POLITYKA ENERGETYCZNA
Tom 13 ✧ Zeszyt 1 ✧ 2010
PL ISSN 1429-6675

Jacek KAMIŃSKI*, Guillaume LEDUC**

Energy efficiency improvement options for the EU food industry

ABSTRACT. This paper presents the most important energy efficiency improvement options that could be applied in the food, drink and tobacco industry in the short and medium term. First of all the energy consumption trends in the key EU Member States producing food, drink and tobacco is analysed, based on the Eurostat data for the period 1990–2006. Then the discussion of possible energy efficiency improvement options is presented. The most important systems and processes where significant energy efficiency improvements can be achieved were identified. Based on publicly available sources (reports, papers, surveys), an analysis of key improvement measures was carried out and the average energy saving potentials were estimated.

KEY WORDS: energy efficiency, food, drink, tobacco sector

Introduction

The food, drink and tobacco industry (hereafter: the food industry) is the largest manufacturing sector in the EU with a turnover of 913 billion EUR in 2007, ahead of the

* Ph.D. Eng. — European Commission, Joint Research Centre, Institute for Prospective Technological Studies (IPTS), C/Inca Garcilaso No. 3, E-41092 Seville, Spain; Instytut Gospodarki Surowcami Mineralnymi i Energią PAN, Zakład Polityki Energetycznej i Ekologicznej, Kraków; e-mail: kaminski@meeri.pl
** Ph.D. — European Commission, Joint Research Centre, Institute for Prospective Technological Studies (IPTS), C/Inca Garcilaso No. 3, E-41092 Seville, Spain; e-mail: Guillaume.LEDUC@ec.europa.eu

automobile and chemical industries (Data & trends… 2008). One of the main characteristics of this sector refers to its high diversity. It is composed of many sub-sectors which apply their own processes. Four major subsectors, namely the meat sector, dairy and beverage products and a wider sub-sector ''various food products'' (heterogeneous category including bakery, pastry, chocolate and confectionery products, pasta and baby food) account for approximately 77% of the total turnover of this industry. Furthermore, around 70% of the total EU turnover is generated by the food producers located in France, Germany, Italy, the UK and Spain (Data & trends… 2008).

The specificity of the food sub-sectors results in a great diversity of primary and final energy consumed throughout the Member States. Therefore, an assessment of the energy breakdown for this sector, as a whole, is very challenging. The potential reduction of energy use in the food sector has not been considered as a major priority until now. On the one hand, available energy-saving technologies were not systematically used due to low energy prices. On the other hand, water and waste management issues are usually considered as environmental concerns of higher priority compared to energy consumption.

Overall, most of the energy consumed by this sector stems from the following operations:

- process heating (e.g. boiling, drying, pasteurisation, evaporation);
- process cooling and refrigeration;
- processing machinery (e.g. fans, pumps, ventilation, mixing, compressed air);
- non-process operations (e.g. building heating and lighting).

1. An overview of energy consumption in the European food industry

In the EU-27 the overall final energy consumption of the food industry has been rather stable since 1990. The total amount of energy consumed by this sector was around 30 Mtoe annually (Fig. 1). Although food industries are existent in all the EU-27 Member States, almost 75% of the total final energy was consumed only by seven out of 27 countries, namely: France, Germany, the United Kingdom, Italy, Spain, the Netherlands and Poland. France (4.4 Mtoe) and Germany (4.1 Mtoe) played a crucial role consuming approximately 14.9% and 14% of the total European sectors' consumption while the UK (3.5 Mtoe), Italy (3.1 Mtoe), Spain (2.8 Mtoe) accounted for around 9.5–12%.

After a significant increase in natural gas consumption from 8.6 to 15 Mtoe over the period 1990–2003, the use of natural gas in the food sector started to fall. This change was mainly the result of a sudden increase in gas price, which doubled between 1996 and 2006. A similar increase in price was observed in relation to petroleum products. However, the abandoning of oil started much earlier, practically at the beginning of the nineties. With a comparatively stable price, electricity constantly increased its share (Fig. 2).

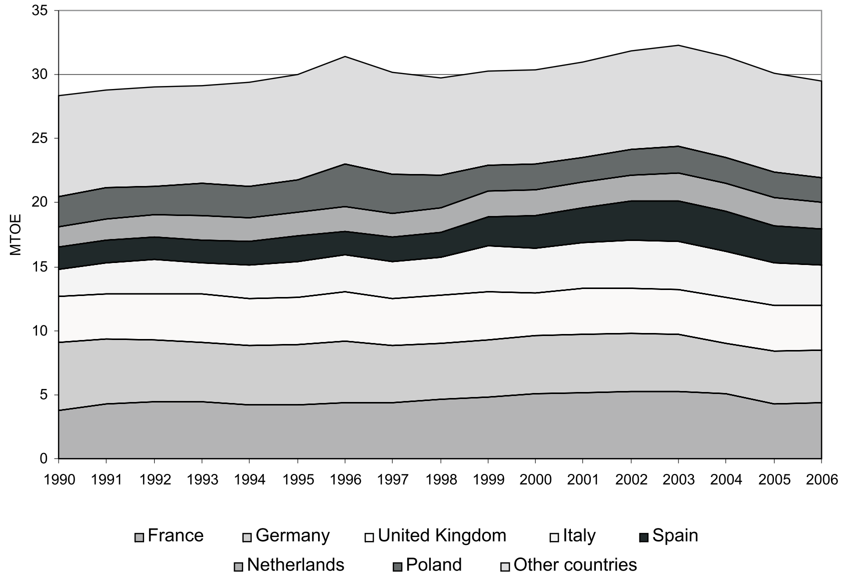

Fig. 1. Final energy consumption in food, drink and tobacco industry, 1990–2006 [Mtoe]
Source: Eurostat

