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The Drivers and Obstacles of Green Energy Transition in Republic of North Macedonia

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Abstract

Despite many differences, the Western Balkan countries shares a similar problems in terms of environment, policy implications and technology issues. The common denominator of the weak green transition relies on sources of energy production which predominantly depends on fossil fuels.

General trends concerning high green gas emission and other environmental issues followed by weak energy transition is the main challenge of the region in terms of decarbonizing of the energy sector and the economy as whole.

The republic North Macedonia has been in an admirable path to address the noted challenge and to create sustainable infrastructure to reinforce the renewable energy in its overall energy mix, and work in key strategic framework for supporting sustainable economic growth in alignment European Union EU integration.

In this context, the aim of the research paper is to show current situation of energy supply and demand, and to identify obstacles and bottlenecks of green transition associated with risks, policies and projects development in renewable energy fields in the republic North Macedonia.

Keywords: Renewable Energy, Energy Transition, RES Project, Decarbonization of Economy

Introduction

The Republic of North Macedonia with total installed capacity of 2.06 gigawatts energy production from which 63% sources of total production relies on coal, 34% hydro power and only 3% from renewable energy sources is a western Balkan countries that faces a serious problem in green energy transition and decarbonizing of energy sector and the economy (Bankwatch, 2011).

Due to Covid -19 outbreak, energy crisis as well as set of obstacles and barriers in terms of law, RES technology, deficiency of knowhow and green financing instruments, the renewable energy landscape in North Macedonia is lag behind projections and potentials. However, the latest development has been on an admirable path to reinforce the overall role of renewable energy sources in energy mix, and the country recently has approved or is in the process of drafting key strategies to support sustainable economic growth with a focus on energy and climate change in cohesion with European Union (EU) legislation.

The north republic of Macedonia modified the national strategy for energy development (NSED) till to 2040, by offering three possible scenarios for decarbonizing the economy (economy.gov.mk). The national strategies and plans are focused on energy related policies and action plans to accelerate the decarbonizing of energy sector and the economy and set specific targets in renewable energy sources, heating and cooling systems and electrification. The North republic of Macedonia have a huge potential in terms of renewable energy sources. However, there is a significant gap between targeted potentials and actual results. Thus, the main objective of this paper is to provide obstacles of decarbonizing the energy sector and national economy and to identify the main drivers of energy transition based on desktop research and data availability.

The central theme question that will addressed is as follow;

1. What is the main drivers of green energy transition and how to overcome obstacles?

Data Presentation

Total Energy (Demand) Consumption

In terms of energy usage the chart 1 shows primary energy consumption over the years in total energy used in the households and entire economy. The outlook of the country through the year shows volatility in terms of the energy consumption in terms of Terra watt per hour.

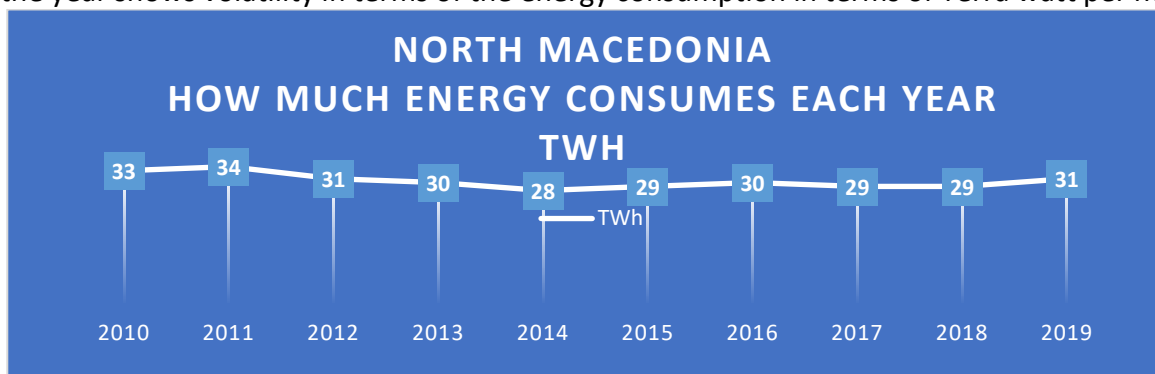


Table 1. Total Energy consumption in North Macedonia

Source: Our world in data <https://ourworldindata.org/energy>

Understanding the breakdown of our energy systems – how much energy we get from coal, oil or gas, how much from solar or wind – is crucial. It allows us to compare energy mixes across the world; track whether we are making progress on decarbonizing our energy systems, and plan and manage demands for natural resources. It is obvious that energy consumption and production from different sources in fact is not so straightforward. These problems arises from different approaches and methodologies applied to primary energy.

