SMART STRATEGIES FOR THE TRANSITION IN COAL INTENSIVE REGIONS. CASE STUDY: JIU VALLEY MICRO-REGION – STEPS FORWARD UNDER TRACER EUROPEAN PROJECT

STRATEGII INTELIGENTE PENTRU TRANZIȚIA REGIUNILOR CU UTILIZARE INTENSIVĂ A CĂRBUNELUI. STUDIU DE CAZ: VALEA JIULUI – ETAPE PARCURSE ÎN CADRUL PROIECTULUI EUROPEAN TRACER

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Abstract: *The TRACER project supports nine coal-intensive regions around Europe to design (or re-design) their Research and Innovation (R&I) strategies, industrial roadmaps and decision support tools in order to facilitate their transition towards a sustainable energy system. The TRACER consortium consists of the following target regions: South East Bulgaria, North West Bohemia - Czech Republic, Lusatian Lignite District - Germany, Western Macedonia - Greece, Upper Silesian Coalfield - Poland, West Region,* ***Jiu Valley - Romania****, Wales – UK, Kolubara - Serbia, Donetsk - Ukraine. TRACER activities include the identification and analysis of best practice examples of successful and ambitious transition processes in coal intensive regions; a detailed assessment of social, environmental and technological challenges; an EDP (Entrepreneurial Discovery Process) to mobilise a wide range of stakeholders in each regions; the elaboration of guidelines on how to mobilise investment as well as dedicated activities to stimulate R&I cooperation among coal intensive regions in Europe and beyond.*

This paper will present Jiu Valley diagnosis in terms of technological, environmental and social state of play.

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Keywords: energy transition, coal intensive regions, R&I strategies, industrial roadmaps, social challenges, re-skilling.

Rezumat: *Proiectul TRACER sprijină 9 regiuni cu utilizare intensivă a cărbunelui (carbonifere[8]) din Europa în elaborarea (sau actualiza) strategiilor de cercetare și inovare (C&I), a foilor de parcurs industriale și a instrumentelor de asistare în procesul decizional, pentru a facilita tranziția către un sistem energetic durabil. Consorțiul TRACER este format din următoarele regiuni țintă: Sud-Est - Bulgaria, Boemia de Nord-Vest - Republica Cehă, Lusația - Germania, Macedonia de Vest - Grecia, Silezia Superioară - Polonia, Valea Jiului din Regiunea Vest - România, Țara Galilor - Marea Britanie, Kolubara - Serbia, Donețk - Ucraina. Activitățile TRACER includ: identificarea și analiza exemplelor de bune practici ale proceselor reușite de tranziție a regiunilor cu utilizare intensivă a cărbunelui; evaluarea detaliată a provocărilor sociale, de mediu și tehnologice; implementarea procesului de descoperire antreprenorială (PDA) pentru a mobiliza o gamă largă de părți interesate din fiecare regiune; elaborarea de ghiduri atragerea investițiilor, precum și activități dedicate stimulării cooperării în domeniul C&I între regiunile cu utilizare intensivă a cărbunelui din Europa și nu numai.*

Această lucrare va prezenta analiza situației actuale din Valea Jiului din punct de vedere tehnologic, mediu și social.

Cuvinte cheie: tranziție energetică, regiuni carbonifere, strategii de C&I, foile de parcurs industriale, provocări sociale, recalificare.

1. Introduction

The **2030 climate and energy framework**, adopted by the European Council[9] in October 2014 and revised in 2018 (for RES and EE targets), includes the following EU-wide targets and policy objectives for the period from 2021 to 2030:

- At least 40% cuts in greenhouse gas emissions (from 1990 levels);
- At least 32% share for renewable energy;
- At least 32.5% improvement in energy efficiency.

As part of the **European Green Deal**, the Commission aims to propose raising the EU target to at least 50% and towards 55% in a responsible way.

Currently, 41 regions in 12 Member States are actively mining coal, providing direct employment to about 185,000 citizens. Planned and ongoing closures of coal mines, and the commitment by a number of Member States (MS) to phase out coal use for power generation are expected to accelerate this downward trend. In view of this, an Initiative was launched and a **Platform for Coal Regions**

[8] aici termenul carbonifer/e nu se referă la era geologică, ci la regiuni mono-industriale în care activitățile economice sunt bazate pe exploatarea, procesarea și valorificarea intensivă a cărbunilor

[9] https://ec.europa.eu/clima/policies/strategies/2030_en

in Transition was designed to assist Member States and regions in tackling the challenge of maintaining growth and jobs in these affected communities. The Platform will enable multi-stakeholder dialogue on policy frameworks and financing, and cover areas such as structural transformation, including economic diversification and reskilling, the deployment of renewable energy technologies, eco-innovation and advanced coal technologies [1]. From Romania **Jiu Valley hard-coal region** is participating among the 20 coal regions from 9 MS which are actively involved in this Initiative, for the moment.

