National and Regional Energy Planning

L. David Roper, roperld@vt.edu http://arts.bev.net/RoperLDavid/

When nations or regions within nations are planning for the energy future, the following general items should be considered.

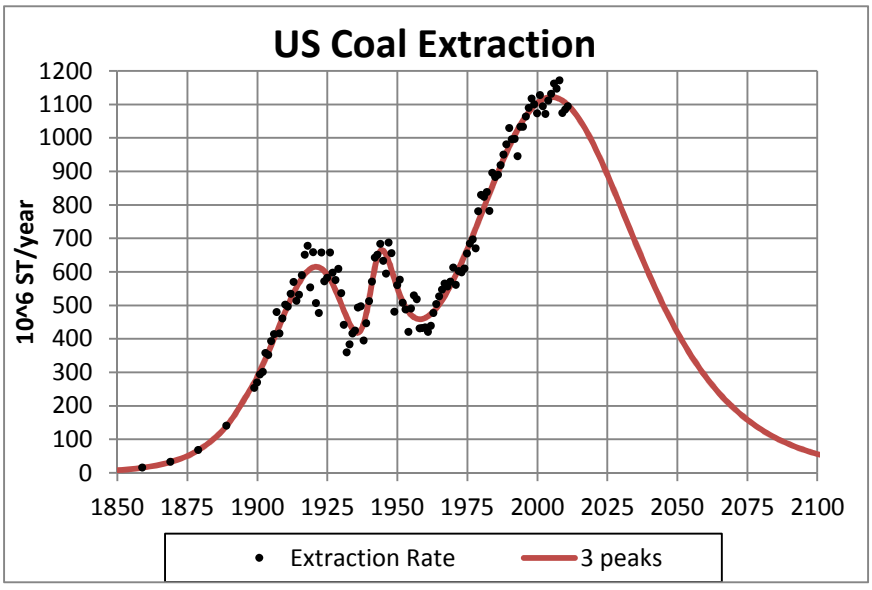
1. Depletion of fossil-fuels and uranium extraction. See below.
2. Effects of burning fossil fuels on global warming. See http://www.roperld.com/science/GlobalWarmingTheory.pdf .
3. Environmental effects of burning fossil fuels.
4. Accelerating increasing energy efficiency in building new buildings. See http://www.rmi.org/ReinventingFire .
5. Accelerating renovation of current buildings to increase energy efficiency. See http://www.rmi.org/ReinventingFire .
6. Motivating energy conservation by citizens. See http://www.rmi.org/ReinventingFire .
7. Accelerating the development of renewable-energy infrastructure. See http://www.rmi.org/ReinventingFire .

This article will examine the first of these considerations for the United States.

Depletion of Fossil-Fuels Extraction

Coal Extraction in the U.S.

Burning coal has been a major source of electrical energy in the U.S. Here is a fit of a depletion curve to the coal-extraction data for the U.S.:



