What Dealing with Climate Change Means for Government Policies

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In the course of a lecture given at the London School of Economics two weeks ago, the Secretary-General of the OECD observed that the endpoint of government policies has to be consistent with the complete **elimination of emissions to the atmosphere from the combustion of fossil fuels in the second half of the century.** He used the term 'zero emissions' as shorthand, but made clear that it embraces technical solutions to capture some emissions through, for example, carbon capture and storage or CCS). Mr Gurria didn't call for zero emissions tomorrow. Not even in 2050, although we should be a long way down the track by then. But he was unequivocal that, sometime in the second half of the century, we will need to arrive there. Why?

'Zero emissions' might sound extreme. Why not just lower emissions? The answer to that is physical. Carbon dioxide is a long lived gas. It hangs around. Of one ton of CO_2 emitted this year, over 60% will still be in the atmosphere twenty years from now and 45% 100 years from now.[i] Some will still be around after thousands of years. Even small on-going emissions will continue to add to the atmospheric concentration. We have an accumulation problem.

Obviously, a human population of 7 billion or more cannot live without any impact on the atmosphere. It is a question of the extent. We have been interfering with the natural carbon cycle for thousands of years as we convert land to food and fibre production. And we will need to continue to do that if we are to feed a further 2-3 billion people. So if we are going to do that *and* limit temperature increases we cannot gobble up all the atmospheric space with fossil carbon. But that is what we are doing. Carbon dioxide from fossil fuel combustion is the most important greenhouse gas produced by human activities.

Energy-related emissions make up the bulk and they are the only ones that can, on the basis of existing technologies, be completely eliminated.

The good news is that we *can* energise the world without interfering in the carbon cycle. The solar flux reaching our planet – and the secondary flows it sets up in wind, waves and rain – is stupendously large. We are developing the technologies to intercept them. And there is potential in biomass and of course nuclear energy, provided safety issues related to nuclear power generation and waste management are properly handled.

Twenty years ago one might have been more cautious about saying we could get to zero carbon. But the technical progress that has been made – despite some truly muddled public policies and all sorts of foot-dragging – is pretty remarkable. We have managed to reduce

the cost of photovoltaic modules by 80% since 2008 and by 99% since 1977; we now have the first solar thermal plants that can deliver electricity 24 hours a day; Tesla is selling high performance 100% electric vehicles with a range of 350 km and recently achieved the best safety rating of any car ever tested by the US government[1].Over the coming decade, advancing energy-storage technology could make electric vehicles cost competitive, bring electricity to remote areas of developing countries, and improve the efficiency of the utility grid.[2]

If universalized, such technologies would radically change the structure of our economies. Getting from here to there involves a transformation that will be disruptive. How costly it is depends on how well elected politicians and their advisers can handle the transition. Knowing when not to intervene, will be as important as knowing when to intervene.

I could give a glass half full speech littered with similar anecdotes for a full half hour. But let me now examine the empty half of the glass. After twenty years of negotiations and policy experimentation the world is nowhere near a trajectory that is consistent with getting us to zero emissions from fossil fuels in the second half of the century. That is true of OECD countries and non-OECD countries alike. Given their different stages of development one would expect them to be on different trajectories, but all those national trajectories will have to converge towards zero in the second half of the century. Despite the technical progress we have made, incumbent industries and technologies are maintaining their market share. Current national emissions reduction pledges for 2020 get us only between a quarter and half way to where we need to be to keep the 2 degree goal within reach.[ii]

Why is it all proving so hard? Ending our reliance on fossil fuel was never going to be easy. Two thirds of electricity generation relies on fossil fuel. Ninety five percent of the energy consumed by the world's transport systems relies on fossil fuels.[iii] It is not a question of vilifying fossil fuels. Much of what we regard as material and social progress has been built on the back of them. Weaning ourselves away from them will mean facing some very powerful currents running in the opposite direction.

