

Article

Linking the National Energy and Climate Plan with Municipal Spatial Planning and Supporting Sustainable Investment in Renewable Energy Sources in Austria

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Abstract: The Austrian National Energy and Climate Plan (NECP) refers to spatial planning as an important instrument to achieve 2030 targets because the technical potential of renewable energy sources (RES) are closely related to the types of land use. In Austria, land use is regulated by the spatial planning laws of the nine provinces, whereby the municipalities play an important role. It was the objective of the transFORMAT project to understand the scope for action of the municipalities with regard to promoting renewable energy use, and to understand the practical implications for renewable energy projects. To this end, the consolidated versions of spatial planning laws were analyzed and supported by a software tool (transFORMAT-Analyzer) that was developed to facilitate this process and the resulting follow-up activities. Responsible administrative departments were approached for supplementary information when deemed necessary. As a conclusion, the legal instrument (municipal ordinance), called a municipal development plan or concept, represents a long-term plan for the development of the municipality with the obligation or the option for revision under specific conditions. In theory, these revision intervals could be used to better align municipal plans with the NECP. In practice, however, significant barriers exist and opportunities for improvement have been identified, leading to recommendations on how investments in renewable energy systems can be planned more realistically and, thus, more sustainably.

Keywords: renewable energy; spatial planning; national energy and climate plan; governance regulation; municipal spatial planning; municipal development plan



Citation: Geissler, S.; Arevalo-Arizaga, A.; Radlbauer, D.; Wallisch, P. Linking the National Energy and Climate Plan with Municipal Spatial Planning and Supporting Sustainable Investment in Renewable Energy Sources in Austria. *Energies* **2022**, *15*, 645. <https://doi.org/10.3390/en15020645>

Academic Editors: Maciej Nowak, Valentine Udoh James and Oleg Golubchikov

Received: 28 November 2021

Accepted: 12 January 2022

Published: 17 January 2022

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1. Introduction

The efficient use of materials, soil, water and energy, as well as the reduction of burdens on ecosystems, are essential for a good life for all of us and future generations.

This is reflected in several European Union (EU) directives that set requirements for the EU Member States (of which Austria is one), among others, with regard to energy efficiency [1,2] and the use of renewable energy sources [3], but also with regard to making use of administrative data [4] to achieve these goals. The EU Governance Regulation [5] requires the definition of targets to be achieved by 2030, the formulation of measures to achieve the targets and the reporting on implemented measures and achieved targets on the basis of National Energy and Climate Plans (NECP). The European Climate Law [6] sets ambitious goals with regard to the reduction of greenhouse gas emissions and thus emphasizes the essential role of renewable energies.

However, the importance of renewables for achieving energy and climate targets also brings to the fore the spatial dependence of the availability of renewables and associated challenges due to the division of responsibilities between the EU and the Member States. In this context, it must be noted that the European Union is based on the Treaty on the Functioning of the European Union [7] which emphasizes the principles of subsidiarity and proportionality, the first meaning that instruments or measures must address the

administrative level where they are most effective (EU, federal, regional or local level), and the latter meaning that instruments or measures must strike a balance between the expenses and effort caused by an instrument or measure and the degree of severity of the problem that the instrument or measure addresses. With regard to its subsidiarity, the treaty clearly defines the areas of exclusive union competence, the areas of shared competence between union and the member states (Article 4 of the treaty, among others, energy and environment), and areas of support and coordination actions listed in Article 6 of the treaty, namely the protection and improvement of human health, industry, culture, tourism, education, vocational training, youth and sport, civil protection, and administrative cooperation. In short, apart from the areas of shared competence regulated in Article 4, spatial planning falls largely within the competence of the member states, while the European Union mainly plays a supporting and coordinating role, for example through guidelines [8] and funding programs [9].

Against this background, it is worth exploring how nationally or regionally defined spatial planning can create the conditions for the use of renewable energies, and at the same time can ensure the necessary contributions to the targets set by the European Union and the NECP.

1.1. The Goal and Approach of This Paper

The importance of renewable energy sources for achieving climate targets, the fact of the spatial reference of the availability of renewables, and the lack of concrete spatial planning measures in the Austrian National Energy and Climate Plan [10] were the reasons for starting the transFORMAT project as a self-financed activity of the Institute in order to investigate the link between the EU level of target and reporting obligations and the local level of project implementation, using Austria as a case study. In the first phase of transFORMAT the focus was on the following aspects: (1) to understand the scope for action of the municipalities, especially with regard to facilitating renewable energy use, (2) to understand the implication for projects with an actual impact on the 2030 targets and beyond as stated in the NECP, and (3) to develop recommendations for a better link between the federal NECP planning and reporting level, and the local project implementation level.

This paper presents the first phase of the transFORMAT project, and the results achieved so far. The following subchapters present the initial situation in the field of renewable energy sources, the obligations of the NECP according to governance regulations, the instrument of spatial planning in the European context of the NECP, and the organization of spatial planning in Austria. Section 2 presents the methods applied, and Section 3 presents the results of the study, followed by a discussion and conclusions for future work.

1.2. Land-Based Use of Renewable Energy Sources

The theoretical potential of renewable energy sources is first determined by natural conditions; solar energy, wind energy and geothermal energy are only available in certain zones to such an extent that economic utilization is possible. While hydropower is fundamentally tied to the presence of water bodies, the actual usable potential of other renewables, such as solar energy and wind, depends on several influencing factors and is less easy to determine.

In this paper, we mainly deal with the renewable energy sources, wind and solar energy, because they are closely related with land use and thus with spatial planning.

Average solar radiation values in kW/m² are available worldwide and indicate in which areas solar energy use is basically possible. However, solar energy is converted into usable energy by means of collectors, and collectors need space, which is available in limited quantities. Thus, the efficiency of solar energy use is also determined by the efficiency of land use. In this context, the goal is the multiple use of surfaces, such as the occupation of noise barriers and the roofing of parking lots in front of shopping centers with photovoltaic modules. A current example is the legally required sealing of the Müllnern

landfill near Villach in the Austrian province of Carinthia, one of the nine provinces (also called federal states) of the Republic of Austria, which is achieved by means of an electricity generation plant; the Müllnern photovoltaic plant is to be designed in such a way that it simultaneously acts as a roofing and final sealing of the landfill. With 35,000 square meters, the plant will be one of the largest in the province of Carinthia [11]. This project is the first of its kind in Austria, and there has already been good experience with it in Germany for several years [12]. While there is good acceptance of such approaches among the societal stakeholders, the installation of photovoltaic surfaces in grassland is discussed quite critically against the background of the lack of land use efficiency.

With regard to wind potential, the situation is similar: wind maps show in which areas the air currents are basically suitable for use. Additionally, for the conversion of wind energy into electric power, an area is required for the installation of wind turbines. In contrast to photovoltaics and solar thermal energy, the installation of wind turbines on land in cold zones with snow and ice does not allow for multiple uses of land. On the contrary, conflicts arise with the interests of nature conservation, tourism, and agriculture due to problems resulting from icing in winter, shadow casting and infrasound, to name a few.

