***2070: A Long-Term Forecast of Global Energy Supply and Demand***

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## Overview

The UH Energy 2070 Forecast Project (UHEFP) is designed to become the benchmark reference for global energy forecasts. Analogous benchmarks for industry and academe include the Quinnipiac University Poll and the Case-Shiller Home Price Index.

Current global energy forecasts that are well known to the public include projections by ExxonMobil, BP, Shell, Statoil, the International Energy Agency (IEA) and the U.S. Department of Energy’s Energy Information Agency (EIA). The full methodologies of these forecasts differ and are not published for peer review or independent verification. The full models, procedures, and data of the UHEFP will be published for peer review, criticism, and verification by third parties. This will contribute to future iterations of the forecast.

Our forecast is designed to contribute to the literature by providing a completely open-sourced baseline trend forecast of global energy demand and supply around which interested economists, academics, business professionals, and government researchers may gauge the likelihood of any of these other popular forecasts which often feel as if they originate out of a black box.

## Methods

The UHEFP is structured simply. Energy demand is forecasted first and then the supply is disentangled from that demand. Energy demand is derived country-by-country from population, GDP, and energy utilization projections for 181 countries:

 *EnergyDemanded =* *GDPperCapita X Population X EnergyIntensity*

All projections extend to 2050. Trend growth is used to project future population and energy intensity levels. A modified Solow Growth Model incorporating changing productivity and population growth rates is used to project the GDP. This model typically involves constant productivity and population growth rates, but we feel that our modified version is a far better reflection of real-world conditions. Forecasts of future productivity and population growth rates are used to complete the model.

The Solow Model’s primary inputs are capital, labor, and factor productivity. Being that capital accumulation is a primary driver of the Solow Growth Model, investment rates and depreciation rates also play a large role. All of these relevant factors differ region-by-region and even country-by-county. As such, ratios and factors are estimated based on current data on a country-by country basis. The UHEFP applies these analyses to data from the World Bank, IMF, Penn World Tables, CIA World Factbook, and UN Comtrade Database. Population and Energy Intensity data are pulled from World Bank Open Data. Country forecasts of energy demand are then aggregated into 9 regions (North America, South America, Europe, Eurasia, Asia, China, Asia Oceania, Middle East, and Africa).

After estimating demand by region, supply is disentangled. Using freely available information from the IEA, energy consumption in each region is broken down into 4 categories (Industry, Transportation, Other, and Non-Energy). Trends for each category are estimated and extrapolated out to 2070 in order to estimate the portion of total energy consumption that can be attributed to each. Then, within each category, energy use is disentangled by source (Oil, Coal, Gas, etc.). A trend for the portion of each category that is supplied by each source is estimated and extrapolated out to 2070.

The final component is disentangling electricity, heat, and oil products, which are all treated as independent energy sources in the IEA datasets. But each is generate using other primary energy sources. These three products are all disentangled into their original energy source, as which point each energy source is aggregated across regions.

The final result is a projection of the energy required to support the global population and economic growth over the next five decades, as well as a projection from where that energy will originate. And while we recognize that the future will almost certainly deviate from the path of the past, painting a clear picture of that path is immensely valuable as a baseline. This is the role our paper fills; capturing the trend of our current energy path in order to clearly understand what a status quo future will look like. This will aid our understanding of just how significantly the path would need to deviate in the future in order to reach any of the projections made by other popular global energy forecasts. Our paper closes by comparing our forecast to these other popular energy forecasts to see which are most in line with the trend and which will require the most radical market changes in order to come to fruition.

## Results

For the sake of keeping this submission under two pages, only select demand side results are presented…

-Driven primarily by large gains in Africa, Asia, and the Middle East, total global energy demand is projected to increase 57% over current levels by 2070.

-However, US total energy demand is projected to decrease 8.5% below current levels by 2070. Peak US energy demand is projected to occur in 2033.

-Africa, Asia, Asia Oceania, Latin America, and the Middle East are projected to experience increasing total energy demand through 2070.

-North America and China have already reached peak total energy demand.

-The largest growth in total energy demand, 5.5-times current use, is projected to occur in the Middle East as the region significantly lags behind the rest of the world in energy intensity gains.

-Energy demand per capita is projected to continue to rise in Asia, Eurasia, Latin America, and the Middle East through 2070.

-Peak energy demand per capita is projected to be reached in Africa in 2036.

-Peak energy demand per capita has already been reached in North America, Europe, China, and Asia Oceania.

-Our forecast of total global energy demand is most in line with the Shell’s Sky 1.5; their forecast projects global energy demand to increase by 20% in 2040 and 45% in 2060 (we project 23% energy demand growth in 2040 and 425 in 2060).

-However, our forecast is significantly more aggressive than DNV L’s projection. They project global energy demand to only increase by approximately decrease by 2050. We forecast 32% global energy demand growth over the same horizon.

-Our forecast is also signifanctly more conservative than the EIA. They forecast a 50% increase in global energy demand in 2050 compared to our 32%.

## Conclusions

While no long-run forecast of this nature can be expected to come close to perfect, our forecast adds significant value to the field by providing a completely transparent baseline trend forecast. Given the ambiguity of the models and/or data selection used by many other popular global energy forecasts, a fully open-sourced version of this endeavour is desperately needed. And while this transparent approach does prevent us from procuring potentially valuable firm-level data, we believe that the value of transparency outweighs this cost. Our methodology is intentionally kept simple so that our procedures and processes may be understood by most anyone with at least an undergraduate economics degree. This ensures that our forecast, with both its benefits and drawbacks, can be readily understood by a wide audience seeking clarity on our energy future - a necessary attribute for any baseline projection. Our concluding comparisons to other global energy forecasts provides valuable clarity on the collective conclusions of the field.