The Truth About Those Carbon Emissions

TN Note: It’s not exactly what most people believe, but carbon emissions are directly tied to economic growth.

Ever since the discussions on how to address “manmade global warming” started to gain traction in the 1990s trillions of dollars have been spent on infrastructure, subsidies, R&D, regulations, trading schemes and even political organizations with the explicit intent of reducing greenhouse gas emissions.

We all know the basic premise. Relentless human progress over decades has led to a continuous increase in the levels of carbon dioxide and other warming gases in the atmosphere, largely from burning fossil fuels which have become indispensable to modern societies. More heat is trapped as a result, pretty much like in a greenhouse, leading to a steady rise in global temperatures year after year. As such, our consumption of these dirty” fossil fuels must be curtailed, or we will all get roasted in the not too distant future.

Developed nations took the lead in reducing the carbon intensity of their
energy infrastructure by gradually replacing fossil fuels with newer renewables (such as solar, wind and biofuels) and cleaner hydrocarbons. In addition, through innovative carbon trading schemes European consumers and companies paid for phasing out polluting enterprises and establishing advanced energy technologies in many developing countries.

Alas, the world has changed considerably since the 1990s. Rather than diminishing, carbon emissions have actually increased by a great deal. Developing countries as a whole are now the #1 emitter. And many OECD (mostly developed) countries are trying to manage very difficult fiscal positions.

In fact, the only thing that seems to have remained constant is the strategy on how to reduce emissions globally. This year, 34 countries signed a climate agreement in Paris to reduce their greenhouse gas emissions, accounting for about half of the world’s total, in the coming years. Exactly how we can’t say, but by the looks of it it’s the developed world that once again will bear the brunt of the cuts and the cost needed to steer the world in that direction.

This could have far reaching implications, possibly altering the architecture of the global economy even more. The loss of the manufacturing / industrial base in many developed countries could accelerate as a result, which in itself presents a set of near-term challenges in terms of know-how and prosperity.

We must therefore ask the question: in light of the results achieved thus far, do we actually have a credible plan in place that can actually deliver carbon emission reductions (even without getting into the point on in a fairness and balance), or is all that money being spent on a wild goose chase?

Let’s look at the data.

**Total Carbon Emissions**

Every year BP, the global energy behemoth, releases its Statistical Review of World Energy, a freely available treasure trove of information.
It includes an entire section on carbon dioxide emissions by country, which we will employ here to gauge the current state of affairs (except where noted otherwise).

Carbon Dioxide Emissions (MM Tons) in Selected Countries/Regions: 2000-2015

The graph above shows total carbon emissions from energy sources only (excluding things like methane leaks from pipelines, trash and cow farts), and therefore may not tie with national calculations. But since these account for the lion’s share of manmade emissions, we should be close to the mark.

The first thing that comes out is that carbon emissions have grown strongly, and at 33 billion tons are now 40% higher than in 2000. In fact, they have grown every single year – with the notable exception of 2009, when the world economy was coping with the devastating effects of the global financial crisis.

[Note to self: since total carbon emissions were basically flat in 2015, what does that tell us about the current condition of the global economy? Hmmm...]

The second noticeable thing is that emissions from the developed world peaked in 2007 and have been steadily declining since, as evidenced by adding up all the bars until “Other OECD” in the graph. Since 2004
these countries no longer account for the majority of carbon emissions worldwide. As of last year their contribution was a mere 37% of total, a figure which will likely continue to fall in the coming years.

In stark contrast, the developing world has been on a tear. Just look at China and compare its bars in 2000 versus 2015. The exact figures are 3.3 billion tons versus 9.2 billion (now a staggering 27% of total carbon emissions), respectively, an increase of almost three times over 15 years. Let that sink in China bears! It is now the world’s largest carbon emitter, after overtaking the US in 2006. India’s emissions increased by over two times during the same period, with the Middle East coming in a tad lower than that.


The graph above shows the change in manufacturing value-added in selected countries since 1980, and it almost provides a mirror image of the relative change in carbon emissions since then.

