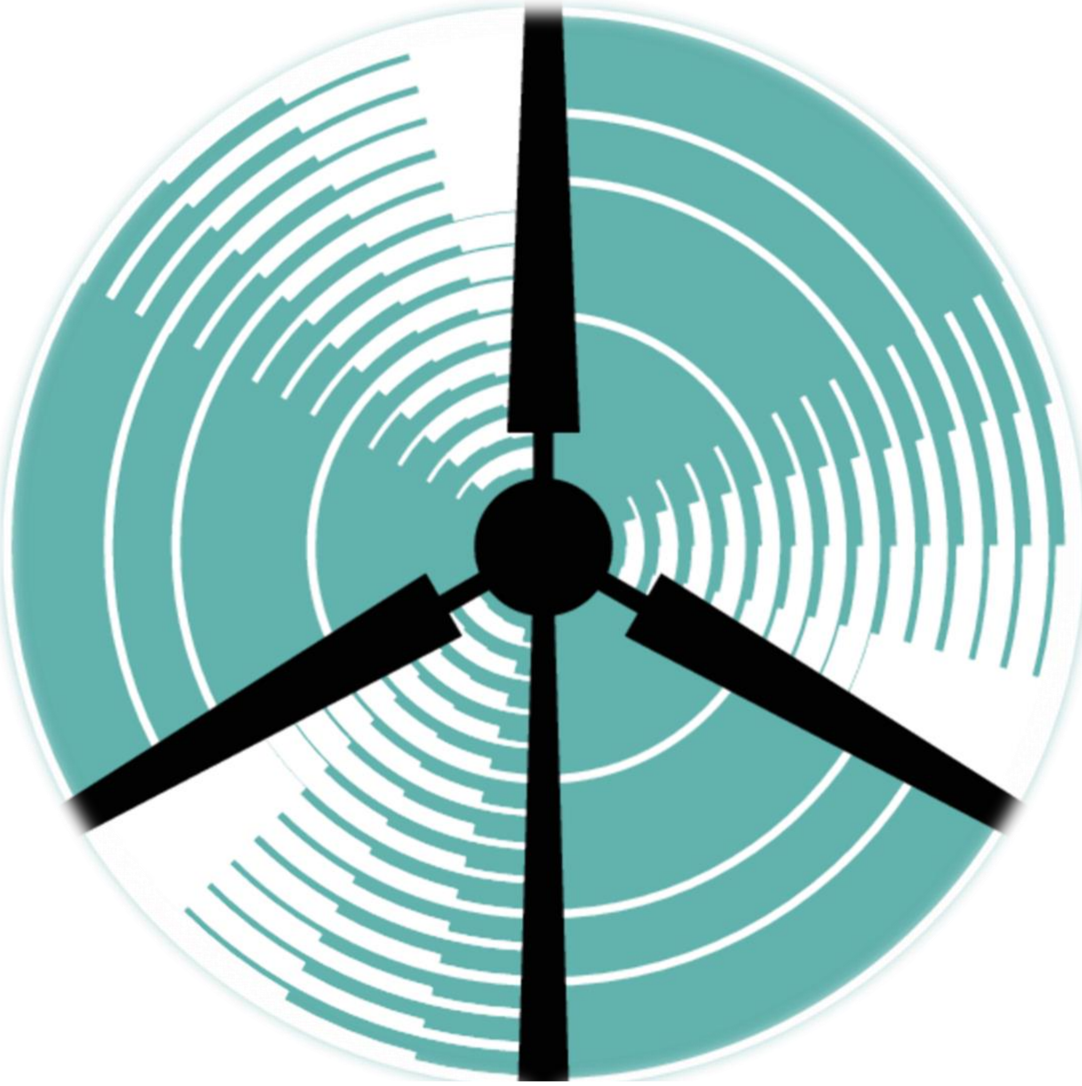


Renewable energy in Romania: Potential for development by 2030

March 2019

Contents

List of tables and figures

List of acronyms

ACER	Agency for the Cooperation of Energy Regulators
	Barrels of oil equivalent
Boe	
BOP	Balance of payments
CAGR	Compounded Annual Growth Rate
CAPEX	Capital expenditure
CAS	Social insurance contributions
CASS	Social health insurance contributions
EC	European Commission
CfD	Contracts for difference
DSO	Distribution system operator
ECC	European Commodity Clearing
	European Energy Exchange
EEA	European Energy Agency
EEX	European Network of Transmission System Operators for
ENTSO-E	Electricity
	Energy Service Company
ESCO	
EUR	Euro
GHG	Greenhouse gases
GW	Gigawatt
GD	Government Decision
IRENA	International Renewable Energy Agency
	High voltage
HV	Low voltage
LV	
Km	Kilometer
LCOE	Levelized cost of energy
M beo	Millions of barrels of oil equivalent
Cbm	Cubic meters
Bn cbm	Billions of cubic meters
M	Millions
Bn	Billions
MMBTU	Million British Thermal Units
	Medium voltage
MV	Megawatt
MW	
MWh	Megawatt-hour
NECP	National Energy and Climate Plans
OPEX	Operating expenditure
BM	Balancing Market
IM	Intraday Market
GDP	Gross Domestic Product
PPA	Power Purchase Agreement
	Romanian Wind Energy Association
RWEA	Particulate matter 10 micrometers or less in diameter

	National Integrated Energy and Climate Change Plan
PM10	Day-Ahead Market
	Renewable energy sources
NIECCP	
DAM	
RES	
Toe	Tons of oil equivalent
VAT	Value-Added Tax
EU	European Union
USD	United States Dollars
VPP	Virtual Power Plant
xEV	Electric vehicle, including all types of vehicles powered by electric power (including hybrid electric vehicles)

Summary

Objectives and general considerations

In line with *Romania's 2013 – 2020 National Climate Change Strategy*, "as part of the fight against climate change currently considered by international expert bodies as a potentially irreversible threat to society and our planet, the measures to reduce greenhouse gas emissions (...) are a core element of the national climate change policy".

The same document indicates that "studies have shown that, in order to prevent the irreversible effects caused by climate change, global emissions must be reduced by approximately 50% by 2050 compared to the levels in 1990".

According to the last inventory of greenhouse gas emissions (GHG) carried out in Romania (in 2014), emissions in the energy sector accounted for approximately 70% of total GHG emissions at national level.

Alongside energy efficiency measures, renewable energy sources appear to be the most sustainable medium- and long-term alternative solution in respect of the reduction of GHG emissions and other air pollutants (SO_2, NO_X, etc.).

Romania is one the EU Member States with the highest natural potential in terms of renewable energy sources. Given Romania's balanced energy mix and technological developments in the field of renewable energy sources, a careful examination of how to use this renewable energy potential is justified. Moreover, this report refers to the advantages that the investments in this field would bring to the Romanian economy as a whole.

This study has been carried out independently by Deloitte, with major efforts and subject to the limits of the available expertise, and aims at considering feasible scenarios concerning the evolution of the share of renewable energy in 2030 and economic benefits associated with the large-scale development of renewable energy in Romania. In this context, the objectives of the study are:

- ✓ Preparing scenarios concerning the development of renewable energy in 2030, which include the share of renewable energy in the final energy consumption, the price of electricity and the estimation of the necessary investments;
- ✓ Examining and analyzing the potential propagation effects which would lead to additional development of the economy as a whole;

- ✓ Supplying an objective tool based on concrete data to support, with rational arguments, possible discussions or debates by various decision-makers concerning the potential of renewable energy for development by 2030

The report refers to the period between 2020/2021[1] and 2030. The development scenarios, the impact and the benefits estimated in the report are based on the existing facts at the time when this document has been prepared.

Input data have been collected from public sources, from the information and data of Deloitte, as well as further to discussions with experts in the field. Forecasts have been compiled based on historical data and on our assumptions concerning the evolution of the Romanian energy sector.

The contents, analyses and conclusions of this report do not necessarily reflect the individual opinions of the participating experts. A wide range of opinions and points of view have been expressed and they have made it possible for the essential issues considered by the study to be examined in a more thorough and objective manner.

Main results

The potential of the weight of renewable energy sources and particularly wind energy in Romania's energy consumption has been determined based on a calculation methodology that has indicated four possible potential scenarios by 2030.

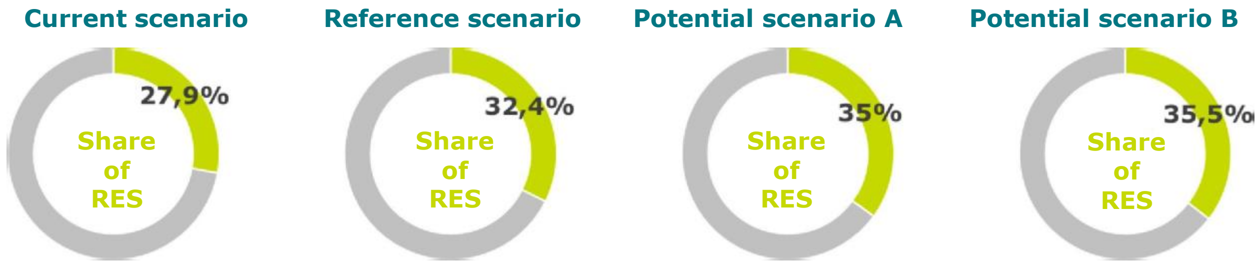
One scenario considers the same current global weight of energy from renewable sources - 27.9% - in the gross final consumption by 2030[2]. Other three scenarios have considered the testing of the feasibility of increase in the share of renewable energy to 32.4%, 35% and 35.5%, respectively, depending mainly on the evolution of the other production capacities.

The scenarios have been named as follows:

Current scenario – 27.9% in 2030;
Reference scenario – 32.4% in 2030;
Potential scenario A – 35% in 2030;
Potential scenario B – 35.5% in 2030.

[1] The start year varies, as appropriate, depending on the source and type of data. For example, the information in the National Integrated Energy and Climate Change Plan (NIECCP) covers the period 2021-2030.
[2] It represents the scenario presented in 2021 – 2030 NIECCP.

Figure 1 – Share of RES in the wind energy development scenarios, 2030, [%]



Source: Deloitte calculations

For each of the 3 scenarios selected for analysis, the evolution of the share of renewable energy has been monitored for the period 2020/2021 – 2030, with focus on interim targets 2023, 2025 and 2027.

As regards the increase in the share of renewable energy, wind energy and solar energy remain essential, given the estimated evolution of the cost for these technologies at global level. Net installed capacities for wind energy will reach 6 GW in the *Reference scenario*, while, for *Potential scenarios A and B,* a level of 7 GW has been estimated. In the *Current scenario*, the installed capacity in wind farms increases up to 4.3 GW (from the current value of 3 GW).

Net installed capacity for solar energy will be 3 GW in the *Reference scenario*, 4.3 GW in *Potential scenario A* and 4.7 GW in *Potential scenario B. The Current scenario* maintains 3 installed GW in photovoltaic farms.

For the testing the feasibility of the selected scenarios, the price of electricity has represented one of the most significant indicators.

In 2030, the price of electricity without VAT and excises will be 112.4 EUR/MWh in the *Current scenario*, 126.6 EUR/MWh in the *Reference scenario*, 113.7 EUR/MWh in *Potential scenario A* and 138.2 EUR/MWh in *Potential scenario B*. The currency used in this study is Euro 2018[3].

Overall investments in the Romanian energy sector for the analyzed period are expected to exceed 17 bn EUR in *Potential scenario A,* 20 bn EUR in the *Reference scenario*, 22 bn EUR in the *Current scenario*, 25 bn EUR in *Potential scenario B*.

As regards wind farms, within total investments, approximately 54% of the capital will be spent domestically, while, as regards transmission and distribution networks, 55% will be spent. As regards the added value of these projects, **results show that one billion EUR spent for wind farms or electricity grids will lead to an added value of at least EUR 2 billion for the Romanian economy**.

[3] The prices forecast after 2020 are expressed in nominal amounts.

I. Context of the preparation of scenarios for a high share of renewable energy

The initiative concerning the increase in the share of energy from renewable sources in the final energy consumption is one of the most important actions taken by the European Commission as regards the fight against climate change. The current framework sets a target of 20 % at EU level for RES in the final energy consumption, which is based on the binding national targets by 2020. Romania's target by 2020 is 24%, which has already been exceeded in 2016, when Romania registered 25% of energy from RES in the final energy consumption. All Member States must also ensure that, by 2020, at least 10% of the fuels used for transportation come from renewable sources.

In June 2018, further to a political agreement between the negotiators of the European Commission, European Parliament and European Council, a new regulatory framework was adopted. This framework included a binding target of 32% for renewable energy in the EU in 2030, with this value being revised for increase after 2023. This target is binding in the EU and will be met through the individual contributions of Member States, guided by the need to reach the EU collective target. The collective target may be also reached without preventing the Member States from establishing their own, even more ambitious, national targets. Member States may support energy from renewable sources subject to the rules on State aid.

Through the National Integrated Energy and Climate Change Plans for the period 2021 – 2030, whose first draft must be sent to the European Commission by the end of 2018, each Member State undertakes a target concerning the share of energy from RES in the final energy consumption.

Thus, in the *draft* NIECCP, Romania has undertaken a target of 27.9% concerning the global weight of energy from RES in the final consumption.

Through the implementation of the National Integrated Energy and Climate Change Plan, Romania should aims at meeting a few main objectives:

- ✓ Diminishing the gap with western countries
- ✓ Increasing Romania’s contribution to the targets of the European Union
- ✓ Anticipating the trends and maximizing opportunities
- ✓ Substantially increasing the quality of life

The process of setting national targets to be support European targets are based on 5 main pillars:

1. Decarbonation
2. Energy efficiency
3. Energy security
4. Internal energy market
5. Research and innovation

The following chapters will present a few development scenarios resulting from a process of macroeconomic analysis and quantitative modelling of data aiming at obtaining a better understanding of the impact of the increase in the share of RES on the energy system in Romania and on the national economy.

II. Development scenarios for renewable energy by 2030

a. Overview

In order to establish the development scenarios for renewable energy in Romania in 2030, a number of assumptions have been made, which have been validated both in the context of the information presented in the previous chapter, but especially in light of the projections concerning the decrease in the costs of technologies used for the generation and storage of RES. The common assumptions of all scenarios[4] are presented in the Annex of this report.

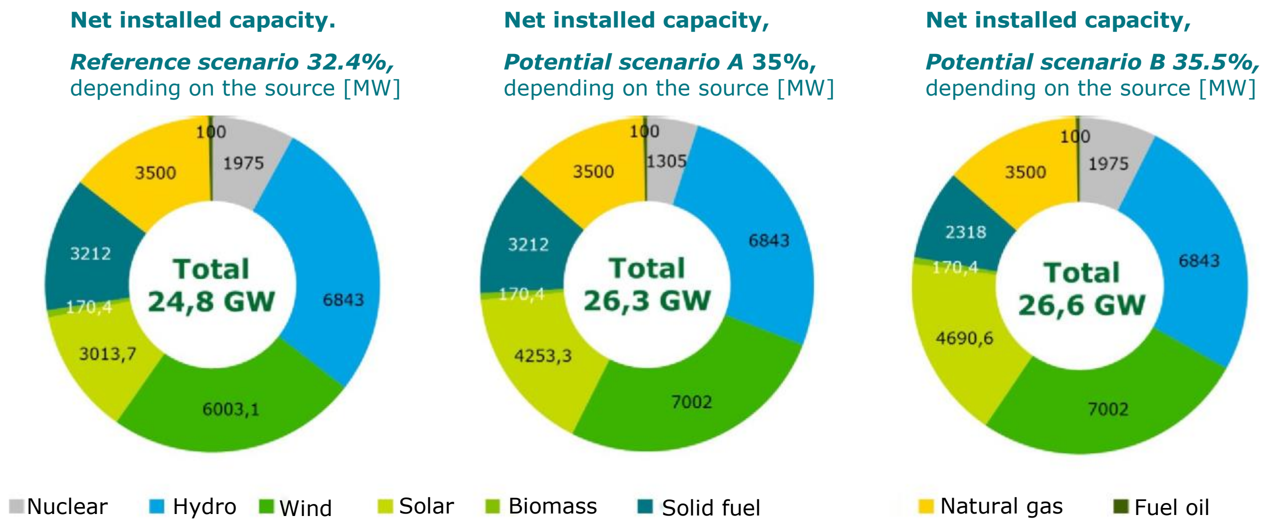
The different assumptions for each scenario[5], which reflect the variations of the main indicators, have been tailored to the new environmental regulations or the probability of implementation of certain projects. They will be detailed below while each of the selected development scenarios is described.

The proposed scenarios are mainly based on the increased use of the potential for wind energy (on land) and solar energy (on roofs). Biomass potential has been considered insignificant as there is no universal agreement on its value, nor access to a verifiable source of data. Geothermal potential has not been considered in this analysis as its value is < 1GW.

The 3 development scenarios resulting from relative modelling reveal, in 2030, significant contributions of RES generation park in the national net installed capacity, as illustrated in the figure below:

[4] Except for the *Current scenario*, taken over from the draft NIECCP
[5] Except for the *Current scenario*, taken over from the draft NIECCP

Figure 2 - Net installed capacity for the 3 scenarios, depending on the source, in 2030, [MW]



Source: Deloitte calculations

i. Reference scenario

The reference scenario takes into account the assumptions that are common to all scenarios, plus the assumptions that are specific to this scenario, namely:

- ✓ **The extension** of the lifetime of existing **nuclear units**
- ✓ **2 additional nuclear reactors** (U3 and U4) will be commissioned in **2030** and **2031**, respectively
- ✓ The gradual and natural **elimination** of all **coal units** by approximately **2035**
- ✓ **The installation of additional RES energy capacities** to anticipate the long-term need accommodated earlier
- ✓ **The decrease of the load factor** for power plants operating on **natural gas**

Thus, in 2030, the net installed capacity for wind energy is expected to reach 6,000 MW, while solar energy capacity is expected to reach the threshold of 3,000 MW.

ii. Potential scenario A

The specific assumptions for potential scenario A have been established by comparison with the reference scenario, its main characteristics being:

- ✓ **The extension** of the lifetime of existing **nuclear units**
- ✓ The **2 additional nuclear reactors** (U3 and U4) **will not be built**
- ✓ The gradual and natural **elimination** of all **coal units** by approximately **2035**

According to the above figure, given that this scenario implies that reactors U3 and U4 will not be built, the installed capacity for nuclear energy will remain at its current level of 1305 MW. This capacity will be compensated by the installation, in addition to the previous scenario, of approximately 1,000 MW from wind sources and of approximately 1,250 MW from photovoltaic sources.

iii. Potential scenario B

Potential scenario B has been analyzed both by comparison with the reference scenario and by comparison with potential scenario A. Its main characteristics are the following:

- ✓ **The extension** of the lifetime of existing **nuclear units**
- ✓ **2 additional nuclear reactors** (U3 and U4) will be commissioned in **2030** and **2031**, respectively
- ✓ Environmental costs will lead to the **elimination of 3 coal units**

As in the case of potential scenario B, the reduced capacity (as regards coal units this time) will be replaced with wind and solar energy. As in the case of potential scenario A, the wind energy capacity will be 7,000 MW, while solar energy capacity will reach 4,700 MW.

These scenarios capture the most likely situations that could affect the Romanian energy sector in the next decade and, at the same time, offer a perspective on the implications of using certain capacities to the detriment of others. The table below allows a numerical comparison of net installed capacities for the 3 scenarios:

Table 1 - Net installed capacities, [MW]

		2015	2030 Reference (32.4%)	2030 Potential A (35%)	2030 Potential B (35.5%)
Nuclear		**1,305**	**1,975**	**1,305**	**1,975**
RES		**11,057**	**16,030**	**18,268**	**18,705**
	Hydro	*6,616*	*6,843*	*6,843*	*6,843*
	Wind	*2,953*	*6,003*	*7,002*	*7,002*
	Solar	*1,362*	*3,014*	*4,253*	*4,691*
	Biomass	*126*	*170*	*170*	*170*
Solid fuel		**5,276**	**3,212**	**3,212**	**2,318**
Natural gas		**3,644**	**3,500**	**3,500**	**3,500**
Oil		**104**	**100**	**100**	**100**

Source: PRIMES (2015), Deloitte calculations (2030)

b. Main results of the development scenarios for renewable energy in 2030

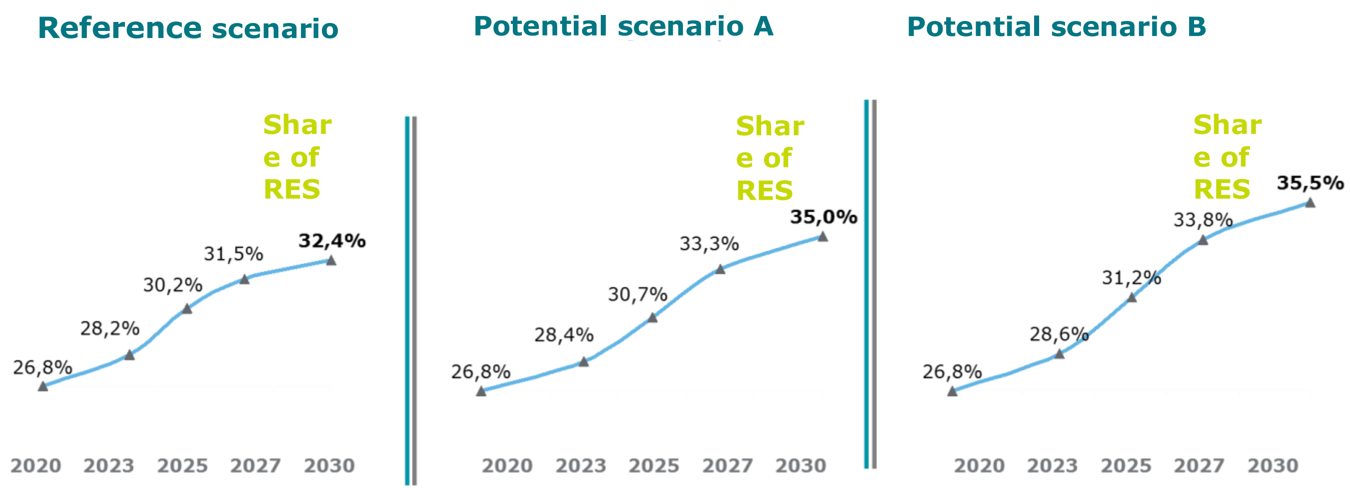
This study has aimed at testing the feasibility of several scenarios to determine under which circumstances Romania could reach a high share of renewable energy, as well as the impact of the decision to increase this share within the energy system and the economy. The projections resulting from modelling focus on the share of renewable energy, the net installed capacity and the net production of electricity for each scenario, the energy prices in each of the analyzed scenarios and the necessary investments for the increase of the share of renewable energy.

i. Evolution of the share of renewable energy in the analyzed scenarios

The interim targets have also been projected for 2023, 2025 and 2027 for each scenario, all with the same starting point - 2020. A share of 26.8% in 2020 has been considered and projected based on the available estimates (in 2016, the share of renewable energy for Romania was 25%).

