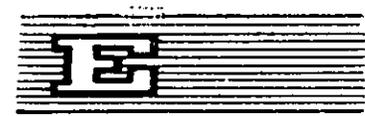


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ENERGY STATISTICS

ENERGY STATISTICS AND ENERGY BALANCES: ESSENTIALS FOR
A UNIFIED ENERGY POLICY FRAMEWORK IN THE ECA REGION

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INTRODUCTION

1. The most important prerequisite for the analysis and understanding of the complex functions and interrelationships of an energy economy is the systematic compilation of data on all energy commodities and on the gamut of energy activities, from production through international trade and conversion to final end-use. Such systematic compilation provides the statistical underpinning for detailed analysis of energy utilization particularly through the preparation of energy balances, whereby the principal elements of supply may be entered in the accounts against those of demand. Such accounts provide a statistical foundation for an analytical study of the functioning of the energy economy, thereby facilitating decision making in management and policy formulation.

2. The terms of reference of the paper comprise the elaboration of a system of energy statistics serving as a framework for the development and improvement of statistics.

I. CURRENT NEEDS IN ENERGY STATISTICS

3. The inadequacies of existing information bases have been revealed by recent critical developments in the world energy economy. ^{1/}, ^{2/} They have accentuated the need for comprehensive and integrated energy planning and policy formulation. Such formulation depends upon access to an advanced statistical foundation, and the planner and policy maker need to have at their disposal the following types of energy data on a regular and timely basis. (See Annex I for a summary of the various energy commodities.)

(a) Resources

- i. The nature and extent of indigenous energy resources distinguishing between "known" and "proven" and "inferred" or interpolated categories;
- ii. The technological and price thresholds for resource development and extraction, compared with prevailing supply alternatives.

(b) Production

- i. Rate of production of primary energy commodities;
- ii. Costs of production.

^{1/} See, for example, Report of the Second African Meeting on Energy, Accra, 8-19 November 1976 (E/CN.14/665; E/CN.14/NRD/E/15), Part Two, para. 29.

^{2/} In addition, see Economic Commission for Africa Report of the Executive Committee on the work of its Sixteenth Meeting, held in Kinshasa from 21 to 23 February 1977 (E/CN.14/682; E/CN.14/ECO/116), Annex II, p. 17, para. 3(a).

(c) Imports

- i. quantity and value of imported primary and secondary energy commodities.

(d) Exports

- i. quantity and value of exported primary and secondary energy quantities.

(e) Bunkers

(f) Changes in Stocks at Producers and Importers

(g) Transfers In of Energy Commodities between Processes

(h) Gross Inland Availability

Comprises Production + Imports - Exports - Bunkers - Changes in stocks at producers and imports + Transfers in (b+c-d=e-f+g).

(i) Transfers Out for Non-Energy Uses

(j) Fuel Used as Input in Energy Conversion Industry

Includes fuel used in coke plants, gas works, thermal power plants, briquetting plants, natural gas processing plants and refineries.

(k) Consumption by Energy Sector

Comprises only the consumption of energy by producers and transformers of energy for operating their installations.

(l) Net Inland Availability (Balance Line)

(h-i-j-k and n+o+p+q+r)

(m) Refinery Output of all Petroleum Products

(n) Consumption in Transportation - by Mode

(o) Consumption in Industry and Construction - by Sector

(p) Consumption in Household and Other Sectors

(q) Changes in Stocks at Consumers

(r) Losses, Statistical Differences and Not Accounted For

4. It should be noted that the above scheme includes the so-called "non-commercial" ^{3/} forms of energy under the production and trade of primary solid fuels. It is recognized that such commodities may contribute a substantial proportion of the total energy base of many developing countries, particularly in the household sector. ^{4/} In Africa a smaller portion is consumed in certain industries often in the form of wastes of the fabrication process and consumed by the company.

5. A serious problem in the compilation of such energy matrices rests with the timeliness of data. Planning and policy depend upon up-to-date information, particularly in the realm of options. The extrapolation of historical trends in production, consumption or price movements is no substitute for dynamic, accurate and timely statistics.

6. An outstanding characteristic of the world energy system is interdependence; few countries or regions are wholly self-sufficient in all sectors of the energy economy; thus, an important adjunct to the above data matrix comprises the establishment of statistics monitoring regional and global variations of energy supply and demand. The interfaces of the energy sector with other sectors of the economy are numerous. The comprehensive statistical treatment of the flow and effective end-use of energy in an economy is a useful stimulus to the identification and understanding of allied macro-economic problems, such as those of the energy-environment interface.