Rys. 1. Zużycie energii końcowej w sektorze wytwarzania żywności, napojów i tytoniu, 1990–2006 [Mtoe]

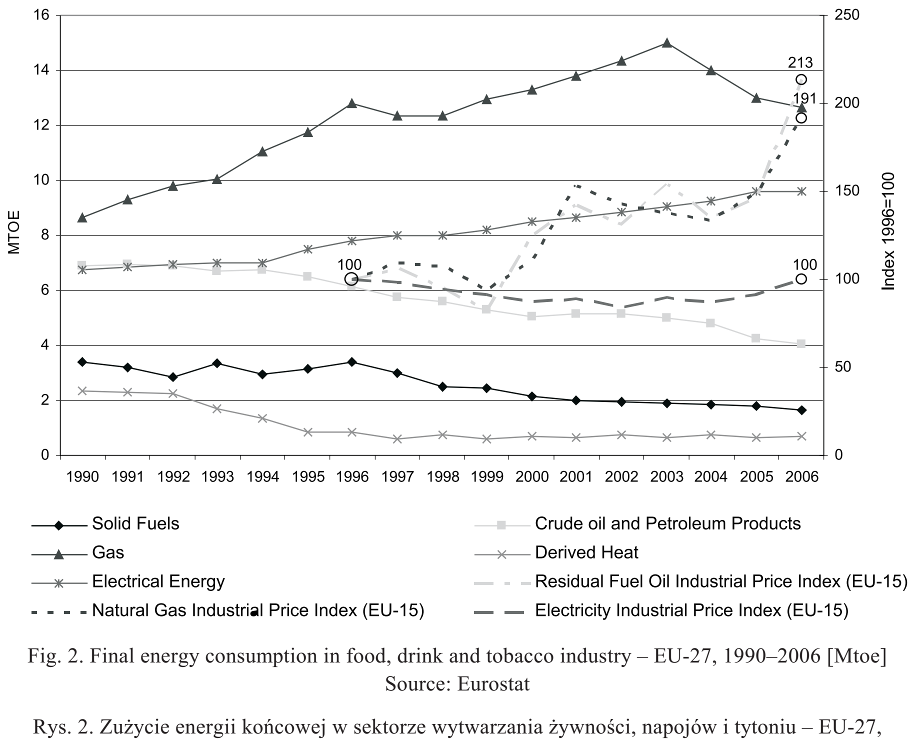

Fig. 2. Final energy consumption in food, drink and tobacco industry – EU-27, 1990–2006 [Mtoe]
Source: Eurostat

Rys. 2. Zużycie energii końcowej w sektorze wytwarzania żywności, napojów i tytoniu – EU-27, 1990–2006 [Mtoe]

2. Analysis of the final energy consumption for selected Member States

Natural gas was the most important energy carrier for the French food industry for several years. The use of natural gas grew from approx. 1.5 Mtoe in 1990 to 2.5 Mtoe in 2000–2004. Then a large fall (by approx. 0.9 Mtoe) caused mainly by the increase in gas price, occurred in 2005. Due to the possibility of taking advantage of cheap nuclear electricity, the systematic increase in electricity consumption was observed. At the same time the consumption of crude oil and petroleum products decreased from 1 Mtoe in 1990 to 0.5 Mtoe in 2006 (Fig. 3).

In Germany, similarly to France, after an increase in natural gas consumption till 2003 a significant decrease, by 0.5 Mtoe, was observed. Despite this reduction gas still played a crucial role in the food sector. The consumption of electricity slightly increased, reaching the level of 1.5 Mtoe in 2006. The use of crude oil fell from 1.4 Mtoe in 1993 to 0.6 Mtoe in 2004–2006. Additionally, a significant decrease in consumption of solid fossil fuels (from 1.3 Mtoe in 1990 to 0.3 Mtoe in 1995) was observed. From that year on, the use of solid fuels stabilised at the level of 0.3 Mtoe (Fig. 4).

The UK benefited from own gas resources. Although in other countries the consumption of natural gas decreased, in the UK gas maintained the same level. After the increase from

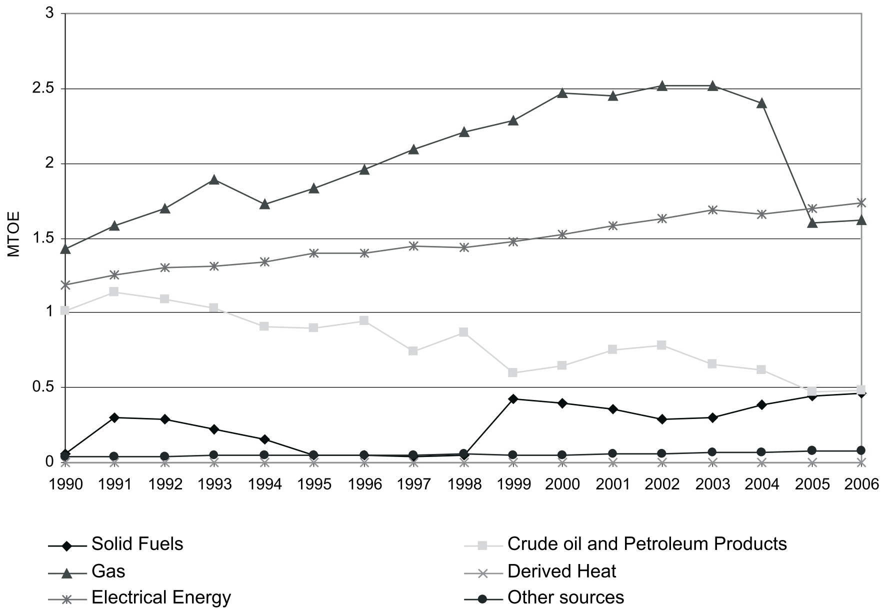

Fig. 3. Final energy consumption in food, drink and tobacco industry – France, 1990–2006 [Mtoe]
Source: Eurostat

