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What we have just been hearing has been a problem with the climate change debate since 1988 continues; climate and energy just go off in their own directions, people do not talk in capitals, and we are in for the same thing in 2015. What I am supposed to do is to provide you with some nuts and bolts of the edifice. When you look at the World Energy Outlook prepared by the International Energy Agency once a year, it is a projection, not a forecast, and looks out 25 years to 2040, and says, if we carry on as we are now, this is where we will be in 2040, and if you do not like what you see in 2040, you need to start now to change your policies to have a different outcome.

Considering the current market with strong oil supplies and lower prices, it looks pretty good to consumers, but there are some signs of strain in the system. Turmoil in the Middle East has not yet affected supplies, but it deters investment in the Middle East in the future. New LNG is coming on, yet there is new political gas tension in Europe with Russia. Other strains are building on the environmental and climate change front. Some new policies, such as the US Clean Power Plan and agreements between the US and China are very important in this regard, yet CO2 emissions keep rising; they rose 2.6% in 2013 on 2012. Subsidies to fossil fuels are at USD550 billion, four times the subsidies to renewables.

Efficiency is paying off: US average fuel economy improves monthly, EU oil demand for road transport is at 1997 levels with even more cars on the road, so policies can work. Will they come in time? Will global energy be shaped by policies or by events? Since 2000, global energy demand is up 33%, but OECD demand is flat since 2000. All growth is in non-OECD, led by China at 45% and the Middle East and India at 10% each. In OECD, efficiency will compensate for growth, with coal and oil declining but gas increasing. Renewables expand by 2.9% per year and nuclear by 0.8%.

China grows until the mid-2020s to one-third of global demand growth, then plateaus by the late 2030s. This comes of slower economic growth, efficiency gains and slowing population growth, but others gain speed, i.e. India alone counts for 15% of global energy demand until 2025 then surpasses China at one-quarter of global growth. Oil grows another 14 million barrels a day by 2040, but at a slower rate. Markets are currently well supplied but problems may lurk, and growth in oil production will concentrate in the US, Canada, Brazil and the Middle East. Production elsewhere falls off. Tight oil will make the US the largest oil producer in the world until the late 2020s, and by 2040 US oil production is back to where it is today. Oil sands in Canada become the main source of North American supply growth, Brazil adds a lot, but after this a gap appears, and this gap needs to be filled by the Middle East, more than half from Iraq. The resources are there, but turmoil in the Middle East today will delay investment.

Gas is different: for now gas security of supply is a European issue, but things should improve even as demand grows by half. A key reason for this is LNG, which almost doubles in volume, and with greater diversity, with Australia, the US and countries in Africa diversifying LNG exports. The 25 liquefaction sites around the world will be 70 by 2040. Coal has provided 50% of energy demand over the last ten years. Coal is abundant and cheap, but it is dirty. Demand for coal has peaked in the OECD, and will fall in the US by one-third by 2040 due to Obama's Clean Power Plan and other relations, Republicans notwithstanding. China looks to cap its coal consumption, reaching a plateau in the 2020s. India becomes the primary source of global coal consumption, soon becoming the world's second biggest coal consumer, offsetting lower OECD coal demand. Coal looks increasingly constrained by policies. Without higher efficiency and eventual CCS, the increased use of coal is incompatible with climate goals. Without these technologies, an important fossil fuel faces an uncertain future.

Changes in power generation are transforming the energy sector, and 40% of the current 6,000 gigawatts of installed capacity is retired by 2040, mostly in OECD countries. Electricity demand growth is moderate in OECD countries but

strong in non-OECD countries. New capacity requirements are huge: the world needs 7,200 gigawatts of new capacity by 2040 at a cost of USD12 trillion. 50% more capacity in kilowatt-hours are needed in the OECD because of the increasing percentage of renewables in the mix.

Regarding nuclear, while capacity rises to 60% by 2040, this is no nuclear renaissance. Its share of power generation barely rises, and in the EU nuclear capacity falls. Many offline plants return to service in Japan, the first two in January next year, in the south, but capacity falls in Japan in the period to 2040 as retirements exceed additions. Increasing nuclear capacity is seen in just a few markets: the US, the largest user of nuclear power today, sees a modest increase in capacity, India and Russia both see significant growth, but in China, where 27 nuclear power plants are under construction, today, sets the global trend, with 15% of global net increase in capacity, to almost 150 gigawatts in 2040, obviously the world's largest.

How realistic is the two-degree target? The IPCC says that the overall budget for emissions is 2,000 gigatonnes since 1900, but we are halfway through our budget, and emitting the remaining 1,000 gigatonnes gives us only a 50% chance of reaching the two-degree target. The budget is used up by 2040 at existing trends, and with all the efforts to date in the US, Europe, China and elsewhere, this implies that we cannot emit any additional CO<sub>2</sub> from 2040 if we want to achieve the two-degree target, which is not particularly realistic.

Therefore, next steps are urgent. We invested USD400 billion low-carbon technologies in 2014, and plans for efficiency, low-carbon technologies and CCS are set to increase by a factor of two in 2040 on 2013, so USD900 billion a year, but that is far from enough to reach the two-degree target, which requires USD1.6 trillion per year until 2040, four times higher than today. Achieving this will require a very strong signal from Paris and even stronger implementation. Therefore, let us not be lulled by today's lower prices. Heightened geopolitical risk exists in strategic parts of the world where investments need to be made. The Middle East remains crucial to oil markets and current tensions jeopardise investments in the longer term. Nuclear power can play an important role, but unless high costs, financing and public concerns are overcome, nuclear will only succeed in regulated markets where governments promote the nuclear option.

Perhaps most importantly, the energy system is not transforming quickly enough to meet the two degree target. Without clear direction from Paris in 2015, the two-degree goal will soon be out of reach and for good. The central scenario the IEA has forecast is for a 3.6-degree change. Taking a step back and looking at the overall energy system, it is clear that actions from well-informed policymakers, industry and other sectors will be needed to steer onto a safer course.