

## **Energy Centre Bratislava**

### **OPET CHP / DH** *Work Package 5*

Training, benchmarking and promotion of energy efficiency,  
including industrial SMEs

## **CROSS COUNTRY REPORT** **BENCHMARKING IN BAKERY SECTOR**

**Bratislava June 2004**



This project is co-funded by the European Community



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## 1. INTRODUCTION

The current report was developed as a summary of outcomes of the WP5 Training, benchmarking and promotion of energy efficiency, including industrial SMEs. The report is based on National reports prepared for each country of the project consortia by members of project teams. The project team Energy centre Bratislava in close collaboration with other project team members developed this cross country report - benchmarking in bakery sector.

The main purpose of the described project is the collection and analysis of data on energy consumption and on the overall production of bakeries in different countries. For the purpose of evaluation a questionnaire was prepared and disseminated overall the sector in all participating countries in order to collect the in-site data and experience. According the data obtained, one pilot company was selected in each participating country.

The project includes 2 old EU members (Austria, Finland) and 4 new EU members (Latvia, Poland, Slovakia, Slovenia).

- ✦ Austria – O.Ö. Energiesparverband (ESV)
- ✦ Finland – Motiva Oy (MOTIVA)
- ✦ Latvia – EKODOMA
- ✦ Poland – The Polish National Energy Conservation Agency (KAPE)
- ✦ Slovakia – Energy Centre Bratislava (ECB)
- ✦ Slovenia – Institut Jozef Stefan (IJS-EEC)

Bakeries have been chosen as common sector for energy benchmarking in all partner countries. The only exception is Finland where the attention was given to graphic arts industry. In order to get an unbiased assessment of energy efficiency it is useful to compare energy consumption among similar enterprises. This has been done by calculating of energy consumed per unit of production. For bakeries the index usually decided on GJs per ton or kilogram of bread produced (or all production, which includes not only bakery production, but eventually confectionary one or pasta production). This indicator describes the energy intensity of the operation. This is usually referred to as the Performance Indicator and the process referred to as benchmarking.

Further purpose of this report is by collecting energy/production data from a available number bakeries to establish what is the spread of Performance Indicators and thereby establish both the optimal and the potential for improvement across the sector.

## 2. DETAILS OF THE CALCULATION

A specific form has been sent out to several bakeries companies in each country. Unfortunately not all partners have delivered more than one filled questionnaire, therefore only Slovakian and Latvian bakery sector could be analysed more in detail.

The survey form (questionnaire) consisted of energy consumption and production related data. The survey form is included as Annex 1 to this report.

Regarding to data gathered benchmarks were developed as follows:

- ❖ Specific electricity consumption: Total amount of consumed electricity (MWh) in bakery divided by amount of goods (t) produced in the same time period.
- ❖ Specific primary energy consumption: Total amount of consumed heat energy generated using some kind of fuel (MWh) in bakery divided by amount of goods (t) produced in the same time period.
- ❖ Total specific energy consumption: Total amount of consumed energy (MWh) in bakery divided by amount of goods (t) produced in the same time period.

### 2.1 Method

It was decided to attempt to collect energy / production data from as many bakeries in each country as possible by means of sending out a questionnaire for completion by each bakery. To expect a realistic response to such a questionnaire it was essential that only questions to which answers were available to the bakery from the normal company records should be put.

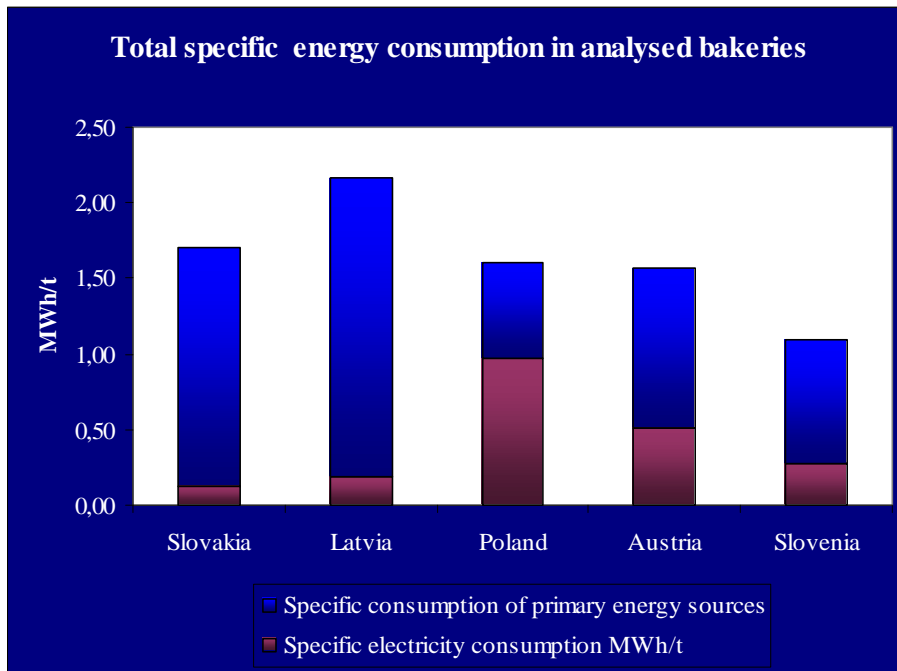
There are weaknesses in this approach in that it would be likely at best to access gross energy figures for the total bakery without the possibility of isolating the energy consumption of individual product lines and space heating fuel consumption. Short of detailed individual plant energy surveys such breakdown was unlikely to be otherwise available and the questionnaire approach seemed to present the most effective first shot at data collection.