Rys. 3. Zużycie energii końcowej w sektorze wytwarzania żywności, napojów i tytoniu – Francja, 1990–2006 [Mtoe]

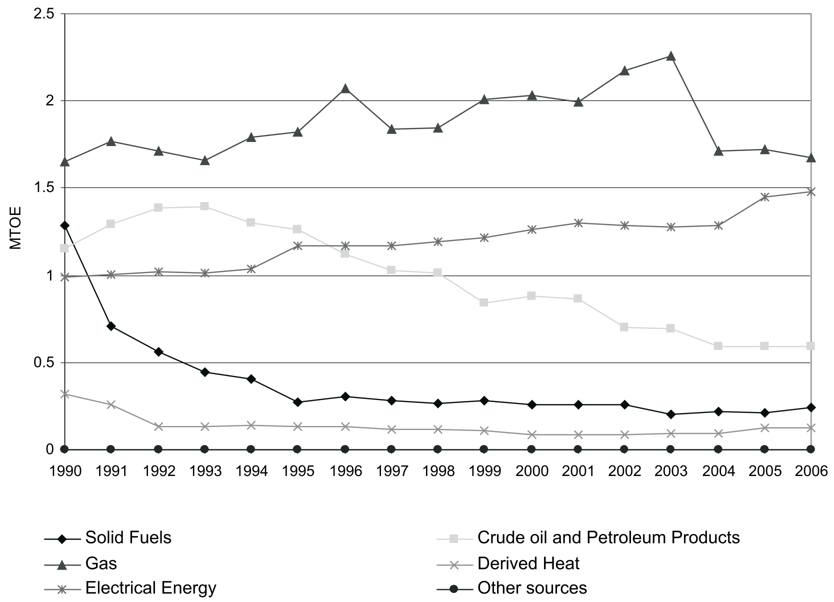

Fig. 4. Final energy consumption in food, drink and tobacco industry – Germany, 1990–2006 [Mtoe]
Source: Eurostat

Rys. 4. Zużycie energii końcowej w sektorze wytwarzania żywności, napojów i tytoniu – Niemcy, 1990–2006 [Mtoe]

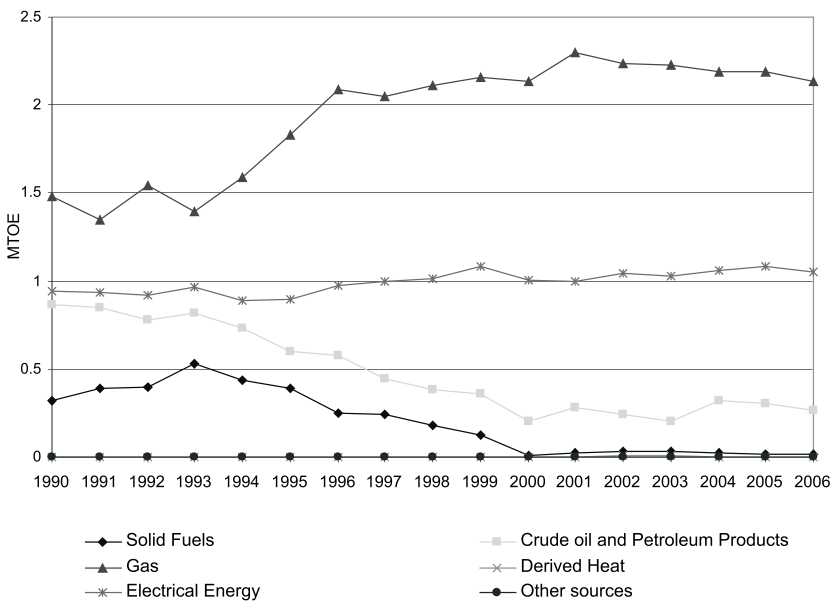

Fig. 5. Final energy consumption in food, drink and tobacco industry – United Kingdom, 1990–2006 [Mtoe]
Source: Eurostat

Rys. 5. Zużycie energii końcowej w sektorze wytwarzania żywności, napojów i tytoniu – Wielka Brytania, 1990–2006 [Mtoe] approx. 1.5 Mtoe in the early nineties to more than 2 Mtoe in 1996, the consumption of gas stabilised at the level of 2–2.3 Mtoe. The use of electrical energy did not change noticeably (approx. 1 Mtoe). Similarly to most countries the consumption of crude oil and solid fuels decreased significantly (Fig. 5).

In Italy natural gas played a crucial role in the food industry. Firstly the use of gas increased from 1 Mtoe in 1990 to almost 1.9 Mtoe in 2003. Then, the position of gas decreased rapidly, and the level of consumption fell to 1.3 Mtoe in 2006. Like in most countries the consumption of electrical energy increased, from 0.6 Mtoe in 1990 to 0.9 Mtoe in 2006. Unlike other countries the consumption of crude oil and petroleum products increased and stabilised at the level of approx. 0.8 Mtoe (Fig. 6).

A change from oil to gas was observed in the Spanish food sector till 2002. The consumption of crude oil and petroleum products, after a short peak in 1994–1995, fell from approx. 1 Mtoe to 0.4 Mtoe in 2006. At the same time natural gas consumption increased rapidly, especially from 1994 (0.3 Mtoe) to 2002 (1.4 Mtoe). Similarly to other countries, the consumption of gas decreased later (to 1 Mtoe in 2005–2006). This decrease was mainly covered by increased use of electricity (from 0.5 Mtoe in 1996 to 1 Mtoe in 2006) (Fig. 7).

