Multilevel governance energy planning and policy: a view on local energy initiatives

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Multilevel governance energy planning and policy: a view on local energy initiatives

Viktorija Dobravec[1*], Nikola Matak[1], Christian Sakulin[2] and Goran Krajačić[1]

Abstract

Background: A sustainable energy system based on renewables, energy-efficiency, decentralisation of energy generation and synergies between different sectors requires new energy planning methods and policies. Energy transition and climate change mitigation achievement can no longer be seen only through top-down activities from a national government. Local and regional governments have a crucial role in delivering public policies relevant to such endeavour. Therefore, the implementation of multilevel governance (MLG) has become a priority for fostering local and regional development more inclusively. Paper analyses the existing energy planning governance in Austria throughout the MLG structure by focusing on the alignment between the local energy and climate initiatives and the national and EU goals. Also, the paper examined the effectiveness of the current MLG structures and outlined the fields where improvements are needed. The successfulness of the MLG approach is shown on Judenburg city case study. Desk research is enhanced by a series of interviews with energy policy experts and implementation of case study measures in TIMES model.

Results: The MLG analysis showed the solid alignment of different governance levels. In contrast, the comparison of the energy and climate initiatives on the local level outlined recommendations for the design of more effective energy planning approach. Four areas of action are identified for further improvement: territorial fragmentation, data availability, spatial energy planning and new integrated MLG. The remaining non-conventional biomass potential of the Murtal region is enough to increase the share of district heating for the residential buildings of the Judenburg city from 16.3 to 30.8% while the building refurbishment increases district heating share to 32%.

Conclusion: Application of MLG analysis demonstrated the alignment of energy targets in Austrian policy on different governance levels. The general willingness of Austrian municipalities to take part in local energy actions was shown through the local initiatives' analysis. It is argued that strengthening the listed areas of work is necessary to raise the effectiveness of the local initiatives. The case study for the city of Judenburg developed in the TIMES model confirmed that coordinated actions from different levels of governance lead to effective implementation of measures.

Keywords: Energy planning, Local energy initiatives, Multilevel governance, Non-conventional biomass

Background

A sustainable energy transition requires a transformation in both the energy sector and society. This requires actions to be transposed into energy and climate policies developed in the coordination of multiple levels of government. However, the realisation of the energy and climate goals cannot be achieved only through top-down activities from a national government. Still, it should be equally supported with a bottom-up approach [1] and include the active participation of all governments level [2]. Therefore, multilevel governance (MLG) has, in recent years, arose as a strategic element in reconstructing existing energy governance. It is argued that the success of the climate and energy governance is

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indispensable from the mobilisation of all the governance levels, including the sub-national level [3]. There is an urgent need to systematically break down the national goals to the local level to meet greenhouse gas (GHG) emission targets.

Moreover, local climate policies and initiatives need to be massively expanded and upscaled throughout multilevel energy governance [4]. Successful energy transition to low carbon and 100% renewable energy systems from the resource potentials, technical and economical perspective has been analysed within several studies [5–7]. Despite the identified feasible technical solutions, their implementation can only be realised throughout an effective governance mechanism. The importance of the governance transition and complexity of policy change has been highlighted in Söderholm et al. [8] through an assessment of several energy scenario studies.

Since the introduction of the idea in European level policy studies in the early 1990s [9], it has gained substantial popularity over the past ten years and has been used in energy and climate policy [10]. MLG development has been inspired by the evolution of the EU. It has been used to describe a new model of global sustainability governance with a focus on the local level and multisectoral economic development since the 'Agenda 21' of the UN Earth Summit in Rio de Janeiro in 1992 [3]. The EU is characterised by strong integration through the number and scope of policy areas, and the way policy is developed. Thus, it is often interpreted as an example of MLG [11]. The MLG theory within the EU is manifested throughout different ways of communication and coordination for the decision-making process and implementation or evaluation of EU policies between governing authorities at all levels: the European, national, regional and local layers. Interaction between layers is realised in two ways: through vertical and horizontal dimension. Vertical dimension refers to the interactions between different levels of government, while horizontal relates to interactions with other relevant actors within the same level. In this way, EU decisions are placed as close as possible to the final consumers—citizens [12]. In the last years, the analysis of the governance structure and the role of different actors in the energy transition have been observed through MLG approach. It describes a division of power in a non-hierarchical way between actors across the horizontal and vertical distribution of responsibilities. However, state management is not restricted only to the government actors but provides flexibility with the inclusion of non-state players such as various interest groups, organisation and civil society [11]. The vital approach for the implementation of MLG reinforcement is the employment of the EU policies by the European Commission oriented to encourage actions at a local level. The MLG approach of the EU to climate and energy governance is via local-level initiatives contributing to strengthen dynamics in pioneering countries as well as to fill gaps in countries with weaknesses at the national level [3].

To support the implementation of the EU legislation at the local and regional level, the EU has established the European Committee of the Regions (CoR). The CoR actively implements MLG approaches which have significant importance for the EU [13–15]. Moreover, in 2014 the CoR adopted a Charter for Multilevel Governance in Europe [13, 16] calling public authorities of all levels of governance (local, national and European) to use and promote MLG in their future undertakings. The EU Cohesion Policy for 2014–2020 with almost a third of the total EU budget is pointing out the need for the new ways to increase ownership on vertical and horizontal levels of governance by emphasising the significance of MLG and partnership strengthening for the EU policy-making [17].

The MLG has been successfully applied to analyse the complexity of renewable energy governance in developing countries, pointing out struggles on implementation of renewable energy act due to powerful local authorities, unclear responsibilities, conflicting regulations, a lack of awareness for national intentions and missing consultation [18]. The impact of MLG structure in the energy field in Romania has shown significant shortcomings in the implementation of the European governance structure. The main incoherence has found a lack of communication paths and autonomy of different administrative levels. Although the structure was copied from the EU level, through MLG was not established since clear responsibilities, cooperation and decision-making process were not clearly defined [19].

The MLG approach has proved to be particularly advantageous in highlighting the functions of different governance levels. Assessment of the existing climate and energy regime of Thailand through MLG framework showed that the national government has a significant role in the energy transition. However, a lack of independent planning agencies is observed as the major governance issue along with the need for active engagement of actors on different level [20]. Peng et al. [21] examined the way of emerging and evolving energy policies within the overall policy framework. The observed strong vertical structure between national and local governance demonstrates the importance of combining national government with the potentials and goals of the city. For some countries, the clear top-down support from the state is inevitable in directing sustainable energy transition on local level [22] while in others sub-national levels of governance are crucial in the implementation of climate and energy policy [3].

The importance of the local level is evident from the pioneering countries Germany and Denmark being leaders in energy transition policy. Local-level actors have a significant and long-term impact on Danish renewable energy development, which is often described as a combination of bottom-up and top-down actions [23, 24].

Followed by the increased interest in MLG approach, the significance of local authorities in the realisation of sustainable energy policies has gained importance in the mid-1990s, [25–27]. Fudge et al. [28] discussed the changing position of local authorities due to their potential to involve a wider community in implementing effective policies concerning energy and environmental issues. The enhanced role of the local authorities requires reinforcement and transformation of the state role, thus calling for the comprehensive investigation of the integrated policy and governance transformation [23]. This question has already been raised in the early 2000s by Hooghe and Marks [29] describing the need for coordinated activities of subnational and national government within the scope of the MLG system. The national climate mitigation policies are often too general and tend to oversee specific needs and variations between the municipalities. Westskog et al. [30] argue that adaptive co-management between national, regional and local levels can serve as a tool to complement the existing gap. However, the solution is not straightforward due to the several limitations, such as the demand for more resources for addressing current and future climate change adaptation. The review of 11 municipalities in Denmark, on the one hand, showed active local engagement in energy planning. At the same time, on the other, it stressed the need for strategic energy planning and defined institutional framework providing support to municipal planning from national level [23].

