EUROPEAN COMMISSION

TASK FORCE

THE FUTURE OF ENERGY STATISTICS

EUROSTAT UNIT F4
June 2000

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ABBREVIATIONS

kWh: kilowatthour

kW: kilowatt

MW: megawatt (10^3 kW)

toe: tonne of oil equivalent

kgoe: kilogramme of oil equivalent

MS: Member State

IEA: International Energy Agency

EEA: European Environmental Agency

ECE: Economic Commission for Europe (United Nations)

NGO: Non-Governemental Organisation

GTCC: gas turbine combined cycle

TSO: transmission system operator

CHP: combined heat and power

GHG: greenhouse gases

GDP: gross domestic product

NACE: nomenclature of economic activities

PRODCOM: nomenclature of community production statistics

CONTENTS

NOTE: All documents have been prepared by Eurostat incorporating the discussions of the
        Task Force except of the ones where an author is indicated.

SUMMARY / CONCLUSIONS

1. The present system of energy statistics has been shaped essentially by policies on security of supplies, fuel diversification, etc. due to the past oil crisis. At international level, the system is represented by the five joint Eurostat/IEA/ECE annual questionnaires, as well as by four short (limited mainly to the supply side) monthly questionnaires. In addition, prices of a number of energy commodities for various users are collected. At national level, statistics are collected essentially from the supply side. This information is occasionally complemented by direct surveys of the consumers. The national statistical systems took advantage of the existence of large, vertically integrated, nationalised energy industries with comprehensive information systems collecting necessary statistics directly from them in a cost-effective way.

2. Over the past few years, the Commission of the EU and the Member States have adopted new policies and measures, namely sustainable development and the liberalisation of energy markets, which affect energy statistics systems both at national and international level.

    These new policies place higher demands on both the quality and coverage of the energy information system. At the same time, national statistical systems are losing their traditional cost-effective sources of information during a period of shrinking public expenditure. These issues are analysed in detail in the annex "Future of energy statistics" (ref. TF/1/2). In summary, the following challenges have been identified:

2.1 Liberalisation/competition

*   national statistical systems need restructuring, since the comprehensive information systems of the supply industries may be lost. Confidentiality issues will arise, in particular during the transition period
*   it is important to follow the degree of liberalisation of the electricity/gas markets and the effectiveness of competition
*   the social impact and economic performance of liberalised markets must be monitored separately as regards generation, transmission/transportation, distribution and commercial activities
*   the effect of liberalisation on final consumers must be monitored.

2.2 Sustainable development

*   it is necessary to assess patterns and factors influencing energy consumption and relevant emissions, studying energy efficiency at a disaggregated (fine) level.
*   the coverage and quality of the present information system must be strengthened, especially the weakest part – the consumption side – in order to provide a better response to user requirements arising from various conventions and the established monitoring mechanism on air emissions.

3. Eurostat convened a Task Force consisting of

*   Commission services DG-TREN (A2, B1, C1, D1), DG-RTD(D2)
*   Topic center on air emissions (CITERA)
*   Member States (D, DK, FR, UK)
*   International organisations (IEA, UNIPEDE, Eurelectric)

assisted by experts to study the issues arising from these new policies. The documents in the annex comprise an extensive analysis of the issues and the recommendations/conclusions of the Task Force. These documents incorporate all modifications arising from the deliberations

of the Task Force and reflect the views of the official bodies participating in the proceedings of the Task Force. They represent a compromise between the extensive ambitions of the users and a realistic approach taking into account present resources to be deployed and giving emphasis to priority policy issues.

4.   This document summarises the conclusions/recommendations of the Task Force as well as presenting a plan of action which is already in progress. With reference to the various challenges identified previously, the following was noted:

4.1   Restructuring of the electricity markets

The structure of the electricity markets under liberalisation, the new actors appearing and their role, the impact on the existing information system and the new requirements arising as a result are presented in detail in doc TF/1/3. It is concluded that:

- it is of paramount importance to keep the present reporting system, as expressed by the relevant joint questionnaire, intact.
- confidentiality issues which may arise, especially during the transition period, are the competence of the Member States. Member States must assure the availability of relevant information on the basis of general public interest, negotiating with operators at national level. Eurostat/IEA will treat matters arising bilaterally with Member States and on a case-by-case basis.
- Eurostat must develop links with Regulators and TSOs in collaboration with DG-TREN (June 2000)
- Member States may replace traditional information sources with the information supplied by the Regulator and the TSOs.

4.2   Monitoring the degree of liberalisation and effectiveness of competition

- A list of variables was defined to monitor the effectiveness of competition (TF/1/4)
- Commission Communication to the Council and the European Parliament COM (2000) 297 of 16.5.2000 stipulates "the Member States have opened up their electricity market further than required by the Directive. However, experience has shown that the degree of liberalisation provided for in the legislation is not necessarily matched by actual developments on the market. Therefore, the Commission, with the support of Eurostat, will develop indicators to assess the degree of true competition on the national markets as well as on the Community market as a whole".
- Eurostat and DG-TREN will contact Regulators/UNIPEDE/TSOs to collect necessary statistics (June 2000)
- Eurostat will present the list to the Energy Statistics Committee for adoption and implementation (Sep 2000)
- DTI will implement the list in the United Kingdom as a pilot exercise and report to the Energy Statistics Committee (Sep 2000)

4.3   Social impact and economic performance of liberalised energy markets.

It was recognised that Council Regulation 58/97 of 20 Dec 1996 providing information on the structure, evolution, competitiveness and performance of businesses in the EU (doc TF/1/5.1) provides an adequate framework for responding to issues relating to the social impact and economic performance of the liberalised markets. However, it is necessary to separately identify economic activities relating to the production, transmission/transport, distribution and sale of electricity and gas markets. Eurostat has already presented the recommendations of the Task Force to the appropriate NACE Committee which has agreed that necessary modifications (doc TF/1/5.2) will be implemented as from the year 2002.

4.4 Effect of liberalisation on final consumers

Directive 90/377/EEC on price transparency for gas and electricity was evaluated in the light of the liberalisation of energy markets (doc TF/1/6). The TF recognised the importance of the Directive on price transparency in monitoring the effect of liberalisation on final consumers. A number of issues arise from the new situation, especially that of assuring that industrial prices reflect actual prices charged to the consumers (user surveys) and not nominal tariffs. Eurostat/DG TREN will convene a meeting of the appropriate Committee foreseen in the directive (in March 2001) to examine issues raised. The objective is to respond to the present recommendation within the spirit of the Directive, if possible without a formal revision.

4.5 Energy efficiency

The issues relating to energy efficiency are analysed in doc TF/2/1. It was recognised that energy efficiency indicators must be defined at a highly disaggregated level in order to draw correct conclusions on policies. It was admitted that energy efficiency indicators for the various economic sectors must be further refined taking into account technologies used and/or products produced. Furthermore, levels of output in economic or physical units must be defined appropriately for each sector, whilst there is a lot of difficulty in defining concepts of level of service or comfort provided by energy consumption in certain activities/sectors.
Doc TF/2/2 presents the Danish experience on energy efficiency, indicating that in many cases indicators are used at an aggregated level as a consequence of lack of reliable statistics at a more disaggregated level.

The Task Force noted that under the SAVE programme numerous energy efficiency issues are treated at a very fine level. The Task Force recognised the importance of such an approach, it was, however, felt that a step-by-step approach is needed addressing in the first instance priority policy issues using official sources of information. Doc TF/2/3 sets out this list of priorities. With reference to this priority list of indicators:

- Commission Communication to the Council and the European Parliament COM (2000) 247 of 26.04.2000 stipulates: "Community-level activity in the area of energy intensity and energy efficiency indicators is being increased with a view to developing a set of common harmonised indicators for the Community. Eurostat and the Member States will work closely together for the development of energy efficiency indicators. The work will be coordinated with similar activities carried out by the IEA and will make use of existing work developed under the SAVE programme".
- Eurostat will receive data and indicators from the priority list, along with details of their origin, from the SAVE programme (June 2000).
- Eurostat will present the priority list to the Energy Statistics Committee, along with the data for adoption (Sep 2000)
- Eurostat, the Member States and the existing network under the SAVE programme will in future collect priority lists in collaboration with the IEA.

The Task Force recognised the importance of disaggregated information by technology/product both for energy efficiency and emissions calculations. It was, however, considered that information available at Member States' level is rather poor and fragmented. Eurostat will organise a meeting with leading experts from Member States with the participation of DG-RTD, DG-TREN and DG-ENV to shape a pilot research project (Oct 2000) to address this issue, thus extending coverage of the energy information system.

4.6 Coverage/quality of energy consumption statistics

The importance of direct surveys of consumers for determining final energy consumption was recognised by the Task Force both for energy efficiency at a fine level as well as for calculation of emissions, especially within the liberalised energy markets. Doc TF/2/4 examines current surveys carried out at national level as a result of Commission legislation as well as ad-hoc projects.

- Industry
  In general, Member States perform surveys of the manufacturing industry to determine energy consumption. The Regulation "Structure of Businesses" provides a legal framework for collecting and reporting consumption statistics, in value-terms. However, all Member States have asked for a period of five years before this should be implemented. Eurostat will ask the relevant Committee to activate the appropriate annex of this Regulation concerning energy, if possible extending it to also include quantitative statistics (2001).

- Transport
  Statistics on energy consumption in transport, especially as presented by the energy balance sheets, are rather inadequate, in particular as regards the requirements arising from the air emissions monitoring mechanism. Information is supplied only by mode of transport based essentially on administrative sources (taxation). It was recognised that specific surveys are needed linking energy consumption to activity data/output both for energy efficiency reasons and air emissions. Eurostat will examine the possibility of extending existing legislation in Road Transport, covering energy consumption at the same time. It was recognised (point 4.7) that extensive modelling work is needed in order to further refine the energy consumption by type of mobile sources and/or separating air bunkers from internal flights. The TF considered that such modelling should rather be the competence of transport authorities, since extensive information on stocks of vehicles/planes and flight characteristics is needed.

- Households
  The TF recognised the importance of ad-hoc surveys financed by Eurostat over the recent past. Eurostat should raise necessary funding in future to continue this exercise under a modified work programme, taking new requirements into consideration. On the other hand, the family budget survey may provide an alternative source of information. Eurostat should evaluate the present survey, extending it to cover present requirements (2001).

- Services
  The TF recognised that this sector is the least well-known. The current survey initiated by Eurostat should be repeated, using a modified work programme. Eurostat should examine, together with policy services, ways of raising necessary funding.

4.7   Air emissions and energy balances

The role of energy statistics in preparing air emissions was examined (doc TF/3/1, TF/3/2). It is noted that:

- the role of energy balances is highly important
- additional information is needed beyond the energy balances for the preparation of inventories, including modelling
- a number of issues were already resolved recently (autoproducers): other issues are currently under study (blast furnaces, non-energy use) or are weak (bunkers in air transport).

The Task Force recommended that:

- Better co-ordination is needed at national and international level between energy statisticians and people responsible for preparing air-emission inventories. This will be achieved by holding joint meetings between relevant authorities (as from this year)
- In order to improve transparency and facilitate evaluation between energy balance sheets and air emissions, a methodology must be developed at national level (including preparation of a manual) linking energy balances and emission inventories.
- Eurostat/IEA should incorporate conclusions of studies under way (specific points above) in joint questionnaires.

- Transport statistics should be responsible for modelling work necessary to disaggregate consumption in transport (see previous point above). Also, joint transport/energy consumption surveys should be promoted at national level (see previous point above).

5. The present document summarises the recommendation of the Task Force with relationship to the new policy issues pursued by Member States and the Commission. The success of this exercise relies on the involvement of all Member States. These conclusions, therefore, will be presented to the Energy Statistics Committee in September 2000. Eurostat will further pursue the conclusions with the relevant Commission services, Committees and operators involved.

Future of energy statistics

1. Introduction

The present system of Energy Statistics is based essentially on the energy balance sheets complemented by external trade statistics and structural information on the energy industry. Prices of energy commodities, often based on tariffs, are the other dimension of the system. It has been essentially shaped by policies on security of supply, fuel diversification, etc. due to the past oil crisis.

At international level, the system is represented by the four joint Eurostat/IEA/ECE annual questionnaires, as well as by the four short (limited mainly to the supply side) monthly questionnaires.

Historically, the national energy statistics systems relied heavily on the energy supply industries. The large nationalised industries had well established information systems, including statistics on deliveries of energy commodities to their consumers based on standard classification systems. The national statistical systems took advantage of this situation, collecting statistics in a cost-effective way from the supply side. This information was, occasionally, complemented by direct surveys of the consumers. The recent work financed by the Commission on direct surveys of household energy consumption and energy consumption in the services sector from the demand side was aimed at improving the quality of relevant statistics on energy consumption.

2. Matters arising

Over the last few years new policies and measures have been adopted across the Union which may lead to the degradation of the quality of the statistical information provided by the existing system and may also present new demands on both the quality and coverage of the statistical information supplied. Therefore, the present system must be critically reviewed and evaluated in the light of:

2.1 Liberalisation and Competition – opportunities

In general terms, energy statistics must encourage transparency by providing information that enables competitive markets to work effectively. Listed below is a non-exhaustive number of requirements to which the present system must be responsive:

Progress of competition
Statistics must be defined to measure the degree and effectiveness of liberalisation/competition (e.g. market shares)

Social implications
Statistics on employment in the energy industry are needed to determine the impact of liberalisation on employment due to productivity gains and/or fuel switching. The new modes of functioning of liberalised energy industries must be adequately taken into account in the relevant methodology/definitions.

Economic issues
There is an interest in monitoring value added, productivity, investment and research and development in the privatised energy sector.

Effects on consumers
The existing system for price statistics must be reviewed and adapted to the new situation to determine the effectiveness of competition, taking into account the new commercial practices and with an emphasis on consumer prices.

2.2   Liberalisation – threats

In a period of shrinking public expenditure, the liberalisation of the energy industries poses an additional burden on the government authorities responsible for the energy statistics system. The fragmentation of the supply industry implies that the responsibility for ensuring a comprehensive coverage lies with the Government rather than a single supply industry.

Furthermore, energy consumption statistics may not be easily available, which will lead to the extensive use of expensive direct consumption surveys in order to maintain an adequate level of quality. Such practices might not be acceptable to certain Member States since they have a strong view on reducing burdens on businesses, especially regarding the supply of statistics.

It is not only the quality of information that may deteriorate; coverage also may be degraded. Energy industries operating in the past under monopoly situations felt confident about disclosing statistical information which was confidential under the relevant regulation. Liberalised markets, operating especially under an oligopolistic environment, may lead (at least temporarily) to the loss of important statistical information on the basis of the dominant company clause under confidentiality rules.

Therefore, liberalised markets pose a potential threat to the energy statistics system. However, the national legislation arising from the liberalisation in conjunction with the Regulator, who will obviously have access to extensive and high quality information in the field of its competence, may be instrumental in maintaining the statistical system under the new environment.

2.3   Sustainable development – Environment

On the basis of the various conventions and agreements signed by the Commission and the Member States (Kyoto Protocol, etc), GHG emissions must be reduced by 8% throughout the EU over the 1990-2010 time framework. Therefore, close monitoring of relevant trends is necessary over this period.

Analysis of energy consumption trends and the factors influencing these trends are of increasing interest. Therefore, statistical information on both energy consumption and levels of industrial output or services provided at the level of the whole economy, sector or subsector and end-use are necessary. Such an in-depth analysis provides explanatory factors in understanding the trends of energy consumption and emissions; it may also identify additional measures necessary to attain the overall objectives. Obviously, energy efficiency and the relevant policies are addressed here as part of sustainable development.

These considerations overlap with the needs of the Commission for the long-term forecasting work based on techno-economic models where account must be taken of any energy efficiency improvement.

The list below is a non-exhaustive list of issues related to energy statistics and sustainable development:

Quality-energy consumption trends
The quality of statistics on energy consumption, i.e. on the weakest part of the energy balances, must be assessed and standards set so that the statistical system is capable of evaluating the attainment of agreed GHG emission levels. Obviously, trends of energy consumption over the time-horizon under consideration, are important, and place a high demand on quality.

Coverage –impact of fuel cycles on environment.
The environmental dimension of the energy statistics system must be responsive to the user needs. Therefore, the coverage of the present system must be reviewed.

Energy efficiency indicators

It is necessary to determine the needs of users for disaggregated information on energy consumption along with statistics on output and services provided (industry, transport, etc) which would allow the assessment of patterns and factors influencing energy consumption and relevant emissions.

The work of Eurostat on specific sectors (renewables, CHP, households, services) has proven valuable in this direction. The existing framework in the "Structure of Business" Regulation and, in particular, the section on energy may provide a starting point for the review. Other sectors must be also considered.

3. Task Force objectives

In order to make the present energy statistics system responsive to user needs, Eurostat will create a Task Force to review the present system. The objectives of the review process are the following:

- define user needs arising from the liberalisation of energy markets (point 2a)
- define user needs arising from the environmental policies and conventions already in place (point 2C)
- set quality standards for energy consumption statistics and trends (point 2c)

The review process will last six months starting in September this year and will bring together:

- users from within the Commission (DG TREN, DG ENV, DG RTD) and the EEA
- users and producers from the MS (UK-DTI, DK-DEA, D-BMWi, FR-Observatoire de l'Energie)
- international organisations (IEA, ECE)

Eurostat will have a leading role in this review process and will engage a consultant who will also assure the link with current activities of DG TREN on shared analysis. It is foreseen that the Task Force will meet in Luxembourg three times, during which Eurostat and the consultant will table specific proposals to the Task Force on the issues raised under points 2a, 2b and 2c above for discussion with the participants. The final recommendations will reflect completely the views of both data users and producers participating in the Task Force, the latter giving a first-hand view on whether the new demands are realistic under the present situation.

4. National systems evaluation

Based on the recommendations of the Task Force, national statistical systems will be examined. This evaluation will be performed by Eurostat and consultants in close collaboration with the appropriate national authorities. The objective of this review is

- to examine in-depth the structure of the national energy statistics system and the sources of information, including their quality
- to review measures already implemented to face the problems outlined in paragraph 2b and propose additional future actions to be implemented to overcome relevant anticipated difficulties
- to propose necessary actions and evaluate relevant costs in order to make the national system compatible with the recommendations of the Task Force (point 3) i.e. responsive to user needs
- to propose existing national centres of expertise having access to such non-official data as determined by the recommendations (point 3).

Eurostat plans to evaluate, in principle, half of the national systems. Although each system has its own specificities, appropriate selection of national systems will allow Eurostat to have a good general overview of the impact of proposed measures on the national systems.

Furthermore, this action will take place in a progressive manner not only because of budgetary limitations but because feedback from the national situations will be valuable in taking appropriate corrective actions for the project. In principle the work should be complete by December 2000.

5. Conclusions of the work

The work outlined above allows the competent Commission services and national authorities to assess the impact of the various policies pursued on the energy statistics system, its effectiveness in responding to the accrued user needs on quality and coverage, the necessary measures to be implemented to face the threats arising from the liberalisation, as well as the costs associated with these actions. Such an informed evaluation will supply necessary arguments at national and Commission level to pursue the matter further with the decision-makers.

As a result of this work and in order to respond to the findings of this project:

- Eurostat will publish the conclusions of this evaluation/review.
- Eurostat will convene the Energy Statistics Committee and examine necessary steps to make the system responsive to user needs. The elaboration of a legal framework will be debated.
- Eurostat will consider the implications of the present findings on the various statistical activities (industry, transport, etc) with the appropriate committees.
- The Commission services and in particular DG TREN and DG ENV must assess the situation and proceed accordingly (Directives, Regulations etc).
- Eurostat/IEA and the ECE will consider adapting the annual questionnaires to the new situation.

The present political situation does not favour the creation of legal obligations of a statistical nature. Furthermore, the increased costs of a new system may be unacceptable to the national authorities. In such a case, we may reform the energy statistics system into an energy information system having two distinct sectors:

- a system of high quality information based on the national statistical systems
- a system of "official" statistics supplied by authorities approved by the national statistical system which will serve as best estimates. They may be assembled on the basis of national expertise. The reduced cost of this system may be supported by the Commission and national authorities.

Such an information system will be fully responsive to the user needs, both at national and the Commission levels. Eurostat will be responsible for making a clear distinction between the two levels of information. It will serve the various policies outlined above.

Electricity Market Restructuring and Statistical Data Collection

P. Capros

1.   Introduction

The electricity sector of the European Union undergoes considerable change as a result of the application of the EC Electricity Directive of 1996 about electricity market liberalisation. All member-states have implemented the directive in their national legislation and electricity market opening has begun showing multiple implications.

The changes introduce gradual restructuring of the industry and sharper competition. Public utility orientations change into a view under private interests, increasing market and investment risks. Liberalisation of the electricity sector is also changing the industry's relationships with policy makers, regulators and consumers to a profound degree. The EU Electricity Directive, reinforced by Member States' policy decisions on market liberalisation (and, in some, privatisation), will increase competition in the European electricity and wider energy market. These new market circumstances are accompanied in some countries by structural rationalisation and consolidation via vertical and horizontal integration, mergers, take-overs and/or strategic alliances. The industry's structure will evolve over time: perhaps leading to a few world-scale integrated companies (as in oil); some multi-utility companies (e.g. electricity, gas, heat, water and telecommunications); some regional players in the EU; and numerous small- and medium-sized companies with strong local or national affiliations with their customer base, or serving niche markets. Many new players, such as bankers, financial analysts, brokers and traders, will play important intermediate roles. In sum, the industry's structure is changing rapidly. It will be less homogeneous than in the past, and motivated by different incentives, leading to new regulatory and policy requirements.

Under these circumstances it is imperative for Eurostat to reconsider the settings for information collection about the electricity sector and design a new process to meet the growing needs for information in this sector. It is also imperative because Eurostat and the member-state offices are asked to support monitoring and policy making for the electricity market, including issues about transparency and competition conditions. Eurostat and the other offices have met, in the past, the requirements about information on electricity, but these were very different than those needed to monitor the market. For the information required in the past, to observe physical flows and technologies was sufficient. The new information needs imply higher complexity, requiring careful design of the information system. The private character of the information needs addressing the confidentiality issues very carefully, for the information system to be sustainable over the future.

The present note addresses these issues and proposes a framework for discussion. Its purpose is to set the basic principles around which a redesigned information system for the electricity sector could become useful to the multiple actors of the new electricity markets and to the policy makers and regulators of this market. There will be need for important work to set the details of such an information system. There will be also need for legislative work to put such a system into force, especially under the circumstances of an increasingly competitive market.

2.   New role for Eurostat's information

For a long time Eurostat and the member states were collecting data on the electricity sector but not on the electricity market. The data, mostly in physical units, were serving the core mission of Eurostat in the energy domain, which refers to the publication of the energy balance sheets. Eurostat was collecting data on the electricity sector about the following:

- Electricity production, transmission and distribution losses, imports and exports (kWh)
- Electricity consumption (kWh) subdivided into several demand sectors
- Quantity of fuel and energy forms (e.g. renewables) used to produce electricity (ktoe)
- Electricity production (kWh) decomposed according to the purpose of the generator: utility, auto-producer
- Electricity production (kWh), installed capacity (MW) and fuel consumption (ktoe) decomposed according to generation technology: thermal, GTCC, hydro, nuclear
- Electricity tariffs (€/kWh) for a set of predefined tariff categories for industry and household sectors
- Surveys on renewable electricity and cogeneration of heat and power reporting on installed capacities and production, further decomposed by technology type

The purpose of this data collection, as carried out up to now, was to support policy analysis at a rather macro level. Market issues were not addressed. The main policy uses of the current data set of Eurostat can be listed as follows:

- Analyse electricity supply and demand and their role in the energy balances
- Analyse the requirements for fuels and energy forms, in order to appraise security of supply issues
- Analyse the use of fuels in order to monitor emissions of pollutants and carbon dioxide
- Analyse the main trends about power technology choice and the possible decentralisation of generation
- Compare the prices of electricity across the European Union regions in order to infer about regional competitiveness and social conditions
- Analyse the penetration of renewables and cogeneration in order to monitor the corresponding European Union policies.

The above list of policy uses of the data does not include observation of the electricity market and obviously cannot support the analysis of issues related to transparency and competition conditions in the electricity market, as required for Eurostat and the member-state offices.

The new requirements for Eurostat information on the electricity sector does not offset the previous requirements and their role, since the above mentioned policy objectives still remain valid and of high importance. Consequently an important issue for Eurostat is first of all to ensure no loss of statistical information under the new competitive structure of the market and the continuous supply at least of the current level of information. As we shall explain, this is not a trivial objective given the private character of many data under the new structure.

The new role of Eurostat's information on the electricity sector requires collection of additional data items that concern the observation of the market and its players/actors.

This new role of information ensues from the broadening of the policy aims that the information has to support, as illustrated below:

- The energy policy aims about security of supply, technology choice, environmental management, promotion of renewables and cogeneration, and similar, still remain valid. It follows that that at least the current information provided by Eurostat should be maintained.

- National and Community authorities need to monitor and evaluate the implementation of the Electricity Directive and the resulting degree of opening of the market towards the establishment of an Internal Electricity Market. This implies a need to observe market prices, companies (and their merging) and other market players.

- In addition the authorities have to evaluate the fairness of competition, the transparency of information and prices (e.g. publication of transmission tariffs is an explicit obligation in the Directive) and detect any signal of emerging oligopoly or monopoly situations.
- National and Community authorities need to assess the implications of the opening of the market on consumers and their perception of public service (e.g. reliability), degree

of satisfaction and market accessibility. This is a new requirement because the social and reliability aspects are not granted, as before, but have to be monitored under the new market conditions.

- Numerous new market players (traders, investors, consumers, providers of ancillary services, etc.) have to be supported by information, as they will prepare their investment and commercial decisions. Among other objectives, the policy underlying the market opening also seek increasing the business activity, promote and support small and medium enterprises and employment. The new players are smaller in size, than previously the utilities, and may not afford the cost of collecting information on their own.

- Eurostat's role as a supranational information provider is strengthened under the new market conditions. In a sense there is a globalisation (at the EU level) of the segmented regional markets. The players and the policy objectives mostly require information for the whole of the EU market, in a harmonised way in order to compare the regions and detect market opportunities (for the players) or observe distortions from the unified market (for the policy authorities).

