CLIMACT

THE SOCIO-ECONOMIC IMPACT OF THE BELGIAN OFFSHORE WIND INDUSTRY

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FINAL REPORT

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BOP

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This study is an update and an extension of a previous study conducted by Climact with Prof. Thierry Bréchet (UCL) and Prof. Johan Eyckmans (KULeuven). It builds on interactions with key stakeholders from the industry and offshore wind experts (AGORIA, ALSTOM, BOP, EDORA, ELIA, GEOSEA).

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INTRODUCTION: OFFSHORE WIND IN THE WIDER CONTEXT

Electricity supply is at a crossroad in Belgium and in Europe. Today's infrastructure is ageing, security of supply needs to be strengthened, and competitiveness and households buying power have to be protected, while supporting the massive reductions in greenhouse gas emissions. Although currently in over-capacity, in the next 15 years significant new generating capacity will need to be built.

The wind offshore industry is still relatively young: the first windmills have been installed in Belgium in 2009 today, with 712 MW the installed base represents around one third of the 2020 objective for offshore wind (2292 MW). These developments would produce about 8,5 TWh, and cover about half of the RES EU obligations for 2020 for the electricity sector.

With these developments, Belgium is currently the sixth highest offshore wind country in the world in terms of installed capacity: after the UK, Germany and Denmark, The Netherlands and China overtook Belgium in 2016 as few (Nobelwind was being built) installations were done. This puts Belgium back as fourth in terms of installed capacity per inhabitant (end of 2016)[1]. It is key to reinforce this pioneering role for Belgium as it opens the door to creating additional jobs across all aspects of offshore wind development, as varied as research, foundation design, project development, marine construction, installation and maintenance, in Belgium and abroad. Leveraging these competences and skills already materializes itself concretely today in increased added value, jobs, improved trade balance. National deployments are essential to provide the industry with the edge required to be involved in the deployments outside Belgium.

Public authorities have a crucial role to play in this context. Aware of the existing trade-offs of the energy transition, they need to make the right decisions to maximize the opportunities and minimize the risks in a context of limited public budget.

Political decisions require consistent information about the impacts of economic growth and the relative benefits and costs of alternative economic development strategies. In the offshore wind context, some typical questions would be: are some of the parts of a windmill designed or manufactured in Belgium and how many additional jobs do they create? How many technicians will be required to operate and maintain the windmill parks in 2030?

This study estimates the socio(macro)-economic impact of the development of the offshore wind industry on the Belgian economy today and in the near future (2030). To do so requires identifying the industry sectors where the investment in offshore wind energy will flow. Indeed, the offshore industry value chain involves a wide variety of actors, from project development and financing, through manufacturing and construction, to operations and maintenance.

This study follows a standard input-output (I/O) multiplier approach from the Federal Planning Bureau to construct an offshore wind energy socioeconomic model. The methodology is explained in Appendix II.

Complementary analyses have been performed to estimate the impact of offshore wind deployment on the trade balance and on public finance. The impact of the offshore wind deployment on electricity market prices has also been illustrated. Finally, the impact on greenhouse gas emissions and the related impact of a carbon price in line with the requirements for the low carbon transition is estimated.

[1] See http://www.gwec.net/wp-content/uploads/2017/02/7_Annual-and-Global-Cumulative-Offshore-wind-capacity-in-2016.jpg

I. OFFSHORE WIND CONTRIBUTES TO THE BELGIAN RENEWABLE ENERGY OBJECTIVE

The figures for 2020 are based on the current plans to develop the 9 assigned offshore concessions, leading to 2292 MW in 2020. This 2020 capacity is the one used in the ELIA 2015-2025 network development plan. The combined production from these parks would produce about 8.5 TWh. In the context of the European 2020 RES targets, Belgium needs to reach 13% of RES across all sectors, which converts to ~21% in the electricity sector. Assuming a stabilization around 80 TWh of electricity consumption the share from offshore wind would represent about 50% of the RES objective.

For 2030, the 4000 MW total offshore wind energy capacity is based on the same green transition scenario in Elia's network development plan[2]. The continued cost reductions are supporting the momentum to continue to build out the offshore wind capacity further.

And while this exercise extends to 2030, offshore wind activity will continue as the operations of the parks will continue, the first parks will need to be renewed, and more parks could potentially be developed, possibly exploring collaboration with countries with larger national sea areas. So, a continuation of the economic impacts is expected after 2030.