The fuel-mix of the Dutch food sector shows high stability. The most important energy carrier was gas with the consumption of approx. 1.1–1.4 Mtoe. The second important energy source was electricity with the consumption of 0.4–0.6 Mtoe. The other energy carriers were almost non-existent, with the exception of derived heat in the recent years (Fig. 8)

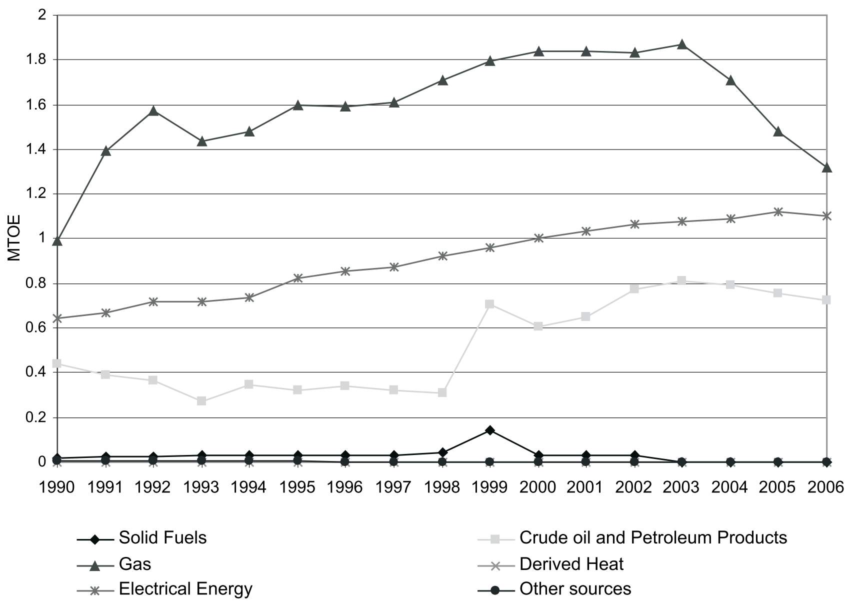

Fig. 6. Final energy consumption in food, drink and tobacco industry – Italy, 1990–2006 [Mtoe]
Source: Eurostat

Rys. 6. Zużycie energii końcowej w sektorze wytwarzania żywności, napojów i tytoniu – Włochy, 1990–2006 [Mtoe]

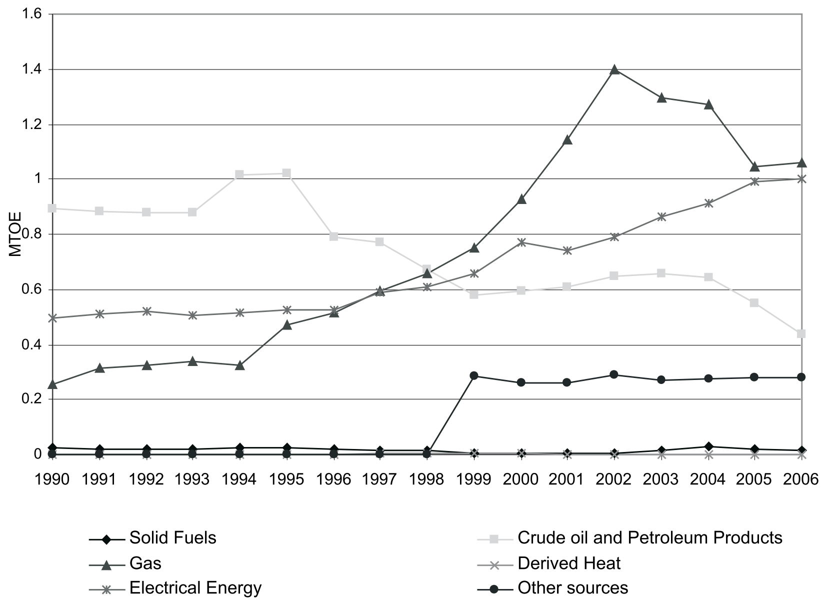

Fig. 7. Final energy consumption in food, drink and tobacco industry – Spain, 1990–2006 [Mtoe]
Source: Eurostat

Rys. 7. Zużycie energii końcowej w sektorze wytwarzania żywności, napojów i tytoniu – Hiszpania, 1990–2006 [Mtoe]

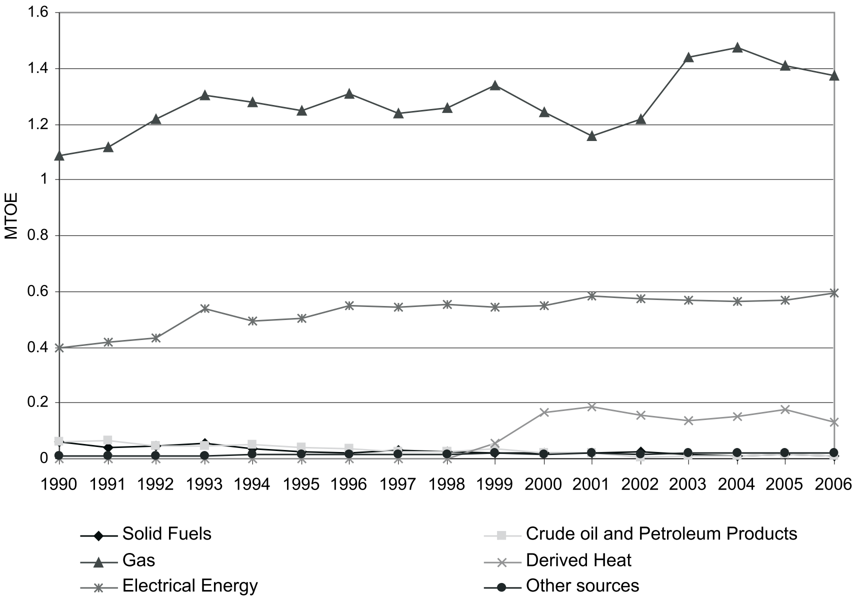

Fig. 8. Final energy consumption in food, drink and tobacco industry – Netherlands, 1990–2006 [Mtoe]
Source: Eurostat

Rys. 8. Zużycie energii końcowej w sektorze wytwarzania żywności, napojów i tytoniu – Holandia, 1990–2006 [Mtoe]

A specific situation happened in Poland, where coal has always played a crucial role in the economy. After a significant increase in consumption up to 2.2 Mtoe in 1996, a fall to 0.7 Mtoe in 2006 was noticed. This reduction was a result of the economy transformation and the decrease in energy intensity accompanied by the fuel switch. The other energy carriers were of smaller importance. However, as the role of coal decreased gas and electricity increased their importance.