3. Implications from the new circumstances in the market

Under the previous electricity market regime, Eurostat was collecting data on rather few items related to the electricity sector. The data collected were about kWh (and kW) and included two activities: production and consumption of electricity.

The following sub-sections illustrate how the new market regime will influence the role and the requirements about Eurostat's information.

3.1 Higher variety of information

Under the new circumstances, Eurostat and the national offices will face a considerably higher complexity. The variety of information increases substantially, as it has to address:

- More commodities: kWh and kW as before but also ancillary services, reliability and a large set of prices
- More activities: production and consumption as before but also wholesale trade, retail trade, contracts and other transactions
- Actors: market entities (generators, traders, suppliers, consumers) have to be observed
- New definitions: imports and exports of electricity in the EU internal market are not any more foreign trade transactions but just commercial transactions between actors located in different regions;
- New type of information: legal status of companies, share holding, number of legal entities are examples of information types that are new for the statistical offices.

The following two figures illustrate the increasing variety of market actors and commodities under the new regime.
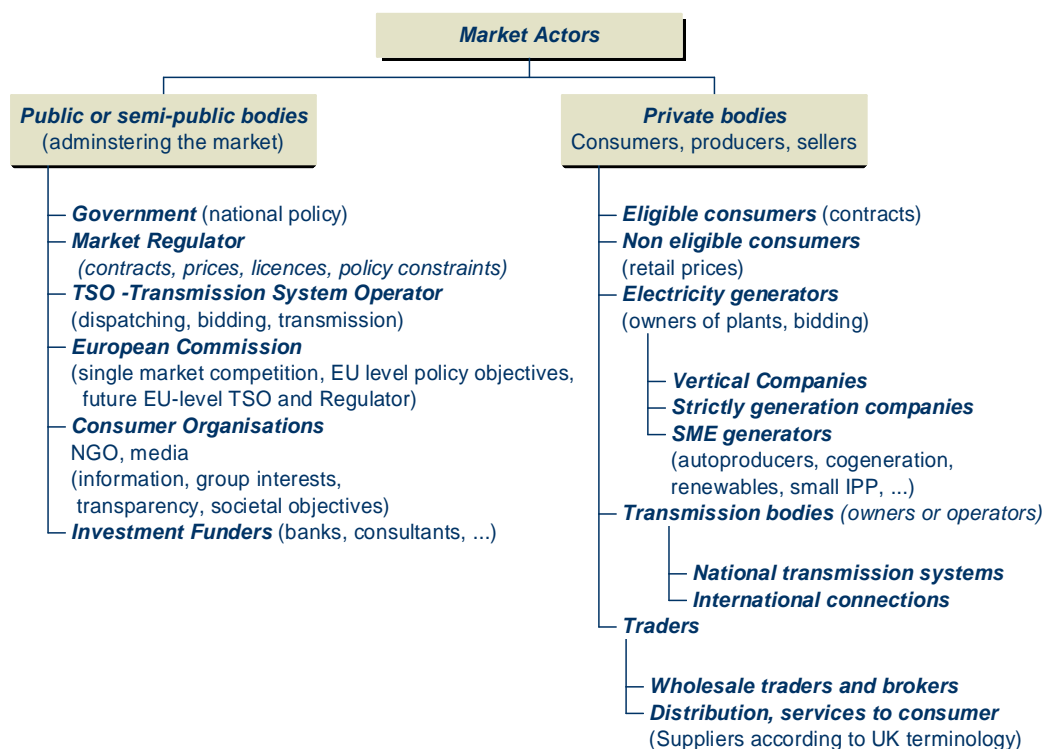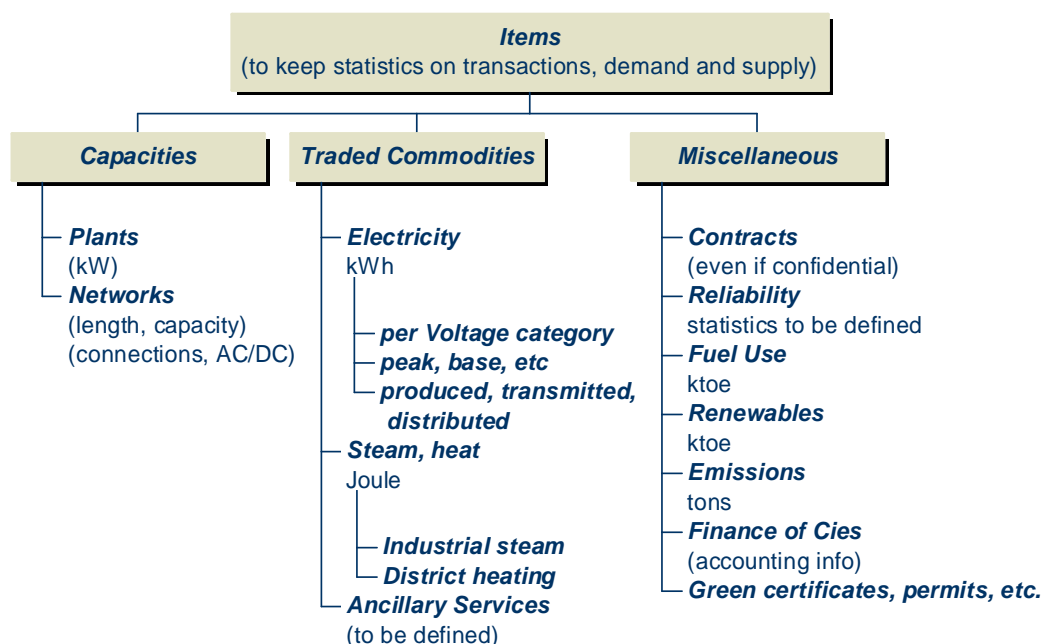
Figure 1: Actors in the New Market

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                        ┌──────────────────────┐
                        │     Market Actors     │
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        ┌───────────────────────────┴────────────────────────┐
┌─────────────────────────────┐              ┌─────────────────────────────┐
│ Public or semi-public bodies│              │      Private bodies          │
│   (adminstering the market) │              │ Consumers, producers, sellers│
└─────────────────────────────┘              └─────────────────────────────┘
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Public or semi-public bodies (adminstering the market)
- *Government* (national policy)
- *Market Regulator*
  (contracts, prices, licences, policy constraints)
- *TSO -Transmission System Operator*
  (dispatching, bidding, transmission)
- *European Commission*
  (single market competition, EU level policy objectives,
   future EU-level TSO and Regulator)
- *Consumer Organisations*
  NGO, media
  (information, group interests,
   transparency, societal objectives)
- *Investment Funders* (banks, consultants, ...)

Private bodies Consumers, producers, sellers
- *Eligible consumers* (contracts)
- *Non eligible consumers*
  (retail prices)
- *Electricity generators*
  (owners of plants, bidding)
  - *Vertical Companies*
  - *Strictly generation companies*
  - *SME generators*
    (autoproducers, cogeneration,
    renewables, small IPP, ...)
- *Transmission bodies* (owners or operators)
  - *National transmission systems*
  - *International connections*
- *Traders*
  - *Wholesale traders and brokers*
  - *Distribution, services to consumer*
    (Suppliers according to UK terminology)

