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PROGRESS REPORT ON THE DEVELOPMENT OF INTERNATIONAL ENERGY STATISTICS

Report of the Secretary-General

SUMMARY

The Statistical Commission at its nineteenth session approved a programme to develop a global system of integrated energy statistics. The present document reports on progress in the recent development of international energy statistics, including the work of an expert group on classification and measurement in this field. It discusses the current work of the Statistical Office in the preparation of energy balances or accounts and in the co-ordination of this work with that of other international bodies.

The next steps in the development of international energy statistics are discussed, based on the recommendations of the expert group. The Commission may wish to comment on the progress report and the work of the expert group and to endorse the proposed programme of work in international energy statistics.

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INTRODUCTION

1. At the nineteenth session, the Statistical Commission discussed a report on energy statistics (E/CN.3/476) which outlined a programme for the Statistical Office to develop a global system of integrated energy statistics. The Commission approved the programme set out in the document, recommended the convening of an expert group and suggested that a consultant be engaged for the preparatory work in connexion with the proposed expert group. 1/

2. The present document describes recent work in the development of international energy statistics, including the work of the Expert Group on Classification and Measurement in the Field of Energy Statistics, which met at United Nations Headquarters in March 1978, and delineates the next steps in the development of the programme of international energy statistics.

I. ACTION BY THE COMMISSION

3. The Commission may wish to comment on the progress report and the work accomplished, including the work of the Expert Group. In particular, the Commission may wish to endorse the four tasks, detailed in paragraphs 33 and 34, proposed by the Expert Group as the priority items for inclusion in the next phase of the work programme of the Statistical Office.

II. PROGRESS IN THE DEVELOPMENT OF INTERNATIONAL ENERGY STATISTICS

4. The keystone of the programme of international energy statistics continues to be the development of energy balances or accounts that reflect the total supply of, and demand for, energy commodities. Despite problems in computer programming and processing of the energy statistics questionnaire, the programme of work outlined to the Commission at its nineteenth session (E/CN.3/476, para. 33) has largely been achieved.

5. The introduction of a new questionnaire on energy statistics has provided a comprehensive and structured framework for the organization of these statistics, in addition to serving as a vehicle for their collection and compilation. The questionnaire was first circulated to countries in June 1977 for the collection of data for the period 1970-1976. By April 1978, 99 of the 154 countries that had received the questionnaire had replied. Several countries indicated that the format of the questionnaire provided a useful guideline for the organization of inter-sectoral energy data on solid fuels, liquid fuels, gases and electricity.

6. Whereas in 1977 the entire questionnaire, covering all energy commodities, was sent to all countries, the 1978 questionnaire was tailored so that only those

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1/ Official Records of the Economic and Social Council, Sixty-second Session, Supplement No. 2 (E/5910), para. 21.

commodity pages appropriate to each country were sent. In this way, both the bulk of materials sent and the burden on countries of unnecessary work were reduced. Also, following the proposals of the Commission concerning the avoidance of duplication (E/CN.3/476, para. 40), copies of section A (solid fuels), section C (gaseous fuels) or section D (electricity) of the questionnaire were not sent in 1978 to the member countries of the Economic Commission for Europe (ECE); statistics on solid and gaseous fuels and on electricity in these countries were compiled from those already collected by the Statistical Division of ECE. However, until statistics of comparable detail for the liquid fuels sector become available in ECE, section B (liquid fuels) of the questionnaire will continue to be sent to the member countries of ECE.

7. World Energy Supplies (Statistical Papers, Series J) has been extended to include a wider range of commodities and the transformation and gross availability of these commodities, as approved by the Commission at its nineteenth session. 2/ Series J, No. 19 provided a detailed 25-year overview of global series trends (1950-1974), as well as a compendium of national, regional and global data sources in the field of energy. The compendium was confined mainly to the principal official governmental and central bank publications containing energy statistics. Series J, No. 20, published in May 1977, initiated coverage on a five-year time period, instead of the more restricted coverage provided prior to that in No. 19. Data for all gases were presented for the first time on a teracalorie basis, in order to reflect more accurately their heating value. In addition, new tables on the production and trade of fuelwood and charcoal, derived from series reported by the Food and Agriculture Organization of the United Nations, have provided coverage of the so-called "non-commercial" sources of energy. This coverage will be expanded as statistics from national sources become available. To facilitate the use of statistics presented in Series J, schematic charts have been introduced to show the routes taken in the process of applying conversion factors from original units of measurement to an interfuel equivalent, the tonne coal equivalent.

8. An improvement of the timeliness of release of the publication and associated data files, in both computer tape and printed form, may be noted. At present, the manuscript is completed 15-16 months following the data period covered, i.e., No. 20 in April 1977 covers the years 1971-1975. Given the lengthy reporting period needed for many countries to supply data to the Statistical Office, there would seem to be little that can be done to improve further the timeliness of the data. However, some improvement has occurred with the inclusion in Nos. 19 and 20 of preliminary production data for the latest year prior to publication, i.e., data for 1976 in No. 20. Should the Commission consider it useful, estimated data for additional series for the latest year could be included regularly, which would provide for planners and policy makers a full set of up-to-date estimated statistical series. These estimates could be made on the basis of partial monthly series available early in the subsequent year, or weighted extrapolation of current trends in individual energy commodities at individual transactions. The estimates would have to be clearly marked as preliminary assessments of the latest trends among energy commodities. It is felt that this type of up-to-date

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2/ Ibid., para. 21 (a).

estimation would enhance the usefulness of Statistical Papers, Series J, as the sole global source of macro-level statistics of energy provided to analysts and forecasters. Such an extension of current practices would be in keeping with the recommendations of the Expert Group (see paras. 14-32 below) towards improving the practicality, usefulness and timeliness of international energy statistics published by the Statistical Office.

9. Following the introduction of the questionnaire on energy statistics in 1977, data have been assembled for use in a companion publication to Series J presenting energy balances on the national, regional and global levels. Subject to restrictions imposed by the availability of computer programmes and access to data manipulation services, it is anticipated that (beginning in 1978) the step-by-step programme in the development of energy statistics will proceed as follows:

(a) Level 1: preparation of country profile data in basic units of measurement for publication. The profile comprises a display of the data available by commodity for each country;

(b) Level 2: preparation of country profile data in common units, following the application of conversion factor matrices (viz. terajoule, tonne coal equivalent, tonne oil equivalent) to the basic work profiles in level 1;

(c) Level 3: preparation of individual commodity balances (viz. solid fuels, non-commercial fuels, crude petroleum and petroleum products, natural and secondary gases and electricity) from the common-unit profiles in level 2; and

(d) Level 4: preparation of over-all energy balances, integrating the individual commodity balances into a single matrix format.