Primary energy, is the form that it is first accounted for in a statistical energy balance, before any transformation to secondary or tertiary forms of energy. For example, coal can be converted to synthetic gas, which can be converted to electricity; in this example, coal is primary energy, synthetic gas is secondary energy, and electricity is tertiary energy.

The second chart (table 2) presents the average energy consumption per capita each year. The energy consumed represent the sum of all energy uses including, electricity, heating and cooling, transportation etc.

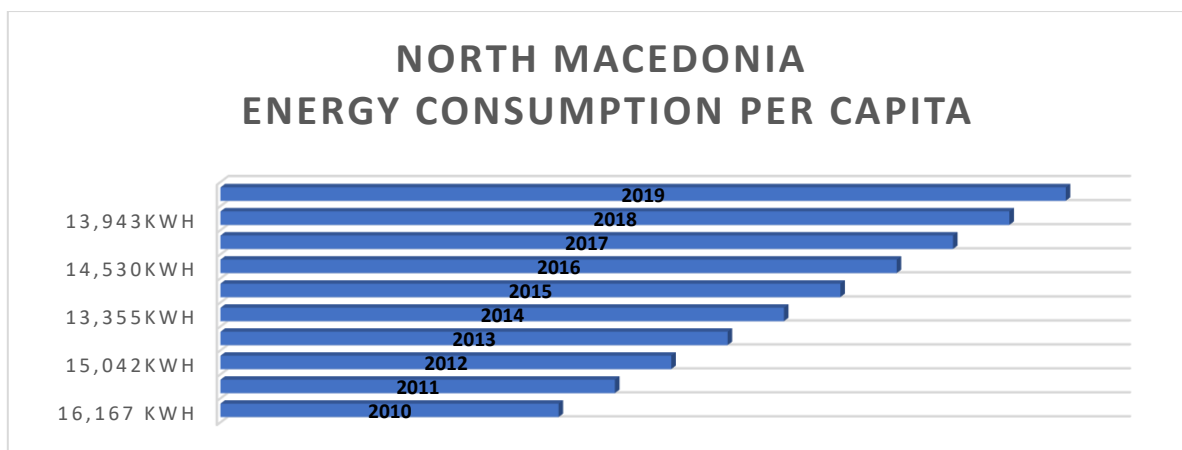


Table 2. Total Energy consumption per capita in North Macedonia
 Source: Our world in data <https://ourworldindata.org/energy>

Energy uses per capita is a significant driver for general energy development strategy and starting point of energy projections. As we can see from table 2 the energy consumption per capita shows none constant growth followed by ups and downs during the last decades. However, the last the last years the growth has been characterized with linear growth.

Like total energy consumption, the amount of electricity a country consumes in total is largely reflected by population size, the average incomes, economic growth and other social and technological parameters of people in the given country.

This interactive chart (table 3) shows the total amount of electricity in the North Macedonia consumes households and the industry in a given year.

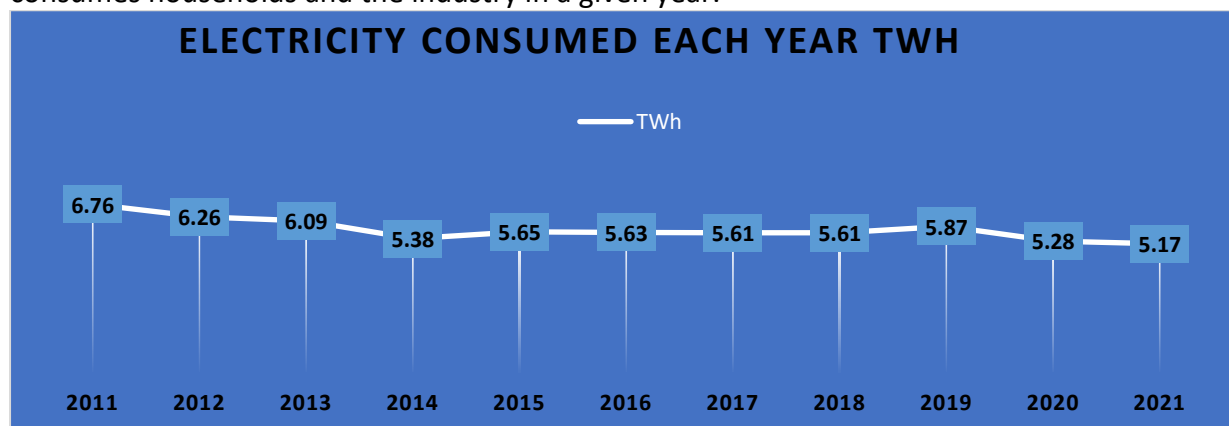


Table 3. Total electricity consumed each year in North Macedonia
 Source: Our world in data <https://ourworldindata.org/energy>