The figure below illustrates the 3 scenarios and the evolutions of the shares in the period 2020 – 2030. Interim targets are very important as they operate as a control mechanism that is able to monitor the course to the target for 2030.

Figure 3 - Evolution of the share of renewable energy, 2020 – 2030, [%]



Source: Deloitte calculations

In the reference scenario, the highest share increases will be recorded in 2023 and 2025, when the increase is estimated to be a little over 2%.

In the potential scenario A, a significant increase of 2.5% will be recorded between 2025 and 2027, while in the potential scenario B, an increase of 2.6% will be recorded in the same period.

The evolution of the shares may be influenced by the likelihood of the implementation of certain projects and environmental regulations. Interim targets may obviously change if the assumptions and, implicitly, development scenarios considered and detailed above change as well.

ii. Evolution of net capacity and production in the analyzed scenarios

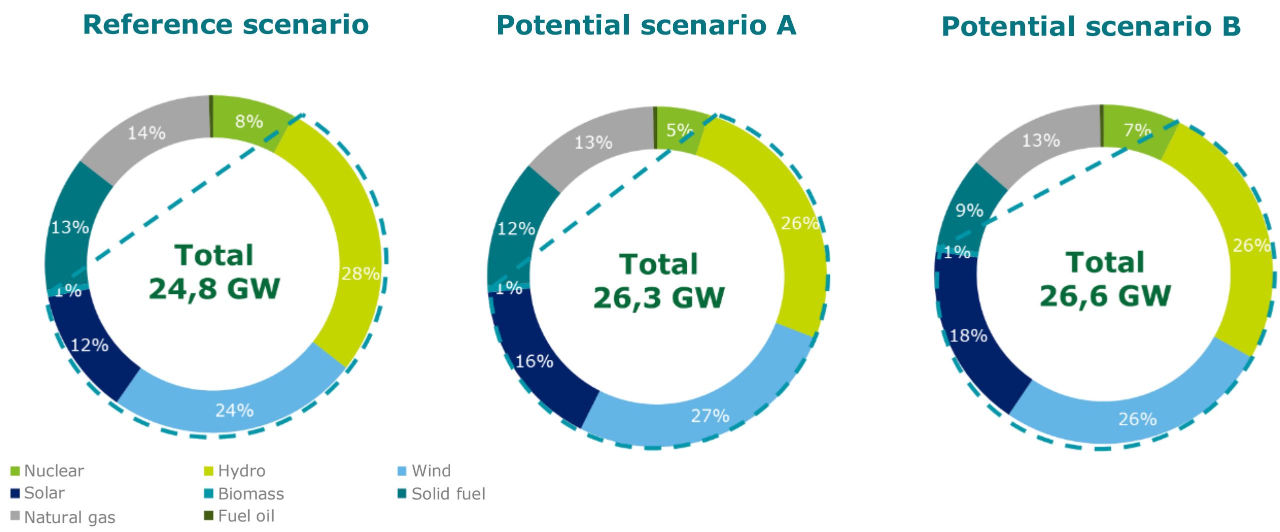
After the presentation of the evolution of the share of renewable energy by 2030, another significant issue is the structure of the net installed capacity, depending on the source, for 2030.

Depending on the assumptions considered for each scenario, the net installed capacity depending on the source may differ. For example, nuclear capacity in potential scenario A will be replaced with energy from solar and wind sources.

In terms of net installed capacity, the values of 2020 are the same in all 3 scenarios, with differences occurring in the first interim stage in 2023.

The figure below presents the net installed capacity per scenario depending on the source and weight of each source in total capacity.

Figure 4 - Net installed capacity depending on the source, per scenario, 2030, [%, GW]



Source: Deloitte calculations

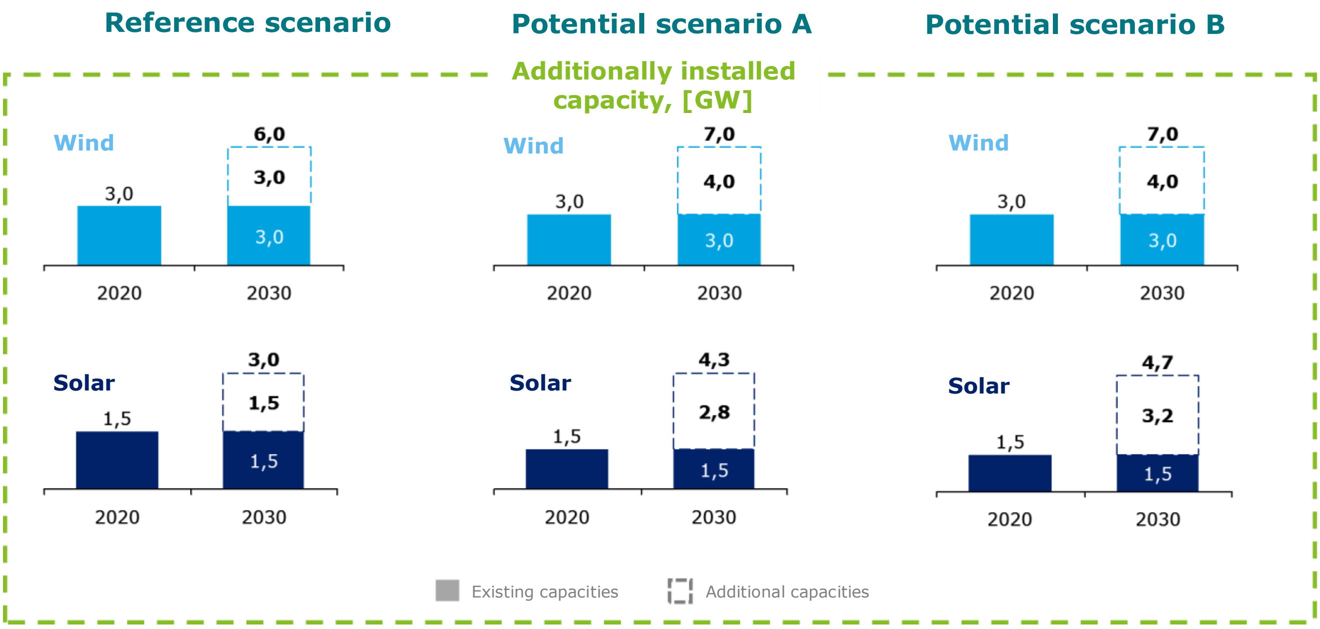
Thus, in the reference scenario, in 2030, over 65% of the net installed capacity comes from renewable sources, while fossil fuel and natural gas account for 27%. The reference scenario includes an increase by 40% in the net installed capacity from RES compared to 2020.

In potential scenario A, 70% of the net installed capacity comes from renewable sources in 2030. Compared to 2030, the increase in the capacity from RES is 60% higher in 2030.

In potential scenario B, 71% of the installed capacity comes from RES in 2030, with an increase by 64% compared to the installed capacity estimated in 2020.

As stated above, in relation to the increase in the share of the energy from RES, the focus is on the increase in wind and solar energy capacity. The figure below illustrates the required capacity that will need to be installed additionally so that the renewable energy shares could be reached in 2030 compared to 2020.

Figure 5 - Wind and solar energy capacity installed additionally, per scenario, 2030 compared to 2020, [GW]



Source: Deloitte calculations

Since approximately 3 GW of installed wind energy are expected to remain in 2020, this capacity is expected to double in 2030 in the reference scenario. For potential scenario A and B, the increase in wind energy capacity will be of 133% compared to 2020, which will reach 7 GW in 2030.

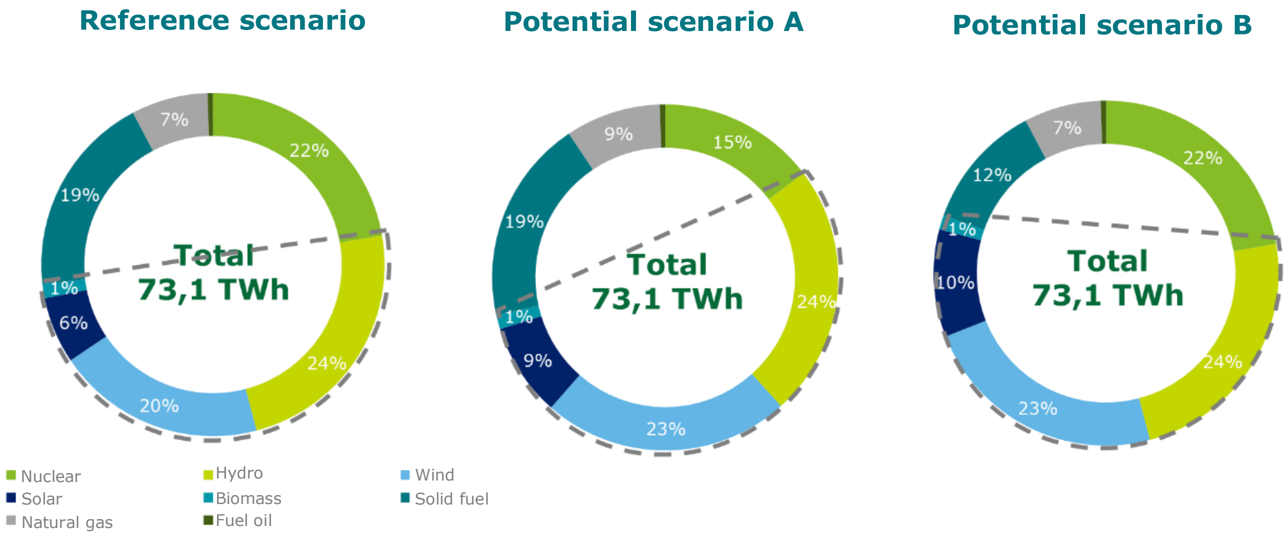
As regards solar energy, in the reference scenario, the capacity will also double from 1.5 GW to 3 GW. In potential scenario A and B, solar energy capacity will increase from 1.5 GW to 4.3 GW and to 4.7 GW, respectively.

Given the high share of renewable energy in the net installed capacity, the impact on net electricity production is significant.

As shown in the figure below, in all 3 scenarios, electricity production will reach 73.1 TWh in 2030, with an expected gradual increase from 64 TWh estimated for 2020.

In the reference scenario, 51% of generated electricity will come from renewable sources in 2030, while in potential scenario A and B, this share increases to 57% and 58%, respectively.

Figure 6 - Net electricity production depending on the source, per scenario, 2030, [%, GW]



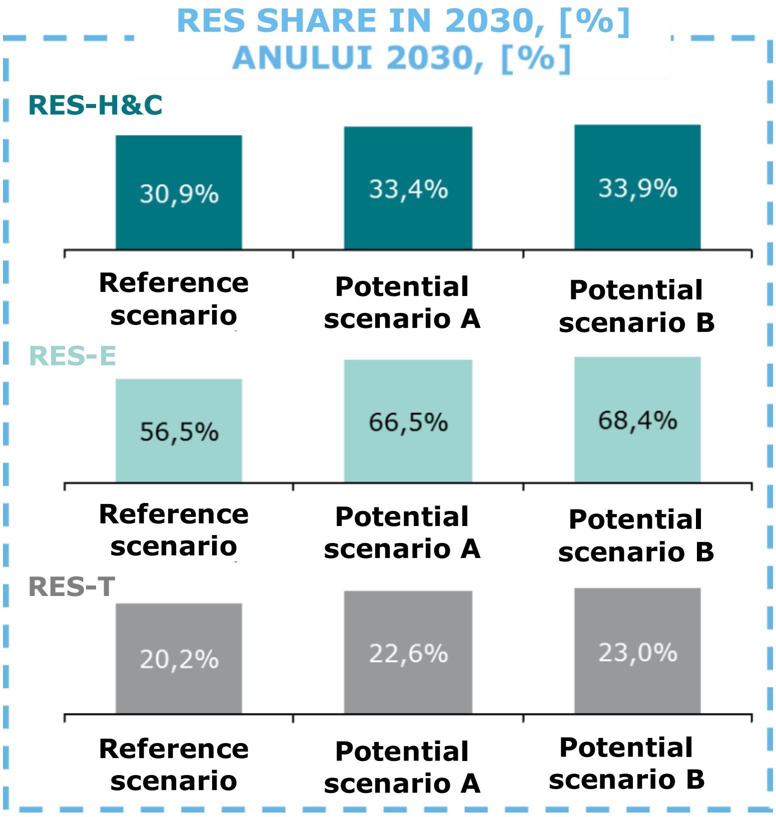
Source: Deloitte calculations

As regards the other sectors which influence the global weight of renewable sources, their estimated evolution has considered, among others:

- Romania's obligation to reach a share of RES-T of 10% in 2020 (and 14% in 2030), in the context of changing multiplication factors associated with the use of RES (e.g. RES in the consumption of electricity for rail transport);
- conditions imposed by the new directive on renewable energy regarding the types of RES used and accepted for the calculation of the share of RES-H&C.

The figure below illustrates the difference in terms of the share of renewable energy for each of the 3 sectors, depending on the scenario.

Figure 7 - RES share in heating and cooling, electricity and transport, per scenario, 2030, [%]



Source: Deloitte calculations

In 2030, RES-H&C will reach 31% in the reference scenario, while, in potential scenario B, it may reach 34%, with a RES global weight of 35.5%.

RES-E share will exceed 55% in 2030, while in 2020 a value of 44% is estimated.

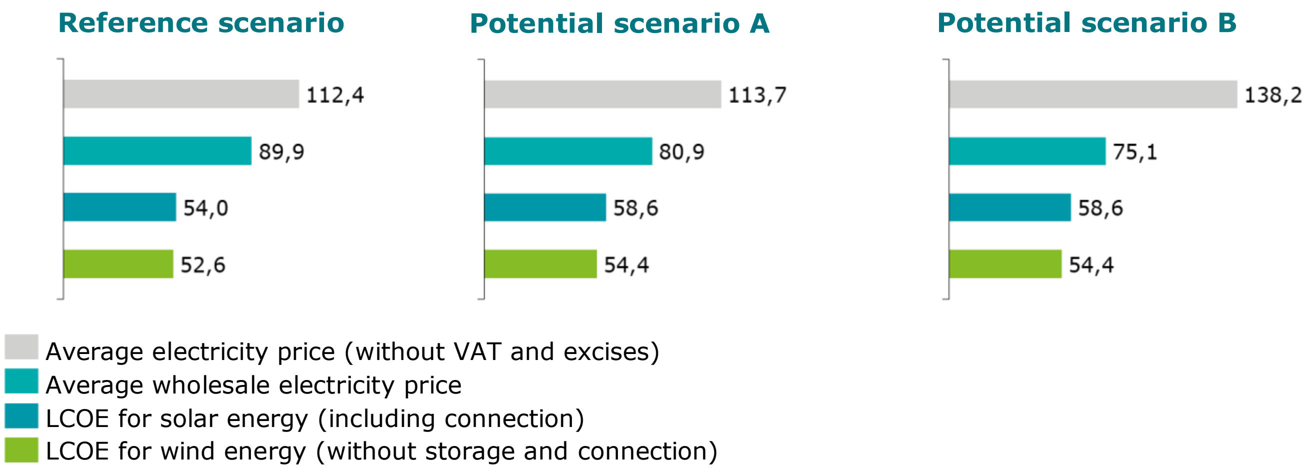
In 2020, RES-T share is expected to be 10.2%, which means that the share imposed by the EC will be reached. RES-T share is estimated to increase in 2030 to 20% in the reference scenario, 22.6% in potential scenario A and 23% in potential scenario B.

iii. Comparative evolution of the electricity price in the Current scenario and in the Development scenarios

In the context of the preparation of the draft National Integrated Energy and Climate Change Plan (NIECCP, 2018), we have extended our analysis of the development scenarios to include a comparison with the main parameters of NIECCP – considered the current scenario.

One of the assumptions on which the modelling of the scenarios has been based is the increase in the consumption of electricity, as illustrated in the annex to this document. This increase in consumption will have to be supported by significant investments in new plants and grids, with the related expenditure reflecting in the electricity price. Estimates based on the analyzed assumptions indicate that the electricity price will reach a maximum value in 2030, to later decrease due to a lower generation cost as a result of technology development.

Figure 8 - Electricity price and LCOE per scenario, 2030, [EUR/ MWh]



Source: Deloitte calculations

The average electricity price has been analyzed by reference to the average cost of electricity production, average wholesale electricity price and LCOE. For LCOE, 2 variants have been calculated, one that includes connection and storage costs and one that includes only connection costs.

As shown in the figure above, the average electricity price is 112.4 EUR/ MWh in the *Current scenario, 113.7 EUR/ MWh in Potential scenario A* and 138.2 EUR/ MWh in *Potential scenario B*.

For the calculation of LCOE, the calculation base has been considered to be the LCOE projection for wind energy according to BNEF – Germany USD '16, as average value for the period 2021-2030. For Romania, an adjustment of 10% in addition to the cost in Germany has been applied. This adjustment is the same in the analyzed scenarios. The resulting LCOE values may be seen in the figure above, both in the variant that includes storage costs and in the one that does not consider such costs.

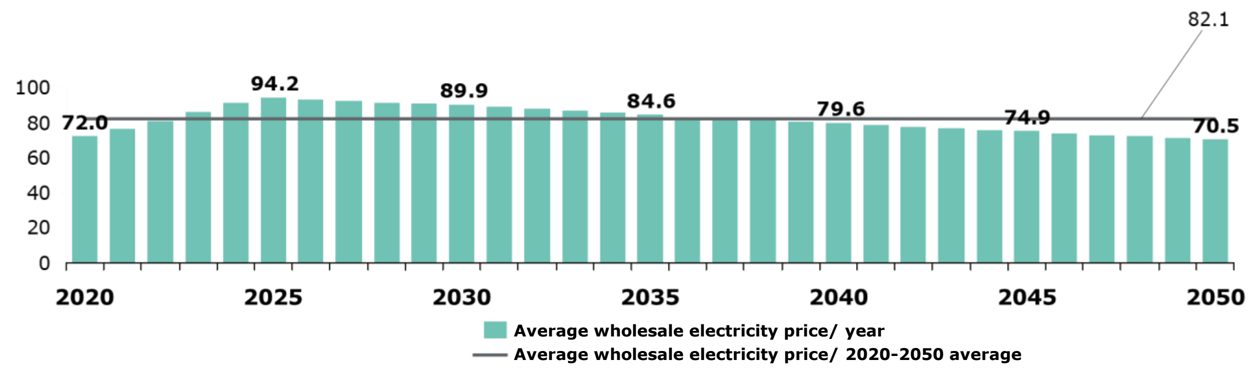
For the calculation of the average wholesale electricity price[6], we have relied on the information collected from the European Energy Exchange (EEX), Hungarian Energy Exchange (HUPX) and Hungarian Derivative Energy Exchange (HUDEX) and Romanian Power Exchange (OPCOM),

[6] None of the prices considers any discounts.

plus the assumptions made by the team of consultants based on the most recent available information at European level[7]. The following average wholesale electricity prices have resulted: 89.9 EUR/ MWh in 2030 in the *Current scenario*, 80.9 in Potential scenario A and 75.1 EUR/MWh in *Potential scenario B*.

