Energy end-use policies and programs towards industrial SMEs – the case of Japan, Belgium, Spain and Sweden

IEA IETS Annex XVI Energy Efficiency in SMEs Task I

Patrik Thollander* Rogelio Zubizarreta Jiménez, Inés Morales, Osamu Kimura, Erwin Cornelis, Magnus Karlsson Mats Söderström, Sandra Backlund

1/14/2014
IEA IETS Annex XVI Energy Efficiency in SMEs

Executive summary

This report is part of Annex XVI Energy Efficiency in SMEs within the IEA Implementing Agreement IETS (Industrial Energy Technologies and Systems) and is the first out of four Tasks in the Annex, covering Energy policies and programs towards industrial SMEs. The Task was split into three Subtasks:

i. Description of the country specific context. Energy mix, overall country energy use, part of energy used by industrial SMEs, etc.

ii. Overview of policies and programs implemented including subsidies, administrative polices, energy audit checks, investment funds, networks, general information campaigns including self-scanning, and benchmarking methods (possibility for SMEs to compare their energy use).

iii. Feedback and outcomes. Overview of the experience, e.g. difficulties met during implementation of the program/policy, outcome in terms of energy saved in relation to, e.g. public money invested in the program and advantages/disadvantages with various designs (micro firms will also be included in this Subtask)

The major method used in answering Subtask I and Subtask II was a literature study, mainly country-specific reports and documents, mostly written in that countries native language. This makes this report unique as research shows that there is not only a scarcity in including industrial SMEs in national government energy end-use policies, but also that research results in the area is scarce.

In Subtask iii, the main method used was workshops. Four workshops have been held. One in Linköping, Sweden, 11th of May, 2011, yet another one in Linkoping, March 13-14th, 2012, and another one in Arnhem, Holland, September, 10-11th, 2012. Lastly, a final workshop was arranged in Malaga, Spain, 13-14th of May, 2013. However, even though this report only includes findings from four countries, a larger number of participants from 13 countries have contributed in these workshops, e.g. researchers from Austria, Brazil, Denmark, Finland, France, Germany, Italy, Norway, and Switzerland.

The report has not directly included supply side policy instruments like taxes (not energy end-use taxation either). The reasons for this, is mainly because focus is given on energy-end-use efficiency, not taxes on the supply and demand of energy. Even though, this may be questioned it has been an important means in order to try to delimit the project’s aim into focusing on energy end-use efficiency in industrial SMEs.

The report starts with presenting the overall country specific conditions for the countries, Japan\(^1\), Spain\(^2\), Belgium and Sweden (Chapter 2), and continuous with presenting the energy end-use policies for these countries (Chapter 3). Finally, the report ends with conclusions (Chapter four).

\(^1\) IETS in co-operation with Japan and Spain.
\(^2\) IETS in co-operation with Japan and Spain.
Some findings of the report are that the overall energy use among industrial SMEs in the studied countries is lower than larger and energy-intensive industry. Focusing on energy end-use efficiency, it may thus be questioned if industrial SMEs should be first priority? On the contrary, as shown in this report, the economic impact from industrial SMEs is of great relevance for a nation. Moreover, the cost-effectiveness of energy-end-use policy measures among industrial SMEs is often high, compared to large firms that may have already exploited low-cost potentials. Larger and energy-intensive companies have higher energy efficiency potentials in absolute terms, but many of these have implemented basic measures because they have sufficient management capability etc. to do so. So, if one just sees the availability of low-cost potentials of energy efficiency measures in the market, share of SMEs might in fact be high.

Moreover, the goal or aim with energy end-use policies may be seen as not only an attempt to improve energy end-use efficiency, but equally or perhaps more importantly support these firms in their long-term survival and success. In these regards, energy end-use efficiency in the longer run is of great importance as firms otherwise may face competitive disadvantageous in comparison with competitors from outside the country.

This report’s presentations of national contexts related to industrial SMEs, together with the national energy end-use policy presentations for the countries Japan, Spain, Belgium, and Sweden, reveals that policies directed towards industrial SMEs are limited, with the exception of Japan.

An attempt was made in order to try categorizing successful policies for improved energy end-use efficiency towards industrial SMEs. These suggestions are the ideas of the individual authors alone, and shouldn’t be seen as the ideas neither from IEA IETS, nor from the Participant’s research bodies. Moreover, the presented list is by no means conclusive but may rather be seen as an attempt to try to categorize and structure various policies directed towards industrial SMEs.

Industrial SMEs have a large diversity in energy use and energy management, and can be categorized into many segments by size and type of business. Among them, we think the following category has particular relevance: i) Medium-sized and energy-intensive industrial SMEs, and ii) Small-sized and non-energy-intensive industrial SMEs. The difference of the two segments are described in table 1.
Table 1. Some characteristics for industrial SMEs.

<table>
<thead>
<tr>
<th>Amount of energy used</th>
<th>Medium</th>
<th>Small</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human resource for energy management</td>
<td>Limited, but they usually have a couple of responsible engineers</td>
<td>Very limited, often without responsible personnel.</td>
</tr>
<tr>
<td>Type of technology</td>
<td>Production and support processes</td>
<td>Mainly support processes</td>
</tr>
</tbody>
</table>

Because the characteristics of in the two segments are different, different approaches are needed in improving their energy efficiency.

**i) Medium-sized and energy-intensive industrial SMEs**
They have in general a modest capacity to work on energy efficiency, so giving economic and/or regulatory incentives is important. This underscores for example regulation (like the Energy Conservation Law in Japan), or LTA/VA (like in Sweden) as effective policy measures. Yet another reason for those types of support is that these companies also have significant energy use for the production processes and for those measures, more support may be needed, e.g. energy audit programs, networks, investment subsidies etc.

**ii) Small-sized and non-energy-intensive industrial SMEs**
They do not in general have enough capacity to work with energy efficiency improvements, and are thus in need of a more supportive approach, e.g. assistance from external experts. Energy audit programs are effective, but should be complemented with networks where an experienced engineer supports the companies within the network.

The report ends with a list of suggested relevant polices for industrial SMEs to be considered among policy-makers:

**Medium-sized and energy-intensive industrial SMEs**
1. Energy Conservation Law/LTA/VA
2. Energy audit programs for industrial SMEs, preferably but not necessarily located regionally or locally
3. Energy networks (preferably locally or regionally anchored)
4. Investment subsidies mainly for investments in production-related technologies
5. Benchmarking
6. Sector guidelines
Small-sized and non-energy-intensive industrial SMEs

1. Energy audit program (preferably locally or regionally anchored)
2. Energy networks (preferably locally or regionally anchored)
3. Investment subsidy
4. Benchmarking
5. Sector guidelines
# Table of Contents

Executive summary ..................................................................................................................... i  
1. Introduction ........................................................................................................................ 4  
   1.1 Method and delimitations ............................................................................................ 4  
2. Country specific context ..................................................................................................... 6  
   2.1 Japan ............................................................................................................................ 6  
      2.1.1 Relevance of SMEs in Japanese economy ........................................................... 7  
      2.1.2 Relevance of SMEs in energy use ........................................................................ 8  
      2.1.3 Energy use in SMEs ........................................................................................... 10  
   2.2 Spain .......................................................................................................................... 11  
      2.2.1 Economic situation ............................................................................................. 11  
      2.2.2 Energy use .......................................................................................................... 13  
   2.3 Sweden ....................................................................................................................... 15  
   2.4 Belgium ..................................................................................................................... 17  
      2.4.1 Aggregated final energy use in Flanders ............................................................ 17  
      a. Flanders ..................................................................................................................... 17  
      b. Wallonia .................................................................................................................... 21  
      c. The Brussels Capital Region ..................................................................................... 23  
      2.4.2 Relevance of SMEs in the Belgian economy ..................................................... 26  
      2.4.3 Relevance of SMEs in energy use ...................................................................... 30  
3. Overview of policies and programs ................................................................................. 31  
   3.1 Japan .......................................................................................................................... 31  
      3.1.1 National goals ..................................................................................................... 31  
      3.1.2 Industrial energy end-use programs in Japan ..................................................... 32  
      3.1.3 Some examples of successful regional policies .................................................. 38  
   3.2 Spain .......................................................................................................................... 39  
      3.2.1 National goals ..................................................................................................... 39  
      3.2.2 Energy programs ................................................................................................. 39  
   3.3 Sweden ....................................................................................................................... 47  
      3.3.1 National goals ..................................................................................................... 47  
      3.3.2 Industrial energy end-use programs in Sweden, 1990-2011 .............................. 47  
      3.3.3 Swedish energy end-use industrial polices 1990-2011 ...................................... 48
3.3.4 Some examples of successful regional policies ................................................. 49
3.3.5 Policy summary.................................................................................................. 51
3.4 Belgium ..................................................................................................................... 52
  3.4.1 Regional goals .................................................................................................... 52
  3.4.2 Objectives from the first NEEAP ................................................................. 52
  3.4.3 Objectives from the second NEEAP ............................................................ 53
  3.4.4 Flanders – The Benchmarking Covenant ................................................... 56
  3.4.5 Flanders – The Auditing Covenant ............................................................... 58
  3.4.6 Flanders – The Energy Governance Agreement ....................................... 59
  3.4.7 Wallonia – The Sector Agreements “Energy / CO2” ................................... 60
  3.4.8 Subsidies for rational use of energy .............................................................. 61
4. Feedback and outcome ..................................................................................................... 64
  4.1 Administrative policies ......................................................................................... 64
  4.2 Information policies ............................................................................................ 65
  4.3 Economic policies ............................................................................................... 66
  4.4 Suggestion for policies directed towards industrial SMEs ................................. 67
5. References ....................................................................................................................... 69
1. Introduction

Energy policies towards industrial SME and non-energy-intensive industry has been scarce compared with policies and programs targeting large and energy-intensive industry (Ramires et al., 2005). Normally, energy audit programs are the most common means towards industrial SME and non-energy-intensive industry while towards large and energy-intensive industry, Long-Term Agreements (LTAs) or Voluntary Agreements (VAs) are common (Bertoldi, 2001).

Policies are normally categorized into four different types where many policies often include several of these types:

- Administrative, i.e. laws and regulations etc.
- Informative, i.e. information dissemination etc.
- Economic, i.e. subsidy, taxes, investment subsidies etc.
- Research and development, e.g. funding for pilot implementation of new technology before market launch

The first three types of policies has been the focus in this report. This report is part of Annex XVI Energy Efficiency in SMEs within the IEA Implementing Agreement IETS (Industrial Energy Technologies and Systems) IETS in co-operation with Japan and Spain, and is the first out of four Tasks in the Annex, covering Energy policies and programs towards industrial SMEs. The Task was split into three Subtasks:

i. Description of the country specific context. Energy mix, overall country energy use, part of energy used by industrial SMEs, etc.

ii. Overview of policies and programs implemented including subsidies, administrative polices, energy audit checks, investment funds, networks, general information campaigns including self-scanning, and benchmarking methods (possibility for SMEs to compare their energy use).

iv. Feedback and outcomes. Overview of the experience, e.g. difficulties met during implementation of the program/policy, outcome in terms of energy saved in relation to, e.g. public money invested in the program and advantages/disadvantages

1.1 Method and delimitations

In this report, the major method used in answering Subtask I and Subtask ii is a literature study, mainly country-specific reports and documents, mostly written in that countries native language. This makes this report unique as research shows that there is not only a scarcity in including industrial SMEs in national government energy end-use policies, but also that research results in the area is scarce. On the contrary, a criticism towards this may be stated to be that the report is merely a compilation of national findings. However, it is this very fact that makes a study like this of great interest because it is first when findings from one country may be compared with other nation’s energy end-use policies in regard to industrial SMEs. This may lead to findings of general nature, i.e. improve the validity of results.
In Subtask iii, the main method used was workshops. Four workshops have been held. One in Linköping, Sweden, 11th of May, 2011, yet another one in Linkoping, March 13-14th, 2012, and another one in Arnhem, Holland, September, 10-11th, 2012. Lastly, a final workshop was arranged in Malaga, Spain, 13-14th of May, 2013. However, even though this report only includes findings from four countries, a larger number of participants from 13 countries have contributed in these workshops, e.g. researchers from Italy, Switzerland, Brazil, Germany, the Netherlands, France, Norway, Denmark, Finland, and Austria.

The report has not directly included supply side policy instruments like taxes (not energy end-use taxation either). The reasons for this, is mainly because focus is given on energy-end-use efficiency, not taxes on the supply and demand of energy. Even though, this may be questioned it has been an important means in order to try to delimit the project’s aim into focusing on energy end-use efficiency in industrial SMEs.
2. Country specific context

In the following sections, answers to Subtask I is presented for the countries Japan, Spain, Sweden and Flanders, the northern part of Belgium, are presented.

2.1 Japan

The aggregated final energy use in Japan is approximately 14 EJ in 2010, 46 % of which is consumed by industrial sector, 24 % by transport, and 16 % by residential, and 13 % by commercial sector. Figure 1 shows evolution of final energy use of each sector. The Figure shows that industrial energy use has not increased since the late 1970’s due to the success of restructuring and energy efficiency measures after the oil crisis, while energy use in residential and commercial sectors keep increasing.