These examples clearly show that the technical potentials of the use of renewable energy sources are closely related to the type of land use being employed. In Austria, land use is not a federal responsibility but is instead regulated by the spatial planning laws of the nine provinces. They play a decisive role, as they determine the scope at the provincial and municipal level with regard to requirements for the use of land. Regulations in the field of supra-local spatial planning and local spatial planning can significantly influence the energy and raw material consumption of economic sectors and the possibilities of using renewable energy sources. Here are a few examples:

- Distances between buildings and building heights can facilitate or impede the use of solar energy. Appropriate specifications can be made in the development plan of the municipalities if the spatial planning law at the provincial level allows for such specifications.
- Specifications for planning can contribute to a better microclimate, increase comfort in summer, and discourage the installation of air conditioning. Air conditioners consume electrical energy and further heat their surroundings through waste heat.
- The designation of zones of suitability for the use of renewable energy in the zoning plan facilitates the implementation of projects.
- The designation of areas with completely obsolete and therefore unused building fabric is the basis for land recycling: using apportionment procedures and private law agreements, such areas can be redeveloped in an economically viable manner, and in such a way that they meet current and future social as well as ecological requirements.

The last point is particularly important, because in view of soil sealing and the requirements in the area of resource and energy efficiency and reduction of greenhouse gas emissions, the focus is on the transformation process of such districts (quarters, neighborhoods) into plus-energy quarters. Renewable energy sources also play a central role in this process.

1.3. The National Energy and Climate Plan

The National Energy and Climate Plan (NECP) is the central policy instrument to ensure that in 2030 the targets of the five dimensions of the Energy Union are achieved, with a view to long-term improvements until 2050. It brings together the policies from these mutually-reinforcing and closely interrelated dimensions and integrates the targets, plan of measures, and reporting on: decarbonization, energy efficiency, energy security, internal energy market, and research, innovation and competitiveness.

The so-called Energy Union aims at giving EU households and businesses secure, sustainable, competitive, and affordable energy. It is based on the Energy Union Strategy that has been a key priority of the Juncker Commission (2014–2019) and addresses the need for a fundamental change in Europe's energy system [13].

The legal basis of the NECP is the regulation on the governance of the energy union and climate action (EU) 2018/1999 that came into force on 24 December 2018 as part of the clean energy for all Europeans package [14]. The governance regulation sets out how EU countries and the Commission should work together, and how individual countries should cooperate, to achieve the Energy Union's goals. It takes into account the fact that different countries can contribute to the Energy Union in different ways by defining the targets according to their specific situation and needs. However, the content of the plan and the conditions for reporting are clearly specified in detail and must be followed. It is important to note that the dimension "decarbonization", which consists of the subsections "greenhouse gas emissions and removals" and "renewable energy", strives for synergies with the international obligations according to the United Nations Paris Agreement to the United Nations Framework Convention on Climate Change [15]. Each country's obligation regarding greenhouse gas emissions is represented by the Nationally Determined Contribution (NDC) which becomes part of the NECP in the European Member States. Although international and European reporting periods are still different, this is an important achievement in terms of streamlining policies, creating synergies, and avoiding duplication of efforts.

1.4. Spatial Planning in the National Energy and Climate Plans

With reference to the above section, renewables are covered by the Decarbonization dimension in terms of installation of equipment and systems, by the Energy Security dimension in terms of the reliability of energy supply, and by the Internal Energy Market dimension in terms of business models and tariffs. It is evident that adequate provisions must be made in all of these dimensions to ensure the success of renewable energy systems. Nevertheless, the construction as such is essential, clearly related to land use and thus spatial planning in the context of NECP.

Looking at the Austrian NECP, spatial planning is mentioned as a very important instrument, but concrete measures are not described [10]. Other NECPs show a similar picture: if spatial planning is mentioned, mainly maritime spatial plans and challenges related to transportation are addressed, but concrete measures related to municipal spatial planning and renewable energy systems are not often presented. The following examples show the different status of the consideration of municipal spatial planning and renewable energies in the NECPs of the EU Member States. For instance, the Spanish NECP states on page 12 without providing more precise information [16]: "*it is important to highlight that the increase of the renewable generation capacity envisaged in this Plan will require the involvement of the autonomous communities, which are responsible for spatial planning, as well as the drafting of additional management rules regarding the protection of the environment, so that the development of the generation facilities is effective and compatible with the environment and the protection of biodiversity and ecosystem services.*" In the Slovenian NECP the challenge of lacking social acceptance regarding the siting of renewable energy plants is addressed, and municipalities are named as actors for the implementation of measures together with the responsible ministry, however without explaining the planning and reporting link between them [17]. In Section 1.3 on consultation with regional and local authorities of the Danish NECP, it is stressed that strategic energy planning should be a mandatory task for municipalities, and that the government should set clear guidelines and provide the necessary resources for this [18]. The Croatian NECP includes a measure named "*OIE-2 Spatial planning requirements for using RES*" with an implementation horizon from 2021 to 2030. It is a regulatory measure with the objective to analyze the existing state of spatial capacities, and to define guidelines and criteria for specific spatial planning elements for RES planning at the state, county and local level [19]. NECP progress reports must be submitted every two years and it is certainly worthwhile to keep track of the progress made and the obstacles encountered, in order to draw lessons for improving policies and measures.

1.5. Spatial Planning in Austria

The spatial planning laws of the nine Austrian provinces set the framework for the content and the formal aspects of spatial development at the provincial level as well as for local development with provisions for zoning plans and land-use plans for building areas, for which the municipalities are responsible. The federal capital Vienna has a special role which will not be further discussed here. Regarding municipal spatial planning, the spatial planning laws contain mandatory minimum requirements and possible contents that go beyond the minimum requirements. The Austrian Conference on Spatial Planning (ÖROK), as an association of the federal provinces, the federal government and the municipalities, has a coordinating role in spatial planning and provides recommendations and guidelines for the provinces, and the overall strategies at federal level, which provinces should adhere to in their regional laws. Unlike in Germany, where there is a framework federal law for spatial planning [20], Austria relies on the ÖROK at the federal level, which is chaired by the responsible federal minister, in the current government the Federal Minister of Agriculture, Regions and Tourism, who belongs to the conservative Austrian People's Party, and not the Federal Minister for Climate Action, who is responsible for the NECP and who belongs to the Green Party.

The overview shown in Figure 1 illustrates that the Austrian federal ministry in charge of the NECP does not have a hierarchical position to impose requirements on spatial planning.