The contribution of the local level mitigation policies for the long-term global response to climate change to protect people, livelihoods and ecosystems have been pointed out in the 2015 Paris Agreement [31]. In [32], Bulkeley and Betsill discussed the crucial role of the local governments in climate policy implementation. They reviewed urban politics of climate change considering MLG and emphasised the increasing role of the non-state actors in defining the urban climate governance as well as the growth of municipal voluntarism and strategic urbanism. Due to the economic development with a more than half of the world's population living in cities and the tendency of their continuous growth, they are often concerned as the source of energy issues but also the key contributors to the energy transition process [33–35] since they have the power to act as drivers of change.

Nevertheless, overall success depends on the harmonisation of local and national interests [36]. Assessment of the opportunities and barriers of multilevel decision making and compatibility of European Union (EU) and national climate policies with local policies for the case study of Helsinki proved that the lower levels of governance have the leading role in implementing the EU directives and national policy [11]. Moreover, cities as frontiers in implementing initiatives which show the feasibility of energy measures can serve as role models for their implementation at the national and the subnational level.

As has been emphasised in the previous paragraphs, cities can play a crucial role in climate change mitigation since they are an important factor in vertical implementation. There is also a need for horizontal cooperation since these increases cities capabilities. Therefore, the International Council for Local Environment Initiatives established Green Climate Cities (GCC) programme [12]. The GCC methodology is built upon nine steps divided into three big groups: Analyse, Act, and Accelerate. The seventh step is mainly focused on MLG through vertical and horizontal collaboration and development of the connections with the similar cities around the world [37]. Another global initiative, i.e. network of large cities committed to contributing to the Paris Agreement target at the local level, represents active international cooperation at the horizontal level of governance [38].

Countries in the EU have recognised the importance of MLG in sustainable energy planning and development of policies, plans and strategies [39]. In support of the EU Climate and Energy Package, the Directorate-General for Energy launched the Covent of Mayors (CoM) initiative. The CoM represents an explicit tool of MLG with the objectives set at the EU level and performed at the local level. In support of the initiative, recent studies showed that effective implementation of energy efficiency policies could hardly be carried out through traditional top-down approaches, but stronger cooperation between multiple levels of government is required [40]. In [41] Melica et al. discussed the horizontal cooperation between the municipalities in the framework of CoM. They have concluded that such collaboration is especially beneficial for the small and medium-size municipalities which would otherwise most likely experience the lack of human and financial capacity, thus failing to adopt policies and develop their action plans. The CoM initiative is a widespread innovative model of MLG, thus effective tool for fostering the activities on local and harmonisation of goals on various administrative levels [42]. An assessment of 16 German municipalities and their local energy action plans showed their contribution to the national energy transition. Nevertheless, the advancement of MLG coordination is required to overcome existing shortcomings within the local administration,

electricity grids or higher penetration of renewables in heat and mobility sector.

Local energy and climate initiatives have a critical role in supporting municipalities in the achievement of energy and climate change mitigation targets [43]. This is due to their responsibility on planning issues and the use of resources, policy development, especially in the domain of buildings and transport. Also, they are energy consumers and represent the closest administrative level to the citizens. Nonetheless, the evaluation of the contribution of local policies to climate change is not adequately controlled by local authorities as the local energy system is a part of a much larger national and international system. This requires in the first-place adequate evaluation of the policies but also coherent actions at all levels of governance.

This paper provides an analysis of the division of power and elements of existing governance structure and mechanisms within the energy sector in Austria. For an EU member state with a federal structure, the authors were able to identify the presence of different initiatives coming from five levels of governance, from global to local level and vice versa, which made an excellent base for a study. Moreover, Austria applies the MLG approach to the vertical distribution of the institutional actors' responsibilities to assess the effectiveness of energy and climate policies and implementation processes with a focus given to the initiatives for sustainable development on the local level. The initiatives provide support and framework for the implementation of the EU and national energy and climate policies on the local level. The main hypothesis of the paper is that the continuous feedback from the lower level of governance and firm management from the political top is needed to establish an environment that would foster the implementation of successful energy policy. In this endeavour, the reinforcement of specific observed area of action is inevitable to increase the effectiveness of local initiatives. Based on the assessment of three types of local initiatives, Austrian municipal level, District level—group of municipalities and EU municipal level 4 areas for recommendations were suggested. Recommendations on the improvements in governance structure in these areas were provided. Moreover, the hypothesis of the paper was examined through the case study, which encompassed two measures, one arising from top-down and another from a bottom-up perspective on the city where remaining non-conventional biomass potential of the region was utilised.

The paper is organised into four sections. The Background section gives the state-of-the-art of the MLG approach concerning the energy and climate field emphasising the growing importance of local authorities in the energy transition. The Methods section presents interviews held, software used and describes a case study with scenario development. The analyses of the division of power in Austria with detailed analysis of the local initiative's recommendations based on the evaluation of the effectiveness of local initiatives and MLG structure and results of the scenario for two given measures are provided in the Results and Discussion sections. All findings are summarised in the Conclusion section.

Methods

The study is built upon desk research on the MLG governance structure to give a theoretical background from the EU perspective and the implementation of EU energy directives within the Republic of Austria. A general MLG structure representing vertical and horizontal interactions is given in Fig. 1.

Desk research is enhanced with a series of interviews for an energy policy analysis of the Austrian energy policy system and a case study analysis for two representative sets of measures, which are top-down and bottom-up initiated. The case study area is the city of Judenburg while the analysis of the higher level of governance was done following the location of the city with a bottom-up perspective. The city of Judenburg is part of Styria, one of nine federal provinces in Austria. Judenburg has been chosen for a case study city as it is actively working on sustainable development and is involved in two local initiatives, CoM and e5, and several finished and ongoing European projects. Therefore, it could serve as a best practice example for the other Austrian cities.

The methods for the development of the results were twofold. Firstly, the interviews were provided by the national level of energy expert. The topics and questions of the interview were focused on the planned measures

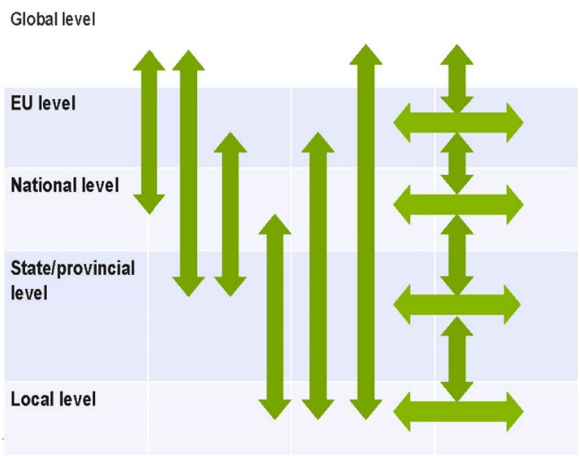

Fig. 1 MLG governance structure: vertical and horizontal interactions [86]

for the improvement of the local energy and climate policies in the case study city. Those topics were covering the usage of biomass in the district heating systems covering top-down political and financial decisions, ministries roles and decisions making regarding national, regional and local energy policies, change of national ministries organisation and its effects on the implementation of energy policies. With the quality control manager for the local energy initiatives in Austria, the second set of interviews was done. In this way, more detail information on the functioning of these initiatives was obtained. These interviews were also used to check and validate the results obtained by the desk research on the local initiatives and their success and role in the implementation of energy and climate policies.

The goal of these interviews was to provide insights on the MLG approach used for the implementation of the energy and climate policies in Austria both from the local and regional/national levels. The comments and the inputs from the interviewed experts are integrated with the results of the desk research and shown in the results section. They are divided into two subsections Framework of the energy governance structure in Austria: top-down division of power and Initiatives for sustainable energy development at the local level. The conclusions which were drawn from the interviews were summaries in the four areas of interest for which improvements were provided in the case study results subsection of the results and discussion.

In the TIMES model scenario development and the modelling of the case study was done. The Integrated Markal-EFOM System TIMES is a model generator developed within the Energy Technology System Analysis Programme (ETSAP), a Technology Collaboration Programme of the International Energy Agency [44]. TIMES model is a long-term accounting model that can be used for the penetration of modern technologies and the phase-out of old ones. The tool can be used on the global, multi-regional, national, state/province, or community level. Model is complex but provides many possibilities for simulation. It can provide detailed modelling and simulation of energy systems, costs, the effect of different policies and constraints [45].

