

# Energy Saving Policy and Industrial Energy Efficiency Network In Lithuania

*F. Zinevicius, Lithuanian Energy Institute*  
*T.H. Gulbrandsen, Institute for Energy Technology, Norway*  
*V. Gaigalis, Lithuanian Energy Institute*  
*R. Skema, Lithuanian Energy Institute*

## ABSTRACT

Lithuania has been in transition to a free market economy since the first days of regained Independence in 1990 and has started to implement comprehensive reforms. One of the major goals of foreign policy is to join the European Union. Lithuanian industry is crucial to the future economy and development of the country. At present, the industry is undergoing restructuring from companies that have worked under a planned economy to companies that can work within a market economy with products suitable for the Western European market. Energy is one of the main inputs in industrial processes, making it an important component in this transition process.

The main document that defines energy policy goals and directions, the National Energy Strategy, was approved by the Government and Parliament in 1999. Six main objectives have been formulated with one of them being to increase energy efficiency. The decision to shut down the first unit of Ignalina nuclear power plant, till year 2005 in the National Energy Strategy is noted also.

In Lithuanian "National Energy Efficiency Programme" it is estimated that the total energy saving potential in industry constitutes a total 33%, or from 20-50% at trade level.

The Lithuanian Industrial Energy Efficiency Network (LIEEN) was established at Lithuanian Energy Institute in 1998 as a counter part of the Norwegian Industrial Energy Efficiency Network, which was established in 1989 and is operated by the Institute for Energy Technology (IFE). LIEEN gave us an excellent opportunity to look at the relation between production efficiency and the energy use in the separate industrial sectors. The results make it easier to make suggestions for improvement and innovation.

The network of bread and pastry, dairy and meat processing sectors (more than 70 enterprises) is presented. Total energy consumption by energy sources in sectors is shown and specific energy consumption per unit of production is calculated for different enterprises and compared (using bench marking).

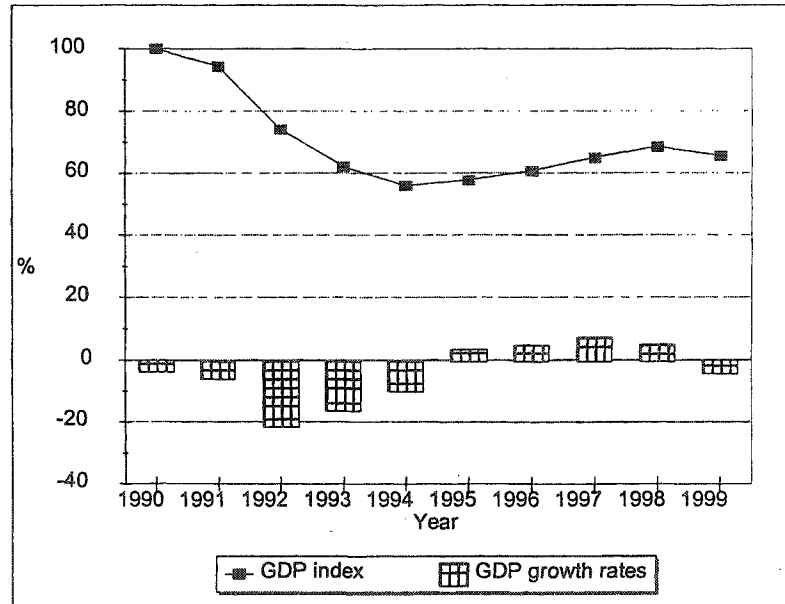
## Introduction

During the last ten years Lithuania's economy has undergone essential changes in all its sectors, including the energy and industry sectors. The abrupt price rise of all primary energy resources with other factors led to a deep decline in industry – energy demand and production have considerably decreased. Gross Domestic Product (GDP) reflects the economic conditions of the country (Fig.1) (DOS 2000). The period from 1990 to 1994 was a period of a dramatic decline and in 1992 the growth rate of GDP fell to -21.3 per cent.

In spite of unfavorable macroeconomic conditions, great efforts were made to lay the foundations for a market economy: fast privatization of small and medium companies

and liberalization of the prices of almost all products and trade conditions. New laws were passed to promote the establishment of new private companies and to create conditions for investment. Therefore, the period from 1995 to 1998 was a period of recovery marked not only by the stabilization of the economy but also by its growth. In 1997, the rate of GDP growth was 7.3 per cent.

The financial crisis in Russia, which started at the end of 1998, influenced the stagnation of Lithuania's economy in 1999. The growth rate of GDP fall to -2.4 per cent. New Western markets softened this impact. Then in 2000 positive growth rate of GDP was reached 2.9 per cent.



