

# REGIONAL GREEN TRANSITION: CASES OF POLISH AND RUSSIAN REGIONS

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**ABSTRACT:** The green transition unfolding on a global scale is much less studied at the regional level, although its outcomes and management are strongly place-specific. This article presents a comparative study of green transition strategies in the Silesian Voivodeship (Poland) and the Khanty-Mansiysk Autonomous Okrug (KMAO) – Ugra (Russia), based on a qualitative content analysis of regional legislation and strategies. The regions share common specialisation in fossil fuel mining and have inherited some features of post-socialist economies. Research shows three common features of green transition policies in the studied regions. Firstly, much attention is paid to the dissemination of information about green transition and its benefits. Secondly, research on various green subjects and educational programmes for green market requirements are developed. Thirdly, it is planned for renewables to have a larger proportion in regional energy mixes. By mid-century, both regions are expected to reach climate neutrality, although by using different paths of development. Coal mines are planned to be closed down in the Silesian Voivodeship by 2050, while the KMAO – Ugra will retain its oil-mining specialisation but diversify it with hydrogen production.

**KEYWORDS:** green transition, region, fossil fuels, sustainability, climate policy, Eastern Europe, Poland, Russia

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## Introduction

The green transition has become one of the cornerstones of the international agenda and academic research in recent years. Importantly, an immense number of studies emphasise the uneven distribution of the adverse effects of both global climate change (Tol et al. 2003; O'Hara 2009; Nazrul-Islam, Winkel 2017; United Nations 2018) and greening of the global economy (Pollin 2015; Stepanov et al. 2021; Ziemacki 2021). On the one hand, the Arctic and dryland areas and least developed countries are more vulnerable because of global warming. On the other hand,

both developing countries lacking capital resources and countries exporting green technologies and fossil fuels are reluctant to support the green agenda due to expected economic losses. Such heterogeneous impacts are observed at international and regional levels (OECD 2020) due to geographically and historically determined characteristics of settlement, industry, transport systems, etc. A relative lack of publications on regional differences of green transition in different scales (international, national and regional) urges in-depth research on regional practices of green transformations. The goal of this article is to compare policies aimed at greening the

economy of the Silesian Voivodeship in Poland and the Khanty-Mansiysk Autonomous Okrug (KMAO) – Ugra in Russia. The selection of the regions covered by this comparative analysis in terms of the level of implementation of energy transformation was purposeful, and the criteria for their selection were: different paths of socio-economic development and their current similar dependence on fossil fuels. This dependence puts them at the risk of not fulfilling the energy transition requirements. The present socio-economic situation of both regions is significantly influenced by the heritage of the past, i.e. the centrally planned economies until the early 1990s. After the collapse of the communist system, these regions began to pursue different paths of social, economic and political transition. The changes that affected the Silesian Voivodeship, in particular after Poland's accession to the European Union in 2004, were largely dependent on the process of integration with the EU structures, as well as the implementation of its directives related to e.g. climate policy and legal or administrative procedures. On the other hand, the socio-economic changes in the Ugra region in Russia depended on the internal policy of the state that was shaped *inter alia* by the influence of international organisations and agreements (Makarov et al. 2018), and, to a lesser extent, on the influence of international organisations. Currently, these regions demonstrate a different level of socio-economic development and different conditions for implementing measures related to the energy transformation.

The article consists of five sections. The first one is an introduction and presents the aim of the study and a short justification for the choice of the investigated regions. The second includes a review of the literature on regional green transition, with a special focus on Polish and Russian studies. The third part provides brief information on the economies of the Silesian Voivodeship and KMAO – Ugra and our methodology of research based on the assessment of the regional practice of preparation for green transformation. The fourth section examines the empirical results of the research on green transition policies for the Silesian Voivodeship and KMAO – Ugra. The article concludes with a discussion on the identified similarities and differences between the studied regional policies.

## Green transition in the light of the literature review

Regional studies of a climate-neutral transition are essential due to place-specific impact of global climate change and greening of the economy as well as the pivotal role of subnational governments in enforcing sustainable policies (OECD 2020). Disproportionate sustainability challenges for regions with carbon-intensive industries has led to studies on the green transition in such disadvantageous areas as coal mining regions (EBRD 2020), old industrial areas (González-Eguino et al. 2012; Schack et al. 2021), regions in industrial transition (OECD 2019) and regions specialised in a dirty industry (Grillitsch, Hansen 2019). These publications, mostly based on innovation studies and evolutionary economic geography, address the prospects for overcoming path-dependency and avoiding lock-ins to ensure a just transition in these regions. Indeed, regional authorities can advance the green transition as they have jurisdiction over important spheres of sustainability policies such as buildings, transport, industry, etc. and are better informed about local needs, strengths and weaknesses (OECD 2020). To fully realise their competencies, subnational governments need to take urgent adaptation and mitigation measures in co-operation with multi-level actors to ensure coherence between different policy areas (OECD 2020). Although a number of studies are dedicated to narrow aspects of regional green transition, e.g. labour market (Botta 2019), energy (Bridge et al. 2013), transport (Wirges et al. 2012), etc., when it comes to policy design and implementation it is important to stick to a systematic rather than a single-technology-focused approach (OECD 2020).

