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# Strategic Roadmap for Serbia

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## IMPRINT

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IPA PP1 Regional Agency for Socio – Economic Development – Banat Ltd (RS)

# CONTENT

# 1. INTRODUCTION

The project DanuP-2-Gas aims to advance transnational energy planning by promoting generation and storage strategies for renewables in the Danube Region by coupling the electric power and gas sector. The effective realisation of this project depends strongly on the legal and regulatory framework. During the work within the WP3 the legal and regulatory status concerning the construction and operation of hubs for coupling the electricity and gas sector was assessed and existing national barriers have been identified.

These assessments are the basis for the development of country specific strategic roadmaps designed to foster energy storage through specific recommendations on different levels - for adjustments of the legal framework, reduce social, technical barriers as well as giving special insights on the potential of the sector coupling hubs in every country. Further, these roadmaps will be combined to a durable strategy to enhance sector coupling in the Danube Region.

In order to obtain valuable results for the roadmaps from the legal analysis and identified barriers, it is imperative to identify which measures and steps are necessary to achieve the EU and national targets for decarbonization, increasing the share of renewable energies as well as increasing energy security in the region. It must be emphasized that there are some barriers that apply to all countries, however country-specific challenges with corresponding national climate targets will play an important role for the developed roadmaps. The roadmaps will be discussed during national stakeholder workshops and individual expert interviews and additional adjustments, based on the interviews, will be incorporated.

Deliverable 3.2.1 serves as a basis for all the above-mentioned objectives. The aim of this Deliverable is therefore to define the needed actions to promote and deploy the sector-coupling hubs in Serbia.

# 2. METHOD

The objective of this Deliverable is to present the developed country-specific roadmaps, which are developed based on the conducted legal assessment in every involved country and, especially, taking into account the identified barriers. In the development

of the national roadmaps work package the core team met twice to discuss the aims, timeline and needed actions. The roadmaps, which than were developed by the respective project partners were disseminated to the important stakeholders/political/policy representatives in each country and gained feedback was incorporated into the roadmaps.

# 3. GENERAL APPROACH

A roadmap is a strategic plan that describes the steps needed to take to achieve stated outcomes and goals. It clearly outlines links among tasks and priorities for action in the near,
medium and long term. A roadmap also includes metrics and milestones to allow regular tracking of progress towards the roadmap's ultimate goals. The IEA defines a technology roadmap as *"a dynamic set of technical, policy, legal, financial, market and organizational requirements identified by all stakeholders involved in its development."*[1]

The development of the roadmap in the DanuP-2-Gas project relies on the general approach proposed by IEA in "Energy Technology Roadmaps. A guide to development and implementation", see Figure 1.

The results of the analysis of biomass potentials, as well as infrastructural challenges made within the WP 2 are an essential part of the roadmap, showing the existing situation with future scenarios. Evaluated use cases of sector coupling hubs within the WP2, highlighting important findings for potential investors or other interested stakeholders, showing the possibilities and weaknesses of the feasibility of such projects in every country.

[1] Energy Technology Roadmaps. A guide to development and implementation. IEA, 2014 Edition