### 3. BAKERY SECTOR OVERVIEW IN PARTICIPATING COUNTRIES

The general trend in EU countries follows the pattern of development of small and family bakeries. Their production is many times so small, that they can supply goods only to one or two shops. In spite of their large number more than 60% of the bakery productions is made in industrial-type bakeries built near large cities. Such bakeries are many times equipped with advanced and efficient conveyors and their production process is very efficient.

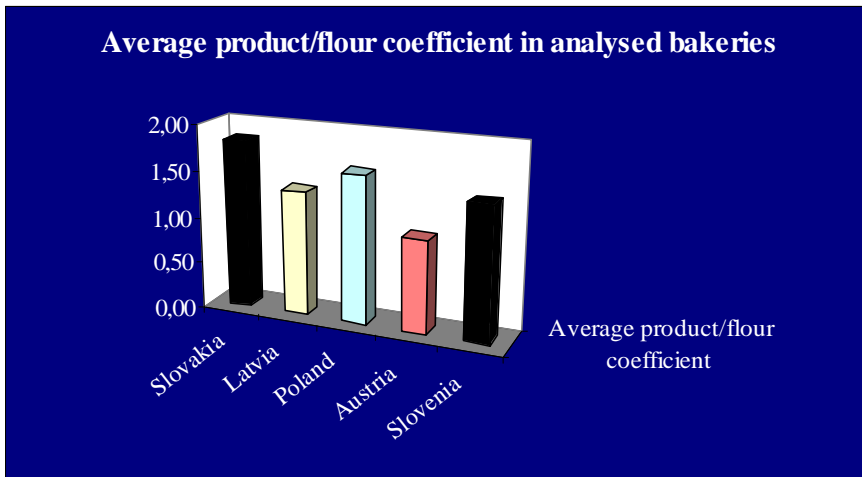
An average indicator of energy intensity in EU shows some 4 GJ/tonne (1,11 MWh/tonne) of produced bread or all production, which includes not only bakery production but eventually confectionary one or pasta production. This average includes small, industrial-type and family bakeries. Since energy costs amount in average to 2-5% of the total turnover of the bakery, energy efficiency is a closely watched indicator. Ratio of the energy consumed for production process for the production of bakery products represents 85% from the total consumption of the bakery. From this some 60% is used for baking and the rest - 25% from the total consumption is used for auxiliary production activities. Only 15% from the total energy consumption of bakeries in average is used for the hot domestic water production and for heating and illumination see Figure 3.1. Both in Poland and Austria there were only one bakery analysed therefore the values of these countries could not be considered as the representative sample.

Figure 3.1: Total specific consumption in analysed bakeries



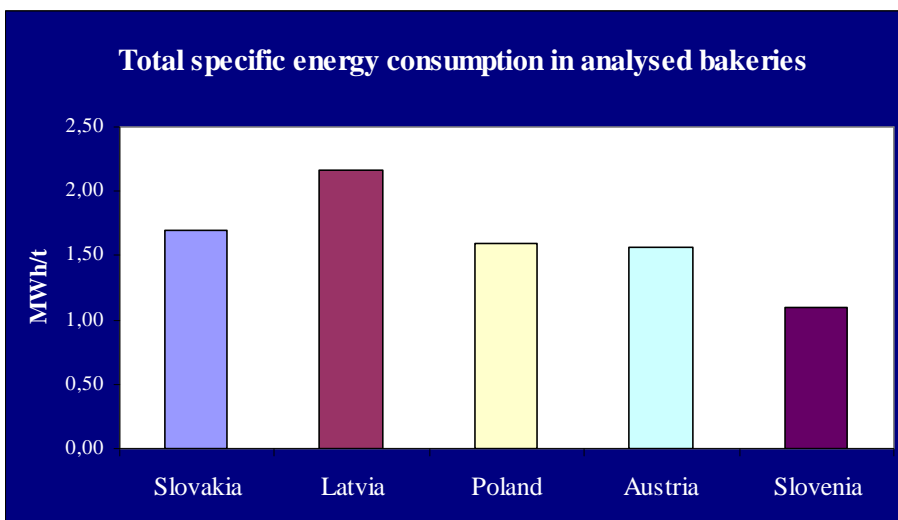
Product /flour indicator shows how much flour is needed for production of one unit of bakery goods. This value depends on structure of production and may effect the energy consumption of baking process.

Figure 3.2: Product/flour coefficient in analysed bakeries



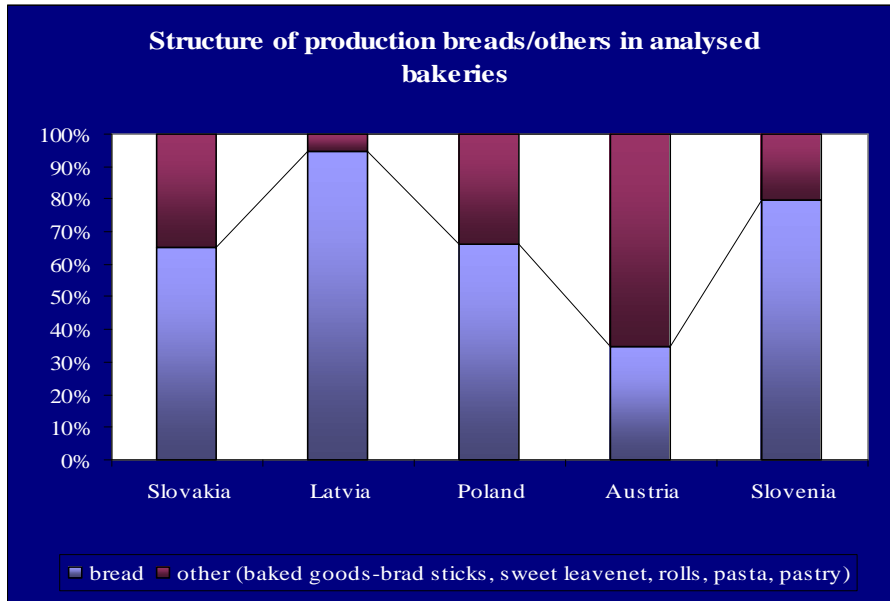
The energy intensity indicator see Figure 3.3, mostly used in bakery sector, expresses the amount of MWh consumed energy per ton of produced bread (or other production, which includes not only bakery production, but eventually confectionary one or pasta production). This indicator describes the energy intensity of the operation. Its calculation or use is often called benchmarking. This originally English term has been naturalized mainly in EU countries, with benchmarking regularly used for the determination and subsequent comparison of energy efficiency or intensity of different industrial sectors or services on the national level or with their counterparts from other countries.

