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Alternative Technologies for Tomorrow's Road Vehicles

An interview with Nils-Olof Nylund

Governments and vehicle manufacturers around the world all have a role to play in expanding the market share of vehicles running on alternatives to oil.

Nils-Olof Nylund has specialist insight regarding the outlook for the new technologies. He provides transport-sector expertise to the IEA Working Party on Energy End-Use Technologies (EUWP), of which he is a Vice-Chair. Dr. Nylund is also Vice-Chair of the Executive Committee of the IEA Implementing Agreement on Advanced Motor Fuels (AMF).

Dr. Nils-Olof Nylund
Vice-Chair, IEA Working Party on Energy End-Use Technologies

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There is much talk about improving road vehicles' fuel efficiency. What is driving parallel efforts to expand use of alternative motor fuels and technologies?

Nils-Olof Nylund

There are two important drivers for alternative fuels. The first is energy security, an ongoing concern that hits the headlines when oil prices are high, as they are today, and when opinion polls tell us that many people believe the world is starting to run out of oil.

The second major driver is the need to reduce greenhouse gas emissions. Improving engines' fuel efficiency can of course address all these concerns effectively, but it cannot reverse the fast increasing numbers of fuel-thirsty vehicles on the world's roads. Different fuel solutions are therefore necessary to provide for the fuel switches needed

[1] The IEA *OPEN Energy Technology Bulletin* is a free, web-based periodical newsletter published by the International Energy Agency (IEA).

for sustainability in the longer term. Some cleaner alternative fuels such as methane can also reduce local pollution. If it comes from biogas or landfill gas, methane can be carbon-neutral, but if it comes from natural gas then CO_2 is still produced, but less than from petrol.

Because the transport sector will remain the principle driver of oil demand in most regions of the world over coming decades, significant de-carbonising will be necessary if the transport sector is to make its necessary contribution to meeting the long-term aim of reducing CO_2 emissions.

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Could you list the different alternatives to the traditional petroleum-fuelled internal combustion engine and give an estimate of their future shares in the road vehicle market?

Nils-Olof Nylund
The internal combustion engine can operate on a multitude of fuels: petrol (or gasoline), diesel, liquid biofuels, natural gas, liquid petroleum gas (LPG) and even hydrogen. But efficiencies vary. Diesel fuels, whether petroleum-based or bioenergy-based, actually attain the highest energy density and efficiency, hence their popularity. At present, we estimate that biofuels account for 1.4% of world transport consumption and the other alternative fuels account for a little more than 2.6%. Roughly 80% of all biofuels are produced in the United States and Brazil.

Most probably, petrol and diesel will still be the dominant transport fuels in 2030. However, we will see increased shares of biofuels as well as gaseous fuels. We need to see faster development of technologies for producing synthetic fuels based on gas, coal, and especially biomass. If coal is used, CO_2 capture and storage should be applied in order to tackle CO_2 emissions during processing of the fuel. Alternative fuels in their totality could represent a market share of between 10% and 30% in 2030, against today's 4%.

As for hydrogen and fuel cell vehicles, my personal feeling today – not shared by all – is that their role will remain rather limited, unless some technology breakthroughs radically change the outlook. In theory, fuel-cell vehicles using renewables-based hydrogen offer large benefits in terms of energy security, climate protection and local pollution. Hybridisation, for its part, is fuel-neutral and offers benefits for all types of vehicle.

When we are talking about alternative motor fuels, it is important to bear in mind that global solutions are not easy to find because different countries have different feedstock availability, different supply infrastructures and different economies. That is why we

need to develop a mix of the many possible options. All these are discussed extensively in our recently published report *Status and Outlook for Biofuels, Other Alternative Fuels and New Vehicles*.

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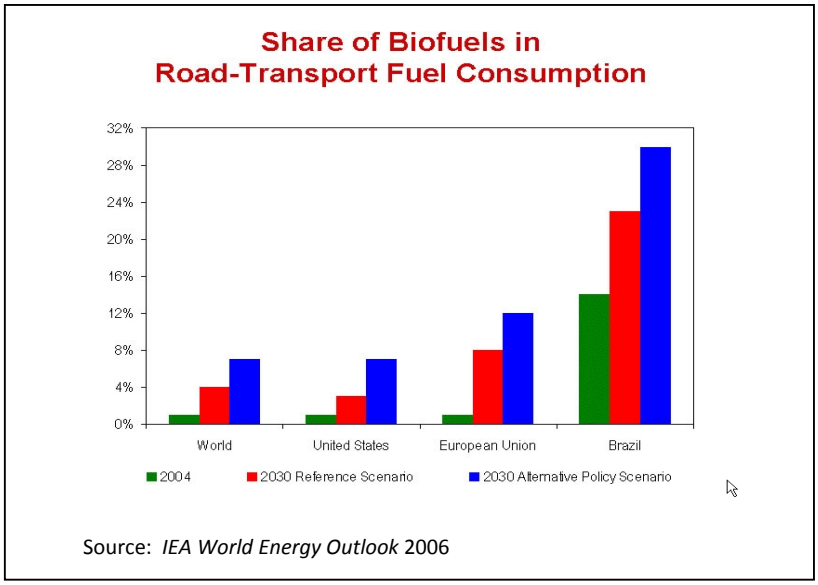
Fears have been expressed over the sustainable production of biofuels and their threat to claim land otherwise available for food production. What ways forward do you see here?