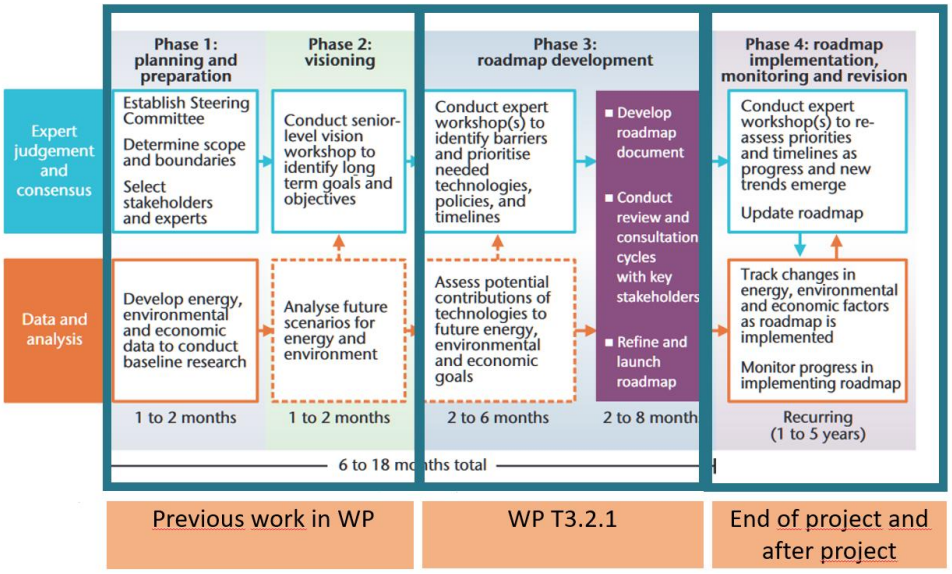


*Figure 1- Roadmap process outline (Adjusted from IEA technology Roadmap Guide, 2014)*

The analysis of the legal framework and identification of existing barriers is the core part of this roadmap. The further development of action items and needed steps to overcome the barriers, which are in line with the specific country goals, shows the step-wise plan to achieve the overall targets and aims of the roadmap.

# 4. THEMATIC SCOPE AND GOAL OF THE ROADMAP

The goal of the roadmap is to support the development towards increased energy security and efficiency in Serbia via storage of surplus renewable energy in the gas-grid and contribute to the EU climate-neutrality by 2050. The roadmap identifies needed actions to overcome existing barriers for wider implementation of sector-coupling hubs within Serbia. The roadmap focuses foremost on adjustments of legal framework, however overall interdisciplinary barriers and challenges are shown and further steps identified.

# 5. SERBIA

## 5.1 NATIONAL (SPECIFIC) GOALS

According to the obligations stemming from the Energy Community Treaty and from the Sofia Declaration on the Green Agenda for the Western Balkans, the Republic of Serbia is preparing the Integrated National Energy and Climate Plan (NECP) from 2021 to 2030 with the vision until 2050 within the IPA project "Further Development of Energy Planning Capacity".

The purpose of the NECP is to set goals for the current decade – to 2030 and create the path for making Serbia climate neutral by 2050.

Government of Serbia presented the preliminary goals for the NECP[2] in July 2022 aiming to cut greenhouse gas emissions by 40.3% and achieve a share of 41% of renewables in gross final energy consumption by 2030.

Provisional 2030 targets include:

- Cut greenhouse gas emissions from 1990 levels by 40.3%
- Reach a 41% share of renewable sources in gross final energy consumption
- Reach a 49.1% share of renewable sources in electricity production
- Reach a 50.9% share of renewable energy sources in heating and cooling
- Reach a 6.1% share of renewable sources in transportation
- Boost energy efficiency to lower primary energy consumption to 14.75 Mtoe
- Boost energy efficiency to lower final energy consumption to 9.528 Mtoe
- Add 1.54 GW in solar power capacity or 100 times more than the current level
- Add 3.51 GW in wind power or ten times more than the currently installed capacity in Serbia.

Within the process of the development of the NECP, alternative scenarios are modeled. Specific transportation targets in all scenarios include the use of electricity, green hydrogen, and bio-LNG in transport, and the target for green hydrogen is set at the level of 1% of the final energy consumption by 2030.

[2] https://mre.gov.rs/dokumenta/strateska-dokumenta/integrisani-nacionalni-energetski-i-klimatski-plan-republike-srbije-za-period-2021-do-2030-sa-vizijom-do-2050-godine

## 5.2 OVERVIEW OF POWER-TO-GAS RELATED ACTIVITIES

So far, no legal and regulatory framework for Power-to-Gas has been developed and no feed-in of hydrogen into the gas network has taken place. Also, the NECP has not yet been adopted. The power-to-gas concept is not specifically recognized as an option in the existing Energy Strategy of Serbia until 2025 or in programs for the implementation of the Energy Strategy until 2025. There are no legal studies for Power-to-Gas available for Serbia.

However, there is an association in Serbia, 'Hydrogen Serbia', which focuses on the application of hydrogen in electricity production. In addition to raising awareness, it aims at applying hydrogen in all spheres of everyday life in Serbia and the region[3].

Furthermore, there is the so-called Hydrogen Storage Initiative Serbia, whose goal is to promote hydrogen storage materials research and to introduce hydrogen and renewables in Serbian energy policy. The Hydrogen Storage Initiative Serbia is also aiming to establish the National Center for Hydrogen Storage Technologies[4].

