Strategies for Advanced Oil Utilization

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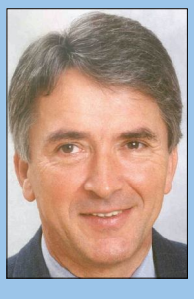

1. Introduction

Is oil much too valuable to burn? Or put it differently: Should oil be shifted from the currently typical one-step use of its energetic functionality to a multi-step use of its material functionality and only at the end of the life-cycle serve as a source of energy?

For a number of reasons it seems to be worth to investigate such a paradigm shift in the use of crude oil in particular and of fossil hydrocarbons in general. Independent of uncertainties in reserves, the new map of geopolitics, the call for a carbon-constraint economy, or new demand from emerging industrialized countries in Asia there should be ample consensus that both owners and users of oil share the common interest to harvest as much wealth out of it as possible, not only just over the next few years but also over any thinkable horizon in the future.

The simple answers of mainstream economics coined in various variations of the Hotelling rule have definitely turned out being too simplistic: the recommended use of an exhaustible resource as oil is maximizing discounted future net-revenues with the implication of exponentially rising prices at the socially accepted discount rate. This perception, however, has never explained quantities and prices of the global oil market.

The still dominating use of oil is its energetic functionality. Major advances in materials science, however, compete for the material functionally of oil. Fiber-enforced polymers can customize the physical properties of every cubic millimeter of a structure. They not only substitute but outperform in many applications concrete and steel. These polymers can be produced out of oil but also of recycled plastics. In a next stage of technological development industrial polymers will be produced out of plant-based materials.

Advances in polymer technologies have reached a point that may encourage a major re-design of the way we provide in our economies the functionality of energy and materials. Without being able to suggest definitive answers we want to make two contributions to these emerging discussions. First, we propose a conceptual framework that is adequate for analyzing this complex issue since we argue that it is more important to put the right questions before giving premature answers. Second, having realized the importance of this issue, we put forward an institutional framework that is devoted to serve as a center of excellence for research, policy analysis and strategic corporate decision making on this topic.

2. Key Features

2.1 Shifting the paradigm: from products to functionalities and services

Our perceptions of economic activity and the related issues of economic welfare have been shaped by the mainstream paradigm that is visualized in Fig. 1: The focus is on the products (material and immaterial) for which we need resources as human and energetic ones. Oil and other hydrocarbons serve in this paradigm mainly as sources for energy and may be substituted by renewables.

The limits of this mainstream paradigm are revealed if we look at what we coin the comprehensive paradigm of economic activity indicated in Fig. 2 with a number of extensions and distinctive differences. First, the emphasis is not on products but on their functionality they provide for nutrition, housing, mobility and knowledge by providing all kinds of services, the most important ones being thermal and mechanical. Not gross domestic products, the conventional measure for measuring the volume of products, is the policy target but welfare expressed in the availability of the functionalities provided by the products. Second, fossil and renewable resources serve not only for energetic but also for material use. This has far reaching implications since it questions both for petroleum based and biomass based resources the one-step energetic use compared to the option of a multi-step product cycle that is terminated only at the very end by using its energy content. Third, energy can for most applications be widely substituted by adequate products, for example vehicles and buildings with a high energy productivity as to the provided services.

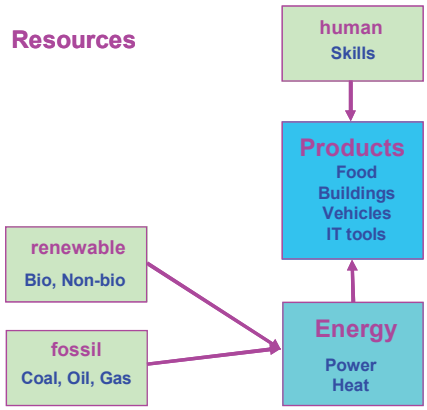

Fig. 1. Mainstream paradigm of economic activity.

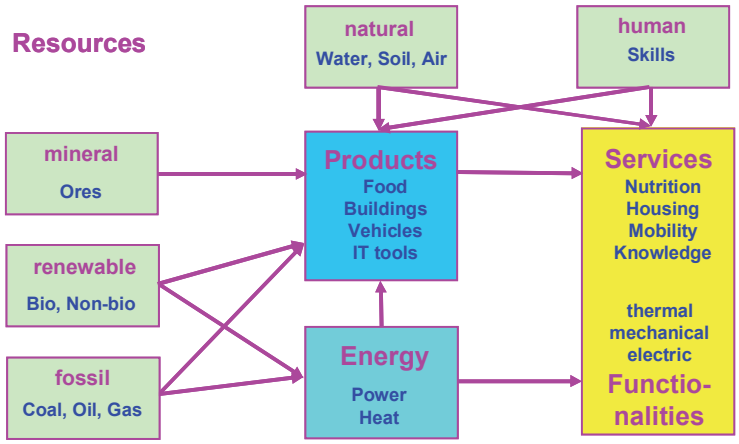

Fig. 2. Comprehensive paradigm of economic activity.

