AFTER THE OIL PEAK
How do we build preparedness with divergent visions of the future?

English summary

This report was written to highlight important issues regarding the preparedness of Swedish society for a potential scarcity of crude oil and possible rapid increases in energy prices. It was commissioned by The Royal Swedish Academy of Agriculture and Forestry (KSLA) and the Swedish University of Agricultural Sciences (SLU) as a framework document for an 'Open Space' workshop of the same name held on April 24-25, 2006 in Stockholm. The report consists of nine chapters covering the following topics:

Chapter 1 introduces and describes the purpose of the report.

Chapter 2 summarizes the available information related to the future availability of conventional crude oil and describes the theory of oil production 'peak' that was first put forth by M.K. Hubbert in the 1950s, and recently brought back to global attention through the work of an international group of petroleum geologists who have stated that global oil production may peak as soon as 2010.

Chapter 3 examines estimates of future oil demand using International Energy Agency global demand forecasts. These estimates (which assume that existing energy policies in the countries of the world continue unchanged) project increases in demand of 45% over today's oil consumption level of approximately 83 million barrels per day.

Chapter 4 considers the question: "when will oil production peak"? The answers currently offered by experts vary widely, from those who say that global oil production has already peaked, or will do so shortly, to those that say the peak is at least two to three decades away. We examine the assumptions behind the various prognoses.

Chapter 5 offers a broad overview of the importance of oil consumption for society. The chapter highlights the concept of Energy Return on Energy Invested (EROEI) as it pertains to fossil and renewable energy sources. The EROEI of conventional crude oil has historically been very high, as the energy expended in retrieving oil from the ground has been small in comparison to the energy received. This is not true of many alternative fuels. In addition to discussing its various current uses, we consider the implications of oil consumption for the current economic order and for international political relations. Specifically, we discuss the relationships between oil producing and oil consuming nations, and the potential tensions that could arise between large consumer nations as they compete for this important geo-strategic resource.

Chapter 6 deals specifically with the role of oil in the Swedish food system (from farm to table), and the Swedish forestry system (from the forest to the mill gate), which together comprise the Swedish 'green sector'. As of this writing, much attention is focused on agriculture and forestry as future energy sources for society. At the same time, we know that agriculture and forestry, as practiced today, are large consumers of fossil fuels. How this paradox can be resolved is a central question for modern societies, and implies significant changes for agriculture and forestry systems, and their associated industries. As an illustration, we offer baseline calculations of the amount of land that would need to be dedicated to raw material production for biofuels, given Sweden's current consumption of gasoline and diesel, the current productivity of Sweden's agriculture and forestry, and the efficiency of existing technology for converting raw material to biofuels. Using recent Life Cycle Assessments (LCAs) performed in Sweden, as well as data from reports commissioned by Swedish governmental authorities, we estimate the land needed to meet Sweden's gasoline and diesel use in the following forms: ethanol from wheat, biodiesel from rapeseed (RME), dimethyl ether (DME) from woody biomass, ethanol from woody biomass, and biogas produced from dedicated pasture crops. Our calculations indicate that Sweden would require as little as ~4 million hectares of dedicated pasture crops to be grown for biogas production to replace its gasoline and diesel consumption, ~6 million hectares to produce an equivalent amount of ethanol and RME, or ~15 million hectares of forestland to replace this consumption by converting wood into ethanol or DME and/or methanol. Given that Sweden currently has 2.6 million hectares of arable land in active production, and approximately 22.7 million hectares of economically productive forestland, becoming free of oil dependence will be a significant challenge.

Chapter 7 presents two future visions, expressed as 'future histories', from the perspective of a hypothetical inhabitant of Sweden in the year 2100. The visions highlight the current diversity of values and expectations that exist in Sweden today regarding the future development of society, and imagine how a given set of assumptions about technological development and energy availability might translate into future reality. The visions take into account three system levels: 1) the global level, 2) Sweden at the national level and, 3) the Swedish 'green sector'. These three system levels are described within two broad future visions: a) the 'high-energy society' and b) the 'low-energy society'. The 'high-energy society' vision is based on the assumption that replacing oil will be relatively easy. In contrast, the 'low-energy society' vision is based on the assumption that today's high level of energy consumption will be impossible to maintain after global oil production peaks, and society will be forced to find new patterns of organization that require less energy consumption. In both visions it is

presumed that global solidarity is maintained, and humanity is able to equalize the global income gap, preserve world peace and protect the environment.

Chapter 8 looks closer at the two visions and analyzes the risks associated with steering society towards one of the two visions if the fundamental assumptions underlying that vision turn out to be incorrect. The salient features of the high-energy vision stem from assumptions made regarding nature and technology, including: the potential for energy-efficient capture of carbon dioxide, the long-term sustainability of biofuel production, the potential of breakthroughs in solar-hydrogen technology, improved photosynthesis through genetic engineering, increased energy efficiency through information technology solutions, and the potential to close material cycles while maintaining high levels of energy use. The high-energy vision further assumes stable oil prices, that income inequality between nations will automatically be equalized in a free market setting, that we can protect the climate through political means while maintaining high levels of energy use, that efficiency gains will not be nullified through higher consumption, and that society is able to monitor the global ecosystem and thereby avoid unpleasant surprises.

The salient features of the low-energy vision stem from the assumption that current economic, political, and institutional realities need to be, and can be, re-oriented towards post-materialist values, while new ground rules for trade and development are instituted at the global level that promote justice and resource stewardship, thus allowing the global economy to contract in an orderly fashion without collapsing.

Chapter 9 presents our conclusions. Our analysis indicates that if the assumptions underlying the high-energy vision prove to be incorrect, there is a risk that the social and ecological consequences could be severe. Basing political decisions on a desired high-energy vision of the future could lead to a large-scale high-risk technological experiment where the future of the planet is on the line. The low-energy vision, on the other hand, minimizes social and ecological risks. A primary drawback with the low-energy vision is that it is extremely difficult to imagine when and how this vision would be enacted, given current trends. When will we have sufficient knowledge about the success or failure of our current course of development towards the high-energy society to make the difficult and uncomfortable decisions that would steer us towards a low-energy society?

The most important decisions that will influence life on Planet Earth for the coming century is whether we choose to find solutions to our energy problems that give positive synergetic effects to the other pressing questions facing humanity, or whether we choose to see the energy supply question as an isolated problem and therefore seek out 'solutions' that are developed at the expense of the environment, citizens of other countries, and world peace.

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