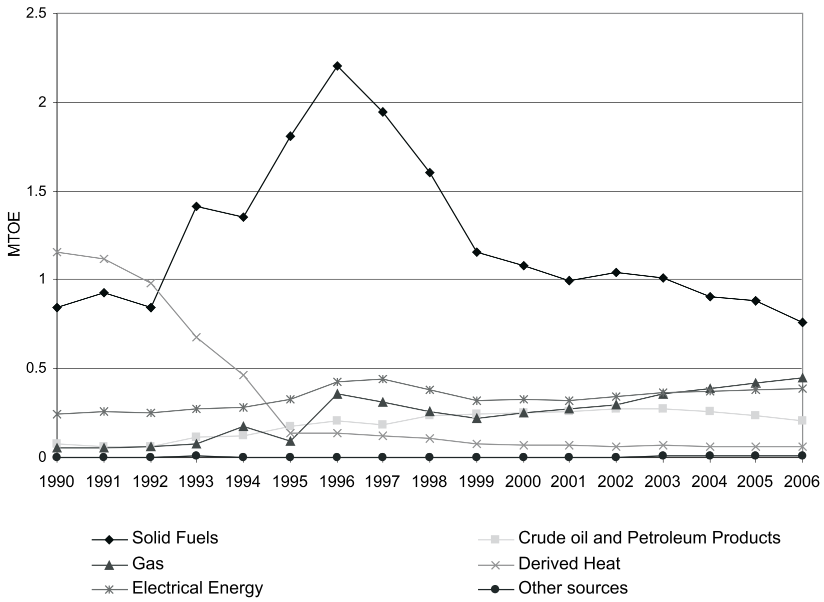

Fig. 9. Final energy consumption in food, drink and tobacco industry – Poland, 1990–2006 [Mtoe]
Source: Eurostat

Rys. 9. Zużycie energii końcowej w sektorze wytwarzania żywności, napojów i tytoniu – Polska, 1990–2006 [Mtoe]

3. Potential and costs of energy efficiency improvements in the European food industry

The objective of this chapter is to underline the key improvement measures that can be applied in the short-to-medium term for reducing the energy use of the food industry. The main areas or processes where significant energy consumption reduction could be achieved are listed below:

1) Steam systems.
2) Motor and pump systems.

3) Compressed air systems.
4) Process cooling and refrigeration.
5) Heating and lighting of buildings.

These processes and systems are relatively common in most of the food industry sub-sectors, even though each sub-sector employs its own specific processes. Energy saving opportunities for the food industry have not been widely covered in the literature. Usually energy saving options focus on a specific sub-sector (e.g. vegetables, meat, dairy products). For the present study, our assumptions are mostly derived from research works undertaken in the frame of the U.S. EPA Energy Star Program on different sub-sectors (see e.g. Masanet et al. 2007; Galitsky et al. 2003a, b; Carbon Trust 2009).

With regard to investment costs, due to difficulties in finding reliable figures, they are addressed through the assessment of payback periods associated with each improvement option. Most of them are taken from the literature cited earlier. Globally, it is assumed that "low (or no cost)" corresponds to a payback period of 6 months or less, "medium cost"

TABLE 1. Potential energy savings from steam systems

TABELA 1. Możliwe oszczędności energetyczne w obszarze systemów parowych

Measure	Potential reduction	Relevant sources	Comments
Improved process control	1.5–3%	Masanet et al. 2007 Energy Efficient... 2004 Einstein et al. 2001	Maintain optimum combustion conditions Attractive for large boilers Installation cost around 7500$ (indicative)
Properly sized boilers	3–8%		
Improved boiler maintenance	5–10%	Masanet et al. 2007 Energy Efficient... 2004	Reduce waterside fouling, scaling, etc.
Improved boiler insulation	6–26%	Masanet et al. 2007	
Condensate return systems	~10%	Galitsky et al. 2003a Galitsky et al. 2003b	A 5°C increase in the temperature of the feedwater will save around 1% of the fuel used to raise steam. Widely implemented
Flue gas heat recovery (e.g. installation of economisers)	1–5%	Energy Efficient… 2004 Einstein et al. 2001	Fuel consumption can be reduced by 1% for each 4.5°C reduction in flue gas temperature. Technology commonly used for large boilers (economisers)
Blowdown heat recovery system	1–4%	Galitsky et al. 2003a Energy Efficient... 2004 Einstein et al. 2001	Especially for small boilers

(e.g. retrofit) corresponds to a payback period from 6 months to 3 years and "capital cost" (new equipment required) refers to a payback period greater than 3 years.

1. Steam systems

Because steam and hot water are widely used by most of the sub-sectors for processing, energy efficiency improvements in boilers and heat distribution systems can offer a very high energy savings potential. Some key technological improvements are summarized hereafter:

a) Improved boiler efficiency

Improvements of boiler efficiency offer several options to reduce the energy consumption. Table 1 presents a list of key potential measures together with their relative potential reduction. Their associated costs and payback periods are given in Table 2.

