ELECTRICAL ENERGY SAVINGS SCENARIOS FOR BELGIUM

A technical analysis done

for Greenpeace Belgium and Bond Beter Leefmilieu Vlaanderen

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EXECUTIVE SUMMARY

1. Belgian capacity for electricity production is ageing, an important share of it will reach the end of its lifetime in the next few years and, in particular, the large nuclear fleet is scheduled to be retired over the next 13 years, starting from 2015. A lack of clarity in future policies and delayed investment decisions have led to a potential shortage in capacity in the future, depending on how electricity demand will evolve and how new capacity can effectively be built.
2. A recent analysis by the federal electricity market regulator (the CREG[1]) highlights that limiting growth in electricity demand would make a significant difference in how much additional capacity will be required. It is therefore of paramount importance that a clear course is given in terms of reaching the large efficiency potential available in Belgium.
3. In this context, this study was commissioned by Greenpeace Belgium and Bond Beter Leefmilieu Vlaanderen to Climact to explore this large potential for electrical energy savings and its implications on the growth in electricity demand.
4. It was done based on consultations, reports and data from many organisations, most importantly, the Federal Planning Bureau (FPB), the CREG, the Fraunhofer institute, the European Commission, as well as Climact's own recent work done for the Walloon region on low carbon 2050 scenarios. Conclusions have been developed in complete independence and are Climact's responsibility only.
5. The study shows that
   - Belgian electricity demand projections for 2015 and 2020 have decreased over the past 3 years, with the latest publications 15% lower than the earlier ones. Even so, these studies still only partly take into account the limited growth in electricity demand from 2005 to 2010, and the 2% decrease in 2011 compared to 2010.[2]
     - Electricity demand in the reference scenarios from the FPB for 2015 has come down from 98 TWh (published in 2009) to 86 TWh (published in 2011), effectively decreasing the expected growth between 2010 and 2015 from 18% down to 3%[3]. However, this latest publication assumes an average annual growth of GDP per capita of 1.6% between 2010 and 2015, which may prove fairly optimistic seen the most recent GDP forecasts around 0 to 0.5% for 2012.
     - ELIA, the Belgian transmission grid operator, recently published its "2010-2020 development plan", first a DRAFT in 2010 and a FINAL version in 2011. Their electricity demand projections are based on the older FPB projections from 2009, although it updates the early years to take the crises into account. Resulting 2020 electricity demand projections in their DRAFT report range from 84 to 96 TWh, surrounding the 90 TWh from the new FPB 2011 report. **Their FINAL report revised the high end of the range downwards resulting in 2015 demand at the same level as 2006 demand (~83 TWh) in both their high and low projections, effectively supporting that there will be virtually no growth in the next few years.** The low range stays almost flat to 2030, while the high range grows from there to 92 TWh. The work from the CREG is based on the high range of the DRAFT ELIA scenario.

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[1] Belgian Commission for the Regulation of Electricity and Gas, see Bibliography item (7).

[2] Based on figures from the Belgian federation of grid operators (Synergrid).

[3] For 2020, these numbers are: 104 TWh (2009) to 90 TWh (2011), decreasing the expected growth from 24% down to 8%.

- Supporting these latest trends, modelling by Climact – leveraging extensive modelling work done by the Department Energy and Climate Change in the UK – shows that **a "no-growth in electricity demand" scenario is indeed realistic**, and would limit electricity demand up to 2030 around ~81 TWh. Compared to the recent FPB reference scenario (2011), **this scenario would avoid 4 TWh in 2015, or 5% of the electricity consumption**. All necessary levers are commercially available, but successful implementation will require all stakeholders to move in the same direction.
- Finally, the study shows that by exploiting the maximum technical potential available for electrical energy efficiency, **electricity demand could even be reduced compared to 2010, with level of electricity demand of -1 to -4% in 2015 and -2 to -12% by 2030 vs. 2010**, depending on the electrification substitution trends in the residential sector. This implies very high ambitions, but would bring significant benefits for the Belgium economy and reduce the need in capacity requirements further. **By focusing first on energy savings and later on electrification, it is possible to save up to 6 TWh by 2015, or ~7% below the reference scenario**.
- Industry represents 50% of current demand and is therefore pivotal in limiting growth in electricity demand. While much is already being done in the various industry sectors to reduce energy demand, significant potential remains to further increase the efficient use of energy.
- The Residential sector represents another third of demand, and has still a very large potential for energy efficiency. On the other hand, electrification will likely drive further growth in electricity demand, particularly after 2020.
- The Tertiary sector represents most of the remaining demand (~17%). It was modelled in less detail than the other sectors, but work by the Fraunhofer institute has shown significant energy efficiency potential for Belgium, making it also feasible to stabilize electricity demand.
- The Transport sector is not analysed in detail as it represents a very limited share of electricity demand today (~2%), with limited growth projected up to 2020.

6. Impacts on investments and fuel costs have not been quantified in this analysis. Climact has quantified the economics in a study for the Walloon region on 2050[4] which revealed that energy savings measures have a net positive financial impact compared to a reference scenario.
7. This study is only a first step. It is based on limited data and calls for deeper analysis in each of the sectors. Also, the impact on peak demand needs to be modelled in more detail to ensure that the reductions in demand can effectively be translated in lower capacity requirements.
8. **However, one can certainly argue based on this work that an increase in electricity demand in Belgium is not unavoidable: many options exist in all sectors to limit electricity demand without limiting the growth for the industry or implying a lack of comfort in our homes. We therefore encourage further work based on a diversified set of models with the highest possible level of transparency.**
9. This report is structured as such: Chapter (A) describes the context of the work and the approach; Chapter (B) looks at existing studies, and details the electricity demand in the latest projections by the FPB; finally Chapter (C) describes alternative no-growth or maximum efficiency scenarios based on our own modelling.

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[4] « Vers une Wallonie Bas Carbone en 2050 », study commissioned by the Walloon Agency for Air and Climate (en cours de finalisation).

(A) CONTEXT AND APPROACH

A.I. Context of the study

a. An ageing fleet and the phasing out of nuclear require alternatives

10. Belgian capacity for electricity production is ageing, an important share of it will reach the end of its lifetime in the next few years, and in particular, the large nuclear fleet is scheduled to be retired over the next 13 years[5]. A lack of clarity in future policies and delayed investment decisions have led to a potential shortage in capacity in the future, depending on the evolution of electricity demand and how new capacity can effectively be built. It is therefore of paramount importance that a clear course is given to exploit the large efficiency potential available in Belgium and build the required new capacity.
11. This phasing-out must happen while ensuring that electricity demand is always fulfilled by electricity supply. Several options can ensure this by working on each side of the equilibrium:
    - Demand side options
        - Limiting electricity demand by implementing energy savings measures – FOCUS of this study. The CREG[6] has shown that a 0% growth in electricity demand (including no growth in peak demand) significantly reduces the need for additional capacity (from 2.3 GW required in the base case to ~1.4 GW required in 2015 with 0.8 GW realizable based on current plans)┐. Additionally, energy efficiency has other benefits: it is often economically attractive, it reduces the electricity bills for the consumer, and it lowers GHG emissions.
        - Working on peaks in electricity demand: Reducing total electrical energy demand does not necessarily result in lowering peak demand and thus the need for new capacity. Generation adequacy studies are required to fully capture the complex dynamic links between consumed electricity on a yearly basis and the reduction in peak capacity requirements. However, specific solutions exist to limit the peaks :
            - Flattening demand: both organizational (e.g., shifting working hours) and technical solutions (e.g., Demand Side Management (DSM) capability) can help stabilizing the need.
            - Increasing the flexibility of demand: shifting demand and reducing the highest peaks.
    - **Supply side options (increasing/replacing power supply):** limiting electricity growth or even reducing electricity demand will not be sufficient, the nuclear phase-out along with other ageing assets which need to be replaced will require additional capacity to ensure system adequacy. Extending the lifetime of existing plants is one way of ensuring short term system adequacy. However, at medium to long term new capacity will be needed and needs to be encouraged. Seen the strong need for flexible supply in the future, flexible gas capacity seems an interesting solution in combination with renewable energy to replace base load capacity such as nuclear.

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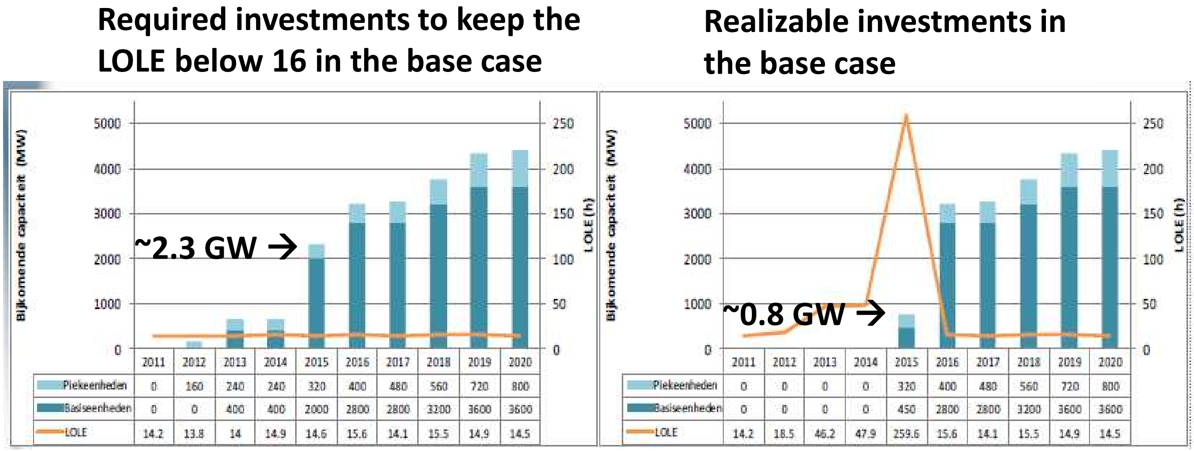
[5] The 6 GW of nuclear power plants Phase-out batches are sequenced as follows: 1.8 GW in 2015, 2.0 GW in 2022 and 2.1 in 2025

[6] Belgian Commission for the Regulation of Electricity and Gas

b. The CREG has shown the urgent need for action

12. The CREG has confirmed the need for urgent investment to ensure generation adequacy in coming years in a recent report**Fout! Bladwijzer niet gedefinieerd.**. Based on a certain set of assumptions on the growth of electricity demand, planned and realizable investments both for centralized and decentralized production, as well as potential electricity imports, their PROCREAS model analyses the need for investments in additional production capacity to reach a certain level of generation security (based on the LOLE concept[7]).

13. In their **base case**, with no extension of the lifetime of nuclear plants or traditional plants, realizable identified investments are far from the required investments. (Figure 1)



Required investments to keep the LOLE below 16 in the base case

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Piekeenheden	0	160	240	240	320	400	480	560	720	800
Basiseenheden	0	0	400	400	2000	2800	2800	3200	3600	3600
LOLE	14.2	13.8	14	14.9	14.6	15.6	14.1	15.5	14.9	14.5

Realizable investments in the base case

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Piekeenheden	0	0	0	0	320	400	480	560	720	800
Basiseenheden	0	0	0	0	450	2800	2800	3200	3600	3600
LOLE	14.2	18.5	46.2	47.9	259.6	15.6	14.1	15.5	14.9	14.5

Source: CREG

Figure 1. Required and realizable investments and resulting LOLE based on the CREG study (2010).

14. The CREG also studied **alternative scenarios** which include various options:
    - **Lifetime extensions** of the following plants till 2020 would keep the LOLE below 16 hours in all years but for 2015 where it would reach 30 hours: Ruien 5 and 6, Awirs 5 (Electrabel) and Langerlo (E.ON) = ~1390 MW (with no extension of the lifetime of nuclear plants).
    - As shown in Figure 2 sourced from CREG's general assembly of July 2011, **another alternative scenario takes as input no growth in both electricity demand and peak electricity demand** (the CREG makes no assessment on whether this is achievable). The analysis shows that with no growth in electricity demand and realizable investments of 0.8 GW in 2015, keeping all other assumptions the same as in the base case, the risk of issues on the network increases only for one in 2015 where the LOLE reaches 42 hours (instead of 16 hours in the base case). Adding another estimated ~0.6 GW (e.g., with 2 single cycle gas turbines or 1 large combined cycle one) or extending the lifetime of a few existing power plants would keep the LOLE below 16, which is the official objective of the CREG.

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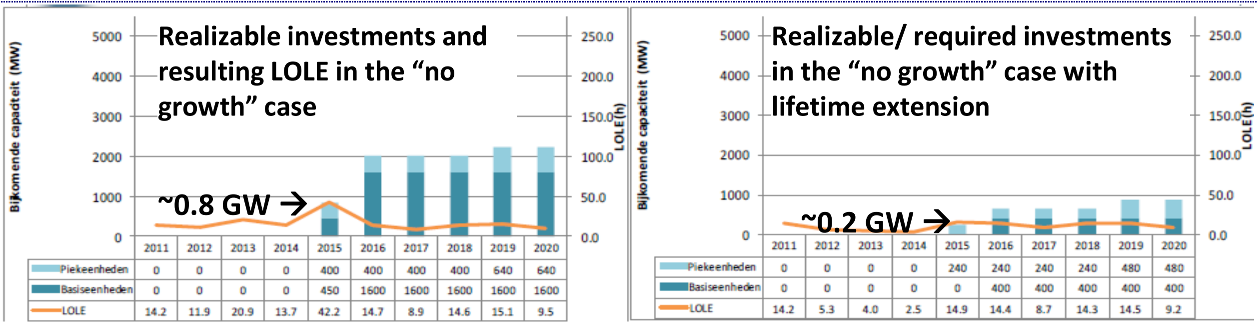
[7] The model works with a typical LOLE (Loss Of Load Expectation) of 16, which means it is accepted that available production resources will likely not cover expected demand completely for a maximum of 16 hours per year.