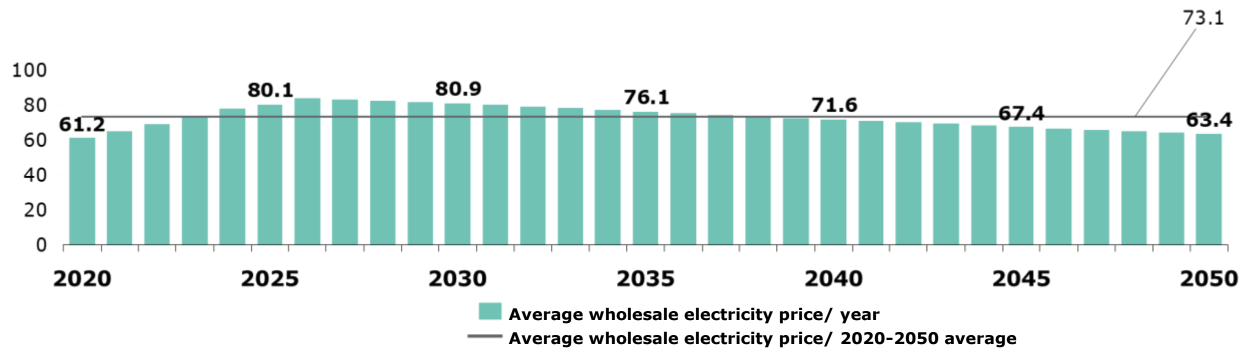
For a better understanding, the figures below show the evolution of the wholesale electricity price in the period 2020 – 2050 for three scenarios. It should be stated that the transactions on EEX/ HUDEX/ OPCOM platforms for the electricity supplied in 2019 varied between 50 and 61.77 EUR/ MWh.

Figure 9 - Evolution of the average wholesale electricity price, 2020 – 2050, in the *Current scenario* [EUR/ MWh]



Source: Deloitte calculations

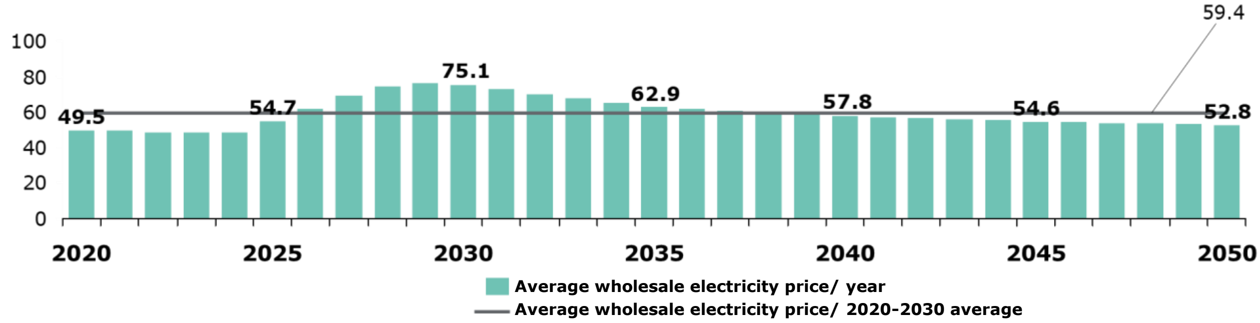
Figure 10 - Evolution of average wholesale electricity price, 2020 – 2050, in the *Potential scenario A* [EUR/ MWh]



Source: Deloitte calculations

[7] Wholesale market prices, revenues and risks for producers with high shares of variable RES in the power system, December 2018 (English version "Wholesale market prices, revenues and risks for producers with high shares of variable RES in the power system"), available at: https://ec.europa.eu/energy/sites/ener/files/documents/metis_s14_electricity_prices_and_investor_revenue_risks_in_a_high_res_2050.pdf

Figure 11 - Evolution of average wholesale electricity price, 2020 – 2050, in the *Potential scenario B* [EUR/ MWh]



Source: Deloitte calculations

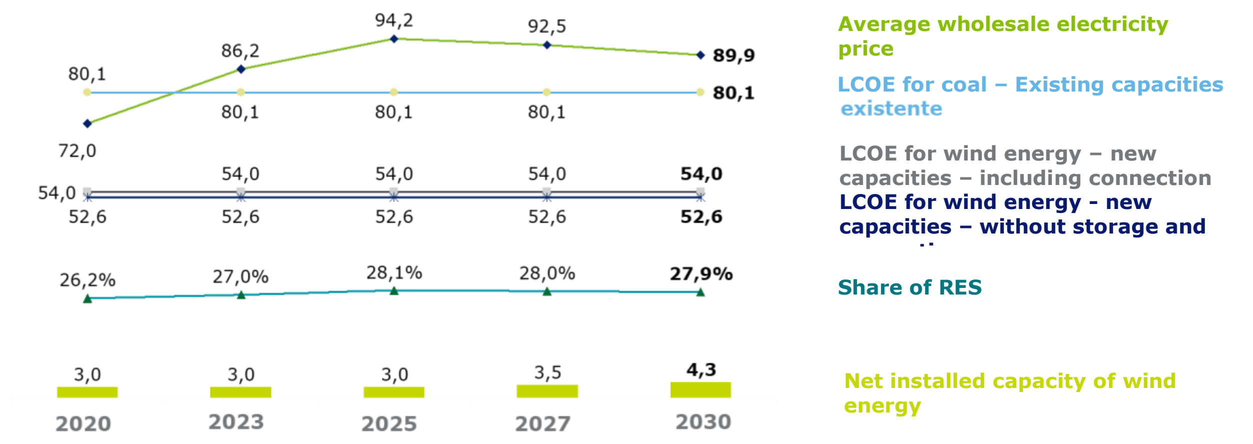
For each scenario, the following have been considered: the evolutions of the net installed capacity of wind energy, of the share of renewable energy sources in the final energy consumption, of the average wholesale electricity price and of LCOE for wind energy, both with and without storage costs. LCOE for wind energy has been considered constant in the analyzed period. As a novelty, LCOE for coal was added in order to allow a comparison between this indicator and LCOE for wind energy.

LCOE for coal has been considered the same in all analyzed scenarios.

According to the calculation assumptions and analyzed data, the levelized cost of electricity from renewable sources – wind energy will reach values similar to those of energy from traditional sources – coal in 2020.

As the figure below indicates, in the *Current scenario*, in 2030, LCOE for wind energy is lower than the average wholesale electricity price. LCOE for wind energy is also lower than the average wholesale electricity price for the period 2020 – 2030.

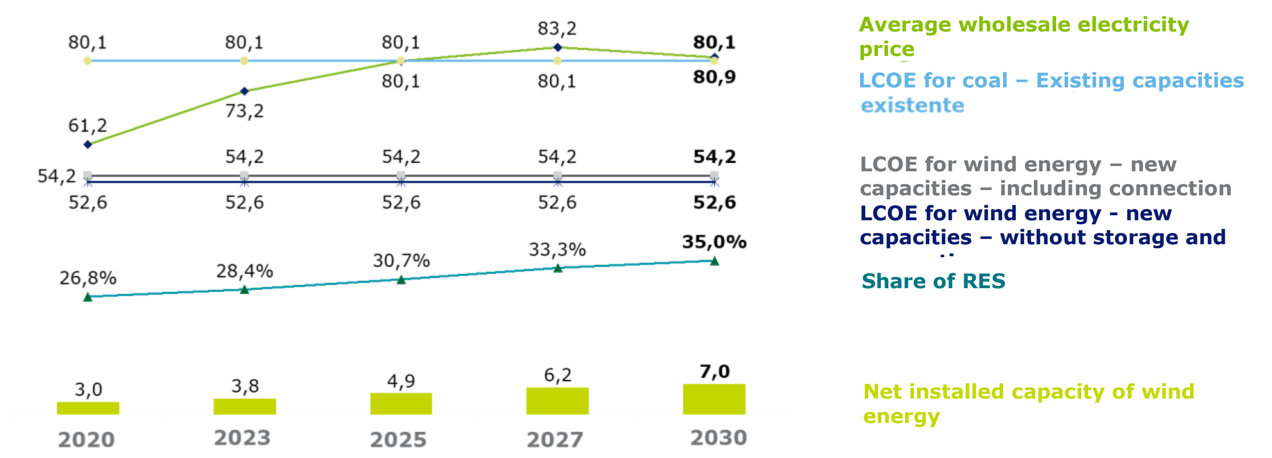
Figure 12 - Evolutions in the *Current scenario*, 2020 – 2030



Evolution of the share of RES (%)
Evolution of the net installed capacity of wind energy (GW)
Evolution of the average wholesale electricity price (EUR'18/MWh)
Evolution of LCOE (2020-2030 average) for wind energy (EUR'18/MWh) - including connection
Evolution of LCOE (2020-2030 average) for wind energy (EUR'18/MWh) - without storage and connection
Evolution of LCOE (2020-2030 average) for coal (EUR'18/MWh)

Source: Deloitte calculations

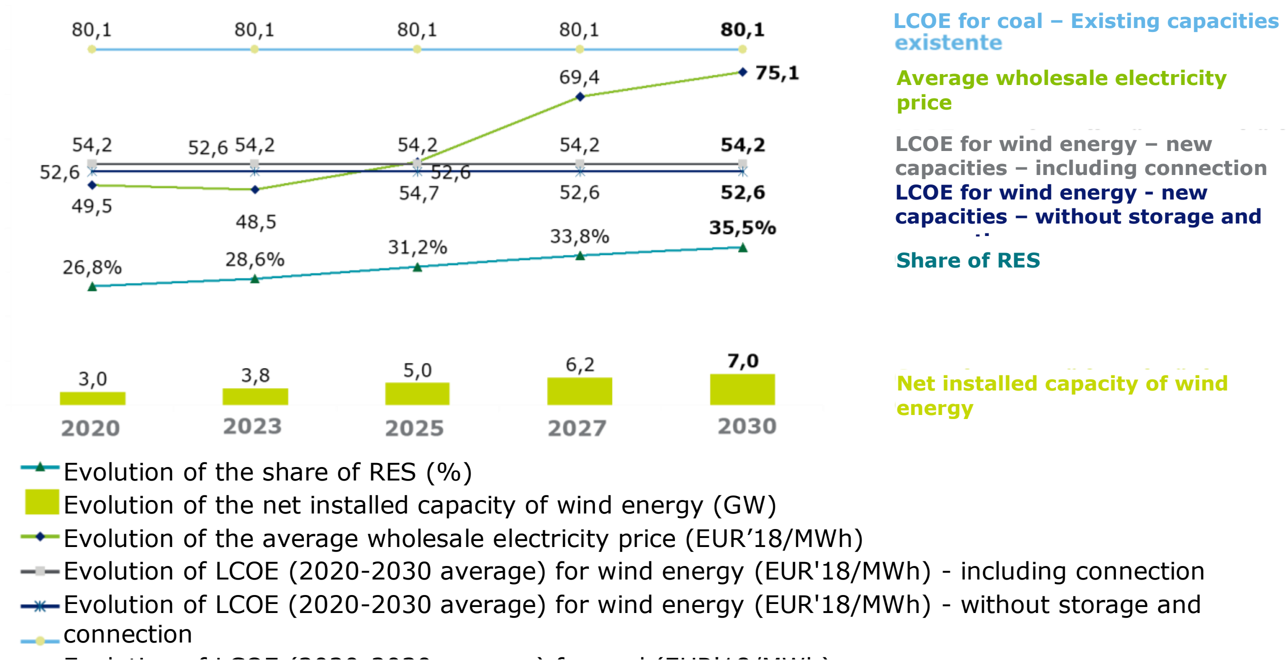
Figure 13 - Evolutions in *Potential scenario A*, 2020 – 2030



Evolution of the share of RES (%)
Evolution of the net installed capacity of wind energy (GW)
Evolution of the average wholesale electricity price (EUR'18/MWh)
Evolution of LCOE (2020-2030 average) for wind energy (EUR'18/MWh) - including connection
Evolution of LCOE (2020-2030 average) for wind energy (EUR'18/MWh) - without storage and connection
Evolution of LCOE (2020-2030 average) for coal (EUR'18/MWh)

Source: Deloitte calculations

Figure 14 - Evolutions in *Potential scenario B*, 2020 – 2030



Source: Deloitte calculations

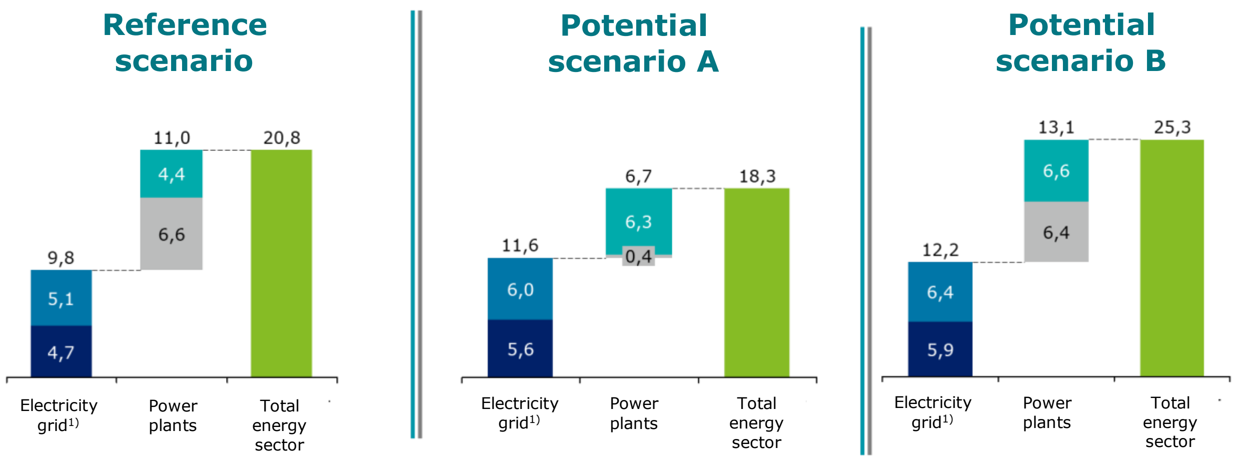
The analysis of these evolutions has revealed that the installation of additional wind and solar energy capacities in Romania's energy mix may represent a feasible solution in the medium and long run and that Romania has a real chance of reaching a share of renewable energy of 35.5% in the final energy consumption.

iv. Investments required for each scenario

The increase in the share of renewable energy implies a series of significant investments in the Romanian energy system, which must be also examined in terms of the support granted by the Union through the funding mechanisms and instruments made available to Member States within the next European budget.

In support of the achievement of the objectives covered by the scenarios, a simulation of the required investments in the period 2021 – 2030 has been carried out. Thus, as the figure below shows, the overall investments in the Romanian energy system for the analyzed period are expected to exceed **18 bn EUR** or to even each **25.3 bn EUR** in *Potential scenario B*.

Figure 15 - Overall necessary investment expenditure, 2021 – 2030 [m EUR]



Note: Additional investments generated in other economic sectors will total 229 bn EUR in the analyzed period

1) Investments in storage facilities represent ~ 9-9.5% of total investments in the electricity grid; percentage shares for public/ private investments have been estimated based on the data included in the 2016 Annual Report prepared by ANRE (Romanian Energy Regulatory Agency).

Source: Deloitte calculations

The forecast investment expenditure consists of expenditure for power plants (materials, equipment, etc.) and for the electricity grid (transmission or distribution).

As regards the electricity grid, investments have been broken down according to their public and private source. Their share is approximately equal and balanced. However, a little more effort from the private sector is envisaged.

As regards power plants, estimations cover the investments that will produce renewable electricity and investments in traditional sources of electricity production.

The scenario with the lowest investment expenditure is *Potential scenario A* as costs for the building of nuclear reactors U3 and U4 have been eliminated. *The current scenario* requires investments of approximately 22.9 bn EUR, according to NIECCP.

In addition to the above, additional investments generated in other economic sectors are envisaged, which will total **229 bn EUR** in the period 2021 – 2030.

In order to meet the EU targets in 2030 as regards energy and climate, additional funding of 270 bn EUR per year is required, which will mainly come from private investors. The weight of estimated investments for Romania accounts for 10% of EU estimates (24.5 billion Euro - total investments in Romania per year, both in the energy sector and in other economic sectors for a share of RES of 35.5%).

Although estimated investments are significant, EU regulations will support the involvement of private capital in the investments. The European Council has announced the initiative for the growth of EU spending on the fight against climate change from 20 to 25% within the budget of the Union for the following financial period (2021-2027).

Apart from this initiative, there are also other support instruments aiming at meeting the proposed targets, such as: The European Fund for Strategic Investments (EFSI) and the implementation of the EU Action Plan on the financing of sustainable development of the energy sector; support schemes pursuant to Article 5 of the RES Directive; the financing platform pursuant to Article 27 of the Regulation on the Governance of the Energy Union; InvestEU Fund, active starting with 2021 (which offers, among others, guarantees to developers); EU ETS Modernization Fund (2021 – 2030); statistical transfers, etc.

III. Impact and benefits of a high share of renewable energy

The energy sector plays a significant part in Romania's economic prosperity, with a share of over 5% in the gross added value at national level (2015).

Romania has a high natural potential in terms of the use of renewable energy sources, based mainly on the use of wind and solar energy.

Decision-makers must make increasingly better informed decisions on the opportunities to support the generation of energy from renewable sources. In most cases, these decisions are mainly based on the comparison of the total levelized cost of energy (LCOE) of production technologies. This study, however, also considers the examination of other macroeconomic indicators in order to measure the additional benefits created in the national economy further to RES investments. That is why it is justified to carry out a more careful analysis of RES contribution to economic growth and an assessment of the added value in the economic sectors, which these investments will bring to Romania as a whole. Moreover, quantifying CO_2 emissions, another macro-indicator, is an indispensable argument given the discussions on the increase of the share of RES.

The impact analysis has been carried out based on Deloitte's expertise and refers to the measurement of the economic impact and additional benefits related to the increase of the share of RES in the consumption of electricity **in the modelled scenarios**. The evolution of the share of RES is a major topic not only for Romania, but also an undertaking towards foreign partners and particularly a responsibility to future generations. The results of the analysis reveal that energy transition will have an unquestionable impact on Romania's economy and energy security. In this context, the objectives of the analysis are:

- ✓ Calculating the economic impact that the investments in the wind power plants will have on Romania's Gross Domestic Product
- ✓ Calculating the economic impact that the investments in the electricity transmission and distribution grids will have on Romania's Gross Domestic Product
- ✓ Analyzing the propagation effects within the overall economy, which may be determined in the sectors relevant for energy transition (for example: transport, constructions, automotive

industry) and which will lead to additional development of the economy as a whole;
- ✓ Describing and comparing the impact of RES scenarios on the environment.

a. Economic impact

This impact analysis considers the investments in new projects aiming at generating wind energy and in transmission and distribution grids in the period 2021-2030. The assessment of the economic impact is based on *Potential scenario A* and implies a share of RES of 35% in the gross final energy consumption.

Throughout this analysis, the economic impact has been measured through the analysis of **the investment volume**, including capital and operating expenditure, and the impact of these investments on **Romania's GDP**. The breakdown by direct and indirect impact shows the effects that RES projects have on the Romanian economy. For more information on the definition of direct and indirect impact, please see section "Methodological Notes" included in the Annex.

Moreover, RES projects have an impact on related industrial sectors and on the entire economy as well. Thus, the analysis also presents the impact that RES investments may have on the Romanian economy (2021 – 2030).

i. Impact of RES investments

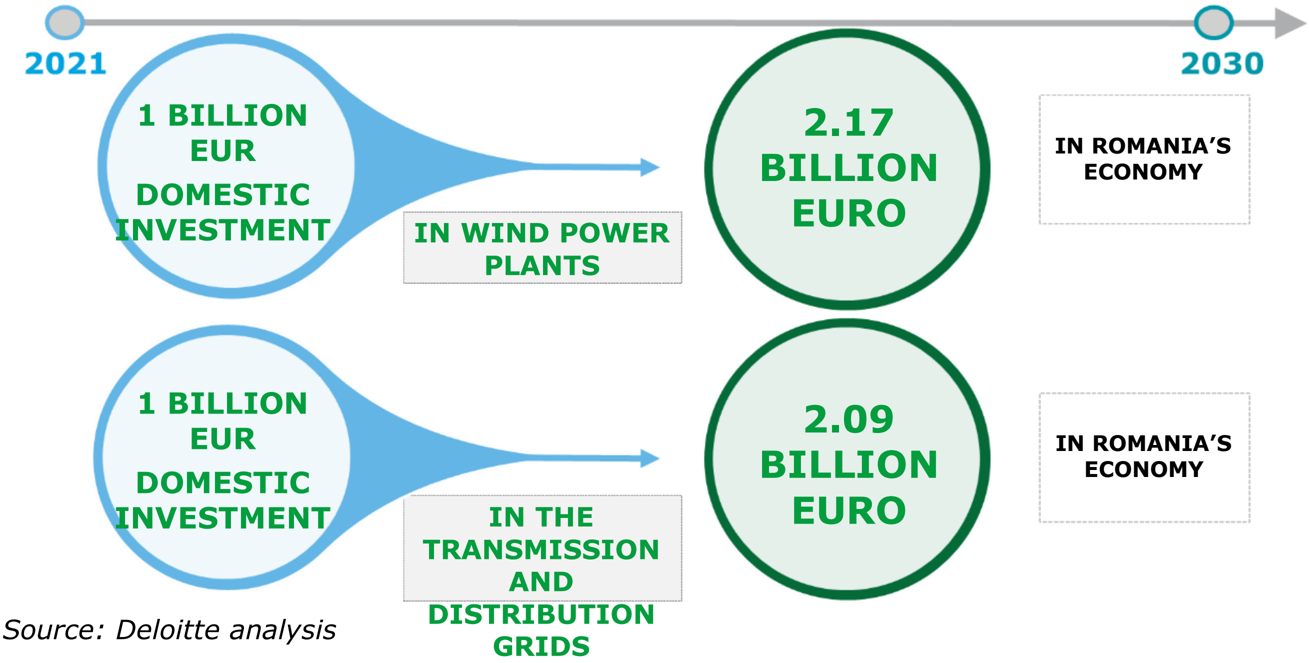
The calculations on which the impact analysis is based show that the overall value of domestic investments in RES amount to **18.3 bn EUR** for the analyzed period. Of total investments in wind farms, 42% will be spent in the Romanian economy, while, for electricity transmission and distribution grids, this value is 55%.

