the region such as universities, knowledge-intensive enterprises, high-tech service providers, educational institutions, and other centres of expertise;
- Connections between knowledge providers and industrial capabilities inside the region;
- Linkages between various industrial players and knowledge providers inside the region, as well as any external (transnational, macro-regional, European or global) networks and systems of innovation, including value chains and business networks.

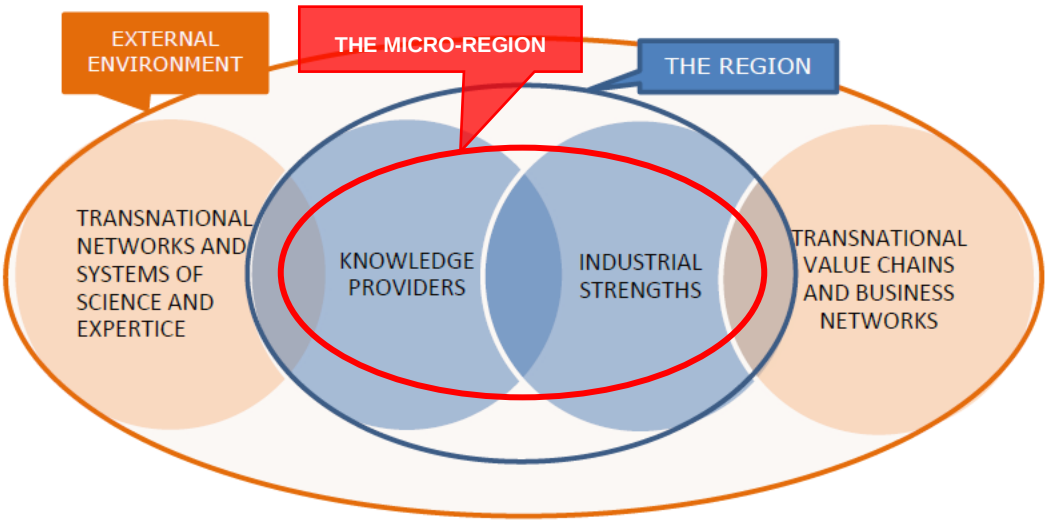


Figure 3: Regional Innovation Ecosystem and its external environment [*Source: Mariussen et al, 2016*]

It is important to mention that, in the nearest future, EU regions and cities will be supported in promoting science and research locally inside the European Research Area (ERA) by helping them to be more effective together, and strongly aligning their research policies and programmes guided by the Pact for Research and Innovation in Europe (EC, 2021) and the Knowledge Exchange Platform, relaunched as KEP 2.0 (EC, 2020).

1.2 Definitions

The regional innovation scoreboard (RIS) is a regional extension of the European innovation scoreboard (EIS), assessing the innovation performance of European regions on a limited number of indicators.

The European Innovation Index (EII) is a composite indicator summarising the overall performance of each country's innovation system; it ranks the innovation ecosystem performance of economies by highlighting innovation strengths and weaknesses and particular gaps in innovation metrics.

Smart Specialisation is a bottom-up approach, which is seen as: *Smart* - it aims to identify the region's specific strengths and assets; *Specialised* - it aims to target research and innovation investment on these strengths; and *Strategic* - it aims to support stakeholders to define a shared vision for regional innovation (TRACER, 2019).

Entrepreneurial Discovery Process – EDP is a wide-ranging and inclusive process of stakeholder engagement (TRACER, 2019). The EDP is an interactive bottom-up process in which participants from different environments (policy, business, academia, etc) are discovering and producing information about potential new activities, identifying potential opportunities that emerge through this interaction, while policymakers assess outcomes and ways to facilitate the realisation of this potential. For Foray EDP is the key mechanism of the smart specialisation process (Foray D., 2015).

Digitalisation (INNOLYTICS, 2021) is the generic term for the digital transformation of society and the economy. It describes the transition from an industrial age characterized by analogue technologies to an age of knowledge and creativity characterized by digital technologies and digital business innovation. Digital transformation is the transition of economy and society, which are characterized by the use of analogue technologies, into the age of digitalisation.

IoT – the internet of things is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. A thing in the internet of things can be a person with a heart monitor

implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an Internet Protocol (IP) address and is able to transfer data over a network (IoT Agenda, 2021).

The European Research Area (ERA) is the ambition to create a single, borderless market for research, innovation and technology across the EU (EC, 2021).

The Pact for Research and Innovation in Europe sets out a list of 10 common values and principles guiding research and innovation in Europe and Europe's collaboration with the rest of the world (EC, 2021).

ERA Knowledge Exchange Platform (KEP 2.0) is an important forum for dialogue with European regions and cities on issues related to research and innovation (EC, 2020).

Industry 4.0. is the fourth industrial revolution "characterized by a much more ubiquitous and mobile internet, by smaller and more powerful sensors that have become cheaper, and by artificial intelligence and machine learning" (Schwab K., 2016)

Renewable natural gas (RNG) is a term used for biogas, biomethane, green hydrogen and syngas (SNG) all meant to replace fossil natural gas (FSR-EUI, 2018). The biogas or syngas used to produce RNG comes from a variety of sources, including municipal solid waste landfills, digesters at water resource recovery facilities (wastewater treatment plants), livestock farms, food production facilities and organic waste management operations. Green hydrogen is obtained from converting renewable electricity using Power-to-Gas technology, via electrolysis, and in the second step, via methanation can be transformed into storable methane. The production of renewable gas involves the use of existing natural gas infrastructure, but at the same time is more environmentally-friendly than that of conventional gas, being carbon neutral.

A **spin-off** is when a company creates a new independent company by selling or distributing new shares of its existing business. A company creates a spinoff expecting that it will be worth more as an independent entity. A spinoff is also known as a spinout or starburst. https://www.investopedia.com/terms/s/spinoff.asp

2. Setting the context

For the programming period 2021-2027 the EU Cohesion Policy will be delivered through the following specific funds:

- The European Regional Development Fund (ERDF), to invest in the social and economic development of all EU regions and cities;
- The Cohesion Fund (CF), to invest in environment and transport in the less prosperous EU countries;
- The European Social Fund Plus (ESF+), to support jobs and create a fair and socially inclusive society in EU countries;
- The Just Transition Fund (JTF) to support the regions most affected by the transition towards climate neutrality;
- The INTERREG Programs (European Territorial Cooperation) to support also better cooperation governance and a safer and more secure Europe.

The new EU Cohesion Policy will support innovation projects in smart specialisation areas, aiming to achieve the following priority objectives (PO):

Table 1 – EU Priorities for 2021-2027

<table>
<tr><th>EU Cohesion Policy Objectives</th><th colspan="4">Funds priorities</th></tr>
<tr><td>EU initial allocation for Romania (M EUR)</td><td colspan="2">25,309.2</td><td>3,537.6</td><td>2,139.5</td><td>372.6</td></tr>
<tr><td>PO1. a more competitive and smarter Europe by promoting innovative and smart economic transformation and regional ICT connectivity</td><td rowspan="4">ERDF main priorities</td><td rowspan="5"></td><td>-</td><td rowspan="5">JTF – support dedicated specific objectives (art.8 of Regulation (EU) 2021/1056)</td><td rowspan="8">INTERREG Programmes</td></tr>
<tr><td>PO2. a greener, low-carbon transitioning towards a net zero carbon economy and resilient Europe by promoting clean and fair energy transition, green and blue investment, the circular economy, climate change mitigation and adaptation, risk prevention and management, and sustainable urban mobility</td><td rowspan="3">Cohesion Fund support</td></tr>
<tr><td>PO3. a more connected Europe by enhancing mobility</td></tr>
<tr><td>PO4. a more social and inclusive Europe implementing the European Pillar of Social Rights</td></tr>
<tr><td>PO5. a Europe closer to citizens by fostering the sustainable and integrated development of all types of territories and local initiatives</td><td>ERDF</td><td>ESF+ main priority</td><td>-</td></tr>
<tr><td colspan="5">Additional policy objectives</td></tr>
<tr><td>A better cooperation governance</td><td colspan="3">-</td></tr>
<tr><td>A safer and more secure Europe</td><td colspan="3">-</td></tr>
</table>

Source: https://ec.europa.eu/regional_policy/en/policy/how/priorities; https://cohesiondata.ec.europa.eu/stories/s/2021-2027-EU-allocations-available-for-programming/2w8s-ci3y/

Based on this supportive background, the R&I and smart specialisation initiatives will be mainly funded via PO1, through the following specific objectives (EUR-Lex, 2021):

- PO1-SO1 developing and enhancing research and innovation capacities and the uptake of advanced technologies;
- PO1-SO2 reaping the benefits of digitisation for citizens, companies, research organisations and public authorities;
- PO1-SO3 enhancing sustainable growth and competitiveness of SMEs and job creation in SMEs, including by productive investments;

- PO1-SO4 developing skills for smart specialisation, industrial transition and entrepreneurship;
- PO1-SO5 enhancing digital connectivity.

The clean and fair energy transition, with its related sectors, will be supported via PO2, through the following specific objectives (EUR-Lex, 2021):

- PO2-SO1 promoting energy efficiency and reducing greenhouse gas emissions;
- PO2-SO2 promoting renewable energy in accordance with Directive (EU) 2018/2001, including the sustainability criteria set out therein;
- PO2-SO3 developing smart energy systems, grids and storage outside the Trans-European Energy Network (TEN-E);
- PO2-SO4 promoting climate change adaptation and disaster risk prevention and resilience, taking into account eco-system-based approaches;
- PO2-SO5 promoting access to water and sustainable water management;
- PO2-SO6 promoting the transition to a circular and resource efficient economy;
- PO2-SO7 enhancing protection and preservation of nature, biodiversity and green infrastructure, including in urban areas, and reducing all forms of pollution;
- PO2-SO8 promoting sustainable multimodal urban mobility, as part of transition to a net zero carbon economy;

Also of interest are the specific objectives under PO4, which will support education, sustainable tourism potential and cultural heritage by:

- PO4-SO3 improving equal access to inclusive and quality services in education, training and lifelong learning through developing accessible infrastructure, including by fostering resilience for distance and on-line education and training;
- PO4-SO6 enhancing the role of culture and sustainable tourism in economic development, social inclusion and social innovation;

The innovative actions for a sustainable urban development will be supported via PO5 and its related specific objectives:

- PO5-SO1 fostering the integrated and inclusive social, economic and environmental development, culture, natural heritage, sustainable tourism and security in urban areas.

In Articles 5 and 6 of the same Regulation (EU) 2021/1058 (EUR-Lex, 2021) are presented the scope of support from ERDF and the Cohesion Fund:

Table 2 – ERDF and Cohesion Fund scope of support for 2021-2027

ERDF	Cohesion Fund
(a) investments in infrastructure; (b) activities for applied research and innovation, including industrial research, experimental development and feasibility studies; (c) investments in access to services; (d) productive investments in SMEs and investments aiming at safeguarding existing jobs and creating new jobs; (e) equipment, software and intangible assets; (f) networking, cooperation, exchange of experience and activities involving innovation clusters including between businesses, research organisations and public authorities; (g) information, communication and studies; and (h) technical assistance	(a) investments in the environment, including investments related to sustainable development and energy presenting environmental benefits, with a particular focus on renewable energy; (b) investments in TEN-T; (c) technical assistance; (d) information, communication, and studies.

Source: (EUR-Lex, 2021)

In Art.7 of the same Regulation (EU) 2021/1058 it is stipulated that the ERDF and the Cohesion Fund shall not support investment related to production, processing, transport, distribution, storage or combustion of fossil fuels, with the exception of:

- the replacement of solid fossil fuels fired, namely coal, peat, lignite, oil-shale, heating systems with gas-fired heating systems for the purpose of:
  - ✓ upgrading district heating and cooling systems to the status of 'efficient district heating and cooling' as defined in point (41) of Article 2 of Directive 2012/27/EU;
  - ✓ upgrading combined heat and power installations to the status of 'high-efficiency co-generation' as defined in point (34) of Article 2 of Directive 2012/27/EU;
  - ✓ investment in natural gas-fired boilers and heating systems in housing and buildings replacing coal-, peat-, lignite- or oil shale-based installations;
- investment in the expansion and repurposing, conversion or retrofitting of gas transmission and distribution networks provided that such investment makes the networks ready for adding renewable and low carbon gases, such as hydrogen, biomethane and synthesis gas, into the system and allows to substitute solid fossil fuels installations.

Referring to the JTF (EU, 2021) aiming to mitigate the adverse effects of the climate transition, the Fund will provide support to the people, economies and environment of territories which face serious socio-economic challenges deriving from the transition process towards the Union's 2030 targets for energy and climate.

The Regulation (EU) 2021/1056 (Article 2) is establishing a single specific objective for the Just Transition Fund (EU, 2021) to contribute to:

- enabling regions and people to address the social, employment, economic and environmental impacts of the transition towards the Union's 2030 targets for energy and climate and a climate-neutral economy of the Union by 2050, based on the Paris Agreement.

According to Art.8 JTF will support R&I activities that are directly linked to its specific objective as those mentioned in table below, items (c) and (h) in relation with (d), (e), (g), (i) and (k) – (m).

Table 3 – Activities supported and excluded by JTF

JTF scope of support	JTF exclusion
(a) productive investments in SMEs, including microenterprises and start-ups, leading to economic diversification, modernisation and reconversion; (b) investments in the creation of new firms, including through business incubators and consulting services, leading to job creation; (c) investments in research and innovation activities, including by universities and public research organisations, and fostering the transfer of advanced technologies; (d) investments in the deployment of technology as well as in systems and infrastructures for affordable clean energy, including energy storage technologies, and in greenhouse gas emission reduction; (e) investments in renewable energy in accordance with Directive (EU) 2018/2001 of the European Parliament and of the Council (17), including the sustainability criteria set out therein, and in energy efficiency, including for the purposes of reducing energy poverty; (f) investments in smart and sustainable local mobility, including decarbonisation of the local transport sector and its infrastructure; (g) rehabilitation and upgrade of district heating networks with a view to improving energy efficiency of district heating systems and investments in heat production provided that the heat production installations are supplied exclusively by renewable energy sources; (h) investments in digitalisation, digital innovation and digital connectivity; (i) investments in regeneration and decontamination of brownfield sites, land restoration and including, where necessary, green infrastructure and repurposing projects, taking into account the 'polluter pays' principle; (j) investments in enhancing the circular economy, including through waste prevention, reduction, resource efficiency, reuse, repair and recycling;	(a) the decommissioning or the construction of nuclear power stations; (b) the manufacturing, processing and marketing of tobacco and tobacco products; (c) an undertaking in difficulty, as defined in point (18) of Article 2 of Commission Regulation (EU) No 651/2014 (18), unless authorised under temporary State aid rules established to address exceptional circumstances or under de minimis aid to support investments reducing energy costs in the context of the energy transition process; (d) investment related to the production,

JTF scope of support	JTF exclusion
(k) upskilling and reskilling of workers and jobseekers; (l) job-search assistance to jobseekers; (m) active inclusion of jobseekers; (n) technical assistance; (o) other activities in the areas of education and social inclusion including, where duly justified, investments in infrastructure for the purposes of training centres, child- and elderly-care facilities as indicated in territorial just transition plans	processing, transport, distribution, storage or combustion of fossil fuels.

Source: (EU, 2021)

JTF may support also other investments that must be approved as part of the TJTP Hunedoara, such as:

- productive investments in enterprises other than SMEs contributing to the transition to a climate-neutral economy and job creation in the defined territory, not leading to relocation;
- investments to achieve the reduction of greenhouse gas emissions from activities listed in Annex I to Directive 2003/87/EC.

Transposing these European objectives at national and regional level (NUTS2 / RO42 and NUTS3 / RO423), was achieved through the effort made by the entities bellow, for preparing the 6 strategic reference documents, listed in **Chapter 1 "Introduction"**:

1. Ministry of Economy, Energy and Business Environment (MEEMA);
2. Ministry of Investments and European Projects (MIPE);
3. ADR Vest / RO42 (West Regional Development Agency);
4. Working Group for Hunedoara JTTP (RO423), coordinated by Hunedoara County Council, with EC - DG-Reform support through SRSP;
5. 6 local public authorities in Jiu Valley, with EC - CRIT (DG-Ener) support through START; and
6. "Jiu Valley Integrated Territorial Development Association" the new governance structure established during the elaboration of the Strategy for the transition from coal of Jiu Valley for the period 2021-2030, with EC - DG-Reform support through SRSS.

The European funding sources managed at central and regional level as well as other funding sources / mechanisms that can be accessed directly from Brussels or national funding programs dedicated to R&I will be presented in **Chapter 4.2 "Funding opportunities"**.

2.1 Regional profile and specialisation

According to the Romanian National Recovery and Resilience Plan, the national target for the level of public funding investments for RDI (1%), in 2020, has not been reached, and Romania's poor results in R&I are hindering the transition to a knowledge-based economy (MIPE, 2021).

Unfortunately, EIS figures presented in **Chapter 1 "Introduction"** reinforce this statement at regional level, according to RIS3 2021-2027 in the Vest Region (ADR Vest, 2021), where there is a limited use of innovative potential in advanced industries, resulting in a low economic impact of RDI activity, SMEs having also a weak appetite for R&I activities.