Figure 2: Information Items in the New Market

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            ┌───────────────────────────────────────────┐
            │                  Items                     │
            │ (to keep statistics on transactions,       │
            │          demand and supply)                │
            └───────────────────────────────────────────┘
     ┌────────────────┬──────────────────────┬─────────────────┐
┌──────────┐   ┌──────────────────┐   ┌─────────────────┐
│Capacities│   │Traded Commodities│   │  Miscellaneous   │
└──────────┘   └──────────────────┘   └─────────────────┘
```

Capacities
- *Plants*
  (kW)
- *Networks*
  (length, capacity)
  (connections, AC/DC)

Traded Commodities
- *Electricity*
  kWh
  - *per Voltage category*
  - *peak, base, etc*
  - *produced, transmitted,*
    distributed
- *Steam, heat*
  Joule
  - *Industrial steam*
  - *District heating*
- *Ancillary Services*
  (to be defined)

Miscellaneous
- *Contracts*
  (even if confidential)
- *Reliability*
  statistics to be defined
- *Fuel Use*
  ktoe
- *Renewables*
  ktoe
- *Emissions*
  tons
- *Finance of Cies*
  (accounting info)
- *Green certificates, permits, etc.*

3.2   Conflicting interests of market participants

Under the new market circumstances the market players will often have conflicting interests. In general they will require information on other players but without willing to disclose their own information. This situation, which is quite common in other sectors, is the source of the major problems to be faced by statistical offices, regarding the collection of information, the presentation of information and the confidentiality issues.

Almost all member-states have established a market regulatory body. One of the missions of this body is to ensure transparency of competition conditions and equal access to information, both for current market players and new entering players. It is therefore logic to consider these regulatory bodies as the natural repository of the electricity market information and the basis for legally addressing the issue of confidentiality and information disclosure. It is expected that the regulatory bodies will establish legislation (for example contractual obligations to allow an entity to play in the market) that will rule the disclosure of information and somehow will resolve the conflictual situation described above. It follows that the statistical offices have to rely on this basis to address the issue of information collection and publication.

A major difference between the information provided by a regulatory body and that provided by a statistical office lies in the timeliness of information. A regulatory body has to be synchronous with market operations for the information to be relevant and useful to market players. A statistical office cannot serve such a purpose and can afford providing the information after a significant delay, in order to supply rich and relevant information without so much harming the private interests. Therefore the timeliness of the information is for the statistical offices a key to solve the conflicts arising from the privacy of market players. However the same information even published after a delay, will be still of utmost importance for policies to evaluate and monitor, as well for assessing the evolution of market competition.

3.3   Complexity of information to monitor policies

The policy making authorities and other organisations (like NGOs) will need more information and indicators to monitor policies and evaluate the implications under the new market regime. Issues regarding consumers, reliability and competition structures have been mentioned before. In addition policies regarding the environment, the renewable energy forms, the small generators, cogeneration, etc. will need information that will be also probably available under conflictual situations. Again the role of regulatory bodies is important, as they are the conveyors of such policies in the market place.

3.4   Higher legal risks

The legal responsibility of Eurostat and national statistical offices increases under these circumstances. This does not only concern confidentiality issues but also issues related to the use of information for investment and bidding.

3.5   Risks in the transition period

The correct management of the transition period is important for the statistical offices and Eurostat. During this period, the rules about handling of information at the level of the regulatory bodies are not yet well established and the legislation supporting Eurostat activities is not yet set. The electricity companies are also themselves in a transition period and often have tendency to over-emphasise the importance of keeping most of the information confidential.

So in the transition period there is clearly a risk of loss of information. This would harm the continuity of statistical time-series but would also undermine the future availability of the same level of information. For example fuel consumption in some plants may not be considered as information to disclose under the new market conditions. Under non adequate legislation, the statistical offices may not be able to publish the information, therefore there will be a serious problem in the continuity of statistics.

Another risk in the transition period concerns the possible unequal coverage of the member-states. There is lack of harmonisation in the setting of the rules about information and confidentiality in the different member-states, also because the member-states develop the market at different velocities. This may cause increasingly diverging situations regarding the

quality and the availability of current Eurostat statistics as collected by member-states. Such a situation would be unpleasant for the coverage of the Community wide policy objectives and information needs.

Therefore there is need for Eurostat to take urgent actions to ensure continuity of the current statistical collection system, even before expanding the system to cover new information needs. As explained, such actions should also focus on the harmonisation aspects and about that the role of Eurostat is important.

3.6   Preparatory actions by Eurostat

Given the complexity of the information on the new electricity sector, Eurostat has to undertake preparatory actions referring to methodological and organisational issues. The undertakings must start early enough in order to manage the transition period and effectively address the new requirements.

A rough list of preparatory actions is as follows:

- Define a methodological framework for the new electricity information system. This would include the definition of statistical variables to observe, their measurement, their linkages and the timeliness of information collection. The methodological framework has to be general and comprehensive enough to be relevant for a long period of time. Even if today one sees difficulties about the collection of some data, their definition has to be included in the framework if there is hope to complete the statistical work in the future. The methodological framework also serves as a basis to establish a progress in the dialogue between Eurostat and the member states about the new information system. It is an objective way to systematically address the different issues and problems.

- Re-shape the sources of information, the formal linkages with these sources and harmonise the national information systems on the same subject. In view of the confidentiality issues and the new bodies (regulator, TSO), the formal linkages of Eurostat with the sources have to be revised and institutionally established. This is a complex process the outcome of which is crucial for Eurostat to obtain completeness of the data coverage, reliability of information and mostly harmonisation across the European Union. The harmonisation issue should not be underestimated because it is a non-granted objective for the Union, given that the formation of the liberalised markets follows at present a bottom-up process. To obtain harmonisation, Eurostat has a tutorial role, as well. The establishment of a methodological framework with the member states is one of the ways to progress towards harmonisation and the establishment of institutionalised links with the information sources.

- Explicitly address the confidentiality issue and start defining a new approach. The standard approach, stating that information cannot be published if it concerns few legal entities will pose many problems if applied to the electricity sector, which by nature (e.g. economies of scale) may have few entities. Since monitoring of transparency and fairness of competition is of concern, such a rule would extremely limit the availability of information. A new approach would consider the substance of the confidentiality issue in accordance with the rules that the national regulators apply in practice. For example, harmonising the information disclosure and the timeliness with the regulators would allow Eurostat to increase the availability of information.

- Define a minimum set of statistical variables, data aggregation and indicators that is possible to observe and publish in the short term, possibly mostly based on existing information sources. It is important to start publishing this information under a new format to signal the willingness of Eurostat to cover this sector, supply new customers and position Eurostat in relation to the new regulatory bodies of the members-states. Of course, current surveys (e.g. renewables, cogeneration) and other statistical activities in

Eurostat (e.g. economic data on the sectors) have to be evaluated, regarding their compliance with the new requirements and revised accordingly.

4. Elements of a methodological framework

The previous section emphasised the importance of establishing a methodological framework to shape the information system required for the new electricity market regime and the related policy aims. Although in a very preliminary stage, it is necessary to propose some basic elements in this note.

First it is necessary to agree on some basic terminology that refers to the new market regime. In the previous sections figures 1 and 2 showed the organisation of the actors in the new market and the information items. The purpose of this section is to link the information items with the actors and provide a preliminary evaluation of the accessibility of the information by Eurostat and national offices.

Under the new regime, it is expected to see complex structures regarding the legal entities playing in the market. Independently of ownership status, the market actors that hold information can be summarised as follows:

- Generators are entities that operate a power or cogeneration plant and may make bids in the liberalised market
- Distributors are entities that operate the physical transmission and distribution of electricity
- Suppliers are entities that sell electricity to end-use customers either eligible to choose their supplier or not eligible; the distinction of customers according to eligibility is changing over time;
- Traders are entities that sell or buy wholesale electricity; [1]
- TSO: transmission system operator that operates and clears the transactions and ensures the physical functioning of the system and the market
- Regulator[2]: a public body that observes the market, accords licences, validates contracts, regulate prices where applicable and applies general policies to the market.

The sub-sections below group the links between actors and information items under the general policy purpose that the information system has to serve.

4.1 Purpose: analyse physical demand and supply and their implications

Electricity demand is measured in kWh and is subdivided into demand sectors. The classification of the sectors needed for analysis is close to NACE but the statistical sources usually observe demand either according to the voltage (high, medium or low) either according to tariff categories. The primary information about electricity demand is available at the level of the TSO and the suppliers. It is expected that if the data are sufficiently aggregated, so as not to disclose information about the consumption of particular customer, there will be willingness to provide the data. The transformation of consumption data by sectors needs work from a statistical office.

The observation of electricity load curves and peak demand is necessary to evaluate global reserve margins and the implications of the electricity market on electricity supply reliability. At present some companies qualify this information as commercially confident. In the future

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[1] Imports and exports of electricity in the EU is a result of a variety of transactions: a supplier or a generator may provide electricity to a customer in different country, a trader may exchange electricity across different countries, etc.

[2] Not established in all member states

there must be an arrangement with the TSO or the regulators to publish a global load duration curve and peak demand information, because this is also an element useful for public policies and essential for transparency facilitating new entry in the market.

The observation of electricity consumption for customers that are heavy users of electricity is necessary for many purposes: monitoring of eligibility of customers as an element of observing market opening; monitoring of electricity consumption to support environmental policies and demand side management. Total consumption at high and medium voltage is one source of information. It will be further necessary to split by economic sector (e.g. iron and steel, non ferrous, etc.) as stated above. The observation of the eligibility and the choices of eligible customers is more difficult because this is in conflict with confidentiality of electricity contracts under the new regime. Probably there must be an arrangement with TSO to publish a few aggregate indicators on the choices of eligible customers, their volume of consumption and source of supply.

Statistics about technological aspects of electricity generation (also cogeneration and district heating) are important for technological and environmental policies. It is necessary to publish a subdivision of electricity generation (and steam/heat) by technology type of the plant: e.g. nuclear, hydro, renewables, GTCC, etc. The primary data, e.g. electricity generated by a particular plant, will be available at the level of generators but it is expected to be qualified as commercially confident.

Data on the use of fuels in electricity (and heat/steam) generation are necessary for two purposes: evaluate total demand for fuels and analyse the prospects about energy security of supply; evaluate emissions of pollutants and compare against environmental objectives or commitments.

Consumption, generation and fuel use data are essential parts of the detailed energy balances.

To obtain the data on electricity generation by technology and the use of fuels will be a delicate issue under the new market regime and again this has to be handled at the level of the regulator. The regulator has a mission to accord licences to generators and consider both the technology and the fuel they are going to use. It is therefore logical to demand from the generators a periodic report about the generation by technology type and the use of fuels. For large generators having multiple plant types, a periodic report on generation and fuels that does not disclose the cross-section between plants and fuels would not be a problem. In any case, the regulator in cooperation with Eurostat and the statistical offices must define a questionnaire on generation and fuel use and oblige the generators to provide the information as a condition to accord generation licences.

Other community legislation, like the large combustion plant directive, also requires such information. Environmental monitoring will also require additional information on emissions and probably on pollution abatement equipment. Again the only possible approach to collect this information on a periodic basis is through the regulator and a questionnaire.

4.2 Purpose: analyse generation capacity, availability and reserve margin

As mentioned before, it is not for granted under the new market regime that the system ensures building enough generation capacity to reliably meet demand in the long run. The regulator and TSO, as well as general public policy need monitoring the market regarding the capacity availability issue.

It follows that for Eurostat and the statistical offices there must be an arrangement with the regulator to agree upon a common questionnaire and indicators that measure generation capacities (possibly by technology type and energy form), the global availability of plants and the system reserve margin. These normally have to be published at a regular basis.

A difficulty will arise about the collection of information on the availability of individual plants, the outages, the maintenance schedules and the cold or spinning reserves. The TSO normally has to collect such information at a detailed level in order to plan for capacity additions, allocate any tariffs that should be paid to generators supplying reserve to the system and the ancillary services (e.g. spinning reserve, etc.). This information is expected to be qualified as confidential. In a short period dispatching also the TSO has to collect information on outages and maintenance schedules, in order to ensure reliability and availability of supply.

Public information on these issues can be envisaged only through well defined but aggregate indicators that show at a global scale the evolution of generation reliability, availability and capacity reserve aspects. So again the statistical offices have to agree with the regulator and the TSO on how to measure and publish these indicators.

4.3   Purpose: Analyse availability of transmission lines

For the fairness and openness of competition under the new regime it is of utmost importance to dispose sufficient and available transmission lines and generally transmission capacity. This is an issue for the domestic competition (within the territory of the member-states) but also for the opening of a EU internal market of electricity[3]. It is also important for the relations with the neighbourhood of the EU and the availability of sufficient system reserve.

It follows that observing the availability and sufficiency of the transmission system serves the monitoring of market operation and competition and the appraisal of system reliability.

Since the transmission system operates under regulated monopoly regime, it is logical to expect that the detailed information on transmission capacities will be available at the level of TSO and somehow will be published to allow for new investment, new entry in the market and for supporting fairness and transparency of transmission tariffs (set by regulation to recover long run costs).

Eurostat and the statistical offices only need aggregated indicators on transmission availability and sufficiency of infrastructure. These needs can be recovered through an agreement with TSO about a periodic publication of such indicators. The primary information is very complex, because it involves spatial data and complex engineering data. To infer, by using the primary data, about sufficiency of transmission capacity and reliability is very complex and cannot be handled by a statistical office.

It is also difficult to define indicators about transmission that would appraise the transmission sufficiency separately for the interior of a member-state territory and the electricity trade across member-states.

4.4   Purpose: Observe prices and assess fairness of competition

A fundamental expectation from electricity market liberalisation is the fall of electricity prices as a consequence of increasing competition. Prices may fall as a result of two basic mechanisms: because of competition the producers and suppliers are expected to move towards a more efficient organisation and the ensuing cost reductions will be reflected on prices; oligopoly or monopoly rents that may have prevailed under the previous market regime are expected to vanish leading to lower prices for the consumer.

There are two ways of accessing farness of competition by using observed information: a top-down and a bottom-up approach.

In a top-down approach, one observes certain information at a macro level and then infers about the degree of competition.

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[3] The Union have further interests on this issue in relation to the Trans-European Networks policy.

- The observed information is used as signals and is interpreted according to general economic theory. For example, by observing the number of independent companies that act in a market, one may indirectly conclude about whether the market is or not dominated by an oligopolistic structure. Also observing entry and exit one may infer about the openness of the market.

- The advantage of a top-down approach is that one may use easily accessible or even published information. The drawback comes from the complexity of the inference. Out of the macro information one may easily conclude with misleading results about the degree of competition. For example, observing the number of companies often is not enough. One may have observed hundreds of operating companies, but possible each one may be a monopoly in its own market segment (for example in case of regionally segmented markets). Also, one may have observed one dominant vertically organised company, but this may be formally unbundled and may act in a strongly competitive environment.

- To draw inferences out of information about the number of companies one has also to observe ownership, merging and acquisition information.

- Using market shares as a proxy is also questionable in some cases. Because of this complexity, statistical offices have extensively used for other sectors the Herfindahl index approach, which is also recommended as an adequate tool for the electricity sector. The Herfindahl index measures the degree of concentration in a sector and in a way normalizes the acting companies to compute the number of 'equivalent' firms.

- The electricity sector, however, involves different markets, including the generation, wholesale trading and retail trading, for which the indicators must be different. This is also a complication in technical terms.

A bottom-up approach consists in an attempt of reconstructing the cost structure of the representative firm and compare against the observed prices.

- In case of a large gap and even worse in the absence of a downward tendency for this gap, one may conclude that oligopolistic rents prevail in the market.

- In technical terms, to do so one has to dispose a model for cost calculation and collect for more data than in the case of a top-down approach. These data are difficult to find since they usually are confidential at a company level.

- In the electricity generation domain, one has to first observe the prices and taxes of the fuels used for electricity production. Although the prices in a spot market for fuels are usually observable, the prices in fuel supply contractors are confidential. Most generators use fuel contracts rather than the spot market for their basic needs. Then one needs to have estimates of heat rates and technology evolution, which may be approached through engineering studies. An engineering approach may also be effective to obtain estimates about capital costs and maintenance costs. Other variable costs may be approximately by using the published accounting balances of the generating companies.

- The bidding prices are available at the level of the TSO, for bids operating within the electricity pool. Probably the TSO will not be informed about the prices of electricity supply contracts, especially when those contracts are agreed with large eligible customers.

- The TSO and the regulator might have interest to construct price indicators out of these bidding prices in order to observe their evolution over time and infer about the progress of competition and indirectly conclude about the trends in generation costs.

- Such indicators are valuable also for Eurostat and the statistical offices and have to be collected in an agreement with TSO and regulator. This has to be carried out independently from the attempt to calculate generation costs. <u>Such price indicators can be used as a stand-alone signal of the effects of market operation on consumer prices</u>.

The approach is different for the transmission prices and fees. The transmission activity is regulated as a natural monopoly and there must be transparency about costs, prices and fees as an element of fairness of competition among generators and traders. The EU electricity directive provides rules for publishing those transmission prices. Therefore Eurostat may directly access and use this information.

It is yet unclear whether the same transparency will be applied for the distribution of electricity. If multiple electricity suppliers act on a single distribution network, then it is natural to see an exigency about full transparency on distribution costs and prices. Oligopolistic structures in the distribution business may obstruct such transparency. Sooner or later the regulators will also apply transparency on distribution prices, therefore the statistical office will access the information.

Observing the end use consumer prices is normally feasible. As mentioned, to observe prices of contracts evolving eligible customers, will be impossible. Knowing retail prices is first possible by observing tariffs as announced by electricity suppliers. It is expected however that, under the competition, the tariffs will increase in variety. Suppliers will offer a variety of contracts to the different categories of customers that may include: discounts, variation of tariffs according to interruption possibility, tariffs for ancillary services, offers on packages of services, etc. Therefore to access the information on retail prices, a statistical office has to follow a model, collect a sample of data and then compute indicators about the real (normalized) prices of electricity paid by the customers. Such standardization must be invariant over time so as to allow for conclusion drawn from the evolution of the price indicator.

It is also important to observe the evolution of wholesale prices. To meet the policy requirements, the statistics have to separate the wholesale trading that takes places in the territory of a member state form the trading indirectly concerning two or more member states. This is needed to infer about the establishment of an EU internal market of electricity. Logically, it is in the mission of TSO and the regulator to assess wholesale trading transactions. Eurostat has then to arrange with these bodies for the publication of adequate price indicators for wholesale trading. Such information goes together with data on the quantities interchanged under wholesale trading.

Under the agreement with the regulatory bodies, it is recommended for Eurostat and the statistical offices to observe a large number of 'institutional' information that may be used to indirectly conclude about the degree of competition and the effectiveness of the market. The following is an indicative list:

- Number of applications to obtain a licence and connect to the system
- Number of generators, traders, suppliers
- Amount of new capacity connected or disconnected
- Number of customers per supplier
- Number and total capacity of eligible customers
- Indicators about the number of wholesale trading transaction
- Published tariffs about the use of the network
- Published tariffs for retail market
- Data on fees, levies and taxes

4.5 Purpose: Observe consumer satisfaction and accessibility

Under the new electricity market regime there will be growing interest about observing customer satisfaction and observation of the degree of adequate public service that the

liberalised market succeeds to offer to the customers. Governments, politicians, consumer associations, marketing professionals and NGOs will be users of such information.
This issue has three aspects:

- **Reliability**: whether the consumers obtain reliable and good quality electricity supply, measured for example through frequency of disruptions, frequency of distribution failures, maintenance and connection services, quality indicators (voltage, system frequency, harmonics) etc.

- **Accessibility**: whether all classes of customers have equal access to electricity supply under the same quality conditions in relation to logical tariff differentials; the social impacts of market restructuring are very important and concern whether certain categories of customers are likely to take advantage of the new market regime (e.g. consider elderly and poor classes, islands and isolated regions).

- **Satisfaction**: whether the consumers feel satisfied with the offered service in relation to the fairness of the price they pay; for example consumer satisfaction surveys may be carried out and be used as a source of data.

The domain of consumer satisfaction is new for Eurostat's energy services. It is probably also new for the national statistical offices. Therefore, these must be a design and a schedule about how to cover these needs for information.
There also exist other aspects that sooner or later must be covered by the statistical information:

- Consumer and regional protection: is the competition at the level of the consumer and regions (e.g. islands and isolated areas) succeeding to offer fair prices and conditions?

- Grouping of customers: have the customers the possibility to band together in a certain area to exercise negotiation leverage as a group or obtain advantages from economies of scale?

- Demand side management: is the competition at the level of the consumer compatible with the goals about efficiency of electricity use? (for example, counting of appliance consumption is possible?)

4.6 Purpose: supply information to investors and bidders

It is expected that under the new electricity market regime there will be opportunities favouring the emergence of numerous new actors, including investors and bidders. It is also expected that these might be increasingly smaller in size. Public policies favour the promotion of small size companies because they sustain employment. It follows that there is willingness to monitor whether the market structures are helping them or obstructing them from surviving in the market place.

Such small-size market actors cannot afford investing in information collection and in studies that would suggest about the opportunity for a new investment or bid. Information collectively gathered will be cheaper and if available publicly will greatly help sustaining free entry to the market place.

Therefore there is a role for the national offices and possibly for Eurostat (supporting aspects of the EU internal market of electricity) to prepare information packages for new investors and bidders. Such a package could, for example, include by region the following information:

- Existing generation, subdivided by technology type
- Fuel consumption
- Peak load and structure of demand
- Capacities of transmission and volume of exchanges
- Reserve margin

- Institutional aspects (number of companies, accounting data, traders, licences, contracts etc)
- Published prices and tariffs concerning the pool, the wholesale and the retain markets
- Links to engineering information and other suppliers of information

Most of these data have been mentioned before in previous sections. The packing of these data, the timeliness, the accuracy of the content and the presentation are important elements to ensure diffusion and usability in the milieu of investors, bidders, banks etc.

5. Addressing the confidentiality issue

Successfully addressing the confidentiality issue is of utmost importance for the sustainability of the information system about the electricity market. It is also important in the transition period.

In theory there are two opposite approaches to the confidentiality problem:

- Consider the electricity sector similarly as statistical offices do for other sectors and apply usual practices and rules about confidentiality. This approach will result in an aggregated and macro-economic, rather that detailed and engineering view of the electricity sector. It will result in a reduction of information about the sector and certainly most of the policy aims mentioned before will not be sufficiently supported with statistical information.

- Consider that there exist major reasons referring to protection of general public interest that justify the collection and publication of specific and detailed information on the sector. Seeking a specification that ensures private information not harming private interest has to be explicitly addressed and agreed upon, conditionally on the view of protection of general public interest. Such a protection is justifiable in terms of security of supply, reliability, consumer protection, environment and competitiveness.

Obviously only the second approach can ensure the provision of information as mentioned in the previous sections and can serve to the policy aims currently prevailing.

The formal interlocutors of the statistical offices and indirectly by Eurostat are the TSO and the regulatory bodies. There will be less formal connections with the ministries and agencies. There is therefore need for long term agreement ruling cooperation. There will be also need for far more effort to be devoted to methodology, definitions and statistical frameworks that will increase the objectiveness of the approach and facilitate acceptance of information collection, their content and their use by policy makers and market players. Regarding the statistical techniques, there will be more use of sample-survey and cross-sectional work, rather than total inventory approaches, in particular in relation to the retail market.

All the above call upon legislative work to which the role of Eurostat is very important as a guarantee of harmonization and equality across member states and regions in the EU internal market of electricity.

There exist contain rules for the statistical work that facilitate acceptance and address the confidentiality issue in a more effective way. Such rules are the following:

- Collect data uniformly using standardized forms regardless of ownership or market coverage
- Publish statistics and disclose information on an equitable basis for all market actors
- Explicitly define timeliness for each information item and for some accept reasonable delaying of publication when this removes confidentiality conflicts