In December 2019, the European Commission released plans for tackling climate and environment-related challenges. Known as the European Green Deal (EGD), and intended to be a response to climate change, environmental risks and pollution of forests and oceans, it “aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 [...]” (Communication from the Commission 2019: 1). Along with the definition

of new directions in climate policy, a number of scientific publications on the implementation of this policy have been released. They can be divided into three thematic groups, covering the following issues: (1) climate policy and activities aimed at introducing innovative zero-emission technologies (e.g. Garrone, Grilli 2010; Grafström 2018; Hainsch et al. 2021), (2) negative effects and costs related to the implementation of green transformation assumptions in European Union member states (e.g. Bouzarovski, Simcock 2017; Köberle et al. 2021), and (3) regional differences in strategies related to the application of the EGD (e.g. Hafner et al. 2020, 2021; Krzywda et al. 2021; Gea-Bermúdez et al. 2022).

From the perspective of the investigated problem, the articles on regional differences in the strategies concerning the implementation of the EGD are of great significance. Among many different opinions, Hafner et al. (2020) concentrate on the methods adopted by the UK to achieve climate neutrality. The authors confirm that policy uncertainty and short-termism in the financial system are the two main investment barriers. The research results show that the identified barriers form a complex system characterised by path-dependency, lock-in and non-linearity. Further research of Hafner et al. (2021) explains that the UK's net-zero emissions target requires substantial investment in low-carbon energy infrastructure. As the authors explain, the closure of the green finance gap policy scenario alongside a low-carbon power scenario leads to the co-benefits of lower power system costs and unemployment, and increases in GDP. Furthermore, Gea-Bermúdez et al. (2022) examined the role of sector coupling towards 2050 in the energy system of Northern and Central Europe when pursuing the green transition. As a result, they show that sector coupling increases electricity demand, variable renewable energy, heat storage capacity, and district heating transmission expansion towards 2050. Moreover, they state that non-restricted investments in onshore wind and electricity transmission reduce emissions and costs considerably (especially with high sector coupling). The scenarios with the highest sector coupling assume the highest emission reduction by 2045: a 76% greenhouse gases reduction compared to 1990 levels, which highlights the value of sector coupling in achieving the green transition. From

the perspective of Central and Eastern European countries, the green transition process is presented, among others, by Bouzarovski and Simcock (2017). Their research is focused on the level of energy poverty diversity in this part of Europe. There is a need for understanding energy vulnerability as an evolving socio-spatial phenomenon embedded in multiple layers of institutional change and organisational practice. The authors identify urban landscapes as the primary site for the geographic expression and articulation of domestic energy deprivation.

In the Polish literature on the subject, there are a number of articles on the green transformation and a great many of them concern the social acceptance of the process. As noted by Hille and Kassenberg (2018), the key issue for the implementation of energy strategies in Poland is the dissemination of information about the EU energy policy, its impact on the reduction of greenhouse gas emissions and the energy security of the state. The results of the authors' research show that Polish society's opinion is concerned about the European Commission's dissuasion of coal-based energy and the enforcement of strict regulations furthering the zero-emission goal. As Mrozowska et al. (2021) observe, politicians and the general public are also concerned about Poland's successful implementation of the assumptions of the EGD by 2050 (Mrozowska et al. 2021). Kochanek (2021), on the other hand, addresses the problem of the costs of the implementation of the EU aim related to the net-zero emission. The author of the article underlines the fact that a large increase in electricity prices in case of introducing the green transition regulations will affect the entire economy and raise the level of energy poverty among Poles. Concluding and more optimistic remarks related to the green transition can be found in Kiciński (2021). The author stresses that a gradual transition from traditional large-scale fossil fuel-based energy generation to distributed energy generation based on renewable resources is inevitable and the whole society will benefit from it.

Studies on the sustainability of Russian regions are generally based on analysing different sets of environmental and socio-economic indicators to test decoupling (Kirillov et al. 2017) or environmental safety (Chereshnev et al. 2015) hypotheses, whereas statistical methods are rarely

used (Gureva 2017). Most articles published before the mainstreaming of the green agenda in public discourse in Russia in 2020 admit a low level of green economy development in Russian regions, numerous environmental problems and low state involvement sometimes compensated by corporate policies of exporting companies (Samarina, Skufina 2015). Despite the vast geographical scope of the literature available on this topic, a specific focus on managing sustainable policies rather than on the state of affairs has been relatively rare. For example, Komarov et al. (2019) found that the majority of regional strategies in Russia encompassed some principles of green growth (environmental protection, waste management, energy efficiency, etc.) but mostly implied retroactive instead of proactive instruments. Recent ratings of the openness of Russian regions to the Green Deal (Greenpeace 2021) compiled on the basis of official responses from regional authorities show a high heterogeneity of current and planned low-carbon initiatives with four leading regions (Sakhalin Oblast, Khabarovsk Krai, Leningrad Oblast and Moscow). Moreover, the study revealed extensive and breakthrough green (organic waste management, waste prevention programmes, heat pumps) and pseudo-green (expansion of gas use, incineration, disposable paper package as alternative to plastics) measures.

