PEER-REVIEWED PAPER

Lessons learnt from two long-term agreements on energy-efficiency in industry in Flanders, Belgium

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Keywords

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Abstract

In Flanders, Belgium, two voluntary schemes or covenants to stimulate energy efficiency in industry are in place. The Benchmarking Covenant targets the energy intensive industry and companies participating in the ETS; it starts in 2002 and ends in 2014. The Auditing Covenant targets medium sized enterprises; starting in 2005 and ends in 2014.The objective of the Benchmarking Covenant is to bring the participating industrial companies to top 10 % most energy efficient plants worldwide by 2012. The objective of the Auditing Covenant is to implement all energy saving measures with a minimal internal rate of return, corresponding with an energy saving potential of about 10 %.

The aim of this article is to describe the design and to analyse the operation of both covenants. The description of the design includes an analysis of the political acceptance and a description of the target group, the obligations of the participants, the compensation from the Flemish Government to the participants and the administration of the covenant. The analysis of the operation of the covenants includes an assessment of the number of participants and the industrial energy consumption covered, an analysis of the determination of the target and an assessment of the monitoring results on the energy efficiency improvements and CO_2 reductions. Monitoring results of 2012 indicate that the benchmarking covenant resulted in an 8.1 % improvement in energy efficiency compared to 2002 and that the auditing covenant resulted in a 9.8 % improvement in energy efficiency compared to 2005.

Lessons can be learnt from the experiences with the covenants on the metrics to monitor the progress in voluntary agreements on energy efficiency, on whether to impose an energy efficiency target or a commitment to take action and on the relation between the achieved energy efficiency improvements and the energy-intensity of a company. These are useful lessons when designing a new voluntary agreement on energy efficiency.

Introduction

Many states all over the world rely on voluntary agreements or long term agreements to stimulate energy efficiency in the industry. The participants in such voluntary agreements agree to take action to detect and implement energy saving measures. The authorities compensate them for their commitment for instance by granting the participants energy tax reductions or investment support for the energy saving measures.

In the second National Energy Efficiency Action Plans (NEEAPs) [DG ENER, 2011], 16 of the 27 EU Member States report to have at least one voluntary agreement on energy efficiency in industry in place, see Figure 1. As Table 1 indicates, some countries have already a long tradition in using voluntary agreements to stimulate energy efficiency in the industry, such as the Netherlands, Germany or the Great-Duchy of Luxembourg, while other EU Member States, such as the Czech Republic, Latvia or Lithuania are in a process of implementing voluntary agreements when these countries drafted their second NEEAP. Some voluntary agreements target specific sectors, while others target specific industrial segments, such as SMEs. Some countries, such as Ireland, Finland and

the Netherlands, even have installed more than one voluntary agreement to tailor the voluntary agreements to the specific characteristics of the various sectors or segments they want to cover.

This is also the case for Flanders, Belgium. In 2002, a first voluntary agreement starts, called the Benchmarking Covenant, targeting the energy intensive industry and ETS-companies. In 2005, a second, the Auditing Covenant, follows targeting non-energy intensive medium-sized companies.

The first part of this article describes the design and the operation of both voluntary agreements or covenants. The description of the design includes an analysis of the political acceptance and a description of the target group, the obligations of the participants, the compensation from the Flemish Government to the participants and the administration of the covenant. The analysis of the operation of the covenants includes an assessment of the number of participants and industrial energy consumption covered, an analysis of the determination of the target and an assessment of the monitoring results on the energy efficiency improvements and CO_2 reductions.

Lessons can be learnt from the experiences with these covenants, which are discussed in the second part of this article. The lessons learnt concern the metrics to monitor the progress in voluntary agreements on energy efficiency, whether to impose an energy efficiency target or commitment to take action and the relation between the achieved energy efficiency improvements and the energy-intensity of company.

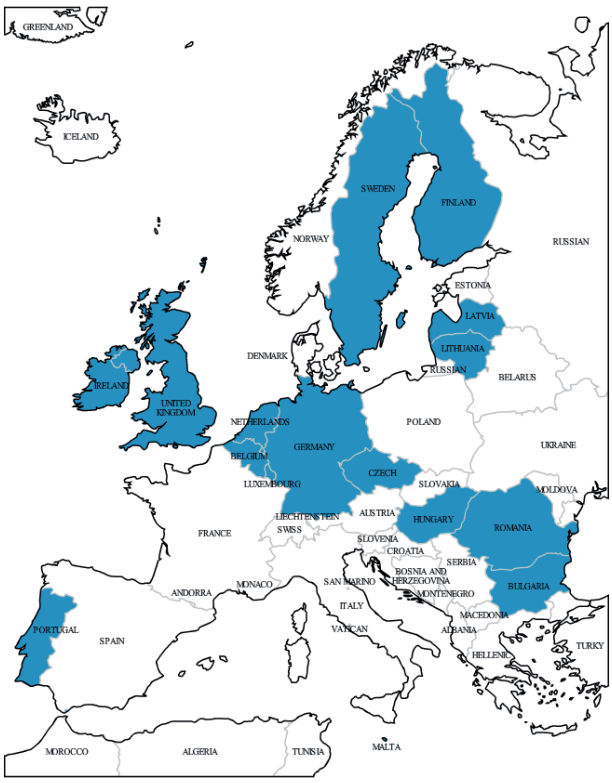

Figure 1. EU Member States with voluntary agreements on energy efficiency in industry.

Table 1. Details of the EU voluntary agreements on energy efficiency in industry.

EU Member State	Target group	Start–End	Expected energy savings in 2016 (GWh)
Belgium – Walloon Region	Non-ETS industry	2004–2010 or 2012	788
Belgium – Flemish Region	Large, energy-intensive companies	2003–2012	1,760
	Medium-sized non-ETS companies	2005–2013	
Bulgaria	SMEs	2008–2016	n.i.
Czech Republic	Non-ETS industry	2011–ongoing	850
Finland	Medium-sized industry	2008–2016	477
	Energy-intensive industry	2008–2016	8,365
Germany	15 industrial sectors	1995–2012	10,500
Hungary	Industry (including SMEs in particular)	2008–2016	n.i.
Ireland	Industry and SMEs	2000–ongoing	2,235
	SMEs	2008–ongoing	400
Latvia	Industry and SMEs	2011–2016	n.i.
Lithuania	Non-ETS industry	2012–n.i.	370
Luxembourg	Non-ETS industry	1996–2007	254
	Non-ETS industry	2008–2010	47
	Non-ETS industry	2011–2016	102
Malta	Water production	1995–ongoing	42
The Netherlands	LTA3: large and medium-sized non-ETS companies	2001–2020	4,863
	LTA-ETS: ETS companies	1999–2020	
Portugal	Not specified	n.i.–n.i.	n.i.
Romania	Not specified	2008–n.i.	n.i.
Sweden	Energy-intensive industry	2004–2014	1,400
United Kingdom	Energy-intensive industry	n.i.–2013	7,500

Ongoing: as indicated by the EU MS in their second NEEAP – n.i.: not indicated.

Design of the Benchmarking Covenant

POLITICAL ACCEPTANCE

The Benchmarking Covenant is enacted in 2002. The covenant is implemented within the framework of the first Flemish Climate Policy Plan 2002–2005. Belgium had to reduce its greenhouse gas (GHG) emissions in the period 2008–2012 by 7.5 % compared to the 1990 levels. In 2004, this national emission reduction target was divided amongst the three Belgian regions. Flanders committed itself to reduce its 2008–2012 levels by 5.2 % compared to the 1990 emission level. This is a challenging target, because between 1990 and 2000, the Flemish GHG emissions increased by 13 %. The transport sector contributed the most to this increase; the building sector to a lesser extent. The industrial GHG emissions, on the other hand, decreased with 9 % from 1990 to 2000, mainly as a result of a switch to natural gas and electricity.

In response to this challenge, the Flemish Government decided that the industry should focus on a continuous improvement of energy efficiency. An alternative policy could have been the introduction of absolute emission caps, but this would have jeopardised the competitiveness of the Flemish industry. Nor did the Flemish Government want to introduce equal relative emission reduction targets for all industrial companies, as this would penalise first-movers or companies in expansion. Instead, Flanders chose the benchmarking approach, inspired by the Dutch Benchmarking Covenant that started in 1999 [Flemish Government, 2003].

The Benchmarking Covenant expires in 2012. The Flemish Government decided to continue with the voluntary agreement approach to stimulate energy efficiency in industry and proposed an Energy Governance Agreement for ETS-companies as continuation of the Benchmarking Covenant [Flemish Parliament, 2013]. As there are delays in the start of this new agreement, it is decided to extend the duration of the Benchmarking Covenant until this new agreements can start in 2014.

TARGET GROUP OF THE BENCHMARKING COVENANT

The Benchmarking Covenant targets the energy-intensive industry, defined as companies with a minimal annual primary energy consumption of 0.5 Petajoule (PJ). This target group consisted of about 105 companies, representing 74 % of the total industrial energy consumption in Flanders [Flemish Government, 2003].