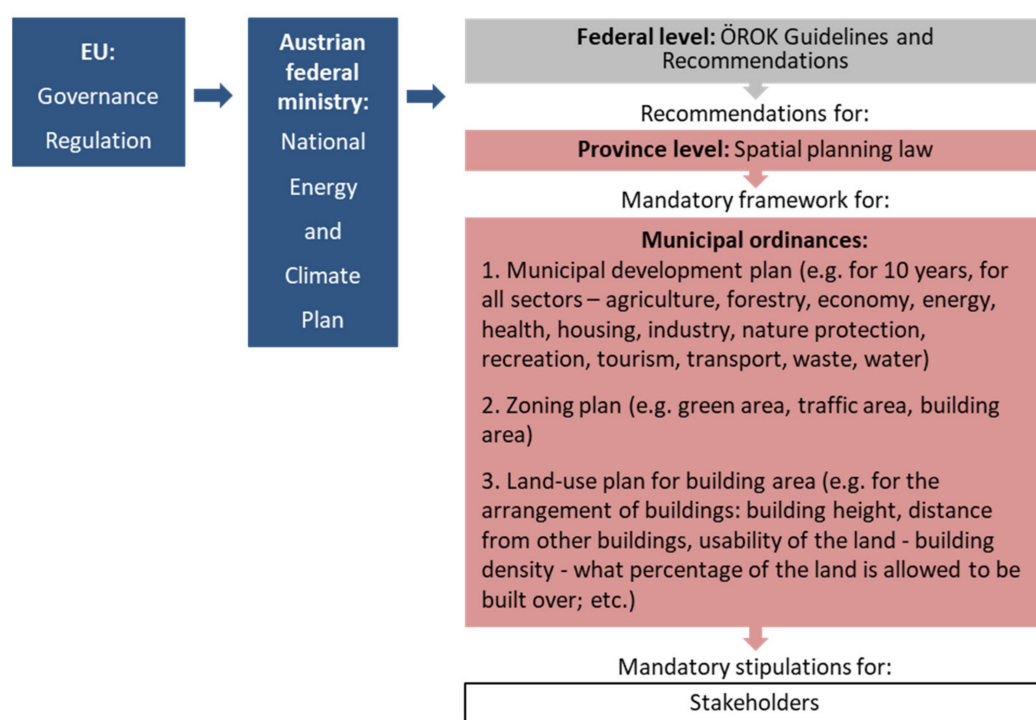


Figure 1. Overview of the Austrian legislative framework for spatial planning and the relation with the NECP and the Governance regulation.

There is great potential for identifying and planning plus-energy neighborhoods by exploiting the energy efficiency potential and renewable energy sources. However, often municipalities do not tap the full potential of the scope and opportunities the legal framework provides due to a lack of professional capacity and lack of staff. To remedy this situation, the province of Styria provided all Styrian municipalities with so-called energy opening balances as support, which were developed by the University of Natural Resources and Applied Life Sciences Vienna on the basis of disaggregated statistical data sets in 2018 [21]. A similar project was started in the province of Lower Austria. In

addition to capacity, the political will to make use of the opportunities provided by the legal framework plays a decisive role, since the municipal development concept, the zoning plan and the land-use planning for building areas are ordinances of the municipality.

2. Materials and Methods

2.1. Studying the Spatial Planning Laws

The spatial planning laws of eight Austrian provinces were examined with regard to provisions that have an influence on the use of renewable energies: Burgenland [22], Carinthia [23], Lower Austria [24], Salzburg [25], Styria [26], Tyrol [27], Upper Austria [28] and Vorarlberg [29]. For this work, the consolidated versions dated 6 July 2021 from the Austrian Legal Information System (Rechtsinformation des Bundes—RIS) were used. The ninth province, Vienna, was left out due to the special legal framework as the Austrian capital and a province at the same time.

It is true that in addition to the spatial planning laws there are many other legal provisions, such as sectoral development plans at regional level and a multitude of substantive legal acts, which are also relevant in this context. In reality, the legal basis for spatial planning in Austria is extremely complex and difficult to delineate [30]. In this paper, however, we focus on the most important ones, namely the laws on regional spatial planning.

In looking at the spatial planning laws, it became clear that there were important differences in terms of structure and content which made it difficult to analyze, compare and discuss the information and to draw meaningful conclusions. Therefore, we defined the following criteria for the analysis of the content, as shown in Table 1.

Table 1. Overview of criteria and sub-criteria for analyzing the provincial spatial planning laws.

Criteria	Sub-Criteria
<ul style="list-style-type: none"> Policy on energy and resources—The specificity of the objectives Accessibility of information generated by planning procedures for third parties Support for municipalities to implement local spatial planning Possibilities of inter-communal cooperation 	<ul style="list-style-type: none"> Legal instruments of spatial planning Period of validity of local plans and review of the needs to revise Private enterprise proceedings Apportionment procedures
<ul style="list-style-type: none"> Overview of municipal spatial planning 	<ul style="list-style-type: none"> General provisions Content
<ul style="list-style-type: none"> Legal instrument: Municipal development plan (all sectors) 	<ul style="list-style-type: none"> General provisions Content
<ul style="list-style-type: none"> Legal instrument: Zoning plan (building area, traffic area, green area) 	<ul style="list-style-type: none"> General provisions Content
<ul style="list-style-type: none"> Legal instrument: Land-use plan of building area 	<ul style="list-style-type: none"> General provisions Mandatory content of land-use plan Voluntary content of land-use plan Voluntary instruments for land-use planning If no land-use plan exists
<ul style="list-style-type: none"> Integrated zoning and land-use planning 	
<ul style="list-style-type: none"> Provisions on renewable energy sources 	<ul style="list-style-type: none"> Wind Solar energy Miscellaneous

The spatial planning laws were analyzed in terms of content, and interesting topics for the transformation process at the municipal level were identified. Relevant texts were extracted, partially shortened and allocated to the topics.

The numbers of paragraphs and sections were kept for making it easy to find the relevant passages in the original version on RIS. The text has been taken over as unchanged as possible. Omissions in a paragraph are marked with [. . .], the omissions of entire paragraphs and sections are not marked but are evident from the context. Additional explanations are marked *Italic*. Please note that the English version does not contain translations of the legal texts.

With reference to Figure 1 it is emphasized that, at the municipal level, there are three legal instruments:

- **Municipal development plan:** It provides a long-term plan for the development of the community and covers all sectors of the economy, including nature protection. The terminology in the provincial laws differs, it is called the spatial development concept, municipal development concept, or municipal spatial development plan.
- **Zoning plan:** It divides the entire municipal area by defining the possible uses for the individual areas by means of dedication and making them visible. There are usually three categories, namely building area, traffic area and green area, such as meadows and pastures, which are then further subdivided. The approved zoning plan forms the basis for the land-use plan.
- **Land-use plan:** It lays down certain rules for the development of building and traffic areas. It can be drawn up for the entire municipal area, individual districts, or neighborhoods.

Municipal regulations must be in line with supra-local legal instruments such as regional energy concepts.

