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Considerations on the Feasibility of Local Energy Planning in Belgium

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We have appreciated the valuable comments
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Of course, only the author is responsible for
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Abstract

Local Energy Planning is in the midst of any energy policy wanting to install market equilibria at low levels of energy consumption. The success of an energy conservation policy depends on the participation of numerous local agents (consumers, energy managers, staff of energy distribution companies, ...).

Local Energy Planning requires a thorough understanding of present energy market conditions. The analysis of energy options and policy scenario's has to be carried out by a skilled staff, cooperating intensively with public authorities and private interests. A lot of attention should be devoted to the planning process itself and to the institutional environment.

In the paper the Local Energy Planning process is analysed. It is explained why this process is extremely difficult to realize in the Belgian energy markets. Some hints for a restructuration of these markets are offered. The lessons of the SESO research on Local Energy Planning are summarized at the end of the study.

CONTENT

Preface

In 1982, the Belgian Prime Minister's Science Policy Office funded a four year study at SESO about Local Energy Planning. As in other countries, the idea of integrated local planning was the natural offspring from studies about district heating development in urban areas. SESO has been involved in such studies for the cities of Ghent and Louvain in Flanders (Belgium). Two major shortcomings of its district heating studies urged SESO to broaden its scope to an integrated approach. First, in estimating demand for heating, the conservation potential was underestimated. Secondly, the competition of district heating with existing or potential supply options was modelled inaccurately.

It was, and still is, our opinion that the conservation potential (demand reduction) should be investigated in a decentralized way, especially when opportunities for influencing it are considered. Also modelling the competition between energy networks asks for a detailed and local basis. In addition, it is at the particular consumption centers (households, factories, services) that demand for and supply of energy meet. Therefore, Local Energy Planning is in the midst of any energy policy wanting to install market equilibria at low levels of energy consumption. The latter objective is set forward by most regional, national and supra-national energy authorities of the world.

In 1985, related research funds were supplied by the European Economic Community, D.G. XVII, in its programme on Regional Energy Analysis and Energy Planning. "The

focal point of this work is clearly the determination of demand (where possible in the form of useful energy) and the opportunities for influencing it (through energy conservation and restructuring) and meeting it by means of energy indigenous to the region "(von Scholz, 1986).
The EEC-task broadened the SESO-research to a regional scope because one of the main goals of the EEC was to obtain consistent energy balances for the Region of Flanders*.

SESO tried to combine both research tasks. Information on energy use for constructing the regional energy balance was collected bottom-up, registering quantity of energy used, place of use, quality of use (end-uses) and time of use when relevant.
The local energy planning methodology under development, although tested on a particular community, was directed towards more general applications, suitable to automated handling.

The ambitious working program is far from finished. In this text we report obtained results, difficulties to overcome and prospects for continuation. We try to imbed the SESO-experience in a broader approach towards the feasibility of local energy planning in Belgium.

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* Two reports on the regional energy balance are available, i.c. part I : Methodology and Balance
part II : Industrial Energy Use