This interactive chart Table 3 (below) shows the annual change in primary energy consumption, given as a percentage of the previous year. The primary of energy used in North republic of Macedonia has changed over the years. This change probably has been driven by advances in technology, energy prices, social pressure, shifting to more green and friendly environment as well as energy efficiency.

The only constant is that the amount of energy used shows volatile growth over period of times.

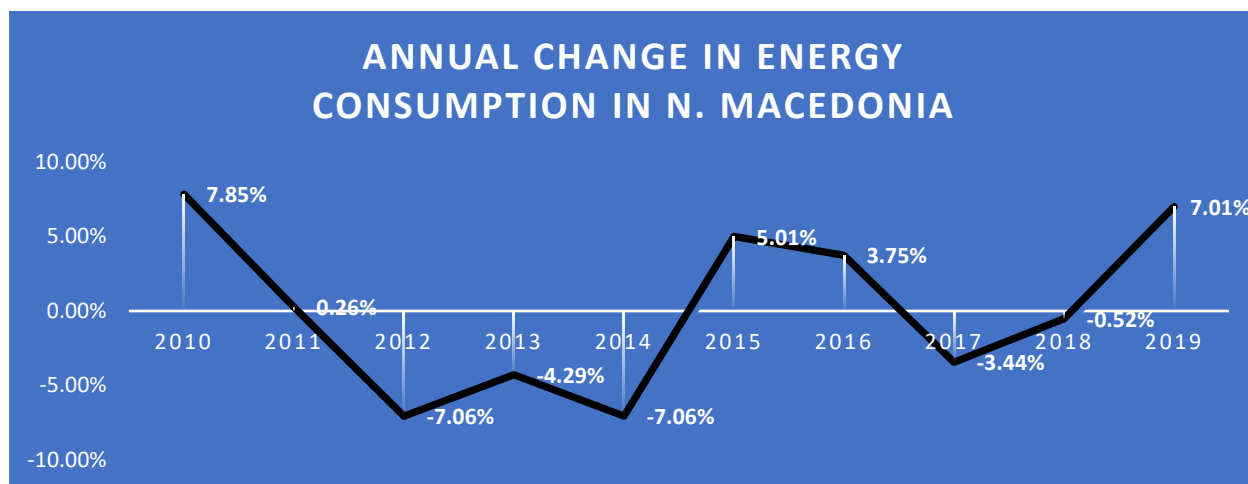


Table 4. Annual change in energy consumption in North Macedonia
 Source: Our world in data <https://ourworldindata.org/energy>

Energy (supply) Production in North Macedonia

Energy supply is one of the main driver of the economic growth and household’s welfare. Where do countries get their energy from – coal, oil, gas, hydro or renewable energy sources it is highly important in designing and implementing the national energy policies and national strategy for mid and long term economic development?

The energy mix – the balance of sources of energy in the supply – is becoming increasingly important as countries try to shift away from fossil fuels towards low-carbon sources of energy (renewables including hydropower, solar and wind). Electricity is just one component of total energy consumption – the other two being transport and heating& cooling according to energy in data.

These interactive charts show the energy mix by sources in north Macedonia.

One is presented as a stacked area chart – allowing us to see a full breakdown of the sources of energy in the supply. The line chart shows the percentage of total energy supplied by each source.