Source: CREG (Algemene Vergadering – Algemene Raad 20 Juli 2011), Climact

Figure 2. Realizable investments in a "no growth" scenario and resulting LOLE based on the CREG study (2010).

c. Greenpeace and BBL commissioned a study looking at the potential for electrical energy efficiency in Belgium to Climact

15. Based on this, Greenpeace and BBL decided to clarify the potential for electrical energy efficiency and whether ensuring "no growth" or even a reduction in electricity demand was feasible. The study was commissioned to, and independently done by Climact. The analysis took place between December 2011 and January 2012.

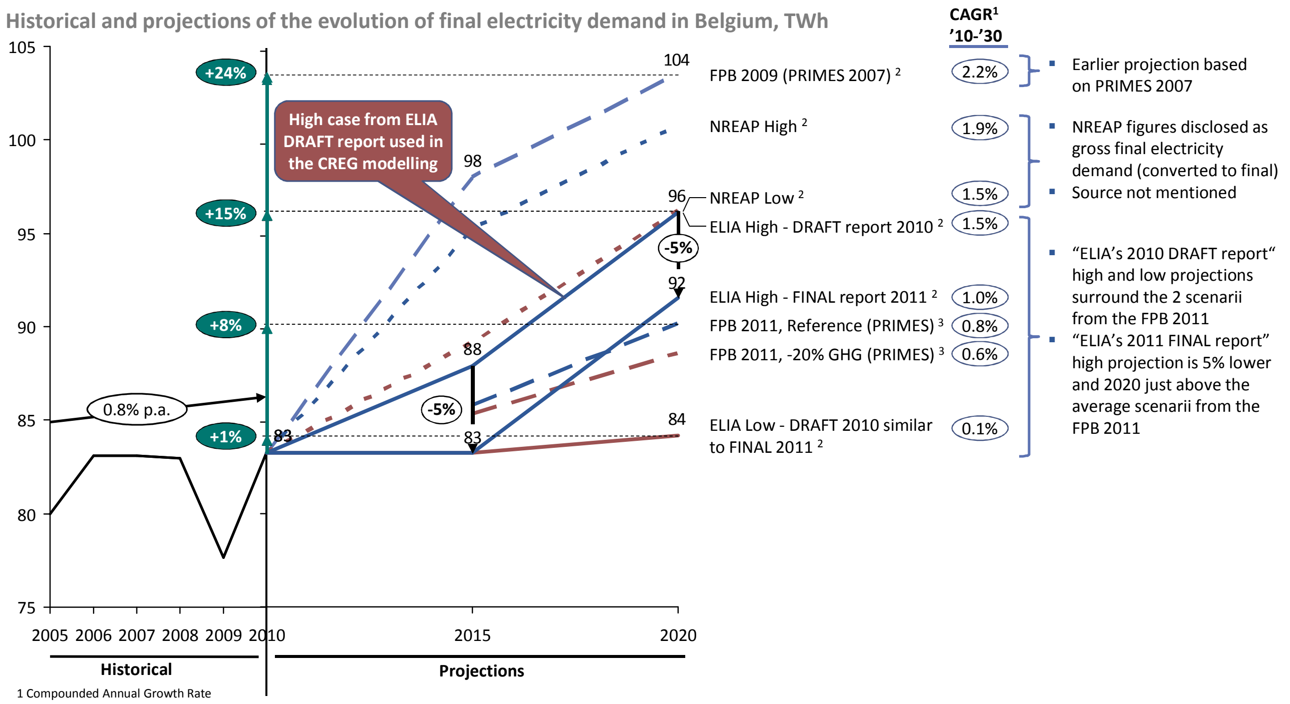
A.II. Approach

16. This report builds on 2 main approaches:
    - It first clarifies electricity demand projections from several of the key existing studies and particularly the latest work from the Federal Planning Bureau (FPB), highlighting the downwards evolution of these projections.
    - Then, 3 scenarios are built based on Climact's own modelling – leveraging the same structure as the DECC's energy demand and supply modelling tool –, first reconstructing the FPB's reference scenario, and further modelling a "no-growth scenario" and a "maximum efficiency" scenario leveraging the additional potential for electrical energy efficiency based on various sources (Fraunhofer, EU Commission, PRIMES and Climact).
17. It is therefore structured around 2 main chapters: (B) Electricity demand in existing studies; and (C) Electricity demand in alternative scenarios.

(B) ELECTRICITY DEMAND IN EXISTING STUDIES

B.I. Existing studies on Belgian electricity demand projections

18. Many reports have looked or used electricity demand projections for Belgium. Five of them have drawn much attention. Their assumptions on electricity demand are shortly described below, and their projections illustrated in Figure 3.



1 Compounded Annual Growth Rate
2 Assuming a stable 15% difference between Gross and Net final electricity demand, and 8% between called electricity and net final electricity demand
3 The FPB 2011 has no value for 2010 as PRIMES projections were still used for 2010 at the time
Source: SPF Economie, Belgium NREAP (2010), ELIA, Fraunhofer (PRIMES), FPB (PRIMES)

Figure 3. Projections developed or used in the various studies analyzed.

- The first is a report by the Federal Planning Bureau (FPB) and DG Energy of the Federal Public Service Economy on electricity production perspectives published in 2009 with much of the research done in 2007.[8] It is based on PRIMES, a partial equilibrium model focused on the energy system.[9] It projected an expected final net electricity demand of 91 TWh in 2010, with a growth of 1.7% p.a. between 2010 and 2020, reaching 104 TWh in 2020. Figures recently released for 2010 by the Federal administration show a demand of only 83 TWh in 2010, resulting in a need for 2.2% growth p.a. to reach this 2020 projection.
- Another important report in the Belgian context is the NREAP[10], which describes Belgium's action plan to reach the EU objectives in terms of renewable energy targets. The source for its assumptions on electricity demand are not disclosed in the document, but the 2 scenarios

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[8] « Etudes sur les perspectives d'approvisionnement en électricité 2008-2017 », version provisoire

[9] The PRIMES model simulates a market equilibrium solution for energy supply and demand in the European Union member states. It was built by the National Technical University of Athens (NTUA).

[10] National Renewable Energy Action Plan for Belgium

included (reference and energy efficiency) show similar growth in electricity demand between 2010 and 2020 of around 1.5% to 1.9%, reaching about 96 to 101 TWh of final net electricity demand in 2020. Although the EU 20% energy efficiency target relates to the overall primary energy consumption and not just electricity, the "energy efficiency" scenario from the NREAP seems very far from reaching this non-binding EU objective as it is only 7% below the PRIMES 2007 reference.[11]

- The 2010 development plan by the national transmission grid operator ELIA[12] presents a detailed estimate of the need for electrical transmission capacity in Belgium. It is based on various assumptions including the growth in electricity demand which is derived based on the projections developed by the FPB**Fout! Bladwijzer niet gedefinieerd.** but correcting for short and medium term evolution based on the impact from the economic crisis. A DRAFT report was published for consultation in 2010 and followed by a FINAL report in September 2011. 2 scenarios are defined, with high and low demand: electricity demand in 2020 reaches 91 to 104 TWh of "called electricity" on the net in the DRAFT report. The high case was revised downwards to about 99 TWh in 2020 in the FINAL report. This latest version of the projections translates to about 84 to 92 TWh of final net electricity demand.[13] **With 83 TWh in 2010 this means only 0.1% growth p.a. or 1% increase by 2020, almost a no-growth scenario.**
- The CREG report already mentioned in the previous section**Fout! Bladwijzer niet gedefinieerd.** is based on the high demand scenario as defined in the development plan by ELIA in their DRAFT report. Understandably, the work from the CREG is based on the high ELIA scenario to ensure that the worst-case can be handled by the transmission grid in the future. However, the work from the CREG is based on the DRAFT version of the ELIA projections. It is therefore still based on 88 TWh of final electricity demand in 2015 instead of 83 TWh (effectively no growth from 2010)[14]. This difference of 5 TWh may seem small, but it has important implications on the need for additional capacity, as shown by the impact of the no-growth scenario in section b.
- The latest report by the FPB published in November 2011 on Belgian energy perspectives by 2020-2030, is based on an update of the same PRIMES model. It is the follow-up of the study from August 2011 on the impact of the "climate and energy package". It now includes the economic crisis in its projections, but leaves aside the 2020 energy efficiency objective as it is non-binding. Electricity demand in 2020 is significantly lower than the previous FPB report, reaching 90 TWh only (and 97 TWh by 2030).

19. **With hindsight, it is clear that the economic crisis has had much impact on the historic evolution of electricity demand.** Based on numbers from the SPF Economie and Synergrid, it is clear that there has effectively been limited growth in electricity demand between 2005 and 2010 (0.8% p.a., and none between 2006 and 2010). Additionally, **the latest numbers from Synergrid for 2011 show a decrease in electricity demand by ~2% compared to 2010.** Synergrid explains it by a furthering of the crisis, but also to milder temperatures and more energy efficiency as the decrease this past year

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[11] More details can be found in the Impact assessment of the latest proposed energy efficiency directive http://ec.europa.eu/energy/efficiency/eed/eed_en.htm

[12] "Federal development plan for 2010-2020" by ELIA

[13] See annex on "varying definitions of electricity consumption" for more details

[14] For 2020 these figures are 96 down to 92 TWh

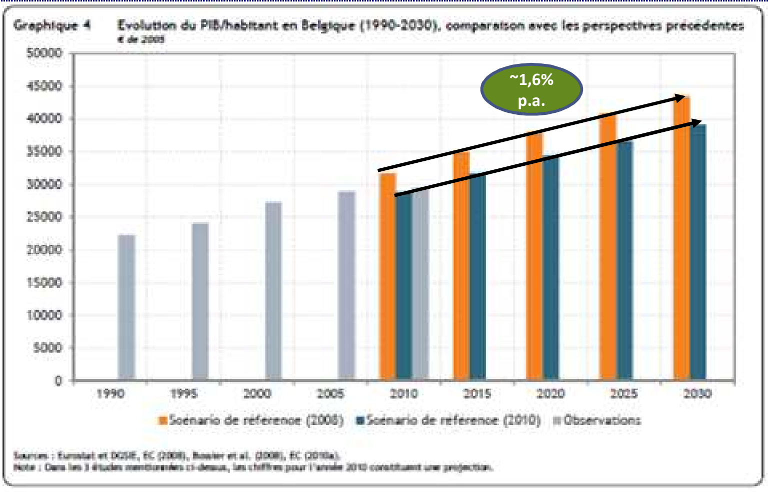
seems to be mostly related to residential customers and SMEs. Also the development of individual and corporate solar photovoltaic production has further lowered the electricity demand called from the grid. **All of this has only partly been included in the various electricity demand projections which, as seen above, have shown a decreasing trend.**

20. Finally, the latest FPB scenarios from the end of 2011 are the official new projections which are meant to replace the previous figures from 2009 which all of the previous reports are based on. **Estimated electricity demand projections for 2020 from the FPB between their 2 reports have come down from 104 to 90 TWh, a drop in the 2010 to 2020 evolution from +24% down to only +8%.** It is therefore most important to first clarify the underlying drivers of these projections further, which we do in the following section.

B.II. Deeper look at the FPB scenarios

a. Demographic and macro-economic assumptions

21. We first describe shortly the key demographic and macro-economic assumptions which form the basis of the projections included in the last FPB report (2011).
22. This report includes a 12% increase in population by 2030, with 9% less people per household. This leads to 17% more households by 2030, which is an important driver of electricity demand for the residential sector.
23. Additionally, GDP per capita is projected to grow 1.6% p.a. from 2010 to 2030, reaching ~39,000 eur/person, or ~35% higher than in 2010. As illustrated in Figure 4, the 2010 projection is reviewed and adapted downwards to take the 2008 economic downturn into account. This while the latest government budget is based on an economic growth of 0.8%, and the latest GDP growth projections for 2012 by the National Bank of Belgium, the FPB or the FMI range between no growth to 0.5%, with an increasing worry that the recession shown in the last quarter of 2011 will continue.



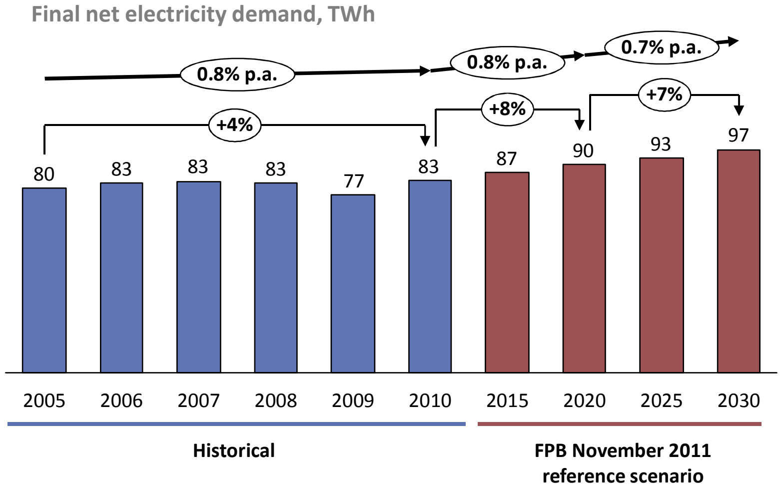
Source: BFP 2011 Energy perspectives (Based on Eurostat, Primes and BFP)

Figure 4. GDP per capita growth assumptions in the FPB 2011 PRIMES modelling.

b. Electricity demand in the reference case by the FPB

24. Final electricity demand was back to 2006 levels in 2010 at 83.3 TWh. Based on the assumption that economic growth will resume after the economic crises, the latest revised electricity demand

projections from the FPB show similar yearly growth between 2010 and 2020 as from 2005 to 2010, with an increase of 8% by 2020, effectively a 0.8% annual growth (Figure 5).