In July 2022, Hungary and Serbia signed a memorandum of understanding on cooperation in the green hydrogen sector that refers to the production, storage, and transport of hydrogen produced from renewables and cooperation on joint projects.

The draft Hydrogen Strategy of the Republic of Serbia[5] was prepared by a working group called the Hydrogen Team, comprising representatives of the academia, companies, and experts, as a response of the Serbian academic and economic community to the existing energy challenges.

The draft defines several specific objectives: the first is legislation; the second is strengthening human resources and capacities for research and development of new technologies, followed by decarbonization of the energy, transport, industry, and agriculture sectors and hydrogen production in new facilities.

[3] https://www.hydrogen.rs/index.php?page=about&lang=eng.
[4] http://ives.edu.rs/.
[5] https://energijabalkana.net/wp-content/uploads/2022/06/NACRT-VODONICNE-STRATEGIJE-REPUBLIKE-SRBIJE.pdf

The target is to create conditions by 2025 for the start of hydrogen production in several renewable power plants, to use at least one percent of total electricity production in Serbia by 2035 and at least four percent by 2050 to produce green hydrogen.

The draft reads that by 2035, hydrogen should be produced in renewable power plants with a total installed capacity of 100 MW (80 MW in wind farms and 20 MW in solar power plants), to use 270 GWh to generate about 5,100 tons of hydrogen per year.

As announced, the hydrogen strategy will be an integral part of Serbia's new energy development strategy by 2050.

## 5.3 SECTOR-COUPLING POTENTIAL IN SERBIA

For the identification of the potential for sector-coupling hubs for Serbia, it is important to take into account the following: biomass potentials, availability, and suitability of gas and power infrastructure and energy system specification.

The optimization tool, developed during the project was used to evaluate different use cases in Serbia, the results give a robust overview of the techno-economic feasibility of sector-coupling hubs. According to the findings, respective recommendations for potential investors are provided.

### 5.3.1 BIOMASS POTENTIAL

Biomass represents 63% of the total potential from renewable energy sources (RES) in Serbia. Forests cover about 30% of the territory, and about 55% of the territory is arable land. In Serbia, biomass is mostly used in the traditional way, in the form of energy for heating, cooking or heating water. In addition to these uses, biomass has recently been used for pellet production, heat production through combustion in boilers and cogeneration plants for electricity and heat production, and also as a raw material for biofuel production.

Biomass potential is estimated to 3.4 Mtoe per year - 2.3 Mtoe is unused and 1.1 Mtoe is already in use. Agricultural biomass, except in the form of biogas, is not used for cogeneration, and plans for the future are modest.

Regarding biomass availability, Serbia mostly relies on unused agricultural biomass (harvest residues and animal manure), and a smaller portion of woody biomass. Other biomass sources considered are usable animal waste but, in a lower amount than the woody and post-harvest biomass. The available potential of agricultural biomass for energy purposes is estimated to be 1.5 Mtoe[6] per year (see Figure 2 for more details).

Harvest residues from agricultural crop production (estimated to be 1,036 ktoe) are mainly located in the Autonomous Province of Vojvodina (45% of total potential in Serbia). Pruning residues from orchards and vineyards (estimated to be 133.6 ktoe) are currently not collected in an organized manner and therefore are available for energy purposes. The potential for the production of biofuels and bioliquids is estimated to be 142.7 ktoe, while available manure for the production of biogas is estimated to be 176.5 ktoe. The potential of biomass for the production of energy from the food processing industry (dairy production, slaughtering industry, etc.) and biodegradable municipal waste is estimated to be 42.9 ktoe.