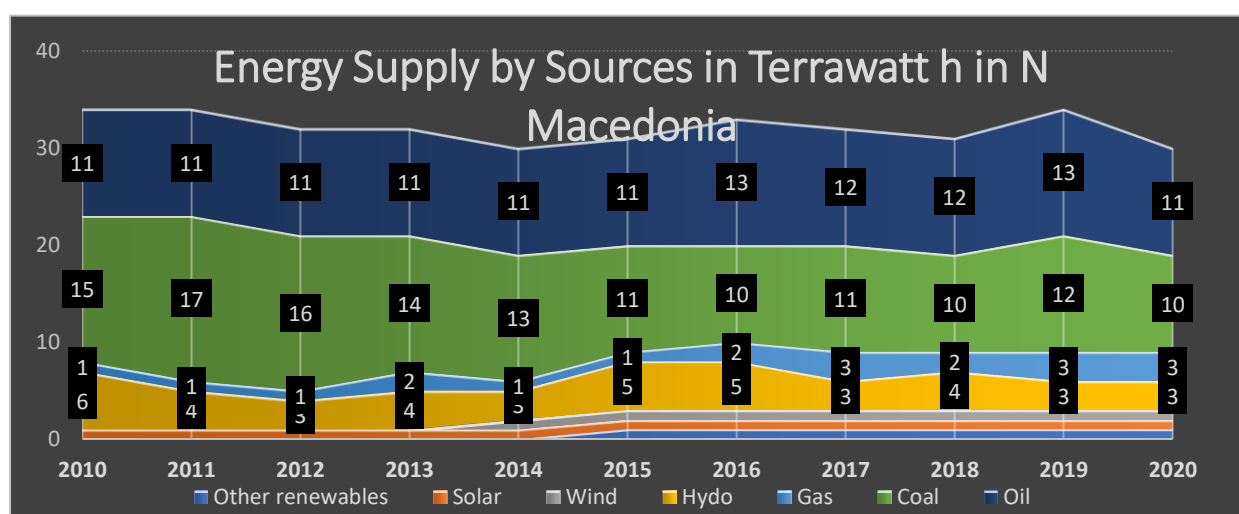


Table 5. Energy supply by sources in North Macedonia
 Source: Our world in data <https://ourworldindata.org/energy>

As we can see from the chart the North Macedonia predominantly the energy supply is rely on fossil fuels. The percentages of low carbon sources of energy is still low, despite the fact of climate action and the technical potentials of the country the actual results is in disfavor of green energy transition.

Electricity production by sources in North Macedonia

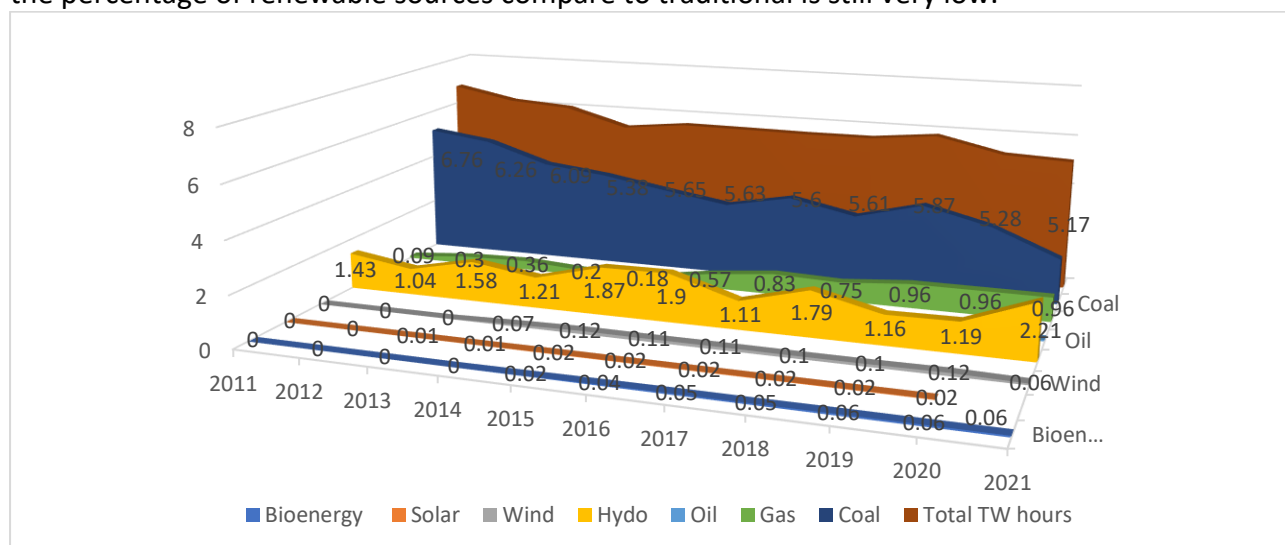
Electricity production in North Macedonia is largely based on the exploitation of oil, coal and natural gas, with the remainder coming from hydropower. In addition to hydropower, the RES industry is slowly expanding in the field of solar energy. In 2019, 5.5 MWs of solar PV were added. While the wind farm with total installed capacity of 37 MW was put into the operation few years ago.

