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THE EUROPEAN WIND ENERGY ASSOCIATION



Macro- economic impact of the Wind Energy Sector in Belgium



Report

December 2012

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This study is based on the following aspects:

- 1. The contribution of the wind energy sector to the Gross Domestic Product (GDP) of Belgium is calculated using three equivalent approaches, recognised by the European System of National and Regional Accounts (ESNRA): expenditure approach, added value approach and income approach.**

These approaches used to calculate GDP (and its components) are applied by Eurostat and EU national statistical bodies.

- 2. The abovementioned approaches have been applied to calculate the contribution of the wind energy sector to the GDP using the information disclosed by companies in their financial statements.**

This analysis has been complemented with additional information, such as cost structures, imports/exports or R&D expenditure, which was gathered through surveys where the main wind industry players were involved. The combination of these two data sets has made possible the calculation of the direct impact on GDP.

- 3. The different sub-sectors of the wind energy industry are linked to other sectors of the economy, purchase and provision of services. These interrelations result in added economic value and contribution to GDP (indirect).**

The calculation of income multipliers based on an input-output model is necessary to quantify the additional contribution. This model is a quantitative economic technique that captures the correlations between different branches of a single economy or from different and competing economies.

In order to evaluate the economic impact, the latest input-output tables of Belgium (2007) published by *Direction générale Statistique et Information économique* have been used. The wind energy sector is not considered as a separate industry in these tables (its sub-sectors have the same problem). Therefore, the Sector information has to be added to the evaluation scheme: the information was completed with the sectoral data collected directly from relevant industry players.

The resulting input-output tables are used to calculate the income multipliers that contain information about the impact of the wind energy sector on the rest of the economy.

Table of content

0.	Executive summary	6
	Impact on GDP	6
	Impact on employment	8
	Wind energy outlook 2020 & 2030	9
	Externalities of the wind energy sector	11
1.	Objective and scope of the study	12
2.	Current status of wind energy and growth forecasts (2020 & 2030)	15
3.	Macroeconomic impact of the wind energy sector in Belgium	17
	Direct Contribution to GDP	18
	Wind industry sub-sectors' contribution to direct GDP	23
	Wind energy producers	26
	Manufacturers	27
	Services	28
	Wind energy sector exports and imports	29
	Tax balance	30
	Indirect and overall contribution to GDP	31
	Economic effort in R&D activities	36
4.	Impact on employment	37
	Direct impact on employment	38
	Indirect and total impact on employment	40
5.	Wind energy outlook 2020 & 2030	41

6.	Wind energy's environmental benefits	45
	Methodology and determination of the energy replaced by wind farms	45
	Avoided CO2 emissions	47
	Avoided fossil fuel imports	48
	Economic impact of the wind energy on the price of the wholesale power market of Belgium	50
7.	Ratios	52
8.	Conclusions	56
	Relevance of wind energy business in Belgium	56
	Macroeconomic impact of the wind industry in 2020 and 2030	57
	Table of figures	59
	List of tables	62
	Appendix I. Regional breakdown of the wind energy sector in Belgium	63
	Direct contribution to GDP	63
	Indirect contribution to GDP	64
	Direct impact on employment	64
	Indirect impact on employment	64
	Appendix II. Assessment approach	65
	Direct contribution to GDP	65
	Indirect contribution to GDP	67
	Appendix III. Methodology to calculate the indirect contribution of the wind energy sector to GDP	68

0. Executive summary

In 2010, around 1‰ of the GDP of Belgium came from the wind energy sector, as estimated in this study.

The quantification of the impact of the wind energy sector in Belgium in terms of employment and GDP contribution has been the main goal of this assessment. Not only economic contributions but also other effects such as taxes paid by the wind industry players, the environmental benefits and the R&D activities have been quantified.

In addition, a quantification of several wind energy externalities has been performed (CO₂ emissions, avoided fossil fuel and impact of wind energy on the wholesale power market price).

Impact on GDP

In 2010, EUR 176.2 million was the direct contribution of the wind energy sector to GDP¹. This means a steady growth from 2007, increasing by more than 57.7% during this period (in constant terms, base 2010).

Moreover, the indirect contribution of this industry to other economic sectors was EUR 139 million in 2010². The indirect impact measures the contribution made by companies related to the wind energy sector to the GDP of Belgium due to its component and service needs.

On the whole, EUR 315.2 million was the overall impact (direct and indirect) of the wind energy sector on the economy of Belgium in 2010³. In 2007, the overall impact was EUR 198.1 million (constant prices, base 2010). That is, the overall impact of this sector on the GDP of Belgium has increased by 59.1%.

¹ According to our forecast, in 2011 it had reached EUR 188.2 million

² According to our forecast, in 2011 it had reached EUR 147.1 million

³ According to our forecast, in 2011 it had reached EUR 335.3 million

millions of €: constant prices (base 2010)	2007	2008	2009	2010	2011 F
Direct contribution to GDP	111.7	127.7	163.8	176.2	188.2
Indirect contribution to GDP	86.4	101.2	130.1	139.0	147.1
Total contribution	198.1	228.9	293.9	315.2	335.3

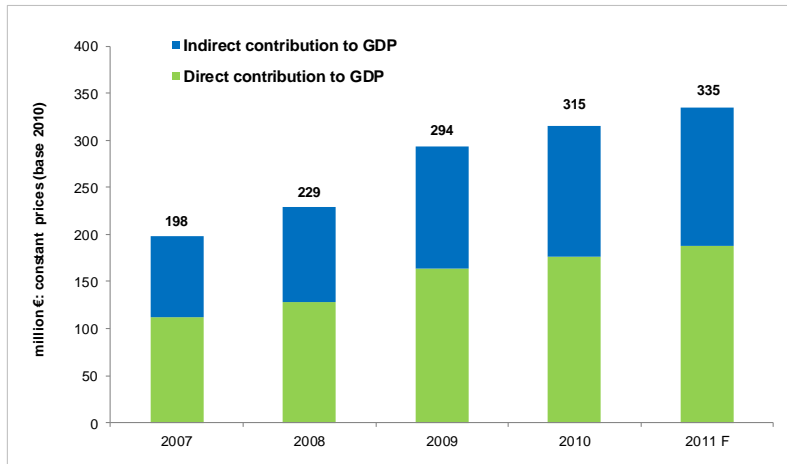


Figure 0.1. Direct, indirect and overall impact of the wind energy sector in Belgium in constant prices (base 2010)

Such a large increase is due to the building of new wind farms (an increase of 612 MW from 2007 to 2010) including the new wind offshore facilities (an increase of 195 MW) and the increase in the energy production (an increase of 1,519 GWh).

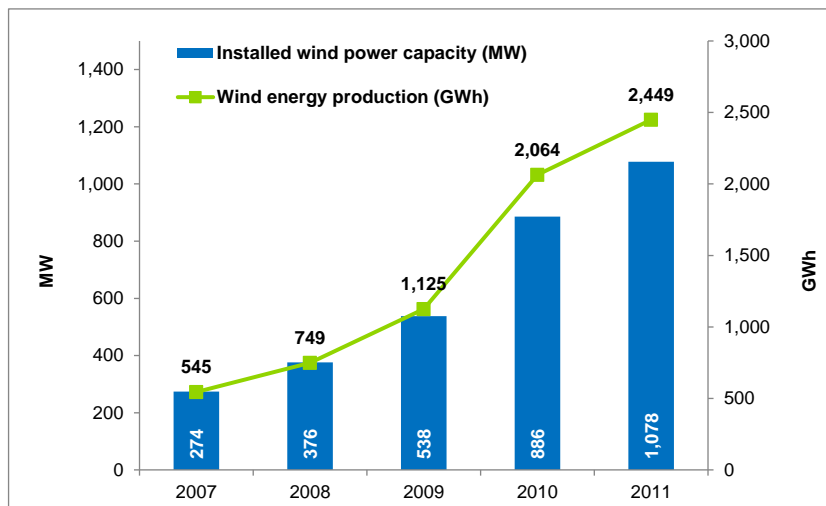


Figure 0.2. Evolution of the installed wind energy power capacity and production in Belgium

Impact on employment

The job market has also been stimulated by the wind energy sector. It has been estimated that in **2010 there were 2,615 professionals directly employed by companies of the Sector.**

The indirect impact on employment accounted for 3,522 jobs. This impact can be related to the indirect economic impact on the economy of Belgium.

All in all, **6,136 professionals worked directly or indirectly in the wind energy sector in 2010.**

Employment	2007	2008	2009	2010	2011 F
Direct	1,806	1,997	2,378	2,615	2,722
Indirect	1,771	2,392	3,237	3,522	3,502
Total	3,578	4,388	5,614	6,136	6,225

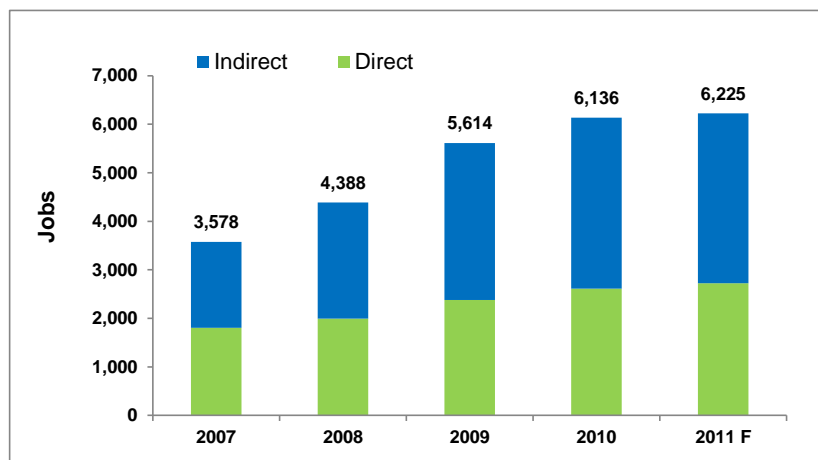


Figure 0.3. Direct, indirect and total employment on the wind energy sector

Wind energy outlook 2020 & 2030

In 2011, 1,078 MW of wind energy capacity had been installed in Belgium. This number can be broken down as follows: 541 MW of onshore capacity in Wallonia, 342 MW of onshore capacity in Flanders and 195 MW of offshore capacity in the North Sea.

The wind energy generation in 2011 was 2.4 TWh and accounted for 3.0%⁴ of the total electricity generation in Belgium. On the other hand, the **Directive 2009/28/CE of the European Parliament and of the Council sets the need to obtain 13% of the gross final energy consumption of Belgium from renewables by 2020.**

In order to reach the **2020 target**, wind energy objectives have been analysed: 2,045 MW in Wallonia, 1,060 – 1,500 MW in Flanders, and 2,000 – 2,825 MW in the North Sea area of Belgium. If those targets were met, wind energy would generate from 13.0 to 16.5 TWh by 2020, contributing to reach 2020 target, resulting in the following impacts on the economy of Belgium:

- **The total GDP contribution would be EUR 1,359 - 1,746 million.** Assuming that a wind turbine manufacturer will be established in Belgium, covering 50% of the demand share, the total GDP contribution would increase to EUR 1,498 – 1,931 million.
- **The number of full-time equivalent jobs would be up to 9,809.** In case of installing a wind turbine manufacturing plant the number of jobs would be up to 10,409.

Additionally, wind energy targets have also been studied for 2030: 2,000 – 3,000 MW in Flanders, 2,727 – 4,544 MW in Wallonia and 3,800 MW in the North Sea area of Belgium. If those targets were achieved, wind energy would generate from 22.1 to 27.9 TWh by 2030.

- **Total GDP contribution would be EUR 2,105 - 2,942 million.**
- **Full-time equivalent jobs would vary between 11,824 and 16,069**, depending on the installed capacity and the existence of a wind turbine manufacturing plant.

⁴ The total power energy demand in Belgium in 2011 was 81,047 GWh. Source: Elia

Assumptions	2020 scenario 1	2020 scenario 2	2030 scenario 1	2030 scenario 2	2030 scenario 3	Source
Cumulative Installed Capacity (MW)						
Wallonia onshore	2,045	2,045	2,727	3,636	4,544	EDORA and ODE
Flanders onshore	1,060	1,500	2,000	2,500	3,000	
Offshore	2,000	2,825	3,800	3,800	3,800	
Total	5,105	6,370	8,527	9,936	11,344	

Table 0.1. Regional cumulative installed capacity (forecast): 2020 and 2030

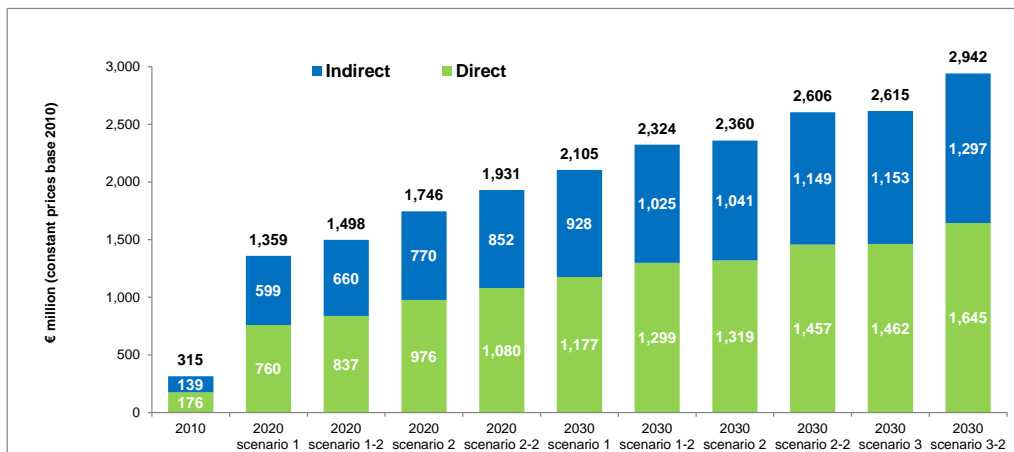


Figure 0.4. Direct, indirect and overall contribution to GDP (forecast): 2020 and 2030

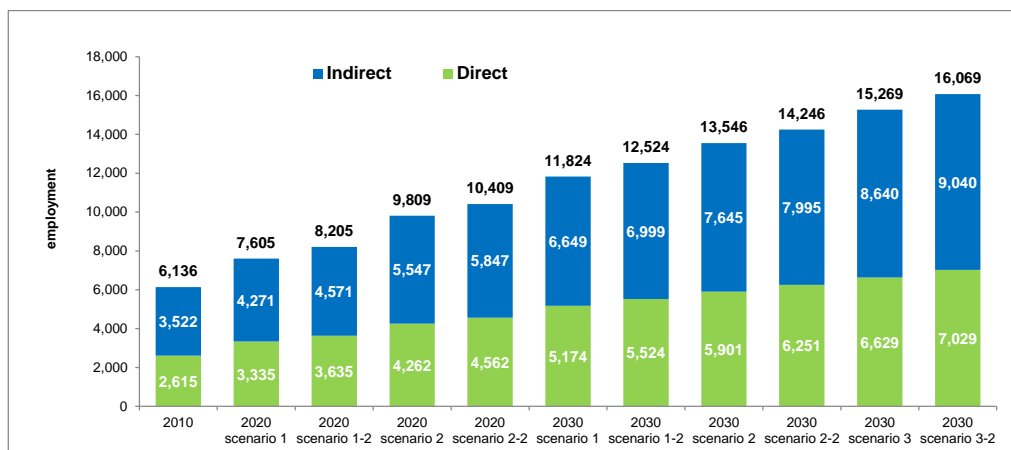


Figure 0.5. Direct, indirect and total employment (forecast): 2020 and 2030

Externalities of the wind energy sector

The reduction in greenhouse gas emissions and the decline in the external dependence of Belgium on energy imports (wind farms replace conventional generating technologies that use fossil fuels as the primary energy source) are further effects of the growth of the wind energy sector.

The savings in 2009 were lower than in 2008, even though wind power production in 2009 was higher than in 2008. The reduction of the prices of natural gas and CO₂ were the main reason for this effect; both prices were lower in 2009 than in 2008.

On the other hand, the wind energy's environmental benefits were more than three times bigger in 2010 than in 2007:

- Firstly, CO₂ emissions from fossil fuel power plants were reduced by 0.94 million tons. This meant savings in emission rights of **EUR 13.48 million in 2010**.
- Secondly, natural gas imports (0.36 million tons of oil equivalent) were reduced. This meant savings of **EUR 67.65 million in fossil fuel imports**.

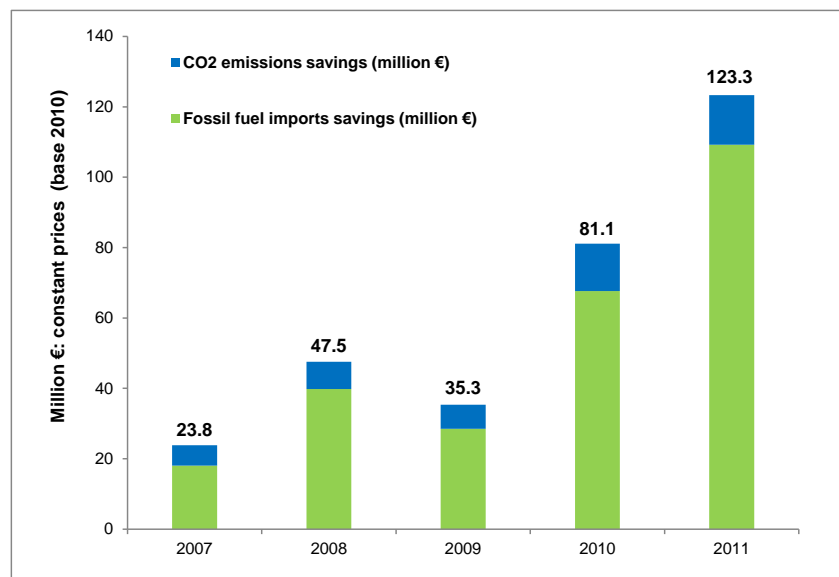


Figure 0.6. Impact of externalities of wind energy in terms of CO₂ emissions and fossil fuel imports savings

Lastly, more expensive energies were replaced by wind energy, cheapening the marginal price established in the wholesale electricity market of Belgium. **This saving amounted to EUR 53.17 million in 2010** (EUR 0.62 per MWh acquired in the market).