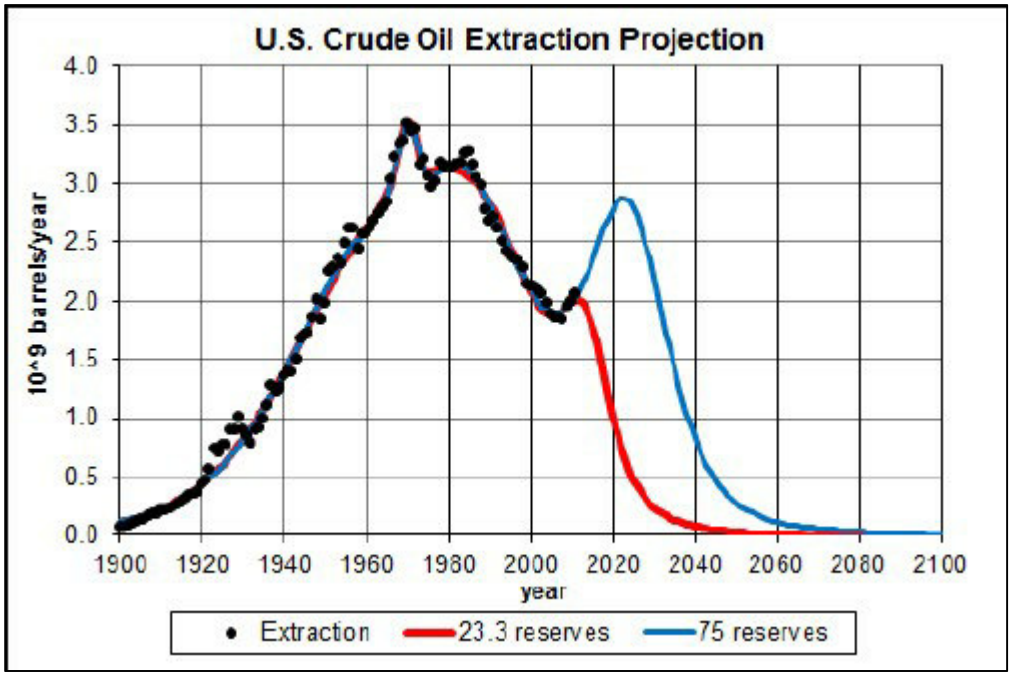
Although there is enough coal for another extraction peak; however, it is unlikely that such a peak will occur because of the deleterious environmental effects, including global warming, of burning coal. An exception might be to use coal for making useful items instead of burning it.

For more details see http://www.roperld.com/science/minerals/CoalExtractionUS.pdf . This article shows that coal extraction for all U.S. states but Wyoming has peaked in coal extraction.

So, plans must be made for replacing burning coal to generate electrical energy in the U.S.

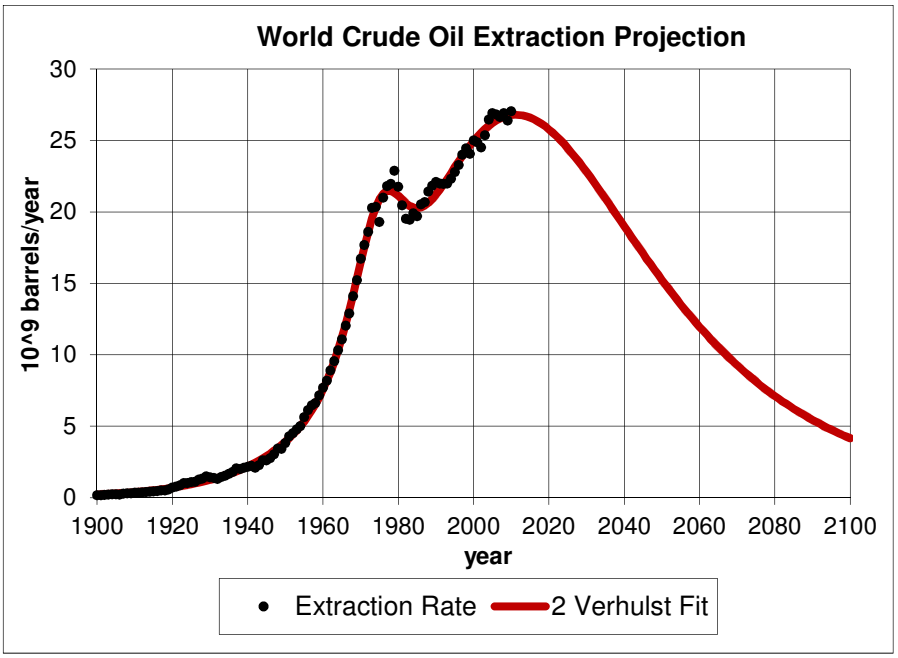
Crude-Oil Extraction in the U.S. and the World

Burning gasoline and diesel made from crude oil has been the major source of transportation energy in the U.S. Here are fits of a depletion curve to the crude-oil extraction data for the U.S. and the world:



The current rise will be short-lived, as there are not reserves to maintain it.

