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M. Goldstein

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LEAP MODEL 22C RESULTS VERSUS EIA 1979 REPORT

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ABSTRACT

A comparison study of LEAP Model 22C predicted results for years 1975 and 1980 versus the compiled "real" data of EIA 1979 report for years 1975, 1976, 1977, 1978 and 1979 has been performed. It is concluded that most of the quantities predicted by LEAP Model 22C for 1975 and 1980 are in reasonable agreement (within about 2%) with EIA 1979 as well as with EIA 1978 data.

Many differences between LEAP Model 22C predicted results and EIA 1979 "real" data for years 1975 and 1980 are also discussed.

I. INTRODUCTION

The Long-Term Energy Analysis Program (LEAP) is an energy-economy model which resides in the Long-Term Energy Analysis Divison (LTEAD) in the Office of Applied Analysis, Energy Information Administration (EIA), U.S. Department of Energy. LTEAD developed Model 22C of LEAP for two reasons: (1) to prepare projections through the year 2020, which were needed for the 1978 EIA Annual Report to Congress[1] and (2) to develop a base for analysis of specific options for federal action.

LEAP Model 22C provides projections for ten equally spaced discrete time points, starting from 1975, while the time interval between two successive time points is 5 years. To the extent that the long-range forecasts published by EIA in 1978 (Ref. 2) and 1979 (Ref. 3) reflects "real" data, it is possible to validate the accuracy assessment of LEAP Model 22C projections for the first two time points (1975 and 1980).

The purpose of this work is to validate the accuracy of LEAP Model 22C results for years 1975 and 1980, by comparison with the compiled data of EIA 1978 (Ref. 2) and EIA 1979 (Ref. 3) Reports. Since these reports do not include specific data for 1980, the validation for 1980 is done by a quantitative comparison of LEAP Model 22C results versus smoothly extrapolated 1975-1979 values of EIA 1979.

II. BASIC DATA DIFFERENCES

The data of EIA 1978 and 1979 reports include small quantities which are not taken into account in LEAP Model 22C:

(a) Geothermal and biomass electricity generation (consumption) is zero in LEAP and less than 0.1% of the overall energy supply (consumption) in EIA reports.

(b) Imports of coal, coal coke, and hydropower are nonexistent in LEAP and less than 0.4% of the overall energy supply in EIA reports.

(c) Exports of crude oil, refined petroleum products, natural gas, coal coke, and hydropower are nonexistent in LEAP and are approximately 1% of the overall energy supply in EIA reports.

Therefore, before a comprehensive comparison was done, the EIA compilation has been corrected to be consistent with the LEAP Model 22C results. The attached diagrams (Figs. 1 through 9) compare the LEAP Model 22C results for the years 1975 and 1980 versus the compiled data of EIA 1978 and EIA 1979 reports. It can be seen that except for few very small differences, the data of EIA 1979 agree fairly well with the data of EIA 1978 report.

III. COMPARISON OF 1975 QUANTITIES

The results of LEAP Model 22C for 1975 are smaller, in general than the 1975 data in the EIA 1979 report. The main differences are:

(a) The domestic gas production is lower by 1.59 Quad. (8%) - (see Fig. 2).

(b) The domestic coal production is lower by 0.99 Quad. (7%) - (see Fig. 2).

(c) The oil consumption is lower by 1.35 Quad (4%) - (see Fig. 4).

(d) The passenger cars fuel rate is lower by 0.47 miles/gal. (3%) - (see Fig. 6).

(e) Finally, the total energy supply is lower by 2.36 Quad. (3%) and the toal energy consumption is lower by 1.9 Quad. (2%) - (see Fig. 9).