1. Objective and scope of the study

In the last years, the wind industry in Belgium has been boosted in order to achieve the policy commitments on renewable energy penetration and CO2 emission reduction.

During the past ten years (from 2000 to 2010), Belgium has increased significantly (68.17 times more⁵) its wind installed capacity, which has resulted in 886.2 MW at the end of 2010⁶. The years when the installed power capacity grew more were 2001, with a 146% increase in relation to 2000, 2005 with a 67% increase in relation to 2004, and 2010 that represented around 65% increase in relation to previous year.

In 2011, the installed capacity accounted for 2.4 TWh of energy, 3.0%⁷ of the total electricity generation of Belgium.

The aim of this study is to explore the impact of the wind energy industry on the economy of Belgium for the period 2007-2010, and to forecast the impact in 2020 and 2030. All the phases of the value chain of the wind energy industry, as well as the effects that these activities have on other economic sectors have been considered.

Based on surveys from a wide range of companies (217 wind industry players from Belgium), this report has the following scope:

- **Evaluation of the impact of the wind energy sector on the economy of Belgium.**
 - ✓ Direct contribution of the Sector to the GDP: a GDP breakdown by wind industry sub-sectors have been carried out (wind energy producers, manufacturers and suppliers of specific services).
 - ✓ Identification of the main components related to the wind industry that contributes to the GDP: internal demand, external demand, total revenue, expenses, employee compensation, business cash flow, etc.
 - ✓ Contribution to job creation in the different wind industry sub-sectors: wind energy producers, manufacturers and suppliers of specific services.

⁵ Installed Wind energy capacity in 2000: 13 MW; installed Wind energy capacity in 2010: 886.2 MW. Source: EDORA and ODE

⁶ Installed Wind energy capacity in 2011: 1,077.8 MW. Source: EDORA and ODE

⁷ The total power energy demand in Belgium in 2011 was 81,047 GWh. Source: Elia

- ✓ Indirect contribution to the GDP of other sectors: metallurgical, electronic equipment suppliers, financial services, professional services, etc.
 - ✓ Indirect contribution to job creation in other economic sectors.
 - ✓ Tax balance assessment.
 - ✓ Impact on trade balance: export and import figures.
 - ✓ Comparative analysis of the wind energy sector contribution to GDP (and its components) regarding other economic sectors in absolute and relative terms.
- **Forecast assessment of the impact of the wind energy sector in the economy of Belgium for 2020 and 2030.**
 - ✓ Direct and indirect contribution to GDP of the Sector.
 - ✓ Direct and indirect contribution to the job market.

This project has been carried out in collaboration with *Fédération de l'Énergie d'Origine Renouvelable et Alternative* (EDORA) and *Organisatie voor Duurzame Energie* (ODE) in order to ensure the best possible outcome, under a framework established with EWEA.

This collaboration was restricted to the following aspects:

- Sectoral contact facilitation.
- Confirmation that all relevant wind industry players have been included in the study⁸.
- Assistance in information gathering (e.g. statistical data), enabling at the same time information access.
- Ensuring that the information gathered and the analyses carried out are aligned with the players' data.

⁸ EDORA and ODE have compiled a list of companies active in the wind energy sector, partially based on the list provided to EDORA and ODE by the Cluster Tweed and Agoria

Several interviews with relevant wind industry players, such as wind energy companies and manufacturers provided by EDORA and ODE, have been conducted by Deloitte's team.

2. Current status of wind energy and growth forecasts (2020 & 2030)

The installed wind energy capacity in Belgium in 2010 reached 886.2 MW, that is, an increase of 348.7 MW (64.87%) in relation to 2009.

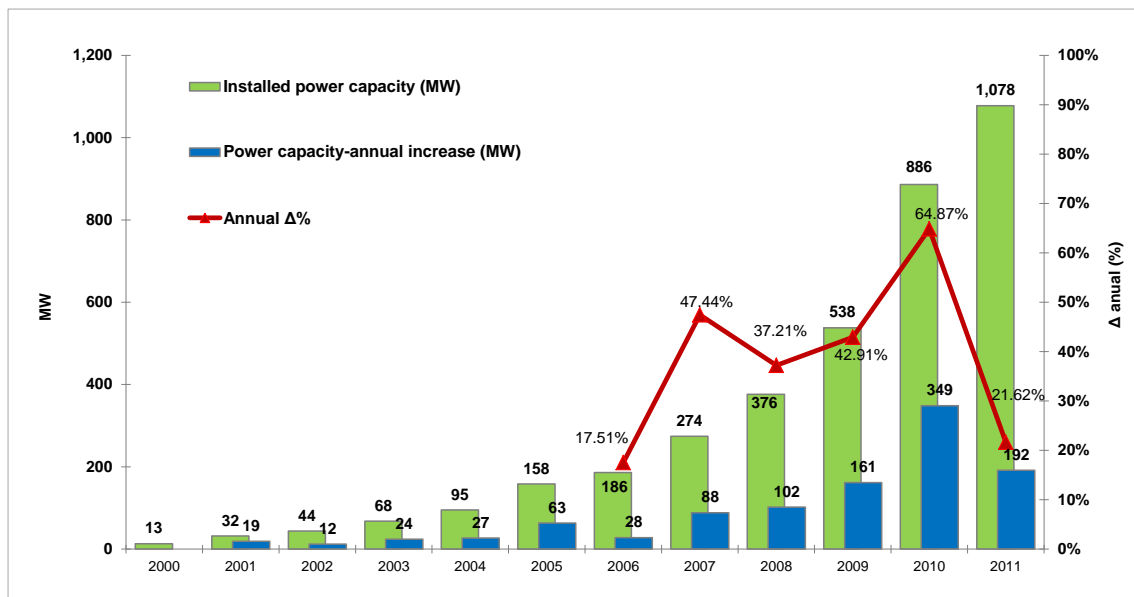


Figure 2.1. Wind energy power capacity. Source: EDORA and ODE, and EurObserv'ER

In 2010, 2.1 TWh of electricity were generated in Belgium by wind power, this figure represented about 2.4% of the total electricity generation. Wind energy has developed significantly between 2009 and 2010:

- The amount of energy generated rose from 1.1 TWh in 2009 to 2.1 TWh in 2010.
- The percentage of wind energy in relation to the total amount of electricity generated was 1.4% in 2009 and 2.4% in 2010.

It has been estimated that the installed wind power capacity in Belgium will be between 5,105 and 6,370 MW⁹ in 2020, and between 8,527 and 11,344 MW in 2030¹⁰.

⁹ Source: EDORA and ODE

¹⁰ Source: EDORA and ODE

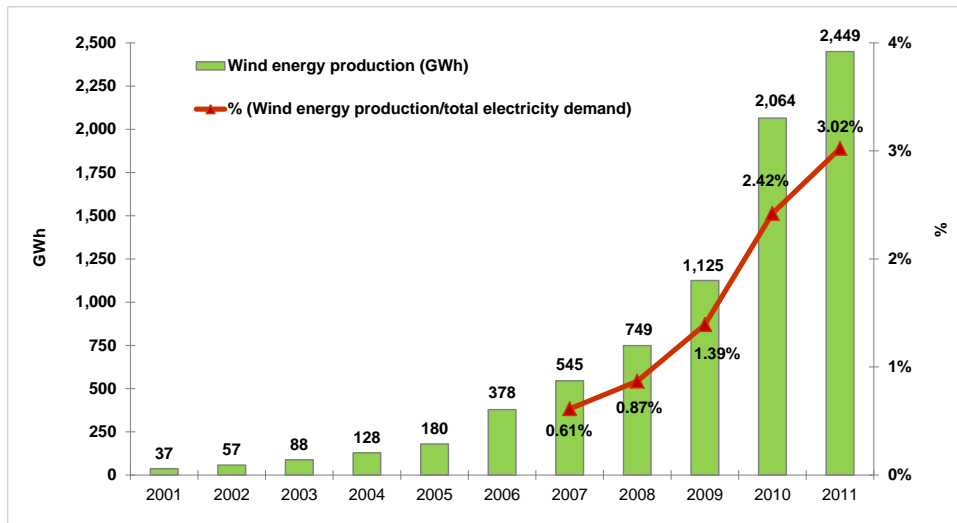


Figure 2.2. Electricity generation from wind and percentage of total electricity generation (Source: EurObserv'ER and ELIA)

In 2011, 18% of the total wind power capacity came from offshore installations, 195 MW of installed power. In the next decades, it is expected that power capacity will increase to 2,000 MW up to 2,825 MW in 2020 and to 3,800 MW in 2030.

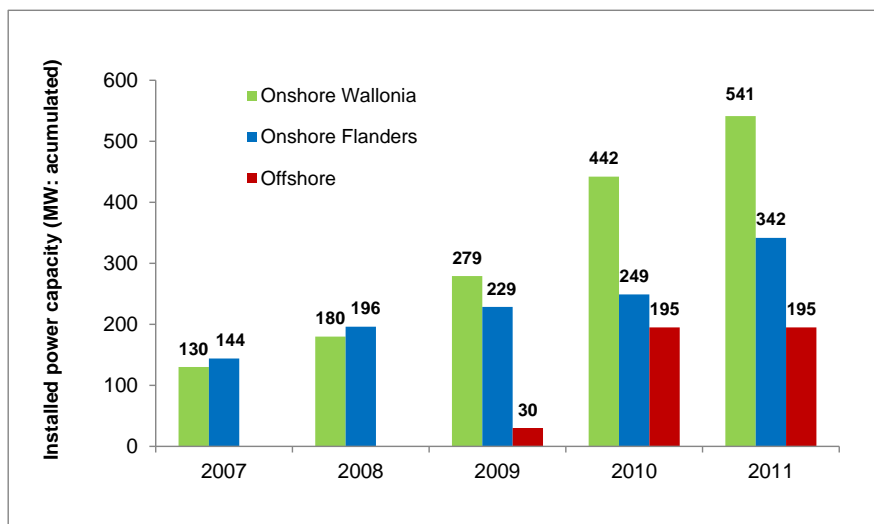


Figure 2.3. Wind energy power capacity in Wallonia and Flanders, onshore and offshore. Source: EDORA and ODE

In 2020, between 13 and 16.5 TWh are expected to be generated by wind energy: 51% - 56% of which will be produced offshore. In 2030, between 22.1 and 27.9 TWh would be produced by wind energy: between 45% and 57% will be supplied by offshore facilities.

3. Macroeconomic impact of the wind energy sector in Belgium

Different estimations can be made to measure the economic impact of the wind energy sector:

- **Contribution to Gross Domestic Product (GDP), direct and indirect impact.**
The direct contribution to GDP is the sum of the added values of all the industries related to the wind energy sector (i.e. wind energy producers, manufacturers and suppliers of specific services).

The indirect impact is the additional effect on other economic sectors. It has been calculated by means of an input-output model which incorporates the wind energy sector.

- **The added direct and indirect effects represent the overall impact of the wind energy sector on the economy.**

Each of the GDP components are evaluated on the survey, according to the methodology used by official statistics organisations: exports and imports, employee compensation, net operating surplus, etc. The same tasks have been carried out for each of the sub-sectors.

- Additional economic data are provided, such as the **tax balance and the contribution to R&D activities**, collected through questionnaires and interviews with relevant players of the Sector.
- **A prediction of the economic impact for 2020 and 2030** has been estimated using different assumptions of installed wind power capacity, electricity generated, price, among others factors.

The main macroeconomic results of the study are presented below.

Direct Contribution to GDP

- The direct contribution of the wind energy sector in Belgium to GDP was EUR 176.18 million in 2010.

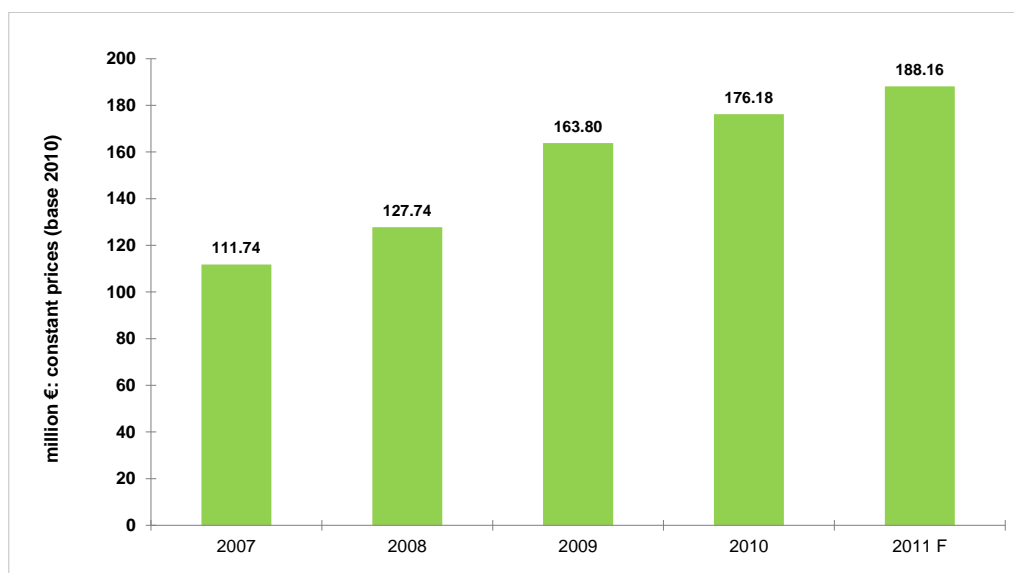


Figure 3.1. Direct contribution of the wind energy sector in Belgium to GDP in constant prices (base 2010)

- In real terms, the wind energy sector increased its direct contribution to GDP by 7.6% compared to 2009.
- Due to the need for importing wind turbines, which constitutes the most expensive component in the development of a wind farm, in 2010 **wind industry net exports** (difference between exports and imports) **were EUR -418.0 million**: exports were EUR 142.0 million.
- In 2010, the total direct expenditure of the wind energy sector was EUR 425.4 million.
- According to the 2011 forecast, the GDP will rise by 6.8% compared to 2010. This growth is due to two main reasons:
 - ✓ Generation from wind turbines increased by 18.7%.
 - ✓ The total installed wind power capacity increased by 192 MW, which was lower than the previous year. Moreover, no new wind energy offshore capacity was installed.

million €	Wind energy sector direct contribution to GDP (current prices)				
	2007	2008	2009	2010	2011 F
Final internal demand (total)	208.3	262.4	482.0	594.2	440.9
Net exports	-102.1	-138.5	-321.1	-418.0	-248.7
Exports	97.1	105.6	131.6	142.0	144.5
Imports (-)	199.2	244.0	452.7	560.0	393.1
Expenditure approach	106.1	124.0	160.9	176.2	192.3
Total Income	412.9	429.0	548.4	601.5	607.5
Total Expenditures	306.7	305.1	387.5	425.4	415.2
Production or value added approach	106.1	124.0	160.9	176.2	192.3
Compensation of employees	62.6	73.1	94.5	100.4	103.7
Gross operating surplus	43.6	50.9	66.4	75.8	88.6
Income approach	106.1	124.0	160.9	176.2	192.3

Table 3.1. Wind energy sector direct contribution to GDP: current prices

million €	Wind energy sector direct contribution to GDP (constant prices, base 2010)								
	2007	Δ	2008	Δ	2009	Δ	2010	Δ	2011 F
Final internal demand (total)	219.2	23.3%	270.4	81.4%	490.7	21.1%	594.2	-27.4%	431.5
Net exports	-107.5	-32.7%	-142.7	-329.1%	-326.9	-227.9%	-418.0	-158.2%	-243.4
Exports	102.2	6.4%	108.8	23.2%	134.0	6.0%	142.0	-0.5%	141.4
Imports (-)	209.7	19.9%	251.5	83.3%	460.9	21.5%	560.0	-31.3%	384.7
Expenditure approach	111.7	14.3%	127.7	28.2%	163.8	7.6%	176.2	6.8%	188.2
Total Income	434.6	1.7%	442.1	26.3%	558.3	7.7%	601.5	-1.2%	594.5
Total Expenditures	322.9	-2.6%	314.4	25.5%	394.5	7.8%	425.4	-4.5%	406.3
Production or value added approach	111.7	14.3%	127.7	28.2%	163.8	7.6%	176.2	6.8%	188.2
Compensation of employees	65.9	14.3%	75.3	27.8%	96.2	4.3%	100.4	1.1%	101.4
Gross operating surplus	45.9	14.3%	52.4	28.9%	67.6	12.2%	75.8	14.4%	86.7
Income approach	111.7	14.3%	127.7	28.2%	163.8	7.6%	176.2	6.8%	188.2

Table 3.2. Wind energy sector direct contribution to GDP: constant prices (base 2010)

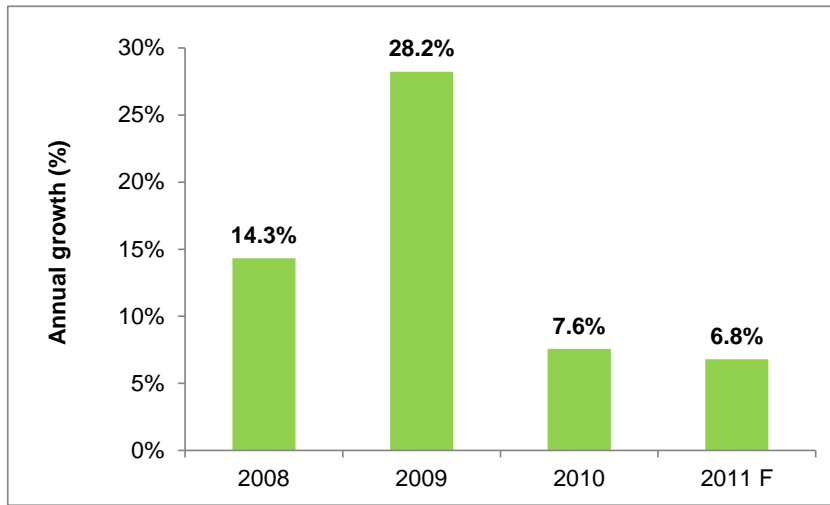


Figure 3.2. Overall wind energy sector contribution to GDP growth

In relative terms, considering macroeconomic indicators, the direct contribution of the wind energy sector to GDP represented 0.55‰ of total GDP of Belgium in 2010, whilst in 2007 it was 0.35‰.

