# COST OF COAL TO ROMANIA

THE COST OF SUBISDIES RECEIVED BY ROMANIAN COAL INDUSTRY IN COMPARISON WITH RENEWABLE INDUSTRY

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### Disclaimer

# Abbreviations

| | |
|---|---|
| ANRE | National energy regulator |
| CCGT | Combine cycle gas turbine |
| $CO_2$ | Carbon dioxide |
| CNH | National Hard Coal Company Petroşani |
| CFB | Circulating fluidized bed |
| CHP | Combined heat and Power |
| EC | European Commission[1] |
| EAFRD | European Agricultural Fund for Regional Development |
| EBRD | European Bank for Reconstruction and Development |
| EEA | European Economic Area |
| e.g. | example |
| EIB | European Investment bank |
| ERDF | European Regional Development Fund |
| EU | European Union |
| FGD | Flue-gas desulfurization |
| GC | Green certificates |
| GDP | Gross domestic product |
| GHG | Greenhouse gas |
| GWh | Gigawatt hour |
| IEA | International Energy Association |
| IFC | International Finance Corporation |
| IRE | National Institute of Energy |
| IRR | Internal rate of return |
| kcal | Kilocalorie |
| kg | Kilograms |
| kv | kilovolt |
| kWh | Kilowatt hour |
| LCOE | Levelized cost of energy |
| Mmt | Million tonnes |
| mn | Million |
| MVA | Megavolt amperes |
| MW | Megawatt |
| MWh | Megawatt hour |
| NGO | Non-governmental organisation |
| Opcom | Romanian centralised market for electricity and gas trading |
| PV | Photovoltaic |
| RE | Renewable energy |
| RES | Renewable energy sources |
| RON | Romanian leu |
| SNC | National Coal Company Ploieşti |
| SNLO | National Lignite Company Oltenia |
| SOE | State-owned enterprise |
| thou | Thousand |
| TSO | Transmission system operator, Transelectrica |
| TWh | Terawatt hour |

[1] *In some, case, when followed by names such as Turceni, Rovinari, Craiova, Oltenia or Hunedoara it stands for 'energy compound'.*

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# Executive Summary

In this study we assess amount of subsidies received by the coal industry and compare this amount to how much renewable power is subsidies in Romania.

Based on official statistics published by the Ministry of Economy we estimate subsidies for the period 2005-2013 for the coal industry at RON 3.76 bn compared to just 0.81 for renewable[2]. If we compare the proposed electricity generation scenarios, we conclude that shifting the support from coal to renewable would more than cover the needs for investments in state of the art technology, which would also make the power system more stable and more reliable.

In total, since 1990 we estimate the coal industry has received subsidies in the amount of RON 15[3] billion, an equivalent of 2.3% of a year's GDP. This count does not include the cost of externalities, such as increased cost to the national health system as a result of diseases caused by air pollution.

We find that power generation from coal and lignite is not economically viable in Romania as there are only very few hours in a year in which power prices are above marginal cost of lignite and in particular hard coal generators, EC Oltenia and Hunedoara. As a result, those generators run only in part loads of maximum of one-third of rated capacity and need further operating support to stay on the market.

Romanian's coal fired sector has received a further subsidy in term of free allocation of carbon. We estimate that in the period between 2008 and 2012 companies which currently make up EC Oltenia compound received a benefit through free $CO_2$ allocation valued at between EUR 300 million and EUR 2 billion assuming either a low of EUR 4/tonne or high of EUR 30/tonne.

In addition to free carbon allocation Romania's coal-fired plants receive a production subsidy through a cogeneration bonus and priority access to balancing and ancillary services markets. We estimate that amount of this subsidy may reach RON 110 million per year and is likely to grow given declining trend in power prices and increase in variable costs caused by likely increases in price of $CO_2$ emissions after 2020.

In the concluding policy recommendation chapter we analyse three possible scenarios for further development of Romanian power sector.

[2] *Value of RON in 2005*
[3] *Value of RON in 2005*

We conclude that the most economical scenario is the one with decreasing reliance on coal and nuclear sources and with steady deployment of renewables. This scenario not only minimises the power bill of the Romanian economy, but also mitigates externalities such as damage to health and the environment, and stimulates investment into modern and productive energy sector.

# Remit and objectives

We were asked to draft a study quantifying total amount of all subsidies, state aid, economic support and other market distorting support received by coal industry in Romania, including coal-based electricity generation. The study covers both the current state of play in Romania and a historic overview since 1990. In addition, we compare the results of the coal industry analysis with support received by the renewable energy sector in Romania.

First, we define subsidies for the purpose of this study. We analyse direct subsidies to the coal mining industry from the state budget. These may be explicit, in the form of cash transfers from the budget to the coal mining industry, or implicit, such as loan guarantees, assumption of environmental and social liabilities connected to mining and various fiscal measures. In addition we analyse indirect subsidies the coal industry receives via electricity and heat generation industries. This indirect support may involve discriminatory access of coal fired plants to balancing or ancillary services markets, fuel contracts at above-market levels, cross subsidisation through heat price and CHP bonus or subsidised retrofits and free carbon allocation. And we quantify subsidies received by the renewable industry, both in terms of direct investment subsidies as well as support through green certificates.

Second, we define market background. In this chapter we review Romanian coal and power generation industries, including the renewable industry. We present both market statistics and we describe main beneficiaries of this public support.

Third, we quantify the subsidies to coal sector. We present annual development of subsidies paid to the coal and renewable industries as well as cumulative support since 1990, to show the trade-off between support forms for both subsectors. Furthermore, we emphasize the subsidises to renewable sector.

Finally, we conclude the study by analysing three scenarios of electricity generation and examine the levelised cost of energy ('LCOE') in order to assess the level of support for renewable required to meet the target in the proposed alternative of electricity generation scenarios.

# Methodology

We define subsidy as any support from public sources from which the coal mining industry benefits either directly or indirectly through cross-subsidies from coal-fired generation sector. Most of the recent support the coal industry has received can be classified as operating subsidies, that is, subsidies designed to keep a matured industry afloat by covering part of its operating costs so that it stays competitive. Without the subsidy the marginal cost would be above what the market is willing to pay for the closest substitute commodity (be it imported hard coal, gas or renewable generation) and Romanian coal mines would have to shut down.

In addition to operating subsidies the coal industry received investment subsidies in the past. Those are costs of opening mines, including relocation of inhabitants from areas affected by mining, which were all born by Romanian state for all mines opened after 1945. Unfortunately, no data exists from Romania to account for those benefits. Assumption of various liabilities due when mining in an area is completed, such as land reclamation, and various social programs are also non-operating liabilities which we include in our assessment.

We categorise subsidies as fiscal, social and environmental. We define fiscal subsidies as all financial and non-financial support with implication on the state budget. Fiscal subsidies may therefore be either direct cash transfers from the state budget, capital allocations, direct subsidies, or support granted via debt write-offs or loan guarantees. Environmental subsidies are the subsidies incurred with mines closure. Social subsidies are related to social security contributions, training schemes.


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Defining the cost of subsidies for the renewable sector is more straightforward exercise. Data on renewable industry in Romania is widely available, both for investment subsidies as well as for production subsidies. Unlike obscure and byzantine system of support for the coal industry renewable industry is supported through one dominant market-based scheme, the green certificate trading scheme, details of which are described below. There are also some renewables projects which benefit EU support instead of the full green certificates scheme.

We compare subsidies paid to the coal industry with subsidies paid to the renewable energy industry based on one single metric between 2005-2014 (2005 is the first year when GC started to be traded). For example, we compare the subsidies allocated to the coal sector (fiscal, environmental and social, based on data provided by Romanian authorities) with subsidies granted to the renewable sector (directly through the GC bonus scheme, as this accounts for the largest part of subsidies granted to the sector).

The time span for data analysed is 1990-2018. Historic inflation was considered in calculations, which were expressed in constant prices of 2005.

We gather data from official sources, such as the economy ministry, coal mining companies, World Bank, European Comission, Euracoal, IEA.

## Direct Subsidies

By direct subsidies we mean subsidies which are located directly to the coal mining industry. Therefore our definition of direct subsides includes both production support for continuous mining as well as support granted to miners' communities for requalification, as well as environmental clean-up and site reclamation following cessation of mining activities.

Table 1 below summarises of what we consider direct subsidies.

**Table 1:** Direct subsidies for the coal industry

| Fiscal | Social | Environmental |
|---|---|---|
| Cash transfers | Social security contributions | Free carbon allocation |
| Tax exemptions | Health insurance contributions | Land reclamation |
| Low royalties | Pension scheme contributions | Environmental clean-up |
| Damage liability insurance | Community development schemes (e.g., small infrastructure) | Water pumping and treatment |
| Micro-Credit Schemes | Employment and Training Incentives Scheme | |
| Debt write-off | | |
| Loan guarantees | | |

*Source: Candole research*

Direct subsidies to be analysed include mine closure related costs, e.g. recovery of mining sites for agricultural purposes or costs to reintegrate ex-miners in productive activities in past programs that were successful. These costs would be incurred in any case for the existing mines, regardless of when they would be closed. However, we use such cost items to illustrate the high costs of extensive coal mining and uneconomic overdevelopment of mines before 1989.

Postponing mine closure increases the cost of subsidies by simply placing the burden of closure-related costs to future generations.

There is significant confusion on the exact status of transfers to the mining industry for several reasons. First, there is considerable ambiguity in the use of terms defining subsidies (in what state authorities report as subsidies and the way those subsidies are classified as direct subsidies). For example, the social allocations include safety equipment, transportation, and meals for workers, which typically would be considered production costs, are not classified as such in Romania. Severance payments are considered as direct subsidies. Second, it is difficult to disentangle the revenues needed to cover current debts to the state budget— health insurance fund, social insurance, and the unemployment fund, from which the mining companies were exempted and this has forced the government to write off some of these tax arrears. Furthermore, these debts were classified as exemptions, and not subsidies.


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Based on the data provided by the Romanian authorities, we portray as fiscal subsidies the cash transfers, direct subsidies and capital allowances. There are other subsidies that we consider important, but are not accounted in the report as there is no consistent data available for the period analysed: damage liability insurance, accelerated tax depreciation allowances for mine capital equipment, bank guarantees, interest subsidy, reimbursable grant, and other forms of tax advantages.

## Indirect Subsidies

By indirect subsidies we mean subsidies which benefit the coal mining industry indirectly through support granted to industry further up the value chain, such as electricity and heat generation. Coal fired power and heat generation sectors are the most important customers of Romanian coal mines and for this purpose the remaining 'viable' coal mines were merged in 2012 with viable electricity generation capacities. Therefore it is imperative that the Romanian government stimulates consumption by the generation industry. Indirect subsidies may thus include measures which keep coal-fired power generation afloat despite its inefficiencies, such as various market-

distorting benefits through balancing and ancillary services markets, CHP bonus, or heat price regulation. The government may have also supported the power and heat industry by subsidising plant retrofits, such as desulphurisation units, or by assuming environmental liabilities of obsolete plants due for decommissioning and land clean-up.

Table 2 below summarises of what we consider indirect subsidies.

**Table 2:** Indirect subsidies for the coal industry

| Fiscal | Social | Environmental |
|---|---|---|
| Support to coal fired generation fleet (cogeneration bonus) | Redundancy payments | Free carbon allocation for coal fired power plants |
| Tax exemptions for households burning coal | Subsidized electricity / heat prices | Retrofitting (such as cost with desulphurisation) |
| Lower freight costs | Health costs of sulphur and dust emissions of the coal fired power and heat sectors | Environmental rehabilitation of obsolete power plants |
| Preferential market access (skipping the merit order-priority dispatch) | | |

*Source: Candole research*

Table 3 below summarises direct and indirect subsidies in the renewable sector we analyse in this study, where the case.

**Table 3:** Direct and indirect subsidies for the renewable sector

| Direct | Indirect |
|---|---|
| Green certificates | R&D grants |
| EU grants | |
| Fiscal exemptions (Low-interest / reduced-rate government sponsored Loans) | |
| Preferential market access | |

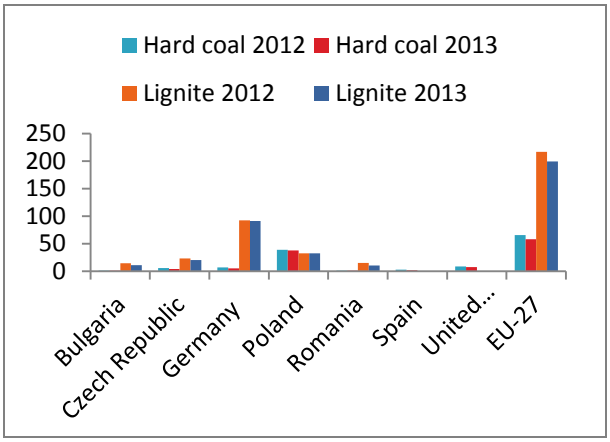
*Source: Candole research*

# Market background

Romania has a long lasting tradition in the mining industry and has important reserves of coal that can ensure continuity of production for over 150 years. Hard coal reserves and resources are estimated at 2,446mn tonnes, of which 252.5mn tonnes are commercially exploitable within the currently leased perimeters. Proven reserves of lignite total 280mn tonnes, with a further 9,640 million tonne of resources.[4]

Coal contributed in 2013 with about 30% to country's energy mix (about 1/5 from burning coal and rest from burning lignite), followed by hydro, 28%, nuclear amounting to 20% and wind scoring 7%. [5] Over the years, coal contributed, on average with about 30-40%. Romania is one of the most significant hard coal producers in Europe, after Poland, United Kingdom, Germany and Czech Republic and one of the top lignite producers after Germany, Poland and Czech Republic (see figure 1).