Breakdown of industrial energy use is presented in Figure 2. Japan has several energy-intensive industries which uses more than 70 % of the nation’s industrial energy use. Among them, iron and steel, chemical, and cement industries are the major ones.

Figure 1. Final energy use by sectors in Japan, 1965-2010. Source: EDMC, 2012.
In Figure 3, the Japanese industries’ energy intensity from 1965-2010 is presented, showing that the energy intensity of the manufacturing sector has decreased by 41% in 2010 compared to 1973 level.

2.1.1 Relevance of SMEs in Japanese economy

In Japan, Basic Law for SMEs defines industrial SMEs as enterprises less than 300 employees or 300 million JPY (Japanese Yen) of capital funds, while industrial small-scale enterprises as less than 20 employees. Number of SMEs in Japan is 4.2 million, comprising 99.7% of all the enterprises in 2006 (SME Agency, 2006). In Figure 4, trends of shares of SMEs in manufacturing sector are presented. It shows that, while manufacturing SMEs’

---

3 Equivalent for 1 million EUR, based on the exchange rate of 100JPY/EUR.
shares in firm number and employees have been declining, economic output of SMEs has been equal to that of large enterprises.

![Graph showing number of firms, number of employees, and shipment value over years.](image)

**Figure 4.** Share of SMEs in the manufacturing sector in Japan, 1995-2006. Notes: numbers in the graphs show SMEs’ share in 2006. 1), 2), 3) indicate enterprises with 4 - 19, 20 – 299, more than 300 employees, respectively. Source: SMEA, 2008.

### 2.1.2 Relevance of SMEs in energy use

How much energy is used by industrial SMEs? In Japan data of energy use of SMEs is limited. Although there are several statistics on economic activity of SMEs as well as those on energy end-use, there is no connection among those. Against this background, the government conducted an estimation of SMEs’ share in CO2 emission in 2010 (Figure 5). The Figure shows that share of SMEs in CO2 emission is 11 % in industrial sector and 9 % in manufacturing sector.

Considering that SMEs have almost 50 % share in shipment value of the manufacturing sector as shown in Figure. 4, the 9 % share of SMEs in CO2 emission seems quite low. This is because large firms are the dominant carbon emitters in energy-intensive industries, as shown by Figure 6, and because those industries have high shares in CO2 emission and energy use but have smaller shares in economic output, as shown by Figure 7.
Figure 5. Estimated CO2 emission from SMEs in industrial and commercial sectors in Japan. SMEs in this estimation are defined as enterprises less than 300 employees. Note: Non-manufacturing industrial sectors includes agriculture, forestry, fishery, mining, and construction. Source: adopted from SMEA, 2010.

Figure 6. Breakdown of energy CO2 emission from energy-intensive industries, 2009. Note: *Firms consuming more than 1,500 kilo liter of crude-oil-equivalent are designated by Energy Conservation Law and Climate Change Policy Law. Source: Author’s own estimation based on MOE, 2012 and EDMC, 2012.
2.1.3 Energy use in SMEs

Is energy cost an important factor for SMEs? As shown in Figure 8, average electricity cost share in the total material costs in manufacturing SMEs in 2009 is 2.7%. This means that energy is not a major cost factor but still an important one for SMEs, since average profit rate of manufacturing sector is only around 4% (METI, 2007).

Figure 7. Share of energy use, energy cost, and economic output in manufacturing sector by industry. Note: Shares of chemical industry and oil/coal products industry are aggregated. Source: EDMC 2012, and METI 2012.

Figure 8. Electricity cost share in material costs in manufacturing SMEs and large enterprises. Source: adopted from SMEA, 2012.
2.2 Spain

2.2.1 Economic situation

The Spanish macro-economic figures show a country currently under a deep economic crisis. Figure 9 present the GDP evolution in Spain since 2000:

![GDP evolution in Spain at market prices (source: Eurostat, 2012)](image)

The economic crisis has affected the country's growth from 2007, and currently GDP reaches similar levels to the year of the start of the crisis, this is, the economy is stagnant and there is no growth despite national governments efforts to boost economic growth policies in last few years.

The relevance of the economic sectors according to GDP and the evolution from 2000 is shown in figure 10.
The most relevant sectors are commerce, public administration, mining and energy supply and manufacturing industry (representing almost 60% of GDP).

When attention is given to the number of companies by sector, figure 11 shows that wholesale and retail trading is equal in relevance in comparison with GDP, as is not the case of manufacturing, where a few companies contribute larger to GDP.

Figure 11. Number of enterprises by sector in Spain 2008 (source: Eurostat, 2012)
The composition of the number of companies, presented in figure 12, by number of employees in Spain show that most of companies falls under the SMEs classification.

Figure 12. Number of companies by employees in Spain (Source INE, Instituto Nacional de Estadisticas, Spanish Statistics Institute).

As shown in figure 12. more than 95% of the companies have less than 10 employees.

2.2.2 Energy use

Final energy end-use evolution in Spain by energy carrier is shown in figure 13.

Figure 13. Final energy end-use in Spain by energy carrier, 2000-2010 (Source: INE, Instituto Nacional de Estadisticas, Spanish Statistics Institute).
The most important energy source is still petroleum products (46% in 2010), in the last three years there is an increase of renewable energy pushed by legislation related to promotion of renewable energy sources – Renewable Energies Plan 2005-2010 (up to 11% in 2010), solid fuels is reducing the relevance in the energy mix (6%) and maintaining nuclear energy.

Energy end-use in industry broken down by sector and final energy source is presented in figure 14.

![Energy end-use by sector and energy source](Source: INE, Instituto Nacional de Estadísticas, Spanish statistics institute).

In figure 15, energy intensity from 2000-2010 in Spain is presented showing that the energy intensity has decreased since 2004 with 14.9%. In 2008 and 2009 the reduction was over the 3% per year, which are good results in terms of total reduction.
Figure 15. Evolution of energy Intensity in Spain (Source: Eurostat, 2012).

No data are available in Spain on how much of industrial energy use that is derived from industrial SMEs.

2.3 Sweden

The aggregated final energy use among the approximately 59,000 Swedish industrial companies is about 152 TWh/year (year 2010) of which nearly 75 percent is used in the energy-intensive industry including about 600 companies (PWC, 2007). In figure 16 and figure 17, the annual energy use in Swedish industry from the 1970ies, are presented. Figure 16-17 shows that the aggregated energy use has not changed significantly in 40 years, but that a large portion of the fossil fuel use has been reduced and the biofuel and electricity shares has increased.
Figure 16. Swedish industries’ energy-end-use in TWh/year per energy carrier between 1970-2009 (SEA, 2010).

Figure 17. Swedish industries’ energy-end-use in TWh/year per sector between 1970-2009 (SEA, 2010).
In Figure 18, the Swedish industries’ energy intensity from 1993-2008 is presented, showing that the energy intensity has decreased with approximately 2.26% annually in average.

Figure 18. Swedish industries’ energy intensity development between 1993-2008 (SEA, 2010).

No explicit data are accessible on how much of the Swedish industrial energy use that is derived from industrial SMEs, but Backlund and Thollander (2011) stated that it represents approximately 25% of the Swedish industrial energy use.

2.4 Belgium

2.4.1 Aggregated final energy use in Flanders

a. Flanders

In 2011, the final energetic use of energy carriers in Flanders, the northern part of Belgium, amounts to 926 PJ. The largest share is used by industry (389 PJ or 42%), followed by households (205 PJ or 22%) and transport (204 PJ or 22%), the services sector (94 PJ or 10%) and agriculture (30 PJ or 3%), see Figure 19.
Figure 19. Energy balance of Flanders, Belgium, 2011 (VITO, 2012).

Figure 20 shows how the industrial energy use evolved from 1990 to 2011. From 1990 until about 2000, the industrial energy use increased steadily with about 10 PJ per year. From 2000 on, the industrial energy use stagnated and declined in 2008 and beyond, as a result of the banking crisis.

Figure 20 also shows the breakdown of the industrial energy use by energy carriers. One can see a shift from oil products, to a lesser extent also from coal products, to gases (natural gas). The use of other fuels, heat and biomass increased over time. There is a slight electrification within the Flemish industry; in 1990, the share of electricity in the total energy input amounts to 23%, which increased to 26% in 2011.
Figure 20. Development of Flemish industrial energy use by vector between 1990-2011, breakdown by energy carrier (VITO, 2012).
Figure 21. Evolution of Flemish industrial energy use by sector between 1990-2011, breakdown by sector (VITO, 2012).

Figure 21 shows the breakdown of the industrial energy use by sector. Chemicals is by far the sector using the most energy, 158 PJ in 2011 or 41% of the total industrial energy use. Second in line is another energy intensive sector: iron and steel, 72 PJ or 18% in 2011. The energy use of the latter sector shows a declining trend from 2004 onwards. The sector showing the most pronounced decline in energy use is textile, leather and footwear: from 17 PJ in 1990 to 6 PJ in 2011.

In Figure 22, the industrial energy use of 1990, 2000 and 2011 is broken down per sector and energy carrier. It indicates to what extent electrification took place in the various sectors, for instance in textile, leather and footwear, and natural gas displaced oil products.
### Figure 22. Breakdown of the Flemish industrial energy use by sector and energy carrier, 1990, 2000, 2011 (VITO, 2012).

#### b. Wallonia

In 2011, the final energetic use of energy carriers in Wallonia, the southern part of Belgium, amounts to 472 PJ. The largest share is used by industry (171 PJ or 36%), followed by transport (146 PJ or 31%), households (106 PJ or 22%), the services sector (46 PJ or 10%) and agriculture (4 PJ or 1%), see Figure 23.
Figure 23. Energy balance of Wallonia, Belgium, 2011 (ICEDD, 2012).

Figure 24 shows how the industrial energy use of Wallonia has evolved from 1985 until 2011. The industrial energy use is broken down by sector.

More than three quarter of the Walloon industrial energy use can be allocated to energy intensive industry: iron and steel (sidérurgie), cement manufacturing (minér. non métal) and chemicals (chimie). Part of the energy use in the remaining part can be allocated to paper mills.

The share of the energy intensive industry in the industrial energy use has however declined over time; mainly due to a decline of production levels in the iron and steel sector. In 2009, as a result of the global financial crisis, production levels in that sector shrank to about one third of the level of the previous years. From 2010 on, the production levels increased again but are still about half of the pre-crisis levels.
Figure 24. Evolution of industrial energy use (non-energy use included) of Wallonia, Belgium, 2011 (ICEDD, 2012). (Sidérurgie: iron and steel – Chimie: chemicals – Minér. Non métal.: non metallic minerals – Autres secteurs: others)

Figure 25 shows a breakdown by sector and energy carrier of the Walloon industrial energy use.

![Energy use breakdown chart]

Figure 25. Breakdown of the Walloon industrial energy use by sector and energy carrier, 2011 (ICEDD, 2012).

c. The Brussels Capital Region

The final energetic use of the Brussels Capital Region at last, a much urbanised region in the center of Belgium, is dominated by the residential (36 PJ or 42%), the services sector (29 PJ or 34%) and transport (19 PJ or 22%). Industry accounts only for 3% (2 PJ) of the final
energetic use in the region, see Figure 26. The largest industrial undertaking in Brussels is a car assembly plant which alone accounts for a quarter of this sector. The rest of this sector is made up of a variety of small enterprises involved in various activities.

Figure 26. Energy balance of the Brussels Capital Region, Belgium, 2010 (BIM-IBGE, 2012).

Figures 27-28-29 show a breakdown of the industrial energy use of the Brussels Capital Region according to sector and to energy carrier. Manufacturing of vehicles or machinery is the main industrial sector in the region, although its share declined in the last decade. More than half of the industrial energy consumption is consumed as electricity; in the sector (non) metallic minerals and mills and bakeries, the share of electricity is 70 to 75%. Apart from manufacturing of vehicles, all other industrial sectors in the region consist mainly of SMEs.
Figure 27. Breakdown of industrial energy use of the Brussels Capital Region according to sector, 1990-2010 (BIM-IBGE, 2012). (Drukwerk, papier: printing – Voeding, tabak: Food and tobacco – Metaal producten: machine manufacturing – Andere: others)

Figure 28. Breakdown of industrial energy use of the Brussels Capital Region according to energy carrier, 1990-2010 (BIM-IBGE, 2012). (Elektriciteit: electricity – Aardgas: natural gas – Aardolieproducten: Oil products – Andere: others)
2.4.2 Relevance of SMEs in the Belgian economy

In order to assess the relevance of SMEs in the Belgian economy, structural business statistics from Eurostat are used.

Figure 30 presents a breakdown of four indicators – the number of enterprises, the turnover, the production value and the value added at factor cost – of manufacturing companies according to the number of employees in the companies.

Of the 37,310 manufacturing companies in Belgium in 2010, more than 99% employ less than 250 employees and 96% less than 50 employees. On the other hand, manufacturing companies with less than 250 employees contribute 36% of the turnover to the total turnover of the manufacturing companies in Belgium and companies with less than 50 employees contribute 16%.