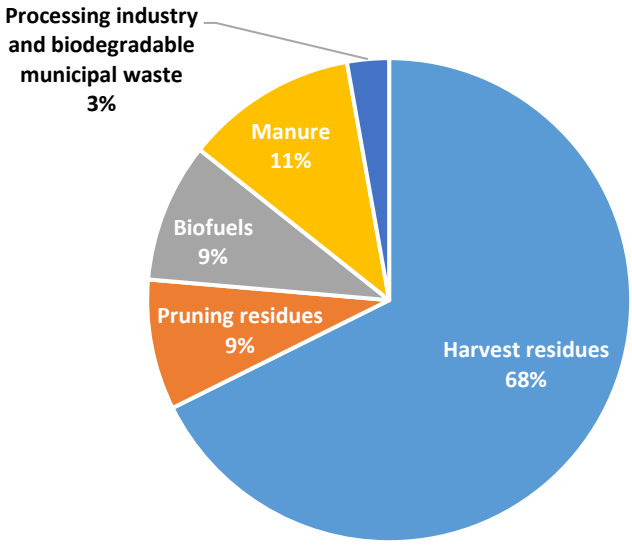


*Figure 2-Available potential of agricultural biomass in Serbia*

[6] Biomass Report (Serbia) – D.T2.1.1, May 2022

### 5.3.2 DESCRIPTION OF THE SERBIAN INFRASTRUCTURE LANDSCAPE

Relevant infrastructure landscape for the P2G sector coupling using bioenergy and surplus renewable energy includes constructed renewable energy power plants, electricity transmission and distribution grid, natural gas transmission and distribution grid, water grid, and transport hubs.

Serbia's industrial sector is heavily dependent on fossil-based energy sources, with coal and gas accounting for 37% of consumption, and electricity (predominantly generated from coal) accounting for another 31% of consumption. The top four industrial sectors by energy consumption are:

1. Non-metallic minerals (20%);
2. Iron and steel (18%);
3. Food and tobacco (16%);
4. Chemicals and petrochemicals (16%).

In terms of energy consumption, iron and steel represents 18% of the total for all industry, while chemicals and petrochemicals (which includes ammonia production and oil refining) represent 16% of total industrial energy consumption. In terms of output, these three sectors represent about 2.8% of Serbia's GDP.

Industrial end-use applications where hydrogen could be most effective or economically advantageous especially compared to low-carbon alternatives are oil refining, ammonia production, and steel making. Large oil companies with a significant market presence in Serbia have few incentives to explore hydrogen and have so far expressed little interest in non-oil-related investments. Serbia has a substantial metal processing sector which could become a contributor to the production of hydrogen technology elements.

In recent years there has been some progress in renewable energy infrastructure installation. However, compared to other countries, Serbia still has much to improve. Despite its beneficial geographical location Serbia has less than 10 MW of installed photovoltaic production capacities. Due to the lower installation costs, there has been some improvement in small photovoltaic installations (residential sector), but not so much on a larger scale. Wind energy has been harvested to a higher extent (397 MW installed capacity), also with some new planned projects. Serbia has also traditionally relied on coal-fired thermal and hydro powerplants, with some of the recent new projects being held due to environmental concerns.

In 2020, the power plants in the Republic of Serbia achieved a total production of 35,540 GWh. Of that, coal-fired thermal power plants produced 68.6%, hydropower plants connected to the transmission system 26.5%, thermal power plants-heating plants 0.5%, wind power plants connected to the transmission system 2.5% while other power plants (small power plants connected to the distribution system ) produced 1,9% of the total electricity produced.

The electricity transmission system is managed by state-owned EMS, including 35 transformer stations (voltage level of 400/x and 220/x) with total installed capacity of 16,585 MVA, 22 transformer stations (400, 220 and 110 kV) and 10,038 km transmission lines.

The electricity distribution system comprises 36,182 transformer stations owned by state-owned Elektrodistribucija Srbije with a total installed capacity of 30,828 MVA and 165,337 km of distribution lines of all voltage levels.

In 2021, gross natural gas consumption amounted to 2,885 million $m^3$, by 15% higher than in 2020. Local production covered only 7.9% of the demand while the remaining gas quantities (92.1%) were provided from import. In 2021, around 83% of the total natural gas quantities were sold to final customers in the open market.

The natural gas transmission systems are operated by three transmission system operators (TSO) - Transportgas Srbija LLC, Yugorosgaz-Transport LLC, Niš and Gastrans LLC, Novi Sad, while distribution system operation are performed by 31 distribution system operators (DSOs).

At the end of 2021, the length of the total natural gas transmission system was 2,478 km in north and central Serbia, 125 km in southeast Serbia, and 402 km gas pipeline from the border with Bulgaria up to the border with Hungary. The length of the distribution network in Serbia in 2021 was 20,831 km.

Currently, there are no plans for injecting biogas into the transmission or distribution gas grid. All production of biogas is used at the production location for electrical and heat power production.