Source: SPF Economie for Historical, FPB 2011 Energy perspectives (Based on Eurostat, Primes and FPB)

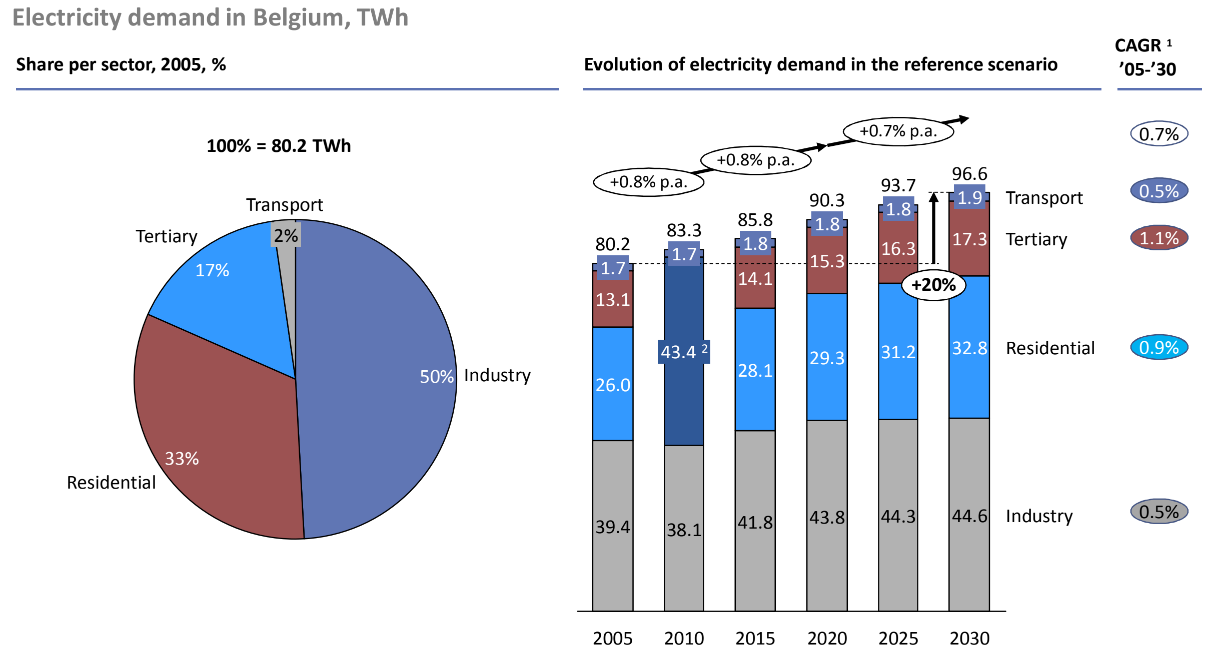
Figure 5. Evolution of net final electricity demand in Belgium, historical and FPB reference scenario.

25. In order to better understand this evolution, we first look at how this demand is split and how each of the key sectors is projected to evolve.

26. Industry is by far the largest consumer of electricity, with half of the Belgian electricity demand, and will therefore be a key driver of overall electricity demand growth. It is followed by the residential sector which represents about a third of demand, itself twice as much as the tertiary sector. Transport has a small contribution of only 2%, mostly through electrified public transportation. The FPB scenarios assume electrification trends in the transport sector will not be a driving force in the short term, even though it is likely going to take a larger share in the longer term with electrified personal transportation. (Figure 6)

27. Also shown in Figure 6, sectors show different trends in the reference scenario from the FPB:

- Industry demand is projected to grow 1.5% per annum from ’10 to ’15, then flattening to almost no growth from ’20 to ’30.
- Residential and tertiary are projected to grow relatively steadily around 1% per annum.
- As mentioned, electricity demand from Transport sector is assumed to grow little in the reference case.



1 CAGR: Compounded Annual Growth Rate is the average annual growth rate compounded over a multi-year period

2 Figures for 2010 for Residential and Tertiary are based on the recent actual data published by the SPF Economie but the split used further in the study is built on 2005 data before the rescoping, following the FBP logic

SOURCE: SPF Economie, Bureau Fédéral du Plan, Primes, Climact

Figure 6. Electricity demand by sector in 2005 and evolution in the reference case.

28. **In the Industry, 2 sub-sectors – Chemicals and Steel – represent almost 50% of the 2008 industry electricity consumption**, and therefore ~25% of Belgian consumption**.** The chemicals sector alone represents almost a third of the industry electricity consumption (Figure 6 and Figure 7).

29. Steel, Cement, Lime and Glass sectors represent lower shares of electricity than energy consumption because the proportion of electricity in their energy consumption is lower. This proportion on the other hand is much higher in the Chemicals; Food, drink and tobacco; Paper; Non-ferrous metals and Machines sectors.

30. The electricity demand of the industry is projected to grow in the FPB/Primes reference scenario from 39 TWh in 2008 to about 45 TWh in 2030. Expected trends like the probable closure of the hot phase in steel, as well as the consequences on other industries appear to have also been taken into account in the FPB reference scenario[15].

31. The reference case from the FPB based on the PRIMEs modelling already assumes the implementation of some level of energy efficiency (decreased energy requirements per unit of output). Compared to the numbers from the FPB reference scenario, trajectories with the same production growth but no improvement in electricity consumption per tonne of product would consume more electricity. Roughly we estimate that the FPB projections include reductions in electricity demand in 2030 compared to the baseline of 4 to 14% depending on the industry sectors.

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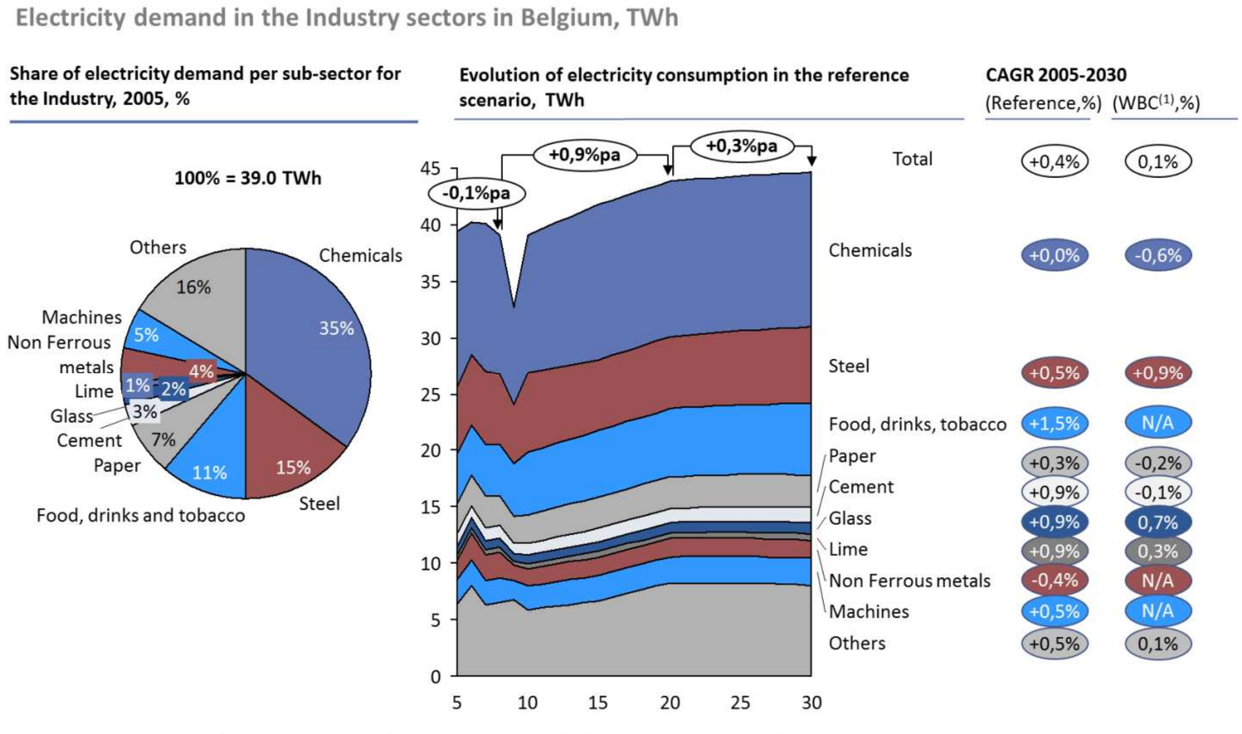
[15] The higher growth in steel of the Wallonia study is explained by a forecasted higher use of the electric arc furnaces.

32. Overall, the growth in electricity consumption is higher than forecasted by the reference scenario of the Wallonia Low Carbon Growth study[16] where significant consultation was done with industry stakeholders. This is likely the result of two trends which we shortly illustrate here for the chemicals industry. First, the expected electricity consumption growth of some industries is higher in Flanders than in Wallonia. This is partly explained by the fact that a significant portion of the chemicals industry is pharmaceuticals in Wallonia and petrochemicals in Flanders, with petrochemicals being a much higher consumer of electricity (so a unit of growth in petrochemicals would lead to larger electricity growth than in pharmaceuticals). Second, in the reference case, the additional potential for energy efficiency in some industries is more limited in Flanders than Wallonia. In the chemicals sector this is likely due to the fact that the largest energy consumers are a step further in terms of energy efficiency, and these tend to be in petrochemicals and in Flanders.



Source: SPF Economie, FBP reference scenario, (1) Wallonia Low Carbon Growth reference scenario for 2008-2030

Figure 7. Electricity demand by sector in the industry in 2005 and evolution in the FPB reference case.

c. Electricity demand in the “-20% GHG” scenario from the FPB

33. The Federal Planning Bureau (FPB) also analysed a scenario which takes into account the “-20% GHG” target set for Europe by 2020. This implies that Belgium is set to reach a reduction of -15% of GHG emissions in its non-ETS sectors. As the reference case, this scenario was run for the FPB with PRIMES.

34. This scenario shows a higher yearly growth for electricity demand than in the reference scenario (0.8% vs. 0,7% from 2005 to 2030), leading to +22% additional electricity demand by 2030 (vs.

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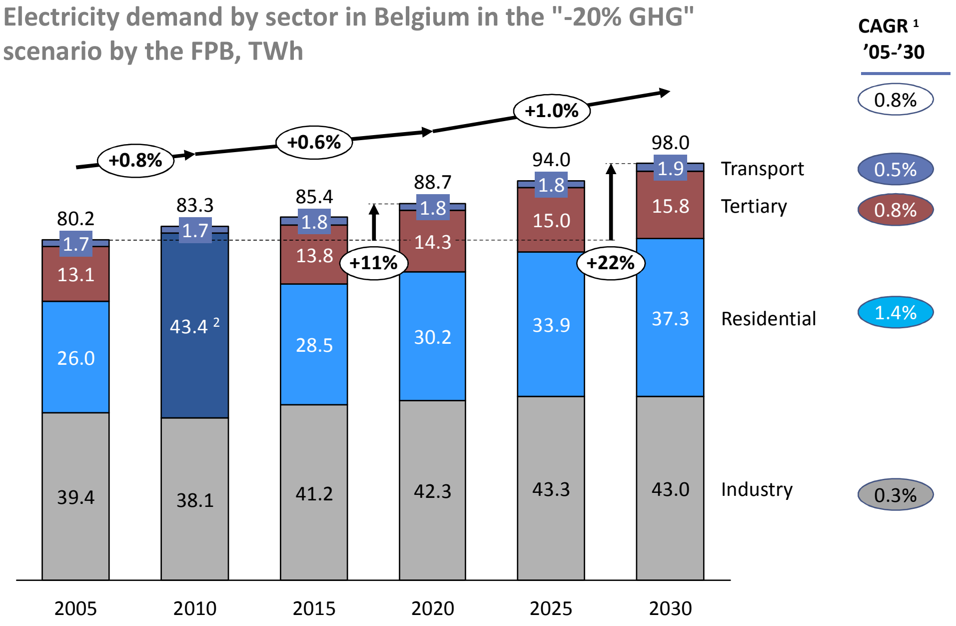
[16] Climact recently concluded a study for the Walloon region on a set of low carbon 2050 scenarios. The relevant modeling work from that study was leveraged in the present analysis.

+20% in the reference scenario). This growth is not linear and shows acceleration after 2020, also shown on Figure 8.

35. The difference between sectors is stronger. The growth in electricity demand is flattening in the industry (+9% in 25 years), while demand for households and tertiary sectors is projected to grow at ~1% p.a., which must assume large electrification of heating. (Figure 8)



Electricity demand by sector in Belgium in the "-20% GHG" scenario by the FPB, TWh

1 CAGR: Compounded Annual Growth Rate is the average annual growth rate compounded over a multi-year period
2 Figures for 2010 for Residential and Tertiary are based on the recent actual data published by the SPF Economie but the split used further in the study is built on 2005 data before the rescoping, following the FBP logic
SOURCE: SPF Economie, Bureau Fédéral du Plan, Primes, Climact

Figure 8. Evolution of electricity demand in the "-20% GHG" scenarios by the FPB.

B.III. Key messages on existing studies

36. First of all, it is important to note that most if not all key studies on the issue of electricity demand projections in Belgium are based on a single source, PRIMES, which is a model developed by the National Technical University of Athens (NTUA) at the European level. This model includes detailed information on all 27 member states, which raises potential questions on its ability to detail all key drivers per country and project them accordingly. There is indeed limited information publicly available on the detailed consumption breakdown outside of the industry, particularly in the residential and tertiary sectors which drive half of the electricity demand.

37. Average Gross Domestic Product projections from 2010 to 2015 are around 1.8% (GDP/capita 1.6% growth), which contrasts with the latest projections for 2012 by the National Bank of Belgium, the FPB or the FMI ranging between no growth to 0.5%[17]. Also, the focus of the GDP growth seems to be relatively strong on the heavy industry, contrasting with some of the discussions we have had in the course of the recent Walloon 2050 low carbon scenarios work.

