

Revised Version

A TALE OF TWO ERAS (1973 – 2014)

World Energy Scene - 40 years after Energy Crisis

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Abstract

Energy crisis of 1973 shocked the world from complacency about energy supply and price. World has responded to energy crisis by significant improvement in energy efficiency and substitution of oil. Global Warming concerns are further driving energy efficiency and rise of renewable. The present article looks to energy scene in World and India before and after energy crisis. Some observations are made based on available data for further action.

Keywords: Energy Crisis, Energy Efficiency, Energy and Economy

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Introduction

Arab Israeli war in 1973 led to energy crisis awakening the world to limited availability and rising price of energy especially oil. International Energy Agency was formed in 1974 by developed world to ensure security of energy supply. It is worthwhile looking at the world energy scene in 1973 and 2014, 40 years after energy crises. International energy agency has brought out its outstanding annual publication "Key world energy statistics 2016"¹ (www.iea.org) also available is Key world energy Trends (2016), a summary from World energy balances 2016. These publications give very interesting trends in World Energy Supply and World Energy Consumption in 1973 (before energy crisis of 1973) and 2014 (40 years after the energy crisis of 1973). This note analyses some characteristics of energy supply and use in pre and post energy crisis world. Also includes similar comparison for India.

Primary energy supply

In 1973 world energy supply was 6101 MTOE (Million Ton Oil Equivalent). In 2014 it was 13099 MTOE. Energy supply increased 2.25 times in 2014 compared to 1973. Shares of various fuels are shown in Table 1. MTOE is based on 1Kg oil = 10,000 KCAL

Table 1
Shares of Fuels in Primary Energy Spply

Fuel	1973	2014
Oil	46.2 %	31.3 %
Coal	24.5 %	28.6 %
Natural gas	16.0 %	21.2 %
Bio fuels and waste	10.5 %	10.3 %
Hydro	1.8 %	2.4 %
Nuclear	0.9 %	4.8 %
Others (Solar, Wind etc)	0.1 %	1.4 %

Sharp rise in oil prices has led to its substitution and efficient use. Oil provides only 31.3% of energy supply in 2014 compared to 46 % in 1973. Share of coal and gas has increased to some extent. Bio fuel which are mainly used in developing countries like India, (firewood, dung cake) still account for 10% of energy supply. Share of nuclear energy shows a sharp increase with marginal increase in share of hydro.

It must be mentioned here that IEA treats nuclear and hydro electricity differently, when converting to oil equivalent.

- Hydro electricity is converted by direct conversion
 $1\text{KWH} = 860 \text{ KCAL}$, $1 \text{ GWH} = 0.000086 \text{ MTOE}$.
- Nuclear is converted by thermal equivalent using efficiency of 33%.
 $1\text{KWH} = 860/0.33 = 2606\text{Kcal}$. ($1 \text{ GWH} = 0.0002606 \text{ MTOE}$).
This practice shows increased share of nuclear and reduced share of hydro.
Solar etc are treated like hydro.
- In 2014 Hydro generation is 3983 Terawatt Hour (TWh) is significantly more than Nuclear Generation of 2535 TWh. But though Hydro is shown as 2.4% compared to 4.8% of Nuclear.

Shares of different regions also show a dramatic change (Table 2)

Table 2
Regional Share of Energy Supply

Region	1973	2014
OECD	61.3%	38.40 %
Non OECD- Europe (Russia and others)	15.5%	8.2%
China	7%	22.4%
Middle east	0.8%	5.3 %
Asia and others	5.5%	12.7 %
Total	100%	100%

OECD includes Europe, USA, Japan and others. Non OECD Europe means Russia and its former associates like Ukraine, Turkministan etc. Asia includes India, Indonesia, Shri Lanka and others. Dramatic rise in energy production in China and Middle East and decline of USA, Europe in energy supply can be seen from Table 2. Share of Asia's energy supply has also increased.

Table 3 Shows values of fuels in actual units and their ratios in 2014 and 1973.

Table 3
Energy Supply by Fuels (Actual Units)

Fuel	1973	2014	2014/1973
Crude oil (Million tones- Mt)	2869	4331	1.509
Natural gas (Billion Cubic Meters - bcm)	1224	3590	2.933
Coal (Million tones – Mt)	3074	7709	2.507
Nuclear (Terawatt Hour- TWh)	203	2535	12.48
Hydro (Terawatt Hour- TWh)	1296	3983	3.073
Total Primary Energy (Million Tons of Oil Equivalent - MTOE)	6106	13699	2.245
Total electricity TWH	6131	23816	3.88

Table 3 shows relative decline of oil, increase of gas and coal and Nuclear and hydro. It may be noted that hydro generation is (3883/2535) 31% more than nuclear but method of conversion used by IEA shows that contribution of nuclear is 4.8% of total energy compared to 2.4% of hydro.

It may be of interest to look at Population, GDP and Energy Intensity as shown in Table 4 (GDP, population data is from World Bank Website).