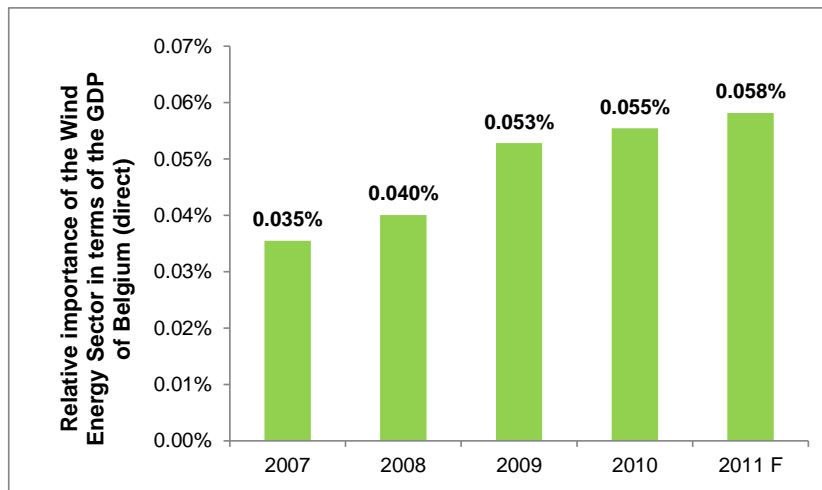


Figure 3.3. Relative importance of the wind energy sector in terms of the GDP of Belgium (direct)

However, if changes in the GDP of Belgium are compared to the contribution of the wind energy sector during the 2007-2010 period, **it can be concluded that the contribution of the Sector grew more than the National GDP.**

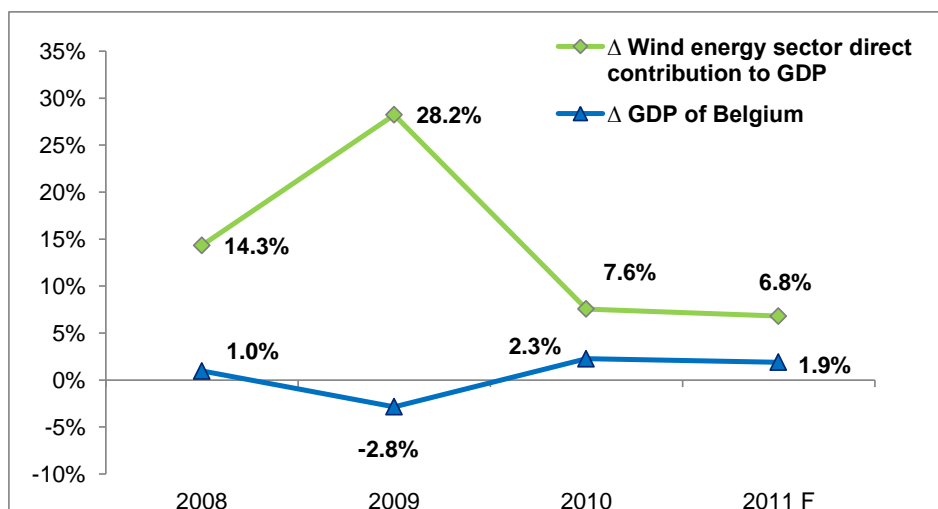


Figure 3.4. Comparison between the growth of National GDP and the wind energy sector direct contribution. Source: Deloitte and International Monetary Fund

The contribution of the wind energy sector to GDP can vary for a variety of reasons; this is why it is more volatile than the National GDP growth rate:

- **Volatile energy price:** energy price is highly volatile, as wind energy is the commodity with the highest price volatility.
- **Development of new wind energy capacity.**
- **Uncertainty regarding the regulatory framework development:** a stable and predictable regulatory framework at a national and European level is imperative for the future development of this industry (means of encouraging investments).
- **Technological risk:** the wind energy sector faces a high technological risk mainly related to offshore installations, where the technology is not sufficiently developed and requires R&D investments and innovation activities.

In the medium term this risk will be mitigated by the maturing process that the Sector will undergo.

Wind industry sub-sectors' contribution to direct GDP

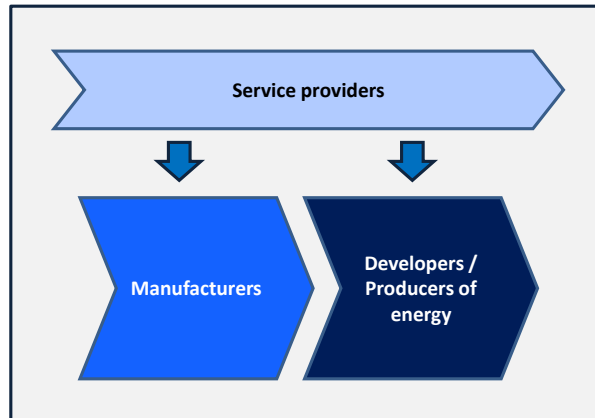


Figure 3.5. Wind industry supply chain in Belgium

One of the most relevant features of the wind energy sector of Belgium is the lack of wind turbine manufacturers: the equipment has to be imported from abroad, which leads to the economic growth of third countries but losing the opportunity to develop new national technologies.

The different sub-sectors have evolved in different ways throughout the period 2007 – 2010 as their growth depends on different variables. Whereas energy producers depend on the amount of energy sold and the fluctuation of energy prices, manufacturers rely on installed capacity in the short and medium term, production costs and market trends. The growth of the service sub-sector can be expressed as an average of previous sub-sectors, as it includes several companies involved in the value chain.

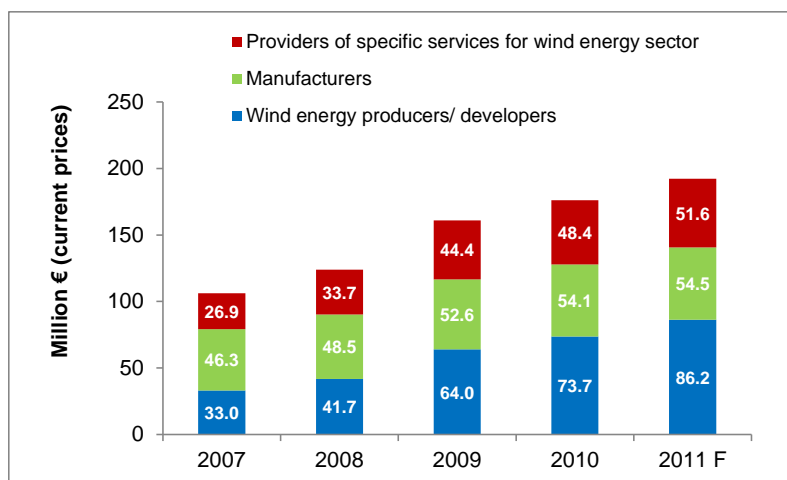


Figure 3.6. Relative weight of the wind industry sub-sectors in terms of direct GDP: current prices

million € - prices 2010	2007	2008	2009	2010	2011 F
Wind energy producers/ developers	34.7	43.0	65.1	73.7	84.4
Manufacturers	48.7	50.0	53.5	54.1	53.3
Providers of specific services for wind energy sector	28.3	34.8	45.2	48.4	50.5
Total	111.7	127.7	163.8	176.2	188.2

Table 3.3. Wind industry sub-sectors contribution to direct GDP

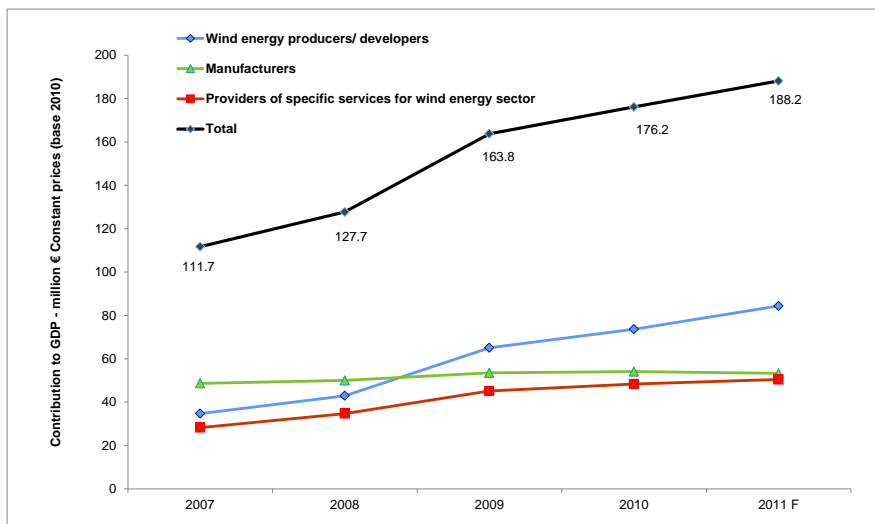


Figure 3.7. Direct contribution to GDP of the wind industry sub-sectors: constant prices (base 2010)

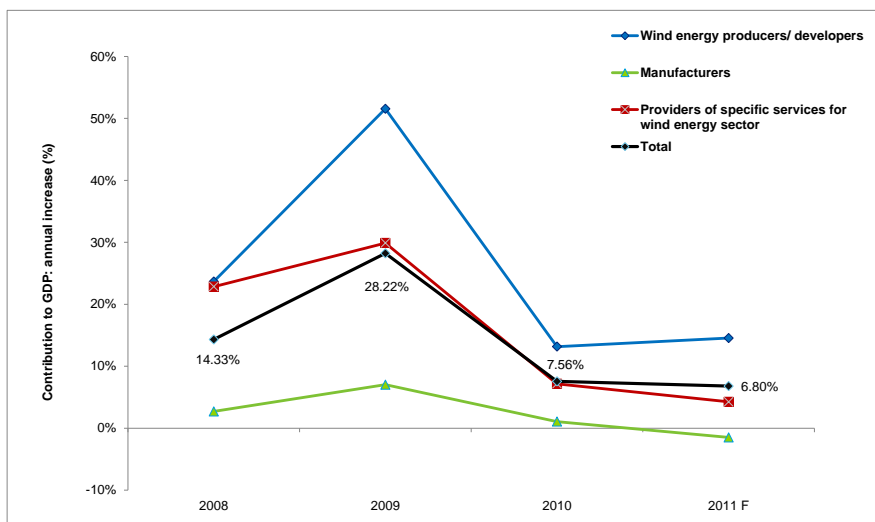


Figure 3.8. Direct GDP growth of the wind industry sub-sectors in Belgium

As the previous figures show, **the three wind industry sub-sectors (wind energy producers, manufactures, and providers of specific services) have an important impact on GDP:**

- The cumulative capacity of wind energy, the electricity sold and the revenue of the **producers** have grown, **resulting in a higher direct contribution to GDP in 2010 compared to 2007.**

The contribution of the wind energy developers and producers amounted to EUR 73.7 million, being the most significant industry sub-sector. It accounts for more than **42% of GDP** contribution of the sector in 2010.

- **The contribution of the manufacturers** is growing in a similar way to the installed wind energy capacity. Nevertheless, **its relative importance within the wind energy sector has decreased from 43.6% in 2007 to 30.7% in 2010.**
- Regarding the development of the wind energy sector, the activity of services suppliers has increased during the previous years: **it accounted for EUR 48.4 million in 2010 in terms of GDP contribution.**

Wind energy producers

million € - prices 2010	2007	2008	2009	2010	2011 F
Total Income	100.72	85.29	169.64	198.04	209.71
Total Expenditures	65.98	42.33	104.53	124.36	125.31
Production or value added approach	34.74	42.96	65.11	73.68	84.40
Compensation of employees	3.87	5.43	11.45	15.30	17.94
Gross operating surplus	30.86	37.53	53.66	58.38	66.46
Income approach	34.74	42.96	65.11	73.68	84.40

Table 3.4. Developers-producers' direct contribution to GDP: constant prices (base 2010)

Developers-producers' contribution to GDP is directly related to the sale of electricity by the companies. Even though the investment required for the development could be attributable to this sub-sector, this work focuses on the value added approach. As this approach subtracts operation expenses from the revenues, the funds invested by this sub-sector represent the revenues of other sub-sector and therefore they are quantified in their contribution to GDP.

During the period 2007-2010, the activity grew significantly:

- **In 2010, the GDP contribution of this sub-sector increased to EUR 73.68 million, this is 112% higher compared to 2007.**
- The expenses related to employee compensation are lower than other items: this is due to the fact that a **significant share of the jobs related to wind energy comes from the construction of wind farms and the manufacturing of wind turbines and other components.**

The number of employees of this sub-sector is significant; as installed capacity grows, the demand for professionals capable of operating wind farms rises. Therefore, in 2010 the expenditure on personnel accounted for EUR 15.30 million.

Manufacturers

million € - prices 2010	2007	2008	2009	2010	2011 F
Total Income	249.74	253.96	263.28	255.20	242.36
Total Expenditures	201.04	203.94	209.75	201.10	189.06
Production or value added approach	48.70	50.02	53.53	54.10	53.30
Compensation of employees	38.11	41.11	46.59	44.00	42.21
Gross operating surplus	10.59	8.91	6.94	10.10	11.09
Income approach	48.70	50.02	53.53	54.10	53.30

Table 3.5. Manufacturers' direct contribution to GDP: constant prices (base 2010)

Given that there are no wind turbine manufacturers in Belgium; **only companies that produce specific goods related to the wind energy are included in the sub-sector of manufacturers.** Some examples of goods directly related to wind power are the following:

- Towers
- Elevators
- Mechanical equipment
- Electrical equipment
- Control and IT equipment
- Software manufacturers
- ...

Other components and raw materials for these product families exist, but they have been included in the indirect impact of the wind energy sector. These sectors are: basic metals, fabricated metals, chemical products, etc.

The revenue of component manufacturers relies on direct investments in wind farms (new installed capacity): exports and internal demand.

In 2010, the main figures of this sub-sector were:

- **The contribution to GDP has increased, in real terms, by 11.1% since 2007.**
- **Employee compensation is the highest component of the GDP contribution, which was EUR 44 million in 2010, accounting for more than 81% of the added value.**

Services

million € - prices 2010	2007	2008	2009	2010	2011 F
Total Income	84.17	102.85	125.38	148.30	142.40
Total Expenditures	55.87	68.08	80.22	99.90	91.94
Production or value added approach	28.30	34.77	45.16	48.40	50.46
Compensation of employees	23.88	28.78	38.19	41.06	41.29
Gross operating surplus	4.42	5.99	6.97	7.34	9.17
Income approach	28.30	34.77	45.16	48.40	50.46

Table 3.6. Services' direct contribution to GDP: constant prices (base 2010)

In this section, only services providing specialised inputs to the other two industry sub-sectors are considered.

Some examples of specialised companies are the following: transport of wind energy equipment, maintenance services, suppliers of monitoring and controlling technologies and solutions, wind energy engineering, consultancy companies that carry out wind energy activities (resource assessment, location evaluation, etc.), information suppliers, R&D agents, training suppliers, specialised insurance services, etc.

The **GDP contribution has increased by 71.0% since 2007** due mainly to the installation of new wind capacity and, more especially, the installation of offshore wind farms.

Wind energy sector exports and imports

million €	Wind energy sector exports and imports: constant prices (base 2010)				
	2007	2008	2009	2010	2011 F
Net exports	-107.5	-142.7	-326.9	-418.0	-243.4
Exports	102.2	108.8	134.0	142.0	141.4
Imports	-209.7	-251.5	-460.9	-560.0	-384.7

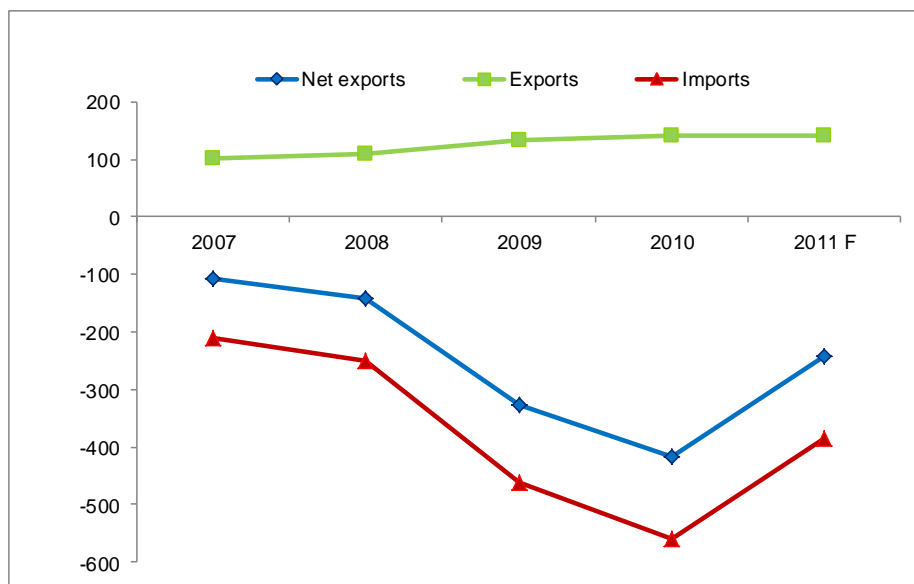


Table 3.7. Wind industry exports and imports: constant prices (base 2010)

Due to the lack of wind turbine manufacturers in Belgium, the country presents a high **external dependence**, thus the net exports during the analysed period were negative.