2.2. Tool for Analysis, Comparison and Discussion

To facilitate analysis and discussion, a software tool (transFORMAT-Analyzer, in short, transFORMAT-A) was developed that is described in the next paragraphs. The tool allows the comparative presentation of the regulations on the individual topics listed in Table 1 by province, as illustrated in Figure 2. On the left-hand side, criteria and sub-criteria representing the topics in Table 1 are displayed (sub-criteria partly collapsed), and on the right-hand side an example of a provincial comparison is shown. All criteria and sub-criteria are explained by a short paragraph in English while the legal texts of the provincial comparison are currently available only in German.

The technical basis of transFORMAT-A is a web application (frontend) with a content management system (CMS) in the background respectively on the server (backend). The tool was developed based on the existing open-source solutions explained below.

2.2.1. Frontend

The web application was programmed on the foundation of the TypeScript framework “Angular”. For the user interface the “Angular Material” library was used. The web app behaves dynamically, i.e., the content, which includes the texts, headings and dropdowns of all pages and the menu structure, can be changed via an interface. The interface runs with “GraphQL” via Hypertext Transfer Protocol (HTTP) and creates a connection to the CMS on the server.

The chronological order of events when loading the transFORMAT-A in the browser is as follows:

- (1) The web-app (transFORMAT-A) without content is retrieved from the server.
- (2) The transFORMAT-A establishes a connection via GraphQL to load and update the content from the CMS (Strapi).
- (3) If the content is changed via the administrator-page of the CMS, the content on the transFORMAT-A gets updated automatically.

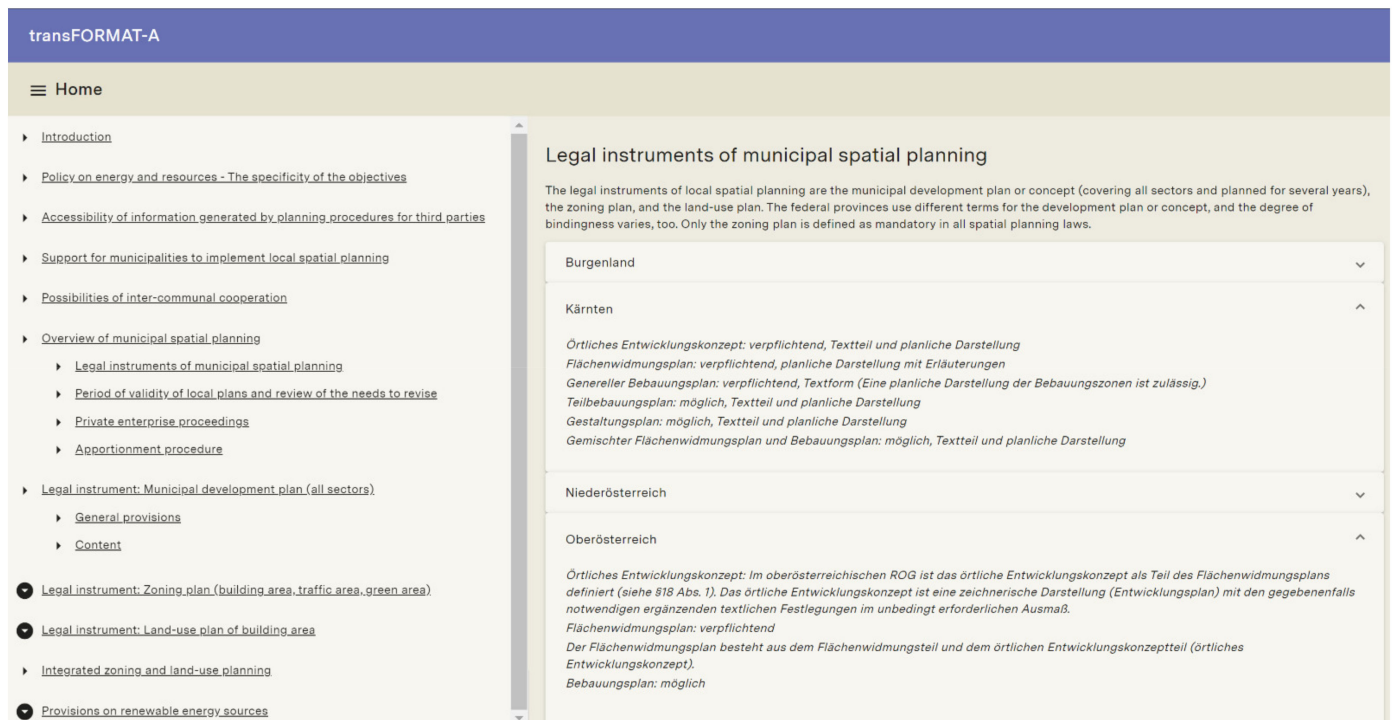


Figure 2. Screenshot of transFORMAT tool, English version. (<https://transformat.sera.global/home>; accessed on 6 July 2021).

2.2.2. Backend

At the server, the open-source CMS “Strapi” runs on a “NodeJS” JavaScript runtime. With the help of “Strapi”, the menu and page entries can be edited, deleted and recreated on an administrator website separate from the web app. More information is available at <https://strapi.io/>, accessed on 6 July 2021.

“Strapi” requires a connection to a database for data storage and management. For this purpose, a local Maria-DB database was created on the server. The server hosts both the web app and the CMS administration page, but over different domains. Since “NodeJS” is not suitable for hosting applications directly on the internet due to security vulnerabilities, a reverse proxy is interposed with “NGINX”, which ultimately makes the web app and the administrator page available on the internet via selected domains.

Figure 3 shows the overview of the main components of transFORMAT-A and the relationship between them.

It is true that for the analysis of eight provinces the development of a software tool would not have been absolutely necessary and may even seem somewhat disproportionate. However, the tool was also developed to provide a basis for discussion with stakeholders; future updates will map the changes in the provincial laws in the relevant criteria and sub-criteria and document the improvements achieved. During development, we have also thought of future extensions, such as comparing the situation in EU Member States or extending the tool to document municipal development concepts.

