The Impact of the Energy/Climate Package on the Development of Renewable Energy Sources in Belgium: Some Insights

By Danielle Devogelaer and Dominique Gusbin*

Introduction

Renewable energy sources (RES) are becoming more and more indispensable in the current global energy landscape. According to the IEA report on Deploying renewables (2008), they are already the third largest contributor to global electricity production today, only marginally behind natural gas. Worldwide, they represented 18% of electricity generation in 2005, and have expanded further since. Focusing on the EU27, the share of renewables in Gross Final Energy Demand reached 8.5% in 2005 and is targeted to go up to 20% by 2020 as part of the *Energy/Climate Package* adopted by the European Parliament in December 2008. The electricity sector in particular experiences a substantial increase in the market penetration of renewables, reaching a share of 15% in EU27 gross electricity generation in 2005. Hydropower takes up the major slice (almost two thirds in 2005) of electricity generation based on renewables, biomass and waste account for 21%, and although spectacularly growing, the share of other renewables like wind, solar and geothermal only represents 2.4% in 2005 EU27 power production. The latter is projected to climb to 11% by 2020 in case of full realisation of the Energy/Climate Package.

Most renewable energy sources make use of technologies that ultimately derive energy from natural phenomena like wind, wave, tidal, sun, water, … Renewable electricity can be generated from wind power, wave, solar photovoltaics (PV), hydro, geothermal and biomass (energy from crops or forestry).

Advantages of most RES are that, once in operation, they have no fuel costs, they exhibit very few unexpected outages and in several cases, less maintenance is needed to keep them functioning (IEA, 2005). However, it is also worth noting that most RES today need subsidies to compete with other technologies. These subsidies should nonetheless steadily decrease over time because of the "learning by doing" process and economics of scale. RES can also play an important role in reducing carbon dioxide (CO2) emissions[1], they can help to enhance sustainability and make a significant contribution towards improving the security of energy supply by reducing Europe's growing dependence on imported fossil energy sources.

Why RES in Europe?

The European Commission has set out a strategy in its Directive 2001/77/EG that by 2010 aims to double the share of renewable energies in gross domestic energy consumption in the European Union (to 12%) and to boost the share of renewables' based electricity in total electricity consumption to 22%. In its Energy/Climate Package (December 2008), the European Parliament further stepped up this effort through adopting a twin target to combat climate change and to develop renewables[2], thereby acknowledging the renewables' benefits in tackling climate change. The definition of this twin target (GHG together with RES) gives way to several desired interactions.

First, as renewables reduce carbon dioxide emissions, climate policy will benefit from installing RES. In specifying the RES development objective, RES become an even more important component of climate policy because the RES objective leads to higher RES deployment than climate policy alone (FPB, 2008). This is so because giving an extra incentive to RES development will postpone the use of other carbon low/free technologies like nuclear or CCS. Second, climate policy also influences the level of RES deployment through the carbon value mechanism (proxy for emission permits' price). Since the RES target is a relative target, two action domains are open: developing RES and/or decreasing final energy demand. The carbon value mechanism then influences both nominator and denominator: it stimulates the use of RES by making fossil fuels more expensive (relative to their carbon content) and it lowers the energy demand through relative price increases.

On top of that, the RES objective prevents the "dash for gas" phenomenon (FPB, 2007) and gives room to a more balanced fuel mix in the power sector than climate policy alone. This is due to the fact that by specifying the RES objective, the accompanying carbon value can be lower, and so polluting fuels like coal do not completely vanish from the power sector scene, which gives rise to a more diversified energy mix (hence, an improvement in security of energy supply).

* Danielle Devogelaer is a commercial engineer, She is part of the Energy-Transport team in the Sectoral Direction of the Federal Planning Bureau. Dominique Gusbin manages the Energy-Transport team in the Sectoral Direction of the Federal Planning Bureau. The opinions expressed in this paper are those of the authors and do not necessarily reflect those of the Federal Planning Bureau.
See footnotes at end of text.