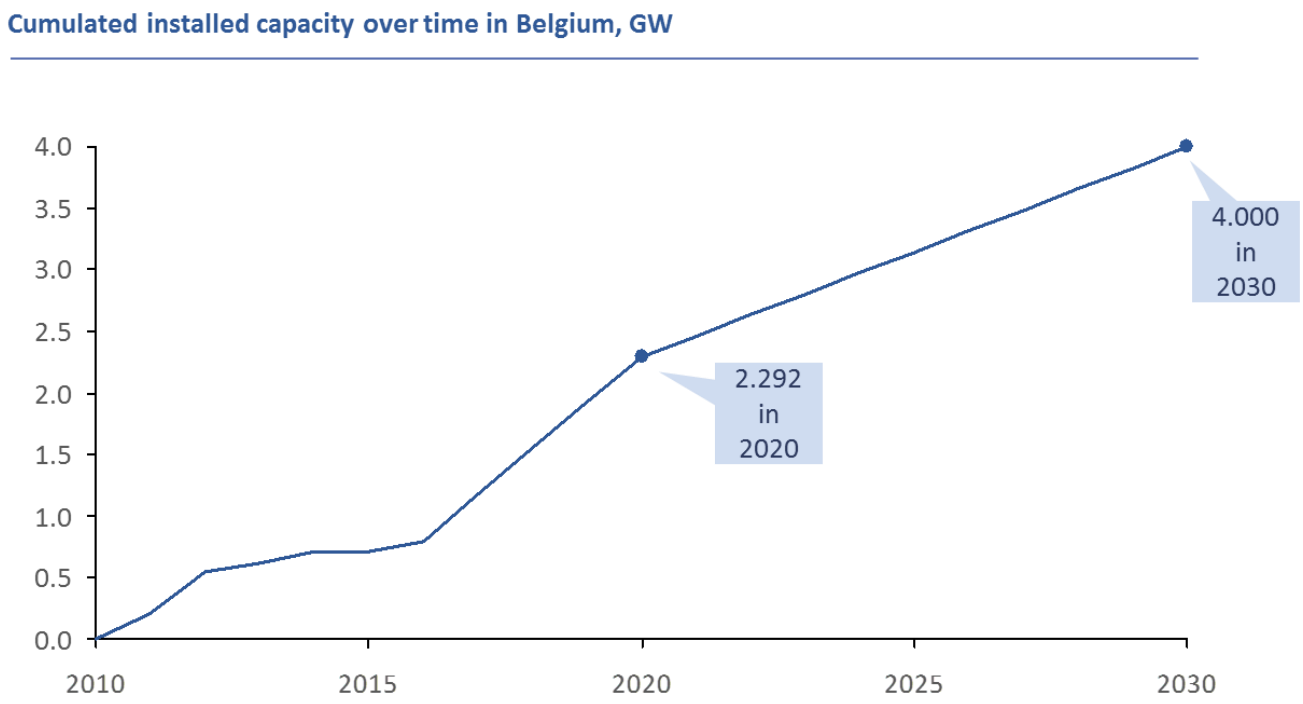

Figure 1. Evolution of offshore capacity assumed for Belgium.

[2] See Elia, Plan de Développement fédéral du réseau de transport 2015-2025, 2015
http://www.elia.be/~/media/files/Elia/Grid-data/grid-development/Plan-de-Developpement-federal-du-reseau-de-transport_2015-2025.pdf

II. THE OFFSHORE WIND INDUSTRY SUPPORTS ABOUT 15 000 JOBS

The offshore wind industry development in Belgium, together with the export activity based on it, supports about 15 000 jobs for the construction and then the operations & the maintenance of the parks. More specifically for the energy sector, which has about 50 000 direct[3] jobs today, the offshore wind industry will continue to bring a significant contribution (both directly and indirectly).

As illustrated in Figure 2, these jobs are split between the ones created through deployments in Belgium and through the Belgian exports for deployments in Europe and in the rest of the world. Europe is the largest contribution, as the Belgian industry is already actively involved in these deployments.

Job creation is mainly due to professional technical services (e.g. engineering) with close to 40% of the jobs created, but also construction, transport, and financial services (each with 10 to 15% of the jobs created).