So there is an important, observable link between emissions and economic performance, as should be expected. But there is more to this story.
A Measure of Efficiency

Another great piece of information contained in the BP report is the amount of primary energy consumed by country. This is basically the energy resulting from the utilization of commercially-traded fuels, including renewables used to generate electricity.

Using this data together with carbon emissions can give us a sense of how much carbon each nation puts out per unit of energy consumed. For simplicity let’s call this “efficiency”, which is simply carbon emissions divided by primary energy.

In one extreme, if a country uses exclusively renewable and/or nuclear energy this number should be zero, meaning the highest efficiency ranking. Its carbon emissions are either non-existent or are fully absorbed elsewhere in the ecosystem, not in the atmosphere (the emissions required to assemble that infrastructure are not considered here). Newer renewables (that is, excluding large hydro) tend to be more expensive than their fossil fuel counterparts, thus requiring some type of government support to become economically viable.

At the other extreme, a fossil fuel plant that has a very low conversion rate into energy will have a high number (lower efficiency ranking). The type of fossil fuel matters as it impacts the technical efficiency of the energy conversion and related emissions. Coal (absent any capture methods) tends to produce much more carbon emissions than natural gas (although methane leaks from natural gas pipelines and other infrastructure can complicate the picture a bit).

The graph below shows all this information for a selected group of countries/regions.
Let’s start with the champions of carbon inefficiency, meaning those with the highest number. Until recently, China had the top spot. This explains why despite having a smaller economy than the US it spews out much more carbon emissions. This is hardly surprising to anyone who has experienced or seen the pictures of pollution in Chinese cities. The Chinese government is trying to address the issue as evidenced by the substantial improvement post 2007, but there’s a lot of work to be done in order to converge to its more carbon efficient peers.

India continues to power on and in 2014 overtook China as the most carbon intensive. It will probably get worse before it gets better, as the country desperately needs more energy and cheap coal tends to be the fuel of choice.

The higher ranking (lower figure) of the rest of the developing countries (ROW) is not driven by cleanliness per se, but in large part because many have yet to embark on the same industrialization process as China and India. For instance, many still use carbon-neutral biomass as a major source of energy (which in turn raises significant sustainability concerns). If India is used as their template global carbon emissions could rise substantially from here.

Trends are more encouraging in the remaining countries. Admittedly the
positive performance of Russia surprised us, given the lingering image of the heavily polluted Soviet industry in our minds. An increase in the use of nuclear power was a key driver behind this steady reduction in carbon intensity.

Japan provides the opposite example of Russia. The nuclear shutdown pursuant to the Fukushima disaster in 2011 meant that the use of fossil fuels as a replacement generated a lot more carbon emissions per energy consumed. This shows once again that the choice of fuel matters a great deal in this domain.

Starting from a higher base the US (dashed blue line) has also improved over the period, as it replaced dirtier coal with natural gas, made abundant by the incredible share revolution, and also ramped up the use of renewables.

Improvements in the EU’s carbon efficiency (dashed green line) were more remarkable than any other country, especially as Europeans reduced their use of nuclear, hydro and natural gas (the “easier” cleaner alternatives) by about 10% over that period. This means that the newer renewables, such as wind, solar and bioenergy, contribute substantially more to energy generation today – having grown by an astounding factor of almost 10 times since 2000.

So why isn’t everyone following Europe’s lead?
Average National Electricity Prices (UScents/KWh) at Current Exchange Rates: 2011 (Source: Ovo Energy)

The graph above shows electricity prices in selected countries. While differences can be attributed to a number of causes (including exchange rates), reducing carbon intensity primarily through the use of newer renewables is clearly not cheap. Germany and Denmark, the traditional poster children for solar and wind power, respectively, pay some of the highest electricity prices in the world. This hurts domestic consumers and other industries (and especially so in export-driven economies).

Moreover, the investment requirements are enormous, and not always optimized. In 2013 Siemens estimated that a cool US$60 billion could be saved by 2030 if renewable energy resources where built where they produce the most, like putting solar panels in sunny Spain instead of cloudy Germany, and transporting the resulting energy back home. Not exactly locally-sourced energy but much cheaper.