The first is a shift to resource abundance. A few years ago, oil and gas were believed to be increasingly scarce. High oil prices and decarbonisation were believed to go hand in hand. That has proved illusory. Instead, we have moved from a world of threatened scarcity to one of apparent abundance. US crude oil production is currently growing sharply and the country is expected to become a net exporter of natural gas by the early 2020s.[iv] Oil and gas production is being ramped up in Brazil, Canada and Kazakhstan, huge conventional reserves remain to be tapped in Iraq and Saudi Arabia together with vast recoverable shale resources in Russia, US, China, Argentina and Algeria,[v] are being pursued.

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[1] http://www.teslamotors.com/about/press/releases/tesla-model-s-achieves-best-safety-rating-any-car-ever-tested

[2] http://www.mckinsey.com/insights/business_technology/disruptive_technologies

Certainly, rising costs of extraction pose a challenge but the recent advances in exploiting tight oil suggest that the technological opportunities for continued exploitation will almost certainly continue to surprise us. Listed companies alone spent USD674 billion in 2012 on finding and developing new sources of oil and gas. [vi] The fact is that there are more than enough reserves to raise temperatures way above levels that even the most reluctant climate regulator would feel comfortable about.

Secondly, low-carbon technologies are facing an array of incumbent technologies that have a huge advantage based on vast investments over decades. Those investments are very profitable and easily attract new capital. More than half of the new capacity in electricity generation installed in 2012 was still fossil fuel-based.[vii] And there is plenty more planned. The owners of these assets aren't going to take kindly to their value being impaired by policies designed to tackle climate change. The Carbon Tracker Initiative estimates that at the current rate of capital expenditure, the next decade will see over $6 trillion allocated to developing fossil fuels.

Thirdly, we face what Mr Gurria labelled "carbon entanglement". What does this mean? Basically, that governments everywhere on behalf of their citizens have major stakes in bringing fossil fuel to market and taking their share of the rents. OECD governments receive around USD200 billion per year from royalty payments, taxes and other revenue streams associated with upstream oil and natural gas rents. The share of such revenues streams in total government revenues is normally low – in the order of 1-4% -- but in countries like Norway and Mexico it gets up to around a third. [viii]

Outside of the OECD the dependence spirals. Russia alone receives around USD150 billion a year from oil and gas, amounting to 28% of total government revenues, while OPEC countries extract revenues of USD 600 to 700 billion a year. [ix] The reliance of these governments on fossil fuel revenues is overwhelming. They have a heavily vested interest in continuing these flows of income. It is scarcely surprising then that cash-strapped governments of all shapes and sizes worldwide are hoping to find and exploit new reserves of oil and gas in places like the Arctic or off-shore Brazil.

Carbon entanglement will not be easily undone and the very modest progress of climate policy over the last two decades is in part testament to that.

The policy challenge

The question before us now is whether we can consolidate the modest progress made to date and turn it into a momentum that will ultimately lead to a transformed energy system and zero emissions in the second half of the century; or whether in 2015 we will cobble together a face-saving agreement in which countries can point to some actions while leaving the 'carbon entanglement' untouched.

If we are to succeed, *every* country needs to ask whether its policy mix is consistent with the scale of the transformation we have to make. We see four areas of policy weakness:

- A lack of strong, consistent carbon pricing signals. Where carbon prices have been imposed, exemptions and carve-outs combined with very low prices have meant that the impact has been marginal at best.

- A lack of action on fossil fuel subsidy reform.

- Mixed messages and stop-go policies and even retroactive changes to renewable energy support, which have seriously shaken investor confidence.

- And, finally, a failure to tackle regulatory and market rigidities that favour fossil fuel incumbency in the electricity sector and which undermine demand-side options that could empower consumers to choose clean energy.

These add up to a lack of credibility if we mean what we say about climate goals. This is much more than a political issue. It is a crucial economic issue. At the moment, most businesses don't believe that governments are serious, and they are investing accordingly – thus perpetuating the carbon entanglement.