In order to address the specific challenges in coal intensive regions, the Commission has also introduced, on the background of the European Green Deal, a **Just Transition Mechanism**[10] (JTM) that will provide targeted support to these territories towards an economically affordable and socially acceptable transition to sustainable energy systems.

In this European technologic, environmental and social context and considering the need for well-prepared transition strategies and action plans, **TRACER project** supports nine coal-intensive regions around Europe to design (or re-design) their Research and Innovation (R&I) strategies in order to facilitate their transition towards a sustainable energy system [2], [3].

The purpose of the paper is to make a brief overview of TRACER project objectives and to present a synthesis of Jiu Valley micro-region's analyses made so far, related to the current state of play in terms of energy technologies, environmental impact and social challenges.

2. The TRACER project

The overall objective of TRACER is to support a number of coal-intensive regions around Europe to design (or re-design) their Research and Innovation (R&I) strategies in order to facilitate their transition towards a sustainable energy system. Nine (9) European regions (**Figure nr.1**) are targeted by TRACER, 6 of them in EU MS (Bulgaria, Czech Republic, Germany, Greece, Poland, Romania), and 3 in countries outside the EU (UK, Serbia and Ukraine).

TRACER partners will assist key stakeholders from each target region, through the provision of information, expertise and advice, as well as by decision support tools, concrete Roadmaps and blueprints on the energy transition paths that will be developed in the framework of TRACER. Starting from the need to boost the effective use of innovation capacities and local knowledge not yet identified, TRACER project has chosen to implement the Smart Specialisation Strategy - S3 approach, based on cooperation and on an inclusive process of stakeholder involvement centred on an "entrepreneurial discovery" process (EDP).

[10] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_17

– Southeast Region (BG34), Bulgaria
– North West Bohemia (CZ04), Czech Republic
– Lusatia Region, Brandenburg (DE40) and Dresden (DED2), Germany
– West Macedonia (EL53), Greece
– Upper Silesia (PL22), Poland
– West Region / Jiu Valley (RO42), Romania
– Kolubara Region (RS11 and RS21), Serbia
– Donetsk Region, Ukraine
– Wales (UKL1, UKL2), United Kingdom

Figure 1. TRACER target regions (in red)

In order to achieve TRACER overall objective several actions are meant to be implemented in each target region, such as:

- investigations of the current status of the social, environmental and technological challenges;
- analysis and identification of the best practices on (i.) Technologies, industrial roadmaps and transitions strategies, (ii.) Smart Specialisation Strategies (iii.) Financing, (v.) Labour market, Social issues and tourism, (vi.) Environmental protection and post-mining land reclamation; …
- assistance in designing R&I strategies and roadmaps, and guidance in financing funds accession.

COVID-19 crisis and alert/emergency state rules have an important impact on TRACER project in terms of live cooperation and knowledge exchanges between target regions, several events being rescheduled or transformed into virtual meetings, but without the expected interest inside former mining communities.

TRACER project is co-financed by the European Commission, Horizon 2020 Programme.

3. Jiu Valley micro-region – state of play

TRACER target region in Romania is the West region (NUTS2, RO42) including four counties: Timiș, Arad, Caraș-Severin and Hunedoara. Jiu Valley – the hard coal intensive micro-region is located in the S-E of Hunedoara County and represents 3% of the total RO42 surface of 32,034 km^2 [4]. Jiu Valley, also called the Petroșani coalfield, is the gateway to Retezat National Park, being

surrounded by Parâng and Retezat Mountains and crossed by the Jiu River. RO42 total resident population in 2018 was 1,784,522 inhabitants, with 7.6% in Jiu Valley (135,989 inh.) [5].