Regarding the water connections i.e. specific points for P2G hubs to connect to the water grid, should be noted that connection points are possible anywhere along the water grid.

In relation to transport hubs, most of the inland transport in Serbia is done by road, and in addition, there are industrial freight train facilities available (road-rail transport hubs), and five river ports (train-road-water hubs).

One of Serbia's largest challenges in developing hydrogen as an energy carrier will be its transition to cleaner electricity production. With Serbia's historical and current reliance on domestic lignite, it is particularly difficult to transition to cleaner electricity production while dealing with the economic, technical, social and political challenges. Retrofitting current coal plants with cleaner alternatives, e.g. with CCS technologies, their conversion to biofuels or the planned phase-out of coal will be difficult and will need to be planned over many years. However, with other countries globally committing to decarbonization, Serbia might not be able to afford a business-as-usual future, especially with the introduction of carbon pricing, carbon trading, and carbon border taxes.

Hydrogen has the potential to reduce Serbia's dependence on coal and reduce GHG emissions, in line with the adopted Green Agenda for the Western Balkans and can also provide increased security of supply by reducing reliance on imports of fuel such as natural gas and oil.

### 5.3.3 USE CASE ANALYSIS

Pre-feasibility studies for Serbia tried to identify optimal locations for sector coupling hubs that store surplus renewable energy in renewable natural gas using biogenic residues and thus reducing strain on the electrical power grid. To this end, the economic feasibility of the P2G hub concept in Serbia is assessed for three locations:

1. HIP Petrohemija Pancevo (petrochemical industry)
2. Solar PV plant Matarova (installed capacity 25 MW)
3. Location in the port area of Novi Sad (greenfield location).

Results of the pre-feasibility analysis pointed out that with existing prices of natural gas it is not economical to engage in biomethane production thus negatively impacting the economic and financial viability of the P2G hub concept implemented in Serbia. Hence, it can be concluded that the implementation of the P2G hub concept in Serbia would require significant financial incentives.

### 5.3.4 EXISTING FUNDING POSSIBILITIES

Financial incentives for the production of renewable hydrogen or renewable natural gas are not available in Serbia. New Law on Utilization of Renewable Energy Sources (OJ RS 40/2021) prescribes that renewable hydrogen can be used in the heating, transport, and natural gas sectors (art.83 para.2 and 3), and envisages the introduction of incentives for production, transport, storage and utilization of renewable hydrogen. However, bylaws of the Law have not been drafted yet, and incentives for renewable hydrogen are still pending.

Within the work on WP4, the following funding possibilities for the construction of P2G hubs are identified:

1. WBIF Investment Grants - WBIF supports infrastructure project preparation activities as well as investments on the local and regional level (two calls for technical assistance and only one call for investment grants per year) with the aim to initiate the process of diversifying the country's energy sources like building, installation and optimization of P2G plant
2. Proof of Concept (PoC) - offers financial and mentoring support to test ideas, hypotheses or assumptions, to prove the technical feasibility of research; PoC instrument provides an opportunity to conduct a P2G pilot project to verify the possibility of a scale-up options
3. Collaborative Grant Scheme Program - designed to incentivize private sector companies and public sector R&D organizations to engage in joint development projects with the goal of creating new products and services, as well as innovative technologies with significant future impact and market potential.

## 5.4 EXISTING BARRIERS

In the following chapter existing barriers and needed actions for the deployment of P2G projects in Serbia are listed. These are based on the findings DT.3.1.2 and barriers identified during stakeholder discussions.

**Legal barriers**

- The appropriate legal and regulatory framework including funding possibilities for the construction of P2G projects is still in development, which hinders the faster deployment.
- It is important that sector coupling technologies, such as P2G, are taken into account accordingly in the respective laws. A legal framework that provides legal certainty and incentives should be further developed. This would promote the implementation of such technologies.

### Socio-technical barriers

- Low awareness of climate change and knowledge of clean technologies e.g. P2G, concentrated knowledge exists in a small group of energy experts and industries.
- Misconceptions surrounding the safety and use of hydrogen.
- Complex and long permission procedures, also because of the insufficient knowledge level of public authorities involved.