I can talk about the first two challenges quite briefly since we have done a great deal of work and have a pretty clear idea of what needs to be done. In our view, any policy response to climate change by *any* country must have at its core a plan to steadily make carbon emissions more expensive. This is fundamental. Without placing a **clear and explicit price on emissions** we are, as the expression goes, just 'pushing at a piece of string' when it comes to changing consumer, producer and investor behaviour. A price on emissions is an unequivocal policy signal aimed at the heart of the problem. Governments that try to avoid visible emissions prices inevitably end up blurring the signal they provide. Regulations, for example, place a 'price' on carbon but it few people know what it is.

Our research indicates that there has been a huge amount of taxing and regulatory action around carbon in many different jurisdictions. It is not as though nothing is happening. On the contrary there is in some ways too much happening. Carbon is priced in a multitude of ways sometimes intentionally, sometimes coincidentally. Sometimes the effective price is very high, often it is low to negligible. It is a chaotic landscape that sends no clear signal.

Fossil fuel subsidies operate as 'negative carbon prices'. Their removal is essential. You would think that twenty years into the climate debate we would at least have made more progress in removing subsidies to fossil fuels that actually *encourage* carbon emissions. Almost everyone these days can quote the IEA's estimate of subsidies to fossil fuel consumers in developing and emerging economies of over USD 500 billion.[x] They are bad

for the economy, the environment, and social justice (even though they are often justified on grounds of alleviating energy poverty).

But it is the persistence of support for fossil fuels in OECD countries that is particularly disturbing. Our recently completed inventory of support to both the consumption *and* production of fossil fuels in OECD countries reveals that that support is non-trivial - in the range of USD55-90 billion per year recently.[xi] Most of the support in OECD countries is quite opaque, particularly as it relates to production subsidies, hidden in the details of taxing statutes. The figure is by no means comprehensive and our work is on-going. For instance, tax breaks for company cars may well amount to over USD 30 billion per year across 25 OECD countries.

Incoherent and inconsistent policies

Prices and subsidies are nice tidy policy subjects to talk about. But there's much more to it than that and I'd like to focus the remainder of my comments on the more systemic fossil bias that is underwriting the status quo and holding back the profound economic transformation that is called for.

Fossil fuel already has a huge advantage as the energy resource of choice. So it certainly doesn't need any more help from subsidies. But its advantage is much deeper than that. Two hundred years of technical development and path dependency mean that the investment playing field is naturally attuned to channelling capital to mature, incumbent fossil technologies the market understands – technologies which are in turn supported by regulations that were designed when fossil fuel was almost the only game in town.

Governments need to stand back and look across the entire range of signals they are sending to consumers, to producers and investors. If they are serious about climate change they need to eliminate *all* conflicting policy signals. A critical element involves how the transition will be financed. There is no shortage of capital in this world. The question is whether non-fossil energy investments will become commercially attractive. That depends in part on the regulatory landscape that governs energy markets and in part on the requirements investors have to satisfy in deciding how to allocate their capital. Let me quickly sketch some of the challenges.

The 'decarbonised' technologies are well known: variable renewables like wind and PV, geothermal plants, hydro, nuclear, all of which run at very low or zero operating costs. To these we must add solar thermal with storage, biomass-based and CCS-fitted plants. To date, new renewables like wind and PV have managed to enter the market on the back of guaranteed prices that have involved costly cross subsidies. This cannot be the long-run solution. They will have to be able to stand on their own commercially. One important question is whether the electricity market price as it is currently determined can provide an effective signal for investment in these technologies?

Let me point to an obvious paradox. We want more competitive investment in low-carbon technologies, paid for by the market. But recent experience shows that the more wind and PV-based electricity that comes on line, the lower the wholesale price of electricity – reaching sometimes negative levels. And yet we expect that price signal to drive these very investments!

The basis of this paradox is that the wholesale electricity price is based on its marginal cost, and with abundant variable renewable capacity, the marginal cost is zero. The price of CO_2 will not change that. The more we decarbonise, the less the price of CO2 will be visible on the electricity markets.

We have to re-think the organisation of electricity markets if, in the future, we want the electricity market price, and the CO2 price as one part of it, to be the drivers of clean-technology investment.