The modelling of the case study city was done by the TIMES City model, which was integrated into the SureCity platform [46]. The platform consists of a TIMES City Model, a Scenario Generator and a software interface. The TIMES-City model represents a city's energy system, covering both the supply technologies and their infrastructure and the demand technologies used in buildings, transportation and industry. TIMES-City model aims to provide support for efficient integrated long-term energy and resource planning at the city level. More specific, to support local governments in identifying and understanding the critical steps needed to perform an energy transition of the urban energy system. This is important both to define consistent long-term targets and policies, and when communicating system-level implications of proposed policies and investments to other stakeholders. The model is set to capture the municipality's activities and operations (travels, building stock, public lighting, etc.) separately from the remaining urban energy system, thus, can be used for either a city's organisation (own building stock, own vehicles, etc.) or the entire city territory [47].

The modelling of the case study was done on the example of the residential sector through the implementation of the top-down and bottom-up energy measures, namely, expansion of DH and building refurbishment. This sector was used to show the results which can be obtained if the MLG approach is applied to the implementation of the energy and climate policy.

Case study and scenarios development

In the baseline year 2015, approximately 20% of all buildings were connected to DH, and 15% of total energy consumption in the residential sector was coming from DH [46]. According to the Urban developmental and traffic concepts city is divided into eight zones which served to capture its spatial characteristics, as shown in Fig. 2. The DH network is passing along the city from west to east through zones 3, 4, 5 and 6. The utility Judenburg is planning to expand the network primarily in two central zones 5 and 6, mainly used for residential purposes.

Moreover, the city aims to achieve 100% renewable energy supply for heating purposes, thus increasing the use of traditional local energy sources such as waste and biomass. The scenario with implemented measures was developed to follow the defined goals of the city and to calculate the potential of the unused non-conventional biomass [46]. New DH is modelled to reduce the share of fossil fuels in zone 3, 4, 5 and 6. Primarily residual fuel oil, coal and natural gas to a certain extent. Natural gas is reduced according to the total potential of non-conventional biomass within the Murtal district. Murtal district including Judenburg encompasses 20 municipalities with a land area of 1676 km^2 and 72, 842 inhabitants while the city of Judenburg covers an area of 63.76 km^2 and in 2015 had 10,072 inhabitants [48]. The heat for the Judenburg DH is not produced within the city borders as but imported. Therefore, the expansion of the DH system is not in the city authority and represents a measure initiated from a top-down level. Building regulations which define standards for energy performance of the buildings are within the provincial authority and execution at the local level while local authority has a strong

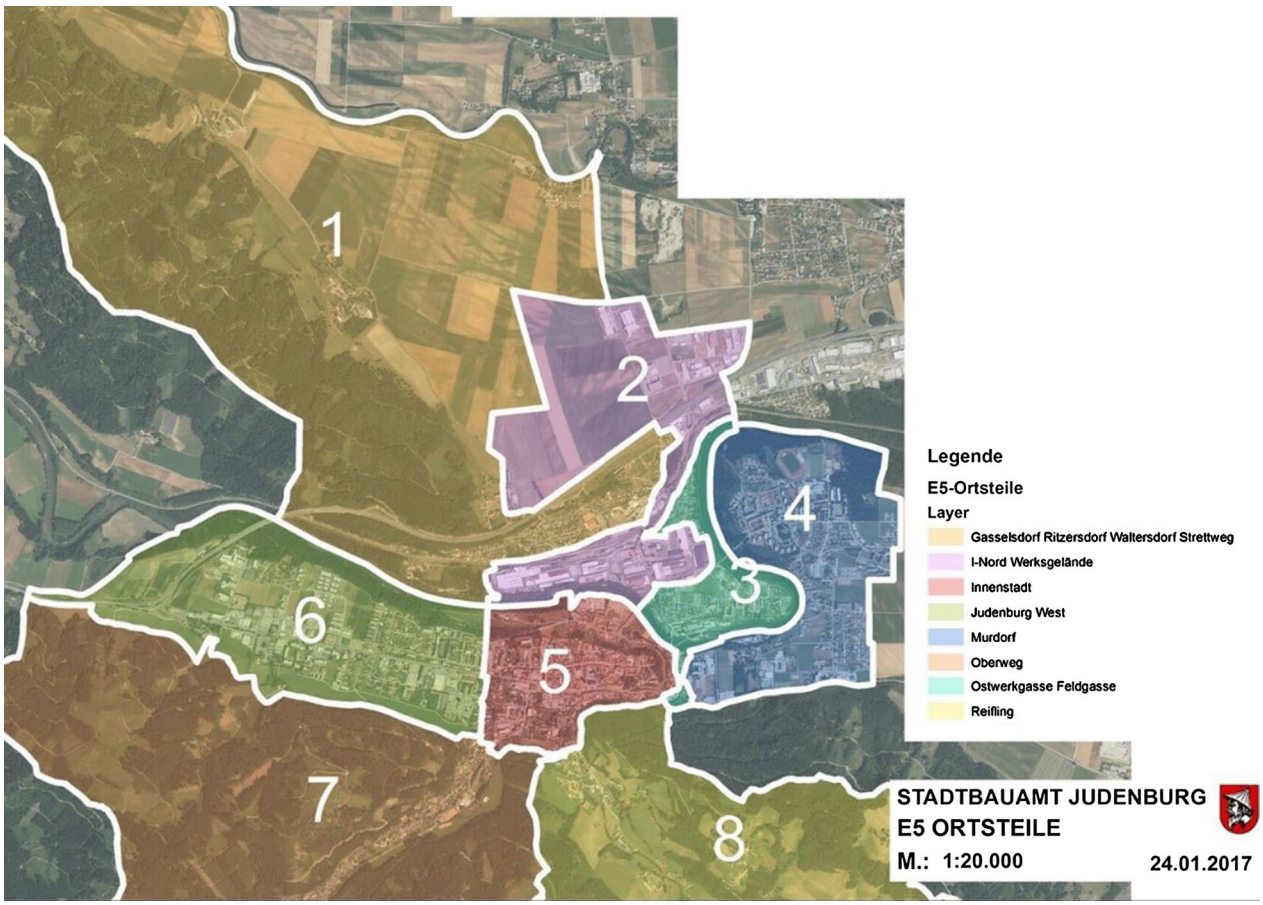

Fig. 2 Map of Judenburg city with city zones [87]

influence on the building refurbishment. Therefore, this measure is initiated from a bottom-up level. The renovation of the building is also applied to the zones 3, 4, 5 and 6 to examine how much increase in the energy efficiency of buildings can contribute to increasing the share of DH in zones and overall in the city. The average specific heat consumption in the targeted zones is 81.4 kWh/m^2. Within the second measure renovation rate of 3% until the year 2030 has been applied based on the obligation for the central government buildings defined in the Energy Efficiency Directive (2012/27/EU) [49]. The renovation level taken for this case is based on the analysis provided by Stocker et al. [50]. They showed on the case of Austria that the cost-optimal performance lies at an annual heating energy demand of about 30 kWh/m^2 excluding domestic hot water and technical equipment.

The existing DH system of the Judenburg city has been constructed based on the strong MLG efforts, thus supporting the paper hypothesis for the need of the MLG structure. The project initiated from the provincial level aimed to construct DH system for several municipalities based on non-conventional biomass and excess heat from the pulp and paper industry thus replacing two small gas DH systems and individual mainly gas boilers. The project depended on the active cooperation between different level of governance and various stakeholders. EU subsidies for projects favourable for environment and climate are transposed to the Umweltförderung im Inland (environment subsidies within Austria) and managed by the ministry responsible for the energy (currently BMNT). Subventions are among others available for the biomass DH systems. Province of Styria provides additional grants for the biomass DH systems, thus creating favourable condition for biomass DH. Coordination of all three-level, EU, national and provincial throughout subsidy system and efforts on the provincial and local level of municipalities, companies and industry resulted in a high success of the project development.