A literature review raises four major problems that could be relevant for the studied regions of Upper Silesia and the KMAO – Ugra. These are: (1) the costs of the green transformation, (2) implementation of the multi-level information policies related to the assumptions of the European Union's and global Green Deal, (3) incentives for the local communities to use new technologies based on renewable energy resources, and (4) the mix of energy sources to meet electricity demand.

By and large, this article contributes to filling the gap in the research on green transition strategies in vulnerable regions with regard to the following three aspects. Firstly, the two regions have been largely neglected in the international literature pertaining to the green transition and its regional socio-economic consequences. Secondly, we present a comparative analysis that helps to identify the common problems and policies in fossil fuel mining regions during the global green transition. Finally, we try to cover as many

regional green policies as possible rather than concentrate on a single area. At the same time, local strategies were not described, due to: the lack of such an approach to the green transition (especially in Russia); and the strong dependence of local actions on regional and national funding sources (which is evident in Poland).

## Materials and methods

A mix-method approach was used in the study (Johnson, Onwuegbuzie 2004). It involved desk research, including a qualitative content analysis of legislation and policy documents. This allowed studying green transition strategies implemented or planned to be implemented by 2030 on national and regional levels in Poland and Russia, with a focus on the following activities: (A) strategies for green development and transition, (B) legal and financial incentives, and (C) technical, social and institutional innovations for the green transition, as well as (D) dissemination of information on the green transition. The assessment of each indicator was done using a scale from 0 to 3, in which:

- 0 – means no solutions for a given indicator: there are no incentives, innovations, strategies or promotional activities on the green transformation in the region;
- 1 – means poor progress of the indicator in terms of the green transition: one or two incentives, innovations, strategies or promotional activities on the green transformation are proposed in the region;
- 2 – means medium progress of the indicator in terms of the green transition: three to six incentives, innovations, strategies or promotional activities on the green transformation are proposed in the region;
- 3 – means high advancement of the indicator in terms of the green transition: more than six incentives, innovations, strategies or promotional activities on the green transformation are proposed in the region.

The above research was conducted in the two industrial areas that represented our case studies: the Silesian Voivodeship in Poland where the Upper Silesia industrial area is located, and the Khanty-Mansiysk Autonomous Okrug (KMAO) – Ugra in Russia (Fig. 1).

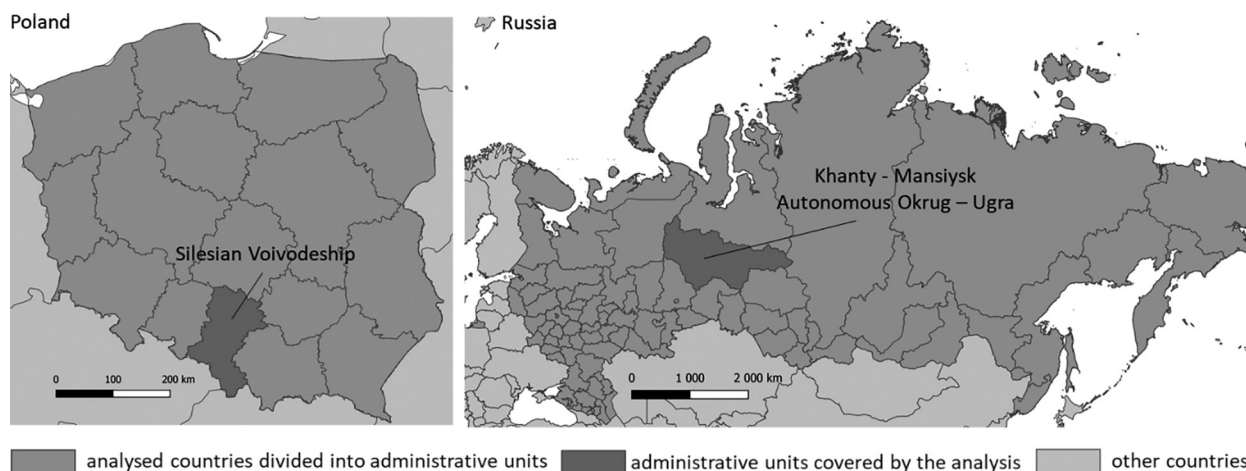


Fig. 1. Regions covered by the analysis in Poland (Silesian Voivodeship) and in Russia (KMAO - Ugra).  
KMAO - the Khanty-Mansiysk Autonomous Okrug.