There are other regulatory challenges. Utilities have expressed concern about the reliability of supply from renewables at the same time as some of their capacity –sometimes quite new and efficient gas turbines- is being 'moth-balled', or just stranded. Part of the solution lies in grid interconnection, particularly in heavily populated and closely located regions like Europe, North America and Asia, is key,

But traditional utilities and some regulators have pushed in addition for capacity mechanisms. These would pay utilities not just for the power they generate but also for standing ready to generate power *if needed*.

There is debate about the extent to which these mechanisms are needed or amount to inspired special pleading. In the context of climate policy, governments will need to know whether these mechanisms will increase the cost of moving away from existing fossil-based generation.

How much is needed by way of capacity mechanisms is very much a supply-side argument. But the demand-side is just as important. If you can manage demand more effectively, the need for special capacity arrangements may be less pressing. Once again, the regulatory architecture can be decisive in determining whether new clean energy solutions can penetrate the market.

We hear that smart meters could work wonders in the home – turning fridges and water heaters on and off depending on the price of electricity, without we, as users, being even aware of the cost-minimisation that would be going on in our homes while we're busy doing something else.

Of course, if end-use electricity prices are regulated, optimising our electricity use to avoid demand peaks is pointless. Energy companies are not going to rush to offer these ICT-based

demand management services if there is no obvious gain to their consumers, nor to the grid, of doing so.

Then there are issues surrounding the ownership of assets. In the EU (and elsewhere) there are prohibitions against the ownership of both transmission and generation assets.
The policy is intended to prevent owners of transmission networks from operating and expanding their networks in a way that favours their own generation or production thereby distorting the market. However, pension funds have been quoted (CPI, 2013) as saying that electricity and gas unbundling regulation in Europe is the single biggest impediment to greater investment in energy infrastructure.

While the policy was developed to avoid the very real possibility of market distortions, institutional investment in renewable energy projects may be collateral damage. Many institutional investors in projects require a degree of control of the assets, so this regulation essentially forces them to choose between owning transmission or generation including renewables.

While owning both transmission and generation assets does not always present a conflict of interest, investors are wary of the legal risks, and will generally avoid embarking on uncertain processes that may involve lengthy investigations before a deal can be approved.

That brings me to financial markets. It is often noted that financial markets tend to reward short-term over longer-term investment. Signs of growing short-termism include the fact that securities holding periods are declining and allocations to long-term assets such as infrastructure are generally very low and are being overtaken in importance by allocations to hedge funds and other high frequency traders[3].

By locking in a preference for short-termism and liquidity, regulatory policies can create obstacles to infrastructure investment generally, including green infrastructure. For example, investment restrictions aimed at ensuring the financial solvency of institutional investors discourage them from investing in infrastructure and other 'illiquid' asset classes. Similarly, financial regulations designed to increase banks' levels of capital and reduce their exposure to long-term debts can discourage long-term investments. Policymakers may need to consider whether ensuring solvency has to be at odds with long-term investments such as infrastructure.

Other policies create roadblocks that are specific to green infrastructure investments. For example, pension funds are often given tax exemptions. But in a number of countries, tax credits are used as the primary measure to support renewable energy. These will typically not benefit pension funds. Or take the case of Master Limited Partnerships in the US and

[3] See Promoting Longer-Term Investment by Institutional Investors: Selected Issues and Policies, http://www.oecd.org/daf/fin/private-pensions/48616812.pdf

Germany[4]. These are designed to facilitate investment in fossil-based energy infrastructure and are highly liquid investment vehicles. Interestingly, they have not yet been permitted for use in green infrastructure investments.

This raises the question of whether the current smorgasbord of tax and investment incentives favouring fossil fuels might not unwittingly contribute to a growing class of stranded investors. We note that that the World Bank, the US Export-Import Bank, the European Bank for Reconstruction and Development and the European Investment Bank have severely limited the cases in which they will finance new coal power projects.[5] One could reasonably expect that responding to the climate challenge will make steps like this more common.

The market capitalization of EU utilities has fallen by $500 billion over the last five years. This is not exclusively the result of competition from subsidized renewables but it does underline the fact that if Governments pursue clean energy options there will be consequences for incumbents and those who have invested in them. Let's remember that the investors include, through pension funds, people like you and me.