Nils-Olof Nylund

Of course, food and fuel production should not be in competition. For biofuels production, we should use non-edible feedstocks that grow on land not needed for food production. That is why it is important to see continuing strong research and development for second-generation biofuels technologies using ligno-cellulosic crops that can grow in poor soil without chemicals, or technologies that exploit waste from food crops or from timber production. In my country, Finland, for example, residues from forestry and various other kinds of waste seem like good options for biofuel feedstocks. Some biogas solutions offer the bonus of resolving environmental problems while at the same time providing fuel.



Source: *IEA World Energy Outlook* 2006

Broadly speaking, sustainable methods for biomass cultivation, harvesting and transportation all have to be taken into account. And some technological breakthroughs will be needed for refining processes before next-generation biofuels using feedstocks from non-food sources become widely available products at filling stations.

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Hybrid vehicles are now a widespread option on the market. How is the technology likely to improve further for hybrids?

Nils-Olof Nylund

There are currently some 1.5 million light-duty hybrids in circulation world wide, and roughly 5 000 heavy-duty hybrids, mostly city buses (with 30% fuel-savings potential), but increasingly delivery vehicles and small trucks. The cost effectiveness of hybrids will improve, and we shall see increasing numbers of hybrids in all vehicle categories. Some manufacturers currently use hybrid technology to boost performance, as with sports-utility vehicles (SUVs). But fuel efficiency is where I think we will see the largest technology focus.

Hybrids offer improved efficiency in two ways: by smoothing demands on the engine and increasing its fuel efficiency, and by recuperating braking energy otherwise lost as heat. Plug-in hybrids (PHEVs) that provide a certain range of pure electric operation are now receiving considerable attention and, when commercialised, will reduce the need for liquid transportation fuels further. These "grid-connected hybrids" can be re-charged from an external electricity outlet and can use both petrol and electricity simultaneously to increase mileage. PHEVs have the potential to reduce air pollution, greenhouse gas emissions (according to the source of electricity) and dependence on petroleum. Not surprisingly, a number of leading vehicle manufacturers have announced plans to produce PHEVs. Meanwhile, plug-in charging is an available conversion option for retrofitting to existing hybrid vehicles.

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Would you say that governments and industry are working well together to advance the various alternative technologies? And which policies appear to be the most effective in promoting switches to alternative vehicles and fuels?

Nils-Olof Nylund

Alternative fuels have been brought to the market through incentives as well as mandatory requirements. In general, vehicle manufacturers are actually not too keen on alternative fuels and generally favour those alternatives that are compatible with existing fuel systems and vehicles. Adopting completely new fuels means steps like re-design of the vehicle, establishing a new distribution system and addressing issues related to vehicle certification.

As for policies, the first and foremost requirement is that policies should provide investors with long-term certainties. We have seen collapses of gas-vehicle markets as well as biofuel markets when subsidies have been removed without warning. There is a lot of inertia in the transport fuel supply chain as well as in advances with vehicle technology. Big changes take time, so a visibly stable policy environment is a must.

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Different IEA "Implementing Agreement" collaborative programmes deal with different transport-sector technology families. How do they work together?

Nils-Olof Nylund

There are altogether seven IEA Implementing Agreement programmes (IAs) dealing in one way or another with R&D and information dissemination relating to transport[2]. We are now in the process of establishing a transport contact group, meeting on a regular basis to facilitate information transfer and co-operation. At the end of March 2008, in conjunction with a meeting of the IEA End-Use Working Party, we arranged a seminar at IEA Headquarters in Paris for the transport-related IAs. We had good attendance and fruitful discussions, and it was decided that we would develop this co-operation further, which will promote synergies and help us all to be more effective in pursuing our objectives. We all want to see more sustainable transport systems around the globe.

IEA Implementing Agreement on Advanced Motor Fuels (AMF)

AMF provides an international platform for co-operation to promote cleaner and more energy efficient fuels and vehicle technologies. Participants are: Austria, Canada, Denmark, Finland, France, Italy, Japan, Spain, Sweden, Switzerland, the United Kingdom and the United States. The programme welcomes new participants. Contact the AMF Secretariat .

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Many thanks for sharing your thoughts with us.

Nils-Olof Nylund

You are very welcome. Don't forget that you can learn more about the IEA Implementing Agreement on Advanced Motor Fuels at our website: http://www.iea-amf.vtt.fi/ .

[2] Advanced Fuel Cells; Advanced Materials for Transportation; Advanced Motor Fuels; Hybrid and Electric Vehicles; Bioenergy; Hydrogen; Emissions Reduction in Combustion.