Energy for Planet Earth – 30 years on

PART ONE: PRIMARY ENERGY DEMAND FORECAST

Background

In September 1990, Scientific American published a special issue entitled 'Energy for Planet Earth'.[1] In this publication, Scientific American explored the sources of energy, the future for energy, made predictions on technological breakthroughs and suggested solutions for what they considered was an imminent energy crisis.

Many of these predictions by Scientific American were made for 2020. Given we have reached that date, we can look back and compare the predictions with what actually happened. In a three-part series, Frontier Economics will compare actual outcomes to 2020 with the predictions made by Scientific American.

This comparison of actual versus predicted outcomes, especially where technological change is involved, can help us learn about the factors that have been determinative to the global community and provide guidance on how we can improve economic forecasts.

We focus on three areas where Scientific American made long term forecasts:

- Primary energy demand
- Energy intensity
- Emissions intensity

Each of these will be the subject of a separate note. This note examines the performance of Scientific American's forecast of primary energy demand.

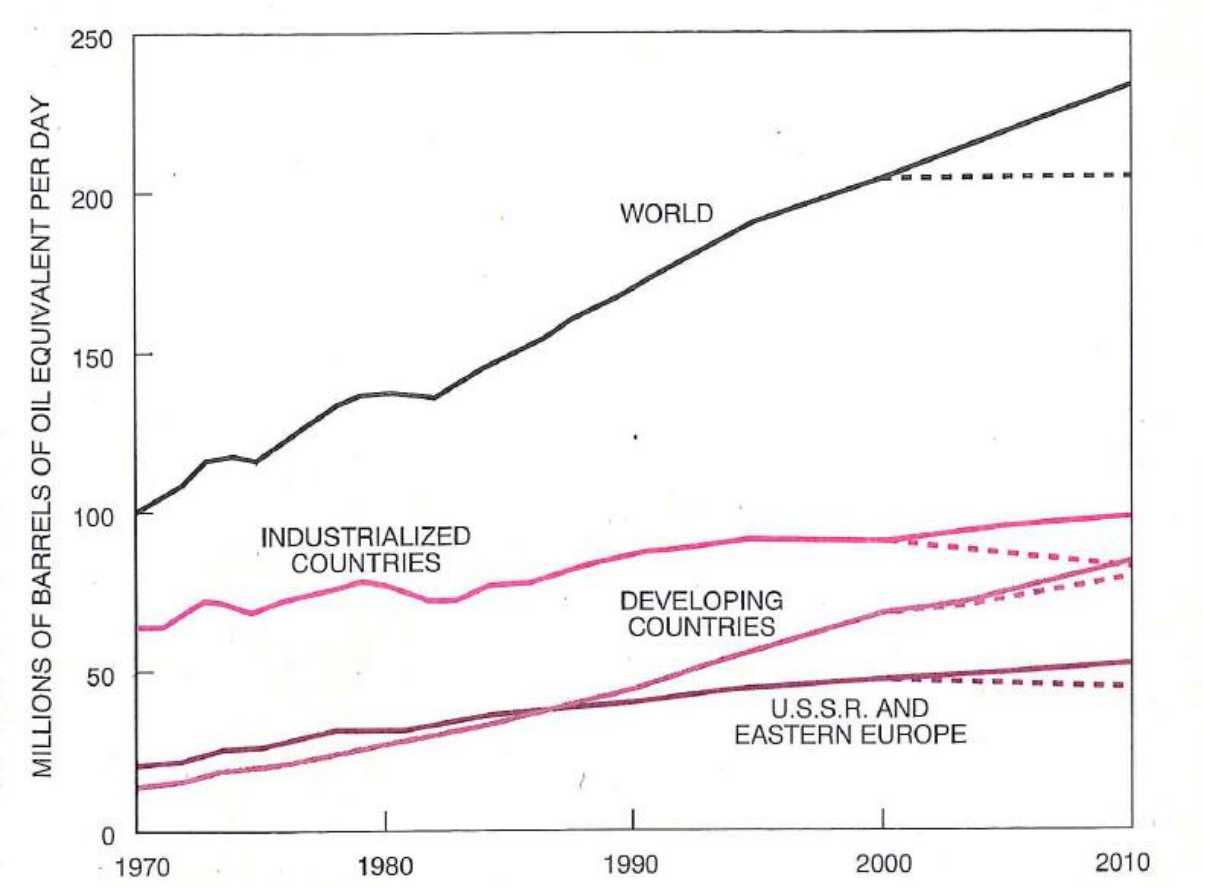
Primary energy demand