Biomass potential

Biomass is traditionally highly accepted renewable energy source (RES) in Austria, thus utilised to a great extent.

In Styria, more than 80% of available biomass potential is already exploited for various purposes such as for production of humus, biofuel, in combined heat and power plants, etc. The potential includes woody biomass, industrial waste, agricultural residues, manure, miscanthus and other. The remaining potential is also envisaged to be utilised [51]. The potential used for this study refers only to existing non-conventional biomass resources within the district of Murtal calculated based on the aggregated potential for the federal state of Styria and specific value of potential per inhabitant.

Results and discussion

The results and discussion section are subdivided into three parts. In the first part, "The framework of the energy governance structure in Austria: top-down division of power", results of the desk research, and interviews with the national-level energy expert is given. The second part, "Initiatives for sustainable energy development at the local level" provides information on the local level initiatives present in the case study area and ends with the main recommendations for critical areas of action: territorial fragmentation, data availability, spatial energy planning and new integrated MLG. In the end, the result of the implementation of two previously described measures in MLG approach on the fulfilling of the energy and climate local goals is given.

The framework of the energy governance structure in Austria: top-down division of power

The administrative structure of the Federal State of Austria consists of three levels of subdivision, each with corresponding administrative organisations [52]:

- At the central government level, the federal government
- At the federal level, the administration of the federal provinces of 9 federal provinces
- At the local self-administration, the municipal administration of 2098 municipalities

In Austria, there are also 94 administrative districts representing organisational authorities integrated into the administration of federal provinces or within a greater city. Districts are not independent territorial authorities (Fig. 3). The highest share of power belongs to the national level, i.e. federal government including legislative and executive power in matters such as mining, forestry, regulation and standardisation of electrical plants and establishments as well as safety measures in this field; provisions about electric power transmission in so far as the transmission extends over two or more provinces; matters of steam and other power-driven

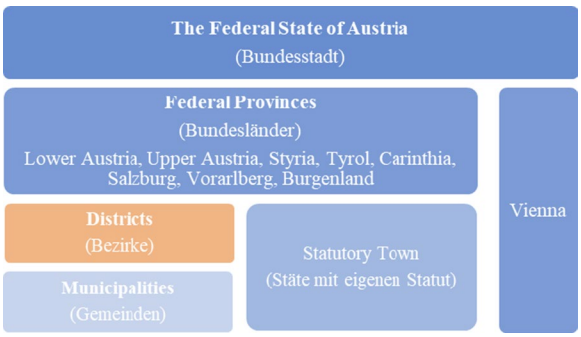

Fig. 3 The vertical state organisation of the Republic of Austria [53, 88]

engines. The federal provinces have certain legislative competences, but their primary function is administrative and executive. In the issues such as electricity (in so far as it does not fall under the above mentioned) or environmental impact assessment for projects relating to these matters where material effects on the environment are to be anticipated; in so far as a need for the issue of uniform regulations is considered to exist, the approval of such projects legislation is the business of the Federation, while execution is the matter of the provinces [53]. Municipalities have no legislative power, and they stand solely as an administrative body. They represent self-governing bodies, meaning that they act independently from the federal state and federal provinces in some fields. Districts are groups of municipalities and in charge of the administration of all matters of administrative law of federal state and federal provinces. A statutory town performs municipal and district administrative duties.

Duties and designations of the Federal Ministries are established based on the Amended Ministerial Law [54] (Fig. 4). Ministry primarily responsible for energy is the Federal Ministry of Sustainability and Tourism (Bundesministerium für Nachhaltigkeit und Tourismus – BMNT). Ministry performs several tasks within the field of energy and activities directly affecting energy business, such as spatial planning. The ministry responsible for the research, technology and innovation in the field of energy is the BMVIT (Bundesministerium für Verkehr, Innovation und Technologie). To define the pathway for energy research and innovation policy, BMVIT and the Climate and Energy Funds developed Energy research and innovation strategy [55]. The strategy is in line with the EU 20-20-20 goals and the Strategic Energy Technology Plan for Europe [56].

The klimaaktiv climate protection initiative and network was founded in 2004 as a governance tool for the energy transition. It is maintained by BMNT and is supporting municipalities, households and companies in

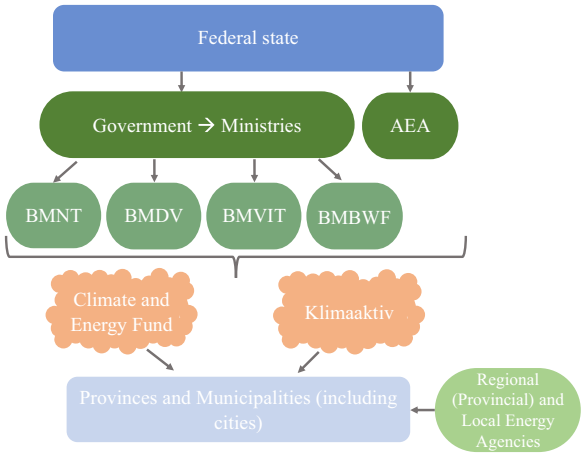

Fig. 4 Structure of the main actors in the vertical energy governance in the Republic of Austria

their climate protection activities. The initiative is linked with the Austrian Energy Agency (AEA) which is responsible for implementing programs and projects. Together with the BMNT and AEA, klimaaktiv is operating e5 program for energy-efficient towns and municipalities in Austria (e5–Programm für energieeffiziente Gemeinden) [55]. The e5 program is a part of the European Energy Award, the European program for local authorities [56].

The Climate and Energy Fund supports the implementation of a sustainable and climate-friendly energy supply system, reduction of greenhouse gas emissions and implementation of the short-, medium- and long-term climate strategy in Austria [57]. The Climate and Energy Fund is maintained by the BMNT and BMVIT. The Fund aims to foster energy transition at the local level throughout the Climate and Energy Model Regions (Klima- und Energie- Modelle Regionen - KEM) [58] and Climate Change Adaptation Model Regions (Klimawandel- Anpassungsmodellregionen - KLAR) [59] programmes and Smart Cities initiative [60].

As an EU member state, Austria is having an active role in implementing EU energy policies. EU climate and energy targets for 2020 and Climate and Energy Package 2009 [61] were translated into Energy Strategy Austria and communicated to the European Commission in June 2010 [62]. Austrian energy strategy is based on three main pillars: security of supply, energy efficiency and renewable energy with an emphasis given to energy efficiency. The Strategy is developed in cooperation with the provinces to harmonise the provincial strategies (Fig. 5). The implementation of the energy strategy is the responsibility of the Austrian Federal Government.

Austria has signed and ratified a globally binding Paris climate agreement. To bring the agreement to life, it developed integrated long-term Austrian energy