As a compensation for their commitment (*cfr infra*), the Flemish Government decided to award all participants with free CO_2 emission rights in line with the committed energy efficiency improvement, as long as the individual participants fulfil the obligations of the covenant (see Compensation from the Flemish Government). As a result, all industrial companies, having obligations under the European Emission Trading System (ETS), requested to expand the target group. So they could accede to the Benchmarking Covenant as well from the very beginning, even when their primary annual energy consumption is less than the threshold of 0.5 PJ.

At the end of 2003, 176 companies acceded the Benchmarking Covenant [Benchmarking Commission, 2003].

OBLIGATIONS UNDER THE BENCHMARKING COVENANT

Following the example of the Benchmarking Covenant of the Netherlands, participants of the Flemish Benchmarking Covenant were required to compare and benchmark the energy efficiency of their process installations against similar installations worldwide in order to determine the deviation from the world's leading edge on energy efficiency. To determine this leading edge, different benchmarking methodologies are proposed in the Benchmarking Covenant [Benchmarking Covenant, 2002]:

- Benchmarking method 1: specific energy consumption of similar process installations outside Flanders need to be determined. These specific energy consumptions must be ranked; the world's leading edge on energy efficiency for this process installation is the highest value of the bottom 10 % values.
- Benchmarking method 2: regions outside Flanders with a similar number and capacity of process installations need to be identified. For each of these regions, the average specific energy consumption of similar process installations must be determined. The lowest average is the world's leading edge on energy efficiency for this process installation.
- Best practice: in case the benchmarking methods cannot be applied, the specific energy consumption of the best process installation needs to be determined. The world's leading edge on energy efficiency for this process installation is then the specific energy consumption of this best process installation plus 10 %.
- In case none of these methodologies can be applied, an energy audit must be carried out and all energy saving measures with an internal rate of return (IRR) after taxes of 15 % or higher must be implemented.

The world's leading edge on energy efficiency is to be determined for the first time when acceding to the Benchmarking Covenant and to be updated after four years. Its calculation needs to take the autonomous evolution of the specific energy consumption into account; i.e. the baseline energy efficiency improvement that would take place in absence of the covenant. In case this autonomous evolution cannot be determined, a default energy efficiency improvement of 0.8 % may be assumed.

By the end of 2014 all process installations are required to take part of the world's leading edge on energy efficiency. In case the process installations deviate from this leading edge, the companies must implement all economic feasible energy saving measures as soon as possible; before the end of 2005 at the latest. These are defined as measures with an Internal Rate of Return (IRR) of at least 15 %. In case of a remaining deviation, the companies must implement all measures with an IRR of at least 6 % as soon as possible; before the end of 2007 at the latest. Still in case of a remaining deviation, the companies must take alternative measures, which means in practice that they have to buy CO_2 allowances on the carbon market to compensate for that deviation.

The participants must report the results of the determination of the world's leading edge for the process installations of the company, including its autonomous evolution in an energy plan, due one and a half year after the date of accession. The

energy plan schedules the mandatory energy saving measures and estimates the improvement of the energy efficiency of the process installations as a result of these energy saving measures. After four years, the energy plan must be updated. Besides that, the participants to the Benchmarking Covenant have an annual reporting obligation; by April 1st, they have to report the energy consumption of the previous year, the evolution of the specific energy consumption and the progress they made in implementing the mandatory energy saving measures.

COMPENSATION FROM THE FLEMISH GOVERNMENT

As a compensation for these mandated commitments, the Flemish Government guarantees not to impose additional measures or policies on rational energy use or greenhouse gas (GHG) emission reduction (particularly energy or CO_2 taxes or emission ceilings). The Flemish Government also commits to take all possible steps to exempt participants from additional measures on energy efficiency or GHG emission reduction at both the federal and European levels. However, the most valuable compensation provided to participants of the Benchmarking Covenant is the granting of full emissions allowances under the EU ETS in line with the committed energy efficiency improvement under the condition that they have fulfilled all obligations under the Covenant. [Benchmarking Commission, 2005].

In 2005, energy tax reductions were added while eligible companies that did not accede the Benchmarking Covenant were excluded from the ecology premium scheme, an investment support scheme for environmental friendly technologies [Benchmarking Commission, 2007].

ADMINISTRATION OF THE BENCHMARKING COVENANT

The Benchmarking Covenant is administered by the Benchmarking Covenant Verification Office (BCVO). The BCVO certifies the external energy experts, verifies and approves the method to determine the world's leading edge. It verifies and approves the energy plans and verifies and approves the annual monitoring reports. The BCVO is the only agency that has access to the confidential data of the individual participants. The staff of the BCVO consists of a manager, 10 experts and 1 administrative assistant.

The BCVO reports to a Steering Committee, called the Benchmarking Covenant Commission (BCC), which has representatives from the Ministry of Energy, the Ministry of Environment and the Ministry of the Economy as well as representatives from every sector association that has members covered by the Benchmarking Covenant.

The BCC clarifies the Benchmarking Covenant where necessary. From 2003 till 2013, the Commission issued 19 clarification, for instance on how the internal rate of return needs to be calculated, on how to take cogeneration into account in the benchmarks or on how to deal with the global financial crisis. The BCC also mediates between the BCVO and participants when necessary and publishes public annual progress reports.

Operation of the Benchmarking Covenant

NUMBER OF PARTICIPANTS AND INDUSTRIAL ENERGY CONSUMPTION COVERED

In the beginning of 2004, 176 companies acceded the Benchmarking Covenant, representing 80 % of the industrial energy consumption in Flanders [Benchmarking Commission, 2005]. As Figure 2 indicates, the sectors with the highest number of participants are the chemical, food, ceramics and technology, and textile sectors.

In the first two years, the number of participants increased due to new entrants; from 2006 on however, the number declined, mostly as a result of a closure of the production site. At the end of 2013, the number of participants declined to 172. From 2004 to 2013, the covenant welcomed 16 new entrants while 20 companies resigned from the covenant since the start. The number of participants declined in the technology and ceramics sector especially, while the amount in the chemical and food sectors remained stable during the period 2007–2012.

Figure 3 shows the sectoral breakdown of the covered primary energy consumption to the extent that the annual monitoring data covered all participants.

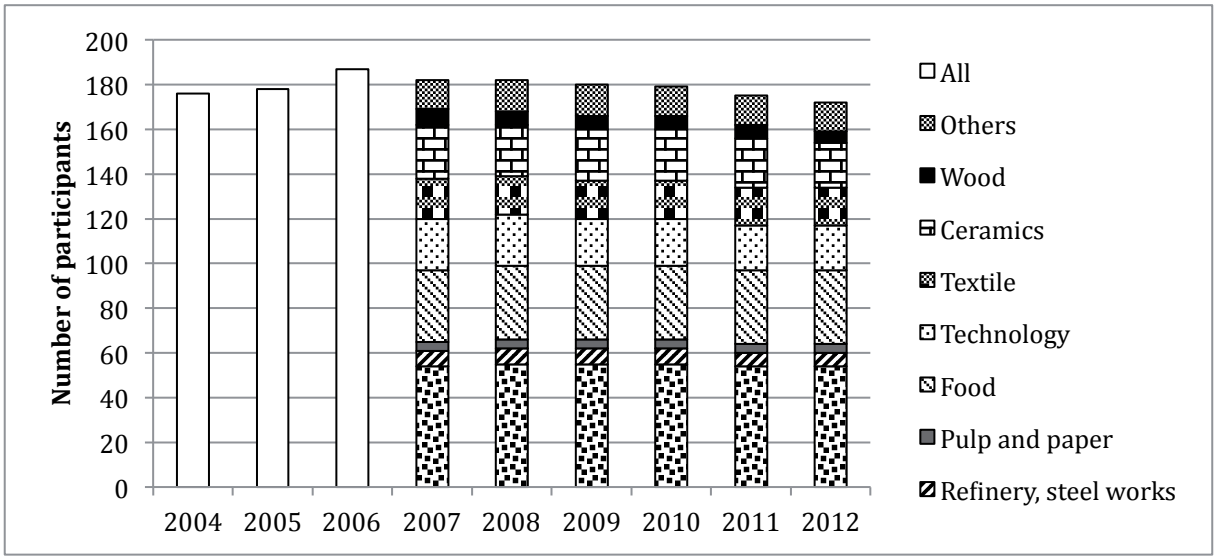

Figure 2. Evolution and sectoral breakdown of the number of participants to the Benchmarking Covenant.

Two sectors account for 80 % of the energy consumption of the participants: the chemical sector and refineries and steel works. Especially the latter group is very energy intensive as these seven companies account for about 35 % of the primary energy consumption of the participants. The average primary energy consumption of the refineries and steel works amounts to 30 PJ/participant, much higher than the average primary energy consumption of the chemical sector and pulp and paper amounting to 4.3 PJ/participant. This is in turn much higher than the average primary energy consumption of the other sectors: 0.75 PJ/participant on average, ranking from 1.5 PJ/participant for the technology sector to 0.32 PJ/participant for ceramics sector.

The total primary energy consumption stabilised between 2004 and 2007, although the number of participants increased. In 2008, the energy consumption declined as a consequence of the impact of the global financial crisis. Especially the year 2009 is earmarked by the significant decline with 13 % in primary energy consumption. From 2010 on, the total primary energy consumption declines in line with the declining number of participants and also due to declining production volumes. As Figure 4 indicates, the production levels dropped significantly in 2009 in all the sectors. The production levels of the sectors technology, wood and textile did not recover afterwards to the pre-2008 levels.