Figure 3.3: The comparison of energy intensity indicator in analysed bakeries



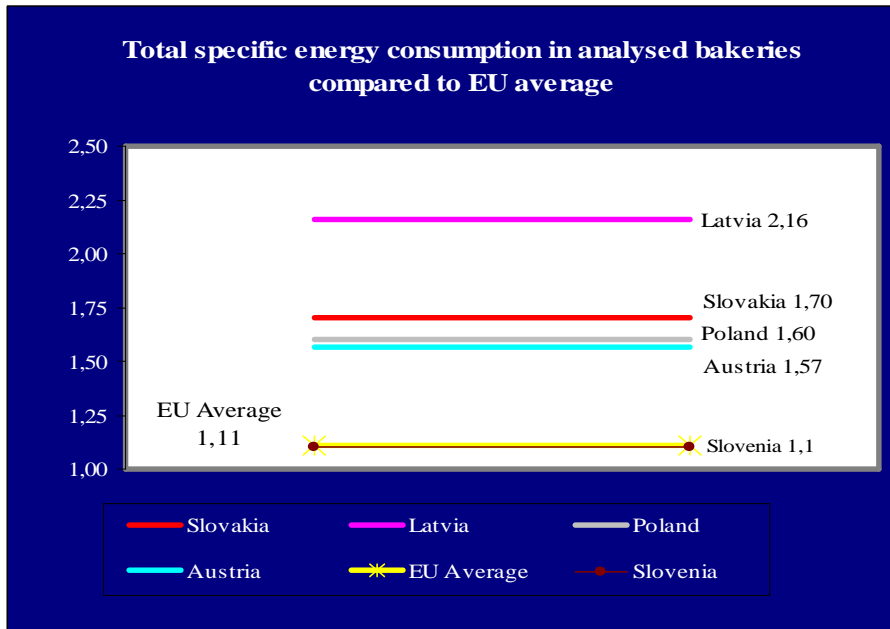
Structure of bakery production varies according type of bakery and installed technology and also on market condition too.

Figure 3.4: Structure of production bread/others in analysed bakeries



According to figure 3.4 specific energy consumption of analysed bakeries in CEE countries is rather high in comparison with the EU average. Due to this situation it is clear that energy saving potential is significant and there are lot of opportunities to improve energy efficiency and to reduce energy consumption in this sector.

Figure 3.4: The specific energy consumption (MWh/t) in analysed bakeries compared to EU average.



## 4. BAKERY SECTOR IN PARTICIPATING COUNTRIES

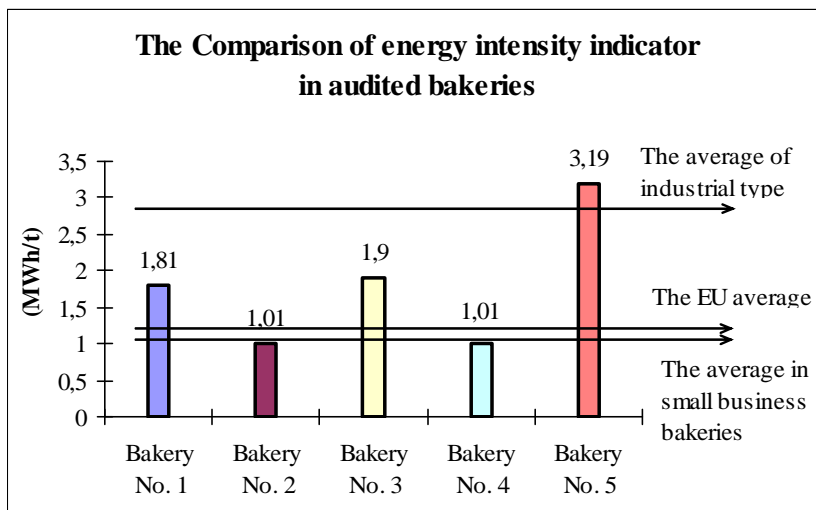
### 4.1 Slovakia

There are about 550 bakeries in Slovakia with annual production of around 320 000 t (in year 2000). Most bakeries are small businesses, about 45-50 are industrial type bakeries. The annual production decreased from more than 400 000 t/a in the 80ies and 90ies to 320 000 t/a in 2000.

The following diagram of energy intensity indicator assessment of the production in five selected bakeries (with completed small energy audits) illustrates in a small sample the idea of benchmarking. The “walkthrough” type of audit was selected as appropriate in this case. Appointments were made for each bakery with senior management and an in-depth interview on aspects of energy consumption, energy management, energy logging etc. Following the interview an inspection tour of the bakery was conducted with management personnel. Particular attention was directed to aspects of abnormal energy consumption, which had been highlighted, either from the original data submitted by post or raised at the interview. Obvious features such as general condition of equipment, lighting, building fabric were noted for incorporation into the overall energy consumption analysis.