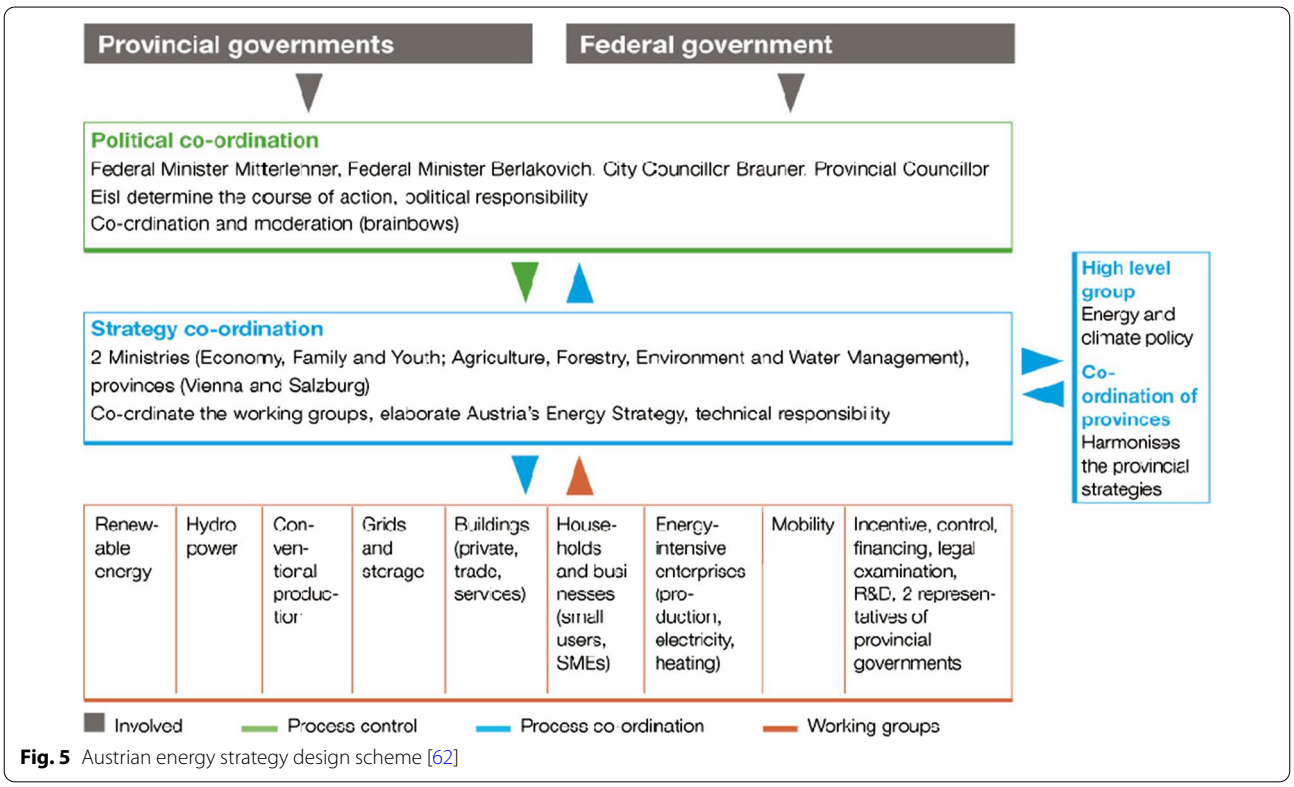

Fig. 5 Austrian energy strategy design scheme [62]

and climate strategy [63, 64]. The Strategy is following and emphasising the importance of multi-stakeholders' approach in implementing energy policy. EU and international targets in particular and the Strategy in general are the basis for developing the Integrated National Energy and Climate Plan for Austria [65].

Member states of the EU are obliged to develop and submit to the European Commission Individual National Renewable Energy Action Plan (NREAPs) [66]. NREAPs describes national pathways for meeting 2020 goals, increase of renewable energy, improvement in energy efficiency and GHG emission reduction. NREAP for Austria has been developed in line with the EU Directive 2009/28/EC and based on the Austrian Energy Strategy (2010) [67]. NREAP is monitored throughout the biannual progress reports, and so far, Austria has developed four progress reports [68–71]. Under the EU Energy Efficiency Directive 2012/27/EC, each member state is obliged to draw up every three years of National Energy Efficiency Action Plans (NEEAPs) [49]. So far, Austria has developed NEEAP for 2014 [72] and 2017 [73]. The implementation of the directive contributed to the introduction Energy Efficiency Act in 2014. The NEEAP of Austria was drawn up in cooperation with the Federal Government and provinces [73].

The decision in the field of energy and energy strategy development in Austria is following the general framework of the MLG governance. These processes are designed in the cooperation of the national governance of the federal state and the representatives for the energy of the provinces. Depending on the importance of the matter, the representatives of the provinces are discussing the issue at the provincial level with the responsible chambers. Following vertical structure from the top-down perspective, energy strategy at the provincial level has also been analysed. As explained in the methods section, the focus was placed on the federal province of Styria.

Province of Styria decided to combine strategies on energy and climate change into a Climate and Energy Strategy 2030. The strategy is in line with the goals set on the national level which cover four areas of action: GHG emission reduction, energy efficiency increase, the share of RES and affordable energy and security of supply.

Initiatives for sustainable energy development at the local level

At the local level, energy efficiency action plans aim to support national and provincial initiative for sustainable energy development. In Austria they are designed as a part of the following programmes:

- e5 – Programme for energy-efficient towns and municipalities (e5 Österreich –Programm für energieeffiziente Gemeinden (e5)) (municipal level) [55]
- Energy-saving municipality programme (Energiespar Gemeinde) equal to the e5 programme but only in Upper Austria (municipal level) [74]
- Climate and Energy Model Regions (Klima- und Energiemodelle Regionen (KEM) (District level – a group of municipalities) [58]
- Covenant of Mayors (municipal level) [75]

In the targeted federal province, i.e. Styria in 2018 there were 3 CoM signatories, 11 e5-municipalities and 25 KEMs including 114 municipalities. The analysis of the effectiveness of the local initiatives has underlined the main characteristic of each initiative, and it was supplemented by the interviews with the quality management team members of e5 and KEM initiative from the Energy Agency Styria.

All the initiatives are based on voluntary commitment; therefore, its execution is highly flexible and without legal or financial consequences in the cases of the failure. Legally binding measures with penalties for non-execution could, however, support a more serious approach in the implementation of the action plans. Such changes should arise from the top-level, namely national political governance and should be equally followed and harmonised with the policy rules on the provincial and local level.

Among all the initiatives, only the CoM defines the quantifiable target of CO_2 emission reduction. Quantified targets can quickly be evaluated, and they represent a clear indicator of the success of each initiative and the way how they contribute to national and European goals. Unlike CoM, e5 and KEM set qualitative targets. Nevertheless, the general objectives of all initiatives can be compiled to a uniform goal of achieving sustainable energy development, increasing the energy efficiency and enhancing the security of supply. The choice of the measures in CoM is arbitrary if the total sum gives the required emission reduction. Although in most of the cases a similar set of measures is used, the predefined set of measures from which each signatory could choose does not exist. On the other hand, in the case of KEM, the list contains 90 measures, thus providing international benchmarking and comparison.

Analysis of the development process has resulted in finding the steps common to all initiatives: (1) Initiation, (2) Application and accession, (3) Baseline energy review, (4) Design or revision of measures, (5) Implementation, (6) Evaluation and reporting. In the case of the KEM, unlike the e5 and the CoM, the commitment is not required from the municipal level, but it

exists independently from the municipal government which affects the scope of the area where measures can be applied. Moreover, KEM regions apply for the call of the Climate and Energy Fund, which opens once a year to become part of the initiative and receive financial support. Application to the call requires from the regions to set the measures in advance. However, the measures can be revised and changed to a certain extent afterwards.

All initiatives contain an evaluation of the measures as an indicator of the success which serves as a motivator when the municipality/region was on track or "modifier" when it failed to keep the track. Therefore, the evaluation can be considered as the most important part of the ongoing process. Assessment and reporting are continuous processes in CoM and e5 initiatives while for KEM, this is often the final stage because most of the regions quit after the first phase is finished. The quality control is performed by the external bodies, which contribute to the credibility and reliability of the initiatives. At least every three years, the KEM municipalities undergo an evaluation by an independent commission depended on the progress, they are accordingly awarded "e" level representing the percentage of the measure implementation. Esurance that the submitted action plans of CoM initiative are carried out is done by the European Commission's Joint Research Centre.

Whereas e5 and CoM are made for the municipalities or cities being the first level of territorial political division, KEM covers regions including at least two municipalities. CoM, however, has an option to group small municipalities which is beneficial from the perspective of financial and human capacity. The CoM and KEM analyse various sectors while e5 include only the municipal sector. Energy analysis of the municipal sector gives high chances for accuracy of the analysed data; however, omitting the other sectors significantly reduces areas with great potential for improvement. The key CoM sectors include buildings, equipment/facilities and industries, public lighting and transport. On the other hand, KEM also analyses all the sectors but measures could be designed in the way that none of the sectors is directly influenced, but they aim at awareness-raising, educational and social activities.