DETERMINATION OF THE WORLD'S LEADING EDGE

In 2003–2004, the world's leading edge for every individual process installation is determined for the first time. Figure 5 shows how the specific energy consumption of the world's leading edge relate to the specific energy consumption of the process installation at the start of the covenant. Values above 100 % indicate that the process installations in 2002 are more energy efficient than the world leading edge. On average, the participants of the Benchmarking Covenant are more energy efficient at the start of the covenant in 2002. Some sectors had

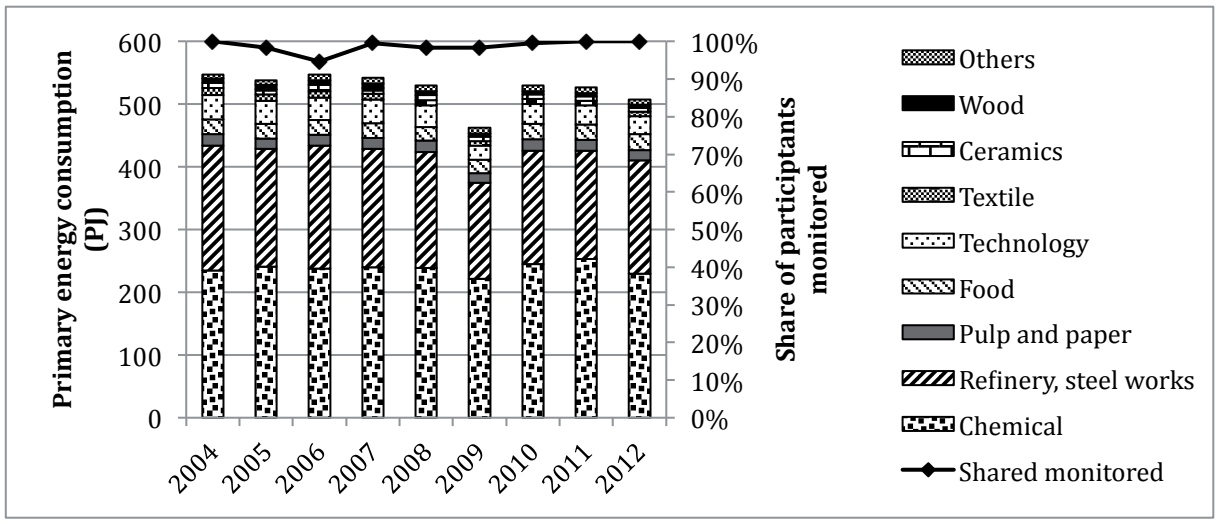

Figure 3. Evolution and sectoral breakdown of the primary energy consumption covered by the Benchmarking Covenant.

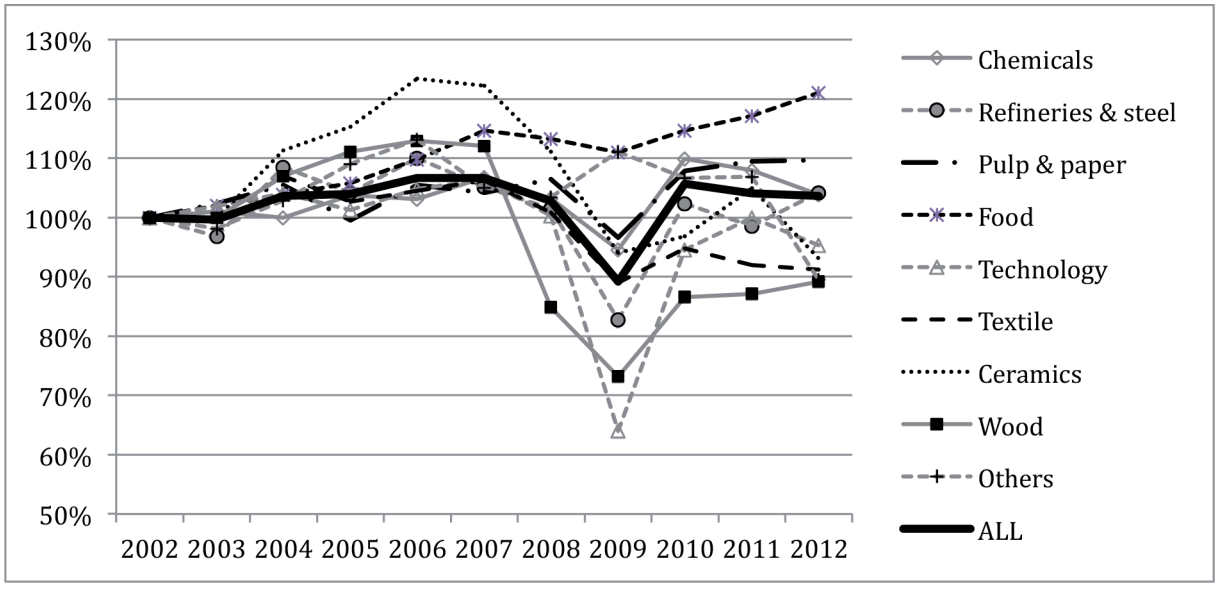

Figure 4. Evolution of the sectoral production levels of the benchmarking companies (2002 = 100 %).

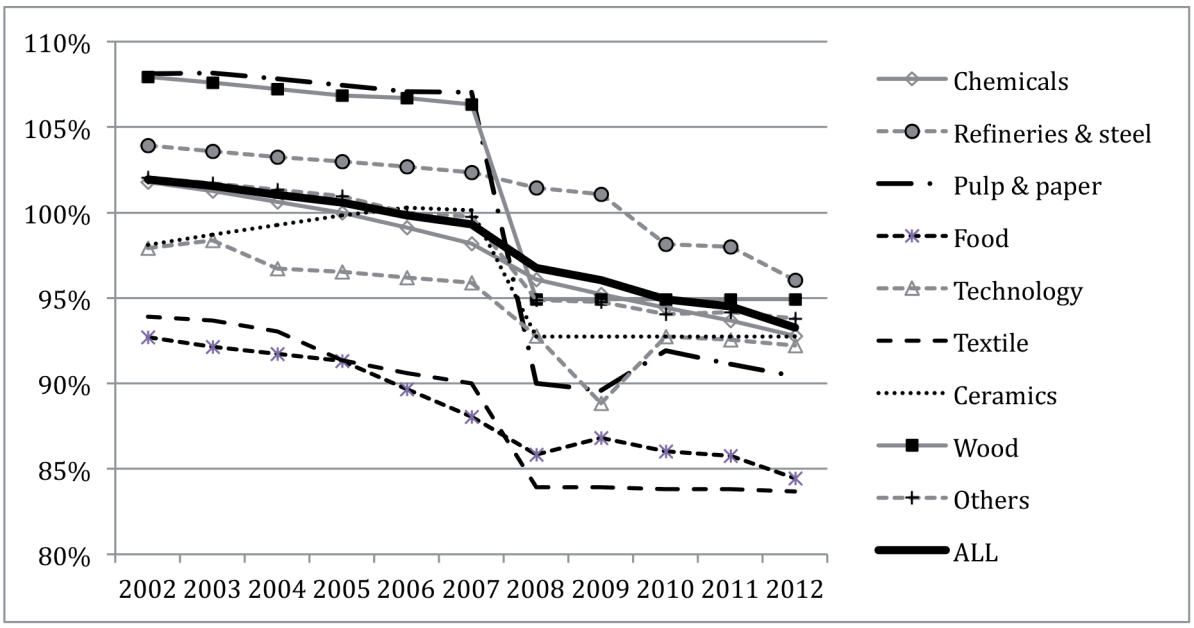

Figure 5. Evolution of the specific energy consumption of the world's leading edge.

a lower energy efficiency, especially the food and textile sectors.

In 2008, the world's leading edge for every individual process installation is updated. This update results in a significant lower specific energy consumption for the world's leading edge for some sectors; such as the pulp & paper, wood and to a lesser extent the food industry. This means that the participants of these sectors need to implement additional energy saving measures to reach the world's leading edge by 2012. On average, the specific energy consumption of the world's leading edge at the end of the covenant is 7 % lower than the specific energy consumption of the participants at the start of the covenant.

A survey amongst the participants of the Benchmarking Covenant assessed their experiences in selecting the appropriate benchmarking method, the determination of the world's leading edge for their process installation and the determination of the autonomous evolution of the energy efficiency of the world's leading edge. The survey was conducted in 2008 and 135 companies out of the 183 returned the questionnaire (response rate of 79 %).

About two in three respondents indicated to experience no significant problems in selecting the appropriate benchmarking method and in determining the world's leading edge. Almost half of the respondents on the other hand indicated having experienced difficulties to determine the autonomous evolution. This was especially the case for the less energy-intensive companies who applied the energy audit approach [Benchmarking Commission, 2008b].

MONITORING RESULTS: ENERGY EFFICIENCY IMPROVEMENTS

A voluntary agreement needs a metric to monitor the progress in energy efficiency. The BCC and the BCVO opted at the start of the covenant for an absolute metric: the evolution of the monitored energy consumption of participating companies. This monitored energy consumption is compared with the energy consumption if their specific energy consumption would be the same as the world's leading edge and with the planned energy consumption after implementation of the mandatory energy saving measures to reach the world's leading edge. In order to filter out the variation in production volumes, this comparison was presented twice. A first time with the real production volumes and a second time with the production volumes fixed at the 2002 level.