This diagram explicitly shows the energy intensity of individual bakeries in their mutual comparison. Of course, because of small size of the sample of mapped bakeries average values do not represent Slovakia sufficiently. Moreover, in the case of such a small sample of operation sites in combination with the name encoding, industrial type bakeries and small bakery business can be compared with each other – a situation which is unacceptable for the assessment of the energy intensity indicator in the context all Slovakia.

Figure 4.1: The comparison of energy intensity indicator in audited bakeries



The comparison of the energy intensity indicator audited in bakeries showed that the average in small business in Slovakia (0,93 MWh/t) is below the EU average, whereas of industrial type bakeries is above 2,8 MWh/t.

Figure 4.2 Share of bread production in analysed bakeries in Slovakia

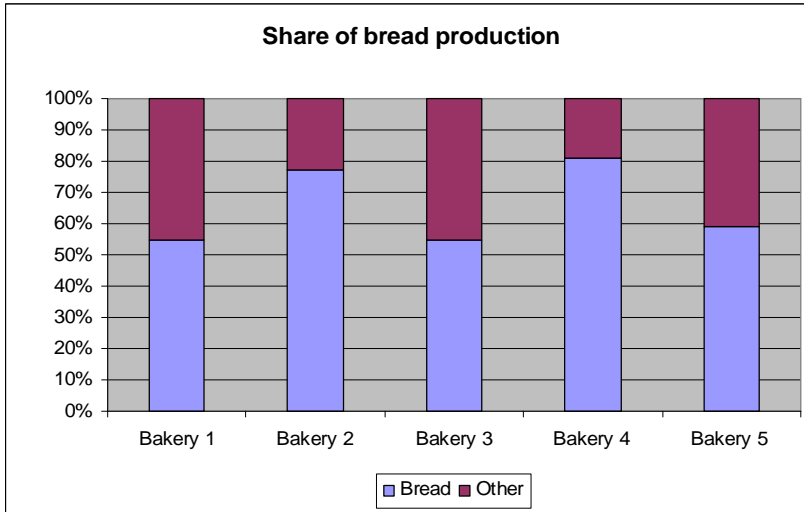
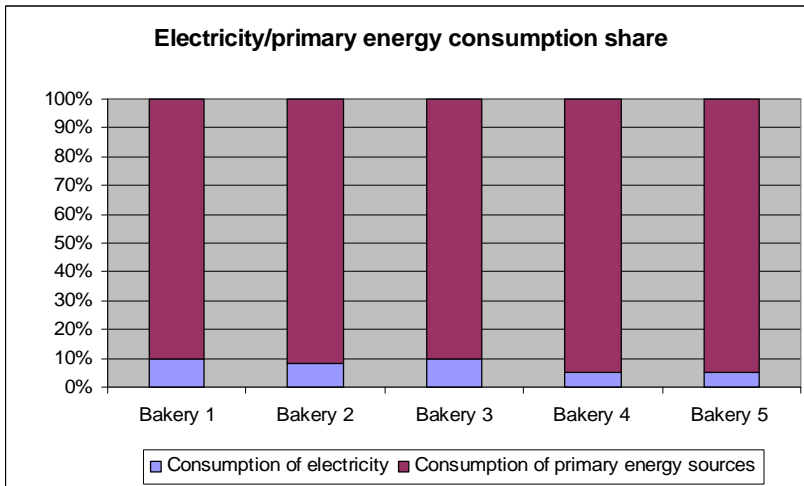


Figure 4.3 Electricity/primary energy consumption share in analysed bakeries in Slovakia



## 4.2 Latvia

In Latvia there are about 150 bakeries, producing bread and pastry. It is estimated, that this number will decrease, because of bankrupts and merging of bread producers.

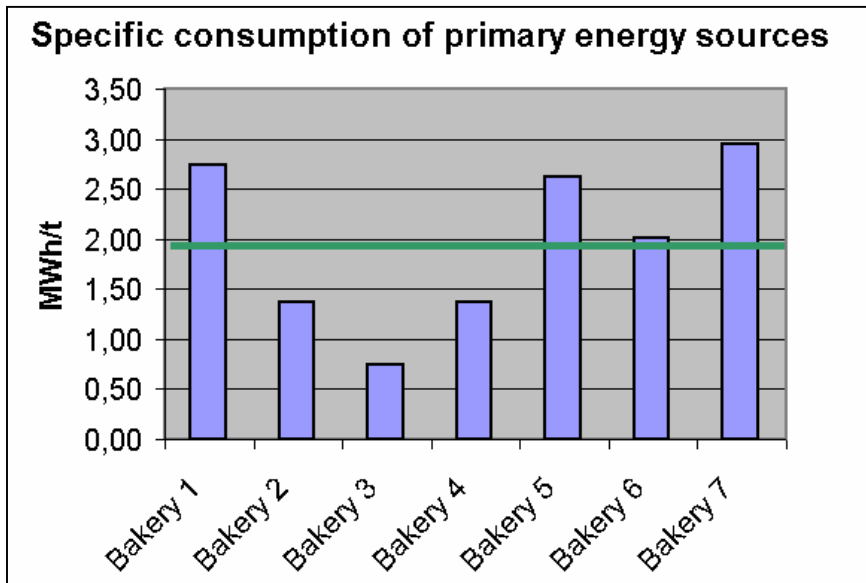
In Latvia there are 5 leader companies in bread production, all together covering more than 55% of total bread market, mainly these bakeries are built with foreign capital. Equipment is very modern and thus efficiency is quite high.

Other bakeries are small or medium size, spread in different regions in Latvia, typically built in 1960-ties, which usually are operating with outdated equipment, low efficiency and very often using less than half of installed capacity. None of these producers covers more than 1 percent of total market share.

There are several individual producers having a market niche as well these companies are modernized and efficient. Producers of pastry which are producing bread as additional good are included in category of bread producers as well.