- Coordinate with the national regulatory bodies and TSO to keep confidentiality at the same level

- Use as much as possible indicators computed according to a data model because this may be more accepted even if referring to few legal entities
- As a last resort only follow the principle about keeping confidential information that may reveal the identification of an individual entity
- Coordinate the legislation about statistics on the electricity sector with the rules of regulatory bodies that aim at ensuring transparency and possibly oblige minimum reporting as a condition for licencing
- In general preserve confidentiality for customer-specific financial data but disclose operational data at a sufficient aggregation level

In summary, the recommendation is for Eurostat to start pushing for legislation in cooperation with the member-states. The policy basis is the role of Eurostat as observatory of the operations and implications of the EU internal electricity market and the pan-European general public interest (environment, harmonisation, competitiveness, consumer and regional equity) that need supporting information.

6. Conclusions

The EU Electricity Directive and the dynamics of change in the market places of the member state require a considerable revision of the current statistical system on electricity. The revision includes:

- Preserving the current level and quality of information
- Considerably extending the coverage and address new issues and requirements
- Establishing a well organised methodological framework
- Formation of official links with new information providers, in particular the TSO and regulatory bodies
- Addressing the confidentiality issues

The preparatory actions for Eurostat and the strategy need considerable work and design.

The challenge is high but the strategic benefits are also important. As a result of successful work, Eurostat can:

- Become a provider of information on the markets rather than a supplier of statistical data
- Considerably enlarge the audience of Eurostat's information
- Increase the policy and commercial value of the information provided
- Play an important role as a EU observatory to harmonize information and watch the evolution of the market and its implications.

The statistical steps are also important because errors may jeopardize the whole effort. Among the possible steps for short term, the following are recommended:

- Renew short-term agreement to preserve current level of information

- Complete the current statistics with new variables that are possible to quantify in the short-term on the basis of existing or easily accessible information (see detailed discussion on a list of variable that took place in the Task Force).

- Contact the regulatory bodies and TSO in the member states, in cooperation with DG TREN, to start establishing formal links, inquire about the methodology and harmonize the approach about collection of information.

- Start preparing a comprehensive methodological framework about the information system on electricity sector and market and start detailed discussions with the interested parties

- Start preparing a reform of legislation about information and confidentiality; this has to be undertaken as a natural follow-up of the discussion with DG TREN, the member states and the regulatory bodies

- Decide upon a schedule for actions and milestones and reserve an adequate budget for investment.

It is going to be an ambitious but rewarding project for Eurostat and for the Union.

List of variables proposed to monitor the progress of competition in the electricity market

1. Generation variables

1.1 Number of main generating companies

Number of generating companies representing, at least, 95% of the national electricity generation and/or capacity.

1.2 Percentage of total generation and capacity by generating company

Generating companies with, at least, a 5% of the national electricity generation and/or installed capacity. The remaining percentage until 100% to be included under "Other generating companies".

1.3 Capacity by type of plant and peak load information

Information at a national level about the capacity by type of technology and the maximum demand of electricity during the period considered (annually).

1.4 Pool prices to distributors

Average, maximum and minimum prices (National Currency/Euro per MWh) recorded in the pool market during the period considered (weekly or monthly).

2. Transmission variables

2.1 Physical volume of electricity transported cross-border by country of origin and destination

Physical flows of electricity transported annually between the Member States and outside the EU with indication of the origin and destination.

2.2 Inter-connectors transmission capacity and load factor

Information about the transmission capacity of the inter-connectors between Member States or between Transmission System Operator (TSO) areas and the percentage of utilisation during the period considered (annually).

2.3 TSO published network tariffs

For the geographical area covered by the TSO, the published tariffs for transporting electricity through the high-voltage transmission grid (National Currency/Euro per MWh) for the period considered (annually).

2.4 Transmission access variables

In order to monitor the dynamism of the access to the transmission network some variables are proposed for the period considered (annually):

- Number of applications to connect to system processed by TSO
- Number of new connections
- Amount of new capacity connected
- Amount of capacity decommissioned

3. Distribution variables

3.1 Distribution published network tariffs

For the geographical area covered by the Distribution System Operators, the published tariffs for transporting electricity through the medium-voltage and low-voltage distribution systems (National Currency/Euro per MWh) for the period considered.

4. Retailing/Wholesale variables

4.1 Number of "wholesale customers" (as defined in Art. 2. point 8 of Directive 96/92/EC) and market share.

Number of "wholesaler customers", so called wholesalers, selling electricity to final customers and market share for those selling, at least, 5% of the total electricity consumed within the Member State in the period considered (annually).

4.2 Eligible customers evolution

Percentage that the eligible customers to be free to conclude electricity supply contracts represent over the total market within the Member State in the period considered (annually).

4.3 Wholesale prices

Average price recorded for the period considered (weekly or monthly) for the electricity directly sold from the generating companies to the wholesalers (National Currency/Euro per MWh)

4.4 Prices to final customers

Prices charged to final customers, both domestic and industrial, including those purchasing electricity directly from the generating companies, defined according to load profiles (Following the structure introduced by Directive 90/377/EEC).

4.5 Final customers switching wholesaler

Percentage of final customers switching from one wholesaler to another during the period considered (annually).

4.6   Electricity volumes traded contractually

Information about the amount of electricity traded contractually within the Member State and cross-border during the period considered (annually) with indication of the origin.

Paper on structural business statistics for electricity and gas enterprises

1. Legislation on Structural Business Statistics

Council Regulation 58/97 of 20 December 1996 established a common framework for the collection, compilation, transmission and evaluation of statistics on the structure, evolution of activities, competitiveness and performance of businesses in the EU. The activities covered by this regulation are Sections C to K and M to O of NACE Rev.1. Energy industry is included under Section E (see paper TF/1/4.1 regarding classification of gas and electricity activities under NACE Rev.1)

There are four groups of statistics, known as modules, to be collected according to this regulation. In two of them the energy industry is involved:

- Annual structural statistics. A set of basic variables covering all sectors of the market economy. Some results are broken down by size classes defined according to the number of persons employed.

- Structural statistics in industry. A detailed list of characteristics for the analysis of industrial activities, including some multi-yearly and regional statistics, and a further list of indicators for the study of special subjects. Here also, some variables are broken down by size classes based on the number of persons employed

The first year for which these statistics should be collected is 1995 although there is provision for a transition period of four years until 1998. Later regulation has set a list of derogations for the transitional period following the requirements of the national statistical systems affecting all Member States (MS) and both of the above mentioned main groups of statistics. In principle, all data will be collected from 1999 onwards.

Regarding timeliness, the results are to be transmitted within 18 months of the end of the calendar year of the reference period (T+18), but preliminary results or estimates for some selected indicators should be transmitted within 10 months of the end of the calendar year (T+10), such as turnover or number of persons employed.

The variables or characteristics to be collected have also been defined in detail in order to allow their comparability. Consequently, the complete implementation of this regulation will enable Eurostat to calculate EU aggregates for the listed characteristics and for different sectors of activity, including those of interest to our work.

2. Indicators collected

The module for annual structural statistics includes the following enterprise characteristics which are to be collected yearly, in addition to the number of enterprises (*):

- Turnover (*)
- Production value
- Value added at basic prices and at factor cost (*)
- Personnel costs
- Total purchases of goods and services (Optional)
- Purchases of goods and services purchased for resale in the same condition as received
- Gross investment in tangible goods (*)
- Number of persons employed (*) and number of employees.

The variables marked with (*) have to be reported by size class also, although it is optional for the gross investment in tangible goods. In the case of the energy industry, sizes are based on the number of persons employed, and cover the following ranges: 1-9, 10-19, 20-49, 50-99, 100-249, 250-499, 500-999, 1,000 or more.

The module for structural statistics in industry, where the energy activities are classified, covers a more comprehensive set of characteristics including those already seen in the previous module, and are also to be collected yearly. We can highlight some of them:

- Number of births and deaths of enterprises
- Gross operating surplus
- Wages and salaries and social security costs
- Number of hours worked by employees
- Total intramural R&D expenditure

3. Current status of the collection of the indicators

Up to now data are available only for 1995 and 1996. All MS requested complete or partial derogations in some of the modules or in some of the NACE Rev.1 Sections. Also, the delay of T+18 months has not been fully respected for both years, 1995 and 1996.

The situation for 1996 in Section E of NACE Rev.1 concerning the core group of annual structural statistics can be summarised as follows:

Variable	Replies received from MS
Number of enterprises	12
Turnover	13
Value added	11
Purchases of goods and services	11
Personnel costs	12
Investments in tangible goods	8
Employment	12

Derogations are the main reason for not having replies fromall MS.The Netherlands, Austria and Sweden are particularly affected.

But, in addition, data sent by some MS are considered as confidential and therefore may not be published. This mainly affects data coming from Greece, France, Ireland and Luxembourg for electricity and France, Ireland, Italy, Luxembourg and Finland for gas. In the UK there also some variables considered as confidential for both commodities.

Data for 1997 has just started to be received and it is expected to have aggregate results available by the middle of next year. For 1998 data, the proposed calendar will almost comply with the allowable delays, if final data are available in T+20, although availability of data in both cases will not be feasible due to derogations. Finally, preliminary data for 1999 should be available by November 2000, that is, T+11.

4. Conclusions

The complete availability of the variables foreseen in this regulation will provide a fairly good picture of the demographic, economic and social evolution of the energy sector in the EU. In this sense, it seems that it covers most of the information needs that a user might need in order to monitor the evolution of the energy enterprises.

However, some weaknesses should be pointed out: the timeliness (T+18), the holes in the information during the transition period (1995-98), the problems of confidentiality and the absence of a proper breakdown of activities until the proposed revision of the energy sector classification under NACE Rev.1 is adopted in 2002.

Classification of gas and electricity activities under NACE rev. 1

1.   Current situation

NACE Rev. 1 classifies the electricity and gas activities as follows:

Electricity
All stages involved in the process of producing, transmitting, distributing and selling electricity are classified in the same Class under Section E: 40.10 "Production and distribution of electricity"

Historically, in most countries, the electricity industry was vertically integrated: a single company, often state-owned, performed all activities from generation to final delivery to end-users. Consequently, this single class was very convenient to cover this branch of activity.

Gas
There are three NACE Classes in three different Sections covering the activities related to gas:

•   Section C. Class 11.10 "Extraction of crude petroleum and natural gas" for gas mining activities.

•   Section I. Class 60.30 "Transport via pipelines" for transporting the natural gas to the distributor.

•   Section E. Class 40.20 "Manufacture of gas; distribution of gaseous fuels through mains" for distribution of gas to end-users. It includes the manufacture of "town gas". Here, again, we used to find that most countries had vertically integrated companies which produced the town gas and distributed it to the final consumers.

2.   New classification proposed for gas and electricity activities

2.1   Electricity

The liberalisation of the electricity markets already totally or partially in place in most of the MS has resulted in the splitting of the traditional single electricity activity into four different businesses which are undertaken by separate enterprises. Now, electricity generation, transmission via high voltage lines, local distribution via low voltage lines and retailing to final consumers can be performed by different companies.

Furthermore, the Directive 96/92/EC concerning common rules for the internal market in electricity has regulated this split of activities in such a way that even the vertically integrated companies are obliged to unbundle their activities, and keep separate accounts for generation, transmission and distribution activities, in order to avoid discrimination and distortion of competition.

Therefore, the current NACE classification of the electricity industry is clearly not adequate to cover the new structure and legal requirements arising from liberalisation of the electricity market. A breakdown of the existing single class is required in order to allow detailed analysis of the separate activities performed by the different actors in the market.

The proposed new classification creates four NACE Classes under Section E, Group 401:

40.11   Electricity generation

40.12   Electricity transmission: high voltage
40.13   Electricity distribution: low voltage
40.14   Electricity sale

2.2   Gas

In the last decade there has been a rapid development of the natural gas market. Under the current NACE classification, the extraction of natural gas is part of the Mining industry while its transport is part of the Transport industry (via pipelines). Therefore, these two activities seem to be classified rather logically.

However, local distribution and retailing of natural gas are classified together with the manufacture and distribution of town gas. It is not very adequate to have the distribution of natural gas in the same Class as the manufacture of town gas. Consequently, a split between the manufacture and the distribution activities seems necessary.

But also in the case of natural gas, there is a new regulation at the EU level. Directive 98/30/CE concerning common rules for the internal market in natural gas is being adopted by the MS with the objective of liberalising it. This regulation also obliges vertically integrated companies in the gas sector to unbundle their activities, and to keep separate records for the transmission, distribution and storage activities. The purpose is the same as that of the electricity directive: to allow competition without discrimination and distortion.

As a result of these circumstances, the proposed new classification creates three NACE Classes under Section E, Group 402:

40.21   Manufacture of town gas
40.22   Distribution of gas
40.23   Gas sale

The first Class refers only to town gas while the other two Classes cover both natural and town gas.

3.   Status of the proposal

This proposal was presented for discussion in the NACE/CPA Committee meeting held in Luxembourg on 28-29/10/99. The need for splitting the existing Classes for gas and electricity activities was generally recognised and also the need for implementing the changes by the year 2002.

Some reservations were expressed about the difficulties of collecting information during the transition period from monopolistic vertically integrated companies to single activity units in a competitive market. Another problem envisaged during the discussion was the treatment of horizontally integrated companies (joint supply of gas, electricity, water, etc).

Paper on the future of gas and electricity prices

1. Problems arising from liberalisation

The current collection of gas and electricity prices at the EU level is based on Directive 90/377/EEC about Price Transparency that came into force in 1991. This directive created a system of standard industrial end-users defined by their annual consumption for which tariffs of gas and electricity are collected twice per year, 1st January and 1st July. In some MS a national price for each consumer is recorded while in others several locations are considered. The supply of gas and electricity prices was extended on a voluntary basis to the domestic consumers following a similar system of standard categories and locations. In both cases the gas and electricity utilities are the original source of information.

However, the evolution of the gas and electricity markets from a monopolistic to a competitive structure is already affecting the price transparency pursued by the Directive. And it will be more evident when the two directives on the liberalisation of the electricity (96/92/EC) and gas (98/30/EC) markets are fully adopted by all MS. Therefore, the collection of gas and electricity prices is facing the following problems:

1.1 More participants in the market

Not only from the quantitative point of view but also because they perform different activities following the separation of the production, transmission/distribution and retailing areas of the business. Unrepresentative prices can result if an appropriate coverage is not reached. In addition, it has resulted in new needs for information in order to ensure price transparency, such as the collection of transmission charges.

1.2 Individually negotiated tariffs

Large industrial consumers at the beginning, but also medium size industrial end-users when liberalisation advances will be able to negotiate individual contracts with special price conditions and without following published tariffs. This may require a more flexible definition of the consumers categories, not based on a fixed annual consumption but in size bands.

1.3 Regional versus national prices

Liberalisation looks for the implementation of a single market for the energy commodities. Consequently, it includes the possibility of free cross-border trade and open competition. The current list of locations for which prices are collected cannot be adapted to these new aspects as it covers the national territory in some MS and several urban areas in others. Price transparency can therefore not be ensured if the customer is unable to find an adequate reference for comparison. On the other hand, Eurostat´s experience of dealing with data users reveals that national average prices are very frequently requested in order to monitor price evolution between MS.

1.4 Confidentiality

The current definition of confidentiality contained in the Directive is focused on the number of consumers (at least three) but not on the number of suppliers. In a competitive market, if there is a very small number of suppliers such as three, the price policy becomes a sensitive matter for those companies. Consequently, the protection of confidentiality requires the addition of suppliers in its definition.

2. Possible ways of action

The above mentioned problems show the need of introducing some possible ways of improving the current statistics of gas and electricity prices:

2.1 Number and definition of consumers

Currently, according to the Transparency Directive, prices are collected for 14 electricity consumers (9 industrial and 5 domestic) and for 12 gas consumers (7 industrial and 5 domestic) designated by letters and numbers and defined according to a fixed annual consumption.

So, it seems reasonable to reduce the number of consumer categories to give them more meaningful names (small, medium, large, very large…) and to define them according to an annual consumption size band system instead of fixed consumption figures. Such size bands should be designed to represent homogeneous groups of end-users in terms of energy consumption and to cover the majority of the market.

2.2 Sources of information

For domestic consumers, there is not too much room to change the source of information since in a market with millions of consumers, the only cost effective way of collecting the price data is through the retailing companies.

In the case of industrial prices, when one considers the increasing number of suppliers that liberalisation will bring, an alternative procedure would be to collect prices through periodical surveys of the end-users. A representative sample of industrial users would be selected and they would be required to supply information about their consumption of each kind of fuel and the corresponding cost during the period considered. This would enable an average fuel price to be calculated and the consumption size band where the end-user is classified to be known.

However, the current procedure of collecting information from suppliers could be maintained if it is more cost effective, and providing that the prices transmitted are representative of the industrial consumer categories.

Each MS should decide the best way to collect price reliable data based on their statistical needs and resources and the conditions and evolution of their internal energy markets.

2.3 Geographical coverage

Each MS should determine if the current locations defined in the Directive still reflect the real picture of their energy market. This analysis might result in the introduction of new locations/regions, the dropping of some others or an improved definition of their geographical coverage. The possibility of cross-border trade should be envisaged if the current locations do not adequately cover border regions.

But, as mentioned above, data users needs could recommend the calculation of some kind of national average price for each consumer category in all MS. In that case, clear rules will need to be adopted if misleading comparisons are to be avoided.

2.4 Periodicity

Twice per year seems to be a fairly good at which to analyse price evolution at this stage of the market situation. But maybe in the future, a shorter period should be considered when liberalisation has progressed further. Another alternative could be to keep the twice per year

arrangement, but to reduce the collection and publication periods (currently five months after reference date) in order to make prices available earlier to the public.

2.5 Transmission charges

The separation of activities brought by the liberalisation directives has also created the need to collecting the transmission charges demanded by the respective operators: TSO for electricity, and transmission and storage undertakings for gas. This information will be essential in order to ensure equal and fair access to the subsequent actors of the market and will have been collected directly from the transmission operators according to the regulation.

2.6 Confidentiality

A minimum number of companies supplying gas or electricity to a certain consumer category in a specific location should be added to the definition of confidentiality. It is not only a question of respecting commercially sensitive interests but also of giving confidence to present and future data suppliers about the use of the information provided. The adoption of a collection system based on surveys of end-users do not avoid this problem since the number of consumers is also included in the definition.

2.7 Statistical time series

Once a course of action has been decided upon, an additional problem could appear if the price data collection system is changed substantially: the breakdown of the historical data series or, at least, the incompatibility between the old and the new series. This will require the adoption of some conversion system and/or the definition of links between the old and new systems.

2.8 Practical implementation of a new methodology

It is necessary to agree not only about what needs to be implemented but also about how to implement it. Currently, domestic prices are collected on a voluntary basis while industrial prices are supplied in response to a Directive obligation. Both ways seems to work fairly well.

On the other hand, if the methodology of data collection established in the Transparency Directive is substantially changed, it will be necessary to amend the directive itself. This, of course, will take some time since the agreement of all MS has to be reached.

Also, in this implementation, the role of the professional associations should be considered. They can provide important help in the implementation of a new methodology by giving their approval and support or convincing their associates of the benefits of data dissemination.

Energy Efficiency Indicators

by P. CAPROS

1. Introduction

The present note aims at proposing how energy statistics should ideally be shaped to cover the current needs of energy policy analysis in view of the large requirements about monitoring and planning the improvement of energy efficiency in the member-states and at the level of the European Commission. The targets related to environmental policy, in particular climate change policy, request considerable effort in the domain of energy efficiency improvement. European-wide debate in this domain have often concentrated on policies and measures defined at a detailed sectoral level because it is believed that the promotion of best available technologies is a key answer to the challenging environmental problems. For this purpose, equipment standardisation, negotiated or voluntary agreements with sectoral associations and monitoring comparing results at a sectoral level are mentioned and used as policy instruments.

To support the growing activity under this policy it is necessary to highly improve the statistical basis and harmonise the information available across the member-states.

The concept of using indicators as a measurement of the progress and of the comparative status of sectors or countries is of course attractive for policy makers. An indicator depends on two factors, the nominator and the denominator. It also depends on the statistical aggregation of the real-world information. For an indicator to be accepted and really useful in policy making, all its constituents have to be transparently known and incontestable. In that case there will be objectivity and progress in the monitoring and policy design.

This requirement calls upon considerable statistical effort, not only to provide statistics for the constituents of an in indicator, but also to provide evidence about how the aggregation might have influenced the apparent change of the value of an indicator. Otherwise, misleading policy conclusions will be drawn out of a poorly understood indicator.

During the recent years, the need of policy to monitor structural change regarding technologies and energy uses has pushed the energy systems analysis to adopt and construct detailed structural energy models and abandon the traditional econometric, hence aggregated, models. The new models attempt to make endogenous how policy factors could drive the required structural changes and mimic how the economic agents may decide to improve energy efficiency while being under market and microeconomic optimisation conditions. The data requirements for this energy systems analysis have grown considerably under these policy needs. This fact has concerned not only the formal mathematical models, like PRIMES extensively used in policy studies of the European Commission, but also other analytical works that have never used a mathematical model. As examples, we can mention the work of the ad hoc group on climate change of the Council of Ministers, and a series of analytical work that supported programmes like Save, Thermie and Joule.

The note below has largely drawn from the structure of data defined in the energy model PRIMES. A similar structure is also followed in the USA in relation to the model NEMS (US/EIA-DOE), in many national teams that maintain the model Markal (Etsap program of IEA/OECD) and by many analysts and consultants in the domain of strategic energy efficiency studies.
The data structure described below will probably be possible to get in an ideal world. Given the limited budget and time, it is expected that part of the data could be found. However it is of utmost important to establish and accept a common data structure and framework even if some data will be missing.

2. General structure

Energy efficiency indicators are of great importance for the energy and environment policy objectives. The presently available information basis is rather poor and disparate. Current policy implementation in the member states, the climate change commitments, the monitoring of the white paper of the Commission on energy efficiency and the monitoring of the policy on cogeneration all require better understanding of the differences across the EU member states consumption sectors and their energy systems and their potential improvements.

In order to have a transparent view of each member state's energy system, given the importance of structural characteristics as regards energy consumption, the effort should be concentrated in the decomposition of energy demand and activity (in economic and/or physical terms) to the most disaggregate level possible. The European economy undergoes considerable restructuring as a result of globalised trade and market competition. To observe energy efficiency it is necessary to observe at a sufficient level of detail the underlying economic activity and structural changes, otherwise the indicators would wrongly be understood as efficiency improvement while in reality just reflecting structural changes.

The information basis to support efficiency indicators must be defined after thorough analysis and standardised to ensure continuity. Such an information basis should be composed of the following levels:

- Activity level: physical and economic activity, revenue or structure statistics
- Energy use structural decomposition scheme
- Useful energy statistics measured at the bottom level of the energy use scheme
- Final energy consumption statistics measured at the bottom level of the energy use scheme
- Efficiency indicators at various level of aggregation

The statistical work on efficiency indicators has to integrate several past and current activities of the Commission and Eurostat, including the following:

- Eurostat surveys on households, tertiary, cogeneration and part of renewables should be restructured and made consistent with the requirements of the efficiency statistical effort
- The methodology of the old Useful energy balances must be revised and the corresponding effort should be re-activated and adapted to the new needs
- Independent surveys carried out through funding from different DG (Research, Thermie, Energy, Environment, Transports) should be re-organised, harmonised and supervised by Eurostat. Examples are:
  - MURE database (Research and Thermie)
  - Ikarus database (national level but indirectly funded in some research projects)
  - ODYSSEE (Save)
  - Several projects of DG environment and research

3. Energy efficiency indicators in Industry

The need for a more in depth analysis as regards energy efficiency indicators in industry is of great importance. Eurostat balances break down energy demand in industry into ten sectors and the suggested efficiency indicators (as described in the first draft on energy efficiency indicators) are not satisfactory enough and may become misleading when doing cross-comparisons across EU member states. There are two reasons that justify this comment.

First, there is no consideration about the internal structure of each industrial sector, a fact that may lead to significant differences of efficiency indicators across member states that cannot

be explained in terms of technology evolution but in terms of production structure. Production structure can be relevant to process technology used (as in the case of iron and steel industry) and/or product output (as in the case of chemical industry).

The second factor that has to be dealt with relates to the use of steam and/or low enthalpy heat in industrial processes. Under conditions of market liberalisation for electricity production there is a tendency of industrial generators to shift from boiler steam production to co-generation production. This tendency is expected to increase in the near future. Given that Eurostat accounts energy requirements for boilers steam in industrial demand, while energy requirements in co-generation plants are accounted as transformation input for auto-producers of electricity, there may be significant discrepancies among member states and from year to year depending on the level of market liberalisation and the penetration of cogeneration.