A summary of the regional key indicators analysis through the elements of interest for Hunedoara County (NUTS3) and the Jiu Valley micro-region are presented in the **Table 4** and **Figure 4** below.

Table 4 Key R&I and associated indicators (2018/2020)

Indicator	MU	HD (RO423) *including Jiu Valley*	Vest Region (RO42)	Romania	EU27
GDP per capita (2019)	EUR/capita	8,200 (2018)	11,700	11,500	31,200
Share of employment in Agriculture & Mining A-B (2019-2020)	%	6.6 - 6.2	12.9 - 8.9	25.2 - 22.0	4.6 - 4.6
Share of employment in Manufacturing C (2019-2020)	%	25.4 - 24.4	37.1 - 37.3	18.8 - 18.8	15.4 - 16.4
Share of employment in Utilities & Construction D-F (2019-2020)	%	13.9 - 13.9	7.1 - 8.1	9.8 - 10.5	8.2 - 8.2
Share of employment in Services G-N (2019-2020)	%	33.6 - 34.4	39.0 - 41.5	41.2 - 43.8	64.1 - 62.9
Share of employment in Public Administration O-U (2019-2020)	%	20.5 - 21.1	4.3	4.9	7.1
Total unemployment rate 15y.-74y. (2019-2020) – *registered statistics**	%	3.0-3.4	3.4 - 4.6	3.9 - 5.0	6.7 - 7.1
People at risk of poverty or social exclusion (2019 - 2020)	%	> 25.0	21.9 - 25.0	31.2 - 30.4	20.9 - 22.0
GERD by sector of performance (2019), total of which	Mil. EUR *(EUR/inh.)* *(% of GDP)*	4.6 (2017) *9.9 (2017)* *0.16 (2017)*	80.359 *45.2* *0.39*	1,067.442 *55.0* *0.48*	311,894.236 *698.6* *2.23*
Business enterprise	Mil. EUR *(%)*	NA	56.795 *71*	616.967 *58*	207,889.753 *67*
Government sector	Mil. EUR *(%)*	NA	13.618 *17*	339.315 *32*	35,455.389 *11*
Higher education	Mil. EUR *(%)*	NA	9.946 *12*	108.938 *10*	66,719.618 *21*
Private non-profit	Mil. EUR *(%)*	NA	0 *0*	2.222 *0.2*	1,829.476 *0.6*
R&D personnel and researchers by sector of performance (2018), total of which	% of population in the labour force	*Head count* *388*	0.470 *3,619*	0.51 *44,733*	2.099 (2019) *4,395,324 (2019)*
Business enterprise		NA	0.151	0.148	1.114 (2019)
Government sector		NA	0.064	0.147	0.233(2019)
Higher education		NA	0.264	0.213	0.737(2019)
Private non-profit		NA	NA	0.003	NA
Patent applications (2017) national/EPO	number	16 / NA (2018)	60 / NA (2018)	1178 / 50	- / 49,212
Enterprises introducing innovation (2018) – product and business process innovation	number	NA	107	4,198	516,497

** In Jiu Valley the real situation is much worse than the registered statistics ranging between 1.4% and 2.5% across its communities*

Sources: EUROSTAT, 2019; EC, 2021; EPO, 2020; INSSE, 2018-2020

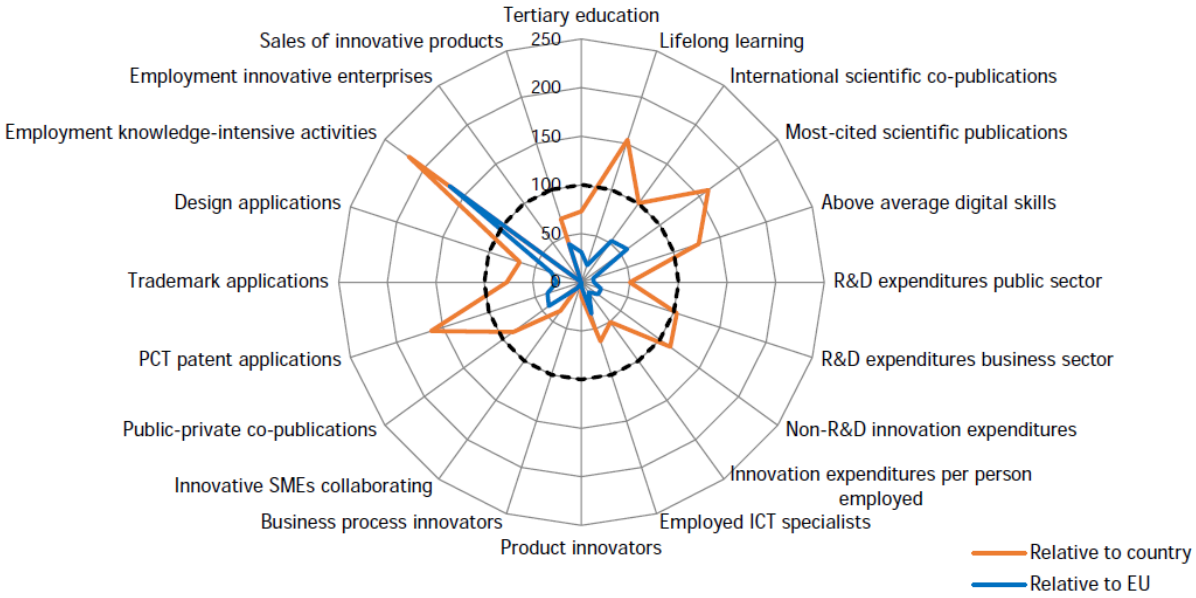


Figure 4: Regional Innovation Scoreboard – Vest (RO42), 2020 [*Source: EC, 2021*]

The following **6 smart specialisation areas** were selected considering the annual turnover, potential for innovation and added-value, and are in the loop **for 2021-2027 in Vest Region** (RO42):

(i) ICT and automotive
(ii) Energy efficiency and sustainable construction
(iii) Manufacturing and processing industry
(iv) Agriculture and food industry
(v) Cultural and creative industries
(vi) Health and quality of life

Following the analysis of the regional R&I context (Vest RO42), these smart specialisation areas have shown a great potential for future development, being able to generate strategic value chains.

At **Vest Region** level disparities in terms of gross domestic expenditures on R&D are even more significant than at the national level, Timiș County spending 75% of the total funds for R&D, while Hunedoara spent only 4.6 mil. EUR (less than 7%) out of which 77% current and 23% capital expenditures (ADR Vest, 2021). Although the business environment has the largest contribution to R&D funding, it does not necessarily mean that money has been invested in ready to market innovation, the investment share being too small. The role of the higher education and academia continues to decline despite an acceptable research infrastructure.

However, in 2018, Hunedoara had the largest allocation of funds for R&D human resources (R&D personnel and researchers) inside Vest Region / RO42. The Vest Region includes 34 R&I structures with 150 laboratories and research centres uneven distributed: 83% in Timis county and 17% in the rest 3 counties Arad, Caras-Severin and Hunedoara/RO423 (**Figure 5**).

The sectoral profile of the R&I units in Vest Region differs from one county to another:

- Arad County - constructions, viticulture and cattle breeding (2 x R&I units); 2 x Universities;
- Hunedoara County – metallurgy, forestry, mining and mining safety (2 x R&I units); 1 x University of Petrosani;
- Caraş-Severin County - mechanical engineering, fruit cultivation and sheep breeding (1 x R&I unit); 1 x University;

- Timiş County - welding and material testing, energy efficiency, chemistry and electrochemistry, physics, forestry, construction, public health, hydraulic machinery, agriculture, medicine, social sciences, etc. (14 x R&I units); 6 x Universities.

Unfortunately, the number of students is decreasing in the region, but in the Jiu Valley, the University of Petrosani, through its new education programs related to the transition from coal and adaptation to a sustainable energy system, has kept its attractiveness and the student body being relatively constant.

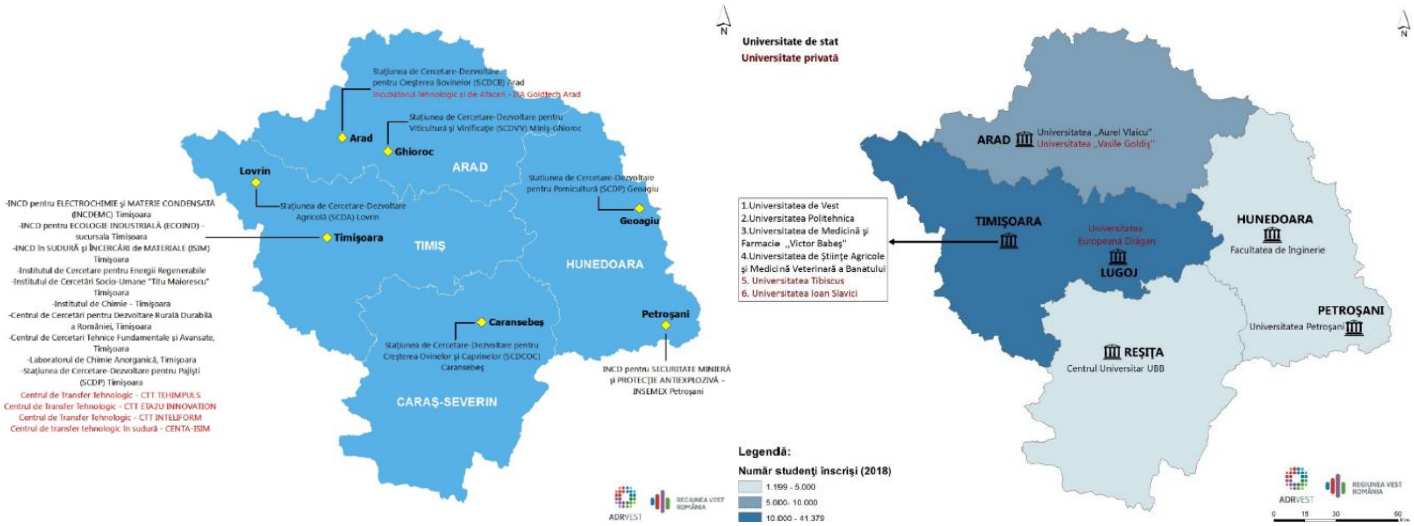


Figure 5: R&I Infrastructure – Vest Region, 2018 [*Source:* ADR Vest, 2021]

Analysing both **Table 4** and **Figure 4** we can see that for both regions Vest RO42 and HD RO423 the share of employment in services is the highest followed by the manufacturing industry – second, and third – the public utilities & administration (in HD) or agriculture & mining (in Vest). At Vest Region level the 2020 RIS scoreboard indicates good figures for the employment in knowledge intensive activities and hopes of improvement for ICT, tertiary education and for sales of innovative products. Good results are also in Patent applications, public-private co-publications and most cited scientific publications. Regional Innovation Indicators most in need for financial support are: innovative SMEs collaborating, employment innovative enterprises, business process & products innovators and digital skills.

In **Chapter 4.2 "Funding opportunities"** are presented among several financing sources, the main ESIF – Operational Programs supporting the R&I sector as POR Vest 2021-2027 (ADR Vest, 2021).

The R&I activity is carried out mainly inside the companies, without too many interactions with universities & research institutes in the region. This can be improved if Universities could, in principle, provide support for research, but they do not have the right infrastructure - high-class laboratories and advanced high-tech equipment. By investing in each own RDI infrastructure, of universities, research institutes and enterprises, the access of all regional stakeholders to equipment and services for innovative purposes can be increased, and generate a real positive impact in the market.

Cluster type collaboration and association is present at regional level, geographically limited to Timis and Arad counties where activates 3 strong clusters in automotive, ICT and sustainable energies, but without members or partners from Hunedoara County / RO423 or Jiu Valley.

International cooperation is not missing, but there is room for improvement starting from ADR Vest / RO42, the Universities from Timis County and the R&I entities in Jiu Valley micro-region, HD / RO423 namely University of Petrosani and INCD INSEMEX. In **Annex 2** are listed the relevant most recent international R&I projects in which the latter two renowned are either coordinators or partners in consortia.

In Vest Region / RO42 there is potential, but it is necessary to strengthen the R&I system by building and developing an entrepreneurial culture for innovation, supported not only by

existing and well-trained young human capital, but also by supporting schemes and financing programs to accelerate the emergence of spin-offs and to scale-up existing start-ups, in order to create innovative products and services by transferring to the market the R&I results from universities.

Analysing employee's concentration in the fields of smart specialization in RIS3 / RO42, **Hunedoara County / RO423** (HD) has a higher share in the manufacturing sector: 37% compared to 21% in Vest Region and in the fields of energy efficiency and sustainable constructions: 26% compared to 21% in Vest Region. A major difference between the region and the county is the number of employees in the ICT and automotive sectors, where HD has much lower values. Generally speaking, in HD there is potential for high and medium-technological intensity, all trends being positive, both in goods production industries or services, thus rising competitiveness.

SMEs are considered a key factor for growth, innovation, employment and social integration.

In HD the decline of the extractive and energy sector has led to the economic collapse of the county, so encouraging and sustaining creativity and entrepreneurship that generates new opportunities is a necessary objective of Territorial Just Transition. The low unemployment rates at NUTS3 level, which do not show the "on site" reality, also do not reflect absorption through jobs created as a result of the county's economy diversification, but a massive internal and external human resources migration.

In this sense, HD TJTP, out of the need to stop this decline, supports the increase of enterprises' competitiveness and the development of the R&I ecosystem by promoting the entrepreneurship and the digitalisation of the public services and enterprises. At NUTS3 level, in order to attract and stabilise the retrained workforce in the region, it is of interest to invest in the sustainable development of the following areas:

- recovery and economic reconversion of historically polluted sites;
- energy efficiency in constructions (residential and public buildings) and in industry (upgrading, retrofitting and extending DHCSs);
- e-mobility;
- urban regeneration through an integrated, smart and efficient waste management and RES integration, both in constructions and in the DHCSs;
- integrated capitalisation of the tourism potential.

According to Jiu Valley Transition Strategy socio-economic analysis (MIPE, 2021), the current profile of the former mono-industrial micro-region underline significant disparities in relation to Vest Region/RO42. Previous economic transformation initiatives have been focused mainly on low-tech sectors, low technical skills and limited investment capital, with no medium- and long-term prospects.

Thus, the current economic profile of the **Jiu Valley** is dominated by the services sector (trade), followed by the manufacturing industry (food, textiles, wood, furniture) and the electricity and heat generation sector. In terms of entrepreneurial initiatives / SMEs, developments are relatively modest in areas such as trade, construction works, road haulage, vehicle maintenance and repair, bread making and tourism. The consumer market is limited (shrinking communities, low purchasing power), with difficult access, as well as a small number of skilled workers, many of whom have emigrated to other regions or countries.

Promoting Jiu Valley as a favourable destination for investors has not yielded results so far, and business incubators were also unsustainable due to the lack of a local entrepreneurial culture and relatively low managerial skills.

For the future, recommendations are made for Jiu Valley micro-region to promote:

- innovative carbon-neutral technologies and processes in industry,
- specific interventions for smart cities to monitor the quality of the environment and energy flows,

- technology and innovation transfer throughout the entire value chain,
- a network of industrial and business parks - locations for several types of high-tech activities, in viable economic sectors as manufacturing of: PV panels, electricity storage batteries with different technologies, electronic components, building's insulation materials, furniture, cardboard production and paper, textile, bio-economy, creative industries etc.

Both at NUTS3 region and Jiu Valley micro-region, investments are needed to support both existing and newly developed SMEs to boosting the economic transition by creating opportunities for the former employees of the traditional industries.

In order to support the efforts to attract investments, granting different state aid intensity in Jiu Valley than for the Vest Region is a must, as well as the adoption of specific local fiscal mechanisms.

The JTF will support, in the next period 2021-2027, the consolidation and promotion of the R&I field and the cooperation between the academic-research and business environments.

2.2 Jiu Valley micro-region's energy and environment outlook

According to the Integrated National Energy and Climate Plan - INECP (MEEMA, 2020), revision approved by the EC, the national energy mix for 2030 is the following:

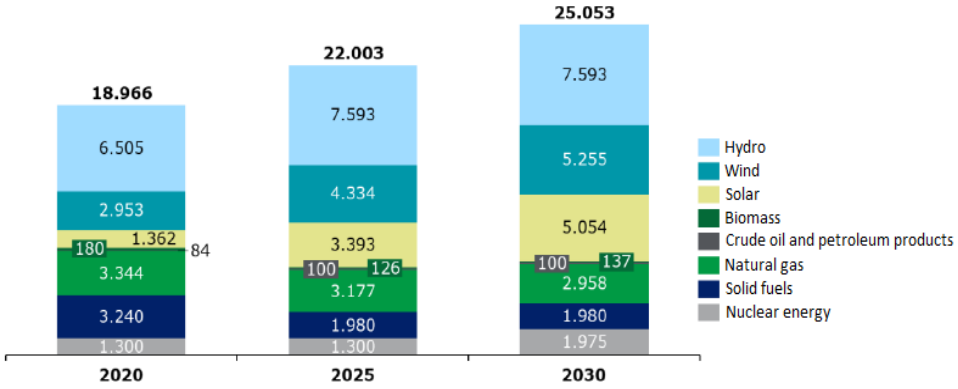


Figure 6: Net installed capacities - mix at national level (MW) [*Source:* MEEMA, 2020]

Projections for 2030 reflect an increase of up to 5,255 MW in the wind capacities and to 5,054 MW in the PV capacities, as shown in **Figure 6**, but 60% of the lignite-based power plants will be still operational. The natural gas-fired capacities include both new highly efficient and flexible units and retrofitted ones, considering the age of the current natural gas-fired plants, estimating that the decrease due to decommissioning will exceed the increase foreseen through the new capacities.