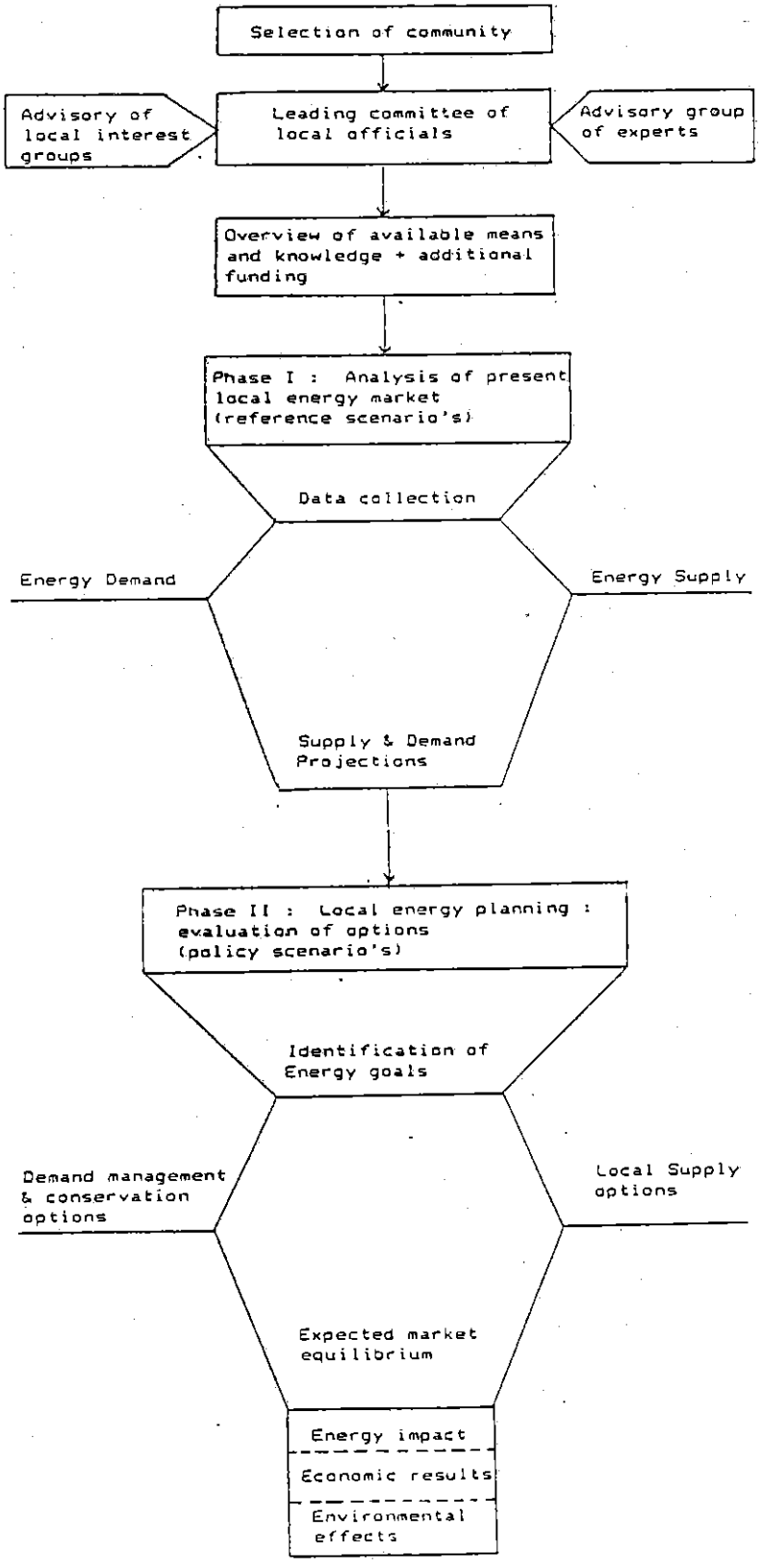
Introduction

At the outset, SESO defined the local energy planning process as an evaluation of energy policy options. For various options with respect to demand management and conservation and with respect to local supply, it is necessary to quantify energy, economic and environmental results. This working program, however, needs to be preceded by preparatory analysis and organisation. In figure 1 an overview of the essential steps of a local energy planning process is given. This overview results from our research experience at SESO and from the available literature (see bibliography). In this text we will follow the main lines of thinking imbedded in figure 1.

In chapter I the selection of a demonstration community is discussed. In chapter II, the crucial problem of organizing local energy planning is at order. Here we will extend somewhat on the Belgian energy sector structure. Means and knowledge to carry out succesful studies are considered in chapter III. In the same chapter we deal with the derivation of reference scenario's.
Policy scenario's, or the evaluation of energy options, are the real aim of planning studies. They are treated in chapter IV. Finally, in chapter V, conclusions are drawn and orientations for continuation of the research are suggested.

Along discussing the proposed steps in local energy planning, we will analyse the contributions and failures of SESO in carrying out its research. Hopefully, this will improve and fasten future efforts in the field in Belgium.

Figure 1 : Steps in Local Energy Planning



I. Selection of Community

Because there is no clear-cut, standard methodology available to carry out local energy planning studies, one generally calls on a demonstration case study to generate methods and to test their applicability.

In selecting a reference community, one has to consider the important impact of some features on the final success of the local planning study. At least the following three aspects should be taken into account :

1°) a community with some local energy experience should have priority. The existence of prior projects that can be expanded or remodelled are a guarantee of (at least some) success.

2°) public participation has to be active as a prove of an open-minded and positive attitude towards integrated planning. When the willingness to succeed is supplemented by the availability of skilled (and eventually experienced) staff at the planning departments of the local government, the necessary basis for a local energy plan is present.

3°) to take off with local energy planning in a community, the availability of funds from outside of the community plays a major role. At the local level, demands for money are too competitive to allow for planning projects with uncertain results that are difficult to quantify and to explain to the constituency. A clear national (or regional or supra-national) direction gives local governments a goal and justification for their own programs. It commits the national government to fund long-term planning, research, and implementation (Kron, et al. p.8).

Considering the above list of prerequisites, few (if any) Belgian communities offer bright opportunities as demonstration cases. One of the major lessons of our research effort points to the necessity of preparing the ground for local energy planning. Our effort should be devoted more at creating firm foundations for, and positive attitudes towards, local energy planning than at attempting full- scale planning studies. A well-organized marketing program should promote the idea of local energy planning at the national, regional and local levels*.

At the national (supra-national) level, a long-term commitment is necessary to overcome problems of initial funding and starting failures. More important than financial support is the creation of an institutional and regulatory environment allowing for the birth and growth of local energy experiments. We will show in the following chapter (II) that in this field a long way has to be gone in Belgium.
At the local level, public authorities should be convinced that local energy planning belongs to their duties when taking care of the general welfare of the population. Two marketing approaches for this idea are recommended. One is to carry out small-size, representative and highly successful demonstration

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* Returns of a local energy planning marketing campaign will not be direct and overwhelming. Since more than a decade the urgent demand for comprehensive land-use planning by scientists and citizen groups has found little response at official boards in Flanders (Belgium).

projects, and to advertise the results directly to the municipal boards. Along with this far-headed but narrow approach, a broad approach should call on each community individually. This can consist of a 'personalized' report (drafted automatically from a software and database library), describing the energy situation in the community, including some general forecasts, and foreshadowing the possible direct and indirect benefits to the local community brought forth by a successful local energy plan.
This type of report is not sufficient to base local energy planning upon but should open the minds of local authorities for local energy planning.

In the first phase of the research on local and regional energy planning, SESO had not the means, nor the insights, to organize and carry out the above working program. There was some awareness that demonstration case studies were necessary, but this was more approached as the anvil for forging and calibrating a general methodology of overall use (it was found that this goal was ambitious and out of reach).

As demonstration community, Hoboken was selected. The origin of this choice lies in the contacts established with the main industry in the community, i.e. Métallurgie Hoboken-Overpelt, a non-ferrous metalurgical company. Representatives of this plant had called on SESO to consider the possibility of waste-heat distribution in the community. This demand was based on the experience SESO had accumulated in cogeneration and district heating feasibility studies. On this issue, several performing computer programs were developed. Later on, the interest by the factory decreased significantly mainly because most waste heat was recovered internally and because understanding between

industry and neighbourhood was harmed by environmental problems caused by the plant (heavy metal emissions).

However, SESO sticked to Hoboken as the demonstration case community. The advantages of the choice were the short distance between the community and our offices, and the open-minded collaboration of the publicly owned utility for gas and electricity distribution. The main drawback was the lack of cooperation with, and initiative from, the local government. Since 1976, Hoboken had lost its statute as an independent community and was integrated in the Antwerp metropolitan area. As we will discuss in the next section, public leadership is of focal importance for successful local energy planning.

II. Organisation of the Local Energy Planning Study

We first show the broad lines of steering a local energy planning process. Next we outline the allocation of energy-related powers and activities to public authorities in Belgium. In a third point, we extend on the particularities of energy distribution organisations because of their dominant role in local energy planning.