Thus, in the analyzed period (2021 – 2030), each billion of RES investments will lead to an added value for the Romanian economy of **2.17 bn EUR** and **2.09 bn EUR, respectively.**

In other words, results show that one billion EUR spent for wind farms or electricity grids will lead to an added value of **at least EUR 2 billion** for the Romanian economy.

The above results are illustrated in the figure below.

Figure 16 - General presentation of the impact of investments in wind energy projects and electricity grids in the period 2021 – 2030



Source: Deloitte analysis

1) Impact of investments in wind farms

With a view to measuring the added value generated by the investments in the production of electricity in dispatchable wind power plants (DWPP), it was broken down by types of impact.

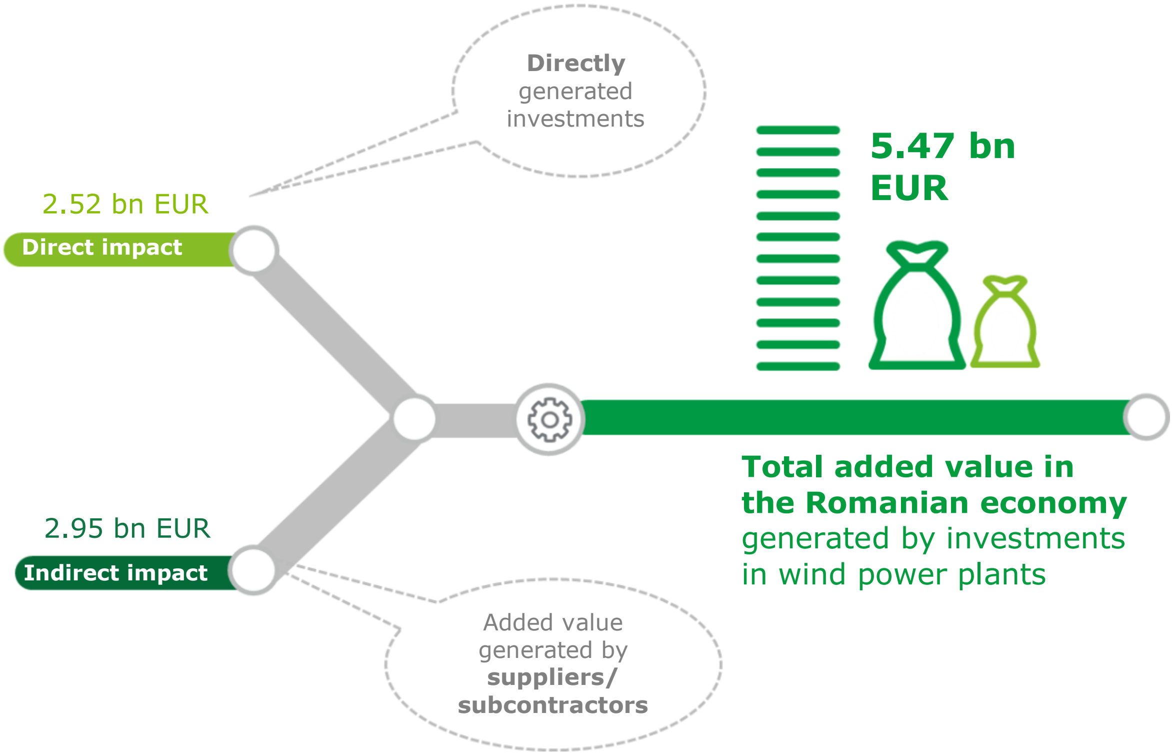
The direct impact includes the investments and activities of the developments of wind power plants, while the volume of investments may be assessed by measuring capital and operating expenditure throughout the lifecycle of the projects. Moreover, a multiplier of 42% (0.42) is applied, which represents the absorption on the Romanian market or, in other words, the weight of total investments spent in the Romanian economy. With a total volume of capital expenditure of 4.51 bn EUR, the adjusted direct impact of wind farms in the economy will amount to **2.52 bn EUR** in the analyzed period.

The second category is that of the **indirect impact**, which represents the sum of all activities carried out by the suppliers and sub-contractors of wind power plants in the industry, mainly including the manufacturers of turbines and other components, as well as the suppliers of services. Further to the application of the multiplication factor (0.55), these activities will result in an indirect impact of **2.95 bn** between 2021 and 2030 in Romania.

In conclusion, the total impact generated both by direct and indirect investments in wind farms amounts to a total added value of **5.47 bn** in Romania's economy between 2021 and 2030.

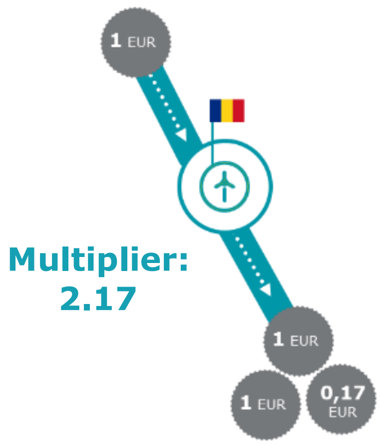
In other words, one billion EUR invested directly in wind farms will generate a total of **2.17 bn EUR** in the country's economy.

Figure 17 - Direct, indirect and total impact of investments in wind farms in the period 2021 – 2030



Source: Deloitte analysis

Figure 18 - Multiplier for investments in wind power plants, 2021-2030



Each EUR invested directly in wind power plants will generate **2.17 EUR** in the Romanian economy.

Source: Deloitte analysis

2) *Impact of investments in electricity transmission and distribution grids*

The added value generated by investments in electricity transmission and distribution grids in Romania has been broken down according to the two types of impact.

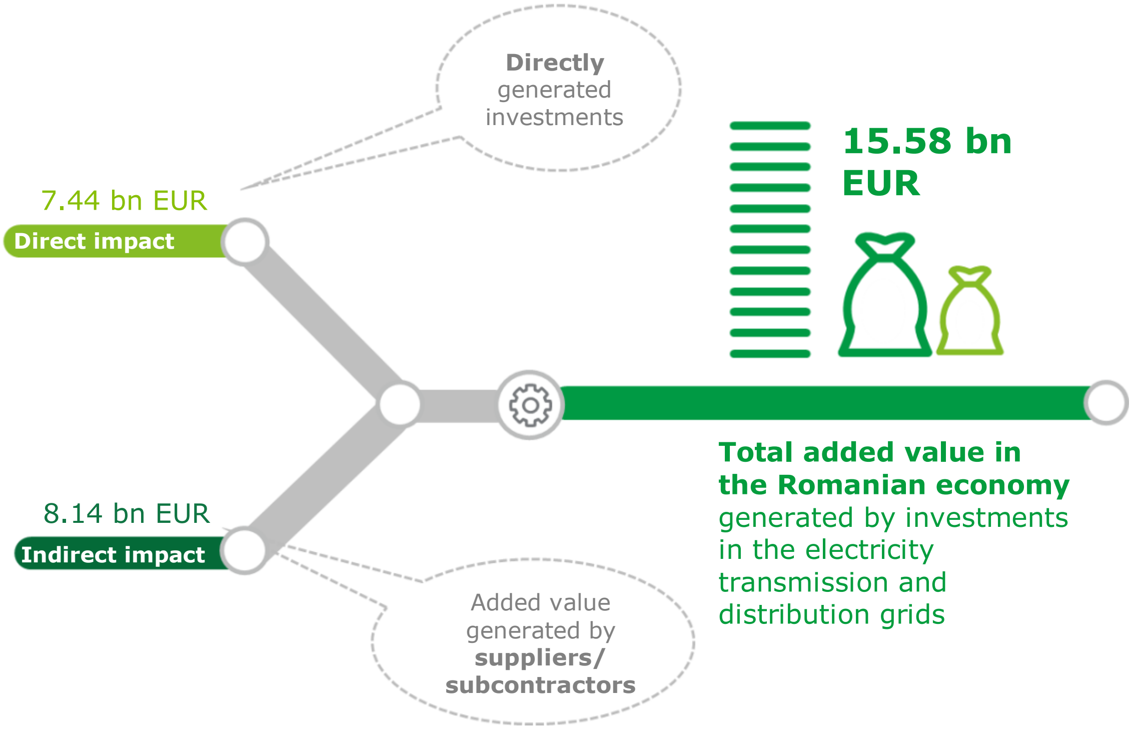
The direct impact includes the investments in electricity transmission and distribution grids and capital and operating expenditure throughout the lifecycle of the projects. For grids, a multiplier of 55% (0.55) is applied, which represents the absorption on the Romanian market. Thus, from the total volume of capital expenditure, the adjusted direct impact of electricity transmission and distribution grids in the economy will amount to **7.44 bn EUR** in the analyzed period.

The indirect impact represents all activities carried out by the suppliers and subcontractors of services and materials involved in the investment projects related to the electricity transmission and distribution grids in Romania; further to the application of the multiplication factor (0.55), indirect impact amounts to **8.14 bn EUR** between 2021 and 2030.

In conclusion, the total impact generated both by direct and indirect investments in electricity grids amounts to a total added value of **15.6 bn EUR** in Romania's economy between 2021 and 2030.

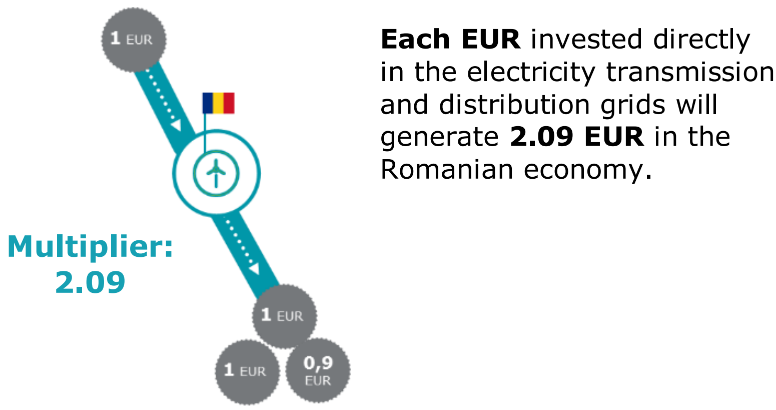
In other words, one billion EUR invested directly in electricity transmission and distribution grids will generate a total of **2.09 bn EUR** in the country's economy.

Figure 19 - Direct, indirect and total impact of investments in electricity transmission and distribution grids in the period 2021 – 2030



Source: Deloitte analysis

Figure 20 - Multiplier for investments in the electricity transmission and distribution grids, 2021-2030



Source: Deloitte analysis

ii. Additional effects of RES development

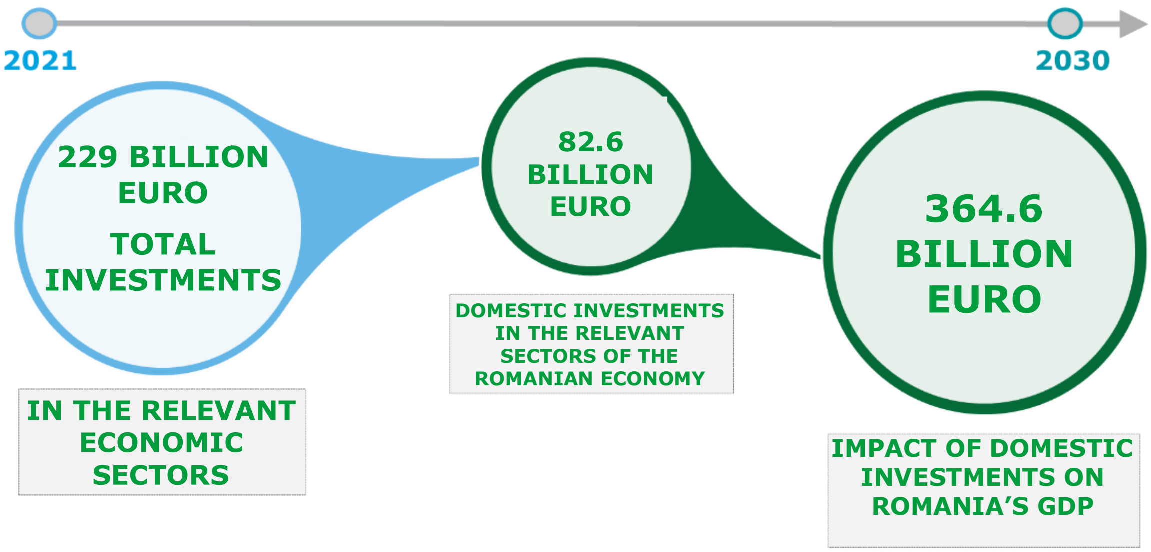
The transition in the field of energy will benefit all economic sectors, while facilitating competitiveness, innovation and new opportunities for investments.

In this study, we have measured the impact of domestic investments to be carried out in the sectors considered to be the most relevant for energy transition on Romania's Gross Domestic Product. The investments in those sectors will amount in total to 229 bn EUR, while the **value of domestic investments** in those sectors of the Romanian economy will be **82.6 bn EUR**, with absorption for the Romanian market varying between 20% and 70%.

The result of the assessment indicates that the **impact of investments** in the selected sectors on Romania's GDP will amount to **364.6 bn EUR** in the period 2021-2030. Thus, each EUR invested in RES in the relevant sectors will generate **4.4 EUR** in the Gross Domestic Product in the analyzed period.

Key results are presented in the figure below.

Figure 21 - Additional effects of domestic investments related to RES in relevant sectors on Romania's GDP in the period 2021 – 2030



Source: Deloitte analysis

The figure below presents the relevant sectors, the domestic capital expenditure (CAPEX) and its impact on Romania's GDP in the period 2021-2030. The automotive industry has the highest potential in terms of the impact of RES investments on the Romanian GDP, with a value of over 43 bn EUR of domestic investments in RES and an impact on the GDP amounting to 132 bn EUR. RES investments in the transportation sector amount to almost 11 bn EUR, with an impact on the GDP amounting to 112 bn EUR, while the construction sector has an impact of 109 bn EUR on the GDP, with a value of RES investments exceeding 20 bn EUR.

Figure 22 - Investments related to energy in the relevant sectors and their impact on Romania's GDP in the period 2021 – 2030

Relevant economic sectors	CAPEX bn €	Impact on GDP in bn €
Industrial production	4,85	4,99
Constructions	20,00	109,44
Transport	11,21	112,43
Automotive industry	43,56	132,49
Energy services	2,92	5,30

Source: Deloitte analysis

Domestic investments in the relevant sectors are intended to create new activities related to energy transition, presented in the figure below:

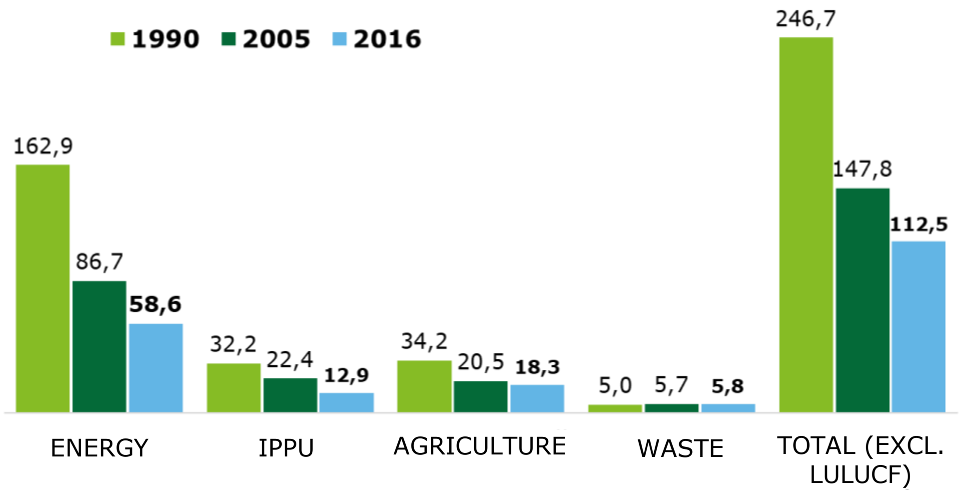
Figure 23 - Activities related to energy transition in the relevant sectors

Industrial production	✓ Manufacturing of equipment (components of the Electricity Transmission Grid, Electricity Distribution Grid, power plants) ✓ Upgrading of production processes ✓ Use and maintenance of new equipment
Constructions	✓ Energy rehabilitation of residential and service buildings ✓ Installation and maintenance of electrical equipment ✓ Development of decentralized generation plants
Transport	✓ Development of railway and port infrastructures (rail electrification, green harbors, etc.) ✓ New logistics services related to the increased integration of solutions for inter-model freight transport
Automotive industry	✓ Manufacturing of electric vehicles, batteries and other components ✓ Development of recharging infrastructures ✓ New business models (common mobility, etc.)
Energy services	✓ Operation and maintenance of new equipment ✓ New business models (balancing production and consumption, aggregation of demand, etc.)

Source: Deloitte analysis

b. Impact on the environment

Figure 24 - Evolution of GHG emissions in Romania, 1990-2016 [m t CO_2 eq.]



Source: National Inventory of Greenhouse Gas Emissions

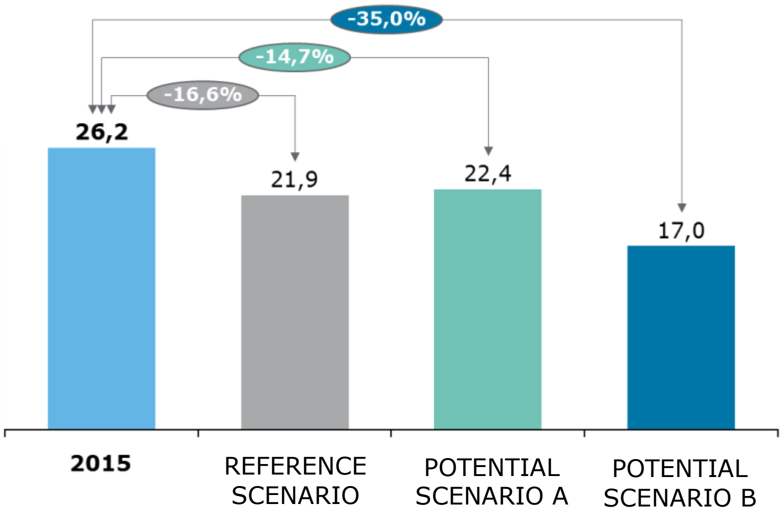
The accelerated decrease of GHG emissions has been the result of a complex process of transformation in the industrial sector; it is expected that this downward trend will be significantly lower in the period 2021 – 2030 compared to the period 1990 – 2016.

The quantities of **greenhouse gases (GHG)** generated according to the 3 analyzed scenarios are presented in descending order compared to the reference year 2015, when the GHG quantity was 26.2 m t CO_2 equivalent.

For the *Reference scenario*, which forecasts a share of RES of 32.4%, the GHG quantity would decrease by 16.6% to 21.9%. *Potential scenario A*, with a target share of RES of 35% in the final energy consumption, could lead to a decrease in the GHG quantity by only 14.7%, while *Potential scenario B*, for which the share of RES in the final energy consumption is only 0.5% higher than the previous scenario, namely 35.5%, the quantity of GHG emissions would decrease by 35%.

The significant difference in terms of GHG emissions between *Potential scenario a and Potential scenario B* is mainly explained by the surplus of nuclear energy generated by units 3 and 4, unlike in the case of *Scenario A*, in which these units will not be built.

Figure 25 - Evolution of GHG from the production of electricity in each scenario, [m t CO2 eq.]

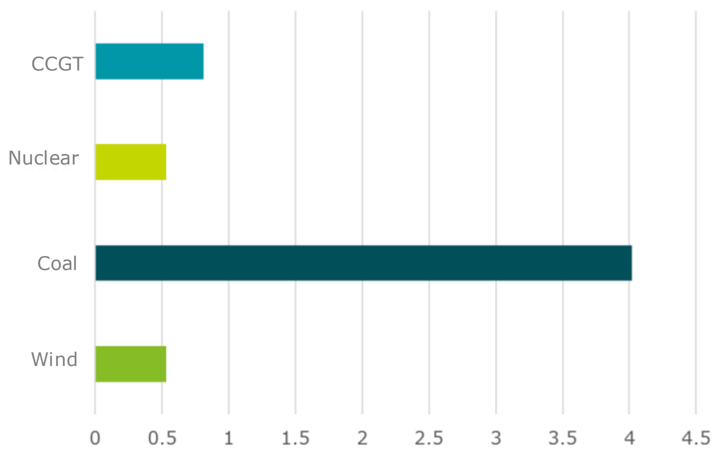


Source: Deloitte calculations

Particulate matter PM10 (Particulate matter 10 micrometers or less in diameter), especially produced by the burning of coal, represents a factor that significantly contributes to air pollution. It may have negative effects on the environment, while inhalation may cause respiratory issues.

The figure below presents the quantities of PM10 emissions for the production of one Kwh of electricity from traditional and renewable sources in Romania. With a quantity of only 0.5 kg/10^5 released further to the production of wind energy compared to 4 kg/10^5 released during the burning of coal, it may be seen that RES development would contribute to the elimination of the negative impact generated by PM10 emissions.

Figure 26 - PM10 emissions for the production of one Kwh of electricity in Romania [kg/10^5]



Source: RWEA

IV. Main obstacles and challenges related to reaching a high share of RES in 2030

The analysis of the main obstacles and challenges related to reaching a share of RES in line with the natural potential for use of renewable energy sources in Romania (82 GW[8], thus exceeding the required capacity – 26.6 GW – by 3 times to reach an ambitious target of 35%) has considered the characteristics of the current regulatory framework in the sector, and the legislative framework related to the tax rate applicable to producers of RES-E.