10. It is not intended to rework in any of the first three steps described in paragraph 9 above materials developed by the Statistical Division of ECE in its regional programme of energy balances. However, such materials will be reproduced in summary form, based on work at the regional level, in level 4 of the programme, to facilitate the compilation of regional and global energy balances. The transaction format used for the energy questionnaire will serve in addition as the format for levels 1, 2 and 3 above, to avoid any additional steps in the presentation of the statistics.

11. As far as the content of the companion publication is concerned, it is envisaged that the quarterly folio series that is to be introduced at the end of 1978 will contain a mixture of the four levels of data presentation indicated above for the following reasons: first, it will not be possible for some countries to develop even commodity balances for several years. Thus, for such countries, publication of the basic data (levels 1 and 2) will serve as a foundation for the gradual development of more detailed statistics of energy. Secondly, while some countries may not yet be able to prepare over-all energy balances, they may be in a position to integrate existing data into accounts for individual commodities, showing the gamut of transactions from production through trade and transformation to end use of those commodities (level 3). Finally, by using simple estimation techniques, such as the assignment of single-purpose

petroleum products to particular end-use consumption rows, 3/ the current data may be extended to provide a full set of integrated statistics in the form of over-all energy balances (level 4).

12. Once the full cycle of publication of country data is completed, according to the tentative schedule indicated in annex I, regional and global aggregates of level 1 and level 2 statistics will be constructed. An assessment will then be made of the statistics available for aggregate regional and global commodity accounts and over-all energy balances (level 4). The latter comprises the long-term goal to be achieved through the step-by-step elaboration of statistics under levels 1, 2 and 3.

13. Together with the developmental work described above concerning energy balances, the other major activity since the nineteenth session of the Commission concerned the Expert Group on Classification and Measurement in the Field of Energy Statistics. Since the implications for the work of the Statistical Office are extensive and involve an expansion of the current programme as well as building on previous recommendations of the Commission (see E/CN.3/476, para. 33 (b), (g), (h) and (i)), those elements of the programme stemming from the work of the Group are described in section III below.

III. EXPERT GROUP ON CLASSIFICATION AND MEASUREMENT IN THE FIELD OF ENERGY STATISTICS

14. In accordance with the recommendation of the Commission at its nineteenth session (see para. 1 above), a consultant was engaged to prepare a report and draft recommendations for discussion by the Expert Group.

15. The Expert Group met at United Nations Headquarters from 6 to 14 March 1978. The report of the consultant was the main document discussed although other materials were considered by the Group (see annex III). In addition to the 15 experts, the United Nations, the interested specialized agencies and other international organizations were represented.

16. A summary list of the recommendations of the Expert Group is provided in annex II. The principal items for attention by the Expert Group were the development of guidelines for a system of energy balances and for the enhancement of national and regional energy statistics, as well as the delineation of principles to be followed in the development of international standards, classifications and methodologies. The participants were asked to define those tasks that could be more easily carried out in the short term, as distinct from those which would need a longer period of time to complete. Although it was important to recognize the usefulness of conceptual and structural frameworks, the Group paid particular attention to recommendations that would be practical and capable of implementation on a step-by-step basis in the near future.

3/ For example, most aviation fuels are used in the air transport sector.

17. The items on the agenda for the Expert Group followed the order of the recommendations contained in the report of the consultant, where there was a full discussion of the various possibilities and strategies. Some recommendations pertained solely to questions of statistical procedure, nomenclature, definition and methodology. Others were more wide-ranging, anticipating needs in the field of energy statistics, in particular in the development of energy balances, and addressing the broader problems and questions of an integrated programme of statistics of energy of relevance to analysts, planners and policy makers.

18. The first 11 recommendations (see annex II) focused on problems of terminology and definition of boundaries that arose in the elaboration of the conceptual and methodological approaches to be adopted in the development of energy balances. Recommendations 1 and 2 defined the difference between primary and secondary energy. It was agreed that the term "fuels" on its own should only be used when describing those energy sources, whether primary or secondary, that must be subjected to combustion or fission in order to release for use the energy stored in them. After debate of the use of the terms "derived", "converted" and "transformed", compared with "secondary", sources, the Group agreed that the term "secondary" was the least ambiguous and was understood to correspond to the French term dérivé rather than secondaire. Recommendation 3 addressed the problem of primary equivalents in assessing the flows of secondary energy sources in trade and stockage. Wherever feasible, international marine and aviation bunkers should be distinguished from reported series on exports of energy commodities, although the Group recognized that the separation of aviation bunkers from exports posed some difficulties. Recommendations 4, 5 and 6 treated questions of accuracy, definition of units of measurement and conversion routes into accounting units, and practices to be followed in data collection.

19. Similarly, Recommendation 7 attempted to elucidate precisely the nomenclature to be used in labelling flows to transformation and/or final users of energy. It was decided not to employ the terms "gross" and "net" in place of "intermediate" and "final", since the former terms were in specific usage to distinguish between two stages of production. The term "final" carried the connotation of "end-use consumption" and thus the term "intermediate" indicated "not for end-use" (i.e., for further transformation). Recommendations 8, 9, 10 and 11 specified the nature of the column and row entries in the matrix format of the energy balance. Particular attention was devoted to the comprehensiveness of coverage of energy commodities and to the level of detail to be adopted in the energy balance. Eight major groupings of commodities were recommended for inclusion under the column headings of the energy balance, namely:

SOLID FUELS: hard coal, brown coal, lignite, coke oven coke, gas coke, brown coal coke, patent fuels, brown coal briquettes, lignite briquettes, coke breeze, low temperature coke and char, coke oven gas, blast furnace gas.

OTHER SOLID FUELS: fuelwood, bagasse, charcoal, dung, peat, tar, wood wastes, municipal and other wastes, vegetal wastes, pulp and paper industry wastes, other solid fuels (to be specified).

CRUDE PETROLEUM, OTHER INPUTS TO PETROLEUM REFINERIES, NATURAL GAS LIQUIDS: crude petroleum, including sources such as oil shale and tar sands; liquid

hydrocarbons produced in the purification and stabilization of natural gas; other inputs of crude petroleum origin for processing (not blending) such as naphtha imports for this purpose and naphtha backflows from the petrochemical industry; inputs of non-petroleum origin such as hydrogen, methanol and benzol.