This approach shows to be a challenging one. The sample of monitored participants vary from year to year as the covenant welcomes new entrants or witnesses companies resigning from it. In order to keep the monitored trend consistent, new entrants have to provide an energy consumption history from 2002 on, while resigned companies are kept in the statistics.

In 2005 and 2006, the monitored improvement of the energy efficiency is lower than the planned improvement of the energy efficiency. The BCVO concludes that fixing the production levels at the 2002 level results in an underestimation of the energy efficiency improvement. Especially the artificially fixing of the production levels at their 2012 performance of old and less efficient process installations, that are in the meanwhile stopped or reduced in activity, contributes to this underestimation. The BCC and the BCVO decides in 2008 to use the most recent year instead of 2002 to filter out the effect of varying production levels, see Figure 6 [Benchmarking Commission, 2007; Benchmarking Commission, 2008].

In 2009, a relative metric, the Energy Efficiency Index (EEI) is introduced. The EEI relates the energy consumption of a specific year to the amount of energy that would have been consumed if the specific energy consumptions would not have improved since 2002 [Benchmarking Commission, 2009]:

$$\mathrm{EEI}_y = \frac{\sum_{i=1}^{n}\left(\mathrm{SEC}_{i,y}^{P/M}.PV_{i,y}^{M}\right)}{\sum_{i=1}^{n}\left(\mathrm{SEC}_{i,2002}^{P/M}.PV_{i,y}^{M}\right)}\times 100$$

With:

EEI	energy efficiency index
y	year
i	number of process installation
SEC	specific energy consumption
P/M	taking the planned (P) of the monitored (M) specific energy consumption into account
PV^M	monitored production volume

From 2009 on, this EEI was used to monitor the progress of the participants to the Benchmarking Covenant in improving the energy efficiency. Figure 7 shows the evolution, based on the most recent monitoring results and compares the EEI to the world's leading edge in 2012. From 2002 to 2007, the average EEI improves with 5 %. In 2008 and 2009, the EEI deteriorates. This is a result of production volume drops (see Figure 4), a consequence of the global financial crisis, while a significant part of the energy consumption is independent from the production volumes. The EEI improves again from 2010 on when the production volumes recover. Finally, in 2012, the average EEI amounts to 92 %, which is lower than the world's leading edge (93 %).

There are sectoral differences both in the effect of the global financial crisis as well as in reaching the world's leading edge, as Figure 7 illustrates. The food sector has the highest improvement in EEI, totalling up to -18 %. Its production volumes are also hardly affected by the global financial crisis. The deterioration of the EEI of the wood sector, on the other hand, is very pronounced, in line with the drastic decline in production volumes. In 2012, the EEI of the wood sector plunges

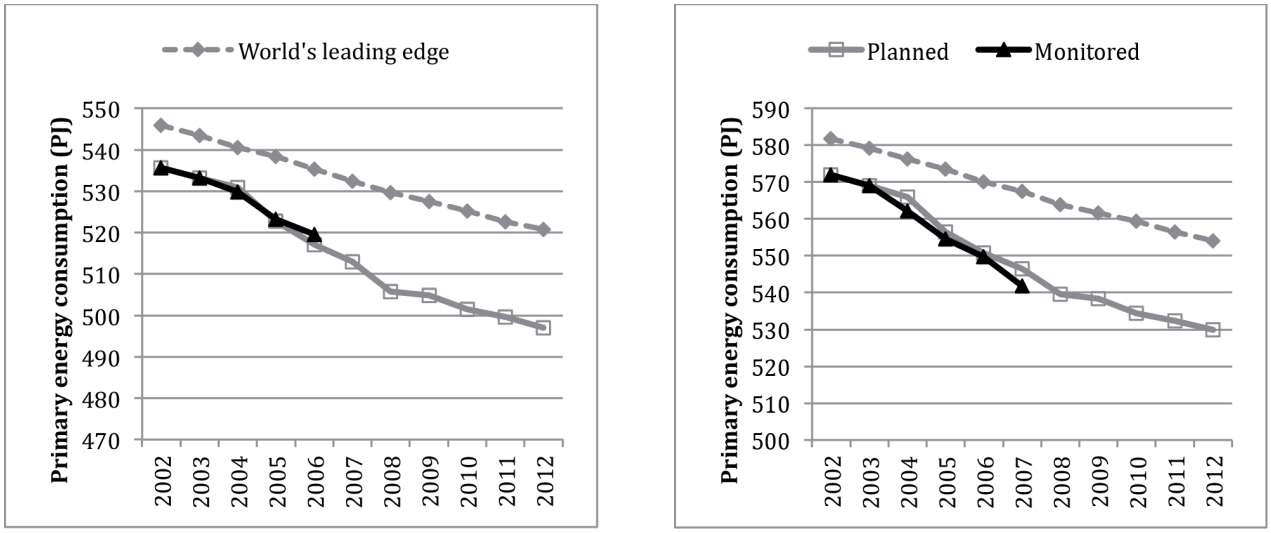

Figure 6. Left: monitoring results 2006 at constant production level of 2002 – Right: monitoring results of 2007 at constant production level of 2007.

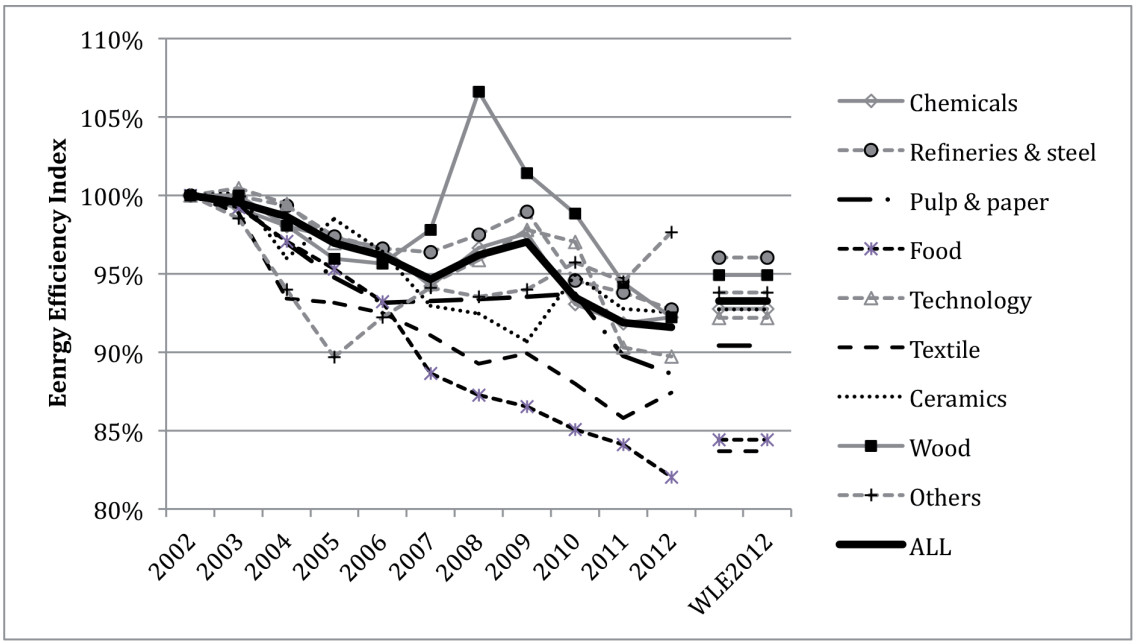

Figure 7. Evolution of the Energy Efficiency Index, comparison with the specific energy consumption of the world's leading edge (WLE) at the end of the covenant.

below the world's leading edgy. Two sectors have in 2012 an EEI that is higher than the world's leading edge: the textile sector and others, both as a result of a decline in production volumes in 2012.

The monitoring results of 2012 indicate that in total 28 companies of the 172 have an EEI above their world's leading edge. In the meanwhile, the Flemish Government decided to prolong the Benchmarking Covenant until the end of 2014 in order to organize a smooth transition from the current Benchmarking Covenant to a new voluntary agreement on energy efficiency in industry, the Energy Governance Agreement. That gives these 28 companies extra time to implement additional energy saving measures. Once the Energy Governance Agreement will be approved and the Benchmarking Covenant ends, the final number of process installations with a remaining deviation from the world's leading edge can be determined. The companies operating these process installations then have to implement additional measures, i.e. they have to compensate their deviation by purchasing emission allowances on the carbon market [Benchmarking Commission, 2013].

Table 2 compares the monitored decrease in primary energy consumption with the aggregated energy savings of the individual savings, reported from 2008 to 2012. The primary energy savings of the monitored measures amount to 21.5 PJ. This is below the decline in energy consumption when taking the real production levels into account (32.2 PJ), but higher than the decline in energy consumption when keeping the production levels constant at the 2012 level (17.0 PJ). It is unclear to what extent variation in production volumes is taken into account when estimating the effect of the individual energy saving measures. Hence, we cannot conclude whether the effect of the individual energy saving measures is overestimated, would be the case if constant production levels are taken into account, or underestimated, would be the case if real production levels are taken into account.