II.1. Steering the local energy planning process

As shown in figure 1 there is set aside a leading function for a committee of local officials. By preference, the highest public authority in the local community (the Mayor) should preside the committee and be assisted by the necessary staff members from the various departments (housing, public works, local transportation, energy distribution, municipal buildings, ...). Leadership should come from this committee.

Two advisory groups are provided. One is composed by delegates of the local interest groups, e.g. electric and natural gas utility companies, fuel (oil, coal) distributors, citizen interest groups, real estate and housing firms, companies supplying consultancy services and equipment when projects are to be realized, ... This group works on a voluntary basis. A second advisory group consists of independent experts helping the leading committee in carrying out studies and in providing organisatory support. Sufficient means should be available for buying high-quality management services.

Along the main lines of a central leading committee with two advisory groups, a variety of practical implementations can be thought of, depending on local means and preferences. A detailed outline of procedures, rules, organisatory processes and feedbacks is given in studies carried out on behalf of the "Bundesministerium für Forschung und Technologie" (Germany) and referenced in the bibliography. When read as an interesting source of inspiration for organisation modelling, these studies are valuable. It is obvious, however, no generic recipes will prove usefull in this matter. A concise list of general tasks that must be completed to produce a successful energy plan is given by Kron, et al. :

1°. Organization : Bringing together people, agencies, and firms in an integrated and efficient structure that facilitates decision making, political support, and accomplishment of work.

2° Management : Deciding what needs to be done, securing funding, and scheduling and completing the work in a timely way and logical sequence.

3° Work : Obtaining the information needed to make decisions, using appropriate analytical tools to determine what the information means, and communicating results to persons outside the energy project structure.

4° Implementation : Seeing that decisions are carried out by appropriate parties.

5° Monitoring and Evaluating : Evaluating programs to see that they are accomplishing their goals, and keeping informed about new problems and opportunities.

At SESO, we learned but late about the central position of organisation and management for carrying out succesful local energy planning studies. SESO operated as a study group, building up expertise for advisory help to a steering committee. The main problem was that there was no steering committee at hand. It was not created spontaneously because the idea of local energy planning is not spread in the communities in Flanders. It was not tried to create one by SESO, because SESO did not see the steering committee's central function in the first half of the study and, in the second half, SESO had not the right contacts nor the assets to push forward the necessary organisational structure. One of the obstacles to the creation of a steering committee of local officials was the distance between the Antwerp city's board of supervisors and the Hoboken local community selected as demonstration field.

Along with most other scholars on local energy planning, we emphasize the central importance of local commitment and organisation in succesful experiments.

II.2. Outline of the Belgian institutional framework for energy-related activities

Because of the central importance of organisation and management for a successful local energy plan, it is necessary to understand the position of local energy policy within its broader context of regional and national policies. In figure 2, the main energy related powers and activities of three governmental levels in Belgium are shown. From this overview, one learns that the centers of decision-making are at the national and at the local level. With the law of August 8, 1980, some powers were assigned to the regional governments but this was done meanly and inconsistently. Within the resulting zone of twilight, the regional government can decide in favour of a dynamic policy as persecuted by Wallonia (presumably infringing the national rights) or in favour of a policy of abstinence leaving the ground to other forces (as is the case in Flanders).

The distribution of responsibilities over the three levels of government is such that an effective and efficient energy policy requires a perfect coordination and cooperation among the levels involved. When e.g. gas and power distribution is under control of local authority, district heating is the realm of regional authority, and power generation and pricing is a national task, it is obvious that consistency in policy among the three decisions levels is necessary to guarantee optimality. A problem arises when consistency and coordination become so costly in time and resources, that they break down, leaving the policy field to better organized interest groups such as energy companies.

Figure 2 : Energy-related powers and activities of government levels in Belgium

National government

1. Sets national energy policy

2. Research and Development
   National R&D Program on Energy (1975-1986)
   International programs and institutionalized activities

3. Supervision on regulation
   electricity generation, transmission and distribution
   gas imports, transmission and distribution
   electricity and gas pricing
   power plant siting

4. Taxing fuels on the basis of national objectives (not just energy-related)

5. Responsible for policies on energy efficiency
   regulations
   subsidies and fiscal incentives
   information & promotion activities

6. Controls indigenous coal mining

Regional government (Flanders)

1. District heating
   planning, investment, promotion

2. Responsibility in subsidizing deficitary coal mining (since 1986)

3. Supervision of formerly national (nuclear) research laboratories and programs (since 1987)

4. Limited supervision on local government's use of municipal monopoly rights on energy distribution

5. Land-use and building codes

Local government

1. May play an active role in energy policy,
   e.g. exemplary energy performance by municipal facilities,
   offering energy audits and advisory services to residents, etc...

2. Monopoly authority on energy supplies (gas and electricity) through pipe lines within the community boundaries

3. Responsible for waste collection and processing
   (tipping, incineration,...)

4. Implementation of land-use policies, with some degrees of freedom for own preferences

In figure 2, one observes the important powers of national government. As in the other nations, it has to define the national energy policy. In Belgium, it took from 1973 to 1982 to formulate the focal issues of energy policy (Billiet, 1986). There is little doubt that the textes came too late, and are too ambigous and too general, to function as guidance for practical decision-making. We have argued elsewhere (Verbruggen, 1986) that, in spite of the significant power and money flows related to energy in the public area, Belgian energy policy is determined predominantly by private interests. This improves the working and performance of some parts of the energy business, but ends into an overall picture of disequilibria and biases (overcapacities in supply infrastructure). The lack of a global public policy makes that one cannot exploit synergies (e.g. cogeneration) and that public goals are more difficult to attain (e.g. environmental quality).

Research and Development has had its ups and downs. Policy related research and research on energy conservation and alternative sources, was carried out during three succesive phases of the National R&D Programme of the Prime Minister's Science Policy Office. At present these activities are no longer funded and R&D is limited to international participations and long-established institutions (e.g. the nuclear research facility at Mol).

The direct regulatory powers of the national government are limited to the approval of the siting of large-scale energy facilities (LNG-terminal in Zeebrugge ; power plants ; high-voltage power transmission lines ; etc. ...). Gas and electricity price regulation takes place within a non-official committee composed of the major interest groups of Belgium (energy companies ;

employer's federations ; trade unions). This self regulatory activity is looked upon by the national government.