Source: own compilation.

The characteristics of the regions was based on a comparative case study selection approach (Seawright, Gerring 2008) with the following arguments determining our choice: population, Gross Regional Product (GRP) per capita and importance to the country's economy, as well as the advancement of the green transition, as indicated by planned funding for the green transformation ('green budget') until 2030.

The Silesian Voivodeship is the most heavily urbanised and the second most populous region in Poland. In 2019, the region was inhabited by 4.5 million people (12% of Poland's population) in a relatively small area: 12,300 km<sup>2</sup>, giving a population density of 366 persons per sq. km. The GRP in 2019 was PLN 277bn (USD 68.2bn current prices/USD 155bn PPP [Purchasing Power Parity] converted using OECD exchange rates) (Statistics Poland, 2021). The region's economy is characterised by a significant share of the mining sector and a high dependence of local labour markets on traditional industries. Seven of the eight sub-regions of the Silesian Voivodeship – the sub-regions of Katowice, Bytom, Sosnowiec, Gliwice, Tychy, Rybnik and Bielsko-Biała – are defined as coal regions and delimit the contemporary extent of Upper Silesia. It is the largest coal basin in Poland: 24 out of 27 domestic hard coal mines are located here. The coal industry employs 74,500 people, and this number accounts for 89.5% of all employees in this sector in Poland. Coal mining in the region provides 79.7% of domestic hard coal production (Statistics Poland, 2021). The region's dependence on coal has led to its inclusion

in the process of just transitions of coal-producing regions in the EU (cf. Communication from the Commission 2021). From 2022, the Regional Plan for Just Transition (based primarily on European funds) will be implemented, with a budget of approximately PLN 6.5bn (USD 1.6bn current prices/USD 3.6bn PPP) until 2030.

The KMAO - Ugra is one of the largest Russian regions (534,800 km<sup>2</sup>), although sparsely populated (3.16 persons per sq. km in 2020). As the leading oil-mining region in Russia (almost 48% of crude oil mined in 2019 [Federal State Statistics Service 2020, Office of the Federal State Statistics Service in the Tyumen region, KMAO - Ugra and YNAO<sup>1</sup> 2021]), the KMAO - Ugra had the GRP of RUB 4,563.06bn (USD 70.49bn, current prices/USD 184.57bn PPP converted using OECD exchange rates) in 2019. Thus, the KMAO - Ugra is the third wealthiest region in Russia with a GRP per capita of RUB 2.7m, current prices (Federal State Statistics Service 2021) or USD 42,225.9, current prices/USD 110,570 PPP. Mining is the driving sector of the regional economy, accounting for 72.1% of GRP (Federal State Statistics Service 2021) and 21.9% of employment (Regional Analytical Centre 2021) in 2019. High dependency on oil mining and exports puts the KMAO - Ugra at risk in terms of the global green transition and urges regional green policies. A total 'green budget' of the KMAO - Ugra, a sum representing the expenditure expected to be incurred on financing measures related to

<sup>1</sup> The Yamalo-Nenets Autonomous Okrug.

sustainability/climate goals mentioned in five regional strategies, is RUB 217.12bn for 2019–2030 (USD 3.01bn current prices/USD 8.86bn PPP).

## Results

Despite many similarities, the Silesian Voivodeship and KMAO – Ugra are pursuing their own paths towards the green transformation, taking into account both internal and external conditions. The former include the local unique industrial heritage and local policies related to the green transition implementation. The external conditions can be defined as the international and state green policy, and the global economy.

For 30 years now, the Silesian Voivodeship, similar to other industrial areas in Poland, has been in a transformation process (*cf.* Strykiewicz 1999; Domański 2006; Rogacki 2006). It involves a gradual change in the economic structure, the development of new sectors, including those based on new technologies, and a greater concern for the environment and the quality of residents' lives (Gwosdz 2014; Klasik, Biniecki 2015). During this time, the number of people directly related to mining in the region has dropped from about 300,000 to about 74,500 (Sitek et al. 2013; Kiewra et al. 2019; Frankowski et al. 2020a). The great importance of the region in the context of equitable transformation is evidenced by the organisation of the United Nations Climate Change Conference (COP2018) in Katowice in 2018, in which the local community was involved.

The basis for the nearest activities related to green development is the Territorial Plan of Just Transition of the Silesian Voivodeship, which is closely linked to other national and regional strategic documents in the field of socio-economic and spatial development. It also identifies social, economic and environmental challenges and determines the needs for economic branching out, retraining workers and the rehabilitation of the natural environment. Under the plan, the coal mines will be gradually shut down, resulting in a 7.7 million tons decline in coal output, from 30 million tons per year in 2021 to 23 million tons per year by 2030. As a result, by 2030 there will be a decline in conventional electricity generation by nearly 80%. The planned reduction in electricity

production from coal will result in CO<sub>2</sub> reductions of 62.1% (from 13.2 million tons in 2019 to 5 million tons in 2030).