MONITORING RESULTS: CO_2 REDUCTIONS

The prime aim of the Benchmarking Covenant is to reduce CO_2 emissions. In 2002, the expectation is that the Benchmarking Covenant would result in a CO_2 reduction of 410 kton in 2005 and in a CO_2 reduction of 2,185 kton in 2010, both compared to 2002 [Taskforce Climate Policy Flanders, 2003].

According to the monitoring results of 2012, the Benchmarking Covenant resulted in 4.36 Mton CO_2 reductions, which is higher than the expected reductions. It should be noted however that in 2002 about 80 companies were expected to accede the Benchmarking Covenant, whereas the monitoring results of 2012 cover 172 companies.

Design of the Auditing Covenant

POLITICAL ACCEPTANCE

The Auditing Covenant is proposed by the Flemish Government within the framework of the first Flemish Climate Policy Plan 2002–2005 just as the Benchmarking covenant. It is a vol-

Table 2. Energy savings of the individual measures of the benchmarking covenant compared to decrease in primary energy consumption (at real production levels and at production levels fixed at the 2012 level).

PJ	Energy savings of individual energy saving measures	Monitored decrease in primary energy consumption with real production levels	Estimated decrease in primary energy consumption with production levels kept at 2012 level
2008	3.5	11.0	-8.7
2009	6.0	77.2	-13.2
2010	13.5	11.6	6.5
2011	19.5	28.6	15.3
2012	21.5	32.2	17

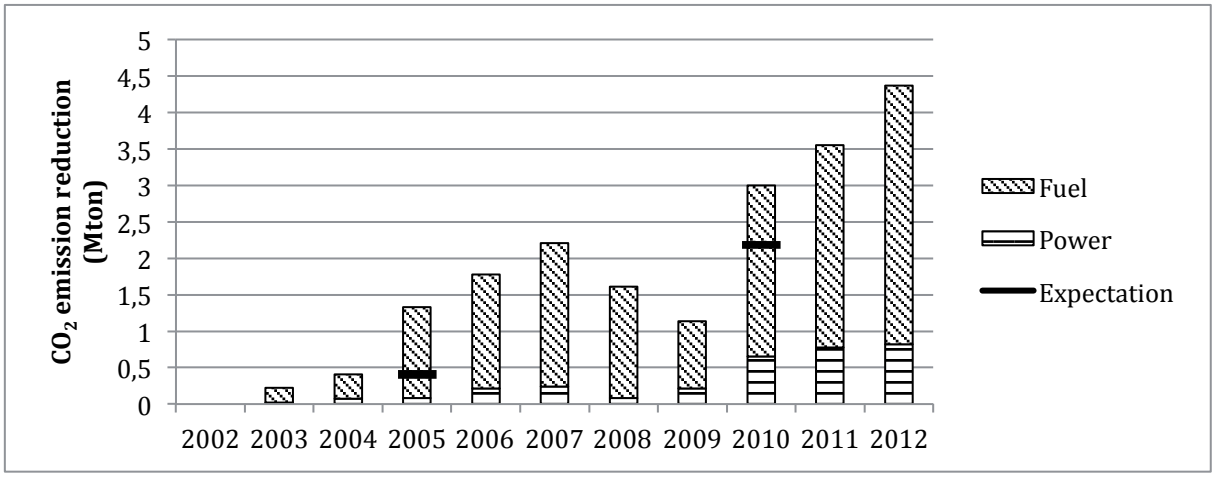

Figure 8. CO_2 reductions of the Benchmarking Covenant.

untary agreement, like the Benchmarking Covenant inspired by a Dutch example, the Dutch Long Term Agreements.

The Auditing Covenant is approved by the Flemish Government in 2005. The Auditing Covenant will operate for eight years, officially ending on Dec 10th, 2013. This end date is also extended to the end of 2014 at the latest in view of the start of a new Energy Governance Agreement for non-ETS-companies. The Flemish Government expected to save 10 % of primary energy by 2013 compared to a business-as-usual scenario [Ministry of Energy, 2005; Commissie Auditconvenant, 2008a].

TARGET GROUP OF THE AUDITING COVENANT

The Auditing Covenant specifically targets medium-sized industrial companies, more particularly industrial companies with an annual primary energy consumption of between 0.1 and 0.5 PJ and that are not covered by the European ETS. The upper limit coincides with the lower accession limit of the Benchmarking Covenant. The lower limit is copied from the Decree on Energy Planning.

This Decree on Energy Planning is approved in 2004 by the Flemish Government. It is an implementation of the amended European IPPC-Directive (96/61/EC) and obliges companies, from industry and other sectors, with an annual primary energy consumption of 0.1 PJ or higher, to make an energy plan when applying for a renewal of their environmental permit. The energy plan must consist of an analysis of the energy consumption of the site and must list all energy saving measures that can be implemented in the company. All measures with an IRR of 15 % or higher must be implemented within three years of the approval of the energy plan.

The Auditing Covenant is further limited to industrial companies, whereas the Decree on Energy Planning is mandatory for all companies from all sectors with an annual primary energy consumption of 0.1 PJ or higher. This limitation is in view of the significance of industry in energy consumption and also to limit the administrative burden of this policy instrument.

About 286 companies are believed to be eligible to accede the Auditing Covenant [Ministry of Energy, 2005]. Those companies are given the opportunity to accede to the Auditing Covenant until Dec 10th, 2005, six months after the final approval of the covenant by the Flemish Government. After that date, eligible companies can no longer accede. Only companies of which the primary energy consumption evolve between 0.1 and 0.5 PJ can accede the covenant from 2006 on.

OBLIGATIONS UNDER THE AUDITING COVENANT

The Audit Covenant starts from a bottom-up approach aiming at the economic potential of energy savings in the companies. For that purpose, participants of the Auditing Covenant have to make an energy plan in a manner similar to that stipulated by the Decree on Energy Planning. However, they have to make the energy plan in the first year following their accession to the covenant, whereas the Decree on Energy Planning requests such an energy plan at the occasion of the renewal of the environmental permit. As an environmental permit is valid for twenty years, the Auditing Covenant is hence an accelerated implementation of the Decree on Energy Planning.

Under the Covenant, the energy plans must be drafted by an external energy expert. In case the participants want to draft the energy plan themselves, it must be validated and approved by an external energy expert.

As with the Decree on Energy Planning, all energy saving measures with an IRR of 15 % or higher must be implemented. There is a difference in timeline for implementation: within four years of approval of the energy plan in the case of the Auditing Covenant compared to three years for the Decree on Energy Planning.

By June 10th, 2009, exactly four years after the approval of the Auditing Covenant by the Flemish Government, all participants have to submit a reviewed energy plan. All energy saving measures with an IRR of 13.5 % or higher – compared to the 15 % from the first energy plan – has to be implemented within four years of approval of the energy plan.

Finally, each year by the 1st of April, participants must submit a monitoring report, detailing the energy consumption of the previous year, the evolution of specific energy consumption indices and the progress made in implementing the mandatory energy saving measures.

COMPENSATION FROM THE FLEMISH GOVERNMENT

Some advantages, offered to the participants of the Auditing Covenant, are similar to those offered to the participants to the Benchmarking Covenant:

- The guarantee that no additional measures or policies on rational energy use or greenhouse gas (GHG) emissions reduction, specifically energy or CO_2 taxes, will be imposed on the participants.
- The commitment of the Flemish Government to take all possible steps to exempt the participants of the Auditing Covenant from additional measures on energy efficiency or GHG emission reduction at the federal or European level.
- Tax reductions on electricity and some fuels, in the event that the participant can demonstrate they have fulfilled their obligations under the covenant.

In contrast to the Benchmarking Covenant, companies of the target group that decided not to accede the Auditing Covenant are not excluded from grant of the ecology premium scheme, but their projects are less prioritised compared to the projects of the participants of the Auditing Covenant. Granting free CO_2 allowances is not an issue here as the Auditing Covenant targets non-ETS companies.

ADMINISTRATION OF THE AUDITING COVENANT

The Auditing Covenant is administered in a similar way as the Benchmarking Covenant, with an Auditing Covenant Verification Office (ACVO) having similar tasks as the BCVO and an Auditing Covenant Commission (ACC) having similar tasks and a similar composition as the BCC. Both verification offices work closely together. The staff of the ACVO consists of a manager, 7 experts and 1 administrative assistant. The ACC issued 6 clarifications to the Auditing Covenant, mainly on practical issues related to the energy plans and monitoring reports.

Operation of the Auditing Covenant

NUMBER OF PARTICIPANTS AND INDUSTRIAL ENERGY CONSUMPTION COVERED

By Dec 10th, 2005, 229 industrial companies had acceded to the Auditing Covenant. In 2005, they consumed 44 PJ primary. Together they represent about 10 % of total industrial energy consumption [Commissie Auditconvenant, 2006 and 2008].

The food and fodder sector has the highest number of participants, followed by chemistry and plastics and the technology sector, see Figure 9. 'Others' groups companies manufacturing mineral products or paper products, printing industry and waste treatment industries.