Recently, at the end of 2021, once with the approval of the National Recovery and Resilience Plan – PNRR (MIPE, 2021), **Romania officially announced coal phase-out by year 2032**.

In Romania coal (lignite and hard-coal) is exploited mainly in Hunedoara (underground hard-coal mines) and Gorj (lignite open pits) counties (NUTS3 regions), summing about 90% of the entire coal mining and energy industry labour force in the country, representing 11,140 jobs (2020) of which in Hunedoara County around 4,000 jobs, including Jiu Valley with 3,234 employees (TRACER, 2021).

Vest Region (Arad, Timis, Caras-Severin and Hunedoara counties), in terms of installed power capacities for electricity generation, had the following structure: 56% coal, 2% hydrocarbons, 35% hydro (large & small/micro), 3% wind and 4% solar. The greener county is Caras-Severin (79% hydro, 21% wind) and at the opposite pole is Hunedoara with 69.37% coal, 30.51% hydro (large & small/micro), 0.0002% wind, 0.03% biomass & biogas and 0.08% solar (TRACER, 2020).

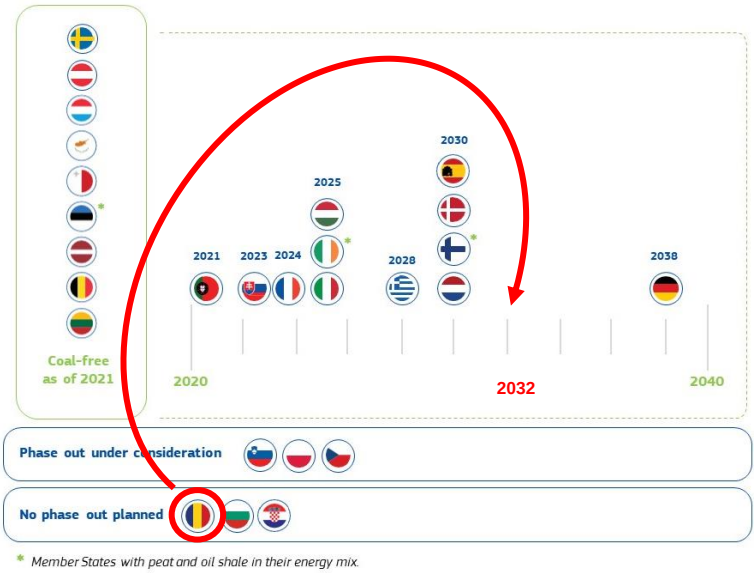


Figure 7: Member States coal phase out year [*Source: Coal Regions in Transition Platform*]

At the beginning of 2021 the energy industry (ETS sources) in Hunedoara County (NUTS3/ RO423), covering also Jiu Valley coal intensive micro-region, had only 385 MWi installed in operational power units belonging to CEH (Hunedoara Energy Holding), including Deva TPP Subsidiary (Mintia): 1 x 235 MWi (which no longer supplied heat all winter 2020-2021) and Paroseni CHPP Subsidiary: 1 x 150 MWi (which no longer supplied heat since winter 2018-2019), together with the Mining Subsidiary with only 2 active underground hard-coal mines Vulcan and Livezeni (Lonea and Lupeni already unrolling a safety mine closure program until 2024).

Both power units were qualified for providing technological services for the NPS (National Power System), but **in July 2021 Deva TPP Subsidiary (Mintia) was shut down**, after 54 years of operation, 1477 employees (55% Jiu Valley, 45% Deva-Mintia), were laid off, benefiting on average of approx. 10 TH. EUR gross income / person, amount staggered over a period of 2 years, from compensatory payments, supplementary income and unemployment taxes, during which time to identify employment and professional reconversion opportunities. At Mintia (Deva TPP Subsidiary) it seems that foreign investors are already interested in getting involved, for implementing and developing new energy source (800 MWi) with predictable carbon neutral technology solutions, to ensure the balance and stability of the NPS.

As for **Paroseni CHPP Subsidiary (150 MWi)**: in 2019 was observing both IED Directive 2010/75/EU and EU Decision 2017/1442, the life cycle of the power unit ending after 25 years (2007-2032); in 2020 supplied the NPS only with electricity, in terms of power grid stability the existence of this power source ensuring and maintaining the power transfer capacity from Romania to Hungary-Serbia axis, and the NPS adequacy level, especially in winter and during severe drought; in 2021 the 150 MWi power unit was active supplying electricity only about 7 month mainly during winter, the rest of the year being in planned or forced outage (ENTSOe, 2021). According to the Ministry of Energy in spring 2022 CEH activity will cease and Paroșeni CHPP together with the 4 mining perimeters (Lonea, Lupeni, Vulcan and Livezeni) will be integrated in a new Jiu Valley energy entity.

Referring to non-ETS sources the major challenge is related to the bankruptcy of the DHS and the fact that Jiu Valley public administrations and population were forced to adopt the following heating systems technologies:

- natural gas based individual thermal installations or thermal plant per block of flats/collective dwellings/residential or public or commercial building (95%-99% efficiency) and stoves per individual houses (low efficiency 40%) – estimated at 75%-80% of total heat demand;

- firewood and sometimes hard-coal based individual thermal installations (90% efficiency) and stoves (very low efficiency 20%-30%) – estimated at 15%-20% of total heat demand;
- electric heating, fossil liquid fuels stoves, or stoves with other type of biomass as wood pellets and wheat/straw briquettes and a very small fraction of solar thermal or electric – estimated at 5% of the total heat demand.

Unfortunately, switching from the centralised thermal energy supply to individual systems on fossil fuels (natural gas) or firewood will lead for sure to acceleration of air quality deterioration and to the occurrence of unwanted events (i.e. risk of installations' explosion or poisoning with CO emissions due to installations improper use, without periodic checking).

The **RES potential and forecast** have never been properly determined at either regional (NUTS2 or NTS3) or local (Jiu Valley micro-region) level. In 2020 updated data were provided for Jiu Valley micro-region, by the electricity DSO and the National Environmental Fund Administration (AFM), declaring about 6 MW installed in electricity and 0.44 MW in thermal energy as micro-Hydro, photovoltaics, solar thermal and biomass/biogas (TRACER, 2021). Also, the JRC (Joint Research Centre), starting from an existing scenario EURCO3232.5 (EUCO scenarios, 2019), analysed the opportunities in coal regions stemming from the deployment of power generation technologies from wind, solar photovoltaics, bioenergy and geothermal sources, as well as on coal-fired power plants with carbon capture (Kapetaki, Z., R., 2020).

Romania coal region in transition Vest (RO42) has, according to JRC report, an estimated technical potential for onshore wind, solar and bioenergy as follows:

Table 5 - Technical wind, solar and bioenergy potential – Vest RO42 / NUTS2 region

WIND		**SOLAR**			
		ground mounted		rooftop	
Capacity (GW)	Production (GWh/y)	Capacity (GW)	Production (GWh/y)	Capacity (GW)	Production (GWh/y)
8.8	17,397	29.12	34,358	2.94	3,468
BIOENERGY					
Crop residues		Livestock Methane		Municipal Solid Waste	
Thermal Capacity (GWth)	Power Capacity (GW)*	Thermal Capacity (GWth)	Power Capacity (GW)*	Thermal Capacity (GWth)	Power Capacity (GW)*
0.64	0.19	0.06	0.02	0.17	0.05
**) Thermal Capacity represents the thermal input delivered by the biomass fuel (MWth/MW thermal).*					
BIOENERGY – forest biomass					
high scenario		medium scenario		low scenario	
Thermal Capacity (GWth)	Power Capacity (GW)*	Thermal Capacity (GWth)	Power Capacity (GW)*	Thermal Capacity (GWth)	Power Capacity (GW)*
2.88	0.87	1.59	0.48	1.22	0.36
TECHNICAL CAPACITY AND POTENTIAL IN COAL MINES for CCS					
Number of operating open-pit coal mines	Total capacity (MW)	Wind capacity (MW)	Solar capacity (MW)	Wind share capacity (%)	Solar share capacity (%)
not mentioned (only open-pit mines were analysed)					

Source: (Kapetaki, Z., R., 2020)

Considering all the above, together with

- the analysed scenarios (Scenario A "with RES and natural gas as transition fuel" and Scenario B "with RES and alternative energy sources" are presented in **Annex 3**) and recommendation made for Jiu Valley energy mix in favour of Scenario B, according to TRACER Report on Projections for the transition to 2030 / 2050 in the target regions (TRACER, 2021);

- the recent agreement signed by the Minister of Energy with the Norwegian company Arbaflame for Paroseni CHPP, for replacing hard-coal with “Arbacore” pellets from green biomass (ME, 2021),

the 2030-2050 forecast for the energy mix and electricity production in Jiu Valley micro-region is presented in the following figure:

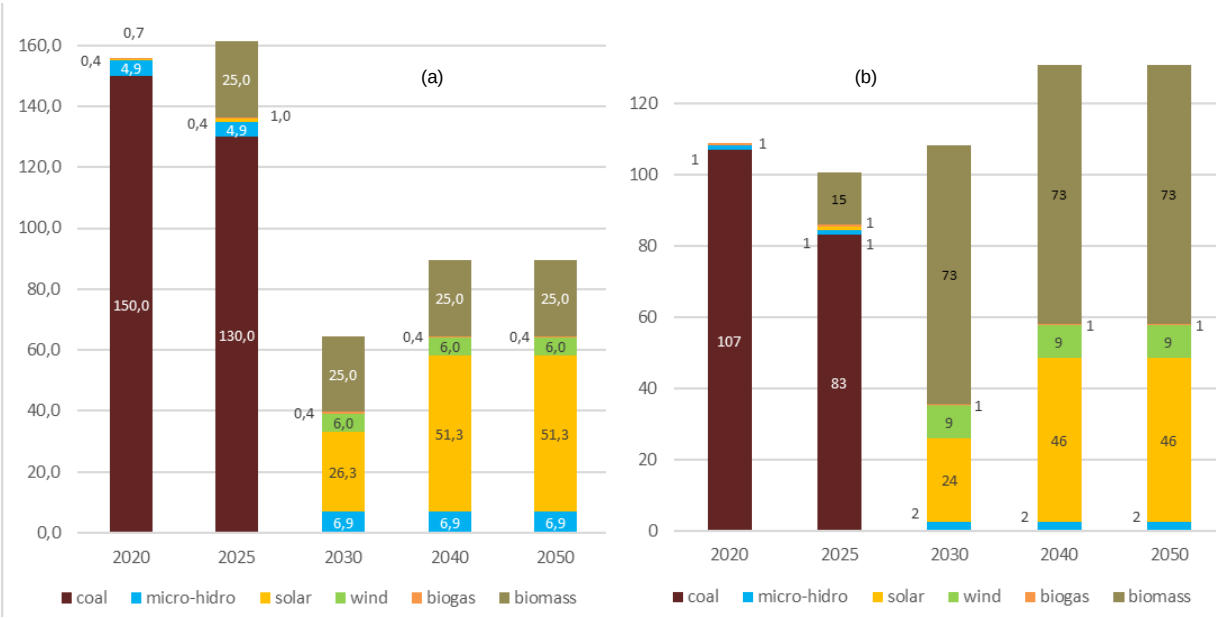


Figure 8: Projections of (a) the installed capacities (MW) and (b) the total electricity production (GWh) in Jiu Valley micro-region [*Source:* TRACER, 2021]

It has to be mentioned that in the absence of a renewable potential assessment study for Jiu Valley micro-region, RES capacities proposed to be installed are purely indicative.

Table 6 - Projections of the installed capacities in Jiu Valley (MW)

		MU	2020	2025*	2030	2040	2050
ETS sources – Paroseni CHPP							
Installed capacity	electric	MW_e	150	150	25	25	25
	thermal	MW_t	174	174	50	50	50
Combustion fuel used hard coal/natural gas/green biomass		%	95/5/0	50/5/45	0/0/100	0/0/100	0/0/100
RES							
Total installed capacity, of which	electric	MW_e	5.69	6.30	64.60	89.60	89.60
	thermal	MW_t	0.44	1.94	53.44	53.44	53.44
MHPP		MW_e	4.91	4.91	6.91	6.91	6.91
$_{ground}$PVP and $_{roof}$PV		MW_e	0.67	1.01	26.31	51.31	51.31
WPP		MW_e	0.00	0.00	6.00	6.00	6.00
Biogas	electric	MW_e	0.38	0.38	0.38	0.38	0.38
	thermal	MW_t	0.44	0.44	0.44	0.44	0.44
Solar thermal / $_{green}$Biomass / HPs	electric	MW_e	NA	0.00	0.00	0.00	0.00
	thermal	MW_t	NA	1.50	3	3	3

Source: TRACER, 2021

In terms of GHG emissions, according to Romania’s Fourth Biennial Report under the UNFCCC (MMAP, 2020), in 2018 the total GHG emissions from the Energy sector accounted for the largest share (66.32%), followed by those from Agriculture sector with a share of 17.1% and those from Industrial Processes and Product Use sector with a share of 11.58%. CO_2 emissions in the Energy sector accounted for 85.68% of total national GHG emissions (without

LULUCF), CH_4 emissions (calculated as CO_2 eq) represent 13.49% and N_2O (calculated as CO_2 eq) represent 0.83%. Compared to 2017, in 2018 GHG emissions from the Energy sector decreased by 2.04%.

According to HD TJTP (Grupul de lucru PTTJ Hunedoara, 2021) at regional (NUTS3/RO423) and local level, no assessment or calculation were performed, but since the energy sector was practically stopped, the major share of GHG emissions (ETs sources) came from the **industrial processes (manufacturing and processing industries)**, followed by non-ETS sources as transport and buildings. The lack of field data regarding primary energy consumption in the non-ETS sector made impossible the assessment of the GHG emissions, but policies and measures, to encourage and support fleet change, urban sustainable mobility and energy savings by increasing energy efficiency in buildings (public, residential and commercial) and in district/neighbourhood micro-CHP systems, will be urgently needed.

The main source of air pollution (CO_2, CO, SO_x, NO_x, N_2O, VOC, mineral dust, PM_{10}) in HD was hard-coal based combustion for power generation, but currently this issue has remained relevant only for the Jiu Valley, where, according to Transelectrica TSO, Paroseni CHPP had an environmental permit valid until May 2021, in the rest of the county the industrial processes taking the leading position followed by the intensive animals breeding and the emissions generated by road and railway transport.

Water pollution is also a problem in HD, due to the negative impact of the mining industry on groundwater, but also due to the historical industrial heritage from 1960-1980, when six energy units (Mintia TPP and Paroșeni CHPP) caused serious environmental issues, from soil and vegetation degradation, to water pollution of Jiu and Mureș rivers. If in the meantime the water quality has been recovered, **soil remediation** remains of great importance. Mines closure and other energy intensive industrial activities have left behind accentuated soil and water pollution. Although with the closure of these pollutant sources the level of GHG emissions decreases, most often another type of long-term pollution is installed, with serious consequences on the environment, on the population health and last but not least, on the local economy.

The historical industrialisation of the county favoured the appearance and maintenance of some perimeters with storage role, which were transformed into **contaminated and potentially contaminated sites**, located in the vicinity of some localities. In the county are identified 41 sites, of which contaminated and potentially contaminated 27 sites, summing up about 702.35 ha (representing 27.7% of the total national identified surface). Only 10 of the 41 sites were properly remediated/greened, of which: 44% tailings dumps, 17% ash and slag landfills, 22% municipal wastes landfills, and 17% mixed (industrial, agricultural wastes landfills). Over 60% of the 41 sites are located less than 1 km from inhabited areas, and 54% are located in **Jiu Valley micro-region**, meaning 22 sites totalling about 380 ha, of which **7 sites (207.41 ha) are at medium risk of contamination**, especially with heavy metals (Cu, Zn, Pb, Mn, Cd) i.e. Vulcan with 2 ash and slag dumps.

Investments in the polluted sites remediation and re-integration into the urban circuit are considered priorities for the county, with major benefits for both the quality of the environment, health but also from the perspective of their economic potential. Most sites are favourably located along major roads network, being suitable domestic or foreign investment.