**Figure 1:** EU Hard coal and lignite production, mn tonnes

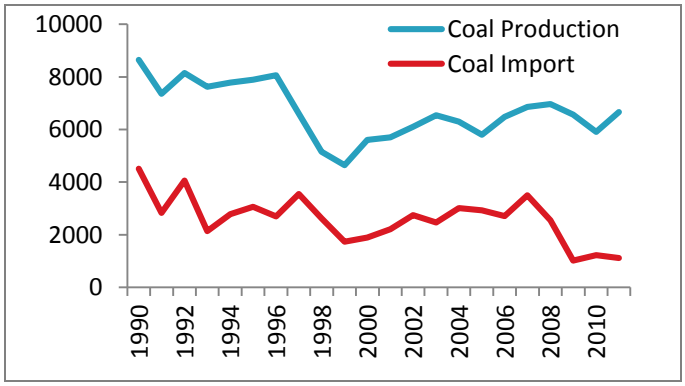



*Sursa:Euracoal*

According to IEA data, the country ranks seventeenth worldwide in coal production.[6]

Coal production has almost halved in 20 years, mainly due to the decrease in mining activity and lower coal consumption (both industry, such as steel, and households – for heat consumed from coal fired power plants). Romania imports mainly hard coal, but

**Figure 2:** Coal (both hard coal and lignite) production and import, thou ton of oil equivalent on a net calorific value, 1990-2011




*Sursa:IEA*

[4] *EURACOAL, Coal Industry across Europe Report, 2013, available at http://www.euracoal.org/pages/medien.php?idpage=1410.*

[5] *ANRE Electricity market monitoring report –December 2013.*

[6] *The Global Methane Initiative, Country overview, available at https://www.globalmethane.org/documents/toolsres_coal_overview_ch29.pdf.*

the share of imported coal as also considerably decreased to about a quarter as compared to 1990 (see figure 2).

In the early 1990s, Romania had an estimated 464 mines for coal and other minerals. By 2004, production ceased in 344 of the most uneconomic mines; 82 had been closed and contracts were concluded for the closure of another 191 mines.[7] The main reasons for closing the mines were the low value of the coal produced and high production costs, caused by obsolete extraction technology, lack of investments in improving efficiency, high costs of complying with environmental standards, and low domestic demand for coal.

The Romanian government initiated the mining sector restructuring in 1997 given that most of the sector was uneconomic and generated losses and arrears to the state budget. It started downsizing the sector (89,000 of the 171,000 workers left the sector voluntarily). A generous package consisting of up to 20 months of wages was offered to workers in the mining sector. The Government's restructuring program started being supported in 1999 by the World Bank, which granted a loan targeting the environmentally safe and permanent closure of 29 loss-making mines and mitigation of social issues. The government financed closure of mines also from own budgetary resources. The most resilient to restructuring have been the hard coal (Jiu Valley) and lignite mining (Gorj), a traditional stronghold of trade unions. As a result, support for mining was reinforced by the government through cross subsidies and support for inefficient thermal electricity generation sector, as will be explained further in the report.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A Mining Sector Strategy for 2004-2010 was approved in early 2004 with the aim to reform the sector (increase profitability of the sector and prop up economic growth in the mining regions) and meet the EU accession requirements (cut subsidies for coal mining by 2010). The strategy objectives triggered a plan to close mines, impose budgetary constraints on inefficient mining companies, reduce direct involvement of

[7] *PSIA World Bank report, Romania Mining sector reform, chapter 10, available at http://siteresources.worldbank.org/INTPSIA/Resources/490023-1120841262639/ch10_romania.pdf.*

the government, downsize,[8] and regenerate the affected mining areas-mitigating the socio and economic issues attached to mines closure.

In 2007, Romania notified to the EC its intentions for granting State aid to the National Hard Coal company (CNH) to cover the difference between production costs and revenues. Provisions were made that the state aid granted does not lower the price of hard coal below the level of the price of coal imported from third countries and that the total amount of aid is not higher than the difference between production costs and revenues. EC approved the extension of subsidies by 2011, the expected deadline for all coal subsidies in all European countries. Nevertheless, the deadline was extended with 7 more years to help member states to tackle the issue in a prudent and socially acceptable manner. Under the new agreement, hard-coal production is expected to gradually reduce its output. CNH is thus the only Romanian coal company that is entitled to state aid by 2018.

By 2012, there were six companies active in the coal sector:

- National Lignite Company of OLTENIA ('SNLO');
- National Coal Company, Ploieşti ('SNC');
- National Hard Coal Company, Petroşani ('CNH');
- 3 energy compounds, Rovinari, Turceni, Craiova. The first two covered about 65% of their coal demand from own mines, while the rest was bought from SNLO. EC Craiova covered only 10% of its resources from internal production and relied heavily on coal bought from SNLO which decreases its competitiveness.

During 2012, following IMF requirements, the coal sector underwent major restructuring. The lignite mines and power plants were combined into the vertically integrated EC Oltenia in an attempt to create a national "champion", to be later partially or fully privatized. The restructuring of the hard coal sector lead to the set up of two separate operating units under the National Hard Coal Company. One will oversee closure of three unviable coal mines in the Jiu Valley by 2018 (but still also sells about 40,000 tons of coal monthly to EC Hunedoara). The other will continue to manage the remaining four coal mines without state aid and supply two coal fired power plants of the newly set up EC Hunedoara and became its subsidiary.

[8] *A decrease in the number of workers was envisaged, from 57,738 in January 2004 to 26,650 in 2007.*

Romania's entire hard coal and lignite output is used for heat and power generation (see Table 4 below for a comprehensive list of coal fired power plants organised under the two national energy compounds, Oltenia and Hunedoara).

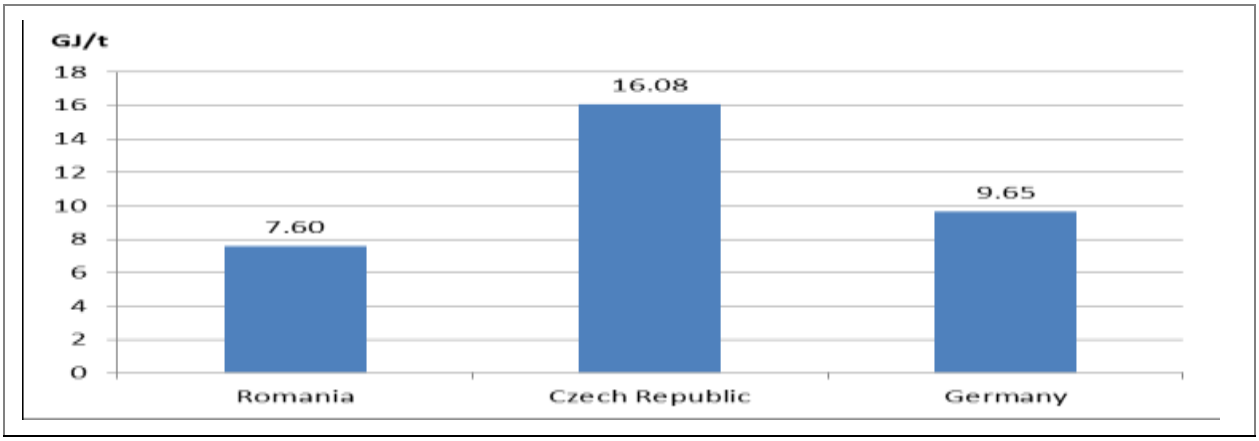
**Table 4.** Main coal fired power plants with an installed capacity above 100MW

| Company | Power plant | Installed capacity[9] |
|---|---|---|
| **Energy Compound OLTENIA** | EC Turceni (comissioned 1978-1987) | 1,980 |
| | EC Rovinari (comissioned 1972-1979) | 1,320 |
| | EC Craiova (comissioned 1965-1976) | 300 |
| | CHP Işalniţa | 630 |
| **Energy Compound HUNEDOARA** | CHP Mintia (comissioned 1969-1980) | 1,050 |
| | CHP Paroşeni (comissioned 1956-1964) | 150 |

*Source: ANRE*

Romanian hard coal has an average energy content of 3.650 kcal/kg. That of lignite varies between 1.650 and 1.950 kcal/kg. Figure 3 below shows that Romanian lignite is has relatively low calorific value, in particular to Czech lignite, but also compared to Germany. This relatively low calorific value, as well as the fact that both hard coal and ortho-lignite have a tendency to crumble when brought to the surface, make transport over long distances economically inefficient. [10] This is why the coal-fired power plants are very close to the extraction sites.

**Figure 3:** Comparison of lignite calorific value




*Source: Eurocoal*

*[9] The installed capacities do not tally to total installed capacity of the energy compounds as it portrays only the coal fired power plants.*

*10 Ecorys Report for European Commission - DG Transport and Energy, An Evaluation Of The Needs For State Aid To The Coal Industry Post 2010, available at http://ec.europa.eu/competition/consultations/2009_coal/ecorys_study_annex.pdf.*

## Hard Coal

The Energy Compound Hunedoara retained 4 viable mines and continues to purchase monthly some 40,000 tons of hard coal from the hard coal company under closure by 2018. The hard coal output is used for the domestic market, entirely for electricity and heat production, mainly in Hunedoara's two coal fired power plants with a total installed capacity of 1200MW, ensuring a long – term supply for these power plants. The Mintia-Deva power plant is de facto bankrupt, but supported through cross subsidies from efficient power plants, through cogeneration bonus, and needs significant environmental investments. Romania has approximately 350 mn tons of total reserves and produces 3 mn tons/year of bituminous coal.[11] Nonetheless, considering that most likely, Mintia-Deva would be shut down due to inefficiency in the next years (and replaced with gas-fired units), just one mine makes economic sense in supplying the Paroseni power plant with hard coal.

The Romanian government evaluated in 2011 the 7 hard coal mines and decided to retain 4 (Lonea, Livezeni, Lupeni and Vulcan) and close the other 3:

- Production Unit - Petrila Colliery, by 31 December 2015;
- Production Unit- Uricani Colliery, by 31 December 2017;
- Production Unit - Paroşeni Colliery, by 31 December 2017.

## Lignite

The National Lignite Company OLTENIA has five main fields: Rovinari (14.9 mn t/year), Jilţ (7.6 mn t/year), Motru (6.6 mn t/year), Berbeşti (2.6 mn t/year), and Husnicioara (3.1 mn t/year). It has reserves of around 2 billion tonnes and produces 35 mn t of lignite. [12] Lignite reserves are concentrated in a relatively small area of about 250 square km, about 95 % of lignite deposits are situated in the Oltenia mining basin and more than 80 % of these are opencast mines. The remaining deposits are not commercially viable.

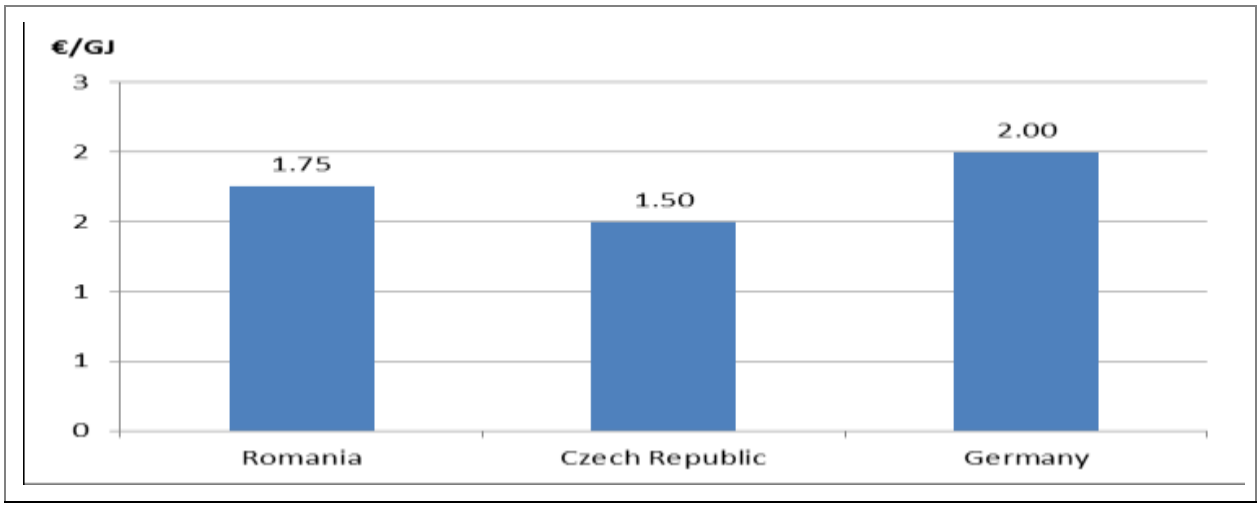
The main consumers are the nearby power plants, mainly the former energy compounds Turceni, Rovinari, Craiova which are now part of EC Oltenia. The plants have been refurbished in the last 6 years in order to comply with environmental standards.