Figure 31 and 32 indicate which subsectors of the manufacturing industry in Belgium consists more of SMEs than other sectors.
Figure 31. Number of Belgian manufacturing enterprises in various manufacturing sectors according to number of employees (2010) (Eurostat, 2013).
Figure 32. Turnover of Belgian manufacturing enterprises in various manufacturing sectors according to number of employees (2010) (Eurostat, 2013).
2.4.3 Relevance of SMEs in energy use

Some data sources on Flemish industrial energy use allow us to break down the industrial final energy use of that region into different size categories of companies:

- The first Flemish Energy Efficiency Action Plan indicates the energy use of the non-EU ETS industrial companies for 2005: 23299 GWh = 83.9 PJ.
- Subtracting this energy use from the reported total final energy use (407.7 PJ) provides the energy consumption of the EU ETS-industrial companies, which are energy intensive companies: 323.8 PJ
- From the non-EU ETS industrial companies, the energy consumption of a subgroup is reported. This subgroup consists of medium sized companies, participating to the auditing covenant and having a primary energy use between 0.1 and 0.5 PJ per annum. In 2005, 227 companies participated whereas the size of the target group is estimated at 286 companies (Cornelis and Reunes, 2012). The reported energy use of the 227 companies, participating to the auditing covenant, has been scaled up to the target group.
- Subtracting this target group from the non-EU ETS industrial companies provides an estimate to the energy use of SMEs.

Table 1 shows the results of this assessment. About 27% of all industrial electricity consumption and about 8% of all industrial fuel consumption can be attributed to SMEs. The ratio fuel / electricity consumption varies according to the energy intensity of the companies:

- About 5 for the EU ETS-industrial companies (large energy intensive companies)
- About 1.1 for the participants to the auditing covenant (medium sized companies)
- About 0.9 for SMEs

The ratio, found for industrial companies in the Brussels Capital Region and which mainly consists of SMEs, confirms the latter ratio. Hence, we may conclude that at least half of the energy use in Belgian SMEs consists of electricity.

<table>
<thead>
<tr>
<th>PJ (2005)</th>
<th>Total</th>
<th>EU ETS – industry</th>
<th>Auditing covenant</th>
<th>SMEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>96.2</td>
<td>54.2</td>
<td>15.4</td>
<td>26.6</td>
</tr>
<tr>
<td>Fuel</td>
<td>311.5</td>
<td>269.6</td>
<td>17.2</td>
<td>24.7</td>
</tr>
<tr>
<td>Total</td>
<td>407.7</td>
<td>323.8</td>
<td>32.6</td>
<td>51.3</td>
</tr>
</tbody>
</table>

Source: VITO
3. Overview of policies and programs

3.1 Japan

3.1.1 National goals

There is no national target solely for energy efficiency improvement in Japan. Indeed, Energy Conservation Law has set non-mandatory energy efficiency targets for individual firms that is 1% improvement of energy intensity per year in 5-years-average, but has no national target.

However, there is a national target for GHG emission reduction made in Kyoto Protocol Target Achievement Plan, which was established in 1998 and revised in 2008. To achieve the 6% reduction commitment in the Kyoto Protocol, the Plan has set an indicative target to limit domestic energy CO2 emission at between 1.3% to 2.3% increase (which should be offset by enhanced carbon sink and Kyoto mechanisms). The breakdown of the energy CO2 emission target is shown in Table 2. Industrial sector was expected to reduce its energy CO2 emission by around 4% compared to the 1990 level.

As the Kyoto target is expiring in 2012, a mid-term target has been being debated since 2008. The government lead by Prime Minister Aso in June 2009 decided to set a 15% reduction target by 2020 compared to the 2005 level 4. Only 3 months later, subsequently elected Prime Minister Hatoyama suddenly declared 25% reduction by 2020 compared to 1990 level 5 at the UN Summit on Climate Change. Since this is an extremely ambitious target, the government began to assess the feasibility and impact of the initiative. But before reaching any official conclusion, Japan changed its Prime Minister two times. At this moment there is no official target for carbon emission reduction after the Kyoto commitment period.

Shutdown of nuclear power plants all over Japan after the Great East Japan Earthquake and the Fukushima accident has completely changed energy and climate mitigation scenarios of Japan. The government set a committee to revise Energy Basic Plan in

Table 2. Indicative targets of energy related CO2 emission in 2010 to achieve the commitment in the Kyoto Protocol.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Emission in base year (1990) [M t-CO2]</th>
<th>Indicative target range of emission in FY 2010 [M t-CO2]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>482</td>
<td>424 - 428 (-4.6% - -4.3%)</td>
</tr>
<tr>
<td>Commercial and others</td>
<td>164</td>
<td>208 - 210 (+3.4% - +3.6%)</td>
</tr>
<tr>
<td>Residential</td>
<td>127</td>
<td>138 - 141 (+0.9% - +1.1%)</td>
</tr>
<tr>
<td>Transport</td>
<td>217</td>
<td>240 - 243 (+1.8% - +2.0%)</td>
</tr>
<tr>
<td>Energy conversion</td>
<td>68</td>
<td>66 (-0.1%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,059</strong></td>
<td><strong>1,076 - 1,089 (+1.3% - +2.3%)</strong></td>
</tr>
</tbody>
</table>


As the Kyoto target is expiring in 2012, a mid-term target has been being debated since 2008. The government lead by Prime Minister Aso in June 2009 decided to set a 15% reduction target by 2020 compared to the 2005 level 4. Only 3 months later, subsequently elected Prime Minister Hatoyama suddenly declared 25% reduction by 2020 compared to 1990 level 5 at the UN Summit on Climate Change. Since this is an extremely ambitious target, the government began to assess the feasibility and impact of the initiative. But before reaching any official conclusion, Japan changed its Prime Minister two times. At this moment there is no official target for carbon emission reduction after the Kyoto commitment period.
October 2011. The committee has been considering three options of energy mix, ranging from 0 % to 25 % of nuclear share. The committee considers energy conservation measures very important regardless of energy-mix, and expects their reduction of energy demand by 22 % by 2030 compared to the 2010 level (Committee on Basic Issues, 2012, Options concerning energy and environment).

3.1.2 Industrial energy end-use programs in Japan

Policies and programs for increasing energy efficiency in SMEs in Japan are formulated by three branches of the government. One is Agency for Natural Resources and Energy (ANRE), whose main concerns are in enhancing rational use of energy and energy security. The second one is SMEA (Small- and Medium-sized Enterprises Agency), which aims at supporting SMEs management and reducing energy cost in SMEs is also an important task. The third one is MoE (Ministry of Environment), one of whose major tasks is to mitigate climate change and reduce CO2 emissions.

In addition, some local governments also have their own policies and programs for increasing energy efficiency. Their major motivations include climate concerns and economic ones (i.e. stimulate local industry).

3.1.2.1 Regulation policies

Law Concerning Rational Use of Energy

Law Concerning Rational Use of Energy (“Enerugi shiyouno gourika ni kansuru houriitu” in Japanese; Energy Conservation Law) is the basic law in the field of energy efficiency in Japan. It was established in 1980 and amended gradually to expand its scope and tighten its regulations in 1993, 1998, 2002, 2005, and most recently in 2008. The current law covers all sectors (industry, commercial, residential, and transport). In industrial and commercial sectors, large firms consuming more than 1,500 kilo litters in crude oil equivalent per year are designated by the law. The designated firms sum up to 12,148 firms in April 2012, and their energy use consist of 98 % and 45 % in industrial and commercial sector, respectively (ECCJ, 2012).

Table 3 shows various requirements by the law. One salient feature of the law is its focus on energy management. It intends to reinforce firms’ energy management by introducing management tools, such as responsible organizations, reporting systems, and management standards (all mandatory). It is considered that the management standards of the law is almost compatible with the requirements for being certified to the international standards on energy management system ISO 50001, except for internal audit (Yamada, 2011). The law also has a quantitative target for improving energy intensity, which is 1 % decrease of energy intensity annually. Although the energy intensity target is voluntary, it is considered as a “soft” regulation since firms have to report their energy intensity and explain the reason when they cannot achieve the target. The government has been conducting on-site

---

6 http://www.enecho.meti.go.jp/info/committee/kihonmondai/index.htm
8 Equivalent to 58 TJ per year. In CO2 emission, it approximates 3,000 t-CO2 per year.
visits to all facilities consuming more than 3,000 kilo litters in crude oil equivalent per year in order to enhance compliance (Kimura and Noda, 2010a).

Table 3. Major requirements of the Japanese Energy Conservation Law.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nomination of qualified “Energy Manager” (mandatory)</td>
<td>both from working- and executive-levels</td>
</tr>
<tr>
<td>2. Development of responsible organization (mandatory)</td>
<td></td>
</tr>
<tr>
<td>3. Reporting (mandatory)</td>
<td>Energy use, flow, major energy-consuming equipments, CO2 emissions</td>
</tr>
<tr>
<td></td>
<td>Compliance status with standards</td>
</tr>
<tr>
<td></td>
<td>Energy efficiency investment plans</td>
</tr>
<tr>
<td>5. Performance standard (voluntary):</td>
<td>1% decrease in energy intensity annually in five-year average</td>
</tr>
</tbody>
</table>

Some SMEs are designated by the law. A survey conducted by ECCJ (Energy Conservation Center Japan) shows that about 70% of the designated industrial factories have less than 300 employees (Figure 33).

![Figure 33. Number of employees of industrial factory designated by Energy Conservation Law. Notes: firms consuming more than 1,500 kilo liter of crude-oil-equivalent are designated by Energy Conservation Law. Source: ECCJ, 2007.](image)

How is the impact of the law? There are only a couple of ex-post evaluations, and their results are mixed. Figure 34 shows the trend of energy intensity in designated firms using data reported by designated firms (ECCJ, 2007). The Figure shows that energy intensity of designated firms is decreased 3% from 1999 to 2007. This implies the regulation may have had some impact. Arimura and Iwata (2007) made an econometric analysis on the impact of the Law’s impact on accommodation industry. Based on panel data of the designated 142 companies in the industry, they estimate that tightening of the regulation from 2002 to 2004 decreased fuel consumption and fuel intensity by 2.8% and by 2.4%, respectively. Kimura and Noda (2010b) undertook case studies of thirteen factories in Japan and reported that the response by firms to mandatory energy management systems was mixed. Some companies actually used energy management to improve their energy efficiency, but others implemented energy management only superficially on paper and it did not deliver energy efficiency improvement.
3.1.2.2 Economic and informative policies

Subsidy and tax credit programs for energy efficiency investments

In Japan, investment subsidy and tax credit are very popular policy instruments to support energy technology adoption. There are 11 subsidy and tax credit programs for energy efficiency investments directed for industrial and commercial sectors (Table 3). Most of them are for both industrial and commercial sectors. Four of them are for SMEs.

There is only limited, fragmented data both on the input (i.e. governmental budgets) and output (i.e. energy savings) associated with the subsidy and tax credit programs. Table shows the governmental budget of and energy savings from the Subsidy program for energy efficiency investment (No. 2 in the Table 4), the largest among the programs listed in Table 4. Cost effectiveness of the program is estimated to be 13,305 JPY/kL of crude oil equivalent, or 50.1 EUR/t-CO2\(^9\). This is a conservative estimate because it assumes 3 years of project duration. Nevertheless, the cost effectiveness seems to be a reasonable level compared to import price of crude oil in Japan which is higher than 15,000 JPY/kL.

---

\(^9\) The author’s estimation assuming 2.62 t-CO2/kL and using the exchange rate of 100JPY/EUR.
# IEA IETS Annex XVI Energy Efficiency in SMEs

Table 4. Subsidy and tax credit programs for energy efficiency investments available for SMEs in Japan

<table>
<thead>
<tr>
<th>Program</th>
<th>Operator</th>
<th>Targeted sector</th>
<th>Firm size</th>
<th>Rate of subsidy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Subsidy for energy efficiency investments in ESCO schemes</td>
<td>Organization for SMEs and Regional Innovation</td>
<td>industrial</td>
<td>SMEs</td>
<td>Up to 1/2 of investment cost or 30 mil.JPY</td>
</tr>
<tr>
<td>2. Subsidy for energy efficiency investments</td>
<td>NEDO/METI</td>
<td>industry/commercial</td>
<td>all</td>
<td>Up to 1/2 of investment cost or 1.5 bil.JPY</td>
</tr>
<tr>
<td>3. Subsidy for energy efficient boilers</td>
<td>Petroleum Association of Japan</td>
<td>industry/commercial</td>
<td>all</td>
<td>1/5, up to 1.2 mil.JPY per boiler</td>
</tr>
<tr>
<td>4. Subsidy for oil/coal-to-gas switching</td>
<td>Center for Urban Gas Promotion</td>
<td>industry/commercial</td>
<td>all</td>
<td>Up to 1/2 of investment cost or 180 mil.JPY</td>
</tr>
<tr>
<td>5. Subsidy for energy efficient refrigerators without CFC</td>
<td>Ministry of Environment</td>
<td>industry/commercial</td>
<td>all</td>
<td>1/3 of additional cost, up to 25 mil.JPY</td>
</tr>
<tr>
<td>6. Subsidy for GHG emission reduction investments</td>
<td>Ministry of Environment</td>
<td>industry/commercial</td>
<td>SMEs</td>
<td>1/3 or 1/2 of investment cost</td>
</tr>
<tr>
<td>7. Subsidy for enterprises joining voluntary ETS (JVETS)</td>
<td>Ministry of Environment</td>
<td>industry/commercial</td>
<td>all</td>
<td>Up to 1/3 of investment cost or 200 mil.JPY</td>
</tr>
<tr>
<td>8. Tax credit for energy efficiency investments</td>
<td>NEDO/METI</td>
<td>industry/commercial</td>
<td>all</td>
<td>7 % of investment cost, up to 20 % of corporate tax</td>
</tr>
<tr>
<td>9. Low-interest loan for energy and environmental investments</td>
<td>Japan Finance Corporation</td>
<td>industry/commercial</td>
<td>SMEs</td>
<td>within 15 yrs, up to 720 mil.JPY</td>
</tr>
<tr>
<td>10. Low-interest loan for energy efficiency projects with energy audit</td>
<td>Shoko Chukin Bank</td>
<td>industry/commercial</td>
<td>SMEs</td>
<td>within 5 yrs, up to 50 mil.JPY</td>
</tr>
<tr>
<td>11. Low-interest loan for enterprises with environmental management system certificate</td>
<td>Shoko Chukin Bank</td>
<td>industry/commercial</td>
<td>all</td>
<td>within 20 yrs</td>
</tr>
</tbody>
</table>

Note: Programs for domestic sector are excluded. Source: SMEA, 2009.
Table 5. Evaluation of “Subsidy program for energy efficiency investment”.