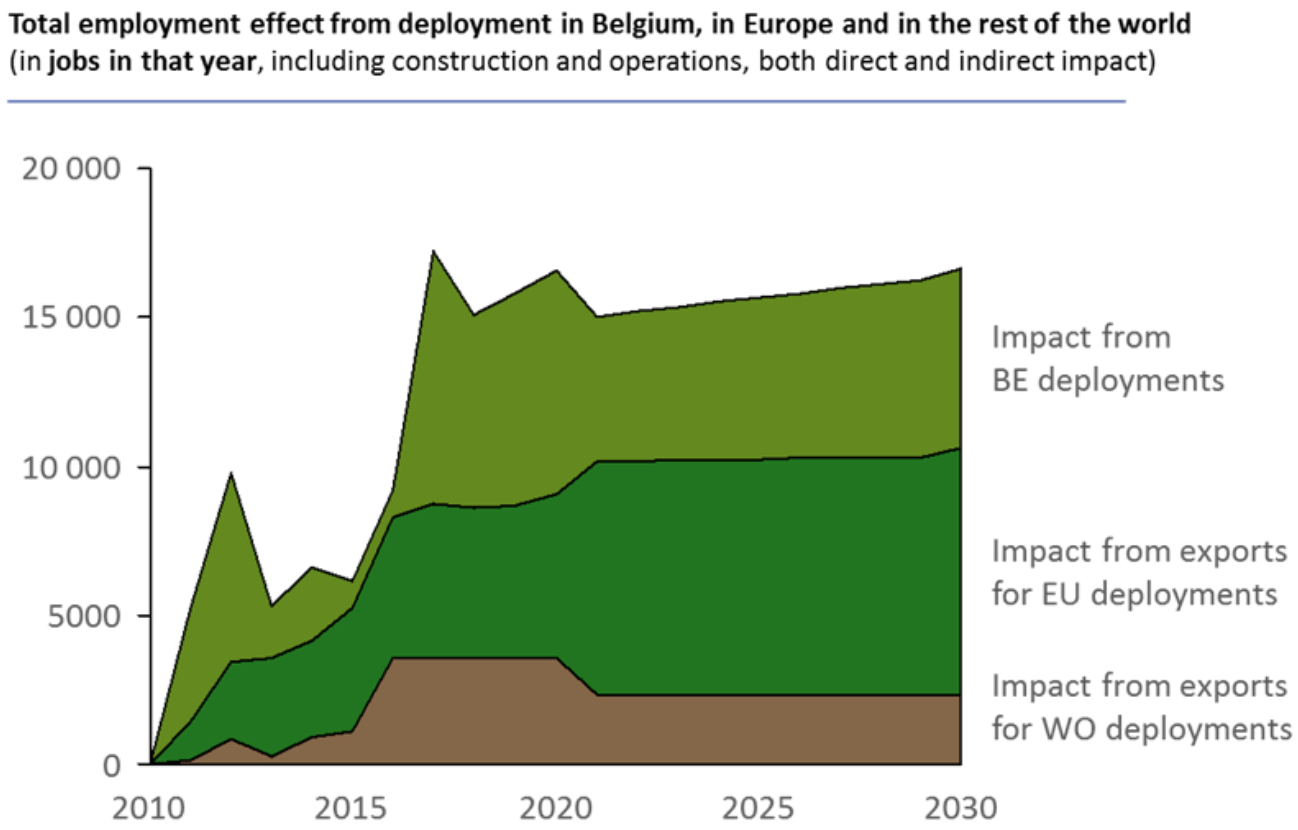

Figure 2. Impact of deployments on employment in Belgium.

[3] The concept of direct and indirect jobs refers to employment in firms that directly service final demand (in the form of exports, final consumption or investments) as well as indirect employment in their chain of suppliers.

III. OFFSHORE WIND CONTRIBUTES TO ECONOMIC ACTIVITY WITH MORE THAN 1 BILLION PER YEAR OF ADDED VALUE

The analysis indicates a potential impact in terms of added value of about 13 billion €$_{2016}$ cumulated over 2010-2030, or ~1 billion €$_{2016}$ per year. For the energy sector, which has about 10 billion €$_{2016}$ in value added per year today, the offshore industry could become a significant contribution in the future (both directly and indirectly).

These figures capture the value added of the offshore wind industry across the whole value chain through both direct (businesses directly involved in the construction of the turbines) and indirect effects (suppliers of these businesses).

The benefits from construction is stable between 2017 and 2030, with a relatively even split between direct and indirect impact. Operations and maintenance become more and more relevant over time with increased installed capacities.

Total GDP impact from 4 GW deployment in Belgium, Europe and world (in Mln €$_{2016}$ in that year)
including construction and operations, both direct and indirect impact