Analysis of the current situation of the municipality/region as well as the proposed measures are done in the form of a report. Availability of the report is one of the steps in the opening data process. The unique form of reporting facilitates traceability and comparability between municipalities/regions. Similar templates are provided for the municipalities/regions of CoM and KEM initiatives. Their detailed reporting in a transparent way is useful not only for the municipality/region itself but also for the other municipalities/regions willing to take part in the initiative and develop their action plans. Even though e5 has detailed uniform template for evaluation, the lack of transparency is observed as the full evaluation is available only to the e5 quality management team, limited version for the municipality and brief certificate is published online.

Variations between initiatives appear for financial and human capacity. The highest level of municipal commitment to secure its funding is in the case of CoM. This is because the initiative arises from the EU level, but direct funding is not provided. The action plan lists possible business plans and sources of funding while online CoM support provides interactive funding guide with links for the most relevant financing publications and initiatives. On the other hand, participation in e5 has small license fee whose costs are along with the costs of professional support during the implementation phase and of creating human resources in the state or the region covered by each respective national funding body. In the case of KEM, projects are funded to a certain extent. Financial support is a great motivator to take part in the initiative, which can be seen from the numbers of participating municipalities (Fig. 7). However, the requirements of the application process discourage participants to continue.

The indication of the MLG approach exists in all the initiatives. Communities participating in the e5 program are also participating in the European Energy Award (EEA) program at European level [56]. At the European level, the initiative is interlocked with other programmes and activities, such as CoM. At the national level, it is in line with national climate and energy goals. At the regional or local level, it is compatible with the creation and implementation of climate and energy policies. The EEA also has a multilevel organisational structure on the international, national and local level with the addition of external audits of municipalities and EEA advisors. Within the KEM initial concept strategies and roadmaps for the regions are analysed, and projects are designed to be in line with local, regional and national energy action plans and strategies. The commitments for CoM signatories are linked to the EU's Climate and energy policy framework while action plans identify and analyses the existing municipal, regional and national policies, plans, procedures and regulations that affect energy and climate issues within the local authority which enables better policy integration.

Moreover, measures for the specific sector are highly advised to follow EU policies and directives. Even though the link between strategies on the local level with the strategies on regional, national and European exists, its applicability and viability in practice are questionable. This is due to the lack of precise top-down directions and continuous feedback loop from lower to a higher level

of governance and vice-versa. Strategies on the national and provincial level set general goals not considering particularities of different municipalities regarding their RES potential and/or energy needs. On the other hand, the involvement of the lower levels is observed, such as in the Austrian energy strategy [62], though cooperation is not transposed into the definition of specific goals to each province.

Analysis and interviews gave four areas where improvements are needed, namely territorial fragmentation, data availability, spatial planning, flexible governance. Thus, this paper presents improvements in the four areas to develop a background for the new flexible energy planning methods and policies. Moreover, the hypothesis of the paper was examined through the implementation of two types of measure arising from a different level of governance.

Case study results

Territorial fragmentation

The province of Styria covering 16,401 km^2 in 2017 had 1,237,298 inhabitants [48]. The state is divided into 287 municipalities which are the lowest hierarchical level of administrative division. Municipalities had undergone a structural reform in 2015 when their number was almost halved. Reform intended to reduce the cost and human capacity for the operation of the municipalities. The municipalities are still generally small with a low number of inhabitants. In 2017 only 14 municipalities had more than 10,000 people with a 37% share in the total population of the state but accounting for only 5.8% area (Fig. 6).

Most of the small municipalities have a restricted financial and human capacity for developing their local energy action plans and taking the energy measures. Therefore, the option of joint participation with the support of the local authorities from each of the municipality is seen as a solution. Such an option exists in the CoM initiative. The initiative is not very widespread over Austria as the other two initiatives e5 and KEM, which have long existence and high level of acceptance. To overcome this barrier, the option of joint participation with the support of the local authorities should be introduced in e5 and KEM initiatives. Support from local authorities is of high importance for the acceptance and implementation of energy projects in all sectors. The analysis of municipalities participating in one of the local initiatives in Styria is presented in Fig. 7, where it can be seen that some of the municipalities are part of more than one initiative. Nevertheless, most of the municipalities are part of the KEM initiative, which does not guarantee long-term commitment. Thus, the risk that municipalities will not continue their participation is rather high.

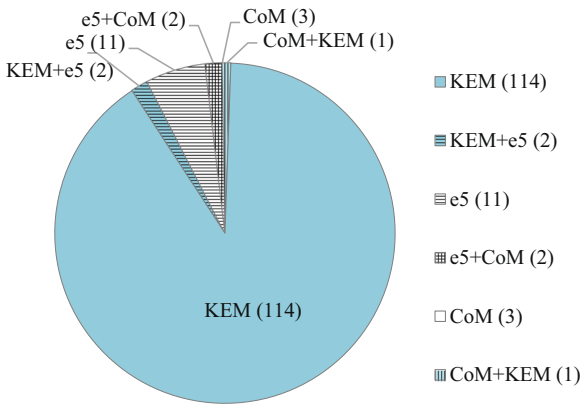

Fig. 7 The share of municipalities per type of the energy and climate local initiative

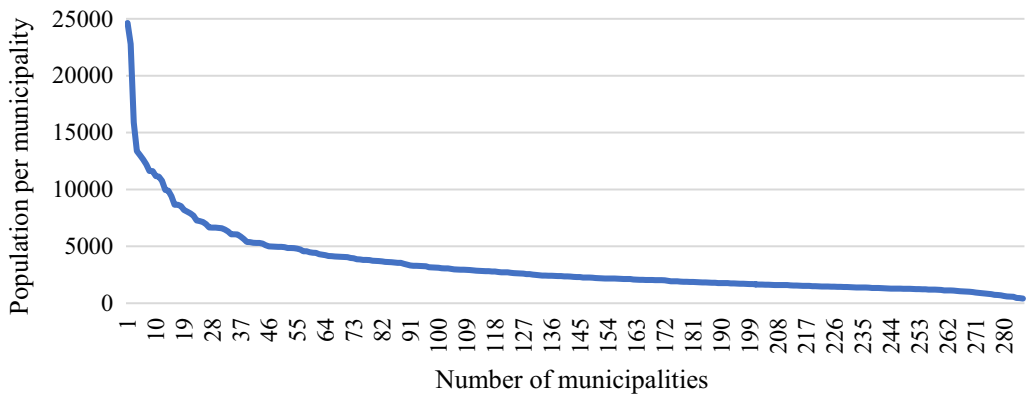

Fig. 6 Municipalities in Styria per number of inhabitants

Data availability

Data availability in Austria has been highlighted as a critical point in the development of flexible MLG energy planning and policy. Data availability varies between federal state. In the focus state of Styria, the weak points could be found within all three categories, namely economic, privacy and information quality. Comprehensive automatically updated database in directly usable form requires additional expenses for the data collection and processing, while on the other hand, this would significantly reduce time, financial and human resources but also rise the accuracy of local energy plans. Data quality is another big issue of the currently available data, which reduces the accuracy of energy strategy development. Even though quality management teams of local initiatives such as e5 are putting much effort to keep the high quality of the energy documents, clear framework and guidelines on the data availability, collection and processing are inevitable to facilitate the procedure of opening data. The difficulty to obtain data, as well as the need for the open energy data, has also been discussed within the CoM initiative. As the CoM is a bottom-up initiative, it especially requires detailed and possibly granulated data at the local level. Required data can be obtained from energy suppliers. However, as at the one location, several suppliers may be active, it is more convenient to obtain data from grid operators. Both energy suppliers and grid operators are often reluctant to provide such data as it is generally considered as commercially sensitive and due to the confidentiality, commercial secrecy, and administrative burden. Therefore, in most of the cases, it is possible to get only aggregated data [76]. Nevertheless, energy market operators within all the member states must *provide on request, but not more than once a year, aggregated statistical information on their final customers* to an agency assigned by the Government [49]. Aggregated data are generally available from the statistics at a regional or national level [48], but this is mostly not appropriate for use in the case of the local initiatives, as mentioned before.