**Figure 1. GDP Growth Rates in Lithuania**

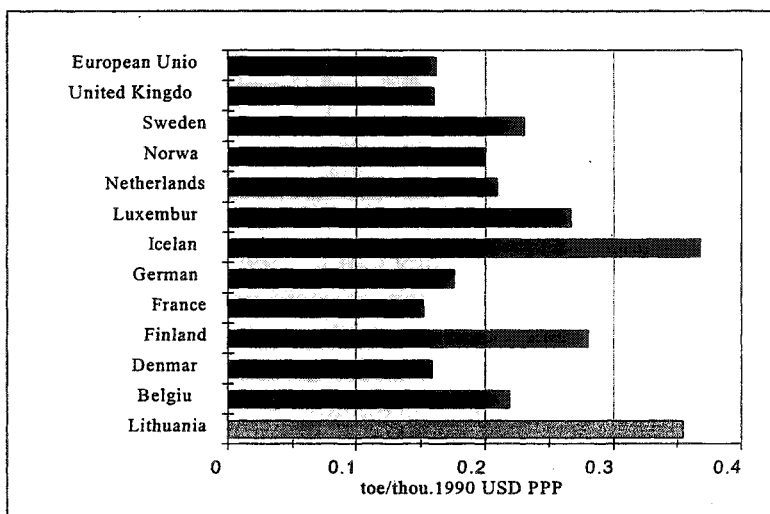
Energy intensity, i.e. energy consumption per unit of GDP, is one of the most important indicators for analysis of energy efficiency. This indicator can be expressed as gross consumption of primary (or final) energy per unit of GDP. In 1996, this indicator of primary energy intensity in Lithuania was 5.7 and indicator of final energy intensity 4 times higher than in the countries of EU. The indicator of final energy intensity is not completely accurate for comparing energy efficiency in developed countries and former centrally planned economies. High energy intensity in the former planned economies is partially determined by low levels of GDP. Net value of similar goods produced and especially of services rendered in these countries is much lower than developed countries. Given this, the Purchasing Power Parity (PPP) is used for setting GDP (Fig. 2) (LEI 2000).

### **Energy Saving Policy and Industry**

Lithuania inherited high energy intensity due to prior low incentives for energy saving, because consumers had decades of cheap energy. Now, energy efficiency must be a permanent objective of the Lithuanian energy policy.

National Energy Strategy (LEI 2000), the main document which defines energy policy goals and direction of its development, was approved by Parliament in 1994 and (revised) in 1999. The main objectives of the Strategy include the principles of the energy policy formation of the EU and individual Member States. These are:

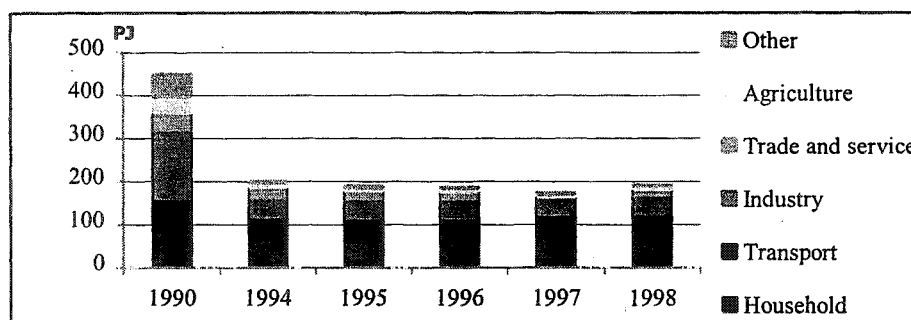
1. Reliable and safe energy supply with least costs;
2. Energy efficiency enhancement;
3. Improvement of the energy sector management, and implementation of market economy principles in the energy sector;
4. Reduction of the negative impact upon environment; assurance of nuclear safety requirements;
5. Integration of the Lithuanian energy sector into the energy system of the European Union;
6. Regional co-operation and collaboration.



**Figure 2. Final Energy Intensity in Lithuania and EU Countries (toe – tons oil equivalent/thousand 1990 USD PPP)**

The National Energy Efficiency Programme (NEEP) was approved by the Government in 1992 and (revised) in 1996. The total increase in energy efficiency is measured by the reduction in energy intensity (MOE 1996).

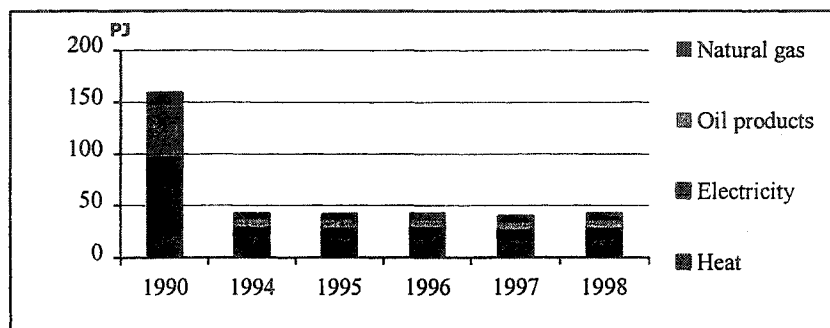
Total final energy consumption in Lithuania decreased from 450PJ (Peta Joules) in 1990 to ~200PJ in 1998 (recession of production due to lost market). The main consumers are: household ~ 62PJ, transport ~ 50PJ, industry ~ 45PJ (Fig. 3) (DOS 1999). In 1990, final demand in industry was 161PJ (36% of total consumption), household 82PJ(18%), transport 72PJ (16%). Thus energy demand in industry decreased during transformation period by 4 times, while in household and transport only 1.4 times.