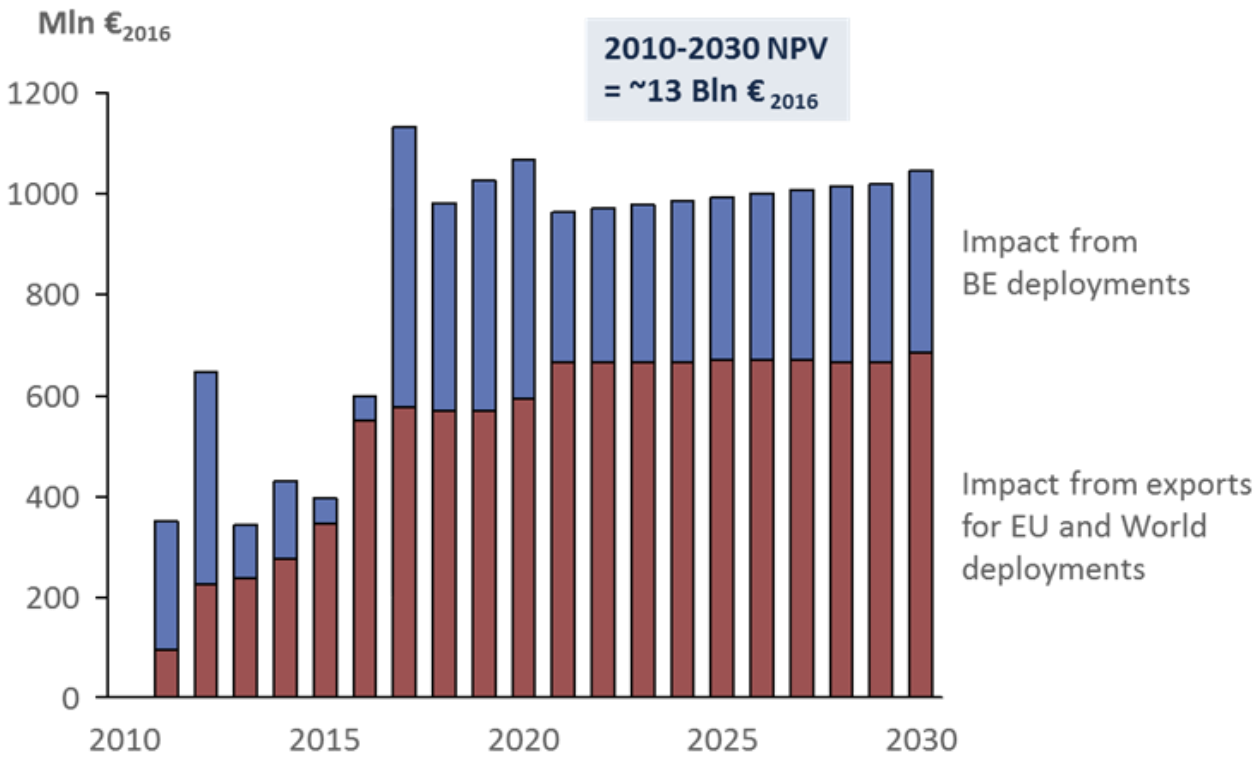

Figure 3. Impact of deployments on GDP in Belgium.

IV. OFFSHORE WIND INVESTMENTS IMPROVE THE BELGIAN TRADE BALANCE

The Belgian offshore wind industry is already actively involved in the development of the wind industry in other countries through export of knowhow, products and services. The trade balance is the sum of the reduced electricity imports due to higher domestic offshore electricity production, plus the additional exported goods and services of Belgian companies active in the industry, minus the imported goods and services required to build the Belgian offshore wind parks.

Avoided electricity imports are based on the capacity deployments mentioned above, leading to 8.5 TWh in 2020 and 14.7 TWh in 2030. This leads to avoided imports for almost 0.5 billion $€_{2016}$ per year by 2030 (based on a wholesale price of electricity of €40 per MWh). **Export sales** of the Belgian offshore industry add around 1 billion $€_{2016}$ per year up to 2030. **Imports** of the Belgian offshore industry amount to a negative ~0.5 billion $€_{2016}$ per year up to 2030.

The net present value of the trade balance effect is about 13 billion $€_{2016}$ cumulated over the 2010-2030 period, reaching 1.4 billion $€_{2016}$ in 2030. This impact is key for inducing the larger macro-economic impact as it means that money flows currently going abroad are being redirected to the Belgium economy.