*[11] Data as of 2010, EURACOAL.*

*[12] Data as of 2010, EURACOAL.*

Starting January 2007, the lignite sector is not entitled to any operational or social protection subsidies. It has benefited low state intervention and some subsidies for underground mining. Given its lower energy content, the Romanian lignite is more expensive than the Czech lignite, however still somewhat cheaper than the German lignite, as Figure 4 below shows. The relative cheapness of Romanian to German lignite is most likely caused by lower operating costs in Romania, including less stringent environmental standards.

**Figure 4:** Comparison of lignite calorific value

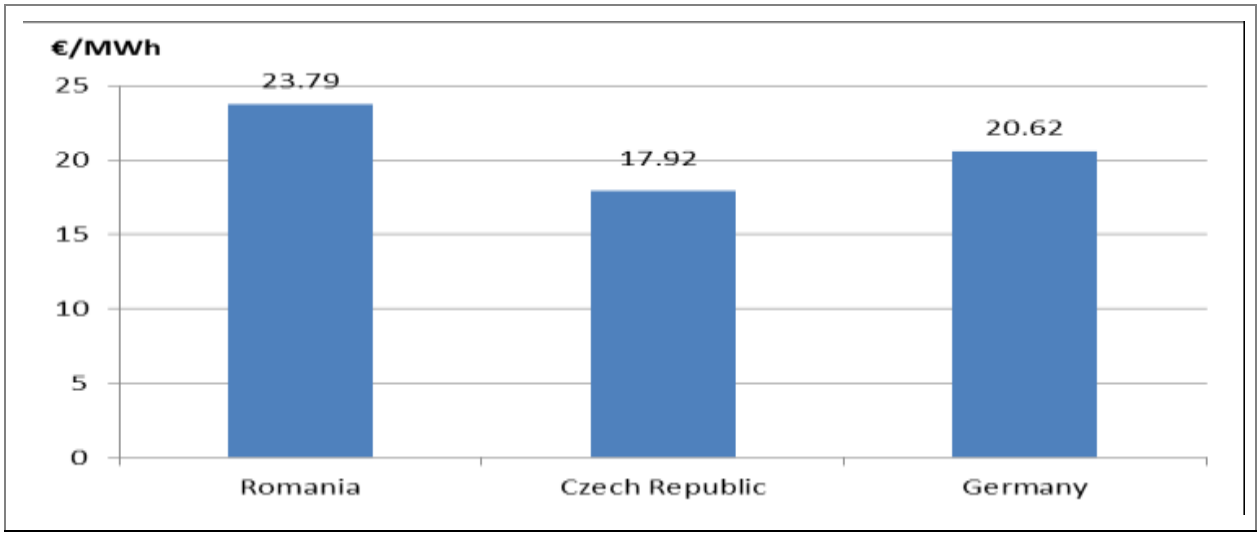



*Source: Eurocoal, Romanian Commodities Exchange, Own research and calculations*

However, as lignite is uneconomical to transport over larger distances given its low calorific content compared to hard coal or gas, the ultimate measure of competitiveness lignite is the fuel cost of electricity generated by a lignite fired power plant. Figure 5 below shows that Romanian lignite-generated electricity is higher than that in Germany and much higher than in the Czech Republic. We include the cost of carbon into the fuel cost calculation. Carbon allowance has economic value for generators even if received for free: the generator may either decide to generate MWh of electricity and use the allowance, or not to generate and sell the allowance on the market.

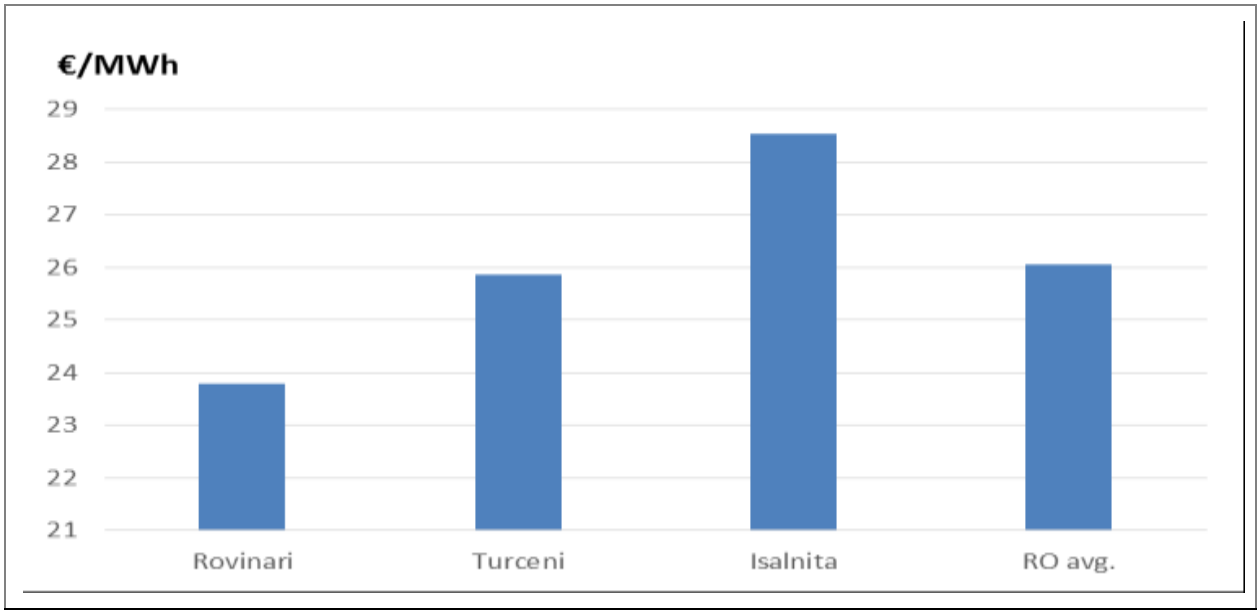
We use the countries' most efficient plant for the comparison. Romania is therefore represented by Rovinari with 34.3% efficiency. The most efficient Czech lignite fired plant has and efficiency of 39%, and the German 43%.

**Figure 5.** Comparison of fuel cost of lignite-genreated electricity




*Source: Eurocoal, Romanian Commodities Exchange, Own research and calculations*

**Figure 6.** Comparison of fuel cost of lignite-generated electricity




*Source: Eurocoal, Romanian Commodities Exchange, Own research and calculations*

Figure 6 above shows comparison of fuel cost of lignite generated electricity in other lignite-fired plants, Turceni and Isalnita. Isalnita is particularly troublesome plant as it had troubles covering its fuel cost in more than one-fifth of hours in 2013. The economics of Romanian lignite would

look even worse if we included operation and maintenance and other variable costs. If we assume that ANRE regulates regulated electricity prices at full value chain cost recovery the blended marginal cost of lignite production represented by EC Oltenia's regulated price would be a staggering EUR 43/MWh[13]. This means that EC Oltenia is in the money only one-third of hours in a year (in 2013 average price on OPCOM was EUR 38/MWh). EC Oltenia therefore needed other subsidised sources of revenues to pay the fixed cost of its vast assets given that it operated its 3900 MW only at one-third of the capacity (it produced 12 TWh in 2013). With a conservative assumption of a fixed cost of EUR 10,000/MW per year and only 30% load we estimate EC Oltenia needed approximately EUR 23.4 million to cover its costs. According to ANRE[14], EUR 16 million was covered by subsidy through the cogeneration bonus. The remaining EUR 7.4 million was most likely covered by a combination of revenues through a market-distorting rule of priority dispatch of the balancing market and access to provision of ancillary services, and an operating loss.

Following the same methodology as described above with an estimated blended marginal cost of generation of EUR 61.5/MWh, the economics of Hunedoara are even more disastrous in 2013 than those of EC Oltenia. The spread between the market price and the marginal cost implies that Hunedoara was in the money only about 3% of hours in a year. Given that Hunedoara actually produced more than one-fourth of hours (about 3.2 TWh) it must have been heavily subsidized. As in the case of EC Oltenia the subsidy came in a form of a cogeneration bonus (worth more than EUR 11 million), priority access to the balancing and ancillary services markets and, possibly, coal that Hunedoara received from CN Huilei during restructuring.

Clearly the two firms are not competitive on liberalised power markets and their continuous presence must be subsidised by a combination of cogeneration bonus and priority access to the balancing market and ancillary services markets, where they can earn additional rents.

Romanian coal mining industry is subsidised through coal-fired power generation industry via the following methods: 1) CHP bonus, 2) priority access to the balancing and ancillary services markets, and 3) free carbon allocation. Those subsides are designed to keep the coal fired power generation on the market so that it can consume output of coal mines, which also receive subsides as we describe above.

[13] *ANRE's Annual report on regulated prices and tariffs, November 2013*

[14] *ANRE's Report on monitoring the support scheme for cogeneration, Q1 2013*

Free carbon allocation is a straightforward production subsidy. Table 5 below summarises free allocation of $CO_2$ credits to companies which currently make up compound EC Oltentia. The market value of the subsidy through free $CO_2$ allocation varies between EUR 300 million and EUR 2 billion assuming either a low of EUR 4/tonne or high of EUR 30/tonne.

Second, Romanian coal fired sector receives support through a cogeneration bonus. Cogeneration bonus is not a specific to Romania and nor to coal-fired generation. The bonus for cogeneration exists in most European countries and is typically meant to promote investment into new modern, clean and efficiency cogeneration units, which demonstrably save primary fuel compared to separate generation of electricity in condensing plants and heat generation in individual boilers.

**Table 5:** Free carbon allocation to EC Oltenia companies

| **Company** | **Year** | | | | | |
|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2010 | 2011 | 2012 | Total |
| SC Complex Energetic Craiova SA | 2 705 339 | 2 705 339 | 2 705 339 | 2 705 338 | 2 705 338 | 13 526 693 |
| SC Complex Energetic Rovinari SA | 4 844 508 | 4 844 508 | 4 844 507 | 4 844 507 | 4 844 507 | 24 222 537 |
| SC Complex Energetic Turceni SA | 5 636 700 | 5 636 699 | 5 636 699 | 5 636 699 | 5 636 699 | 28 183 496 |
| Complex Energetic Craiova | 1 445 035 | 1 445 034 | 1 445 034 | 1 445 034 | 1 445 034 | 7 225 171 |
| **Total** | **14 631 582** | **14 631 580** | **14 631 579** | **14 631 578** | **14 631 578** | **73 157 897** |

*Source: Ministry of Economy*

Typically this scheme would set a fixed bonus per kWh of electricity generated in cogeneration cycle on top of wholesale electricity price. In addition, the scheme would set a cap on operating hours and overall national cap on support payable to prevent uncontrolled investment booms and thus too much of a burden on the economy. Often countries would set higher bonus for small cogeneration units to promote investment into modern decentralised generation which is beneficial for the grid from the point of view of balancing and resilience.

This is not the case in Romania, which differs from the standard support schemes in one important aspect: it introduces a maximum rate of return a generator can earn as an eligibility criterion. This leads to a perverse situation which rewards generators for inefficiencies such as high fuel costs and high emissions. The generator in a vertically integrated structure, such as EC Oltenia or Hunedoara, would have an incentive to report high fuel costs in order to push its

profitability below this threshold. Romanian regulator decided that such as threshold should be 9% rate of return (it is unclear whether this is real, or nominal, equity or company return).

With such a threshold it is obvious that his scheme is designed to keep inefficient incumbents afloat rather than to stimulate new investment as no investor would invest into a project which yields less than 9% return and punishes him for investing into an efficient technology. And, as we should in the chapter on market background given very low efficiency of Romanian generation fleet, the most efficient lignite plant Rovinary has efficiency of mere 35% in the condensing mode, it is questionable that EC Oltenia and Hunedoara meet modern high efficiency cogeneration standards.

The cogeneration bonus for the coal fired sector was set by ANRE at a level of RON 190/MWh for lignite and hard coal. EC Oltenia received a subsidy through the cogeneration bonus worth RON 61.2 million (source: ANRE) and Hunedoara RON 42.9 million in 2012 (source: ANRE). The bonus pay-out increased by 15% between 2012 and 2013.

Finally, the coal-fired plants receive a subsidy through statutory granted priority access to the balancing and ancillary markets. EC Oltenia and Hunedoara are able to earn revenues from capacity reservation scheme of Transelectrica for ancillary services and skip the merit order curve on the balancing market. This means that they receive capacity reservation fees and are dispatched on the balancing market even though they are more expensive than other units which could satisfy the demand at lower prices.

## Renewables

Renewables represent a small but rapidly growing sector of the generation fleet and has contributed to country's energy mix end of 2013 by about 7%.[15] The increase in installed generation capacity is mainly triggered by the development of wind generation. In 2012, renewable energy represented 26.40 GWh, an increase by about 65% compared to the previous year due to the new wind capacities installed. According to Transelectrica, as of end 2013, there were 2,522.39 MW installed capacity in wind farms, 466.81 in solar parks and 30 MW installed capacity in biomass.

Romania's potential in wind energy is considered the highest in South Eastern Europe. The Moldova and Dobrogea areas are considered the most appropriate areas for wind farm developments. In particular, the southeast of Dobrogea was ranked, second in terms of potential

[15] *ANRE Electricity market monitoring report –December 2013.*

in Europe.[16] The wind potential of Romania is estimated at 14,000 MW installed capacity, equivalent to total annual production of 23 TWh.