See http://www.roperld.com/science/minerals/CrudeOilUS.htm .

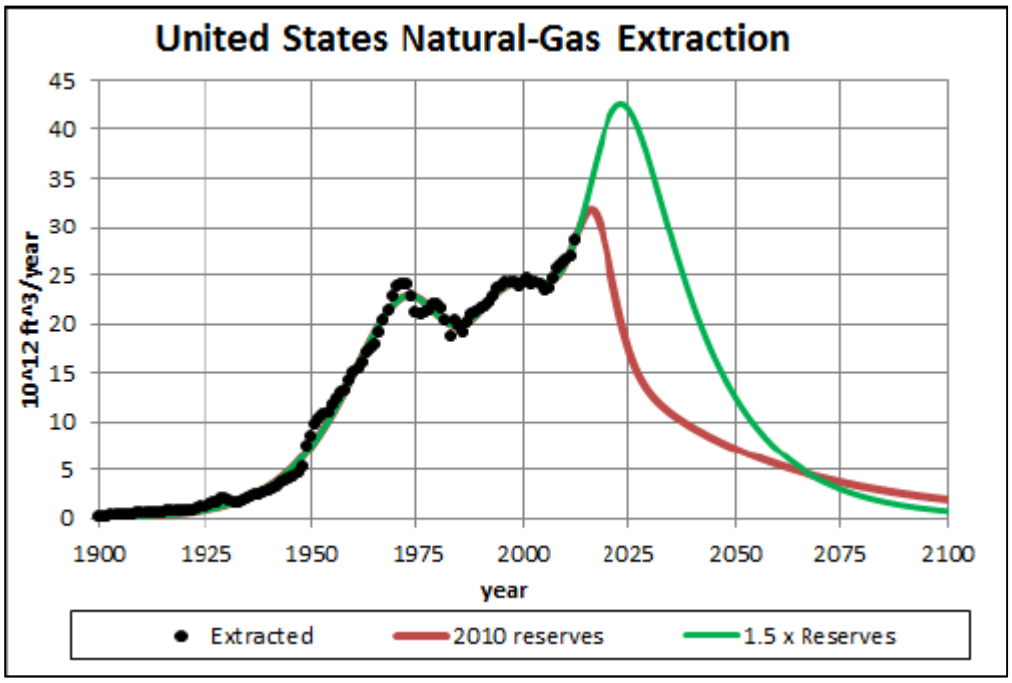


The tight oils in shale and sand will not affect this curve very much because of their quick depletion and deleterious environmental effects. See http://www.roperld.com/science/minerals/CanadaOilSands.htm .

For more details see http://www.roperld.com/science/minerals/CrudeOilExtractionUS.pdf and http://www.roperld.com/science/minerals/crudeoilusresurgenceno.pdf .

Natural-Gas Extraction in the U.S.

Natural gas has been burned for generation of electricity and for some transportation. The recent resurgence of natural-gas by fracturing shale formations (fracking) has caused a large increase in using natural gas for electricity generation and plans to use it for truck transportation. So, it is important to have a depletion curve for natural-gas extraction in the U.S. Using the recent fast rise in extraction and the estimate of the reserves the following depletion curve is obtained:



Natural-gas extraction has occurred so fast, mainly because of minimal environmental regulations for fracking; that extraction will peak before year 2025 and then will fall rapidly. So, the U.S. cannot depend on natural gas for more than another generation.

For more details see http://www.roperld.com/science/minerals/shalegas.htm .