We do not know the extent to which institutional investors are exposed to the risk of regulatory changes that will devalue carbon-heavy assets. But it is likely to be non-trivial. The Asset Owners Disclosure Project estimates an average of over 55 per cent of pension funds' portfolios is being invested in high carbon assets or sectors significantly exposed to the physical impacts of climate change and climate change-related regulation.[xii] An example of regulatory changes that will devalue carbon-heavy assets is the proposed US standards for new coal-fired generation. These have contributed to a precipitous drop (over 70%) in the share prices of two of the largest U.S. coal companies.[6] Changes like this may imply a looming choice may be either stranding assets like these or stranding the planet unless you can retrofit capture and storage (CCS).

Meanwhile, oil and gas companies continue to explore and exploit new reserves, often with the support of favourable taxation provisions. Policymakers may wish to consider whether contradictory incentives could be placing pension funds and others at risk of stranding their investments in the future.

All this serves to emphasize the potential pitfalls of the needed energy transition. But it would be wrong not to give equal emphasis to the up-side. I have already mentioned smart-meters and the possibilities of demand-side management. There is a universe of ICT-based

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[4] A publicly traded limited partnership that includes one or more partners who have limited liability

[5] World Bank (2013), "World Bank Group Sets Direction for Energy Sector Investments"; Bloomberg (2013), "Obama's Overseas Coal Pledge to Curb Ex-Im Bank Financing"; EBRD (2013), "Draft Energy Sector Strategy"; EIB (2013), "EIB to reinforce support for renewable and energy efficiency investment across Europe".

[6] http://ecowatch.com/2013/10/01/the-shrinking-u-s-coal-industry/. [I confirmed the change in share prices.]

solutions that has barely been imagined. There are huge public health benefits associated with transformative zero-emission technologies. And there will be some incredibly exciting economic opportunities. The energy transition will require products and services that simply don't exist today.

The fact that they will be provided by companies that barely exist or are yet to be born doesn't make it any easier to argue the case for change when there are large incumbent companies that are understandably more comfortable with the status quo. The cost of exiting from the status quo can appear daunting. And the transition to a zero emissions economy will certainly not be a costless one. Governments must be frank about this. On the other hand, they are presiding over a battery of regulatory instruments that, if left untouched, could make the transition more costly than it need be. All of this simply underlines the key point the OECD Secretary-General was making: we need to stand back and look across the entire range of signals that are being sent to consumers, to producers and investors alike. If ever there was a case for joined-up policy, this is it.

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[i] Joos et al. (2013), "Carbon dioxide and climate impulse response functions for the computation of greenhouse gas metrics: a multi-model analysis." *Atmos. Chem. Phys.*, 13, 2793-2825, doi:10.5194/acp-I 3-2793-2013.

[ii] UNEP (2010), *The Emissions Gap Report 2010: Technical Summary*.

[iii] IEA (2013), World Energy Outlook

[iv] IEA (2013) World Energy Outlook

[v] US Energy Information Administration (2013), *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*.

[vi] The top 200 listed oil and gas and mining companies

[vii] BNEF (2013), Clean energy investment – Q2 2013 fact pack: http://about.bnef.com/presentations/clean-energy-investment-q2-2013-fact-pack/

[viii] OECD analysis based on revenues reported by governments where available and supplemented by; estimates obtained using IMF data on total government revenue and data from the IMF World Economic Report.

[ix] Ibid.

[x] http://www.worldenergyoutlook.org/resources/energysubsidies/

[xi] OECD (2013), *Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels 2013*, OECD Publishing. doi: 10.1787/9789264187610-en

[xii] That is, not only oil and gas companies but also the banks that finance them and the manufacturers that rely on the continued supply of their output. That compares to less than 2 per cent of a typical asset owner's portfolio invested in low carbon assets such as renewable energy infrastructure, renewable energy equipment manufacturers and energy efficiency companies (source: AODP, 2013; Deutsche Bank 2010).