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Climate Change : Climate Solutions

IEA Future Energy Scenarios: Change We Have to Believe In

The International Energy Agency has published its vision of how a cleaner, less oil-dependent future could look like. Dolf Gielen, one of the study's lead authors, talks about the way out of the current oil crisis and explains how we can halve carbon dioxide emissions by 2050.

Dolf Gielen, International Energy Agency, Co-author of IEA Energy Technology Perspectives

"If you have a combination of maximum efficiency and alternative fuels, you can reduce oil demand in 2050 by 27 percent compared to 2005 levels." (Photo: Dolf Gielen)

Why has the IEA issued this new report?

The current outlook is not sustainable, fossil fuels demand continues to rise very rapidly and CO2 emissions are going through the roof. So we developed scenarios where we asked if it is technologically feasible to stabilize or halve emissions, and what it would imply for energy policies.

What did you look at exactly?

We covered energy supply and demand. What is, of course, very important for emissions is power generation and synthetic fuels – that's producing oil products from coal, natural gas, and biomass. In our baseline scenario, there is a significant growth of oil production from coal, which has much higher CO2 emissions per unit of product than if you just take natural oil and refine it. On the demand side, we looked at industry, transport, and energy use in buildings.

Some energy experts say that no matter what we do, we will not be able to meet future energy demand. Do you agree?

Supply must meet demand. That is what we have in our baseline scenario, but then we looked at alternative scenarios. What can we do with fuel efficiency? We think a lot can be done to make a transition to a more sustainable energy system. And we looked at three key alternative fuel options: biofuels, especially second-generation biofuels; hydrogen or fuel-cell vehicles; and plug-in hybrids and battery electric vehicles.

The potential of these options is very significant, and if you have a combination of maximum efficiency and these alternative fuels, you can reduce oil demand in 2050 by 27 percent compared to 2005 levels while

still enjoying very significant economic growth.

How much potential is there for more energy efficiency?

All in all, some 36 percent of total CO2 emissions reductions could come from energy efficiency. Fuel-efficient cars are an important option, as are efficient appliances. There is a lot that can be done with building shells and industrial motor systems. There is significant potential for efficiency in all sectors, maybe more in buildings than in transport and industry.

Biofuels, one of your alternative fuel suggestions, have been blamed for increasing food prices. How would you avoid such negative side-effects?

The discussion is mainly around first-generation biofuels – biofuels from food crops. Second-generation biofuels are produced either from food crop residues or wood and straw-type crops. The potential of the residues alone is already significant. And because you can also use less-productive land for straw-type crops, the potential of second-generation biofuels is very good without competing with food production.

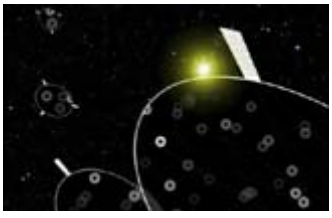
In our most extreme scenario, where we go for a halving of global emissions, biomass use by 2050 will be at the same level as oil use today. Half of that biomass would be by-products and residues, and the other half would come from low-quality land. You would need about 150 million hectares, which is about a quarter of the agriculture land area of the United States.

You also mention hydrogen. It had been slated as a technology for the future, but hasn't lived up to initial expectations. Do you think that could change?

Well, Honda has now started to lease their hydrogen fuel-cell cars. Technologically we are almost there, but it is still a question of economics and infrastructure. If you want to use hydrogen cars, you will need hydrogen fuelling stations. So probably by around 2020 or 2030, you could see the first mass applications.

But in recent years, there has been significant progress in battery technology. So suddenly plug-in hybrids and battery electric vehicles are starting to look like an attractive alternative to hydrogen vehicles. Right now, we are not sure which technology will gain the dominant position.

In a scenario where both options are not available and where you have to rely only on fuel efficiency, carbon dioxide emissions in 2050 would be about 20 to 25 percent higher than in 2005.



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Even if hydrogen cars became economically viable, you would still need electricity to produce it. Where would you get this power from?

Hydrogen can be produced from electricity, fossil fuels, or in the future, possibly even from heat from nuclear reactors. The electricity mix in our hydrogen scenario is virtually CO2-free. A combination of fossil fuels with CO2 capture and storage accounts for about a quarter of electricity supply. Another quarter would be from nuclear power, and nearly half the electricity supply would come from renewables.

What kind of renewables?

It will be wind, hydro power, and solar; each of them producing around 5,000 Terawatt hours a year by 2050. Another 4,000 Terawatt hours would come from biomass and geothermal together.

Carbon capture and storage is still very expensive and experimental. Will it really work?

We think that you will be able to do CO2 capture and storage (CCS) for coal-fired power plants at a cost of 50 dollars per ton of CO2 abated, which is not cheap, but if you compare it to costs of emissions abatement in the transport sector, it is attractive.

The real challenge for CCS is that you will need 20 to 30 demonstration plants in the very near future. And each of these plants cost one to two billion dollars a piece. Investors are shying away from that amount. That's the key problem at the moment.

Gas processing plants in Norway and Algeria are already using CCS technology. In California they are building a CO2-capturing unit at a large-scale refinery. And Shell is doing something at its refinery in Rotterdam. But so far, demonstration for coal-fired power plants are lacking, and that is what the key option would be. It is still stuck somewhere between good will and reality.

If it works, what will you do with all that captured carbon dioxide?

You store it underground, either in depleted oil or gas fields or in aquifers. In many places below the ground, you have salt water reservoirs where you can dissolve the CO2.

Storage in the oceans had been discussed before, but to my knowledge there is no significant research being done in this area. There is a lot of opposition and people are concerned about the environmental impacts that this could have. There is so much potential for underground storage, which is far less controversial.

How much would it cost to store CO2 underground?

It depends what you include, if it is only the well or if you also need the pipeline to get the CO2 there. But the typical figure would be around ter dollars per ton of CO2. The CCS option will always cost money, and that makes if different from renewables or nuclear, which could be cheaper than coal-fired power plants someday.

In your alternative scenarios, nuclear plays an important role. Is there really enough fuel or would we face the next energy crisis fifty years down the road?

Well, if you have once-through nuclear cycles, where you take natural uranium, enrich it, use it, and store the waste somewhere, then you would have enough uranium for something like a 100 years. If you take the waste from the reactors and separate and upgrade it, then you would have sufficient uranium for hundreds of years. If you really want to go for massive nuclear expansion, you will need this type of reprocessing.

What about the scenarios that predict that we will run out of energy?

I don't see that threat. If you look at the area needed to produce enough solar power to provide all the energy we use today, it would be relatively small. But there may be an issue about oil and gas supply. Maybe not so much on the resource side, more on having access to the resources and the necessary investments.

That is one of the advantages of these alternative scenarios, because they not only reduce CO2 emissions, but result also in a very significant decrease in fossil fuel demand, at least compared to the baseline.

And what would it take to make the alternative low-carbon scenarios come true?

You will need a credible, long-term CO2 price, or at least the prospect of such a price. You need the developing countries on board; you cannot do it with OECD countries alone. And you need the technological change, sufficient investments in research and development and in technology deployment to get the costs down.

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The total additional investment costs would be 45 trillion dollars, which is about one percent of global GDP. That would halve CO2 emissions by 2050 and significantly reduce dependence on oil.

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