Taxing and subsidizing of energy is based on national objectives, e.g. the protection of indigenous coalmining or the need for taxmoney income, etc. ...

With the Law of August 8, 1980, the national government stipulated that energy conservation policies (denominated "rational energy use" policies) would obey central authority. Regulation, subsidies and fiscal incentives, information and promotion activities are controled by the national administration. Decentralization of policy-making in this field in Belgium is very limited. This is at variance with the decentralized nature of decision-making on energy use and energy conservation. The national policy objectives regarding energy conservation were completed by a modest implementation effort at the national level (Allé, 1984). The crucial organisational steps to promote and to realize energy conservation policies at the local level, where demand for energy is met directly, were not taken in Belgium. Only nations with some organized effort in heat planning (e.g. Denmark, Sweden, Federal Republic of Germany) have invested in the foundations of local energy planning.

The national government in Belgium is still responsible for the coal mining activities in Flanders, although financing the losses will be regionalized.

The twilight of the regional powers on energy is mentioned above. The Flemish regional government does not aim at an active role and leaves policy making to national government and to private interest groups. Its power in district heating is little effective when

decoupled from all influence in the gas and electricity markets, and in the energy end-use markets (energy conservation). Lately, the regional government herited some energy assets (problems) from its national colleague. We doubt that loss-making coal mines and over-staffed nuclear research facilities can function as levers for future policy.
Land-use planning and building codes are primarily decided at the regional level. Maybe the lacking of energy standards for buildings (anno 1987) in Flanders, illustrates best the low profile taken by the regional government regarding energy policy.

Local governments can play an active role in energy policy. The key of their power is the monopoly rights they own with respect to gas and electricity distribution in their constituency. When this power is added to their other tasks (domestic refuse handling, street maintenance, public lighting, etc. ...) a basis of activity is present for policy definition and implementation (see 'Stadtwerke' in the Federal Republic of Germany). After the second world war the multi-scope, publicly owned local utilities were developing in some municipalities in Belgium. Since then, most of these were dissolved (the last major one in the City of Ghent in 1984). The various tasks of the communities are assigned to specialized organizations, breaking up the multi-scope view of an integrated policy and loosing the opportunities for synergies. Gas and electricity distribution are incorporated mostly in a special type of structure, directed in practice by the private energy companies. Learning about this type of organization is crucial in understanding the landscape in which local energy planning has to realize its objectives.

II.3. Structure of the energy distribution sector

The monopoly rights on electricity distribution (later extended to other pipe or wire bounded distributions) were assigned to the communities by law in 1925. Economies of scale in density are the origin of natural monopolies within a given area. Economies of scale in extending the covered area are limited, or non-existent. Because of these cost characteristics, and in order to monitor the monopolist's behaviour from nearby, the communities should control gas and electricity distribution.

The communities were free in selecting the optimum organisation to accomplish their tasks, giving birth to four main types :
1°) franchising the monopoly right to a private company (consessions) ; 2°) creating a company owned and directed by the municipality (regie) ; 3°) a coordination of various communities without (or 4°) with), private companies as a partner. Both latter types of organisation (institutionalized by law in 1922) are denominated "intercommunale" (abbreviated as IC). They became very popular in the post-war period as may be seen from table 1.

In an IC, at least two communities have to cooperate for a given task. More communities may join, as may one (or more) private company. The IC keeps its prerogatives of public institute (especially important with respect to tax legislation), whether or not private partners are sharing.
When no private companies are involved, the fully public organisation has to manage all distribution tasks (planning, financing, organizing, monitoring, controlling). When a private company is involved, it

Table 1 : Shares of power distribution organisational forms in Belgium (based on population served)

Year	1949		1976		1986	
Type of organazition	Number (1000)	%	Number (1000)	%	Number (1000)	%
Concession	5 302	61,6	8	0,1	6	0,1
Regie	1 457	16,9	332	3,4	191	1,9
IC without private cy	899	10,5	1 817	18,5	1 795	18,2
IC with private cy	944	11,0	7 657	78,0	7 867	79,8
TOTAL	8 602	100,0	9 814	100,0	9 859	100,0

Source : Bedrijfsfederatie der Voortbrengers en Verdelers van Elektriciteit in België "De distributie van de elektrische energie".

takes over the major management tasks and the local officials at best stipulate general guidelines and aim at ex-post control. Because public participation is vital to the prerogatives of the IC as a public institute, there is a regular effort to increase this participation. Given the regularity of repeated efforts on this point, the problem seems to stay unsolved (Billiet, 1986, p. 132). Practically in all communities where gas and power are distributed by IC's with involvement of private partners, it are the (national) energy companies that make up energy policy. In this way these companies integrate generation, transmission and distribution. Their control spans the market from supply till demand, because with the distribution link one reaches the consumption or demand sources.

The evolution in the organisational forms of electricity distribution (table 1) is due to several factors. The restructuration and rationalization of power generation in the post-war period has reduced the number of private producing utilities from 39 in 1955 to 3 presently. The increase in economies of scale and of efficiency in power generation has been reflected in distribution activities. There has taken place a quasi total conversion from 'concessions' to 'IC with private cy. involvement' (table 1). In addition, small-scale, local and, in many cases, badly managed 'regies' were substituted for IC's. During these transitions the share of the publicly governed organisations (regies plus IC's without private cy) has decreased. In the struggle for power distribution, large-scale, well-organized and influential private power companies seem more powerful than the public interests. SESO has carried out several studies in this area, and has participated as advisory expert group in crucial debates (see bibliography : Verbruggen & Buyse 1985,

Verbruggen, Buyse & Nelen, 1985 and 1986 ; Buyse & Verbruggen 1986). Some major lessons we retained from this work are repeated here without proof (see the studies mentioned).

In the debates about the selected organisational form of energy distribution in a community, no attention is devoted to energy policy issues. The idea of local energy planning is totally absent.