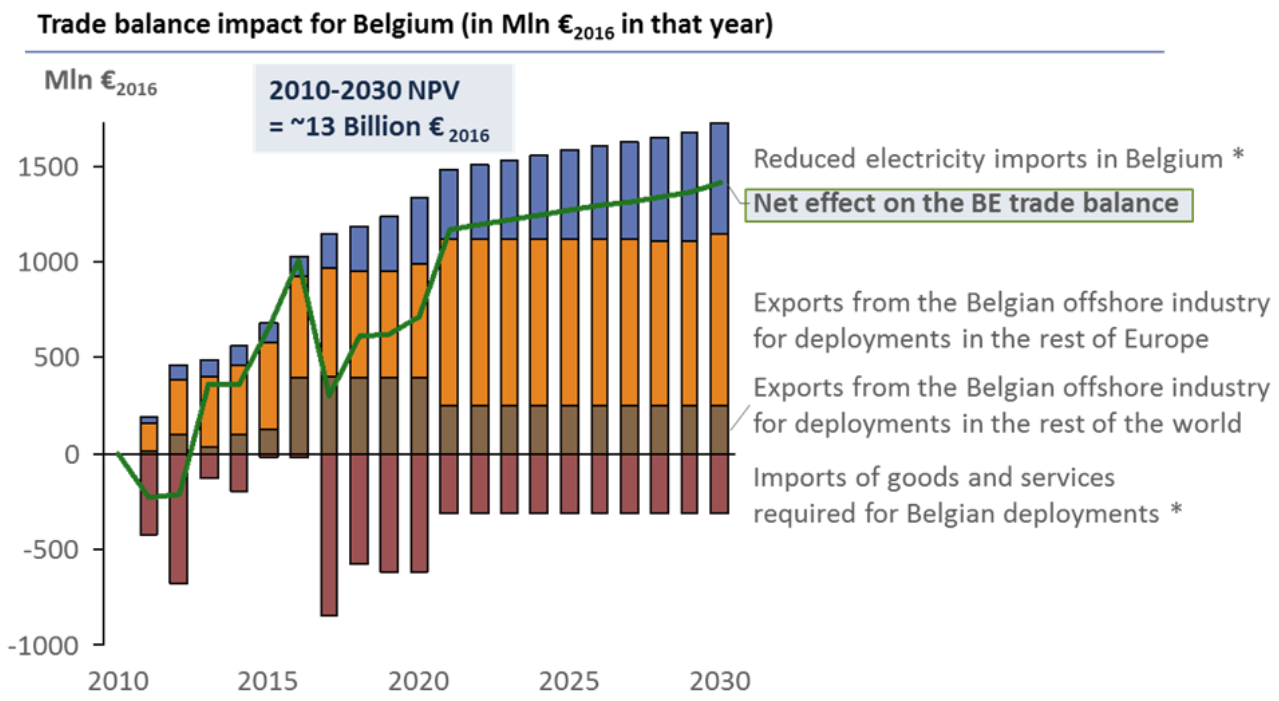

Figure 4. Trade balance impact from the activity of the offshore wind industry. (*) Installed capacity of 4 GW in 2030.

V. THE NET COST ON PUBLIC FINANCES IS POSITIVE

The impact on public finances needs to look at the full impact of the offshore wind industry. This combines 3 effects: reduced government expenditures through job creation (social security savings), additional government revenues through income taxes, and of course the required government spending to support offshore deployment. It is directly related to deployments assumed in the 3 geographies : in Belgium, the rest of Europe and the rest of the world.

Job creation enables **social security savings** reaching ~0.4 billion $€_{2016}$ per year and additional **income taxes** account for ~0.3 billion $€_{2016}$ per year. Both increase with additional deployments and job creation.

The **cost of subsidies** ramps up from ~0 in 2010 to almost 0.5 billion $€_{2016}$ in 2020. This assumes only the deployments where the subsidies have been agreed upon and only until 2020. Since the future cost of OWF is not known today, the impact beyond 2020 has not been taken into account.

Combining these 3 effects, the net impact on Belgian public finances cumulated over the 2010-2020 period is positive at ~1 billion $€_{2016}$. This underlines how much the discussion on subsidies for offshore wind is short-sighted in the public debate as it forgoes the importance of the offshore wind industry also based on exports.

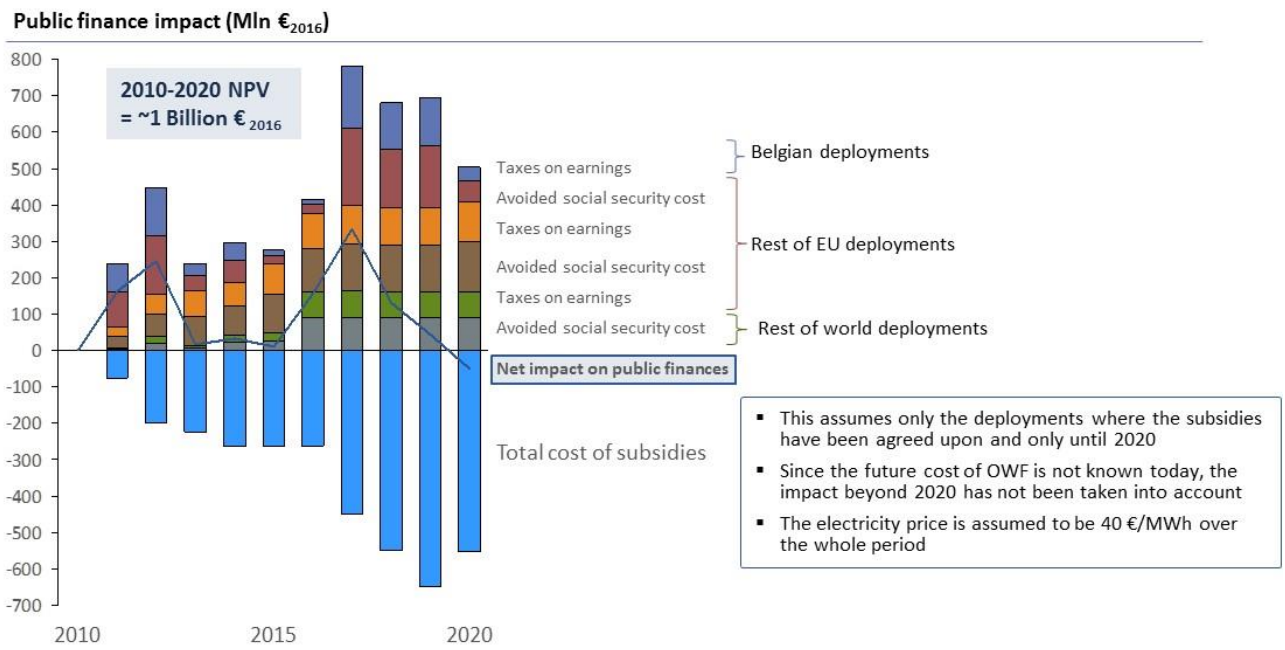

Figure 5. Various contributions and net impact on Belgian public finances.