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>No. of firms funded</th>
<th>Governmental budget [bill. JPY]</th>
<th>Energy savings per year [1,000 kL(^{a})/yr]</th>
<th>Cost per energy saved (^{b}) [JPY/kL (^{a})]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-2003</td>
<td>255</td>
<td>23.64</td>
<td>522</td>
<td>9,057</td>
</tr>
<tr>
<td>2004</td>
<td>107</td>
<td>14.75</td>
<td>403</td>
<td>7,320</td>
</tr>
<tr>
<td>2005</td>
<td>98</td>
<td>11.23</td>
<td>413</td>
<td>5,438</td>
</tr>
<tr>
<td>2006</td>
<td>372</td>
<td>13.79</td>
<td>270</td>
<td>10,215</td>
</tr>
<tr>
<td>2007</td>
<td>452</td>
<td>22.39</td>
<td>441</td>
<td>10,154</td>
</tr>
<tr>
<td>2008</td>
<td>304</td>
<td>24.96</td>
<td>416</td>
<td>12,000</td>
</tr>
<tr>
<td>2009</td>
<td>352</td>
<td>38.96</td>
<td>508</td>
<td>15,339</td>
</tr>
<tr>
<td>2010</td>
<td>166</td>
<td>29.54</td>
<td>457</td>
<td>12,928</td>
</tr>
<tr>
<td>Total</td>
<td>2,106</td>
<td>179.26</td>
<td>3,430</td>
<td>10,452</td>
</tr>
</tbody>
</table>

Notes: The formal name of “Subsidy program for energy efficiency investment” in Japanese is “Enerugi shiyou gorika jigyosha shien jigyo”. \(^{a}\) Kilo litter of crude oil equivalent. Electricity savings are converted in primary energy. \(^{b}\) Cost per energy saved is the author’s estimation assuming 5-year lifetime of energy saving. Source: NEDO, 2009.

Energy audit program

In Japan, the government has been conducting several energy audit programs since the Oil Crisis. They are operated by governmental subsidiary organization, such as ECCJ (Energy Conservation Center Japan) and NEDO (New Energy and Industrial Technology Development Organization). The ECCJ audit program conducts fully-subsidized audits for about 1,000 small- and medium-sized firms annually, while NEDO’s program offered about 40 to 100 audits per year to large facilities from 1999 to 2007. Most of the audits were provided to firms in non-energy intensive industry which did not have enough expertise in energy management in-house. Most of the recommendations are operational improvement that requires no investment, but also include investment measures with short payback periods (usually less than three years). Overview of major energy audit programs in Japan is presented in Table 6.

Table 6. Three government-funded energy audit programs in Japan.

<table>
<thead>
<tr>
<th>Operating organization</th>
<th>ECCJ (^{a})</th>
<th>NEDO (^{b})</th>
<th>Organization for SMEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope</td>
<td>SMEs</td>
<td>Large firms</td>
<td>SMEs</td>
</tr>
<tr>
<td>No. of audits</td>
<td>300-1,000 per year (9,446 (up to 2008))</td>
<td>40-100 per year (501 in total)</td>
<td>500-2,000 per year (12,896 in total)</td>
</tr>
<tr>
<td>Type</td>
<td>One day walk-through plus one week measurement</td>
<td>One day walk-through</td>
<td>One day walk-through</td>
</tr>
</tbody>
</table>


*corresponding author: patrik.thollander@liu.se
Kimura and Noda (2010b) conducted an ex-post evaluation of the program operated by ECCJ. The cost for the government was 4,524 JPY/kL of crude oil equivalent that was equivalent to 2,598 JPY/t-CO2. The benefits for society, as the net benefit to private firms minus the costs to government, were 10,589 JPY/kL of crude oil equivalent. They also analyzed the program by NEDO, and got similar figures as shown in Table 7.

Table 7. Estimation of cost-effectiveness of major energy audit programs in Japan.

<table>
<thead>
<tr>
<th>Program</th>
<th>Governmental cost-effectiveness $^{c)}$</th>
<th>Societal cost-effectiveness $^{d)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECCJ audits for SMEs $^{a)}$</td>
<td>4,524 [JPY/kL]</td>
<td>-10,589 [JPY/kL]</td>
</tr>
<tr>
<td></td>
<td>2,598 [JPY/t-CO2]</td>
<td>-6,086 [JPY/t-CO2]</td>
</tr>
<tr>
<td>NEDO audits for large facilities $^{b)}$</td>
<td>2,588 [JPY/kL]</td>
<td>-6,623 [JPY/kL]</td>
</tr>
<tr>
<td></td>
<td>1,486 [JPY/t-CO2]</td>
<td>-3,804 [JPY/t-CO2]</td>
</tr>
</tbody>
</table>


3.1.2.3 Specific energy training programs

Seminars for SMEs

ECCJ, local governments, and government-funded organizations conduct various seminars that provide general/technical information on energy efficiency measures as well as information on Energy Conservation Law. They are usually targeted for SMEs in all sectors, not solely for industrial SMEs. A typical one is a free, half-day seminar that includes several presentations by energy engineers and producers/providers of energy efficiency products and services. Such seminars typically attract about 100 guests from interested nearby SMEs. No data is available as to how many such seminars are held all over Japan in a year.

3.1.2.4 Networks

Local Network of Designated Firms of Energy Conservation Law

Local Network of Designated Firms of Energy Conservation Law aims to share information on energy efficiency measures and actions for effective energy management. Facilitated by the Kanto regional office of METI (Ministry of Economy, Trade, and Industry), there are 12 sub-local Networks in Kanto region, each of which is joined by 20 to 40 designated firms. The network typically conducts annual conferences and site tours for mutual learning on effective energy management. The Network is, however, not directed explicitly towards industrial SMEs.

---

$^{10}$ Approximates 26 EUR/t-CO2, based on the exchange rate of 100 JPY/EUR.

$^{11}$ The assumption is more than 100 per year.
Local networks of interested firms for energy efficiency

There are a few local networks that voluntarily emerged from private firms aiming for mutual learning on effective energy management. In such networks, a managing firm coordinates meetings and seminars on energy management, and provides one-day energy audits to interested firms for free. They are not funded by the central/local governments, so they are managed totally on voluntary basis by firms with strong interests in energy efficiency and climate mitigation. Such networks are in action in Shinshu area in Nagano Prefecture and in Shonai area in Yamagata Prefecture. These networks are, however, not directed explicitly towards industrial SMEs.

3.1.2.5 General information campaigns including self-scanning, and benchmarking methods

No general information campaigns directed towards industrial SMEs exists in Japan.

3.1.3 Some examples of successful regional policies

Kyoto Center for Climate Actions: Energy audit program for SMEs, 2009

In 2010 Kyoto Center for Climate Actions started an energy audit program specifically directed towards SMEs in Kyoto. The program has two unique features. Firstly the program provides not only one-day walk-through audits, like the one by ECCJ, but also detailed measurement that takes several weeks. Secondly, the audits are conducted by a non-profit organization called “Kyoto Senior Venture Club”, which is consisted of retired engineers.

The program is, however, not directed explicitly towards industrial sector.

Fukuoka City: Energy Conservation Adviser Program, 2011-

In 2011 Fukuoka City started Energy Conservation Adviser Program, which is specifically targeted towards SMEs with less than 10 million yen of energy costs per year. This is basically an energy audit program, but with follow-up advice by auditors after conducting energy audits. Seeing the fact that only a small portion of recommended measures are implemented in energy audits12, the aim of this program is to improve implementation of recommendations by providing detailed advice. The program is also distinct from other energy audit programs in Japan in that it is not free; firms have to pay one third of the total cost (JPY 48,00013 per audit). Remaining two thirds are subsidized by the city government. The program is, however, not directed explicitly towards industrial sector.


Tokyo Metropolitan Government implemented Reporting Program of Climate Mitigation Measures from 2005 to 2009. This regional program, just as the Energy Conservation Law, designated large firms consuming more than 1,500 kiloliters in crude oil

---

12 In the ECCJ energy audit program, the implementation rate is about 30 % (Kimura and Noda, 2010)
13 EUR 480, based on the exchange rate of 100 JPY/EUR.
equivalent per year. No data is available as to how many industrial SMEs are designated, though there should have been some.

The focus of the program was to provide detailed information and extensive consultation on emission reduction potentials and measures by using Action Plan on Climate Mitigation Measures, which all designated firms had to submit to the Metropolitan government. In this program, the Tokyo Metropolitan Government had provided energy audits to almost all of the designated firms in the manufacturing sector, which sum up to 130, and helped firms making effective Action Plans. This is a program based not only on informational/educational approach but also on “name-and-shame” approach, i.e. the Metropolitan government reviewed and rated publicly the Action Plan as well as its implementation in each designated firm. This seems to have given important incentive to designated firms. Indeed, more than 90 % of the measures in Action Plans were conducted by the end of the program (Nishio et al., 2011). Kimura et al. (2011) made an ex-post evaluation on the program and concluded that the program was effective in removing informational barriers to energy efficiency by providing detailed information. Based on a survey for designated firms, Nishio et al. (2011) estimated that 32 % of the measures planned in the Action Plans would not have been implemented without the program.

3.2 Spain

3.2.1 National goals

Spanish government defined the target of 20% of reduction in energy use, 20% of renewable energy contribution to energy mix and 20% of reduction in CO2 emissions by 2020. To follow the expected results and the execution of the planned actions, several intermediate targets were established in the Actions Plans. The target of 20 % reduction of energy use implies a reduction of 88,000 ktoe (primary energy) in 2012 (in compare with initial stage), the expected contribution from the industrial sector amounts to 25,000 ktoe.

3.2.2 Energy programs

Following the EU guidelines expressed in various directives, Spain has settled different actions to increase energy efficiency reduce emissions and increase RES. The most important strategic policy framework for improving energy efficiency in Spain was established in 2003 by Spanish Government under the Strategy for Energy Saving and Efficiency (E4) 2004-2012.

These strategic plans have been supplemented with other strategies and Planning approaches of relevance, such as the Spanish Strategy for Sustainable Development, the Spanish Strategy for Climate Change and Clean Energy, the Strategy for Sustainable Mobility, the Planning of the Electricity and Gas Sectors 2008-2016, the Strategic Plan for Infrastructures and Transport, 2005-2020 (PEIT), Renewable Energies Plan, 2005-2010 (PER) and the R+D+i Plan, 2008-2011.

The E4 strategy aims at reducing the intensity of energy in Spain, maintain energy prices at a reasonable level, and protect the environment. Spain imports the majority of fossil
fuels from countries that are not stable geopolitically. For this reason reducing the dependence from external energy sources and boost local sources will reduce the risk of energy supply and will secure the needed quantity, and moreover stabilize the price in the future. For this reason, reduction of dependency of fossil fuels plays a special role in the definition of national energy policies.

The analysis of the most intensive energy using sectors was developed and the potential savings for them were established in 99,939 ktoe in terms of primary energy at the end of 2012 (in compare with initial stage).