**Figure 3. Final Energy Consumption in Branches of Economy**

When analyzing final consumption of different energy carriers within industry (Fig. 4) (DOS 1999) it is evident, that in period from 1990 to 1994 the final heat

consumption decreased more than 3 times, final electricity – more than 2 times, oil products more than 7 times, natural gas – by 2 times. In period from 1994 to 1998 the main energy source was heat 19 – 21PJ (42 - 46%), electricity 10 – 11PJ (22 - 25%), oil products 6 – 7PJ (15 – 16%), and natural gas 5 – 6PJ (13 – 15%).



**Figure 4. Energy and Fuel Demand in Industry**

The main goal of the industrial policy (MOE 1999) is higher industrial efficiency and competitiveness due to the introduction of state-of-the-art technologies and high quality production. The principle prerequisites to this end are the promotion of investment into industry and the attraction of foreign direct investment into Lithuanian economy, thus the introduction of the most advanced technologies and innovations.

In 1998, the manufacturing industry enjoyed over 75.4 per cent of private capital (17.5 per cent foreign capital included), which produced about 86 per cent of industrial production. Industry was based upon 2500 public and private companies, which produced about 90 per cent of quarrying and manufacturing industries production. More than 60 per cent of enterprises had reorganized their production, changed their product lines, improved quality and strengthened their position in domestic and foreign markets.

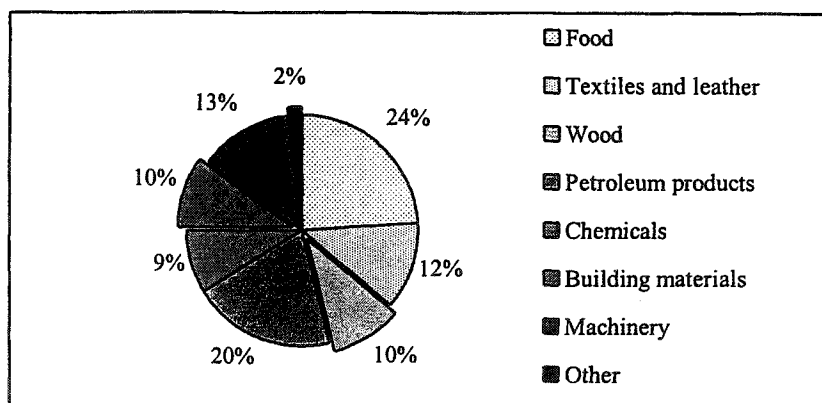
Active innovative restructuring of industry has been chosen as the method for implementing the industrial policy goals.

Two categories of companies can be seen in terms of restructuring. These are:

- Enterprises previously incorporated in the USSR military complex (electronics, electrical engineering, machinery construction industries). These have encountered difficulties under market conditions.
- Enterprises, which were able to solve their restructuring problems without much interference of the state, moreover, they were able not only to survive, but also to grow (food, lightning products, chemical and furniture industries).

In respect to the first group, EU recommended a safeguard policy that reflected the necessity to rapidly direct inefficiently used resources to more effective areas.

In 1998, the structure of manufacturing industry (production 20.1 billion Lt (1USD = 4Lt)) was: food – 29%, textiles – 17%, oil processing – 16%, machinery – 13%, chemistry – 9%, wood products – 9%, building materials – 4%, other – 3%. Shares of expenses for energy in these sectors presented in figure 5. (DS 1999).



**Figure 5. Distribution of Expenses for Energy in Manufacturing (1.48 billion Lt)**

In 1999 the primary foreign investment in Lithuanian manufacturing came from: Switzerland 14.8%, Denmark 13.9%, USA 12.7%, Germany 10%, Sweden 9%. Foreign investments total 2.7 billion Lt/year. Gross domestic product at current prices was 42.6 billion litas (Lt).

### **Industrial Energy Efficiency Network**

The technology in industrial processes within Lithuania are changing rapidly and becoming more complicated. Highly qualified personnel will be needed at all levels in manufacturing to achieve cost-efficient output. Both sophisticated technology and skilled personnel will be needed for Lithuania to meet the challenge from international and domestic competitors in the years to come.

At the end of 1998, the Secretariat of Lithuanian Industrial Energy Efficiency Network, with support from Norwegian Institute for Energy Technology, was established at the Lithuanian Energy Institute. The activities of the Secretariat are supported by the Ministry of Economy, the Energy Agency, and the Confederation of Lithuanian Industrialists. (Fig.6).