Table 6

Electricity production by sources in North Macedonia Source: IRENA

| Year | Bioenergy | Solar | Wind | Hydro | Oil | Gas | Coal | Total TW hours |
|------|-----------|-------|------|-------|------|------|------|----------------|
| 2011 | 0 | 0 | 0 | 1.43 | 0.07 | 0.09 | 5.17 | 6.76 |
| 2012 | 0 | 0 | 0 | 1.04 | 0.09 | 0.3 | 4.83 | 6.26 |
| 2013 | 0 | 0.01 | 0 | 1.58 | 0.11 | 0.36 | 4.03 | 6.09 |
| 2014 | 0 | 0.01 | 0.07 | 1.21 | 0.15 | 0.2 | 3.74 | 5.38 |
| 2015 | 0.02 | 0.02 | 0.12 | 1.87 | 0.14 | 0.18 | 3.3 | 5.65 |
| 2016 | 0.04 | 0.02 | 0.11 | 1.9 | 0.1 | 0.57 | 2.89 | 5.63 |
| 2017 | 0.05 | 0.02 | 0.11 | 1.11 | 0.09 | 0.83 | 3.39 | 5.6 |
| 2018 | 0.05 | 0.02 | 0.1 | 1.79 | 0.05 | 0.75 | 2.85 | 5.61 |
| 2019 | 0.06 | 0.02 | 0.1 | 1.16 | 0.06 | 0.96 | 3.51 | 5.87 |
| 2020 | 0.06 | 0.02 | 0.12 | 1.19 | 0.06 | 0.96 | 2.87 | 5.28 |
| 2021 | 0.06 | 0.02 | 0.06 | 2.21 | 0.06 | 0.96 | 1.8 | 5.17 |

As we can see from table 6, the electricity production is over dominated by fossil fuels, while the percentage of renewable sources compare to traditional is still very low.



Renewable energy in North Macedonia

The North Macedonian 2030 goal for the share of renewable energy in final energy consumption in the electricity sector is 66%; in the heating and cooling sector it is 45%; and in the transport sector it is defined as 10% (data from energy transition strategy).

As a result of significant renewable energy sources potential, renewable energy sector is considered as a critical factor in decarbonizing the economies and a capable method in building sustainable and resilient economy, which in result would offer attested and affordable energy to spur the higher economic growth and significantly reduces the fossil fuel import dependence and environmental degradation

The total energy produced by renewable sources (including Hydro) in 2020 has been reached to 42.8 percent of total produced capacity. The data in table shows that the investment in renewable energy sources must be accelerated especially to solar and wind power sources where the actual investments are lack behind the technical potential of North Macedonia and the percentage produces is insignificant in total energy production.

Table

Source IRENA

| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|-------------------|------|------|------|------|------|------|------|------|------|------|
| % of RES in Total | 33.9 | 35.1 | 36 | 38.8 | 40 | 39.5 | 39.8 | 40.1 | 40.5 | 42.8 |

Table

Source IRENA

| Installed Capacity MW | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|-----------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Hydropower | 556 | 595 | 617 | 630 | 658 | 661 | 671 | 674 | 678 | 686 |
| Wind Energy | | | | 37 | 37 | 37 | 37 | 37 | 37 | 37 |
| Solar Energy | 2 | 4 | 7 | 15 | 17 | 17 | 17 | 21 | 26 | 94 |
| Bioenergy | | | | | 4 | 5 | 7 | 8 | 10 | 10 |
| Total | 558 | 599 | 624 | 682 | 716 | 720 | 731 | 740 | 751 | 827 |

The renewable Installed power capacity data represents the maximum net generating capacity of power plants and other installations that use renewable energy sources to produce electricity.

Carbon Emission Intensity

The *carbon intensity* of electricity is a measure of how much CO₂ emissions are produced per kilowatt hour of electricity consumed. Energy is a larger contributor to CO₂- the burning of fossil fuels accounts for around three – quarters of global greenhouse gas emission. So, reducing energy consumption can inevitably help to reduce emissions. However, some energy consumption is essential to human wellbeing and rising living standards.

Energy intensity can therefore be a useful metric to monitor. Energy intensity measures the amount of energy consumed per unit of gross domestic product. It effectively measures how efficiently a country uses energy to produce a given amount of economic output. A lower energy intensity means it needs less energy per unit of GDP(our data).