PETROLEUM PRODUCTS: liquefied petroleum gases, refinery gas, naphthas, aviation gasoline, motor gasoline, jet fuels, kerosene, distillate fuel oil, residual fuel oil, diesel oil, bitumen, lubricants, white spirit, industrial spirit, petroleum waxes, petroleum coke, petrochemical feedstocks, refinery fuel n.e.s., other petroleum products.

GASES: natural gas (excluding natural gas liquids), gas works gas (coal, oil or other origin), colliery methane (and other methane from sources other than gas fields).

NUCLEAR FUELS

ELECTRICITY

STEAM AND HEAT

20. Recognizing that any classification or grouping of commodities should be compatible with accepted classifications and nomenclature in the field of energy statistics, the Statistical Office was given latitude for adjustment of the column headings in the energy balance in the light of constraints of other work in the United Nations and other international organizations in this field of statistics. In particular, it should be noted that the Conference of European Statisticians, at its twenty-fifth plenary session, approved the conclusions reached at the 3rd meeting on general statistics (held at Geneva, 11-15 October 1976) concerning the collection of national data on over-all energy balance (OEB) sheets. The experience gained in the initial stage of the collection of OEB data for countries in the ECE region will be considered at a future meeting on general energy statistics to be held under the Conference work programme for 1978/79. The Expert Group noted that this work of the Conference differed in detail from energy balances published by the Organisation for Economic Co-operation and Development (OECD) and the Statistical Office of the European Communities (SOEC). Further, the needs of the developing countries would have to be reconciled with the existing formats of ECE, OECD and the European Economic Community (EEC) energy balances in the adoption of an energy balance for use at the global level.

21. Accordingly, the structure, nomenclature and definitions employed in the column headings of the energy balance have been adjusted in view of these considerations, in particular to take account of the availability of data on energy commodities in the developing countries. The Statistical Office proposes the following groupings of commodities for inclusion under the column headings of the energy balance:

A. SOLID ENERGY SOURCES

1. hard coal, brown coal, lignite, peat for fuel;

2. hard coal briquettes (patent fuels), brown coal briquettes, lignite briquettes, peat briquettes, coke oven coke, gas coke, brown coal coke, coke breeze, low temperature coke and char, coke oven gas, blast furnace gas.

B. OTHER SOLID ENERGY SOURCES ("NON-COMMERCIAL")

fuelwood, bagasse, charcoal, dung, tar, wood wastes, vegetal wastes, pulp and paper industry wastes, municipal and other wastes, others (to be specified)

C. LIQUID ENERGY SOURCES

1. crude petroleum, other inputs to petroleum refineries, natural gas liquids. Includes crude petroleum from such sources as oil shales and tar sands; liquid hydrocarbons produced in the purification and stabilization of natural gas; other inputs of crude petroleum origin for processing (not blending) such as naphtha imports and naphtha backflows from the petrochemical industry; inputs of non-petroleum origin such as hydrogen, methanol and benzol.

2. aviation gasoline, motor gasoline, jet fuels, kerosene, naphthas.

3. distillate fuel oils, residual fuel oils.

4. liquefied petroleum gases, refinery gas, white spirit, industrial spirit, bitumen, lubricants, petroleum waxes, petroleum coke, petrochemical feedstocks, refinery fuel n.e.s., other petroleum products (to be specified).

D. GASEOUS ENERGY SOURCES

natural gas (excluding natural gas liquids), colliery methane (and other methane from sources other than gas fields), gas works gas.

E. ELECTRICITY

F. NUCLEAR FUELS

G. STEAM AND HEAT

22. The column headings of the energy balance matrix also would include: total energy; memorandum item - primary fossil fuel equivalent of electricity; and memorandum item - solar and other energy from non-conventional sources (free format). The major adjustments from the format under study in ECE comprise an expanded treatment of the liquid energy sources, the introduction of treatment of the so-called "non-commercial" fuels, the reduction of coverage of the solid energy sources and of electricity to two columns each and the introduction of columns for nuclear fuels and for solar and other non-conventional sources.

23. Recommendations 12-18 focused on accounting levels and conventions to be followed in the preparation of energy balances. Recommendation 12 established the level of detail that should be sought, not only in the energy balance but also in the form of supplementary presentations. Concerning estimates of useful energy consumed by each final consumption sector, opinion was divided (Recommendation 13). Some experts argued that the concept of useful energy was too difficult to define in a meaningful way. The technical efficiency of an appliance in converting an input of energy to an output of heat might be high (so that its efficiency in producing "useful heat" might seem to be high) but much of that heat might be lost if it was allowed to escape into the atmosphere (as with electric storage heaters or combustion appliances without thermostatic control of air or fuel feeds). It was also argued that the recommendation had little relationship to the data problems of developing countries. In reply, it was pointed out that one developing country had been using this concept for the past 10 years precisely because demand for energy was a demand for useful heat. Another expert underlined that, in looking at energy growth rates, it was important to look at the rate for useful energy as well as at the rates for primary sources and for energy supplied to final energy users. Similarly, some difficulties were encountered in the treatment of primary energy inputs to hydro and nuclear electricity (Recommendations 14 and 15). Some experts argued in favour of showing nuclear and hydroelectricity only in terms of the equivalent quantity of fossil fuel input. Others pointed out the need to avoid notional figures for hydroelectricity. Proponents of the fossil fuel equivalent emphasized the interest of energy policy makers in the impact on petroleum demand of different methods of generating electricity or heat. It was proposed that the two views could be reconciled by adopting the convention used in the ECE balance of having two columns each for nuclear and for hydroelectricity. In the case of hydroelectricity, one column would be used for the "electricity basis" and the other for the "fossil fuel equivalent basis". In the case of nuclear electricity, one column would be used for the "heat release", or "burn-up basis" and the other column for the "fossil fuel equivalent basis"; this was not agreed upon and it was not included in the energy balance.

24. The treatment of "primary energy input" for renewable sources of energy (Recommendation 16) was less difficult, being measured at the output of the first stage in an energy-capturing process. It was felt to be ncessary, in addition, to make provision for the direct use of mechanical energy (e.g., from windmills for pumping), as well as heat or electrical output. Recommendations 17 and 18 specified the conventions to be adopted concerning primary energy input and embodied energy in trade in energy commodities.