Regarding non-ETS sources, a sector that should not be neglected in terms of substantial contribution to GHG emissions is the **buildings heat supply** (residential, public and commercial buildings). The last urban centres with operational DHSs were Deva (DHS connection degree 68.52%, thermal energy supply services stopped in winter 2020/2021), Brad (connection degree 22.24%) and Petrosani, in Jiu Valley (connection degree 9.24%, last winter with thermal energy supply services 2018-2019). The gradual transition to individual natural gas heating systems and the maintenance of a large number of firewood- stoves have a significant impact on air quality, considering in Vest Region (NUTS2/RO42) a total of 7,096 collective dwellings, 91% of which being built between 1950 and 1999, of which the most 2,515 are located in HD (35%). In Jiu Valley micro-region, there are 1,068 collective dwellings. By 2023, only 5.4% of all households in collective housing in HD were or will be renovated or

thermally insulated, and for 2021-2027, HD local councils are considering 1,015(44%) collective dwellings proposed for thermal renovation.

Additionally, in HD, there are 535 public buildings, 70% built between 1950 and 1999, of which in Jiu Valley are located 187. By 2023, 24 buildings have been thermally insulated or will be renovated in HD (4.4% of all buildings). For the period 2021-2027, HD has proposed a number of 199 public buildings for thermal renovation, especially those with social, educational, sanitary purpose and social infrastructure.

According to HD Environmental Protection Agency Annual Report, in 2019 (APM-HD, 2020) at NUTS3/RO423 level the highest amount of ammonia comes from residential heating (88.60%), followed by: transport, institutional heating, mobile sources non-road and other stationary engines. The highest amount of VOC (79.74%) and carbon monoxide (76.88%) emissions come from fossil-based (firewood and natural gas) residential heating installations and food preparation and 99.71% of CH_4 emissions come from the road transport sector. Also, the highest share of PM emissions (82.45% $PM_{2.5}$ and 68.77% PM_{10}) comes from fossil-based (firewood and natural gas) residential heating installations and food preparation.

2.3 Jiu Valley micro-region's current energy related R&I landscape

The SWOT matrix for R&I in Vest Region (NUTS2/RO42) is presented in the following table:

Table 7 - Vest Region R&I SWOT matrix (2018)

STRENGHTS	WEEKNESSES	OPPORTUNITIES	THREATS
Well-developed university education with important research infrastructure	Most RDI units are concentrated in Timiș County; discrepancies between component counties in accessing RDI	Development of research funding opportunities through financial instruments (business angels, equity funds)	The West is an emerging innovator, far from the EU average and the assumed 2.23% of GDP (2019)
Overall trend of increasing the GERD in the period 2011-2017 *2019-2020 is decreasing*	Significant regional differences in GDP expenditure for RDI	Specialisation and finding of specific opportunities for research centres in other areas of the region, other than Timișoara	Decrease in the share of RDI expenditures of academia and research institutes (66% private sector)
Increasing the number of RDI staff, which is generally highly qualified *2019-2020 is decreasing*	Lack of competent researchers, which are choosing to work in the private sector or emigrate to other countries due to uncompetitive salaries and lack of R&I funding	Development of public-private partnerships for developing collaborations and joint research projects, investments in the regional university system, inclusion of multidisciplinary approaches	Lack of skilled workers to use medium and high technology equipment as well as lack of applied knowledge and technical skills of young researchers
Clusters with an important presence in Vest Region (automotive, ICT, energy and tourism)	Decreasing the intensity of the strong influence of clusters in the innovative ecosystem of Vest Region	Development / support of clusters in areas with a large innovation component and great opportunities for growth and development	Most clusters in the Western Region fall into the last category in terms of rank by the European Secretariat for Cluster Analysis
Increase in technology transfer units as a result of European investment	Technology / industrial parks provide a basic infrastructure without taking steps to facilitate the process of innovation, partnerships, etc.	Stimulating the innovative spirit especially by increasing entrepreneurship	Research funding focuses on basic research, regardless of concept validation, technological and product development, marketing, etc.
Diversification of research units and institutes in Vest Region	The number of patents registered in Vest Region is steadily declining	Development of a R&I regional hub for the development of the innovative spirit	Focus on process innovation at the expense of product innovation or disruptive

Source: ADR Vest, 2021

According to Jiu Valley – Regional Profile (CRIT-START, 2020) in the past decade a degree of economic restructuring and diversification towards manufacturing and service activities is

evident in the valley, although entrepreneurship and business start-ups are still relatively limited. Local communities are facing complex challenges associated with the ongoing closure and contraction of significant coal mining facilities and associated activities.

Similar to the regional R&I ecosystem (NUTS3/RO423), Jiu Valley, with a specific mono-industrial background which recently collapsed, cannot overstate that key actors in the field of R&I in energy and environment have increased their interest in specific activities and projects to boost innovation and creativity in this period of profound socio-economic transformations. Past experience showed that the retraining programmes did not match with the market diversification needs, lacking of capacity, innovative creativity and attractiveness. The inevitable result was inadequate economic transformation and limited reorientation of the skills and knowledge of the workforce and population, thereby reducing the interest of international investors.

The R&I ecosystem of the Jiu Valley is represented by the 2-state owned key entities - the University of Petrosani (UPET) and National Research Institute INSEMEX and few SMEs active in the high-tech industry (industrial process automation & control, electrical and electronic spare parts etc.) and ICT. UPET and INSEMEX are institutions with high R&I potential, being in the same time promoters and connections binders inside the innovation ecosystem. Also, notable capabilities exist in specialised high-schools regarding economics, informatics and industrial subjects (i.e. robotics).

Within INSEMEX there is a high-performance R&D infrastructure "Explosives / development and testing site for explosives, flammable / toxic substances, anti-explosive equipment and training of emergency personnel for toxic / explosive environments". The institute carried out RDI activities, as well as specific scientific and technological services for companies from:

- oil & gas industry and other industries with potentially explosive hazards environments, for the assessment of the level of explosion safety and measures for the safe use of technical installations;
- mining industry - studies on the mining unit’s security status, methane leakage, self-ignition phenomena.

The University of Petroșani includes an important research network consisting of: Department of Research Management, Development and Innovation; 7 research centres; 2 scientific research laboratories: Laboratory of Analysis and Testing in Constructions and Laboratory for Research and Testing of Construction Materials, Elements and Structures. The following fields are considered a priority in UPET R&I activity: Mines; Energy; Medium; Transport; Fundamental, economic and socio-human sciences.

Starting with 2020, UPET received the title of "European University" being selected by the European Commission among the top 10 higher education institutions in the country that hold this title. "European universities" are transnational alliances of higher education institutions across the European Union that work together for the benefit of students, teachers and society as a whole, with the aim of increasing the quality, inclusion, digitisation and attractiveness of European higher education. Thus, UPET became part of the European university consortium EURECA-PRO.

UPET joined a series of R&I partnerships, some in the field of robotics with high-schools in the micro-region, others for postgraduate and university courses in the field of energy production systems from RES. Recently, a project proposal has been submitted to improve the programs of 3 doctoral schools set up in another partnership between the University of Petroșani, Ovidius University of Constanta and the University of Alba Iulia. Within the proposed actions, Jiu Valley Transition Strategy recommend to extend the curriculum with new specialisations in fields of interest as - robotics, renewable energy, sustainable development, digitalisation and the establishment, in the micro-region, of the R&I Excellence Centre in the energy field.

In **Annex 2** are presented the relevant most recent international R&I projects in Jiu Valley micro-region.

3. R&I in Energy and Environment: Vision for 2030 & 2050

During the development of all 4 (four) initiatives, supporting actions and projects (TRACER, SRSS, START, SRSP), an unprecedented stakeholder consultation process (EDP) took place in Jiu Valley micro-region, which finally generated a **common vision**, valid for any approach for the next period.

Jiu Valley - a micro-region socially revitalised, sustainable and interconnected with a competitive economic environment, supported by investments, innovation and recognised for its local specificity.

The integrated transition of Jiu Valley micro-region will be implemented by investing in human's potential, education, spirituality and morality, thus creating the right environment and generating the necessary force for the human capital, able to develop the local economy by implementing innovative ideas.

3.1 Objectives and outcomes

Starting from this shared common vision, the current status and need of the R&I ecosystem at regional (NUTS2/RO42 and NUTS3/RO423) and local levels, objectives and outcomes were set-up, in order to contribute and support the development of the key pillars of Jiu Valley Transition Strategy (MIPE, 2021).

For an effective transition from coal and a socio-economic transformation of Jiu Valley micro-region through R&I, the correlation between and complementarity of these 2 strategic documents for Jiu Valley micro-region – the Transition Strategy and the R&I Strategy in the field of energy – is more than necessary.

Table 8 - Objectives' complementarity between R&I Strategy and Transition Strategy in Jiu Valley

Transition Strategy 2021-2030		**R&I Strategy in the energy field**
Development pillars	**Main transition objective**	**R&I objectives**
I. Increasing life quality and creating a healthy and sustainable environment for future generations	Create a dynamic and efficient socio-professional climate for optimising living standards and for ensuring socially acceptable transition of the Jiu Valley to the green economy	Consolidating Jiu Valley micro-region R&I ecosystem by: a. Cultivating the culture of innovation by encouraging co-creation activities and developing knowledge hubs, living-labs etc. b. Enhancing the involvement of young people by promoting open science and increasing R&I activities attractiveness c. Creating opportunities for up-skilling / re-skilling programs in high-tech 4.0 industry and strengthen basic competences in ICT and foreign languages d. Encouraging the creativity and entrepreneurship in innovation by making the most of the natural and cultural heritage of Jiu Valley e. Supporting the growth and competitiveness of the innovative business environment for high value-added production/services diversification f. Improving access to R&I funding opportunities especially for SMEs for innovation through digitalisation and carbon-neutral processes and/or products g. Deepening the cooperation between R&I entities – businesses – public administrations for promoting ready to market R&I products/services h. Updating and opening access to the R&I infrastructure
II. Economic diversification, innovation and entrepreneurship	Create a diversified economic environment, focused on strengthening existing SMEs growth and competitiveness, with high value-added activities and products, and attracting other enterprises to the micro-region. To this aim, policies and fiscal mechanisms have to be put in place for supporting R&I initiatives and local entrepreneurship, focused on developing the entire value chain of an industry in the micro-region.	
III. Sustainable capitalisation of the local specificity	Coherent and sustainable development of tourism, culture, sports, leisure activities and creative industries, by stimulating local producers and creators, highlighting the natural, cultural, industrial and social heritage of Jiu Valley and by connecting/twinning with neighbouring regions	
IV. Accessibility, mobility and connectivity	Sustainable development of multi-modal urban mobility, in a unitary way, facilitating accessibility in all areas of the micro-region by strengthening	

Transition Strategy 2021-2030		R&I Strategy in the energy field
Development pillars	**Main transition objective**	**R&I objectives**
	the connectivity between the component cities / municipalities and the immediately neighbouring areas.	i. Supporting the connection and integration of Jiu Valley R&I key players in global value chains and business networks j. Addressing national and regional policies priorities and challenges in R&I

Outcomes will be also established when setting up the R&I Projects proposal pipeline and the Action Plan to be endorsed by the R&I ecosystem in Jiu Valley, in order to deliver an effective evaluation and monitoring process.

3.2 Key guiding principles

Before setting key guiding principles customised for Jiu Valley micro-region ADR Vest made several recommendations in RIS3 2021-2027 (ADR Vest, 2021), from which the most appropriate are:

- increasing the support for open innovation activities and pitching young entrepreneurs' R&I ideas;
- diversifying and improving access to R&I funding opportunities especially for SMEs (i.e. innovation vouchers) for innovation through digitalisation and carbon-neutral processes and/or products;
- encouraging R&I competitions; and production diversification, especially for value-added and ready to market R&I products;
- supporting technology transfer by improving services and skills inside technology transfer centres, and developing common R&I platforms (academia - businesses)
- increasing the role and stimulating the interest of young people in higher education and R&I careers; facilitating their interaction, at institutional level, with experienced researchers, including R&I units visits;
- stimulating public - private partnerships for R&I internships programs development;
- attracting researchers from other countries.

Based on ADR Vest recommendations above, the following **key guiding principles for enhancing the development of the R&I in energy and environment in Jiu Valley micro-region** were defined:

1. Ensuring an effective apolitical governance oriented to open science and dialogue towards a socially acceptable transition from coal;
2. Pursuing the complementarity of European, national, regional (NUTS2 and NUTS3) and local initiatives to avoid duplication and overlaps;
3. Encouraging constant communication and EDP roll-out to ensure cooperation and coordination between 4 helix stakeholders 'categories - public, private, research & education, civil society;
4. Supporting the involvement of young people by promoting R&I activities and its attractiveness, avoiding migration and supporting diaspora return;
5. Deepening monitoring the implementation of European, national and regional policies & measures, in order to meet R&I key objectives in smart specialisation areas;
6. Maximize the use of support schemes and increase the degree of access to dedicated funding sources to support existing initiatives and the connection between them at all local, regional, national and international levels;
7. Maintaining and developing international relations and initiating new collaborations in the R&I sector.

4. Support framework for R&I in Energy and Environment

The support framework defined by policies and measures as drivers for developing R&I solutions and projects in the fields of energy and environment are present, very briefly by summarising from each of the 6 strategic documents already listed in **Chapter 1**.

1. **The 2021-2030 Integrated National Energy and Climate Plan** (MEEMA, 2020)

The contribution of Romania to the achievement of the EU objectives by 2030 is outlined in the table below

Table 9 - INECP 2021-2030 main national objectives by 2030

By 2030 Overview of the main objectives of the 2021-2030 INECP by 2030	
ETS emissions (% compared to 2005)	**-43.9 %**
Non-ETS emissions (% compared to 2005)	**-2 %**
Overall share of renewable energy in gross final energy consumption	**30.7 %**
⬇	
RES-E share	49.4 %
RES-T share	14.2 %
RES-H&C share	33.0 %
Energy efficiency (% compared to the PRIMES 2007 projection for 2030)	
Primary energy consumption	-45.1 %
Final Energy Consumption	-40.4 %
Primary energy consumption (Mtoe)	32.3
Final energy consumption (Mtoe)	25.7

Source: (MEEMA, 2020)

In order to reach the ambition levels in 2030 regarding CO_2 emissions reductions, rising the share of renewable energy and increasing the energy savings, Romania will develop a series of policies and measures in relevant sectors - heating and cooling, electricity and transport, by maximising the synergies between the various projected actions.

Additionally, in the context of the European Green Deal Investment Plan - EGDIP (EC, PRESS, 2020), Romania through this INECP is also addressing the bases of the policies and interventions designed to ensure a socially just transition in Romania.

The summary of the main 6 trans-sectoral policies and measures is presented in the table below and suggested graphically in Figure 9 – INECP 6 main pillars, as key objectives, policies and measures, R&I and competitiveness being one of the pillars.