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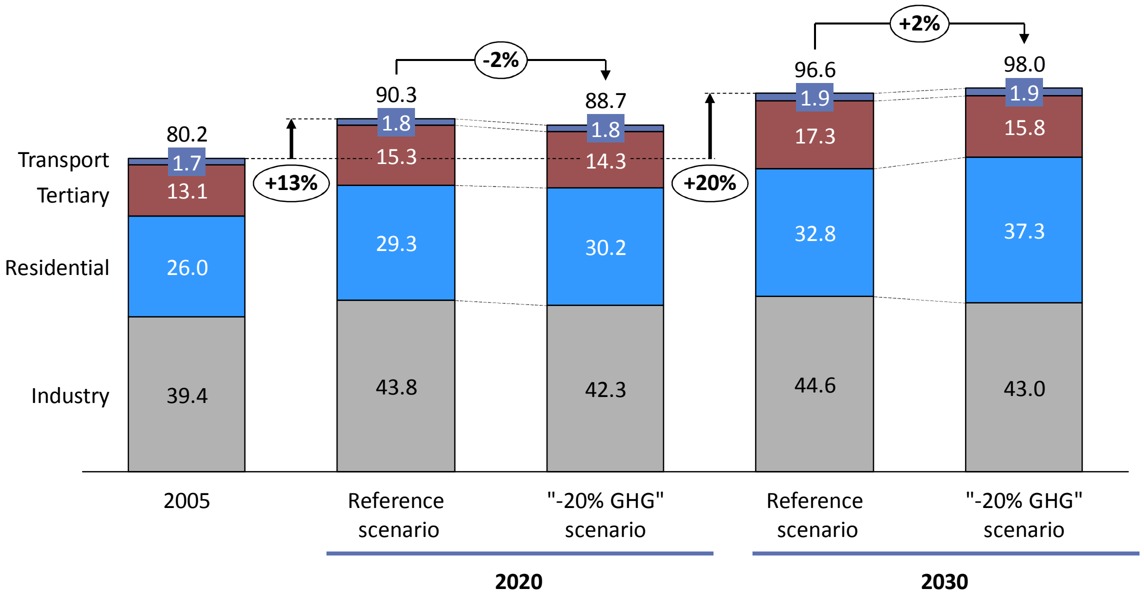
[17] The latest work from the FPB projects 0.1% growth for 2012. In this case, reaching an average GDP growth of 1.8% between 2010 and 2015 would require annual growth above 2.2% for the remaining 4 years.

38. As shown in Figure 9, by 2020 electricity demand is almost the same between the reference scenario and its “-20% GHG” scenario. The impact from improved efficiency in the industrial and tertiary sector is only slightly stronger than the growth in households (~+7% from 2010 to 2020) and the electrification trend in the residential sector.

39. By 2030 this trend is inversed, as electricity demand in the “-20% GHG” scenario from the FPB is slightly higher than in the reference case, likely due to significantly higher electrification in Buildings. The tertiary and the industry sectors become slightly more efficient, however, the residential sector is assumed to see further growth in households (~+8% households from 2020 to 2030) and to electrify significantly more, thereby increasing its electricity demand significantly.

Electricity demand in Belgium in 2 scenarii from the FBP, TWh



SOURCE: Federal Plan Bureau/Primes, Climact

Figure 9. Electricity demand in the reference case and the “-20% GHG” scenarios by the FPB.

40. To better understand the potential underlying drivers of these scenarios, the following chapter will leverage another model and detail the trends by type of use in each of the sectors. This will give us more insights in the projections assumed in the existing reports and highlight additional energy efficiency potential for electricity consumption.

(C) ELECTRICITY DEMAND IN ALTERNATIVE SCENARIOS

41. Chapter (B) described scenarios from published studies from various organisations and deep dived into the latest FPB scenarios. This chapter will now describe various alternative scenarios leveraging additional energy savings potential. These are based on an energy balance model originally developed by the Department of Energy and Climate Change (DECC) in the UK, and further improved by Climact in the Belgian context. The methodology used in this model is described in the following section.

42. The 3 scenarios analysed are the following:
    - **The "reference scenario"** from the FPB was replicated based on our modelling, and we clarify one set of assumptions reaching such a scenario. Seen different models are used, there may be differences in the exact evolution of each underlying driver, but the key high level assumptions are set alike.
    - The model was then used to test what **a "no-growth scenario"** implies in terms of electricity demand growth by sector and of implementation of the various levers which can reduce electricity demand.
    - Finally, **a "maximum electrical energy efficiency scenario"** highlights how far extensive efforts can take us. This scenario would require effective implementation at a very high ambition level from all actors involved, from consumers to industry and political decision makers. **It is not meant as a projection, only a measure of what is technically feasible, and is therefore an important reference for policy making**.

C.I. Methodology

43. The methodology is based on a « bottom-up »[18] modelling approach. The model explores in detail the energy requirements and the GHG emissions of the various sectors (industry, transport, buildings, agriculture and energy production). Energy supply and demand evolutions are modelled up to 2050 on the basis of detailed parameters for each of these sectors and their relevant sub-sectors. The same modelling structure was used for the Walloon low carbon roadmap and was built jointly with the Department Energy and Climate Change of the UK (DECC UK).

44. The model is built to analyse **the evolution of the energy balance** of a country/region and ensures the energy supply satisfies the demand. It first computes the energy demand evolution – this is the focus of our work in the context of this study. This computation is done, on the one hand, based on the evolution of the demand for services (e.g. based on the evolution of population) and on industrial production levels (e.g. the evolution of lime production until 2030 or 2050). On the other hand, the analysis takes into account the level of implementation of the demand levers which reduce energy demand in each of the sectors (e.g., the evolution of buildings insulation, or energy efficiency in industry sectors). Based on resulting demand levels it builds up the appropriate supply based on an energy mix from various sources (conventional or various types of renewables)

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[18] To be contrasted with a « top-down » approach which would compute the evolution of energy requirements based on macro-economic parameters like GDP growth or energy consumption per value added.

45. A schematic view of the principles of the energy balance is presented in Figure 10.

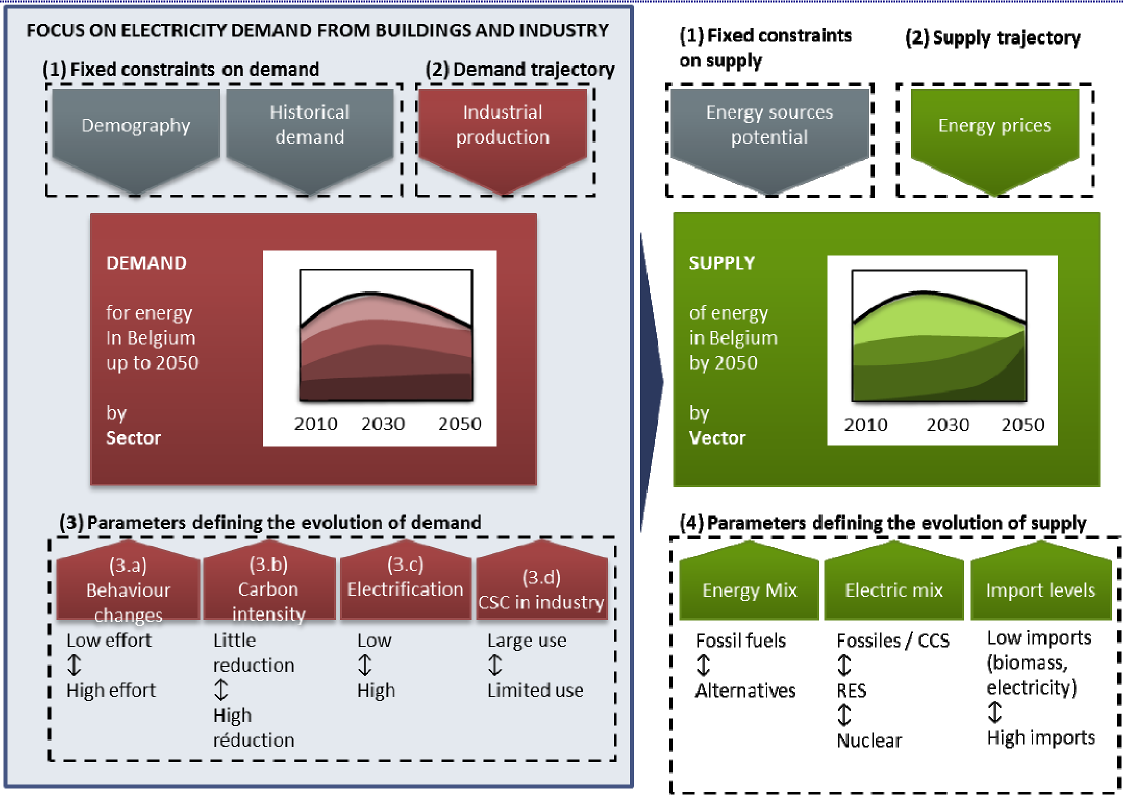

Figure 10. Energy balance model used in the study, with a focus on the demand side.

46. This logic is modelled in a tool with **4 categories of parameters**:

- (1) fixed parameters;
- (2) Parameters on which Belgium's influence is limited (e.g. evolution of steel demand and therefore of the Belgian production);
- (3) parameters related to GHG reduction in energy demand sectors on which the country has a strong influence, like:
  - behavioural and societal organization levers (e.g. reducing the need for travel per person),
  - carbon intensity reduction levers (energy efficiency, alternative processes in the industry, alternative fuels, etc.),
  - electrification of energy demand levers,
  - the use of carbon capture and storage(CCS) in the industry ;
- and finally (4) the energy supply decarbonisation parameters

47. For each variable parameter, **four ambition levels have been defined,** ranging from a weak ambition level (level 1) to a maximum ambition level (level 4). We shortly describe the logic of these 4 levels below, more concrete examples will be highlighted further below:

- **Level 1**: Limited efforts to reach significant decarbonization, only short-term efforts; no new low-carbon policies are implemented; the mix of technologies bought on the market and their rate of renewal does not change compared to today (e.g., heating technologies, housing refurbishments); non-demonstrated low-carbon technologies are neither developed nor deployed.

- **Level 2**: A level of effort described by most experts as ambitious but accessible; for some sectors this is equivalent to the speed of development of recent programs whose implementation is considered a success; implies improving the mix of new technologies and their rate of implementation.
- **Level 3:** A level of effort described as significantly ambitious. This level will only be reached if existing technologies are deployed at higher pace in the energy system (e.g., faster implementation of housing refurbishments).
- **Level 4**: Effort considered to be close to what is physically feasible; approaches the limit of technical and practical feasibility (e.g., technical limitations to the share of heat pumps in the heating mix, social and practical limitations to the rate of housing refurbishments).

The levels have been defined for each parameter by taking into account the existing literature and integrating the observations of numerous consulted experts, both national and international.

48. The flexibility of the model allows analysing a variety of scenarios with various levels of implementation for each of these levers. This allows us to test the implications of more or less extensive energy efficiency targets on electricity demand. The model does not optimize the parameters described above based, for example, on cost levels. It rather provides energy demand and supply as well as financial information as an output to enable to compare scenarios and make informed decision in terms of pathways to implement.

C.II. Reference, no-growth and maximum efficiency scenarios

a. Reference scenario

49. In order to better understand the reference scenario of the FPB, we needed to model it within our tool. We focused on the industry and the residential sectors which together represent more than 80% of current electricity demand. We built our reference scenario from the evolution of each high level sector and of the industry sub-sectors in the FPB scenario (see Figure 6 in section b). The industry sector was already described by sub-sector in section b, therefore we focus here on detailing the reference scenario by type of use for the residential sector. The Tertiary sector is covered only “top-down” in the following sections, and the Transport sector is not analysed in detail as it represents a very limited share of electricity demand today (~2%, mostly from rail transport), with limited growth projected in the short to medium term.

50. Additionally to the FPB data, our modelling is based on discussions with experts as well as efficiency potential from a variety of sources, including the DECC work[19], Fraunhofer data (including its work on energy efficiency for Europe[20]) and the European Commission[21].

51. **Residential electricity demand** is made of electric heating (space and water), cooking and electric appliances/lighting. Belgian energy experts agree in saying that there is much uncertainty in the split between these types of uses. Part of this confusion comes from the Belgian data collection itself where the scope between the residential and tertiary sectors has shifted since 2005. Figure 11

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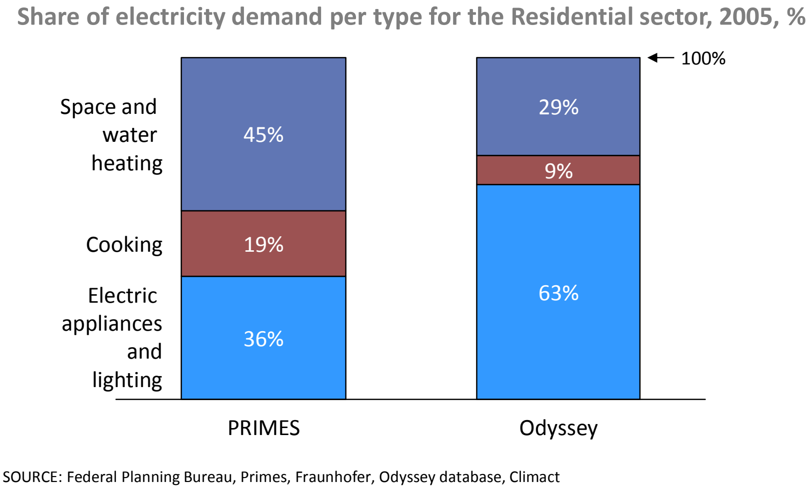
[19] See http://www.decc.gov.uk/en/content/cms/tackling/2050/2050.aspx

[20] See http://www.eepotential.eu/

[21] See http://ec.europa.eu/energy/observatory/trends_2030/

shows data from both PRIMES and Odyssey[22], and highlights how different the split can be. For the sake of consistency we have used the PRIMES shares along with the PRIMES data, but there is a clear need for further investigation.