7. Global and regional statistics, including those of the ECA areas, are currently compiled by the Statistical Office of the United Nations in its publication World Energy Supplies ^{5/} as part of an ongoing modernization of the United Nations statistical system aimed at making its role commensurate with the needs for integrated and comparative data on the world energy system. In this respect, the Statistical Commission has also agreed on the use of energy balances as a key instrument in the co-ordination of work on energy statistics and the provision of data in a suitable form for understanding and analysing the functioning of the energy economy and the interrelationships between its constituent elements. ^{6/}

II. THE NEED FOR INNOVATION IN ENERGY STATISTICS: ENERGY BALANCE AS A BASIC TOOL FOR PLANNING AND POLICY

8. The data set outlined above represents the first, or raw stage of statistical work in energy. While individual series of statistics may be indicative of particular trends or problems, the important prerequisite today comprises the development of an integrated and co-ordinated framework for presenting the total picture in a country or region rather than ad hoc and disparate data on different sectors and activities in the energy economy.

^{3/} The term "non-commercial" denotes those sources which do not normally enter commercial energy markets but are consumed largely by producers, such as fuelwood, lumber-mill wastes, bagasse and other fuels that are largely of local significance, such as animal dung, straw, paddy husk and other vegetal matter.

^{4/} See further, Report of the Second African Meeting on Energy, Accra, 8-19 November 1976 (E/CN.14/665; E/CN.14/NRD/E/15, Part Three (A) Recommendations, para. 23.

^{5/} Statistical Papers, Series J. The twentieth issue covering the quinquennium 1971-1975 was released in April 1977 (United Nations publication, Sales No. E.77.XVII.4).

^{6/} Statistical Commission - Report on the Nineteenth Session (8-19 November 1976), Economic and Social Council Official Records: Sixty-Second Session, Supplement No. 2 (E/5910; E/CN.3/500), Chapter II B, para. 14.

9. Accordingly, the following outline indicates the scope of a simple form of energy accounting. In the initial stages, it is inexpensive to implement, easy to compile and integrated. At the same time it affords a plainly visible analysis of interfuel substitution possibilities, indigenous versus imported supply choices and, above all, the assessment of the effective use of energy at end-use. It should be emphasized that this simpler form of energy account, balance or profile is readily computerized thereby enhancing the timeliness of presentation and reducing the possibility of error. The essence of the methodology comprises the balancing or accounting of the production (i.e., supply) of energy by source against the use (i.e., demand) by sector, including the conversion or transformation of primary into secondary commodities (and the losses arising therefrom).

A. Energy Commodity Profiles

10. The typical commodity profile contained in table 1 of Annex II to this paper moves vertically from production through end-use and horizontally through a selected time period; the time series facilitates assessment of rates of change and characteristics of sectoral behaviour, as well as a partial check on data. Minor discrepancies may arise in the data due to differences in definitions, time of reporting, level of detail and rounding and errors of arithmetic. Particular attention should be given to these problems in the interests of comparability. In this connection, it should be mentioned that ECA has prepared a simplified energy balance sheet for the year 1975 which will appear in its Statistical Information Bulletin.

11. Data are initially compiled from the primary sources in original units; upon completion of the raw set a second set of profiles is prepared with all data converted to a common unit or base (e.g., tons coal equivalent, tons oil equivalent or kilowatt hours equivalent). Whatever common base unit is adopted, an integrated conversion factor matrix for reduction to that base should be constructed for common use throughout the system. Care should be exercised to balance the production inputs with uses, using net inland availability as the balance line.

B. Energy Sector Profiles

12. The sector profiles (see Annex III, Sector profiles 1, 2 and 3 in particular) are constructed from the data in the commodity profiles, reallocating the usage of individual energy commodities after conversion to common units on appropriate sheets. Sector profile 4 treats the energy conversion industries, i.e., the input and output and the losses accruing thereto in coke ovens, gas works, briquetting and refinery operations. Sector profile 5 treats diversion, disappearance and loss through non-fuel usage, losses in processing and non-accounted quantities, including statistical differences.

13. Finally, the consolidated commodity/sector summary (Annex III, Summary Profile 6) is prepared from the totals on the commodity sheets, to present an overview of the main features of the energy economy.

C. Conclusion

14. The key to effective planning and policy-making in the energy economy is the availability of accurate synopses of individual sectors, of an overview of the total scenario, and in particular of the uses and flows of particular commodities through end-use. In this light, it is encouraging to note that the Economic Commission for Africa has recognized this point and has included in its forthcoming two-years programme the development of a data base which will include energy balance sheets. ^{1/} The above basic profile sets provide the starting point in rendering such data available in a manageable and easily understood format. Further modification and extension of this approach may be undertaken, according to the depth of detail required on either an over-all or a sectoral basis. At the outset, it must be recognized that comprehensive statistics may not be available in the detail outlined in this paper: accordingly, the paper represents a long-term goal, the individual parts of which may be implemented as the level of detail of statistics increases.