Safeguarding the interests of the population (energy consumers) against monopoly power was the basis for assigning the monopoly right to public representatives (the community boards). The communities do exercise their power very indirectly by the selection of a particular organisational form for the next 20 to 30 years. The predominant criterium for the selection is the amount of profits extracted from the distribution activities that flow towards the municipal board. These profits may be considered as energy excise tax income, avoiding the imposition of other community taxes*.

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* The private gas & power companies involved in IC's point out these profit transfers are their tax payments on realized company profits. Because of their involvment in IC's (public, tax-exempted institutions) the utilities do pay but little direct taxes on their noticeable profits.

When the primary goal is profit maximization, one is a long way from welfare maximization, and from energy conservation options, possibly lowering the earnings.

Excesses in monopoly power abuses by IC's are restrained by a system of national uniform tariffs (since 1975). Profit maximization therefore results from sales maximization on the one hand, and from cost minimization on the other hand. While the latter goal is beneficial to the community, the former is opposing the idea of local energy planning (with energy conservation and optimum market sharing between supply modes, as its main instruments).

There is a tendency to organize larger IC's with tens of communities as members linked to one of the private companies. An important incentive for this concentration is the tariff structure for power purchased at the transmission network by the distribution utilities. The enlargement of the IC's offers but little economies of scale and obstructs all freedom of action or influence by individual communities. Community-based local energy planning becomes fiction*.

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* Them impact of the institutional structure on the expansion of heat distribution was investigated by SESO (Verbruggen & Marcelis, 1986)

Local energy policy is modeled and managed by the large-scale energy production/transmission companies aiming at sales maximisation. Utility-sponsored energy conservation programmes are motivated by the desire for increased consumer satisfaction and by opportunities to prevent loss of attractive customers. This has to do with long-term versus short-term sales and profit maximisation.

Concluding, the basis for local energy planning in the communities in Belgium has eroded significantly. In most communities there is no staff and no expertise available in energy matters. Thinking, planning, financing, managing energy has been left over to well-organized and influential private energy companies. The objectives of these companies are not coinciding with (mostly hostile to) the goals of local energy planning (least-cost long-term energy provision by demand reduction and by equilibrated energy supplies, making maximum use of local resources). Given the institutional structure of wide-spread and long-lasting IC-organisations, there is little hope for a fast change of this situation in the nearby future. Before local energy plans can be seeded and will flourish one has to break the ground, by creating community-based centers of expertise and of assets. Built-in incentives towards more energy sales (increasing the cash flow for communities and community boards) have to be bended towards more energy conservation.

III. Analysis of present local energy markets : reference scenario's

The crucial role of community leadership, broadly acknowledged (Kron, et al, 1985 ; BMFT, 1984), has been discussed in the previous chapters. When the organisational difficulties are mastered, one has to plan and start work. Before embarking on major working programs, an overview of available means and knowledge and of available budgets should be drawn up explicitly. From this overview the requirement for additional data collection can be assessed more accurately (see III.1). Reference scenario's have to be built in a consistent way, suggesting partial market equilibrium models as logical framework for modeling facts and ideas (see III.2).

III.1. Getting started : resources and work planning

By necessity, local energy planning is broad of scope. The interrelationships of energy planning with land-use, housing, urban development, local transportation, environmental policy (e.g. domestic refuse handling ; zoning policies, etc ...), industrial policy, etc ... cannot be overlooked. Trading-off interests of these various aspects is a delicate balancing exercise charged on the leading committee. Succesful performance requires the committee to be risen above particular interests and to have authority when imposing solutions. The practical way to success will consist of numerous meetings, bargainings, readjustments, etc ...

When the contours of the local energy planning process are elucidated, one will look in vain for a ready available methodology pertinent to the case under study. We have observed that the ambitions to develop general local energy planning methodologies were inversely related to the experience of the developpers in local energy analysis. There is also little help in the simple transposition of foreign experiences and results on the own community. Actually, one needs access to the whole spectrum of energy analysis and planning methods and to extensive datafiles. When narrowing the view from a national to a local scope, the requirement in knowledge and data is not reduced, but enhanced. On the one hand, insight in national energy situations and policies is necessary for modeling the links between the local island and its surroundings quite accurately. On the other hand, a local community is a miniature reflection of the national community with residential, commercial, industrial, service activities, with a sample of most existing energy technologies, with opportunities for applying most new technologies, with consumer behaviour and producer attitudes, etc ... The advisory expert group (see figure 1) has to encompass versatile know-how of skilled and experienced people with access to specialist advice when needed.

Carrying out local energy planning asks for detailed data about the community (population, housing stock, energy flows, industrial activities, ...) The amount of data necessitates automated processing and direct access to available data files (e.g. collected and stored by the energy companies). In most communities there is a lack of reliable information about energy use and

energy-related variables. When extensive data collection is set up, this activity consumes a lot of staff time and of available funds. When no good solution is found for this problem, a local energy planning study is drowned in data gathering and data handling.

On the three mentioned issues (overlooking leading committee ; versatile know-how ; mastering data flows), the SESO work in local energy planning undoubtly failed. The first failure was explained in the previous chapters, and surmounts the SESO-responsability. On the second point, our energy team was not sufficiently large, experienced and multi-disciplinary to carry all the burden of a full-sized local energy planning programme.

Good results were obtained in forecasting residential energy use, and in modeling optimal decision-making on energy distribution network expansion (e.g. Hermans, 1985). However, too many aspects of the problem were uncovered for the creation of a consistent and comprehensive methological framework. It is doubtful whether the present conditions for organizing research in economics at universities in Belgium, leave sufficient ground for building up high-quality teams that can afford the tasks of a local energy planning advisory group. The SESO-work mostly was drowned in data problems. Unexperienced researchers and lacking up-to-date electronic data processing equipment resulted in incomplete and slowly available datafiles.

Solutions to the last problem can be thought of in two ways. Either one can start with clearly defining the options to be analyzed and collect fewer data, focussing on the data truly needed in the analysis. Or, one can use predominantly existing data files with the help of

advanced techniques. Therefore, national data collection should be structured in a way to be useful to local energy planners. Care must be taken to ensure that the data are available in a timely manner (consider, for example, the value of 1981 census data in 1986 available). Energy sales records from the energy companies should be made accessible directly to public authorities.