SOURCE: Federal Planning Bureau, Primes, Fraunhofer, Odyssey database, Climact

Figure 11.Types of electricity uses in the residential sector.

52. Figure 12 shows one potential configuration of how the 18% growth (between 2010 and 2030) in electricity demand in the Residential sector in the reference case can be reproduced, reaching a very similar yearly increase in electricity demand as in the FPB reference scenario. There are clearly alternative ways, but the growth in the number of households of 17% from the FPB has strong implications on the rest of the drivers and limits the available options. There is a strong increase in electric demand for heating (particularly with an increasing share of heat pumps) as well as for electric appliances, which are strongly related to this increase in the number of households along with limited improvements in efficiency. Lighting on the other hand is already assumed based on most sources to sharply decrease in the next 10 years with stricter regulation in place. The following 2 sections will show alternative scenarios with higher energy efficiency solutions implemented in each of these types of use (space heating, lighting, etc.).

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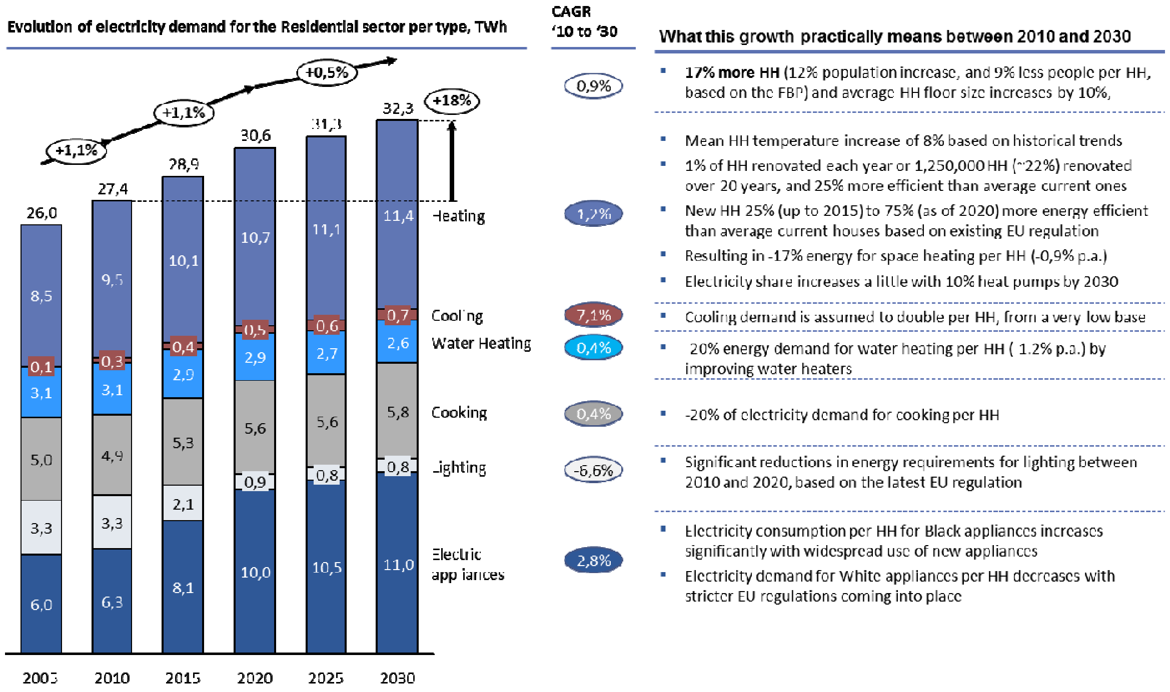
[22] ODYSSEE MURE is a project supported under the Intelligent Energy Europe Programme of the European Commission. It aims at monitoring energy efficiency trends and policy measures in Europe.



What this growth practically means between 2010 and 2030

- **17% more HH** (12% population increase, and 9% less people per HH, based on the FBP) and average HH floor size increases by 10%,
- Mean HH temperature increase of 8% based on historical trends
- 1% of HH renovated each year or 1,250,000 HH (~22%) renovated over 20 years, and 25% more efficient than average current ones
- New HH 25% (up to 2015) to 75% (as of 2020) more energy efficient than average current houses based on existing EU regulation
- Resulting in -17% energy for space heating per HH (-0,9% p.a.)
- Electricity share increases a little with 10% heat pumps by 2030
- Cooling demand is assumed to double per HH, from a very low base
- 20% energy demand for water heating per HH (1.2% p.a.) by improving water heaters
- -20% of electricity demand for cooking per HH
- Significant reductions in energy requirements for lighting between 2010 and 2020, based on the latest EU regulation
- Electricity consumption per HH for Black appliances increases significantly with widespread use of new appliances
- Electricity demand for White appliances per HH decreases with stricter EU regulations coming into place

SOURCE: Federal Plan Bureau, Primes, Fraunhofer, EU Commission, Climact

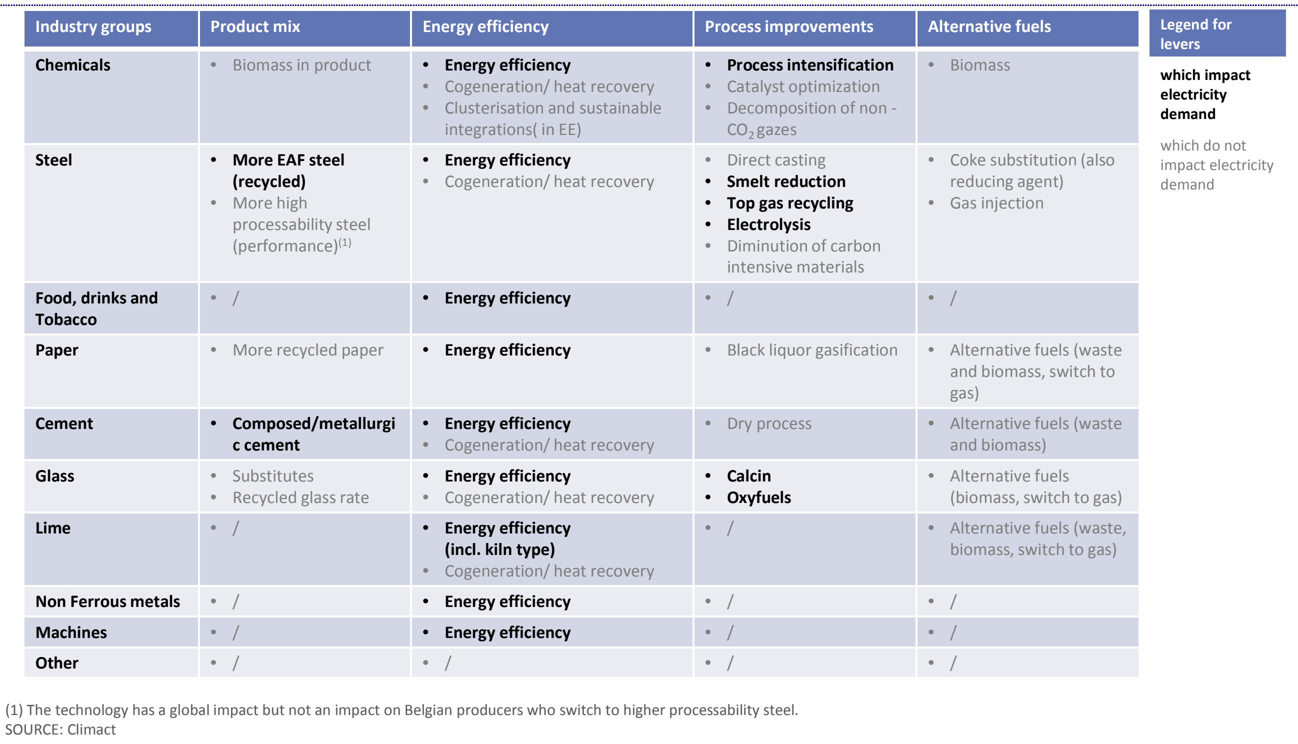
Figure 12. Evolution of electricity demand by type in the residential sector in the reference case.

b. “No-growth in electricity demand” scenario

53. The reference scenario includes some level of energy efficiency. Further options exist to limit the growth in electricity demand, and need to be encouraged. This section describes the implementation required to stabilize electricity growth over the next 20 years. As described above, it is based on Climact’s work on Walloon low carbon scenarios in collaboration with the DECC. Our work for the industry was refined in consultation with industry experts to take into account some of the key differences between the Walloon and the Flemish industry structure. For example, savings potential for the chemical sector was revised downwards for Belgium seen the very different type of production and actors in Wallonia and Flanders.

b.1. Industry

54. We have explored levers available for the Industry, assessing the potential implementation in most of the key sectors of the Belgian industry based on our work for the Walloon industry and further consultations with Fraunhofer institute, the FPB and industry experts. Of the 35 levers addressed to reduce industry emissions in the Wallonia low carbon growth study, ~15 directly reduce the electricity consumption. They are mostly related to energy efficiency measures and process improvements (Figure 13). The implementation of a level 3 ambition for these levers enables to reach a “no growth” scenario.



Industry groups	Product mix	Energy efficiency	Process improvements	Alternative fuels
Chemicals	- Biomass in product	- **Energy efficiency** - Cogeneration/ heat recovery - Clusterisation and sustainable integrations(in EE)	- **Process intensification** - Catalyst optimization - Decomposition of non - CO_2 gazes	- Biomass
Steel	- **More EAF steel (recycled)** - More high processability steel (performance)(1)	- **Energy efficiency** - Cogeneration/ heat recovery	- Direct casting - **Smelt reduction** - **Top gas recycling** - **Electrolysis** - Diminution of carbon intensive materials	- Coke substitution (also reducing agent) - Gas injection
Food, drinks and Tobacco	- /	- **Energy efficiency**	- /	- /
Paper	- More recycled paper	- **Energy efficiency**	- Black liquor gasification	- Alternative fuels (waste and biomass, switch to gas)
Cement	- **Composed/metallurgic cement**	- **Energy efficiency** - Cogeneration/ heat recovery	- Dry process	- Alternative fuels (waste and biomass)
Glass	- Substitutes - Recycled glass rate	- **Energy efficiency** - Cogeneration/ heat recovery	- **Calcin** - **Oxyfuels**	- Alternative fuels (biomass, switch to gas)
Lime	- /	- **Energy efficiency (incl. kiln type)** - Cogeneration/ heat recovery	- /	- Alternative fuels (waste, biomass, switch to gas)
Non Ferrous metals	- /	- **Energy efficiency**	- /	- /
Machines	- /	- **Energy efficiency**	- /	- /
Other	- /	- /	- /	- /

Legend for levers

which impact electricity demand

which do not impact electricity demand

(1) The technology has a global impact but not an impact on Belgian producers who switch to higher processability steel.

SOURCE: Climact

Figure 13. Levers assessed in the industry sectors.

55. Four highly common energy efficiency measures are described below:

- (1) **Motor systems** can be improved**. Installing variable frequency drives** enables to adjust the speed of electric motors to match demand. In some cases, the breaking energy can also be stored back. Additionally, **smarter regulation** (to control the drive frequency) enables to identify when to adjust the frequency. These improvements often lead to large potentials.
- (2) **Compressed air systems** can be improved. The cheapest way to assess if there are leaks is to listen when the plant is shut down (e.g. for maintenance). Several other optimizations exist (e.g. sophisticated leak detection systems, network reconfigurations, pumps improvements, pressure adaptation). This area is often considered a quick win and can require very limited investment.
- (3) **Increasing insulation** prevents heat losses and therefore consumption. This type of energy efficiency typically has limited impact on the electricity consumption.
- (4) **Motors can often be downsized and upgraded**. This solution often leads to limited potential and is often delayed until a new motor needs to be purchased anyway.

56. While further work is required to refine the potential for each sub-sector in more detail, there is no doubt that a large potential and many options are available for further energy efficiency in the key sectors. This potential is recognized in various reports as well as by industry experts. We highlight some specific examples below. While many of these measures will reap benefit over time from reduced energy consumption, the economic attractiveness will vary depending on the required level of implementation of the measures. More detail on the cost dimension can be found for Wallonia in the Walloon low carbon scenarios study.

Companies have already shown that electrical energy efficiency is feasible and economically sound

- The retail sector has identified a large electricity reduction potential and has started to adapt its stores to limit electricity use. Companies such as Delhaize and Carrefour started relighting their stores and adding doors on their refrigerated units. These measures show potential energy use reductions of up to 60%, which corresponds to over 100 GWh for large groups such as these.

  Measures such as efficient or more appropriate lighting, closed cooling units and heat recovery from the refrigerated areas to heat the stores have also been implemented by Colruyt, some of them leading to 50% electricity demand reductions.
- The electricity consumption of the UK air compressors of a large industrial group such as Ideal Standard was reduced by 6.5% by simply identifying and reducing leaks.
- SWIFT is planning to reduce the energy consumption of its data centers by over 50% by 2013. It will also virtualize its servers, saving almost 7 GWh of electricity every year.
- KONE improved the energy efficiency of its elevators by 50% between 2006 and 2011, allowing savings of approximately 1,800 MWh/year for the newly installed equipment in Belgium.
- Infrabel installed electronic drives on its bridge cranes in Schaerbeek which saves 40 kWh per minute of lifting or lowering charges. More generally, 70% of the electricity consumption in the Walloon industry is used to power pumping, ventilation/compression or dragging systems. Electronic drives can be used on these systems and allows energy savings between 20 and 30% depending on the application. Schneider Electric, ABB, Siemens and other equipment providers offer and advertise these types of solutions. A generalized implementation of these technologies in Belgium would lead to savings of the order of 8 TWh. Our study of the different sectors illustrates how savings of 15 to 20% are reachable (without considering the self-production potential such as CHP).
- Other examples can be found at the end of the Climate 2012 booklet of the Belgian Enterprises Federation or on the website of the Energymag on http://www.energymag.be/fr/efficiency.