Tax balance

In 2010, a total amount of EUR 16.6 million was paid by wind industry players, EUR 15 million for corporate tax and EUR 1.6 million for other taxes¹¹.

million € (current prices)	2007	2008	2009	2010	2011 F
Corporate tax	7.8	8.4	10.7	15.0	19.6
Other taxes	0.7	0.8	1.2	1.6	2.1
Total Taxes	8.5	9.2	11.9	16.6	21.7

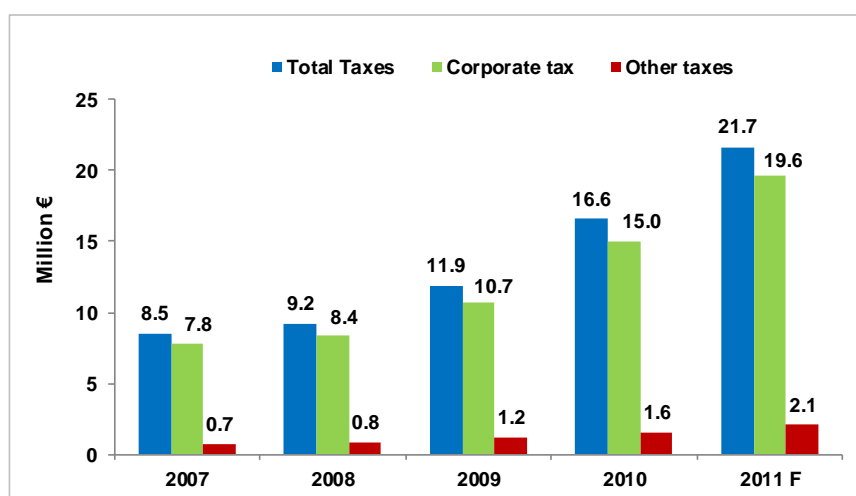


Figure 3.9. Taxes paid by the wind industry (current prices)

The taxes paid by the wind industry increased by 95% over the period studied, from EUR 8.5 million in 2007 to EUR 16.6 million in 2010.

¹¹ Example: Regional and local taxes, taxes linked to business activity, real estate taxes, taxes linked to vehicles.

Indirect and overall contribution to GDP

Wind industry players interact with companies of different sectors. This interaction results in an indirect impact as a consequence of the investment in wind farms and the production of wind electricity (see Appendix III).

These relationships between different economic sectors can be calculated by means of an input-output model, which consists of a series of matrixes that represent the relationships.

Nevertheless, the input-output tables do not segregate the wind energy sector as an individual area of activity; this is included in other sectors such as electricity production, manufacturing of electrical equipment, metallurgy, other business services, etc.

		HOMOGENEOUS BRANCHES	Wind Energy Sector	Products of agriculture, hunting and related services	Products of forestry, logging and related services	Fish and other fishing products; services incidental of fishing	Coal and lignite; peat
Code		PRODUCTS (CPA)	A	01	02	05	10
No			A	1	2	3	4
A	A	Wind Energy Sector	1.2324	0.0009	0.0004	0.0003	0.0005
1	01	Products of agriculture, hunting	0.0230	1.1616	0.0205	0.0138	0.0034
2	02	Products of forestry, logging and	0.0009	0.0017	1.1963	0.0011	0.0037
3	05	Fish and other fishing products	0.0003	0.0007	0.0001	1.0245	0.0001

Figure 3.10. Example of the adapted input-output tables

In order to achieve a more accurate result, a survey has been conducted to assess the cost structure of the main players of the wind energy sector. The information collected has then been used to build the new matrixes including a wind energy sector column (see Figure 3.10).

The outcome of this assessment is the following:

- The indirect contribution to GDP of the wind energy sector in Belgium accounted for EUR 139 million in 2010, which was approximately 44.1% of the overall impact (EUR 315 million).

millions of €: current prices	2007	2008	2009	2010	2011 F
Direct contribution to GDP	106.1	124.0	160.9	176.2	192.3
Indirect contribution to GDP	82.0	98.2	127.8	139.0	150.3
Total contribution	188.2	222.2	288.7	315.2	342.6

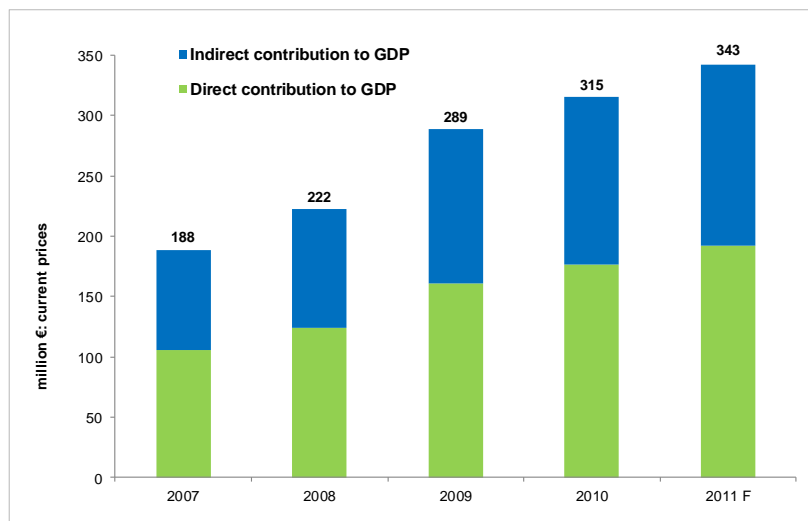


Table 3.8. Direct, indirect and overall impact of the wind energy sector in Belgium (current prices)

millions of €: constant prices (base 2010)	2007	2008	2009	2010	2011 F
Direct contribution to GDP	111.7	127.7	163.8	176.2	188.2
Indirect contribution to GDP	86.4	101.2	130.1	139.0	147.1
Total contribution	198.1	228.9	293.9	315.2	335.3

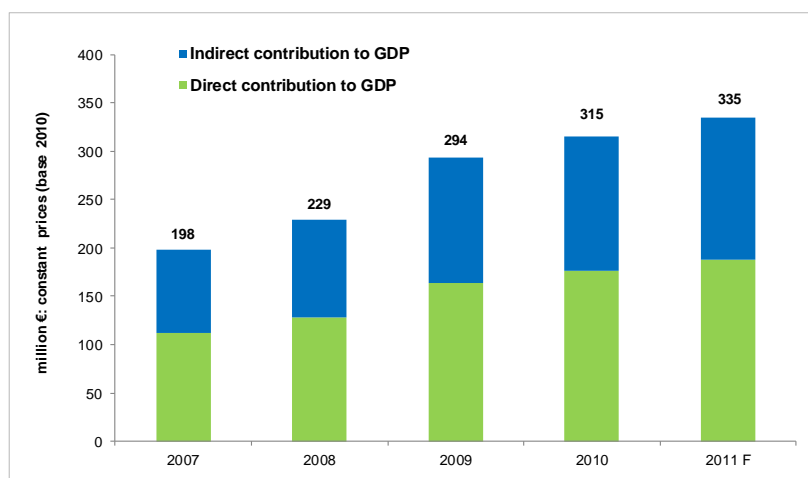


Table 3.9. Direct, indirect and overall impact of the wind energy sector in Belgium: constant prices (base 2010)

- In the 2007-2010 period, **the overall wind energy sector contribution to GDP increased by approximately 59.1%** (in constant prices).
- The economic sectors that are benefiting (indirectly) more from the activities carried out by the wind energy sector are:
 - ✓ **Transport**
 - ✓ **Construction**
 - ✓ **Electric and electronic equipment**
 - ✓ **Fabricated metal products**
 - ✓ **Basic metal**

Figure 3.11 provides an overview of the 2010 indirect added value generated by the wind energy sector per unit of GDP directly generated.

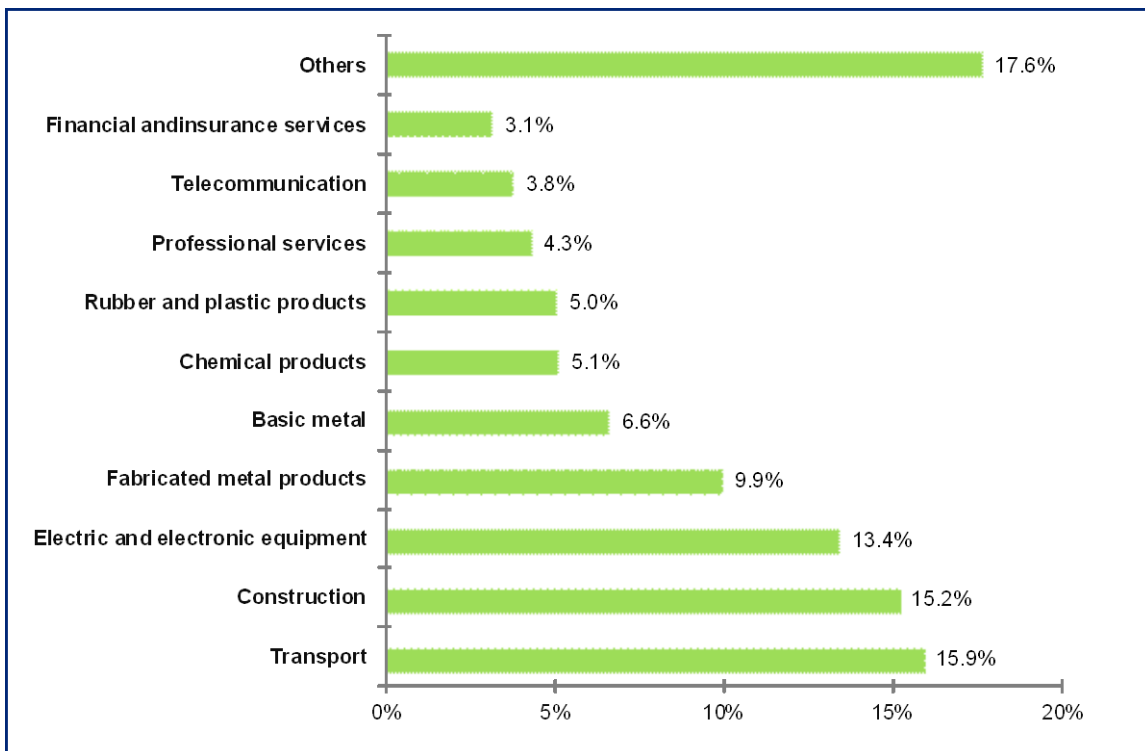


Figure 3.11. Indirect added value generated by the wind energy sector in other sectors in 2010

- The overall impact of the wind energy sector represented 1‰ of the GDP of Belgium in 2010¹².

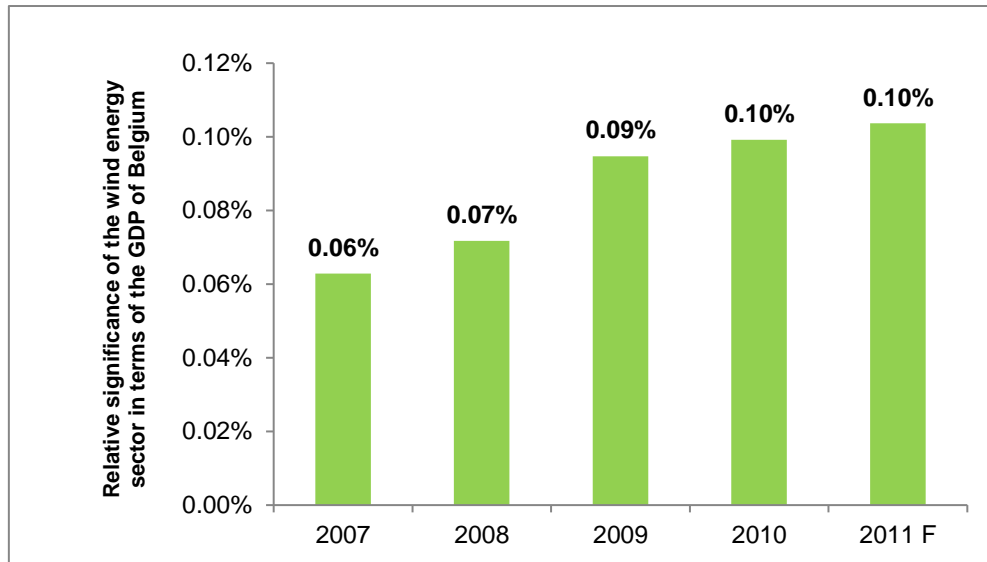


Figure 3.12. Relative significance of the wind energy sector in terms of the GDP of Belgium
(Overall impact on GDP)

¹² Source of GDP (2007-2011): Eurostat

- Nowadays, the contribution of the wind energy sector is still very low in comparison to the main economic sectors of Belgium.

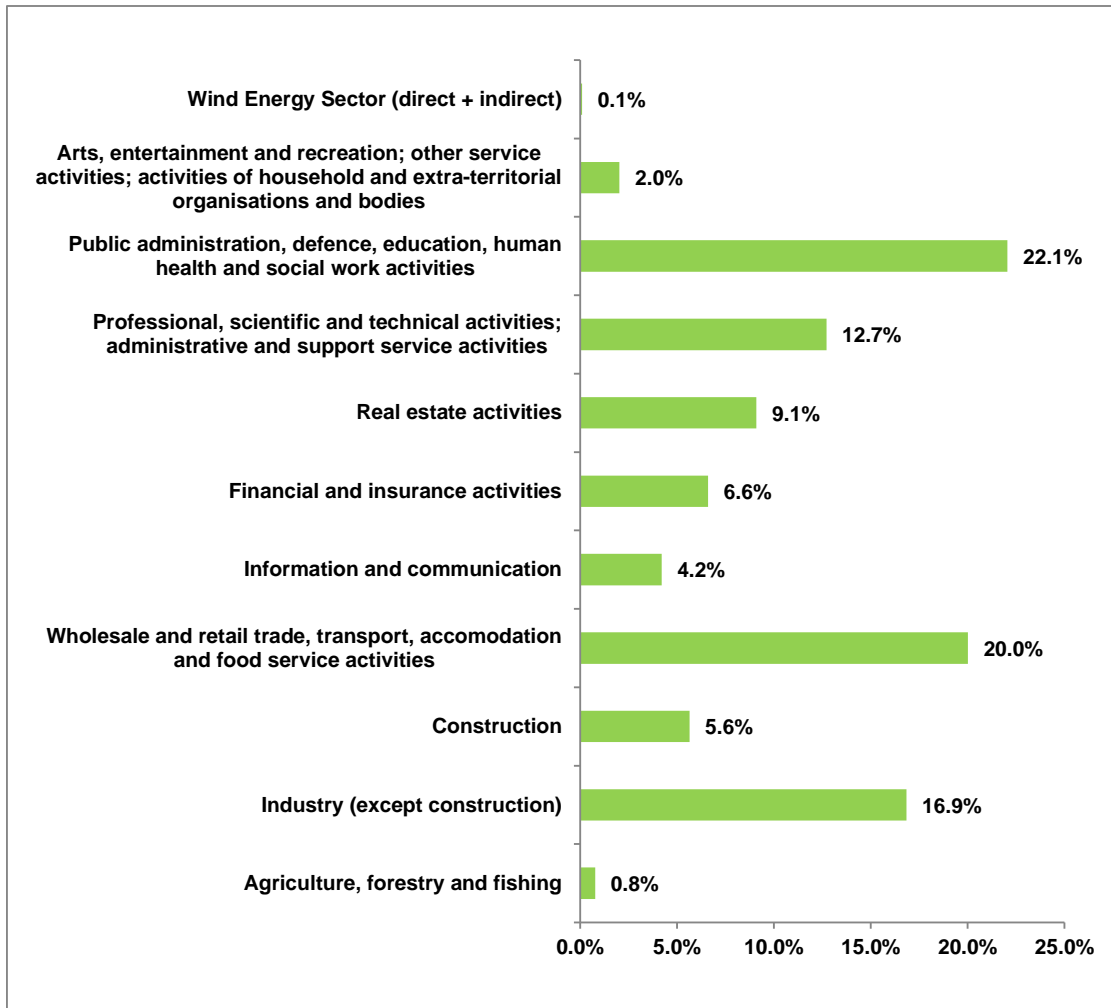


Figure 3.13. Contribution to GDP of the main economic sectors: comparative analysis

Economic effort in R&D activities

In Belgium, the wind energy sector invests in Research and Development (R&D), in proportional terms more than other sectors of the economy. This is due to the fact that the wind industry is experienced and on-going technological development and will continue investing in R&D in order to improve current technology, with special attention to the offshore sub-sector. In 2010, the R&D expenditure of the wind industry represented **3.43% of its direct GDP**, whilst in the same year the R&D expenditure of other sectors of the economy was estimated to be **1.99%**¹³.

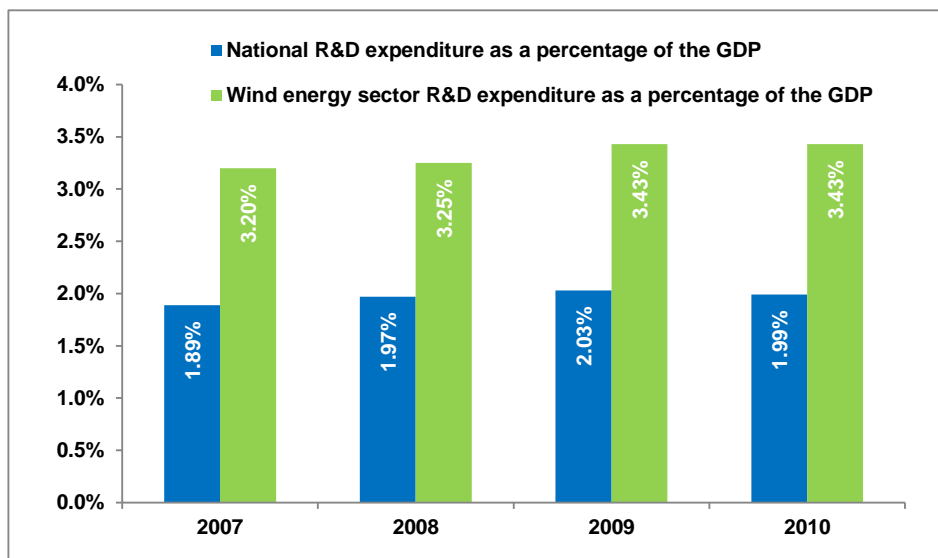


Figure 3.14. Evolution of the wind energy sector and the National expenditure on R&D as a percentage of GDP

¹³ Source of the expenditure of R&D in Belgium as a percentage of GDP: Eurostat

4. Impact on employment

Throughout the previous years, the growth and consolidation of the **wind energy sector in Belgium has had a major impact on employment**. New positions have been created across the entire value chain, from Wind electricity production (**direct employment**) to a series of economic sectors and activities related to Wind (**indirect employment**).