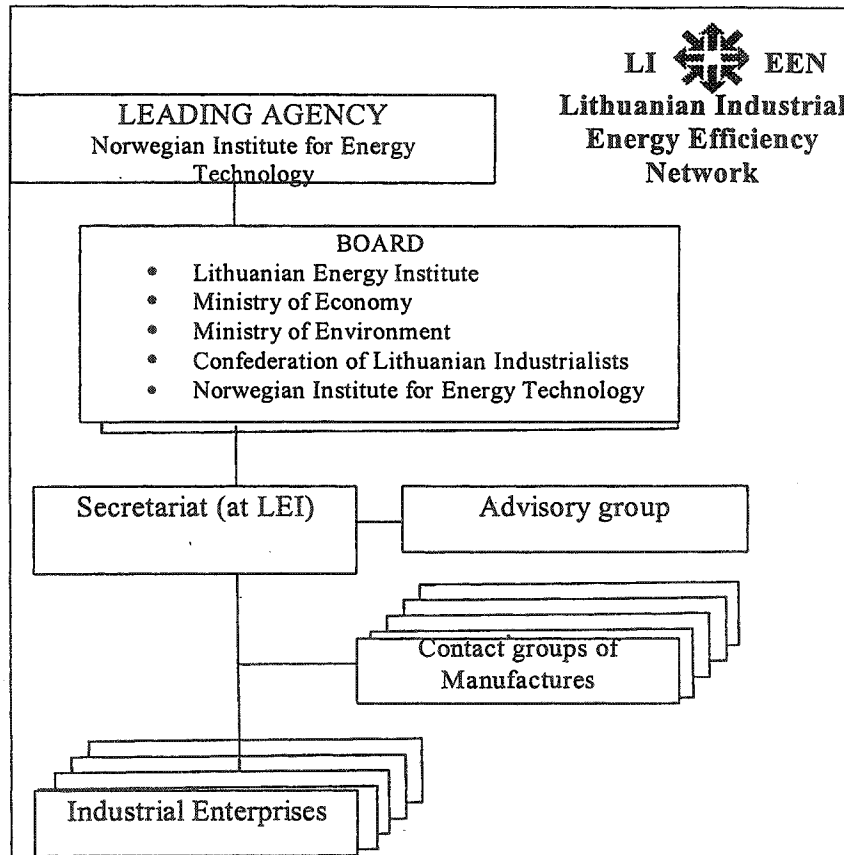
Our Network is the counterpart of the Norwegian Industrial Energy Efficiency Network, which was established in Norway in 1989, and is operated by the Institute for Energy Technology. The number of member sectors is 13 and it comprises approximately 530 individual member companies in Norway.

Such networks have been successfully established in several countries of Europe: in Austria, Greece, Portugal, Spain (initiative was taken by IFE in 1995, THERMIE – B project) and in Latvia.

The LIEEN was founded on the idea to sectorise the industry and focus on similar problems in similar industrial sectors. This gave us an excellent opportunity to look at the relation between production efficiency and the energy use. The results make it easier to motivate for improvement and innovation.

Network implementation started with the largest industry – Manufacture of food and beverages. Food and beverage manufacturing is over 30% all industrial production. The first phase selected the Bread and Pastry, Dairy, and Meat processing sectors, predominant sectors in this industry. Jointly with the Institute for Energy Technology, three seminars have been arranged: for bakeries (28 October 1998), for the dairy sector (10 February 1999) and for meat processing (27 April 1999).

LIEEN now comprises 74 companies.



**Figure 6. Organization of the Lithuanian Industrial Energy Efficiency Network (LIEEN)**

## **IEEN of Bread and Pastry Enterprises**

During one year period, 37 enterprises joined the Network. The Network covers more than 30 Lithuanian towns as it is shown in the Lithuanian map (Fig. 7). Total energy consumption in these enterprises was 150GWh per year. In 1997, bakeries consumed mostly natural gas – 36.5% and oil products – 26.6% (Fig.8). Heat energy share was 14.6% while electricity was 13.8% (Gaigalis, Zinevicius and Skema 2000). In Norway bakeries are using mainly electricity – 76% and oil products – 20% (IFE 1997; IFE 1998).

The specific energy consumption in Lithuanian enterprises has wide range variations from 0.4 up to 3.5 kWh per kg of bread production (Fig. 9). The specific energy consumption in Norwegian bakeries was from 0.25 up to 1.35 kWh/kg. On the average, the specific energy consumption in Lithuanian bakeries is 2 – 3 times higher than in Norway.

A few Lithuanian enterprise were selected to undergo energy audits, so-called “walk-through audits”. At each enterprise the energy audit was carried out in order to identify the major energy saving opportunities. Special attention in the audits was given to processes and equipment where it was anticipated to identify the most feasible energy savings. Each energy audit was described in a report. The audits were carried out together with Norwegian and Danish auditors. Owners of enterprises must take the following actions, as search for finances and implementation of energy saving proposals.