The main obstacles identified further to the analysis may be summarized as follows:

1. The current market rules and mechanisms do not offer a trading framework (electricity and green certificates) adapted to the specific character of the production of electricity from renewable sources;

2. The access of developers to the grid is subject to the fulfilment of excessive technical conditions, coupled with lengthy and complex administrative procedures, which also imply significantly higher costs than those at national level (compared to traditional technologies) or European level;

3. The unstable fiscal and regulatory framework generate additional costs, which affect the profitability of existing power plants and discourage potential new investors;

On the other hand, the contribution of renewable energy sources could be essential in Romania's answers to reaching the targets provided for in the legislative package "Clean energy for all Europeans", particularly given the ETS emissions. In this regard, expanding the geographical area for this resource outside of Dobrogea is a challenge.

[8] Deloitte calculations

a. Characteristics of the current electricity trading framework

One of the most significant current obstacles to the development of renewable energy sources is the available trading framework in Romania. It lays down selling and buying rules which make activity difficult or increase the costs of producers of electricity from renewable sources. In line with OPCOM rules, a producer of this type – with units with installed power exceeding 3 MW - should contract on the wholesale market a firm quantity of electricity with a pre-established time profile in contrast with the variable nature of its production.

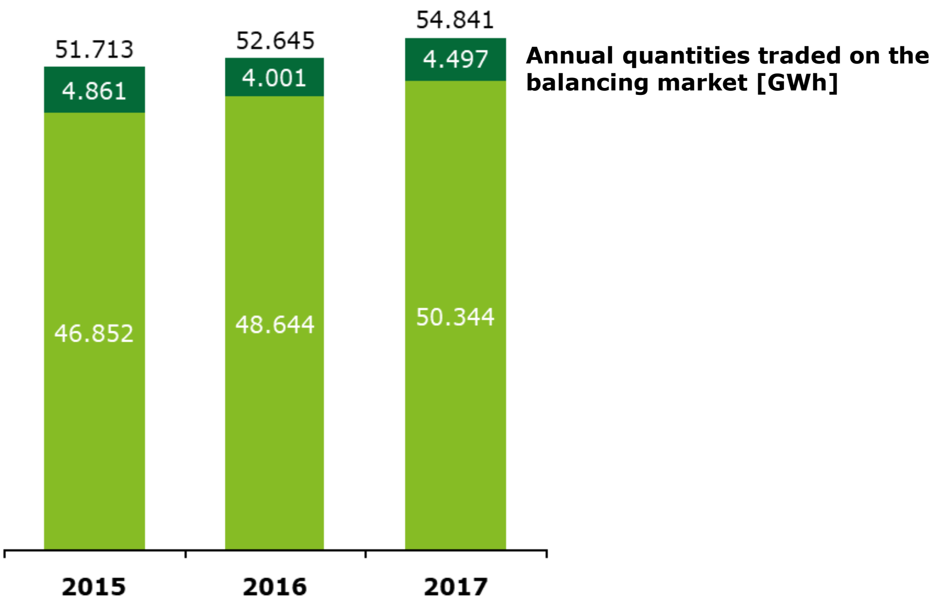
The impossibility of supplying the contracted energy (due to reasons related to the weather forecast or group availability) is severely penalized on the balancing market.

On the other hand, producers and suppliers of electricity which operate on the retail market in Romania conclude supply contracts with domestic and/or non-domestic customers, which are based on variable profiling depending on the consumption of these customers (with significant differences between the time slots of the same day). The contracts concluded on the retail market may be terminated unilaterally by end customers, without any penalties applied, subject to a 21-day prior notice.

On the wholesale market, even if the notice period were similar, the option of the unilateral termination of contracts implies the payment of penalties, which significantly increase the trading costs of the market participants. Moreover, the sale/ purchase of electricity on the markets operated by OPCOM is accompanied in most cases by the obligation of submitting security instruments, which contribute additionally to the increase in trading costs.

The inadequacy of the trading framework is also the result of the size of the balancing market. A balancing market on which the traded quantities (presented below) are significant is the proof of its non-adjustment to the needs of the market participants, which generates additional costs.

Figure 27 - Size of the balancing market in total consumption, [GWh]



Source: ANRE, Annual report of ANRE's Activity - 2017 and Electricity Market Monitoring Report – December 2017

b. Limited access to the grid – issues related to the physical infrastructure and system

For reasons related to the safe operation of the National Energy System (NES), Transelectrica uses, through an operational procedure, a calculation methodology[9] for the power received from wind power plants and photovoltaic power plants based on the availability of the fast tertiary reserve both for increase and decrease.

Moreover, using the same calculation criteria, the procedure aims at assessing the influence of the installed power in the wind power plants and photovoltaic power plants on the evolution of the required reserves in NES in the following year, but also at indicating the power produced by the wind power plants and the photovoltaic power plants that may be received within the activities regarding the access of the wind power plants and photovoltaic power plants to the grid in terms of the balance between production and consumption at NES level.

Thus, the current regulatory framework exclusively allows the installation of new wind and photovoltaic power plants depending on the availability of resources and of the hydroelectric power plants/ power plants operating on natural gas (the two sources may be regarded as suppliers of the fast tertiary reserve).

[9] See the Operational procedure regarding the establishing of the power produced in wind power plants and photovoltaic power plants, which may be received subject to the safe operation of NES, TEL code -07.38

Even in the case of the unlimited integration of RES in the grid in terms of safe operation, the condition of the infrastructure used to receive the energy generated by wind power plants and photovoltaic power plants is not optimal, according to the findings of annual reports on the achievement of the performance indicators for electricity transmission, system and distribution services[10].

The electricity transmission and distribution infrastructure is facing shortcomings and challenges from a technological point of view; significant investments are required both as regards the upgrading and digitalization and the reinforcement, extension and increase in the interconnection of the transmission grid.

Most of the current equipment of the electricity transmission and distribution grid has operated for over 35 years. However, upgrading actions have been taken only for a part of the infrastructure. Thus, according to official reports:

- High-voltage electricity transmission and distribution lines commissioned after 2000 only account for 2.3% / 3.8% of their total length
- Of 81 transmission substations, 8 were retrofitted in 2017
- 57.2% / 27.9% of the installed power of transformers/ autotransformers in the transmission/ distribution substations were commissioned after 2000

Table 2 - Percentage of equipment commissioned after 2000 [%]

	HV	MV	LV	Transformers/ Autotransformers
Transmission electricity grid	*2.3*	*-*	*-*	*57.2*
Distribution electricity grid	*3.8*	*10.1*	*18.4*	*27.9*

Source: ANRE report on the achievement of the performance indicators for electricity transmission, system and distribution services and the technical conditions of the transmission and distribution grids, 2017

c. Costs for connection to the grid

According to RWEA, the costs for the reinforcement of the transmission grid (included in the general connection costs) in the case of a large wind farm may reach 120,000 EUR/MW, which represents an effort of approximately 10% in addition to the initial costs with equipment, materials etc.

According to the study by ENTSO-E "Overview of Transmission Tariffs in Europe: Synthesis 2017"[11], costs for connection to the grid in ENTSO-E member states may be divided into three categories: super-shallow - all

[10] See http://www.anre.ro/ro/energie-electrica/rapoarte/rapoarte-indicatori-performanta
[11] https://docstore.entsoe.eu/Documents/MC%20documents/ENTSO-E_Transmission%20Tariffs%20Overview_Synthesis2017_Final.pdf

costs are socialized via the electricity transmission tariff, shallow - applicants pay for the infrastructure connecting the unit/ installation (OHL/ cable, other necessary equipment) and deep - which reflect the above-mentioned costs plus the reinforcements/extensions required for the grid to receive the connected power.

Of the 35 ENTSO-E member states, only 9 (among which Romania as well) apply a significant connection charge/ cost. In this regard, the situation of new electricity production units should be analyzed – as they are the ones which have to fully cover the costs for the reinforcement/ extension of the grid/ grids (including the distribution grid) compared to older units, which are exempted from the payment of this cost/ charge.

d. Unpredictable fiscal framework

A recent example in this regard is the proposal for amendment of the Fiscal Code to include the towers supporting the wind turbines in the category of buildings for which the authorities of the local public administration may charge local taxes and duties.

Another recent example is Government Emergency Order No 114/2018, which provides for the obligation of producers to pay a contribution of 2% of the turnover (for supplies of electricity).

e. Slow progress of digitalization

Digitalization has wide ramifications in the improvement of operational issues along the entire value chain of electricity, increasing the efficiency of the system operation through its multiple applications and uses – an example in this regard is the demand response management, a set of operations which actually contribute to reducing the weight of the balancing market in total transactions and, implicitly, of the costs incurred by producers, suppliers and end customers.

The digitalization rate in the Romanian energy system is slow as a result of the reluctance of the regulatory authority to assess the benefits of the process other than from the perspective of initial high costs.

Thus, the implementation of a basic component of digitalization – smart metering – has been successively postponed, 2028 being its current term for completion.

f. Geographical expansion of the resource

One of the particularities of NES is that almost the entire production of energy from renewable sources is located in Dobrogea. One of the many effects of this geographical concentration is the fact that wind production varies often across a wide power interval, from zero to almost close to the installed capacity.

The absence of wind farms in areas such as Moldova or Banat, where the natural potential has become sufficient as a result of technological progress means that the level of safety and continuity of NES operation is not maximal. Given the rapid and significant variability of wind conditions in a relatively small area, the transmission operator is subject to technical stress, which in the long run should be eliminated. Thus, during the periods of strong wind in Dobrogea, Transelectrica must evacuate to the west/ north-west part of the country approximately the entire wind and nuclear energy produced in Romania. On the other hand, when wind intensity decreases, the National Energy Dispatcher must order rapid increases of power, which negatively affects the lifecycle of those energy units.

Under these circumstances and as mentioned above in the analysis of the evolution of GHG emissions in Romania, the actual improvement in the period 1990 – 2016 was due to the transformation of the industrial sector. As this means has exhausted its potential, in the future, RES investments will be necessary to maintain the decrease in GHG emissions.

These investments will be, however, possible only if the challenges generated by the absence of a favorable framework for their implementation are overcome. A stable and adequate framework that promotes and encourages investments gives investors confidence and later reflects in a minimum cost of capital and, implicitly, in a sustainable contribution of the energy sector to the national decarbonation targets.

V. The main factors that will support the integration of a high share of RES

A share of RES of 32%, established further to interinstitutional consultations at European level in June 2018, requires a review of current regional and national policies and measures.

Under these circumstances, the approach towards the achievement of this share must be based on stable regulations, efficient market mechanisms and the development of technologies. These elements will contribute to a development of RES that is as efficient and effective as possible from the perspective of costs and acceptance at institutional and public level in Romania.

The main assessment, determination and monitoring tool for the targets established at European level in terms of decarbonation, energy security, energy efficiency, market rules and, not least important, renewable energy will be represented at national level by the National Integrated Energy and Climate Change Action Plan (NIECCP).

The objectives, policies and measures included in this plan, coupled with the financing mechanisms/ instruments used to support them, will mainly determine the path of the Romanian energy sector by 2030.

Given, in particular, the recommendations of the Commission regarding the assumptions that must be considered upon the preparation of the National Plans, the main factors/ pillars that will support the integration of a high share of RES in Romania are, in our opinion, the regulatory framework, the transition support mechanisms and technological development. The related measures need a consistent implementation framework, irrespective of RES LCOE convergence with other traditional sources.

Against a background of more mature technologies, the increase of living standards and of the quality of life, the increase of the awareness of all stakeholders regarding decarbonation as a main factor of the fight against climate change, a set of other policies/ measures – complementing the above - may be implemented in line with the level of the Romanian economy's convergence with the economies of developed countries.

However, in contrast to national/ regional policies, in the period of transition to an energy sector/ economy with a low intensity of greenhouse gas emissions, local authorities may take charge and adopt more rapidly measures at local level. Thus RES will benefit from an additional impulse determined by the fight against the effects of pollution or other factors that affect the quality of life in those towns/ cities.

a. Regulatory framework for RES integration

The remodeling and adjustment of the electricity market in Romania is an essential step towards the increase of the share of RES in the final energy consumption.

Market participants, especially on the wholesale market, are exposed to unpredictable factors, which may generate an increase in consumption, caused, for example, by extreme temperature or energy poverty, for example as a result of adverse circumstances for electricity production in hydropower plants further to low water levels on the Danube. Thus, new regulations and viable options will be necessary for real protection against risks in order to reduce the volatility of the market.

Moreover, the adjustment of regulations to respond to new technologies with the potential to significantly contribute to the progress of energy systems will be a step towards the modernization of the market.

Consequently, the measures aiming at the improvement of the market design will ensure a flexible circuit of electricity and will help to obtain undistorted prices, encouraging the operation of energy reality on solid footing.

For this objective to be met, the current national regulations need to be reviewed and supplemented with updated measures in line with the provisions of the "Clean Energy Package".

<u>European directors to be implemented at national level:</u>

i. Provisions for participants on the internal energy market

1) Producers of electricity

The provisions of Law No 184/2018 will contribute to a more efficient sale of energy and will implicitly result in an advantage in terms of costs for end consumers due to fewer unbalances in the system. Thus, pursuant to the new law, 2 or several producers of energy from renewable sources (irrespective of the technology used) may participate on the competitive energy markets together, as a single aggregated entity, with a view to the improvement of financial and production performance.

2) Electricity transmission and system operators

Pursuant to the European provisions (Proposal for EU Regulation - COM(2016) 861), transmission system operators should set up a framework for cooperation and coordination between regional operation centers[12]. Moreover, operators must ensure that the purchases of balancing services[13] are transparent, non-discriminatory, based on market mechanisms and ensure the actual participation of all market participants, including RES, energy storage units and aggregators. Operators will not be eligible to own, manage or operate storage units and control entities which supply ancillary services[14].

3) Electricity distribution operators

The activities of electricity distribution operators will have to include, among others, the integration of electric vehicles, data management and the purchase of grid services to ensure flexibility. Such flexibility services may improve the efficiency of distribution grids through the elimination of the need for expensive grid updating. Operators will have to prepare grid development plans that include the investments planned for the next five to ten years.

4) Aggregators

The Romanian State will have to ensure the participation of aggregators on the retail market, without any obligation to obtain the consent of other market participants and without the payment of compensation to suppliers or producers. Furthermore, the State will have to establish clear rules that assign roles and responsibilities to all market participants, to lay down rules and procedures concerning the data exchange between market participants and to set up a conflict settlement mechanism.

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[12] Regional Operation Centers are entities involved in the coordination of the cross-border operation of the electricity grid, provided for in the proposed regulation on the internal market for electricity (COM (2016) 861).

[13] "Balancing services" ensure that the volume of supplied electricity is equal to the demand for electricity in real time (or close to real time).

[14] The proposed directive defines an "ancillary service" as a service required for the operation of the transmission system, including balancing.

5) *Local energy communities*

Pursuant to the European provisions, a framework will be implemented for local energy communities, which will have the right to become involved in local electricity generation, distribution, aggregation and storage services, as well as in energy efficiency services. Local communities will have access to all organized markets and will have the right to establish, lease and manage community grids.

The main responsibilities of local energy communities in the context of energy transition

- Development of RES power plants, including VPPs
- Extension and improvement of the infrastructure for the electricity grid
- Extension and stimulation of the range of services in the field of energy efficiency
  Policy and social inclusion of local energy communities

6) *End customers*

Pursuant to the new European provisions, the market design will include a set of <u>extended or even new rights for end consumers of electricity</u>.

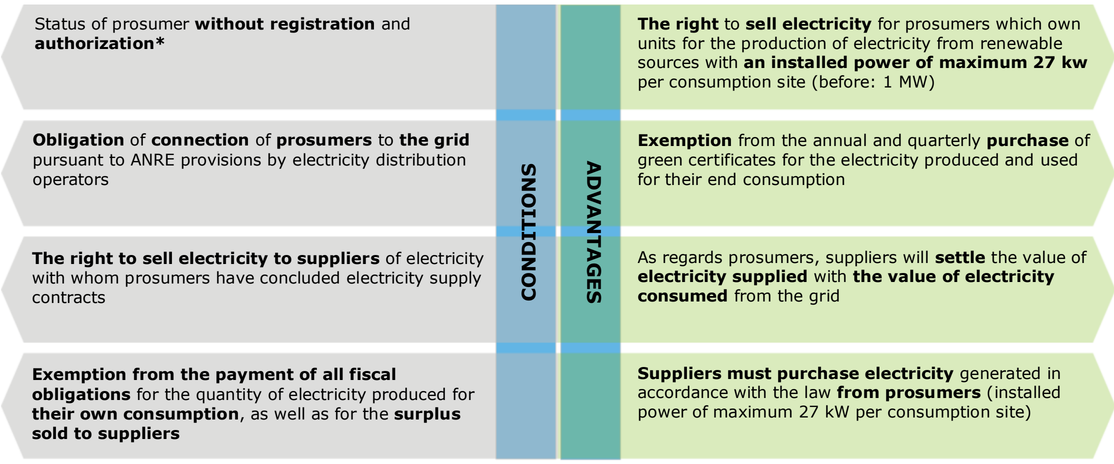
- The choice of electricity supplier or aggregator must be free
- There should be no charges for changing the supplier, except for the cases where a fixed-term contract offering provable benefits for the customer is terminated early
- The involvement of the customer through the adjustment of the demand, own generation, own consumption, storage and sale of electricity - on an individual basis or through an aggregator
- Information available to customers on opportunities and risks of a contract based on dynamic prices
- Encouraging customers to participate on the organized markets by the national regulatory authorities
- Defining the technical means of participation in the adjustment of the demand by the regulatory authority
- Updating of rules on out-of-court settlement of disputes
- Integration of rules that include clearer information on billing: bills must be clear, correct, concise and comparable
- Billing information must be supplied at least twice a year or at least once a month in the case of remote meters
- The obligation of authorities to introduce smart metering systems with a view to the customers' participation on the electricity market
- Pursuant to the current legislation, this provision does not apply if, further to a cost-benefit analysis, smart metering systems are found to be uneconomic

- However, each customer has the right to request a smart meter, which should be installed in equitable and reasonable conditions within three months as of the date of the request

7) *Prosumers*

By adopting Law No 184/2018, the Romanian State has introduced new provisions for end consumers which produce electricity:

Figure 28 - Prosumers in Romania after the adoption of Law No 184/2018



***Location of equipment by** prosumers - in their own buildings, including apartment buildings, residential areas, shared, commercial or industrial service sites or within the same closed distribution system

Source: Deloitte analysis based on the provisions of Law No 184/2018 and related secondary legislation

8) *Regulatory authorities*

With a view to interconnection, the obligation of the national energy regulatory authorities to cooperate with regulatory authorities of the neighbouring countries and with ACER in respect of cross-border issues has been considered. National regulatory authorities should ensure the maximization of interconnection capacities made available.

Moreover, the Clean Energy Package provides for the setting-up of a "one-stop-shop" mechanism for the coordination of the entire approval process in respect of the generation, transport and distribution of new RES capacities. The responsible authorities will have to observe a maximum 3-year period for the approval of these capacities and a period of maximum one year for the applications related to the recommissioning of existing RES units (or six months if the requests have no adverse impact on the environment). As regards new capacities, a simple notification procedure will apply to all RES projects and units with capacity below 50kW for connection to the grid.

ii. Balancing market

The Balancing Market (BM) ensures non-discriminatory participation based on the various technical capacities for production of energy from variable renewable sources, consumption and storage by:

- Organizing transparent purchase procedures, subject to confidentiality obligations
- Ensuring information on balancing prices in real time
- Allowing bids as close as possible to real time, thus reducing the need for expensive action by the system operator to maintain stability
- Clearing unbalances at a price which reflects the value of energy at the time of its production
- Using the available capacities after the closing of the IM to compensate for possible unbalances

The strengthening of regulations for balancing and short-term markets will increase available liquidities and encourage participation of several types of resources, especially flexible ones.

iii. Day-Ahead and Intraday Markets

Short-term markets are affected by organizational shortcomings primarily through the lack of agility under the new circumstances, as participants must adjust their portfolios more frequently, on a short decision-making term, and, secondly, through the fact that they do not offer equitable opportunities for all types of resources – traditional power, RES, storage, demand.

The principles reflecting the correct foundations of the market and ensuring a transparent, non-discriminatory framework, which observes the confidentiality of the transactions must be also strengthened for DAM and IM markets, while system operators must be able to develop trading products adapted to local realities.

Recommendations:

- Developing options to conduct transactions in real time or as close to real time as possible
- Ensuring that trading is possible during time periods at least as short as the period required to remedy an unbalance
- Gradual harmonization of products and trading closing times

The harmonized sequence of spot and forward markets (DAM, IM and BM) will allow the trading of resources across all time slots, thus contributing to the optimization of prices and the overall system in the short run, reflecting the real value of electricity and configuring long-term investment signals.

More mature markets will also result in positive effects for the participation of RES entities. Through the specificity of the production process, the accuracy of their forecasts is relatively narrow, displaying an acceptable degree of certainty only shortly before the actual production due to the weather conditions.

Thus, setting-up short-term markets with solid bases will become essential with a view to ensuring the sustainability of RES participants.

iv. Forward markets

The principles of operation must offer new options for protection against volatility mainly by replicating risk management instruments of developed markets.