Hard coal exploitation started here in 1840, summing up at the end of IX century, according to Jiu Valley National Mines Closure Society (SNIMVJ), mining perimeters of about 8,991.5 ha (90 km^2). In the 90^{th}, 17 hard coal mining perimeters were located in Petrosani basin, currently (2018) exploitation being carried out only in 4 perimeters (Lonea, Lupeni, Vulcan and Livezeni underground mines). Hard coal production in 2015 was 1.3 million tons with a decreasing trend in 2016 (1.07 million tons), 2017 (0.78 million tons) and 2018 (0.54 million tons). The mining industry registered, in 1989, about 55,000 employees compared to 3,479 in 2018 (Hunedoara Energy Holding (CEH) - Mining Division).

The expected closure of mining perimeters and the mono-industrial specificity of Jiu Valley area will generate a "domino" effect in terms of unemployment, social vulnerability and depopulation, decrease in population incomes, and quality of life [3].

3.1. Energy technologies

According to the National Agency for Mineral Resources (ANRM) [6] the mining industry regulator, the only exploitation licenses in the Jiu Valley are held by CEH and SNIMVJ. The companies currently operating in the **hard-coal** mining industry, in Jiu Valley are presented in the Table 1.

SNIMVJ produced hard-coal until 2017, when the reserves were exhausted, starting in parallel a safe closing and remediation procedure.

The average calorific value of the Romanian hard-coal is estimated at 3,500-4,000 kcal/kg. Jiu Valley hard-coal, even if it is devoid of pyrite, has a high sulphur content being energetically weak with no export market potential, being strictly used for the domestic electricity and heat generation and supply. The hard-coal production decreases at CEH by 30% and the productivity with about 10% in 2018 compared to 2016, and the trend does not change even in 2019. The inefficient exploitation of the 4 active underground mines also results from zero investments in mining technology and equipment after the 90^{th} and from the average annual sale prices, which shows an increase of 40%, reaching 120 €/tons of hard coal which is not competitive at all.

Practically the 4 underground hard coal mines, Lonea, Lupeni, Vulcan and Livezeni – CEH subsidiaries, are still active only through State Aid, considering both social issues related to the household's thermal energy supply (heat and hot water) and the maintenance of an adequate slow tertiary reserve to ensure a safe, secure and reliable power grid operation.

Table 1. **Jiu Valley micro-region hard-coal mining industry**

Company	Private/Public	Structure	Mining perimeters (km^2)
CEH Mining Division	state owned	Lonea, Lupeni, Vulcan and Livezeni (underground) Mines Subsidiaries	51.17
		PrestServ Petroșani Subsidiary	-
SNIMVJ	state owned	Petrila, Paroșeni and Uricani non-competitive underground mines	19.2
Energomec Transind	SME	Balomir-Uricani hard-coal open pit	1.0

Source: TRACER project D3.2 Report on Technical concepts for the transition of the energy system into a smart, sustainable and renewable energy system in the TRACER target regions [7]

In terms of energy generation facilities CEH is the only power and heat coal-based producer in Hunedoara County, including Jiu Valley micro-region. CEH has a strategic role in the Romanian National Power System in terms of security of electricity supply and geographic location, having 1,225 MW installed in the following hard coal-based Power and Heat Generation Subsidiaries:

- Deva TPP Subsidiary (4x210 MW + 1x235 MW) – located in Mintia village, in the North part of Hunedoara county;
- Paroşeni CHPP Subsidiary (1x150 MW) – located in Vulcan municipality, inside Jiu Valley – TRACER target region, and having in operation [6], [8]:

- 1 x power unit (n^o.4) equipped with Turboatom extracting steam turbine type, having an installed capacity of $150MW_{el}$ and $174.4MW_{th}$ (150Gcal/h) at the steam bleed, and a Babcock-Hitachi steam boiler (540t/h, 138bar, 541°C), PCC type (pulverised coal combustion), running on hard-coal; this power unit had completed an upgrading and retrofitting program in 2007, being qualified, according to legislation in force, as highly efficient cogeneration unit;
- 1 x hot water boiler (HWB) from IMUC Pitești, running on hard-coal, with an installed capacity of $120MW_{th}$ (103.2Gcal/h, 70/150°C), capable of supplying 4 DHSs (Lupeni, Vulcan, Aninoasa, Petroșani);
- 1 x TP (Thermal Plant) for start-up, LOSS International, equipped with 2x20t/h steam boilers ($28MW_{th}$ installed capacity), running on n.g (natural gas).

Main technical features, power and heat generation and supply, for the year 2018 are presented in **Table 2**.