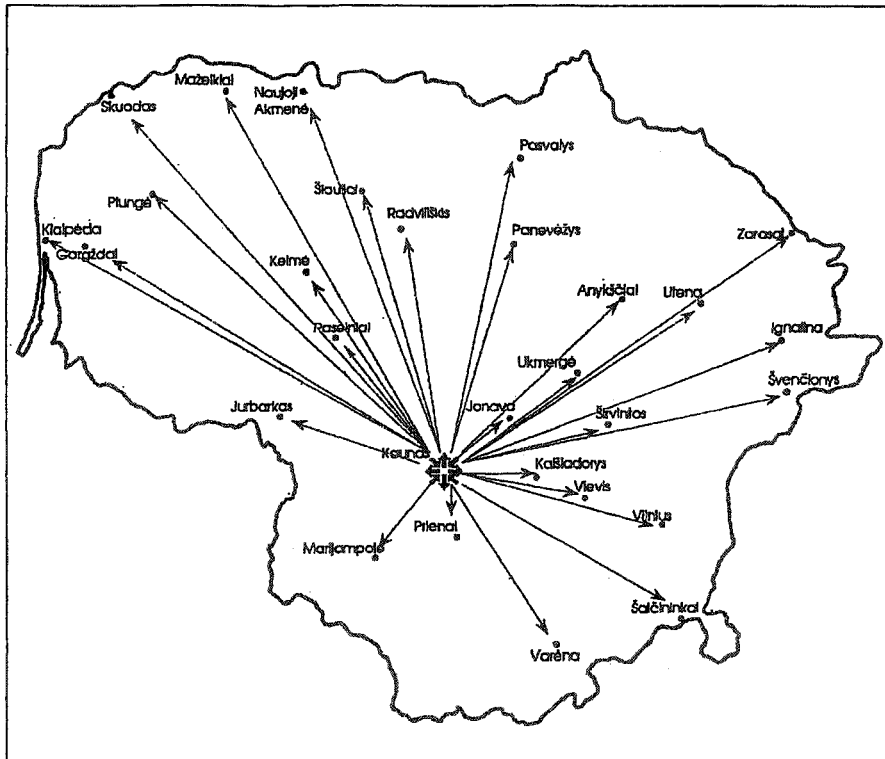


Figure 7. LIEEN of Bread and Pastry Enterprises

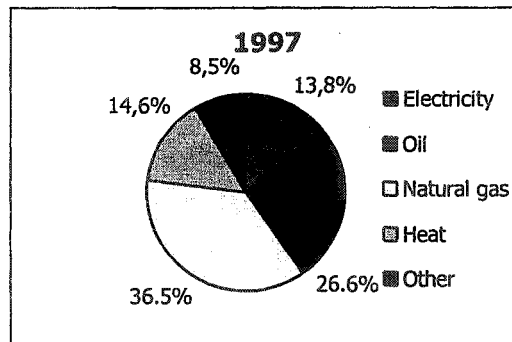


Figure 8. Percent Share of the Most Common Energy Sources in Bread and Pastry Enterprises – Members of LIEEN

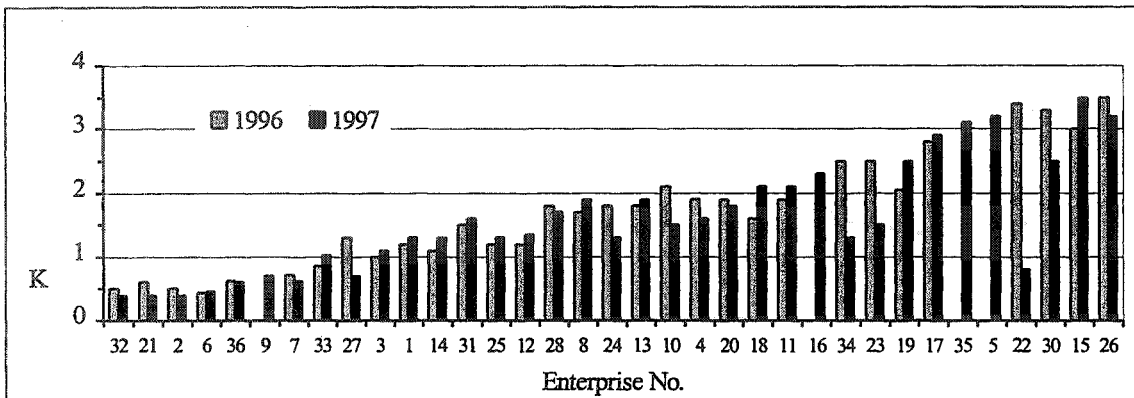


Figure 9. Specific Energy Consumption in Bread and Pastry Enterprises – Members of LIEEN. (The numbers on the x-axis represent the individual member enterprises in the Network.)

## IEEN of Dairy Enterprises

Volume of dairy product (milk) decreased more than 1.5 one-third, from 2900 thousand tons in 1991 to 1900 thousand tons in 1997. The Lithuanian dairy industry is going through a reduction process preparing the business for increasing competition with many actors in the decreased market.

Till September of 1999, 23 dairies were registered as members of LIEEN (Fig.10). Total energy consumption in these enterprises was 430 GWh in 1997 and in 1998. Figure 11 shows the percentage of the most common energy sources: oil products (32 – 34%), natural gas (24%), electricity (17%), and heat from District Heating (15%) for the dairy industry.