### Techno-economic barriers

- Lack of appropriate infrastructure for hydrogen use in mobility and for injection into the gas grid.
- The acceptability of hydrogen to the current users of natural gas requires technical work to understand the technical limits of current appliances for the initial introduction of hydrogen, as well as the design for pure hydrogen use.
- P2G business cases are often non-competitive. However, from the national economy point of view, projects for the generation, distribution and use of green gases as well as the maintenance of existing infrastructure have positive effects on GDP, jobs, import reduction, etc. Therefore, the stronger focus on these positive effects should be used to gain additional/alternative funding, and to increase public acceptance.
- The P2G process is not yet fully technologically mature; there is a need for more demonstration projects. As well as constant market observation and targeted networking with demonstration projects can ensure that we remain technologically "up-to-date". Innovations should be anticipated as soon as possible.

- High production costs of domestic green gas from P2G applications. However, the system service function (being able to create load balancing in the electricity grid and offering seasonal storage options for wind and PV) can be used nationally and thus long-term support can be argued for. This is an important reason to develop P2G projects nationally because, through the import of green hydrogen from abroad, no possibility for nationally necessary system services will be available.

## 5.5 ACTION ITEMS AND RECOMMENDATIONS

Taking into account the identified existing barriers, a variety of action items and needed steps, which should be taken to overcome these gaps and barriers and to achieve the goals of the roadmap, are summarised in this chapter.

### Action items needed to overcome legal barriers

- Finalize the legal and regulatory framework for the construction of P2G projects through the adoption of necessary by-laws and secondary and tertiary regulations.
- Further development of a supportive legal framework for sector-coupling hubs is required to allow investors to understand their cost and revenue basis and to reach a financial investment decision.

### Action items needed to overcome socio-technical barriers

- The community uptake of hydrogen as a 'green' solution to energy delivery will need to be promoted through targeted engagement activities to proactively socialize the benefit of hydrogen to the public.
- Address the safety and use of hydrogen, as well as promote the environmental credentials of hydrogen as a means to decarbonize Serbia's energy system.
- Increase the knowledge level of public authorities through learning from other regions which have already begun the development of hydrogen

industries, and apply best practices for streamlining and simplification of permitting procedures for the construction of P2G projects.

Action items needed to overcome techno-economic barriers

- Support the development of logistical infrastructure to transport the hydrogen from generation to consumption sites through blending hydrogen with natural gas and/or repurposing natural gas pipelines for hydrogen, and provide support for the construction of refueling infrastructure for vehicles.
- Establishment of R&D programs aiming to provide evidence to understand any technical limitations of current users to accept hydrogen and address any technical challenges associated with the hydrogen market.
- Promote a valuable increase in GDP and employment stemming from the development of the hydrogen industry, and the development of strong domestic supply chains to replace import-intensive supply chains for oil and natural gas.
- Develop financing mechanisms and support both fundamental research/innovation and demonstration projects based on a collaborative approach with EU states, and participate in and access early-deployment markets and programs.
- Promote the ability of green hydrogen to match the seasonality of renewable energy generation and provide seasonal flexibility to the power system with high shares of solar and wind, and perform a cost-benefit analysis of different flexibility instruments.

Further action items and recommendations

- The cooperation between investors, governments, and public authorities should be intensified in order to foster the development of new projects.
- Provide long-term signals and commitments in the form of net zero emission targets, to attract private capital needed for scaling up green hydrogen production and use.
- Support development of technical standards and certification schemes compatible with electricity and gas schemes.

- Promote transparency and openness and link public support with requirements for the project data, to allow academia to analyze such data and work toward closing the gaps.

# LIST OF ABBREVIATIONS

| | |
|---|---|
| CCS | Carbon Capture and Storage |
| DSO | Distribution system operator |
| EU | European Union |
| GDP | Gross Domestic Product |
| GHG | Green House Gasses |
| GW | Gigawatt |
| GWh | Gigawatt hour |
| IEA | International Energy Agency |
| km | kilometer |
| ktoe | Kilotons of oil equivalent |
| kV | Kilovolt |
| LLC | Limited Liability Company |
| Mtoe | Million tons of oil equivalent |
| MVA | Mega Volt Ampere |
| MW | Megawatt |
| NECP | National Energy and Climate Plan |
| RES | Renewable Energy Sources |
| WP | Work Package |