The E4 Strategy has been developed into 2 action plans; a new plan has been defined to cover the period until 2020 (to comply with Directive 2006/32/EC on Energy End-use Efficiency and Energy Services):

- Action plan 2005-2007 (PAE4)
- Action plan 2008-2012 (PAE4+)

### 3.2.2.1 Action plan 2005-2007 (PAE4)

This plan identified strategic goals and the paths that energy policy should go to achieve the same objectives: security of supply in quantity and price levels of self-sufficiency thresholds, taking into consideration the environmental impact and the relation with competitiveness of the enterprises. The final objective is reducing the intensity of energy in Spain, reducing the increasing trends of energy use through energy efficiency measures. This was the first plan and the coordination actions among regional and local governments have focused on the main efforts, the coordination actions have allowed making a better use of public funds because the involvement of all regions in Spain and the multiplier effect of investment. This plan aims at reducing 12,000 ktoe (in total 2005-2007) in terms of primary energy in 2007. In the industrial sector, the following measures were proposed:

- Voluntary commitment between business associations and Public bodies to reduce energy use promoting and encouraging actions to disseminate energy efficiency in the sector: information days, workshops, etc.
- Energy audits program- the energy audits help to identify potential energy savings and the benchmarking of processes. This measure was financed with public funds up to 75% of the cost of energy audits in preferred sectors: chemical, food. The total investment required reached up to 4,029,333 € (3,022,000 € from public funds)
- Public Aids Program aimed at improving energy efficiency in industrial sector; this program encourages the adoption of measures that have been identified in energy audits and move private investment for reducing energy use. This action allows reducing ROI (Return of investments) ratios, and making it easy the adoption of measures to reduce energy use in industry sector. Total investment
required for this measure is € 485 mill. (€ 108 mill from public funds). The measures that have been pushed can be divided in two groups:

- Horizontal measures: exhaust heat recovery, steam pressure reduction, low use lighting, control and monitoring of cooling plants, thermal isolation, inverters etc.
- Specific sector measures - several specific sector measures have been identified and applied in companies.

**Additional measures** - these measures are mid-term measures focused in demand reduction but with a social and economic cost higher than the other measures and with a higher level of complexity in its execution. These measures have been carried out in the following sectors: transport, building, equipment, and farming.

**Results**

This plan has invested from public funds € 540.5 million, 1,325,000 actions have been developed in different sectors (buildings, transport, waste, farming and commerce/institutional), 3,000 actions in industrial sector, 500 in farming and 500 in energy transformation sector.

The actions that have been developed have been focused on financing energy efficiency projects in collaboration with local and regional governments (each region had the possibility to adapt global requirements to local needs in order to achieve better results in their specific plans), dissemination activities (energy labeling for equipment’s, buildings, etc.) and regulatory measures (the most relevant is the technical building code).

The obtained results from direct measures show a saving of primary energy of 3,500 ktep/year in 2007; the diffusion effect has been valued at 3,500 ktep/year for the same period. At the end of 2007 and considering the cumulative effect from 2005 to 2007, the energy savings reach 15,000 ktep (a 25% above expected results for this period).

**3.2.2.2 Action plan 2008-2012 (PAE4+)**

This action plan was a continuation of PAE4 and the principles and objectives were defined in the same way: energy efficiency contributes to secure supply and reduce external dependence, reduction in CO2 emissions is directly related to energy efficiency measures and contributes to achieve Kyoto commitments and energy efficiency contributes to improve competitiveness of Spanish enterprises. This action plan detected several sectors that are responsible for usage of large amounts of energy but the usage points are highly scattered; these sectors are called diffuse sectors, the most relevant are: transport, buildings and appliance; on these sectors the major efforts will be allocated with measures to drive the change and get a reduction in energy use. The primary energy savings objective in this period is 87,933 ktep (totally in the period 2008-2012). This plan sets the potential reduction in energy use for the industry sector (year 2012) in 24,750 ktep; the measures that were adopted are listed below:
Voluntary commitment of business associations to reduce energy use promoting and encouraging actions to disseminate energy efficiency in the sector: information days, workshops, etc.

Energy audits program - the energy audits help to identify potential energy savings and let the benchmarking of processes. The number estimated of energy audits to perform in 2008-2012 period is 260. Public funds will finance 75% of the total cost of energy audits: € 2.85 million from public funds. (Government estimated that the average cost for each audits was 14.600€)

Public funds to encourage the adoption of measures that have been identified in energy audits. This action allows reducing ROI ratios and making easy the adoption of measures to reduce energy use in industry sector. This measure is valued in € 1.671 mill where € 367 mill are public funds. Figure 34 shows the planning for these investments.

<table>
<thead>
<tr>
<th>Sectoral Application</th>
<th>Investment (ME)</th>
<th>Public Aids (ME)</th>
<th>Primary Energy Saving (ktce)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>1,671</td>
<td>370</td>
<td>24,750</td>
</tr>
<tr>
<td>Transport</td>
<td>1,893</td>
<td>408</td>
<td>33,471</td>
</tr>
<tr>
<td>Buildings</td>
<td>13,468</td>
<td>804</td>
<td>15,283</td>
</tr>
<tr>
<td>Household and Office</td>
<td>1,999</td>
<td>533</td>
<td>4,350</td>
</tr>
<tr>
<td>Automation Equipment</td>
<td>683</td>
<td>94</td>
<td>1,634</td>
</tr>
<tr>
<td>Agriculture</td>
<td>1,351</td>
<td>89</td>
<td>1,739</td>
</tr>
<tr>
<td>Public Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Transformation</td>
<td>1,085</td>
<td>29</td>
<td>6,707</td>
</tr>
<tr>
<td>Communication</td>
<td>40</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>22,190</td>
<td>2,367</td>
<td>87,934</td>
</tr>
</tbody>
</table>

Source: IDAE

The difference with the previous action plan has been the adoption of Life Cycle Assessment for investment projects in order to highlight those projects that are energy efficiency during the life of the investment. The following measures were adopted:

- Legislative actions: development of regulations and mandatory standards.
- Incentive actions: energy audits, analysis of consumption associated with processes and technologies, investments in equipment to save energy or increased energy efficiency.
- Training in good practices: increase knowledge on available technologies, new management techniques in consumption and demands and in the correct use of energy.
- Dissemination of recommendations and best practices, culture of savings, impacts on the production chain and transforming, etc. Energy labeling for companies. An example of good practices is the Guidelines for SMEs: “Energy Efficiency Guide for SMEs” edited by IDAE and Gas Natural.
- Focusing now on the industrial sector, the objectives of reduction are the following:
Results

Strategic projects - 95 projects have been financed with public funds, € 1.800 million has been invested in these projects with € 272 millions of public funds, the total saving achieved are 203 ktoe/ year. The distribution per sector shows that 45% of the projects were financed in the industrial sector and the energy savings have reached 136 ktoe/year. Results are presented in figure 35.

![Distribution of financed projects](image)

![Energy savings](image)

Figure 35. Results from conducted strategic projects.

Measures focused on improving Energy Efficiency (subsidies for several actions like renewal plan for HVAC systems, lighting, lifts, boilers and fenestration), renewable energy sources (subsidies and financing of renewable energy installations), and vehicle renewal plan (subsidies for hybrid or electrical cars).

Final energy use in the industrial sector has led to reduction of 26.468 ktoe at the end of 2010.

Action plan 2011-2020:

This plan will continue the same path that PAE4 and PAE4+, the results from the previous action plans have lead Spain to improve the ratio of energy dependence (now the ratio is 26%), primary energy intensity has been reduced from 2004-2007 in 2,52% per year and 2,49% per year from 2008-2010, as shown in figure 36.
The transport and industry sectors have reduced the energy use in a significant way because of the economic crisis. The target of reduction of final energy use is 20% in 2020 (to get the commitment of Kyoto protocol); it leads to 35.585 ktoe/year in 2020. The distribution by sector is show in figure 37 below.
Figure 37. Final energy savings target by sector (source MINETUR, Ministry of Industry, Energy and Tourism)

The evolution of expected final energy use is presented in table 8, below.

Table 8. Final energy use in Spain (ktoe/year) (source MINETUR, Ministry of Industry, Energy and Tourism)

<table>
<thead>
<tr>
<th>Sector</th>
<th>2004a</th>
<th>2007a</th>
<th>2008a</th>
<th>2009a</th>
<th>2010a</th>
<th>2016a</th>
<th>2020a</th>
<th>(annual rate of change)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transporte</td>
<td>37.736a</td>
<td>40.604a</td>
<td>39.313a</td>
<td>37.464a</td>
<td>36.744a</td>
<td>38.670a</td>
<td>38.752a</td>
<td>0.53%a</td>
</tr>
<tr>
<td>Residential, Services, and others</td>
<td>29.030a</td>
<td>30.448a</td>
<td>28.866a</td>
<td>26.975a</td>
<td>28.470a</td>
<td>30.016a</td>
<td>30.827a</td>
<td>0.80%a</td>
</tr>
<tr>
<td>Total</td>
<td>96.621a</td>
<td>101.130a</td>
<td>98.440a</td>
<td>90.906a</td>
<td>93.423a</td>
<td>94.720a</td>
<td>95.355a</td>
<td>0.20%a</td>
</tr>
</tbody>
</table>

It leads to savings target in industry of 2.489 ktoe/year in 2016 and 4.489 ktoe/year in 2020. Some of the specific measures that are planned are the following:

- Strategic projects in industry (financial instruments) - demonstration projects that lead to energy savings in the sector and mobilize private investment. € 740 mill to finance this measure.
• Energy audits program in industry sector - the energy audits help to identify potential energy savings and let the benchmarking of processes. € 7.8 mill to finance this measure.
• Implantation of energy management systems in industry sector. Management systems will provide tools to companies not only to focus on specific actions, but it will make focus on continuous improvement as a way to reduce energy use in a continuous and permanent way. € 2 mill to finance this measure.
• Dissemination and diffusion actions: energy services for energy savings.
• Energy Efficiency Standards: Eco-labeling for industrial products.
• Refurbishment of building envelope, substitution of HVAC and lighting systems for more efficient systems. Target: 4.800 ktoe/year.
• Combined heat and power installations.
3.3 Sweden

3.3.1 National goals

In the Swedish Government Bill (2009) the national energy target for 2020 is described. The formulation is that: “A goal of 20 percent energy efficiency should be achieved by 2020. The goal is expressed as a sector-wide target of reducing energy intensity of 20 percent between 2008 and 2020”. The goal for 2020 is thus set to be an energy intensity decrease of 1.7 percent per year (GB, 2009).

3.3.2 Industrial energy end-use programs in Sweden, 1990-2011

In Sweden improving energy efficiency has been an important issue on the policy agenda, particularly since the Oil Crises in the 1970ies. Especially conversion from oil to other energy carriers has been very successful. Sweden has reduced its share of oil dependence in the industrial sector, from contributing to nearly half of the energy use 1970 to only about 10 % in 2008 (SEA, 2009).

As a means to improve energy efficiency in Europe, the European Union launched the European Energy End-use Efficiency and Energy Services Directive (ESD) in 2006, which propose a 9% reduction in the use of energy within the Member States to be achieved by the ninth year of application of the directive (EC, 2006). In addition to promoting energy services, the directive is addressing a number of other activities and services such as the availability of high quality independent energy auditing for SMEs. Beyond the targets for 2016 are the 2020 targets with the aim of reducing emissions of GHG with 20%.

From a Swedish perspective, being part of the European Union since 1995, it has to comply with EU laws and directives. The industrial energy programs in Sweden, launched after the ESD (2006) was presented, are thus a result from that. Prior to that, launched energy policies in Sweden have been due to national attempts rather than to comply with EU directives.

Thollander et al. (2007) made a review of Swedish programs 1990 in Sweden showing that that Project Highland and the PFE are the by far largest programs, in terms of participating companies, up until 2007, in Sweden for industrial and commercial customers. However, the current Swedish energy audit program is forecasted to cover around 1,000 companies up until 2014 (Thollander and Dotzauer, 2010), and has now turned out to be the largest program in terms of number of companies in Sweden. There was also a national program, EKO-Energi (Uggla and Avasoo, 2001; Lindén and Carlsson-Kanyama, 2002), a VA, between the years 1994 and 2001 including 72 large energy-intensive industrial companies. Apart from actual industrial energy-end-use programs, there is one administrative policy, the Swedish Environmental Code. There has thus been five major policies directed towards improving industrial energy end-use efficiency in Sweden, the Swedish Environmental Code, the PFE, the Swedish energy audit program, the EKO-Energi, and the energy audit program, project Highland. These five policies are presented below.
3.3.3 Swedish energy end-use industrial policies 1990-2011

3.3.3.1 Regulation policies

The Swedish Environmental Code

The Swedish Environmental Code came into force in 1988. The code addresses, among other activities, energy efficiency as a key aspect, where one issue is that best available technology (BAT) should be used. Energy efficiency requirements from the Code have recently gained increased attention when environmental permits for companies are issued. The authorities thus have the possibility to stress energy efficiency measures and activities through the environmental code when issuing a permit as well as through the supervision procedure. It should be noted that even though legal grounds exist, this instrument is quite slow and has only recently begun to be practiced. (Johansson et al., 2007).

Major emphasize has been towards energy-intensive companies and larger companies, not on industrial SMEs. Only in recent years, and only in some counties, the county board of administration together with the municipality environmental protection offices have directed some of their effort towards industrial SMEs, through, e.g. site visits. (Miljosamverkan, 2011).

No figures are available on the effect of the Code. However, it may be estimated that the effect from the Code has been very limited so far in Sweden, as it has only recently begun to be practiced.