TABLE 2. Costs and payback period of the improvement options

TABELA 2. Nakłady inwestycyjne i okresy zwrotu wybranych opcji zwiększenia efektywności energetycznej w obszarze systemów parowych

Measure	Implementation costs	Payback period (years)	Relevant source (for costs)
Improved process control	Low (however for O2 trim systems investment costs can vary from 20.000$ to 30.000$ with 4% energy savings and payback period of 2–3 years)	0.6 <1	Einstein et al. 2001 Galitsky et al. 2003a
Properly sized boilers	–	–	
Improved boiler maintenance	Low	0 <1	Einstein et al. 2001 Galitsky et al. 2003a
Improved boiler insulation	Low		
Condensate return systems	Medium	1.1 2–3 >1	Galitsky et al. 2003b Masanet et al. 2007 Galitsky et al. 2003a
Flue gas heat recovery (e.g. installation of economisers)	Medium/high	2 >3	Einstein et al. 2001 Galitsky et al. 2003a
Blowdown heat recovery system	Medium Ex: recovering exhaust steam would cost 1690$ to implement (source: Galitsky et al. 2003a) Ex: around 12.000€ of investment cost for steam recovery vessel used with an automatic TDS system to minimise blowdown and to recover heat from the flash steam (Energy Efficient… 2004)	1.5–2.7	Einstein et al. 2001 Galitsky et al. 2003a Galitsky et al. 2003a Masanet et al. 2007 Energy efficient… 2004

b) Improved steam distribution
Several improvement options of steam distribution are summarised in Table 3, while costs and payback periods are given in Table 4.

TABLE 3. Potential energy savings from improved steam distribution

TABELA 3. Możliwe oszczędności energetyczne w obszarze dystrybucji pary

Measure	Potential reduction	Relevant sources	Comments
Improved steam trap maintenance + monitoring system	10–15% (+5% for automatic monitoring)	Masanet et al. 2007	Using automatic steam trap monitoring gives an additional 5% energy savings
Leak repair	3–10%	Masanet et al. 2007 Einstein et al. 2001	
Improved insulation	3–13%	Galitsky et al. 2003a Einstein et al. 2001	

TABLE 4. Costs and payback time of the improvement options

TABELA 4. Nakłady inwestycyjne i okresy zwrotu wybranych opcji zwiększenia efektywności energetycznej w obszarze dystrybucji pary

Measure	Implementation cost	Payback period (years)	Relevant sources (for costs)
Improved steam trap maintenance + monitoring system	Low / Medium	0.5 + 1 <2	Einstein et al. 2001 Galitsky et al. 2003a
Leak repair	Low	0.4 <1	Einstein et al. 2001 Galitsky et al. 2003a
Improved insulation	Low	~1	Einstein et al. 2001 Galitsky et al. 2003a Galitsky et al. 2003a Masanet et al. 2007

Estimation of the average energy savings: improved boiler efficiency and distribution systems can reduce energy consumption by around 15–20%. Einstein et al. (2001) assumed that 19–20% savings in steam system final energy consumption is feasible, that roughly represents 7% of total industry final energy use. Note also that Energy Efficient… (2004) considers energy savings potential between 10% and 15%. Overall, a 15% reduction in energy consumption can be achieved.

2. Motor and pump systems

Significant energy savings can be obtained by improving the efficiency of motors and pumps (mainly electric motors). Some of the most important measures are listed in Table 5. The costs and payback periods are shown in Table 6.

TABLE 5. Potential energy savings from motor and pump systems

TABELA 5. Możliwe oszczędności energetyczne w obszarze systemów silnikowych i pompowych

Measure	Potential reduction	Relevant sources	Comments
High-efficiency motors/pumps	Motors: up to 5% of energy efficiency improvements are feasible Pumps: 2–10%	Masanet et al. 2007 Motors and Drives... 2007	Replacing a motor with a high-efficiency motor
Properly sized motors/pumps	Motors: 5–10% Pumps: 15–25% reduction of electricity use	Masanet et al. 2007 Food and Drink… 2006	If possible, replacing motors by smaller and higher efficiency ones
Improved maintenance and monitoring	Motors: 2–30% of total motor system energy use (typically 10%) Pumps: 2–7% of pump energy use	Masanet et al. 2007 Food and Drink… 2006	Implementation of motor/pump system maintenance programme
Pump control systems			Pumps can be turn off automatically depending on electricity demand
Variable Speed Drives (VSDs)	Motors: 15–45% 20% is rough estimate	Galitsky et al. 2003a	Wide range of energy savings potential. Commonly used in the food and drink industry

TABLE 6. Costs and payback time of the improvement options

TABELA 6. Nakłady inwestycyjne i okresy zwrotu wybranych opcji zwiększenia efektywności energetycznej w obszarze systemów silnikowych i pompowych

Measure	Implementation cost	Payback period (years)	Relevant sources (for costs)
High-efficiency motors/pumps	Medium ~10.000$	1–2	Galitsky et al. 2003a
Properly sized motors/pumps	–	–	
Improved maintenance and monitoring	Medium ~1.600$	~1	Galitsky et al. 2003b
Pump control systems	Medium	~1	Galitsky et al. 2003b
Variable Speed Drives (VSDs)	Medium ~12.000$ (total costs)	2–3	Masanet et al. 2007 Galitsky et al. 2003a Galitsky et al. 2003a

Estimation of the average energy savings: overall, a 20% reduction can be obtained from motors/pumps improvements.

3. Compressed air systems

Compressed air systems are widely used in the food industry and can account for around 20% of the total electricity consumption for some sub-sectors (e.g. bakeries). They can be used for dehydration, bottling, conveying, spraying coatings, cleaning, etc.

Management and technical actions can be implemented to improve energy savings for a typical compressed air system[1] (Energy Efficient… 2005). Along with management actions such as the implementation of maintenance programme and monitoring systems, technical measures can be implemented as the ones described in Table 7.