- Implementation of hedging instruments to manage risks. They work through the contracting of a fixed price for a certain period, thus protecting the parties from violent price fluctuations. The introduction of these options would increase the predictability of the market operation and support companies in managing the risk of not obtaining the future yield of investments
- Implementation of forward solutions, particularly as regards producers which use renewable technologies

v. Capacity mechanisms

In order to prevent a possible deficit of electricity, states may set up various types of capacity mechanisms. They may vary conceptually, but all offer suppliers of capacity additional revenues to make electricity capacity available.

At European level, the sector inquiry has revealed two types of mechanisms: targeted mechanisms, which offer additional capacities without subsidies, and market mechanisms, which must observe reliability standards.

The mechanisms must be properly organized in order not to lead to the restriction of the participation of suppliers or technologies or overcompensation, which may result in the artificial increase of prices. The European Commission recommends, as a priority, the application of market reforms to ensure the security of supply before or simultaneously with the introduction of a mechanism of this type.

<u>Recommendations:</u>

- Detailed definition of capacity mechanisms depending on eligibility (who may participate), allocation (who sets the price and how suppliers are selected) and concept of the product (obligations and sanctions imposed on capacity suppliers);
- In order to minimize the potential distortion of competition, an open process for the selection of capacity suppliers and additional

protection measures are required (a transparent process for trading of certificates);

- Capacity mechanisms must ensure incentives for reliability and avoid a major split from electricity deficit prices;
- The introduction of reliability options for long-term adequacy, where participants receive a capacity regulated revenue, but give up the possible profits from high deficit prices;
- The maintenance of strategic reserves for temporary risks, outside the market;
- The observance of CEP recommendations, particularly the possible introduction of a limit for equivalent CO_2 emissions for technologies which qualify for the capacity market.

vi. Virtual Power Plants

Virtual power plants will be able to include units for production from photovoltaic, wind, hydro, natural gas or combined electricity-heat sources, most with a RES profile. Their decentralized geographical and administrative location may be approached within a VPP system, which may be augmented through the connection of small-sized (local communities) or large-scale storage elements, as well as through the interaction with electro-mobility elements.

The smart control of these elements may uniform the predictability of RES supply, with energy supplied fluidly and profitably from an economic point of view, without overloading the grid.

<u>Operating mechanism:</u>

- VPP calculates the quantity available for trading through the combination of factors such as available capacity, forecast of general demand and forecast of renewable energy production
- The optimization system orders the allocation of capacities depending on the needs of the various markets and will compensate regional differences between production and consumption through the injection or absorption of energy in or from the grid

VPP will also allow the granular segmentation of consumers by consumption, geography, etc, to optimize analytical details and increase the accuracy of forecasts and may include spot and derivative trading instruments.

Table 3 - Virtual Power Plants - Advantages and precautions

Advantages	Precautions
The harmonization of production and consumption of energy	A mandatory scalable infrastructure to support peak periods
The diminishing of price fluctuations	The possibility of replacing hardware and software components without interrupting operation

The increase in the security of supply

The protection against increasingly frequent cyber-attacks

The management of a wide range of sources of energy production irrespective of the technology used and without restricting the participation of small companies

The connection of power plants with renewable production sources

Source: Deloitte analysis

b. Financing mechanisms/ instruments

The convergence of total levelized cost of production from renewable sources with the similar costs of traditional sources is a process which may be conducted faster or slower, depending on the potential and initiatives of each EU Member State.

In the context of the congruence of the national RES potential with the downward trend of technology costs, Romania may continue to support capacities for production from renewable sources by ensuring a favorable regulatory framework that allows the development of adequate financing mechanisms/ instruments both for investors and consumers.

Financing mechanisms/ instruments must play a role in terms of the security offered to investors from the standpoint of financing costs and risks posed by a wind electricity production project.

Within LCOE, the financing cost accounts for a significant share, alongside the cost of initial capital, the operating and maintenance cost (O&M) and the capacity factor. While technological development will lead to a decrease in the costs of required initial capital, the decrease in O&M expenditure and the increase of the capacity factor, financing costs must be minimized through adequate financing mechanisms and instruments.

i. Support and financing initiatives at national level

1) Power Purchase Agreements (PPAs) concluded with end customers

Power Purchase Agreement (PPAs) are one way of promoting RES and particularly wind and solar energy. Typically, a PPA is a bilateral contract for the long-term supply of energy concluded by the end customer (the buyer) and the energy producer (the seller). The agreement provides the supply of an hourly quantity of electricity (with the related guarantees of origin) depending on the consumption profile of the end customer.

According to the Deloitte study "Global renewable energy trends – Solar and wind move from mainstream to preferred", the quantity of RES electricity purchased/ produced at global level amounted in 2017 to 465 TWh (compared to Romania's consumption of 54.6 TWh in the same reference year).

PPAs, which cover a significant percentage of the above-mentioned quantity, become preferred instruments to secure electricity particularly by large companies. Thus, according to the same study, 66% of the companies present in Top Forbes 100 set targets regarding the share of RES in the consumed energy and many of them joined RE100, a group of 140 companies (September 2018) undertaking to purchase 100% of consumption from renewable sources.

<u>Advantages for the end customer (buyer):</u>

- A means of purchasing energy from renewable sources for buyers willing to use RES exclusively
- The possibility of negotiating the contractual terms directly
- Independence and protection against energy price fluctuations during high demand periods
- Long-term price stability
- The diversification of supply partners – lower risk of interruption of power supply

<u>Advantages for the producer of electricity (seller):</u>

- Guaranteed revenues for the generation of electricity from renewable sources in the long run
- The possibility of negotiating the contractual terms directly
- Support for RES investments already made
- Financing of future projects – an alternative for public support schemes
- Strengthening of solvency – better financing terms
- Facilitating the entry on the energy market
- The diversification of sale partners – lower risk of non-payment

For more information on PPAs and the related operating mechanisms, please see the Annex, which includes, from the practices at European level, the description of 3 types of PPAs for the sale of energy from renewable sources.

In September 2018, ANRE launched the process of public consultations regarding a Regulation on the organized trading framework on the centralized market for the award of power supply contracts for very long periods – which, at first sight, are similar to PPAs.

The regulation, in its draft form, provides – as an element of novelty in the transactions on the wholesale market in Romania – for the possibility of economic operators which have concluded a connection contract with a grid operator concerning the connection of an electricity production unit or combined heat and electricity production unit to generate the electricity to be traded based on the concluded contract on the long-term centralized market.

The initiative seems to be a step forward in the attempt at creating favorable conditions for investors in new production units (given the possibility for this contract to be used as a security instrument for cash flows before a bank/ financing institution and the possibility for the contracted price to be adjusted upon delivery by reference to the date of conclusion of the contract through the use of specific indicators published by the electricity wholesale market operator for the centralized electricity markets).

However, the trading framework provided for under Article 4 (2)(f) provides that the *bid* must include well-defined characteristics regarding the quantity of electricity offered for purchase/ sale, the time slots for supply, the contractual term, the requested/ offered price and the supply terms, the payment and security, firmly established upon their placing on the market.

Under these circumstances, the attractiveness of this trading instrument for market participants appears to be limited, also in light of the failure of another instrument launched a few years ago – contracts for the market of large consumers (with similar bidding characteristics).

Other project limitations which should be settled or even eliminated are:

1. The impossibility of implementing all versions of PPAs. "On-site" or "near site" contracts cannot be signed even if, through such contracts, certain grid-related costs decrease or are eliminated;
2. Profiling production is discriminatory and eliminates producers of renewable energy;
3. The limit of at least 3 participants to submit bids (free negotiation is proposed below);
4. Participation fees must allow the unprohibited access to the market. The existence of a connection contract is restrictive given the high connection costs;
5. Total transparency of the contract is unacceptable;
6. The signing of a contract without knowing the partner may be incompatible for companies listed on the stock exchange and not only for them;
7. The duration of a PPA implementation process is not determined;
8. Certain parties usually involved in a new energy project, for example the financing institution and law firm, are excluded from this process;
9. There can be no aggregators;
10. The fixed contractual term - a certain contract validity terms is required (for example, a fixed term of 10 years, with an option for extension by 4 years).

2) Contracts for difference (CFD)

The support mechanism of the Contracts for difference (CFD) considers the development of energy projects with low carbon emissions. In line with the new targets set by Romania within the National Integrated Energy and Climate Change Plan for 2030 concerning the share of energy from renewable sources, the mechanism may offer adequate support to meet theses targets.

The mechanism ensures long-term security for producers of energy from renewable sources, with low carbon emissions. In this way, producers will receive funds from the Romanian State if the price of electricity on the market decreases below a certain threshold. If the price exceeds that threshold, producers will have to repay the difference.

The implementation of a CfD mechanism may offer additional benefits and an attractive and predictable environment for investors because:

- It creates a higher degree of revenues certainty and stability through the elimination of the exposure to volatile prices on the wholesale market
- It avoids overcompensation of producers when the price of electricity exceeds the value of the exercise price
- It protects producers against price fluctuations on the market
- It protects consumers against the support-related payment when the price on the electricity market increases;
- It guarantees a contractual understanding under the law for a pre-determined period, which offers a reasonable level of flexibility for project developers and protection against unforeseen changes;
- It offers a high level of safety for investors: Once the contract has been signed, investors may implement the projects, without being affected by policy-related risks or by the fact that market developments could critically affect the profitability of the projects.

In order to support the necessary investments, the CfD mechanism must create a clear and transparent framework that responds to the long-term risks to which investments are exposed and offer confidence and predictability to investors.

In conjunction with the evolution of withdrawals from service of certain units and against a background of the need for additional units (determined by the increase in demand), new production units could benefit from the CfD based on auctioning, which means that the support would be directed to the smallest price offered by an investor/developer (irrespective of the technology used).

The transition from fixed subsidies for RES to establishing them through competition is an advantageous mechanism particularly as regards costs as it determines a more efficient allocation of capital expenditure in the context of the establishment of RES production units.

Tendering procedures to obtain funds for RES projects have already been implemented in several EU Member States, such as Germany and Spain. Given these examples within the EU, it is reconfirmed that the auctioning system may speed up the integration of a high share of RES on the electricity market and may result in a significant cost reduction within the entire support system.

3) Green Bonds

"Green Bonds" are a means of promoting projects involving energy from renewable sources, which first appeared in 2014. These financial instruments are issued by organizations, financial institutions and other enterprises, particularly operating in the energy sector, which intend to finance RES projects.

Since 2015, the green bond market has been strongly growing at global level and especially in the United States. However, the market is still young and investors continue to allocate a small part of their capital for RES investments and sustainability.

Although the yield of green bonds is low compared to other high-risk financial instruments, they are more frequently used on European markets as well. In Central and Eastern Europe, five countries have already entered the green bond market, with a subscription volume worth 2.3 billion EUR. Therefore, the upward trend may be also noted on the regional market and is determined by the investors' increasing demand.

For the market in the region, there are three main types of green bonds: those issued by the Government, by the public sector/ State companies and by the corporate environment, while the market growth potential is determined both by a regulatory framework favorable to RES development and by the investors' awareness of the support of sustainable development options.

In Romania, the potential for the development of a "green" bond market is coupled with the appearance of preferential factors, such as initiatives by the Government, a stable legislative framework and the adjustment of the investors' preferences, which would result in a favorable investment environment. Moreover, the relevant European legislation will encourage a series of national initiatives so that RES targets could be met and will also stimulate a rethinking of the players on the capital markets in favor of more extensive activities of investment in RES, among which the issuance of "green" bonds.

ii. Support and financing initiatives at EU level

For the period 2014-2020, European Structural and Investment Funds (ESIF), through the Operational Program Competitivity and Cohesion, and in particular Priority Axis 4 for "promotion of energy efficiency and renewable energy resources" have set the declared goal of investing in energy efficiency and promoting the use of RES. For the analyzed period 2021-2030, the EU will have to supply the necessary instruments in order to allow the continuity of ESIF and related programs so that the proposed RES targets could be met at European level.

In this regard, the new program InvestEU will unite the multiple support mechanisms of the European Union offered to Member States. InvestEU will run between 2021 and 2027 and is considered to a follow-up to ESIF. Under InvestEU, the European Union will continue to promote public and private investments in Member States, addressing the failures of the market and the lack of investments in order to implement the EU policies, with the achievement of RES targets being a priority. A main advantage of this coherent program is the integrated governance of projects under InvestEU. In this way, the program will be able to implement a multisectoral approach by incorporating several instruments in a single structure.

Furthermore, the legislative "Clean Energy Package" proposes a set of cooperation mechanisms aiming at speeding up cross-border cooperation between EU countries (and with countries outside the EU). These mechanisms may materialize as follows:

1) ***NER 300: financing of demonstration projects related to innovative technologies in the field of renewable energy sources***

NER 300 is a funding instrument based on the revenues available further to the auctioning of 300 million of carbon emission allowances. The funding supplied within the program is not part of the general budget of the European Union. Therefore, it may be combined with funding from other instruments, including structural and cohesion funds and the European Energy Program for Recovery (EEPR). It may also be combined with loans under the Risk-Sharing Finance Facility – RSFF set up by the Union and the European Investment Bank (EIB).

Furthermore, the funds will be reserved only for projects that use innovative technologies by reference to the current state of technology in the main sub-branches of each technology (for example: storage). These technologies must not yet be available on the market, but they must be sufficiently mature to represent a demonstration project at pre-commercial scale. They must also have a high potential for multiplication and, consequently, offer major perspectives for the profitable reduction of CO_2 both at EU and at global level.

2) ***Modernization Fund***

The revised EU Directive has established a few financial mechanisms starting with Phase 4 (2021-2030) for 10 low income Member States (including Romania):

- Modernization Fund

- Transitional free allocation for the modernization of the energy sector (Article 10c)
- Allowances distributed for the purposes of solidarity

The primary objective of the Directive is to support the 10 Member States as regards the modernization and decarbonation of their energy systems.

Member States which opt for Article 10c must publish a detailed national framework laying down the competitive bidding process by 30 June 2019, while the decision for the transfer of a part or all allowances to the Modernization Fund must be made by 30 September 2019.

Romanian will receive 12% of the Modernization Fund (at least 27 million allowances) for the modernization of the energy sector, energy efficiency and just transition in carbon-dependent regions.

If the price of a tone of carbon dioxide were 25 EUR, Romania would have at its disposal an amount equivalent to over 900 m EUR[15], which would have to be directed to projects considered priorities and which may benefit from 100% funding.

3) Projects of common interest (PCI)

Projects of common interest (PCI) are another cooperation mechanism for the strengthening of the European energy sector. These projects will contribute to the achievement of the final goals of the Energy Union: ensuring accessible, secure and sustainable energy for all Europeans. This mechanism applies particularly to common projects which refer to the consolidation of the European energy infrastructure through grid interconnection.

5 projects from Romania have been promoted and included on the list of projects of common interest as part of Priority Corridor No 3 on electricity: "North-South Electricity Interconnections in Central Europe and South Eastern Europe".

According to Transelectrica, their implementation, together with the projects included in the Plan for the Development of the Electricity Transmission Grid for the period 2018 – 2027, will lead to the achievement of the interconnection target of 15% for 2030.

c. Technological development

According to the study "Technology pathways in decarbonization scenarios", prepared within a project financed from European funds – ASSET (Advanced System Studies for Energy Transition), the

[15] Eclareon, "EU Support for the Energy Sector in Romania", presented during the workshop organized by the European Commission on 14 November 2018 in Bucharest (source: https://ec.europa.eu/clima/events/technical-workshops-eu-ets-funding-mechanisms-modernising-energy-sector-including_en)

assumptions regarding the development of technologies, in terms of cost and yield, are essential to determining the impact on the targets considered in the long run, but also on the decarbonization of energy systems.

In this regard, alongside e-fuels (CH_4 and other complex hydrocarbons, as well as H_2 generated from decarbonized electricity), the evolution of future configurations of wind turbines, the energy storage technologies and the digitalization of transmission and distribution grids play a crucial part in the development and integration of RES within the system.

i. Technical potential of wind turbines

From the setting-up of the first wind farm in Romania in 2010, wind energy has seen an expansion trend and continues to have a significant potential for growth both at national and European level. In 2017, wind energy was the technology with the largest extension of installation capacities in the EU, while, within all new installed capacities, wind energy accounted for over 55% (15.6 GW).[16] Moreover, from 2016, wind energy is the technology that is in 2nd place as regards the new electricity generation capacities, with an installed capacity of 169 GW last year (after natural gas, with 199 GW). In 2005, wind energy had a capacity of only 41 GW.

Technological progress and, implicitly, cost reductions for the installation of wind energy production units are among the key drivers for this consistent growth. Modern turbines are higher and their blades longer than those of the previous generation. "Low-wind" turbines start from slow wind speeds, thus allowing an energy generation yield 10 to 25% higher than the previous generation of turbines.[17]

ii. Digitalization of transmission and distribution grids

The quality of transmission and distribution services may be improved through the implementation of a smart grid infrastructure, as it is a key component of the digitalization process.

Other key advantages of the smart and digitalized infrastructure integrating environmentally-friendly technologies are: the increase in the accuracy of the forecasts of producers from intermittent sources, the possibility of aggregating the various sources (for example, wind, hydro), with an impact on the increase of system stability, the reduction in the frequency and duration of power outages, as well as the reduction in the supply restore time in the event of outages.

[16] WindEurope Report, Wind in Power, 2017.
[17] EEA Report, Renewable energy in Europe, 2017.

The smart grid can integrate the behavior and actions of all its users to ensure sustainable, economic and safe supply. Smart grids offer flexibility and many other benefits for the entire value chain of electricity (generation, transport, distribution, supply and consumption) and society as a whole.

Smart grids have a positive impact on the following aspects:

- *Flexibility of services* – characterized by the ability of the grids to adapt to certain unexpected circumstances
- *xEV infrastructure* – in the context of the significant increase of electrification in the transport sector, smart grids must be prepared to support the infrastructure for the charging of electric vehicles
- *Energy efficiency* - smart grids offer information on consumer behavior and, combined with smart meters, may contribute to informing consumers, identifying effective means of energy saving and may help identify investment opportunities that stimulate long-term energy efficiency
- *Owning and management of measuring equipment* – measuring equipment may be an element of interest as far as consumers are concerned. The management of these meters is carried out in line with a regulated or liberalized model. For the regulated market, distribution operators will be in charge of managing the equipment and of the efficient integration and operation within the grid
- *Management of available data* – the new characteristics of a smart grid depend on the availability of the data supplied by the measuring equipment. Such data may be used both in commercial operations (supply of flexibility services and operation services in respect of the infrastructure for the charging of electric vehicles), and by grid operators (both for short-term and long-term grid management). The access to such data will be ensured by the distributor in a non-discriminatory manner with the help of smart metering systems. Moreover, for reasons of compliance with the European provisions, the data format will be standardized across the EU.

In order to support infrastructure digitalization, authorities must ensure a convergent grid through high-performance telecommunications equipment, with national coverage, at a competitive cost level. The telecommunication system is a pre-requisite for the implementation of digitalization, large-scale installation, extended national coverage and low grid latency being necessary. Ad-hoc connection services may be supplied under partnerships with the large telecommunication companies.

The introduction of smart meters in the energy systems in Romania should be a priority, as a first step towards the digitalization of the Romanian infrastructure.

The purpose of smart metering is to make the meter reading process and operating costs more efficient, at the same time helping to reduce technological losses. Moreover, the meter ensures the necessary data for invoicing based on real consumption, which is measured on a daily basis.

Smart metering will also help transmission and distribution operators determine the consumer’s behavior pattern (for example, low and high consumption). This could lead to a more efficient consumption and the possibility for suppliers to offer customized service packages, which, in turn, could fight against energy poverty.

The installation of smart meters and their combination with smart household appliances, with a high ecological profile, is a major step and needs to be supported by means of financial incentives for consumers, such as dedicated financing lines or risk distribution methods. These actions should be accompanied by promotion campaigns whereby consumers correctly understand the possible advantages and the very low risks posed by the transition to smart systems.

iii. Storage technologies

The traditional benefit of storage technologies has implications related to a more efficient consumption through the intake of energy at low prices and its injection in the market rotation points, when prices are high. VPPs will act based on algorithms that combine market information regarding the price and consumption needs to select the optimum processing times.

Storage technologies will also supply a solution for the correction of major energy production or availability fluctuations through the VPPs and will limit system interruptions during breakdown times so that the impact on consumption needs is low.

The appearance of storage solutions is favored by the transition of energy systems from a traditional configuration, with low variation of production, towards a modern configuration, with its core formed of new sources of production which exhibit a high degree of unpredictability, thus generating the need to capture/ manage energy. Certain studies show that a system with a significant RES component (over 50%) is highly likely to be cost-efficient through the inclusion of storage options.

The contribution of these solutions may be accelerated by means of a solid regulatory framework that stimulates investments in this area and encourages technological progress. The proposed measures aim at limiting the effects of market distortions and will result in the harmonization of price fluctuations, the reduction of the energy circuit cost and the facilitation of the share of RES in the energy system.