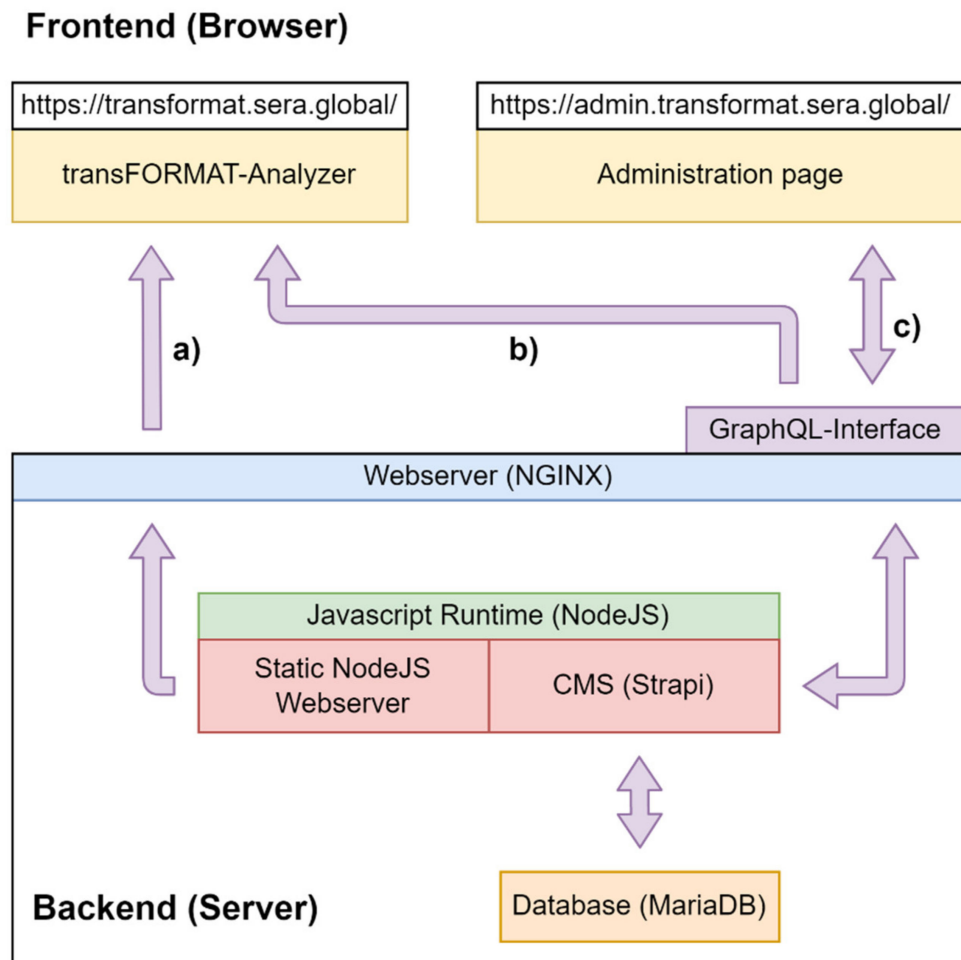


Figure 3. Overview of main components of transFORMAT-A and the relationship between them. (a) One-time retrieval of the transFORMAT-A application without content. (b) Dynamic content updating process. (c) Content change requests.

3. Results

This section consists of three parts. First, a comparative summary of the spatial planning laws is presented by transFORMAT-A criterion, showing the scope of action for municipalities. Secondly, the status quo with regard to the legal instrument of municipal development plans is described in detail because this is considered to be the crucial element for ensuring the link with the NECP and also for providing the basis for investments in renewable energy systems. In the third part, the conclusions drawn are presented.

3.1. Overview of Results by TransFORMAT-A Criterion—Scope of Action of Municipalities

3.1.1. Policy on Energy and Resources—The Specificity of the Objectives

Spatial planning pursues objectives that are partly competing with one another. Therefore, specific objectives are especially important because they facilitate the necessary weighting of interests and, as a result, concrete action planning and monitoring. Clear trade-off mechanisms outlining how to deal with conflicting objectives are essential. Priority should be given to mechanisms for resolving conflicting objectives and, when this is not possible, for balancing competing objectives. Objectives should be weighed against each other in a way that best serves the overall welfare of the population. To achieve this goal, a technically appropriate and transparent method is required.

The use of renewable energy is explicitly addressed in the objectives by six out of eight spatial planning laws. The weighing of conflicting objectives is also addressed, but only in a very general way, which opens a broad range of interpretation. Carinthia, Upper Austria, Salzburg, Tyrol, and Vorarlberg deal with the challenge of weighing in that public interest and the interest of future generations is more important than private property. However, in practice these provisions are not specific enough to help; for example, in weighing climate protection as a result of renewable energy use against protection of biodiversity as a result of excluding wind power plants from a specific area.

3.1.2. Accessibility of Information Generated by Planning Procedures for Third Parties

The easy accessibility of documents relevant for the transformation process of communities towards plus energy balance is important because businesses, such as energy service companies, can use the data for carrying out initial screening with regard to project opportunities in the area of renewable energy installations and deep building renovations. Furthermore, initiatives by committed private individuals are facilitated, for example in the context of renewable energy communities [31]. Easy access to data lowers the hurdle for third-party project development initiatives. The central electronic availability of data and clear rules under which conditions the data may be obtained and used by businesses and civil society for the development of projects is particularly important. However, this is not yet ensured, and the situation is even more difficult as provisions differ a lot among the provinces. There are also access restrictions, for example, regarding intellectual property rights and personal data protection as stated by the province of Carinthia. Only the zoning plan is mandatory in all provinces and in terms of access, the range identified goes from viewing zoning plans in person during office hours (e.g., Upper Austria) to making them available to anyone on the internet (e.g., Tyrol and Vorarlberg).

3.1.3. Support for Municipalities to Implement Local Spatial Planning

The human and financial resources of municipalities are limited. Support services provided by the provinces are therefore important for the transformation process at the municipal level. All spatial planning laws provide advice to the municipalities, more specifically in the form of advisory services by the responsible agency of the provincial administration or financial resources for companies that work together with municipalities to develop the necessary plans. Supra-local programs at the regional level provide guidance and orientation for municipal development plans but can also limit the scope of decision making of the municipality.

3.1.4. Possibilities of Inter-Communal Cooperation

In terms of economic viability, some measures to reduce greenhouse gases can only be optimally planned and implemented if they are considered across municipalities. In this regard, various mechanisms are provided for regional coordination in the spatial planning laws of the federal provinces, ranging from the voluntary coordination between municipalities affected by specific projects (e.g., Upper Austria) to the formal establishment of regional development associations (e.g., Burgenland), to the development program enacted for a specific region in the province (e.g., Lower Austria).

3.1.5. Overview of Municipal Spatial Planning

The local spatial planning of the municipalities is based on public-law instruments and private-sector procedures. Local spatial planning must not conflict with the higher-level planning of the respective province and be in line with the recommendations of ÖROK, representing the federal level. To ensure compliance, municipal plans are submitted for approval to the responsible office of the provincial government.

This section provides an overview regarding the following aspects: legal instruments of municipal spatial planning, period of validity of local plans and review of the needs to revise, private enterprise proceedings, and apportionment procedures.

Legal instruments of municipal spatial planning: The instruments of local spatial planning under public law are a development plan (also called development concept) for the municipality, which is planned for several years, the zoning plan which divides the land basically into a green area, traffic area and building area, and the land-use plan for the building area. The federal provinces use different terms for the municipal development plan, and the degree of bindingness also varies. Only the zoning plan is defined as mandatory in all spatial planning laws. An overview is provided in Table 2.

Table 2. Overview of legal instruments of municipal spatial planning.