The main source of funding for the objectives of the Territorial Plan for Just Transition are EU funds for 2021–2027, i.e. the Just Transition Fund supplemented by grants from the European Regional Development Fund and the European Social Fund. These sources are primarily planned to finance incentives, including grants, loans, prizes and guarantees to finance investments aimed at a holistic green transformation of the region. However, there are no legal solutions dedicated to the Silesian Voivodeship that would accelerate the transformation. The National Renewable Energy Sources Act of 2015 (amended in 2021) provides solutions for electricity generation from renewable energy sources (primarily solar energy, but also wind, geothermal and biomass energy). However, it is insufficient in the context of the needs prevailing. Despite this, in recent years, there have been activities carried out in the region, related to the promotion of energy efficiency and the reduction of greenhouse gases, also financed by the EU operational programmes from 2014 to 2020. They were related to the renovation of existing residential buildings in terms of energy efficiency and the implementation of demonstration projects carried out in accordance with energy efficiency criteria. At the same time, the transformation process is associated with extensive educational activities aimed at a wide range of audiences, including children and young people in schools, to ensure a high level of acceptance for the proposed solutions. A crucial role is played by universities and research institutes, where innovative solutions for green development are developed. They propose concepts of socio-economic transformations that are to ensure a greener future for the region (Frankowski et al. 2020b).

Scanning relevant KMAO – Ugra policies has revealed several main regional climate strategies and programmes (Table 1) and reaffirmed the high rating of Ugra green initiatives and ESG (Environmental, Social and Governance)-performance (Komarov et al. 2019; Ministry of Natural Resources, 2019; Greenpeace, 2021; RAEX, 2021). Nevertheless, some imbalances in regional sustainable policies will be also discussed further.

Table 1. Characteristics of the green transition policy in the Silesian Voivodeship and KMAO – Ugra.

Silesian Voivodeship	KMAO – Ugra
<b>(A.) Strategies for green transition</b>	
<ul style="list-style-type: none"> <li>- Territorial Plan for Just Transition of Silesian Voivodeship</li> <li>- strategy of regional development: Silesia 2030, emphasising green development,</li> <li>- regional sectoral strategies concerning: urban development policy, urban regeneration, transport system development, air protection</li> <li>- low-carbon economy and energy policy strategies up to 2030</li> </ul>	<ul style="list-style-type: none"> <li>- sections ‘Sustainable ecological development’ and ‘A roadmap Sustainable ecological development’ in Strategy of Socio-economic Development of KMAO – Ugra until 2030</li> <li>- five regional strategies with sustainability sections/ goals concerning housing and utilities complex, solid waste management, transport system development, environmental safety and reproduction of natural resources</li> </ul>
<b>(B.) Regional incentives for green transition</b>	
<b>(B1.) Legal incentives</b>	
<ul style="list-style-type: none"> <li>- no legal incentives dedicated exclusively to green transition of Silesian Voivodeship</li> <li>- main nationwide document governing support for green transition is Renewable Energy Sources Act of 2015</li> </ul>	<ul style="list-style-type: none"> <li>- No regional legal incentives dedicated exclusively to green transition</li> </ul>
<b>(B2.) Financial incentives</b>	
<ul style="list-style-type: none"> <li>- subsidies, loans, awards and guarantees to finance investments aimed at reducing CO<sub>2</sub>, which are allocated with programme ‘European Funds for Silesia 2021–2027’</li> </ul>	<ul style="list-style-type: none"> <li>- tax incentives to stimulate implementation of measures aimed at improving environment, introducing environmentally friendly and low-waste technologies</li> <li>- six subsidies and subventions for reimbursement of lost income and/or delivery expenses to suppliers of electricity and liquefied gas</li> <li>- subsidies for modernising and energy-efficient repair of utilities and infrastructure</li> </ul>
<b>(C.) Regional innovations for green transition</b>	
<b>(C1.) Technical innovations</b>	
<ul style="list-style-type: none"> <li>- renovation of existing residential buildings for energy efficiency and demonstration projects and support activities in accordance with energy efficiency criteria</li> <li>- installation of power generation systems based on renewable energy, including wind, solar and biomass with high greenhouse gas reductions, and other types of renewable energy (including geothermal energy)</li> </ul>	<ul style="list-style-type: none"> <li>- three functioning solar power plants</li> <li>- measures to increase use of associated petroleum gas</li> <li>- transition of vehicles to gas engine fuel</li> <li>- modernisation of equipment in energy and utilities sectors</li> <li>- sectoral measures to boost energy efficiency (buildings, oil and gas mining)</li> </ul>
<b>(C2.) Social innovations</b>	
<ul style="list-style-type: none"> <li>- expert support of local universities and research institutes (e.g. University of Economics in Katowice)</li> <li>- idea to create in Silesian Voivodeship National Climate Change Research Centre (independent science institution supporting Polish climate policy) in nearest future</li> </ul>	<ul style="list-style-type: none"> <li>- Environmental Dynamics and Global Climate Change UNESCO Chair at Ugra State University</li> <li>- master’s programme «Sustainable Environmental Management in Oil &amp; Gas Region» at Ugra State University</li> </ul>
<b>(C3.) Institutional innovations</b>	
<ul style="list-style-type: none"> <li>- Combined heat and power plants in Upper Silesia have the right to emit CO<sub>2</sub>, the amount of which is determined by the National Centre for Balancing and Managing Emissions</li> </ul>	<ul style="list-style-type: none"> <li>- Introduction of separate collection of solid waste</li> <li>- plans for treatment (composting) of food waste</li> <li>- inventory of greenhouse gas emissions in region in 2011–2016</li> </ul>
<b>(D.) Dissemination of information on green transition</b>	
<b>(D1.) Regional reports on sustainable development</b>	
<ul style="list-style-type: none"> <li>- reports prepared by public institutions, in particular by European Commission for Renewable Energy Industry Development and by Polish Economy Team at the Minister of Climate, concerning benefits obtained resultant to implementation of sustainable policies of energy extraction</li> <li>- reports prepared by social organisations, including Association of Polish Green Network and WWF (World Wide Fund for Nature) Poland</li> <li>- reports prepared by research institutes, including universities and Institute for Structural Research</li> </ul>	<ul style="list-style-type: none"> <li>- Overview of achievement of sustainable development goals in KMAO – Ugra in 2021</li> </ul>

