The remarkable changes in human societies during the 20th century were built on ever-increasing use of added energy to do things beyond what humans could otherwise do (see Box 1). This added energy made possible fourfold growth in world population, huge increases in industrial production, and massive expansion of motorized movement of people and goods.

In 1900, coal and wood were the predominant fuels. Today they are oil, coal, and natural gas. Most coal is used to produce electricity. Oil and natural gas serve as feedstocks for plastics, fertilizers, pharmaceuticals, and numerous other manufactured products, and well as providing heat and electricity. Just under half of oil production fuels transportation of people and goods.

Civilization as we know it depends on continuing supplies of these fossil fuels: coal, oil, and natural gas. Availability of the last two is in question. It’s not a matter of their literally running out. Large amounts remain to be extracted. The main challenge is that of production not keeping up with demand. This seems to be happening now for natural gas in North America, and could well happen within a few decades for oil worldwide. Box 2 provides the best estimates of recent and future production; it shows declining production after 2012. The rate of new discoveries has fallen steeply; production from existing wells cannot be increased enough to offset their depletion. When demand exceeds supply, prices rise steeply if demand cannot be reduced.

Current plans would replace oil with hydrogen, mostly for use in fuel cells. Today, almost all hydrogen is made from natural gas, production of which in North America is already not keeping up with demand. Practicable alternative means of producing large quantities of hydrogen are not available; distribution would present major challenges. Widespread use of fuel cells seems several decades away, especially for transport purposes. Liquid fuels can be made from coal, but only in ways that are energy-intensive and polluting. Nuclear energy could be massively expanded to generate electricity for production of hydrogen by electrolysis, but this inefficient process comes with strong waste-management challenges.

A sustainable strategy would minimize use of added energy for heating and cooling and use electricity produced from wind, sun, and other renewable sources to power industry and transport. The latter would mostly comprise tethered vehicles using energy from wires or rails, which provide the most energy-efficient transport.

In the energy-constrained world of the 21st and subsequent centuries, continuation of civilization as we know it could well require measured reversion to the energy-use levels of 1900 or earlier.