Table 10 - INECP main 6 trans-sectoral policies and measures

Main Pillars	Main drivers for reaching the objectives	Supporting policies and measures	Interactions with other pillars
1. Decarbonisation via GHG emissions removals	Contributes directly to the achievement of the targets on the use of RES energy, EE, energy security and R&I and competitiveness Sectors to be decarbonised: energy, industry, transport and waste management.	- Promoting investments in new low-carbon power generation capacities - Using the revenues from the EU ETS Mechanisms and the Structural Funds for RES and EE projects at national and international level (2021-2027) - Implementing BAT to reduce GHG and to increase EE in the industrial sector - Priority development and fostering the use of rail transport for passengers - Promoting transition to a circular economy	2, 3, 4, 6
2. Decarbonisation via RES energy	Increasing in the use of renewable energy in transport	Promoting of use of renewable energy and of biofuels in transport (RES-T)	1, 3

Main Pillars	Main drivers for reaching the objectives	Supporting policies and measures	Interactions with other pillars
	will result in reduction of GHG emissions and increase in EE in the same sector		
3. Energy efficiency	Generates benefits under other dimensions: decarbonisation by reducing GHG emissions, increase in RES share and combating energy poverty through solutions implementation in the residential sector, industry, and transport sectors	- Implementing the Long-Term Renovation Strategy - LTRS - Increasing EE in EU-ETS industrial sectors - Developing and promoting alternative mobility - Renewing the vehicle stock	1, 2
4. R&I and competitiveness	Generates quantifiable effects for the following dimensions: ▪ decarbonisation by reducing GHG emissions and increase RES share, and ▪ EE mainly by adopting advanced technologies with the highest degree of maturity (according to TRL/technology readiness level observing EC Decision C(2014) 4995)	- Increase in and diversification of funding sources, the strengthening of a legal framework dedicated to R&I activities, a surge in R&I projects in State-owned companies and the development of educational resources at all levels, for: ▪ Adopting advanced technologies in the energy sector (i.e. CCS, LCT, electricity storage, solar and wind power plants pilot and demonstration projects promoting use of hydrogen, etc.) and digitalisation of the energy system (smart grid/micro-grids/metering; IoT, decentralised storage, blockchain and smart applications by strengthening the public-private partnership) ▪ Fostering investments in the development of the RES (RES-E, RES-T and RES-H&C) equipment manufacturing industry (i.e. Scientific research in the RES area) and electromobility ▪ Developing the production of biofuels (e.g. production of advanced biofuels and coprocessing of oils) and biogas within the territory of Romania ▪ Supporting and fostering research and development projects and demonstration projects related to new technologies and techniques of extended renovation ▪ Fostering the development of intermittent capacities and mechanisms for integration of RES into the NES, in electrical accumulator systems, including small storage capacities at the prosumer's location	1, 2, 3, 5
5. Internal energy market	Provides for a favourable environment, through efficient organisation based on free market mechanisms, in order to support the development of new renewable energy capacities and will enable integration with other energy markets in the region, thus enhancing energy security. Moreover, the protection of vulnerable consumers is sought by means of EE policies	- Developing the power transmission grid, thus reaching an interconnectivity capacity of at least 15.4 % in 2030 - Digitalisation of the Romanian energy system - full liberalisation of electricity and gas markets as of 2020-2021 - Integrating the Romanian energy markets in the single European energy market - Regulating and defining the vulnerable consumer and means for their financing - Implementing a capacity mechanism - Electricity market mechanisms/rules in line with the provisions of the "Clean energy for all Europeans" legislative package - Developing a support mechanism of the Contracts for Differences (CfD) - Enabling to conclude long-term power purchase agreements with clients (PPA) outside centralised markets	2, 3, 4, 6
6. Energy security	Provides interactions with policies and measures from all	- Encouraging the development of energy storage capacities	1, 2, 3, 4, 5

Main Pillars	Main drivers for reaching the objectives	Supporting policies and measures	Interactions with other pillars
	the other dimensions: decarbonisation (new renewable energy capacities, EE with low GHG emissions will be developed, in particular high-efficiency cogeneration plants; storage capacities will ensure the systems' flexibility and will also foster competition on the internal energy market and R&I activities will support digitalisation of the national energy system and the enhancement of the capacity of response to cyberattacks).	- Implementing demand response measures - Implementing the Decarbonisation Plan of the Oltenia Power Holding (CE Oltenia) - Developing high-efficiency cogeneration	

Source: (MEEMA, 2020)

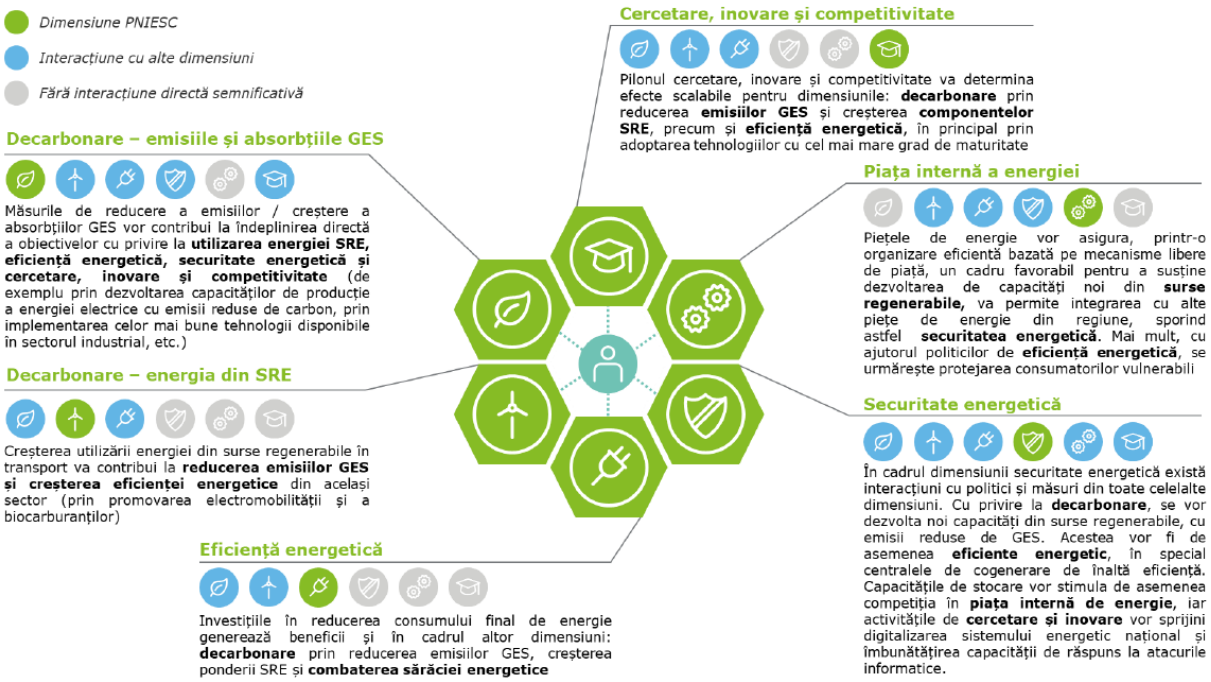


Figure 9: INECP 6 main pillars, as key objectives, policies and measures [*Source*: MEEMA, 2020]

INECP 2021-2030 is envisaging a **legal framework for granting R&I tax facilities** by including the following measures:

- the additional deduction of research-development costs on calculation of the income tax;
- the full exemption from the payment of the income tax for a period of ten years for companies carrying out solely research-development activities;
- exemption from the payment of the income tax for the remuneration costs of persons included in the research-development and innovation projects;
- the projects regarding intellectual property rights would require designing a favourable legal framework. From this viewpoint, measures may be provided for the investment effort at the stage of research or for the operating period. A good practice example consists in levying a low tax for profits gained from the use of intellectual property rights;
- the selection of priority areas and the tactical initiatives presented in the INECP must be completed by streamlined public procurement procedures. Considering the current situation and the incipient context, this support must be allocated specifically for projects targeting research/development or the implementation of pilot projects for the areas covered by INECP.

Last but not least, additional measures are highlighted for the R&I and competitiveness dimension in the energy sector, targeting the support of education and the promotion of scientific research:

- Developing higher education in the field of energy and harmonising it with the energy sector needs;
- Establishing partnerships with the energy industry for:
  - Developing oriented education and vocational training, and supporting vocational secondary education by fostering gender equality;
  - Supporting fundamental and applied scientific research in the field of energy;
- Developing the capacity for attracting European and international funding sources for scientific research through research-development-innovation institutes participation in international consortiums;
- Increasing the number and quality of human resources in R&D activities in priority fields by incentivising young independent teams, scholarships for junior researchers, international mobility projects and projects for reintegration of diaspora researchers;
- Building on the high level of specialisation reached in nuclear research by developing technologies for advanced generation IV reactors and developing the infrastructure for lead-cooled fast reactors under a European and international partnership;
- Conceptual development, construction and operation of research infrastructures described in the national roadmap seeking streamlining with the ESFRI infrastructures and the SET plan by providing investment funds and supporting the development of human resources;
- Fostering research, development and innovation activities in energy related fields as environment, transport and energy efficiency in buildings and industry, by creating new jobs and opportunities for SMEs.

Concerning the socially acceptable transition from coal in Jiu Valley, the INECP underline that an ITI – Integrated Territorial Investment allocation will be dedicated for the period 2021-2027, the micro-region having as strategic reference documents the Strategy for the transition from coal of Jiu Valley, for the period 2021-2030 (MIPE, 2021) and the Territorial Just Transition Plan (TJTP) for Hunedoara County, NUTS3 region (AARC Consortium, 2021).

2. **Romania's National Recovery and Resilience Plan – PNRR** (MIPE, 2021)

Among the 6 pillars of PNRR, structured according to the recovery and resilient mechanism (RRM - Regulation (EU) 2021/241 setting up the Recovery and Resilience Facility), the components of interest for R&I in energy and environment, are presented in the table below:

Table 11 - PNRR pillars of interest

Pillars of interest	**Component inside pillars**	**Proposed reforms** of interest
P.I. Green Transition	C5. Renovation wave *(public, residential and heritage buildings)*	- R1. Achieving a simplified and up-to-date regulatory framework to support the implementation of investments in the transition to green and resilient buildings - R2. Strategic, normative and procedural framework to support the seismic resilience of the built fund
	C6. Energy	- R1. Energy market reform, by replacing coal in the energy mix and supporting a stimulating legislative and regulatory framework for private investment in RES - aiming the entry into force and implementation of two regulations, namely: ▪ the law on decarbonisation approving the coal / lignite phasing out timetable up to 2032; ▪ the new energy law, with an impact on increasing RES share in the energy mix. - R2. Improving the corporate governance of state-owned enterprises in the energy sector - R3. Green budgeting

Pillars of interest	**Component inside pillars**	**Proposed reforms** of interest
		- R4. Developing a legislative and regulatory framework in favour of technologies of the future, in particular hydrogen and storage solutions - R5. Reducing the economy energy intensity by developing a sustainable mechanism to stimulate energy efficiency in industry and increase resilience - R6. Increasing the competitiveness and decarbonising the heating-cooling sector
P.III. Smart, sustainable and inclusive growth, including economic cohesion, jobs, productivity, competitiveness, RDI, and a well-functioning internal market with strong SMEs	C9. Private sector support, research, development and innovation	- R1. Legislative transparency, debureaucratisation and procedural simplification for the business environment - R2. Streamlining governance in research, development and innovation - R3. Researcher career reform - R4. Strengthen cooperation between business and research - R5. Support for the integration of Romanian research, development and innovation organizations in the European Research Area
P.IV. Social and territorial cohesion	C10. Local fund	- R1. Creating the framework for sustainable urban mobility - R2. Creating the policy framework for sustainable urban transformation - R3. Creating a policy framework for sustainable rural transformation: setting up administrative consortia in functional rural areas - R4. Improving housing quality - R5. Development of the planning system - Land use planning, urbanism and constructions code
P.VI. Policies for the next generation	C15. Education	- R6. Updating the legislative framework to ensure ecological standards of design, construction and endowment in the education system

Source: (MIPE, 2021)

3. **R&I Smart Specialisation Strategy - RIS3 2021-2027 for Vest Region** (RO42) (ADR Vest, 2021)

Already analysed in **Chapter 2.1 Regional profile and specialisation**

4. **Territorial Just Transition Plan (TJTP) for Hunedoara County** (AARC Consortium, 2021)

The structure of TJTP objectives at NUTS3 level and related proposed actions provides the necessary framework for integrating Jiu Valley R&I priority areas and corresponding key actions presented in Chapter 4.3.

Table 12 - Hunedoara TJTP objectives (*draft version February 2021*)

Objectives	**Proposed actions**
Developing R&I ecosystem that supports and stimulates sustainable economic growth.	- investments in the development of R&I entities and the creation of new ones, as the need arises - investment in R&I and technology transfer in enterprises, leading to increased enterprises competitiveness - cooperation between R&I entities and infrastructures and enterprises / SMEs, as well as collaboration between enterprises
Increasing the adaptability of the local economy and creating new opportunities for the workforce through the development of entrepreneurship	- productive investment in SMEs, including start-ups, leading to economic diversification and reconversion - investments in the creation of new enterprises, in areas with potential, especially in the high-tech manufacturing industry, circular economy, renewable energy, tourism - investments in enterprises other than SMEs - supporting and developing business support structures and services

Objectives	Proposed actions
	- supporting and developing business incubators, both through hard investments, but also through know-how / consulting services / skills development
Increasing the digitalisation of enterprises and public services to support the sustainable transformation of the economy	- investments in the digitalisation of public services - investments in digitalisation for Smart City development, in the 6 major Smart areas - supporting digitalisation in enterprises (hardware, services and software)
Improving thermal comfort and reducing energy costs by increasing energy efficiency and RES integration	- investing in increasing residential buildings EE, especially those with owners affected by energy poverty - investing in increasing public buildings EE, especially those with a social purpose - educational, health, social infrastructure - RES integration
Increasing the quality of life by decontaminating and regenerating polluted sites and integrating them into the local economy; promoting a green and healthy approach to urban regeneration	- decontamination of industrial sites in urban and rural areas - remediation, reconversion and inclusion of former polluted sites / unproductive lands in the urban green heritage or in the economic / tourist circuit - specific activities related to mining areas closure / greening / rehabilitation / conservation - restoration of affected ecosystems, including afforestation of former industrial sites - increasing the number and quality of public green spaces in cities
Strengthening the circular economy by stimulating new consumption patterns that prevent waste generation; waste reduction, efficient reuse and recycling	- increasing recyclable wastes collecting rates - expanding the sorting and recovery capacity for recyclable waste - separate collection of household bio-waste and their use in composting stations - setting up collecting points for all types of wastes (construction, biomass and textile waste; bulky oils, edible oils, electrical and electronic objects and equipment, batteries) - setting up collecting centres for hazardous waste and their disposal facilities - restoration of clandestine landfills and greening of non-compliant landfills - promoting campaigns for raising public awareness on the benefits of the circular economy and of recycling
Reducing pollution by improving DHS energy efficiency; improving heating systems and reducing costs.	- developing and integrating RES in DHS - upgrading and expanding the heat distribution networks - replacing the use of coal and firewood for heating purposes with the expansion of natural gas distribution networks
Decarbonising the local transport system by promoting green mobility	- developing / upgrading / expanding clean / green public transport fleet and infrastructure - eV charging stations for supplying the public transport fleet - purchasing alternative electric means of transport (i.e. e-bikes, mopeds, scooters) - developing smart traffic management systems, e-ticketing, ITS - developing and upgrading non-motorized transport infrastructure - developing bike-sharing systems
Promoting and developing the tourism potential, through integrated investments in tourism infrastructure and services and transforming it into a viable and sustainable alternative to socio-economic transition	- expansion and upgrading of the tourism infrastructure and natural assets, as well as related services in areas with high potential - rehabilitation and promotion of industrial, mining or historical built heritage, for tourism development - creating and developing integrated tourist routes and circuits - supporting professional qualification / retraining of people affected by the transition from coal, including their integration in tourism activities - supporting the development / expansion / upgrading of accommodation units or leisure facilities, including RES integration - promoting tourism resources (natural, human and ecological) - encouraging deprived people to take part in tourism

Objectives	Proposed actions
Developing and increasing the quality of medical and social services to mitigate the impact of economic transition and demographic decline	- developing new social services in relation to the existing needs at local / county level, for all vulnerable categories, children or adults and the elderly - investments in the rehabilitation / up-grading / development of the existing social services infrastructure - supporting investments in the social inclusion economy - developing social measures to support vulnerable groups affected by the transition process - developing the health service infrastructure, with a focus on deficient areas and areas with high incidence of disease
Retraining, diversifying and improving human resources skills and abilities to support the economic transition and promote active employment measures	- upskilling, training and reskilling of adult jobseekers and reintegration into the labour market - reskilling and conversion of workers according to labour market requirements - developing new trainings according to labour market requirements - trainer's training / specialisation - programs development aiming young people who are not professionally employed, do not follow any "NEET" education or training program, to facilitate their integration into the labour market - developing young people's entrepreneurial skills - TVET development, including schools with dual education system - promoting the TVET through information, awareness, counselling and guidance campaigns - developing counselling measures and job search assistance - active measures for the social integration of vulnerable groups, mainly laid-offs from the mining and energy industry - other activities in the fields of education and social inclusion

5. **Strategy for the transition from coal of Jiu Valley, for the period 2021-2030** (MIPE, 2021)

The main development pillars, objectives and strategic directions of Jiu Valley Transition Strategy are presented in the next table:

Table 13 - Jiu Valley Transition Strategy development pillars and strategic directions

Development pillars	Strategic directions
I. Increasing life quality and creating a healthy and sustainable environment for future generations	I.1 Calibrating local human potential to increase employment and combat social exclusion
	I.2. Optimising medical services and developing social services to overcome vulnerabilities
	I.3 Upgrading and making more attractive the education system, at all levels (primary, secondary, tertiary and higher); enhancing access to education and investing in skills (dual education and re-skilling programs correlated with the market needs) and competences (ICT and foreign languages);
	I.4 Supporting the transition to a green economy to protect the environment
II. Economic diversification, innovation and entrepreneurship	II.1 Reconfiguring the energy sector of the micro-region by capitalising the development potential, on various levels
	II.2 Attracting investments, in areas specific to the profile and needs of each city in the Jiu Valley, with potential for a sustainable economic development of the area
	II.3 Supporting entrepreneurship by developing specific skills and competences; individual local businesses and new economic initiatives
III. Sustainable capitalisation of the local specificity	III.1. Elaboration of Jiu Valley tourism integrated concept
	III.2 Upgrading and diversifying the tourism infrastructure and services
	III.3. Development of the fields of culture, sports activities, leisure and creative industries, adapted to the local specifics
	III.4. Using local resources in the field of agri-food and handicrafts

Development pillars	Strategic directions
IV. Accessibility, mobility and connectivity	IV.1. Renovating and upgrading road and rail infrastructure to connect Jiu Valley at territorial, regional and cross-border level
	IV.2 Developing an eco-efficient public transport system in an integrated, sustainable and intelligent manner
	IV.3. Renovation and construction of streets and pedestrian areas with improved accessibility for people with reduced mobility / disabilities, public landscaping
	IV.4 Development of utility networks, communications and street lighting networks

Source: MIPE, 2021

4.1 Multi-level governance structure for R&I policies in Jiu Valley micro-region

According to RIS3 2021-2027 for Vest Region, the concept of RIS3 governance is based on a broad innovation perspective, which implies that stakeholders in various fields of activity should be widely and constantly engaged in the strategy design. For Vest Region the implementation of this strategy is based on several institutions that had a defining role in the creation, development and approval of RIS3 2021-2027:

- Council for Regional Development (CDR) having as member also Hunedoara County Council (RO423) and Uricani mayoralty, Jiu Valley;
- Regional Innovation Consortium (CRI);
- Vest Regional Development Agency (ADR Vest);
- Regional actors gathered during the EDP.

