



Sustainable Energy Community Tools

Project EIE/05/155/SI2.419594

Guidelines for energy supply planning, Lithuania

0. Preface

These guidelines are intended to strengthen municipal energy planning, which has been mandatory since 2003 when Heat Law entered into force. Currently, all municipalities have prepared their energy supply plans. It is the first time when municipal energy planning in Lithuania was carried out on such a big scale.

Accumulated planning experience allows to draw some conclusions and generalisations. This paper briefly describes findings of the recent planning experience. It also touches some important aspects of planning, which have not received enough attention and thus deserve to be developed and incorporated into newly prepared or reconsidered and renewed heat plans.

Recommendations are intended to municipal staff who is responsible for municipal participation in and supervision of special heat planning as well as to heat and natural gas supply companies, consulting companies and other stakeholders of heat planning.

Below follows a summary of the recommendations.

I. Introductory considerations about energy economy

Notices on energy supply strategy in the EU context

Regarding non-technological developments, the EU energy policy focuses on the following general actions:

- Development of measures intended to decrease EU dependency on imported fuels and thus increase energy supply security within the EU
- Implementing measures to stimulate an increasing share of renewable fuels in overall primary energy consumption

- Increasing energy efficiency on the consumer side, mostly by retrofitting older buildings with poor thermal characteristics
- Support of sustainable, energy-efficient local communities mostly reliant on local and renewable fuels and using already existing state-of-art equipment, introducing energy saving habits in consumer behaviour as well as smart energy management
- Increasing public awareness of environment problems related to burning fossil fuels.

European cities consume more than 75% of energy. All over Europe international city-networks have been established with the aim to substantially reduce CO₂ emissions, improve energy efficiency and increase use of renewable energies.

These tendencies should be kept in mind by any heat planner. It is likely that the EU would financially support planned actions and measures that are in line with the general targets mentioned.

Principal objective of the heat planning

A principal question, to which heat planning must give an answer, is finding optimal division of the heat market between district heating (DH) and autonomous heat producers.

District heating

- Penetration of district heating and other building heating modes – statistical data show that 85.4% of multiapartment houses are connected to DH networks;
- Advantages of district heating:
 - Higher efficiency in heat production compared to individual boilers;
 - Enables use of CHP technology, which further increases fuel efficiency;
 - Allows fuel diversification thus ensuring supply security;
 - Due to better efficiency is considered an environment-friendly technology - reduces CO₂ release into atmosphere.
- Disadvantages of district heating:
 - In many cases DH networks in Lithuania are oversized and in bad shape which leads to high heat losses;
 - Overall DH efficiency is highly sensitive to the number of consumers;
 - DH efficiency considerably falls in summer periods when heat consumption is low but heat losses in the DH network are nearly the same as in winter.

Autonomous heat production with natural gas

- Penetration of autonomous heat production – statistical data show that major part of individual houses (88.6%) are heated with wood fuel, 8.8% - with natural gas. Few individual houses are connected to DH networks (1.7%)
- Comparison with Western European countries
- Advantages of autonomous heat production with natural gas:
 - Not so sensitive as DH to the number of consumers and heat consumption density;
 - Provides consumers with easy means for regulation of consumption;
 - Pollutes little, is the best technology among all autonomous heat production modes.
- Disadvantages of autonomous heat production with natural gas:

- Reduces fuel diversification and possibilities to exploit price fluctuations in the fuel markets;
- To secure continuous heating, needs installation of a reserve heating mode (e.g. electrical boiler);
- Becomes doubtful in case of fast rising natural gas prices;
- Increases Lithuania's dependence on Russian gas.

Comparisons between DH and autonomous heat production modes from the consumer point of view

- Factors favouring DH:
 - No need for a consumer to take care of autonomous heat production and related problems (such as equipment installation in a building or flue gas removal);
 - Better heat price stability due to a possibility to burn several fuels;
 - Clean living environment;
 - Reasonable heat price in large and properly operated DH systems especially in those with CHP technology;
 - No heating security problems, no need to install a reserve heating source.
- Factors favouring autonomous heat production in buildings:
 - Higher heat price in smaller DH systems. This adversely affects local economies of smaller towns, which are areas of lower economic development already;
 - Often is cheaper than DH.