Spatial energy planning

Federal states are in the power of defining spatial planning regulations by an appropriate spatial planning act. Local authorities are responsible for land allocation, where area usage is defined in the zoning plan. Moreover, the urban planning and urban law fall within the competences of federal states while the execution of the laws belongs to responsibility of the local authorities, namely the jurisdiction of the mayor [67]. Even though the regulation of spatial planning is well defined and established, and the Styrian Spatial Planning Act defines that the energy transition and climate protection should be considered, energy aspects are seldom considered. The province of Styria opened the call for proposals on 03/08/2018 to support municipalities in defining energy measures taking into consideration spatial dimension [77]. Until February 2019 only two municipalities have developed their Concepts for the Energy Sector (Sachbereichskonzept Energie), namely municipality of Semriach and Kapfmeberg.

Local communities have, high but unutilised opportunity to include energy planning into their spatial plans. Spatial energy planning has become a significant topic within the European cities that are gradually developing approaches to introduce energy policy instruments [78–80]. Until now, in Austria, concrete actions on spatial energy planning have not at all or rarely been taken into consideration within local energy action plans. Spatial energy planning has been mentioned as an important instrument to reach the energy and climate protection goals within the Austrian Energy and Climate Protection Strategy. The present situation of low exploitation rate of spatial energy planning measures can be best seen from the analysis of the most common measures in KEM (Fig. 8).

Concrete public regulation and administrative processes for spatial energy planning have the potential to define energy zones for specific energy technologies and uses thus exploiting energy and services such as public transportation or DH network most efficiently and economically. Thus, the availability and quality of energy data with an emphasis on georeferenced data is of critical importance. Energy zoning has the potential of achieving technically, economically and ecologically suitable energy transition within the municipalities as the area allocation, i.e. the way land is utilised is inseparably linked [81]. Defining best suitable technology according to the availability of the RES and customers demand the specific zone would not just contribute to optimised allocation of technologies and bring benefits to the efficiency of the energy system but also contribute to the market innovations. Such an example is the technological and market uptake in Denmark, which is a result of the appropriate land allocation [82, 83].

New integrated multilevel governance

Challenges of sustainable development are not limited to the respective administrative border. They intertwine horizontally between the areas of the same administrative level as well as vertically in both directions from the highest administrative level to the lowest and vice-versa [84]. Often actions are not taken within the artificially bordered administrative levels but rather within functional geographical areas such as neighbourhoods, metropolitan areas, cross border and macro-regions

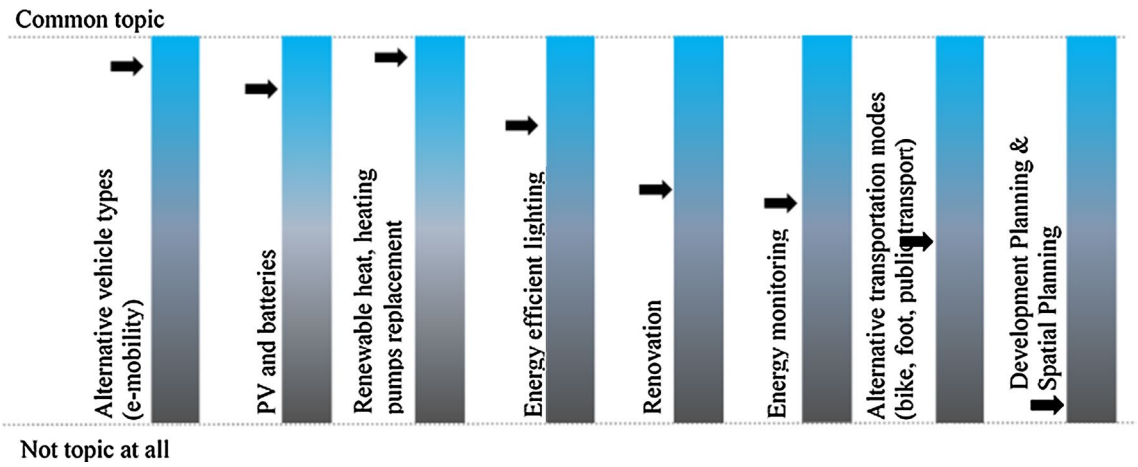

Fig. 8 Analysis of the focus areas in KEM implementation concepts (January 2018) [89]

where the integration of different policies exists. Due to the constant changes of the geographical area, i.e. growth of the city metropolitan boundaries the levels of functional geographies, namely neighbourhoods and metropolitan areas should rather be kept as flexible levels, where important activities are carried out in less formal ways. The idea of flexible MLG arises from Jacquier [85]. However, the interpretation of flexible MLG in this paper follows the idea presented in Tosics [84] where both hierarchies exist at the same time. This type of new governance is introduced in Fig. 9 as a new integrated action space.

It can be seen throughout the section *Framework of the energy governance structure in Austria: top-down division of power* that energy objectives at different levels of governance coincide with each other and they are in line with the European objectives. The objectives are taking account top-down definition by taking into consideration the bottom-up approach throughout the consultation with the provincial representatives and relevant chambers of the provincial governments. Even though

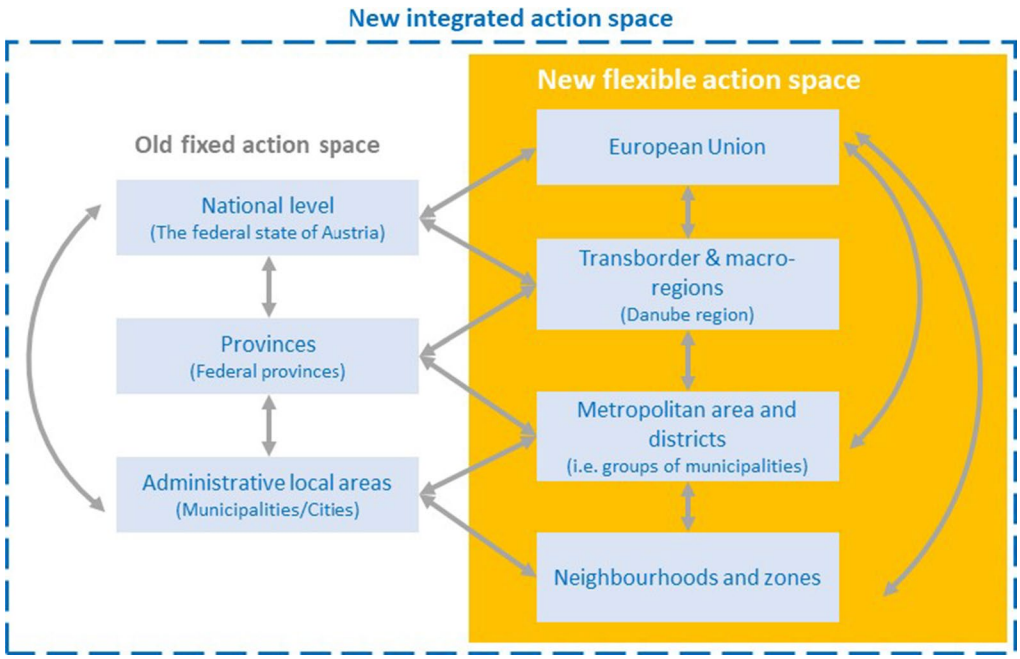

Fig. 9 New integrated action space (Modification based on [85])

cooperation of the different level of governance is seen, it should be strengthened with a stronger influence of the bottom-up approach and horizontal cooperation. Therefore, in a proposed future MLG structure with a new integrated action space, it is important to keep fixed action for defining framework and giving the guidelines while giving the space for more flexibility to non-administrative areas. In a fixed action space, all levels of governance would strengthen their role throughout a more specific definition of activities for the energy transition. The national state should provide a more precise framework for energy transition with a concrete focus on the potentials and the needs of administrative areas of the lower level. Moreover, it would create preconditions for implementing local initiatives through solving the issues of data availability and stimulating spatial energy planning. On the other hand, municipalities and cities would provide constant feedback on the strategy implementation progress by taking a bigger role in drafting the national and provincial energy policy an implementing more actively proposed measure. The flexible action space would enable to cover land characteristics arising from the development of the defined administrative area but also to consider renewable energy potential, which is rarely defined with administratively imposed borders. The smallest level of flexible action space, i.e. districts or neighbourhoods, would have the key role in spatial energy planning acting as the energy zones. In this way, reorganisation of the current division of power could ensure more effective implementation of local initiatives.

