



WHAT WOULD BE REQUIRED TO ELIMINATE FOSSIL FUEL USE?

Searching for growth in the
undervalued and the novel.

ABSTRACT:

An analysis of estimated future global energy demand reveals the need for continuing growth of supply. Even with the introduction of renewable energy sources the need for fossil fuels cannot be eliminated over the coming 30 – 50 years.

KEYWORDS:

Energy, Oil, Renewable Energy, Cubic Mile of Oil.

INTRODUCTION:

Can renewable energy cater for the increasing global demand for energy? A review of the different available energy sources reveals that fossil fuels will remain a major source of energy.

DISCUSSION OF RESULTS:

Cubic Mile of Oil: The IEA estimates that total primary energy supply is 1.575×10^{17} Wh (= 157.5 PWh, 5.67×10^{20} joules, or 13,541 Mtoe, or about 18 TerraWatts ("TW") on averageⁱ. Can any of us really conceptualise 18 TW in any useful way other than it sounds like a lot? Our global energy system has two key components – the underlying source and the related delivery infrastructure so the already unfathomable number of 18 TW tells us little. This is where the concept of the cubic mile of oil ("CMO") comes into playⁱⁱ. Significant sources of energy include oil, coal, natural gas, nuclear, hydroelectric, and biomass (largely wood) Other energy sources include geothermal, wind, photovoltaic, and solar thermal. The various energy units commonly used to measure these CMO is intended to provide a visceral scale for comparing the contributions of these diverse energy components as a percentage of global energy use.

The global economy consumes approximately 35 billion barrels of oil/year or ~1.3 CMO and ~1 CMO of coal, ~0.75 CMO from natural gas, and ~0.25 CMO from hydrothermal, nuclear power, and wood each, totalling ~4 CMO. All combined, solar, wind, and biofuels produced less 0.1 CMOⁱⁱⁱ. Therefore, stripping out all the conflicting units of measurement, a CMO/yr is about 5.084 TW continuous, making current world energy use ~ 18-20 TWs.

How much will we need in the future? Between 1981 and 2005, 600 million Chinese citizens moved out of poverty, reducing the poverty rate from 85% to 16%. This achievement required a quadrupling of energy consumption. Using ~20 bbls/person/year as the benchmark for a developed country's middle-class consumption level and ~5 bbls/person/year for an emerging economy and assuming 170 million people join the middle class every year^{iv} over the next 10 years that represents ~25 billion bbls/year of additional demand (70% increase from today or ~ 170 million bbls/day)

Even at a modest growth rate of 2%/year (corresponding to a doubling every 36 years and not the rate reflected above), the world's energy demand by 2050 will be over 7 CMO. Over the next 40-50



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	1 CMO/yr of infrastructure	Infrastructure to meet the full expected 4 CMO/yr energy increase by 2050	Infrastructure if oil and, natural gas and coal are reduced to 0.
Nuclear	<ul style="list-style-type: none"> • 2,500 nuclear plants of 1 GW capacity.^v • 1 per week for 50 years 	• 6 per week	• 11 per week
Hydro-electric	<ul style="list-style-type: none"> • Using the 22.5 GW Three Gorges Dam as comparable, • ~1 additional Three Gorges Dam every 4 months for 50 years 	• 1 every 18 days	• 1 every 10 days
Wind Turbines	<ul style="list-style-type: none"> • 3 million 2-MW wind turbines^{vi} • 1,200 per week for 50 years 	• 7,500 per week	• 13,125 per week
Photo-voltaic	<ul style="list-style-type: none"> • 4.2 billion residential rooftop PV systems (2-kW)^{vii} • 250,000 per day for 50 years 	• 11,000,000 per week	• 19,140,000 per week
Coal	<ul style="list-style-type: none"> • 2,600 underground mines • 1 per week for 50 years 	• 6 per week	

years we will need to develop energy sources that can deliver an additional 3 to 5 CMO annually. Consider for a moment what it takes to produce even 1 CMO/yr.

Now place the data above into the context of the desire from some quarters to turn off our hydro-carbon sources of energy in the short-term to hopefully gain greater insight into the magnitude of the energy growth challenge we face given current trajectories.

CONCLUSION:

Even with the introduction of renewable energy sources, fossil fuels will remain a major source of energy.

REFERENCES:

- i Wikipedia, 2013 data
- ii A CMO is a unit of energy created by Hew Crane of SRI International to simplify understanding of global-scale energy consumption and resources.
- iii 2013
- iv Brookings Institute, The Unprecedented Growth of the Middle Class - An Update, Homi Kharas, Feb 2017
- v 900MW @ 90% availability
- vi 1.65MW @ 35% availability
- vii 2.1kv @ 20% availability



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