III.2. Analysis of local energy markets

Economic objectives and principles take a central position in local energy planning, given its goal is the least-cost, long-term energy provision by reducing demand and by equilibrating energy supplies, making maximum use of local resources (see also : von Scholz, 1986, p. 5).

A practical definition of rational use of energy is built upon the rational use of energy money and not of physical energy. It is a way of use, minimizing the discounted overall (included social) costs over an infinite horizon. Because it is unpractical to quantify all outcomes of a project in monetary flows, qualitative trade-offs and choices have to be made, pointing to multi-criteria analysis. Anyhow, the core of a project appraisal will consist of a reliable cash flow analysis.

As an economic criterium for comparing the costs of competing solutions, the nett present value of project proposals is to be assessed. This asks for a consensus about time horizon, time preference (discount rate), and scope of the analysis. The practical implementation of these variables is not always obvious, and may be rather different for one promoting energy conservation policies and for another promoting energy supply additions.

There are many advantages in formulating local energy planning as a partial equilibrium market model, functioning within the constraints and the conditions of the national energy market. Estimating demand and supply functions for local markets should profit from the resemblance to and links with national markets.

When flexible and detailed national demand models are available, it should be but a data problem to assess total demand in a community. Mostly, those versatile demand models are lacking. In addition, local planning requires very precise localisation of the demand sources on the city plan (e.g. to project energy distribution networks). Both factors urge most local energy planners to gather specific and detailed data and to try to develop own techniques for assessing and forecasting demand. In most local energy planning studies in Germany, inventory of demand in buildings took up a major share of study time and funds (Dütz et al., 1984).

The lack of suitable demand models in Belgium that were accessible for use in local energy planning, urged SESO to develop own techniques. In cooperation with the staff of the National R&D Energy Programme management a simulation model for the residential sector was developed (BRUSH = Belgian Residential Energy Use for Space Heating).

In the demonstration case study of Hoboken a technique was developed for assessing heat demand by unifamily houses in a fast way (Coene, 1984). In the balance between handsome modeling and accurate results SESO did not succeed sufficiently in creating a transferable methodology, in spite of the many resources going to this aspect of the study. A time- and funds consuming effort was spend on data gathering resulting in no more

than an outdated description of the demand situation in the demonstration community (Coene, Jennes, 1986). Major efforts of data collection by questionnaries did not lead to transferable results.

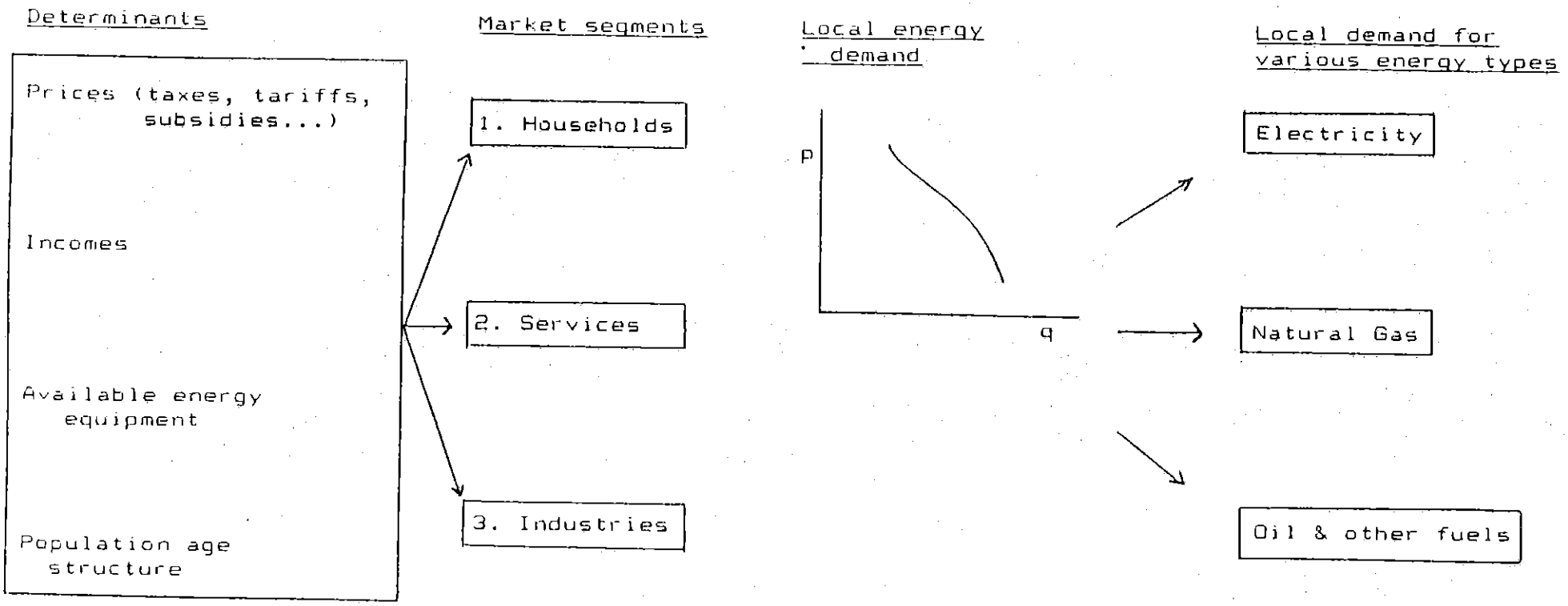
In analysing energy demand in a community (e.g. Hoboken), SESO tried to process the data along the model shown in figure 3. This structure was implemented rather succesfully for the energy demand by households. For the other market segments, the methodology and knowledge were not available.

In the reference scenario's no special supply options are considered. It is assumed that present practice goes on without discontinuities. Local supply therefore is mainly seen as a minor part of national supply. Supply functions in a community do not slope upward, because at given prices (nationally determined) the consumers in the community can buy all the energy they want.

Equilibria in local markets settle where demand and supply meet. Mostly, it will prove necessary to split the local energy market in its various submarkets (at least electricity, natural gas and storable fuels should be distinguished.