TABLE 7. Potential energy savings from compressed air systems (technical measures only)

TABELA 7. Możliwe oszczędności energetyczne w obszarze systemów skompresowanego powierza (tylko techniczne opcje)

Measures	Fuel saved*	Investment
Implement a leak reporting and repair programme	20–40%	<2 600 €
Do not pressurise the system during non-productive periods	2–10%	<2 600 €
Fit dryer controls (refrigerant and desiccant)	5–20%	2 600–13 200 €
Install compressor drive and system control measures	5–15%	2 600–13 200 €
Install heat recovery measures where appropriate	Up to 75%	2 600–13 200 € (typical range is 4 000–10 000 €)

* Indicative percentage (not cumulative).
Source: Energy Efficient… 2005

Estimation of the average energy savings: based on analysis of available sources, a 25% reduction from air compressed improvements can be achieved.

4. Process cooling and refrigeration

Energy consumption due to refrigeration systems can represent 50% (or even more) of the total energy use for several sub-sectors such as ice-cream, meat or fish. Simple actions can significantly reduce the energy use, for instance:

- ✧ Better matching of cooling capacity and cooling loads (283.000$; 3.6 years payback; see Galitsky et al. 2003a);
- ✧ Improved operations and maintenance (<1 year payback; see e.g. Galitsky et al. 2003a);
- ✧ Monitoring system performance (e.g. installation of sensors at key points in the system can reduce energy consumption by 3%; see e.g. Galitsky et al. 2003a). For instance, an installation of electronic temperature controllers requires a capital cost of around 500$.

[1] Operating at 7 bars with an output of 500 litres/s.

- ✧ System modifications and improved design e.g. installation of an evaporative condenser (4% electricity savings (see e.g. Galitsky et al. 2003a); capital cost of 42.000$; payback period around 3 years).

Estimation of the average energy savings: overall potential energy savings of 20% can be obtained (e.g. Refrigeration… 2006).

5. Heating and lighting of buildings

With regard to building heating and lighting, there are several energy efficiency measures which can be applied to most of the sub-sectors. Typical measures for heating management are:

- ✧ Improvement of the design of HVAC systems to reduce electricity consumption;
- ✧ The use of energy monitoring and control systems;
- ✧ Reduced leakages;
- ✧ The use of low emissivity surfaces (e.g. windows);
- ✧ Improvement of building insulation;

Usual measures for improving energy efficiency of lighting systems are:

- ✧ The use of occupancy sensors that turn off lights automatically. The savings range from 10 to 20% (see e.g. Masanet et al. 2007). Typical costs lie between 100$ and 150$.
- ✧ The use of LEDs, electronic ballasts, etc.

Estimation of the average energy savings: an average energy savings of 15% can be achieved.

Conclusions

The analysis of energy consumption and energy efficiency options in the European food industry is a very complex issue. This is caused mostly by the wide range of processes applied to specific subsectors. Furthermore, each country has a particular fuel-mix pattern, usually inherited by a historical availability of fuels. This makes the food sector a very difficult subject for any energy-related analysis.

The major EU27 food producers are France, Germany, United Kingdom, Italy, Spain, Netherlands and Poland. Altogether they consume approx. 22 Mtoe annually. The most significant energy consumers are France and Germany. Gas and electricity are the commonest energy carriers used in the food industry. Crude oil and petroleum product are used to a lesser extent while solid fuels and derived heat are the least important energy carriers.

The analysis of energy efficiency options that could be applied in the food industry shows a substantial potential of this sector concerning energy savings. The following average energy savings were estimated in relation to different systems and/or processes:

1. Steam systems – 15%.
2. Motor and pump systems – 20%.
3. Compressed air systems – 25%.

4. Process cooling and refrigeration – 20%.
5. Heating and lighting of buildings – 15%.

The results of this analysis can be used as a basis for a broader study of the potential for energy efficiency improvements in the whole European Union. The estimation of the total energy savings potential would require an in-depth analysis of applicability of the measures presented in this paper for each Member State separately.

Disclaimer

The views expressed in this publication represent exclusively the positions of the authors and do not necessarily correspond to the views of the European Commission. Neither the European Commission nor any person acting on their behalf, may be held responsible for the use to which the information contained in this publication may be put, or for any errors which, despite careful preparation and checking, may appear.

References

Carbon Trust website: http://www.carbontrust.co.uk/, 2009.

Data & trends of the European Food and Drink Industry. Confederation of the food and drink industries of the EU, CIAA 2008.

EINSTEIN D., WORRELL E., KHRUSHCH M., 2001 – Steam systems in industry: Energy use and energy efficiency improvement potentials. Lawrence Berkeley National Laboratory, University of California.

Energy efficient compressed air systems. Good Practice Guide GPG 385, Carbon Trust, 2005.

Energy efficient Operation of Boilers – Good Practice Guide. GPG 369, Carbon Trust, 2004.

Food and Drink Processing. Introducing energy savings opportunities for business. CTV 004, Carbon Trust, 2006.

GALITSKY C., MARTIN N., WORRELL E., LEHMAN B., 2003 – Energy Efficiency Improvement and Cost Saving Opportunities for Breweries – An Energy Star Guide for Energy and Plant Managers. http://ies.lbl.gov/

GALITSKY C., WORRELL E., RUTH M., 2003 – Energy efficiency improvement and cost saving opportunities for the Corn Wet Milling Industry: An ENERGY STAR Guide for Energy and Plant Managers. Lawrence Berkeley National Laboratory.

MASANET E., WORRELL E., GRAUS W., GALITSKY C., 2007 – Energy Efficiency Improvement and Cost Saving Opportunities for the Fruit and Vegetable Processing Industry – An ENERGY STAR Guide for Energy and Plant Managers. August 2007. http://ies.lbl.gov/

Motors and drives. Introducing energy saving opportunities for business. Technology Overview, CTV 016, Carbon Trust, 2007.