The research, published in Nature Energy, measures the full lifecycle greenhouse gas emissions of a range of sources of electricity out to 2050. It shows that the carbon footprint of solar, wind and other renewable energy sources are many times lower than coal or gas with carbon capture and storage (CCS). This remains true after accounting for emissions during manufacture, construction and fuel supply (carbon-footprints)

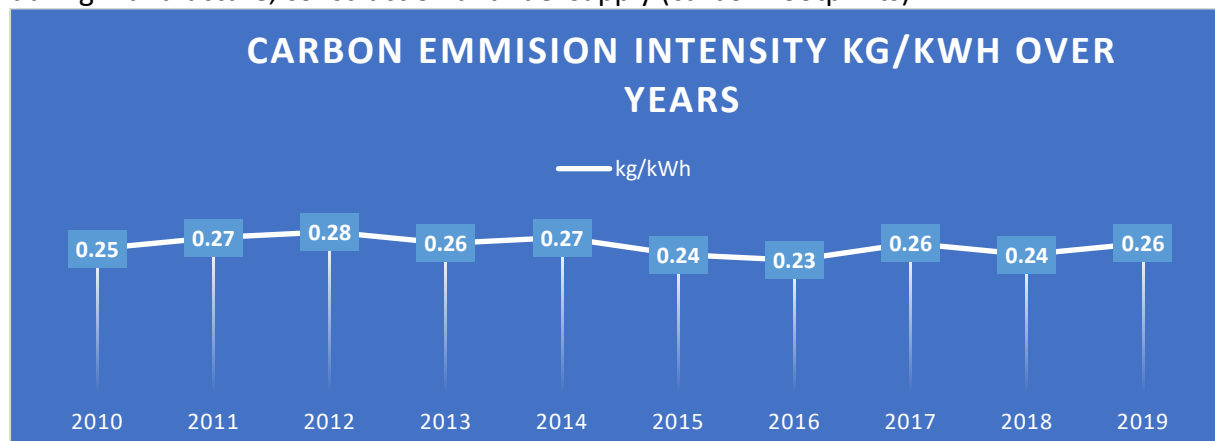


Chart – Carbon emission

As we can see from the chart the carbon emission intensity in North Macedonia measured follows close relationship between the amounts of CO₂ emitted per unit of energy. This metrics is key for the Macedonian economies in order to accelerate and find a solution for green transition strategy. This transition in can be reached only by using less energy or using lower carbon energy. As we transition our energy mix towards lower carbon sources, the amount of carbon we emit per unit of energy should fall.

If no more coal is utilized to produce electricity, in the case of Macedonia it would mean that on average 7 million tons of coal will not be combusted on an annual basis. In summary, REK Bitola and TPP Oslomej contribute to environmental pollution by the following: i) Over 6.3 million tones CO₂ each year ii) Over 85 000 tones SO₂ iii) Over 15 600 tones dust released in the air. Although these figures are small compared with the emission of harmful substances by industrialized countries, they are very large for our local and immediate environment.

Strategies, plans and commitments to decarbonize the economy in North Macedonia

North Macedonia has initiated an ambitious decarbonization pathway that forms a solid basis for attracting renewable energy investments in the country. To date, such efforts have focused on renewable energy for power with some attention given to heating and cooling in the most recent strategy and plans.

Energy trends are emphasizing more ambitious transition towards low-carbon economy, with renewable energy sources (RES), energy efficiency (EE) and greenhouse gas (GHG) emissions among the most important enablers of transition.

The strategies, plans and commitments are outlined in key documents, which are detailed in this section. As of August 2021, the documents include climate commitments in the NDCs, the NSED, the NECP, and the Renewable Energy Action Plan for the Republic of North Macedonia until 2025 with vision until 2030, and the Long-Term Strategy and Law on Climate Action until 2050.

North Macedonia has developed a strong policy framework, capable of attracting renewable energy finance, especially in the power sector which can extend to the electrification of heating and cooling. The country's strategies and plans are based on an already existing legal framework for renewable energy, which continues to develop with the renewable energy

reforms. The 2018 Energy Law and its accompanying decree, decision and program on renewable energy are the basis of this framework.