^{1/} United Nations Economic and Social Council, Economic Commission for Africa, Programme of Work and Priorities for 1978 and 1979 (E/CN.14/TECO/35/Rev.1 - 13 January 1977, p. 113 - Industrial Statistics).

SELECTED REFERENCES ON THE SUBJECT

- Department of Energy, United Kingdom, Energy Balances - Some Problems and Recent Developments - Energy Paper Number 19 - London, 1977
- Guyol, Nathaniel B., Energy in the Perspective of Geography - Prentice Hall, New Jersey, 1971
- Organization for Economic Co-operation and Development, Energy Balances of OECD Countries, 1960-1974, Paris, 1976
- United Nations Conference of European Statisticians - Meeting on general energy statistics (15-19 March 1976) - General Energy Statistics (CES/AC.32/10-16 January 1976) - Memorandum prepared by the Statistical Office of the United Nations.
- United Nations Conference of European Statisticians - Working Group on General Energy Statistics (First Session: 17-21 February 1969), The Methodology of Energy Balance Sheets - Problems Encountered in Compiling Energy Balance Sheets,
- United Nations Economic Commission for Europe. Annual Bulletin of Coal Statistics for Europe, Annual Bulletin of Electric Energy Statistics for Europe, Annual Bulletin of Gas Statistics for Europe and Annual Bulletin of General Energy Statistics for Europe, Geneva, 1976.
- United Nations Economic and Social Commission for Asia and the Pacific. Comprehensive Energy Surveys: An Outline of Procedure, Bangkok, 1967
- United Nations Economic and Social Council. Towards a System of Integrated Energy Statistics - Report of the Secretary General (E/CN.3/476 - 15 March 1976) - Paper prepared for the Nineteenth Session of the Statistical Commission, New Delhi, 8-19 November 1976.
- United Nations Economic and Social Council. Training of Highly Skilled Technical Manpower in the Field of Energy in Africa (E/CN.14/NRSTD/E/5 - 22 January 1976) - Paper submitted by the United Nations Institute for Training and Research (UNITAR) for the Second African Meeting on Energy, Accra, Ghana, 1-12 March 1976.
- United Nations Statistical Office. World Energy Supplies, 1971-1975 (Statistical Papers, Series J, No. 20 - Sales No. E.77.XVII.4), New York, 1977.

Annex I

SUMMARY OF ENERGY COMMODITIES

Section A: Solid fuels

Statistics on hard coal
Statistics on brown coals/lignite
Statistics on coke oven coke
Statistics on gas coke
Statistics on brown coal coke
Statistics on patent fuel (hard coal briquettes)
Statistics on brown coal/lignite briquettes or peat briquettes
Statistics on peat (for fuel uses)
Statistics on non-commercial solid fuels

Section B: Liquid fuels

Statistics on natural gas liquids
Statistics on crude petroleum
Statistics on aviation gasoline
Statistics on motor gasoline
Statistics on jet fuels
Statistics on kerosene
Statistics on distillate fuel oils
Statistics on residual fuel oils
Statistics on lubricants
Statistics on bitumen (asphalt)
Statistics on naphthas
Statistics on petroleum waxes
Statistics on petroleum coke
Statistics on white spirit and industrial spirit
Statistics on liquified petroleum gases
Statistics on refinery gas
Statistics on other petroleum products

Section C: Gases

Statistics on natural gas (including LNG)
Statistics on manufactured (gasworks) gas
Statistics on coke oven gas
Statistics on blast furnace gas

Section D: Electricity

Statistics on electricity: net installed capacity
Statistics on electricity: gross production and consumption
Statistics on fuels consumed in public and industrial thermal power stations
Statistics on steam and hot water

Annex II

TYPICAL COMMODITY PROFILE
(FRAMEWORK OF THE ENERGY BALANCE)

TABLE 1. SOURCES AND USES OF _____

Unit: _____

	<u>197.</u>	<u>197.</u>	<u>197.</u>
1. PRODUCTION			
2. IMPORTS			
3. EXPORTS			
4. BUNKERS			
5. CHANGES IN STOCKS AT PRODUCERS AND IMPORTERS			
6. TRANSFERS IN OF ENERGY COMMODITIES			
7. GROSS INLAND AVAILABILITY (1+2-3-4-5+6)			
8. TRANSFERS OUT FOR NON-ENERGY USES			
9. USED AS INPUT IN ENERGY CONVERSION			
In Coke-Over Plants			
In Gas Works			
In Thermal Power Plants			
10. CONSUMPTION BY ENERGY SECTOR			
By Coke-Oven Plants			
By Gas Works			
11. NET INLAND AVAILABILITY (7-8-9-10 AND 14+15+16+17+19) (BALANCE LINE)			
14. CONSUMPTION IN TRANSPORTATION SECTOR			
In Railways			
In Roads			
In Air			
15. CONSUMPTION IN INDUSTRY AND CONSTRUCTION			
In Iron and Steel Industry			
In Other Industries			
16. CONSUMPTION IN HOUSEHOLD AND OTHER SECTORS			
17. CHANGES IN STOCKS AT CONSUMERS			
19. LOSSES, STATISTICAL DIFFERENCES AND NOT ACCOUNTED FOR			