In order two tackle the above problems one must move towards a further disaggregation of industrial sectors both in terms of production (in economic and/or physical terms) and in terms of energy demand.

Structural decomposition of production and energy demand by type of process technology and/or product cannot be uniform across industrial sectors but should relate to each sector's characteristics. This decomposition will lead to a better information about the structure of the industrial energy system for EU member states, the structural changes and the existing diversifications in terms of production processes, sectors intensiveness, contribution of recycling etc.

Once this decomposition is defined, on the basis of technical information and/or surveys performed by Eurostat as regards the contribution of energy uses to the production process one can determine the steam/low enthalpy heat requirements of industrial sectors as well as the corresponding fuel input. In addition, at this disaggregated level, energy efficiency indicators reflecting installed equipment characteristics and, correspondingly, useful energy requirements can be defined in a more appropriate manner.

The above data definitions allow for a better interpretation of the member states energy system as energy intensity indicators (energy consumption per unit of value), unit consumptions (energy consumption per unit of physical production/activity) and energy efficiency indicators (useful energy to final energy) become available at a more disaggregated level reflecting the underlying structural and technological characteristics of industrial sectors.

A suggested decomposition of industrial sectors is given below:

Iron and steel:
the sector is characterised by the process technology used for the production of iron ore, as there is a significant change in energy requirements depending on whether integrated blast furnaces or electric arc processing is used for the production process.

- Physical production/ Value added by process technology subdivided in integrated blast furnaces (steelworks) and electric arc processing
- Energy consumption by process technology
- Energy consumption by energy use (several subcategories per process type)
- Useful energy requirements by energy use
- Unit consumption/energy intensity indicators for the different process technologies
- Efficiency indicators for the different energy uses.

Chemical industry:
chemical industry produces a large variety of products, which range from energy intensive ones (such as fertilisers) to high value added, low energy intensive ones (pharmaceutics, cosmetics etc.). In addition, a variety of different energy uses and processes are used in chemical industries. In order to obtain a clear view of the sector for each EU member state a

decomposition of energy demand and physical production/value added among the different products is needed.

- Physical production/Value added by type of chemical product (petrochemicals, plastics, fertilisers, inorganic chemicals, low energy chemicals etc.). It is necessary to define an index of volume of production for a few characteristic products of the industry.
- Energy consumption by type of chemical product
- Energy consumption by energy use (several types per product)
- Useful energy requirements by energy use
- Unit consumption/energy intensity indicators for the different chemical products
- Efficiency indicators for the different energy uses.

Non-metallic minerals production:
This is another sector with great diversity among products and their energy requirements. Besides that process technologies used for the production of each product may alter significantly the corresponding energy needs (e.g. wet/dry cement processing, container/flat glass production). Finally the role of glass recycling is also important as regards energy requirements in glass production.

- Physical production/Value added by type of product (cement, glass, ceramics, bricks and tiles, other building materials)
- Energy consumption by type of product
- Energy consumption by energy use (several categories per product)
- Useful energy requirements by energy use
- Contribution of glass recycling to total glass production
- Relative consumption of glass recycling to basic glass processing
- Split of glass production by product type (container glass, flat glass etc.) and relative consumption by product type
- Unit consumption/energy intensity indicators for the different products and technologies where available (e.g. cement, glass)
- Efficiency indicators for the different energy uses.

Non-ferrous metals industry:
the sector produces alumina, aluminium, copper, zinc, lead, nickel and other non-ferrous metals and alloys. Each product has different energy requirements (both in terms of energy consumption and of energy related equipment) and provides different economic benefit to the producer (value added per ton of output).

- Physical production/Value added by type of product (alumina, aluminium, copper, zinc, lead, nickel and other non ferrous metals)
- Energy consumption by type of product
- Energy consumption by energy use (several categories per product type)
- Useful energy requirements by energy use
- Contribution of aluminium recycling to total aluminium production. Similarly for lead and copper.
- Relative consumption of secondary aluminium compared to basic aluminium processing
- Unit consumption/energy intensity indicators for the different products
- Efficiency indicators for the different energy uses.

Paper and pulp industry:
The manufacturing of paper requires that a fibre source (e.g. wood) is chipped, digested, bleached and then formed as slurry (pulping) from which paper is produced. However, the use of waste paper (recycling), instead of wood, reduces energy requirements avoiding the initial processing which is energy-intensive.

- Physical production/Value added by type of product (pulp, paper production)

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- Energy consumption by type of product
- Energy consumption by energy use (several categories)
- Useful energy requirements by energy use
- Contribution of paper recycling to total paper production
- Relative consumption of paper recycling to pulp processing for paper production
- Unit consumption/energy intensity indicators for the different products and technologies
- Efficiency indicators for the different energy uses.

Other industrial sectors:

Other industrial sectors (food, drink and tobacco; textiles, leather and clothing industry; Engineering and other metal industry; and Other industries) are characterised by low energy intensiveness and use of, mainly, cross-cutting technologies.

- Physical production/Value added by sector
- Energy consumption by sector
- Energy consumption by energy use (taking into account the country specific structure of each sector)
- Useful energy requirements by energy use
- Unit consumption/energy intensity indicators by sector
- Efficiency indicators for the different energy uses.

4.   Services sector

Services sector is one of the most important (because of its rapid economic expansion) and difficult to deal with (because of its heterogeneity) energy demand sectors.

A sectoral approach is satisfactory. This could distinguish between: Hotels and Restaurants (NACE 55); Health and Social Work (NACE 85); Education (NACE 80); Other Community, Social and Personal Service Activities (NACE 90-93); Offices and Administration (NACE 60-67, 70-75, 99); Commerce (NACE 50-52). A decomposition by energy use could be: space heating/cooling; lighting and electrical appliances: processes (e.g. bakeries, laundries, super markets etc.).

However, given that energy requirements will be split by energy use one can further proceed to the computation of useful energy requirements (on the basis of technical characteristics of existing energy related equipment). Also because of prospects for the penetration of small scale cogeneration for small district heating/cooling (applied to blocks of buildings), it is necessary to know heat/steam/cooling needs per type of sub-sector and gradually introduce measurements at the level of useful energy.

- Activity data including value added, number of employees, total area in sqm
- Energy demand by energy use (space heating/cooling, lighting, electric appliances, specific processes such as in bakeries, laundries, super markets etc.); care should be devoted to small and dispersed tertiary consumers as compared to large and concentrated consumers;
- Useful energy requirements by energy use and appliance type (for electric appliances)
- Unit consumption/energy intensity indicators for the different sub-sectors
- Efficiency indicators for the different energy uses

The data requirements for the *agricultural* sector should also be split by energy use. The use of renewable energy (agricultural by-products, small scale wind mills for pumping, photovoltaic in the future, greenhouses, geothermal low enthalpy, etc.), has to be better defined.

5. Households

As in the case of services the approach retained for households is also satisfactory. However, one could further elaborate in terms of split of households by type of equipment choice pattern. In fact, the choice of the main heating equipment (an issue of great importance since energy needs and comfort standards of households are highly related to installed heating equipment) influences the choice of energy technology for cooking and water heating. Also the energy consumption behaviour (consumption per households and per sqm) differs substantially depending on the household and technology choice pattern. For example a household using small independent heating consumes less than the same household having central heating. The changes of unit of consumption are largely explained by the shift of the households from one category to another, because of higher income and comfort. It is therefore necessary to define a number of standard energy patterns, classify the households and observe the shifting to other categories.

The following is an indicative list of needed information:

- Activity data including private consumption (households income), number of households, inhabitants per household, sqm per household, appliances per household.
- Structural data concerning the split of households by pattern, for example defined according to the type of main heating equipment. Examples are: central boiler households, households with mainly electric heating equipment, households with mainly direct gas heating equipment, households connected to district heating, non-full heating households
- Energy demand by energy use (space heating, space cooling, hot water production, cooking, specific uses of electricity – electric appliances, lighting) and household type
- Useful energy requirements by energy use
- Unit consumption/energy intensity indicators by household type and energy use
- Efficiency indicators for the different energy uses

6. Transports

Energy demand in transports should be split in two sub-sectors: Passenger transports and freight transports. It is also necessary to split between urban transports, domestic non-urban transports and international transports. This split is additional to the existing Eurostat split between road transports, train transports, aviation and inland navigation. For each sub-sector the following data are needed:

- Activity data including passenger/tonne-km travelled and vehicle-kilometres.
- Structural data: split of activity by transport mean (busses and coaches, motorcycles, cars, light duty vehicles, trains, aviation and inland navigation for passenger transports; trucks, trains and inland navigation for freight transports); stock of vehicles by transport mean and type of vehicle (e.g. gasoline and diesel cars), number of vehicles registered in the reference year by transport mean; average distance travelled by vehicle per year. Decomposition of transport capital in vintages.
- Infrastructure statistics (roads, railways, metro, airports, etc.)
- Specific consumption (lt/100km) of the actual vehicle stock and for newly registered vehicle stock, by transport mean and vehicle type.

7. Appendix: The Data Structure of the Demand-side of PRIMES V.2

7.1 General Structure of the Demand-Side Sub-Models

The demand-side sub-models of PRIMES V.2 have a uniform structure. Each sub-model represents a sector that is further decomposed into sub-sectors and then into energy uses. A technology operates at the level of an energy use and utilises energy forms (fuels). The following graphic illustrates the hierarchical decomposition of the demand-side models.

Decomposition Structure of the Demand-side Models
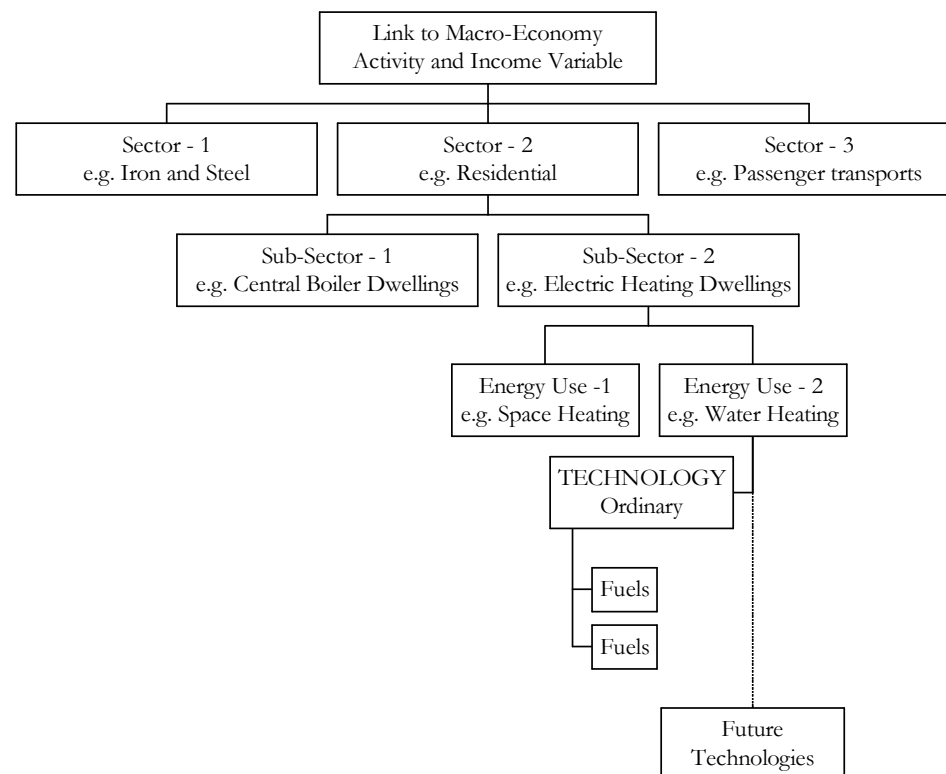
The data that are necessary to calibrate the model for a base year (1995) and a country (all EU member-states) can be divided in the following categories:

- Macro-economic data that correspond to demographics national accounts, sectoral activity and income variables. These data usually apply to sectors.
- Structure of energy consumption along the above-described tree in the base year and structure of activity variables (production, dwellings, passenger-kilometres, etc.). Some indicators regarding specific energy consumption are also needed for calibration.
- Technical-economic data for technologies and sub-sectors (e.g. capital cost, unit efficiency, variable cost, lifetime, etc.).

The basic source of data for energy consumption by sector and fuel is Eurostat (detailed energy balance sheets). By using additional information (surveys of cogeneration operation and capacities and surveys on boilers), we modify the balance sheets in order to represent explicitly the production of steam.

According to PRIMES definitions, steam includes industrial steam and distributed heat (at small or large scale). In the balance sheets, Eurostat reports on steam production in the transformation input/output only if the producers sells that steam. If the steam, irrespectively of the way it is produced (e.g. a boiler or a CHP plant), is used for self-consumption only, Eurostat accounts for only the fuels used to produce that steam and includes these fuels in final energy consumption. Our modification consists in introducing that steam (for self-consumption) in the final energy consumption tables of the balance sheets and inserting the

fuels used to produce that steam in the table of transformation input and output. This is necessary for the model to calibrate to a base year that properly accounts for the existing cogeneration activities (even if they are used for self-generation of steam).

The fuel types are as follows:

Solid fuels except lignite and peat
Lignite and Peat
Residual Fuel Oil
Diesel Oil
Liquefied Petroleum Gas
Kerosene
Gasoline
Naphtha
Other oil products
Bio-fuels
Natural and derived gas
Thermal Solar (active)
Geothermal low enthalpy
Steam (industrial and distributed heat)
Electricity
Biomass and Waste
Hydrogen

Data on fuel purchase prices, with and without taxes, are needed for large customers and small customers.

7.2   Industrial Sector

The industrial sector consists of nine sectors. For each sector different sub-sectors are defined. At the level of each sub-sector a number of different energy uses are represented. A technology at the level of an energy use may consume different types of fuels (one of which is steam generated from the power and steam sub-model of PRIMES, so only steam distribution and use costs are accounted for in the demand-side, together with a price for steam).

The structure for the industrial sector is given below:

SECTORS	SUB-SECTORS	ENERGY USES
Iron and Steel		
	Iron and Steel integrated	
		Air compressors
		Low enthalpy heat
		Lighting
		Motor drives
		Rolled steel
		Sinter making
		Steam and high enthalpy heat
		Blast furnace
		Process furnaces
	Electric arc	
		Air compressors
		Low enthalpy heat
		Lighting
		Motor drives
		Electric arc
		Electric process
		Rolled steel

		Foundries
		Sinter making
		Steam and high enthalpy heat
		Process furnaces
Non ferrous metals production		
	Primary aluminium production	
		Air compressors
		Lighting
		Motor drives
		Electric furnace
		Electrolysis
		Process furnaces
	Secondary aluminium production	
		Air compressors
		Lighting
		Motor drives
		Electric furnace
		Electrolysis
		Process furnaces
	Copper production	
		Air compressors
		Lighting
		Motor drives
		Electric furnace
		Electric kilns
		Low enthalpy heat
		Steam and high enthalpy heat
		Process furnaces
	Zinc production	
		Air compressors
		Lighting
		Motor drives
		Electric furnace
		Electrolysis
		Process furnaces
	Lead production	
		Air compressors
		Lighting
		Motor drives
		Electric furnace
		Process furnaces
	Other non ferrous metals production	
		Air compressors
		Lighting
		Motor drives
		Electric furnace
		Low enthalpy heat
		Foundries
		Process furnaces
Chemicals production		
	Fertilizers	
		Air compressors

		Low enthalpy heat
		Lighting
		Motor drives
		Electric processes
		Steam and high enthalpy heat
		Thermal processes
	Petrochemical	
		Air compressors
		Low enthalpy heat
		Lighting
		Motor drives
		Electric processes
		Steam and high enthalpy heat
		Thermal processes
		Energy use as raw material
	Inorganic chemicals	
		Air compressors
		Low enthalpy heat
		Lighting
		Motor drives
		Electric processes
		Steam and high enthalpy heat
		Thermal processes
	Low enthalpy chemicals	
		Air compressors
		Low enthalpy heat
		Lighting
		Motor drives
		Electric processes
		Steam and high enthalpy heat
		Thermal processes
Building materials production		
	Cement dry	
		Air compressors
		Lighting
		Motor drives
		Low enthalpy heat
		Cement kilns
		Drying and separation
	Ceramics and bricks	
		Air compressors
		Lighting
		Motor drives
		Electric kilns
		Low enthalpy heat
		Tunnel kilns
		Drying and separation
	Glass basic production	
		Air compressors
		Lighting
		Motor drives
		Glass annealing electric

		Glass tanks electric
		Low enthalpy heat
	53	Glass annealing thermal
		Glass tanks thermal
	Glass recycled production	
		Air compressors
		Lighting
		Motor drives
		Glass annealing electric
		Glass tanks electric
		Low enthalpy heat
		Glass annealing thermal
		Glass tanks thermal
	Other building materials production	
		Air compressors
		Lighting
		Motor drives
		Low enthalpy heat
		Material kilns
		Drying and separation
Paper and pulp production		
	Chemical paper	
		Lighting
		Motor drives
		Pulping electric
		Refining electric
		Steam and high enthalpy heat
		Low enthalpy heat
		Pulping steam
		Drying and separation
		Refining steam
	Mechanical pulp and paper	
		Lighting
		Motor drives
		Pulping electric
		Refining electric
		Steam and high enthalpy heat
		Low enthalpy heat
		Pulping steam
		Drying and separation
		Refining steam
Food, Drink and Tobacco production		
	Food, Drink and Tobacco goods	
		Air compressors
		Cooling and refrigeration
		Lighting
		Motor drives
		Drying and separation electric
		Steam and high enthalpy heat
		Low enthalpy heat
		Space heating
		Drying and separation thermal

		Specific heat
		Direct heat
Engineering		
	Engineering goods	
		Air compressors
		Lighting
		Motor drives
		Drying and separation electric
		Machinery
		Coating electric
		Foundries electric
		Steam and high enthalpy heat
		Low enthalpy heat
		Space heating
		Drying and separation thermal
		Coating thermal
		Foundries thermal
		Direct heat
Textiles production		
	Textiles goods	
		Air compressors
		Cooling and refrigeration
		Lighting
		Motor drives
		Drying and separation electric
		Machinery
		Steam and high enthalpy heat
		Low enthalpy heat
		Space heating
		Drying and separation thermal
		Direct heat
Other industrial sectors		
	Other industrial sectors goods	
		Air compressors
		Lighting
		Motor drives
		Drying and separation electric
		Machinery
		Steam and high enthalpy heat
		Low enthalpy heat
		Space heating
		Drying and separation thermal
		Specific heat
		Direct heat

Macroeconomic Data (for each sector, not sub-sector):
- Value added for the industrial sectors in Million ECU90

Production Data (for each sub-sector):
- Index of industrial production – in physical units or an aggregator proxy

Energy Consumption structure:

- Fuel consumption (steam is a fuel) per sector, sub-sector and energy use (in toe) for the base year (1995).

Specific energy consumption data:
- Energy consumption per unit of physical production (preferably at the level of sub-sector). It may be computed if all above data are available.

Useful energy indicator (in toe) at the level of each energy use.
- It requires assumption on average energy efficiency of the energy use in a sub-sector.

Technical economic data for ordinary technology for each energy use
- Capital purchase cost (ECU'90/toe-year) for a unit capacity of an energy use.
- Variable and fixed costs (ECU'90/toe) of an energy use
- Efficiency rate per fuel type and energy use.
- Capital utilisation factor (average yearly load factor in %) of an energy use.
- Lifetime in years.

Statistical data for technology for each energy use:
- Average age in years in the base year (1990).
- Degree of overcapacity in the base year (%)

Technical-Economic data for sub-sectors.
- Non energy related capital investment cost per unit of production
- Non energy and non-capital related operating costs per unit of production
- Price of production of each sub-sector.

7.3   Tertiary Sector

The tertiary sector comprises of 4 sectors. At the level of the sub-sectors, the model structure defines groups of energy uses, which are further subdivided in energy uses defined according to the pattern of technology. The structure is as follows:

SECTORS	SUB-SECTORS	ENERGY USES
Agriculture		
	Lighting	
		Lighting
	Space heating	
		Electric
		Gas connected
		Boiler
		District heating
		Solids
		Greenhouses
	Electrical uses	
		Electrical uses
	Pumping	
		Pumping
	Motor energy	
		Motor energy
Offices and Services		
	Lighting	
		Lighting
	Space heating	
		Electric
		Gas connected

		Boiler
		District heating
		Solids
		Greenhouses
	Air conditioning	
		Electric
		Gas connected
		District heating
	Electrical uses	
		Electrical uses
	Water heating	
		Water heating
Trade		
	Lighting	
		Lighting
	Space heating	
		Electric
		Gas connected
		Boiler
		District heating
		Solids
		Greenhouses
	Air conditioning	
		Electric
		Gas connected
		District heating
	Steam uses	
		Steam uses
	Electrical uses	
		Electrical uses
	Water heating	
		Water heating
Public services		
	Lighting	
		Lighting
	Space heating	
		Electric
		Gas connected
		Boiler
		District heating
		Solids
		Greenhouses
	Air conditioning	
		Electric
		Gas connected
		District heating
	Steam uses	
		Steam uses
	Electrical uses	
		Electrical uses
	Water heating	
		Water heating

Macroeconomic Data (for each sector, not sub-sector):
- Value added for the tertiary sectors in Million ECU90

Employment per tertiary sector
Structural Data (for each sub-sector):
- Index of surface per employee

Energy Consumption structure:
- Fuel consumption (steam is a fuel) per sector, sub-sector and energy use (in toe) for the base year (1995).
- Useful energy indicator (in toe) at the level of each energy use.
- It requires assumption on average energy efficiency of the energy use in a sub-sector.
- Average Thermal integrity of buildings in each tertiary sector
- Technical economic data for ordinary technology for each energy use
- Capital purchase cost (ECU'90/toe-year) for a unit capacity of an energy use.
- Variable and fixed costs (ECU'90/toe) of an energy use
- Efficiency rate per fuel type and energy use.
- Capital utilisation factor (average yearly load factor in %) of an energy use.
- Lifetime in years.

Statistical data for technology for each energy use:
- Average age in years in the base year (1990).
- Degree of overcapacity in the base year (%)
- Technical-Economic data for sub-sectors.
- Non energy related capital investment cost per unit of production of a tertiary sector
- Non energy and non capital related operating costs per unit of production of a tertiary sector

7.3   Residential Sector

The residential sector distinguishes five categories of dwelling. These are defined according to the main technology used for space heating. They may use secondary heating as well. At the level of the sub-sectors, the model structure defines the categories of dwellings, which are further subdivided in energy uses. The electric appliances for non heating and cooling are considered as a special sub-sector, which is independent of the type of dwelling. The structure is as follows:

SECTORS	SUB-SECTORS	ENERGY USES
Dwellings		
	Central boiler households that may also use gas connected to the central boiler (flats)	
		Space heating
		Cooking
		Water heating
		Air conditioning
	Households with mainly electric heating equipment (non partially heated)	
		Space heating
		Cooking
		Water heating
		Air conditioning
	Households with direct gas equipment for heating (direct gas for flats and gas for individual houses)	
		Space heating
		Cooking
		Water heating
		Air conditioning

	Households connected to district heating	
		Space heating
		Cooking
		Water heating
		Air conditioning
	Partially heated dwellings and agricultural households	
		Space heating
		Cooking
		Water heating
		Air conditioning
Electric appliances		
		Washing machines
		Dish washers
		Dryers
		Lighting
		Refrigerators
		Television sets

Macroeconomic Data:
- Population
- Number of households

Structural Data (for each sub-sector):
- Index of surface per dwelling category
- Number of households per dwelling category
- Number of electric appliances (per type) per household

Energy Consumption structure:
- Fuel consumption (steam is a fuel) per sector, sub-sector and energy use (in toe) for the base year (1995).
- Useful energy indicator (in toe) at the level of each energy use.
- It requires assumption on average energy efficiency of the energy use in a sub-sector.
- Average use per year of an electric appliance per household
- Average Thermal integrity of buildings in each category of dwelling
- Technical economic data for ordinary technology for each energy use
- Capital purchase cost (ECU'90/toe-year) for a unit capacity of an energy use.
- Variable and fixed costs (ECU'90/toe) of an energy use

Efficiency rate per fuel type and energy use.
- Capital utilisation factor (average yearly load factor in %) of an energy use.
- Lifetime in years.
- Statistical data for technology for each energy use:
- Average age in years in the base year (1990).
- Degree of overcapacity in the base year (%)

7.5   Transport Sector

The transport sector distinguishes passenger transport and goods transport as separate sectors. They are further subdivided in sub-sectors according to the transport mean (road, air, etc.). At the level of the sub-sectors, the model structure defines several technology types (car technology types, for example), which correspond to the level of energy use. The structure is as follows:

SECTORS	SUB-SECTORS	ENERGY USES
Passenger transports		
	Busses	
		Internal combustion engine
		Electric motor
		Fuel cell
		Gas turbine
	Motorcycles	
		Internal combustion engine
		Electric motor
	Private cars	
		Internal combustion engine
		Electric motor
		Fuel cell
		Gas turbine
	Passenger trains	
		Internal combustion engine
		Electric motor
		Fuel cell
	Air transports	
		Gas turbine
	Navigation passengers	
		Internal combustion engine
Goods transports		
	Trucks	
		Internal combustion engine
		Electric motor
		Fuel cell
		Gas turbine
	Trains	
		Internal combustion engine
		Electric motor
		Fuel cell
	Navigation	
		Internal combustion engine

Macroeconomic Data:
- Gross Domestic Product in ECU'90 for the base year
- Volume of Imports and Exports

Structural Data (for each sub-sector):
- Passenger-kilometres and ton-kilometres per type of transport mean

Energy Consumption structure:
- Fuel consumption per transport mean and transport technology (in toe) for the base year (1995).
- Useful energy indicator (in toe) at the level of each transport technology.
- It requires assumption on average energy efficiency of the energy use in a sub-sector.
- Average use per year of a vehicle per type (kilometres per vehicle per year)
- Average number of passengers per vehicle type
- Technical economic data for ordinary technology for each energy use
- Capital purchase cost (ECU'90/toe-year) for a unit capacity of a transport technology.

- Variable and fixed costs (ECU'90/toe)
- Efficiency rate per fuel type and technology.
- Capital utilisation factor (average yearly load factor in %) of a technology.
- Lifetime in years.

Statistical data for technology for each energy use:
- Stock of vehicles per technology and transport mean
- Average age in years in the base year (1990).
- Degree of overcapacity in the base year (%)

Energy Statistics and Energy Efficiency Indicators in Denmark

by Peter DAL - Danish Energy Agency

The paper has two purposes. First it tries to summarise the work in Denmark on energy efficiencies indicators: How they now are integrated in the energy statistics and how they are used politically. It should be noticed that the Danish Energy Agency is an integrated part of the Ministry of Environment and Energy. Further, it is meant as a contribution to the discussion of what indicators should be implemented by Eurostat and IEA.

## 1.	Background for the Danish work on Energy Efficiency Indicators

Denmark has since the beginning of the 90'ties participated in the Cross Country Comparison on Energy Efficiency Indicators (EnR-Save). This project has been very profitable for the Danish work with indicators. In addition to this Denmark takes part in and follows IEA's work on Energy Efficiency Indicators very closely. The Danish work is very much inspired by the ideas of Lee Schipper. In 1995 Lee Schipper was the main contributor to the publication "Energy Use in Denmark and other OECD Countries", which was issued as a supplement to the Danish energy plan "Energy 2000" (National target - still valid: 20% reduction in CO_2 from 1988 to 2005).

## 2.	Publication of Energy Statistics

Over the last five years the contents of the published Danish energy statistics have been thoroughly changed. In 1994 the statistics were dominated by numerical energy data and key figures in tables supplemented with a few graphs published in booklets.

In the 1998-statistics all tables, including a "make your own table-facility" and graphs can be found on Internet (www.ens.dk). The paper version contains 10 tables and 94 commented graphs.

The graphs refer to:
•	Energy statistics
•	Key figures
•	Energy efficiency indicators
•	Factors and human activity behind the energy consumption

The new format of energy statistics has been very well received. The energy statistics have generated more comments in the press than previously, which has contributed in a constructive way to the political debate on vital energy issues.

Advantages of the new approach:
•	Closer connections between the energy sector and the economic and environmental sectors
•	Creates increasing interest in energy issues in general
•	Easier for the press to communicate vital information
•	Easier for politicians to monitor the development in important areas.

## 3.	Requirements of a "Good Indicator"

For energy efficiency indicators to be implemented in the energy statistics it has been a decisive consideration that the indicators are:

- Well defined
- Reliable (based on sound statistics)
- Well updated (not later than t-2)
- Easy to explain
- Easy to understand

As a result of the two last requirements a number of interesting indicators from the EnR-Save and IEA work have been judged to be so complicated that they are not as yet included in the annual statistics.

4. Energy Efficiency Indicators Integrated in the Danish Energy Statistics

The energy efficiency indicators integrated in the published energy statistics are listed below. At the meeting on the 17th March a number of the indicators will be shown and commented.

Macro level:
- Primary energy intensity (adjusted)
- Final energy intensity (climate adjusted)
- The ratio of final to primary energy consumption (adjusted)

Transformation sector:
- Electricity from CHP as share of total electricity production
- Heat from CHP as share of total heat production

Road transport:
- Energy consumption per person-km
- Energy consumption per ton-km
- Actual energy consumption per km for the car fleet and specific energy consumption for new gasoline cars (test value, ECE)

Agriculture and industry:
- Energy and electricity intensities in agriculture and industry (climate adjusted)
- Energy and electricity intensities in agriculture (climate adjusted)
- Energy and electricity intensities in manufacturing (climate adjusted)
- Energy and electricity intensities in manufacturing at constant structure
- Energy and electricity intensities in construction (climate adjusted)

Tertiary sector:
- Total energy and electricity intensities (climate adjusted)
- Energy and electricity intensities by branch (climate adjusted)

Households:
- Final energy consumption per m^2 (climate adjusted)
- Electricity consumption and private consumption (not really an indicator)
- Stock of electrical appliances
- Specific consumption of electrical appliances

5. Adjustments of the raw data may be needed

There is a common understanding that climate adjustment often is required if the trend in a time series is to be clearly depicted. Also that an adjustment for structural changes can be helpful in many cases when energy efficiency is evaluated.

It is much harder to reach a common understanding when it comes to adjustments in the reported statistics for foreign trade with electricity and border trade with gasoline and diesel. The cases shown below nevertheless reveal that such adjustments can be necessary.

The implication of this is that Eurostat/IEA have to supplement their annual data collection with data that have a systematic, strong influence on the energy efficiency indicators.

Case 1:
The indicators "Primary energy intensity" and "Ratio of final energy consumption to primary energy consumption" with and without national adjustments for foreign trade with electricity.
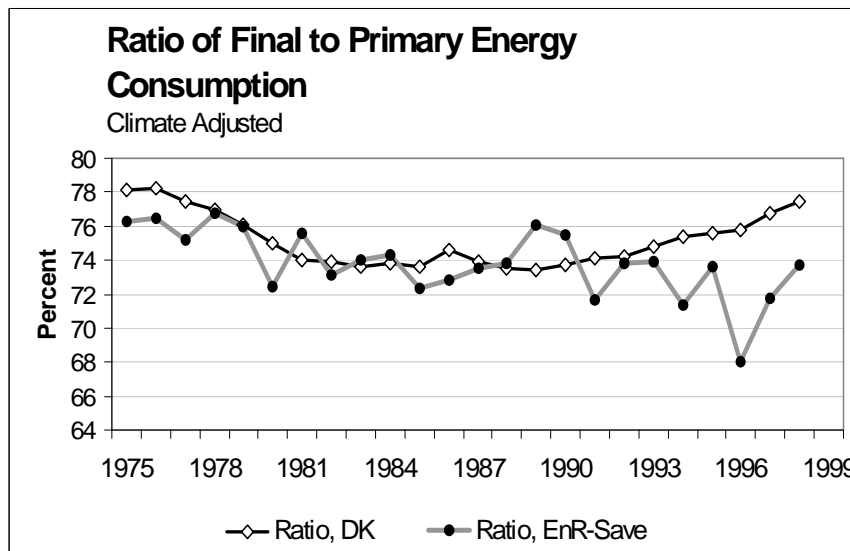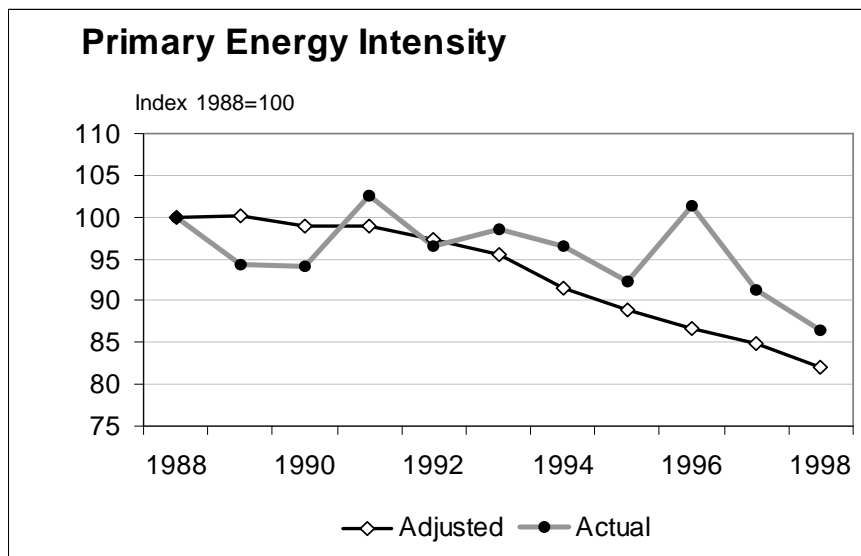
Case 2: The implications of border trade with gasoline
Over past years the price of gasoline in Germany and Denmark has been remarkably different, which has resulted in a border trade of important magnitude. In mid 80'ties the price was lower in Germany, which resulted in a net border trade import. In the mid 90'ties the flow was reversed because of lower prices in Denmark, see the figure. If border trade is not taken care of it can reduce the value of the correspondent indicators.