Implementation of measures

The results of the implementation of the measures in the city of Judenburg showed that coordinated actions from different levels of governance lead to effective implementation. The remaining non-conventional biomass potential is enough to increase the share of DH in Judenburg for the residential buildings from 16.3 to 30.8%. The building refurbishment, which contributes to the reduction of heating demand, is increasing the DH share to 32%. Total heat demand for space heating and hot water preparation after the implementation of both measures was 317.54 TJ. Fuel types used to cover heat demand after the implementation of both measures are presented in Fig. 10.

Both measures were applied only to zones with an existing DH network, namely zones 3, 4, 5 and 6 due to the potential for new DH connections and renovation of buildings. Therefore, the implementation of the measures in these zones led to increasing of DH share from initial 19.5 to 52.3%. This enabled to phase out coal and residual fuel oil completely and to reduce natural gas for space heating and domestic hot water preparation for 82.5%. The approach represents the introduction to spatial energy planning through MLG. Defining zones that should be supplied by DH or natural gas, respectively enable to establish efficient and low-emission energy system and also prevents over investments in infrastructure [83]. Future research should include mapping the renewable energy potential and energy demand to develop the method for designing energy zones on the local and

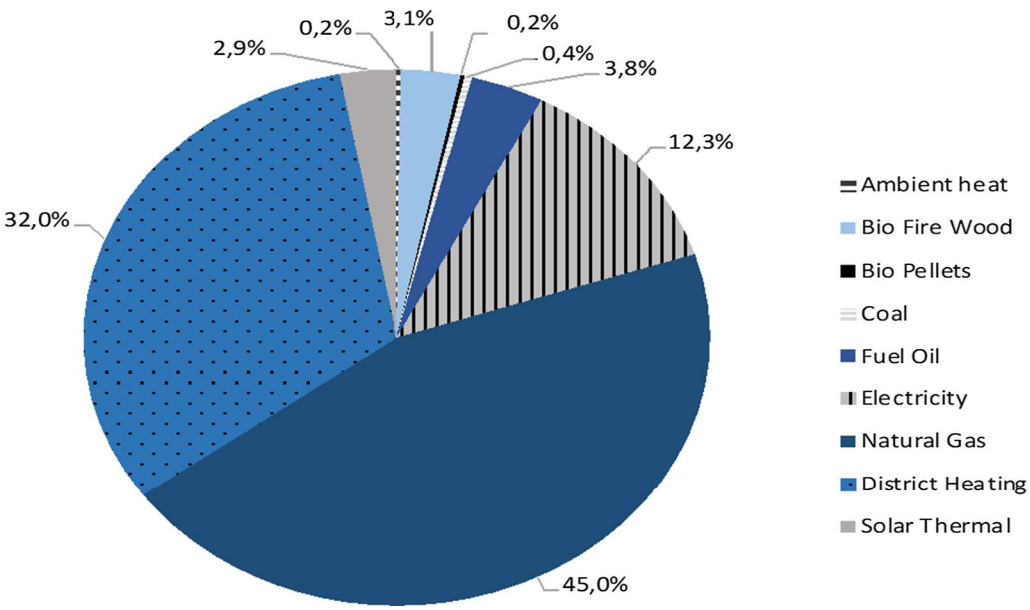

Fig. 10 Fuel shares for heat demand

regional level. Due to the exploited biomass potential future work should examine the potential of production of additional non-conventional biomass such as fast rotation plantation or algae. Moreover, further analysis should include other sectors and economic analysis of the implemented measures.

Conclusions

The application of MLG governance approach to the Austrian energy policy system showed that energy transition goals and pathways are in line with the global and European energy targets at all level of authorities from national, provincial to local, namely cities and municipalities. Moreover, solid cooperation of different levels of governance from top-down and bottom-up perspective has been observed. The general willingness of Austrian municipalities to take part in local energy actions is analysed through the local initiatives. The review of the three ongoing local initiatives in the federal province of Styria enabled to highlight the most important four areas for their implementation to various level of governance.

It is argued that strengthening the listed area of action is necessary to raise the effectiveness and the general quality of the local initiatives. The main observed areas of actions are divided into four groups, namely territorial fragmentation, data availability, spatial energy planning and new integrated MLG governance. To overcome the lack of financial and human capacity of individual local authority due to the territorial fragmentation, the paper elaborates the idea of restructuring the existing local energy initiatives. This means that local initiatives would allow grouping smaller local authorities while having the political support of the local authorities. This option is already available for the CoM signatories; however, the CoM initiative has a low rate of acceptance in Austria due to the other well-established initiatives.

Additionally, the lack of open energy data inevitable to design high energy plans makes it difficult to create quality strategies as well as sound monitoring of the implemented measures. The regulations on data availability must be set with clear guidelines at the top level of governance. Moreover, almost none of the local initiatives cover the area of spatial energy planning which is suggested as an important part of a holistic strategy for the energy transition. The utilisation of space and energy demand are directly interlinked and inseparable. Moreover, since the local authorities have a strong influence within the matter of spatial planning, it is argued that there is both the potential and the need to enhance spatial energy planning activities. Proposed new integrated MLG action space serves a background to accomplish listed activities. It entails a combination of fixed old action space and new flexible action space. This means that firm government structure would still define clear framework while at the same time having enough flexibility to include all the territorial particularities of areas outside the strict administrative borders. The fixed action space should be enhanced through a constant feedback system to ensure that national and regional strategies are developed, taking into consideration all the aspects of the specific energy potential and demand of the local area.

The case study of Judenburg city showed how coordinated activities from higher and lower administrative levels could lead to accomplishing national, regional and local goals. The need for spatial energy planning was especially outlined by considering the remaining potential of non-conventional biomass resources. Zoning the areas would not just enhance the most efficient use of the technology and measures but would enable to exploit the potential of RES in the most effective way.

Abbreviations

AEA: Austrian Energy Agency; BMNT: Bundesministerium für Nachhaltigkeit und Tourismus – eng. Federal Ministry for Sustainability and Tourism; BMVIT: Bundesministerium für Verkehr, Innovation und Technologie – eng. Federal Ministry for Transport, Innovation and Technology; CCP: Cities for Climate Protection; CoM: Covenant of Mayors; CoR: Committee of the Regions; DH: District heating; e5: Programme for energy-efficient municipalities; EEA: European Energy Award; ETSAP: Energy Technology System Analysis Programme; EU: European Union; GCC: Green Climate Cities; GHG: Greenhouse gas emissions; KEM: Klima- und Energiemodelle Regionen; KLAR: Klimawandel-Anpassungsmodellregionen – eng. Climate Change Adaptation Model Regions; MLG: Multilevel governance; NEEAP: National Energy Efficiency Action Plan; NREAP: National Renewable Energy Action; OECD: Organisation for Economic Co-operation and Development; RES: Renewable energy source.

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Authors' contributions

VD performed literature analysis, data collection and multilevel governance analysis for the case of Austria with a focus on the local level energy and climate initiatives and programmes. She also performed the analysis of the district heating expansion and building refurbishment for the case study of the city of Judenburg. NM updated results and restructured the paper. CS and GK supported and supervised these activities. All the authors contributed, read, and checked the paper.

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Availability of data and materials

The data that support the findings of this study are obtained from several sources where some are publicly available while the others obtained from the city of Judenburg and the Austrian Institute of Technology are subject to the third-party restrictions. Publicly available data used for the case study include: Energieaktionsplan Judenburg 2020 [available at: www.eumayors.eu]. D. Preiß, T. Baumhackl, B. Fischer, and M. Umgeher, "Klima- und Energiestrategie Steiermark," November 2017. [available at: www.technik.steiermark.at]. D. Suna, A. G. Marijuán, E. Volkar, C. Sakulin, N. Pardo-Garcia Deliverable 2.1.2 Status-quo for the city of Judenburg including presentation of the possible future scenarios [available at http://surecityproject.eu/]. Statistical data from the www.statistik.at

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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