Autonomous heating with natural gas is a highly competitive alternative due to relatively low heating costs (12-15 ct/kWh calculated after the gas boiler) and little pollution. These advantages supplemented with high level of automation and easy regulation of heating make this heating alternative highly attractive to consumers. However, the latest developments in gas supplies from Russia, autonomous heating with natural gas boilers leaves consumers unprotected against unpredictable swings in gas prices.

Selection between district heating and the individual natural gas heating

This task has always been a complicated problem in cases a district heating network was already in place. Miscalculations or other planning mistakes may be costly due to heavy investment costs.

In making a decision, two DH related options should be analysed:

- more extensive use of biofuel and local fuels in heat production
- CHP option.

These strategically important options cannot be realised without well developed DH systems.

Anticipated changes in heat consumption must be taken into account. If at the time of planning many consumers have decided to disconnect from the DH system, this may render the DH system redundant.

General recommendations on energy planning

Planning methodology employed is a planner's tool, often of confidential character. Some essential points are not to be forgotten.

Recommendations of general character:

- Large enough number of options must be analysed to make sure that the best option has not been missed
- DH related options should include broader use of biofuels and CHP feasibility analysis
- Perspective heat demand should be given proper attention. Renovation of houses must be taken into account as well as perspective change in the number and composition of consumers
- Officially approved planning data should be used to maximum possible extent
- It must be shown that a heat plan ensures the least-cost solution for the country
- Indications on the projected heat price must be provided
- Sensitivity analysis is required to do regarding critical assumptions.

Recommendations of technical character:

- Calculations should be done for a long enough period of time, not shorter than 20 years. If the period is limited, residual value of fixed capital must not be omitted. Otherwise unacceptable mistakes may occur.
- It is useful to compare options by relative costs of production of 1 kWh heat. This indicator is recommended to calculate in addition to the widely accepted criteria of NPV and IRR. It is close to a heat price and can be easily imagined in comparison with the other options.

Identify inefficient elements in the heat supply system

Before making comparative analysis it is recommended to perform a thorough search for inefficient elements of the current system. With this purpose in mind, it is necessary to identify parts of the system where heat supply costs are high and there are reserves for their reduction.

The biggest cost element – fuel - makes up 53% in the average cost structure of heat supply throughout Lithuania¹. However, depreciation and labour are significant cost items too (12% and 11% respectively).

The best way to trace inefficient parts of the system is benchmarking. This requires data on highly efficient DH systems of similar size, which may serve as patterns for replication.

Such “system diagnosis” has not received proper attention in Lithuanian heat planning yet.

Investments must reduce heat supply costs

Heat law requires the plan to ensure minimum heat supply costs provided atmosphere pollution resulting from heat production remains within allowed limits.

Respect is to be shown to this principle when planning investments, which as a rule must reduce heat supply costs. Otherwise investments are senseless except two cases:

¹ Lithuanian heat supply companies in 2006. Survey by Lithuanian District Heating Association.

- Pollution from current heat production exceeds norms permitted and must be brought under the permitted limits;
- Equipment cannot be operated further due to poor technical condition and needs replacement despite the new equipment costs more than the old.

When heat is produced autonomously by means of the consumer equipment, 1 kWh heat production cost remains an important, however not the only one criterion of investment. For example, a new individual gas boiler may offer better opportunities to regulate consumption and thus change comfort level and quality for a consumer.

Consumer disconnections from a DH system

Consumer disconnections were given wrong interpretation in some heat plans. When explaining zoning issues a consultant treated zones as territories where change a building heating mode is forbidden to a consumer. In such cases consumers were considered forced to stay connected to a single heating mode permitted in the zone until the plan had been revised and the zone redesigned.

A zone means that the municipality must refrain from new investments in the zone because such investments are proved redundant. As to consumers, they are allowed for disconnection. Municipality only can set a certain period of negotiations (up to 2 years), after which consumer's disconnection must be allowed without further impediments provided the consumer has not changed his mind.

Municipal authority only may force to stay connected to the DH system municipal-owned or controlled buildings, organisations and institutions like schools, kindergartens, hospitals, etc., of which heating costs are financed from municipal budget. The municipal-owned sector defines a minimum long-term size of the DH system.

Perspective heat demand

Heat demand forecast depends on two factors:

- Modernisation of buildings ensuring their better energy efficiency
- Change in the composition of consumers

Considerations on the first factor include:

- Description of the current situation of renovation of multifamily buildings, which is unsatisfactory. Only 2-3% of buildings with poor thermal characteristics were reconstructed
- Summary of recent government steps to stimulate reconstruction of old houses.