Annex III

SECTOR PROFILES AND SUMMARY PROFILE

Figure 1

SECTOR PROFILE 1. ENERGY CONSUMPTION IN THE TRANSPORTATION SECTOR

Air

Aviation gasoline
Jet fuels
Total

Road

Motor gasoline
Distillate fuel oils
Total

Coastal and inland navigation

Hard coal
Briquettes
Motor gasoline
Kerosene
Distillate fuel oils
Residual fuel oils
Total

Railways

Hard coal
Brown coal
Coke-oven coke
Briquettes
Distillate fuel oils
Residual fuel oils
Other
Total

Foreign Bunkers

Hard coal
Aviation gasoline
Jet fuels
Distillate fuel oils
Residual fuel oils
Total

Figure II

SECTOR PROFILE 2. ENERGY CONSUMPTION IN INDUSTRY AND CONSTRUCTION

Hard Coal
Brown coal
Cokes
Briquettes
Peat for fuel use
Non-Commercial solid fuels
Motor gasoline
Kerosene

Distillate fuel oils
Residual fuel oils
Liquefied petroleum gases
Natural gas
Manufactured gas
Coke oven gas
Other
Total

Figure III

SECTOR PROFILE 3. ENERGY CONSUMPTION IN HOUSEHOLD AND OTHER SECTORS

Hard Coal
Brown coal
Cokes
Briquettes
Peat for fuel use
Non-commercial solid fuels
Motor gasoline
Kerosene

Distillate fuel oils
Residual fuel oils
Liquefied petroleum gases
Natural gas
Manufactured gas
Coke-oven gas
Electricity
Total

Figure IV

SECTOR PROFILE 4. PROCESSING PLANT INPUT AND OUTPUT

1. Coke ovens

Input

Hard coal

Brown coal

Total

Output

Coke oven coke

Brown coal coke

Coke oven gas

Total

Output - input

2. Gas works

Input

Hard coal

Brown coal

Cokes

Distillate fuel oils

Residual fuel oils

Other

Total

Output

Gas coke

Gas works gas

Total

Output - input

3. Briquetting plants

Input

Hard coal

Brown coal

Peat for fuel

Output

Hard coal briquettes

Brown coal briquettes

Peat briquettes

Output - input

4. Thermal power plants

Input

Hard coal

Brown coal

Briquettes

Peat for fuel

Other solid fuels

Crude petroleum

Distillate fuel oils

Residual fuel oils

Natural gas

Manufactured gas

Coke-oven gas

Other

Total

Output

Production of thermal electricity

Output - input

5. Natural gas processing plants

Input

Natural gas (WET)

Output

Natural gasoline

Plant condensate

Plant liquefied petroleum gases

Other finished liquid products

Total

6. Refinery losses

Input

Crude petroleum input to refinery

Output

Total output of all petroleum products

Refinery fuel and loss

Total

Output - input

Figure V

SECTOR PROFILE 5. ENERGY DIVERSION, DISAPPEARANCE AND LOSS

<u>Non-fuel uses</u>	<u>Lost and not accounted for (including statistical differences)</u>
Lubricants	Hard coal
Bitumen/asphalt	Brown coal
Naphthas	Peat
Petroleum waxes	Briquettes
Petroleum coke	Cokes
White spirit and industrial spirit	Non-Commercial solid fuels
Others (unfinished oils residues and petro-chemical feed stocks)	Gasolenes
	Kerosene and jet fuels
	Distillate fuel oil
	Residual fuel oils
	L.P.G. and refinery gas
	Natural and manufactured gases
	Electricity
A. Total	C. Total
<u>Lost in processing</u>	Over-all total (A + B + C)
Coke ovens	
Gas works	
Briquetting plants	
Thermal power plants	
Natural gas processing plants	
Petroleum refineries	
B. Total	

Figure VI

SUMMARY PROFILE 6. CONSOLIDATED ENERGY CONSUMPTION BY COMMODITY AND SECTOR

<u>Commodity</u>	<u>Sector</u>
Solid fuels	Transportation
Petroleum products	Air
Gases	Road
Electricity	Coastal and inland navigation
	Railways
	Foreign bunkers
Total	Industry and construction
	Household and other sectors
	Lost in processing
	Non-fuel uses
	Lost and not accounted for (including statistical differences)
	Total