Regarding indirect employment, indirect impact of the wind energy sector on employment, different economic areas (basic metallurgy, financial services, etc.) have seen a progressive demand for workers. Therefore, it is important to realise that the wind energy sector is contributing to the creation of jobs in a wide range of branches of the economy.

Direct impact on employment

The final figures for the direct employment come from the job information published by companies that belong to the wind energy sector in Belgium (financial statements).

After the revision of the financial statements of the companies, the following results have been obtained:

- **In 2010, the wind energy sector directly employed 2,615 professionals in terms of full-time equivalent jobs.** In the historical period (2007-2010), the number of jobs increased by 44.8% (809 professionals) from 1,806 to 2,615 positions.

These results prove the relevance of the wind energy sector in supporting job creation. It is also important to bear in mind that during 2007-2010 the unemployment rate in Belgium grew from 7.47% to 8.27%¹⁴, which gives more importance to the previous statement.

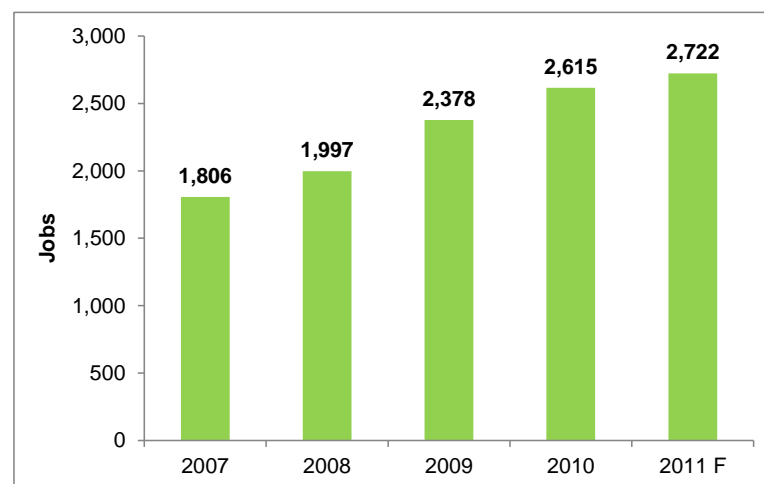


Figure 4.1. Evolution of the wind energy sector direct employment in Belgium

¹⁴ Source: International Monetary Fund

- Breakdown by wind industry sub-sector:
 - ✓ **Industrial activities and manufacturers employed the majority of resources: 1,244 in 2010**, representing more than 47.6% of the total wind energy sector jobs (2,615 employments).
 - ✓ The number of **jobs related to the services' sub-sector was 989 in 2010**. This figure includes personnel working in the engineering and construction of wind farms, operation and maintenance and research institutions, consultancy firms, universities, financial services and other similar organisations.
 - ✓ **Lastly, wind energy producers and developers accounted for 382 jobs in 2010**.

Direct employment	2007	2008	2009	2010	2011 F
Wind energy producers/ developers	101	142	283	382	393
Manufacturers	1,006	1,098	1,266	1,244	1,303
Providers of specific services for wind energy sector	699	757	829	989	1,027
TOTAL	1,806	1,997	2,378	2,615	2,722

Table 4.1. Evolution of the direct employment by wind industry sub-sectors in Belgium

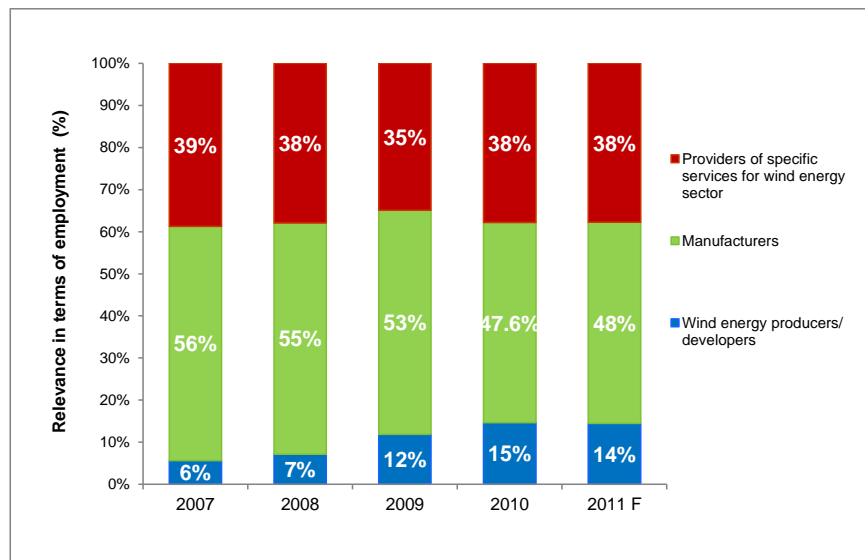
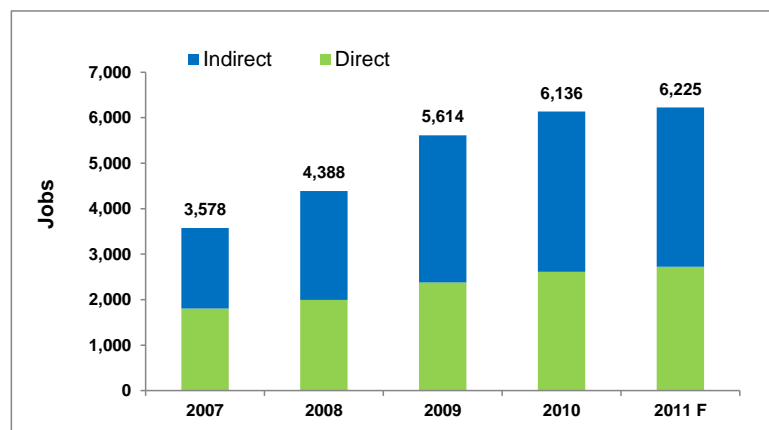


Figure 4.2. Direct employment distribution by wind industry sub-sectors

Indirect and total impact on employment

The indirect impact on GDP is related to the creation of jobs in other economic sectors. Input-output tables are used to estimate this contribution, where added value and full-time jobs are linked by a set of coefficients. To sum up, in 2010 the wind energy sector accounted for:

- **2,615 direct full-time jobs in the wind energy sector.**
- **3,522 indirect** full-time jobs in other sectors; these employments were not considered under the direct impact.
- **The wind industry was responsible for 6,136 jobs, directly and indirectly.**



Employment	2007	2008	2009	2010	2011 F
Direct	1,806	1,997	2,378	2,615	2,722
Indirect	1,771	2,392	3,237	3,522	3,502
Total	3,578	4,388	5,614	6,136	6,225

Table 4.2. Evolution of direct, indirect and total employment of the wind energy sector in Belgium

5. Wind energy outlook 2020 & 2030

European environmental objectives and the need to reduce energy dependence on third countries ensure a continuous growth of importance of renewable energies in the short, medium and long term. At the same time, the progressively increasing energy needs for advanced and emerging economies and the depleting fossil fuels reserves, among other factors, are forcing energy prices to increase to levels that are difficult to sustain.

Wind industry is expected to play a more relevant role in the energy sector of Belgium in the medium and long term. In order to assess the future impact of the Sector on economy and employment, the following scenarios have been taken into consideration:

- **In 2020, between 5,105 and 6,370 MW** of power capacity would be **installed in Belgium**:
 - ✓ 3,105 - 3,545 MW would correspond to onshore facilities (2,045 MW in Wallonia and 1,060 - 1,500 MW in Flanders).
 - ✓ 2,000 - 2,825 MW would be offshore.
- **In 2030**, three different scenarios with several wind energy penetration levels will be considered:
 - ✓ Low: 8,527 MW of installed capacity; 4,727 MW onshore (2,727 MW in Wallonia and 2,000 MW in Flanders) and 3,800 MW offshore.
 - ✓ Moderate: 9,936 MW of installed capacity; 6,136 MW onshore (3,636 MW in Wallonia and 2,500 MW in Flanders) and 3,800 MW offshore.
 - ✓ High: 11,344 MW of installed capacity; 7,544 MW onshore (4,544 MW in Wallonia and 3,000 MW in Flanders) and 3,800 MW offshore.
- **Load factors**:
 - ✓ Wallonia: 2,200 equivalent hours.
 - ✓ Flanders: 1,800 equivalent hours.
 - ✓ Offshore: 3,300 equivalent hours.
- **Investment on wind turbine manufacturing facilities**: the deployment of a wind turbine manufacturing facility in Belgium is considered. Part of this assessment is based on the assumption that up to 50% of the wind turbine demand will be covered by the facility in 2020 and 60% in 2030. Moreover, to complete the study, the simulation is carried out without considering the creation of this facility, i.e. importing the turbines from abroad would be required.

Assumptions	2020 scenario 1	2020 scenario 1-2	2020 scenario 2	2020 scenario 2-2	2030 scenario 1	2030 scenario 1-2	2030 scenario 2	2030 scenario 2-2	2030 scenario 3	2030 scenario 3-2	Source
Capacity to be installed (MW)											
Wallonia Onshore (new + repowering)	161	161	161	161	317	317	408	408	499	499	EDORA and ODE
Flanders Onshore (new + repowering)	82	82	126	126	225	225	275	275	325	325	
Offshore (new + repowering)	181	181	263	263	400	400	400	400	400	400	
Total	423	423	550	550	941	941	1,082	1,082	1,223	1,223	
Cumulative Installed Capacity (MW)											
Wallonia onshore	2,045	2,045	2,045	2,045	2,727	2,727	3,636	3,636	4,544	4,544	EDORA and ODE
Flanders onshore	1,060	1,060	1,500	1,500	2,000	2,000	2,500	2,500	3,000	3,000	
Offshore	2,000	2,000	2,825	2,825	3,800	3,800	3,800	3,800	3,800	3,800	
Total	5,105	5,105	6,370	6,370	8,527	8,527	9,936	9,936	11,344	11,344	
Production (GWh)											
Wallonia onshore	4,500	4,500	4,500	4,500	6,000	6,000	8,000	8,000	10,000	10,000	EDORA and ODE
Flanders onshore	1,908	1,908	2,700	2,700	3,600	3,600	4,500	4,500	5,400	5,400	
Offshore	6,600	6,600	9,323	9,323	12,540	12,540	12,540	12,540	12,540	12,540	
Total	13,008	13,008	16,523	16,523	22,140	22,140	25,040	25,040	27,940	27,940	

Assumptions	2020 scenario 1	2020 scenario 1-2	2020 scenario 2	2020 scenario 2-2	2030 scenario 1	2030 scenario 1-2	2030 scenario 2	2030 scenario 2-2	2030 scenario 3	2030 scenario 3-2	Source
Economic assumptions											
Onshore investment (billion €)	0.22	0.22	0.26	0.26	0.45	0.45	0.56	0.56	0.68	0.68	EWEA
Offshore investment (billion €)	0.27	0.27	0.39	0.39	0.49	0.49	0.49	0.49	0.49	0.49	
Electricity (market price for NGCC, no onshore incentive assumed) (€/MWh)	108.4	108.4	108.4	108.4	119.3	119.3	119.3	119.3	119.3	119.3	European Commission
Prices of offshore electricity (market price for NGCC, 15% incentive with respect to onshore) (€/MWh)	124.7	124.7	124.7	124.7	137.2	137.2	137.2	137.2	137.2	137.2	
Imports of turbines and equipment as percentage of total investment	100%	50%	100%	50%	100%	50%	100%	50%	100%	40%	

Table 5.1. Assumptions used to forecast the impact of the wind energy sector in 2020 and 2030

Based on the former assumptions, the forecast of the overall contribution to GDP (constant prices, base 2010) would be as follows:

- In 2020, the overall GDP contribution would be EUR 1,359 - 1,746 million; if a wind turbine manufacturer was built the contribution would be EUR 1,498 – 1,931 million.
- In 2030, the overall GDP contribution would range between EUR 2,105 and 2,942 million, depending on the wind energy penetration level and the possibility of installing a wind turbine manufacturing facility in Belgium.

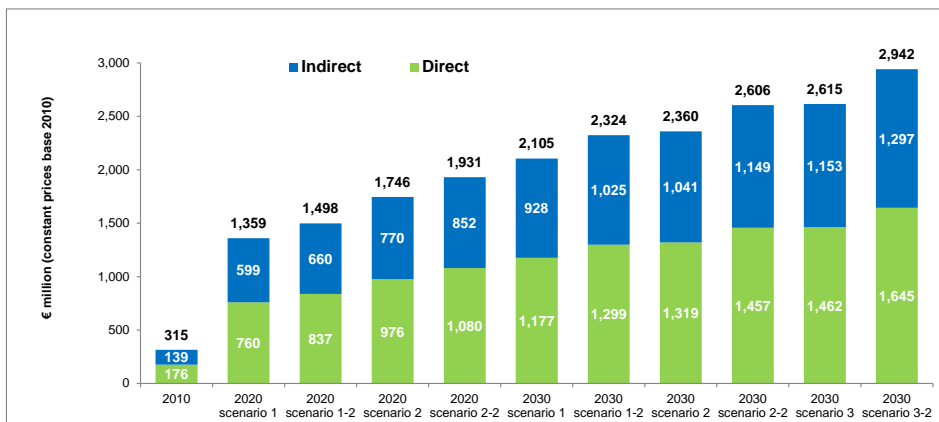


Figure 5.1. Direct, indirect and overall contribution to GDP (forecast): 2020 and 2030

Full-time equivalent jobs would range between 7,605 and 9,809 in 2020 and between 11,824 and 15,269 in 2030 if a wind turbine manufacturing facility was not developed in Belgium. On the contrary, full-time equivalent jobs would be up to 10,409 in 2020 and between 12,524 and 16,069 in 2030, depending on the wind energy penetration level.

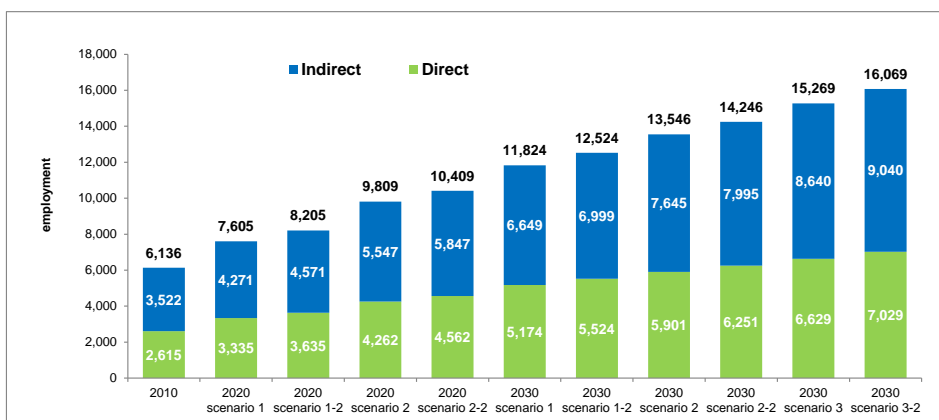


Figure 5.2. Direct, indirect and total employment (forecast): 2020 and 2030

6. Wind energy's environmental benefits

This section presents some of the benefits derived from the wind energy sector. The **externalities detailed below (reduction of CO2 emissions, fossil fuel imports, and wholesale power market price) are only part of the overall economic benefits/externalities derived from Wind power generation** (e.g. externalities in terms of improved health, prevented climate change effects, etc.).

Methodology and determination of the energy replaced by wind farms

It is well known that there are several ways to generate electricity and that fossil-fuel power stations are among the most common approaches to do it (combined cycle gas turbine, coal and fuel). Regarding **externalities or external costs**, wind industry presents a clear advantage over fossil-fuel generating facilities.

- Conventional energy sources produce greenhouse gases that contribute to global warming: the replacement of conventional approaches with renewable energy sources will contribute to reduce greenhouse gas emissions, meeting the policies of Belgium and the EU on emissions savings.
- The reduction of conventional energy sources also has a relevant effect on avoiding other pollutant emissions, such as SO₂ and NO_x.
- Almost all fossil fuels resources are located outside the borders of Belgium. This fact has a double impact on the economy: firstly, there is a high dependence on imported resources to produce energy; secondly, a big amount of money is spent abroad weakening the internal economy.
- Fossil fuel prices are highly volatile, more than the forecast generation costs of wind energy.
- The security of the supply of such resources poses a high risk to the economy.

In order to assess, in a quantitative manner, the positive effects of the wind power penetration in the national electricity system, the following methodology has been applied:

- **Replacement of conventional energy:** wind farms replace conventional generating technologies that use fossil fuels as the primary energy source; the amount of conventional energy replaced by wind is estimated.
- **CO2 emissions savings:** quantification of the tones of CO2 released into the atmosphere by fossil fuel sources, taking into consideration the figures published by Ghent University and the replacement of energy mentioned above.
- **Avoided fossil fuels imports:** to assess the impact of the reduction of energy dependence, avoided imports of fossil fuel are estimated in terms of Tons of Oil Equivalent (toe).
- **Savings in CO2 emission allowances and imports:** calculation of the economic savings in CO2 emission allowances, as well as the fossil fuel imports, according to their prices.