The renewable energy market expanded in Romania due to the favourable legal framework. The national support scheme for renewables was set up in 2005. In order to make the energy sector even more attractive for potential investors, the national support scheme for renewable energy was amended in 2008 to extend the period and the GC price to be increased. Similar to other countries in Europe such as Italy, Netherlands, Belgium, Sweden, Romania decided to adopt a market-oriented mechanism in order to compensate producers of electricity from renewables for the extra investment costs. The amount of compensation varies with the technology used and starts from the estimated Internal rate of return ("IRR") on equity of every technology. The number of applications for new renewable installations augmented significantly due to the attractiveness of the bonus scheme. However, generous tariffs, or allocation of green certificates per MWh of renewable energy generated, lead to an exuberant market and number of applications which the TSO and distribution companies found difficult to handle, both technically (in terms of ensuring grid connections) as well as administratively. In addition the government and other stakeholders, including the thermal generation sector and its advocates, raised concerns about ability of households and industry to finance such a boom.[17]


This has triggered amendments to the supporting mechanism which was halved the number of green certificates per MWh granted (3GC for solar instead of 6 and 1GC for wind instead of 2) and has significantly decreased the rice of GC to the minimum historical price of 30.96 €/MWh

[16] *Energy Investments & Finance, An Overview of the Renewable Energy Market in Romania, available at http://investeast.ro/renewable_energy_in_romania.pdf.*

[17] *According to the TSO, a significant number of requests for endorsing Solution Studies were sent to Transelectrica and the distribution companies (40,000 MW as of the end of December 2012 only for wind farms).*

in March 2014, after a price of 56 €/MWh scored in 2011 and 2012.[18] Frequent amendments made the respective legislation more complicated and uncertain. Legal uncertainty, rather than the value and number of green certificates, is the biggest factor hindering more investment into the renewable sector in Romania.

## Assumptions

To compare the alternative electricity generation scenarios only from the point of view of policy choices, we maintained for 2020 the minimum assumptions from the latest official strategy (2011-2035) on the relative fuel prices and on the growth of GDP and electricity demand (71.2 TWh). The minimum assumptions on international relative fuel prices are also quite similar to the assumptions used by the World Bank's META program. We assume also a very conservative $CO_2$ price of 23 EUR/t (30 USD/t).

**Table 6:** Relative fuel costs compared to lignite

| | **2015** | **2020** |
|---|---|---|
| Lignite – Min | 1 | 1 |
| Lignite – Max | 1,32 | 1,56 |
| Import coal - Min | 2,32 | 2,81 |
| Import coal – Max | 2,52 | 3,31 |
| Gas - Min | 4,43 | 6,43 |
| Gas - Max | 5,04 | 7,32 |
| Fuel oil | 4,65 | 5,83 |
| Uranium | 0,25 | 0,33 |

*Source: Ministry of Economy, 2011*

[18] *Opcom monthly report for March 2014 available at http://www.opcom.ro/opcom/uploads/doc/rapoarte/lunar/R_1403_RO.pdf.*

# Quantification of Subsidies

This chapter quantifies subsidies allocated to the coal sector since 1990 and renewables. First, we assess the subsidies allocated to the mining sector from 1990-1997. Year 1997 marks the starting point of the restructuring process launched by the government. Second, we review the 1998-2003 period. The period portrays the joint efforts of World Bank and Romanian Government to decrease state aid to the mining industry and downsize it in terms of employment. Third, we evaluate a period between 2004 and 2007. In 2004, the

Romanian government adopted Strategy for the mining industry and advanced several measures aimed at restructuring of the sector. Forth, we estimate subsidies granted to the sector between years 2007 and 2010, first and second notification to EC regarding state aid to mining sector. Finally, we assess subsides as approved by the European Commission to be granted to the mining sector between years 2011 and 2018. We sum up our findings with a focus on subsidies to main companies active in the mining sector. Next, we assess subsides allocated to the renewables sector.

## Subsidies to coal sector 1990 – 1998

Many of Romania's resources were over-developed before 1989 and efforts are needed to put the extraction on an economically, socially and environmentally sustainable basis. Under communism, the mining sector was a privileged sector, with relatively high wages and influential trade unions. Political power of trade unions has made the restructuring of the sector challenging. Nonetheless, the opposition to mine closures and restructuring also had legitimate reasons, such as the lack of experience in closing mines in an environmentally safe manner, given that the extraction practices before 1989 had no consideration for environment and many sites required decontamination and proper post-closure management. The government had scarce resources and limited expertise. The second reason was the social problem. Mining communities are often remote and mono-industrial. In many cases, mines were overdeveloped beyond the limits of economic sustainability and mining communities were overpopulated with miners brought from other regions. The downsizing plunged entire areas in poverty and economic disarray. By end-1998, about 83,000 miners (out of a total of about 173,000 workers total for coal and other mining industries) left the industry. Table 7 below shows the total subsidies granted to coal sector and

**Table 7:** Total subsidies granted to coal sector, USD mn

| 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|
| 337.8 | 167.6 | 233.3 | 181.6 | 162.9 | 203.9 | 138.7 | 45.2 | 40.2 |

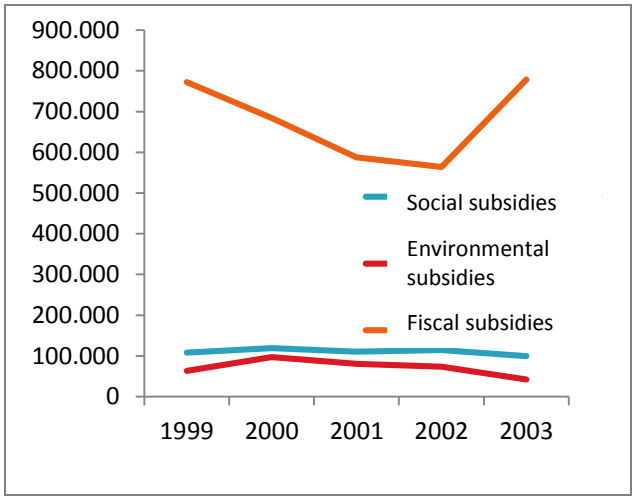
*Source: the Ministry of Economy*

portrays a 88 % drop in subsidies between the level of subsidies in 1990 and end of the analysed period.

## Subsidies to coal sector 1999 – 2003

The 1999-2004 period marks the active involvement of the World Bank in mine closure. In the beginning of the period, most of the redundancies were voluntary. The government was keen to start closing uneconomic mines (in 2004, the number of mines in operation was down to an estimated 120). Figure 7 classifies under fiscal subsidies the operating subsidies concerning on-going operations of the mining companies, as well as investments, but also redundancy payments, which are classified as direct subsidies. The social allocations include safety equipment, transportation, and meals for workers. Environmental costs include only costs with mine closure. The increase of fiscal subsidies in 2003 followed a new wave of restructurings and collective layoffs in the thermal generation and mining sectors.

**Figure 7:** Aid granted to coal mining sector, 1999-2003, thou lei (RON 2005 )

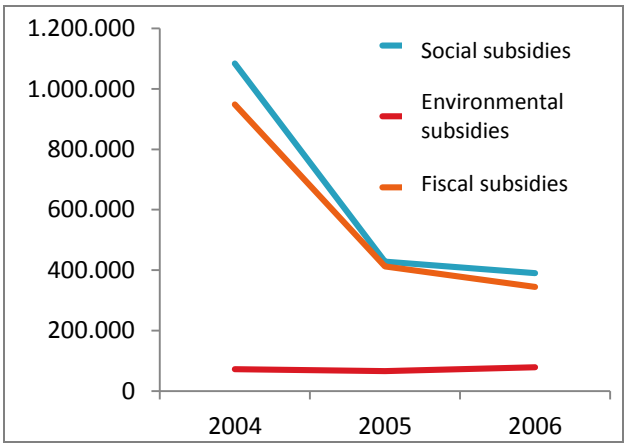



*Sursa: Ministerul Economiei, calculele autorului*

## Subsidies to coal sector: 2004 – 2006

The share of state aid granted to coal sector compared to other sectors of the economy during the analysed period had an ascending trend, it accounted for 13% of total state aid granted in Romania in 2004 and for about 17% at the end of the period. Nonetheless, overall the total aid granted to coal sector has decreased driven by steep decline in direct costs, once the redundancy pay for layoffs of 2003-2004 was absorbed (see figure 8). The fiscal subsidies (which include also tax breaks or cancellation of debts to the budget, as well as operational and investment subsidies) had a descending trend over the analysed period and were to be ceased in 2007 in order to assess the economical viability of the

**Figure 8:** Aid granted to coal mining sector, 2004-2006, thou lei (RON 2005)



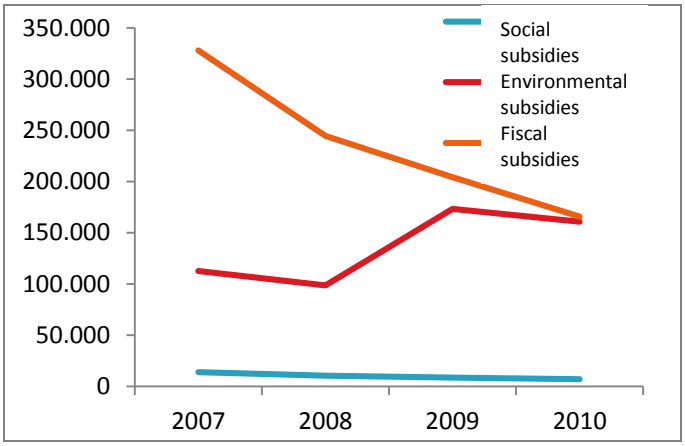

*Sursa: Ministerul Economiei, calculele autorului*

companies. In 2004, the government drafted a sector's strategy and pledged to restructure the sector by decreasing state intervention, privatising mines, and downsizing.[19]

## Subsidies to coal sector: 2007 - 2010

Beginning of 2007, Romania notified to the EC the state aid scheme N 239/2007 with an objective to restructure the coal mining sector. The only mining company entitled to receive state aid for the period 2007-2010 was the National Hard Coal Company. During this period, the company did not close any of its seven production units[20] and decreased the number of employees by 21%, from 11,700 to 9,300. The subsidies granted were aimed to cover the difference between production costs and revenues through direct subsidies and the social costs of mining. During this period (see figure 9), the state aid allocated was about RON 1.29bn (RON 1.24bn were fiscal subsidies while social subsidies amounted to RON 53mn). Environmental subsidies increased for the period 2009-2010.[21]

**Figure 9:** Aid granted to coal mining sector, 2007-2010, thou lei (RON 2005 )




*Sursa: Comisia Europeană, calculele autorului*

## Subsides to coal sector: 2011- 2018

Following Council Decision 2010 / 787 / EU on state aid to the coal industry, the national hard coal company is entitled to receive state aid by 2018. Three out of seven of company's production units will be closed by 2018. The aid to be granted by the EC is intended exclusively to facilitate closure of three uncompetitive mines and does not cover historical debts of the National Hard Coal Company. For example, mid 2011, the company had registered debts to the state budget as well as overdue payments to local municipalities amounting to € 1.2bn. By 2018, the company is to reduce its production by 2/3 (from 735 thousand tons of hard coal to 245) and its employees by 88%, (from 3,355 to 406).[22]

[19] *Compania Naţională a Huilei Petroşani, Societatea Naţională Lignit Oltenia S.A., Societatea Naţională a Cărbunelui Ploieşti.*

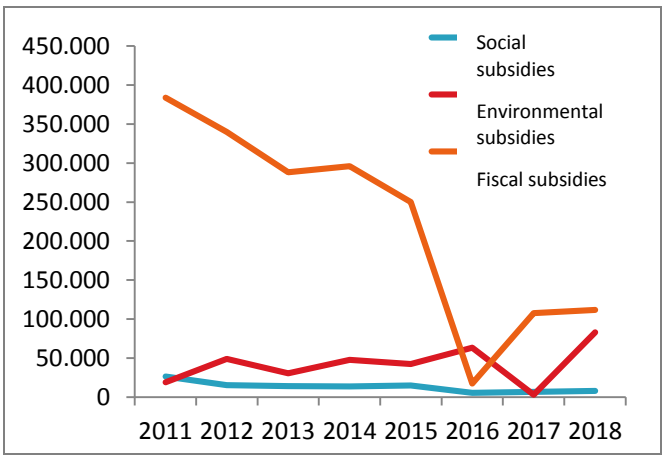
[20] *Lonea, Petrila, Livezeni, Vulcan, Paroşeni, Lupeni şi Uricani.*

[21] *We have used aggregated figures for years 2009-2010.*

[22] *Data as of 2011.*

Figure 10 shows the total amount of subsidies to be granted to the National Hard Coal Company for the period 2011-2018. The social subsidies amount to RON 103.82 mn and include costs related to severance payments (redundancy), costs related to the professional retraining, costs of supply of coal to workers who will lose their jobs or the monetary equivalent (coverage of the cost of electricity, free coal allowance). The environmental costs include costs arising from the closure of coal production units (closure of underground mining works and decommissioning equipment and shutting the mine in safe conditions), costs related to the rehabilitation of former coal mining sites (decommissioning infrastructure) and costs of surface re-cultivation and score about RON 211.38mn. The total amount of fiscal aid is RON 1.17bn (€ 269.18mn) and includes costs to cover the current production losses of coal production units (the aid shall not exceed the difference between the foreseeable production costs and the foreseeable revenue for a coal year and is to be adjusted annually).