(D2.) Advertisement campaigns informing local people	
<ul style="list-style-type: none"> <li>- academic and industry conferences and workshops with different groups of actors (economic self-governments, craft guilds, entrepreneurs and trade unions, NGOs, youth assembly, representatives of business environment institutions, media)</li> <li>- activities directed at school, primary and secondary youth and students</li> <li>- promotion of just transition on Internet through website</li> </ul>	<ul style="list-style-type: none"> <li>- Eco-educational TV programmes</li> <li>- advertising campaigns dedicated to waste management</li> <li>- promotion of separate waste management through website</li> <li>- educational events for children and students</li> <li>- social events aimed at promoting sustainable consumption, environmental protection, etc.</li> <li>- governor's grants for projects aiming at environmental protection</li> <li>- academic conferences</li> </ul>

Source: own research.

Above all, to date there has been no strategy for sustainable or green development of the KMAO - Ugra. Although a section on sustainable environmental development and green growth appears in the Strategy of Socio-economic Development of KMAO - Ugra until 2030, the concepts imply a broader environmental scope, with a focus on a smart use of resources, environmental safety, etc. Climate risks are not included in the list of the main regional development challenges. Moreover, the Strategy issued in 2013 does not foresee any decrease in global oil demand. Perhaps as the result of such an analytical basis, no mechanisms to modify the regional specialisation are developed (two green technological innovations are still planned in oil mining). Instead, the majority of green innovations focus on the energy sector (four technological innovations) as well as housing and utilities services (two technological innovations), with special attention on solid waste management (two institutional innovations). Furthermore, the introduced innovations are of an adaptive/retroactive nature (Greenpeace, 2021), both with regard to breakthrough green (organic waste management) and pseudo-green (expansion of gas use for transport; waste deactivation) measures. Only renewable energy and regeneration of forests can be regarded as genuine climate mitigation instruments, although the latter is not really innovative. Besides, the scale of renewables uses, targeted at 1.5% of regional energy mix by 2030, seems insufficient to effect profound changes.

A prescriptive approach prevails in KMAO - Ugra climate policies: regional authorities set targets that business has to comply with and sometimes to finance (e.g. increase of associated petroleum gas uses up to 98% by 2030). There are no legal incentives but the fiscal ones are quite

numerous. Yet this impressive list of fiscal stimuli turns out to be dominated by subsidies aimed at improving electricity affordability and energy efficiency. Admittedly, such outcomes, albeit contributing to the decrease of energy intensity of regional GRP, have only indirect effects for sustainability. On the contrary, tax incentives to stimulate use of best available technologies are a good example of a green fiscal incentive. Another strength of the KMAO - Ugra green transition management is the information policy aimed at raising public awareness of sustainability challenges and well-being gains from the green transition and at strengthening public support for regional green initiatives. This policy has a special focus on waste management (26% of initiatives) and targeted events for children and youth (31% of initiatives).