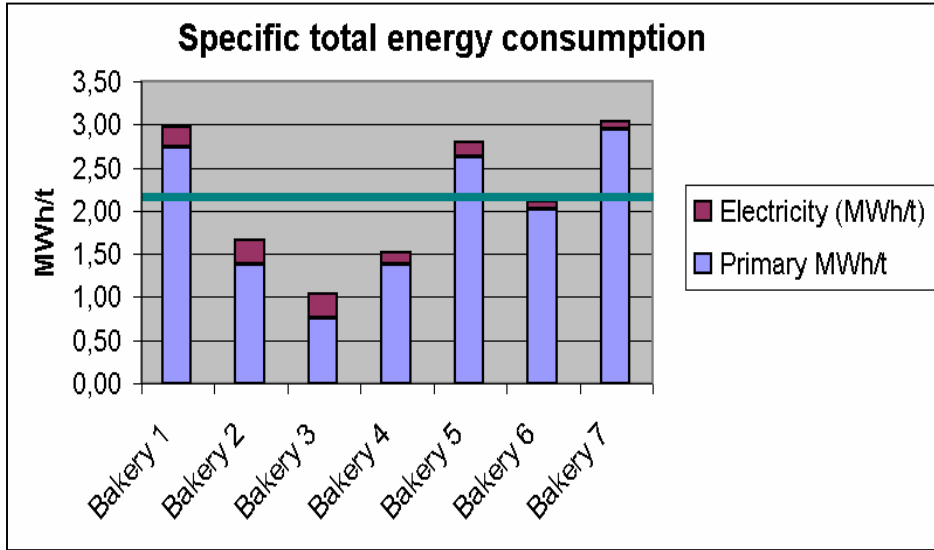
The rest are small private bakeries with small capacities, which are specialized in some kind of production and have their market niche.

Figure 4.4: Specific consumption of primary energy sources



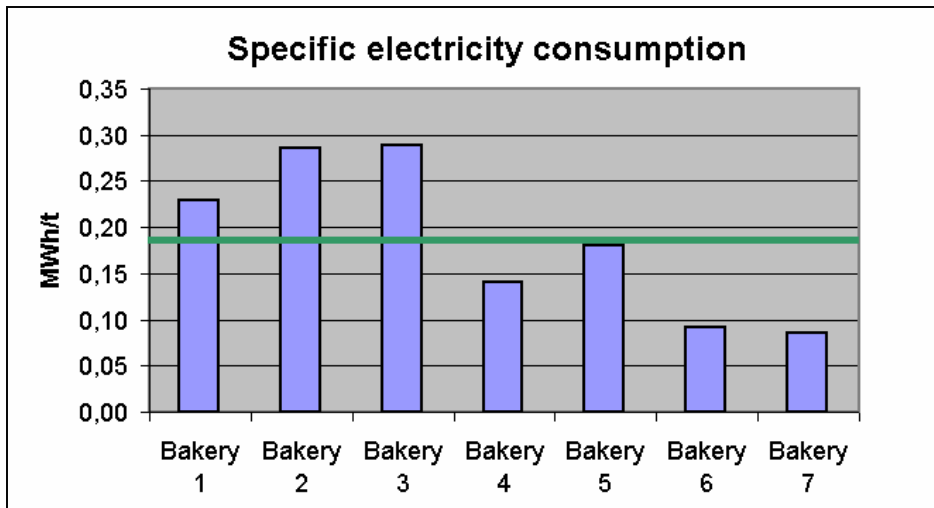
Note: Average consumption of primary energy sources – 1,97 MWh/t

Figure 4.5: Specific total energy consumption



Note: Average total energy consumption – 2,16 MWh/t

Figure 4.6: Specific electricity consumption



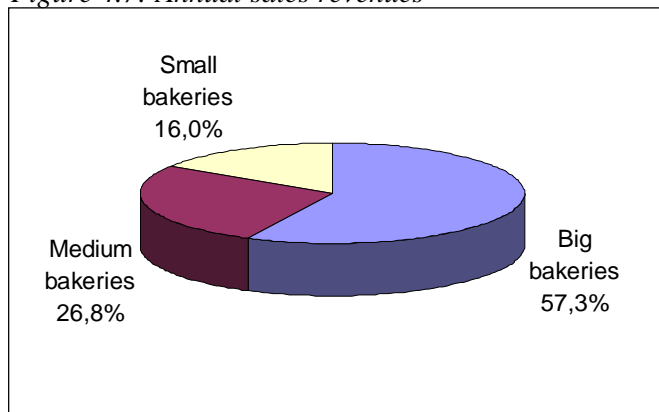
Note: Average specific electricity consumption – 0,19 MWh/t

### 4.3 Slovenia

Energy benchmarking is not a common practise in Slovenian industrial branches, there is no programme on national level. Benchmarking among the Slovenia companies is not enough known and appreciated.

The branch of bakeries in Slovenia includes 92 registered companies with 6000 employees. There are 9 big, 12 medium and 71 small size companies. Share of the sector in the net sales within the manufacturing sector in Slovenia is 4%. Annual sales revenues approximately 600 million EUR

Figure 4.7: Annual sales revenues



A specific form (questionnaire) has been sent out to several bakeries companies in Slovenia (6 large – industrial bakeries), the response was 3 filled forms. All data are for operation period 2003.