VI. OFFSHORE WIND ENERGY HAS A DOWNWARD IMPACT ON ELECTRICITY MARKET PRICE

Electricity production technologies with low operational costs like wind power have a downward impact on the electricity market price, and this effect applies on 100% of the electricity bought on the market (while subsidies are obviously only paid for the offshore wind production which represents about 4% of 2015 Belgian electricity production).

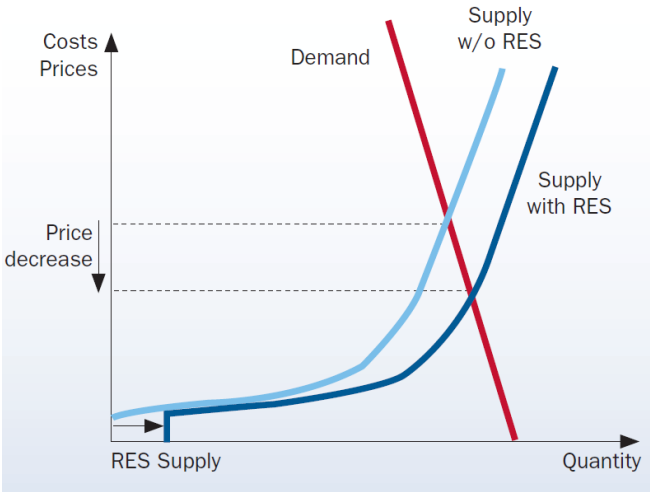

Figure 6. Illustration of the impact of wind power on the merit-order. [4]

This effect is well described in several studies that assessed this so-called Merit Order Effect. The increase in renewable energy sources has contributed to containing and even lowering electricity wholesale prices in many markets (although not necessarily retail prices) by causing a shift in the merit order curve and substituting part of the generation of conventional thermal plants, which have higher marginal production costs. Depending on their main assumptions, these studies estimate a merit-order impact between 3 and 23 €/MWh. The study which looked specifically at Belgium estimated the impact in the top of the range.[4]

This merit order impact is of a similar order of magnitude of the impact of the subsidies for offshore wind on average per MWh sold. The CREG has even recognized this merit order effect[5] in its report in 2013 by stating that the reduction of the electricity price on ENDEX from the large RES electricity contribution was much bigger than the impact of offshore wind on the electricity bill (2.2 €/MWh sold at the time). The offshore wind cost is currently 3.8 €/MWh sold [6], still at the bottom of the range identified for the Merit Order Effect.

Also, the cost of subsidies reduces over time as they are not adjusted to inflation while the rest of the economy is. A 2% inflation is assumed, which leads to a ~40% reduction in the subsidies received in the last years of the subsidy period.

[4] Pöyry, Wind Energy and Electricity Prices, 'Exploring the merit order'. A literature review for the EWEA, 2010.
[5] See http://www.creg.info/pdf/Studies/F1258NL.pdf
[6] http://www.creg.be/sites/default/files/assets/Tarifs/Elia/Elia-Tarifs2016-2019-FR.pdf

VII. OFFSHORE WIND LEADS TO OTHER POSITIVE EXTERNALITIES

The numbers above do not take into account the positive impacts of offshore wind development on other issues such as public health, air quality and lower GHG emissions helping to stabilize the climate, the so-called externalities.

Making estimates of the economic costs of climate change is extremely challenging, as the impacts cover an extremely wide range such as turmoil occurring outside Europe through trade effects, infrastructure, geopolitical and security risks, as well as migration issues. Historically, climate-related extreme events in member states of the European Union account for more than EUR 400 billion of economic losses since 1980[7].

Improvements in air quality has a more direct positive effect on public finances through lower health care cost. High level estimates from the OECD put the cost of air pollution at about 1% of global GDP[8].

In terms of GHG reductions, offshore wind deployments in Belgium would enable significant reductions. Compared to a typical gas plant, offshore wind electricity production would represent a reduction of about 6 MtCO2e[9] per year by 2030 (and double that amount compared to coal-based imports). This is 5% of 2015 Belgian emissions (118 MtCO2e) and 50% of power emissions (12 MtCO2e)[10]. Depending on the price of carbon required for the low carbon energy transition, this reduction would lead to theoretical[11] savings of up to ~200 M€ in 2030 with a carbon price of 40 €/tCO_2e.

[7] Climate change poses increasingly severe risks for ecosystems, human health and the economy in Europe, EEA, 2017
[8] See http://www.oecd.org/env/the-economic-consequences-of-outdoor-air-pollution-9789264257474-en.htm
[9] Million ton CO2 equivalent
[10] Febeg reports 12,15 MtCO2e for the power sector, and SPF Environment reports 118 MtCO2e for Belgium
[11] EU GHG obligations on power production are now set by production facility across Europe through the ETS system. This means there is no direct link between these avoided emissions from offshore wind and state or company obligations.

CONCLUSION

Belgium has been one of the pioneer countries in the offshore wind industry and should continue to capture the various benefits of this industry.