25. Recommendations 19-24 dealt with problems of accounting units, conversion factors and routes, and calorific values. With regard to Recommendation 19 on conversion factors, some experts suggested that average conversion factors could be misleading because different cells in a given energy commodity column could contain different grades of that commodity (e.g. power station coal in one row and coking coal in another row of the "coal" column). Calculation of average factors would be an additional burden. A better arrangement would be to ensure that a complete table of conversion factors should accompany published balances. Other experts acknowledged the convenience of having "broad-Brush" average factors. The experts agreed that it was desirable for the United Nations to publish a

handbook of such factors, and this suggestion was consolidated with other items concerning units and factors in Recommendation 41 (see para. 33 below).

26. Following general discussion of calorific values (Recommendations 20 and 21) there was a lengthy discussion of the relative merit of the joule and the calorie as the common accounting unit to be used in energy balances. It was pointed out that the joule had been adopted by the World Energy Conference for its statistics on resources and reserves and by ECE and EEC/SOEC for their energy balances. The joule was used by 13 of the 19 countries which completed the new ECE energy balance. Austria, New Zealand, Norway, Hungary, Portugal, Sweden, Poland and the member countries of EEC had adopted the joule in national work. On the other hand, the convenient equivalence of 10^7 kilocalories to one tonne of oil was emphasized, given the need to present data on all energy sources in terms of a unit reflecting the preoccupations of energy policy makers and that most people could readily understand. Concerning the United Nations World Energy Supplies, supplementary units such as the tonne oil equivalent (TOE) and/or the joule could be added to the tonne coal equivalent (TCE) used at present in the summary tables. Several experts questioned the suitability of the joule as a unit for energy statistics outside a narrowly scientific field of work. Some experts suggested that the replacement of the teracalorie by the terajoule would cause problems for the statistical offices in developing countries. However, other experts did not think a gradual change to the terajoule would be too difficult. In this context, Recommendations 22, 23 and 24 treated the question of units of measurement, both for use in energy balances and for adoption in the current work of the Statistical Office.

27. Recommendations 25-29 dealt specifically with the structure of energy balances and associated tables. The importance of considering the over-all energy balance in relation to individual commodity balances was stressed by the experts. Separate commodity statistics should be structured to ensure that basic commodity statistics are internally consistent within each energy commodity and externally consistent between all energy commodities. An over-all energy balance tested that external consistency. Within the recommended format, several modifications of the row items from the ECE energy balance were proposed, 4/ namely:

(a) Blast furnace and coke oven gas are treated as produced within "industry" and will be expressed in terms of the coal etc. used as input, so that no rows are provided for blast furnaces or coke ovens;

(b) Electricity generation is given a single row;

(c) Liquid hydrocarbons produced in the purification and stabilization of natural gas should be shown as primary flows;

(d) The memorandum item on "solar and other energy" should be completed as appropriate by countries, not necessarily in the form of statistics but as descriptions;

4/ See annex IV, "Proposed structure of the over-all energy balance-sheet".

(e) Row 7, "total energy requirements" was preferred to the ECE usage "gross consumption of primary energy and equivalents";

(f) Row 17, "Transfers", referred to intersectoral or intercommodity transfers.

28. The distinction between aggregated balances for policy makers, more disaggregated balances as sources for economists and statisticians and more detailed balances for use at desk level was recognized. A number of experts urged that balances published by international organizations should show separate rows for nuclear, hydro, geothermal and conventional thermal generation and for combined heat and power generation (CHP). It was pointed out that CHP took two forms. In one case exhaust heat from public supply power stations was recovered for production of district heat and hot water. In the other case industrial establishments increased the temperature and pressure above the levels needed for process heat and used the increased energy content in the steam to generate electricity. In the latter case, joint products resulted from a single set of inputs. In principle, it was necessary to provide at least one separate row in an energy balance for CHP generation.

29. Recommendations 30 and 31 addressed the question of classifications. In this regard, discussion of the energy commodities to be included in the columns of an energy balance was considered in the context of a number of basic United Nations classifications. It was pointed out that special classification needs for energy policy purposes should be considered in the context of the over-all harmonization of classifications. In particular, the relationship between activities and commodities was important in this regard. While the International Standard Industrial Classification (ISIC) was now undergoing revision it was felt that it should remain as a guideline for the classification of energy statistics. Some experts felt that specific detailed extension of energy statistics towards the assessment of the impact of energy activities or of levels of intensity of energy use, for example, would necessitate the development of more detailed classifications and questionnaires. A criterion for classification might be the energy intensity of users. The conclusions on classification of this Expert Group would be put before the joint United Nations Statistical Office/Statistical Office of the European Communities Working Group on World Level Classifications.

30. Six recommendations treated the methodological problems of incorporating particular flows and accounting methodology in the over-all energy balance (Recommendations 32-37). With regard to Recommendation 33, the experts agreed that future waste recovery technology was too uncertain to warrant building into current output data the provision for the possible future use of waste coal. Similarly, in the discussion of Recommendation 34, a proposal to include reinjected gas in production was rejected. It was recognized that the subsequent re-extraction of reinjected gas was as uncertain as the recovery of coal residues from waste-tips.

31. The question of the need for statistics on the end use of energy included a wider discussion of items upon which new recommendations might be formulated at

a later date, once the over-all energy balance programme had been implemented. It was felt to be important both for retrospective analysis and for forecasting to extend knowledge of energy use beyond the level of energy delivered to final users. This extension was twofold. One extension pointed towards useful energy and the other towards use by purpose within final use sector. The first aim was already the subject of a recommendation. The second raised the further question of whether a balance should seek only to record the first use made of energy by the sector to which it was delivered or whether each sector's total use should, in principle, be recorded. If the latter was the case, then an account should be developed that could show explicitly the occurrence and use of recovered heat within an end-use sector. Some experts felt that such an analysis would be premature; others pointed out that such analyses were already being worked upon in a number of countries. The relationship between end use analysis within sectors and energy analysis of the total energy content of commodities was considered. The two forms of analysis were not unconnected but they were distinct. The former was a direct extension of macro energy statistics in the final-use submatrix of an energy balance. The latter was a matter of micro analysis at the level of a commodity or process or of a group of commodities or processes typical of an industry.