From 2006 until 2008, the total number of participants hardly varied, although the covenant welcomed newcomers while some participants resigned. From 2009 on, the number of participants started to decline to 214 in 2013; 17 participants less than in 2008. The sectors with the highest decline in the number of participants are the technology sector (from 47 to 39), textile and wood (from 33 to 25) and others (from 22 to 19).

Figure 10 shows the evolution of the primary energy consumption of participants and its sectoral breakdown. Its decline is in line with the declining number of participants, but is also influenced by the effect of the energy saving measures and by the drop in production volumes, a consequence of the global financial crisis.

As Figure 11 indicates, the production level dropped in 2009 in all sectors as a result of the global financial crisis, however to a lesser extent than at the participants of the Benchmarking Covenant, as the comparison between Figure 4 and Figure 10 reveals. In this Auditing Covenant, there are sectoral differences in decline as well. There is hardly a decline in the food &

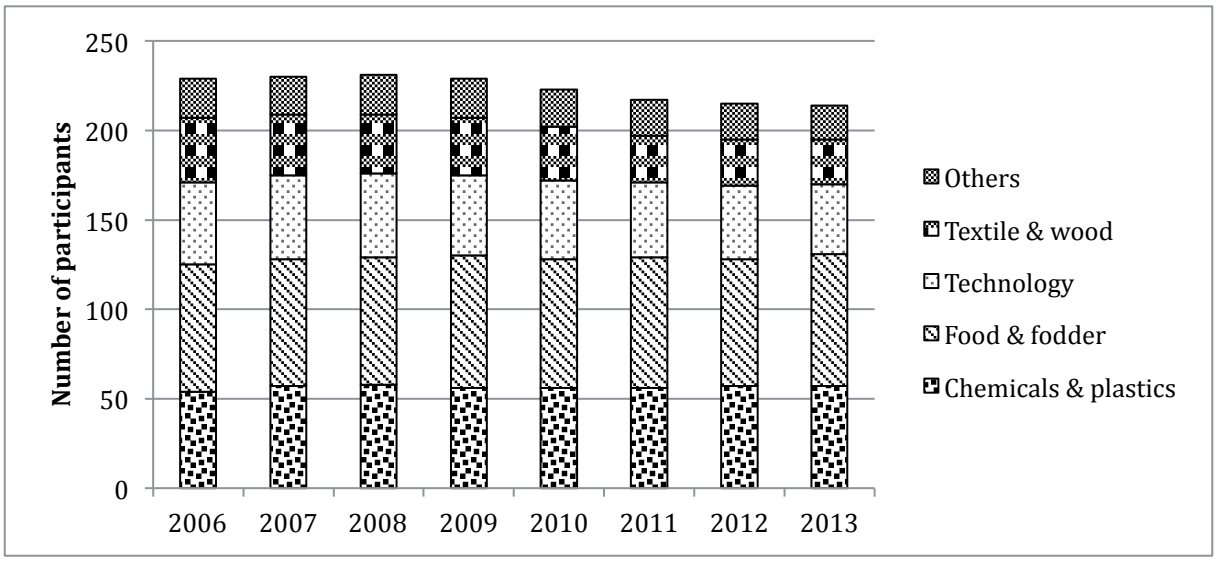

Figure 9. Evolution and sectoral breakdown of the number of participants to the Auditing Covenant.

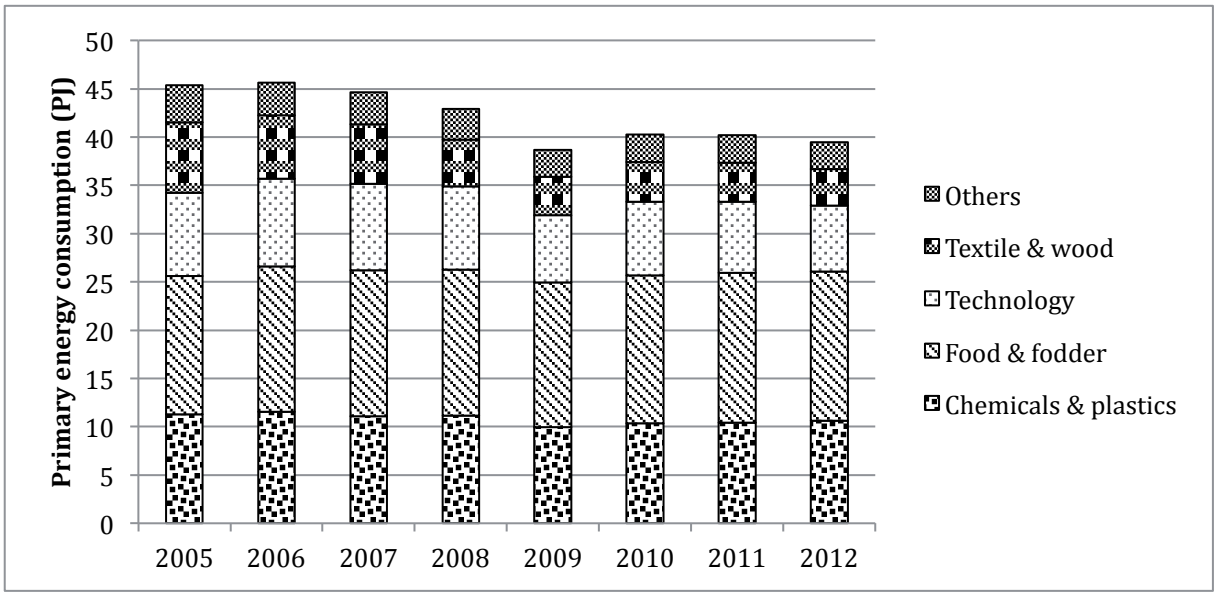

Figure 10. Evolution and sectoral breakdown of the primary energy consumption of participants to the Auditing Covenant.

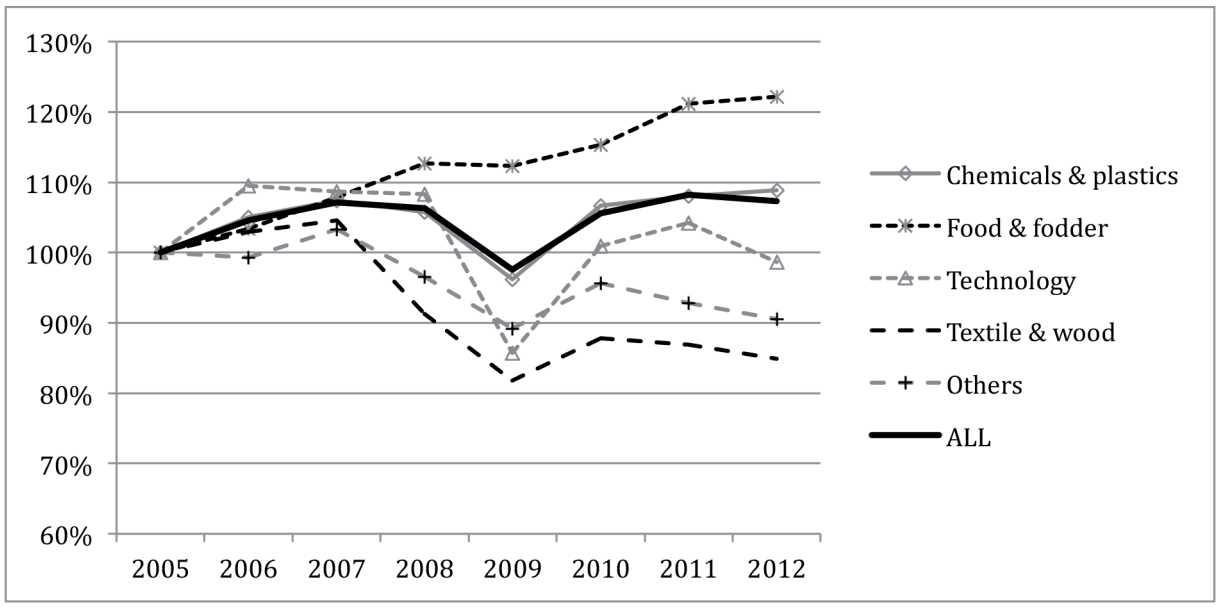

Figure 11. Evolution of the sectoral production levels of the participants to the Auditing Covenant (2002 = 100 %).

fodder sector on the one hand and a substantial decline in the sectors technology and textile & wood on the other hand. In 2012, the production indices of the textile & wood sector and others was still below the 2005 reference level.

DETERMINATION OF ENERGY SAVING POTENTIAL

Table 3 summarises the results of the energy audits from the energy plans, drafted in 2006 at the start of the Auditing Covenant, and from the updated energy plans, drafted in 2009 [Cornelis and Reunes, 2012]. The energy savings are categorised according to level of commitment:

- Committed: these are energy saving measures with an IRR of 15 % or higher (13.5 % or higher in Energy Plan 2009) and with a proven technical feasibility; these are mandatory measures that the participants must implement;
- Potentially feasible: these are energy saving measures with an IRR of 15 % or higher (13.5 % or higher in Energy Plan 2009) but whose technical feasibility needs further assessment;
- Unfeasible: energy saving measures with an IRR is less than 15 % (13.5 % or higher in Energy Plan 2009).