Refrigeration. Introducing energy savings opportunities for business. Technology Overview, CTV 002, Carbon Trust, 2006.

Jacek KAMIŃSKI, Guillaume LEDUC

Możliwości zwiększenia efektywności energetycznej w europejskim sektorze produkcji żywności

Streszczenie

Sektor produkcji żywności, napojów oraz tytoniu jest największym sektorem produkcyjnym w Unii Europejskiej, osiągającym przychody na poziomie 913 miliardów EUR (2007 r.). Jedną z podstawowych cech charakterystycznych dla tego sektora jest duża różnorodność produktów finalnych. Sektor ten składa się bowiem z szeregu podsektorów, w których stosowane są specyficzne procesy technologiczne. Cztery podstawowe podsektory, tzn. produkcji mięsa, nabiału, napojów oraz szeroko rozumiany podsektor „różne produkty spożywcze" generują łącznie 77% przychodów całego sektora. Ponadto, około 70% przychodów sektora spożywczego powstaje w pięciu państwach europejskich (Francja, Niemcy, Włochy, Wielka Brytania, Hiszpania).

Specyficzność oraz różna wielkość produkcji podsektorów produkcji żywności skutkuje dużym zróżnicowaniem zużycia energii pierwotnej i finalnej w poszczególnych państwach członkowskich Unii Europejskiej. Dlatego też praktycznie każda analiza zużycia energii w sektorze wytwarzania żywności, napojów i tytoniu – rozpatrywanym w ujęciu całościowym – jest zadaniem bardzo złożonym. Tym bardziej, że do tej pory potencjał redukcji zużycia energii w tym sektorze nie był uznawany za priorytetowy (jak dotąd badania w zakresie zmniejszenia energochłonności produkcji skupiały się na takich sektorach jak energetyka czy produkcja aluminium, żelaza i stali, cementu itp.) Ponadto, ze względu na stosunkowo niskie ceny energii przez wiele lat nie analizowano w tym kontekście funkcjonowania sektora produkcji żywności, skupiając się na zarządzaniu efektywnym zużyciem wody i zagospodarowaniem odpadów poprodukcyjnych. Wraz ze wzrostem cen energii, zarówno pierwotnej jak i finalnej, coraz większą uwagę poświęca się możliwościom zwiększenia efektywności energetycznej.

Punktem wyjścia do dalszych badań była analiza trendów zużycia nośników energii w kluczowych państwach produkujących artykuły spożywcze (bazując na danych Eurostat z lat 1990–2006). W 27 państwach UE zużycie energii finalnej było ustabilizowane na poziomie około 30 Mtoe rocznie. Choć sektor produkcji żywności jest obecny we wszystkich państwach członkowskich UE, prawie 75% energii zużywane jest przez siedem państw (Francję, Niemcy, Wielką Brytanię, Włochy, Hiszpanię, Holandię i Polskę), z których Francja i Niemcy są odpowiedzialne za 14,9% i 14% całkowitego europejskiego zużycia.

Analiza zużycia poszczególnych paliw wskazuje, że po początkowym istotnym wzroście konsumpcji gazu ziemnego z 8,6 do 15 Mtoe w okresie 1990–2003 nastąpił stopniowy spadek zużycia tego paliwa. Było to spowodowane nagłym wzrostem cen gazu, które praktycznie podwoiły się w okresie 1996–2006 r. Podobny wzrost cen obserwowany był w odniesieniu do produktów naftowych, co również spowodowało zintensyfikowanie procesu odejścia od tego paliwa zapoczątkowanego we wczesnych latach dziewięćdziesiątych ubiegłego wieku. Ze względu na stosunkową stabilność cen energii elektrycznej paliwo to systematycznie zwiększało swój udział w strukturze paliw używanych w sektorze żywnościowym. Następnie przeanalizowano możliwe opcje zwiększające efektywność energetyczną w odniesieniu do zdefiniowanych obszarów/procesów. Kluczowe środki, które mogą być zastosowane w krótkim lub średnim okresie odnoszą się do

pięciu obszarów/procesów, w których możliwe jest osiągnięcie istotnej redukcji zużycia energii. W szczególności są to:

1) systemy parowe,
2) systemy silnikowe i pompowe,
3) systemy skompresowanego powietrza,
4) chłodzenie i mrożenie,
5) ogrzewanie oraz oświetlenie w budynkach.

Bazując na dostępnych źródłach (raporty, artykuły, badania) przeprowadzono analizę możliwych opcji i oszacowano średnie wartości dla każdego systemu/procesu. Ponadto, w odniesieniu do najważniejszych z nich podano okres zwrotu z zainwestowanego kapitału.

W wyniku przeprowadzonej analizy możliwości zwiększenia efektywności energetycznej stwierdzono, że sektor produkcji żywności, napojów i tytoniu ma istotny potencjał ograniczenia zużycia energii. Oszacowane wielkości oszczędności energetycznych w odniesieniu do poszczególnych systemów/procesów przedstawiają się następująco:

1) systemy parowe – 15%,
2) systemy silnikowe i pompowe – 20%,
3) systemy skompresowanego powietrza – 25%,
4) chłodzenie i mrożenie – 20%,
5) ogrzewanie oraz oświetlenie w budynkach – 15%.

Wyniki analizy przedstawionej w niniejszym artykule mogą być zastosowane w szerszych badaniach w zakresie całkowitego potencjału zwiększenia efektywności energetycznej w Unii Europejskiej. Oszacowanie możliwej do osiągnięcia redukcji zużycia energii wymagałoby dogłębnej analizy zastosowania środków przedstawionych w tym artykule w odniesieniu do każdego z państw członkowskich z osobna.

SŁOWA KLUCZOWE: efektywność energetyczna, sektor produkcji żywności, napojów i tytoniu