Province	Legal Instrument of Municipal Spatial Planning	Mandatory or Possible
Burgenland	Municipal development concept	Mandatory
	Zoning plan	Mandatory
	Land-use plan for building area	Possible
	Regulation of specific requirements	Possible alternative to land-use plan
Carinthia	Municipal development concept	Mandatory
	Zoning plan	Mandatory
	Overall land-use plan for building area	Mandatory
	Specific land-use plan for building area	Possible
Lower Austria	Municipal spatial program (MSP)	Mandatory
	Municipal development concept	Voluntary part of MSP
	Zoning plan	Mandatory
	Land-use plan for building area	Possible
Upper Austria	Zoning plan	Mandatory
	Municipal development concept ¹	Mandatory part of zoning plan
	Land-use plan for building area	Possible
	Spatial development concept	Mandatory
Salzburg	Zoning plan	Mandatory
	Land-use plan for building area	Mandatory (exemptions possible)
	Municipal development concept	Mandatory
	Zoning plan	Mandatory
Styria	Land-use plan for building area	Mandatory (under specific conditions)
	Municipal spatial concept	Mandatory
	Zoning plan	Mandatory
	Land-use plan for building area	Possible
Tyrol	Municipal spatial development plan	Mandatory
	Zoning plan	Mandatory
	Land-use plan for building area	Possible
	Regulation of specific requirements	Possible alternative to land-use plan

¹ The local development concept is a graphic representation (development plan) with any supplementary textual specifications to the extent absolutely necessary.

Period of validity of local plans and review of the needs to revise: The local development concepts, zoning plans and land-use plans can be revised anytime, if there are important reasons. In addition, an active review of local development plans for the need of revision is obligatory after a certain period of time in most federal provinces. Information about these intervals is provided in Table 3.

Private enterprise proceedings: These include contracts, such as land purchase agreements, urban development contracts and mobility contracts. These private law agreements regulate aspects, such as the distribution of the costs for the development of properties with supply and disposal lines or aspects of energy spatial planning.

Apportionment procedures: If existing land is no longer suitable for certain purposes, a reallocation process can be initiated by public authorities or citizens. This is particularly relevant for the design of areas with obsolete, unused building fabric. Such areas should be fundamentally rebuilt or deconstructed to allow for new developments that meet social, environmental and climate needs.

Table 3. Overview of municipal development concepts by province.

Province	Name	Elements	Mandatory or Possible	Planning/Revision Interval
Burgenland	Municipal development concept	Wording of the regulation Text part Development plan	All elements mandatory	10/10 years
Carinthia ¹	Municipal development concept	Text part Plan representation	Both elements mandatory	10/12 years
Lower Austria	Municipal development concept	No elements defined	Voluntary part of municipal spatial program	No interval
Upper Austria	Municipal development concept	Graphic representation Supplementary textual specification	Mandatory Optional	15/15 years
Salzburg	Spatial development concept	Text part (spatial development objectives and measures) Plan representation (development plan)	Mandatory Mandatory	25/10 years
Styria	Municipal development concept	Text part Plan representation (development plan) Textual specifications	Both elements mandatory	15/10 years
Tyrol	Municipal spatial concept	Maps and plans including explanations of plan symbols	Both elements mandatory	10/10 years
Vorarlberg	Municipal spatial development plan	Elements can be defined by regulation		-/10 years

¹ Revised law which enters into force on 1 January 2022.

3.1.6. Legal Instrument: Municipal Development Plan

The municipal development plan is a long-term concept of how the municipality should develop, and it covers all sectors. Thus, it also forms the basis for the zoning plan. The motivation and idea are similar in all federal provinces, but the terminology differs as well as the level of obligation regarding content, the period of validity and the provisions regarding the need for revision. More information is provided in Section 3.2.

3.1.7. Legal Instrument: Zoning Plan (Building Area, Traffic Area, Green Area)

The zoning plan is mandatory in all federal provinces. It divides the municipal area by defining the possible uses for the individual areas and making them visible. There are usually three categories, namely, building land, traffic areas and grassland/open/green land, which are then further subdivided into more specific uses. The provisions of the zoning plan form the basis for the land-use plan affecting mainly the building area. They differ between the provinces, as shown by some typical examples below:

- The Styrian spatial planning law prescribes that the building area is to be subdivided into defined types. Regarding energy supply, those areas to be connected to district heating systems must be visible.
- In Salzburg, there are mandatory official designations in the zoning plan and voluntary ones. For example, voluntary official designations refer to areas with the potential of renewable energy use, and areas which are particularly important due to ecological or other reasons.
- In Upper Austria, there are specific provisions regarding the construction of PV systems and wind power plants in designated building areas, traffic areas and green areas.
- In Lower Austria, adaptation to climate change is explicitly emphasized and must be considered when developing local plans.

3.1.8. Legal Instrument: Land-Use Plan of Building Area

The regulations differ between the provinces, regarding the obligation to enact a land-use plan, and regarding the mandatory and voluntary elements of the land-use plan. The land-use plan can define more precise rules for developments in building and traffic areas. It can be enacted for the entire municipal area, individual districts, or defined neighborhoods. The provincial spatial planning laws define mandatory elements which always apply if a land-use plan is enacted, and voluntary elements which the municipality is free to enact or not. Usually, the obligatory elements of land-use plans are the type of development (free-standing buildings, multi-attached buildings, semi-detached buildings), the usability of the plot (percentage of allowed overbuilt area), and the height of the building. Depending on the province, voluntary elements can be far reaching, such as detailed rules for greening the facades and roofs, or stipulations for improving energy efficiency.

3.1.9. Provisions on Renewable Energy Sources

The use of renewable energy sources depends on the spatial conditions; it is land-bound, and thus often subject to utilization conflicts. This is especially true for free standing renewable energy systems. In such a case, possible uses will be subject to a balancing process, including a weighting procedure that will be applied to come up with a decision for or against investments in renewable energy systems. Thus, clear regulations facilitate the decision-making procedure, and provide a reliable framework for project developers, as well.

Free standing solar systems and wind power plants are regulated by zoning plans. While most of the provincial spatial planning laws address free standing renewable energy systems with rules regarding the designation of green areas in the zoning plan, the law of Upper Austria also contains provisions regarding traffic areas and building areas. In Lower Austria, the spatial planning law stipulates the enactment of a regional program for the construction of wind power plants, in order to identify those areas where municipalities located in the concerned region are allowed to designate wind power zones in their municipal zoning plans. Regarding photovoltaic systems, in Burgenland, priority must be given to building integrated systems and the conditions for approval of free standing systems are clearly specified, e.g., if plants are operated by a Renewable Energy Community according to the recast Renewable Energy Directive (RED II) [3]. In contrast to free standing renewable energy systems, the potential of building-integrated use of solar thermal systems and photovoltaic systems is mainly influenced by provisions of the land-use plan, such as building height, distance, and orientation.