The special issue commences with a piece from Ged. R. Davis, who was the head of energy in group planning for Shell at the time. Davis talked about the environmental consequences of unchecked growth in energy demand and projected that if international protocols were established by mid-1990's (assuming population and economic growth were consistent with projections at the time), the world's primary energy demand could be stabilised at approximately 205 million barrels of oil equivalent (MMBOE) per day.

Accompanying this projection, Davis included a graph (produced by Andrew Christie), that illustrated historic growth in primary energy demand and provided an overlay of the unchecked future growth in primary energy demand compared with the projected growth in primary energy demand if the international community adopted energy-use protocols (see **Figure 1**).

[1] Scientific American, *Energy for Planet Earth*, Special Issue, Vol 263, Issue 3, September, Website: https://www.scientificamerican.com/magazine/sa/1990/09-01/

Figure 1: Scientific American primary energy demand forecast to 2010



PRIMARY ENERGY DEMAND is expected to vary from one part of the world to another. Most of the increase will probably occur in the developing world, where population growth rates are high and industrialization and urbanization are under way. In contrast, demand is expected to remain stable or drop in the industrialized countries, where population growth rates are low. It could stabilize or decline in Eastern Europe and the U.S.S.R. depending on the success of economic reforms. Much hinges on whether consensus or sustainable policies are enacted.

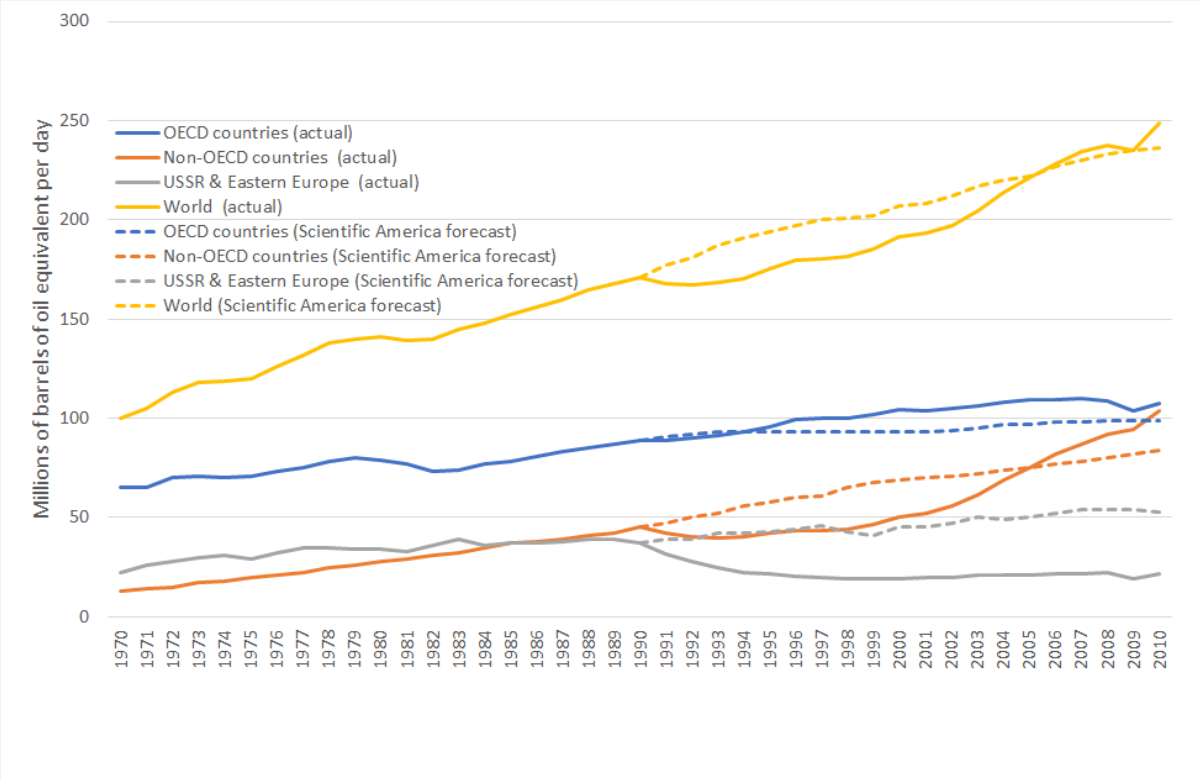
Source: Scientific American, 1990, Vol 263 No 3, p27