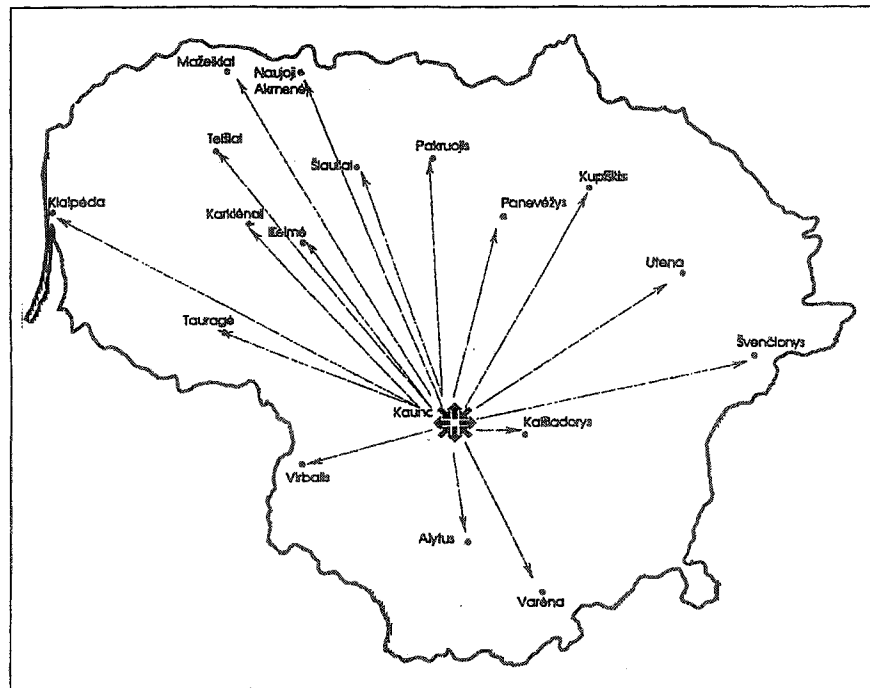


Figure 10. LIEEN of Dairy Enterprises

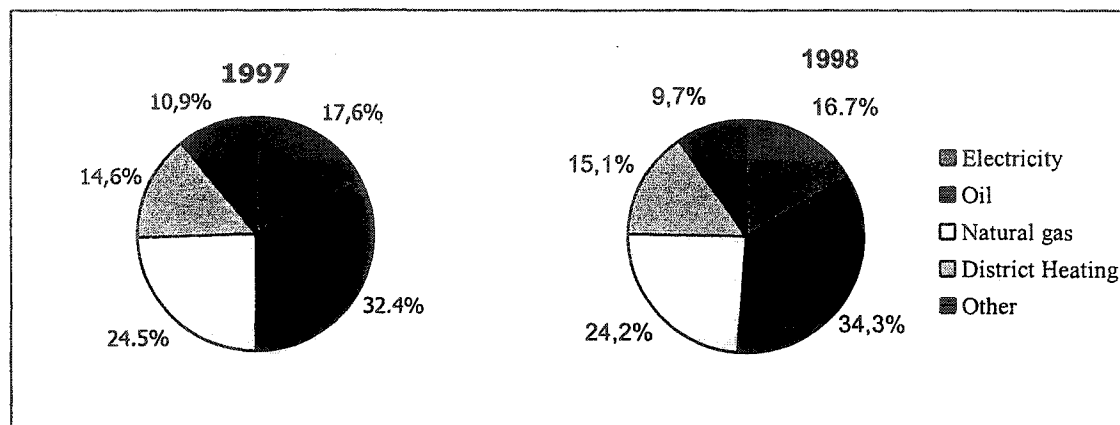


Figure 11. Percent Share of the Most Common Energy Sources in Dairy Enterprises – Members of LIEEN



In Norway the consumption of electricity and oil products reflects the prices of energy source. So, electricity share could be more than 70% if it is enough rain water for hydro power stations and only 50% in unfavorable case. Correspondingly, the share of oil products could be 20 or 40% (IFE 1997; IFE 1998).

Benchmarking figures could be produced by the use of two different methods: energy consumption over treated milk volume or energy consumption over weighted production. The second new method, in accordance with Norwegians, shows a decrease in specific energy consumption varying from 6 to 12% for five main groups of products.

The results of calculations of specific energy consumption in Lithuanian dairies presented in Fig. 12. Variations covers interval from 0.1 to 0.65 kWh per kg of produced milk. Norwegian data are from 0.08 to 0.3. On the average the specific energy consumption in Lithuanian dairies is 1.5 times higher than in Norwegian ones.

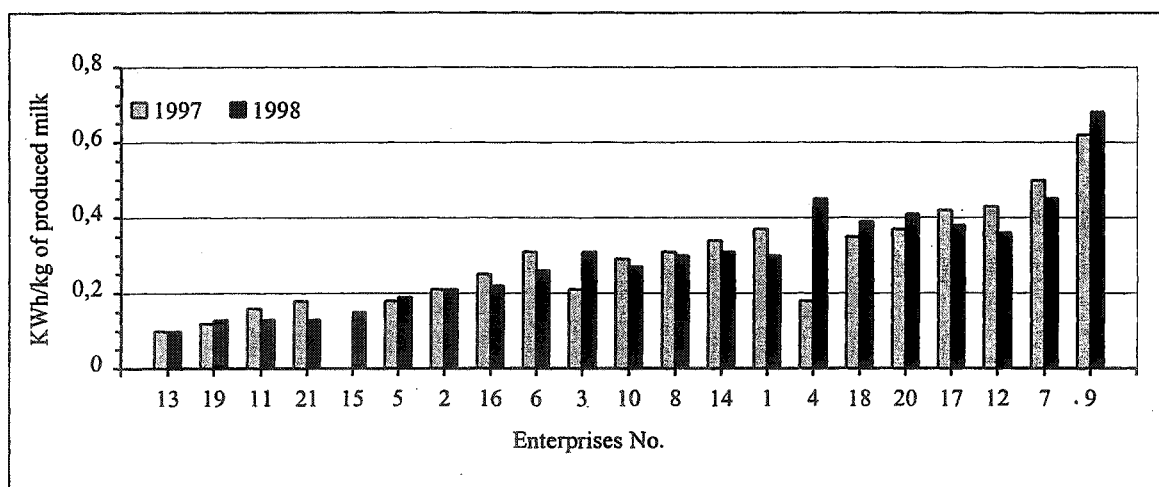


Figure 12. Specific Energy Consumption in Dairy enterprises – Members of LIEEN. (The numbers on the x-axis represent the individual member enterprises in the Network.)