Table 4
World Population, GDP and Energy Intensity

	1973	2014	2014/1973
Population	3850 million	7220 million	1.87
GDP Current US Dollars	4580 billion	78100 billion	17.05
GDP/Capita Current US Dollars	1169.5	10757.3	9.19
Energy Supply MTOE	6101	13699	2.25
Energy Intensity Kg Oil/GDP (dollar)	1.33	0.175	0.13

It can be seen that GDP is rising at a much faster rate than energy supply because of increasing energy efficiency as well as structural changes in economy. This leads to larger contribution by transport, residential and services consumption. Table 5 gives final energy consumption by various sectors in 1973 and 2014.

Table 5
World and OECD Final Energy Consumption by Sectors

	World 1973 MTOE (%)	World 2014 MTOE (%)	OECD 1973 MTOE (%)	OECD 2014 MTOE (%)
Industry	1534.49 (32.9%)	2751.17 (29.19%)	958.18 (34%)	808.49(22.28%)
Transport	1081.26 (23.19%)	2627.02 (27.87%)	695.32 (24.6%)	1215.16 (33.49%)
Residential Commercial Services others	1758.88 (37.73%)	3218.98 (34.15%)	941.43 (33.4%)	1262.19 (34.78%)
Non Energy Use	286.50 (6.14%)	827.52 (8.78%)	220.63 (7.8%)	343.03 (9.45%)
Total Consumption MTOE	4661.19	9424.69	2815.6	3828.16

Table 5 shows declining trend in Industrial Energy Consumption, increase in transport and residential energy consumption especially in OECD. Manufacturing has moved from OECD to Asia.

It may be also worthwhile noting ratio of final consumption and Total Energy Supply in 1973 and 2014.

For 1973 $\frac{\text{Final Energy Consumption}}{\text{Total Energy Supply}} = \frac{4661}{6101} = 76\%$

For 2014 $\frac{\text{Final Energy Consumption}}{\text{Total Energy Supply}} = \frac{9424}{13699} = 68\%$

This shows higher electrification of energy use. This leads to higher losses in electricity generation showing less final consumption compared to supply.

It also may be noted that while WORLD Energy consumption has more than doubled in 2014 compared to 1973. OECD energy consumption has increased by 28 % only.

It may be worthwhile looking to Energy scene in India in 1973 and 2014 Table 6

While 2014 data is from Energy Statistics of India² and IEA sources. 1973 energy data is from author's publication "Energy Policy of India (1978)"³ and other source. GDP, population etc are as per World Bank. International data is for calendar year. Data for India is for financial year. A dramatic increase in all energy supply and improvement in energy efficiency can be noted from Table 6.

Table 6
Energy in India (1973 -2014)

	1973	2014	2014/1973
Population (million)	593.4	1295	2.18
GDP (billion) Current US Dollars	83.01	2042.14 (8720 PPP)	23.47
CO ₂ /Capita	0.378	1.6	4.23
GDP /Capita Current US Dollars	150	1560	10.6
Coal	77	600	7.79
Oil Million Ton	23 (65% imported)	190 (80 % imported)	8.26
Gas billion m ³	1.6	35.0	21.0
Power capacity	17000 MW	270,000 MW	14.70
Generation	70 billion KWH (50% Hydro)	1080 billion KWH (15% Hydro)	14.70
Firewood Agriwaste Dung cake	180 Million Tons 90 MTOE	200 MTOE	2.0
Total energy	180 MTOE	824 MTOE	4.57
Energy intensity Kg Oil/GDP (dollar)	2.06	0.40	0.196

Summary and Observations

- World energy supply has more than doubled from 1973 to 2014 . Oil production has increased by only 50 %. This shows a significant increase in fuel efficiency and fuel substitution. Oil has been substituted by coal and gas in power generation and other uses. Transport remains the main use for oil.
- In India Oil demand has increased by 800 % compared to 50% increase in world oil demand.
- Electricity production has increased nearly four times compared to doubling of energy supply. This shows the trend towards electrified world. Coal and gas provide for 65% of electricity generation
- Energy productivity (Efficiency) has improved dramatically. World GDP increased by 17 times (current dollars) Energy supply has increased 2.25 times. Adjusted for inflation GDP will be about 10 times more.
- India has also made dramatic progress in all forms of energy Coal, Gas and Electricity production. It has also improved energy productivity due to efficient use and structural change. Services provide more than 50% GDP now. Industries share has dropped from 70% to 25 % .
- Two major problems of energy scene in India are rising oil demand and poor efficiency of biomass fuel use. Crude oil use has gone up by eight times. This could have been avoided by proper policy.
- Rising oil demand can be and should be curbed by shifting transport from road to railways and promoting public transport against private transport. These two steps are urgently required.
- Conventional bio mass fuels still supply 25% of energy compared to 50% forty years back . These fuels are used mainly for cooking. Cook stove efficiency remains at 8-10 % even when improved chullas with 25-30 % are available for long time. A major program for promotion of efficient cook stoves and solar cooker is needed on lines of LED lamps and Renewable Energy. By January 2018 ,28 crore LED Bulbs were distributed.
- Coal has to remain major energy source for power generation.
- Recent Government programmes for massive promotion of Renewable is a step in right direction. Similar programmes are required for Energy efficiency.

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References

1. **Key World Energy Statistics 2016.** International Energy Agency Paris.
www.iea.org
2. **Energy Statistics 2016** Central Statistics Office. Govt. of India
www.mospi.gov.in
3. Energy Policy for India 1978 B.G.Desai, published by Jyoti Ltd., Baroda

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