Recommendations on how to forecast changes in heat consumption are made more specific.

Use of biofuels

- Mostly wood and wood waste are used as a biofuel in Lithuania
- Straw has only received a limited use. It is used as a biofuel in 3 municipalities out of 60
- Achievements and failures vary throughout the country. There is no uniform technology because various approaches are applied, in particular as regards fuel supply and equipment used.

- Biofuel supply side has received rudimentary development only. If biofuel supply were organised in a more uniform and efficient way, the amount of biofuel could be increased significantly
- Wood and wood waste used as a fuel contain much water (typically about 50%)
- No biofuel based small CHP unit has been implemented yet
- Equipment quality is different. In some cases there are complaints regarding functionality, automatisisation and such technicalities as ash removal.

II. Recommendations on energy planning methodology

1. Planning criteria

1.1. Least cost for all consumers criteria

The alternative selected in the Plan should meet heat demand of all consumers at the least cost for them compared with other possible options.

1.2. Limited negative impact on environment criteria

The alternative selected in the Plan cannot exceed the allowed negative impact on environment. Provisions of the law on Air preservation and the law on Evaluation of impact on environment of planned economic activities must be met in the part of atmosphere pollution.

1.3. Urban criteria

Unacceptably much polluting heating modes may be forbidden in urban, recreation or other territories of increased sensitivity to pollution as a necessary precondition for planning.

2. Principles of planning

2.1. Long term planning principle

Planning is carried out for a 15 year period.

2.2. Principle of periodic reconsideration and revision of the plan

Plan is to be reconsidered and if necessary revised every 5 years the longest, taking into account the renewed National Energy Strategy, changes in heat production and transferring technology, new requirements for environment pollution and other factors important for planning territories.

2.3. Cost discounting principle

When evaluating alternatives, all costs are to be calculated for one time moment by discounting them at a discount rate set. Period duration, during which costs made are evaluated in calculations, is determined by accuracy of calculations needed and the discount rate used.

2.4. Principle of accounting prices

Costs are to be evaluated in accounting prices. Accounting prices are derived from market prices by subtracting taxes and profit (adding loss).

2.5. Principle of economic evaluation of negative impact on environment

Negative impact on environment due to discharging harmful pollutants from fuel burning in the atmosphere must be evaluated by equivalent cost equal to the harm made.

3. Object of planning

3.1. Object of the Plan is the part of municipal heat economy which is going to be directly regulated by means set in the Plan.

3.2. Planning embraces the municipality controlled heat supply systems and the systems beyond the municipal control, of which consumers are households as well as consumers that have installed autonomous heating systems based on heat production in buildings or flats.

3.3. Planning embraces heat consumers, to which a municipality intends to provide earmarked subsidies or other financial support so that they could change a heating mode or reconstruct heat and hot water supply systems in their buildings.

3.4. Also planning embraces entities in the heat sector, to which a municipality intends to provide an earmarked financial support with the purpose to facilitate the heat sector related activities, like a financial subsidy or guarantee issued to a lender.

4. Plan contents

4.1. In the Plan, present situation in the heat economy must be presented, its condition evaluated and the main problems formulated. It is recommended to describe the present situation by using principle indicators of the heat economy (Table 1).

4.2. In the Plan summary, there must be presented:

4.2.1. Average costs of heat production and transmission to consumers with a well based conclusion on whether such costs are acceptable for the local community.

4.2.2. Sorts and amounts of fuel planned to use in heat production in the course of the Plan period. Inter alia, possibilities of use of local and biofuel for heat production must be considered.

4.2.3. Air pollution from heat production. Compliance of heat production equipment with the EU requirements.

4.2.4. Investment programme for implementation of the Plan, list of investment projects, which will have to be developed and project financing sources. Investment programme specified by years must present annually needed investment funds with financial sources to implement the investment programme.

4.3. It is also recommended to present in the Plan:

4.3.1. Defined heat consumer territories (zones), within which it is economically beneficial to use just one or several building heating modes including maps with delimited consumer zones.

4.3.2. Analysis of a heat sector development scenario based on co-generation.

4.3.3. Institutional-organisational means foreseen to implement in the municipal heat economy management structures.

4.3.4. Summary of the planning indicators of heat economy to be submitted to the ministries of Economy and Environment (Table 2).