Gasoline for Road Transport
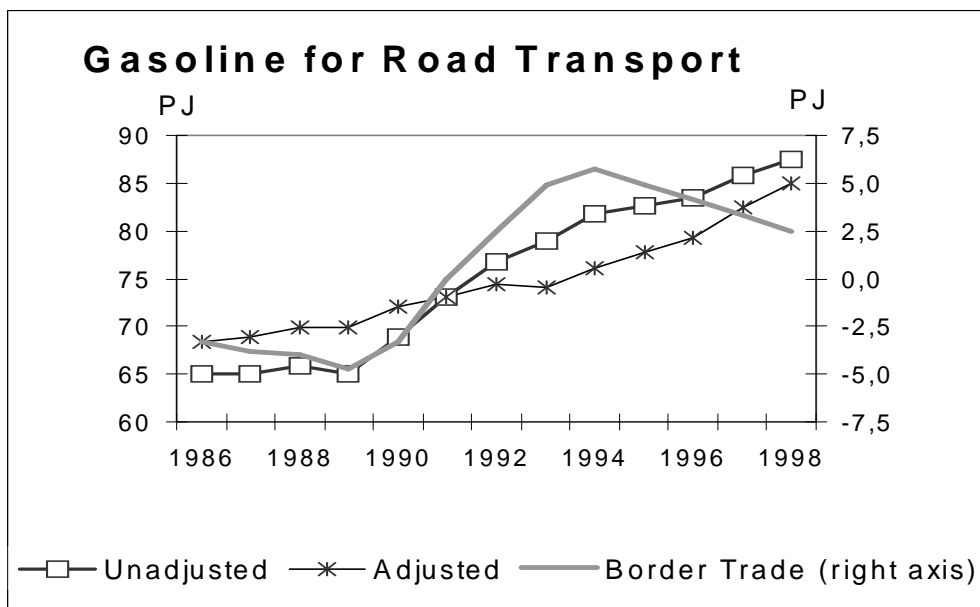
6. International Comparisons: What Should/Can be Compared?

Energy efficiency indicators provide useful and strong instruments for cross country comparisons. Normally there will be an intention to make comparisons between absolute levels as well as trends over time. However, attention has to be given to what really can be compared. Regrettably, there are only few areas in important energy sectors where the performance of the various countries can be directly and satisfactorily compared. The reasons for this can be differences with respect to the energy supply systems, the industrial structure or the climate. Cross country comparisons of the *level* of indicators based on actual (not adjusted) time series will therefore often be of poor value and may easily result in the wrong conclusions.

One way to deal with these problems is to adjust the actual time series so that they fit a common framework of reference, i.e. EU-industrial structure or EU-climate. This procedure is not with out problems.

Case 3: The Indicator for Energy Consumption per Dwelling

Because of a colder climate the indicator (without adjustment) for the Nordic countries will – ceteris paribus – be distributed around a higher level than the indicator of the southern countries.

Adjusted to a common climate EU-reference the opposite will be the case. The Nordic countries will be found well below the southern countries. This is due to the fact that the consumer cost of heating is much higher in the Nordic countries. Therefore the incentives to insulate the dwellings and save money are much stronger.

Alternatively one can choose to disregard the structural and climatic differences between countries and only monitor the trends in each country. This is a safe and unproblematic way to evaluate the performance of each country. But is this altogether satisfactory?

A medium way is to group countries, which show a high degree of similarity in their background and to make comparisons on both levels and trends within each group.

7.   Selection of "Top Ten" Indicators

The work with indicators nationally as well as internationally has progressed much in the last few years. A model for a close co-ordination between the work in Eurostat/EnR-Save and IEA seems now within scope. An important task, which remains to be solved, is to bring the work into a politically acceptable format. Below you will not find any specific recommendations on which indicators should be used in the politically work. Instead some criteria are listed supplemented by a newly political case in Denmark.

Criteria for selection of political useful indicators:

- Observance of the requirements listed on page 2
- Relevance in respect of significant fields of activity
- It should be clear what we want to measure and what purposes the various uses of energy are intended to serve, see case 4
- Concentration of a rather limited number of indicators
- Avoidance of conflicting indicators within a sector, see case 5.

When it comes to the final selection of indicators you will unavailable be confronted with the dilemma: The dilemma between clarity and the complication of the political issues, which also can be expressed as the dilemma between the practical rules of thumbs (political pracmatism) and scientific correctness.

Case 4: What do we want to measure and what are the purposes the various uses of energy are intended to serve?

Passenger Transport
The energy consumption in the transport sector depends on the need of people to be transported and the need of companies to get goods transported (freight). The amount of energy needed to fulfil the demand of passenger transport depends on two factors:

- The number of passengers who buy/take a trip
- The actual number of kilometres each passenger need to be transported

Adding up every passenger's level of transport – measured as total kilometres of transportation in a given year – results in the total demand of passenger transport. However there is often a lack of such detailed data, and as a substitute we estimate the level of passenger demand by multiplying the level of kilometres driven by each mode (bus, car etc.) with the average number of passengers per vehicle.

Regardless of the method of calculation it is the total number of driven/sailed/flown kilometres, which indicates the activity level. The question is "How much energy is used for transporting each passenger each of his/hers kilometres?". This is shown in the figure below. The overall energy intensity of passenger transport – measured as MJ per passenger-kilometre – has decreased with 6 % from 1975-1998 (shown by the thick black line). This means that in average each kilometre of passenger transport is carried out with less energy. It is also seen from the figure that the energy intensity varies a lot across transport modes. Passenger transport by train and bus has much lower energy intensity than transport by cars and aeroplanes. The variation across transport modes can be explained by two things, first

the utilisation factor of the modes varies a lot and, secondly the actual energy use per vehicle kilometre also varies.

The decrease in overall energy intensity could either be caused by increased share of collective modes, higher utilisation factors, or more energy efficient modes. Some of these things will be analysed by decomposing the energy consumption in the national report.

This indicator is good because it shows the country's ability to reduce the amount of energy needed per unit of passenger transport.

Energy Intensity for Passenger Transport

Source: Odyssee database and Nøgletal 1999.
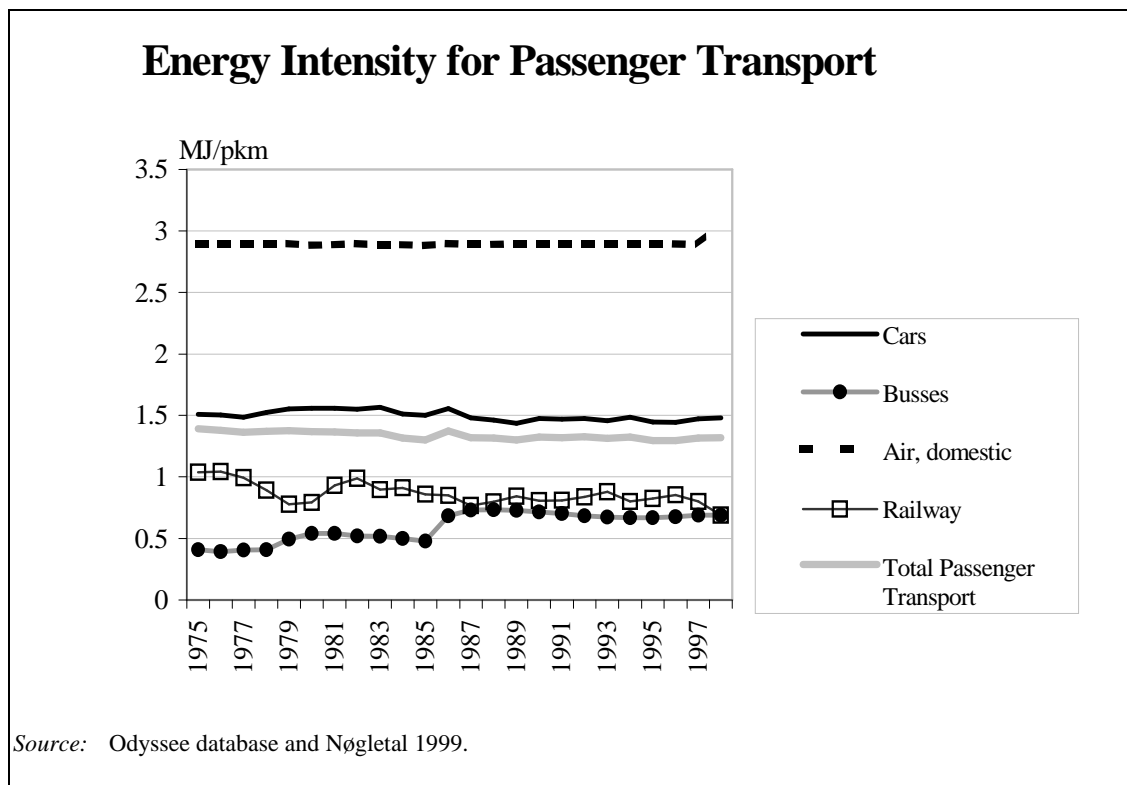
Case 5: The Ministry of Trade and Industry's new strategy plan

In a newly published strategy plan of the Danish Ministry of Trade and Industry a list of targets for the next years is set up. The targets concern many aspects of business conditions in Denmark including improvements in the physical environment.

From the Ministry of Environment and Energy was suggested indicators of energy intensity in agriculture, industry and trade and the service sector assuming a constant structure. However, these indicators were found to detailed and not political usable.

After some negotiation the result was to use cross country comparisons (8 countries) of the indicator "Primary energy intensity".
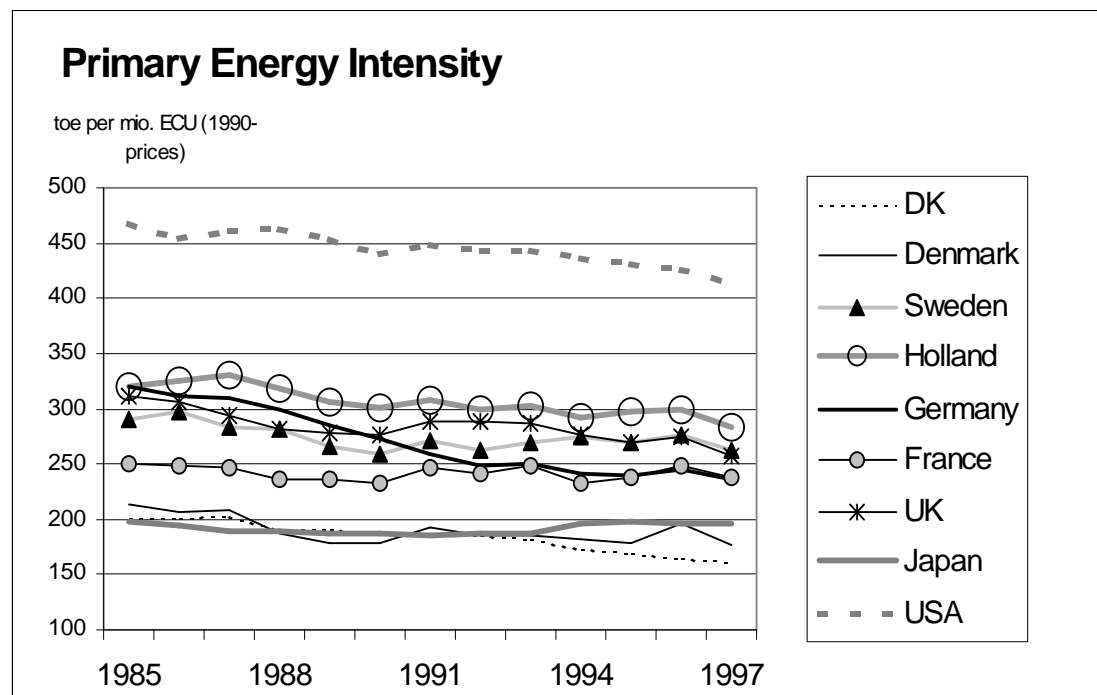
Case 6: What should energy consumption in the tertiary sector be measured against?

When the energy efficiency in the tertiary sector is to be evaluated, there are at least three indicators to monitor. These are the energy intensity "toe per value added-unit" or the unit consumption indicators "toe per 1000 employed" and "toe per 1000 m^2" (all indicators should be climate adjusted).

The figure shows that the result of the evaluation can be strongly dependent on what denominator is used. If you find that it is the value of the services produced (the value added) that count and not the number of persons behind or the floor area required, the energy intensity will be the most important indicator to monitor.

Value Added, Employment and m2 in the Tertiary Sector

Index
1990=100
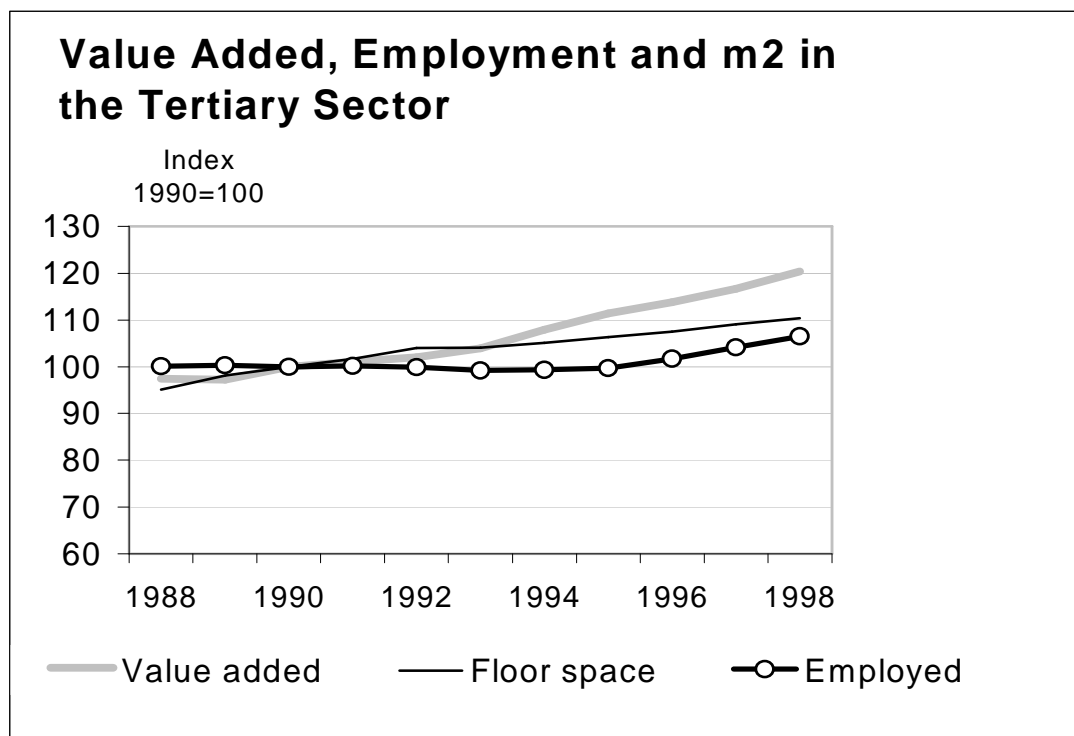
Energy Efficiency Indicators
Priority list

Political background

In order to promote policies, programmes and measures which will provide the intended impact on energy intensity (e.g. SAVE, ALTENER, 5[th] Framework Programme, Structural Funds 1[st] objective, etc.) at the lowest possible cost, it is necessary to establish common effective and reliable monitoring and evaluation indicators. For this to be done, increased co-operation among Member States and international organisations is required to ensure comparability of data and harmonisation of methodology.

Community-level activity in the area of energy intensity and energy efficiency indicators is being increased with a view to developing a set of common harmonised indicators for the Community.

In the Council Resolution on energy efficiency of 7[th] December 1998[4], the Commission was invited to prepare a proposal for a prioritised action plan for energy efficiency as soon as possible. It also states that this Action Plan should take account of the specific measures included in the Resolution, the contribution of other Community policies towards energy efficiency, and indicate Community and Member State responsibilities, particularly regarding financing and timetables.

The Resolution was itself a response to the Commission's Communication on energy efficiency[5] which set out a strategy to achieve a 1% per year improvement in energy intensity by the year 2010 over and above that which would otherwise have been attained. The Council supported this indicative target for the Community as a whole, describing it as ambitious and providing useful guidance at Community level.

Work objectives

Eurostat and the Member States will work closely for the development of energy efficiency indicators in co-ordination with similar activities carried out by the IEA.

Taking into account existing work in this field under the SAVE programme this paper aims to:

- determine the most appropriate indicators relevant to policies
- provide a shortlist of energy efficiency indicators by sector
- identify the data requirements and availability for producing these indicators
- propose alternative indicators to those listed above that may be readily available from existing statistics.

The indicators proposed for each of the following sectors under the heading list of indicators are presented in a hierarchical order. The A0,B0,C0 level indicators are those which ideally respond to policies. If, due to missing data, one of these indicators is not available, level A1, B1, C1 indicators will be produced as an alternative. When these indicators are not available either, then A2 B2 and C2 indicators will be produced.

This approach is adopted on the one hand in order to limit the number of indicators to those which are most essential and closely related to policies and, on the other hand, to neutralise such external effects as structural or climatic variations.

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[4] 98/C 394/01, OJ, 17.12.98.

[5] Energy Efficiency in the European Community – Towards a Strategy for the Rational use of Energy COM(1998) 246 of 29.04.98.

Zero level indicators (e.g. A0, B0, etc.) relate to policy issues. Indicators of a higher level (e.g. A1, A2, etc.) are used as an alternative whenever the necessary statistics for producing the zero level indicator are not available. Higher level indicators are usually less data demanding.

Actions towards such objectives need to be defined at both European and Member State level. Firstly, the availability of information already collected at a European level by other units of Eurostat (e.g. industry, transport or national accounts' statistics) and which are needed for energy efficiency indicators, must be investigated and linked to the energy database.

Secondly the possibility must be examined of extending existing relevant data collection projects and surveys, currently performed within an EU legal framework, (e.g. the family budget survey, PRODCOM, the structural business statistics regulation, etc.) in order to obtain useful data for energy efficiency indicators.

Finally, at Member State level, an in-depth examination of the national energy statistics system is required to identify sources of information and the quality of existing data (surveys, studies or best estimates) as well as to propose actions necessary for improving the system.

Working closely with the national statistical authorities, a specific questionnaire may also be drawn up with a view to producing a harmonised and transparent methodology for indicators and data collection and give a more official and systematic profile to this project. This initiative may also be inspired by similar work carried out under the SAVE programme.

The indicators listed in this document were selected after discussion in the task force meeting on "The future of energy statistics", of March 17, 2000 in Luxembourg.

1.   Macro Energy Efficiency Indicators

Macro indicators are used for the assessment of overall energy efficiency in Member States and the European Union.

Macro indicators usually refer to the gross inland consumption or final energy consumption intensity of a country, taking into account the use of resources, the transformation sector and final energy consumption.

Data required for macro indicators are on aggregate level and therefore availability is good. These indicators are used for observing trends over time at national level and also for country to country comparisons, taking into account existing structural and climatic differences. Macro indicators cannot be easily associated to specific measures or factors influencing energy efficiency. In particular the effects of structural changes are not isolated. For this reason indicators A0 and A2 are proposed as an attempt to isolate this effect.

List of macro indicators:
A0. Final energy intensity at constant GDP structure[6] with climatic correction (kgoe/EC90)
A1. Final energy intensity with climatic correction (kgoe/EC90)
A2. Final energy intensity at constant GDP structure (kgoe/EC90)
A3. Final energy intensity (kgoe/EC90)

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[6] The final energy intensity at constant structure is a fictitious value of the final energy intensity, calculated by assuming that the structure by sector is unchanged since the base year and by taking into account the actual variation in energy intensity of each sector. For industry and tertiary sectors, the energy intensities are calculated as the ratio of final energy consumption to value added. For these sectors, a constant GDP structure means that their value added increases at the same rate as GDP. In industry, the intensity is measured at constant structure of industrial value added, among the usual 10 divisions. For transport the energy intensity is calculated as the ratio of transport energy consumption to GDP. For the residential sector, finally, the intensity is calculated as the ratio of household energy consumption to private consumption. For this sector, a constant GDP structure means that the private consumption increases at the same rate as the GDP.

B0. Gross inland consumption intensity (kgoe/EC90)
C0. Ratio of final to primary energy

2. Energy Efficiency Indicators for Transport

Road transport is the most important mode as far as energy consumption is concerned. Air transport, although small in terms of energy consumption, is expanding fast. Thus, we concentrate on indicators for only these two modes.

For road we distinguish:
car (passengers)
trucks (freight)
light vehicles (encompassing all petrol vehicles)
heavy vehicles (diesel trucks and buses).

For air transport only passenger air transport is considered here.

List of indicators for transport:

Road transport indicators for passenger cars
A0. Test specific consumption (l/100 km) of new cars: separately for diesel and petrol-driven cars.
This is a weighted average by the sales of different models of cars per year: specific consumption (l/100 km) of a model according to specifications.
B0. Car efficiency (l/100 km) of actual stock in a country: separately for diesel and petrol.
This is the total consumption of petrol-driven passenger cars over one year in a country divided by the number of cars and average number of km per car and year.
C0. Fuel consumption of passenger cars per passenger kilometers (l/pass. x km)

Road transport indicators for trucks (freight)
D0. Specific consumption (l/ton x km) of diesel per ton of freight and km of transport.

Air-passengers
D0. Specific consumption (t/passenger x km).
D1. Unit consumption (toe/passenger).

3. Energy Efficiency Indicators for Industry

The rational use of energy in industry is closely linked to the competitiveness of EU industry and impact on the environment.

In the existing Eurostat energy balances the manufacturing industry is broken down into the following ten divisions:

1. Iron & steel industry
2. Chemical industry
3. Glass, pottery & building mat. industry
4. Non-ferrous metal industry
5. Ore-extraction industry
6. Food, drink & tobacco industry
7. Textile, leather & clothing industry
8. Paper and printing
9. Engineering & other metal industry
10. Other industries

In 1997 industry accounted for 28% of the final energy consumption, half of which was consumed in the first three above-mentioned branches. There are two possible interpretations of energy efficiency in industry: the economic interpretation (how much energy is required to produce one unit of value-energy intensity) and the physical interpretation (how much energy is required to produce a unit of certain product's quantity-unit consumption).

Current data availability is very good for both industrial energy consumption and value added and statistics. It is however important to decide to what level of detail efficiency indicators should be introduced in order to explain the sector's behavior. Structural changes also influence energy use, such as imports of energy intensive components, changes in the technologies used (e.g. replacement of oxygen furnaces with electric furnaces) and production diversification. Eurostat data at this stage are not sufficient in order to track such structural changes.

List of indicators for industry-energy intensity
A0. Energy intensity of industrial groups at NACE 3-digit level (ktoe/EC90)
A1. Energy intensity of the industry as a whole and of the divisions (Eurostat/IEA breakdown) (ktoe/EC90)
B0. Energy intensity of the industry as a whole at constant (value added) structure (ktoe/EC90)

List of indicators for industry-unit consumption
In this case the final energy consumption is linked to the physical (volume) production. The physical volume of production may depend on the technology used (electric arc etc. in iron and steel industry) or final product (fertilizers etc. in chemical industry) and in such a case the final energy consumption must be determined separately for each technology/product. This information is currently not available to Eurostat, although extensive work has already been done elsewhere. Availability of such data at Member State level would allow unit consumption calculations (toe/t) at technology or product level for at least the three larger industrial consumers - iron and steel, chemical and glass and the pottery and building material industry.

List of indicators for industry- unit consumption
C0. Unit consumption of energy intensive industries (toe/t)

4. Energy Efficiency Indicators for Households

Energy consumption in households comprises the following end-uses:

- space heating
- hot water production
- cooking
- specific uses of electricity (electrical appliances, lighting)

Space heating is by far the largest end use. Separation of energy consumption by end-use implies a considerable effort in data collection. The two surveys financed by Eurostat over the last ten years have contributed towards this direction.
The household sector has been the target of various Community and national programmes to improve energy efficiency, namely:

- space heating : national standards for thermal insulation of dwellings, financial incentives for renovation of existing dwellings
- specific uses of electricity: mandatory labelling of electrical appliances (EU), DSM programmes for more efficient use of electricity

Energy consumption in space heating (the major end-use) depends on the external temperature, technical improvement of systems, fuel switching and insulation standards as well as standard of living (size of dwelling, houses versus flats, level of comfort).

Efficiency indicators should address different end uses targeted by separate policies, isolating factors affecting energy consumption.

List of indicators for households:
A0. Unit consumption per m^2 for space heating with temperature correction (toe/m²)
A1. Unit consumption per equivalent dwelling with temperature correction (toe)
B0. Unit consumption per equivalent dwelling for lighting and electrical appliances (kWh)

5. Energy Efficiency Indicators for Services

The characteristics of the services sector as far as data collection and indicators are concerned are as follows:

- It is the most heterogeneous sector,
- It is less known, information often being obtained by subtraction from other better known sectors, e.g. households,
- Its importance is increasing due to its economic expansion,
- Electricity is the fastest growing energy source used.

In the project financed by Eurostat and DG TREN the following divisions were identified for the services sector. Statistics on energy consumption by fuel and use will be collected:

1. Hotels and Restaurants (NACE 55)
2. Health and Social Work (NACE 85)
3. Education (NACE 80)
4. Other Community, Social and Personal Service Activities (NACE 90-93)
5. Offices and Administration (NACE 60-67, 70-75, 99)
6. Commerce (NACE 50-52)

The main uses of energy in the sector, where energy-saving policies have been drafted, are:

for space heating/cooling:
Building regulations for thermal insulation, central or district heating/cooling use, co-generation, etc. are often the subject of policy makers

for lighting and electrical appliances:
This is an important component of most of the above six sub-sectors. The results of policy measures and technological progress towards more efficient appliances is evident, e.g. equipment labelling and high-efficiency lamp bulbs.

for processes:
This is an important component for some sub-sectors where processes are energy-intensive (usually electricity) e.g. bakeries, laundries, supermarkets, etc.

List of indicators for services:
A0. Energy intensity of the sector temperature corrected (kgoe/EC90)
B0. Unit consumption of services sector for space heating per m² with temperature correction (toe/m²)
B1. Unit consumption of services sector for space heating per person employed with temperature correction (toe/per.)

C0. Unit consumption of electricity (excluding electricity for space heating) of the services sector per m² (kWh/m²)
C1. Unit consumption of electricity (excluding electricity for space heating) of the services sector per person employed (kWh/per.)
D0. Electricity intensity (kWh/EC90)

Due to the heterogeneous nature of this sector the production of these indicators by sub-sector would be of particular interest.

6. Energy efficiency indicators for the transformation sector

The conversion of primary fuels into electricity and heat is associated with transformation losses in the power stations or district heating plants. These losses depend on the structural characteristics of plants such as the technology and fuel used for electricity and/or heat generation as well as the age of the machines, the use of the associated to the electricity heat produced (CHP), etc.

The transformation sector has been the target for policy initiatives and programmes aiming to improve energy efficiency. One of the most important at EU level was the Communication (COM(97)514) from the Commission to the Council and the European Parliament: 'A Community strategy to promote combined heat and power (CHP) and dismantle barriers to its development'. This document sets as its target the doubling of the percentage of electricity generation from CHP from 9% to 18% by 2010.

List of indicators for the transformation sector:
A0. Efficiency for electricity generation from nuclear energy(%)
B0. Efficiency for electricity generation from fossil fuels(%)
C0. Percentage of the CHP electricity to the total thermal electricity generation (%)
D0. Overall efficiency of public power plants (%)
E0. Overall efficiency of autoproducers power plants (%)
F0. Overall efficiency of district heating plants (%)
G0. Overall efficiency of refineries (%)

Existing legal basis and surveys
relating to energy efficiency indicators
data requirements

Introduction

As mentioned in the document on Energy Efficiency Indicators the possibility should be examined of extending existing relevant data collection projects and surveys currently performed within an EU legal framework (e.g. transport related regulations, the family budget survey, PRODCOM, the structural business statistics regulation, etc.) in order to obtain useful data for energy efficiency indicators. The existing relevant legal frameworks are presented below:

European Regulations and Surveys

As data required for energy efficiency indicators are often not directly linked to energy statistics but to other statistical domains such as transport, industry statistics, etc., research was carried out to find out what information is provided on a regular basis to Eurostat within the context of a legal framework which could be of use to this project.

In summary, it was found that:

- for transport sector indicators one Regulation exists concerning freight transport by road, for passenger air transport there is a voluntary database, but nothing for passenger cars;
- for industry sector indicators there is the Regulation on Structural Business Statistics;
- for household's sector indicators there is the family Budget Survey;
- for services sector indicators nothing was found;
- for transformation sector indicators there is the PRODCOM Regulation (for CHP).

1. Council Regulation (EC) No.1172/98 of 25 May 1998 on Statistical returns in respect of the carriage of goods by road

1.1 Subject and scope

Each Member State will compile Community statistics on the carriage of goods by road by means of road vehicles transporting goods which are registered in that Member State and on the journeys made by such vehicles.

This Regulation shall not apply to the carriage of goods by road by means of:

- road vehicles transporting goods whose authorised weight or dimensions exceed the limits normally permitted in the Member States concerned;

- agricultural vehicles, military vehicles and vehicles belonging to central or local public administrations, with exception of goods road vehicles transporting goods belonging to public undertakings, and in particular railway undertakings.

Each Member State may exclude from the scope of this Regulation road vehicles transporting goods whose load capacity or maximum permissible laden weight is lower than a certain limit. This limit may not exceed a load capacity of 3.5 tonnes or maximum permissible weight of 6 tonnes in the case of a single motor vehicle.

1.2   Data collection

It is specified in the Regulation that Member States shall compile statistical data relating to the following areas:

- vehicle-related data
- journey-related data
- goods-related data

These variables are defined in detail the annex of the Regulation. Much of the information listed is of interest in the context of energy efficiency indicators, the most important being the tonnes*kilometres which is required for road transport indicator.

2.   Draft Council Regulation (EC) on Statistical returns in respect of carriage of passengers, freight and mail by air

2.1   Subject and scope

The scope of the proposed Regulation is to provide the Community institutions with comparable, consistent, synchronised and regular statistical data about the scale and development of the carriage of passengers, freight and mail by air within the Community or to and from the Community.

This Regulation covers the carriage of passengers, freight and mail on all commercial air services to and from Community airports as well as the total aircraft movements at Community airports.

2.2   Data collection

The variables defined in the annex of the proposed Regulation which refer to statistics are number of passengers, freight and mail, flight stages, passenger seats available and aircraft movement.

This proposed Regulation was not adopted by the Council but a voluntary database exists.

The only information of use to this project currently available to Eurostat is the number of passengers.

3.   Council Regulation (EC, EURATOM) No 58/97 of 20 December 1996 concerning Structural Business Statistics

3.1   Subject and scope

The objective of this Regulation is to establish a common framework for the collection, compilation, transmission and evaluation of Community statistics on the structure, activity, competitiveness and performance of business in the Community.

3.2   Data collection

The statistics to be compiled which may be used to calculate energy efficiency indicators relate to purchases of energy products (in value) namely, hard coal, coke, patent fuels, gas oil, heavy fuel oil, other petroleum products, natural gas, derived gas, renewable energy, heat and electricity. The domains referred to in Annex 2 'Detailed module for structural statistics in

industry' of this Regulation cover NACE Rev. 1 classification sections C and D at 4-digit level. A great advantage to indicators is that at the same time value added is also reported.

Many Member States have asked to opt out for the first four years. However, data are available in the Eurostat database on purchases of energy products (in value) for NACE section C (mining and quarrying) in 1997 for Belgium, Spain, Ireland, Austria, Portugal and Finland and for NACE section D (manufacturing) in 1997 for Belgium, Denmark, Spain, Ireland, Austria, Portugal, Finland and Norway.

The proposed frequency of data collection for the section on energy commodities is at least every five years but the reference year for future data collection has not yet been decided.

4.   Family Budget Survey

The family budget surveys give a detailed picture of the structure of consumption expenditure in households. They also provide valuable information about household characteristics and accommodation.

Data is presented in different ways in order to cover several socio-economic variables such as the socio-economic category of the head of household, the income category, the type of household, the degree of urbanisation or the region.

This information is collected at a national level. There is no European legislation regulating this collection, but it is a well-established process in all Member States. The reason for this is the need to know living conditions and patterns of consumption in households and, at the same time, to obtain the necessary statistical support in order to calculate consumer price indexes by providing the weightings applicable to each of their components.

The surveys have been conducted every five years so far. The last complete survey had 1994 as its year of reference (in some countries data were obtained in 1993 or 1995), and the results were published by Eurostat last year. The following survey was carried out in 1999 but the results will not be available until 2001.

The family budget survey provides certain information that could be used to calculate energy efficiency indicators in households such as:

- the average expenditure on energy by type of fuel (electricity, gas, liquid fuels and solid fuels)
- information about the type and size of dwelling as well as its year of construction.
- the availability of some electrical appliances (TV sets, videos, home computers, washing machines, dishwashers, etc)

5.   Council Regulation (EEC) No 3924/91 of 19 December 1991 on the establishment of a Community Survey of Industrial Production

5.1   Subject and scope

PRODCOM is the title of EU production statistics for mining and quarrying, manufacturing, and electricity gas and water supply, i.e. NACE Rev. 1 sections C, D, and E.

The basis of the survey is Council Regulation 3924/91 on the establishment of a Community Survey of Industrial Production (PRODCOM Regulation (EEC) No. 3037/90 on the classification of economic activities in the EU. In accordance with the above-mentioned Regulation, production is to be recorded according to the product headings of the PRODCOM list.

5.2   Data collection

The survey covers information on the physical volume and value of production sold during the survey period for each heading. The headings which may provide useful information for energy efficiency indicators are:

Manufacture of motor vehicles (NACE 34.10):
under this heading information is required by vehicle type, engine size, fuel use, etc.

Manufacture of motorcycles (NACE 35.41):
under this heading information is required by motorcycle type and engine size.

Production and distribution of electricity (NACE 40.10):
Steam and hot water supply (NACE 40.30):
these headings provide a legal basis for Combined Heat and Power plants statistics which are useful for transformation sector indicators.

Eurostat Energy Statistics Division surveys and studies

Over the last 10 years Eurostat has, in conjunction with the financial assistance of the former Directorate General for Energy (principally funds from the ALTENER and SAVE programmes) and the Directorate General for Research, initiated specific surveys in the Member States on:

•   energy consumption in households (1988 and 1996)
•   energy consumption in services (1996-1998)
•   combined heat and power plant statistics (1994, 1996, 1997 and 1998)

In addition to its value in terms of methodology, this work provides a useful source of harmonised information for energy efficiency indicators. Moreover, future surveys will be more orientated towards the provision of data for energy efficiency indicators.

The objective of Eurostat in carrying out such actions is to encourage and help to improve national statistics in both politically important as well as less well-covered statistical fields. The data from these surveys are available to Eurostat and generally published in separate publications.

French Experience on the Use of Energy Balances for Air Emission Inventories

by Jean-Pierre FONTELLE – CITEPA

Introduction

This paper presents some general thoughts about the use of energy balances for the preparation of air emission inventories in France.

1.   Description of the french air emission inventory system

The French system, for producing air emission inventories is based on a unique core database. This database is sufficiently detailed to fulfil most requirements from internationally selected needs especially those in relation to international conventions [UNFCCC (United Nations Framework Convention on Climate Change) and UNLRTAP (United Nations Economic Commission for Europe/Long Range Trans-Boundaries Air Pollution)].

In practice this database is the final step of a complex process starting with primary data collection followed by stages of processing and the implementation of intermediate databases and models.