The Energy Law was adopted in May 2018 and it harmonizes the existing energy legislation of North Macedonia with the EU Third Energy Package,

In the power sector, the law regulates the provision for two types of supportive measures for renewable-based electricity generation: a feed-in tariff (FiT) that is administratively set and the feed-in premium (FiP) that is offered following competition (i.e. auction) to selected power producers. The FiP may be used as an alternative to the FiT. These are the main innovations introduced by the recent legislative changes.

| | Reference scenario | Moderate scenario | Transition | Green scenario |
|------------------------------------|--|--|------------|---|
| Vision | Transition from conventional energy based on current policy and least-cost principles | Progressive transition from conventional energy based on new policy and least cost principal | | Radical transition from conventional energy based on new policy and lignite |
| Demand drivers | <ul style="list-style-type: none"> •Macedonian GDP growth to reach neighboring EU countries' GDP per capita levels of today by 2040 • Current energy efficiency policies • Penetration of EVs | <ul style="list-style-type: none"> • Same GDP growth as for reference • Energy efficiency based on enhanced policy (in line with EU Directives / EnC guidelines) • Highest penetration of Evs | | <ul style="list-style-type: none"> • Same GDP growth as for reference • Same as moderate transition but more incentives and advanced technologies • Highest penetration of EVS |
| Generation Investment focus | <ul style="list-style-type: none"> • Lignite PP revitalization choice based on least cost principles • High focus on RES investments | <ul style="list-style-type: none"> • Lignite PP revitalization choice based on least cost principles • Further focus on RES investments | | <ul style="list-style-type: none"> • Lignite PP revitalization choice based on least cost principles • Further focus on RES investments |
| ETC Entrance | 2027 | 2025 | | 2023 |
| Commodity prices | Based on Current Policy Scen | Based on New Policy Scenario | | Based on Sustainable Development Scenario |
| Fuel supply/availability | <ul style="list-style-type: none"> • Lignite production capped at a maximum level of annual supply expected (~ 5 Mt 2018-2035, ~ 3 Mt 2035-2040) | | | |

| |
|---|
| <ul style="list-style-type: none"> • Hydropower production and wind/solar in line with historical trends and adjusted for new entering power plants • Cross-border capacities (electricity and gas) evolution in line with the ENTSO-E, ENTSO-G and EnC • Sustainable consumption of biomass • Battery storage (EVs and pump storage) |
|---|

Table Energy Transition in North Macedonia

The Law on Energy Efficiency was passed in February 2020 with the relevant by-laws. The law drives adoption of RES in buildings and hence provides a legal basis to fulfil future efforts to electrify the heating and cooling sectors. The law covers end-to-end energy supply, transmission and distribution of energy. The scope of the law entails regulations for buildings to increase their energy codes. Finally, the law targets large energy users, including the public sector, traders and providers of energy services.

The law climate action will introduce obligations for the development of a long-term strategy on climate action and the needed institutionalization of the national GHG emissions inventory system. It is expected to be adopted by the end of 2021.

Decarbonization of the Energy Sector on North Macedonia

The most important problems that energy sector faces in Macedonia are unfavorable energy mix with high prevalence of domestic lignite, which is characterized by a low energy value; strong dependence on energy import; high dependence on imported energy fuels (50%); poor condition of the energy systems and high degree of inefficiency in energy production and use. The above-mentioned problems are burdened by the need for electrical power imports for the entities that purchase the electricity on the free trade.

Macedonia has sufficient renewable energy resources at its disposal to fully meet the needs for electricity generation without utilization of fossil fuels. Accomplishing the goal to guarantee the production of electricity from its own domestic (renewable) energy sources, to stop imports of electricity and energy for production and to improve the living environment of citizens. However, is not an easy and simple task. The obstacles that need to be overcome in making this goal come true are of different nature;

Above all, they are of:

1. Political.
2. Financial.
3. Technical.

The main technical barrier in greater utilization of RES in the power system comes from its stochastic manner of production. One cannot plan the production in advance and there have to be standby electricity producers whose production is not dependent on climate conditions. The gains from the utilization of the renewable resources offer dual purpose solution i.e. to enable economic growth as well as to decarbonize the economy across the world.

Risks and obstacles of renewable energy transition in North Macedonia

A number of obstacles exist to developing North Macedonia's renewable energy potential. Financing of renewable energy projects is challenging due to both the high cost of capital, resulting from investors' perception of risk, and existing market barriers.

Comprehensively, barriers to renewable energy investment typically pertain to three main areas: i) project start-up and development; ii) investment risk management; and iii) scaling up of investment as detailed in Figure 8.