Notes: Solid lines in the graph depict primary energy demand with no international protocol on energy use.

Davis expected the highest increase in primary energy demand to occur in the developing countries bracket with its high population and economic growth rates. He anticipated that the industrialised countries would not experience much growth in energy demand and may even experience a decline. Davis predicted that primary energy demand in Eastern Europe and the U.S.S.R would stabilise or slightly drop, depending on the success of the economic reforms being considered at the time.

Using data from the U.S. Energy Information Agency (EIA)[2], Frontier Economics was able to graph the actual primary energy demand from 1990 to 2010, allowing us to compare Scientific American's projections from 1990 to 2010 with actual figures. These data are presented in **Figure 2**.

Figure 2: Actual primary energy demand compared with Scientific American forecasts (1970 to 2010)



Source: Scientific American, EIA and Frontier Economics

Looking at the (solid and dashed) yellow lines in **Figure 2**, which depict the world's primary energy demand, it is clear that Scientific American's projected growth of primary energy demand where there is no international energy use protocol adopted (which is practically the case), is very close to the actual energy demand by 2010 (the last year of the Scientific American forecast).

While the overall forecast was relatively accurate, Scientific American did not perform as well on the growth performance by country. Most significantly, Scientific America materially underestimated the rapid and large increase in the growth of developing nations (orange lines), such as China and India and the effects on primary energy demand. For example, a combination of a huge increase in population, massive government spending and a tightly monitored currency [3] led to a 6.35% growth in

[2] International Energy Statistics, U.S. Energy Information Administration, 20107, Website: https://www.eia.gov/beta/international/data/browser/#/?c=4100000002000060000000000000g00020000000000000000001&vs=INTL.44-1-AFRC-QBTU.A&vo=0&v=H&start=1980&end=2017&showdm=y

[3] Kimberley Amadeo (2019) "China's Economic Growth, Its Causes, Pros, Cons, and Future", the balance 18 December 2019, Website: https://www.thebalance.com/china-s-economic-growth-cause-pros-cons-future-3305478

annual GDP ($827.7 billion to $6.1 trillion) in China from 1990 to 2010.[4] China's economic development and the similar conditions emerging in India has driven the surge for primary energy well above that projected in 1990 by Scientific American.

Against this underestimation of the unexpected growth in developing countries, Scientific American materially overestimated the demand for energy in Eastern Europe and the USSR (grey lines). The democratization of the Soviet Union, triggered by Mikhail Gorbachev's loosening of government power and finalised by Boris Yeltsin's decision to dissolve the USSR, meant that former USSR businesses were opened up to global competition, thereby exposing their inefficiency. For many producers in Eastern Europe and the USSR, the transition to a global economy was too fast for them to become competitive, and many facilities closed. This widespread deindustrialisation resulted in a decline in energy demand in Eastern Europe and the USSR.

Looking back, and forward

While Scientific American may be disappointed that an effective international energy protocol has not emerged since 1990 – even with most countries being signatories to various UN greenhouse gas agreements – they can be satisfied that their overall projections of primary energy demand were accurate.

What this exercise has shown, quite starkly, is the importance of large and rapidly growing economies on the demand for energy. This has its own consequences, including potential environmental problems associated with unchecked growth in energy demand in these countries. The impact of this demand for energy is shown in another Frontier Economics publication examining global emissions from coal-fired electricity generation from 1904-2050.

Parts 2 and 3 of this series will address the forecasts of energy intensity and emissions intensity.

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[4] World Bank 2019, China Data, Website: https://data.worldbank.org/country/china

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