The total wind energy generation in 2010 amounted to 2,064 GWh, it implied an increase of 83.5% with regard to 2009. In the mid and long term, wind power production would be increased between 13,008 and 16,523 GWh in 2020 and between 22,140 and 27,940 GWh in 2030.

Considering the energy mix of Belgium, wind power production replaces only combined cycle gas turbines (CCGT).

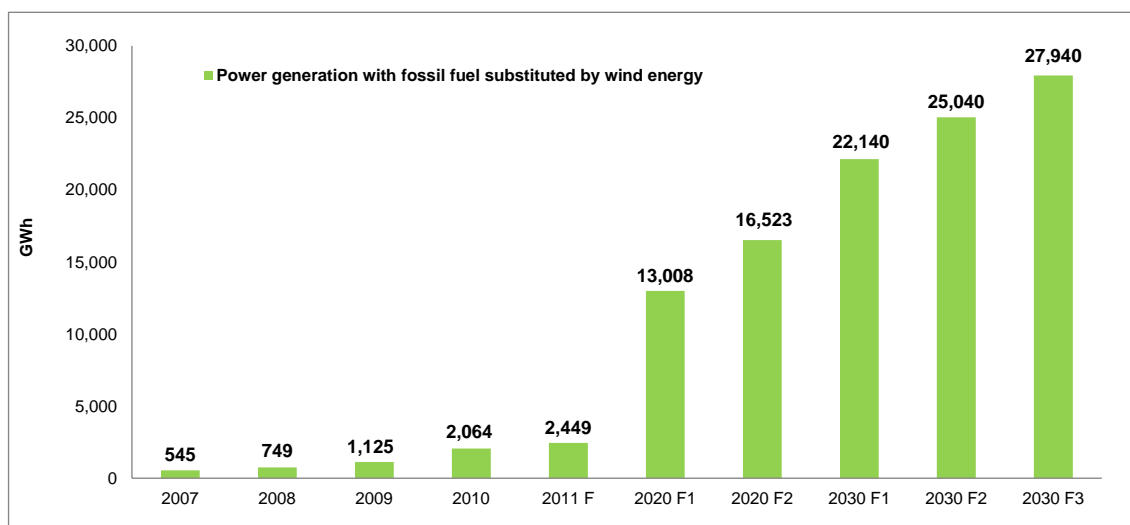


Figure 6.1. Wind power production that replaces electricity generated with natural gas combined cycle

Avoided CO2 emissions

According to the estimates made, wind power presents the following environmental benefits:

- **Cutting CO2 equivalent emissions by over 0.94 million in 2010.**
- In economic terms, savings in emissions rights in 2010 amounted to EUR 13.48 million.
- In the mid and long term, wind power production would avoid between 5.93 and 7.53 million tons of CO2 in 2020 and between 10.10 and 12.74 million in 2030.

CO2 Savings	2007	2008	2009	2010	2011	2020 F1	2020 F2	2030 F1	2030 F2	2030 F3
Million tons of CO2	0.25	0.34	0.51	0.94	1.12	5.93	7.53	10.10	11.42	12.74
Million €	5.52	7.52	6.70	13.48	14.39					

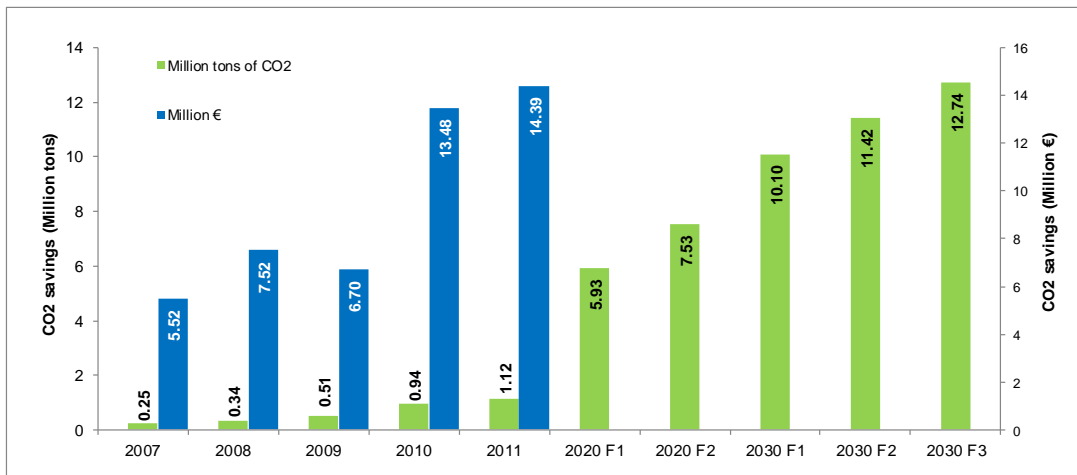


Figure 6.2. CO2 emission savings

Avoided fossil fuel imports

Wind power production contributes significantly to reducing the imports of fossil fuel. According to the estimates made, the fossil fuel imports were as follows:

- During 2010, wind power production in Belgium avoided the import of 0.36 million tons of oil equivalents (fossil fuel).
- In economic terms, it has implied a significant saving for Belgium. In accordance with the fossil fuel prices, **wind energy avoided in 2010 around EUR 67.65 million of fossil fuel imports¹⁵**.
- In the mid and long term, it would avoid between 2.24 and 2.85 million tons of oil equivalent in 2020 and between 3.82 and 4.82 million in 2030.

Fossil fuel imports savings	2007	2008	2009	2010	2011	2020 F1	2020 F2	2030 F1	2030 F2	2030 F3
Million toe	0.09	0.13	0.19	0.36	0.42	2.24	2.85	3.82	4.32	4.82
Million €	17.13	38.62	28.02	67.65	111.61					

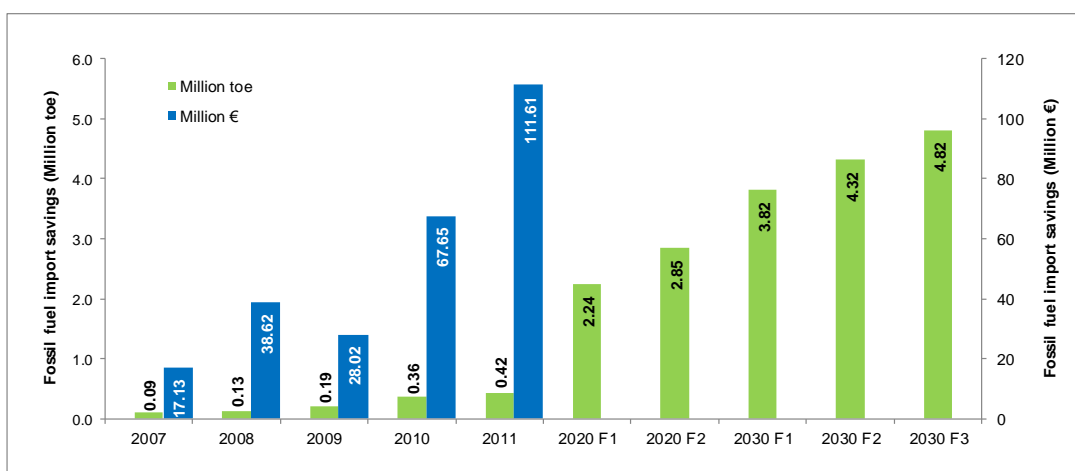


Figure 6.3. Evolution of fossil fuel import savings

Price	2008	2009	2010	2011
Natural Gas (€/MWh)	25.78	12.45	16.39	22.79
CO2 (€/ton)	22.02	13.06	14.32	12.89

¹⁵

- The monetary value of the externalities (CO2 emissions and fossil fuel imports) due to the wind energy penetration has increased by EUR 57 million from 2007 to 2010 (EUR 81.1 million in 2010 and EUR 23.8 million in 2007).

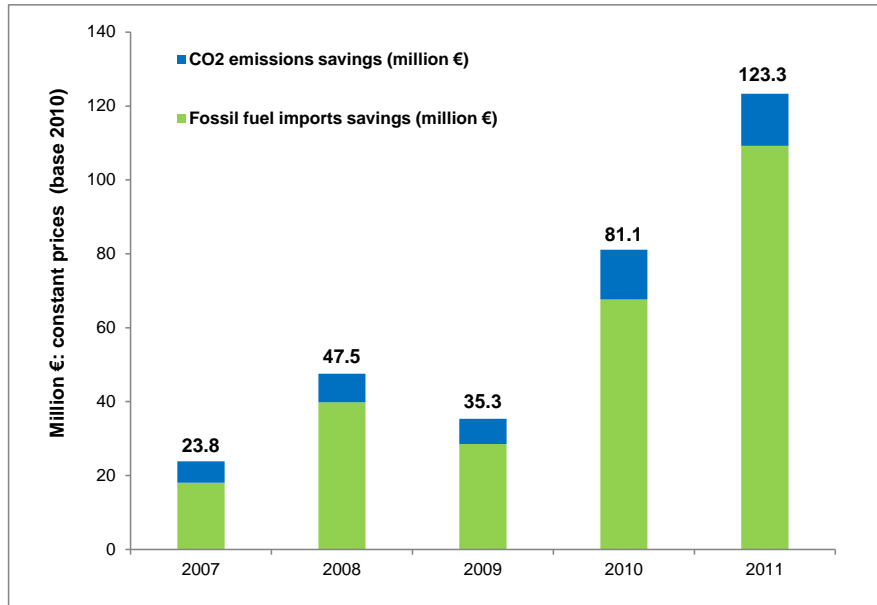


Figure 6.4. Wind energy savings in terms of CO2 emissions and fossil fuel imports

- As it can be seen in the previous figure, the externalities in 2009 were lower than in 2008. This is due to the fact that although there was more wind power production in 2009 the prices of CO2 and natural gas were lower than in 2008.

Economic impact of the wind energy on the price of the wholesale power market of Belgium

The existence of wind generation units has an impact on the wholesale power market: **wind energy replaces conventional generation units. As a result of this the electricity price in the wholesale market is reduced.**

In order to evaluate this effect, an hourly wholesale market has been simulated for 2010 and 2011 taking into consideration the electricity market of Belgium according to the following analysis framework:

- Hourly power demand in Belgium published by the System Operator of Belgium.
- Power capacity of the power system.
- Marginal cost of power units based on fuel markets (simulation of market mechanism according to perfect competition criteria: all the players offer the energy based on their marginal costs).
- Hourly wind energy generation published by the System Operator of Belgium.

Based on this scheme the hourly power prices were calculated for 2010 and 2011 according to two different scenarios:

1. The first scenario takes into account the hourly wind power production.
2. The wind power production has not been included in the second simulation.

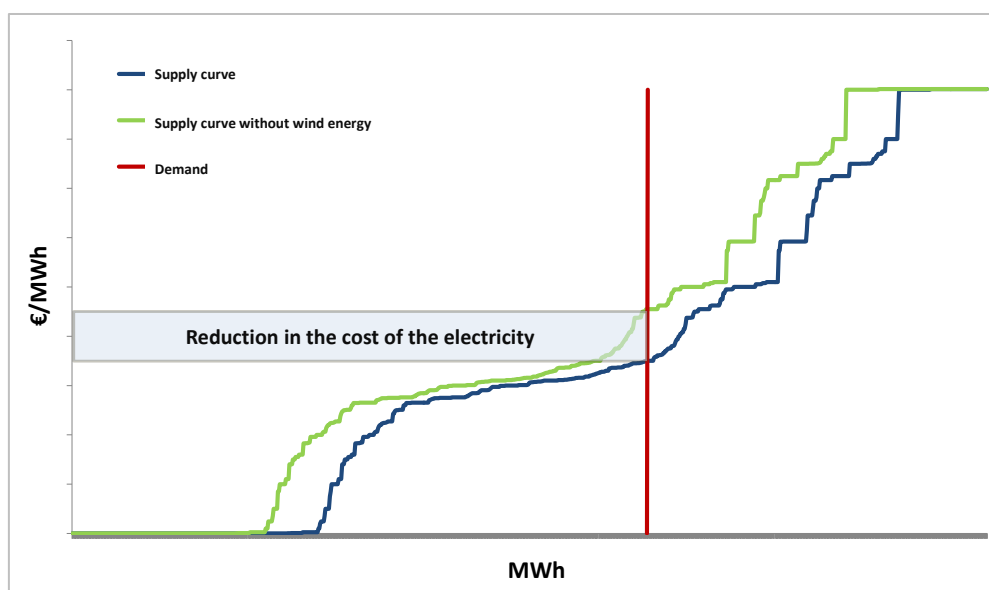


Figure 6.5. Methodology applied to compare the match schedule in the wholesale electricity market with and without wind energy

The analysis shows a reduction of the energy cost derived from the lower marginal cost of wind energy.

The simulation shows a price reduction of EUR 53.2 million in 2010 (EUR 0.62 per MWh acquired in the market) and EUR 59.0 million in 2011 (EUR 0.73 per MWh acquired in the market).

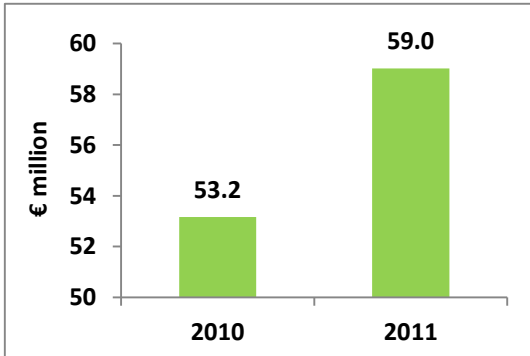


Figure 6.6. Cost savings in the wholesale power market of Belgium due to the penetration of wind energy

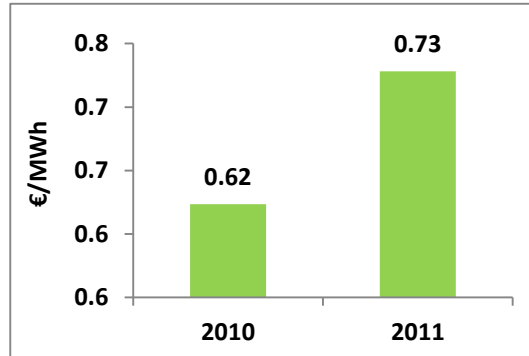


Figure 6.7. Benefit derived from the penetration of wind energies in the wholesale power market of Belgium: savings in the cost of energy in the wholesale power market per MWh

7. Ratios

Overall Sector contribution to GDP / Installed wind energy capacity (million €/MW): constant prices (base 2010)	2007	2008	2009	2010	2011 F
Contribution to GDP of the Sector (million €)	198.09	228.93	293.86	315.17	335.29
Installed wind energy capacity (MW)	274.10	376.10	537.50	886.20	1,077.80
Overall Sector contribution to GDP / Installed wind energy capacity (million €/MW): constant prices (base 2010)	0.72	0.61	0.55	0.36	0.31

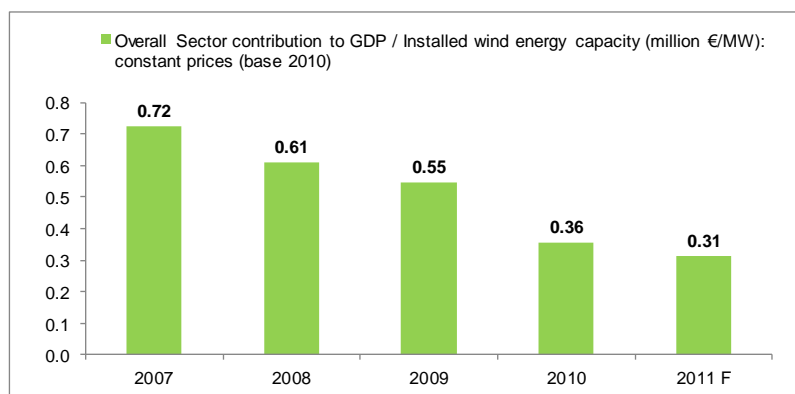


Figure 7.1. Overall Sector contribution to GDP divided by installed wind energy capacity (million EUR/MW): constant prices (base 2010)

Direct contribution to GDP of the Sector / Installed wind energy capacity (million €/MW): constant prices (base 2010)	2007	2008	2009	2010	2011 F
Direct contribution to GDP of the Sector (million €)	111.74	127.74	163.80	176.18	188.16
Installed wind energy capacity (MW)	274.10	376.10	537.50	886.20	1,077.80
Direct contribution to GDP of the Sector / Installed wind energy capacity (million €/MW): constant prices (base 2010)	0.41	0.34	0.30	0.20	0.17

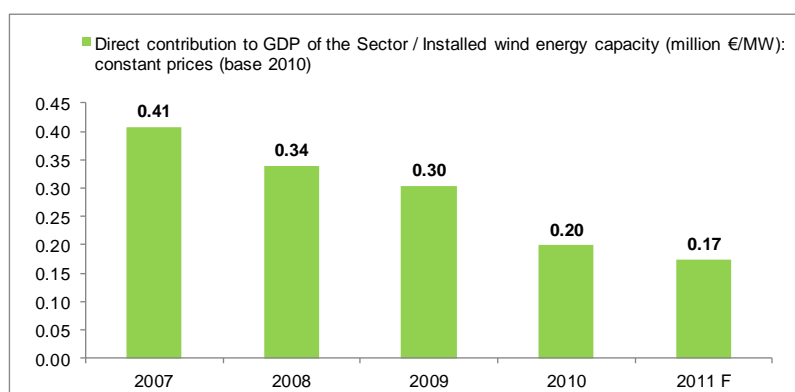


Figure 7.2. Direct contribution to GDP of the Sector divided by installed wind energy capacity (million EUR/MW): constant prices (base 2010)

Wind energy producers' contribution to GDP / Installed wind energy capacity (thousand €/MW): constant prices (base 2010)	2007	2008	2009	2010	2011 F
Wind energy producers' contribution to GDP (thousand €)	34,737	42,960	65,107	73,679	84,398
Installed wind energy capacity (MW)	274.10	376.10	537.50	886.20	1,077.80
Wind energy producers' contribution to GDP / Installed wind energy capacity (thousand €/MW): constant prices (base 2010)	126.73	114.22	121.13	83.14	78.31