Regarding Jiu Valley micro-region, it was found-out that R&I representatives (i.e. University of Petrosani, INSEMEX etc.) are not integrated nor involved in this Vest regional governance structure.

As already mentioned, several European actions/initiatives (SRSS, START, SRSP) were rolled-out in parallel with TRACER project implementation in Jiu Valley micro-region, on the background of the COVID-19 pandemic years 2020-2021. To this aim, additional efforts have been made to synchronise all actions, including related EDP, for their complementarity and for avoiding overwhelming Jiu Valley communities' representatives, key stakeholders being practically targeted for crossfires.

Therefore, considering also that Jiu Valley micro-region will benefit from Integrated Territorial Investment - ITI allocations, it is recommended to acknowledge **a unique official governance structure**. Thus, the main role for planning and managing the socio-economic transformation process in Jiu Valley micro-region, including transition from coal, is being taken over by the new official local governance structure properly designed also for conducting the ITI mechanism "Asociația pentru Dezvoltare Teritorială Integrată Valea Jiului" (**Jiu Valley Integrated Territorial Development Association**), hereinafter referred to as the Jiu Valley Association (TRACER, 2021).

The main purpose of Jiu Valley Association will be to provide services in the field of initiation, development and promotion of competences and local development policies, to support the implementation of the ITI mechanism inside the micro-region's territorial administrative units.

The role of this governance structure will be to coordinate and ensure the implementation of the Strategy for the transition from coal of Jiu Valley, for the period 2021-2030 (MIPE, 2021), in correlation with ITI Valea Jiului, providing indirect support for matching existing funding with projects that are integrated into the priority axes of Jiu Valley Transition Strategy.

Having in view that priority R&I areas for energy – environment (**Annex 1**) are integrated in the 4 (four) development pillars inside the Transition Strategy (MIPE, 2021), the Jiu Valley Association will manage and monitor also the implementation of the R&I Strategy and Roadmap in the field of energy (current report).

The Association has as founding members:

- Hunedoara County Council;
- 6 Local Councils in Jiu Valley: Petroșani, Lupeni, Vulcan, Petrila, Uricani and Aninoasa;
- University of Petroșani;
- NGOs from each sector: social, economic, environmental, urban development.

In terms of organisational chart, when the official foundation process ends, the Association could include a General Assembly, an Administrative Board and executive staff, the decision-making mechanism being performed based on the majority vote. It is assumed that this Association will play a key role in securing a sustainable future development for Jiu Valley.

4.2 Funding opportunities

EU funding landscape, if properly managed and planned, offers a number of opportunities to support the implementation of sustainable energy systems, with a focus on transition strategies from coal. Comprehensive planning, including a good financing strategy, coordinating fund mobilisation efforts and capacity building at the regional and local level will support local actors, with limited capacity to access finance, to turn Transition and R&I Strategies into successful implemented projects (CRIT, 2021).

Several funding programs and mechanisms are available, for:

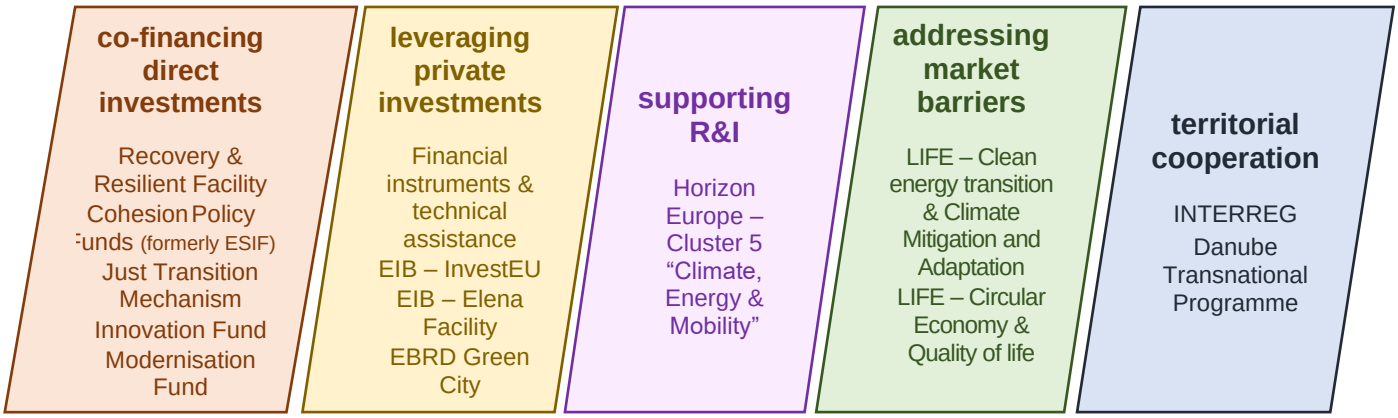


Figure 10: EU financing opportunities [*Source:* Dobrin, M. et al, 2021]

The first step to finance mobilisation is to ensure that there is a sufficient number of high-quality projects to finance.

Once a project is identified and prioritised, the second step lies in preparing different documentation, such as:

- technical feasibility studies
- risk assessments
- financial planning
- grant applications.

According to CRIT - Transition Financing Toolkit (CRIT, 2021) support for **projects preparation** can be found in several initiatives like JASPERS[1], ELENA[2], URBIS[3], TARGET[4], the European Investment Advisory Hub[5] or the EEEF's technical assistance facility[6].

[1] https://jaspers.eib.org/
[2] https://www.eib.org/de/products/advising/elena/index.htm
[3] https://eiah.eib.org/about/initiative-urbis.htm
[4] https://ec.europa.eu/energy/topics/oil-gas-and-coal/eu-coal-regions/target-technical-assistance_en
[5] https://eiah.eib.org/
[6] https://www.eeef.lu/eeef-ta-facility.html

The European City Facility – EUCF[7] provides grants to local authorities to develop investment concepts, as well as technical assistance and capacity building opportunities. Investment concepts translate a project idea into financial language in order to mobilise financing for its realisation.

The Covenant of Mayors has an interactive funding guide[8] that gathers EU and national funding sources, as well as information about support services and innovative financing schemes.

Strengthening the administrative capacity for finance mobilisation among public authorities, SMEs, R&I entities, transition governance structures find support through LIFE and Horizon Europe programs. The LIFE programme[9] offers training for setting up so-called 'Integrated Programmes' via own dedicated technical assistance calls (via the funding & tender platform). For Horizon Europe, the network of National Contact Points (NCP portal[10]) is the main structure to provide guidance and training on all aspects of participation. For Romania NCP coordinator is Mrs Letiția Pavelescu, Ministry of Research, Innovation and Digitalization (MCID), t. 021 303 4186.

Specific technical support for coal regions refers to TARGET[4] (Technical Assistance for Regions undergoing a Green Energy Transition) which is a new technical assistance programme co-developed by the EC and EIB for EU coal, peat and oil shale regions to support the pipeline development and implementation of projects. TARGET is focusing the following areas: clean energy and energy efficiency, in particular clean heating and energy-efficient renovations of buildings. For this technical assistance can apply Jiu Valley public authorities and specific project promoters (public or private).

As presented in **Figure 10** EU financing opportunities are diverse and can be of three types: grants (non-repayable funding), loans (lend money in favourable conditions) and guaranties (whereby funding partners take over / a part of / the obligation if the debt cannot be paid back.

Table 14 - Funding programs overview

Type of funding	Focus on	Recipients	Application via
ERDF[11]			
Grants, loans and guarantees	- Innovation and research - Digital transition - Support for SMEs - Low-Carbon Economy	Regional public and private entities, with special attention paid to disadvantaged regions and areas, notably rural areas and outermost regions	Operational Programs URBACT[12] Urban Innovation Actions[13] INTERREG[14]
ESF+[15]			
Grants	- Investments in youth, especially to support them finding a qualification and job - Support to the most vulnerable suffering from job and income losses - Promotion of social innovation, social entrepreneurship and cross-border labour mobility under the new Employment and Social Innovation (EaSI) strand	Public administrations, workers' and employers' organisations, NGOs, charities and companies.	Operational Programs Funding & Tenders platform[16] for EaSI strand and ESF+ technical assistance
Cohesion Fund (CF)[17]			

[7] https://www.eucityfacility.eu/apply-for-eucf-support/application-process.html
[8] https://www.eumayors.eu/support/funding.html
[9] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/programmes/life2027
[10] https://www.horizoneuropencpportal.eu/
[11] https://ec.europa.eu/regional_policy/en/funding/erdf/
[12] https://urbact.eu/
[13] https://uia-initiative.eu/en
[14] https://www.interregeurope.eu/
[15] https://ec.europa.eu/esf/main.jsp?catId=62&langId=en
[16] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/programmes/esf
[17] https://ec.europa.eu/regional_policy/en/2021_2027/

Type of funding	Focus on	Recipients	Application via
Grants (the level of financing from the Cohesion Fund for a programme can amount to up to 85% of its cost)	- Trans-European transport networks, notably priority projects of European interest as identified by the EU. - The Cohesion Fund will also support infrastructure projects under the Connecting Europe Facility. - Environmental projects that are related to energy or transport, e.g. improving energy efficiency, use of RES, developing rail transport, supporting intermodality, and strengthening public transport, etc	Public and regional authorities in Bulgaria, Croatia, Cyprus, Czechia, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, **Romania**, Slovakia and Slovenia.	Operational Programs
HORIZON Europe[18]			
Grant funding and prizes	- Focus of pillar II: health; culture, creativity and inclusive society; civil security for society; digital, industry and space; climate, energy and mobility; food, bioeconomy, natural resources, agriculture and environment - Focus of 'mission areas': adaptation to climate change including societal transformation; cancer; climate-neutral and smart cities; healthy oceans, seas, coastal and inland waters; soil health and food.	Scientists and academics, research organisations, universities, industry, SMEs, students, etc.	Funding & Tenders platform[19]
JTF[20]			
Just Transition Fund / grants Invest EU programme EIB public sector loan	Support of investments in SMEs that target diversification; creation of new firms; research and innovation; environmental rehabilitation; clean energy, energy efficiency and district heating projects; up- and reskilling of workers; job-search assistance and active inclusion of jobseekers' programmes; transformation of existing carbon-intensive installations.	National and local authorities, businesses and start-ups in the in the territories most negatively affected by the transition process (as identified in the Territorial Just Transition Plans).	Member states / NUTS3 level
JTF – Public sector loan facility			
Grant funding and loans	Energy and transport infrastructure; district heating networks; public transport; energy efficiency measures; social infrastructure.	Exclusively for public entities	Member states / NUTS3 level
LIFE Programme[21]			
Grant funding	- Focusing on the topics 'Environment' and 'Climate Action' under four sub-programmes: Nature and Biodiversity, Circular Economy and Quality of Life, Climate Change Mitigation and Adaptation and – most importantly for coal regions – Clean Energy Transition - Contribute to the shift towards a clean, circular, energy efficient, low-carbon and climate-resilient economy, including through the transition to clean energy; protect and improve the quality of the environment; halt and reverse biodiversity loss, thereby contributing to sustainable development.	EU national or local authorities, private commercial organisations and private non-commercial organisations (e.g. non-governmental organisations).	LIFE website

[18] https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en
[19] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/programmes/horizon
[20] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en#financing
[21] https://cinea.ec.europa.eu/life_en

Type of funding	Focus on	Recipients	Application via
Connecting Europe Facility - CEF[22]			
Primarily grants, with different co-financing rates depending on the project type; blending calls	Energy; transport; digital.	The new CEF (2021-2027) will focus more on climate change, digital connectivity and renewable electricity. Industry, small and medium-sized enterprises, research organisations, other public and private entities established in a Member State or in a third country associated with the programme or created under EU law, and international organisations.	CEF website
Research Fund for Coal and Steel - RFCS[23]			
Grant Funding	- For steel: clean steel production processes; optimised utilisation and conservation of resources, energy savings and industrial efficiency improvements; emission reductions from steel production. - For coal: health and safety at work; environmental protection; technologies supporting transition away from coal in coal regions.	Universities, research centres and private companies.	RFCS website
Modernisation Fund[24]			
Grants, guarantees, loans, capital injections (decided by Member States)	Generation and use of energy from renewable sources; energy efficiency; energy storage; modernisation of energy networks, including district heating, pipelines and grids; just transition in carbon-dependent regions: redeployment, re-skilling and upskilling of workers, education, job-seeking initiatives and start-ups.	Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovakia	Member States select the investments they wish to submit for Modernisation Fund support.
Innovation Fund[25]			
Grants (up to 60% of additional capital and operational costs).	Innovative low-carbon technologies and processes in energy intensive industries, including products substituting carbon-intensive ones; innovative renewable energy; energy storage; carbon capture and storage (CCS); carbon capture and utilisation (CCU).	EU Member States	Funding and tender's platform
European Globalisation Adjustment Fund for Displaced Workers (EGF)[26]			
Grant funding (co-financing rate 60-85%)	The EGF can co-finance measures such as: help with looking for a job; career advice; education, training and re-training; mentoring and coaching; entrepreneurship and business creation.	EU Member States	Member states via contact person
Recovery and Resilient Facility - RRF			
Grants and loans	Clean technologies and renewables; energy efficiency buildings; sustainable transport and charging stations; rollout of rapid broadband services; digitalisation of public administration and services; data cloud capacities and	EU Member States; and, indirectly, EU citizens, public or private organisations and businesses.	Member States (based on PNRR)

[22] https://cinea.ec.europa.eu/connecting-europe-facility/energy-infrastructure-connecting-europe-facility_en
[23] https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/research-fund-coal-and-steel-rfcs_en
[24] https://ec.europa.eu/clima/eu-action/funding-climate-action/modernisation-fund_en
[25] https://cinea.ec.europa.eu/innovation-fund_en
[26] https://ec.europa.eu/social/main.jsp?catId=326&langId=en

Type of funding	Focus on	Recipients	Application via
	sustainable processors; education and training to support digital skills.		
Invest EU[27]			
Grants, loans and guarantees	- Sustainable Infrastructure; research, innovation and digitalization; small and medium businesses; social investment and skills. - Coal regions may especially use this mechanism for strategic investments focusing on building stronger value chains as well as supporting activities in critical infrastructure and technologies	Public and private investors, project promoters, and SMEs.	Financial implementing partners (i.e. EIB)
INTERREG			
Grants	- P1 – A smarter Europe (i) developing and enhancing research and innovation capacities and the uptake of advanced technologies (iv) developing skills for smart specialisation, industrial transition and entrepreneurs hip - P2 – A Greener, low carbon Europe (ii) promoting renewable energy (iv) promoting climate change adaptation, and disaster risk prevention, resilience, taking into account ecosystembased approaches (v) promoting access to water and sustainable water management (vii) Enhancing protection and preservation of nature, biodiversity and green infrastructure including in urban areas, and reducing all forms of pollution - P3 – A more social Europe - P4 – A better cooperation governance	local, regional and national public authorities and organisations established and managed by public authorities responsible for research, innovation, technology transfer institutions, sectoral agencies and regional development agencies, networks, clusters and associations, research and development institutions, universities with research facilities, business support organisation (e.g. chamber of commerce, business innovations centres, technology information centres), higher education, education/training centre and school, NGOs, private enterprises including SME, or industrial and technological hubs and parks	Danube Transnational Programme[28]

Source: (CRIT, 2021)

For Romania the following **Operational Programs**[29] (OP) were prepared by the Ministry of Investments and European Projects, according to the Partnership Agreement 2021-2027 with the EC, in order to support projects implementation based on the future calendar for calls for proposals and applicants guides:

- Programul Operațional Creștere Inteligentă, Digitalizare și Instrumente Financiare (POCIDIF) / Smart Growth, Digitalisation and Financial Instruments OP
- Programul Operațional Dezvoltare Durabilă (PODD) / Sustainable Development OP
- Programul Operațional Tranziție Justă (POTJ) / Just Transition OP
- Programul Operațional Asistență Tehnică (POAT) / Technical Assistance OP
- Programul Operațional Sănătate (POS) / Health OP
- Programul Operațional Educație și Ocupare (POEO) / Education and Employment OP
- Programul Operaţional Incluziune și Demnitate Socială (POIDS) / Inclusion and Social Dignity OP
- Programul Operațional Acvacultură și Pescuit (POAP) / Aquaculture and Fishing OP
- Programul Operaţional Transport (POT) / Transport OP
- Programele Operaționale Regionale (POR) / Regional OPs

[27] https://europa.eu/investeu/home_en
[28] https://www.interreg-danube.eu/about-dtp/priorities-objectives-2021-2027
[29] https://mfe.gov.ro/minister/perioade-de-programare/perioada-2021-2027/

The main OPs with focus on R&I in the fields of energy and environment are POCIDIF, POTJ (to be implemented only in 6 NUTS3 regions of Romania, including Hunedoara/RO423), PODD, POEO managed at national level and POR Vest Region (West Regional Operational Programme) managed and deployed at NUTS2 / RO42 level by ADR Vest. For additional information visit the OP website https://adrvest.ro/por-2021-2027/.