Offshore wind could become an even more significant addition to the clean electricity generation, could contribute to the further decarbonisation of the power sector and could enable Belgium to benefit from long term economic benefits such as additional GDP, jobs (creating up to 15 000 jobs) and higher exports (improving the trade balance by around 1.4 Billion € a year in 2030), while improving energy independence of Belgium and overall societal impact (externalities). Also, as other alternative electricity production options with low running costs, offshore wind can lead to a downward impact on wholesale electricity prices

All this while it could have a positive impact on public finances as exports from the Belgian offshore wind industry lead to higher taxes and less unemployment costs, which compensate the cost of subsidies.

There is a distinct advantage in further deploying the offshore industry thanks to the combination of highly skilled people, and large wind resources in the North Sea. The national deployments are essential in providing the Belgian industry with the edge required to be involved in international deployments.

APPENDIX I: MAIN ASSUMPTIONS

Factor	Value	Source
Offshore capacity	2200 MW in 2020 4000 MW in 2030	Federal Planning Bureau "EE/RES" scenario (RES 24% in 2020)
Inflation	2%	FPB/BNB
Discount rate	2%	Literature
Tax rate on earnings	30.9%	Pr. Brechet & Pr. Eyckmans
Tax rate on job income	Included in earnings tax	Pr. Brechet & Pr. Eyckmans
Avoided social security costs (for reduced unemployment)	25000 $€_{2016}$ / Job	Pr. Brechet & Pr. Eyckmans
Electricity price	40 $€_{2016}$ per MWh (assumed stable over time in real terms)	Expert discussions
Subsidies	Relevant subsidy is applied to each of the parks	Royal Decree 16-07-2002 as modified, CREG publications

APPENDIX II : METHODOLOGY

The input-output (I/O) multiplier approach has been used to develop the offshore wind energy socio-economic model[12]. This methodology is the standard approach, and it is used by the Federal Planning bureau and this work leverages the multipliers which they have developed. This methodology is illustrated in Figure 7.

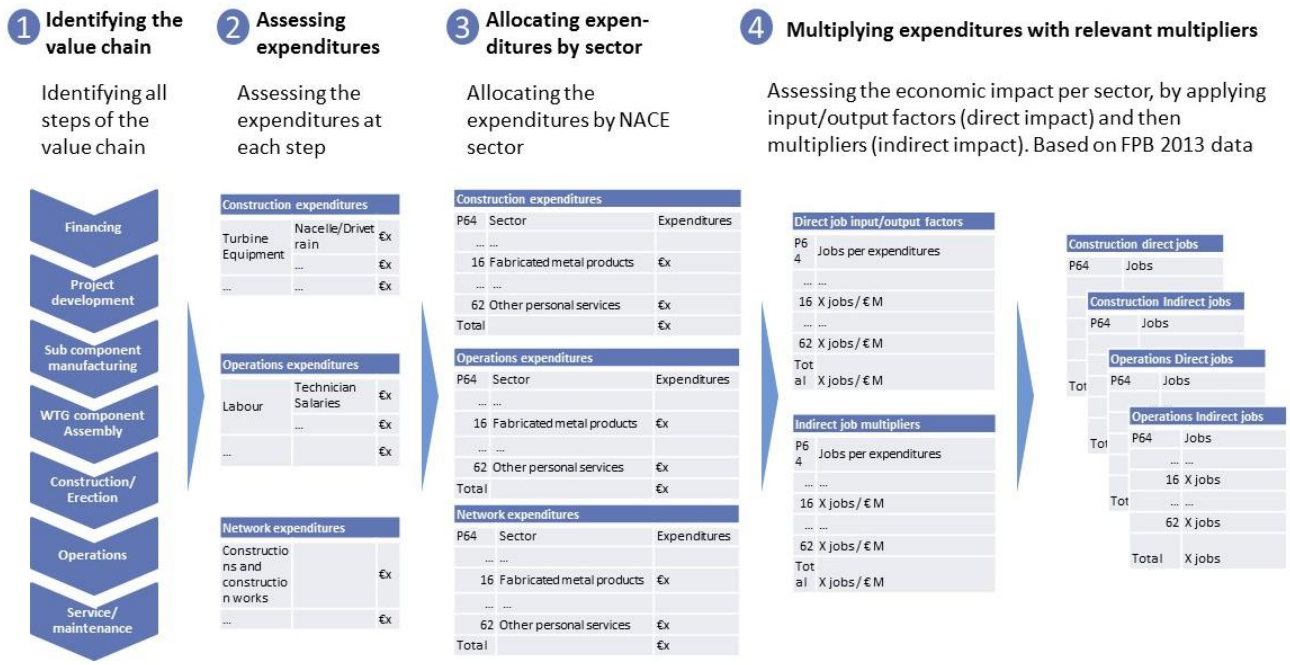

Figure 7. input-output (I/O) multipliers methodology used in the study

Through the I/O multiplier methodology, the offshore wind value chain has been linked with the underlying sectors of the Belgian economy. A model using the multipliers has been built to assess the impacts of offshore deployment on output, earnings and jobs based on expenditures in the offshore industry, on its suppliers like the parts manufacturers, the construction sector and also on their suppliers and so on.