The resulting database is used to serve clients by means of specific interfaces which enable the production of specific inventories - so called formats.

The different current formats provided are :

IPCC:[a]   Related to the UNFCCC and EU CO_2 Monitoring Mechanism . This format will soon be extended to comply with the new UNFCCC/CRF specifications. It includes an extended geographical coverage (metropolitan and overseas territories).

UNECE:[b]   Related to the LRTAP (EMEP area only).

EMEP   Related to the LRTAP (every 5 years according to the EMEP grid – 50 x 50 km cells)

SECTEN   specific format used by CITEPA to display emissions from the main economic actors included, long time period data and various assessments.

NAMEA[c]   Related to the NACE nomenclature (EUROSTAT).

GIC (LCP)   Related to the Large Combustion Plant Directive (European Commission).

DEPART   geographical distribution of emissions at NUTS II and III levels (regions and departments).

PRQA   geographical distribution of emissions at detailed levels (subdivisions of departments and urban areas > 100 000 inhabitants).

Other formats on request.

[a] Intergovernmental Panel on Climate Change
[b] United Nations Economic Commission on Europe
[c] National Accounts Matrix including Environmental Accounts

Unfortunately, most of the international formats are not harmonised; geographical coverage, substances, emitting activities and source category definitions vary.

These discrepancies lead to inconsistencies in all European countries and result in special data treatment, flawed comparisons and supplementary effort.

In France, as in other countries, the national energy balance and detailed energy statistics are used extensively to perform air emission inventories.

The national energy balance provides the framework and the sectoral approach is implemented because it is more convenient for obtaining relevant emission estimations for many substances (it would not be justified if CO_2 was the only gas concerned).

The weakest points are developed here. They deal on the one hand with international causes and on the other hand with national circumstances.

2. Geographical specificity

The geographical area represented by "France" depends on the inventory :
for UNFCCC : "France" includes in the national total the sum of emissions occurring in Europe (metropolitan France) together with those occurring in overseas departments (DOM)[7] and those occurring in overseas territories (TOM)[8].

- for UNECE, EMEP, NAMEA : "France" includes only emissions from the territories located in the EMEP area (metropolitan France).

- for EU implementation (LCP directive and other directives) : the coverage is metropolitan France plus the overseas departments.

In practice, for reasons of consistency there is an exception in that for the EU CO_2 Monitoring Mechanism, emissions declared are identical to those provided to UNFCCC.

These geographical considerations introduce some difficulties with regard to energy statistics:

- inquiries and statistics are carried out by different operators.

- completeness and consistency are not as good for overseas areas as they are for European areas and there are possible misuses of energy data.

- operational combustion conditions are not necessarily the same : differences in behaviour, climatic conditions, type of fuels (e.g. cane-trash). But the emission factors used are generally the same.

- problems with definition of "international" traffic and related energy budgets especially for air traffic (key points are overlapping, intermediate stops, tankering, etc.).

Fortunately, the energy consumed in DOM and TOM represent only a small percentage (<3%) of the total French energy budget.

Other countries may have similar problems: e.g., Denmark (with Greenland), the UK and the United States. The status of their non-metropolitan territories may be different and the question may not be relevant.

3. International discrepancies in air emission inventory definitions

Once again international commitments are based on heterogeneous definitions.

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[7] Guadeloupe, Martinique, Guyane, Ile de la Réunion, St Pierre et Miquelon, Mayotte.

[8] Nouvelle Calédonie, Polynésie Française, Wallis et Futuna.

For the UNECE, CO_2 has to be reported as for the UNFCCC but this rule is not applicable to other substances. Thus the road transport energy balance used should be based:

- on sales, whatever the substance is, for the UNFCCC.

- on sales for CO_2, on actual consumption for other substances, for the UNECE.

For maritime and air traffic, different phases of traffic are also considered (cf. section 5.5).

For CO_2 and SO_2, emissions can be easily calculated for both fuel sale and fuel consumption, but for other substances it is quite tricky to manage two different energy budgets and related traffic assumptions and data.

4. Timeliness and data availability considerations

Each year's national energy balance is available by the spring of the next year. However, some difficulties still occur:

- due to further revision of the data, a year or more may elapse.

- due to later availability of detailed data by sub-sectors of industry - share of energy uses, fuel characteristics (e.g. sulphur content) etc. - which is not always provided within one year.

- due to a two-year delay in getting some data (e.g. bio-mass and renewable energy statistics from Eurostat). It should be noted that until 1999, the French Energy Observatory did not include non-commercial fuels in its statistics; however from this year more relevant information is available.

5. French sectoral considerations

As the French inventory system is based on a sectoral approach, the availability of relevant breakdowns of energy data by sector, fuel use and fuel type is essential.

The national energy balance provide data for aggregated type of fuels and large branches. Fuels are:

- Coal and lignite
- Coke and patent fuels
- Petroleum products
- Natural gas
- Other gases
- Electricity (not used in the inventory because of the approach which is source-oriented)
- Renewable energy (not used in the inventory because of air emissions do not occur or because figures are incomplete - as for bio-mass fuels).

Branches are:

- Energy industries including oil and gas refineries, electricity production (power plants and auto producers), collieries and statistical adjustments.
- Steel industry
- Industry (except steel)

- Residential and tertiary including district heating
- Agriculture
- Transports
- Non-energy consumption

More detailed data are delivered by different data producers involved in the national energy balance process. Therefore, supplementary data are made available:

- Data for industrial sectors including petroleum products breakdown (petroleum coke, heavy fuel-oil, gas-oil, LPG and other petroleum products). Data are also available (but in a more aggregated fuel category) at the level of economical nomenclatures (NAF which is equivalent to the NACE). Some of them are classified as confidential due to statistical criteria and therefore are not accessible. To go further is possible but requires an official special agreement to access the individual data.

- Detailed data on residential and tertiary activities are published but generally late (approximately 18 months after the year concerned).

- Some limited information is also available for agriculture.

- Energy data related to transport are available by fuel and by mode. Supplementary information may give access to more refined data but only by means of top-down considerations.

- Non-energy consumption can be obtained with differentiation of petroleum products.

At this stage the limitations noted in the use of energy data deal with:

- Lack of reliable data on energy use (share in boilers, machinery, process, crude material, etc.).

- Lack of reliable data on bio-mass fuels (better global figures are now expected to be available but details still not sufficiently comply with environmental needs. Eurostat partly provides similar data but at a later date (approximately within 18 months).

- Timeliness of data with regard to the official schedule for submission. It should not be forgotten that after delivery of energy data, a certain period of time is necessary to compile the inventory itself, to validate the results, to prepare the reports and then to deliver them.

- Failure of energy balances and supplementary data to fulfil all emission inventory needs, especially concerning sectoral coverage.

It should be noted that these problems have few consequences on global CO_2 emissions because there are very few that depend on operational conditions. Moreover, the national system is organised in such a way that surrogate data are used when data are missing (previous year's report, projection, expert review, etc.). Consequently, major mistakes should not occur but uncertainty is temporarily higher and updates are absolutely necessary in subsequent years.

The inventory process makes up for these problems as follows:

5.1 Energy industries

Almost all plants are investigated on an individual basis (most of them belong to the Large Combustion Plant category covered by directive 88/609 (> 50 MW). The LCP inventory

achieved each year includes approximately 300 plants and takes into account the actual characteristics of fuels consumed (NCV, sulphur content) and combustion / control devices.

UNFCCC and UNECE classifications take district heating into account while it is included in the national energy balance under the item "residential and tertiary". Data coming from a specific inquiry permits a complete overview which is made explicit with the information provided by the LCP inventory.

5.2   Industry including steel

The national energy balance reports auto-production of electricity in energy industries, but supplementary energy statistics provide total industrial fuel consumption whatever its use. The latter data are used as reference.

By using this information combined with other data and assumptions, the total amount of fuel consumption Q is subdivided into different parts:

- Allocation of a quantity Q1 to industrial machinery

- Allocation of a quantity Q2 to industrial energy processes (combustion with contact)

- Use of industrial LCP data (combustion with contact split in > 300 MW and 50 – 300 MW categories) ; respectively Q3 and Q4

- The balance Q5 which corresponds to remaining equipment such as gas turbines, stationary engines, boilers < 50 MW and other combustion equipment (all referring to combustion without contact) is calculated as Q5 = Q – (Q1 + Q2 + Q3 + Q4)

5.3   Residential and tertiary

The national energy balance includes in this category "district heating" which is estimated separately (see above). Therefore, a correction is done to consider only relevant activities as regards inventory specifications.

Military fuel consumption is included in this branch, but cannot be identified because of confidentiality rules. Consequently, fuels used in mobile military engines are counted as fuel used in stationary equipment resulting in a lack of reliability for emissions for substances such as NOx, CO and NMVOC (CO_2, SO_2, heavy metals are practically not affected). However, the order of magnitude of the amount of fossil fuels in turn is less than 3 % of the branch.

5.4   Agriculture

Fuel data consumption is allocated to different uses of machinery.

5.5   Transports

Energy data are available for different modes and fuels.

5.5.1 Road
Emissions are calculated by using the COPERT model which is based on the national energy balance of road traffic fuels. The consistency between different requirements has already been discussed in a previous section. Emissions are reported in a transparent way in order to make other arrangements possible. Due to uncertainties linked to all factors involved in the determination of emissions, the impact for substances such as NOx, CO, NMVOC, N_2O, PAH and other non-related mass balance pollutants is probably negligible. It is different for CO_2.

5.5.2 Inland waterways
No particular difficulty is observed with regard to the energy balance.

5.5.3 Railways
No particular difficulty is observed with regard to the energy balance.

5.5.4 Maritime
Energy data provide details for fishing and marine bunkers. Due to particular definitions in international reporting, it is necessary to estimate separately the share of fuel consumed relative to national traffic on the basis of movements and fuel consumption functions. The French contribution to international traffic is calculated as the balance between the total bunker fuels and the amount allocated to the national traffic.

5.5.5 Air traffic
Energy data do not provide the necessary details for air emission inventories. It is necessary to calculate fuel consumption for the following cases:

- *National* traffic below 3000 ft on landing or take-off (LTO)
- *International* traffic below 3000 ft (LTO)
- *National* traffic over 3000 ft (cruising)

This consumption is calculated from traffic data including the type of plane/engine, airport, route, etc. and from fuel functions.

International traffic over 3000 ft (cruising) is calculated as the balance between the global energy budget and the sum of the three cases of fuel consumption listed above. In fact, this balance represents only the French contribution to international air traffic.

Some particularly French geographical aspects (traffic between Europe and French territories outside Europe) can make the question quite complicated to solve. Similar difficulties also occur at EU level because the domestic traffic for EU overlaps with domestic and international (for a part) traffics from Member states.

For 1998, CO_2 emissions reported under international items represented 20.3 Tg which corresponds to less than 6 % of national total net CO_2 emissions (4 % when excluding removals).

5.6 Non-energy use

These data are useful to check whether the various data used and results are consistent or not. They are also useful for estimations of other processes.

5.7 Global reconciliation

Each item of the national energy balance does not fulfil exactly the air emission inventory needs. However, existing data and relevant treatment permit the reconciliation of the sectoral approach with the global energy balance. Small differences observed when comparing the reference and the sectoral approaches are mainly due to the relative inaccuracy of different energy statistics, the discrepancy introduced when considering by-products instead of primary fuels, the use of different definitions or fuel characteristics such as actual NCV instead of default values.
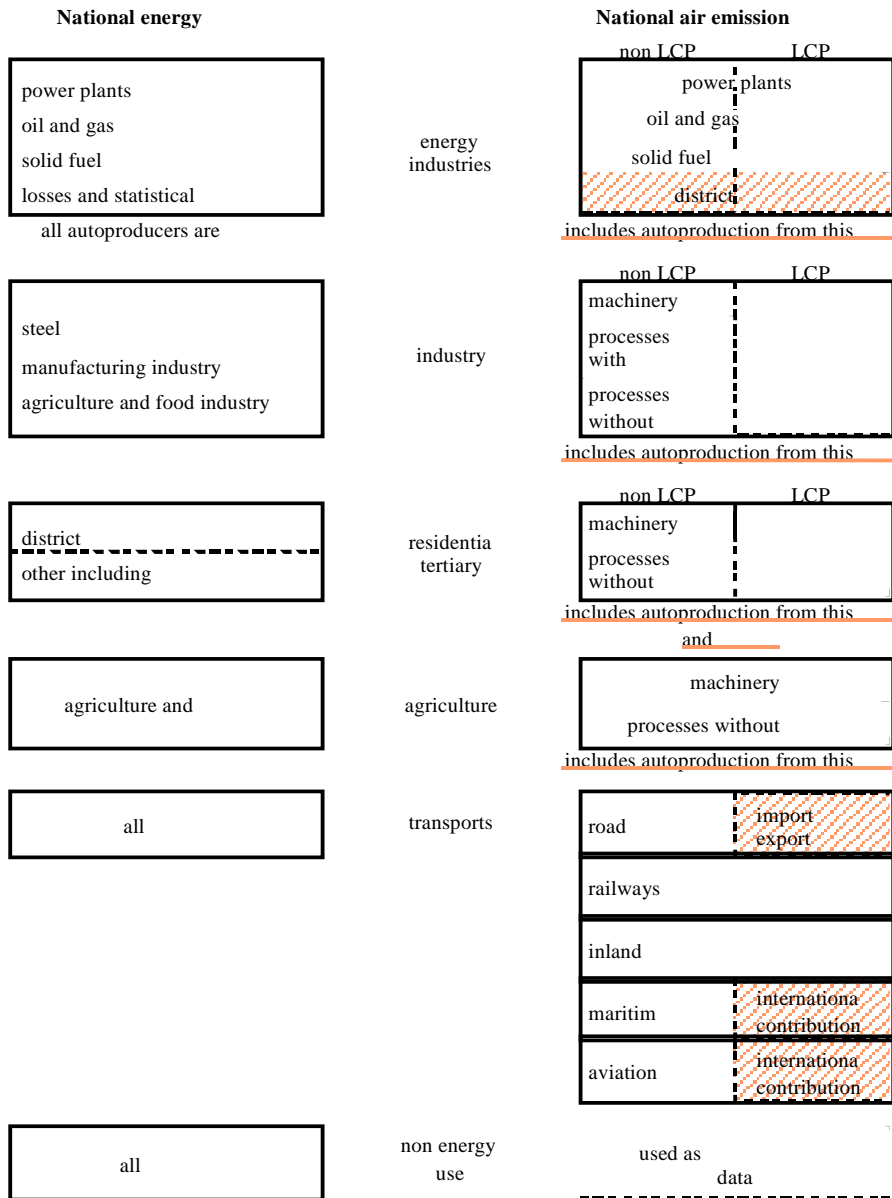
These differences remain in an acceptable range of 2 or 3% as underlined by the IPCC Good Practices under preparation.

Conclusion

Efforts should be redoubled to harmonise the situation as follows:

- one reporting standard should be defined and definitions should be set for all international air emission inventories.
- more convenient data from energy statistical offices should be available regarding air emission inventory needs. This recommendation is addressed to national organisations as well as to international organisations such as Eurostat or IEA. Most of the problems described in this paper are common to several European countries as well as the following raising questions:

  ◊ fuel combustion data to be split in different combustion equipment categories with distinction between stationary (boilers, gas turbines, engines, furnaces, fireworks, etc.) and mobile (road engines, off-road engines, air transport engines, sheep engines, etc.) by fuel, size and energy sector.

  ◊ energy statistics to be extended to make available more precise data on by-products such as industrial gases, charcoal, straw, cane-trash, etc. (consumptions, characteristics).

  ◊ amounts of fuels allocated to autoproduction from each producing sector.

  ◊ detailed and relevant data for non energy use (type of energy products, quantities, types of use, fates).

  ◊ quantified uncertainties attached to energy data.

  ◊ Clarification and harmonisation of statistics relating to maritime and air international traffics.

Energy data split comparison between the
French energy balance and the air emission inventory

National energy   **National air emission**

non LCP   LCP

| power plants |
| oil and gas |
| solid fuel |
| losses and statistical |

energy
industries

| power plants |
| oil and gas |
| solid fuel |
| district |

all autoproducers are   includes autoproduction from this

| steel |
| manufacturing industry |
| agriculture and food industry |

industry

non LCP   LCP

| machinery |
| processes with |
| processes without |

includes autoproduction from this

| district |
| other including |

residentia
tertiary

non LCP   LCP

| machinery |
| processes without |

includes autoproduction from this
and

| agriculture and |

agriculture

| machinery |
| processes without |

includes autoproduction from this

| all |

transports

road	import export
railways	
inland	
maritim	internationa contribution
aviation	internationa contribution

| all |

non energy
use

used as
data

░ **differences between national energy balance and air emission**

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Where France is concerned, these difficulties are satisfactorily overcome through significant effort and the comparison between the national energy balance and the air emission inventory is quite good. However, improvements are continuously implemented in order to increase accuracy due to the sensitivity of results in the political context.

Emission inventories and energy statistics

By Tim SIMMONS

Introduction

UNFCC requirements

The ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC), signed by about 150 countries in 1992, is the stabilisation of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. As a means of monitoring actions taken to achieve this objective the Convention calls upon Parties to commit themselves to:

- develop, update periodically, publish and make available to the Conference of Parties their national inventories of anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol.

- use comparable methodologies for inventories of GHG emissions and removals, to be agreed upon by the Conference of Parties.

Emissions, removals and concentrations

The Convention and later agreements seek to stabilise concentrations by reducing the emissions from anthropogenic sources and enhancing the removals by sinks of the direct GHGs (CO_2 , CH_4 and N_2O) and indirect GHGs (CO, NO_x and the NMVOCs). Annual inventories for each of these gases are constructed by Parties showing the emissions and removals subdivided by major anthropogenic activities. In only a very few cases can emissions and removals of GHGs from a particular activity be measured directly, consequently, the preparation of inventories relies on estimation.

Emissions and removals inventories

Construction of the inventories requires certain defining principles, definitions of national territory, classification of activities and methods for the estimation of emissions. The practice of preparing inventories for air emissions did not start with the UNFCCC. The problems of acid rain had prompted similar inventory exercises in Europe many years before and underlying principles and classifications for the Long Range Transboundary Air Pollution (LRTAP) already existed. The obligations of the Convention and the analytical work they imply led to the involvement of the Intergovernmental Panel on Climate Change (IPCC) under the WMO and UNEP. The Working Group 1 of the IPCC put in place a global effort, in 1990, to bring together suitable methodologies for the estimation and reporting of GHG inventories which could be used by all Parties. This led to the first issue of the *IPCC Guidelines* in 1995 and, later to the *Revised Guidelines* for the use by Annex 1 Parties. References to the *Guidelines* below will mean the *Revised Guidelines*.

1.   The structure of emissions reporting

1.1   Estimation methodologies

The anthropogenic activities leading to emissions are divided into six main categories; energy, industrial processes, solvents and other product use, agriculture, land use change and forestry, and waste. An inventory for a GHG should be divided into these six main parts and further sub-divided in accordance with the reporting instructions issued by UNFCCC. Together with common principles for the construction of inventories the common reporting should assist comparability of national inventories.

An inventory contains estimates of emissions from sources and removals by sinks in the year to which it relates and for the national territory of the country, including any other lands over which the country has jurisdiction. This is called the national boundary principle. The geographical scope of an inventory prepared for the UNFCCC is an important consideration because it may differ from that required by other bodies gathering emission inventories for different purposes. Equally, it may differ from the basis on which the data it uses are collected.

The *Guidelines* permit departure from the national boundary principle in a few cases. The Conference of Parties has decided that total national emissions should not, for the present, include any part of emissions from international marine and air transport. However, the emissions must be reported so that their contribution to global emissions is recorded. For reasons of practicality, it has also decided that estimates of national emissions from road transport should be based on the sales of vehicle fuel in the country rather than estimates of consumption within the country. This is important for countries carrying heavy transit traffic or where a country's transport fuel prices are significantly lower than those in neighbouring countries.

1.2   Source categories

Emissions of GHGs are widespread and cover all human activity. The six main source categories are further subdivided in a manner that depends on the main category but which reflects natural groupings of emission sources and/or economic activities. Annex 1 contains the source categories adopted by the IPCC and which form the basis of the UNFCCC Common Reporting Format (CRF) attached as Annex 2. The headings chosen to describe the source categories are drawn partly from the technological analysis of emissions (for example, stationary or mobile) and partly from the economic activities within which emissions occur (for example, public electricity and heat generation). The inclusion of technological classifications of emissions is the root of several of the difficulties encountered when using energy statistics to prepare estimates of emissions from energy use according to Annex 1 and the CRF. The widespread practice of basing energy consumption figures on deliveries without further systematic analysis of fuel use weakens the power of energy statistics in the emissions domain.

The process of estimating emissions within the source categories and constructing national inventories depends on the country but, for UNFCCC reporting, it should follow the methodological principles set out in the *IPCC Guidelines*. The *Guidelines* contain a collection of methodologies covering the many source categories reflecting past experience in the widely different fields. In particular, the *Guidelines* have imported much of the experience of the EMEP/CORINAIR experts and their *Air Emissions Guidebook* provided detailed information on the estimation of emissions from point and area sources.

From the beginning of the IPCC programme for compilation of methodologies it has been a political imperative to ensure that all Parties can participate in the process of constructing a national inventory. Consequently, in several important areas, there are choices of methodology for estimating the emissions from an activity. Simple methods are suggested for countries that have limited data or technical expertise. Equally, countries with sophisticated models and wide experience are required to aggregate their results into the source categories of the CRF. The methods for emissions estimation are described within the *IPCC Guidelines* as Tier 1, Tier 2 or Tier 3 in order of increasing detail and technical demand.

1.3   Fossil carbon and emissions from fuel combustion

The GHGs differ in their global warming potentials. Certain gases have GWPs several thousand times that of carbon dioxide but, fortunately, they are emitted in relatively small quantities. The major contribution to the GHGs in the atmosphere comes from the carbon bearing molecules and, of these, CO_2 is the most important. A carbon molecule in the atmosphere can be assumed to have last come from fossil carbon or biomass. There are two

"first" sources of fossil carbon, fossil fuels and calcium carbonate which is used in cement manufacture and a number of other processes. The extraction of fossil fuels is, by far, the larger source.

CO_2 emissions from fossil carbon are reported in the main source categories for energy, industrial processes, solvents and wastes. The emissions from energy are divided into those from fuel combustion and those from fugitive losses arising from deliberate and accidental release of fossil carbon molecules into the atmosphere. Emissions from energy, and from fuel combustion in particular, exceed considerably fossil CO_2 emissions from the other main source categories.

The industrialised countries usually prepare their national GHG inventories in a "bottom-up" manner in which the detailed analysis of the many activities uses characteristics of the emitting process/activity and models to estimate the emissions. In this manner emissions of each GHG can be estimated at the same time from the approach adopted. The need to provide estimates for the emissions of non-CO_2 gases, for which the carbon content of the fuel is only one factor, is the reason for a modelling approach. The estimates for the emissions of carbon-based molecules from the models can be compared in total with the supplies of carbon to the activities and energy statistics are widely used for this purpose.

Figure 1
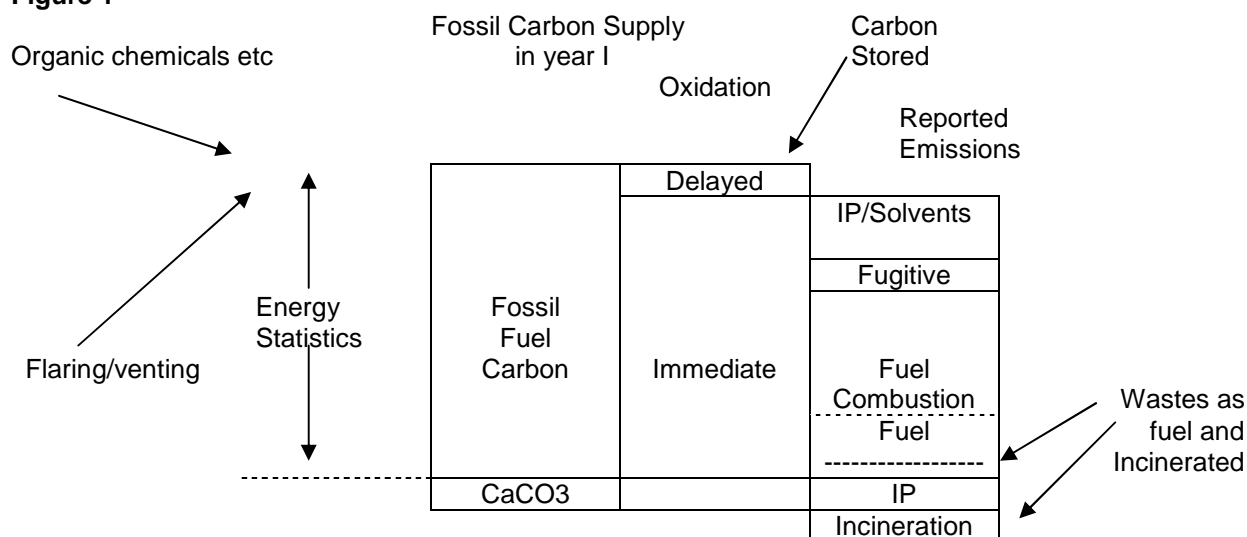
IP = Industrial Processes

Activities using the carbon supply are wider than simply fuel combustion. Fuels delivered to the industrial branches may, for example, use carbon for industrial processes or as a raw material. Industrialised countries are therefore likely to use energy statistics selectively adjusting the implied carbon supply to isolate the fuel combustion emissions. (*See Figure 1*) However, for countries with little detailed information on combustion activities, methods based on fuel supplies or fuel deliveries are recommended. In fact, it is a requirement of the CRF that estimates for CO_2 from fuel combustion be compared with the IPCC Reference Approach (RA) for CO_2 from fuel combustion. The RA uses fuel supplies to estimate the flow of carbon into a country as the central part of the estimation method.

It is not surprising therefore that energy statistics are crucial to the preparation of estimates of emissions from the energy sector and make important contributions to estimates of emissions from industrial processes and the use of wastes for heat production. The extraction and processing of fossil fuels is a natural starting point for those wishing to follow the uses, the formation of carbon stocks in products and ultimate fate of fossil carbon. UNFCCC reporting and the *IPCC Guidelines* require that all carbon molecules released by fuel combustion to the atmosphere be counted as CO_2 as well as in their own right. This double counting may be

justified as most non-CO2 carbon molecules oxidise rapidly to CO2 and different gaseous inventories can be used in the analysis of short and long-term effects of the gases.

It is evident, however, that the different historical development of energy statistics and emission inventories as well as the different needs of the environmental analysis have led to conventions for reporting emissions which differ from those used for energy statistics and these should now be examined.

2. Differences in geographical scope

The national boundary principle is a fundamental element of reporting emissions and energy statistics. Regrettably, however, although the intended geographical scope of reporting is often clear, the extent to which the collection of data from more remote parts of the national territory is complete is often uncertain. Moreover, the coverage of data may vary according to activity or, in the case of energy statistics, the particular fuel.

Fortunately, the lack of precision usually implies that the quantities of fuel use or emissions which are uncertain are small compared with the "mainland" figures but the problem can be important for air transport fuel consumption and emissions. The Conference of Parties' decision to exclude emissions from international air transport from national totals mean that domestic air transport must be defined and the fuel it uses identified for UNFCCC reporting. If the national boundary includes islands several thousand kilometres distant from the mainland (as in the case of France) issues arise as to whether this consumption should be part of the national consumption or part of international air consumption. Even where this matter is decided, national energy statisticians cannot normally separate fuel use for domestic and international flights. This reflects the difficulty of collecting data at the aircraft fuelling points and deciding what constitutes an international flight and how any domestic flight stages of an "international" flight should be treated. Agreement on this matter and in a manner which is practicable for data collection is very desirable. Equally, any agreement should take into consideration the definitions used for emissions reporting. Unfortunately, which parts of flight stages correspond to national and international emissions vary between the UNFCCC, EMEP/CORINAIR and the UNECE LRTAP methods quite simply because the reporting in each case is satisfying different policy requirements.

Similar issues exist for marine transport but, because the fuel use is much smaller and the trend in consumption is flat, the priority should be given to rationalising definitions and data collection for air transport.

3. Differences in classification

An inspection of Annex 1 will show that the main problems arising from the use of energy statistics are related to the differences in classification of activities and, in some cases, the use of a greater level of detail in source category identification than is the case when classifying economic activities in energy statistics.

3.1 Fuel combustion and industrial processes

The first and fundamental decision is what constitutes a fuel combustion emission. The definition which has emerged relies on the purpose of the combustion. Use of fuels specifically for heat raising is considered an energy activity and the associated emissions are reported under the fuel combustion source categories. Other emissions from combustion/oxidation are reported elsewhere. For example emissions from:

- gas flaring are considered fugitive emissions within the energy category.

- incineration of waste are reported within the waste category, but emissions from waste used as fuel are reported as fuel combustion, and

- oxidation of carbon in chemical processes are reported under industrial processes even if the heat produced is used for energy purposes by the enterprise.

This last example, the use of fuels as feedstock, can create complications when using energy data for estimates of emissions in the energy or industrial process parts of the inventory and can lead to double counting or omission of emissions.

The most debated example of the choice between an energy or industrial process classification arises from iron and steel manufacture. Estimation of emissions can be conducted at the level of the industry branch. Efforts should then be made to identify carefully the carbon inputs and outputs so that carbon emissions can be inferred from the difference between the two. In so doing any use of fuel by-products for energy purposes (for example, use of coke oven or blast furnace gas for electricity generation within the industry) cannot be included in the energy source category or double counting will occur. If efforts are made to keep, within the energy source category, the activities which are strictly energy according to the above definition then, amongst the processes involving energy conversion in the iron and steel industry, only blast furnaces and oxygen steel furnaces remain within the industrial processes source category. At present, few countries are reporting energy statistics of these activities in the level of detail which would allow sound estimation of their emissions directly from energy data. International definitions need some improvement to encourage better reporting. The large majority of carbon emissions at blast furnaces arise from the heating of the blast air using mainly (but not exclusively) blast furnace and oxygen steel furnace gas ultimately derived from the carbon in the coke charged into the furnace. Energy statistics should identify the gases used at blast furnaces and any other fuels used for heating blast air/oxygen and distinguish them from fuels entering blast furnaces. Other uses for energy purposes elsewhere on the plant should also be reported (heating coke ovens, electricity and heat generation and final energy use within the plant).

Inspection of national inventories submitted to the UNFCCC indicates that the distinctions between energy use and industrial process use of fuel carbon in industry other than iron and steel are hard to make. Countries either show the carbon use as entirely industrial process or entirely energy use depending on the fuel commodity. The only notable exception is the petrochemical sector which is referred below.

3.2   Non-energy use

With the non-energy use of fuels defined as their use for purposes other than heat raising then the emissions from the related activities fall almost entirely within the industrial processes source category. Estimation of emissions in a "bottom-up" manner usually proceeds through detailed knowledge of the process or the chemical equations describing it. This is method is used for the "pure" carbon fuels, coal or petroleum cokes used in soda ash (natural process), silicon and calcium carbide production, carbon anode use in metals manufacture, etc. Energy statistics can contribute here by improving final consumption statistics so that the branches of industry taking the "pure" carbon fuels can be more easily identified. Despite this, however, some of the carbon supplied (mainly cokes) can be used as fuel and carbon use in the process should be confirmed by checking for consistency with production figures for the process outputs. Energy statisticians can also assist by improving figures for trade in petroleum coke and imports of carbon in non-fuel forms to ensure that the coverage of deliveries to consumers is consistent with supply.