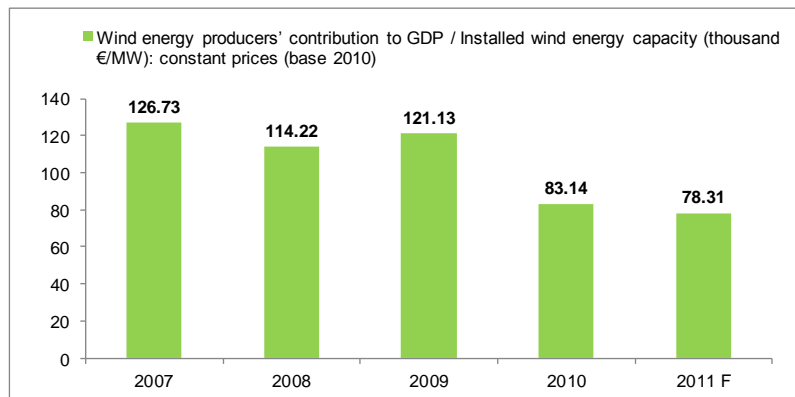


Figure 7.3. Wind energy producers' contribution to GDP divided by installed wind energy capacity (thousand EUR/MW): constant prices (base 2010)

Wind energy producers' contribution to GDP / Wind power production (thousand €/GWh): constant prices (base 2010)	2007	2008	2009	2010	2011 F
Wind energy producers' contribution to GDP (thousand €)	34,737	42,960	65,107	73,679	84,398
Wind power production (GWh)	545	749	1,125	2,064	2,449
Wind energy producers' contribution to GDP / Wind power production (thousand €/GWh): constant prices (base 2010)	64	57	58	36	34

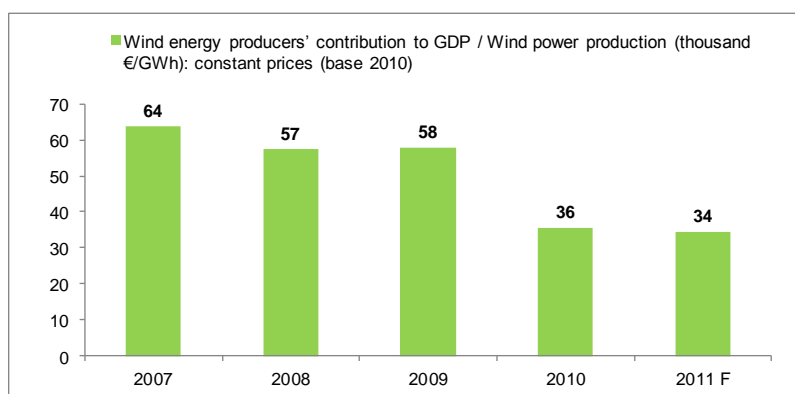


Figure 7.4. Wind energy producers' contribution to GDP divided by wind power production (thousand EUR/GWh): constant prices (base 2010)

GDP of the Sector / Wind energy sector employment (thousand € per person): constant prices (base 2010)	2007	2008	2009	2010	2011 F
GDP of the Sector (thousand €)	198,095	228,932	293,860	315,173	335,287
Wind energy sector employment (persons)	3,578	4,388	5,614	6,136	6,225
GDP of the Sector / Wind energy sector employment (thousand € per person): constant prices (base 2010)	55.36	52.17	52.34	51.36	53.86

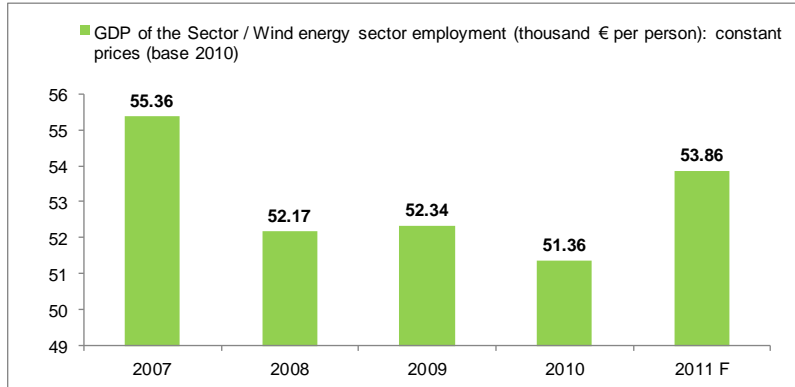


Figure 7.5. Sector GDP divided by number of professionals (thousand EUR per person): constant prices (base 2010)

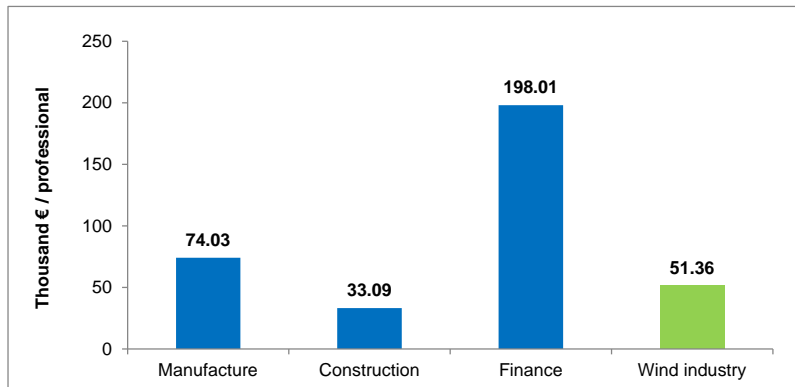


Figure 7.6. Comparison of the contribution to GDP per professional among different economic activities (thousand EUR per person): 2010¹⁶

¹⁶ Source: Eurostat & Deloitte

Number of professionals of the Sector / Installed wind energy capacity (number of professionals/MW)	2007	2008	2009	2010	2011 F
Number of professionals of the Sector	3,578	4,388	5,614	6,136	6,225
Installed wind energy capacity (MW)	274.10	376.10	537.50	886.20	1,077.80
Number of professionals of the Sector / Installed wind energy capacity (number of professionals/MW)	13.05	11.67	10.44	6.92	5.78

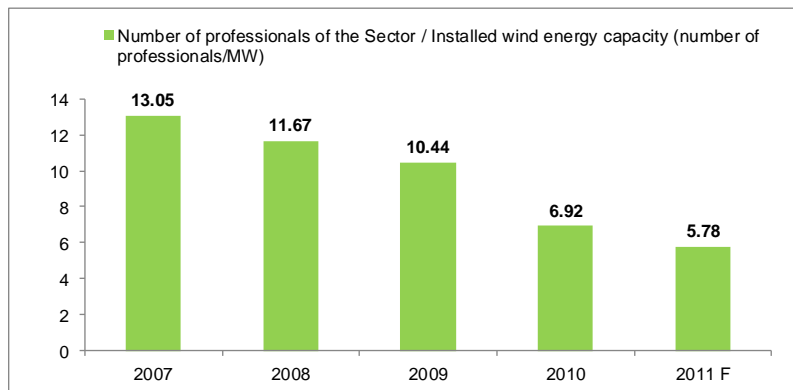


Figure 7.7. Number of professionals of the Sector divided by installed wind energy capacity (professional/MW)

Employment in the wind industry vs National employment	2007	2008	2009	2010	2011 F
Employment in Belgium (persons)	4,383,000	4,461,000	4,453,000	4,484,000	4,545,000
Employment in Belgium (index)	100.0	101.8	101.6	102.3	103.7
Wind energy sector employment (persons)	3,578	4,388	5,614	6,136	6,225
Wind energy sector employment (index)	100	122.6	156.9	171.5	174.0

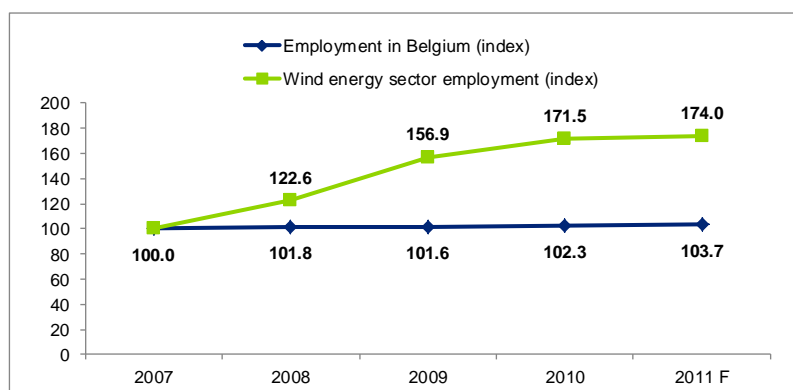


Figure 7.8. Comparison between the employment growth in the wind energy sector and in Belgium with respect to 2007

There is a big difference in the employment growth comparing 2007 and 2011 values: in Belgium it has increased by 3.7% from 2007 while in the wind energy sector the increase was 74%.

8. Conclusions

Relevance of wind energy business in Belgium

Renewable energies, and wind energy among them, result in environmental and economic benefits. The study has shown that the wind energy sector has a favourable impact on two important aspects: greenhouse gas emission reduction and energy dependence mitigation.

The replacement of conventional energy sources by wind energy not only helps meet the EU policy on emissions savings but also contributes to reducing the energy resources dependence on third countries.

Moreover, a set of positive effects on the economy of Belgium has been quantified:

- **The direct contribution to GDP of the wind energy sector was EUR 176.2 million in 2010 (0.55‰ of GDP of Belgium).**

In real terms, the wind energy sector increased its direct contribution to GDP by 7.6% in 2010 compared to 2009.

The average contribution per installed power was EUR 0.2 million in 2010.

- **The wind industry in Belgium imports considerably more than it exports. In 2010, the Sector exported EUR 142 million while the imports amounted to EUR 560 million;** the difference between exports and imports was EUR -418 million.

These figures show that there is a high external dependence.

- The **Sector directly employed 2,615 professionals** in 2010 with a productivity of EUR 67,378 per professional.
- The Sector had a significant impact on other economic activities:
 - ✓ **In 2010, the indirect impact on the rest of economy accounted for EUR 139 million** (additional GDP contribution).
 - ✓ **Indirect employment (additional) accounted for 3,522 in terms of full time equivalent jobs in 2010.**
- **Taxes paid by the wind industry was EUR 16.6 million in 2010;** EUR 15 million in corporate taxes.
- **The Sector put significant effort into R&D, which was 1.72 times the average of Belgium (2010):** 3.43% of sector GDP was related to R&D activities, while the average in Belgium only reached 1.99%.

- Special regime generation from Wind farms assumes that the marginal price set in the wholesale electricity market of Belgium is lower than the one obtained in the absence of such technologies.

In other words, wind energy replaces fossil fuel units with a high marginal cost that would set higher marginal prices. **This price reduction was around EUR 53.2 million (EUR 0.62 / MWh) in 2010.**

Macroeconomic impact of the wind industry in 2020 and 2030

In **2020**, the installed wind power capacity is expected to be between **5,105 and 6,370 MW** (depending on the scenario), of which 2,000 – 2,825 MW would be offshore. By **2030**, it is expected to have an installed wind power capacity of **8,527 - 11,344 MW**, of which 3,800 MW would be offshore.

This growth would be reflected by an increasing wind industry contribution to the economy and GDP growth of Belgium, it would have a positive impact on the environment and it would help to meet the objective of gross final energy consumption from renewables.

- **Strong contribution to the reduction of greenhouse gas emission and mitigation of the energy dependence of the country.**

- ✓ In 2020 and 2030 between 5.93 and 7.53 million tons of CO₂ and between 10.10 and 12.74 million tons of CO₂ would be avoided, respectively.
- ✓ It would be avoided between 2.24 and 2.85 million tons of oil equivalent in 2020 and between 3.82 and 4.82 million tons of oil equivalent in 2030.

- **Relevance in the economy of Belgium in 2020:**

- ✓ The direct contribution to GDP would amount to EUR 760 - 976 million. If a wind turbine manufacturing facility was established in Belgium, covering 50% of the demand share, the direct contribution to GDP would be higher, EUR 837 – 1,080 million.

The indirect impact on the rest of the economy would amount to EUR 599 - 770 million or 660 - 852 million in case of developing a wind turbine facility in Belgium.

Consequently the **overall (direct + indirect)** impact on the forecast GDP would vary between **EUR 1,359 and 1,931 million.**

- ✓ Regarding job opportunities, 3,335 - 4,262 professionals would be directly employed by the Sector (3,635 - 4,562 professionals in case of installing a wind turbine manufacturing facility).

Indirectly, due to the demand of the wind industry, 4,271 - 5,547 equivalent jobs would be generated (4,571 - 5,847 jobs in case of installing a wind turbine manufacturing facility).

All in all, wind industry would reach between 7,605 and 9,809 employments (8,205 - 10,409 jobs in case of installing a wind turbine manufacturing facility).

- **Relevance in the economy of Belgium in 2030:**

- ✓ The direct contribution to GDP for 2030 would amount to EUR 1,177 - 1,645 million, depending on the wind energy penetration level and the existence of a wind turbine manufacturing plant in Belgium.

The indirect impact on the rest of the economy would vary from EUR 928 million to 1,297 million.

Consequently, the **overall (direct + indirect)** impact on the forecast GDP would be **EUR 2,105 - 2,942 million**.

- ✓ Between 5,174 and 7,029 professionals would be directly employed by the wind energy sector.

The indirect effect would result in 6,649 - 9,040 equivalent jobs (depending on the scenario of wind energy penetration and the existence of a wind turbine manufacturing plant in Belgium).

Adding direct and indirect jobs, the total number of professionals somehow related to the Wind energy would range between 11,824 and 16,069.

Table of figures

Figure 0.1. Direct, indirect and overall impact of the wind energy sector in Belgium in constant prices (base 2010)	7
Figure 0.2. Evolution of the installed wind energy power capacity and production in Belgium	7
Figure 0.3. Direct, indirect and total employment on the wind energy sector	8
Figure 0.4. Direct, indirect and overall contribution to GDP (forecast): 2020 and 2030	10
Figure 0.5. Direct, indirect and total employment (forecast): 2020 and 2030	10
Figure 0.6. Impact of externalities of wind energy in terms of CO2 emissions and fossil fuel imports savings	11
Figure 2.1. Wind energy power capacity. Source: EDORA and ODE, and EurObserv'ER	15
Figure 2.2. Electricity generation from wind and percentage of total electricity generation (Source: EurObserv'ER and ELIA)	16
Figure 2.3. Wind energy power capacity in Wallonia and Flanders, onshore and offshore. Source: EDORA and ODE	16
Figure 3.1. Direct contribution of the wind energy sector in Belgium to GDP in constant prices (base 2010)	18
Figure 3.2. Overall wind energy sector contribution to GDP growth	21
Figure 3.3. Relative importance of the wind energy sector in terms of the GDP of Belgium (direct)	21
Figure 3.4. Comparison between the growth of National GDP and the wind energy sector direct contribution. Source: Deloitte and International Monetary Fund	22
Figure 3.5. Wind industry supply chain in Belgium	23
Figure 3.6. Relative weight of the wind industry sub-sectors in terms of direct GDP: current prices	23
Figure 3.7. Direct contribution to GDP of the wind industry sub-sectors: constant prices (base 2010)	24
Figure 3.8. Direct GDP growth of the wind industry sub-sectors in Belgium	24

Figure 3.9. Taxes paid by the wind industry (current prices)	30
Figure 3.10. Example of the adapted input-output tables	31
Figure 3.11. Indirect added value generated by the wind energy sector in other sectors in 2010	33
Figure 3.12. Relative significance of the wind energy sector in terms of the GDP of Belgium (Overall impact on GDP)	34
Figure 3.13. Contribution to GDP of the main economic sectors: comparative analysis	35
Figure 3.14. Evolution of the wind energy sector and the National expenditure on R&D as a percentage of GDP	36
Figure 4.1. Evolution of the wind energy sector direct employment in Belgium	38
Figure 4.2. Direct employment distribution by wind industry sub-sectors	39
Figure 5.1. Direct, indirect and overall contribution to GDP (forecast): 2020 and 2030	44
Figure 5.2. Direct, indirect and total employment (forecast): 2020 and 2030	44
Figure 6.1. Wind power production that replaces electricity generated with natural gas combined cycle	46
Figure 6.2. CO2 emission savings	47
Figure 6.3. Evolution of fossil fuel import savings	48
Figure 6.4. Wind energy savings in terms of CO2 emissions and fossil fuel imports	49
Figure 6.5. Methodology applied to compare the match schedule in the wholesale electricity market with and without wind energy	50
Figure 6.6. Cost savings in the wholesale power market of Belgium due to the penetration of wind energy	51
Figure 6.7. Benefit derived from the penetration of wind energies in the wholesale power market of Belgium: savings in the cost of energy in the wholesale power market per MWh	51
Figure 7.1. Overall Sector contribution to GDP divided by installed wind energy capacity (million EUR/MW): constant prices (base 2010)	52
Figure 7.2. Direct contribution to GDP of the Sector divided by installed wind energy capacity (million EUR/MW): constant prices (base 2010)	52

Figure 7.3. Wind energy producers' contribution to GDP divided by installed wind energy capacity (thousand EUR/MW): constant prices (base 2010)	53
Figure 7.4. Wind energy producers' contribution to GDP divided by wind power production (thousand EUR/GWh): constant prices (base 2010)	53
Figure 7.5. Sector GDP divided by number of professionals (thousand EUR per person): constant prices (base 2010)	54
Figure 7.6. Comparison of the contribution to GDP per professional among different economic activities (thousand EUR per person): 2010	54
Figure 7.7. Number of professionals of the Sector divided by installed wind energy capacity (professional/MW)	55
Figure 7.8. Comparison between the employment growth in the wind energy sector and in Belgium with respect to 2007	55
Figure II.1. Information collection for the value added and income approaches	65
Figure II.2. Estimation of direct GDP contribution using three recognised methodologies	66
Figure II.3. Outline of the analytical methodology used	67
Figure III.1. Outline of the analytical methodology applied	68
Figure III.2. Example of a symmetric Input-Output Table for domestic output at basic prices	69
Figure III.3. Questionnaires	69
Figure III.4. Example of the adapted input-output tables	70