Recommendations:

- The elimination of administrative, market or regulatory barriers so that non-discriminatory access to the market is ensured for each relevant participant
- The performance of commercial activities for the development and operation of storage systems by market participants instead of regulated entities
- The inclusion of storage options within the general energy circuit planning, starting from a clear definition that distinguishes between solutions for production and consumption, thus ensuring the coherence required for classification purposes
- The technical characteristics of a storage system – namely the capacity, power and response time – must be defined as clear and as flexible as possible particularly by simulating extreme requirements – very short term or long-term flexibility. In this way, one may address more efficiently the cases requiring the increase of the storage period, which affects the profitability margin of an operator, by reducing the actual cycles of use
- Product standardization to facilitate their spread within the market, particularly in the medium and long run
- The stimulation of investments and their correlation with market results instead of central action through the allocation of subsidies. Emerging technologies require predictability of revenue flows and the possible monetization of more opportunities within the circuit
- The full capitalization on storage solutions:

    - The traditional benefit of storage technologies has implications related to a more efficient consumption through the intake of energy at low prices and its injection when prices are high
    - However, the direction of the market needs to stimulate the expansion of this basic function so as to capitalize on the wide potential for flexibility as regards the supplied quantity and time slots
    - Thus, the ecosystem must allow participating companies to access adjacent sources of revenues based on the supplied services, for example, balancing services or services to reduce congestion within the grid, the avoidance of procedures that limit the supply of electricity, the decarbonization in industry and mobility.
- The consolidation of pricing based on electricity shortages and the strengthening of price signals to allow storage solutions to receive instant financial compensation, with solid arguments in favor of long-term investments

- Mature trading at intervals that are as short as possible (< 15 min.) to reward the flexibility of storage systems
    - The initial practical applications may be identified on the IM, which encourages the introduction of RES systems
    - Dynamic price contracts may also have a positive impact on the rewarding of the flexibility of storage systems
- The definition of a set of coordinates for the actual localization of storage solutions. Centralized storage must be connected to the grid or physically located near generators. This may help large producers of RES meet their contractual obligations on the market, including balancing. At household consumer level, storage options may be located near the electricity meter, which couples distribution and storage and encourages the active participation of consumers, as well as the recycling of their own energy
- The development of thermal storage for heating or cooling energy originating from the use of electricity. This solution may have practical applications on the electricity market, based on demand signals, with a positive impact on household consumers and for the increase of energy efficiency within buildings or industries

iv. Research, development and innovation

The European Union has launched a series of policies and measures which ensure a regulated framework for all programs and initiatives related to research, innovation and increase of competitiveness. These measures also include means of access to public funds for the financing of development projects.

<u>Support programs for research and innovation may be implemented in the following areas:</u>

- Technology and digitalization
- Transport system
- Bioenergy
- Buildings in the energy system
- Generation of electricity and the energy system
- Industry
- Sustainable society
- Studies on energy systems
- Business development and sales
- International cooperation

Romania should actively monitor the European opportunities and take advantage of the facilities made available. One priority will be attracting European funds to finance research and development projects, given the gap between Romania and the countries in Western Europe. Another direction for action is an investment strategy for research and development in the field of batteries and electric engines to capitalize on the opportunities in the automotive field.

Given that a decisive factor of the transition towards clean energy is the electrification in the transport sector and the adjustment of the market to e-mobility, projects of research and investments to support and extend the development of new technologies in this area will be particularly required.
In conclusion, the development and implementation of advanced technologies are essential factors as regards the integration of a high share of RES, while the main measures that need to be considered refer to:

- The integration and aggregation of RES to balance the system through the implementation of innovative methods of storage and consumption control
- The implementation of Virtual Power Plants - VPPs, which may represent a major turning point within the industry
- Regulations to encourage the inclusion of storage services on competitive platforms, which may deliver new options for more efficiency
- The strengthening of digital barriers for protection and permanent international cooperation to reduce the risks of attacks directed against energy resources

d. The RES alternative in the residential sector, transport and industry

In light of the foreseen replacement of the current range of sources/ fuels used in the residential sector (mainly as regards heating and cooling - H&C) and transport, the use of electricity in the above-mentioned processes is a significant alternative, against a background of sharp decarbonization of electricity production. At the same time,

In this regard, a high level of RES penetration within the two sectors will ensure a basis for constant growth of installed capacities using these sources.

i. Electrification in the residential sector

The quality of life in Romania is on the rise, with implications on the national energy consumption. The transition from forest biomass for heating, especially in rural areas, to the use of natural gas may be noted.

In recent years, many of the urban cogeneration units have been decommissioned due to ecological inadequacy, the lack of investments in the management of the distribution system and the low quality of services offered to consumers. According to the data provided by the National Regulatory Authority for Community Services of Public Utility/ ANRE, only 60 units have remained active in cities, but they are also facing major economic difficulties.

This type of heating is subsidized by local municipalities, particularly in densely populated areas, such as Bucharest. For institutional, administrative, local, financial and social reasons, this type of heating is obviously declining.

The consumption of energy in the residential sector will decrease by 26% in the period 2015 – 2050, but the weight of electricity in the final energy consumption in the residential sector will increase significantly, from 15% in 2015 to 41% in 2050.[18]

To meet these targets and to ensure electrification in the residential sector, Romania's policies must include:

- Specific regulations for the residential sector with a view to improving control mechanisms in the current legislation
- Mandatory quality standards for energy efficiency and conservation, including thermal insulation, lighting, use of air-conditioning, etc.
- Market mechanisms that ensure that the electricity price reflects the actual cost of supply
- Investments in the grid infrastructure to encourage heating using electric sources
- The promotion of efficient solutions in residential communities, such as heat pumps (in combination with natural gas/ photovoltaic panels, where applicable). They face significant implementation barriers due to the initial high cost and insufficient awareness of the public in relation to their benefits
- Information campaigns to define emissions caused by various types of equipment or properties
- The elimination of heating subsidies that do not address a specific segment of consumers
- Alternative solutions to support vulnerable consumers
- Actions to encourage the use of LEDs/ smart bulbs instead of conventional ones

ii. Electrification in transport

Transport remains the sector that exhibits the lowest level of RES penetration within the European Union. In 2015, the weight of renewable energy in transport was below 7%[19].

The transformation of the transport sector is an essential stage, while it is an important sector in terms of energy intensity. For example, in EU Member States, over 33% of total final energy consumption in 2016 came from the transport sector. In Romania, however, the weight of the sector in the final energy consumption is lower: 27% in 2016.

[18] Energy datasheets: EU28 countries.
[19] Eurostat, 2017.

Approximately 98% of the final energy consumption in transport is currently ensured by oil products, while the common target is to reduce oil products to 68% of the final energy consumption in transport and also to improve the contribution of electricity to 27%, a target that must be met by 2050.

Moreover, with the help of policy incentives, it is estimated that, in 2030, up to 60% of sales of passenger vehicles in the EU will fully be accounted for by electric or hybrid vehicles.[20] Thus, a significant penetration of xEVs on the European market is envisaged, which will reach the equivalent of 40 million electric vehicles on European roads by 2030 (representing 16% of current inventory).[21]
At national level, the transport sector could become a major source of carbon emissions in the near future. Once our country enters the Schengen Area and the road infrastructure develops, heavy traffic connecting the Black Sea to the Hungarian border will increase. In this context, electrification in the transport sector appears to be a priority.

In order to support the increase of electrified transport, Romania should have 4.5 million charging points for electric vehicles by 2050. The measures required to meet this target should envisage:

- Campaigns promoting electric vehicles through the support of the development of public and private infrastructure for charging stations
- A plan for the implementation of public charging networks and the encouraging of private investments to develop infrastructure through an incentive mechanism
- Tax reductions and exemptions for the purchase and use of xEVs – particularly for company fleets
- Models and regulations in support of operators interested in investing in electric mobility infrastructure
- An attractive rate ensured for new applications in the field of electricity, such as electric mobility, which reflects the current cost of acquisition and system costs. It would have to deliver an attractive level of profitability and guarantee economic sustainability
- High environmental taxes to limit the purchase of used vehicles
- The limited traffic of conventionally powered vehicles in city centers to improve air quality
- Special lanes for electric vehicles and public means of transportation
- Municipal regulations for limited access parking places, thus ensuring a guaranteed charging space for owners of electric vehicles which do not own a garage

[20] IRENA REmap 2018.
[21] Ibid.

- Actions aiming at promoting electric mobility, in line with long-term decarbonization targets
- Plans for the improvement of air quality in busy cities, such as Bucharest. The wide use of electric vehicles will reduce the population's health risks, while the specific energy production dedicated to each city will be easier to regulate as power plants in those urban areas are less fragmented geographically and in terms of shareholding, which offers the possibility for an easy implementation of best practices
- Bidirectional interaction technologies between the vehicle and the electricity grid will allow xEVs to deliver energy allocation services depending on several elements, such as the grid load – the charging rate or rate of reversion to previously stored capacities will be able to be modulated

The smart approach to the charging of electric vehicles multiply the beneficial elements within the entire energy system, thus reducing the need for investments in traditional generation or grid equipment and offers flexibility for subsequent integration.

The benefits for consumers will translate into lower costs through natural synergies of the energy and transport system. Moreover, users of electric vehicles will benefit from additional sources of revenues through smart charging services, thus reducing the total cost of ownership compared to traditional vehicles.

The massive spread of electric mobility will have an impact on the other objectives, such as the reduction in GHG emissions in the field of private sectors, the improvement of energy efficiency, the integration of RES on the market or the stimulation of electricity cost reduction. Electric mobility will become an integral part of innovation platforms through the increasingly profound and varied interaction with real life.

iii. Electrification in industry

In Romania, GHG emissions generated by industrial processes[22] represent approximately 15% of total emissions at national level (including LULUCF).

The anticipated consumption of products manufactured in the industrial sector and particularly in energy-intensive industries (cement, steel, etc.) imposes a transformation based first of all on an adjustment to future emission limits.

Under these circumstances, the reduction of emissions generated directly and indirectly by these industrial sectors is essential for the decarbonation process and may be

[22] Ministry of Environment, National Inventory of Greenhouse Gas Emissions

possible through a combination of factors related both to the increase in the consumption of electricity (from renewable sources) and advanced technological options, already available or which may be implemented further to research, development and innovation actions:

- Electrification of technological steam production processes;
- Use of hydrogen (fully originating from the conversion of renewable sources) as raw material or fuel;
- Capture and storage of carbon;
- Adjustment of electricity consumption to production (demand-side management);
- Improvement of energy efficiency.

e. Communication of the effects of climate change and campaigns for RES promotion

Public awareness is an important step towards the transformation of the European energy system. The legitimization of actions against climate change and for its prevention may be achieved only further to an awareness and education process of the Romanian society. The Eurobarometer poll, which monitors and assesses the perceptions of EU citizens, published in 2017 a special edition[23] which explores the views of Europeans on "Climate Change". It should be noted that most of the answers supplied by Romanian citizens allow for a less favorable assessment of climate change awareness. Moreover, the poll reveals that the permeability of the means employed to reduce energy consumption and energy efficiency solutions is very low among end consumers, particularly compared to the other EU Member States.[24] Another finding that is relevant for this study is the question whether the respondent has taken any action to fight climate change over the past 6 months. For this question, the rate of affirmative answers supplied by Romanians is the lowest in the entire EU.[25] Sweden, a model as regards the reduction of emissions, RES targets and environmental protection, is at the other end of the spectrum. The results of the poll underline the correlation of these issues and prove the need for citizens' involvement in the promotion of RES and the fight against climate change.

Awareness actions and campaigns as regards climate change and the reduction of emissions, such as RES promotion, may be:

- The mobilization of the entire society through programs and initiatives at national and local level with the help of the various channels of communication (digital, classical, etc.) and locations, such as schools, places of work, public areas etc. to approach various target groups

[23] Special Eurobarometer 459.
[24] Special Eurobarometer 459, page 40.
[25] Romania: 22% of the answers "Yes", 77% of the answers "No" and 3% of the answers "Don't know".

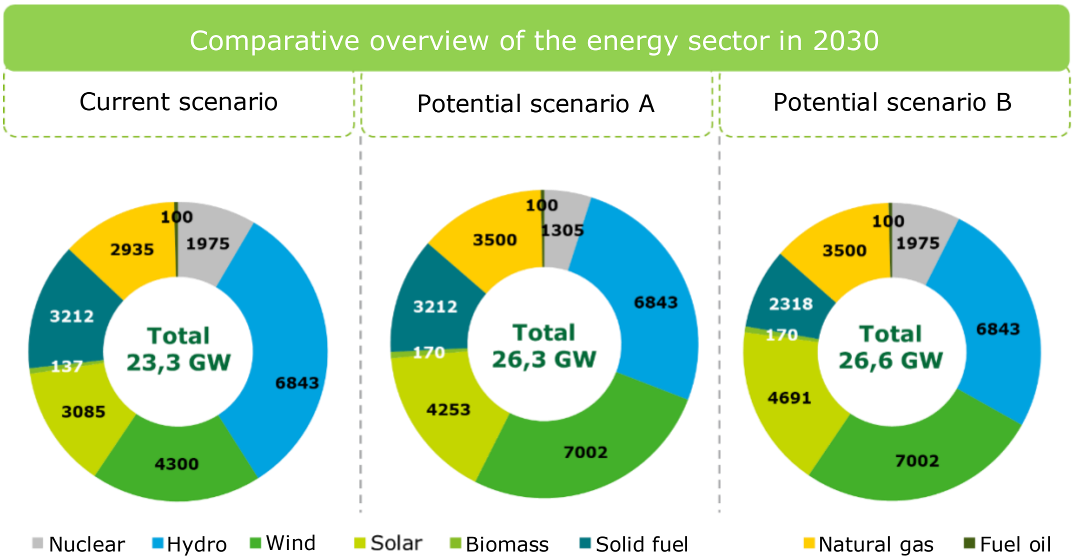
- Climate change awareness campaigns as integral part of the national climate change strategy (according to the Swedish model)
- The participation and active involvement in international actions in the field such as "Education for Sustainable Development Programme" and "Climate Change Education and Awareness" of UNESCO
- Advice and professional training for land owners, managers, etc.: trainings on the adjustment to climate change, reduction of emissions, etc. (for example, in areas such as agriculture and forestry)

VI. Conclusions

Romania's natural potential for the use of renewable sources exceeds by 3 times the capacity required to meet the threshold of 35% within final consumption. Solar energy has a potential of 54 GW (19 GW industrial and 35 GW on roofs), onshore wind farms of 12 GW, offshore wind farms of 4GW, while hydropower energy could reach 11 GW.

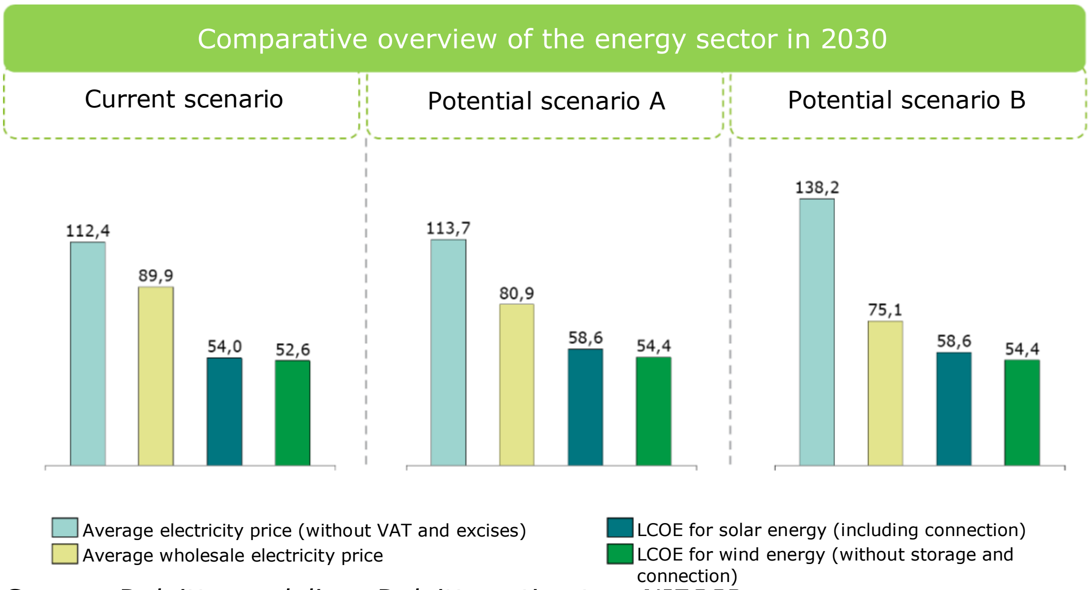
The fundamental difference between the results of the 3 scenarios presented in Figures 27, 28 and 29 below is the vision for the development of the Romanian energy system, focused on the concept of energy security – the current scenario and an ambitious transition to the concept of energy and climate change by 2030.

Figure 29 - Comparative overview of the energy mix [MW/ resource]



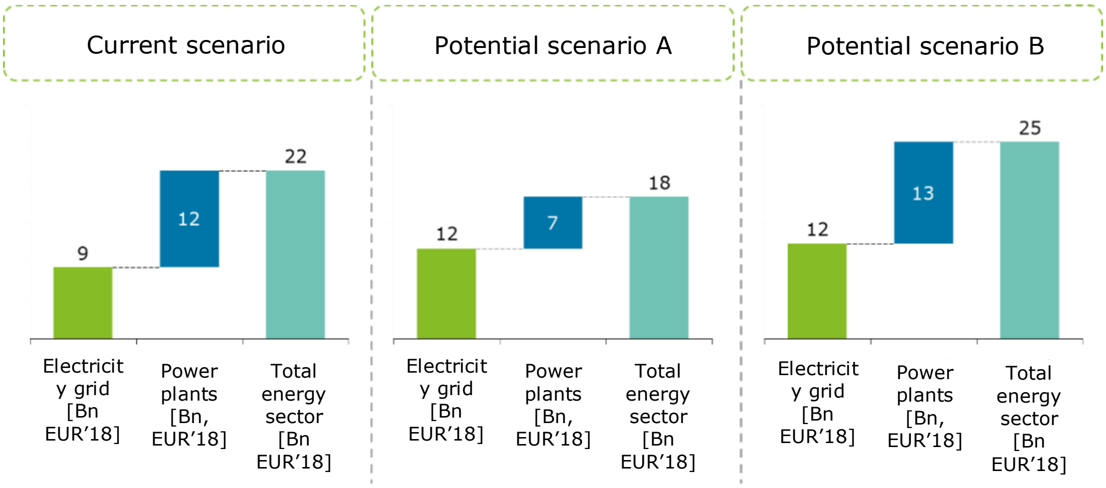
Source: Deloitte modeling; Deloitte estimates; NIECCP

Figure 30 - Comparative overview of prices [EUR'18 / MWh]



Source: Deloitte modeling; Deloitte estimates; NIECCP

Figure 31 - Comparative overview of investments in the period 2021-2030 – aggregate values [EUR/ MWh]



Source: Deloitte modeling; Deloitte estimates; NIECCP

The impact of the ambitious transition is accompanied not only by the necessary additional funds, but also by the direct and indirect effects on the Romanian economy - investments in the relevant economic sectors will generate a total impact of 350 bn EUR in Romania's gross domestic product in the period 2021 – 2030. Local investments of 79.4 bn EUR will focus in the above-mentioned period particularly on the automotive industry (41.9 bn EUR) and the construction industry (19.2 bn EUR).

The capitalization on the above-mentioned potential would be possible based on actions focused on the gradual implementation of adequate policies and measures that increase the benefits offered by the increased integration of RES within the National Energy System and, at the same time, minimize related costs. In the context of the high likelihood of the introduction of sustainability criteria regarding a mandatory minimum local/ national contribution to the implementation of investment projects for RES-E, local/ national investments in RES equipment and products/ services will be supplemented. Consequently, the acceleration of the transition to an energy system with a high share of RES may determine a significant increase of the measured impact compared to the above values.

The main factors encouraging the integration of a high production of RES-E by 2030 will be:

- a primary and secondary legislative framework aligned with the principles of European directives and regulations;
- the gradual decrease of the cost of technologies, which will make RES (particularly wind turbines and solar panels) be competitive compared to traditional sources;
- the transition to smart grids through the implementation of smart metering and grid digitalization;
- the development of energy storage capacities;
- the rapid electrification for light road transport;
- the growth of GDP, gross added value within the economy and revenues available to households;

Based on the analysis of the current circumstances and the results of the modelling process, an optimum path for increased integration of RES in the Romanian energy mix is presented below:

Figure 32 – Optimum path for increased integration of RES in the Romanian energy mix

2019 The implementation of PPA auctions for large end consumers to allow the development of new projects without a support scheme

2020 The adjustment of the current market rules and mechanisms to the specificity of the production of electricity from renewable sources. The access of developers to the grid must not be conditioned upon the fulfilment of excessive technical and administrative conditions.

2021 The implementation of a financing mechanism aiming at the development of electricity storage facilities

2023 The implementation of smart metering

2025 The cost of light electric cars becomes equal to or lower than the cost of traditional cars. The cost of technologies for H&C based on electricity becomes widely accessible.