The generated, as well as the supplied electricity decreased by 44% in 2018 compared to 2016, a trend that will continue. Related to the electricity sales price at CEH level there is an increasing trend with 40-70% in 2018, 2017 compared to

2016, but nevertheless the production cost is not even 50% covered in 2018 - which mirrors the inefficient operation of all CEH subsidiaries (mining and energy generation) [7].

Table 2. **Technical features for hard coal-based energy generation facilities CEH-Paroșeni CHPP, in Jiu Valley micro-region (2018)**

Features		**CEH - Paroșeni CHPP**			
Energy generation units		TP**	HWB	Power unit n°.4	Total
Used technology			PCC	PCC	-
Commissioning year		2010	1998	2007	-
Installed / available capacity (MW)	running on hard coal	-	120 / 120	150 / 150	270 / 270
	running on other fuel	28 / 28	-	-	-
Efficiency (%)	designed	NA	88.5	40.9	-
	annual average in operation	-	76.0	36.0	-
Hard coal-based power generation – electricity (MWh/year)		-	-	239,220.0	239,220.0
Hard coal-based heat generation - thermal energy (MWh/year)		-	83,486.0	23,040.2	106,526.2
Total energy generation (electrical & thermal energy) (MWh/year)		-	83,486.0	262,260.2	345,746.2
Annual average fuel consumption (toe) hard coal and support fuel (n.g.)		-	13,456.7	89,394.5	102,851.2
Fuel consumption structure (%) hard coal / n.g.		- /100	98 / 2	98 / 2	98 / 2
Electricity supply (MWh/year) NPS* / others		-	-	211,460.0 / 157.0	211,460.0 / 157.0
Heat and hot water supply (MWh/year) households / non-households		-	5,718.5 / 11,432.3	4,278.5 / 6,997.4	9,997.0 / 18,429.7
Total energy supply (MWh/year) electrical & thermal energy		-	17,150.8	222,892.9	240,043.7

Source: TRACER project D3.2 Report [7]

In 2016, in Jiu Valley, the following companies were active in the field of DHS – District Heating Systems [9]:

- Paroseni CHPP (cogeneration and thermal energy transmission networks operator);
- Termoficare Petrosani; Termoficare/Edil Therma/Pregoterm Vulcan, Citadin Aninoasa and Universal Edil Lupeni (DHS operators).

The hard-coal produced in Jiu Valley is used only for energy purposes (power and heat generation) at CHPP Paroșeni and Deva TPP. The former hard coal quota allocated to CEH employees was transformed in the so called "heating aid" during 2 winter months out of 5 on average per season.

After the 90th the unique DHS operator in the Valley "IGCL Petrosani" supplying about 35,000 consumers [7], splits in 4 utility services companies, having as main shareholder each Local Councils. Hard coal use for domestic purposes (households' heating in the urban areas) has been cut gradually due to the aggressive lobby of companies delivering individual n.g. heating systems, the lack of investments – maintenance works and the high losses, generating inefficient heating services: it started before 2016 with Aninoasa city, then Lupeni and Vulcan municipalities having only public buildings still connected to the DHS network, and before the last winter 2019-2020 CEH - Paroseni CHPP stopped supplying all types of consumers from Jiu Valley urban areas, including Petrosani municipality. The reduction of the amount of thermal energy delivered to both households and non-household's consumers in Jiu Valley, led to a constant number of consumers disconnected from the DHS (10-20% per year), the connection rate reaching only 20%. Switching from the centralised thermal energy supply to individual systems on fossil fuels (natural gas) or firewood can lead to acceleration of air quality deterioration and to the occurrence of unwanted events (e.g. risk of installations' explosion or poisoning with CO emissions due to installations improper use, without periodic checking).

High-efficient cogeneration is the green way to generate both electricity and heat, but as long as this technological solution is not supported enough at government level by appropriate policies and investments, in Romania it will be difficult to win the households supply prices competition against individual thermal installations on natural gas.

The DHSs being bankrupt Jiu Valley population was forced to adopt the following heating systems technologies, in residential buildings switching from DHS to:

- 75% natural gas - individual thermal installations or thermal plant per block of flats / collective dwellings / residential building (95%-99% efficiency) and stoves (low efficiency 40%);
- 20% of the households on firewood and sometimes hard-coal - individual thermal installations (90% efficiency) and stoves (very low efficiency 20%-30%);
- 5% of the households on electric heating, fossil liquid fuels stoves, or stoves with other type of biomass as wood pellets and wheat/straw briquettes.