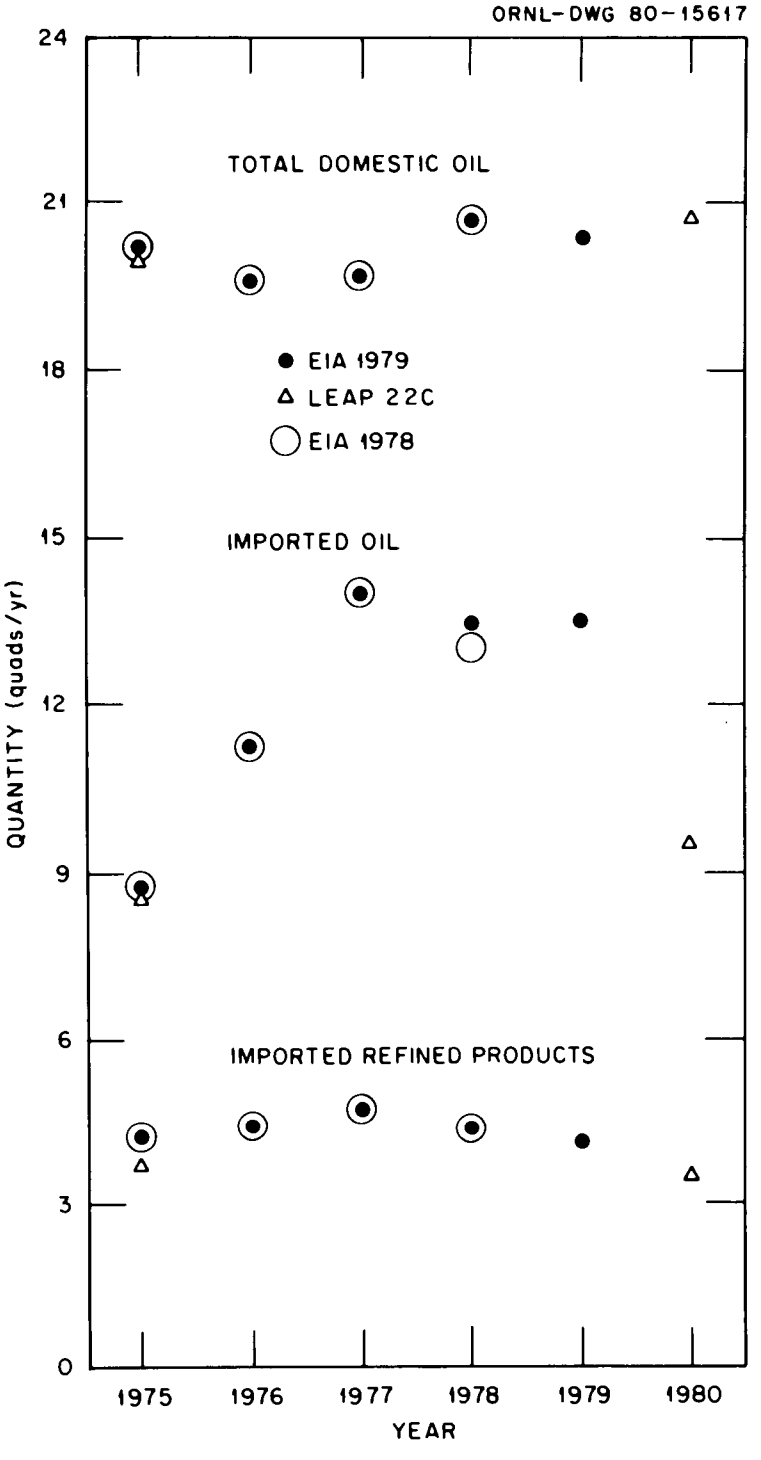

Fig. 1. Oil Supply

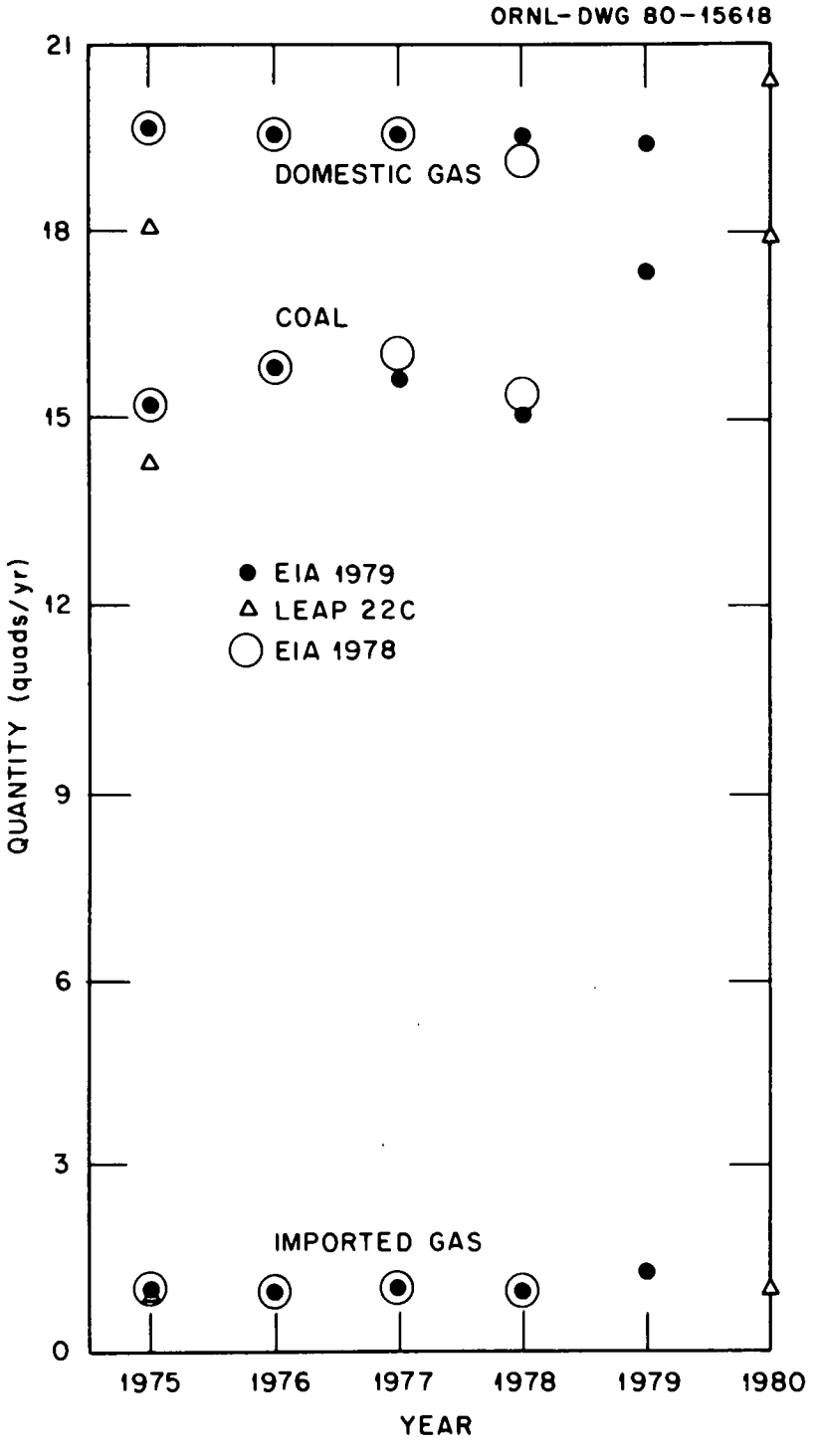

Fig. 2. Gas and Coal Supply

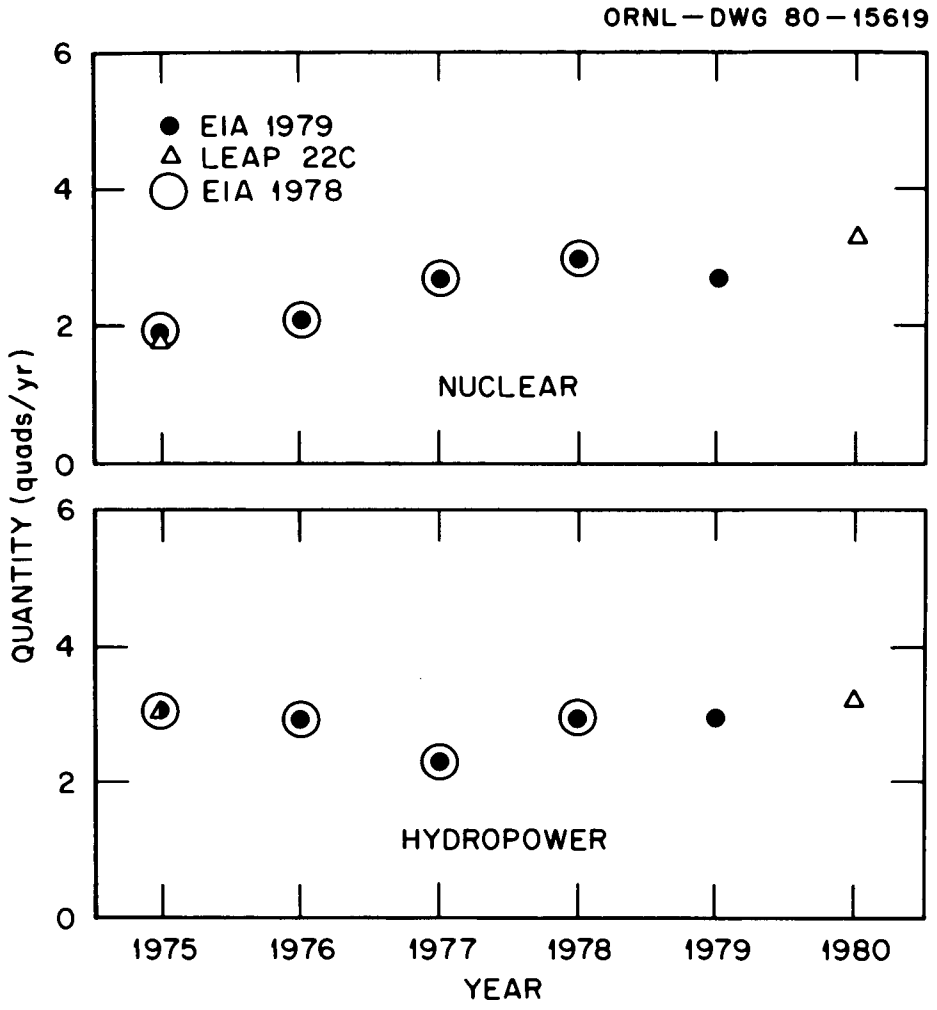

Fig. 3. Nuclear and Hydropower Supply and Consumption

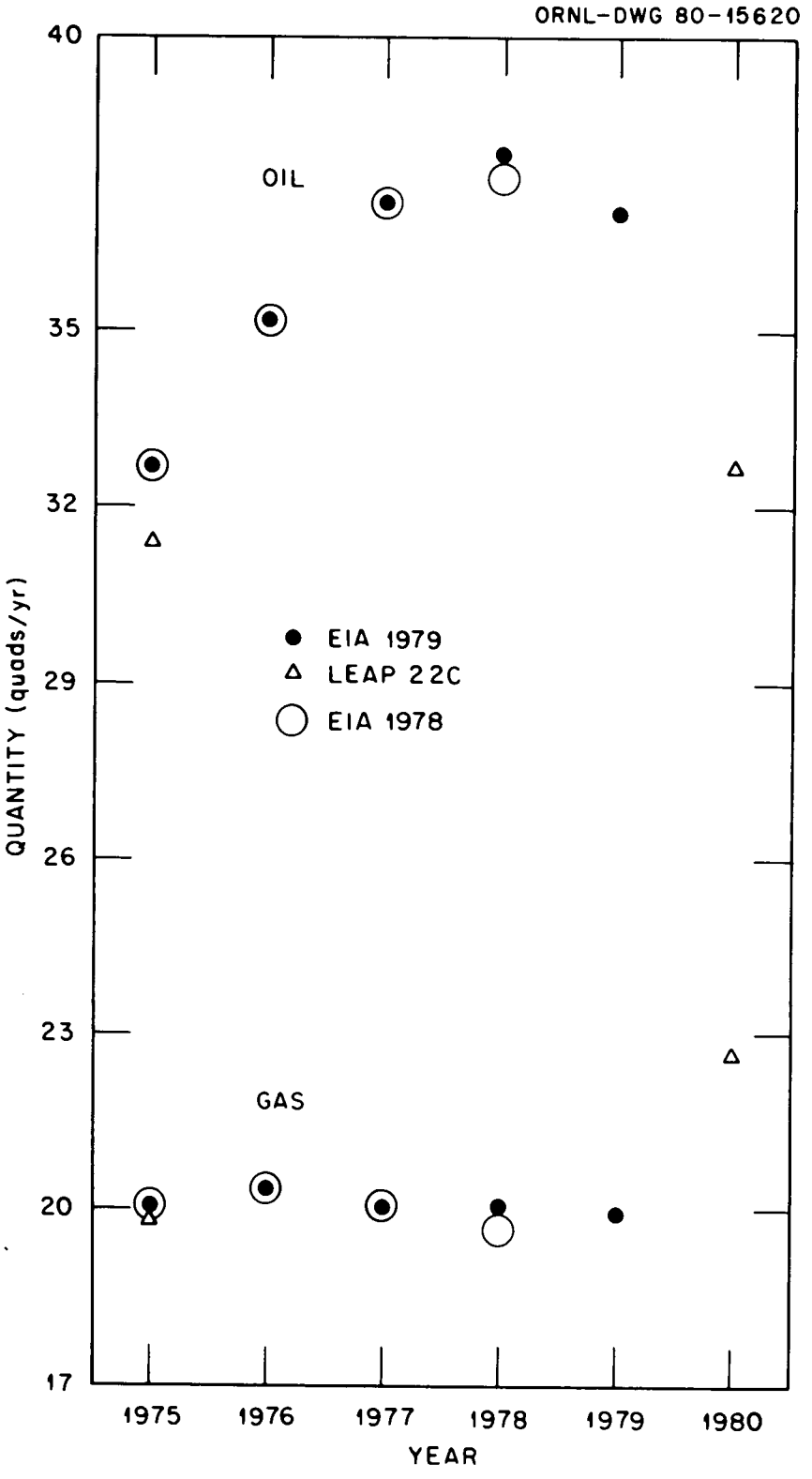

Fig. 4. Oil and Gas Consumption

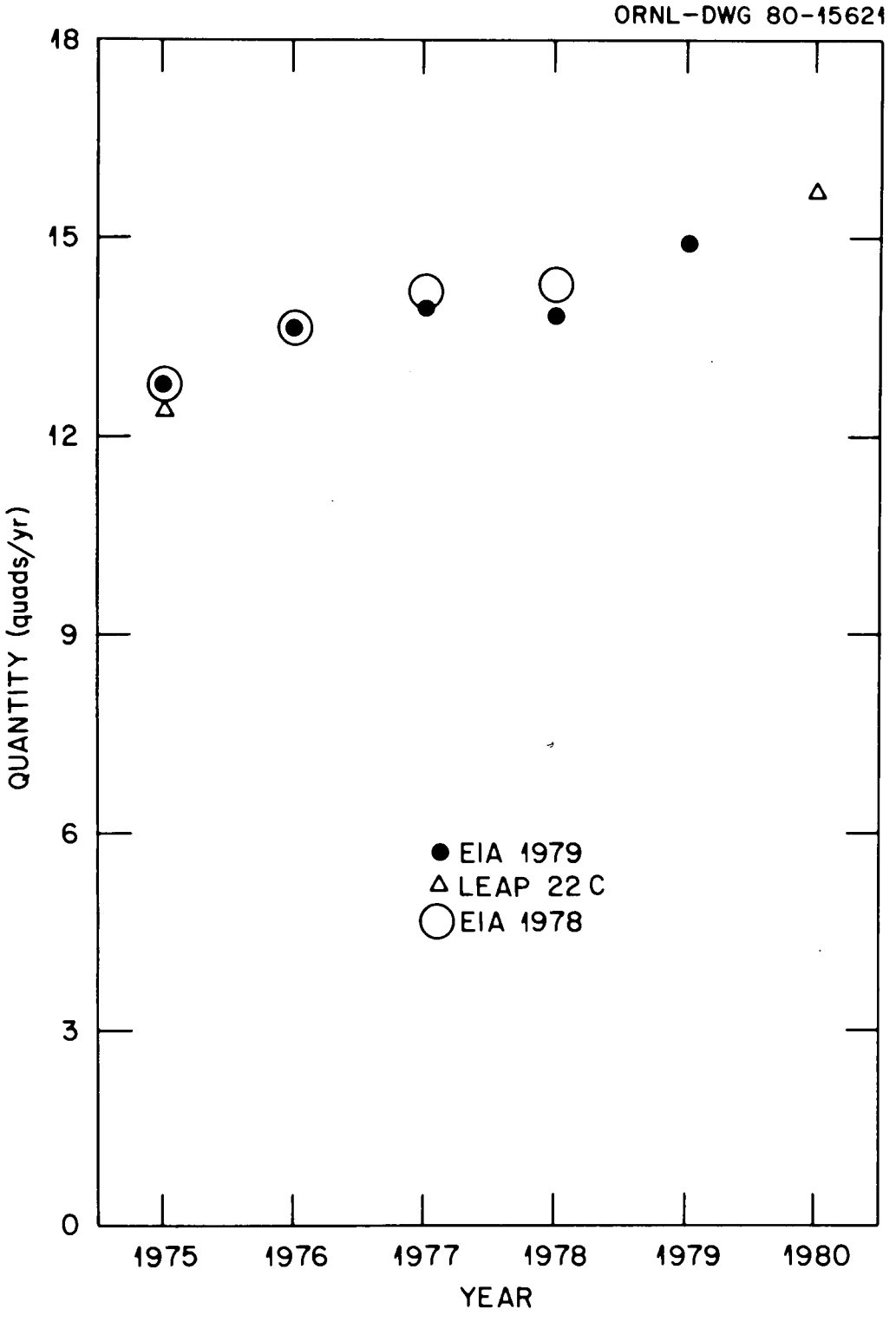

Fig. 5. Coal Consumption

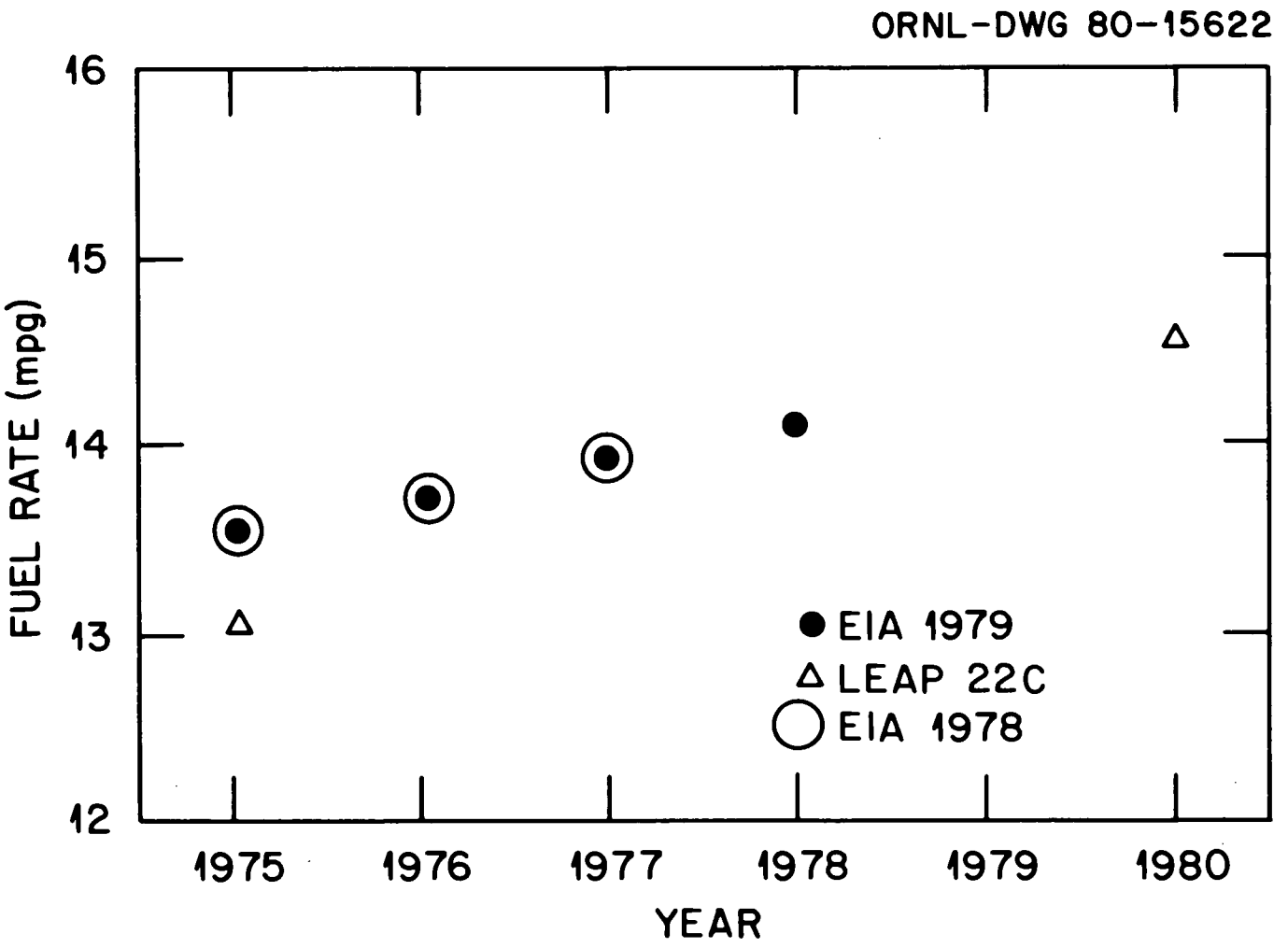

Fig. 6. Passenger Cars Fuel Rate

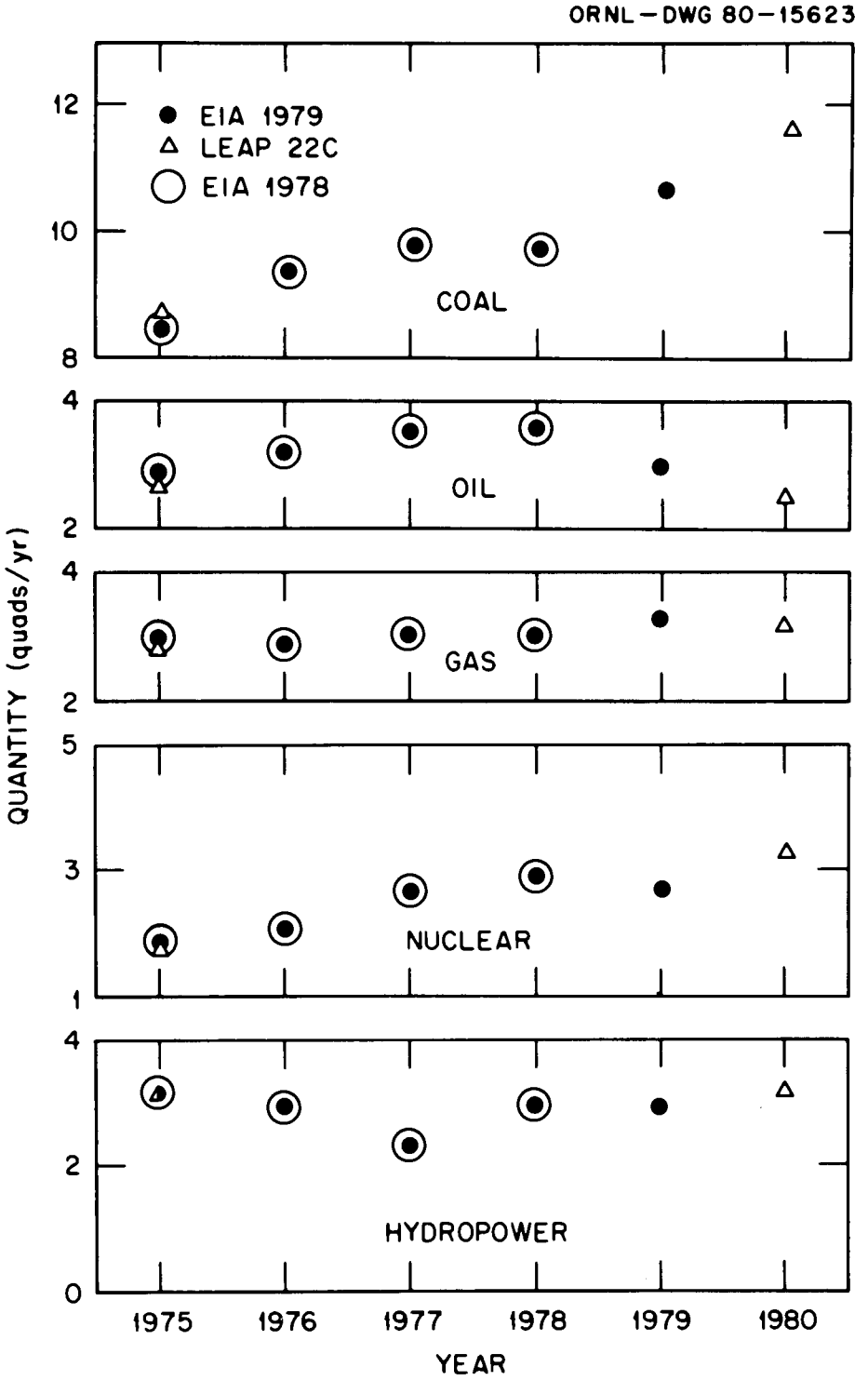

Fig. 7. Primary Electrical Input Fuels

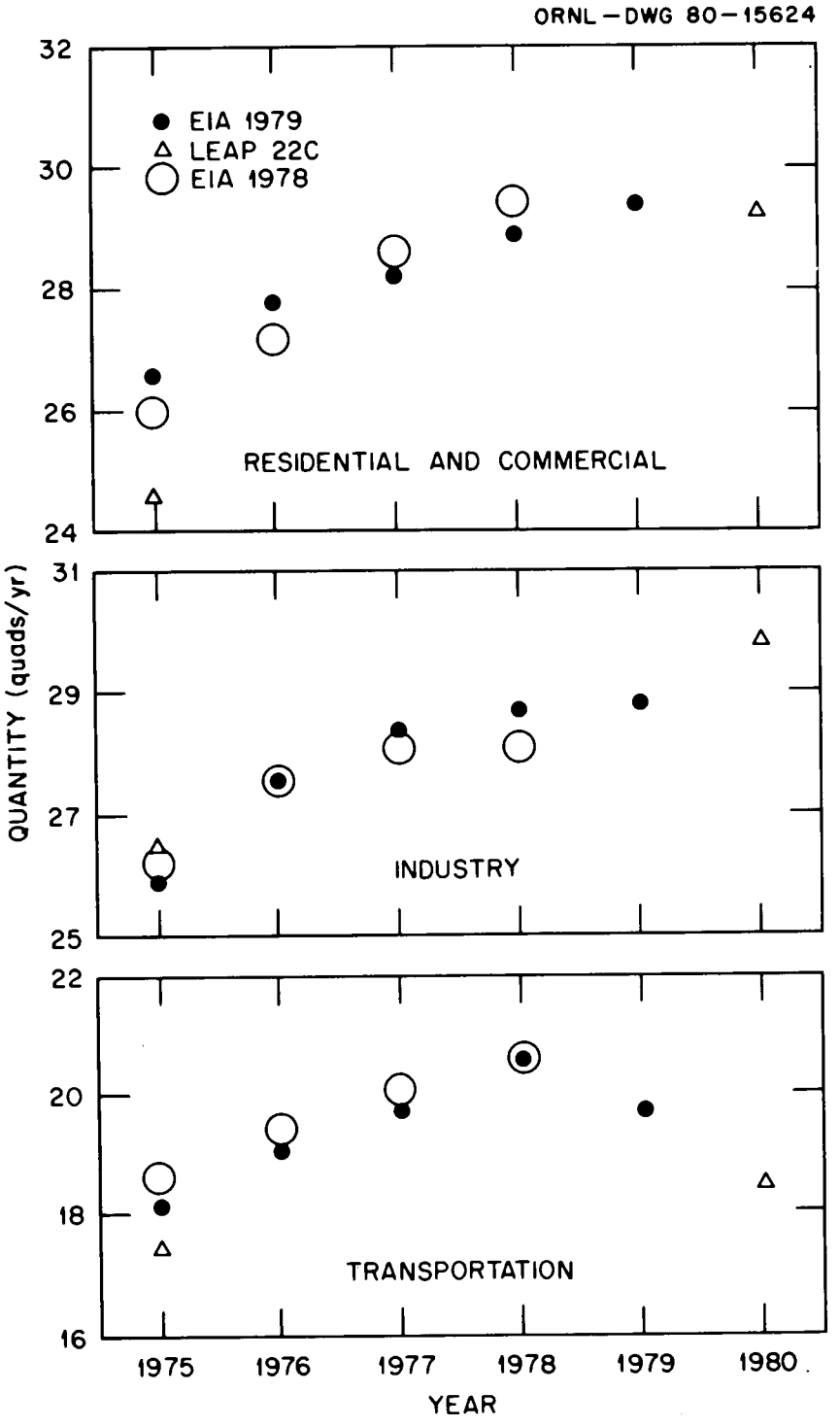

Fig. 8. Consumption of Energy by End-Use Sectors

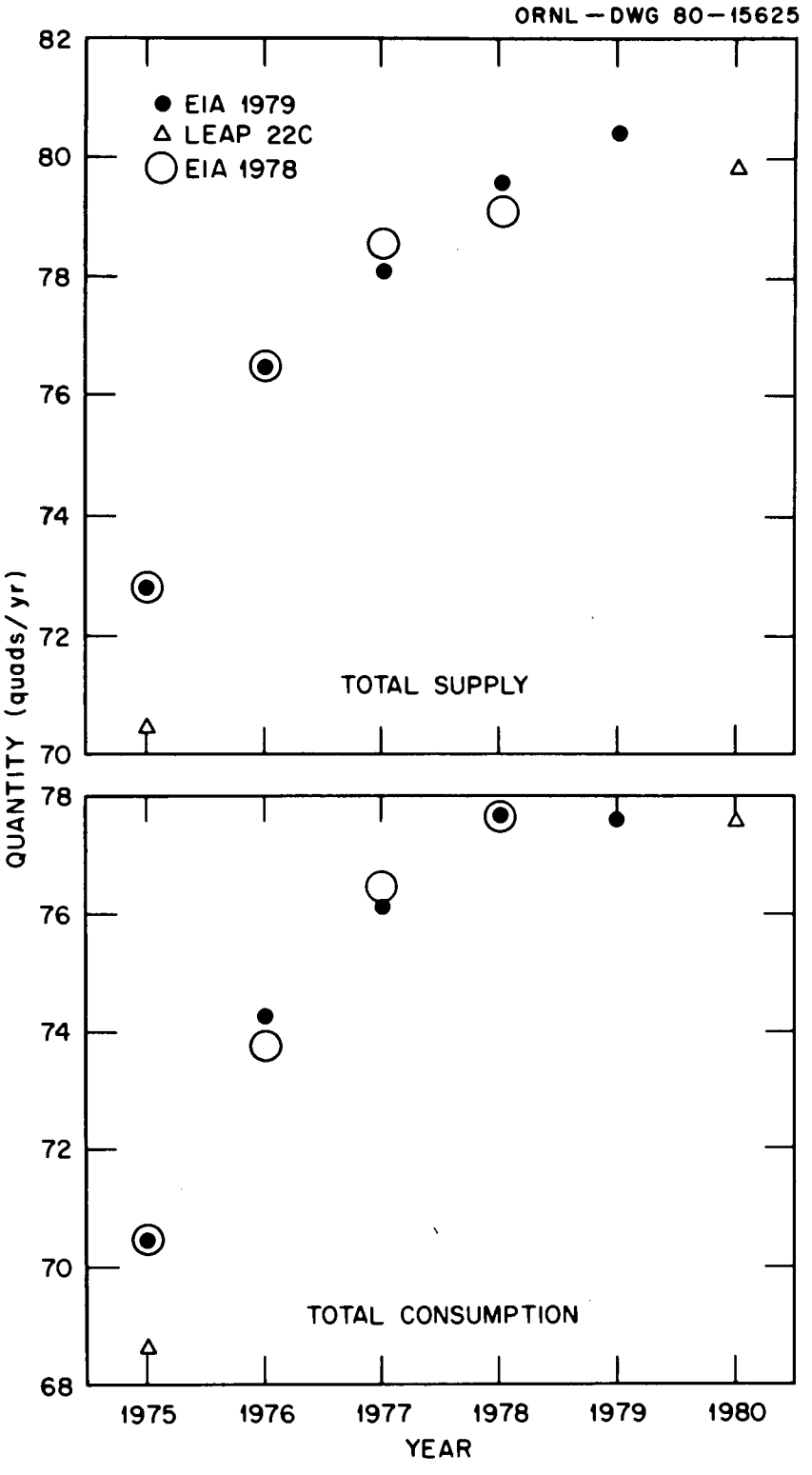

Fig. 9. Total Supply and Total Consumption