32. The final group of recommendations attempted to specify for the Statistical Office the immediate steps that should be taken, in addition to the development of the format of the energy balance itself, in order to provide guidelines and assistance to national statistical offices in the improvement of energy statistics as a whole (Recommendations 38-42). It was agreed that the recommendations of the Expert Group represented an appropriate programme of future work for the Statistical Office. Similarly, concerning links between current work and that on energy balances, the Group agreed that the latter represented the extension of current work under way with the questionnaire and compilation of energy commodity profiles.

IV. THE NEXT STEPS IN THE PROGRAMME OF ENERGY STATISTICS

33. Summarizing the work of the Expert Group with regard to the particular items to which the attention of the Commission is drawn, four tasks were recommended for implementation as soon as feasible. First, national, regional and global over-all energy balances should be developed according to the guidelines, format and principles recommended by the experts and adjusted by the Statistical Office within the constraints of other work in the United Nations in this field of statistics (Recommendation 28). Paragraphs 8-12 above outline the immediate steps proposed to implement this strategy, which would have as its longer-term goal the publication of energy balances in the format contained in annex IV. Given that some modification of the ECE over-all energy balance is anticipated in 1978-1979, it is proposed to incorporate the decisions of the Conference of European Statisticians on a final format of that energy balance in the balance table of the Statistical Office, in the interests of harmonization and

co-ordination. Secondly, the Expert Group recommended that the report of the consultant, suitably amended in the light of the discussions of the Expert Group, should be made available for circulation to national and international statistical offices and other appropriate agencies concerned with the field of energy statistics, policy and planning (Recommendation 39). Thirdly, the Statistical Office should publish an international handbook of conversion factors and units of measurement for use in the field of energy statistics (Recommendation 41). The experts endorsed the contents of document ESA/STAT/AC.8/10 (see annex III), which had been presented as a model for such a handbook, with appropriate adjustments for international usage. The document will be circulated to national statistical offices and interested regional and international bodies for comment. Fourthly, the Statistical Office should investigate the possibility of establishing a programme of technical co-operation in the field of energy statistics (Recommendation 40). Such a programme was felt to be crucial to the development of national and international energy statistics on a scale commensurate with the problems facing policy makers.

34. The attention of the Commission is drawn to these four tasks and the Commission may wish to include them in the programme of work of the Statistical Office. In addition, it is recommended that the Statistical Office participate in and co-ordinate its work closely with the proposed meetings on the development of energy statistics and energy balances of the Economic Commission for Europe (1978-1979) and the Economic and Social Commission for Asia and the Pacific (1979). In this way, the steps outlined above in the programme of international energy statistics could be developed in a co-ordinated manner on a broad front, commensurate with the scale of the need for accurate and comprehensive energy statistics faced by policy makers and planners, and reflecting the pervasive influence of energy activities upon the economies of all countries.

Annex I

PROVISIONAL PUBLICATION PROGRAMME FOR ENERGY BALANCES
(LEVELS 1, 2 AND 3) a/ b/

Fourth quarter, 1978 (20 countries or areas): Argentina, Belize, Cape Verde, Cyprus, Dominican Republic, Fiji, French Guiana, Guam, Hong Kong, Hungary, India, Jamaica, Kenya, Malawi, Malta, Nigeria, Qatar, St. Pierre and Miquelon, Turkey, Yugoslavia.

First quarter, 1979: preparation of Statistical Papers, Series J, No. 22.

Second quarter, 1979 (20): Canada, Chile, Iceland, Iran, Ivory Coast, Morocco, Pacific Islands, Panama, Panama Canal Zone, Poland, Portugal, Republic of Korea, Sabah, Senegal, Seychelles, Solomon Islands, Thailand, Trinidad and Tobago, Uganda, Wake Island.

Third quarter, 1979 (21): Bahamas, Bahrain, Benin, Comoros, Cuba, Czechoslovakia, Gabon, Lao People's Democratic Republic, Martinique, Philippines, Puerto Rico, St. Lucia, Samoa, Sierra Leone, Singapore, Sweden, Togo, Tonga, United Arab Emirates, United Republic of Tanzania, Yemen.

Fourth quarter, 1979 (21): Afghanistan, Antarctic Fisheries, Australia, Barbados, Burundi, El Salvador, Gambia, Gibraltar, Gilbert Islands, Japan, Mauritius, Nepal, New Caledonia, Paraguay, Rwanda, St. Vincent, Saudi Arabia, Southern Rhodesia, Spain, Venezuela, Western Sahara.

First quarter, 1980: preparation of Statistical Papers, Series J, No. 23.

Second quarter, 1980 (20): Austria, Bermuda, Cayman Islands, Central African Empire, Democratic Yemen, Indonesia, Jordan, New Hebrides, Nicaragua, Niger, Romania, St. Helena, St. Kitts, Sao Tome and Principe, Sarawak, Tunisia, United States of America, Upper Volta, Viet Nam, Zambia.

Third quarter, 1980 (21): American Samoa, Bolivia, Bulgaria, Chad, Christmas Island, Congo, Cook Islands, Dominica, Egypt, Faeroe Islands, Ghana, Greenland, Guinea-Bissau, Guyana, Haiti, Mozambique, Norway, Oman, Pakistan, Sri Lanka, Sudan.

Fourth quarter, 1980 (20): Algeria, Angola, Antigua, Brazil, Brunei, East Timor, Ethiopia, Finland, Guatemala, Iraq, Liberia, Macau, Madagascar, Nauru, New Zealand, Peru, Réunion, Union of Soviet Socialist Republics, United Republic of Cameroon, Uruguay.

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a/ See para. 9 of the report for a discussion of the levels.

b/ The countries or areas shown for each quarter are those which, it is expected, could be tabulated.

First quarter, 1981: preparation of Statistical Papers, Series J, No. 24.

Second quarter, 1981 (20): Bangladesh, Costa Rica, Democratic Kampuchea, Democratic People's Republic of Korea, Ecuador, Equatorial Guinea, French Polynesia, Grenada, Guinea, Honduras, Israel, Mali, Mauritania, Mexico, Mongolia, Papua New Guinea, Surinam, Switzerland, Syrian Arab Republic, Zaire.

Third quarter, 1981 (19): Albania, British Virgin Islands, Burma, China, Colombia, Djibouti, Falkland Islands (Malvinas), German Democratic Republic, Greece, Guadeloupe, Kuwait, Lebanon, Libyan Arab Jamahiriya, Malaysia, Montserrat, Netherlands Antilles, Somalia, South Africa (including data for Botswana, Lesotho, Namibia, Swaziland), United States Virgin Islands.