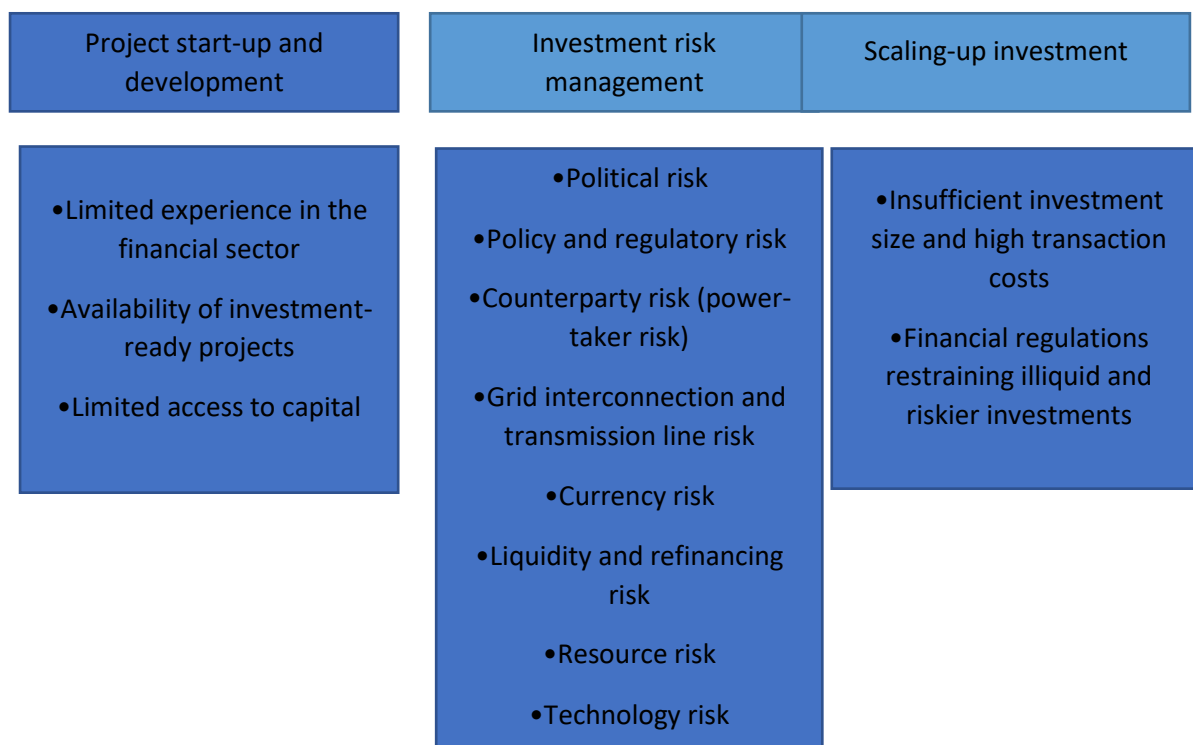


Figure Types of investment constraints in renewable energy

Source: IRENA 2016

Contribution

This study has required to review the possibilities for introducing a lower carbon supply in Macedonia's and how to accelerate the energy transition with concrete scenarios. This research paper also points out the possibility of developing a much wider risk tools to overcome the obstacles in energy transition and decarbonization of the economy.

In this context, the main contribution of the research paper is to show current situation of energy supply and demand, and to identify obstacles and bottlenecks of green transition associated with risks, policies and projects development in renewable energy fields in the republic North Macedonia. There are significant opportunities for renewable energy investment in Macedonia, beyond and above the recommendations offered by official documents. These opportunities could help reduce or completely eliminate the need to expand the country's coal generating capacity;

Conclusions

The rising dependency on energy imports, increase of greenhouse gas emissions, energy security and energy prices. These are some of the problems that faces most of the countries with weak green energy transition strategy. One of the most promising ways for reducing

dependency on energy imports relies on diversification of energy resources. Hence, the common goal of the European Union is to increase the share of RES in the final energy consumption and compliance with Paris agreement and COP 26 to stop climate change and maintain the rise of the average global temperature below 2 degrees Celsius.

As one of the signatories of the agreements, Macedonia faces many challenges but also threats in terms of the obligations and compliances. The results of analyses show that 100% renewable energy system by 2050 in Macedonia is possible. Macedonia also has sufficient renewable energy sources at its disposal to fully meet the needs for electricity generation without utilization of fossil fuels. In order to achieve these forecasts, Macedonia has to construct all hydropower plants as projected in the Strategy for Development of the Energy Sector until 2035. The same applies to the other power plants related to the RES sector. However, a lot of obstacle and risks remains in RES landscapes and decarbonizing of energy sector and national economy.

The conclusion is that there will be manageable. The expected gains are huge and we shouldn't miss the possibility of moving toward 100 % renewable energy system by 2050

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