A similar process has been started for the public buildings, disconnected from the DHS and installing individual heating systems mainly on natural gas.

Without being further supported by national policies, heating systems with the use of DHS, electricity or RES technologies will not be sufficiently competitive

given the natural gas low price in Romania, a trend that is not expected to change fundamentally by 2030.

In terms of RES Jiu Valley had an extremely modest approach with few small exceptions in the micro-hydro and biogas/biomass fields, presented in **Table 3** below.

Table 3. **Existing RES in Jiu Valley micro-region**

Owners	**RES type technology/system**		**Installed capacity (MW)**	**Location territorial administrative units**
Hidro-electrica	Livezeni	Small - micro sized HPPs	0.24	Aninoasa
	Buta		0.49	Campul lui Neag
	Valea de Pesti		0.2	Uricani
Apa Serv Valea Jiului	Polatistea		0.2	Petrosani
	Valea de Pesti		0.2	Uricani
	Brazi - Vulcan		0.034	Vulcan
	Biogas-based microCHP	Biogas	0.38	Petrosani
Local Council	Biomass-based CHP (under development)	CHP	NA	Aninoasa

Source: TRACER project D3.2 Report [7]

According to Transelectrica TSO and our energy market regulatory authority ANRE, there is no wind or solar RES installed in Jiu Valley. The Environmental Fund Administration [10] registered 14,000 approved individual projects to be financed at national level (PV kit of minimum 3 kW/household), under "Photovoltaic Green House" Financing Program, but without a clear geographical distribution of projects by regions…probably also in Jiu Valley.

Regarding the biomass - even if wood biomass potential exists in Hunedoara County, the restrictions, imposed by the presence of large environmental protected areas, limit the volume of wood harvested for processing, and still furniture manufacturing is in the top 5 turnovers. Currently, there are 2 projects of biomass or biogas-based cogeneration plants in Jiu Valley:

- Apa Serv Valea Jiului, 2 x biogas-based micro-CHPP summing up $0.38MW_{el}$, $0.436MW_{th}$ by revaluating the Danutoni WTP sewage sludge in Petrosani municipality;
- Biomass-based cogeneration unit in Aninoasa city – under development with ESIF 2014-2020 support.

Concerning the geothermal resources, in Jiu Valley there are no available information about the existence of such geological resources.

3.2. Environment

In terms of compliance with environmental requirements (air quality), in 2018 in Paroseni CHPP two major environmental investments were completed: the FGD installation and the ash & slag removal system in dens slurry, the plant being now in compliance with Directive 2010/75/EU on industrial emissions (IED) [8]. To this aim, the values of the polluting emissions (NO_x, SO_2 and PM) are within the limits imposed by Law 278/2013 regarding industrial emissions and BAT-ELVs are observed, Paroseni CHPP having, starting with 2019, an IEP (Integrated Environmental Permit n^o.3/02.05.19) and an Environmental Authorization valid until 11.10.2022 for cogeneration and district heating [7].

Regarding the water quality Hunedoara Environmental Protection Agency required that each mining exploitation to be equipped with its own sewage treatment plant. Additionally, the hard-coal preparation plant in Coroieşti was retrofitted and upgraded, thus substantially reducing the impact on the West Jiu River ecosystem. In order to avoid groundwater contamination, the area of ash and slag ponds were performed: a clay waterproofing of the slopes, an efficient drainage system and a reverse wells system.

CEH Mining Subsidiary holds an operating license for concessional perimeters by 2024. The total mining perimeter in Jiu Valley has a surface of about 90 km^2, of which the total reclaimed land is estimated at 38 km^2 (42%). The main problems related to post-mining land and tailings use management still are:

- the proper observance of the legislation in force in the field of land reclamation process in order to avoid landscape degradation;
- the subsidence phenomenon (0.51 km^2) that led to the destruction of a large number of households and the cultural centre in Dâlja Mare commune; and demolition of a large number of miners' colony "80 houses" in Lupeni municipality due to safety issues;
- the mechanical instability of about 17% of the tailings dump slopes and irregularity of over 80% of the land [11].

3.3. Social challenges

Demographic change is one of the key challenges in Jiu Valley – related to the phenomenon of shrinking cities, mainly due to population migration gradually moving to the negative indices, but also to ageing and mortality growth. Increasingly more young people leave Jiu Valley to study in large Romanian university centres (such as Timişoara, Cluj-Napoca and Bucharest) or to take advantage of better professional opportunities either in large cities or abroad. The trend in recent years (2015-2018) is constant but not as pronounced as the aggressive reduction compared mainly to the '90s [12].