Fourth quarter, 1981: regional and global totals in original units and common units.

First quarter, 1982: preparation of Statistical Papers, Series J, No. 25.

Annex II

SUMMARY OF RECOMMENDATIONS OF THE EXPERT GROUP ON CLASSIFICATION AND MEASUREMENT IN THE FIELD OF ENERGY STATISTICS

A. Terminology and Boundary Problems

1. "Primary energy" should be used to designate sources that only involve extraction or capture, with or without separation from contiguous material, cleaning or grading, before the energy embodied in that source can be converted into heat or mechanical work.

2. "Secondary energy" should be used to designate all sources of energy derived from primary sources.

3. Imports, exports and stock changes of secondary energy should be treated in an energy balance in the same way as change in the supply and use of primary energy. These flows of secondary energy sources should be designated as "primary energy" (or "primary equivalents"). Bunkers should be treated in the same way, as part of the "primary equivalent" flows.

4. National and international statistical offices should consider seriously attempting to assess the sensitivity of each major published aggregate in their energy statistics to errors of plus or minus (say) 5 or 10 per cent in the less reliable components of such aggregates.

5. National and international statistical offices, and bodies that advise them or undertake work for them, should define clearly the accounting units or presentation units employed in published analyses. The conversion factors and the routes used to convert original physical units into the chosen common accounting unit or units should also be stated, or a readily available published source where they may be found should be cited. It should also be made clear whether energy units are defined on a gross or net calorific basis.

6. Wherever possible, data from national offices should be collected in original rather than converted units.

7. In order to avoid possible confusion between the meaning of "final" (and "intermediate") in national accounts, input/output and other economic analysis, on the one hand, and in energy balances, on the other, tables and texts that refer to the flows involving the energy transformation industries and/or final users of energy should always make clear what is meant by "final" (and - if the term is used - "intermediate").

8. (a) An over-all energy balance should cover all flows of energy, including the so-called "non-commercial" energy sources. Coverage of such sources should be as extensive as possible. When such sources are known to be important but few data exist, such steps as sample surveys should be instituted to improve the quality of the data.

(b) Autogeneration of electricity from purchased fuels, with or without the joint production of heat, should be treated as part of the transformation sector.

(c) The framework of the over-all energy balance should not be limited by the lack of availability of data.

9. Energy balances should cover the supplies and uses of all primary and secondary energy sources, showing clearly the non-energy use of such sources.

10. (a) Energy balances should cover all the liquid and gaseous hydrocarbon commodities in the list adopted by the Expert Group.

(b) The problems of defining and obtaining more complete data on the gross and net energy flows between oil refineries, on the one hand, and petrochemical plans, on the other, should be investigated more fully. Satellite tables to the over-all energy balance could usefully show as fully as possible at least the more important flows of energy byproducts (and recovered heat) within the major branches of the chemical industry.

11. In reporting refinery output, data on particular petroleum products should include the fuels subsequently consumed by the refinery itself.

B. Accounting levels and conventions

12. An energy balance should show all flows at each level that can be adequately recorded with existing data, so that the relationships between primary source inputs to transformation, secondary source outputs from transformation and transformation losses can be clearly seen. For some purposes, as a supplementary statistic, the primary energy input equivalent of secondary energy sources delivered to final energy users may be useful.

13. National and international statistical offices should consider publishing estimates of the quantities of useful energy consumed by each final consumption sector. Such estimates should be accompanied by details of the methodology used.

14. The "primary energy input" to hydroelectricity should be defined as the energy value of the electricity itself. The "fossil fuel equivalent energy" should be recorded as an additional statistic, using, for simplicity, either the national average thermal efficiency of all classifical thermal stations in the country concerned, or a standard efficiency, in a second column in the energy balance table.

15. The primary energy input to nuclear electricity should in principle be defined as the heat released by reactors during the accounting period. In practice, a proxy for this may need to be used, namely, the figure obtained by dividing generation of nuclear electricity by the national average efficiency of all nuclear power stations.

16. The "primary energy input" for the so-called "renewable" sources of energy should be defined as follows and applied to the output of the first stage in an energy-capturing process that yields a measurable output of heat or electrical energy:

Solar:	Biomass	Heat content of the output of the fermentation, combustion or digestion device
	Photovoltaic cell	Electrical energy output
	Other collecting devices	Heat output of the device
Water and air:		Heat, electrical or mechanical output of the device, whichever of these is the first measurable form of energy
Geothermal:		Heat output of capturing installation

17. Imports and exports of secondary sources of energy should be recorded for an over-all energy balance in terms of the energy content of the fuels (or electricity) that actually flow across national frontiers. If a more detailed analysis is needed of the primary energy input to foreign trade, such an analysis can be made but it should be additional to, and not part of, the main over-all energy balance. Trade in non-energy products derived from primary energy sources (e.g., lubricants, carbon black, electrodes) should similarly be included in the main energy balance.

18. International trade in embodied energy is a proper subject for a detailed assessment of energy problems. Nevertheless, an over-all energy balance can and should be constructed in the first place on the basis of, among other flows, only visible trade in energy sources.

C. Accounting units, conversion factors and routes, calorific values

19. Energy balances should themselves contain in the column headings for each energy source the average conversion factor appropriate for expressing the original units in (or underlying) that column in terms of the common accounting unit as shown in the balance. Such average factors should be complemented in foot-notes or accompanying text with clear descriptions of the routes and stages followed in any conversions that are not adequately defined by the average factors.

20. When expressing the energy content of primary and derived energy sources in terms of a common energy accounting unit, net calorific values (NCV) should be used in preference to gross calorific values (GCV). If and when recuperation of the differnce between GCV and NCV from exhaust gases becomes a practical possibility and seems likely to become a reality, this recommended basis may need to be reconsidered.

21. In reporting values in energy units, it should always be indicated whether the values shown are gross or net.

22. Given that the joule, and multiples of it by raising it to powers of 10^3, is the only energy unit in the Système International, international and national statistical offices should consider adopting the joule (0.239 kcal) as the accounting unit for energy balances. The tonne oil equivalent (1 TOE = 10^7 kcal NCV) and/or the tonne coal equivalent (1 TCE = 7 x 10^3 kcal), currently used by the United Nations, may be used as supplementary units. Whenever they are used, they should be clearly defined in terms of joules and the route used for converting original data to TOE and/or TCE should be clearly described.