List of tables

Table 0.1. Regional cumulative installed capacity (forecast): 2020 and 2030	10
Table 3.1. Wind energy sector direct contribution to GDP: current prices	19
Table 3.2. Wind energy sector direct contribution to GDP: constant prices (base 2010)	20
Table 3.3. Wind industry sub-sectors contribution to direct GDP	24
Table 3.4. Developers-producers' direct contribution to GDP: constant prices (base 2010)	26
Table 3.5. Manufacturers' direct contribution to GDP: constant prices (base 2010)	27
Table 3.6. Services' direct contribution to GDP: constant prices (base 2010)	28
Table 3.7. Wind industry exports and imports: constant prices (base 2010)	29
Table 3.8. Direct, indirect and overall impact of the wind energy sector in Belgium (current prices)	32
Table 3.9. Direct, indirect and overall impact of the wind energy sector in Belgium: constant prices (base 2010)	32
Table 4.1. Evolution of the direct employment by wind industry sub-sectors in Belgium	39
Table 4.2. Evolution of direct, indirect and total employment of the wind energy sector in Belgium	40
Table 5.1. Assumptions used to forecast the impact of the wind energy sector in 2020 and 2030	43
Table I.1. Direct contribution to GDP of the different wind industry sub-sectors in constant prices (base 2010): 3 years average (2009, 2010, and 2011)	63
Table I.2. Indirect contribution to GDP of the different wind industry sub-sectors in constant prices (base 2010): 3 years average (2009, 2010, and 2011)	64
Table I.3. Direct impact on employment of the different wind industry sub-sectors: 3 years average (2009, 2010, and 2011)	64
Table I.4. Indirect impact on employment of the different wind industry sub-sectors: 3 years average (2009, 2010, and 2011)	64

Appendix I. Regional breakdown of the wind energy sector in Belgium

Direct contribution to GDP

Developers - Producers million € - prices 2010	Flanders Onshore	Wallonia Onshore	Offshore
Total Income	50.28	76.95	65.23
Total Expenditures	30.10	47.21	40.76
Production or value added approach	20.18	29.75	24.47
Compensation of employees	4.13	6.15	4.62
Gross operating surplus	16.05	23.60	19.85
Income approach	20.18	29.75	24.47

Manufacturers million € - prices 2010	Flanders Onshore	Wallonia Onshore	Offshore
Total Income	113.23	140.39	-
Total Expenditures	89.27	110.70	-
Production or value added approach	23.95	29.69	-
Compensation of employees	19.77	24.49	-
Gross operating surplus	4.18	5.20	-
Income approach	23.95	29.69	-

Providers of specific services million € - prices 2010	Flanders Onshore	Wallonia Onshore	Offshore
Total Income	63.42	75.27	-
Total Expenditures	41.42	49.27	-
Production or value added approach	22.01	26.00	-
Compensation of employees	18.41	21.77	-
Gross operating surplus	3.60	4.23	-
Income approach	22.01	26.00	-

Table I.1. Direct contribution to GDP of the different wind industry sub-sectors in constant prices
(base 2010): 3 years average (2009, 2010, and 2011)

Indirect contribution to GDP

Indirect contribution to GDP million € - prices 2010	Flanders Onshore	Wallonia Onshore	Offshore
Developers - Producers	15.91	23.44	19.25
Manufacturers	18.88	23.41	-
Providers of specific services	17.34	20.49	-
Total	52.14	67.34	19.25

Table I.2. Indirect contribution to GDP of the different wind industry sub-sectors in constant prices (base 2010): 3 years average (2009, 2010, and 2011)

Direct impact on employment

Direct employment	Flanders Onshore	Wallonia Onshore	Offshore
Developers - Producers	99	148	92
Manufacturers	568	703	-
Providers of specific services	434	514	-
Total	1,101	1,365	92

Table I.3. Direct impact on employment of the different wind industry sub-sectors: 3 years average (2009, 2010, and 2011)

Indirect impact on employment

Indirect employment	Flanders Onshore	Wallonia Onshore	Offshore
Developers - Producers	132	197	124
Manufacturers	756	936	-
Providers of specific services	577	684	-
Total	1,465	1,817	124

Table I.4. Indirect impact on employment of the different wind industry sub-sectors: 3 years average (2009, 2010, and 2011)

Appendix II. Assessment approach

Direct contribution to GDP

The calculation of the wind energy sector contribution to the Gross Domestic Product (GDP) has been carried out according to **the three equivalent approaches recognised by the European System of National and Regional Accounts (ESNRA)**: Final expenditure, Added Value and Income approaches.

- **Final expenditure approach:** market value of all final goods and services produced within a territory in a given period of time. According to this method, GDP is the sum of the different expenditure components, mainly consumption, investment (which together account for the internal demand), and net exports (exports minus imports).
- **Added Value approach:** the sum of the value added of all companies in a given economy or sector.
- **Income approach:** the sum of all payments for production factors (i.e. employee compensation, gross fixed capital consumption, net operating surplus and mixed income).

The wind energy sector is comprised of companies performing a wide range of activities integrated in the industry value chain.

The **methodology** used for the preparation of this study divides the wind energy sector into four sub-sectors:

- Wind farm developers and energy producers.
- Manufacturers.
- Specific services suppliers in the wind energy sector.

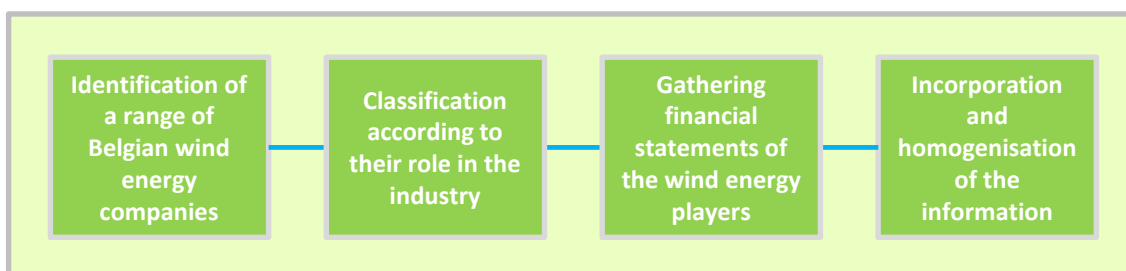


Figure II.1. Information collection for the value added and income approaches

Financial statements include income, current expenditure, salary and cash flow information that allow the estimation of the contribution to GDP according to two of the three methods mentioned above: Added Value and Income approaches. Additional information has been gathered as a result of a survey carried out to complete the financial statements data in order to calculate the total direct impact.

The calculation from the third method application, the Expenditure approach, has been carried out by estimating the final consumption of electricity produced by wind energy turbines, the players' investment, and the Sector exports and imports. For this purpose, data regarding production of electricity from wind energy and installed capacity has been collected from official information sources.

Cost structures and exports and imports figures have been obtained from a players' questionnaire, covering all phases of the wind industry value chain.

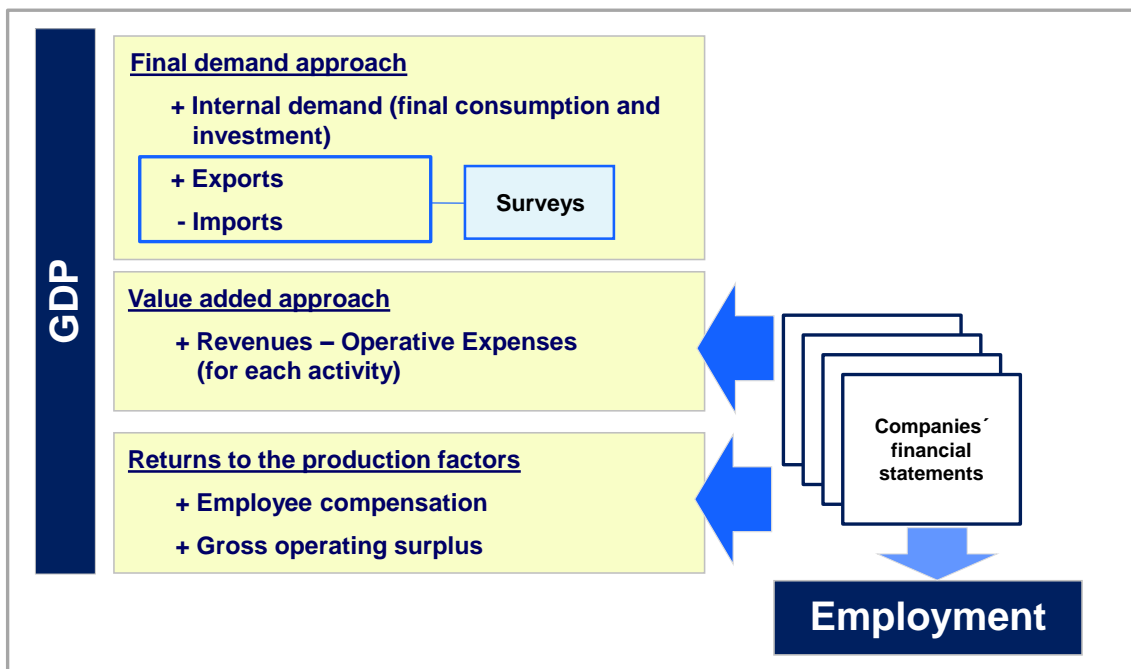


Figure II.2. Estimation of direct GDP contribution using three recognised methodologies

All the information is presented in both current and constant values, using the GDP deflator published by International Monetary Fund.

Indirect contribution to GDP

The sub-sectors of the wind energy industry purchase and provide services to other economic sectors. These relationships among the different economic activities produce an additional economic value, which is measured by using an input-output model.

An input-output model is a quantitative economic technique that represents the interdependencies between different branches of a national economy or between branches of different and competing economies.

In order to evaluate the economic impact, the latest input-output tables (2007) published by *Direction générale Statistique et Information économique* have been used. These tables do not consider the wind energy sector as a separate industry. Therefore, it is necessary to add the Sector information to the evaluation scheme.

The same methodology used by the EU and national statistics bodies has been applied in order to fulfil the following tasks: relevant players of the wind energy industry were interviewed to evaluate their supply structures and the destinations of their sales. In order to prepare the input-output tables including the wind energy sector and evaluate the impact on the rest of the economy of Belgium, Deloitte has provided sectorial data as a result of a questionnaire distributed among the most significant industry players.

Based on this input-output table, the income multipliers are calculated: these multipliers contain the information of the impact that the wind energy sector has on the rest of the economy (the methodology used for this calculation can be found in Appendix II).

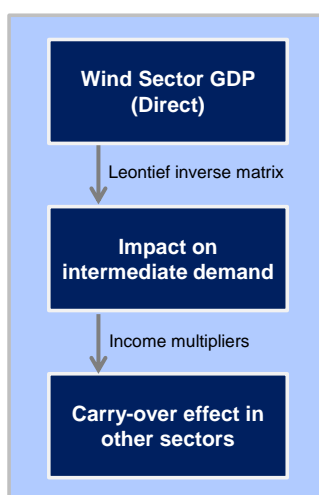


Figure II.3. Outline of the analytical methodology used

Appendix III. Methodology to calculate the indirect contribution of the wind energy sector to GDP

The input-output analysis methodology was developed by Wassily Leontief in 1936. It is a quantitative economic technique that represents the interdependencies between different branches of national economy and different or competing economies.

The sub-sectors of the wind industry demand products and services from other activities. Therefore, the Sector has an additional economic impact on other sectors that can be evaluated from input-output tables.

The input-output tables show all the production and distribution operations that take place between the different sectors of the economy. The indirect effects of an industry on other sectors of the economy can be quantified from the matrix of technical coefficients and the Leontief inverse matrix.

Currently, the national accounts tables do not break down the wind energy sector. Therefore it is necessary to evaluate the relationships with other economic sectors. In order to achieve this, a questionnaire was prepared and completed by the industry players regarding the supply structure of the industry sub-sectors.

Therefore, from the latest tables published and the information contained in the questionnaires, a new model of tables was built containing the broken down sub-sectors identified in the wind energy sector.

The methodology applied is as follows:

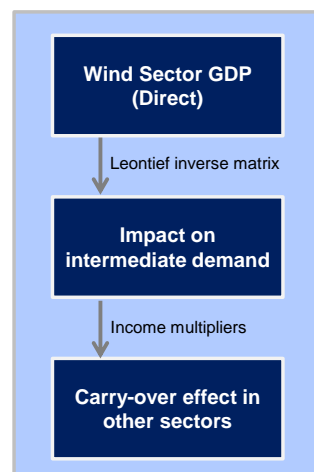


Figure III.1. Outline of the analytical methodology applied


Procedure to calculate the indirect impact:

1. The latest downloaded Input-Output tables (2008).

		HOMOGENEOUS BRANCHES	Input of Products						
			Products of agriculture, hunting and related services	Products of forestry, logging and related services	Fish and other fishing products; services incidental of fishing	Coal and lignite; peat	Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying	Uranium and thorium ores	Metal ores
	Code	PRODUCTS (CPA)	01	02	05	10	11	12	13
No			1	2	3	4	5	6	7
1	01	Products of agriculture, hunting	46201	441	51	14	10	0	
2	02	Products of forestry, logging ar	212	6237	3	27	17	1	1
3	05	Fish and other fishing products	64	1	320	0	0	0	
4	10	Coal and lignite; peat	157	9	0	456	25	0	2
5	11	Crude petroleum and natural g	5	0	0	3	5336	0	4
6	12	Uranium and thorium ores	0	0	0	0	0	0	
7	13	Metal ores	7	1	0	7	6	0	57
8	14	Other mining and quarrying pro	326	7	17	15	8	0	2
9	15	Food products and beverages	36444	78	349	8	56	0	
10	16	Tobacco products	0	0	0	0	0	0	
11	17	Textiles	316	9	201	5	4	0	
12	18	Wearing apparel; furs	83	21	11	12	24	0	
13	19	Leather and leather products	117	4	12	11	6	0	
14	20	Wood and products of wood ar	1027	261	43	162	23	1	2
15	21	Pulp, paper and paper product	747	44	18	18	26	0	1
16	22	Printed matter and recorded m	404	90	12	26	21	0	1
17	23	Coke, refined petroleum produc	7276	512	688	196	288	1	23
18	24	Chemicals, chemical products	13938	184	37	207	315	1	16
19	25	Rubber and plastic products	1633	88	66	244	76	1	6

Figure III.2. Example of a symmetric Input-Output Table for domestic output at basic prices

2. Questionnaires are developed to break down the wind energy sector into sub-sectors. Considering these questionnaires, the intermediate consumption flows between the sub-sectors (promoters, producers, turbine manufacturers, component manufacturers and services) and other economic activities are quantified.
3. Questionnaires are completed by the industry players




Activity:	Wind Farms Development & Wind Farms Operations
Company:	
Contact name:	
Date:	

Macro-economic impact of the Wind Energy Sector in Belgium

Wind Farms Development & Wind Farms Operations

Thank you very much for your collaboration



WIND FARMS DEVELOPMENT

1. Could you please provide an average estimate for the capital cost breakdown (in million (M€)) required for developing/building a wind farm in 2010, differentiating whether the concept has been purchased inside/outside Belgium?

Cost	Onshore		Offshore	
	Belgium (within EU)	Outside Belgium (within EU)	Belgium (within EU)	Outside Belgium (within EU)
Wind Turbine				
Other equipment and/or materials (control, security, ...)				
On-site civil and engineering services (roads, foundations, ...)				
Electric infrastructure and grid connection				
Project Management				
Development Costs (Technical, environmental, economic studies)				
Legal Costs (permits and licenses management)				
Financial services (interests, bank fees)				
Insurance				
Other services				

Figure III.3. Questionnaires

4. Based on the information collected from questionnaires, the matrix is modified including the transactions between Wind Industry Sub-sectors and other sectors.

		HOMOGENEOUS BRANCHES	Wind Energy Sector	Products of agriculture, hunting and related services	Products of forestry, logging and related services	Fish and other fishing products; services incidental of fishing	Coal and lignite; peat
		PRODUCTS (CPA)	A	01	02	05	10
No	Code		A	1	2	3	4
A	A	Wind Energy Sector	1.2324	0.0009	0.0004	0.0003	0.0005
1	01	Products of agriculture, hunting	0.0230	1.1616	0.0205	0.0138	0.0034
2	02	Products of forestry, logging and	0.0009	0.0017	1.1963	0.0011	0.0037
3	05	Fish and other fishing products	0.0003	0.0007	0.0001	1.0245	0.0001

Figure III.4. Example of the adapted input-output tables

Once these steps have been carried out, the following calculations are applied:

- a. **Technical coefficients matrix**, which measures the relative importance of each industry in the total production of another sub-sector.
- b. **Leontief inverse matrix**, which measures the indirect impact of a sector on other economic activity, through the multiplier effect that a sector has on the intermediate production of another.
- c. **Income multipliers**, which measure the existing relationship between gross added value (contribution to GDP) and total production.

This set of indicators multiplied by the intermediate production quantifies the indirect impact that an increase of 1EUR in the wind energy sector GDP has on the GDP of the rest of the economy.

5. Build the Technical coefficients matrix (Matrix A): every component of the matrix is divided by the total sum of each column.

It represents the relative importance of each industry in the total production of another sub-sector.

6. Build the Leontief matrix $(I-A)^{-1}$: measures the indirect impact of a sector on other economic activity, through the multiplier effect that a sector has on the intermediate production of another.
7. Calculate the Income multipliers: to multiply the values of the Leontief matrix column (of the Sector evaluated) by the quotient of each economy sector added value and the total sectorial production value.
8. Indirect impact of wind energy sector is calculated multiplying the direct impact on GDP by the multipliers mentioned above.