**Figure 10:** Aid to be granted to the Romanian Hard Coal Company, 2011-2018, thou lei (RON 2005)




*Sursa: Comisia Europeană, calculele autorului*

## Subsides to coal sector: to sum up

There is considerable ambiguity in the use of terms defining subsidies as we've explained in the methodology chapter. There are some direct, as specifically indirect subsidies that were not accounted for due to lack of consistent data over the analysed period. Nonetheless, we will point to some relevant subsidies and valuation. For example, guarantees issued by Eximbank on behalf of the state for coal companies amounted to RON 30mn for EC Craiova and RO 942mn for EC Oltenia end of 2012, while in 2013, about RON 905 mn were guaranteed for EC Oltenia.[23]

Coal power plants are an important contributor to air pollution in Europe, and an important public health threat. Exposure to outdoor air pollution is linked to a number of health impacts such as higher rates of respiratory and cardiovascular disease. Emissions from coal power plants in Europe contribute significantly to the burden of disease from environmental pollution. Health and Environmental Alliance ranked top 20 largest coal power plants in terms of electrical power and burn large amounts of coal, as well as pollution. In 2009, EC Turceni ranked second, EC Rovinari

[23] *Data from finance ministry.*

ranked 6th while power plant Mintia-Deva ranked second last. Economic valuation of the health impacts in Romania was estimated between € 2,315 to 6,409 mn.[24] Nonetheless, the assessment excludes health impacts from emissions to water, and focuses only on three main air pollutants, while costs to health are also excluded. Also based on 2009 data level, European Environment Agency assessed the damage costs to health and the environment resulting from pollutants emitted from industrial facilities. The aggregated damage costs positions Romania on the 6th place among the largest European polluters, [25] after Germany and Poland, while the aggregated damage costs by country normalised against GDP shows the significant impact on country's national accounts as it ranks second, after Bulgaria.[26] Considering that the data reveals the situation in 2009, second year after accession to EU, Romania was in the process of implementing relevant environmental legislation. Significant investments in order to meet environmental standards were carried at EC Rovinari and EC Turceni after the assessment was carried. For example, EBRD granted a syndicated loan of up to EUR 200mn to EC Oltenia aimed to finance the rehabilitation and modernisation of one of EC Turceni lignite fired power plant units with the aim to decrease emissions so as to comply with EU environmental directives.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Based on the data provided by Romanian authorities, the figure 11 below shows the total subsidies granted to the coal sector classified as direct costs (including capital allocations, transfers), environmental costs (mainly with mine closure) and social costs (costs attributed to employees).

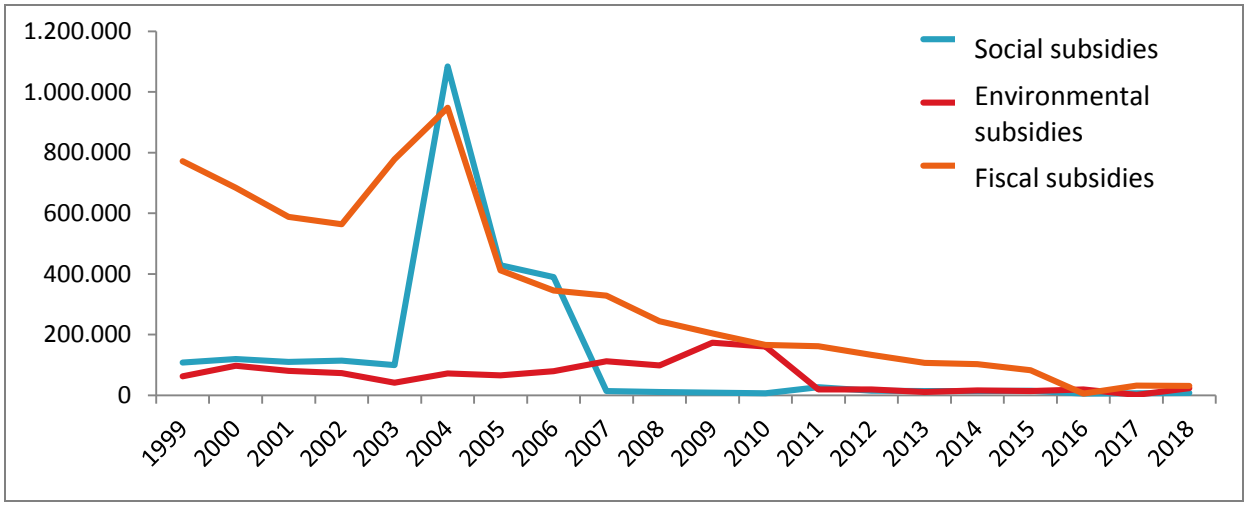
*[24] Health and Environmental Alliance, The unpaid health bill: How coal power plants make us sick, March 2013, available at http://www.env-health.org/IMG/pdf/heal_report_the_unpaid_health_bill_how_coal_power_plants_make_us_sick_final.pdf.*

*[25] European Environment Agency, Revealing the costs of air pollution from industrial facilities in Europe, EEA Technical Report, No 5/2011, available at http://www.eea.europa.eu/publications/cost-of-air-pollution.*

*[26] Damage costs normalised by GDP (EUR/GDP x 103).*

The figure shows a significant increase in what the economy ministry classifies as direct subsidies. As we mentioned above, severance payments are considered direct subsidies; social subsidies, such as retraining and support for finding a new job increased as well during layoffs, particularly because the World Bank program introduced some social measures for miners that had been laid off also in the first period, 1997-1999, and currently living in depressed areas. Direct and social subsidies were high up to 2007, the year when the government had to review economic viability of the mining companies and notify to the European Commission the level of subsidies to be granted. Starting 2007, only the hard coal company was entitled to receive state aid, though indirect forms of state aid continued also in the lignite sector (see section 5.2 above for an assessment of hidden and cross-subsidies).

**Figure 11:** Total subsidies granted to coal sector, 1999-2018 (RON 2005)



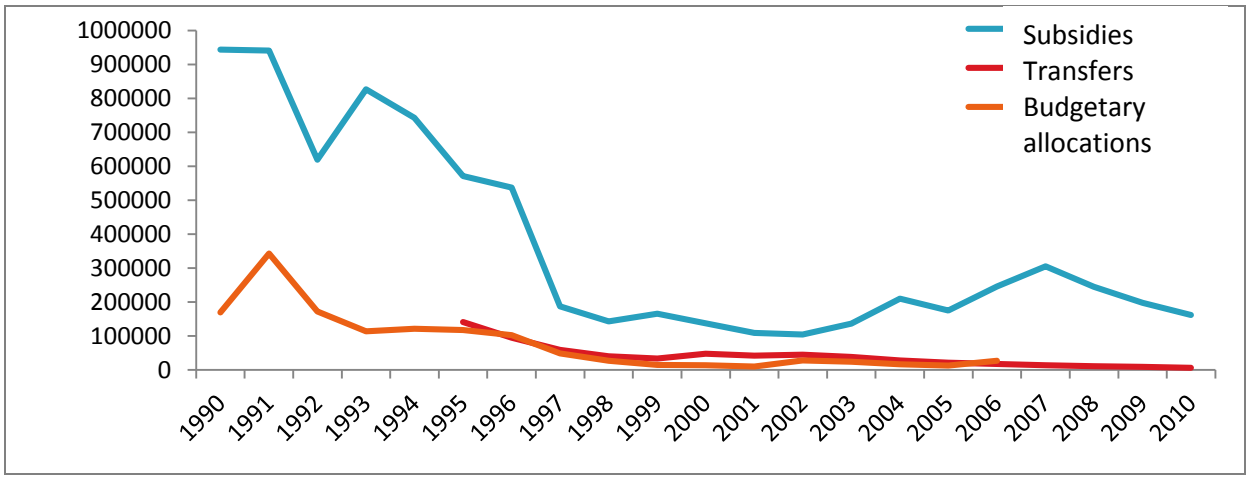

*Sursa: Ministerul Economiei, Comisia Europeană, calculele autorului*

Figure 12 below shows the subsidies granted to the National Hard Coal Company which follows the general trend, that is the increase in subsidies granted starting 2003, which was continued after Romania's accession to the EU. Between 2011-2012, those direct subsidies were ceased, and according to EC decision C(2012) 2010/2, state aid was granted only for covering losses from production and for exceptional costs (about RON 114mn for 2011 and RON 49mn for 2012). End of 2012, a National Company responsible for mines' closure was set up with the aim to manage the closure of mines. About RON 1.17bn will be granted as state aid (with EC's approval) by 2018. In 2012, RON 139mn was granted to cover costs with losses and RON 49mn to cover exceptional costs. About RON 131mn are granted for production costs and RON 32mn for exceptional ones in 2013. The government decided to allocate RON 174 mn to the National Hard Coal Company in 2014 to the three production units that are to be closed by 2018. About 70% of the funds (RON 122mn) are allocated for covering losses from current production while RON

52mn are to be granted for exceptional expenses (incurred with mines closure-RON 28mn, with retirement funds and training).

As of end-2013, the government decided to write-off a debt that EC Hunedoara had towards the National Hard Coal Company for unpaid hard coal delivered to power plants Mintia-Deva

**Figure 12:** Total direct subsidies related to National Hard Coal Company, 1990-2010 (RON 2005)



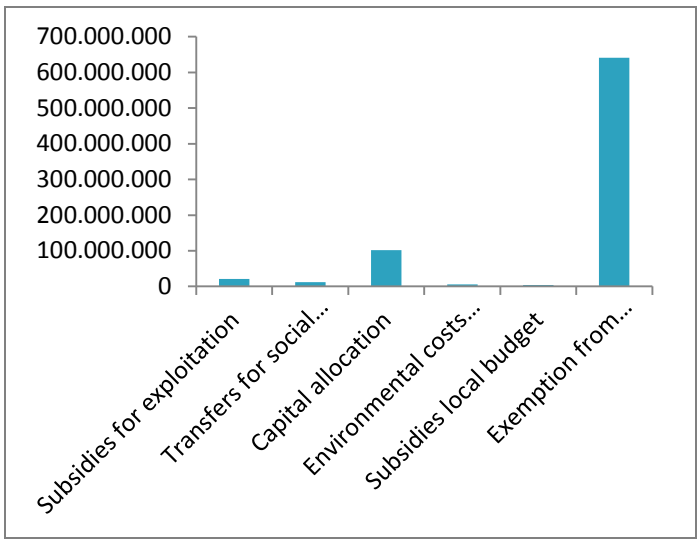

*Sursa: Complexul Energetic Hunedoara*

and Paroseni with the aim to avoid insolvency of the energy compound. The state also decided to write-off the debts that the National Hard Coal Company had towards the state budget in order to cover for the debts that EC Hunedoara had towards its coal supplier, namely RON 70mn. End of 2012, EC Hunedoara imported about 455,000 t of hard coal, a contested decision, which pushed the Government to accept later further purchases from the National Hard Coal company, as miners started to protest. With the same goal of avoiding insolvency, recently, EC Oltenia transferred the property of a lignite mine to the Govora CPP in exchange for an unpaid debt of EC Oltenia.

The decision to write-off EC Hunedoara's arrears was aimed at improving its investment attractiveness as it is to be privatised. All in all, it is very difficult to disentangle the total value of such hidden subsidies, e.g., the real value of coal from CNH in intercompany debt offset.

The National Lignite Company received between 1989-2013 about RON 769mn in direct subsidies, social subsidies of RON 116mn and environmental subsidies allocated for mine closure of RON 6mn (see figure 13).

**Figure 13:** Total direct subsidies to National Lignite Company, 1989-2013



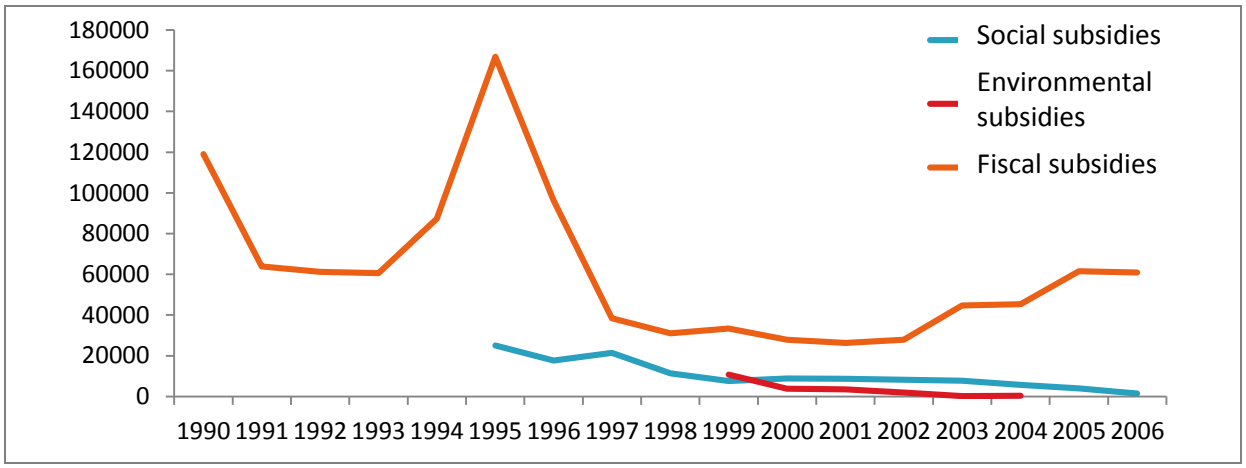

*Source: SNLO Oltenia*

To continue extraction, a major issue for the National Lignite Company is the acquisition of land in order to develop exploration sites. This may take up to 4-5 years of litigations and requires significant financial resources. SNLO Oltenia needs to acquire about 200 hectares per year and the tree compounds Turceni, Rovinari and Craiova about 50-60 hectares per year.[27] Currently the expropriation for public utilities is relatively straightforward and was made even easier, in 2009 and 2011, by extending a fast track procedure for expropriation to all public utilities, which was initially designed only for roads. So far mining has been defined as commercial activity and therefore not eligible for the fast track. However, there is a proposed amendment to the mining law which would allow private mining companies to expropriate land needed for the mining operation on the same procedures like "public utility expropriations". The EC Oltenia intends to develop 2 exploration sites, an investment worth RON 2bn to be carried by 2030.[28] On top of that, the compensation for land owners is estimated at about RON 11mn, amount to be allocated from economy ministry's budget. This represents a potential social subsidy.

