

THE ENERGY LADDER: A MODEL FOR PROJECTING ENERGY DEMAND

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Overview

Shell's scenarios team develops long-term energy scenarios, intended to draw attention to important strategic issues. A core element of Shell's World Energy Model for projecting energy demand is the so-called *energy ladder*, describing the relation between energy demand and economic development. This talk describes the methods used to develop these energy ladders, the way they are used for quantifying Shell's energy scenarios, and the implications they have for long-term energy demand in the world.

Methods

Shell's World Energy Model uses separate energy ladders for all end-use sectors in 100 different countries and regions, each represented by an S-shaped curve. As a country develops, its energy demand tends to shift from industrial sectors to the services and transport sectors. The S-curve has a number of different parameters that allow it to be different across countries and sectors. For example, some countries start their industrial phase at a lower income level than others, and in some countries people travel longer distances than in others, et cetera. The parameters for each sector and country are determined by a combination of statistical analysis of historical data and energy analysts' expert opinions based on scenarios of future development. The historical data includes energy demand, real income per capita and a number of other explanatory variables, such as the price of energy, energy efficiency, population density (e.g. affecting travel needs), and climate (e.g. affecting heating needs). The resulting energy ladders are then used to project each country's aggregate energy demand into the future.

Results

The energy ladders indicate that global energy demand may double over the first half of this century. In particular in China and India, the world's two most populated countries, energy demand per capita is expected to rise strongly, as their economies are on the steepest part of the energy ladder. China's energy demand should level off in a decade or so, but India may well become the number one energy demand growth country in the world sometime in the 2020s. From a global perspective, the strong rise in energy demand is expected to continue beyond 2050 in most sectors. Then eventually, as more economies mature, the S-shape of the ladders suggests a saturation in energy demand at an aggregate level. On the other hand, this may be a low-side estimate, as we do not see saturation in all of the sectors, and humans may develop new future potential energy services.

Conclusions

As people in developing countries are emerging from poverty, global energy demand rises to unprecedented levels, as shown by the energy ladders. This will put the world's energy resources increasingly under stress, and at the same time CO2 emissions continue to grow alongside the demand for energy, as it will take time for low-carbon energy to scale up. Governments and the energy industry face the difficult challenge of ensuring sufficient affordable energy in an environmentally sustainable way.