Table 4.1: Amount of production in analysed bakeries

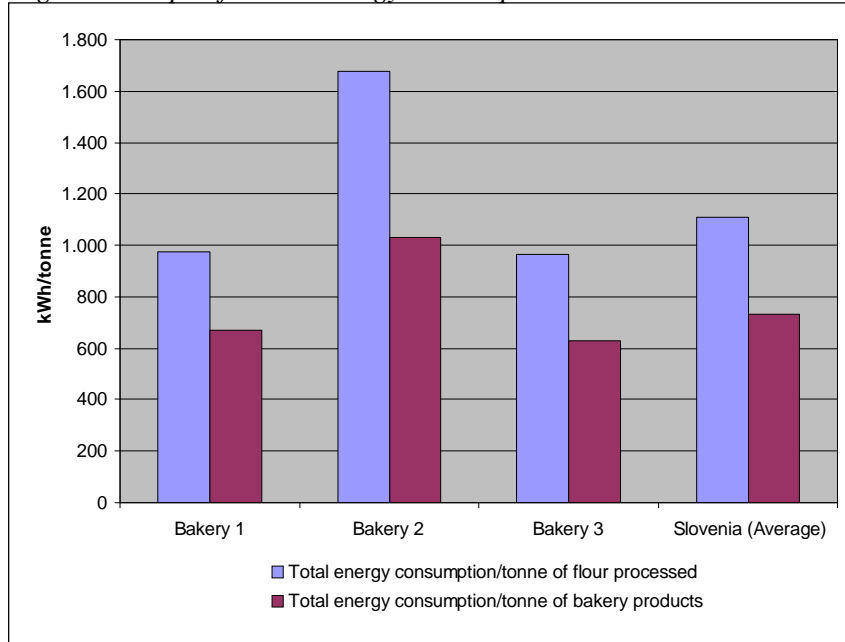
Bakery production	Total production		Avarage production
	(tonnes)	%	(tonnes/bakery)
Bread	16 168	79,8	5 389
Baked goods – bread sticks	3 458	17,1	1 153
Sweet leavened baked goods - rolls	627	3,1	209
Total:	20 253	100,0	6 751

As indicators for benchmarking following energy indicators are used:

1. amount of energy used in baking ovens per 1 tonne of flour processed,
2. amount of energy used in baking ovens per 1 tonne of bakery products,
3. an amount of electricity consumed per 1 tonne of flour processed,
4. amount of electricity consumed per 1 tonne of bakery products (bread, baked goods ...).

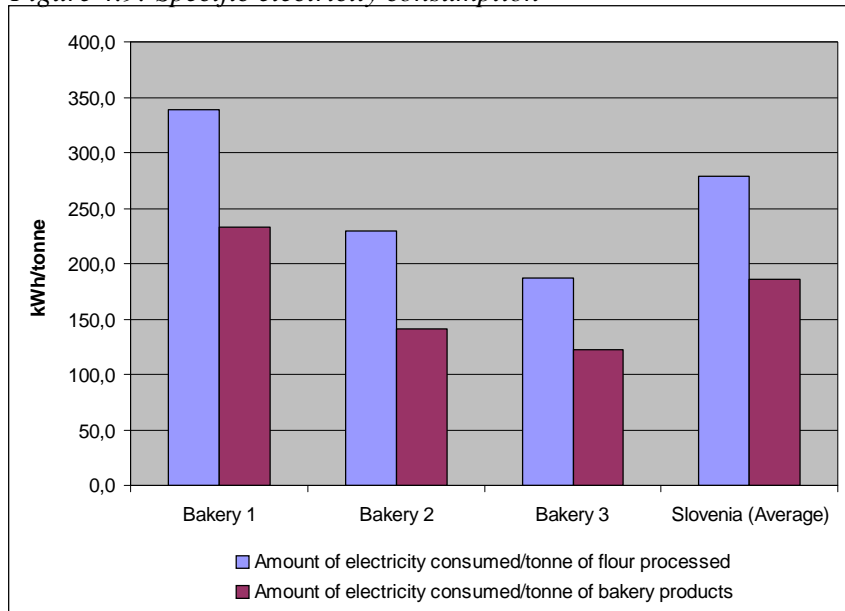
Specific total energy consumption of selected bakeries represents an amount of total energy consumed per 1 tonne of flour processed, and amount of total energy consumed per 1 tonne of bakery products.

Figure 4.8: Specific total energy consumption



Specific electricity consumption is set here as an amount of electricity consumed per 1 tonne of flour processed, and than amount of electricity consumed per 1 tonne of bakery products (bread, baked goods ...).

Figure 4.9: Specific electricity consumption



#### 4.4 Poland

In Poland there were available data only from one bakery. Due to low level of energy technologies (absence of metering devices) it is hard to find out relevant data regarding fuel consumption or primary and electric energy consumption. Further reason is the private property of these companies, where cooperation with the "industry" sector is still very difficult.

Analysed „J. Tokarsky Bakery” in Wolomin has 5 baking ovens with total area of 60 m<sup>2</sup> installed in 90ies. Operation period of bakery is 6 days within the week and 16 hours per day. The bread covers the main part of the production (68%). The rest consist of baked goods – sweat leavened beaked goods, bread sticks and rolls.