[27] *Director of Mineral Resources Department, Economy Ministry, Sorin Gaman.*

[28] *Jilt Sud quarry with a production capacity of 8.5mn tonnes/year and Rosia de Jiu quarry with a production capacity of 8mn tonnes/year.*

**Figure 14:** Total subsidies granted to National Coal Company, thou lei, 1990-2006




*Soursa: SNC Ploieşti, Ministerul Economiei*

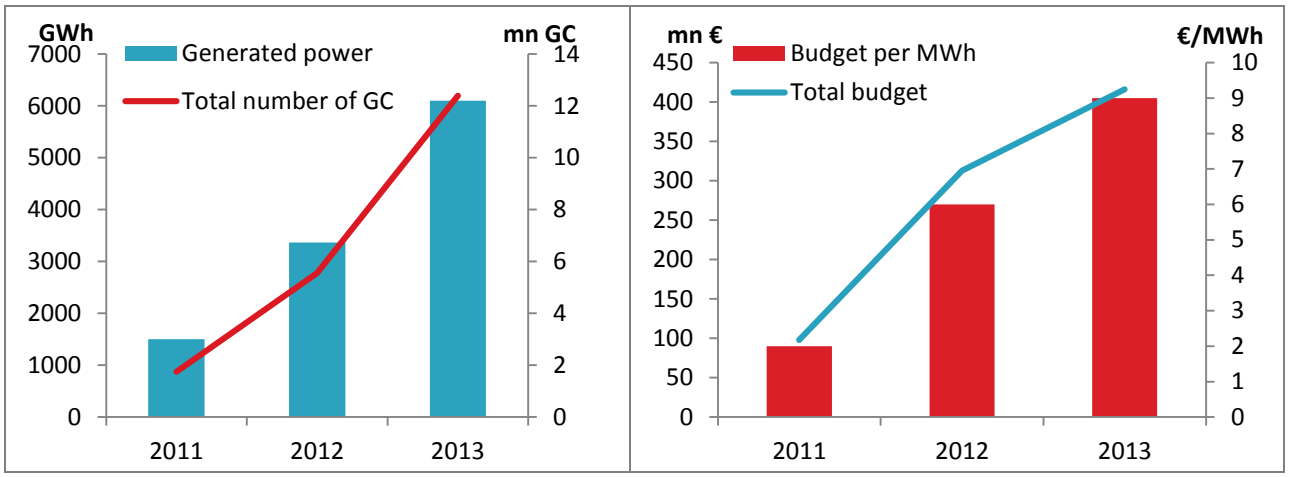
Figure 14 above shows the total state aid granted to the National Coal Company before 2006, before the Government was constrained by EU's state aid rules. As mentioned before, the government notified in 2007 the state aid to be granted to the coal sector and only hard coal was allowed to be subsidized afterwards. The figure shows a significant increase in direct subsidies in the last three years before Romania's accession to EU (2004-2006).

## Subsides for the renewable sector

There are several types of subsidies granted to the renewable sector. First, there are the direct subsidies, such as the support scheme (GC mechanism), the EU grants allocated for renewables projects and other types of funds allocated. Second, there are indirect subsidies such as investments needed to upgrade the national grid. Significant investments are required to upgrade the local grids and these have to be added to the overall costs of renewable energy in Romania. The TSO estimated that about EUR 500mn is needed to upgrade the grid in order to connect more renewables (our assessment follows in the Policy recommendations section).

According to ANRE, the financial impact on prices to end users increased from 0.026 Lei/MWh in 2005 to 9.03 Lei/MWh in 2011 because of the national support scheme for renewables. Despite increases in prices to end users triggered by the national support scheme for renewables, electricity prices in Romania are still among the lowest ones in the EU. Electricity prices for households are the third cheapest in the EU after Bulgaria and Estonia with an average rate for households of EURc 10.9 /kWh in real prices, all taxes included (compared to the EU average of EURc 18.4) and the second cheapest for the industry sector, after Bulgaria, with EURc 8/kWh (compared to the EU average of EURc 12.9). The figure below shows the subsidies granted o the RES sector through the GC mechanism.

**Figure 15:** Green certificates and budget allocated




*Source: ANRE*

Considering that Romania has declared the development of renewable energy a priority in the National Strategy for the Energy Sector and in order to meet its EU obligations, the renewable energy sector in Romania has been included in the framework of support by the European Structural Funds. These subsidies are compatible with the specific support regime for renewable incentives in Romania.

Investment funds can be partly covered by European Union and Romanian budget (please see Appendix for a comprehensive list of types of funds and allocated budget).

## Policy recommendations

As the Government is currently updating the energy strategy, assessing policy choices between coal and renewables are crucial for the future decisions concerning power generation. Investments can be targeted to shift the energy mix and the technologies through support by subsidies / state aid (admissible under EU legislation for investments that support clean energy and better market integration) or by policy measures (e.g., trading of $CO_2$ certificates or full liberalization of fuel prices). From this perspective, particularly on the state aid, there is a clear tradeoff: e.g., with the same public resources that are now used to clean up the existing coal power plants, the Government may choose to support renewables, reduce GHG, invest in grids for better integration of renewables.

To highlight this tradeoff, for simplicity, we compare 3 scenarios by 2020, which include only generation investments and incremental investments in transmission and distribution required for the integration of new capacities:

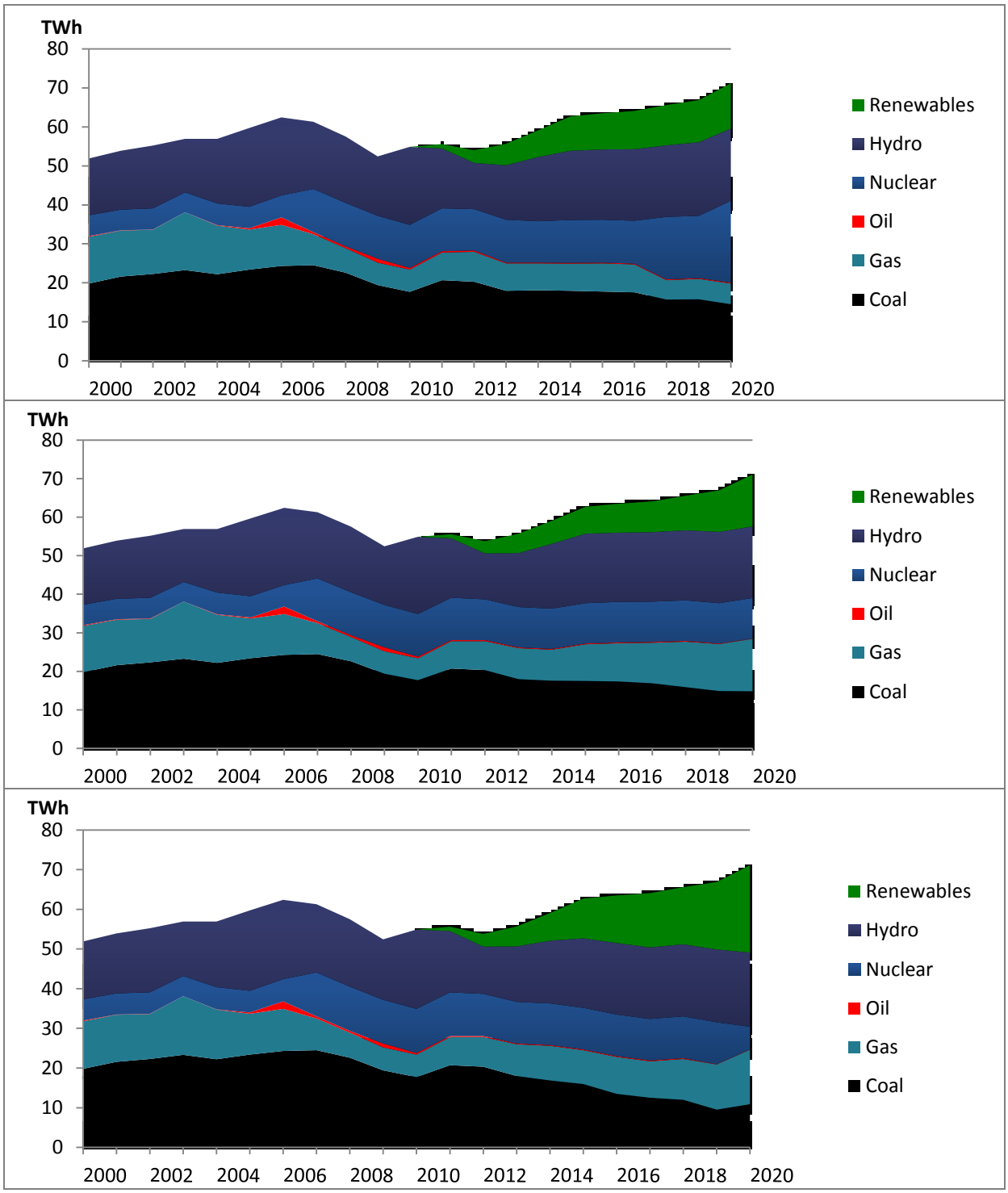
**Scenario A** is the current Government plan (from the draft strategy 2011-2035). The planned investments would offset the phasing out of 5,500 MW of old thermal plants. It includes ambitious generation investments in conventional energy, including desulphurization for 6 coal units, two new reactors in Cernavoda, and upgrades / new coal units.

**Scenario B** is a proposed alternative without the two additional nuclear units; the upgrading of 2,200MW coal-fired units; but with significantly higher investments in wind and solar PV, and in flexible conventional power generation to manage increased system load of intermittent renewables. It includes distributed pumped storage, dispersed (small and medium size) gas-fired combined cycle power plants, and circulating fluidized bed (CFB) combustion units in cogeneration. This scenario requires additional investments in grid infrastructure to integrate intermittent renewables; and in reduction of distribution losses.

**Scenario C** is an ambitious, low-carbon, renewables-oriented option. It includes almost 5,000 MW more of renewables, particularly wind and solar PV, considering that solar PV has become much more competitive in recent years even without substantial state aid, and that wind technology is also improving (this means also that wind and PV can be used at slightly higher capacity factors). Compared to scenarios A and B, the 500 MW supercritical coal unit would not be built. This alternative allows even the phasing out of one of the two existing reactors in Cernavoda; but requires the finalization of the inner ring Nort-East / South West for transmission; and stations and lines of 110/20 kV for the connection of wind / PV and connection of distribution for consumers.

The three scenarios would cover the same energy consumption expected in the official scenario of 71.2 TWh. Energy savings by 2020, e.g., caused by energy efficiency improvements, of up to 5% would not influence the decisions to (dis-)invest in capacity, as these investments are discrete, not continuous; savings can be managed by lower capacity factors in less efficient power plants, which are also larger and with higher marginal costs than the modern, distributed generators.

**Figure 16:** Electricity generation in Scenarios A, B, C




*Source: Ministry of Economy, 2011; World Bank, 2013; own calculations*

We compared the costs of the 3 scenarios using the META model developed by the World Bank[29]. The costs, for which the META includes estimates in 2010, were adjusted with latest available figures (e.g., nuclear costs have almost doubled in the past 4 years; PV has become substantially cheaper; state-of-the-art on-shore wind has comparable costs with state of the art coal- or gas-fired plants; large hydro or pumped storage have significantly higher environmental costs; higher environmental standards for coal-fired plants etc). Overall, the moderate Scenario B costs EUR 3.8 billion less than the government plan (Scenario A); whereas Scenario C costs EUR 2.2 billion more than the Government's plan.

Scenarios B and C have several advantages:

They save a significant amount (over 6 billion EUR) in public resources by avoiding the construction of 2x700 MW nuclear reactors. Scenario C also includes the hypothetical situation of shutting down one of the two existing reactors, which would require preparation of renewables ahead of time and investments in gas-fired generation to compensate the production gap. Alternative B is also cheaper in terms of both levelized cost of energy and emission costs, at a very conservative 30 USD/t, the assumption used in the META model, for $CO_2$ prices post-2020. For higher $CO_2$ prices, the benefit would increase proportionally. Alternative C is cheaper only in terms of emission costs, as it includes the least coal of all three scenarios. The $CO_2$ emission savings in Scenarios B and C compared to A are relatively modest because the Government scenario includes 1400 MW of $CO_2$-free nuclear capacities. Lower nuclear capacity and upgrades of existing thermal generation are offset in Scenarios B and C by higher efficiency gas- and coal-fired units and more renewables. In Scenario C, the only coal investments are small distributed high-efficiency cogeneration units. In both Scenarios B and C, coal is gradually replaced by gas (faster in Scenario C). E.g., Deva hard coal unit would be replaced by gas-fired generation.