3.3.3.2 Economic and informative policies

PFE (the program for improving energy efficiency in energy-intensive industries)

The PFE (program for improving energy efficiency in energy-intensive industries) was initiated in 2005 as a consequence of the introduced electricity tax in July 2004 of 0.5 EUR/MWh and is an LTA (Long-Term Agreement) between the Swedish authorities and the electricity-intensive Swedish industry (Ottosson and Petersson, 2007). In the program, electricity-intensive firms are offered a full discount of 0.50 €/MWh on the tax on electricity for Swedish industry if the company fulfills the requirements (Ottosson and Petersson, 2007), including: within the first two years, the participating companies must undertake an energy audit with a systems approach. The audit should result in a number of energy efficiency measures that could be implemented over the remainder of the period (the last three years), and the implemented measures should result in savings at least equivalent to the tax discount (Ottosson and Petersson, 2007). The program also includes mandatory elements such as the implementation of an energy management system, the introduction of standardized routines for purchasing of energy-efficient technologies and planning, energy systems, and plants (Ottosson and Petersson, 2007).

Of the approximately 1,200 firms that are eligible for participation, only about 100 have joined the program (SEA, 2011). The outcome was end-use electricity savings of 1.45 TWh/year (SEA, 2011). 30 percent of the participating companies within PFE consist of industrial SMEs.
The Swedish energy audit program

The Swedish energy audit program was initiated in 2010 and will last until 2014. The program targets companies using more than 500 MWh/year, and offers a subsidy of up to 3,000 EUR, for 50% of the audit cost. After the audit is finished the company must within 6 months report the energy audit report, including an energy action plan on which measures to actually implement. After 2-3 years the company submits its final report including which if the measures from the energy action plan were, de facto, implemented (SEA; 2011). For a more thorough presentation of the logics of the program, please see Thollander and Dotzauer (2011).

3.3.3.3 Specific energy training programs

No specific training programs for industrial SMEs exist in Sweden.

3.3.3.4 Energy sector guidelines

No energy sector guidelines exist in Sweden.

3.3.3.5 Investment funds

No technology directed policies exist in Sweden.

3.3.3.6 Networks

There is a newly initiated network for energy-intensive industry within the PFE for energy controllers. Moreover, there is one expert network for researchers within the field of energy efficiency in industry, however, not directed explicitly towards industrial SMEs.

3.3.3.7 General information campaigns including self-scanning, and benchmarking methods

No general information campaigns directed towards industrial SMEs exist in Sweden. However, there is a web-based tool named ENIG (Energy Networking in Group) where one may benchmark energy use (ENIG, 2012). The policy however, have not been widely used by industry in general and industrial SMEs in particular.

Moreover, every Swedish municipality has its own local authority energy consultant who is supposed to offer support to local SMEs. However, the policy has up until now, primarily been focused on individuals.

3.3.4 Some examples of successful regional policies

3.3.4.1 Project Highland

Project Highland was up until 2010 the largest Swedish energy program since the 1990, in terms of participating companies; the program offered energy audits in six municipalities. A total of about 340 energy audits were conducted, of which approximately 140 audits, were directed towards the industrial sector and the rest towards the services and sales sector. Due to limited amount of time assigned to each audit, and partly due to the fact that the SEA (the Swedish Energy Agency) did not allow complete audits, due to a risk of

IEA IETS Annex XVI
competitive disadvantages for enterprises not included in the program, less than half of the recommended measures were quantified, i.e. only half of the proposed measures were quantified in terms of energy saved per year (Thollander et al., 2007; Thollander and Rohdin, 2010).

Table 9, presents results from the previous evaluation of the industrial part of project Highland together with the evaluation for the service and sales sector from project Highland (Thollander et al., 2007; Thollander and Rohdin, 2010).

Table 9. Key figures for project Highland (Results from the industrial firms from project Highland has previously been published in Thollander et al. (2007)).

<table>
<thead>
<tr>
<th>Service and sales firms in project Highland</th>
<th>Industrial firms in project Highland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of firms</td>
<td>28</td>
</tr>
<tr>
<td>Total energy savings, including electricity (GWh/year)</td>
<td>0.35/0.7&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total energy use (MWh/yr)</td>
<td>12 029</td>
</tr>
<tr>
<td>Total energy saving potential (MWh/yr)</td>
<td>3 227</td>
</tr>
<tr>
<td>Number of measures</td>
<td>48/90&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Subsidy, including program administration (EUR)</td>
<td>42 600 (adm.+audit costs)</td>
</tr>
<tr>
<td>Cost-effectiveness for all measures (kWh/EUR)</td>
<td>8/15&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Results indicate that the degree of implementation for the two sectors, industry and service and sales, differs substantially. While the relative percentage of proposed measures is equivalent, the degree of adoption of measures, are higher for the industrial sector. This fact will affect the outcome of the cost-effectiveness of the audits as the cost for the audits did not

<sup>14</sup> Thollander et al. (2007).
differ substantially between audits made in service and sales firms versus audits made in industrial firms.

3.3.5 Policy summary

Table 10 summarizes the various energy policies directed towards industrial SMEs since 1990 (regional and sector-specific networks excluded).

Table 10. Swedish industrial energy efficiency programs from 1990-2011 (based on Thollander et al., 2007).

<table>
<thead>
<tr>
<th>Energy program, year</th>
<th>Type of program</th>
<th>Number of companies</th>
<th>Evaluation</th>
<th>Subsidaries</th>
<th>Calculated energy efficiency potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Highland, 2003-2008</td>
<td>Energy audits</td>
<td>Approx. 340 small and medium-sized</td>
<td>Impact evaluation</td>
<td>Public sponsored audit</td>
<td>Electricity savings, total energy savings</td>
</tr>
<tr>
<td>Oskarshamn, 2000-2001</td>
<td>Energy audits</td>
<td>9 largest companies in Oskars-hamm</td>
<td>Process evaluation</td>
<td>Public sponsored audit</td>
<td>Electricity saving 48%, total energy saving 40%</td>
</tr>
<tr>
<td>Elost,</td>
<td>Energy audits</td>
<td>7</td>
<td>N.a.</td>
<td>Public sponsored audit</td>
<td>Electricity saving 58%</td>
</tr>
<tr>
<td>Energieffektiva VästraGötaland, - 2005</td>
<td>Energy audits</td>
<td>9</td>
<td>N.a.</td>
<td>Public sponsored audit</td>
<td>Total energy saving 16%</td>
</tr>
<tr>
<td>Sustainable municipalities, 2004-2006</td>
<td>Energy audits</td>
<td>Approx. 40</td>
<td>Impact evaluation/ process evaluation</td>
<td>Public sponsored audit</td>
<td>Electricity saving 20-60%, total energy saving 30-38%</td>
</tr>
<tr>
<td>The energy audit check, 2010-2014</td>
<td>Energy audits</td>
<td>Approx. 1 000</td>
<td>Ex-ante impact evaluation</td>
<td>Subsidized energy</td>
<td>N.a.</td>
</tr>
</tbody>
</table>
As shown in table 10, the two major energy end-use policy instruments towards Swedish industrial SMEs are the energy audit program and the PFE.

3.4 Belgium

Extracts are taken from the National Energy Efficiency Action Plans (NEEAP), which Belgium submitted within the framework of Directive 2006/32/EC, in order to describe the energy saving policy towards industry.

3.4.1 Regional goals

The first NEEAP (2008-2010) consists of 4 regional action plans; each competent level, having authority in the field of energy, submitted its own regional action plan: Flanders, Wallonia, Brussels Capital Region and the Federal government, for the issues it is competent for. The second NEEAP is an aggregated one, compiling the regional action plans into one.

3.4.2 Objectives from the first NEEAP

The rational use of energy falls within the competence of the three regions. Each of the three regions stipulated an overall energy efficiency target for 2016, which corresponds to 9% of the final inland energy use covered by the scope of Directive 2006/32/EC:

- Flanders: 16,959 GWh = 61 PJ
- Wallonia: 8,358 GWh = 30 PJ
- Brussels Capital Region: 2,929 GWh = 11 PJ

The Federal State also implemented some measures aimed at enhancing energy efficiency within its competences (taxation, product standards,). As all the final inland energy use has been allocated to the regions, the federal level could not indicate an overall energy saving target.

Each of the four competency levels proposed measures to achieve this energy saving target.
Table 11. Number of energy saving measures proposed by each of the competency authorities in the first National Energy Efficiency Action Plan of Belgium.

<table>
<thead>
<tr>
<th>Number of measures</th>
<th>Flanders</th>
<th>Brussels Capital Region</th>
<th>Wallonia</th>
<th>Federal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information and legislative-informative measures</td>
<td></td>
<td></td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Financial instruments</td>
<td>1</td>
<td>21</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Voluntary agreements and co-operative instruments</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>EEI mechanisms and other combinations of previous (sub)categories</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal and cross-sectoral measures</td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Flanders was the only region that has assessed the energy saving potential of the proposed measures. The estimated total expected primary energy savings by 2016 amount to 18,174 GWh (65 PJ), which exceed the target. Industry is expected to contribute 5% to this energy savings:

- Measures in the residential sector: 4,704 (GWh by 2016)
- Measures in the tertiary sector: 4,025 (GWh by 2016)
- Measures in industry (excluding ETS): 979 (GWh by 2016)
- Measures in the agricultural sector: 2,330 (GWh by 2016)
- Measures in the transport sector: 5,293 (GWh by 2016)
- Cross-sector: 843 (GWh by 2016)

3.4.3 Objectives from the second NEEAP

In the second NEEAPs, the final energy saving targets have been reviewed; the final energy saving target for 2016 is set at 99.1 PJ.

<table>
<thead>
<tr>
<th></th>
<th>GWh</th>
<th>Final energy savings (2010)</th>
<th>Final energy savings (2016)</th>
<th>Target</th>
<th>Achieved</th>
<th>Target</th>
<th>Projection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flanders</td>
<td>5,653</td>
<td>10,818</td>
<td>16,959</td>
<td>25,093</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brussels CR</td>
<td>733</td>
<td>2,199</td>
<td>2,311</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wallonia</td>
<td>2,786</td>
<td>3,574</td>
<td>8,358</td>
<td>7,307</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flanders</td>
<td>20.4</td>
<td>38.9</td>
<td>61.1</td>
<td>90.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brussels CR</td>
<td>2.6</td>
<td>7.9</td>
<td>8.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wallonia</td>
<td>10.0</td>
<td>10.9</td>
<td>30.1</td>
<td>26.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Each of the competent authorities proposed measures to reach this target; their estimated final energy savings amount to 124.9 PJ. Especially Flanders will overachieve its target.

The table below lists the energy saving measures proposed to save energy in the industrial sector. In 2016, these measures are believed to save 9.2 PJ final energy, which is 7.4% of the total final estimated energy savings by 2016.

Table 13. Energy saving measures in industry proposed by each of the competent authorities in the first National Energy Efficiency Action Plan of Belgium.

<table>
<thead>
<tr>
<th>Title of the energy saving measure</th>
<th>end-use targeted</th>
<th>Category</th>
<th>Duration</th>
<th>Energy savings expected In 2010</th>
<th>Energy savings expected In 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Federal level</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flemish region</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audit agreement</td>
<td>Utilities and processes in medium-sized, energy-intensive companies with a yearly primary energy consumption between 0,1 and 0,5 PJ that are not covered by the emissions trading directive</td>
<td>4. Voluntary agreements and co-operative instruments 4.1 Industrial Companies</td>
<td>10/06/2005 - 10/12/2013</td>
<td>Final: 1249 Primary: 1993 for both audit and benchmark agreement</td>
<td>Final: 1760 Primary: 2640 for both audit and benchmark agreement</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Utilities and</td>
<td>4. Voluntary</td>
<td>From 2003</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


### Brussels Capital Region

<table>
<thead>
<tr>
<th>Agreement</th>
<th>Details</th>
<th>Time Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Voluntary agreements and co-operative instruments</td>
<td>4.1 Industrial Companies 4.2 Commercial or Institutional Organisations</td>
<td>Since 1999</td>
</tr>
</tbody>
</table>

### Walloon Region

<table>
<thead>
<tr>
<th>Subsidies for industry investment (excluding building)</th>
<th>Details</th>
<th>Time Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Companies’ electricity and heating consumptions</td>
<td>3. Financial instruments</td>
<td>Final: 13 Primary: 20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voluntary Agreements excluding ETS</th>
<th>Details</th>
<th>Time Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity consumption and business processes</td>
<td>4. Voluntary agreements and co-operative instruments</td>
<td>Final: 788 Primary: 1048</td>
</tr>
</tbody>
</table>

Apart from a subsidy in Wallonia with a minor expected contribution to industrial energy savings (30 GWh by 2016), all proposed energy saving measures are voluntary agreements on energy efficiency in industry.

In Flanders there are two voluntary agreements on energy efficiency in industry:
• The benchmarking covenant for industrial companies with a primary energy consumption above 0.5 PJ per annum or having obligations under the European Emission Trading System
• The auditing covenant for industrial companies with a primary energy consumption between 0.1 and 0.5 PJ per annum

Voluntary agreements are also in Wallonia the backbone to stimulate energy efficiency in industry. Whereas Flanders has agreements between individual companies and the government, the Walloon voluntary agreement is a sector agreement between sectors, represented by their associations, and the government.

Besides the voluntary agreements, listed in the NEEAPs, industrial companies can apply for subsidies for implementing energy saving measures. Next subchapters describe these measures more in detail.