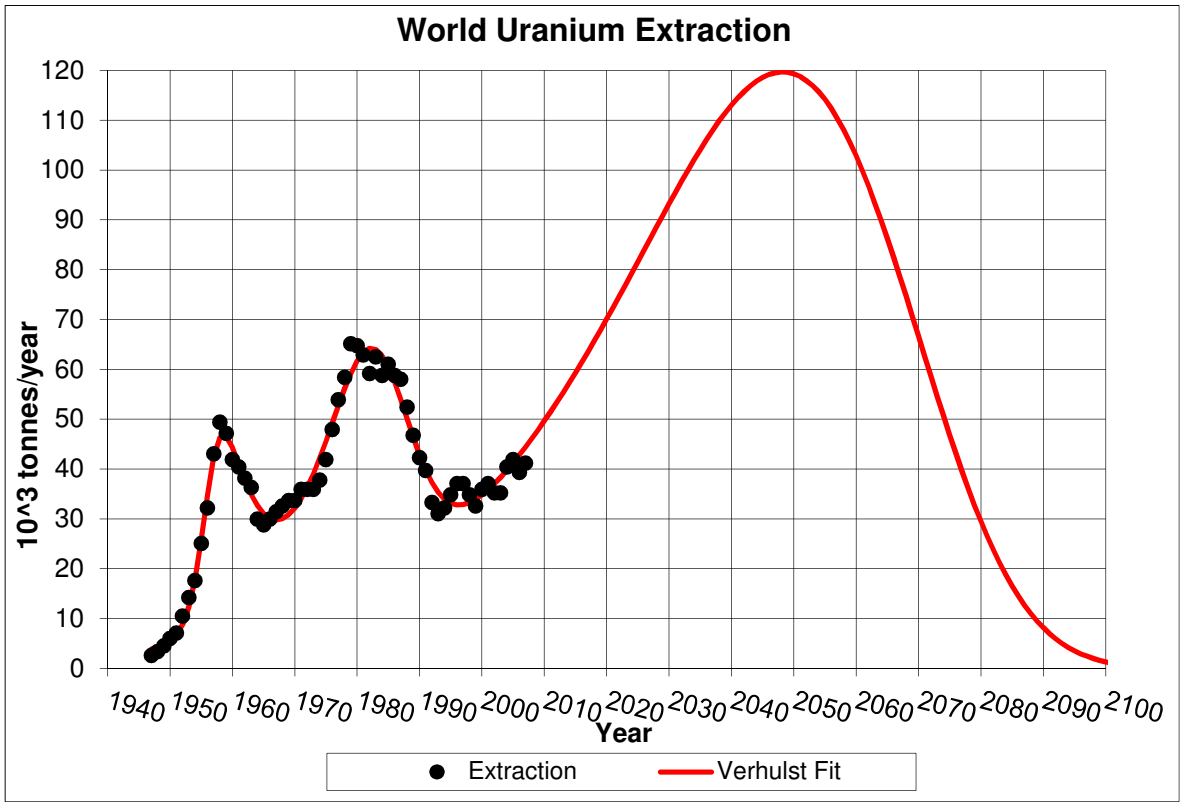
Fossil-Fuels Conclusions

The above depletion curves for coal, crude oil and natural gas for the U.S. show that plans must be made for other sources of energy for the U.S., both for electrical generation and for transportation.

With regard to transportation, the transition must be made to electricity for personal transportation and mass transportation and to biofuels for truck transportation. See http://www.rmi.org/ReinventingFire .

Depletion of Uranium Extraction

The only remaining source of energy for the U.S. from minerals is uranium for nuclear energy. Here is a fit of a depletion curve to the uranium-extraction data for the U.S.:



The total amount to be extracted eventually used for the fit is 8,800x10^3 tonnes (1 tonne = 1000 kg), which is about the estimated uranium resources (6,306x10^3 tonnes) plus the amount already extracted ~2500x10^3 tonnes).

Although it looks promising for using uranium to generate electricity for the next fifty years, the actual energy supplied is very small compared to the energy currently supplied by burning fossil fuels. Also, there are many other considerations besides supply of uranium involved in generating electricity by nuclear reactors.

For more details see http://www.roperld.com/science/uranium.htm and http://www.roperld.com/science/NuclearPowerDecline.htm .

Conclusion

From the analyses above it is clear that fossil and uranium fuels are not sufficient to provide power for generations in the near future. What is left of those fuels must be used to develop the extensive infrastructure for renewable energy.

For more details see http://www.roperld.com/science/SolarFuture.htm .