[29] *Calculations were made using the META tool, Model for Electricity Technology Assessment, available at http://www.esmap.org/node/3051.*

**Table 8:** Valuation of the three scenarios

| GENERATION INVESTMENT COST (EUR) | Scenario A | Scenario B | Scenario C |
|---|---|---|---|
| | 2014-2020 | 2014-2020 | 2014-2020 |
| Wind (on-shore) | 1,652,500,000 | 3,305,000,000 | 4,400,000,000 |
| Solar PV | 449,475,000 | 1,348,000,000 | 6,150,000,000 |
| Biomass | 971,600,000 | 971,600,000 | 971,600,000 |
| Large hydro | 1,250,000,000 | 1,250,000,000 | 1,250,000,000 |
| Pumped storage (large) | 900,000,000 | 900,000,000 | 900,000,000 |
| Pumped storage (distributed) | - | 360,000,000 | 360,000,000 |
| Nuclear | 6,650,000,000 | - | - |
| FGD installation 6 x 330MW | 410,000,000 | - | - |
| Upgrade coal/gas | 1,200,000,000 | - | - |
| Coal supercritical | 875,000,000 | 875,000,000 | - |
| Coal CFB | - | 520,200,000 | 520,200,000 |
| CCGT F-type | - | 753,600,000 | 753,600,000 |
| CCGT E-type | - | 341,400,000 | 341,400,000 |
| INFRASTRUCTURE INVESTMENT COST (EUR) | - | - | - |
| Single overhead line 400 kV | 700,000,000 | 234,000,000 | 259,000,000 |
| Double overhead line 400 kV | 299,000,000 | 448,500,000 | 473,500,000 |
| Transmission substations (MVA) | 200,000,000 | 238,372,875 | 265,372,875 |
| Distribution substations (MVA) | 70,928,000 | 217,217,000 | 717,217,000 |
| Distribution lines | 34,658,000 | 34,658,000 | 434,658,000 |
| Smart infrastructure | 60,000,000 | 133,000,000 | 163,000,000 |
| TOTAL INVESTMENT (EUR) | 15,723,161,000 | 11,930,547,875 | 17,959,547,875 |
| $CO_2$ emission cost (EUR) | 255,437,220 | 241,535,100 | 130,962,000 |

*Source: World Bank, 2013, updated; own calculations*

Scenario C is more expensive than the Government's proposal, but of the EUR 2.2 billion, about EUR 1 billion consist of investments in transmission and distribution for the integration of a much larger share of renewables. Such investments are needed not only to integrate renewables, but to also substantially enhance the safety of the transmission grid and power system. Scenarios B and C have the benefit of substantially improving energy security by relying on state-of-the-art technologies; and distributed generation, instead of the existing large units. Even if the inner ring and adjacent infrastructure with Serbia and Moldova are built after 2025[30], these would contribute both to increasing Romania's interconnection and enhancing the security of electricity supply in the country. Also, distributed cogeneration ensures lower costs of balancing the system nationally and reduces the risks and costs associated with the failure of one unit or one transmission line.

Pump storage capacity (Tarnita and distributed units) would be needed in both Scenarios B and C, to increase the flexibility and respond to variations in intermittent renewable power generation.

In terms of public funding (including available EU funds or amounts from sales of $CO_2$ allowances), the cheapest alternative is Scenario B. However, all 3 scenarios also include other forms of state aid, paid directly by the consumers, and not quantified in the table below (the green certificates scheme, the cogeneration bonus). The extent to which such schemes can be used depends on the energy price affordability for the end-consumer and the cost of latest renewable technologies. However, the technology costs for renewables have dropped sharply in recent years. The economic feasibility of the renewables expansion is examined below. The necessary public funds could be used from: savings from coal subsidies, direct and indirect, as highlighted before; EU funds for 2014-2020 (about EUR 200 million from the total allocation of EUR 250 million would be available for projects from the list below); sale of $CO_2$ certificates; and full commercialization of the energy sector (e.g., liberalization of energy prices or partial or full privatizations) so that SOEs such as Hidroelectrica and Oltenia may cover investments from their own revenues.

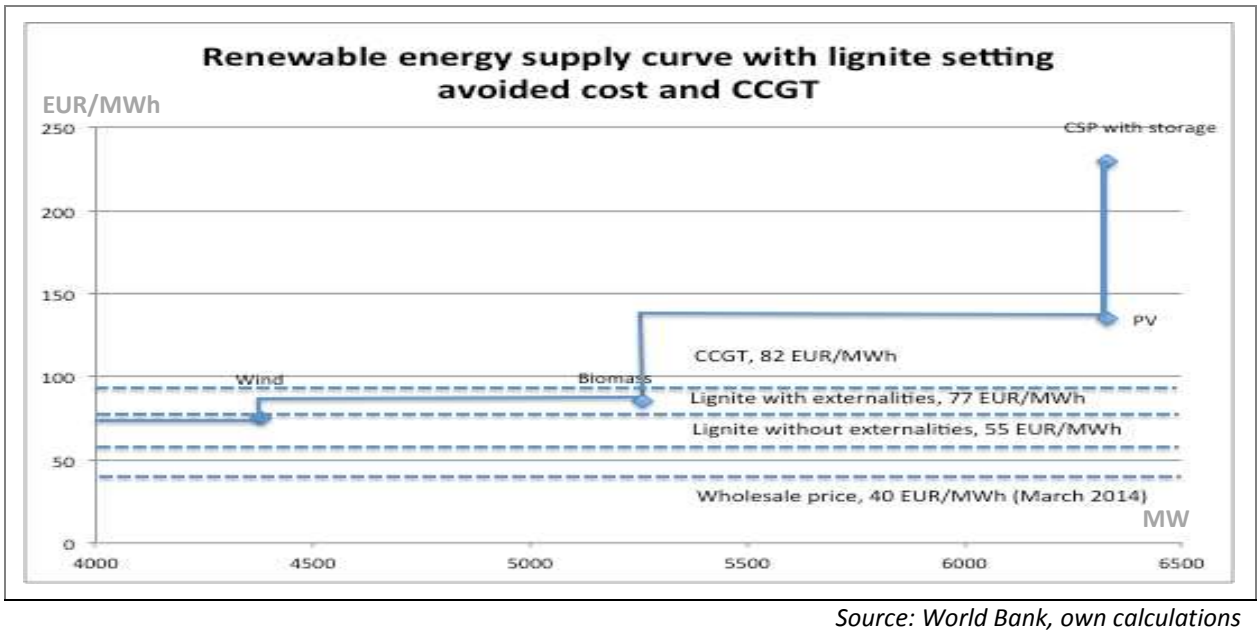
*[30] Serbia (400 kV line Romania - Serbia, 400 kV Iron Gates – Reșița including substation modernizations), and Moldova (400 kV line Suceava – Bălți, Suceava - Gădălin and Gădălin – Oradea/Mintia)*

**Table 9:** Financing sources for the three scenarios

| GENERATION | Financing source | Scenario A | Scenario B | Scenario C |
|---|---|---|---|---|
| Wind (on-shore) | Private | - | - | - |
| Solar PV | Private | - | - | - |
| Biomass (steam) | Private | - | - | - |
| Large hydro | Hidroelectrica JV (50% private) | 625,000,000 | 625,000,000 | 625,000,000 |
| Pumped storage (large) | Hidroelectrica | 900,000,000 | 900,000,000 | 900,000,000 |
| Pumped storage (distributed) | Hidroelectrica | - | 360,000,000 | 360,000,000 |
| Nuclear | Private (JV) | - | - | - |
| FGD installation 6 x 330MW | SOEs (Oltenia, Hunedoara); EU | 410,000,000 | - | - |
| Upgrade coal/gas | SOEs (Oltenia, Hunedoara, ELCEN) | 1,200,000,000 | - | - |
| Coal supercritical | Private | - | - | - |
| Coal CFB | Private | - | - | - |
| CCGT F-type | Private | - | - | - |
| CCGT E-type | Private | - | - | - |
| INFRASTRUCTURE | | | | |
| Single overhead line 400 kV | Transelectrica & EU funds | 350,000,000 | 117,000,000 | 129,500,000 |
| Double overhead line 400 kV | Transelectrica & EU funds | 149,500,000 | 224,250,000 | 236,750,000 |
| Transmission substations (MVA) | Transelectrica & EU funds | 100,000,000 | 119,186,438 | 132,686,438 |
| Distribution substations (MVA) | Private & Electrica | 26,598,000 | 81,456,375 | 358,608,500 |
| Distribution lines | Private & Electrica | 12,996,750 | 12,996,750 | 217,329,000 |
| Smart infrastructure | Private & Electrica | 22,500,000 | 49,875,000 | 81,500,000 |
| | Total public funding | 3,796,594,750 | 2,489,764,563 | 3,041,373,938 |

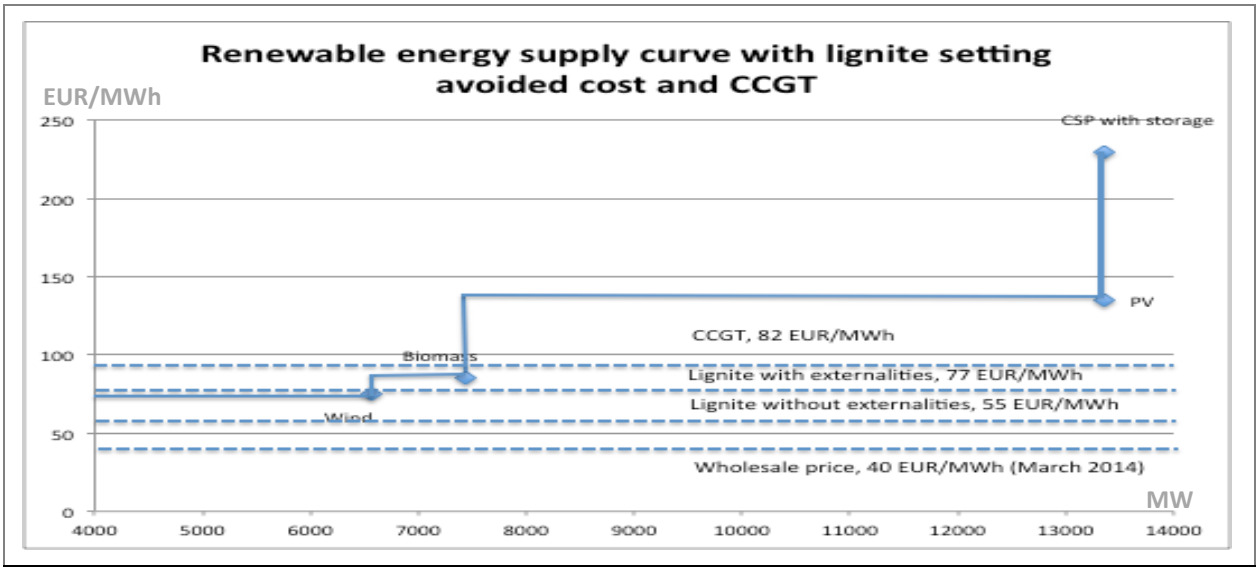
We calculated the levelized cost of energy (LCOE) for renewables in alternative scenarios B and C and constructed an economic supply curve based on these two plans. Again, the calculation of LCOE is based on World Bank's META model of 2010, which includes values for LCOE for each technology in Romania, and adjusted with more recent figures; the revisions were downward, because the technological development for renewable technology outpaced the expectations in 2010. The supply curve (Figure 17-18) ranks the least costly renewables options and indicates the incremental cost (required subsidies) needed to scale up the renewables to the levels in Scenarios B and C, respectively. By comparing with the current level of support (the existing green certificates scheme), one can assess whether the latest scheme is conducive to reaching the renewables targets in Scenarios B and C. All renewables options considered have higher LCOE than fossil fuel-fired generation technologies, although the LCOE of on-shore wind generation is close to that of the lignite-fired generation, if $CO_2$ pricing is factored in. In other words, all renewables still need support to attract investments until full internalization of $CO_2$ costs.

**Figure 17:** Supply curve of renewable power – Scenario B




*Source: World Bank, own calculations*

**Figure 18:** Supply curve of renewable power – Scenario C




*Source: World Bank, own calculations*

Table 10 below for Scenario B shows the amount of subsidy required through 2020 to support investments in renewables, assuming a conservative price for $CO_2$ of USD 30/t (EUR 23/t). Considering that the capacity would be installed gradually, the annual subsidy would increase gradually to EUR 200 million so that renewables replace lignite-fired plants, which would be taken out of the market. One can make a similar comparison with a CCGT to show what would be the support required so that existing lignite fired power plants are replaced by renewables, and not by other power plants, such as a modern CCGT. In this case, the subsidy required is lower, EUR 63 million per year, or only 89 eurocents per MWh to be paid for by the end-consumer. In any case, the existing green certificates scheme should cover the investment support needed to reach the targets by 2020, considering today's price of 36 EUR/GC; and, in the case of full $CO_2$ cost internalization, wind would need no support. Of course, such a calculation does not take into account the policy risk: while investors might be satisfied with the current level of support *per se*, the major barrier to reaching the 2020 targets could be the uncertainties in the policy, legal

and regulatory framework, which have seriously shaken investor confidence in 2013 when the scheme was slashed for wind and PV[31].