## Discussion

The main goal of the green transition process is to bring about widespread climate neutrality in the near future in regions heavily populated by industrial activity, especially in industrial regions that are established in the Silesian Voivodeship and KMAO - Ugra. The method of qualitative content analysis used in the investigation of legislation and policy documents related to the transition helped to reveal quite a balanced total of shared and distinct features in both regions (Fig. 2).

Some similarities are explained by the fact that both these regions specialise in fuel mining. Firstly, dissemination of policy information is actively carried out. Indeed, information support is highly important in fuel mining regions because local communities might be opposed to



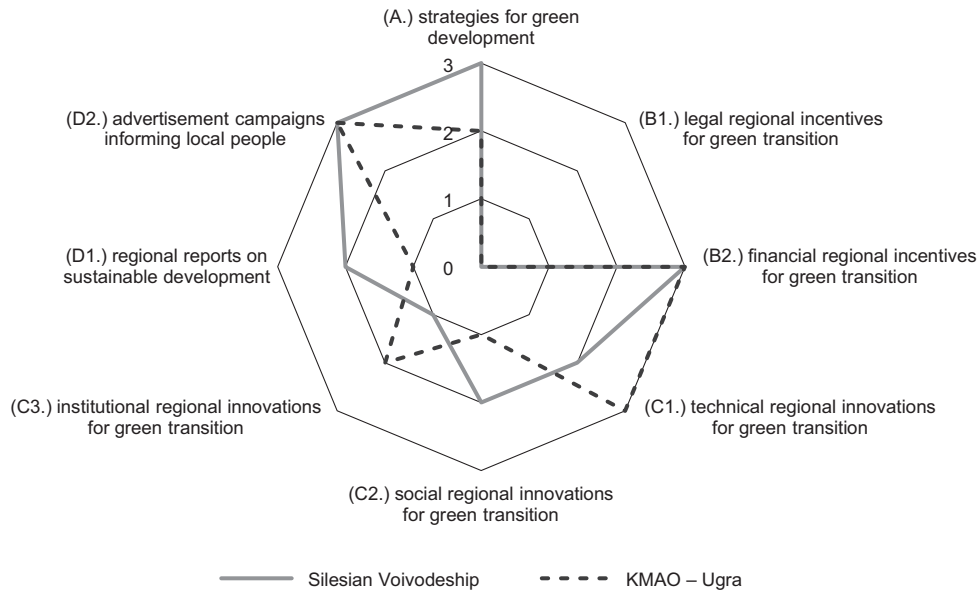


Fig. 2. Evaluation of the green transition policy in the Silesian Voivodeship and in KMAO – Ugra. KMAO – the Khanty-Mansiysk Autonomous Okrug. Source: own research.

the low-carbon economy due to expected welfare losses. The threat of the negative consequences of the implementation of the Green Deal among the local communities is very common in many regions of the world and is widely investigated by researchers (e.g. Bouzarovski, Simcock 2017; Köberle et al. 2021; Gea-Bermúdez et al. 2022). Secondly, the other similarities can be found among the social innovations, where emphasis is put on research and education. This is logical because the green transition requires amendments in the region's carbon-intensive specialisation and retraining for workers employed in mining and relative industries. The problem of education and retraining of the local labour force in industrial regions in the face of the implementation of green innovations concerns also other regions in Poland and Russia (e.g. Fagiewicz et al. 2021). Thirdly, technological innovations are driven by energy efficiency improvements and enlargement of renewable energy use. Certainly, mining regions mostly rely on fossil fuels in their energy mix, which needs to be changed to cut emissions. The problem of optimising the energy mix and energy sector coupling has been investigated by Gea-Bermúdez et al. (2022) in the states of northern-central Europe. The results of the research prove that the integration of energy end-use and supply sectors with one another leads to the reduction of the decarbonisation costs. Therefore,

the energy sector coupling appears to be a promising chance for the Silesian Voivodeship and KMAO – Ugra and other industrial regions to reach zero-emission goals in the near future.

Another couple of similarities—absence of regional legal incentives and a variety of financial ones—are mostly associated with power distribution in the EU and Russia. The legal basis for a low-carbon development is adopted on the highest authority level, while regions are free to stimulate local business with financial instruments (cf. Hille, Kassenberg 2018; Mrozowska et al. 2021).

Most differences observed are induced by a more active and longer elaborated green agenda in the EU. Accordingly, there are more green development strategies in the Silesian Voivodeship (e.g. Territorial Plan for Just Transition, low-carbon economy and energy policy strategies), while there are only green sections in regional strategies in the KMAO – Ugra. However, by May 2022, each Russian region is required to work out a plan for adaptation to global climate change. Moreover, no radical change of 'dirty' specialisation is foreseen in KMAO – Ugra strategy 2030, whereas in the meantime, the Silesian Voivodeship is expected to cut coal mining. This advancement in the strategic approach in the case of Silesian Voivodeship realises a hope expressed by Kiciński (2021) for reaching zero-emission

goal at least in some regions of Poland by 2050. Finally, while institutional green innovations are focused on the energy sector in the Silesian Voivodeship, the KMAO – Ugra is lagging one step behind the implementation of systems for waste management and greenhouse gas emission monitoring, both of which are already established in Poland.