Two main difficulties arise here. First, the splitting of the global energy market in its constituent parts involves problems of captive demand, consumer attitudes and expectations, real and perceived cost-price differences, cross-price elasticities, etc... Research carried out in this area from a macroscopic view has not been transposed to local markets. Secondly, the interpretation of the equilibrium on a segmented local market is not straightforward. The concept of

Figure 3 : Demand submodel



consumer's surplus applied on a intermediate commodity such as energy is not always obvious. E.g. new lighting equipment carries a lower price tag and consumes less electricity than the current one. The new technology reduces demand for power and increases utility to the consumer. Therefore, one will use rather consumer's expenditures than consumer's surplus in comparing various solutions.

IV. Analysis of future local energy markets : energy options and policy scenario's

When getting acquainted with the local energy market conditions, one can start the policy process of setting energy goals, budgetting means for realisation, and assessing direct and indirect effects of the proposed policies. Complexity of the problem points to comparing the various policy scenario's with a reference scenario (see chapter III), by focusing attention on the principal differences between the scenario's and their results.

IV.1. Identification of energy goals

In nations with accumulated experience in local energy planning, there is a clear commitment to energy conservation and to the maximum use of renewable resources. In order to be succesful, a conservation policy has to be implemented at the particular sources of energy demand. Calling on renewables is in most applications very site specific. When conservation and renewables rank high in the energy priorities list, local energy planning is no longer a choice but a necessary interface between policy making and policy realisation.

It will prove practical to specify the energy options as easy to understand objectives, e.g. reduction of heating energy use in buildings by x %, limiting the share of particular energy types (mostly oil) to y %, augmenting locally (co)generated power above z % of total electricity use, etc... Specific targets are easy for communication and control, and it is generally more obvious whether conflicts and incompatibilities can

arise than with broadly defined options.

In the parliamentary debate in Belgium (June 1982, February 1983) emphasis was put on the necessity of energy conservation and on the use of local resources (e.g. cogenerated power). Little progres has been made since then to refine the general intentions to specific, let alone quantitative, energy options. In particular, the administrative, organisational and financial resources, necessary for realisation of the policy aims, were not decided (Allé, 1984).

Significant effort towards energy conservation and regional energy policy has been undertaken by the regional government of Wallonia. The Flanders' regional government did but spend little attention to energy problems. At the national level the Prime Minister's Science Policy Office (National R&D Energy) stimulated research and demonstration projects. Educational programs for energy managers were organized along branch specific problems (schools ; hospitals ; ...). In most major Belgian cities (e.g. Bruges, Antwerp, Liège ...), offices for free advice on energy use in buildings were opened. This idea is prolonged by the Ministerial Department on Energy by opening offices in smaller provincial towns (e.g. Hasselt), with plans to open an office in other cities as well. National services were created (e.g. Dienst voor Energiebehoud) to inform energy consumers about conservation measures (e.g. an energy bus has been visiting industrial and commercial installations provinding free audits of limited depth).

In spite of the measures taken, efforts and realisations are too limited and too despersed to be ranked as consistent energy policy.

The idea of local energy planning was mostly imported from abroad (e.g. through international cooperation programs of the European Economic Community D.G. XVII and of the International Energy Agency). Because of the lack of clear national, regional, and local energy policy options in Belgium, the necessity to engage in local energy planning was not felt.

IV.2. Integrated programs

A full size local energy plan (in Germany one generally uses the term "Versorgungskonzepte") is an integrated program dealing with energy demand measures, local supply opportunities, and the equilibrium between demand and supply. The framework of analysis will be again the partial market equilibrium model as in the reference scenario analysis.

a. Demand policy

The sources of energy demand are extremely diverse and dispersed. Various ends intended to by various actors at different times and places, require specific quantities and qualities of energy. No demand policy can be succesful if not supported and carried out by the millions of consumers. Therefore the best demand policy is the one that gives sufficient incentives to the consumers to move in the direction of the stated demand management and conservation options. Incentives can be classified in three groups along their impact on the freedom of the consumer. First, consumers should be provided with information. General information (e.g. on the evolution of energy technologies) should be complemented with specific information (what can one do in his specific situation). This type of interventions do not affect the rules of the market. A second group

of incentives is more influencial and consists of financial measures (e.g. pricing of energy or energy related goods ; subsidies and taxes). The consumer cannot avoid the impact of the measures but can call on a wide range of options to accomodate to the new market conditions. The availability of up-to-date and reliable information sources is crucial for smoothening the adaptation processes. In a third step, mandatory measures can be put upon consumers. This makes only sense when there is an obvious malfunction of the market (e.g. myopia ; persistent monopoly power ; imperfect information, ...) and when public policy is more suitable to remedy this than leaving the market to itself. Again, third degree incentives about a particular issue have to be built upon fully developed first and second degree incentives. If so, most third degree measures considered will prove redundant or will not be felt as mandatory by the majority of the customers. Building codes and the obligation for each building to register energy characteristics officially (as in Denmark), are third degree energy measures.

For the realisation of this three-leveled energy demand policy a suitable organisational structure has to be operational. This structure consists of two main parts : a central headquarter and a multitude of local offices (in principal each community should have one). The central office should reside under the highest energy authority in the nation or the region. In Belgium, the creation of the "National Committee on Energy" in 1975 was a step in this direction. After its creation it was never given the necessary means to

meet its difficult tasks*. Policy analysis and definition are the main tasks of the central authority. In addition R&D will be stimulated in the areas and in the direction of supporting the policy and policy implementation process (e.g. technology assessment of particular new energy conservation technologies).

However ideal and perfect the plans of a central authority may be, no results will be marked when plans are not implemented in the right way. No right implementation is feasible when the necessary organisational and financial means are not available. To realize an energy demand policy, a vast network of decentralized branches and offices should stay in direct contact with the numerous energy consumers. In Belgium, there is no network available for a consistent and long-term transmission of national (central) energy policy towards the consumers. The decentralized, energy-specific networks (e.g. electricity and natural gas distribution) are under control of branch-oriented, large-scale private energy companies. The demand policy carried out through these networks is the one aimed at by the companies. Long-run profit maximisation overrides energy conservation and other public policy objectives. In section II.3 we discussed the organisation of the energy distribution sector in Belgium more in detail.