Above that, RES also give rise to the creation of new industries and new functions within the existing economy. Whole new industries can be conceived through the manufacturing and operating of RES, as well as creating completely new jobs and tasks within established sectors, e.g., finance (green investment bankers), research, administrations (monitoring), …

European RES Objectives

The E/C Package then stipulates an increase in the share of renewable energy in gross final energy demand at EU27 level up to 20% by 2020 (starting from 8.5% in 2005). In order to arrive at that 11.5 percentage points leap, a European effort sharing scheme based on equity, cost efficiency and national circumstances is adopted in which all Member States share a part of the burden. This scheme takes flexibility into account, hence admitting that the use of “flexmechs” is needed in order to efficiently arrive at the proposed national targets.

Although every Member State has to live up to its own particular renewables’ target, one thing is common: a 10% RES objective in the transport sector, meaning that each Member State has to reach a 10% renewables’ share in its gasoline and diesel transport consumption by the year 2020. Renewables used in transport can originate from first and second generation biofuels, green hydrogen and green electricity.

Three sectors for RES use are defined which cumulatively have to contribute to the national target: the electricity sector (RES-E), transport (RES-T) and heating and cooling (RES-H). Besides the 10% mandatory target in the transport sector, no specific sector objective is defined and a country, therefore, is free to allocate its objective amongst the three sectors.

Impact of the E/C Package on the Belgian Energy System

In order to obtain a good grasp of the impact the E/C Package is likely to have on the European and Belgian energy systems, several quantitative analyses were realised with the aid of the PRIMES model (EC, 2008, Capros, 2008, FPB, 2008). PRIMES is a partial equilibrium model that integrates energy supply and demand on a national or European level. Since it is a partial equilibrium model, the energy system alone is modelled and not the rest of the economy. It is principally conceived to build energy projections for the long term (up to 2030), to analyse scenarios and to study the impact of policies and measures that potentially can influence the energy system. Although numerous aspects of the energy system can be analysed with PRIMES, this article only focuses on a selection of indicators within the Belgian context. In what follows, gross inland consumption, final energy demand and power generation will pass the scene, with major focus on RES deployment.

As a starting point, a baseline is run. The baseline that is used for this analysis is similar to the one published in April 2008 by DG TREN of the European Commission (EC, 2008). In the PRIMES baseline, energy developments are simulated on the basis of assumptions concerning, e.g., economic and social development, world energy markets and implemented policies. Starting from these assumptions, developments are driven by market forces so that efficient energy solutions are chosen whenever this is economic taking into account subjective discount rates including risk premiums.

The PRIMES baseline depicts the Belgian economy under current trends and policies taking into account the policies implemented up to the end of 2006. This baseline may come up with energy forecasts that do not lead to the realisation of agreed targets (e.g., Kyoto target). In PRIMES, the indicators on CO_2 emissions or the share of RES are model results that inform the policy process about the effects of policies or their absence. This approach enables the baseline to illustrate the gap between policy ambitions and what is already underway for delivering on these policy aspirations. This approach allows the baseline to be a valid reference case for the subsequent evaluation of the effects of energy and climate policies and measures. Such measures are modelled in the policy scenarios irrespective of their state of implementation (answering “what if” questions).

The policy scenario studied in this article originates from the work the Federal Planning Bureau performed on the quantitative analysis of the impact of the combined GHG and RES targets on the Belgian energy and economic system (FPB, 2008). In PRIMES, the installation of a constraint (be it on emissions or renewables) is equivalent to the introduction of a variable that reflects the economic cost imposed by this constraint. In the case of GHG emissions, this variable is the marginal abatement cost (also called carbon value) associated with this constraint; it represents the cost to reduce the last unit of emissions that needs to be eliminated in order to reach the set emission target. The marginal abatement cost can also be seen as the emission permits’ price determined on a perfect market and of which the quantity corresponds to the constraint. The carbon value (CV) by hypothesis is unique for all sectors; it initiates changes in the relative prices of the different energy forms, reflecting by this the differences in the carbon content of fuels. These changes induce technological modifications/innovations and behavioural adaptations of producers and consumers of energy.