3.4.4 Flanders – The Benchmarking Covenant

The Benchmarking Covenant was enacted in 2002 and ended in 2012. It was a voluntary agreement with industry targeting industrial companies with an annual primary energy consumption of 0.5 PJ or higher and industrial companies having obligations under the European Emission Trading System (EU ETS).

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 operations against similar operations worldwide. By the end of 2012 all operations were required to form part of the world’s leading edge on energy efficiency. To determine this leading edge, different benchmarking methodologies are proposed in the Benchmarking Covenant. In case none of these proposed 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.

As compensation for these mandated commitments, the Flemish Government guaranteed not to impose additional measures or policies on rational energy use or greenhouse gas (GHG) emissions reduction (particularly energy or CO2 taxes or emission constraints). The Flemish Government also committed to taking 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 permits under the EU ETS where it can be shown they have fulfilled all obligations under the Covenant.

In response to this compensation, all but a few eligible energy intensive companies joined the Benchmarking Covenant at the start of the Benchmarking Covenant in 2002. These 178 energy intensive companies represent about 80% of industrial energy use of Flanders.

Figure 38 compares the monitored energy use (“Bedrijven volg. Monitoring”) of the 175 companies, participating to the Benchmarking covenant in 2011, to their benchmark (“Wereldtop”) and to their planned energy use after implementing energy saving measures in
line with their obligation ("Bedrijven volgens Plan"). In all three energy using figures, the production value was corrected to the volume of 2011.

Already at the start of the covenant, all participants together performed better than the benchmark. As a result of the implementation of energy saving measures between 2002 and 2007, the distance to the benchmark was increased from 10 PJ primary energy to 25 PJ primary energy in 2007. In 2008, the benchmark was reassessed. At the same time, the financial crisis affected the energy efficiency performance of the participants; in 2009, the energy use (corrected for production volumes) exceeded the benchmark. The monitored energy use increased because the specific energy use of the various processes deteriorated as a result of a decline in production volumes.

From 2010 on, the participants retained their pre-crisis activity, with a decline in specific energy use as a result and allowing the participants to perform better than the benchmark. In 2011, the distance to the benchmark was 16 PJ primary energy; however, the actual energy use was still 2 PJ primary higher than planned.

Figure 38. Energy use of participants to Flemish benchmarking covenant 2002 – 2011 ("Wereldtop": benchmark; “Bedrijven volgens Plan”: planned energy use of participants after implementation of energy saving measures; “Bedrijven volg. Monitoring”: actual energy use of participants)

Table 14 presents the achievements of the Flemish benchmarking covenant in a different way; it shows the evolution of the Energy Efficiency Index. In nine years, an energy efficiency improvement of 8.1% has been achieved.
Table 14. Evolution of the Energy Efficiency Index of the participants to the Flemish benchmarking covenant 2002-2011.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>100</td>
<td>99.05</td>
<td>97.11</td>
<td>96.33</td>
<td>95.45</td>
<td>94.83</td>
<td>93.12</td>
<td>92.58</td>
<td>91.50</td>
</tr>
<tr>
<td>Monitor</td>
<td>100</td>
<td>98.65</td>
<td>96.96</td>
<td>96.17</td>
<td>94.66</td>
<td>96.21</td>
<td>97.04</td>
<td>93.48</td>
<td>91.90</td>
</tr>
</tbody>
</table>

3.4.5 Flanders – The Auditing Covenant

The Auditing Covenant was approved by the Flemish Government in 2005. Just like the Benchmarking Covenant, it is a voluntary agreement. The Auditing Covenant is designed for industrial companies with an annual primary energy use of between 0.1 and 0.5 PJ and that are not covered by the European ETS. The Auditing Covenant operates for eight years, officially ending on Dec 10th, 2013.

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 had to make a first energy plan in the first year following their accession to the covenant.

All energy saving measures, identified in the energy plan, with an IRR of 15% or higher must be implemented; in the case of the Auditing Covenant within four years of approval of the energy plan 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 had 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 – had 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.

By Dec 10th, 2005, 229 industrial companies had acceded to the Auditing Covenant: 71 are companies from the food and fodder sector, 54 from chemistry and plastics, 46 from the technology sector, 36 from textile or wood processing and the 22 remaining companies are from the mineral products, paper products, printing, and waste treatment industries. In 2005, participants consumed 44 PJ. Together they represent about 10% of total industrial energy consumption.

Figure 39 presents the evolution of the actual energy use of the participants (“Reëel energieverbruik”) and the corrected energy use for production volumes (“Energieverbruik bij productieniveau 2011”); the production volume is fixed at the 2011 levels. In six years, the
auditing covenant achieved a 4.2 PJ primary energy saving, which corresponds to an improvement of the energy efficiency of 9.5%. Just like the participants to the benchmarking covenant, there was a deterioration of the energy efficiency performance for the participants of the auditing covenant in 2008 and 2009, however to a lesser extent.

![Figure 39. Energy use of participants to Flemish auditing covenant 2005 – 2011 (“E.P.I.”: Energy Performance Index; “Reël energieverbruik”: actual energy use of participants; “Energieverbruik bij productieniveau 2011”: energy use of participants corrected for production volumes)](image)

### 3.4.6 Flanders – The Energy Governance Agreement

In the course of 2012-2013, negotiations are going on how to continue with the policy to stimulate industrial energy efficiency based on voluntary agreements. It is agreed to continue this policy and that both covenants will be merged into one covenant, which will be called the ‘Energy Governance Agreement’. In the course of 2013, a final agreement is expected. In the meanwhile, both the benchmarking and the auditing covenant continue to operate.

As in both covenants, the threshold for participating to the new agreement is an annual primary energy use of 0.1 PJ. SMEs are hence not covered by this Energy Governance Agreement.
3.4.7 Wallonia – The Sector Agreements “Energy / CO2”

The Walloon industrial energy policy mainly relies on voluntary agreements between sector associations and the Walloon regional government. According to the terms of the covenant, the industrial sectors commit themselves to improve their energy efficiency and to decrease their CO2 emissions by 2010 or 2012 (depending on sector agreement). Industrial companies, making part of a specific sector agreement, can decide amongst themselves which companies are taking energy efficiency measures in order to achieve the sectors target.

In 2003, two sectors acceded to this sector agreement; in 2010, 16 sectors have signed sector agreements, representing 177 industrial companies, of which their 217 industrial sites represent 80 to 90% of the industrial energy consumption in the Walloon region; Table 15 provides more details on the sectors and the number of industrial companies participating, the number of sites covered, their objective and their achievement in 2010.

In 2011, the targets for each of the sectors have been reviewed and adopted based on the actual energy efficiency improvements realized by the individual sectors.

Table 15. Sectors having a sector agreement with the Walloon government with details on number of participating companies, number of covered sites, targets and achievements (2010)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Number of participating companies in 2010</th>
<th>Number of covered sites in 2010</th>
<th>Energy efficiency objective (original)</th>
<th>By</th>
<th>Energy efficiency improvement in 2010</th>
<th>Energy efficiency objective (final)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron and steel</td>
<td>6</td>
<td>18</td>
<td>5.6%</td>
<td>2010</td>
<td>9.0%</td>
<td>8.4%</td>
</tr>
<tr>
<td>Chemicals</td>
<td>28</td>
<td>31</td>
<td>20.0%</td>
<td>2012</td>
<td>19.7%</td>
<td>20.0%</td>
</tr>
<tr>
<td>Cement production</td>
<td>3</td>
<td>6</td>
<td>8.3%</td>
<td>2010</td>
<td>8.0%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Glass</td>
<td>8</td>
<td>9</td>
<td>11.4%</td>
<td>2010</td>
<td>16.3%</td>
<td>11.6%</td>
</tr>
<tr>
<td>Food and fodder</td>
<td>51</td>
<td>51</td>
<td>7.4%</td>
<td>2010</td>
<td>18.7%</td>
<td>14.00%</td>
</tr>
<tr>
<td>Lime quarries</td>
<td>1</td>
<td>3</td>
<td>2.8%</td>
<td>2010</td>
<td>2.6%</td>
<td>2.8%</td>
</tr>
<tr>
<td>Pulp and paper</td>
<td>4</td>
<td>5</td>
<td>33.0%</td>
<td>2012</td>
<td>34.7%</td>
<td>33.0%</td>
</tr>
<tr>
<td>Lime quarries</td>
<td>1</td>
<td>3</td>
<td>2.4%</td>
<td>2010</td>
<td>0.3%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Machine manufacture</td>
<td>11</td>
<td>12</td>
<td>13.5%</td>
<td>2010</td>
<td>21.2%</td>
<td>19.0%</td>
</tr>
<tr>
<td>Bricks and ceramics</td>
<td>6</td>
<td>10</td>
<td>2.7%</td>
<td>2012</td>
<td>3.7%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Grooves</td>
<td>9</td>
<td>19</td>
<td>8.6%</td>
<td>2012</td>
<td>9.6%</td>
<td>8.6%</td>
</tr>
<tr>
<td>Textile and wood</td>
<td>7</td>
<td>7</td>
<td>7.1%</td>
<td>2012</td>
<td>14.5%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Cast iron</td>
<td>7</td>
<td>7</td>
<td>8.7%</td>
<td>2010</td>
<td>6.8%</td>
<td>8.7%</td>
</tr>
<tr>
<td>Printing</td>
<td>7</td>
<td>7</td>
<td>12.6%</td>
<td>2012</td>
<td>14.5%</td>
<td>12.6%</td>
</tr>
<tr>
<td>Electronics</td>
<td>23</td>
<td>23</td>
<td>18.2%</td>
<td>2012</td>
<td>32.5%</td>
<td>18.2%</td>
</tr>
<tr>
<td>Non-iron</td>
<td>5</td>
<td>6</td>
<td>11.0%</td>
<td>2010</td>
<td>23.6%</td>
<td>21.0%</td>
</tr>
</tbody>
</table>

177 217
Figure 40 shows the overall energy efficiency improvements; these are expressed as an energy efficiency index:

\[ IEE_{\text{year}} = (1 - \frac{EC_{\text{year, actual}}}{EC_{\text{year, no measures}}}) \]

With:

- IEE: Energy Efficiency Index (indice d’efficience énergétique)
- \( EC_{\text{year, actual}} \): actual energy consumption in that particular year
- \( EC_{\text{year, no measures}} \): energy consumption in that particular year if no energy efficiency measures would have been taken

Note that the IEE starts at 91.7% in 2004, because the calculation takes the effect of energy efficiency measures taken since 2001 into account.

In 2010, the accumulative primary energy savings, as a result of the sector agreements, are estimated at 25 PJ (Walloon Government, 2005-2011).

![Figure 40. Energy efficiency improvement expressed as Energy Efficiency Index (line, left axis) and primary energy savings (bars, right axis) as a result of the Sector Agreements in the Walloon Region, Belgium (2004-2010)](image)

### 3.4.8 Subsidies for rational use of energy

SMEs cannot participate to any of the voluntary agreements, described above; they are designed to stimulate energy efficiency in energy intensive industry. Each of the regions...
however has implemented policies to stimulate energy efficiency in SMEs as well. Energy efficiency in SMEs is stimulated by granting subsidies for energy efficiency measures; either by granting subsidies directly by the government; or by obliging distribution grid operators to promote the rational use of energy at the end-consumers, amongst others SMEs.

### 3.4.8.1 Direct subsidies for energy efficiency measures

In Flanders, companies can apply for subsidy since 1990. Statistics on the uptake of these energy saving measures in the framework of the ecology premium are not publically available.

The Walloon region issues investment grants for energy savings measures in industry since 2005. The investment grants cover a part of the additional costs of RUE investment after deducting the expected gains over the first five years of operation. Examples of supported energy saving measures are: cold regulation and defrosting optimization, frequency variation on electric motors driving pumps, fans and compressors operating on partial load, direct heat gas applications, heat recovery from natural gas powered industrial furnace flue-gases, wide modulation range of gas burners in industry, and so forth.

In 2010, the Walloon government issued 360,000 € of subsidies; the primary energy savings of the supported measures is estimated at 20 GWh per year (0.072 PJ/annum). (Source: SPW, 2011)

### 3.4.8.2 Energy Efficiency Obligations of power distribution grid operators

In each of the three regions, there is an energy efficiency obligation scheme into place since 2003. The obliged parties are distribution grid operators for power (power only, gas grid operators have no obligation). The energy efficiency target varies from region to region. In Flanders for instance, their obligation is to finance energy saving measures and to realize primary energy savings that amount to 1% (obligation in 2003) of the power they have provided to end-users two years before. Due to the fact that the energy saving obligation is expressed in primary energy, energy savings at the thermal side are as eligible as energy savings at the electrical side. In time the obligation in Flanders has changed, but never exceeded 2%.

The energy savings can be carried out in the residential sector and the services sector, but also in the industrial sector. In Flanders, energy savings, realized in the industrial sector, contribute to 25% to 30% of the overall energy savings realized under these energy efficiency obligation schemes in 2003-2008 (1.1 PJ primary energy on average). Table 16 shows which energy savings measures contributed to these savings.