3.2. *Municipal Development Plans and the Implication for Projects with an Actual Impact on the 2030 Targets and Beyond*

Section 1 explains the relation between spatial planning at the provincial level and spatial planning at the municipal level. The provinces can set up their sectoral programs, for example, regarding energy, or more specifically, regarding the utilization of wind power. However, the provinces can only undertake planning that is not in the predominant interest of the individual municipalities because the municipalities are responsible for concrete zoning and land-use planning. Most provincial spatial planning laws, except those of Lower Austria and—to some extent—also Upper Austria, include mandatory provisions for a strategically oriented municipal development plan. In Carinthia, the existing law does not require municipal development plans, but the revised law which enters into force in January 2022, does.

In these plans, municipalities can set their own objectives and spatial development priorities for the next one to two decades. This is crucial regarding long-term developments, such as climate change mitigation and adaptation, but also regarding the municipality's position towards sectoral programs at the provincial level. The terminology differs between the provinces while the meaning is the same: it is called a concept or plan, with a reference

to spatial planning or municipal planning. An overview is provided in Table 3, also showing the planning horizon and the mandatory interval of revision, if any.

With the transFORMAT project, an initiative was made to collect the development plans of the municipalities throughout Austria (except Vienna), to build the basis for aligning the efforts at the municipal level with the targets of the National Energy and Climate Plan. For this purpose, the responsible offices of the provincial governments were contacted with the following results:

- Not all municipalities have a municipal development plan (Lower Austria, Carinthia).
- There is no central collection point of municipal development concepts at the federal province (Vorarlberg, Burgenland, Carinthia).
- The municipal development concepts are not available to the province in digital form (Upper Austria, Tyrol).
- The quantity of data and the effort for electronic transmission is too high (Styria).
- The information transfer of the local development concepts exceeds the competences of the provincial departments. The documents are the property of the municipalities, and the intellectual property rights of the local planners also play a role (Salzburg, Carinthia, Burgenland).

The case of Tyrol is presented in detail as an example. The geographical spatial information system of the province of Tyrol, called *tiris*, offers a large selection of geodata via the Open Data Initiative, which is freely available for any further use. There are various geospatial layers on the development plans of the municipalities. However, the textual definitions (ordinance texts) of the municipal development plans are not available in digitalized form and can therefore not be accessed via *tiris*. The reason is that the individual changes made by the municipalities to the development plans over time would make it very time-consuming to include all of these amendments in the overall documents. However, the complete collection of analogous documents is available at the responsible provincial department. This collection consists of the bound ordinance text for each municipality, which must be submitted as the basis for the initial approval of the development plan (approx. 30 to 50 pages), and all amendments in the form of a loose collection of sheets. The electronic transmission of all relevant and legally binding documents is hardly possible because of the large number of documents available for each municipality, the huge amount of data and the enormous administrative effort caused by such a task.

In addition to such difficulties, some provinces state that this is even beyond the province's competence, as the data is the property of the municipalities and has to be requested directly from them.

In Vorarlberg, the Department of Spatial Planning and Building Law (Dept. VIIa) is currently in the process of collecting the regional and municipal development plans as part of a stocktaking activity. In parallel, clarifications are also being made regarding the publication of the documents in question in terms of compliance with the General Data Protection Regulation. It is the objective to create an overview of the existing plans and to make them available for download via an online platform.

The usual case, however, is still that municipal development concepts can be accessed during office hours at the municipal office. In addition, some municipalities publish their development plans or concepts on their official website, from which they can be retrieved.

As a conclusion, the municipal development plans or concepts represent a long-term plan for the development of the municipality with the obligation or the option for revision under specific conditions. Currently it is hardly possible for an interested third party to find out which municipalities are preparing for revision or in which municipalities a revision would be due. Therefore, it is actually impossible to approach these municipalities to propose a joint action to revise the municipal development plan or concept in order to better comply with the NECP.

3.3. Understanding the Municipalities' Scope of Action and the Implications for Renewable Energy Projects

The analysis with transFORMAT-A shows that the spatial planning laws of the provinces differ substantially in certain points. Sometimes, this is justified and even necessary due to the spatial differences. However, with regard to the use of renewable energy sources and the transformation of neighborhoods towards a plus energy balance, there are differences that cannot be convincingly argued with regional circumstances, whereas a harmonization of provisions would facilitate the link with the NECP planning and reporting level. This concerns two aspects in particular:

- The concrete definition of targets in the area of renewable energy use and resource efficiency, as well as the transparent designation of the balancing mechanism to be used when weighing up competing targets;
- The harmonization of binding requirements for the municipal development plan, for example with regard to minimum content. Those criteria that simplify reporting in the context of the NECP should be anchored accordingly.

With regard to the first aspect, it is important to distinguish between general planning principles and planning objectives. The so-called principles must be taken in any case into account in planning decisions, and they are not at all subject to a weighing procedure. The planning targets, on the other hand, also include conflicting objectives, which means that not all targets can be achieved at the same time and to the same extent. The weighing of conflicting targets is carried out on the basis of the baseline survey and with a view to the interests of the concerned municipality [32]. Concrete targets are important because they facilitate a transparent balancing procedure. In addition to the concreteness of the targets, the transparency and quality of the weighing process itself is a crucial element. In this regard, the lack of information about the applied methods can lead to serious problems with inhabitants due to insufficient transparency and civil society involvement. While there are clear procedures and recognized methods for balancing public and private interests in the Nordic countries [33], procedures in Austria mainly rely on expert opinions, and can be biased due to the way experts are selected.

Regarding the second aspect, it is essential that the requirement of a mandatory medium-term municipal development plan exists, because this has the potential to provide a clear and reliable framework for investments, such as in renewable energy systems and infrastructure in general. The provisions regarding the review and revision of such plans are also crucial because situations may arise that require an adjustment of municipal planning, such as the effects of climate change and, in connection with this, the requirements of the National Energy and Climate Plan. It therefore makes sense to anchor both, a regular and an ad hoc review of municipal development plans in the spatial planning laws of the provinces. These reviews should be used as an opportunity to check the plans for climate change suitability and to adapt them if necessary.

This requires know-how that may not be available in the municipality administration, because usually there is the challenge of staff shortage and lack of professional qualification. Therefore, it should be possible that this knowledge can also be brought in from outside the administration, for example by project developers interested in the development of activities together with the community. However, for this purpose, comprehensive information must be available to third parties. The research carried out within the framework of transFORMAT-A showed that only the zoning plans can be viewed centrally at the province level for all of the Austrian municipalities, while the municipal development plans have to be researched laboriously in the municipalities themselves. The municipal development plans must be approved at the provincial level to ensure that they are compliant with the provincial sectoral plans, and it would therefore be natural to assume that the municipal plans are available in the relevant provincial department. It is also reasonable to assume that relevant information is publicly available due to the provisions of the Open Data Directive (EU) 2019/1024. However, based on our research, we conclude that currently this is not the case throughout Austria.

