

World Fossil Fuel Reserves and Projected Depletion

White Paper

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The United States, Russia and China are the leading producers and consumers of world energy. Together, these three countries produced 31% and consumed 41% of the world's total energy in 1999 [IEA 1999]. The United States led in terms of consumption, using more than three times as much energy as China, the world's second largest consumer. During 1999, petroleum, natural gas and coal accounted for nearly 85% of world energy production; hydro and nuclear resources made up the bulk of the remaining 15%, with renewable resources contributing a nominal amount [IEA 1999]. These figures are consistent with consumptive use patterns, clearly indicating that fossil fuels are relied upon across the globe more so than any other energy resource.

More than two thirds of the primary fuels currently consumed in the world are used to produce electricity [Gluskoter]. The installed electric capacity of the world is predominantly thermal (coal, gas and oil) with hydroelectric and nuclear contributing relatively significant amounts. Non-hydro renewable resources (geothermal, solar, wind and biomass) make up less than 1% of the world's installed generation capacity [Gluskoter].

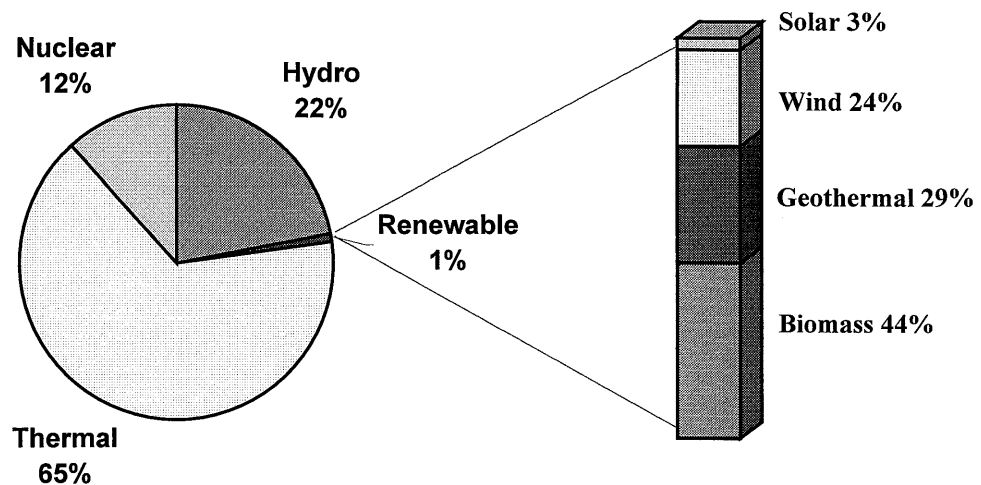


Figure 1: World's Electric Generating Capacity Allocation

Although fossil fuels are heavily relied upon to produce electricity, there are still over two billion people in the world – roughly one third of the earth's population – without access to electricity [Ausubel]. Over time, as population growth continues and developing nations become more industrialized, worldwide energy demand will increase. It can be safely assumed much of this demand will be met with fossil fuels for economic

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reasons and because of the indigenous fossil resources many developing countries possess. For example, India and China rely predominantly on coal as their primary source of commercial energy and will likely continue to do so as their populations grow [Gluskoter].

It is generally recognized there are trade-offs between the benefits to society that economic development brings and the possibility of ecological and environmental degradation. Putting these tradeoffs aside, and ignoring the particulate matter, airborne lead, sulfur dioxide, carbon dioxide, nitrogen dioxide, carbon monoxide and other byproducts and impacts associated with burning fossil fuels, another issue that comes to the forefront is that of sustainability. In other words, at what point will alternatives to fossil fuels need to be used to meet worldwide demand for energy, and more importantly, electricity, in order to support a growing standard of living?

Although simplistic on the surface, this question is not easy to address. For starters, there are wide variations when it comes to estimating worldwide petroleum, natural gas and coal reserves. When surveys are done by organizations such as the US Geological Survey, often times field data from responding countries is incomplete. In other cases, there are misinterpretations of key terms such as “proved reserves”, “probable reserves” and “possible reserves,” thereby skewing results. Further, some countries make little distinction between developed reserves (those that are currently accessed through production techniques) and undeveloped reserves (those that are not accessed and may not be for some time due to technology limitations or economics). All of these factors add uncertainty to reserve estimates.

Another important variable that has an impact on estimating the longevity of fossil fuel reserves is their rate of consumption. This variable is influenced by many factors ranging from economics to technological advances to conservation to worldwide population growth. Taking something as straightforward as the correlation between energy consumption and population growth can readily become complicated when factors such as per-capita energy consumption are taken into account. For example, most future worldwide growth will occur in nations where the per-capita energy consumption is relatively low. This will tend to reduce the overall rate at which energy demand increases with population growth. However, as underdeveloped countries become more advanced, per-capita energy consumption will likely increase, having the opposite effect.

Even though forecasting the supply and demand sides of the fossil fuel equation are not easy tasks, making a few broad-based assumptions allows numbers to be developed that provide a good indication of when we can expect petroleum, natural gas, and coal supplies to near a practical limit. Certainly, environmental and ecological factors would come into play long before reaching the proverbial “end” and economic factors would likely make alternatives such as renewable energy sources more palatable; however, looking at the estimates provided in Table 1 below provide a sense of reality that our fossil energy resources are not endless in supply.

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<i>Global Fossil Fuel Reserves</i>	World Petroleum	Natural Gas	Coal
	<u>(Billion Barrels)</u>	<u>(Trillion Cubic Feet)</u>	<u>(Billion Short Tons)</u>
World Reserves (Jan 1, 2000)	1,017	5,150	1089*
World Potential Reserve Growth	730	3,660	--
World Undiscovered Potential	939	5,196	--
TOTAL RESERVES	2,686	14,006	1,089
ANNUAL WORLD CONSUMPTION	27.340	84.196	4.740
YEARS OF RESERVES LEFT**	98	166	230

*World Estimated Recoverable Coal **Based on current levels of consumption and estimated total reserves

Table 1: World Fossil Fuel (Petroleum, Natural Gas, Coal) Assessment¹

The numbers shown in Table 1 make some very simplifying assumptions including that current levels of consumption remain constant over time and that estimates of fossil fuel reserves are accurate. Although technological advances, new discoveries and conservation may tend to make resources last longer, population growth and development will likely have a more influencing impact on consumption thereby making the results shown in Table 1 overstated. In fact, several studies have indicated projected crude oil reserves will near an end between 2050 and 2075 [Walsh / Ivanhoe].

Given the many uncertainties surrounding reserve estimates, future consumption patterns and the counterbalancing effects that variables often have on one another, the figures shown in Table 1 tell a fair, albeit optimistic, story. However, more important than the raw numbers, the results indicate a bottom line that most can agree upon: there are practical limits to the use of petroleum, natural gas and coal. With this in mind, alternative energy resources should be pursued well before an absolute end to fossil fuels is reached to protect our environment and our quality of life².

References

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¹ Data from USGS World Petroleum Assessment 2000 and US DOE IEA 1999: World Energy Overview.

² Estimated greenhouse gas emissions in the US alone exceeded 1,547.4 million metric tons of carbon equivalents from the combustion of fossil fuels in 2000 according to the EIA, Emissions of Greenhouse Gases in the US 2000.