Based on a detailed mapping of the various components of constructing and operating windmills and on the expenditure requirements across the value chain over time, multipliers have been used to estimate future GDP and employment effects: the expenditures in the construction of the windmills (CAPEX) create a final demand stimulus for the products and services required to realize that expense. These products and services originate from both Belgium and other countries. Similarly, operating and maintaining windmills implies a demand stimulus for products and services, with a higher domestic content.

Figure 8 illustrates the estimated share of the Belgian industry in the construction of offshore wind projects in Belgium.

[12] Multipliers show the ratio of a change in national income due to an initial change in the level of final demand spending: some initial increase (or decrease) in the rate of spending will bring a more than proportionate increase (or decrease) in national income. This approach allows to capture the direct and the indirect effects of a change in the offshore landscape: the amount of a product (good or service) produced by a given (sub) sector in the economy is determined by the amount of that product that is purchased by all the users of the product. This enables us to analyze the Belgian economy as an interconnected system of sectors that directly and indirectly affect one another, tracing structural changes back through sectorial interconnections.

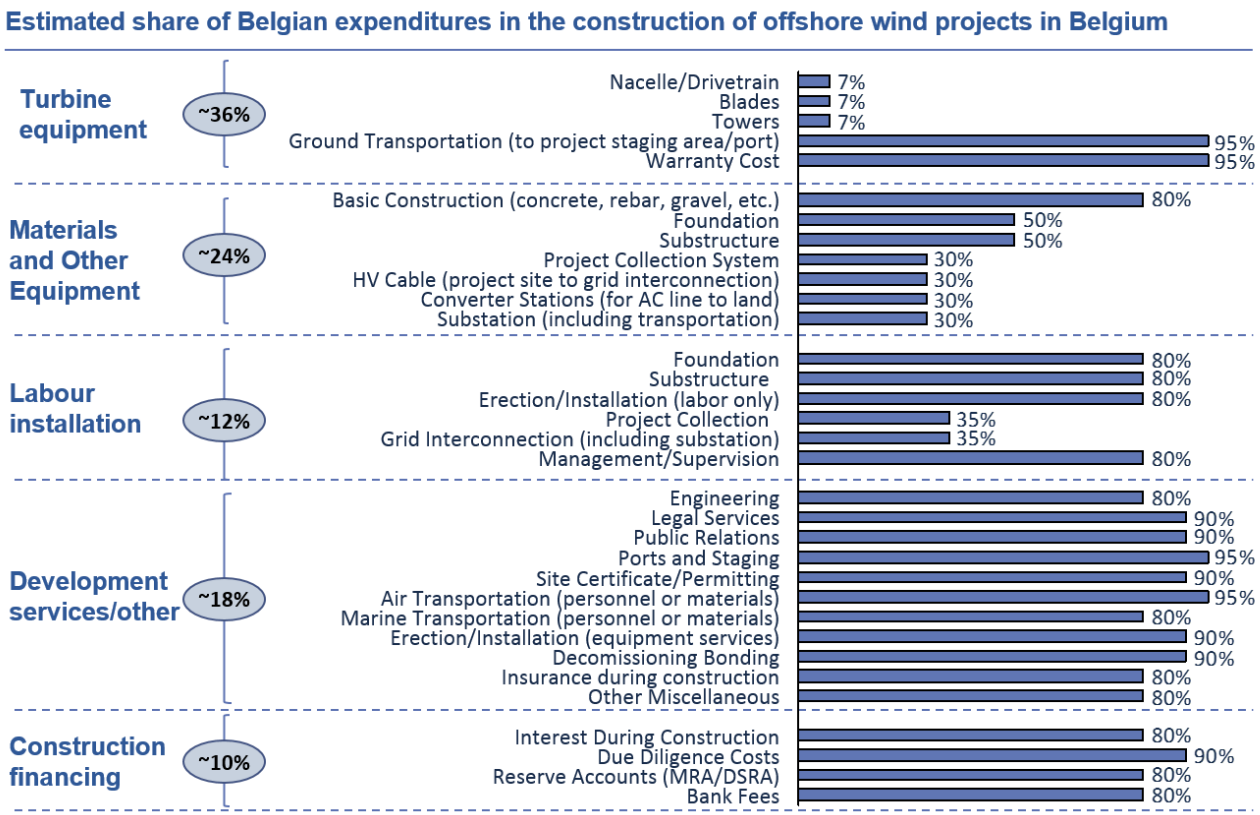

Figure 8. Estimated share of Belgian expenditures on the construction of offshore wind projects in Belgium

The same rationale applies for the operations of offshore wind projects in Belgium. For offshore wind projects in the rest of Europe, the share of the Belgian industry has also been assessed. For international deployments, the share of operations allocated to the Belgian industry is much smaller than for Belgian deployments (operations will tend to be run domestically and much less subcontracted to Belgian workers).

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