When a constraint is put on RES, things are a bit different. Instead of imposing directly an overall target for renewables, it is assumed that a certain positive monetary value is associated with any unit of energy produced by a renewable energy source. Such a monetary value does not involve payments but its presence alters the economic optimality of calculations of the agents. This monetary value could be interpreted as a "virtual" subsidy and enters in the model calculations as a negative unit cost (a benefit), which is called a renewables value (RV). Being a virtual subsidy, the renewables value does not make energy cheaper but just influences the optimal fuel mix as considered by each economic agent.

Evolution of the Belgian Energy System under Unchanged Policy

Starting from a projection of the Belgian energy system under unchanged policy (baseline), a selection of energy indicators is presented. The final year studied is 2020 since this is the horizon stated in the E/C Policy Package. The same indicators are afterwards scrutinized for the policy scenario.

Gross Inland Consumption

The first indicator is the Gross Inland Consumption (GIC) or Primary Energy Demand. The GIC is an indicator that describes a nation's total energy consumption and that consists of primary production (energy sources that are exploited on the nation's soil, e.g., wind and hydro) and net import (energy sources that are imported by the country, e.g., oil). The baseline GIC for Belgium follows a growth pattern: from 55 Mtoe in 2005[3] to 59 Mtoe by 2020. The share (and absolute amount) of renewables follows this increase: from 3.7% in 2005, it climbs to 6.3% by 2020.

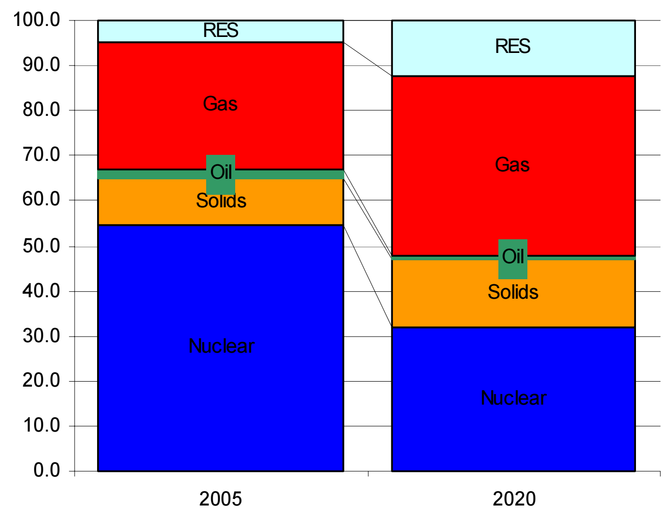
Final Energy Demand

Zooming in on the FED (Final Energy Demand, i.e., the energy consumption of industry, households, the tertiary sector (including agriculture) and transport), we see that between 2005 and 2020, the FED increases by 13.9% (or an average annual growth rate of 0.9%). All energy forms seem to grow, with the exception of oil which stabilizes. Renewable energy sources like biomass and solar thermal develop strongly (annually by 3.8% on average), but represent the smallest share in 2020 (8.2%).

Power Generation

The evolution of net electricity generation between 2005 and 2020 is depicted in Figure 1. A significant change in shares can be noticed: more gas and RES are used in 2020, the share of solid fuels increases somewhat, while both oil and nuclear energy[4] decline.

Zooming in on power generation based on renewable energy sources, Table 1 summarizes net power generation and installed capacity for the 4 RES (hydro, wind, biomass & waste[5] and solar PV). With the currently implemented or approved policies (green certificates, investment subsidies, etc.) and the evolution of fossil fuel prices, the net installed RES power capacity grows from a rather low 800 MW in 2005 to approximately 4000 MW installed in 2020; subsequent RES based electricity generation grows from 3900 GWh in 2005 to 13200 GWh in 2020. This means that the share of RES in total electricity production increases from 4.7% in 2005 to 12.4% in 2020. The power capacity grows a bit faster than the production due to the intermittent nature of (some of) the renewables. In 2020, the largest capacity will be provided by wind energy, with total wind capacity estimated to be 2228 MW.