And according to kind:

- Non-process related measures: good housekeeping measures or improvement of the energy efficiency of utilities, such as steam, compressed air, …
- Process related measures: improvement of the energy efficiency of process equipment, such as furnaces, reactors, product processing machines, …

The energy saving measures from the 2006 energy plan would have altogether saved 4.7 PJ of primary energy, if they were all implemented. This is slightly higher than the expected energy savings of the Auditing Covenant, being 10 % of the total reported energy consumption of the participants for 2005 (44.4 $PJ_{primary}$). However, the aggregated energy savings of the mandatory or committed measures amounts to 2.0 PJ primary energy per year only. Hence, reaching the expected energy savings of 4.4 PJ primary was at risk.

Analysis of the first energy plans reveal that the proposed energy saving measures focuses on efficiency improvements of utilities. Less attention is devoted to optimization of the production processes or operations. In order to ascertain that the objectives of the Auditing Covenant would be achieved, the Auditing Covenant Commission urges participants to focus specifically on process optimization when carrying out the energy audit for the second energy plan in 2009 [Commissie Auditconvenant, 2008a]. However, soon after these directives were issued, the banking crisis began.

In the energy plan of 2009, new energy saving measures are presented, corresponding to a cumulative annual energy saving potential of 3.8 $PJ_{primary}$/year, which is 18 % less than the cumulative energy savings from the energy plan of 2006. Also the number of proposed measures is 18 % lower. The committed energy saving measures from the energy plan of 2009 would save altogether 1.7 $PJ_{primary}$/year. Added to the cumulative energy savings of the implemented and planned measures from the amended energy plan of 2006, 4.9 $PJ_{primary}$/year would be saved. This means that the expected energy savings objective of 4.4 PJ would be met.

The analysis of the energy saving measures indicates that the focus in the second energy audit, conducted in 2008–2009, indeed shifts from non-process to process-related energy saving measures. In the energy plan of 2006, only 45 % of the cumulative energy saving potential could be allocated to process optimization and more than half of it was indicated as potentially feasible. In the energy plan of 2009, the share of process-related energy saving measures amounted to 59 % [Cornelis and Reunes, 2012].

MONITORING RESULTS: ENERGY EFFICIENCY IMPROVEMENTS

For monitoring the progress in improving the energy efficiency within the Auditing Covenant, lessons are learnt from the experiences of the Benchmarking Covenant and it is decided to use

Table 3. Summary of the measures proposed in the energy plans of 2006 and 2009 according to level of commitment and kind of measure.

	Level of commitment	Kind of measure	Number of energy saving measures		Cumulative annual energy savings [PJ_{pr}/year]		Share within cumulative annual energy savings	
Proposed in Energy plan 2006	Committed (IRR>15 %)	Non-process	1049	1334	1.247	1.997	27 %	43 %
		Process	285		0.750		16 %	
	Potentially feasible	Non-process	509	809	1.183	2.298	25 %	49 %
		Process	300		1.115		24 %	
	Unfeasible (IRR<15 %)	Non-process	141	181	0.149	0.359	3 %	8 %
		Process	40		0.210		5 %	
	TOTAL		**2324**		**4.655**		**100 %**	
Proposed in Energy plan 2009	Committed (IRR>13.5 %)	Non-process	592	1104	0.712	1.668	19 %	43 %
		Process	512		0.956		25 %	
	Potentially feasible	Non-process	278	640	0.734	1.891	19 %	49 %
		Process	362		1.158		30 %	
	Unfeasible (IRR<15 %)	Non-process	95	162	0.144	0.290	4 %	8 %
		Process	67		0.146		4 %	
	TOTAL		**1906**		**3.849**		**100 %**	

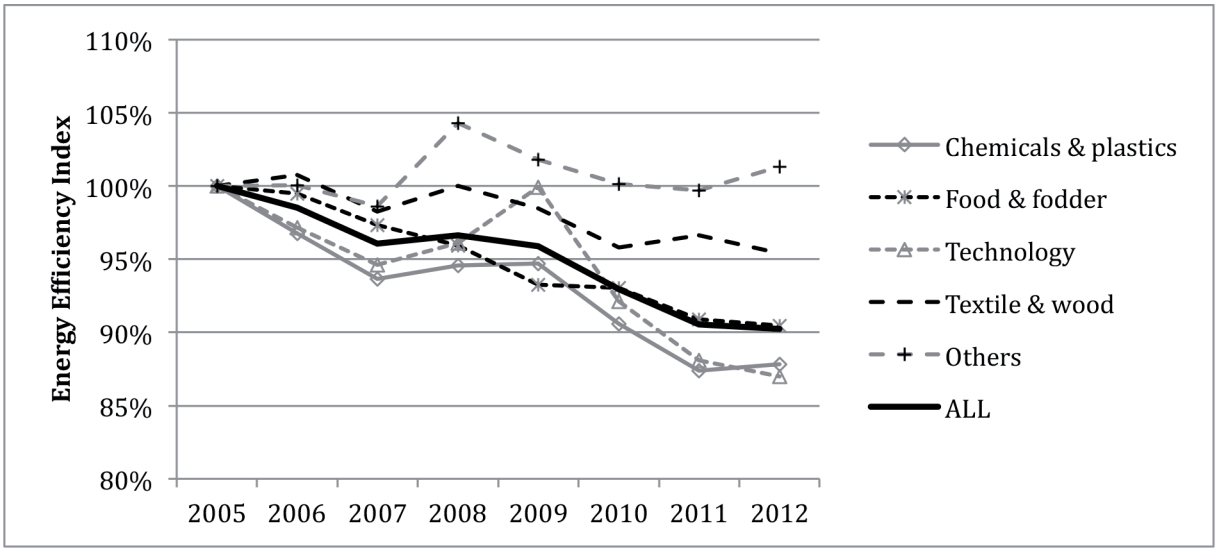

Figure 12. Evolution of the Energy Efficiency Index of the Auditing Covenant.

the same metric as in the Benchmarking Covenant: the Energy Efficiency Index (EEI).

As Figure 12 indicates, a 10 % improvement of the Energy Efficiency Index is achieved by 2012. The sectors chemicals & plastics and technology even have a EEI improvement of 13 %, whereas the EEI improvement of the textile sector is 5 % and the sector 'others' ends with a higher EEI. The modest results of the latter two sectors is a consequence of the fact that they still have not fully recover from the global financial crisis, as the evolution their product levels (see Figure 11) and the number of resigning companies from the Auditing Covenant (see Figure 9) illustrate. The EEI deteriorated in 2008–2009 in general as a consequence of the global financial crisis, however not to the same extent as for the Benchmarking Covenant.

Table 4 compares the aggregated energy savings of the individual measures to the realised energy savings, both when taking the real production levels into account and with production levels fixed at 2012 levels. The aggregated energy savings of the individual measures is estimated at 5.15 PJ primary per year. This is higher than the realized energy savings: 1.28 PJ primary/year when taking the real production levels into account and 4.27 PJ primary/year when fixing at 2012 level. This indicates that the aggregated effect of the individual energy saving measures is overestimated.

MONITORING RESULTS: CO_2 REDUCTIONS

The Auditing Covenant is proposed in a CO_2 emission reduction policy framework. In 2002, the expectation is that the Auditing Covenant would result in a CO_2 reduction of 122 kton in 2005 and in a CO_2 reduction of 550 kton in 2005, both compared to 2002 [Taskforce Climate Policy Flanders, 2003].

Table 4. Energy savings of the individual measures of the auditing covenant compared to decrease in primary energy consumption (at real production levels and at production levels fixed at the 2012 level).

PJ	Energy savings of individual energy saving measures	Monitored decrease in energy consumption with real production levels	Estimated decrease in energy consumption with production levels kept at 2012 level
2005	0.05	0.00	0.00
2006	0.34	-1.18	0.69
2007	1.14	-1.54	1.36
2008	1.85	-0.74	1.85
2009	2.87	4.57	1.72
2010	3.73	0.59	2.93
2011	4.45	0.84	4.16
2012	5.15	1.28	4.27

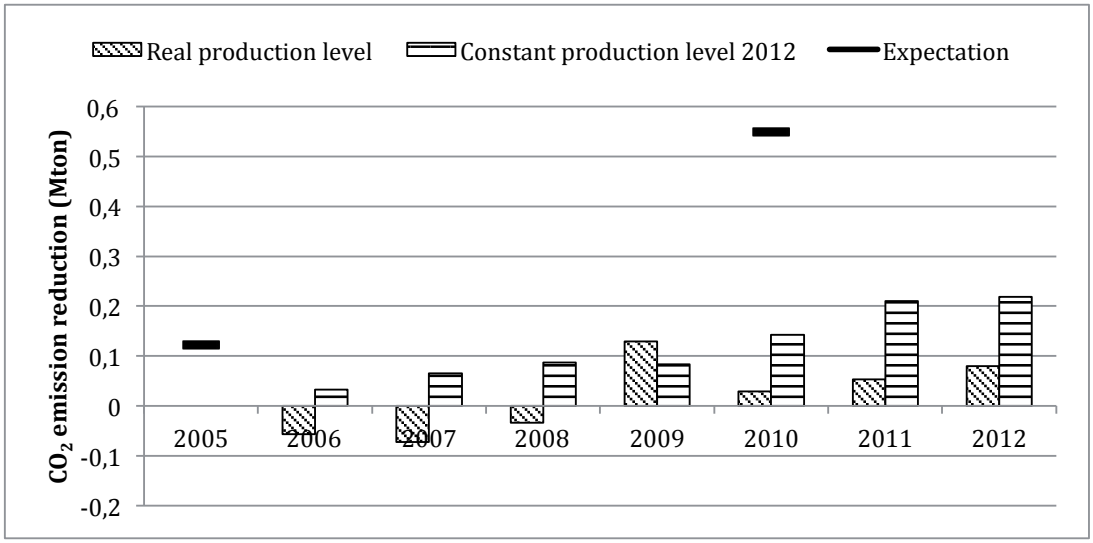

Figure 13. CO_2 reductions of the Auditing Covenant.