**Table 10:** LIGNITE avoided cost

| RE option | Production - GWh | LCOE EUR/MWh | Incremental cost if $CO_2$ internalized | Incremental cost if $CO_2$ not internalized | Subsidy volume |
|---|---|---|---|---|---|
| Wind | 4380 | 75 | -2 | 20 | 87,600,000 |
| Biomass | 876 | 85 | 8 | 30 | 26,280,000 |
| PV | 1073.1 | 135 | 58 | 80 | 85,848,000 |
| Total (annual) | | | | | 199,728,000 |
| Per unit annual subsidy if CO2 price not internalized, EUR/MWh | | | | | 31.56 |
| Subsidy to be paid by consumers per MWh consumed in Romania, EUR/MWh | | | | | 2.80 |

*Source: Own calculations*

**Table 11:** CCGT

| RE option | Production - GWh | LCOE EUR/MWh | Incremental cost if $CO_2$ internalized | Incremental cost if $CO_2$ not internalized | Subsidy volume |
|---|---|---|---|---|---|
| Wind | 4380 | 75 | -10 | -5 | - |
| Biomass | 876 | 85 | 0 | 5 | 4,380,000 |
| PV | 1073.1 | 135 | 50 | 55 | 59,020,500 |
| Total (annual) | | | | | 63,400,500 |
| Per unit annual subsidy if $CO_2$ price not internalized, EUR/MWh | | | | | 10.02 |
| Subsidy to be paid by consumers per MWh consumed in Romania, EUR/MWh | | | | | 0.89 |

*Source: Own calculations*

A similar calculation for Scenario C shows that the support needed for the investments in renewables capacity to reach the targets should be significantly higher, above EUR 630 million per year through 2020 (on average, each MWh of renewable capacity needs 47 EUR subsidy, and the consumers need to pay almost 9 EUR/MWh consumed to support the scheme). Today's scheme would not allow investments as high as those proposed in the Scenario, though the adjustments needed would not increase the end-consumer energy price as much as one might

*[31] The current GC scheme, slashed in July 2013, allows: 1 GC for wind, 4 GC for PV, 2 GC for geothermal and biomass, 1 GC for biogas and 0.5-1 GC for micro-hydro. The table for Scenario B seems to suggest that even current support over 2014-2020 is sufficient to allow profitability for wind and solar PV, and that indeed the GC scheme before July 2013 had been excessively generous. However, such rash policy decisions and uncertainties might discourage investors, more than the level of support itself.*

expect. (However, Scenario C requires large investments in infrastructure for the integration of these additional capacities).

**Table 12:** LIGNITE avoided cost

| RE option | Production - GWh | LCOE EUR/MWh | Incremental cost if $CO_2$ internalized | Incremental cost if $CO_2$ not internalized | Subsidy volume |
|---|---|---|---|---|---|
| Wind | 6570 | 75 | -2 | 20 | 131,400,000 |
| Biomass | 876 | 85 | 8 | 30 | 26,280,000 |
| PV | 5913 | 135 | 58 | 80 | 473,040,000 |
| Total (annual) | | | | | 630,720,000 |
| Per unit annual subsidy if $CO_2$ price not internalized, EUR/MWh | | | | | 47.21 |
| Subsidy to be paid by consumers per MWh consumed in Romania, EUR/MWh | | | | | 8.85 |

*Source: Own calculations*

**Table 13:** CCGT

| RE option | Production - GWh | LCOE EUR/MWh | Incremental cost if $CO_2$ internalized | Incremental cost if $CO_2$ not internalized | Subsidy volume |
|---|---|---|---|---|---|
| Wind | 6570 | 75 | -10 | -5 | - |
| Biomass | 876 | 85 | 0 | 5 | 4,380,000 |
| PV | 5913 | 135 | 50 | 55 | 325,215,000 |
| Total (annual) | | | | | 329,595,000 |
| Per unit annual subsidy if CO2 price not internalized, EUR/MWh | | | | | 24.67 |
| Subsidy to be paid by consumers per MWh consumed in Romania, EUR/MWh | | | | | 4.62 |

*Source: Own calculations*

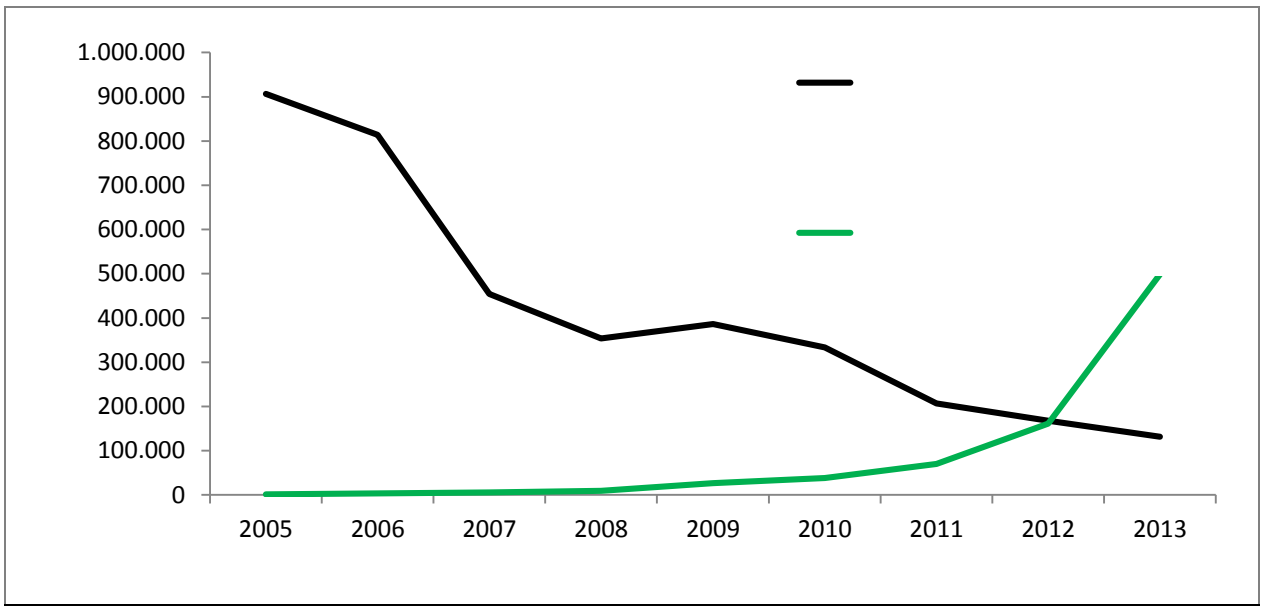
Actually, in both scenarios B and C, the average support for renewables to replace the lignite capacity is 32-47 EUR/MWh, which falls within the minimum and maximum price range of a GC today (27 EUR – 55 EUR / MWh).

The total support for renewables, divided by the total electricity consumption (assumed at 65 TWh in 2020) amounts to some 2.8 EUR/MWh on the invoice of end-consumers in Scenario B, and 8.85 EUR/MWh in Scenario C. As of mid-2013, when the scheme was slashed, ANRE reported a contribution of 11 EUR/MWh. While this indicates indeed that the previous support was excessive, the contribution figure does not take into account the positive substitution effect: the GC scheme increases the supply of renewables and replaced the most expensive coal-based marginal generation that normally sets the market-clearing price. Indeed, in early 2013,

# Conclusions

In this study we assess amount of subsidies received by the coal industry and compare this amount to how much renewable power is subsidies in Romania. We conclude that even on conservative basis using statistics published by the ministry of economy the coal industry has received almost five times more in subsidies than the renewable industry since 2005, RON 3.76 billion for coal compared to 0.81 for renewables (Figure 19). In total since 1990 the coal industry has received subsidies worth staggering RON 15 billion, an equivalent of 2.3% of a year's GDP. This count does not include the cost of externalities, such as increased cost to the national health system as a result of diseases caused by air pollution.

**Figure 19**:




*Sursa: Ministerul Economiei, Opcom, calculele autorului*

In the first part of the study we establish methodology for our research. We divide subsidies into direct, that is those from which the coal industry is a direct beneficiary, and indirect, that is subsidies the coal industry receives through power generating industry. In addition we further divide the subsidies into fiscal (production support from the state budget), social (support for mining communities, such as re-training of redundant miners) and environmental (support for mine closures).

In addition we find that power generation from coal and lignite is not economically viable in Romania as there are only very few hours in a year in which power prices are above marginal

cost of lignite and in particular hard coal generators, that is recently formed EC Oltenia and Hunedoara. As a result, those generators run only in part loads of maximum of one-third of rated capacity and need further operating support to stay on the market.

This support, which we believe mainly goes to cover fixed costs of running on partial loads, is granted through a cogeneration scheme and market distorting subsidy via priority access to balancing and ancillary services markets. We estimate that amount of this subsidy may well reach RON 110 million per year. Since we believe that power prices will stay subdued due to large supply of zero marginal cost renewable power from Germany and steady demand those subsides will only grow in future. In addition the coal fired sector will take a further hit as we expect price of $CO_2$ emissions to start increasing after 2020 to gradually reach EUR 36/tonne by 2030.

On top of that Romanian's coal fired sector has received a subsidy in term of free allocation of carbon. In the period between 2008 and 2012 only companies which currently make up EC Oltenia compound received a benefit through free $CO_2$ allocation valued at between EUR 300 million and EUR 2bn assuming either a low of EUR 4/tonne or high of EUR 30/tonne.

Fundamental difference between subsidies to coal industry and renewable industry is that subsidies for renewable industry can be considered to be a research and development support. The objective of this support it to introduce new technology to the market. Given steep decreases in per unit investment costs of wind as well as solar plants we can conclude that this subsidy has achieved its objective and can be gradually scaled back as those technologies are being integrated into the wholesale market.

Subsidies for the coal industry on the other hand just extend lifetime of a sunset industry creating structural problems in the meantime. As a result of keeping the ailing coal industry afloat investment and employment in the sector is slow to adjust. For example market distorting rules of privileged access of coal fired generators to the balancing and ancillary market and the way cogeneration bonus scheme in Romania is designed may hinder investment into clean and flexible generation which is needed to facilitate large-scale introduction of renewables into the grid.

In the concluding policy recommendation chapter we analyse three possible scenarios for further development of Romanian power sector. We conclude that the most economical scenario is the one with decreasing reliance on coal and nuclear sources and with steady deployment of renewables. This scenario not only minimises power bill of the Romanian economy, but also mitigates externalities such as damage to health and the environment, and stimulates investment into modern and productive energy sector. In fact, if we compare the total support in 2005-2013

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# Appendix

Investment funds for RES sector:

ERDF: European Regional Development Fund, sectoral operational program Increase Economic Competitiveness, Measure 4.2, Investment in Renewable Energy.

- Program period: 2007-2013;
- Funding available: EUR 463 million;
- 88% non-refundable EU funds, 12% co-financed by ministry of economy;
- Single company may receive up to € 18 mn in non-refundable funding for wind projects to cover up to 70% of eligible investment costs.

EAFRD: European Agricultural Fund for Regional Development, Measure 121, Modernisation of Agricultural holdings

- For electricity production exclusively for the farm use and not fed to the grid:
    - Maximum eligible costs for the project cannot exceed € 2mn;
    - Co-financing up to 40% of eligible costs (€ 800 000)
    - Time period 2010-2013
- For projects that included investment into agricultural production:
    - Maximum eligible costs for the project cannot exceed € 3mn

EEA Grants, over 90% funded by Norway:

- Available between 2009-2014;
- Allocation for Romania € 190.75mn;
- Available to NGOs, research institutions, public and private sectors in areas of environment and climate change, health, civil society, social affairs, justice, research and scholarships;
- In 2004-2009 period € 672mn was available and funded 800 projects. 200 included joint financing of EEA Grants and Norway Grants;
- ¼ of the grants used for environmental protection and sustainable development. Most of the funding went to increasing energy efficiency and renewable energy in public buildings such as schools or hospitals.

Norway Grants:

- € 115mn available for Romania between 2009-2014;

Romania has been allocated € 306mn in EEA and Norway Grants since 2007. 97% of the funding was provided by Norway.

Key area is increasing competitiveness of green enterprises:

- Energy efficiency: allocation of € 8mn;
- Renewable energy: allocation of € 8mn;
- Green industry innovation: € 24mn.

Romanian Environmental Fund administered by the environment ministry:

- Grants financing of up to 50% of eligible costs for wind projects;
- In Bucharest and Ilfov counties max 40% co-financed;
- Maximum amount one beneficiary could receive was RON 30mn;
- The program closed in 2010;
- 50 projects funded with RON 440mn;
- Funding increased to RON 900mn in 2011, unclear whether new projects could be submitted in 2012-2013.

EBRD and IFC:

- € 114.8mn and € 73mn to EDP Renovaveis for wind farms in 2011;
- In 2011 EBRD lent € 10mn to Raiffeisen for syndicating energy efficiency loans up to 2.5mn each.

EIB: provided a loan of € 200mn for a wind farm (the CEZ project) in 2010.