Another concerning aspect is the rising number of people at risk of poverty (10.25% estimated for 2018).

In the labour market the average number of employees in Jiu Valley micro-region had a significant negative trend being cut with 34% in 2018 (24,971 employees) compared to 2015 (37,884). Focusing the analysis on the hard-coal mining industry the average number of employees decreased by 41% from 2015 to 2018, the impact of laid off being more pronounced for male employees (44%) and the 25y-54y age group (42%) [12], [13].

Closure of coal mines and related activities generated a dramatic growth in rate of unemployment, not being compensated with creation of new job opportunities. In 2015 unemployment rate in Jiu Valley ranged between 25–30%, one of the highest rates in Romania, generating situations such as in Aninoasa city where unemployed population outnumbers employed population. However, recently unemployment rate has been reducing on the back of rising depopulation process, but still the major impact is supported by young people (15y-24y).

The need for training and requalification of approx. 7000 people (in mining and related activities) and to provide them with appropriate and sustainable jobs. We underline the need for training and reskilling of approx. 7000 people (from mining industry and related activities), which has to be merged with new investments providing appropriate and sustainable jobs. The solution can be Jiu Valley education infrastructure, which in 2018, registered 21 school units: 3 preschools, 7 primary and secondary schools, 9 high schools, one post-high school, and one university, summing up 20,507 enrolled students, out of which 73% in pre-university education system. But, due to lack of attractiveness and connection with the labour market needs, the graduation rate was very low in 2018 in high-schools (22%). In the same year 3,297 students (from Romania, Republic of Moldova and other countries) were enrolled in higher education programs (bachelor's, master's, postgraduate courses, doctorate and postdoctoral programs) with only 20% graduation rate. Higher graduation rates would be achievable if school laboratories were equipped with appropriate equipment and more PCs would be available in schools and high-schools (only 9.5% of the students had access to a PC) [12]. In order to increase the socio-professional insertion of graduates and reduce youth unemployment rate, we consider that the accelerate development of vocational and dual education system is the key solution for Jiu Valley.

4. Challenges and future opportunities for Jiu Valley micro-region

The Increased dependence of CEH on subsidies despite mass layoffs, lack of investments, high unemployment rates and constant social protection generated a decline of former miners' life quality, which deepened the inertia of non-engagement and the lack of entrepreneurial initiatives [7].

The assessment of internal and external factors influencing the socio-economic environment in Jiu Valley, in terms of political and legislative framework – technologies – environment – resources, and the initial screening of the micro-region potential towards a sustainable energy future, lead to a top 10 lists of challenges and opportunities [14], [15] presented in Table 4 below:

Table 4. **Top 10 challenges and opportunities in Jiu Valley micro-region**

Challenges	**Opportunities**
1.Inexistent heating and hot water households supply, despite 185 km length of existing DHS network;	1.Comparative Feasibility Study for the transition to a semi-decentralized DHS, with the transformation of TS into micro-CHP or TP, RES and/or natural gas based vs. the use of natural gas as a transition fuel "Paroseni CHPP switching from hard-coal to a flexible cogeneration CHP-CCGT plant, provided there is enough heat demand;
2.Constant number of consumers disconnection from the DHS (10-20% per year), the connectivity rate reaching only 20%;	2.Change coal & firewood-based heating with natural gas where no DHS exists;
3.Inappropriate post mining land & buildings use management, legal disagreements and no formally temporary exemption from taxes at ownership transfer;	3.Increasing EE, energy savings and RES use in buildings, public lighting and industry;
4.Lack of RES related field data, no regional / local potential assessment studies;	4.R&I projects on topics as surplus heat recovery, heat storage and mine waters potential; underground mines methane capture (MMC) living lab;
5.Poor connectivity infrastructure (roads, railways, ICT); obsolete energy infrastructure (electricity distribution);	5.PV-PPs, Hybrid PPs potential use on former mining lands, tailings, ash & slag dumps, and buildings, in parallel with electricity distribution grid retrofitting;
6.Deficit of institutional capacity, competences & abilities to attract funds and investors; no cooperation between local administrations;	6.Jiu Valley a future electricity storage HUB, including also investments in smart grid and meters;
7.High unemployment and energy poverty rates;	7.Jiu Valley re-training centre for market-oriented re-skilling programs, including institutional capacity / competence / ability programs and project financing assistance;
8.SMEs incapacity of covering co-financing rates;	8.Supporting and encouraging domestic, industrial and agricultural prosumers;
9.Low economic development affecting the local budget and no specific "transition fiscal regime", incentives etc.;	9. EC-SRSS, EC-START and ITI allocations for Jiu Valley micro-region; several other financing programs (ESIF, Just Transition Fund, Modernisation Fund, Horizon Europe, LIFE, Danube Interreg, Innotech-student, TECH Nation etc.) to be launched;
10. Retraining and reskilling programs not oriented to market or investors needs and under developed dual education or apprenticeship system.	10. Defining specific Jiu Valley "transition eligibility rules" and fiscal regime (facilities & incentives package) to attract the young diaspora back home and stimulate investments, and sustainable employment.