Figure 4.10: Annual bakery production

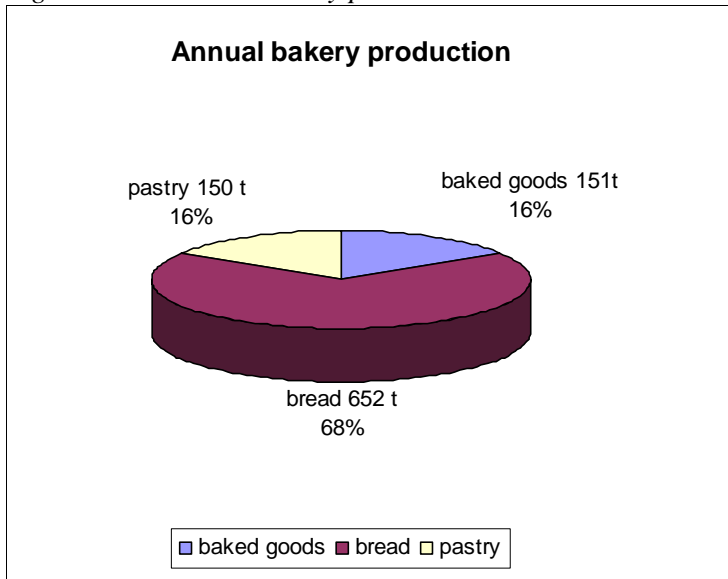
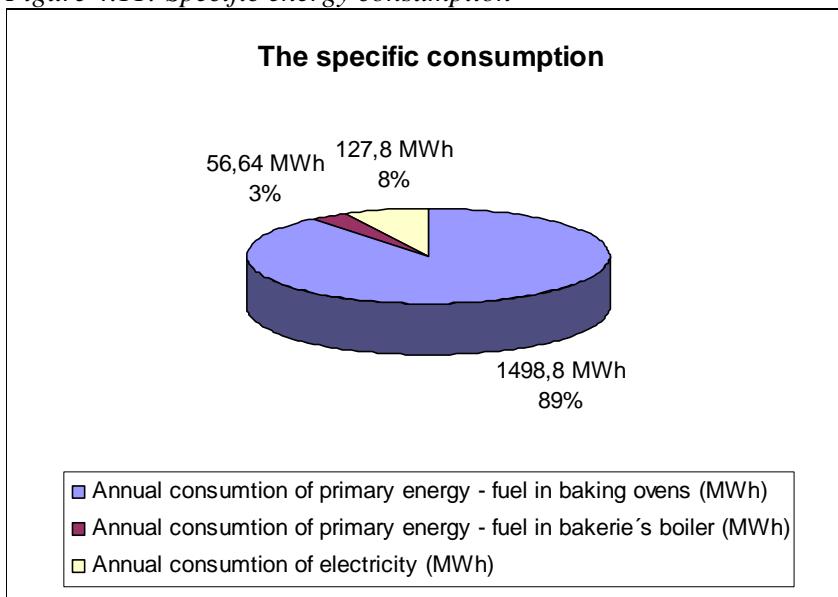


Figure 4.11: Specific energy consumption



As indicator for description of energy intensity of the operation for benchmarking is used ratio between total bakery production (983 t per year) and total annual consumption of energy. It means 1,6 MWh consumed total energy per tonne of produced bakery goods.

#### 4.5 Austria

Analysed bakery in Austria is specific in structure of production, where the share of bread makes only 60% of total production. Therefore the product / flour coefficient is much smaller than comparison with analysed bakeries in other countries.

Selected bakery in Austria has following parameters:

Figure 4.12: Annual bakery production

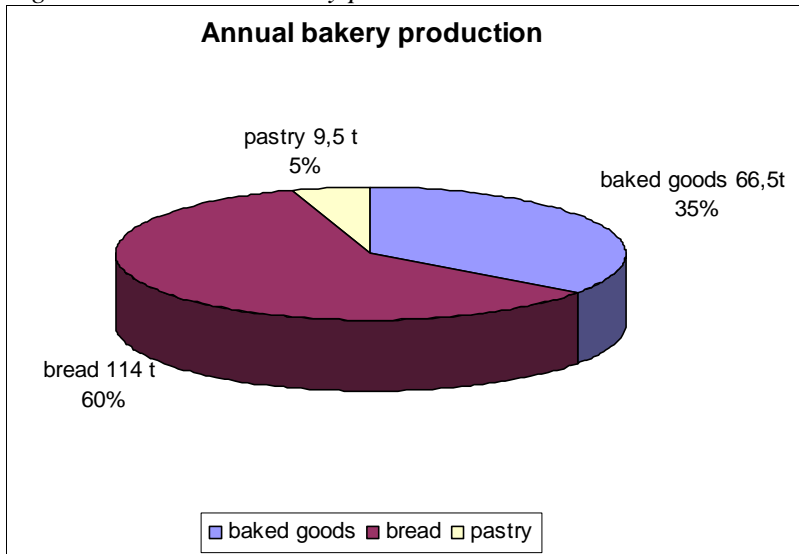
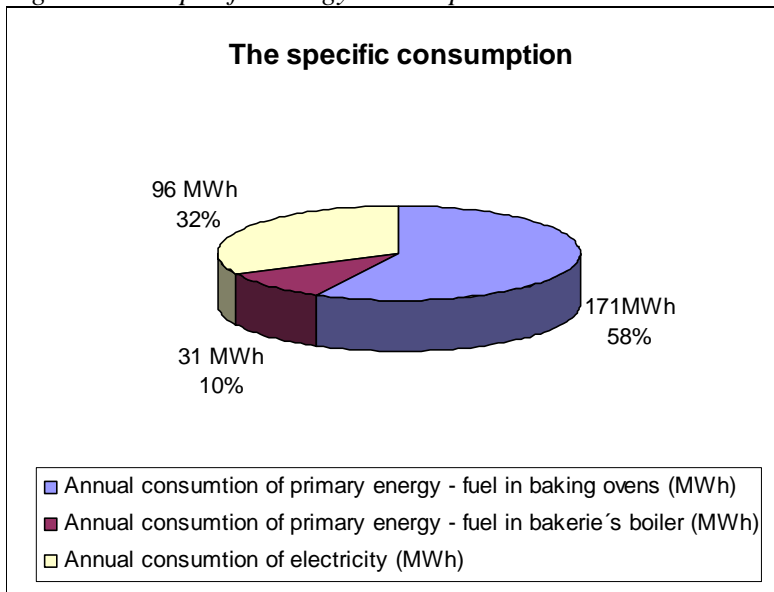