### LIEEN of Meat Processing Companies

The Lithuanian meat industry slaughtered 200 000 tons in 1998, the same volume as Norway. Yet, in 1991 the Lithuanian meat industry produced 450000 tons. In 1998, the main kinds of production were: pork (44%), beef (42%), and fowl (13%) (DS 1999).

As of September, 2000 there were 16 enterprises within the Network (Fig.13). The energy consumption is distributed between specific electricity uses like motors, lighting, and energy used for production of hot water. Steam is also used for heating and ventilation. Total energy consumption was 140 GWh per year. In 1998 the sector used natural gas, electricity, and oil products: 29%, 29%, 21% respectively. The share of district heat was 18%. (Fig.14). As a comparison, the Norwegian meat industry used: electricity at 77%, oil products at 19%, and natural gas, and other at 4% in 1997 (IFE 1997; IFE 1998).

Fig. 15 shows energy consumption per slaughtered and produced kg of meat. The weighted average was ~ 1.7 kWh per kg (ranging from 0.4 to 4.2 kWh per kg). Norwegian weighted average for 1997 was 1.2 kWh per kg.

As in bakeries, energy audits were carried out in dairies and meat industry companies. Energy saving proposals have been selected for each company with indication of energy saved, money saved, investment, and payback time.

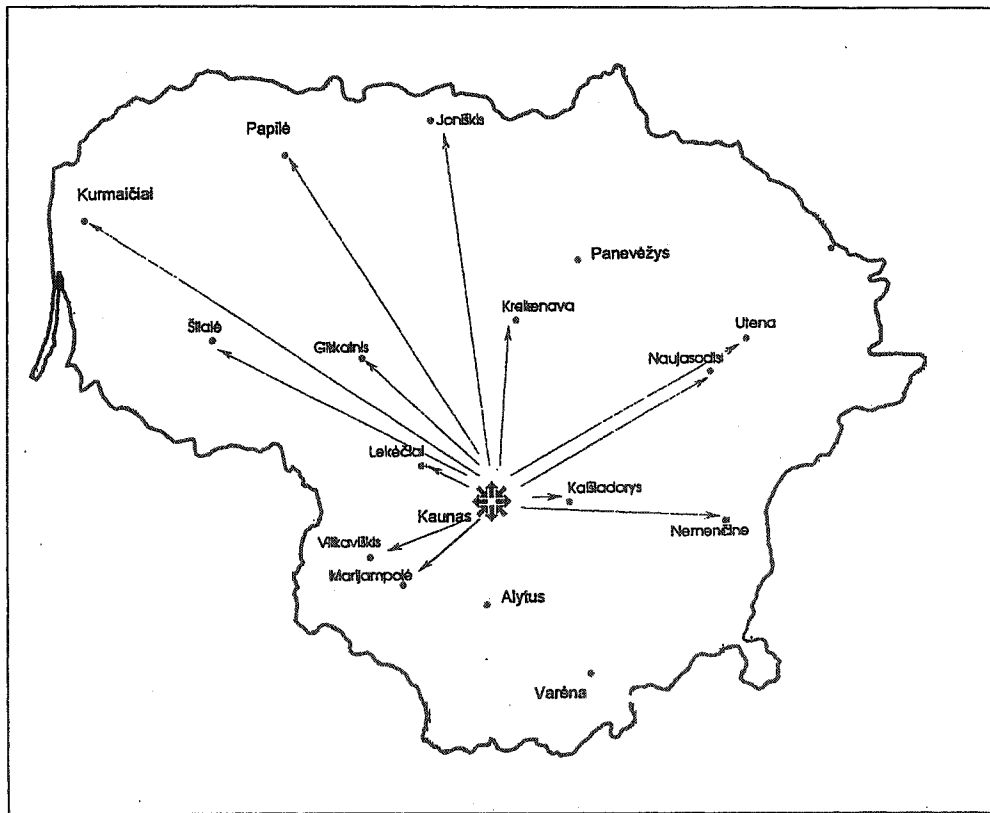


Figure 13. LIEEN of Meat Processing Enterprises

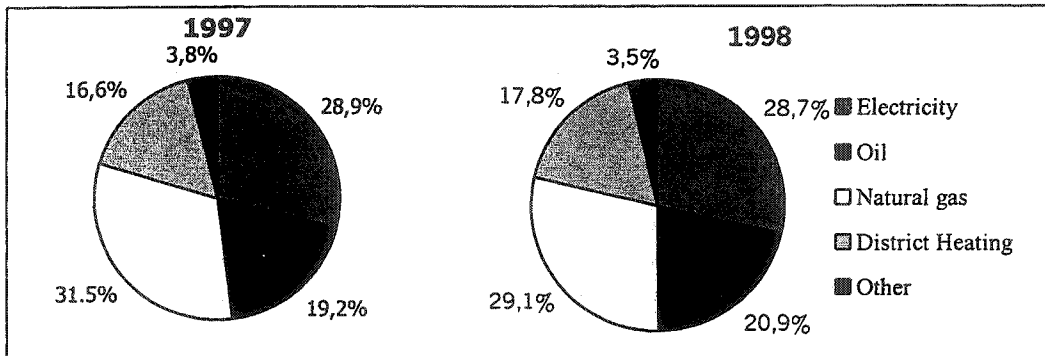


Figure 14. Percent Share of the Energy Sources in Meat Processing Enterprises – Members of LIEEN

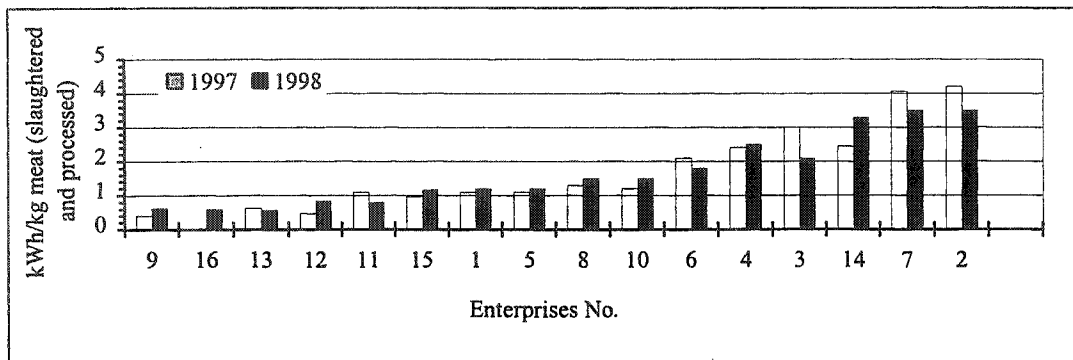


Figure 15. Specific Energy Consumption in Meat Enterprises – Members of LIEEN. (The numbers on the x-axis represent the individual member enterprises in the Network.)

## Conclusions

1. The reconstruction of Lithuanian energy sector to a free market conditions was followed by significant decrease of energy consumption in all branches of the economy. However, the energy intensity, which shows the efficiency of consumption of energy sources, remains one of the highest in Europe.
2. The analysis of energy consumption in industry showed, that the main attention must be paid to the biggest activity of Manufacturing industry – Manufacture of food products and beverages, as it covers almost one third of the total energy consumption of industry.