5. Conclusions

The West Region (Arad, Timis, Caras-Severin and Hunedoara counties), in terms of installed power capacities for electricity generation, has the following structure: 56% coal, 2% hydrocarbons, 35% hydro, 3% wind and 4% solar (PV). The greener county is Caras-Severin (79% hydro, 21% wind) and at the opposite pole is Hunedoara with 69.37% coal, 30.51% hydro, 0.0002% wind, 0.03% biomass & biogas and 0.08% solar. The structure of the energy park in Jiu Valley (**Figure 2**) demonstrates the dominance of the coal-based installed capacities for electricity generation and the very low development of RES [7].

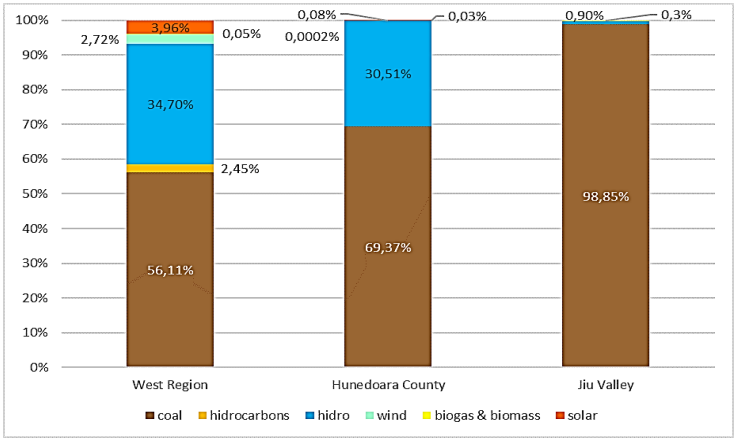

Figure 2. Installed power capacities, West Region – Hunedoara County – Jiu Valley

The transformation into a RES-based sustainable energy system with low carbon emissions can be made gradually, with natural gas (n.g.) as a transition fuel, in order to provide a time buffer for upgrading and retrofitting the electricity distribution networks, as many of them are obsolete. The gradual transition of Jiu Valley micro-region to a RES-based energy system, by switching power/cogeneration units from hard-coal to n.g. is also necessary, knowing that wind and solar energy are variable resources, unable to ensure the entire energy demand, especially in extreme weather conditions generated by the increasing negative impact of climate change.

Each TRACER region, a mix of urban, peri-urban and rural communities, responds in a personalized way to current and future socio-economic challenges.

In conclusion, in order to succeed in addressing the socio-economic challenges of the transition from coal, Jiu Valley micro-region needs a strategy and

effective policies intervention focused on human capital, financial support and a community responsible dialogue and engagement are mostly needed.

To this aim, for Jiu Valley micro-region it is a must to take advantage of the following 2 major opportunities provided by the EC and the Romanian government:

1. being included in the European Commission's Platform for Coal Regions in Transition,

- the Ministry of European Funds obtained support from the Commission to fund the preparation of "Jiu Valley Strategy for Transition from Coal 2021-2030", through the Structural Reform Support Service (SRSS);
- all 6 Local Councils signatories of the partnership MoU in 2019 "Jiu Valley Partnership for a Just and Fair Transition" will receive initiative support through the Secretariat's Technical Assistance for Regions in Transition (START).

2. for the period 2021-2027, the Ministry of European Funds is envisaging Jiu Valley micro-region to benefit from ITI allocations - Integrated Territorial Investment mechanism; initiative which will replicate the good practices in the Danube Delta [16], through customised financing programs structured according with Jiu Valley specificities and needs.

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