Source: PRIMES, FPB (2008)

Figure 1
Net Electricity Generation (%), Baseline, Year 2005 and 2020

RES in Gross Final Energy Demand

The E/C Policy Package subscribes to a 20% share of renewable energy in Gross Final Energy Demand by 2020 for the EU as a whole. For Belgium, this boils down to a 13% share. In the baseline, nonetheless, without the adoption or implementation of any additional incentives or actions by the end of 2006, we see that we are still a long way from reaching this objective. Starting from an absolute amount of 778 ktoe of RES in 2005, we arrive at 3167 ktoe by the year 2020. Expressed in percentage of Gross

Final Energy Demand, this amounts to 7.5% in 2020.

The expansion in the share of biofuels (RES-T) is remarkable: it rises from non-existent (0% in 2005) to 6.9% in 2020. However, this sharp rise does not suffice to meet either the 2010 target (5.75%) or the 2020 target (10%).

	Net power capacity (MW)		Net electricity generation (GWh)	
	2005	2020	2005	2020
Hydro	102	108	280	362
Wind	167	2228	227	5334
Biomass and waste	551	1547	3375	7403
Solar PV	2	93	1	71
Total	822	3976	3883	13169

Source: PRIMES, FPB (2008)

Table 1
RES Power Capacity (MW) and Electricity Generation (GWh), Baseline, Year 2005 and 2020

The E/C Package for Belgium in 2020

A next step then is to look at the same indicators in a policy driven scenario in which the E/C Package for Belgium is mimicked as close as possible[6], this means including resort to flexibility mechanisms for the GHG reductions (JI/CDM) as well as for RES (trading) (FPB, 2008). Figures are reported compared to the baseline in the year 2020.

Gross Inland Consumption

In 2020 under the influence of the twin target, the energy system undergoes a dual effect: energy savings on the one hand (total GIC declines by 5.3% or 3162 Mtoe) and a significant jump in RES deployment on the other (increase with 44.7% or 1655 Mtoe). The RES share now boils down to 9.6% (compared to 6.3% in the baseline).

Final Energy Demand

In the FED, we also notice this double effect: the total FED in 2020 decreases by 5.7%, the RES deployment augments further.

Power Generation

The power generation also bears the influence of the Package. As seen earlier, a first reaction of the system is to lower its energy demand, including its electricity consumption (basically because of the rise in energy prices). Next, the power mix changes due to substitutions: the shares of solids and gas decrease considerably (respectively, from 15 to 10% and from 37 to 34%), whilst the renewables' based electricity is able to expand its part to 19.2% (up from 12.4% in the baseline). Net installed RES power capacity then jumps to 6101 MW (+46% compared to baseline), net RES electricity production reaches 19503 GWh in 2020 (+48% compared to baseline).

Res in Gross Final Energy Demand

Belgium should reach a 13% share in Gross FED by 2020. In the baseline, we saw that a 7.5% share or 3167 ktoe is obtained with current trends and policies. The policy scenario with the aid of the renewable value then is able to step up this effort and reaches 12.3% of RES in a cost efficient way. This boils down to an absolute amount of renewables in Gross FED of 4904 ktoe. The deficit of 0.7 percentage points can be remedied through the use of flexibility mechanisms.

The share of biofuels in transport reaches 9.5%[7]. In other words, this means that the incentive systems in place to reach the GHG and the RES target would normally suffice to reach the set goal of 10% renewable energy in transport.

Conclusion

In a nutshell, this article describes some reasons why a specific RES target was added to the adopted European E/C Package (instead of a single GHG emission reduction objective). The benefits of this twin target are outlined.

Next, a Belgian baseline up to the year 2020 is presented in which current policy, ongoing trends and structural changes endure, without any specific efforts or additional policies to constrain damaging greenhouse gases or develop renewables other than those already implemented by the end of 2006. Zooming in on renewables, we see that by 2020 the share of RES mounts in GIC as well as in FED, but that it stays rather modest (6 to 8%). Power generation will count on RES for 12.4% in 2020, basically through wind and biomass.