For 1975, the LEAP Model 22C input values used for the first iteration are higher, for some specific quantities, than the output of LEAP 22C for 1975. (See Table I).

Table I. Comparison Between LEAP 22C Input Values, LEAP Output, EIA 1977 and EIA 1979 Data for Year 1975

Quantity	LEAP 22C input*	LEAP 22C output*	EIA 1977*	EIA 1979*
Domestic gas production	18.93	18.043	19.0	19.64
Domestic coal production	14.6	14.193	14.6	15.19

*The quantities are expressed in Quad./year.

It seems that during the up and down iterations, the values for domestic gas production and domestic coal production for 1975 are continuously changed and finally, when convergence is reached, they are appreciable lower than the initial values. Moreover, the inital values implemented in the LEAP Data Base for the above quantities agree reasonably well with the EIA 1977 (Ref. 4) data and are low in comparison with the more adequate compilation of EIA 1979. Therefore, it can be concluded that the main reasons for the differences concerning the domestic gas and coal production for year 1975 are:

(1) Inadequate input data for the domestic gas production and domestic coal production.

(2) The iterative character of the LEAP code.

The difference in the oil consumption can be explained by the fact that the LEAP calculated prices for oil in year 1975 are higher in comparison with the prices specified in EIA 1979. (See Table 2).

Table 2. Comparison Between Domestic Crude Oil Prices in 1975

Quantity	LEAP 22C Result	EIA 1979
Domestic Crude Oil Prices (1975 $/MMBtu)	1.9887	1.44*