57. While this report is focused on the potential to reduce electricity demand, significant potential exists for combined heat and power production (CHP) in the industry.[23] Of the 30 TWh identified by the CREG by 2020 across all industrial sectors, we estimate that 15 TWh of CHP can be reached by the Chemicals sector at an ambition of level 3 (~11 TWh at level 2) making the Chemicals sector autonomous on electricity.

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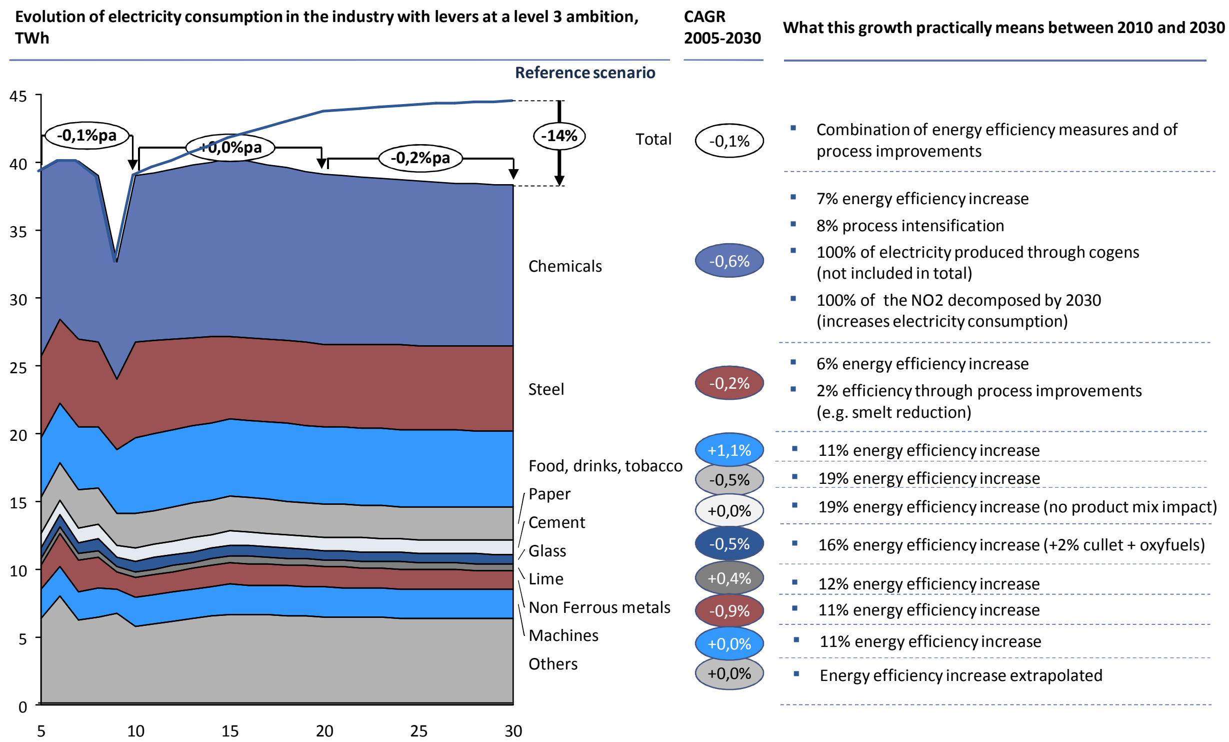
[23] Smaller auto-production which is not distributed on the network may not be included in the industry electricity consumption.



Source: FBP/PRIMES assuming a BAU energy efficiency increase, Climact analysis. CHP potential not included in Electricity consumption

Figure 14. Electricity demand for the industry in the no-growth scenario.

b.2. Residential sector

58. For the residential sector, decarbonisation levers are grouped in 4 key areas: (1) heating comfort level; (2) housing thermal efficiency; (3) efficiency of lighting and appliances; (4) electrification of heating and cooking. All of these levers support a transition to a low carbon economy, but **some of these levers reduce electricity demand (demand reduction and efficiency levers) while others increase the need for electricity (electrification levers).** This dynamic will be critical in the mid-term in the residential sector.

59. As described in the methodology section, 4 levels of ambition are modelled for each of these groups of levers. While the reference scenario is at level 1 for all levers, **setting the ambition level for all demand and efficiency levers at 2 with no further electrification is sufficient to stabilize electricity demand in the residential sector.** This “no growth, no electrification” case implies:

(1) **Heating comfort:** effectively reducing the increase in average temperature – currently at ~18°C on average in the entire house – by 2030 from 8% in the reference scenario to 3% (level 2).

(2) **Housing thermal efficiency:** increase the annual refurbishing rate from 1% historically to 1.25% of the housing stock (level 2). Additionally, renovated households lower their consumption to a level in line with EU legislation, with demand after renovations down from 150 to 100 kWh/m^2.yr, but still far from low-energy housing which corresponds to 30-40kWh/m².yr. New builds on the other hand follow the strict standards applied in the reference case early on and start being even more efficient than the reference case after 2025, down from 50 to 40 kWh/m^2.yr. 40 kWh/m^2.yr is in line with low-energy housing and compared to the average

performance of the current building stock, it represents a reduction of the energy needs of residential buildings by about 85%.

(3) **Efficiency of lighting and appliances:** for lighting this means the improvement level is the same as for the reference case which is already very aggressive. The rate of reduction of consumption per household from white appliances improves from 0.9% p.a. to 1.1%, implying slightly stricter standards applied at a slightly faster pace. For black appliances the reference case assumes a significant increase of 5% p.a. in electricity demand per household, where in the level 2 this increase is limited to 4% only (level 2).

(4) **Electrification levers:** no further electrification beyond the reference case (level 1).

60. Alternatively, more emphasis can be set on starting the low carbon transition early, therefore intensifying electrification trends even before 2020. In this case, higher efficiency levels will be required to counteract the increase from electrification. This “slight growth with electrification” case implies:

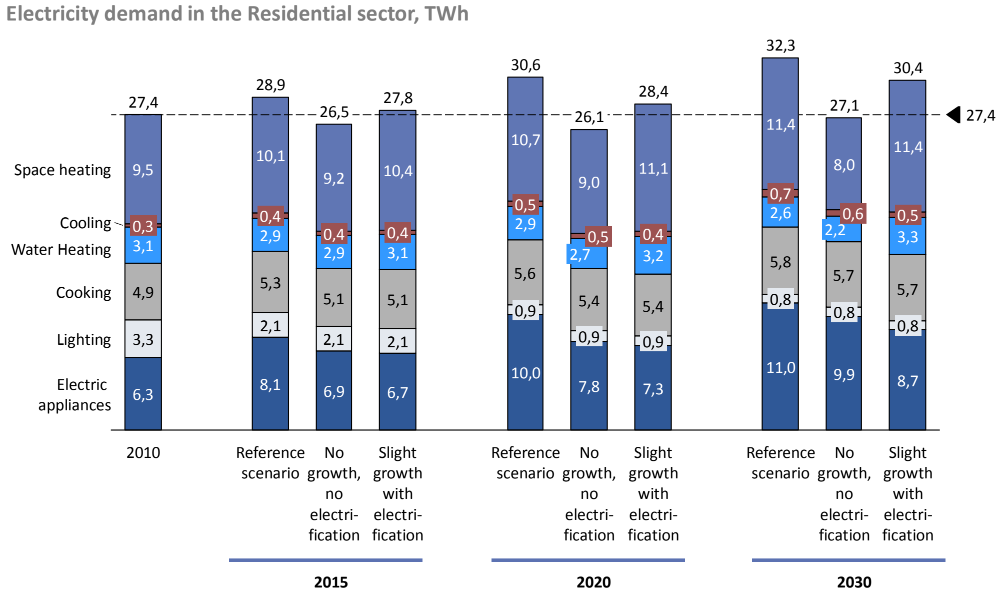
(1) **Heating comfort**, effectively replacing the increase by 2030 of 8% in average temperature – currently at ~18°C on average in the entire house – in the reference scenario to a decrease by 3%, requiring some level of behavioural change (level 3).

(2) **Housing thermal efficiency**: increase the refurbishing rate from 1% historical to 1.75% (level 3). Additionally, renovated households reach lower consumption levels than in the reference case, decreasing their resulting demand after renovations from 150 to 80 kWh/m². New builds are also more efficient after 2025 than in the reference case (40% lower, from 50 to 30 kWh/m², levels comparable to the performance of the most efficient low-energy housing).

(3) **Efficiency of lighting and appliances:** for lighting this means the improvement level is the same as for the reference case which is already very aggressive (level 3). Consumption of white appliances improves from 0.9% p.a. to 1.3%, implying stricter standards applied at a faster pace. For black appliances the reference case assumes a significant increase of 5% p.a. in electricity demand per household, where in the level 3 this increase is limited to 3% only.

(4) **Electrification levers** imply significant substitution effects, with a penetration of heat pumps from ~0% to ~30% for space and water heating by 2030 (level 3), which can support effective decarbonisation by 2050, and moving to mostly electric cooking by 2050.

61. Figure 15 shows the impact on these variances on electricity demand. Both cases remain below or only slightly above the 2010 level for 2015, 2020 and 2030. Seen the tight situation in terms of available production capacity in Belgium it may be wise to time the levers optimally by focusing on energy efficiency up to 2015, and encouraging electrification more significantly in the mid-term to reach the decarbonisation targets. Seen the focus on limiting growth of electricity demand in this scenario, the “no growth no electrification” case is used.



SOURCE: Federal Plan Bureau, Primes, Fraunhofer, EU Commission, Climact

Figure 15. Electricity demand in the Residential sector in the reference and alternative no-growth scenarios.

b.3. Tertiary sector

62. The tertiary sector represents a significantly smaller share of Belgian electricity consumption than the industry and residential customers, with only ~17%. We have directly applied the Fraunhofer analysis to highlight electricity savings potential for this sector. Fraunhofer's extensive work on Energy Efficiency was done in 2009 for the European Commission for DG Energy and Transport[24] and highlights the energy efficiency potential in all sectors for the various member states. The results for Belgium show significant potential to stabilize electricity demand for the Tertiary sector, with an electrical energy efficiency potential of ~20% compared to their reference case from 2007. Interestingly the latest projections by the FPB are significantly below this 2007 reference case, and suggest that the level that could be reached by implementing significant energy efficiency is likely much below that. The resulting demand by applying Fraunhofer Energy Efficiency potential on the FPB scenario is illustrated by the red curve in Figure 16 below and is used in all the alternative scenarios below.

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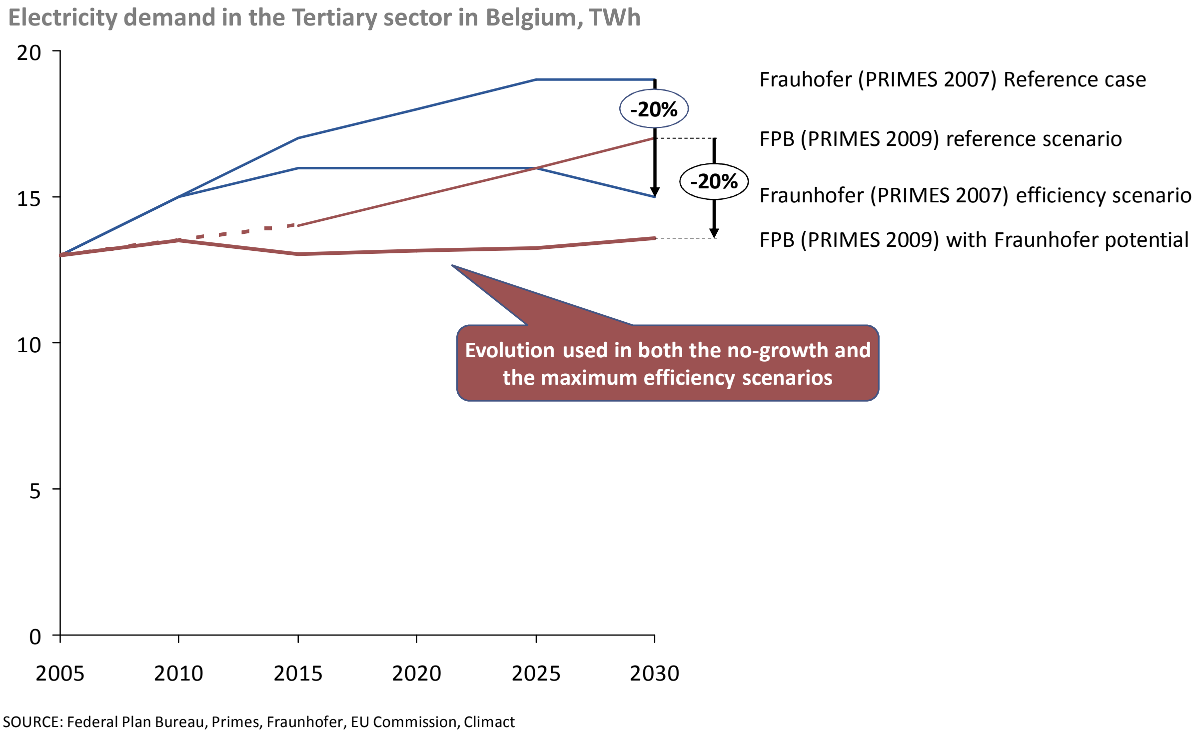
[24] "Study on the Energy Savings Potentials in EU Member States, Candidate Countries and EEA Countries", Fraunhofer et. al, see http://www.eepotential.eu/esd.php