For Jiu Valley micro-region, the instrument of territorial development through which the integrated urban development will be implemented under POR Vest Region is ITI "integrated territorial investments", according to Regulation (EU) no. 1060/2021, art. 28 (a), to be applied to the 6 cities and municipalities - Aninoasa, Lupeni, Petrila, Petroșani, Uricani and Vulcan. ITI will make it possible to combine resources from several European funds, within the priority axes of one or more Operational Programs.

Of great importance for Jiu Valley is to facilitate access of local SMEs to private finance - an element of many urban transition strategies. Local financial institutions in EU countries can access EU funds to provide loans, microfinance or equity funding through venture capital funds, business angels or social investors. For additional information visit the European Investment Fund[30] (EIF) website.

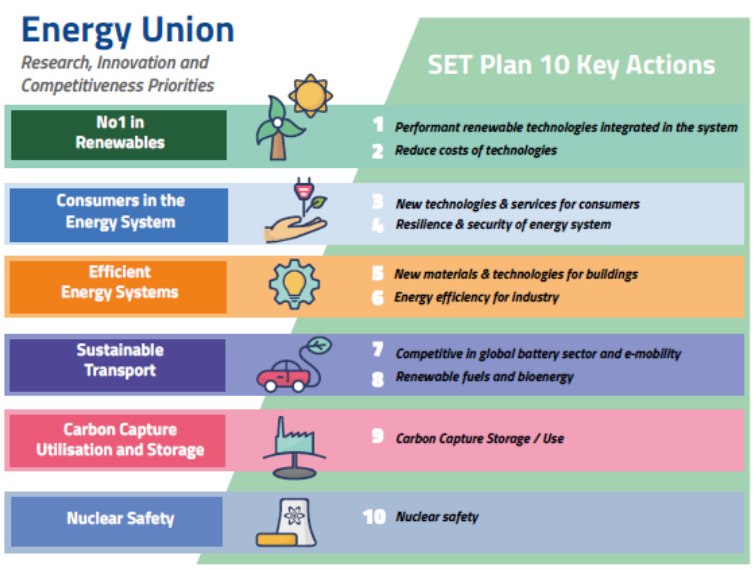
Other programs and grants could be available, as: **EEA and Norway grants**, **EBRD Green Cities**, national and local programs supported by the state and the local budget (e.g. AFM – Environmental Fund Administration).

For Romania, the new IT platform https://oportunitati-ue.gov.ro/ offers the necessary information support for all stakeholders' categories interested in developing a project in the Jiu Valley (legal entities - public, SMEs, large enterprises, NGOs, and individuals).

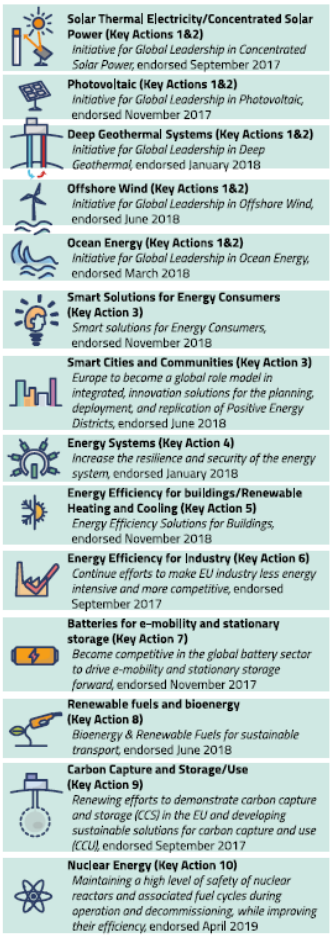
4.3 Priority areas for Research and Innovation

As mentioned in TRACER Report on "Projections for the transition to 2030/2050 in the target regions" (TRACER, 2021) SET Plan - Strategic Energy Technology Plan (EC, 2021) is the R&I pillar of the EU's energy and climate policy, lined up with the Energy Union's R&I priorities. SET Plan defined 10 key actions (**Figure 10a**) and fourteen (14) technology areas that have the highest innovation potential for delivering cost reductions and improvement of performance quickly, thus contributing to the decarbonisation of the European energy system. In **Figure 10b** are presented the association between the 14th of the technology areas - key actions and implementation plans *(italic)*.

[30] https://www.eif.org/index.htm



(a) SET-Plan's 6 Priorities and associated 10 Key Actions



(b) SET-Plan's Technology Areas - Key Actions and the Implementation Plans

Figure 11: (a) and (b) SET-Plan; Source: (Dufour, E. L. R., 2019)

At Vest Region / RO42 level the smart specialisation areas, specialisation niches and potential niches to explore are presented in the following table.

Table 15 - Smart specialisation areas in Vest Region

Smart specialisation priority areas	Specialisation niches	Potential niches to explore
i) ICT and automotive	- Custom software - Computers and electronic products manufacturing - Telecommunications - Electrical and electronic equipment, parts and accessories for vehicle's manufacturing - Tire manufacturing - Electrical and electronic wires and cables, other electrical equipment for equipment's manufacturing	- IoT, automation / robotics, artificial intelligence, big data, virtual reality - autonomous cars - smart transport systems - communications equipment's manufacturing - systems design, customisation
ii) Energy efficiency and sustainable construction	- Residential / non-residential building works - road / highway construction works; - HVAC / electrical works and fabrication of metal constructions - Transport - goods handling and storage; - Electricity distribution and supply.	- smart buildings - new models and technologies for modular buildings - smart energy grids
iii) Manufacturing and processing industry	- Plastic articles manufacturing; - Production of ferrous metals and wire articles; - Furniture manufacturing.	- advanced and high-tech materials - industrial design and production - new and customised production technologies - 3D printing

Smart specialisation priority areas	Specialisation niches	Potential niches to explore
iv) Agriculture and food industry	- cereal cultivation; mixed farm activities; poultry farming; pig breeding; ancillary activities in crop production - processing / preserving meat and meat products manufacturing; bread, cakes / pastries manufacturing; dairy products / cheeses manufacturing;	- biotechnology and the improvement of agricultural products; - development of animal husbandry; - biosecurity and variety certification; - processing local and other value-added products; - production of biofuel from vegetable plants.
v) Cultural and creative industries	- architecture and engineering, including technical consultancy, testing and technical analysis; - dental medical devices, apparatus and instruments manufacturing; - other software publishing activities; - other products manufacturing.	- design and artistic creation; - support infrastructure for creative communities.
vi) Health and quality of life	- outpatient and dental care; - hospital care activities; - other general healthcare activities.	- wellness and medical tourism; - innovative treatments for degenerative illnesses; - emerging technologies in medical ICT; - e-health.

Source: (ADR Vest, 2021)

Within TJTP HD / RO423 the areas of interest for R&I were already underlined in the introduction to **Chapter 4 Support framework for R&I in Energy and Environment**. and are targeting:

- Supporting the development of R&I entities
- Increasing SMEs competitiveness by promoting R&I activities in enterprises and by intensifying the collaboration between SMEs and R&I entities
- Increasing EE and RES integration in constructions (residential, public, commercial, tourist) and in thermal energy supply systems
- Decontamination, restoration and reconversion of former mining sites
- Urban green regeneration
- Sustainable urban mobility.

Rehabilitation and promotion of industrial, mining or historical built heritage, for tourism development The Transition Strategy 2021-2030 focuses on deepening R&I in the following areas of interest:

- I.1 Calibrating local human potential to increase employment and combat social exclusion;
- I.3 Upgrading and making more attractive the education system, at all levels (primary, secondary, tertiary and higher); enhancing access to education and investing in skills (dual education and re-skilling programs correlated with the market needs) and competences (ICT and foreign languages);
- I.4 Supporting the transition to a green economy to protect the environment;
- II.1 Reconfiguring the energy sector of the micro-region by capitalising the development potential, on various levels;
- II.2 Attracting investments, in areas specific to the profile and needs of each city in the Jiu Valley, with potential for a sustainable economic development of the area;
- II.3 Supporting entrepreneurship by developing specific skills and competences; individual local businesses and new economic initiatives
- III.2 Upgrading and diversifying the tourism infrastructure and services

- IV.2 Developing an eco-efficient public transport system in an integrated, sustainable and intelligent manner
- IV.4 Development of utility networks, communications and street lighting networks.

Corroborating SET Plan recommendations for technology's areas with maximum innovation potential with

- the elements structured at the level of the strategic documents mentioned above,
- EDP conclusions developed within TRACER project and highlighted in the Report on setting out a vision and future oriented priorities in Jiu Valley, Vest Region (RO 42), Romania (TRACER, 2021).

the priority areas for R&I in the energy and environment fields are defined for Jiu Valley micro-region in the following table:

Table 16 - Jiu Valley micro-region R&I priority areas, key actions and technologies / systems / services

R&I priority areas	Key actions	Technologies / systems / services
R&I.I. Renewable and alternative sources; and bioenergy generation	RES potential assessment, mapping and 3D modelling/simulation	- GIS, Digital solutions for 3D modelling/simulation and LCA - Hybrid solar panels and solar thermal (roof type) - Concentrated solar power / CPV; Ground PV and roof PV - Vertical wind turbines - Various type of HPs and geothermal pumps, including research drillings for assessing the potential - Mine Methane Capture (MMC) or UCG (Underground Coal Gasification) for syngas production used in micro-CHP - RNG from energy crops to produce bio-methane - Green sustainable biomass - Green hydrogen from RES for heating, transport, electricity storage - Training simulators for different nuclear energy technologies
	RES integration for public/private consumers and prosumers and energy communities	
	Performant RES integrated in the NPS	
	Renewable fuels production	
	Green hydrogen generation hub	
	Nuclear energy	
R&I.II. Urban regeneration	Integrated urban and territorial planning, specific to a functional urban area (such as Metropolitan Area or Integrated Development Association)	- GIS - BIM (Building Information Modelling) - Digital solutions for innovative energy technologies planners - Cost-effective innovative construction materials (converting the building envelope into electricity-producing surfaces, sheep wool thermal-insulation etc.) - Energy and resource efficient workflows - Digital solutions for integrated energy demand-response - Digital solutions for building automation control - NZEB and positive energy buildings / districts / neighbourhoods - Smart city, smart districts, smart campus - Smart micro-grid infrastructure - Smart metering and data centres - New construction standard / Smart-green renovation concept and creation of the Jiu Valley buildings registry - Air quality/natural ventilation, natural lighting - Innovative and more energy efficient Building Integrated Photovoltaics (BIPV) - Micro-CHP biomass-based and/or syngas-based - Reversible HPs with no GHG
	Smart and green solutions for district heating and cooling (H&C)	
	Energy and resource efficient buildings renovation	
	Architectural aesthetic in line with the local cultural heritage	
	Buildings' functionality reconversion	
	RES integration in district / zonal / building H&C systems RES integration in buildings combined with urban service facilities	
R&I.III. Energy storage	Electricity storage hubs for e-mobility and stationary sources	- Energy management - Digital solutions to optimise the storage systems for different technologies (i.e. li-ion, sodium-sulphur,

R&I priority areas	Key actions	Technologies / systems / services
	Thermal energy storage pilots/proof of concept	hydrogen from electrolysis, or second life eVs batteries) - Energy storage systems with bidirectional charging - Thermal energy storage tanks in former underground mines
R&I.IV. Environmental protection	Monitoring and preserving air, water and soil quality	- Digital solutions for LCA and EIA and carbon footprint calculation, for air and water quality - Digital solutions for modelling and simulation - Digital innovative solutions for traffic management - New innovative solution for industrial wastes re-use - Innovative soil remediation solutions by making the most of its energy potential (i.e. reuse of mine waters for heating, ground PV on unproductive lands, energy crops and biofuels production etc.) - New smart green constructions on unproductive lands / former historically polluted site based on new construction standard and regreening an equivalent surface or regreening the entire historically polluted site - Ecosystem services to increase life quality by increasing the quality of the environment
	Updating mining closure guidelines and regulations for a sustainable remediation of former mining sites / mine tailings	
	Unproductive lands mapping and capitalisations	
	Industrial wastes re-use (i.e. ash and slag, construction materials from buildings demolition/renovation etc.)	
	Assessing and constantly monitoring the carbon footprint of Jiu Valley micro-region	
	Development of green-blue corridors between urban, peri-urban and the natural environment	
R&I.V. Competitive and innovative manufacturing and processing industries	Energy efficiency and sustainable use of resources - solutions for industry	- Heat recovery in industry - Digital solutions for smart metering, processing and decision-making support tools - Digital solutions for industrial process automation & control - Digital solutions for LCA and EIA - VxG charging systems production for e-buses, e-vehicles, e-bicycles and e-scooters - PCB (printed circuit board) production in compliance with RoHS and REACH Directives - Advanced electricity storage systems production - Innovative green biomass production - Digital hubs / industrial parks / business incubators
	Cost-effective manufacturing of electric and electronic, micro-electronic parts for various fields/niches (i.e. e-mobility, urban digitalisation, smart metering, industry automation, RES spare-parts etc.)	
	Green biomass sustainable generation from wood processing industries and agriculture	
R&I.VI. Innovative technologies and services for consumers (public, private, energy communities, individual prosumers)	Utilities, fuels and other urban indicators monitoring, reporting and management (i.e. energy, water, carbon footprint, climate, indoor-outdoor air quality, biofuels and others (n.g.), wastes etc.)	- Smart metering - BMS – building management system - ICT, IoT, big data, open data models - Innovative protective systems for potentially toxic / inflammable / explosive atmospheres - Mobile applications - User-friendly interfaces - Green schools and innovative, flexible and adaptive curricula - Living labs / proof of concept
	Advanced protection for industries and civilian areas against toxic / inflammable / explosion hazard	
	Decision making support tools	
	Developing new and supporting existing innovative, flexible and adaptive to market needs of CVET, higher-education and dual-education systems and programs curricula	
	Consumers' behaviour monitoring for rising awareness and changing attitudes	
	Facilitating social innovation, co-creation, promote education and CVET for sustainability	

Through the implementation of the recommended R&I key actions above, with the financial support described in **Chapter 4.2**, the R&I ecosystem in Jiu Valley micro-region will be more developed and mature, thus contributing to reaching the national targets set-up in INECP 2021-2030 (MEEMA, 2020).

In **Annex 1** also presents the intersection of these key innovative sectors and priority R&I areas for energy - environment and related fields with all 4 (four) development pillars inside the Strategy for the transition from coal of Jiu Valley, for the period 2021-2030 (MIPE, 2021).

4.4 Evaluation and Monitoring

It is recommended that the governance structure “Jiu Valley ITI Association” be responsible for carrying out the evaluation and periodic monitoring (annually) of the R&I Strategy implementation in Jiu Valley, simultaneously with the monitoring process enrolled for assessing the Strategy for the transition from coal of Jiu Valley, for the period 2021-2030, and its Action Plan deployment.

In order to anticipate the need for continuous change / transformation / transition and to manage properly, Jiu Valley ITI Association will have to monitor and evaluate the progress made. Establishing and determining the KPI, with the support of ADR Vest, will allow the comparison to other countries and / or regions. These performance indicators are periodically evaluated at regional level (NUTS2/RO42) through the Regional Innovation Scoreboard. To this aim, it is recommended that the governance structure “Jiu Valley ITI Association” to cooperate with ADR Vest to determine the same KPI at the level of Jiu Valley micro-region, in order to compare and manage their evolution.

Another method of evaluation and monitoring is based on the objectives and results (outcomes) set and the assessment of the level of achievement, or by collecting data from the R&I calls for projects proposals, from national and European funds, tracking the number of completed, ongoing and in preparation R&I projects, products and services launched and integrated on the market, collaborations of the local R&I ecosystem with creative industries, and how the results of these projects have been disseminated to key actors and the general public in Jiu Valley micro-region.

It is the role of the governance structure to decide and choose the appropriate method of monitoring, evaluating and reporting for Jiu Valley R&I Strategy, which we recommend to be done simultaneously with the evaluation process of Jiu Valley Transition Strategy level of implementation.

Concluding note

Even if the national & regional figures and EC assessment are not optimistic in terms of R&I, the Jiu Valley micro-region takes over the regional model and is keen to contribute to and synchronize with ADR Vest effort to boost the public and private R&I potential, currently under-exploited in the region.

Innovation depends on cooperation, which can allow underused knowledge and innovation capacities to be identified and used more effectively. To this aim, the communication channels initiated and used by EDP, throughout the elaboration of this strategic document, must be kept alive, the connections must be maintained and resumed periodically so that the implementation process of the R&I Strategy be a successful one with tangible results in Jiu Valley micro-region.

For Jiu Valley micro-region being connected and competitive in the global economy is a must and depends on transnational activities and participation in business value chains.