In a second step, the impact of the E/C Package as adopted by the European Parliament is investigated on the Belgian energy system, with focus on RES. First observation is that the energy system switches to energy savings: the three indicators all point to a decrease in energy consumption. Next, the deployment and share of RES increases. The proposed 13% share that was appointed to Belgium seems to be within reach. Condition is that Belgium starts to act as soon and as swift as possible on the implementation of this Package in terms of policy measures and awareness campaigns. There is no time to waste.

Footnotes

[1] As is the case for any equipment, there are indirect CO2 emissions associated to RES technologies. These emissions are taken into account in the country where RES technologies are produced or in the emissions of industry if they are being produced domestically.

[2]GHG reduction objective of 20% (possibly 30%) in 2020 with respect to 1990 at European level and RES development objective of 20% of Gross Final European Energy Demand in 2020.

[3] 2005 is the last year of observed statistics available from Eurostat.

[4] The reader is brought to memory that Belgium did decide on a nuclear phase out: the nuclear installed capacity is gradually decommissioned to have completely vanished by the year 2025, following the Belgian law of 2003 on the nuclear phase out (Belgian Monitor, February 28, 2003, pp. 9879-9880).

[5] The designation 'biomass and waste' is the generic term for a set of different sources, being biogas, solid biomass and waste of all sorts (bio and non-biological waste).

[6] Given best available knowledge at the time of publication.

[7] 9.5% stands for the biofuels' contribution being produced domestically (in Belgium). The deficit (remaining 0.5%) can be purchased through a mechanism of intra-community trade, since the mandatory target of 10% renewable energy in transport on EU ground is honoured

References

Bossier F., D. Devogelaer, D. Gusbin and F. Verschueren (2008), *Impact of the EU Energy and Climate Package on the Belgian energy system and economy,* Federal Planning Bureau, Working Paper 21-08.

Capros et al. (2008), *Model based Analysis of the 2008 EU Policy Package on Climate Change and Renewables*, Report to the European Commission, DG ENV.

Devogelaer D. and D. Gusbin (2007), *Energievooruitzichten voor België tegen 2030 in een tijdperk van klimaatverandering*, Federal Planning Bureau, Planning Paper 102.

European Commission (2007), *Limiting Global Climate Change to 2 degrees Celsius, The way ahead for 2020 and beyond*, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions.

European Commission (2008), *Annex to the Impact Assessment*, Commission Staff Working document.

European Commission, Directorate-General for Energy and Transport (2008), *European Energy and Transport, Trends to 2030 – Update 2007*, prepared by NTUA with the PRIMES model.

European Commission (2008), *Clarifications regarding the definition of final energy consumption in Article 2(c) of the RES directive*, Non-paper.

Federal Planning Bureau (2006), *La politique climatique post-2012: analyse de scénarios de réductions d'émissions aux horizons 2020 et 2050, Het klimaatbeleid na 2012: Analyse van scenario's voor emissiereductie tegen 2020 en 2050*.

Federal Planning Bureau (2006), *Long term energy and emissions' projections for Belgium with the PRIMES model*, report addressed to the Commission Energy 2030.

IEA (2005), *Variability of wind power and other renewables, Management options and strategies*.

IEA (2008), *Deploying Renewables, Principles for Effective Policies*.

Careers, Energy Education and Scholarships Online Databases

IAEE is pleased to highlight our online careers database, with special focus on graduate positions. Please visit http://www.iaee.org/en/students/student_careers.asp for a listing of employment opportunities.

Employers are invited to use this database, at no cost, to advertise their graduate, senior graduate or seasoned professional positions to the IAEE membership and visitors to the IAEE website seeking employment assistance.

The IAEE is also pleased to highlight the Energy Economics Education database available at http://www.iaee.org/en/students/eee.aspx Members from academia are kindly invited to list, at no cost, graduate, postgraduate and research programs as well as their university and research centers in this online database. For students and interested individuals looking to enhance their knowledge within the field of energy and economics, this is a valuable database to reference.

Further, IAEE has also launched a Scholarship Database, open at no cost to different grants and scholarship providers in Energy Economics and related fields. This is available at http://www.iaee.org/en/students/List-Scholarships.aspx

We look forward to your participation in these new initiatives.