3. The comparison of specific energy consumption in the Lithuanian and Norwegian industries, using same calculation methodology showed, that in Lithuanian bread and pastry, dairy and meat processing enterprises energy consumption per production unit is 1,5 – 2,0 times higher as in Norway.
4. On the basis of the energy audits carried out together with Danish auditors the saving potential for the Lithuanian industry has been estimated: electrical saving potential ~ 14% (manufacture of food products and beverages ~10%, manufacture of textiles ~15%); heat saving potential ~ 21%.
5. It is necessary to continue energy auditing activity together with West experts. The knowledge on new industrial technologies must be extended. Specific energy consumption per production unit must be defined not only for manufacture of food products, but for other manufactures also. For the realization of mentioned aim – the activity of LIEEN must be supported and strengthened.

## References

- [DS] Department of Statistics. 1999. *Statistical yearbook of Lithuania*. Vilnius: Department of Statistics to the Government of the Republic of Lithuania.
- [DOS] Department of Statistics. 1999. *Energy balance 1997 – 1998*. Vilnius: Department of Statistics to the Government of the Republic of Lithuania.
- [DOS] Department of Statistics. 2000. *Statistical yearbook of Lithuania*. Vilnius: Department of Statistics to the Government of the Republic of Lithuania.
- Gaigalis, V., Zinevicius, F., Skema, R. 2000. “Lithuanian Industrial Energy Efficiency Network.” 2000. *In Proceedings of CTI Training Course for Eastern Europe. Climate Technology and Energy Audit as a Tool for Improved energy Efficiency. 26-29 September*. Tallinn, Estonia.
- [IFE] Institute for Energy Technology. 1997. *Industrial Energy Efficiency Network in Norway*. NVE’s operating agent – Industrial sector: Institute for Energy Technology.
- [IFE] Institute for Energy Technology. 1998. *Norwegian Industrial Energy Efficiency Network*. NVE’s operating agent – Industrial sector: Institute for Energy Technology.

- [LEI] Lithuanian Energy Institute. 2000. *National energy strategy*. Kaunas: Lithuanian Energy Institute (in Lithuanian).
- [MOE] Ministry of Economy. 1996. *National Energy Efficiency Programme*. Vilnius: Ministry of Economy.
- [MOE] Ministry of Economy. 1999. *Medium term economic strategy of Lithuania in the context of its accession to the European Union*. Vilnius: Ministry of Economy.