These distinguishing features of the comprehensive paradigm can be made easily accessible for housing. The product building is needed for providing the functionality of housing with the corresponding thermal services. How much energy is needed depends, however, to a large extent on the thermal quality of the product buildings and the state of the natural resource describing the climate zone the building is located in. Austria, for example, has become a technology leader for advanced building designs. Compared to the existing building stock, new buildings typically cut energy consumption by the factor four. Advanced buildings achieve even factor ten and pilot projects reveal that currently available technologies enable building designs that harvest more energy than they actually need themselves and are thus called plus-energy buildings which we may coin hyper buildings. Similarly we can discuss advanced car designs that have become known as hyper cars. Their specific design characteristics are extremely light-weight structures based on fiber-reinforced polymers and powered by hydrogen fuel cells or electricity.

2.2 Advanced oil utilization by switching from energetic to material use

Using the conceptual framework outlined in the comprehensive paradigm of economic activity we approach again the issue of exploiting increasingly the material functionality of oil compared to the traditionally used energetic one.

Fig. 2 indicates that all uses of a resource should be evaluated against the functionalities provided. Obviously the functionality of a unit of oil can be expanded by a number of technology actions:

- By increasing the productivity of the corresponding product involved, e.g. the thermal quality of a building and the fuel efficiency of a vehicle,
- By improving the human skills that are involved in providing a certain functionality, e.g. by improved controls of a production process,
- By improving all transformation processes that generate end-use energy from primary energy.

A fundamental decision still remains: To what extent should material resources such as oil and all other hydrocarbons but also biomass also be used for producing material products? This can be better answered if we look at the multiple impacts of such a switch in the usage of material resources by producing for example polymers.

- They substitute other material products as cement and steel, thus lowering total energy requirements,
- They have also lower energy requirements when operating products based on light-weight structures, as hyper cars,
- They typically offer longer life-cycles,
- They are available as an energy resource at the end of the life-cycle.

Having all this considered it seems difficult not to recommend in particular a transition in the use of oil from the currently dominating energetic functionality to an enhanced material functionality. The obvious advantages are both a substantial reduction of oil requirements in our economies linked with a substantial increase in prices due to the much higher productivity of this resource.

2.3 Establishing a center of excellence for the transition to advanced oil utilization

Virtually all drivers that change the global oil market identify one strategy that meets the interest of all stakeholders, namely a sharp enhancement of oil productivity with the following key propositions: increasing the use of oil in materials as production of polymers, where oil contributes to a high value added, and decreasing the use of oil in traditional applications as heating, where oil is facing increased substitution by other types of energy, and finally switching to technologies that improve the productivity of oil over the complete product cycle from the oil field to the final energy service.

It seems obvious that such a transition serves all stakeholders involved: oil producers are able to secure the wealth of their oil reserves by expanding the availability at higher prices and oil consumers are able to afford the functionality of oil despite higher prices due to its higher productivity.

The academic community has so far only vaguely responded to this challenge. We could imagine a pilot project at a well established institution that demonstrates the feasibility and operationality of such transition strategy by involving all stakeholders in a program of excellence both in teaching and research.

4. References and Bibliography

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Speaker's Biography

Stefan P. Schleicher is Professor of Economics at the University of Graz, Austria, at the Wegener Center of Climate and Global change. He serves as a consultant to the Austrian Institute of Economic Research, is a member of the Council of the University of Leoben, is co-chair of the Czech-Austrian Energy Expert Group, and a lead author for the Intergovernmental Panel on Climate Change.

He obtained his academic degrees from the University of Technology in Graz and the University of Vienna and held academic positions at the Institute for Advanced Studies in Vienna, the University of Bonn, the University of Pennsylvania in Philadelphia and Stanford University.

His research focuses on innovation, incentives and institutions with special emphasis on sustainable development in the context of energy, climate, and environmental policy. His current research activities involve:

- TranSust, a research project funded by the European Commission aiming at modeling the transition to sustainable economic structures.

- Innovation & Climate, a research and policy platform initiated by Austrian industry linking the Lisbon Strategy with climate policy, and

- Supporting research for preparing the Austrian National Allocation Plan for the EU Greenhouse Gas Emission Trading Scheme.