SOURCE: Federal Plan Bureau, Primes, Fraunhofer, EU Commission, Climact

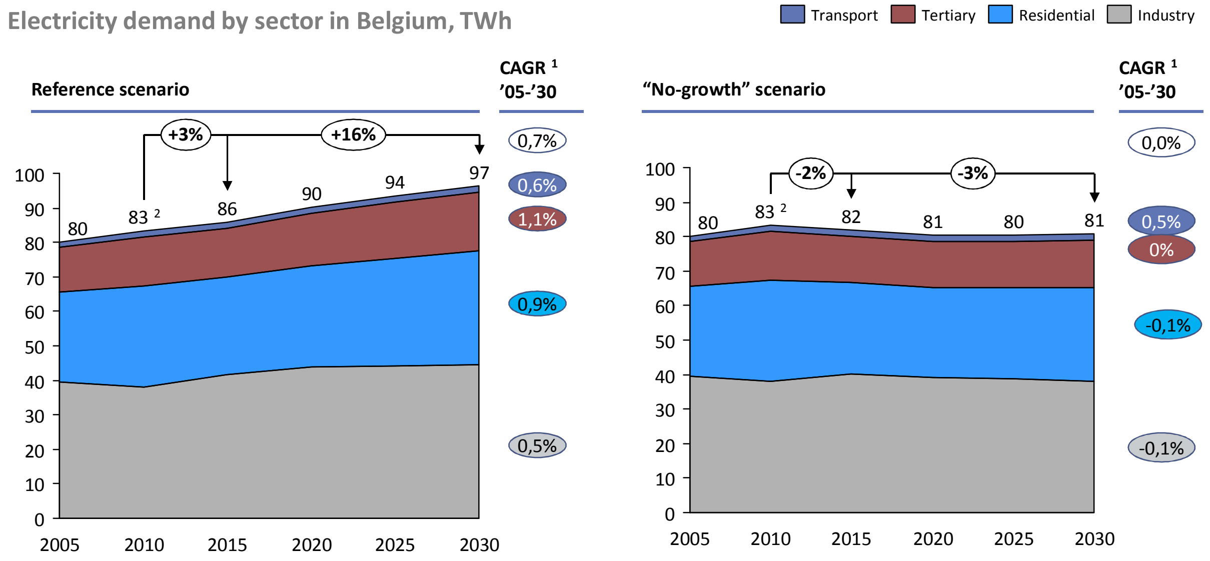
Figure 16. Electricity demand in various scenarios for the Tertiary sector.

b.4. Transport sector

63. As previously mentioned, transport has a small contribution of only 2%, mostly through electrified public transportation. The FPB scenarios assume electrification trends in the transport sector will not be a driving force in the short term, even though it is likely going to take a larger share in the longer term with electrified personal transportation. We keep the same projections in our modelled scenarios.

b.5. Resulting overall electricity demand in the "no-growth" scenario

64. Based on the evolution for the various sectors highlighted above we find that **a no-growth scenario is reachable with reasonable ambition level in each sector.** Figure 17 below shows the resulting evolution of electricity demand at the Belgian level for 2015 and 2030.



1 CAGR: Compounded Annual Growth Rate is the average annual growth rate compounded over a multi-year period
2 Figures for 2010 for Residential and Tertiary are based on the recent actual data published by the SPF Economie but the split used further in the study is built on 2005 data before the rescoping, following the FBP logic
SOURCE: SPF Economie, Bureau Fédéral du Plan, Primes, Fraunhofer, DECC, Climact

Figure 17. Electricity demand in the Reference scenario by the FPB and the "No-growth" scenario.

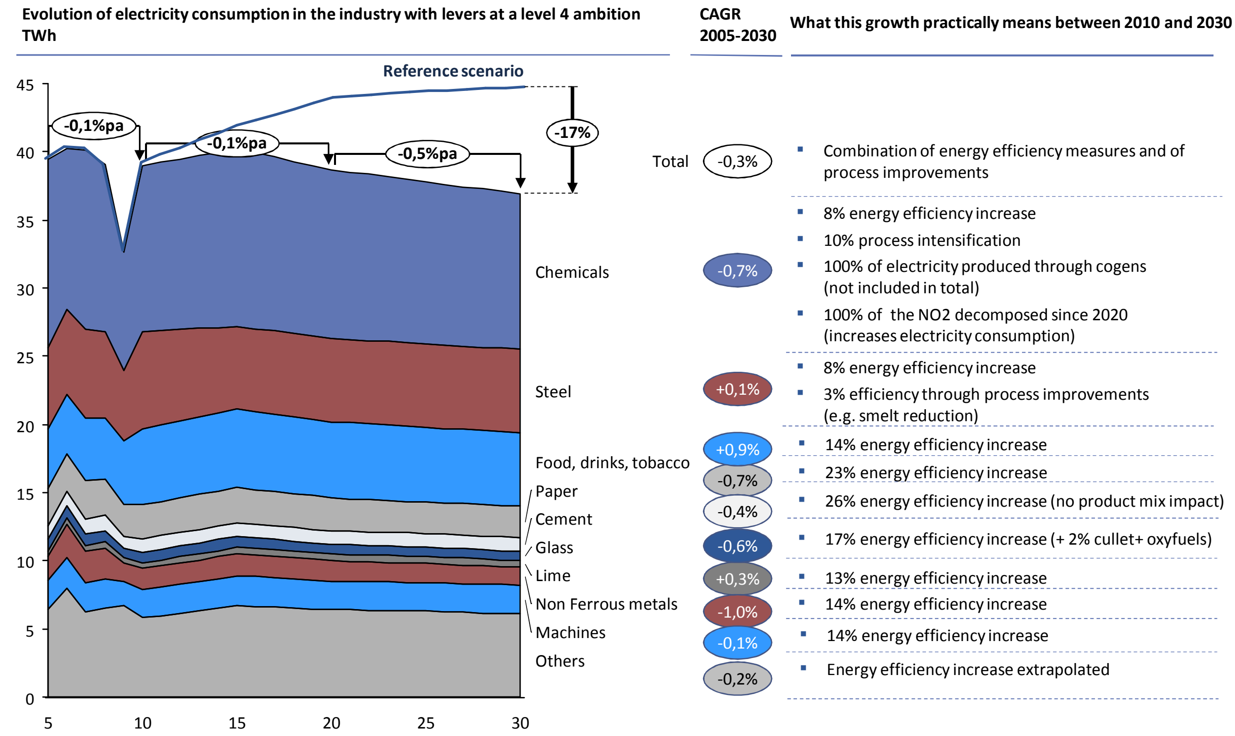
c. "Maximum electrical energy efficiency" scenario

65. In the "Maximum electrical energy efficiency" scenario all sectors are analysed with a similar modelling approach but pushing levers to their maximum level.

c.1. Industry

66. Implementing energy efficiency measures at an ambition level 4 in the industry can lead to a 6% decrease in electricity consumption by 2030 relative to 2005. Reaching a level 4 ambition requires implementing not only economically attractive energy efficiency solutions with a quick payback, but also several technologies which currently have lower profitability – it should be noted however that higher energy and carbon prices in the future could improve the share of attractive measures. The only sector which would still grow significantly in this case (~1% p.a.) is the food and drinks sector, because of the strong demand growth projected by the FPB.

67. Similarly to above, of the 30 TWh identified by the CREG by 2020, we estimate that ~25 TWh of CHP can be reached by the Chemicals sector in 2030 with a level 4 ambition, making the Chemicals sector a net electricity producer. Note however that, as most large scale opportunities have already been exploited, the profitability of new CHP projects is expected to decline.



	CAGR 2005-2030	What this growth practically means between 2010 and 2030
Total	-0,3%	Combination of energy efficiency measures and of process improvements
Chemicals	-0,7%	8% energy efficiency increase 10% process intensification 100% of electricity produced through cogens (not included in total) 100% of the NO2 decomposed since 2020 (increases electricity consumption)
Steel	+0,1%	8% energy efficiency increase 3% efficiency through process improvements (e.g. smelt reduction)
Food, drinks, tobacco	+0,9%	14% energy efficiency increase
Paper	-0,7%	23% energy efficiency increase
Cement	-0,4%	26% energy efficiency increase (no product mix impact)
Glass	-0,6%	17% energy efficiency increase (+ 2% cullet+ oxyfuels)
Lime	+0,3%	13% energy efficiency increase
Non Ferrous metals	-1,0%	14% energy efficiency increase
Machines	-0,1%	14% energy efficiency increase
Others	-0,2%	Energy efficiency increase extrapolated

Source: FBP/PRIMES assuming a BAU energy efficiency increase, Climact analysis. CHP potential not included in Electricity consumption

Figure 18. Electricity demand for the industry in the "Maximum electrical energy efficiency" scenario.

c.2. Residential sector

68. For the residential sector we leverage the same levers as described in previous sections, but push the ambition level to 4, including the electrification lever. This implies the following assumptions:

(1) **Heating comfort**, effectively replacing the increase of 8% by 2030 in average temperature – currently at ~18°C on average in the entire house – in the reference scenario to a decrease by 10%, requiring a significant level of behavioural change (level 4).

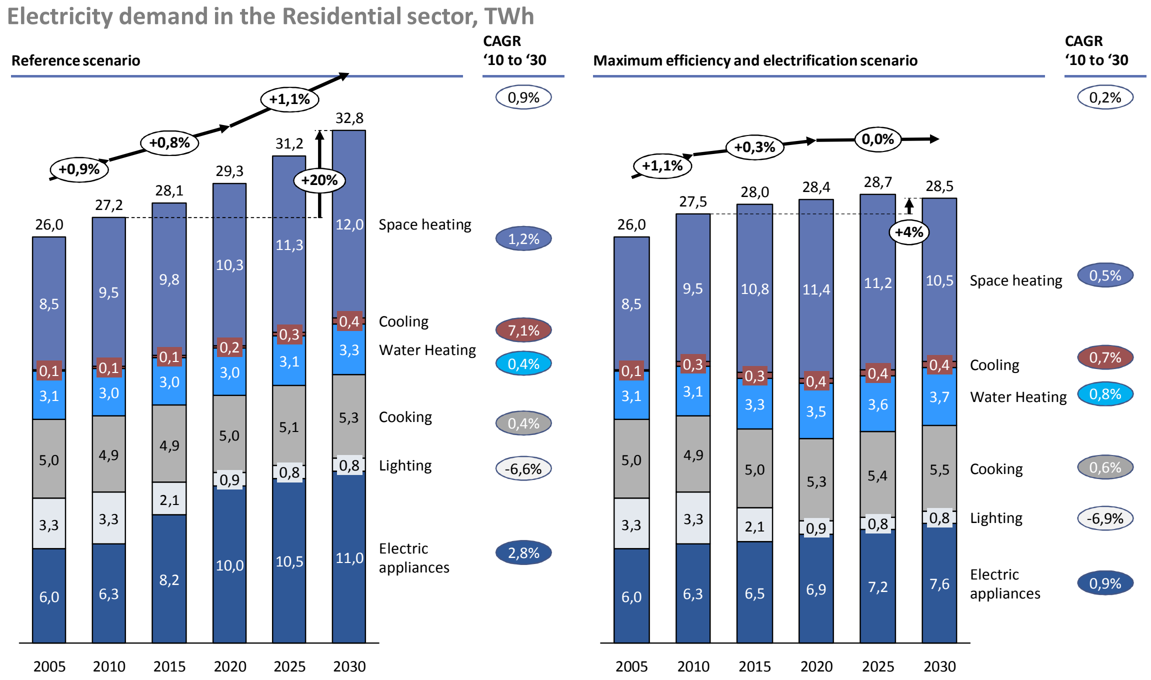
(2) **Housing thermal efficiency** implies among others to more than double the annual refurbishing rate from 1% historically to 2.5% of the housing stock (level 4). Additionally, renovated households reach lower consumption levels than in the reference case, decreasing their resulting demand after renovations from 150 to 45 kWh/m^2.yr, which is better than many current new-builds and close to low-energy housing which corresponds to 30-40kWh/m^2.yr. While technically feasible, reaching these levels through renovations will require very significant investments and a high political priority/ambition. New builds are yet more efficient after 2025 than in the reference case (from 50 to 30 kWh/m^2.yr), levels comparable to the performance of the most efficient low-energy housing (passive housing would correspond to ~15 kWh/m^2.yr.). Compared to the average performance of the current building stock, a performance of 30 kWh/m^2.yr represents a reduction of the energy needs of residential buildings by almost 90%.

(3) **Efficiency of lighting and appliances:** for lighting this means the improvement level is yet even more ambitious than the reference case which is already very aggressive, but it adds little as levels in the reference case are already very low (level 2). Consumption per household from white appliances improves from 0.9% p.a. to 1.5%, implying yet stricter standards applied at a much

faster pace. For black appliances the reference case assumes a significant increase of 5% p.a. in electricity demand per household, where in the level 4 this increase is limited to 2% only.

(4) **Electrification levers** imply far reaching electrification through substitution with up to 50% electrified heating by 2030 on the way to ~85% heat pumps in 2050 (level 4).