*Refiner acquisition price of domestic crude oil.

The difference concerning the passenger cars fuel rate in 1975 is explained in Ref. (5) as follows:

"The 13.1 mpg differs from the Federal Highway Administration number of 13.7 because LEAP fuel input was 10.05 Quads., which includes 0.5 Quads. of off highway gasoline. Otherwise, using a 9.55 Quads. figure results in 13.7 mpg. These are fleet average figures tracking MEFS through 1990."

IV. COMPARISON OF 1980 QUANTITIES

According to the attached diagrams and assuming a smooth extrapolation of 1975-1979 values of EIA 1979, it seems that the following quantities predicted by LEAP Model 22C for 1980 are in reasonable agreement with EIA 1978 and EIA 1979 compiled data:

(a) Total domestic oil production (Fig. 1)

(b) Imported refined products (Fig. 1)

(c) Total coal production (Fig. 2)

(d) Imported gas (Fig. 2)

(e) Nuclear supply and consumption (Fig. 3)

(f) Hydropower supply and consumption (Fig. 3)

(g) Coal consumption (Fig. 5)

(h) Passenger cars fuel rate (Fig. 6)

(i) All primary electric input fuels (Fig. 7)

(j) Consumption of energy by residential and commercial sectors (Fig. 8)

(k) Consumption of energy by transportation sector (Fig. 8)

(l) Total consumption of energy (Fig. 9)

The following quantities appear to be higher than the EIA 1979 data:

(a) Domestic gas production (by ∿4%) (Fig. 2)

(b) Gas consumption (by ∿10%) (Fig. 4)

(c) Consumption of energy by the industrial sector (by ∿2.5%) (Fig. 8)

Finally, the following quantities are lower in comparison with EIA 1979 compiled data:

(a) Imported oil (by ∿30%) (Fig. 1)

(b) Oil consumption (by ∿10%) (Fig. 4)

(c) Total energy supply (by 2.5%) (Fig. 9)

Apparently, there is no straightforward connection between the predicted versus "real" data differences in 1975 and 1980. In other words, the differences between the predicted and "real" data encountered in 1980 are not always accompanied by similar differences in 1975. For example, the domestic gas production and the gas consumption are predicted higher than the "real" data for 1980, while in 1975 the predicted results are lower and equal to the "real" data, accordingly. On the other hand, the quantity predicted for imported oil in 1980 is lower, while in 1975 it is in good agreement with the "real" data. Therefore, the differences between the predicted and "real" data encountered in 1980 cannot be explanined on the basis of the 1975 differences. Further work is needed to fully understand the reason for the above mentioned differences.

V. CONCLUSIONS

This study suggests a fair agreement, in general, between LEAP Model 22C projection for 1980 and the values extrapolated from EIA 1979 report. However, for a few 1980 quantities as well as for some 1975 quantities there are appreciable differences, as noted. Further work could be needed to fully understand the reason for the above mentioned differences.

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