2030 The capacity for production of electricity from wind sources exceeds 7,000 MW

Source: Deloitte analysis

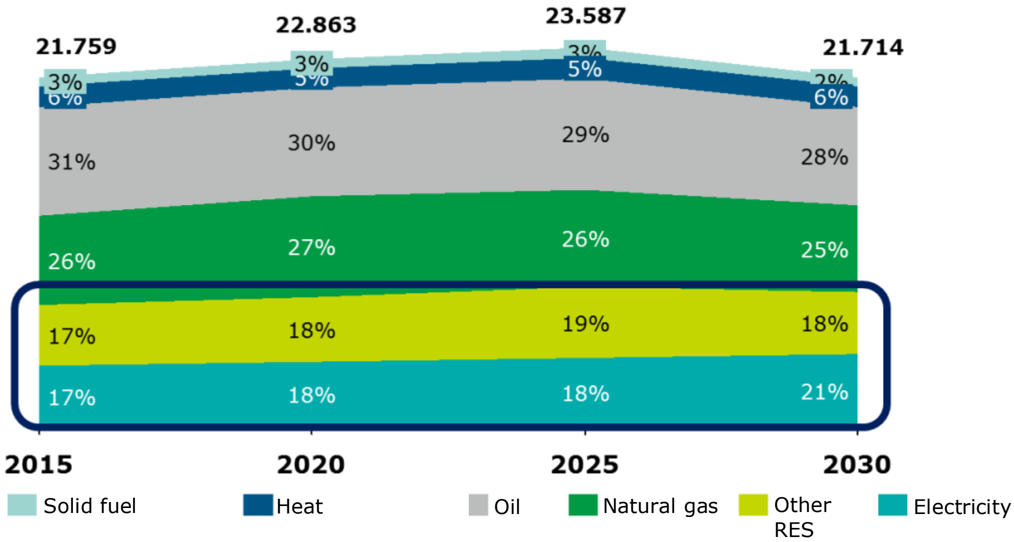
Annex

Common assumptions in all development scenarios

The assumptions presented below have been used within the modelling process and are common to all development scenarios.

- ✓ Forecasts for the energy market:
    - The cost of technologies will decrease gradually, making RES (particularly wind turbines and solar panels) be competitive compared to traditional sources
    - For the period 2021-2030, the average investment cost for wind energy will be ~ 1,086 EUR/kW
    - The connection cost has been estimated at ~ 120,000 EUR
    - The average storage cost for the period 2021 – 2030 has been estimated a 452,435 EUR
    - In line with the evolution forecast of the European Commission, ETS carbon prices will increase significantly, reaching
      42 EUR'16 / t CO_2 in 2030
    - Power plants operating on coal require substantial investments to comply with the pollution regulations provided for by the environmental law
    - Evolution of consumption by 2030 will be influenced by:
        - electric transport - ~ 500,000 electric cars in 2030) and
        - the increase in the consumption of electricity in the residential sector (the increase of households connected to the grid, the increase of households with an electric heating and cooling system, the improvement of the quality of life)
    - Final energy consumption and electricity consumption are considered constant in all analyzed scenarios, while its evolution is detailed, by fuel, in the figures below:

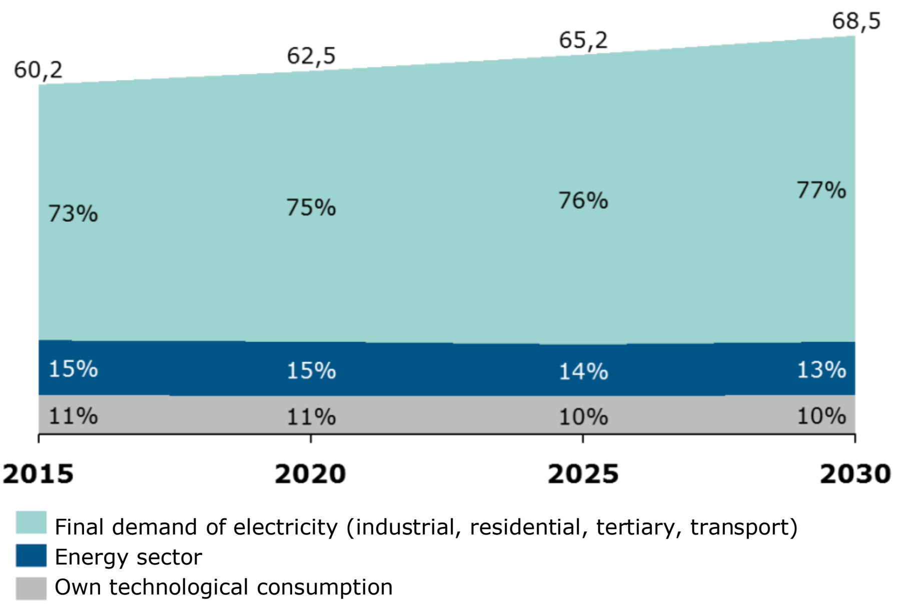
Figure 33 - Evolution of final energy consumption depending on the fuel used, [Thousand toe]



Source: Deloitte calculations

Final energy consumption is estimated to increase by 2025 and to then decrease by 2030 to a level similar to that in 2015. This decrease is associated with the increase of energy efficiency.

Figure 34 - Evolution of final electricity consumption depending on destination, [TWh, %]



Source: Deloitte calculations

- ✓ Infrastructure:
  - The transition to smart grids through automation, the introduction of smart metering and grid digitalization
  - The modernization of the transmission and distribution systems – reduction of own technological consumption

- The development of energy storage capacities within the Electricity Transmission Grid/ Electricity Distribution Grid to improve balancing capacity
- The interconnection of the national electricity transmission grid – 15% (2030)
- The development of transport capacities for the natural gas in the Black Sea
- The extension and modernization of natural gas storage units

✓ Macroeconomic indicators:

- In 2050, electricity consumption/ inhabitant in Romania will exceed the EU 2015 average (of 5.390 kWh/inhabitant)
- In 2030, this consumption will reach 54% of the EU 2015 average
- In 2020, electricity consumption/ inhabitant will reach 45% of the EU 2015 average
- ~ 18 million inhabitants in Romania at the end of the analyzed period

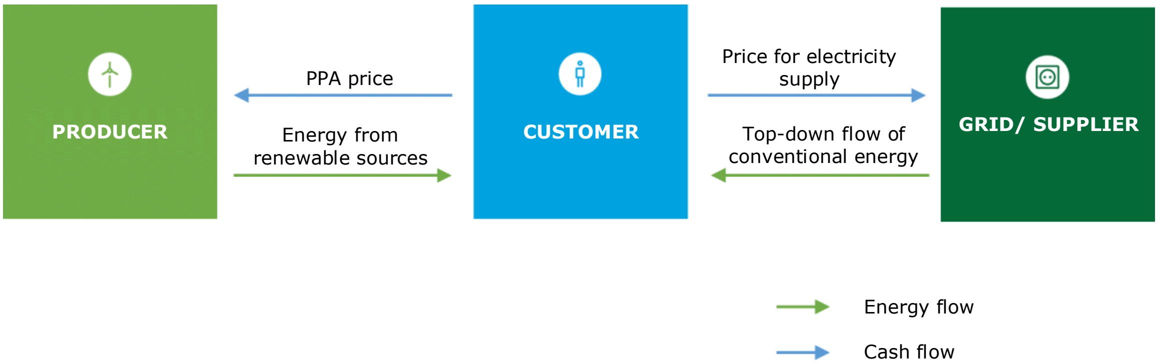
Conversion factors		
1 MWh	=	94.28 cbm
1 bn Cbm	=	35,687,347.87 MMBTU
1 toe	=	6.84357 boe
1 toe	=	1.11 thousand cbm
1 pc	=	0.029 cbm

Types of PPA contracts

Type 1: Physical on-site PPA

- The producer builds, operates and maintains the RES power plant within the premises of the customer
- The energy produced is supplied directly in its own electricity grid
- The price of the PPA is based in the characteristics of the agreement and of the RES power plant

Figure 35 - Physical on-site PPA

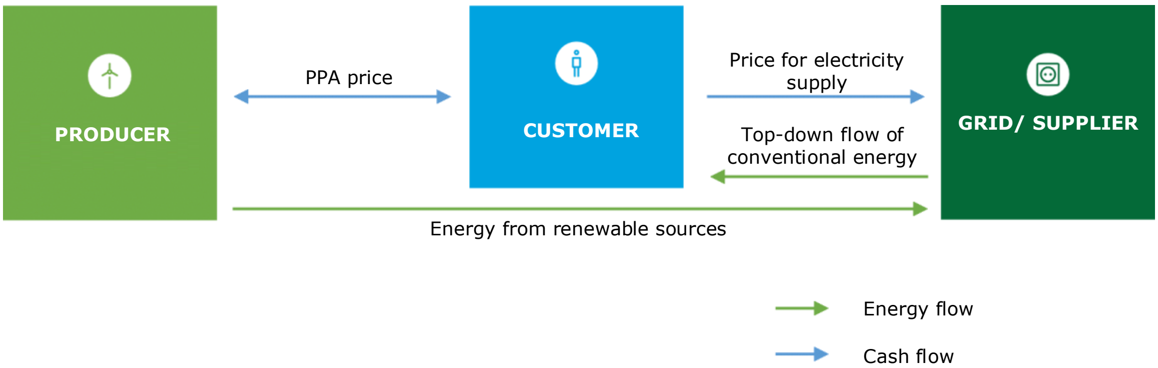


Source: EEX Power Purchase Agreements, August 2018, Deloitte

Type 2: Physical off-site/ corporate/ sleeved PPA

- The producer sells energy directly to the end customer, pursuant to the agreement
- The producer supplies energy to the end customer through the common electricity grid, pursuant to the agreement

Figure 36 - Physical off-site PPA

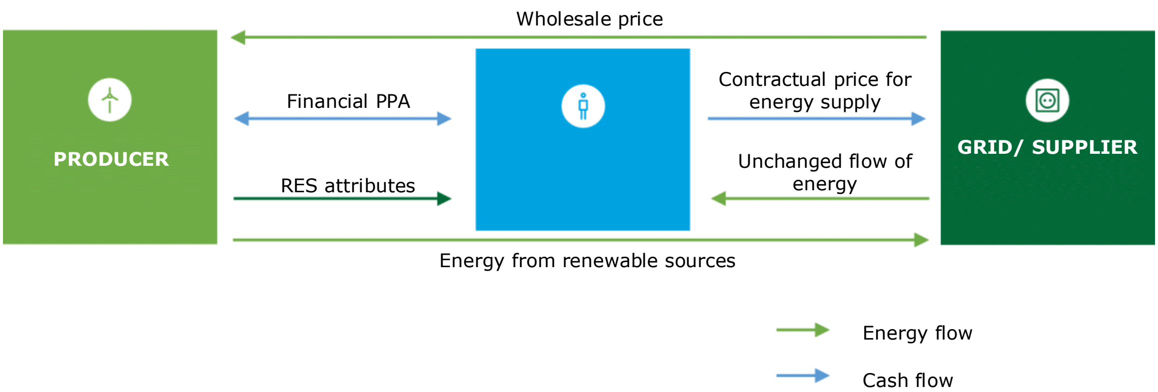


Source: EEX Power Purchase Agreements, August 2018, Deloitte

Type 3: Virtual/ financial (synthetic/ merchant) PPA

- The indirect sale and purchase of the energy quantity established in the agreement through spot markets (not physically between the 2 parties)
- Energy is supplied through the grid, possibly by several suppliers
- Clearing of differences between the price established in the agreement and the one paid on spot markets through contracts for difference

Figure 37 - Virtual/ financial PPA



Source: EEX Power Purchase Agreements, August 2018, Deloitte

Table 4 - Characteristics related to negotiation for the conclusion of a PPA

Characteristics related to negotiation for the conclusion of a PPA	
Price	Pricing: fixed price, capped price (minimum/ maximum value), variable rate based on indices
	Most PPAs are Type 2 and essentially contracts for difference between the producer and end customer
Term	Prices may be negotiated for a period of up to 15 years or for shorter periods (for example 6 years) and later renegotiated
Quantity/ capacity	The quantity of supplied energy is usually fixed, depending on the regular demand of the customer or based on an estimated demand
Structure of the agreement	PPAs are concluded bilaterally, there is no standard template
Risks	The counterparty risk is an impediment which causes difficult and length negotiations

Source: EEX Power Purchase Agreements, August 2018, Deloitte

<u>Risk hedging through OMP (Organized Market Place) futures contracts, settled in cash:</u>

- Standard OMP product
- Means of mitigating commercial risk
- Added value for counterparties

Market participants which have concluded a PPA may ensure security for maximum 6 years in advance through a set of futures contracts (with a single price), issued by OMP, to cover the exposure of a PPA to commercial risk. In this way, participants benefit both from the stability of the long-term price and from the mitigation of the counterparty risk, offered through a clearing house.

In the energy sector, PPAs are relevant particularly if producers must cover a share of RES from the supplied electricity. Currently PPAs are used as a mechanism for support and promotion of RES in countries such as: the United Kingdom, the United States, Norway, Ireland, the Netherlands and Poland. Photovoltaic PPAs are also developing in countries with sunny weather. Moreover, PPAs may be a viable solution for offshore electricity production units.

Methodological Notes

Modelling instrument

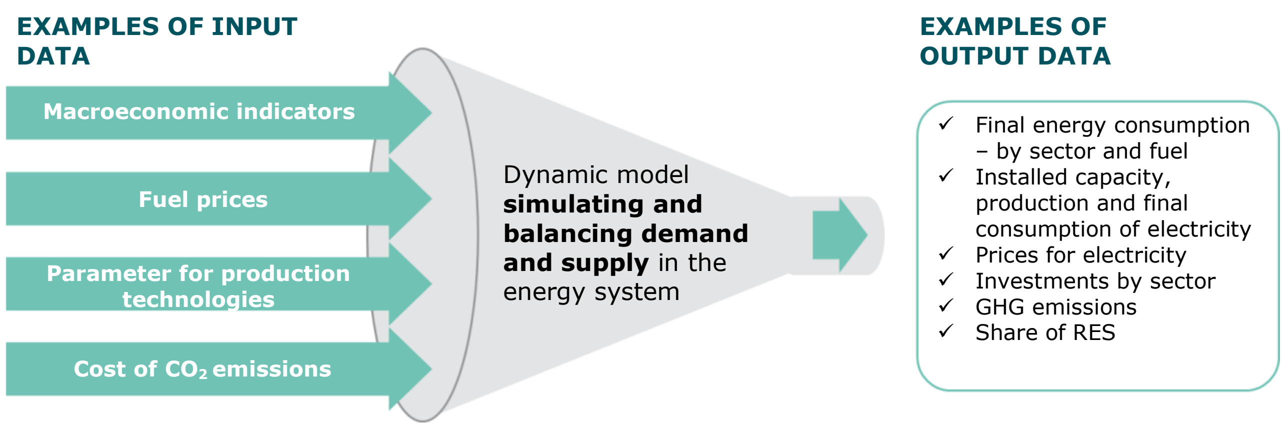
The modelling instrument used is based on the methodology used by the European Commission. The energy model is a complex model which focuses on the market mechanisms and concerns the explicit forecasting of prices, which influence the evolution of energy demand and supply, technological progress, economic, financial and behavioral components, as well as environmental considerations. The model has a modular structure, while modules differ from sector to sector in an attempt at capturing as realistically as possible the behavior of the agent and its interactions on the market. The design of the model combines the microeconomic basis of behaviors with engineering and technology details. Specifications focus on simulating structural changes and transitions of the energy system in the long run rather than on short-term forecasting.

The model is a dynamic instrument which offers detailed predictions on the demand, supply, prices and consumption of energy, as well as required investments, covering the entire energy system, including emissions and trading of energy products.

The model uses prices as a means of balancing demand and supply simultaneously on several markets for energy and emissions. The model determines the balancing volume of the market by identifying prices for each energy. In this way, the quantities that producers find more suitable to supply correspond to the quantities that consumers wish to use.

The figure below presents the operational principles of the energy model used to establish the development scenarios for RES energy.

Figure 38 - Operational principles for the energy model



Source: Deloitte methodology

Input-Output method for the calculation of the impact of investments in projects concerning energy from renewable sources in the Romanian economy

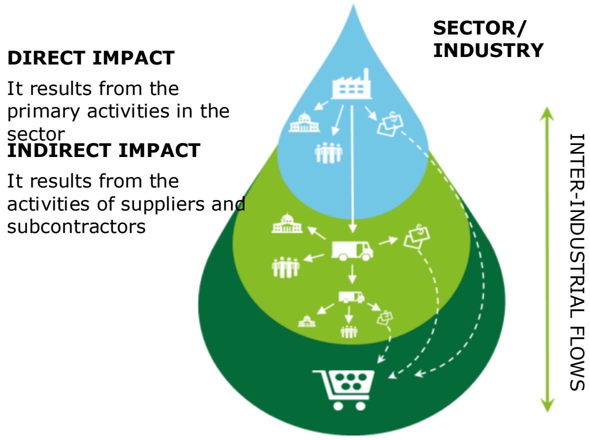
Any economy – analyzed at national or global level – includes sectors and industries that are interdependent. Within these sectors and industries, there are companies whose operations depend on, but also influence other companies and economic operators. In order to analyze the social and economic impact of a certain industry, we must use a methodology that considers such flows and proves the way in which production in many different industries becomes an incentive for other industries and, thus, generates added value, additional employment and revenues within the economy.

Wassily Leontief, an economist who, in 1973, received the Nobel Prize for his achievements, was the first to note such interdependencies in the economy of the United States. Ever since, these tables – referred to as symmetrical input-output tables – have been created for almost all countries by the national statistics offices with data from national accounts. These tables, compared to financial data on expenditure, revenues, salaries and taxes in a certain industry or certain companies in a sector, are a powerful instrument to prove social and economic impact.

Using a model based on the input-output table for the Romanian economy and the input data for the industry, we have calculated the following types of impacts in respect of the projects for the development of renewable energy:

- **Direct impact**, generated by the activities carried out further to the projects related to the development of renewable energy.
- **Indirect impact**, related to the business transactions with suppliers and subcontractors within the projects for the development of renewable energy. The purchases of goods and services by the promoters of this project from the Romanian suppliers generate business for those suppliers, allowing them to support their jobs and generate revenues. However, the effects do not stop here – direct (first-level) suppliers have their own (second-level) suppliers, etc., whose production grows due to the initial impulse of the projects for the development of RES, creating a chain effect in the economy. These effects, including all rounds of transactions, are actually considered in the model used.

Figure 39 - Operational principles for the Input-Output model



Source: Deloitte methodology

Geographical area

The Study refers to scenarios for the development of the share of energy from renewable sources in the gross final consumption for Romania and to the measurement of the impact of such scenarios.

Input data

The analysis has been conducted using public data and private sources of information of Deloitte and the groups of experts, while forecasts have been compiled based on historical data and on our assumptions concerning the evolution of the Romanian energy sector.

Period covered

The development scenarios resulting from the modeling cover the period 2021 – 2030, with certain references to 2050, and focus on 2023, 2025 and 2027 interim targets. For certain indicators, evolutions have been presented for a 5-year period, starting from 2015.

Limitations of the model

The model used is limited by the accuracy and completeness of national data, as well as by the published data of national input-output tables, whose record is difficult to keep by national statistics offices (the most recent symmetrical input-output tables for Romania were published in 2013 and include prices for 2010 - source: EUROSTAT). To compensate for the discrepancy between input-output tables and the current year, the most recent figures are adjusted based on the national inflation rates starting with the year of publication of the tables. This implies that the interdependencies between the multiple sectors of the economy have remained at levels that are similar to the base year, which offers a static representation of economy.

At a broader level, other limitations of the input-output models include the inability to accurately explain finite resources or the effects of economies of scale.

Despite the limitations of the methodology and data, the model can offer a general representation of the impact of the increase in the share of RES energy in Romania's final energy consumption, this methodology being extensively used at international level.

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Authors’ responsibility

Deloitte Consultanță SRL (hereinafter referred to as “Deloitte”, the “consultant” or “we”) has conducted an independent study on “Renewable energy in Romania: Potential for development by 2030 (the “Study”, the “Report” or the “Analysis”). The Report has been prepared at the request of the Romanian Wind Energy Association (“RWEA”, the “Client”) in accordance with the contractual terms between RWEA and Deloitte.

The analysis has been conducted independently by Deloitte, which has mainly used its own expertise and resources, as well as the public sources mentioned above.

Deloitte has prepared and delivered the Study for the benefit and for the information of RWEA. Consequently, Deloitte does not accept and does not undertake any responsibility towards a party other than RWEA in relation to this Report, the statements, findings, conclusions, recommendations or opinions presented in or implied from this Report. Any reference to this Analysis by a third party shall be made on the latter’s own responsibility.

Our analysis is an objective and reasonable starting point for a rational discussion concerning the economic benefits of potential developments of energy from renewable sources by 2030 in Romania. Any possible debates on the assumptions included in this analysis are certainly not excluded. Deloitte undertakes no responsibility/ and will take no part in possible polemics on this topic.

Before acting on the information included in this Study, additional competent professional assistance and a careful analysis of the circumstances in question are required. Decision-makers are fully responsible for decisions made based on the information presented in this Study.

The information included in this Study represents general information and is not meant to refer to the particular circumstances of a certain person or entity. The Report does not set out to approach or offer an analysis of the relevant legal implications and circumstances and has not been prepared based on the professional analysis of a legal adviser. Although we have endeavored to supply accurate and updated information, there is no guarantee that this information is accurate at the date of its supply or that it will continue to be accurate in the future.

Input data have been collected from public sources, from the information and data of Deloitte, as well as further to discussions with experts in the field. Forecasts have been compiled based on historical data and on our assumptions concerning the evolution of the production of electricity from wind sources.

The contents, analyses and conclusions of this report do not necessarily reflect the individual opinions of the participating experts. A wide range of opinions and points of view have been expressed and they have made it possible for the essential issues considered by the study to be examined in a more thorough and objective manner. An overview of the methodology and sets of statistical data used by the authors is included in the annex to this document.

All information obtained from public sources is assumed to be correct and complete. It has not been audited or revised independently, its accuracy or completeness has not been verified by reference to sources, information or evidence of Deloitte. Thus, Deloitte undertakes no responsibility for any errors or omissions this information might contain or which could have appeared in the conclusions and results included in this document.

Romanian Wind Energy Association

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