Willingness, constant and committed engagement of key local stakeholders, together with good governance will be the main drivers for effectively developing and implementing the R&I solutions and projects which will be further identified and promoted in the next TRACER deliverables and activities:

- Report on the needs for workforce retraining
- R&I Roadmap in the field of energy
- Matchmaking events with EU programs representatives and potential investors

According to Jiu Valley common vision investing in human's potential, education, spirituality and morality, thus creating the right environment and generating the necessary force for the human capital, will trigger the development of the local economy by implementing innovative ideas.

In the future, supporting the involvement of young people, by openly promoting R&I activities and increasing their attractiveness, by avoiding migration and encouraging the diaspora return, will be essential for the effective implementation of Jiu Valley R&I Strategy and Roadmap in the field of energy.

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Annexes

Annex 1 - Intersection of key innovative sectors and priority R&I areas for energy - environment with the development pillars inside the Transition Strategy for Jiu Valley

Starting from EDP shared common vision, priority areas for R&I were set-up, integrated within the 4 development pillars of Jiu Valley Transition Strategy (MIPE, 2021), including related objectives and strategic directions which were considered appropriate. The correlation between and complementarity of these 2 strategic documents for Jiu Valley micro-region – the Transition Strategy and the R&I Strategy in the field of energy – is presented in the table below:

Table 17 - Integration of the priority areas for R&I in the field of energy and environment within the Transition Strategy development pillars

<table>
<tr><th colspan="3">Transition Strategy 2021-2030</th><th colspan="2">R&I Strategy in the field of energy & environment</th></tr>
<tr><th>Development pillars</th><th>Main objective</th><th>Strategic directions
of interest to be correlated</th><th>Objectives</th><th>Priority areas</th></tr>
<tr><td rowspan="3">I. Increasing life quality and creating a healthy and sustainable environment for future generations</td><td rowspan="3">create a dynamic and efficient socio-professional climate for optimising living standards and for ensuring socially acceptable transition of the Jiu Valley to the green economy</td><td>I.1 Calibrating local human potential to increase employment and combat social exclusion</td><td rowspan="6">Consolidating Jiu Valley micro-region R&I ecosystem by:
a. Cultivating the culture of innovation by encouraging co-creation activities and developing knowledge hubs, living-labs etc.
b. Enhancing the involvement of young people by promoting open science and increasing R&I activities attractiveness
c. Creating opportunities for up-skilling / re-skilling programs in high-tech 4.0 industry and strengthen basic competences in ICT and foreign languages
d. Encouraging the creativity and entrepreneurship in innovation by making the most of the natural and cultural heritage of Jiu Valley
e. Supporting the growth and competitiveness of the innovative business environment for high value-added production/services diversification
f. Improving access to R&I funding opportunities especially for SMEs for</td><td rowspan="3">R&I.I. Renewable and alternative sources; and bioenergy generation
R&I.II. Urban regeneration
R&I.IV. Environmental protection
R&I.V. Competitive and innovative manufacturing and processing industries</td></tr>
<tr><td>I.3 Upgrading and making more attractive the education system, at all levels (primary, secondary, tertiary and higher); enhancing access to education and investing in skills (dual education and re-skilling programs correlated with the market needs) and competences (ICT and foreign languages);</td></tr>
<tr><td>I.4 Supporting the transition to a green economy to protect the environment</td></tr>
<tr><td rowspan="3">II. Economic diversification, innovation and entrepreneurship</td><td rowspan="3">create a diversified economic environment, focused on strengthening existing SMEs growth and competitiveness, with high value-added activities and products, and attracting other enterprises to the micro-region. To this aim, policies and fiscal mechanisms have to be put in place for supporting R&I initiatives and local entrepreneurship, focused on developing the entire value chain of an industry in the micro-region.</td><td>II.1 Reconfiguring the energy sector of the micro-region by capitalising the development potential, on various levels</td><td rowspan="3">R&I.I. Renewable and alternative sources; and bioenergy generation
R&I.II. Urban regeneration
R&I.III. Energy storage
R&I.IV. Environmental protection
R&I.V. Competitive and innovative manufacturing and processing industries
R&I.VI. Innovative technologies and services for consumers (public, private, energy communities, individual prosumers or/and consumers)</td></tr>
<tr><td>II.2 Attracting investments, in areas specific to the profile and needs of each city in the Jiu Valley, with potential for a sustainable economic development of the area</td></tr>
<tr><td>II.3 Supporting entrepreneurship by developing specific skills and competences; individual local businesses and new economic initiatives</td></tr>
<tr><td>III. Sustainable capitalisation</td><td>coherent and sustainable development of tourism, culture,</td><td>III.2 Upgrading and diversifying the tourism infrastructure and services</td><td>R&I.II. Urban regeneration</td></tr>
</table>

Transition Strategy 2021-2030			R&I Strategy in the field of energy & environment	
Development pillars	**Main objective**	**Strategic directions** *of interest to be correlated*	**Objectives**	**Priority areas**
of the local specificity	sports, leisure activities and creative industries, by stimulating local producers and creators, highlighting the natural, cultural, industrial and social heritage of Jiu Valley and by connecting/twinning with neighbouring regions		innovation through digitalisation and carbon-neutral processes and/or products g. Deepening the cooperation between R&I entities – businesses – public administrations for promoting ready to market R&I products/services h. Updating and opening access to the R&I infrastructure i. Supporting the connection and integration of Jiu Valley R&I key players in global value chains and business networks j. Addressing national and regional policies priorities and challenges in R&I	R&I.III. Energy storage R&I.IV. Environmental protection R&I.VI. Innovative technologies and services for consumers (public, private, energy communities, individual prosumers or/and consumers)
IV. Accessibility, mobility and connectivity	sustainable development of multi-modal urban mobility, in a unitary way, facilitating accessibility in all areas of the micro-region by strengthening the connectivity between the component cities / municipalities and the immediately neighbouring areas.	IV.2 Developing an eco-efficient public transport system in an integrated, sustainable and intelligent manner IV.4 Development of utility networks, communications and street lighting networks		R&I.I. Renewable and alternative sources; and bioenergy generation R&I.II. Urban regeneration R&I.III. Energy storage R&I.IV. Environmental protection

Annex 2 - Relevant most recent international R&I projects in Jiu Valley micro-region

Table 18 - Relevant R&I projects in Jiu Valley micro-region

Duration / Funding	Project title
University of Petrosani (UPET)	
2020-2021 / EURECA-PRO	European Alliance on Responsible Consumption and Production
2020-2021 / National Edu Program	Cooperation, performance and visibility - access keys to consolidating UPET international dimension
2020-2021 / National Edu Program	Choose the initiative! Choose engagement! Join SAS UPET
2020-2021 / RO Private R&I Program	Frost-thaw resistance, determination of hard rocks elasticity module and petrographic and mineralogical nature (macro and microscopic) for 9 rock samples
2020-2021 / RO Private R&I Program	General slope stability analysis and determination of the maximum depth of exploitation at Rușchița - top North marble quarry
2020-2021 / National R&I Program	Research Results Award - Articles, 2020 Competition
2019-2021 / ERANET-ERAMIN	Study related to microwave assisted cutting of carbonate rocks (MIWACUT)
2020-2021 / RO Public R&I Program	Increasing energy efficiency by developing, analysing and optimising the thermal and fluid balance sheets of the energy installations within Apa Serv Valea Jiului, Petrosani (water management operator)
2020-2021 / ESIF 2014-2020	SMART 2020 - Multidisciplinary practical training system
2020-2021 / National Edu Program	Efficiency and quality of the Doctoral School activity, UPET by implementing a digital module for managing PhD students
2020-2021 / RO Private R&I Program	Research and development for a LED lamp with integrated EAN code-ID communication through the visible light spectrum
2019-2020 / National Edu Program	Development of the R&I institutional capacity in UPET
2019-2021 / H2020-RFCS	Risk assessment of final pits during flooding (RAFF)
2019-2021 / H2020-EIT Raw Materials	Zero waste recovery of copper tailings in the ESEE region (RIS-CuRE)
2019-2020 / National Edu Program	Observatory for highlighting the labour market profile and suggestions for the adequacy of the educational offer - Observatory - UPET
2019-2020 / National Edu Program	Internationalisation - passport for increasing UPET visibility through the perpetual development of academic quality and scientific research
2019-2020 / National Edu Program	Promoting the university's educational offer and increasing social equity for candidates' access to the online admission process (e-AD-UPET)
2019-2020 / ESIF 2014-2020	EU - ENTREPRENEUR - increasing the participation of vulnerable students in undergraduate programs through entrepreneurial innovation
2019-2020 / National Edu Program	Successful entrepreneur with SAS UPET
2019-2020 / National R&I Program	Comparative study on demolition solutions using mechanical equipment and explosives applied during the performance of the assembling platform and the laying ditch for the natural gas transmission pipelines, located in protected natural areas
2019-2020 / Public R&I Program	Study on the constructions and land stability, in the perimeter of influence of the Old Salt Mines (Ocna din Deal and Ocna din Vale), Victoria, Unirea and Cantacuzino according to existing data (topographic, archaeological, geological, hydrogeological)
2019-2020 / Public R&I Program	Annual general ventilation project of the Ocnele Mari Salt Mine (2020)
2019-2020 / Public R&I Program	Protection works for Transylvania Mine and the Ocna Dej mining perimeter: - Determination of the enclosure surface and the administrative headquarters deformations at the Ocna Dej Salt Mine - Surveillance based on surface topographic measurements and of the Transylvania mine underground

2019-2020 / Public R&I Program	Carrying out topogeodesic measurements and preparing geodetic documents in order to monitor the hydro-technical constructions behaviour on Olt River, RÂMNICU VÂLCEA, AHE Olt Mijlociu
2018-2019 / National Edu Program	START- UPET: Entrepreneurial Students for Romania of Tomorrow
2018-2019 / Public R&I Program	Study on establishing the causes of the discontinuous subsidence phenomenon in Lupeni mining perimeter
2018-2019 / National R&I Program	Advanced coal mines' safety parameters monitoring process
2018-2019 / National R&I Program	Model to Assess the Quality of Magmatic Rocks for Reliable and Sustainable Constructions
2018-2019 / National Edu Program	Relationship and professional orientation system for UPET students and graduates
2017-2018 / National R&I Program	High-performance construction to support underground mining excavations located in difficult geo-mechanical conditions
2017-2018 / National R&I Program	Study on stability checking for Turda Salt Mine, Iosif Mine – Echoes Chamber and the chamber area of influence on the land located in its dome, at the surface
2017-2018 / National Edu Program	Be an entrepreneur; be active in the S.A.S. UPET!
2016-2017 / RFCS	Bucket wheel excavators operating under difficult mining conditions including unmineable inclusions and geological structures with excessive mining resistance (BEWEXMIN)
INSEMEX	
2020-2022 / National R&I Program	Explosion safety of the buildings' closing walls - SAFE-WALL
2019-2022 / National R&I Program	Increase national capacity for expertise in explosions, fires, explosion-proof equipment, explosives, technological processes, the environment, and the development of solutions to improve OHS specific to hazardous (explosive / toxic) industrial applications - EXTOX 2 including the following projects:
	▪ Modernization of the research infrastructure for the complete investigation of both the physico-chemical quality parameters of the environmental components inside landfills, and the working environments in order to increase the health and safety degree
	▪ Technical expertise capacity development for fire type events in residential and industrial environments, through computer simulations
	▪ Increase the technical expertise capacity by developing of laboratory analysis methods for the characterization of hazardous substances involved in fire / explosion events type
	▪ Expanding the laboratory testing capacity by developing test methods for explosion-proof electric motors with explosion-proof capsular protection type and increased safety.
	▪ Fundamental research and computer simulations on the initiation of explosive gas mixtures by means of potential ignition sources of different nature
	▪ Increasing the technical and operational capacity for expertise in explosives and in techniques for surface and underground industrial applications.
	▪ Techniques and solutions for the development of scientific and technical skills in explosion prevention and protection.
	▪ Technical and methodological infrastructure development for testing and evaluation of security parameters specific to civil explosives and pyrotechnic articles
	▪ Infrastructure development for CVET program addressed to the intervention and rescue personnel in toxic / explosive / flammable environments by creating a mobile training system

2018 / National R&I Program	Developing the institutional capacity to carry out the technical expertise of explosion / fire events.
2018 / National R&I Program	Research to develop the ability to evaluate and test the technical equipment for use in potentially explosive atmospheres and the protective equipment
2018 / National R&I Program	Research to improve health and safety in hazardous environments with explosive, flammable and toxic atmospheres.
2018-2021 / National R&I Program	Manufacture, calibration and testing of advanced integrated sensor systems aiming applications in peoples' security - TESTES
2017-2020 / National R&I Program	Integrated system for rapid intervention in CBRNE (Chemical, Biological, Radiological, Nuclear, and high yield Explosives) incidents
2017-2018 / National R&I Program	Digital method for assessing the extent of the hazardous area in case of explosions caused by gas leaks in confined spaces - COMALEX
2017-2018 / National R&I Program	Experimental validation of the response of a building in frames, subject to explosions (Experimental validation of the response of a full-scale frame building subject to blast load) - FRAMEBLAST

Annex 3 – Recommended technological solutions for the defined scenarios in 2030-2050 projections

In order to forecast coal-based energy and RES production for 2030-2050, a series of hypotheses were established and two scenarios defined in TRACER Report D6.1 (TRACER, 2021) for ETS and non-ETS sources:

- SCENARIO A "with RES and transition fossil fuel" - scenario including policies and measures to reduce GHG emissions, as EE, RES, syngas and/or mine methane recovery and natural gas substitute as transition fuel from coal (new CCGT-CHP unit);
- SCENARIO B "with RES and alternative energy sources" - scenario including additional measures and green biomass substitute for coal (new or existing CHP unit).

Table 19 - Recommended technological solutions for the defined scenarios in 2030-2050 projections, in Jiu Valley micro-region

Forecast period	**SCENARIO A** "with RES and transition fossil fuel"	**SCENARIO B** "with RES and alternative energy sources"
2020 2025 2030	▪ Mines' closure and reclamation procedure, ▪ New CCGT-CHP on natural gas (40 MW_e and 50 MW_{th}) ▪ Ground PVP on unproductive lands and electricity storage (1 x 25 MW_e) ▪ New MHPP Baleia (2 MW) ▪ Building's renovation campaign through EE in existing public buildings and residential individual households or collective dwellings ▪ Thermal RES in public buildings and residential individual households ▪ Roof-PV for public buildings, individuals and SMEs (around 1.5 MW_e), including e-storage ▪ Small insulated retrofitted DHS with former DHS Thermal Stations (TS) transformation (around 1.5 MW_{th}) into: ✓ Thermal Plant (TP) or micro-CHP on natural gas ▪ UCG (syngas recovery) and/or micro-CHP running on mine methane captured (MMC)	▪ Mines' closure and reclamation procedure, ▪ A new green biomass based CHPP unit (25 MW_e and 50 MW_{th}) ▪ Thermal energy storage in former underground mines, associated with mine water heat pumps systems ▪ WPP on unproductive lands (2 x 3 MW_e) ▪ Ground PVP on unproductive lands (1 x 25 MW_e) and electricity storage ▪ New MHPP Baleia (2 MW) ▪ Building's renovation campaign through EE in existing public buildings and residential individual households or collective dwellings ▪ Thermal RES in public buildings and residential individual households ▪ Roof-PV for public buildings, individuals and SMEs (around 1.5 MW_e), including e-storage ▪ Small insulated retrofitted DHS with former DHS Thermal Stations (TS) transformation (around 1.5 MW_{th}) into: ✓ TP or micro-CHP on natural gas ▪ UCG (syngas recovery) and/or micro-CHP running on mine methane captured (MMC)
2030 2040	▪ Building's renovation campaign through EE in existing public buildings and residential individual households or collective dwellings ▪ Thermal RES in public buildings and residential individual households ▪ Small insulated retrofitted DHS with former DHS Thermal Stations (TS) transformation (1.5 MW_{th}) into: ✓ TP with heat pumps systems (heat recovery of the groundwater or/and mine water thermal potential) and/or ✓ green biomass-based TPs (wood wastes resulting from wood industrial processing and agricultural wastes)	▪ Additional PVP on unproductive lands (1 x 25 MW_e) and electricity storage ▪ Building's renovation campaign through EE in existing public buildings and residential individual households or collective dwellings ▪ Thermal RES in public buildings and residential individual households ▪ Small insulated retrofitted DHS with former DHS Thermal Stations (TS) transformation (1.5 MW_{th}) into: ✓ TP with heat pumps systems (heat recovery of the groundwater or/and mine water thermal potential) and/or ✓ green biomass-based TPs (wood wastes resulting from wood industrial processing and agricultural wastes)
	It is recommended that until 2035-2040, population supply with firewood for heating purposes to be switched to green biomass - pellets and wheat/straw briquettes, through the development of an integrated collecting and processing mechanism of wood wastes, resulting from wood industrial processing, and agricultural wastes, for the entire Jiu Valley.	
2040 2050	No additional measures	Other alternative energy sources, as the development of a green hydrogen plant, the natural gas still used for heating purposes being gradually replaced by hydrogen, once the National Strategy on Hydrogen will be approved and start to be implemented.

Source: TRACER, 2021