The difficulty of identifying quantities of feedstock used directly as a fuel rather than in the chemical processes exists for other fossil fuels particularly oils and natural gas supplied to the petrochemical industry. Petrochemical processing covers the manufacture of basic chemicals, intermediates and finished plastics, chemical compounds and solvents. Processing comprises a cascade of activities where by-products or exothermic reactions may provide heat for the plant. The simplified emission methodologies (Tier 1) attempt to overcome the lack of

information on the energy use of feedstock carbon by estimating the carbon stored in the products manufactured and subtracting the quantity from the fuel carbon supplied to the enterprises. In reality, there is very little reliable data on which to base carbon storage factors and, also, the enterprises may receive unknown amounts of carbon as imported organic chemicals.

An alternative approach is for the fuel in petrochemical manufacture to be inferred from the figures for total requirements and feedstock use by the industry. However, the quality of data claiming to show the non-energy use of fuels in petrochemical activities is generally poor. There is good reason for this as what constitutes energy use will depend at what level heat raising is considered to occur. Some processes are exothermic in one stage and endothermic in the next. Overall there may be a net inflow or outflow of energy. The chemical reactions concerned will involve carbon but, perhaps, not hydrogen. Who is to say whether or what fuel is involved? In short, there is a lot of work to do to define the energy use of fuels in these and other conditions and so, by default, the non-energy use.

Non-energy use also includes the use of products for their physical properties. Examples are, lubricants, bitumen and road oils, waxes and solvents. Emissions from the use of lubricants are reported under fuel combustion as some 50 percent of the quantities used are assumed to be oxidised in motor engines. Emissions from solvents are reported in the main source category devoted to solvents and other product use. Solvent emissions are mostly as NMVOCs but oxidation in the atmosphere to CO_2 is assumed to occur within a short period of time. Both lubricants, solvents and other waste oils may be recovered for recycling or use for heat raising. Energy statistics are silent on this activity but it is an area which warrants further examination. Quantities of used lubricants are traded internationally but customs classifications do not distinguish the commodity. Anecdotal evidence suggests that there is use of waste lubricants for injection into blast furnaces, heating of motor vehicle workshops, heating of greenhouses and in cement kilns. It is likely that the oxidation of lubricants is considerably higher than the 50 percent figure currently used. Combusting used lubricants is approved only under controlled conditions as they contain heavy metals so it may be difficult to obtain estimates of the scale of the activity.

3.2   Autoproduction

The UNFCCC has adopted the EMEP/CORINAIR and IPCC practice of including emissions from autoproducers in the industrial or commercial branch where it takes place. As the national energy tatisticians obtain the figures for fuel use for autoproduction from the enterprises the reclassification of autoproducers to the final consuming branches from the transformation sector should pose few problems. Indeed, as figures for deliveries to the branches are also available and the figures will contain the fuels used for autoproduction the deliveries alone may provide the basis of estimation. (See, however, the discussion below relating to transport fuel use).

It is probably appropriate to mention under this topic the present inadequacy of data relating to waste combustion for heat raising. National inventories for CO_2 should exclude emissions from biofuels and, to do so, specialised wastes containing mainly fossil carbon should be distinguished from the use of biofuels. Separating fossil from bio carbon requires the different types of waste to be carefully distinguished. Some modification of the present waste categories and better data on the bio/fossil proportions within them and the calorific values and emission factors for each part are needed.

3.4   Stationary and mobile consumption, and transport

Mobile sources include more than those covered under transport and deliveries of "transport" fuels correlate better with mobile source use than transport activities. Off-road and non-transport use of gas/diesel oils, motor gasoline and aviation fuels are particularly relevant for the agriculture, forestry and military sectors. Within some industrial enterprises gas oil is used for moving goods and personnel on site, lifting and excavating. Unfortunately, the deliveries

basis for classification of transport consumption in energy statistics tends to assume that all deliveries of road transport fuels are for road transport. Some off-road use can be identified if separate data are available as a result of differences in taxation of on-road and off-road uses.

Most national inventories base their estimates of emissions from the mobile and transport sources on models which are constrained by the fuel deliveries data. The modelling is amongst the most detailed conducted in inventory construction and reflects the complications of estimating the non-CO2 gases under the different operating regimes of the mobile sources. Better energy data would help inform the models and, in particular, help relate emissions based on technologies to the economic activity sectors. A combination of improvements is required. A closer coupling of transport activity statistics and fuel consumption through user surveys, better insight into the use of fuels in enterprises and better separation of fuels for marine and air transport between national and international or other activity use (deep sea fishing, crop spraying etc).

4. Fugitive emissions

In addition to the emissions of fossil carbon based molecules from fuel combustion, smaller but significant emissions occur when the unburned gases are released into the atmosphere. Within the energy sector these are mostly from coal extraction, oil and gas extraction and oil processing. Apart from the few main areas described below fugitive emissions are the result of scattered and isolated incidents or activities. They comprise venting of apparatus or pipelines during maintenance, pre-ignition release of gas in cookers and boilers, leaks from gas pipeline networks, evaporative venting of volatile oils to prevent pressure build up and accidental release.

The methodologies for estimation of emissions in almost all of these areas is weak. There are few points where the activity responsible for the emissions is defined and measured well enough to form a reliable basis for estimation. The only important example is the flaring and venting of natural gas. As the definition of natural gas production specifically excludes these quantities, the data should be explicitly collected to assist the estimation process and should be accompanied by data on the characteristics of the gas vented and flared.

In principle, it should be possible to relate fugitive emissions of gases and NMVOCs from refining to the numerous processes in the refinery. However, this is more appropriately the subject of special study. The energy data for production and storage will be of some value but greater detail on the movement and processing of the oils is required to model refinery emissions.

Equally, the quality of energy data for colliery methane production at deep mines is very variable. If a figure is available in energy statistics it usually relates to the quantity recovered for energy use at the mine or nearby plant. A figure for the total amount recovered and vented for safety reasons is more difficult to locate. Where countries are taking steps to control and monitor flows of methane into the atmosphere information is becoming available but the data are not yet entering energy statistics. Emissions from open-cast mines are much smaller and, by their nature, unmeasurable. Estimation is made on the basis of coal production and so separate figures for production from open-cast mines are needed. With the entry of the C&EE countries into the EU the importance of theses emissions will be increased.

5. Confidentiality

The level of discrimination between emission source categories used in the modelling and reporting of emissions is much finer than has been used in classical energy statistics. Some industrial energy surveys are now operating at two or three digit levels of NACE but distinctions between the types of end use within the economic activities are only rarely measured. Where data are available for analytical purposes they are often confidential as

they are company specific for some part of the information. Statistical legislation quite correctly prevents the release of such data. However, there seems little effort made by national offices to check whether the company concerned would consent to release or, more likely, consent to release after a fixed time period. For many model building purposes five year old data (say) would be perfectly satisfactory and have little commercial sensitivity for the company. The move to more pertinent energy data will mean seeking and releasing more detail and, inevitably, more individual data. Solutions to the technical problems described above will depend on the elaboration of a closer understanding with data suppliers so that their commercial interests are protected whilst information which ceases to be sensitive may be come available for analysis.

Conclusions

In summary, to improve the quality of estimation of CO_2 emissions from fuel combustion and help discriminate between energy related emissions and those from industrial processes energy statistics should be strengthened in the following respects:

- Examine critically the geographical scope of national data and that reported to the international organisations. Seek to align them with those used for national inventories or work with the environmental analysts to find adjustments to national energy data to put them on a basis identical to that used for the national inventory.

- Statistics of final consumption should be broken down by end use so as to distinguish use for steam production for electricity and heat separately, other heat production (ovens, dryers etc) raw material use and mobile use.

- Continue the work started to improve the breakdown of autoproduction statistics and the use of CHP in all types of enterprises and the services sector.

- Work to define and improve data for non-energy use in the petrochemical industry.

- Improve reporting of fuel use for blast furnaces in the iron and steel industry.

- Improve statistics of fuel delivered for air transport, distinguishing international flights, domestic flights and for military use. This should be done on the basis of models linking through to flight movements or by obtaining reported data from airports. Discussion of the definition of an international flight stage should be started with the aim of producing a common criterion which can be linked easily to measurable fuel use.

- Seek joint elaboration of surveys with road transport statisticians to establish fuel consumption by vehicle types and activity (interpreted broadly). Existing surveys differ between countries and improvement of fuel consumption/emissions data has not been a priority.

- Seek to classify wastes used as fuels more rigorously so as to separate those with a minority or no biomass content from the others. Try to avoid grouping different types for confidentiality reasons.

- Re-examine the rules on statistical confidentiality to encourage National Statistical Offices to work out with companies whose data are currently suppressed means for the eventual release of data.

Annex 1: Emission source categories

Taken from revised IPCC guidelines 1996
Volume 1 - Reporting Instructions
Common Reporting Framework

1.   Understanding the common reporting framework

This chapter contains a listing, with definitions, of the categories you should use when reporting emissions and removals. The source/sink categories have been grouped into sectors as follows:

- Energy
- Industrial Processes
- Solvent and Other Product Use
- Agriculture
- Land-Use Change and Forestry
- Waste

The sectors and their source/sink categories are described and discussed in the chapters of the Reference Manual and the modules of the Workbook. This chapter also contains a brief explanation of the principles underlying the Sectoral Tables and Summary Report Tables for reporting national inventories.

1.1   Source/sink categories

Users of the Revised 1996 IPCC Guidelines are requested to estimate and report all anthropogenic emissions and removals of greenhouse gases. The numerous sources and sinks are categorised and described on the following pages. The source/sink categories are grouped into the major sectors shown overleaf. The proposed categories should cover most activities emitting or removing greenhouse gases. However, some countries may need to add activities to the „Other‰ sector in order to cover their particular circumstances. If so, then the nature of the activities should be carefully described so that the list of sectors and their source/sink categories can be updated by the IPCC at a later date.

All activities are limited to anthropogenic activities and related emissions and removals.

Recognising that the IPCC needs to accommodate other existing inventory programmes, Annex 2 IPCC and CORINAIR Source Categories provides details of correspondences with CORINAIR, a programme developed by the Commission of European Communities for use in Europe.

Sectors	Description of activities included
1. Energy:	Total emission of all greenhouse gases from stationary and mobile energy activities (fuel combustion as well as fugitive fuel emissions).
2. Industrial processes	Emissions within this sector comprise by-product or fugitive emissions of greenhouse gases from industrial processes. Emissions from fuel combustion in industry should be reported under Energy. Emissions should, wherever possible, be reported according to the ISIC Group or Class within which they occur.
3. Solvent and other product use	This category pertains mainly to NMVOC emissions resulting from the use of solvents and other products containing volatile compounds
4. Agriculture	Describes all anthropogenic emissions from this sector, except for fuel combustion emissions and sewage emissions, which are covered in Energy and Waste modules.
5. Land-use change & forestry	Total emissions and removals from forest and land-use change activities.
6. Waste	Total emissions from waste management.
7. Other:	Any other anthropogenic source or sink not referred to above (must be appropriately documented).

1 ENERGY	Total emission of all greenhouse gases from stationary and mobile energy activities (fuel combustion as well as fugitive fuel emissions). Sum of categories I A & B.
1 A FUEL COMBUSTION ACTIVITIES	Total emissions of all greenhouse gases from all fuel combustion activities as described further below. CO_2 emissions from combustion of biomass fuels are not included in totals for the energy sector. They may not be net emissions if the biomass is sustainably produced. If biomass is harvested at an unsustainable rate (that is, faster than annual regrowth), net CO_2 emissions will appear as a loss of biomass stocks in the Land-Use Change and Forestry module. Other greenhouse gases from biomass fuel combustion are considered net emissions and are reported under Energy. (Sum of I A 1 to I A 5). Incineration of waste for waste-to-energy facilities should be reported here and not under Section 6C. Emissions based upon fuel for use on ships or aircraft engaged in international transport (1 A 3 a i and 1 A 3 d i) should, as far as possible, not be included in national totals but reported separately.
1 A 1 ENERGY INDUSTRIES	Comprises emissions from fuels combusted by the fuel extraction or energy- Producing industries.
1 A 1 a Public Electricity and Heat Production	Sum of emissions from public electricity generation, public combined heat and power generation, and public heat plants. Public utilities are defined as those undertakings whose primary activity is to supply the public. They may be in public or private ownership. Emissions from own on-site use of fuel should be included. Emissions from autoproducers (undertakings which generate electricity/heat wholly or partly for their own use, as an activity which supports their primary activity) should be assigned to the sector where they were generated and not under 1 A 1 a. Autoproducers may be in public or private ownership.
i Public Electricity Generation	Comprises emissions from all fuel use for electricity generation except those from combined heat and power plants.
ii Public Combined Heat And Power Generation (CHP)	Emissions from production of both heat and electrical power for sale to the public, at a single facility; co-generation plant.
ii i Public Heat Plants	Production of heat for sale by pipe network.
1 A 1 b Petroleum Refining	All combustion activities supporting the refining of petroleum products. Does not include evaporative emissions, which should be reported separately under 1 A 3 b v or 1 B 2 a below.
1 A 1 c Manufacture of Solid Fuels and Other Energy Industries	Combustion emissions from fuel use during the manufacture of secondary and tertiary products from solid fuels including production of charcoal. Emissions from

	own on-site fuel use should be included.
c i *Manufacture of Solid Fuels*	Emissions arising from fuel combustion for the production of coke, brown coal briquettes and patent fuel.
c ii *Other Energy Industries*	Combustion emissions arising from the energy-producing industries own (on-site) energy use not mentioned above. This includes the emissions from own-energy use in coal mining and oil and gas extraction. Combustion emissions from pipeline transport should be reported under 1 A 3 e.
1 A 2 MANUFACTURING INDUSTRIES AND CONSTRUCTION (ISIC - 3rd REVISION)[9]	Emissions from combustion of fuels in industry including combustion for the generation of electricity and heat. Emissions from autoproducers should be assigned to the sector where they were generated and an attempt made to separately identify the emissions associated with autogeneration from those associated with process heat. Emissions from fuel combustion in coke ovens within the iron and steel industry should be reported under 1 A 1 c and not within manufacturing industry. Emissions from the industry sector should be specified by subsectors that correspond to the International Standard Industrial Classification of All Economic Activities (ISIC). Energy used for transport by industry should not be reported here but under Transport (1 A 3 below). Emissions arising from off-road and other mobile machinery in industry should, if possible, be broken out as a separate subcategory. For each country, the emissions from the largest fuel-consuming industrial categories (ISIC) should be reported, as well as those from significant emitters of pollutants. A suggested list of categories is outlined below.

1 A 2   a   Iron and Steel (ISIC Group 271 and Class 2731)
1 A 2   b   Non-Ferrous Metals (ISIC Group 272 and Class 2732)
1 A 2   c   Chemicals (ISIC Division 24)
1 A 2   d   Pulp, Paper and Print (ISIC Divisions 21 and 22)
1 A 2   e   Food Processing, Beverages and Tobacco (ISIC Divisions 15 and 16)

1 A 2 f Other	The remaining emissions from fuel combustion in industry should be reported here. This also includes emissions from the construction branch. Please specify what is reported, as far as possible by ISIC categories. Care should be taken not to double count emissions from construction by including them also in Categories 1 A 3 e ii and/or 1 A 5.
1 A 3 TRANSPORT	Emissions from the combustion and evaporation of fuel for all transport activity, regardless of the sector, specified by subsectors as follows. Emissions from fuel sold to any air or marine vessel engaged in international transport (international bunker fuels) should as far as possible be excluded from the totals and subtotals in this category and should be reported separately.

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[9] International Standard Industrial Classification of all Economic Activities, Series M No. 4, Rev. 3, United Nations, New York, 1990.

1 A 3 a		Civil Aviation	Emissions from international civil aviation and domestic air transport (commercial, private, agricultural, etc.), including take-offs and landings. Exclude use of fuel at airports for ground transport which is reported under 1 A 3 e Other Transportation (below). Also exclude fuel for stationary combustion at airports; report this information under the appropriate stationary combustion category.
	i	International Aviation (International Bunkers)	Emissions which relate to fuel use for international civil aviation. Note that these emissions are to be excluded as far as possible from national totals but should be reported separately. (In other inventory methodologies, landing and take-off (LTO) cycle emissions are often considered as domestic emissions. For the purpose of greenhouse gas emissions inventories, fuel used during landing and take-off for an international flight stage is considered to be part of International Bunkers fuel use.)
	ii	Domestic	Includes all civil domestic passenger and freight traffic inside a country (not used as international bunkers) and including take-offs and landings for these flight stages.
1 A 3 b Road Transportation			All combustion and evaporative emissions arising from fuel use in road vehicles, including the use of agricultural vehicles on highways.
	i	Cars	Automobiles designated primarily for transport of persons and having a capacity of 12 persons or fewer. Gross vehicle weight rating of 3900 kg or less.
		Passenger cars with 3-way catalysts	Passenger car emissions from vehicles with 3-way catalysts.
		Passenger cars without 3-way catalysts	Passenger car emissions from vehicles without 3-way catalysts.
	ii	Light Duty Trucks	Vehicles with a gross vehicle weight of 3900 kg or less designated primarily for transportation of light-weight cargo or which are equipped with special features such as four-wheel drive for off-road operation.
		Light duty trucks with 3-way catalysts	Light Duty Truck emissions from vehicles with 3-way catalysts.
		Light duty trucks without 3-way catalysts	Light Duty Truck emissions from vehicles without 3-way catalysts.
	iii	Heavy Duty Trucks and Buses	Any vehicle rated at more than 3900 kg gross vehicle weight or designed to carry more than 12 persons at a time.
	iv	Motorcycles	Any motor vehicle designed to travel with not more than three wheels in contact with the ground and weighing less than 680 kg.
	v	Evaporative Emissions from Vehicles	Evaporative emissions are included here (they are estimated with the same activity data as are used for estimating combustion emissions).

1 A 3 c Railways	Includes emissions from both freight and passenger traffic routes.
1 A 3 d Navigation	Emissions from fuels used to propel water-borne vessels, including hovercraft and hydrofoils.
i International Marine (Bunkers)	Comprises emissions from fuels burned by sea-going ships of all flags that are engaged in international transport. These emissions should as far as possible be excluded from national totals and reported separately.
ii National Navigation	Emissions from fuel used for navigation of all vessels not engaged in international transport, except fishing (which should be reported under 1 A 4 c iii). Note that this may include journeys of considerable length between two ports in a country (e.g. San Francisco to Honolulu).
1 A 3 e Other Transportation	Combustion emissions from all remaining transport activities including pipeline transportation, ground activities in airports and harbours, and off-road activities not otherwise reported under 1 A 4 c Agriculture or 1 A 2. Manufacturing Industries and Construction. Military transport should be reported under 1 A 5 (see I A 5 Other, below).
i Pipeline Transport	
ii Off-road	
1 A 4 OTHER SECTORS	Emission from combustion activities as described below. Emissions from autoproducers should be assigned to the sector where they were generated and an attempt made to separately identify the emissions associated with autogeneration from those associated with process heat.
1 A 4 a Commercial / Institutional	Emission from fuel combustion in commercial and institutional buildings. (All activities included in ISIC categories 4103, 42, 6, 719, 72, 8, and 91-96).
1 A 4 b Residential	All emissions from fuel combustion in households.
1 A 4 c Agriculture / Forestry / Fishing	Emissions from fuel combustion in agriculture, forestry, or domestic inland, coastal and deep-sea fishing. This includes traction vehicles, pump fuel use, grain drying, horticultural greenhouses and other agriculture, forestry or fishing related fuel use. (Activities included in ISIC categories 05, 11, 12, 1302). Highway agricultural transportation is excluded.
i Stationary	
ii Off-road Vehicles and Other Machinery	
iii Fishing	
1 A 5 OTHER (Not else where specified)	All remaining emissions from non-specified fuel combustion. Include emissions from military fuel use.

1 A 5 a Stationary 1 A 5 b Mobile	Combustion emissions from all remaining transport activities including pipeline transportation, ground activities in airports and harbours, and off-road activities not otherwise reported under 1 A 4 c Agriculture or 1 A 2. Manufacturing Industries and Construction. Military transport should be reported under 1 A 5 (see I A 5 Other, below). Vehicles and Other Machinery, Marine and Aviation (not included in 1 A 4 c ii or elsewhere).
FUGITIVE EMISSIONS FROM FUELS	Fugitive emissions are intentional or unintentional releases of gases from anthropogenic activities. In particular, they may arise from the production, processing, transmission, storage and use of fuels, and include emissions from combustion only where it does not support a productive activity (e.g., flaring of natural gases at oil and gas production facilities). Evaporative emissions from vehicles are included under Road Transport as Subsection 1 A 3 b v. Sum of 1 B 1 & 1 B 2.
1 B 1 SOLID FUELS	Total release of methane during coal mining and post-mining activities. Combustion emissions from colliery methane recovered and used should be excluded here and reported under Fuel Combustion Emissions.
1 B 1 a Coal Mining	Total emissions from underground and surface mining and post-mining activities.
i Underground Mines	
Mining activities	Emissions from underground mines, brought to the surface by ventilation systems.
Post-mining activities	Emissions from coal after extraction from the ground, which occur during preparation, transportation, storage, or final crushing prior to combustion.
ii Surface Mines	Total emissions from surface mining and post-mining activities.
Mining activities	Emissions primarily from the exposed coal surfaces and coal rubble, but also emissions associated with the release of pressure on the coal.
Post-mining ativities	Emissions from coal after extraction from the ground, during preparation, transportation, storage, or final crushing prior to combustion.
1 B 1 b Solid Fuel Transformation	Fugitive emissions arising during the manufacture of secondary and tertiary products from solid fuels.
1 B 1 c Other	Fugitive emissions from fuel treatment plants not elsewhere specified.

Annex 2: UNFCCC Common Reporting Framework - Fuel Combustion
Summary 1.a summary report for national greenhouse gas inventories (IPCC table 7A) (sheet 1 of 3)   Year:

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 Emissions	CO2 removals	CH4	N2O	HFCs [10]		PFCs 10		SF6		NOx	CO	NMVOC	SO2
						P	A	P	A	P	A				
		(Gg)				CO2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals															
1. Energy															
A. Fuel Combustion	Reference Approach[11]														
	Sectoral Approach 11														
1. Energy Industries															
2. Manufacturing Industries & Construction															
3. Transport															
4. Other Sectors															
5. Other															
B. Fugitive Emissions from Fuels															
1. Solid Fuels															
2. Oil and Natural Gas															
2. Industrial Processes															
A. Mineral Products															
B. Chemical Industry															
C. Metal Production															
D. Other Production [12]															
E. Production of Halocarbons and SF6															
F. Consumption of Halocarbons and SF6															
G. Other															

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.   A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

Note: The numbering of footnotes to all tables containing more than one sheet continue to the next sheet. Common footnotes are given only once at the first point of reference.

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[10] The emissions of HFCs and PFCs are to be expressed as CO2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

[11] For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach. Where possible, the calculations using the Sectoral approach should be used for estimating national totals. Do not include the results of both the Reference approach and the Sectoral approach in national totals.

[12] Other Production includes Pulp and Paper and Food and Drink Production.

Summary 1.a summary report for national greenhouse gas inventories (IPCC table 7A) (sheet 2 of 3)   Year:

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 Emissions	CO2 removals	CH4	N2O	HFCs 10 P	HFCs 10 A	PFCs 10 P	PFCs 10 A	SF6 P	SF6 A	NOx	CO	NMVOC	SO2
	(Gg)				CO2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use														
4. Agriculture														
A. Enteric Fermentation														
B. Manure Management														
C. Rice Cultivation														
D. Agricultural Soils	13	13												
E. Prescribed Burning of Savannas														
F. Field Burning of Agricultural Residues														
G. Other														
5. Land-Use Change and Forestry	14	14												
A. Changes in Forest and Other Woody Biomass Stocks	14	14												
B. Forest and Grassland Conversion														
C. Abandonment of Managed Lands	14	14												
D. CO2 Emissions and Removals from Soil	14	14												
E. Other														
6. Waste														
A. Solid Waste Disposal on Land	15													
B. Wastewater Handling														
C. Waste Incineration	15													
D. Other														
7. Other *(please specify)*														

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[13] According to the IPCC Guidelines (Volume 3. Reference Manual, pp. 4.2, 4.87), CO2 emissions from agricultural soils are to be included under Land-Use Change and Forestry (LUCF). At the same time, the Summary Report 7A (Volume 1. Reporting Instructions, Tables.27) allows for reporting CO2 emissions or removals from agricultural soils, either in the Agriculture sector, under D. Agricultural Soils or in the Land-Use Change and Forestry sector under D. Emissions and Removals from Soil.
Parties may choose either way to report emissions or removals from this source in the common reporting format, but the way they have chosen to report should be clearly indicated, by inserting explanatory footnotes in the corresponding cells of Summary 1.A and Summary 1.B. Double-counting of these emissions or removals should be avoided. Parties should include these emissions or removals consistently in Table 8(a) (Recalculation - Recalculated data) and Table 10 (Emission trends).

[14] Please do not provide an estimate of both CO2 emissions and CO2 removals. "Net" emissions (emissions - removals) of CO2 should be estimated and a single number placed in either the CO2 emissions or CO2 removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

[15] Note that CO2 from Waste Disposal and Incineration source categories should only be included if it stems from non-biogenic or inorganic waste streams.

Summary 1.a summary report for national greenhouse gas inventories (IPCC table 7A) (sheet 3 of 3)   Year:

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 Emissions	CO2 removals	CH4	N2O	HFCs 10		PFCs 10		SF6		NOx	CO	NMVOC	SO2
					P	A	P	A	P	A				
	(Gg)				CO2 equivalent (Gg)						(Gg)			
Memo Items: [16]														
International Bunkers														
Aviation														
Marine														
Multilateral Operations														
CO2 Emissions from Biomass														

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[16] Memo Items are not included in the national totals.

TABLE 1 SECTORAL REPORT FOR ENERGY   Year :
(Sheet 1 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	Nox	CO	NMVOC	SO2
				(Gg)			
Total Energy							
A. Fuel Combustion Activities (Sectoral Approach)							
1. Energy Industries							
a. Public Electricity and Heat Production							
b. Petroleum Refining							
c. Manufacture of Solid Fuels and Other Energy Industries							
2. Manufacturing Industries and Construction							
a. Iron and Steel							
b. Non-Ferrous Metals							
c. Chemicals							
d. Pulp, Paper and Print							
e. Food Processing, Beverages and Tobacco							
f. Other *(please specify)*							
3. Transport							
a. Civil Aviation							
b. Road Transportation							
c. Railways							
d. Navigation							
e. Other *(please specify*							

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TABLE 1 SECTORAL REPORT FOR ENERGY
(Sheet 2 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	Nox	CO	NMVOC	SO2
				(Gg)			
4. Other Sectors							
a. Commercial/Institutional							
b. Residential							
c. Agriculture/Forestry/Fisheries							
5. Other *(please specify)*[17]							
a. Stationary							
b. Mobile							
B. Fugitive Emissions from Fuels							
1. Solid Fuels							
a. Coal Mining							
b. Solid Fuel Transformation							
c. Other *(please specify)*							
2. Oil and Natural Gas							
a. Oil							
b. Natural Gas							
c. Venting and Flaring							
Venting							
Flaring							
Other *(please specify)*							
Memo Items:[18]							
International Bunkers							
Aviation							
Marine							
Multilateral Operations							
CO2 Emissions from Biomass							

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[17] Include military fuel use under this category.

[18] Please do not include in energy totals.