So, in the current decade, the Silesian Voivodeship and KMAO – Ugra are pursuing their own although partially overlapping paths of the green transition. However, in the long-run, both regions are expected to reach net-zero. The energy transformation and the achievement of climate neutrality are some of the key areas of activity of the world community and its organisations, including the European Union in recent times. Russia and Poland, the countries whose energy supplies are based mainly on fossil fuels, are facing the challenge of reduction of the greenhouse effect caused by emission of gases. The paths involved in achieving zero-emission vary across European countries (OECD 2020). While in the countries that are old members of the European Union (i.e. before the reunification process in 2004), there is, at least in a declarative dimension, a strong drive to achieve this goal in 2040, in the countries more recently admitted to the European Union (i.e. as a result of the reunification process in 2004), there is less interest in such a fast process of decommissioning the use of fossil fuels in the energy balance. Poland is an example of a country in which there are far-reaching concerns related to such a rapid energy transformation. On the one hand, there are declarations by representatives of the central authorities regarding the achievement of this goal, and on the other, the structure of the Polish industry does not allow for such rapid changes in the scope of the acquired energy source and the abandonment of coal. At the same time, Poland, as a member of the European Union, must implement its plans (Simon 2020). Moreover, there is a sort of bargaining game between different administrative levels. On one side, the representatives of the regional level, who are responsible for the distribution of the European Union funds, are interested in implementing the regulations and programmes limiting the gas emission. On the other side, the representatives of the local administration have to balance the risk and opportunities related to

implementing these regulations. The European Union projects create new opportunities for local firms to develop and sell technologies based on green innovations. At the same time, the EU projects and programmes are also promoting the closure of the mining companies, which causes the instant increase of the local unemployment rate and the ‘transitional ruptures’ from the hitherto path development, which can have positive or negative consequences (Wilson 2014). The problem affects most local administrations, who have to cope with it.

In this respect, Russia is showing greater freedom in shaping its energy and climate policy. The goal of achieving net-zero emissions by 2060 in Russia was a product of the aspirations of the federal authorities as well as the guidelines of international institutions (notably the UN) but not the European Union (however, the EU Carbon Border Adjustment Mechanism (CBAM) might be quite sensitive for Russian carbon-intensive exports). By now, the nationally determined Russian contributions as specified under the Paris Agreement are already almost fulfilled. To secure its economic growth in the low-carbon future, Russia is striving to set favourable rules, e.g. gain international recognition of national methods of absorption capacity calculation and green labelling of nuclear and large hydro plants. As for the KMAO – Ugra, it might set the climate neutrality target by 2050 (according to the KMAO – Ugra Strategy 2050 currently on the anvil), keeping, however, its oil-mining specialisation supplemented with production of hydrogen from associated gas.

## Conclusions

Building up a low-carbon economy is a big challenge for the Silesian Voivodeship and KMAO – Ugra as long as both regions are highly dependent on fossil fuel mining. On the one hand, the Silesian Voivodeship seems to be in a more favourable position because it can apply for European funds and technical assistance for its green transition. On the other hand, European green guidelines, being one of the most advanced in the world, require quicker and deeper changes than the region might be currently ready for (*cf.* Communication from the Commission, 2021). In

its turn, the KMAO – Ugra has more room for manoeuvre because, firstly, national rules don't foster decarbonisation and, secondly, oil has more applications in the net-zero future (e.g. for chemical production). In any case, further green transformation in both regions requires massive investments in restructuring regional industry, transport and residence, business models and consumption patterns. Once the path of the KMAO – Ugra to climate neutrality is settled, these long-term policies of the green transformation in Polish and Russian regions might become the subject of further research. The comparative studies presented in the article provide an opportunity to exchange ideas and experiences about introducing green transition projects and plans. The greening of the Polish economy imposed by the European Union provides good examples of the projects and programmes related to fulfilling the requirements of the zero-emission target in the Silesian Voivodeship that the KMAO – Ugra could follow. One of them is implementing strategies to more strictly monitor green gas emissions. The monitoring will help to find the locations (e.g. factories, community houses) where the technical innovations have reduced gas emissions.

Another consequence of the quick green transformation that could be further investigated is the social change related to the shocking shift from the historically heavy industry oriented labour market into a new, uncertain and green energy oriented one. The new directions of the research should concentrate on the consequences of the break with the heavy industry heritage of the examined regions. Further research along this direction should also focus on the influence of the green transformation on the job changes of many individuals who have been holding, for generations, the same type of position in the heavy industry.

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### Author's contributions

All parts of the article and stages of the work were worked out jointly by the authors, with a leading role of M.M. The authors have read and agreed to the published version of the manuscript.

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