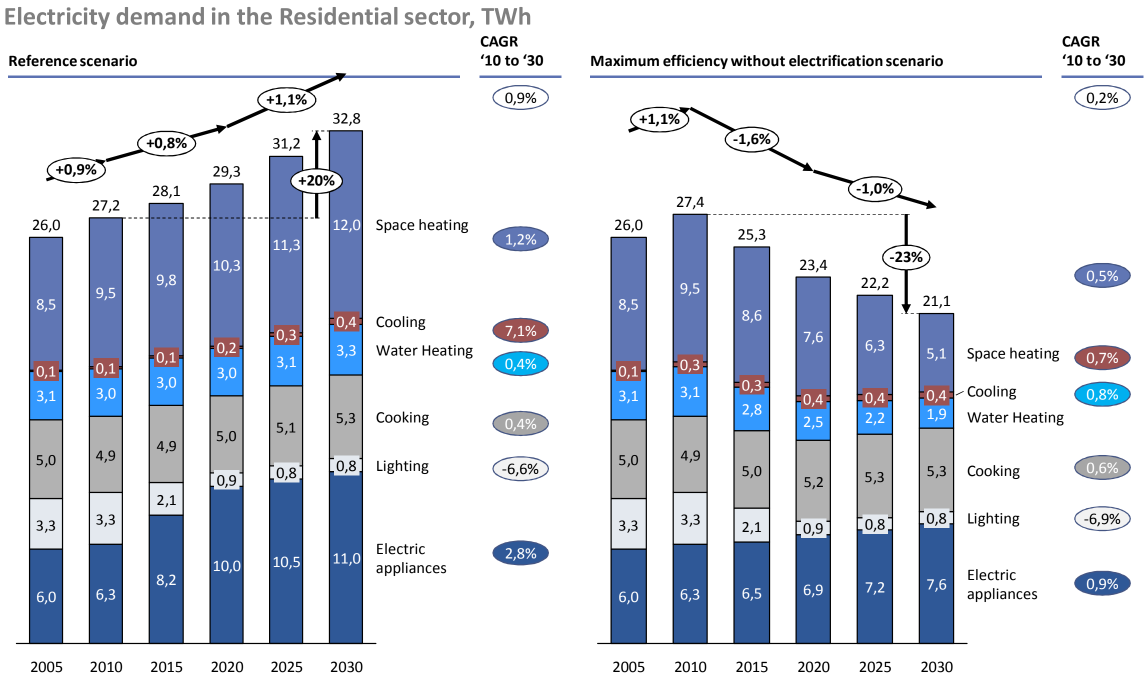
69. With all levers at the maximum level, including electrification, electricity demand ends up relatively flat, increasing by 4% over 20 years up to 2030.



SOURCE: Federal Plan Bureau, Primes, Fraunhofer, EU Commission, Climact

Figure 19. Electricity demand in the residential sector in the reference and maximum efficiency scenarios.

70. However, taking out the ambitious electrification, electricity demand drops 23% below 2010 levels. This shows how large the impact of electrification is in the residential sector.



SOURCE: Federal Plan Bureau, Primes, Fraunhofer, EU Commission, Climact

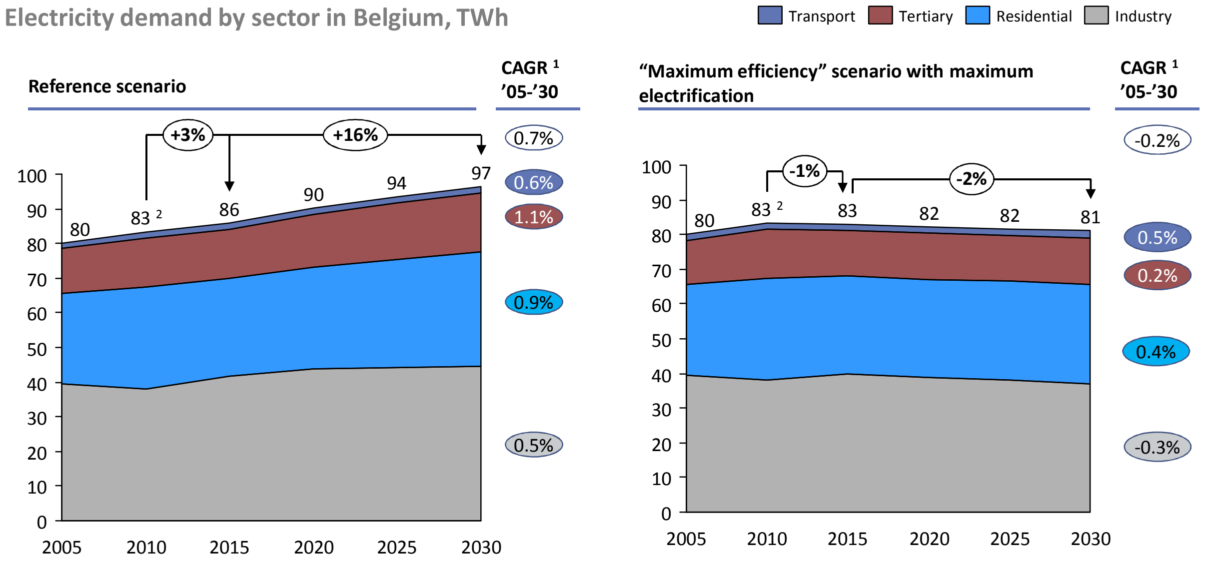
Figure 20. Electricity demand in the residential sector in the reference and maximum efficiency without electrification scenarios.

c.3. Tertiary sector

71. The Fraunhofer Institute does not present a more aggressive scenario than 'no-growth' for the Tertiary sector. This is the best source of electrical energy efficiency scenarios we found. Consequently, we use the same results for the Tertiary sector as in the "no-growth" scenario, considering this as a conservative choice.

c.4. Resulting overall electricity demand in the "maximum efficiency" scenario

72. Electricity demand is reduced by 2% by 2030 in this "maximum efficiency" scenario, knowing this scenario includes massive electrification through substitution for the residential sector.



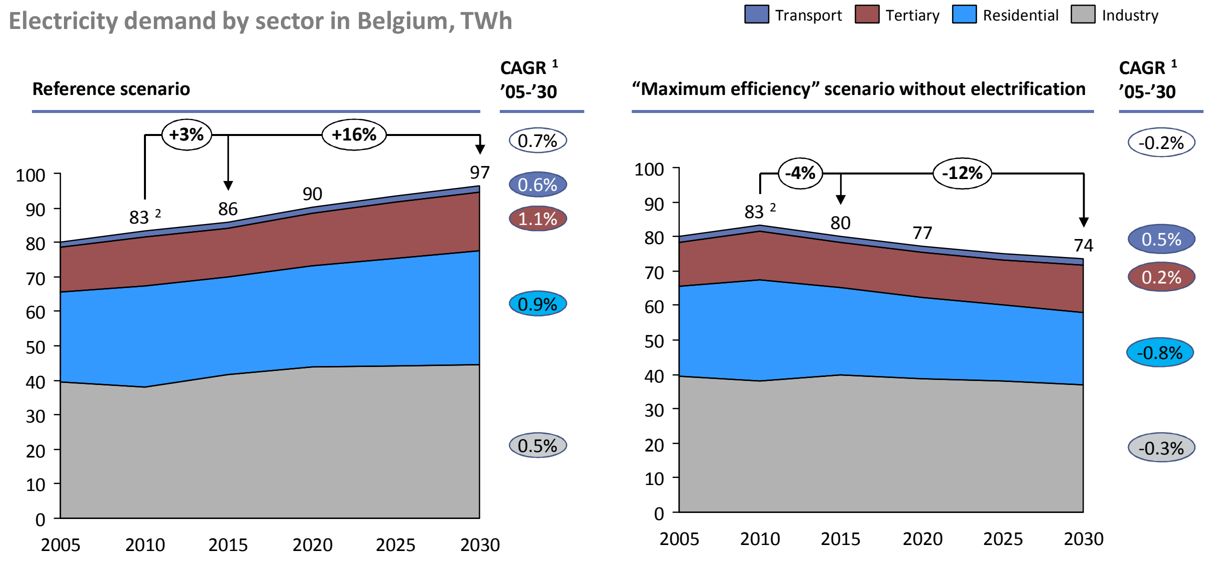
1 CAGR: Compounded Annual Growth Rate is the average annual growth rate compounded over a multi-year period

2 Figures for 2010 for Residential and Tertiary are based on the recent actual data published by the SPF Economie but the split used further in the study is built on 2005 data before the rescoping, following the FBP logic

SOURCE: SPF Economie, Bureau Fédéral du Plan, Primes, Fraunhofer, DECC, Climact

Figure 21. Electricity demand in the « maximum efficiency » scenario with electrification.

73. With no additional electrification compared to the reference level in the residential sector this reduction would reach 12% by 2030 (compared to a 16% increase in the reference scenario), highlighting the significant impact of energy efficiency on electricity demand.



1 CAGR: Compounded Annual Growth Rate is the average annual growth rate compounded over a multi-year period

2 Figures for 2010 for Residential and Tertiary are based on the recent actual data published by the SPF Economie but the split used further in the study is built on 2005 data before the rescoping, following the FBP logic

SOURCE: SPF Economie, Bureau Fédéral du Plan, Primes, Fraunhofer, DECC, Climact

Figure 22. Electricity demand in the « maximum efficiency » scenario without electrification.

CONCLUSIONS

74. A significant share of the electricity production capacity in Belgium must be renewed, but the lack of political clarity has slowed down investments to replace it.

75. The CREG states in a recent report that large investments are rapidly needed to minimize the risk of black-out. However, this report shows that this statement is based upon already outdated electricity demand projections which don't reflect the latest information on the recent evolution of electricity demand. Thus, even without taking into account more opportunities for energy savings, electricity demand and required investments are higher than what the latest publications suggest. Additionally the projections used take limited energy saving opportunities into account. Seen the importance of these projections in these decisions, they should be analysed and discussed in more detail.

76. The CREG also states that, if electricity demand would not grow above 2010 levels, fewer investments would be needed, without testing if such a no-growth scenario is technically feasible.

77. Our analysis shows that a no-growth scenario between 2010 and 2030 *is* technically feasible and does not require leveraging the full technical potential of energy savings opportunities in the major electricity consuming sectors.

78. This no-growth scenario would decrease electricity demand from 83 TWh in 2010 to 82 (2015) and 81 (2020) TWh, compared to an increase to 86 (2015) and 90 (2020) TWh in the latest 2011 FPB reference case, and importantly compared to 88 (2015) and 96 (2020) TWh used by the CREG in their analysis, the no-growth scenario being lower by 7% (2015) and 15% (2020). As described in the context, this could fundamentally change the need for new capacity in the short to medium term.

79. By using technical electricity savings opportunities to their full potential, we could even reduce the demand below 80 TWh in 2030, with the final demand depending strongly on the level of electrification.

80. It seems therefore reasonable to analyse the implications of diverting large part of investment opportunities towards the development and deployment of electricity saving technologies in order to lower demand while increasing energy independence and security.

81. Further work should be encouraged to better understand this potential, its impact on electricity demand and its added-value for society.

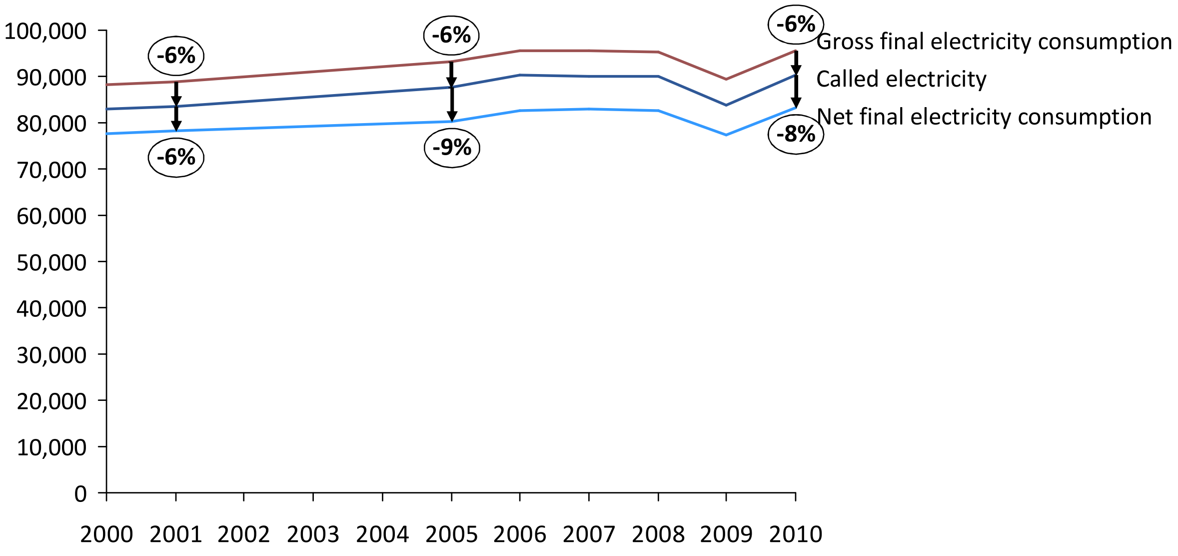
APPENDICES

Varying definitions of electricity consumption

- Net final energy consumption = consumption by the final users only
  - Final energy consumption covers energy supplied to the final consumer for all energy uses. It is calculated as the sum of final energy consumption of all sectors: industry, transport, households, services and agriculture.
  - It excludes transmission and distribution losses as well as energy sources used as raw materials (oil in the chemical industry for example) and auto-consumption by the energy producing industries.
- Called electricity (or internal electricity consumption) = consumption by the final users + losses
  - The energy called on the network corresponds to the observed final consumption of electricity, plus network losses (transmission and distribution networks).
  - It can also be defined by the amount of electrical energy produced by plants minus their own consumption of power (= net production) plus the amount of electrical energy consumption for pumping (Coo-Plate-Taille) and increased/decreased by the net amount of imported/exported electricity.
- Gross final electricity consumption = consumption by the final users + losses + auto-consumption of the energy production section
  - The electricity supplied for energy uses to the industry, transport, households, services, including public utilities, agriculture, forestry and fishing, including the electricity consumed by the energy branch for electricity losses on the networks and for the generation of electricity.

Electricity demand can vary by 6 to 14% based on the various perimeters assumed (Figure 23).

Historical evolution of electricity demand in Belgium according to various definitions, TWh



Source: Computations from Climact based on data from the SPF Economie (« Marché de l'énergie en 2009 » and 2010 data)

Figure 23. Electricity demand in Belgium according to various definitions.

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