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* Compare this e.g. with the Netherlands' NEOM (Nederlandse Energy Ontwikkelings Maatschappij) and the Danish Ministry of Energy, created around the same time and grown out to sophisticated energy authorities.

Public energy authorities in Belgium can proceed in two ways. On the one hand, one can make more fully use of the regulatory powers officially disposable, to get public policy through in the private energy businesses. There is room for this type of policy extension because energy utilities are aware of their statute of utilities providers. On the other hand, community-based energy expertise can be restored by relocating energy distribution in the hands of communal firms. These firms should be managed as private companies but owned and supervised by public interests. When operated efficiently these firms will be sources of technical assistance and financial funds in support of the community policy.

In practice, Belgian policy should follow both channels of policy improvement, with emphasis on the former. Remodeling the energy sector in Belgium, as suggested by the latter way, will be very requiring.

b. Supply policy

As may be obvious from the previous pages, energy supply is not forged on the needs of local communities. Because of economics of scale in the provision of the classical energies (oil, gas, electricity, ...), large-scale centralized companies have been growing. Therefore, present energy supply in a community is a small part of a vast energy system. From a marginalist point of view the cost of supplying any particular community is no more than the marginal cost of the system, being generally low and sometimes decreasing.

At the supply side, local energy planning consists of a comparison between the branches of the central supply

system in the community and the development of local resources. By definition, local resources are site specific. Renewables (wind, solar, biomass, micro-hydro) depend on climate and on siting possibilities. Constant availability and cost-effectiveness are major problems for their development. A more promising part of local resources consists of the recuperation of energy*. Recuperated energy may take many forms, e;g. methane from sewage plants' refuse. Low-temperature heat is, however, the predominant type (industrial waste heat ; condensing heat ; refuse incineration ; geothermal sources ; ...).
To get use of low-temperature waste heat, it has to be supplied at the right places. This requires a heat distribution network, being capital-intensive. The provision or the extension of heat distribution networks is in the midst of local energy planning in urban areas.

In Belgium, the supply of low-temperature heat has been studied as large-scale district heating schemes in the major cities. The obvious shortcomings of these studies were improper trade-offs between heat distribution and existing distributed energies and between heat conservation and heat supply. Competition from existing energies has been sharpening since the beginning of the eighties, mainly because of overcapacities, due to unforeseen demand reductions. Although low-temperature heat is suitable to be conserved a lot, its market has been the outlet of most overexpanded sypply systems

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* The distinction between supply of recuperated energy and demand reduction by energy conservation is that the former involves a market transaction and the latter does not.

(natural gas ; electricity). Arguments to bring in this market a new, capital-intensive supply system are eroded by reduced demand and by (temporary ?) excess capacities of other supply options.

The development of local resources and waste heat supply systems requires a thorough rethinking of energy supply policy in Belgium. Large-scale, branch-specific expansion plans have to be replaced by overall energy concepts. In these concepts, opportunities of combined heat and power generation, of energy conservation, of renewable energy applications, ... have to be considered from a common point of view. Investment and pricing should be used as the main instruments in realizing common policy goals. A modest development of heat distribution networks will be part of these common supply concepts.

c. Market equilibria

Depending on the time perspective, local energy plans may consist of long-term strategic, or medium- and short-range concepts or implementations plans. An optimal plan will contain all three levels.

Local energy plans are evaluated along three aspects : energy, economics and environment. In order to checking whether the energy goals set forward are met by the plan, one shall identify the plan's results as far as possible.

The energy aspects of the plan are evaluated primarily on the basis of the forecasted flows of energy use. Quantitative figures should be completed by consideration of supply reliability, diversification, flexibility, of demand reduction, of oil substitution,

etc...

Economics should be considered from a dual perspective. First, the money balances of the plan need detailed attention. Financial profitability criteria should be common for all solutions, although these criteria are not absolutely neutral. Net present values of projects depend on the selected time perspective (discount rate ; time horizon of plan) and on the scope of analysis. Secondly, the social compatibility of the plans should be investigated. One should e.g. pay attention to the housing cost relative to income, to the consumer's freedom of choice, to housing quality, to urban and regional economic development, etc...

Last but not least, environmental impact of the various energy plans should be considered. From a practical point of view, comparisons should be made on the basis of emissions of noxious externalities. The link between emissions and actual damage is still difficult to evaluate as it is to compare various externalities among one another. Qualitative judgment will be necessary.

V. Conclusions

Some major findings are recapitulated briefly :

1 Local energy planning is crucial, maybe necessary, for the realisation of energy conservation policies. Demand should be addressed directly on site, in its specific occurrences.

2 Local energy planning is a very complex process, involving many interests. Difficult trade-offs have to be made. Local leadership is essential for successful planning and implementation.

3 As yet, there is no firm ground in Belgium to built local energy planning upon, because :
   (i) there is no clear national direction towards local planning.
   (ii) the local energy provision structures are grown wrong in branch-specific and sales-maximizing organisations.
   (iii) in most communities, the commitment to the idea of local energy responsibility is too weak to give birth to strong local leadership in the field.
   (iv) fully experienced and versatile study groups for providing high-quality advice on the subject are sparsely at hand.

4 Considering how progress can be made, one should spend most effort at creating firm foundations for, and positive attitudes towards, local energy planning. This may involve :

(i) no full-scale planning studies in particular communities should be addressed.

(ii) small-size, representative and highly-successful demonstration projects are to be searched. Their results should be promoted widely.

(iii) for each community seperately an individual energy report can be drawn. This general report, making use of easily available data and knowledge can awake the interest for the communities' energy problems.

(iv) know-how centers on local energy planning should be cultivated.

5 Local energy planning will stay very difficult in Belgium when no rethinking of the energy situation and policy has taken place. Two major shifts are necessary :

(i) a refocusing of the national energy policy on energy conservation and indigenous energy supplies (renewables, recoveries, refuse). Refocusing means the redirection of important management and financial resources.

(ii) a far-reaching restructuring of local energy supply from branch-specific, sales-maximizing organisations towards multi-scope, energy servicing utilities.

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