The situation is especially cumbersome in the province of Lower Austria because the municipal development plan consists of a mandatory zoning plan and a voluntary written plan with targets and measures of how to achieve them, which means that the voluntary part is often not available. This can turn into a serious problem if the sectoral program at the provincial level impacts heavily at the municipal level, for example in the case of installing wind power plants. The provincial sectoral wind power program defines those areas in the province of Lower Austria on a map where municipalities are allowed to make the corresponding provisions in their zoning plans [34]. Municipalities in the designated areas are in the position to decide if they consider wind turbines in their zoning plans or not. In practice, the affected municipalities often agree without a transparent weighing procedure to balance the construction and operation of wind power plants with other important objectives, such as nature protection and maintaining biodiversity. In the north-eastern region of Lower Austria, the Waldviertel, a very well-organized citizens' initiative has formed that is strongly resisting the expansion of wind power in the Waldviertel. The fierce resistance of the population and citizens' initiatives against the construction of new wind power plants and the expansion of existing ones is also based on the aforementioned circumstance that much data and many decisions on the part of the municipality and the provincial government are not publicly accessible. The residents of the affected areas are often not informed in advance and are not involved in the planning of the project. However, access to relevant information should be possible for all citizens at all times and in a low-threshold manner, which is not the case. For example, transfer contracts with wind power operators are not made public, which leads to a mistrust of the authorities by the population [35]. This situation is disadvantageous for the investors as well as for climate policy, as an important contribution to achieving the set goals fails to materialize in the end.

4. Discussion

Municipal development plans are regulated in different ways by the respective provincial spatial laws. The full potential of these plans in terms of achieving the goals of the NECP 2030 and beyond is currently not realized because the minimum content requirements and procedures are not sufficiently aligned with the needs of the NECP. Regarding renewable energy systems, the integration of photovoltaic systems into built structures is less challenging in terms of societal acceptance, while the risk of conflicts is high concerning the construction and operation of free standing systems such as wind power plants due to trade-offs especially regarding objectives related with nature protection and preserving biodiversity. At present, the weighing procedure to deal with conflicting objectives in spatial planning is mainly based on experts' opinions and lacks transparency. Public access to relevant information is unsatisfactory and thus prevents third parties from making solution-oriented contributions for project developments. It is therefore obvious that a solution is needed that will not only benefit renewable energy systems but also other necessary undertakings, such as the conversion of existing built-up areas into plus-energy districts and neighborhoods by means of deep interventions in the building fabric.

The central question is how the existing situation could be improved in terms of a better link between the federal NECP planning and reporting level and the local project implementation level. The existing complexity of spatial planning regulations calls for a streamlining of the provincial and municipal regulations relevant to the NECP which is to be planned and reported at the federal level. Looking at the Federal Constitutional Law that defines the distribution of competences between the federal government and the provinces, it becomes clear that there is no direct legal competence for the matter of spatial planning at the federal level: Article 15 (1) states that *"in so far as a matter is not expressly assigned by the Federal Constitution to the Federation for legislation or also execution, it remains within the provinces autonomous sphere of competence."* Article 118 (3) states that *"a municipality is guaranteed official responsibility in its own sphere of competence for performance of specific matters that are listed in the law, among others the matter of local development planning"* [36]. ÖROK as the coordinating organization at federal level provides only general recommendations

and research and has no mandate to make binding provisions that the provinces must follow [37]. However, Article 15a (1) offers a possible solution, namely that *“the Federation and the provinces may conclude agreements among themselves about matters within their respective sphere of competence.”* This approach to developing a binding guideline for better aligning the NECP with municipal spatial planning is less radical than it might seem at first glance because we already applied a similar policy in the field of building regulations that can serve as a model.

5. Conclusions

The proposed approach to improve the link between the federal planning and reporting level and the local implementation level follows the example of the guidelines issued by the Austrian Institute of Construction Engineering (OIB) with the aim of harmonizing the building regulations, which also falls under the responsibility of the federal provinces. For instance, OIB Guideline 6 is the common basis for all provinces to transpose the Directive 2010/21/EU on the energy performance of buildings to legislation at regional level [38].

The new guideline should include minimum requirements that the municipal development plans must comply with, as these requirements can be stipulated by the provincial spatial planning laws. In addition to defining the mandatory elements of the municipal development plan, this guideline should include a clear and transparent method for trade-off analysis to resolve target conflicts in spatial planning. Clearly, expert opinions will always play an important role in such a process, but more transparency will benefit the quality of overall outcomes. For example, a register of qualified experts could be set up following the example of the Energy Efficiency Directive (EED) [2], and the awarding of contracts could be published in the same register, in order to increase transparency and to reduce the likelihood of grievances due to bias or partiality. Furthermore, it is necessary to be very clear about the availability of information to third parties. In this respect too, the EU policy on energy efficiency in buildings (EPBD) [1] can serve as an example for orientation. In several EU member states, such as Denmark, Spain and Italy, geocoded data from Energy Performance Certificates (EPC), which contain building related information useful for project development, are made publicly available through linking EPC databases with geographic information systems. In Austria, concerns regarding personal data protection have so far prevented the use of such data for exploiting energy efficiency potentials [39]. However, the evolution of the framework at the EU level is clearly moving towards strengthening the role of geographic information systems and interoperable databases, as well as the use of administrative data to facilitate the planning of compliant projects, and to enable the monitoring and evaluation of progress. It is therefore recommended that the results of spatial planning are also available in electronic form and in standardized data formats. Similar to the EPC database, a database would be desirable in which the information is imported via standardized XML interfaces and thus made usable for project development and also verifiable in the course of progress reporting.

For many years, the Austrian Climate and Energy Fund has been promoting activities in municipalities and regions within the framework of the funding programs KEM (Klima- und Energie-Modellregionen—climate energy model regions) [40] and KLAR! (Klimawandel-Anpassungsmodellregionen—climate change adaptation model regions) [41]. After a long time of voluntary measures, a sound enough knowledge base has been created to take a step towards a binding framework and to permanently anchor the necessary adjustments.

The identified room for improvement presented in Section 3.3, namely the concrete definition of targets in the area of renewable energy use and resource efficiency, including the transparent designation of the balancing procedure to tackle conflicting targets, and the development of obligatory requirements for the municipal development plan, is also reflected in parts of the 14th Call for proposals of the Austrian Climate Research Program that will close at the end of January 2022 [42].

We therefore believe that we have taken up this topic at the right time and are looking forward to the exchange and discussions with stakeholders in Austria and other EU Member States in the next phase of the transFORMAT project.

Author Contributions: Conceptualization, methodology, formal analysis, writing—original draft preparation, S.G.; software, A.A.-A.; investigation, D.R. and P.W.; writing—review and editing, P.W. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Information supporting the reported results can be found at <https://transformat.sera.global/home> (accessed on 6 July 2021).

Conflicts of Interest: The authors declare no conflict of interest.

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