23. The United Nations Statistical Office, in the 1979 and subsequent issues of World Energy Supplies, should add to the present tonne coal equivalent unit in its world and regional totals equivalents in terajoules and tonne oil equivalent. In the forthcoming publications on energy balances, the unit to be adopted should be the terajoule, supplemented by the tonne oil equivalent and tonne coal equivalent.

24. The relationship between the original-unit data as used for an energy balance and as published in the statistics about each energy industry should always be made clear.

D. Energy balance structure and associated tables

25. In the treatment of nuclear fuels and generation of electricity from nuclear sources:

(a) In the main energy balance, "Nuclear electricity generation" should have its own row. A new column should be added for "nuclear fuel". The entry in the common cell should be the recorded or estimated heat release (or fuel burn-up) in the reactor (with a negative sign). This same figure should be carried up the column and repeated (with a positive sign) either in the "production" or the "import" row, according to whether the country concerned was a producer or an importer of uranium ore. For simplicity (in the main balance), no attempt should be made to distinguish whether imported ore was enriched or fabricated in the country that used it or to show export of any nuclear material. (A new row, in principle, would need to be introduced for "fuel processing plants" - including in particular isotopic separation plants - so that the balance could show the electricity flow to this intensive energy industry. The row could be located either in the transformation section or the final-use section of the balance - see also paragraph (d) below).

(b) In a satellite table, rows and columns should be provided to accommodate the flows to and from thermal reactors (as illustrated in Appendix C of the consultant's report). Such a table should show the available data at least in original units (tonnes). If possible, a second table with the same structure should show the same flow in terajoules. For the conversion into terajoules, the factor should reflect current nuclear technology (namely light water reactor with three recyclings of irradiated fuel or heavy water reactor with no recycling. These two technologies have approximately the same conversion factor).

(c) If and when fast breeder reactors become important in the production of electricity and heat for direct industrial use, the satellite table and conversion factors would need to be revised.

(d) A new row would be introduced. After discussion of the most suitable location of the enrichment row in the main balance, it was recognized that this was now unlikely to be completed (in the electricity input cell) if the row was separated from all other rows. It was decided that enrichment should be included as part of "other industry" and that a foot-note should invite countries to show as a "pro memoria" item the figure for estimated electricity use by the nuclear fuel processing industry.

(e) The International Atomic Energy Agency (IAEA) will supply the Statistical Office with a short note recommending the factors that should be used to convert original units (tonnes of fissile fuels) into terajoules in the satellite tables.

26. Energy balances should be constructed in matrix form with the following characteristics:

Use columns for energy sources (commodities);

Use rows for origins and uses of energy (transactions);

Separate submatrices for:

(i) supplies of primary fuels and "equivalents";

(ii) transformation inputs and outputs, energy industries' own use, transmission and other losses;

(iii) final uses.

27. An over-all energy balance is a single integrated account developed from separate accounts for multiple energy commodities.

28. The Statistical Office of the United Nations should publish energy balances in the spirit of the recommendations of the Expert Group, using the format in its report as the guideline for a presentation format. The current energy questionnaire of the Statistical Office should be the vehicle for collection of the basic statistics necessary for the compilation of accounts for energy commodities, prior to the integration of such accounts into an over-all energy balance.

29. Each method of generation contributing a significant amount of the total commercial supply of electricity should be distinguished in a separate row in the generation section of an energy balance.

E. Specifications

30. Existing classifications and definitions of energy commodities and uses by industry should be examined by the Secretariat of the United Nations with a view to establishing an agreed international set of designations, groupings and definitions as appropriate in the light of the other recommendations of the Expert Group.

31. Current international classifications, nomenclature and definitions should be evaluated with a view to their suitability for use with energy balances as a whole.

F. Particular flows and accounting methodology

32. Published energy balances, whether for particular energy sources or for all energy sources in a single table, should always make clear whether flows represent production, deliveries, receipts or consumption, and the coverage of stock changes (and stock levels) should make clear whether or not they cover producers', importers', transformers', distributors' and final users' stocks.

33. Production of coal should be defined as extraction from the ground minus the wastes and screenings sent to the waste-tip plus recoveries from the waste-tip.

34. The production of natural gas should include the gas subsequently flared (shown separately) but should not include the gas subsequently reinjected for repressuring of fields or other purposes.

35. Electricity output from pumped storage should not be added to electricity produced by methods other than pumped storage (because the latter already includes the electricity that is redistributed through time by means of pumped storage) when compiling an energy balance. The difference between the input to and and the output from pumping should be treated as part of the electricity industry's own use and losses.

36. Materials returned to oil refineries should be included as inputs to refining, even though such materials have previously been accounted for in refinery output.

37. National statistical offices might wish to consider development of statistics on end-use of energy, such as in the manner illustrated in the consultant's report. Other topics for review were contained in chapter VII of the report.

G. Other recommendations

38. The report of the consultant should receive full credit for its extensive and comprehensive treatment of the subjects under discussion.

39. The report of the consultant, suitably amended in the light of the discussions of the Expert Group, should be made available for circulation to national and

international statistical offices and other appropriate agencies concerned with the field of energy statistics, policy and planning. (It was noted that, if possible, the document would be translated for this purpose).

40. The Statistical Office of the United Nations should investigate the possibility of establishing, in conjunction with other international organizations, other United Nations bodies and interested national statistical offices, a programme of technical co-operation in the field of energy statistics. (This programme would assist in the integration of data from different sources within countries, would assist in the development of statistics of energy where none currently existed and would provide guidelines and assistance for the compilation of basic energy statistics, commodity balances and over-all energy balances).

41. The Statistical Office of the United Nations should publish an international handbook of conversion factors and units of measurement for use in the field of energy statistics.

42. The international organizations working in the field of energy statistics, and in particular energy balances, should integrate their work as closely as possible to avoid unnecessary duplication of effort.