Figure 4.13: Specific energy consumption

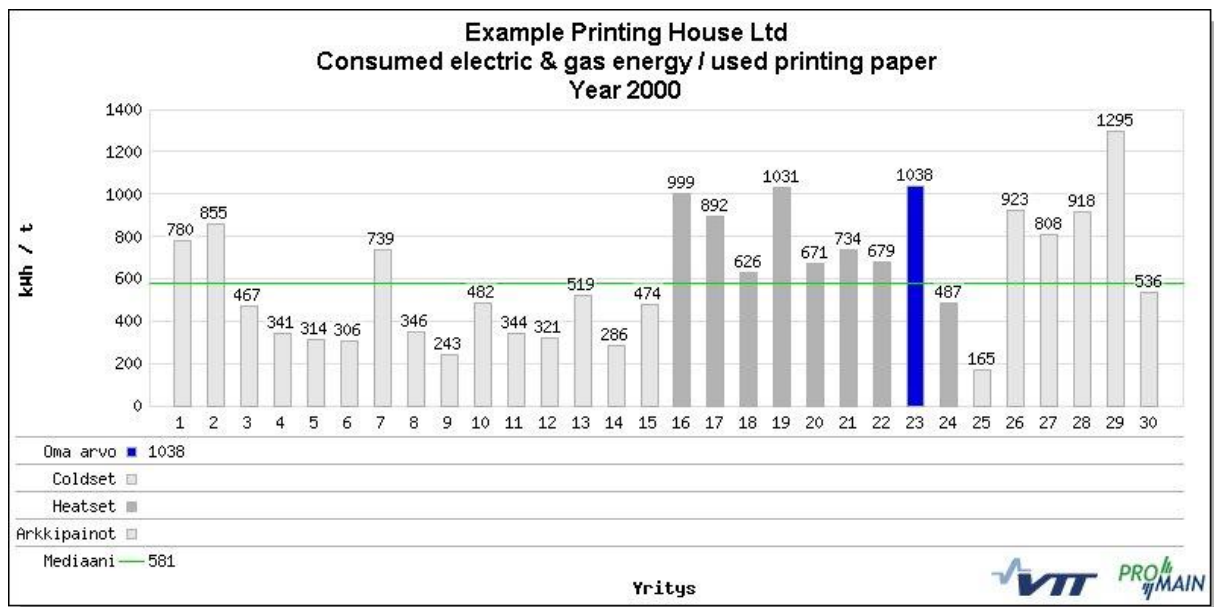


Energy intensity indicator of operation is 1,57 MWh consumed total energy per tonne of produced bakery goods. This value is comparable with other analysed bakeries, but still too high in comparison to EU average. There are not sufficient information in order to propose efficient technology measures and energy management. For this purpose detailed analyse should be elaborated.

#### 4.6 Finland

At the moment there aren't any comprehensive energy benchmarking systems in Finland for SME's. Comparison of the specific consumption (energy / production) with other consumers of the same branch was realised in graphic arts industry sector.

Figure 4.14: Total energy consumption regarding to amount of production in graphic arts industry on Finland



## 5. CONCLUSIONS

Comprehensive system of energy benchmarking in CEE countries is not established. The results of provided benchmarking shows great difference of the specific energy consumption among the participating countries and EU average (1,11 MWh/t). Indicator is higher in all selected countries except Slovenia. The oldest bakeries have the highest potential of efficiency increase. However the market situation has to be kept in mind – these companies currently are performing very inefficient, and there is need of investments to keep the company working.

The results of benchmarking provided in these companies will lead to concrete measures which have to be done in order to improve the overall level of energy efficiency.

### 5.1 Proposed Remedies

In order to support initiation of energy efficiency-oriented decision making, subsequent installation or vindication of anticipated actions in front of directors or bakery owners, it is necessary to continue monitoring and ongoing assessment of energy intensity indicator. Its transformation in time, together with additional information on the production and season, can facilitate the more specific identification of areas of poor energy performance. Such information can help finding quantitative indicators of possible energy-saving impact of individual remedies. This background is sample enough for the further economical assessment of a specific energy saving remedy. Of course, such information is site-specific for each bakery, and requires certain degree of confidentiality.

In those cases, where the potential energy savings have already been defined, the next step would be the prompt development of detailed implementation strategy for individual remedies, but the most important step is the decision on reasonable and economically expedient advance of each such individual remedy. The next step following the implementation of each remedy is the monitoring of its impact on energy intensity indicator. Such information can serve as evidence of resultant savings, and should such company decide to share its own experience with its colleagues in other operation sites, it can be used as a basis for the development of case studies.

Considering the comfortless financial situation in bakeries, especially bakeries which have huge problems, it is reasonable to prefer these remedies, which are either free, or where the efficiency of investments is too high.

Examples of Remedies which are free:

- ❖ Closing the outside doors and windows.
- ❖ Excessive turnover of air increases heat consumption.

Identification of these sections of bakery, which are not directly engaged in the production and for administrative purposes. Insulation of these sections simultaneously with

their disconnection from the heating system can have a significant positive impact on the reduction of space heating needs.

Examples of Low Cost Remedies:

- ✦ Installation of Insulating Curtain in the Shipping Room Gate, which is the place of very high heat losses.
- ✦ Installation of thermostatic valves on heaters, together with thermodynamic balancing of the heating system. This remedy is self-evident mainly in large bakeries.
- ✦ Installation of steam and heating pipelines.
- ✦ Maintenance of steam suction fans in a good shape.

The reduction of the temperature difference between upper and lower layers of air belongs to the moderately expensive investments. This can be achieved by installing fans under the ceiling, pushing warmer air downward. However, such remedy is worthwhile only in high halls with large footage.

Generally speaking the shortest possible return of investments is the case of reconstruction of the building (replacement of ineffective windows and insulation of walls). The cheapest solution is clearly the reconstruction and insulation of the roof. The good quality of the roof is the essential prerequisite for energy savings in heating.