The scheme in Flanders is still in operation today, as well as the scheme in Brussels Capital Region and Wallonia, results are presented in table 16.

Table 16. Evolution of the energy savings according to type of measure realized under the Flemish energy efficiency obligation scheme (2003-2008).
### Supported actions

<table>
<thead>
<tr>
<th>Supported actions</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy audit</td>
<td>44%</td>
<td>45%</td>
<td>48%</td>
<td>19%</td>
<td>41%</td>
<td>34%</td>
</tr>
<tr>
<td>Measurements and control</td>
<td>0%</td>
<td>2%</td>
<td>0%</td>
<td>3%</td>
<td>11%</td>
<td>24%</td>
</tr>
<tr>
<td>Energy efficient lighting</td>
<td>4%</td>
<td>7%</td>
<td>8%</td>
<td>3%</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>Energy efficient heating</td>
<td>1%</td>
<td>2%</td>
<td>2%</td>
<td>3%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Frequency drives</td>
<td>42%</td>
<td>17%</td>
<td>29%</td>
<td>47%</td>
<td>26%</td>
<td>21%</td>
</tr>
<tr>
<td>Energy efficient measure from audit</td>
<td>3%</td>
<td>25%</td>
<td>6%</td>
<td>20%</td>
<td>13%</td>
<td>11%</td>
</tr>
<tr>
<td>Others</td>
<td>6%</td>
<td>2%</td>
<td>7%</td>
<td>4%</td>
<td>3%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Source: VITO
4. Feedback and outcome

Initially, it should be stressed that the overall energy use among industrial SMEs in the studied countries is lower than larger and energy-intensive industry. Focusing on energy end-use efficiency, it may thus be questioned if industrial SMEs should be first priority? On the contrary, as shown in this report, the economic impact from these companies is of great relevance for a nation. Moreover, the cost-effectiveness of energy-end-use policy measures is often high, compared to large firms that may have already exploited low-cost potentials. Larger and energy-intensive companies have higher energy efficiency potentials in absolute terms, but many of these have implemented basic measures because they have sufficient management capability etc. to do so. So, if one just sees the availability of low-cost potentials of energy efficiency measures in the market, share of SMEs might in fact be high.

Moreover, the goal or aim with energy end-use policies may be seen as not only an attempt to improve energy end-use efficiency, but equally or perhaps more importantly support these firms in their long-term survival and success. In these regards, energy end-use efficiency in the longer run is of great importance as firms otherwise may face competitive disadvantageous in comparison with competitors from outside the country.

The above presentation of national contexts related to industrial SMEs, together with the national policy presentations for the countries Japan, Spain, Belgium, and Sweden, reveals that policies directed towards industrial SMEs are limited, with the exception of Japan. In this section, the feedback and outcomes of the policies directed towards industrial SMEs are presented, followed by an expert communication from the Participants in Annex XVI to e.g., policy-makers, on how policies is suggested be directed towards industrial SMEs. These suggestions are the ideas of the individual Participant alone, and should not be seen as the ideas neither from IEA IETS, nor from the author’s research bodies.

Moreover, the presented list is by no means conclusive but may rather be seen as an attempt to try to categorize and structure various policies directed towards industrial SMEs.

It should also be noted that the current report only covers direct energy end-use efficiency policies. A promising policy not directly related to improved energy efficiency is the innovation policy in Italy where they cluster SMEs together and by so indirectly achieve increased energy efficiency as secondary outcome.

4.1 Administrative policies

Apart from Japan, administrative or regulative policies have not been adopted on a full-scale nationally, or put it differently; such regulation is in place but is not used extensively in practice except for Japan. Based on experience from Japan, it can be concluded that the Energy Conservation Law is a sound policy instruments for medium-sized industrial SMEs and energy-intensive industrial SMEs. Experience from the Japanese Energy Conservation Law for small industrial enterprises is however that it is less suited for such
companies. Rather, when these small industrial enterprises are regulated by the Law they tend to just work on paper work rather than actual actions in order to comply with the law. They sometimes hire a consultant to fulfill the mandatory requirements from the Energy Conservation Law, but these requirements, mostly does not result in action in terms of new investments or change in routines. On the contrary, the law has an important role to motivate medium-sized and energy-intensive industrial enterprises for energy management (Kimura and Noda, 2010a).

In conclusion, administrative policy instruments for medium-sized enterprises may be a sound policy instrument in promoting energy efficiency but may not be so for small-sized enterprises, both in terms of technology investments and in terms of energy management activities.

A final note in regard to administrative policies are that in the studied countries, the governmental officials conducting the enforcement of the laws, many times are not well experienced leading to problems of actually enforcing/stressing adoption of BAT (Best Available Technology).

4.2 Information policies

In the presentation of various policies, it is seen that informative policies forms the backbone in the various countries’ policy mixes. The major informative instruments are information campaigns including seminars, and energy audit programs. The former, information campaigns, has been shown to lead to increased awareness but very seldom lead to change in actual behavior, or lead to actual investments (Stern and Aronsson, 1984, Thollander and Palm 2013).

Energy audit programs towards industrial SMEs have been proven to be extremely cost-effective: Results from Sweden shows that is about 10-20 times more cost-effective than an LTA or VA towards energy-intensive industry. Even though more research is needed to further exploit this issue, both in Sweden and elsewhere, in order to draw general conclusions from such figures, it may be concluded that an energy audit program does improve energy efficiency in industrial SMEs (Kimura, 2010: Thollander et al., 2007; Thollander and Rohdin, 2010), reduce barriers to energy efficiency (Schleich, 2004), and are extremely cost-effective compared with other energy-end-use programs (Morgenstern and Al-Jurf, 1999; Tonn and Martin, 2000; Fleiter et al., 2012; Vaisanen and Reinikainen, 2002; Khan, 2006; Thollander et al., 2007).

In Japan, Belgium, and Sweden there are also voluntary information instruments like the Swedish LTA-program, the PFE (Program for improving energy efficiency in energy-intensive industry). Apart from Sweden, these policies has to the author’s awareness not been evaluated.

Apart from that, Spain and Belgium has benchmarking in their energy policy programs. The outcome of the Spanish program has, to the author’s awareness, not been evaluated while the outcome of the Belgium program has shown that the program leads to actions as the
energy intensity of the participating companies has been reduced more than baseline. Moreover, networks are also present in both Japan and Sweden, though not explicitly directed towards industrial SMEs. However, the Participants (in this project) see a promising approach in Switzerland and Germany using networks (Koewener et al., 2011). This approach has proven to double the impact from an information programs like an energy audit program (Koewener et al., 2011)!

Finally, in particular Japan has many regional and local information programs. The importance of regionally and locally related programs aiming for improving energy efficiency in industrial SMEs cannot be underscored enough as the industrial SMEs normally puts an information provider, closer to them, as more trustworthy (Stern and Aronsson, 1984). A regionally or locally anchored program, thus increases chances of success.

It has also been concluded that there is a demand for guidelines or a standard on how to evaluate polices for SMEs. If the target is clear, it is quite easy to evaluate. Otherwise, it is difficult to say anything. The importance of actually metering the outcome must be balanced with the cost for this metering. Here lies a great challenge as the number of SMEs are vast compared with evaluating large firms which use large shares of a nation’s energy use and are few in numbers. In particular, the importance of guidelines on how to evaluate energy programs is emphasized as the current evaluations in the international literature, e.g. Fleiter et al (2011), Thollander et al. (2007), all use different ways of calculating the effect and cost-effectiveness.

4.3 Economic policies

In both the energy audit programs expressed above and the Swedish LTA, informative policies are merged with economic policies, i.e. subsidies are given if joining the program. The level of subsidy has large implications on the policy’s cost-effectiveness. However, there is little research on adequate levels of for example how much an industrial energy audit should be subsidized. The Finnish industrial energy audit program – Europe’s most mature program – started with a 50 % subsidy but reduced that to 40 % after some years (Vaisenen et al., 2011). Even though results from this report does not give relevant new input into this crucial issue, previous research results provide us with knowledge that applying for funding for industrial SMEs should be extremely easy taken that these firm’s management capability is limited, compared with larger, more structured firms with divisions solely focusing on environmental and energy issues. Results from Germany revealed that many SMEs were not even aware that grants were available (Gruber and Brand, 1994).

As regards investment funds, these may be seen as relevant, taken that a thorough energy audit has been conducted. However results from the Dutch Energy Bonus revealed that up to 85 % of the investments funds were given to measures which would have been implemented anyway, i.e. a free-rider effect of up to 85 %. Results from Spain revealed on the contrary that the current economic situation in the country and in individual industrial SMEs, makes energy audit without the option of investment subsidy of less relevance. Companies simply do not prioritize investments in improved energy efficiency even with extensive
information (coming from an energy audit) on the benefits of such. This is in line with previous research by, e.g. Sorrell et al. (2004).

Among the studied countries, direct investments subsidies were only offered in Belgium.

4.4 Suggestion for policies directed towards industrial SMEs

In this section, an attempt is made in order to try categorizing successful policies for improved energy end-use efficiency towards industrial SMEs.

These suggestions are the ideas of the individual authors alone, and should not be seen as the ideas neither from IEA IETS, nor from the Participant’s research bodies. Moreover, the presented list is by no means conclusive but may rather be seen as an attempt to try to categorize and structure various policies directed towards industrial SMEs.

Industrial SMEs have a large diversity in energy use and energy management, and can be categorized into many segments by size and type of business. Among them, we think the following category has particular relevance: i) Medium-sized and energy-intensive industrial SMEs, and ii) Small-sized and non-energy-intensive industrial SMEs. The difference of the two segments are described in table 17.

Table 17. Some characteristics for industrial SMEs.

<table>
<thead>
<tr>
<th></th>
<th>Medium-sized SMEs and energy-intensive industrial SMEs</th>
<th>Small-sized SMEs and non-energy-intensive industrial SMEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of energy used</td>
<td>Medium</td>
<td>Small</td>
</tr>
<tr>
<td>Human resource for energy management</td>
<td>Limited, but they usually have a couple of responsible engineers</td>
<td>Very limited, often without responsible personnel.</td>
</tr>
<tr>
<td>Type of technology</td>
<td>Production and support processes</td>
<td>Mainly support processes</td>
</tr>
</tbody>
</table>

Because the characteristics of in the two segments are different, different approaches are needed in improving their energy efficiency.

i) Medium-sized and energy-intensive industrial SMEs

They have in general a modest capacity to work on energy efficiency, so giving economic and/or regulatory incentives is important. This underscores for example regulation (like the Energy Conservation Law in Japan), or LTA/VA (like in Sweden) as effective policy measures. Yet another reason for those types of support is that these companies also have
significant energy use for the production processes and for those measures, more support may be needed, e.g. energy audit programs, networks, investment subsidies etc.

ii) Small-sized and non-energy-intensive industrial SMEs

They do not in general have enough capacity to work on energy efficiency, and are thus in need of a more supportive approach, e.g. assistance from external experts. Energy audit programs are effective, but should be complemented with networks where an experienced engineer supports the companies within the network.

Below follows a list of suggested relevant polices for industrial SMEs to be considered among policy-makers:

**Medium-sized and energy-intensive industrial SMEs**

1. Energy Conservation Law/LTA/VA
2. Energy audit programs for industrial SMEs, preferably but not necessarily located regionally or locally
3. Energy networks (preferably locally or regionally anchored)
4. Investment subsidies mainly for investments in production-related technologies
5. Benchmarking
6. Sector guidelines

**Small-sized and non-energy-intensive industrial SMEs**

1. Energy audit program (preferably locally or regionally anchored)
2. Energy networks (preferably locally or regionally anchored)
3. Investment subsidy
4. Benchmarking
5. Sector guidelines
5. References

Arimura and Iwata, 2007, CO2 emission reduction under the law concerning the rational use of energy: an empirical study of energy management in the Japanese hotel industry. Review of environmental economics and policy studies, 1, pp.79-89. (In Japanese)


Commission of the auditing covenant on energy efficiency in industry in Flanders, annual reports 2006-2011

Commission of the benchmarking covenant on energy efficiency in industry in Flanders, annual reports 2003-2011


ECCJ (Energy Conservation Center Japan), 2007, Shouenerugi taisaku jittai chousa [Survey on implementation of energy efficiency measure], ECCJ. (in Japanese)


EDMC (Energy Data and Modeling Center), 2012, Handbook of Energy and Economics Statistics in Japan, ECCJ.


METI (Ministry of Economy, Trade, and Industry), 2012, Census of Manufactures 2009.

MOE (Ministry of Environment), 2012, GHG emissions database of designated firms of Climate Change Mitigation Law, MOE. (in Japanese)


NEDO, 2010, Heisei 22 nendo jigyō hyoukasho [Evaluation of the program, fiscal year 2010], NEDO. (in Japanese)


SMEA, 2009, Guidebook of energy efficiency programs for SMEs, Fiscal Year 2009, SEMA. (in Japanese)


VITO, energy balance of the Flemish region 1990-2011, 2012


PWC, 2007. Incitamentsformer för ökade energieffektiva investeringar utanför energiintensiv industri [Types of incentives for increased energy efficiency investments outside the energy intensive industry]. Örhlings Pricewaterhouse Coopers, Stockholm. [in Swedish].