Annex III

DOCUMENTATION OF THE EXPERT GROUP ON CLASSIFICATION AND MEASUREMENT IN THE FIELD OF ENERGY STATISTICS

Document Symbol	Title
ESA/STAT/AC.8/1	Energy statistics; current practices and future needs: report of a consultant to the Statistical Office of the United Nations
ESA/STAT/AC.8/1/Add.1	Appendix A, Combined heat and power (CHP) and measurement problems
ESA/STAT/AC.8/1/Add.2	Appendix B, The nuclear fuel cycle
ESA/STAT/AC.8/1/Add.3	Appendix C, Nuclear accounting
ESA/STAT/AC.8/1/Add.4	Appendix D, Energy in NACE/NIPRO
ESA/STAT/AC.8/1/Add.5	Appendix E, Institutions and people consulted
ESA/STAT/AC.8/1/Add.6	Appendix F, References
ESA/STAT/AC.8/2	Summary and check list of recommendations
ESA/STAT/AC.8/3	Energy statistics in the ESCAP region; note by the ESCAP secretariat
ESA/STAT/AC.8/4	Experience gained with the preliminary over-all energy balance in the ECE region; note by the ECE secretariat; and ECE Questionnaire for the collection of national data in accordance with a preliminary format of over-all balance sheets of energy
ESA/STAT/AC.8/5	Questionnaire on energy: Statistical Office of the United Nations, 1977
ESA/STAT/AC.8/6	World Energy Supplies, 1971-1975 (Statistical Papers, Series J, No. 20) a/
ESA/STAT/AC.8/7	Provisional agenda
ESA/STAT/AC.8/8	Energy statistics at the OECD

a/ United Nations publication, Sales No. E.77.XVII.4.

ESA/STAT/AC.8/9	Energy indicators and relational data: note by Statistics Canada
ESA/STAT/AC.8/10	Energy interrelationships; a handbook of tables and conversion factors for combining and comparing international energy data: report by United States Federal Energy Administration, National Energy Information Center
ESA/STAT/AC.8/11	Report of the Expert Group on Classification and Measurement in the Field of Energy Statistics
ESA/STAT/AC.8/12	Energy and power for development (notes); and Problems and strategies of energy planning in developing countries (case studies of India), by M. Chatterjee

E/CN.3/504
Annex IV

English only

STATISTICAL OFFICE OF THE UNITED NATIONS

Country:

OVERALL ENERGY BALANCE SHEET (revised)

Year:

Unit: Terajoule

	TRANSACTIONS / COMMODITIES	Hard coal, brown coals, lignite	Briquettes and cokes a/	Other solid energy sources ("non-commercial") b/	Crude petroleum, other inputs to petroleum refineries, natural gas liquids	Light petroleum products c/	Heavy petroleum products d/	Other petroleum products e/	LPG and other petroleum gases f/	Natural gas g/	Derived gases h/	Nuclear, hydro and geothermal electricity	Nuclear electricity	Hydro and geothermal electricity	Electricity	Steam and hot water i/	TOTAL ENERGY	
												Conventional fuel equivalent	Physical energy input				Conventional fuel equivalent	Physical energy input
1	Production of primary energy																	
2	Imports																	
3	Exports																	
4	Marine bunkers																	
5	Stock change																	
6	Total energy requirements*																	
7	Energy converted																	
7.1	Briquetting plants																	
7.2	Coke ovens and coke plants																	
7.3	Gasworks																	
7.4	Blast furnaces																	
7.5	Petroleum refineries																	
7.6	Electric power plants**																	
7.7	Heating plants***																	
7.8	Other conversion industries																	
8	Transfers																	
9	Consumption of energy sector																	
10	Losses in transport and distribution																	
11	Consumption for non-energy uses																	
12	Final consumption																	
12.1	Manufacturing industry, mining and construction																	
12.1.1	Iron and steel industries																	
12.1.2	Non-ferrous metal basic industries																	
12.1.3	Chemical and petrochemical industries																	
12.1.4	Other manufacturing industries, mining and construction																	
12.2	Transport																	
12.2.1	Road																	
12.2.2	Rail																	
12.2.3	Air																	
12.2.4	Inland and coastal waterways																	
12.3	Households and Other Consumers																	
12.3.1	Households																	
12.3.2	Agriculture																	
12.3.3	Other consumers																	
13	Statistical differences (6+7+8+9+10+11-12)																	

* Gross consumption of primary energy and equivalents.

** Public power plants and power plants of self-producers.

*** Including combined heat and power (CHP) plants.

a/ Hard coal briquettes (patent fuel), brown coal briquettes, lignite briquettes, peat briquettes, coke oven coke, gas coke, brown coal coke, coke breeze, low temperature coke and char. Includes coal derivatives and by-products.

b/ Peat, fuelwood, charcoal, bagasse, dung, tar, wood wastes, vegetal wastes, pulp and paper industry wastes, municipal and other wastes n.e.s.

c/ Aviation gasoline, motor gasoline, white spirit, industrial spirit, naphthas, jet fuels, kerosene.

d/ Distillate fuel oils, residual fuel oils.

e/ Bitumen, lubricants, petroleum waxes, petroleum coke, petrochemical feedstocks, refinery fuel n.e.s., other petroleum products n.e.s.

f/ Liquefied petroleum gases (LPG), refinery gas, ethane.

g/ Natural gas, colliery methane.

h/ Gasworks gas, coke oven gas, blast furnace gas. Includes production of substitute natural gas (SNG).

i/ Includes geothermal heat distributed as such to consumers.

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Annex IV

Unit: Terajoules (kcal)

Country:

PROPOSED STRUCTURE OF THE OVER-ALL ENERGY BALANCE SHEET

Year:

		Solid fuels	Other solid fuels	Crude petroleum, other petroleum refinery inputs and natural gas liquids	Petroleum products	Gases	Nuclear fuels	Electricity	Steam and heat	Total energy		Memorandum item: Primary fossil fuel equivalent of electricity*		Memorandum item: Solar and other energy from non-conventional sources (free format)
1	Production													
1a	Flaring of natural and associated gas and other losses in production													
2	Net production													
3	Imports													
4	Exports													
5	Marine bunkers													
6	Stock change													
7	Total energy requirements													
8	Electricity generation													
9	Oil refining													
10	Gas manufacture													
11	Heat and steam plant													
12	Energy converted													
13	Consumption of energy sector													
14	Losses in transformation, transport and distribution													
15	Consumption for non-energy uses													
16	Secondary production													
17	Transfers													
18	Statistical differences													
19	Final inland consumption													
20	Industry													
	A. Basic metals industry													
	(i) Iron and steel industry													
	(ii) Other basic metals industry													
	B. Chemical industry													
	C. Petrochemical industry													
	D. Other industry **													
21	Construction													
22	Transport													
	A. Road													
	B. Rail													
	C. Air													
	D. Inland and coastal waterways													
23	Other sectors													
	A. Agriculture													
	B. Commercial													
	C. Public service													
	D. Residential													

* E.g. tonnes of oil equivalent to 10^7 kcal.

** Including treatment of nuclear fuels.