The actual CO_2 emission reductions at constant production level of 2012 amount to 0.22 Mton, see Figure 11. The CO_2 emission reductions at real production levels to 0.08 Mton. This is far below the reduction level that is expected from the Auditing Covenant. However, in 2002, it is expected that about 400 companies would accede the Auditing Covenant, while the monitoring results of 2012 cover only 209 companies.

Lessons learnt from both covenants

ON THE METRICS TO MONITOR THE PROGRESS IN VOLUNTARY AGREEMENTS ON ENERGY EFFICIENCY

There are different metrics to be used to monitor the energy efficiency improvement in a voluntary agreement. An absolute metric indicates the absolute energy savings. This metric might be an appropriate choice if the voluntary agreement has an absolute energy savings target. A relative metric focusses on the improvement of the specific energy consumption, which is the ratio between the energy consumption and an output figure. This is an appropriate choice in case of a relative energy efficiency improvement target.

Both approaches have been tested in the Benchmarking Covenant and both approaches face specific challenges. A first challenge is how to deal with the constant variation in the sample of the monitored companies, as companies resign from the covenant while other accede. Both impose challenges to keep the time series consistent. The Benchmarking Covenant first kept resigning companies in the statistics, but found out that this created a bias in the time series. So, it was decided to remove resigning companies from the statistics. Newcomers had to provide energy data from the start year of the covenant anyhow. In case these data could not be collected, a constant energy consumption or a constant specific energy consumption was assumed.

A second challenge is posed by the influence on production volumes, both on the absolute energy consumption and on specific energy consumption. In case the target of the covenant is expressed as absolute energy savings and the covenant ends in full crisis, the target of the covenant will be achieved easily, although the energy efficiency improvements might lag behind. In case the target of the covenant is expressed as specific energy consumption or energy efficiency improvements, and the covenant ends in full crisis, achieving the target of the covenant is at risk, as investments in energy efficiency will not pay off due to the reduction of production volumes. The evolution of the Energy Efficiency Index of the Benchmarking Covenant, and also to the Auditing Covenant to a lesser extent, demonstrates that risk. One should take this risks into consideration when de-

signing a voluntary agreement on energy efficiency and when selecting a metric to monitor its progress. Based on the lessons learnt during the global financial crisis, the new Energy Governance Agreements have introduced the concept of "excuse for economic reasons" (in Dutch: "economische pardonnabiliteit") that allows the participants to postpone the implementation of mandatory measures, in case their implementation would jeopardize the competiveness of the company.

Another approach to monitor the energy efficiency improvement in a voluntary agreement is to aggregate the energy savings of the implemented energy saving measures. This approach is applied now in the Dutch long term agreement LTA3 for non-ETS-companies [Abeelen, 2013]. Experience from the Auditing Covenant indicates that the aggregation of the energy savings of the individual measures tends to an overestimation of the energy savings at company level. One should take this risk of overestimation in consideration when selecting such a metric to monitor the energy efficiency improvement of a voluntary agreement on energy efficiency.

ON WHETHER TO IMPOSE AN ENERGY EFFICIENCY TARGET OR COMMITMENT TO TAKE ACTION

When designing both covenants, the Flemish Government was confronted with the question whether to impose the participants an energy efficiency target, they have to achieve at the end of the covenant, or a commitment to take actions that enhance the energy efficiency of their installations.

For the Auditing Covenant, the Flemish Government opted for the second option. The covenant imposes the participants to carry out an energy audit and to implement energy saving measures with a minimum internal rate of return (IRR). This approach reckons the progress first movers have made in energy efficiency before acceding the covenant. They might have a limited list of mandatory energy saving measures they must implement, but still respect their obligations under the covenant.

The Benchmarking Covenant imposes the participants, by design, an energy efficiency target. This target is not prescribed in forehand by the covenant, nor in absolute or relative terms, but needs to be estimated for every sector individually at the start of the covenant and to be updated halfway. For many participants, however, especially the less energy-intensive ones, this target is determined by auditing. These participants have hence in essence a commitment to take action as well, just like the participants of the Auditing Covenant.

The new Energy Governance Agreements, that will succeed the Benchmarking and Auditing Covenant, both have the commitment approach that is very similar to that of the Auditing Covenant. They impose all participants to carry energy audits and to implement energy saving measures with a minimum IRR. There is only a difference in minimum IRR between ETS-participants and non-ETS-participants: 14 % for the former – 12.5 % for the latter. The difference attempts to take the cost of CO_2 allowances into account. With this choice, not only the target approach is abandoned but also the benchmarking approach. This approach has been abandoned already in the Netherlands when the Benchmarking Covenant stopped in 2009 [AgentschapNL, 2012].

Should a voluntary agreement, which imposes mandatory actions to its participants, have itself an energy efficiency target? One would argue that such an overall target for the voluntary agreement as a whole will conflict with the individual actions the individual participants must take and hence cannot be imposed. Another would argue that the voluntary agreement is a policy instrument within the Member State's policy to fulfil its energy efficiency obligation. The Member State hence needs to estimate the energy savings as a result of the voluntary agreement ex-ante. This estimation can later be used in an ex-post evaluation of the voluntary agreement to assess whether it has delivered what was expected.

The Auditing Covenant has an overall energy efficiency target. This target is not an official one but an indicative one as the commitments of the participants to take actions have priority. That indicative target revealed anyhow that the identified energy savings in the first phase would not deliver enough and stimulated the Auditing Covenant Commission to urge the participants to focus on process optimisation in the second phase, which the participants eventually did.

ON THE RELATION BETWEEN THE ACHIEVED ENERGY EFFICIENCY IMPROVEMENTS AND THE ENERGY-INTENSITY OF COMPANY

Table 5 examines the relationship between the achieved energy efficiency improvement and the size of the company. The achieved energy efficiency improvement is indicated as the average decrease in energy efficiency index (EEI) per year, as this filters out the difference in duration of both covenants. The energy-intensity of the sector is given as the average primary energy consumption per participant. The average increase of the production volume since the start of the covenants has been added to the table in view of the strong correlation between the variation in production volumes and the decrease of the EEI.

Table 5 suggests a positive correlation between the decrease in average energy efficiency index per year and the energy-intensity of the sector: the less energy-intensive, the higher its decrease in EEI or the higher the improvement of the energy efficiency. This can be explained by the fact that the energy-intensive industry has a long tradition in energy management, in contrast with the less energy-intensive industry. Results of a survey amongst participants in 2008 confirms this [Benchmarking Commission, 2008b]. Some of the less energy-intensive participants of the Benchmarking Covenant and some participants of the Auditing Covenant started paying attention in a structural way to energy efficiency once they acceded the covenants, leaving a significant potential for low hanging fruit energy saving measures. The head start position of the energy-intensive participants of the Benchmarking Covenant compared with the world's leading edge and the lag of the less energy-intensive ones illustrates this.

The energy efficiency improvement of the benchmarking sectors refinery & steel works and chemicals, the first and third most energy-intensive sectors, amounts to about 0.8 %, which equals the default value for the autonomous development. This results might seem modest and might raise questions about the additionality of the Benchmarking Covenant. However, the covenant allowed both sectors to maintain this leading position. Moreover, two in three respondents of the survey carried out in 2008 support the covenant as an appropriate instrument to implement an energy efficiency industry. They state that the covenant has created a framework to embed and to enforce the energy efficiency policy of the company. The covenant also re-

Table 5. Average energy efficiency improvement per sector.

Covenant	Sector	Primary energy consumption / participant (2012) (PJ)	Average increase (decrease) of production volume	Average decrease of EEI per year
Benchmarking	Refinery, steel	30.1	0.42 %	-0.73 %
	Pulp & paper	4.3	0.97 %	-1.14 %
	Chemicals	4.3	0.39 %	-0.78 %
	Technology	1.5	-0.47 %	-1.03 %
	Wood	1.0	-1.1 %	-0.78 %
	Food	0.75	2.1 %	-1.80 %
	Others	0.62	-1.1 %	-0.24 %
	Textile	0.42	-0.88 %	-1.26 %
	Ceramics	0.32	-0.69 %	-0.75 %
Auditing	Food & fodder	0.22	3.2 %	-1.36 %
	Chemicals & plastics	0.19	1.3 %	-1.74 %
	Technology	0.17	-0.19 %	-1.86 %
	Textile & wood	0.15	-2.2 %	-0.66 %
	Others	0.14	-1.4 %	0.19 %

sulted in a higher priority to energy savings projects amongst other projects when discussing investment plans on the board of directors [Benchmarking Commission, 2008b].

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