5. Heat consumer territories (zones)

5.1. In the Plan, there may be defined heat consumer territories (zones), for which principal technical solutions are set to enable use of just one or several alternative kinds of energy or fuel for heating consumer buildings.

5.2. Ecological and clean heat sources such as electricity and geothermal energy are allowed to use throughout the whole territory of the municipality.

5.3. Limitation on use of certain kinds of energy and fuel is not applicable for individual living houses, except those built in the new territories.

5.4. In the zone where one or several alternative heat sources for heating consumer buildings are foreseen, it is forbidden to invest with the purpose of heating buildings in energy or fuel supply networks that were not foreseen for this zone.

5.5. Consumer connection to the energy or natural gas supply networks, of which development was not foreseen in the zone, may be done at the consumer expenses only.

5.6. Consumer disconnections from the district heating networks are regulated in a zone by articles 25, 26 ir 27 of the Heat law. The order of consumer disconnection within a zone does not differ from the order of disconnection consumers located outside the zone.

6. Planning procedures recommended

6.1. Provisions of this part are not compulsory in preparation of the Plan.

6.2. 8 percent discount rate is to be employed in calculations.

6.3. The following planning data is to be used:

Accounting prices of fuel and electricity to be used in heat production (Annex 1);

Aggregated cost norms (Annex 2);

Calorific values of various kinds of fuel (Annex 3);

Data on air pollution caused by fuel burning (Annex 4);

Equivalent costs for air pollution caused by fuel burning (Annex 5);

Conversion coefficients to convert market prices into accounting prices (Annex 6).

Economy minister may change Annexes 1-6 in January, every year with public announcement of the changes made.

6.4. Costs are to be evaluated for an unlimitedly long period according to the formulae

$$\sum_{\substack{i=0,1,2,\dots,j-1 \\ t_i \leq T_1}} (I_i + E_i + A_i) \times \frac{1}{(1+d)^{t_i - T_0}} +$$

$$+ \frac{1}{1 - (1+d)^{-(T_2 - T_1)}} \times \sum_{\substack{i=j, j+1, j+2, \dots \\ t_i \leq T_2}} (I_i + E_i + A_i) \times \frac{1}{(1+d)^{t_i - T_0}} .$$

where i stands for planning years. The series of planning years starts from the year 0 and further 1, 2, 3, etc.;

j stands for the first year of the life period of the renovated principal technological equipment. j is defined by the condition $t_j = T_1$;

t_i – time moment corresponding the end of the year i ;

d – discount rate;

T_0, T_1, T_2 – stand for moments of time indicating beginning of the planning period (T_0), full renovation of the principal technological equipment (T_1) and the end of life of the renovated principal technological equipment (T_2);

I_i, E_i, A_i – stand correspondingly for investment costs (I), operation costs (E) and environment pollution (A) in the year i of the project, evaluated in accounting prices. It is assumed that all the costs in the year i are made at the end of the year.

6.5. Costs equivalent to environment pollution (A) are evaluated for three substances released into atmosphere due to fuel burning – CO_2, SO_2 ir NO_x .

6.6. The following building heating options should be considered:

District heating;

Heat production with natural gas boilers installed in the consumer buildings or apartments;

Heat production with individual boilers fired with other fuels (except natural gas) installed in the consumer buildings or apartments;

Heating buildings with electricity;

Heating buildings with stoves and fire-places.

6.7. The following cost groups are possible in the supply buildings and flats with heat:

Investments in a district heating boiler house;

Investments in the heat transmission, natural gas or electricity supply networks;

Investments in a local boiler for heat production installed in the consumer building or in other consumer installations related to heat production ;

Investments in a heating and hot water system installed in the consumer building (except boiler house);

Cost of fuel or electricity used for heating;

Cost due to losses in the networks;

Costs related to operation of the boiler house;

Costs related to operation of the supply network;

Costs related to operation of a building heating and hot tap water system;

Costs equivalent to air pollution due to fuel burning in heat production.

6.8. Heat consumer territories (zones) are defined provided consumers are intended for using either district heating or autonomous heat production by means of natural gas boilers

installed in buildings or flats. Otherwise zones are not defined. Also zones are not defined if no priority is given to any building heating mode and heat consumers may freely choose any of the alternative heating modes.