This evidence suggests that Europeans are already paying out the wazoo to reduce their and even other’s carbon emissions (although we haven’t seen any studies that confirm this - probably not what politicians want to see advertised when asking for more money from their constituents to combat climate change).
High Level Drivers of Carbon Emissions

Countries all over the world have been investing significantly to promote cleaner energy alternatives.

Investments in renewable energy from developed countries peaked in 2011 at US$191 billion. Since then the figure has been substantially reduced, likely as a consequence of fiscal difficulties, to the point where the developing world as a whole is now the largest investor.

This begs the question. With all this investment, why have total carbon emissions continued to grow so strongly?

We can answer it by differentiating between changes in VOLUME – the total amount of primary energy consumed, normally positively correlated with economic and/or population growth – and CARBON EFFICIENCY (as we have defined above, basically emissions per volume), which can be improved through the use of less carbon intensive technologies.
If we do this by splitting the data between developed (broadly, OECD) and developing (Non-OECD) countries, the results are quite revealing.

The graph above shows this split for OECD countries. We can now clearly see why their emissions have been falling since 2007. Carbon efficiency has broadly improved throughout the period (negative orange bars), meaning that all that investment did generate some improvements. But the real cause for the declines were primarily caused by big reductions in volume (negative blue bars), particularly since the 2008 financial crisis.

As we know, the economic environment was substantially more dynamic in the developing world. Accordingly, positive volume increases were recorded through the entire period, even during the 2008 financial crisis. But on a brighter note, carbon efficiency has been on the rise in recent years, also as a reflection of increased investments in renewables, but remains clearly insufficient to offset those volume increases.

The evidence from both groups seems to suggest that based on the current technological footprint the only way to reduce carbon emissions is through a reduction in economic activity, since volume changes have contributed a lot more than efficiency improvements.

This is a painful realization, because the resulting job losses, stunted growth and reduction in prosperity levels are simply politically unacceptable in any country. Otherwise, despite their very important contribution, today’s clean technologies will not get us there.

**Easier Said than Done**

This is probably why the folks signing the new Paris climate agreement opted for more of the same (and from what we can tell, without any binding reduction targets): more investment and regulations paid primarily by the citizens of developed countries, even if they no longer
account for the majority of those emissions, and which absent any major economic contractions will not do much to stop the increase in emissions anyway.

We’re not even sure of what the reduction targets should be to avoid the much touted climate apocalypse. If anything, the study of economics has taught us to be skeptical of any model that produces an exact number. And the climate is vastly more complex than dealing with human emotions. This does not inspire much confidence on any mandated reduction number, especially given how poorly climate models have performed in recent years.

Even a small percentage change in emissions can make a huge difference on the intended outcome. For instance, let’s assume we want to go back to the “depressed” carbon emission levels in 2009. That’s a 10% reduction from current levels, or some 3.3 billion tons of carbon. To put that figure in perspective that’s more than half of all emissions in the US, the world’s second emitter.

We suspect that more ambitious targets will need to be established to really make a difference, but just to go back to 2000 levels… an equivalent of the whole of China would need to become carbon-neutral! And this will only increase as other countries become more developed.

We don’t wish to sound pessimistic here, but if our survival is indeed at stake we do hope that the climate change “deniers” – those who assert that recent temperature changes are driven primarily by natural events as opposed to human actions – are ultimately proven correct.

Otherwise, we just can’t see how the world will ever achieve any meaningful carbon emission reductions absent any massive curtailment in economic activity worldwide. To reiterate the point, based on the data we have seen, the technology we have at our disposal today has proven to be insufficient to offset emissions resulting from growth under normal circumstances, no matter how much investment and well-intentioned regulations have been deployed to solve this issue.

The Way Forward
Ah, but aren’t we making excellent progress in finding new, cheaper, cleaner ways to produce energy?

Even if that’s the case, let’s be real here. It takes decades for any new form of energy to achieve a significant proportion of global production. And as pointed out by Vaclav Smil, Distinguished Professor Emeritus at the University of Manitoba, each of those energy transitions seems to be taking longer to unfold. If we need to reduce emissions urgently then we are clearly running out of time.

So what can we do?

The good news is that taking concrete steps to preserve our environment should also produce positive results in terms of reducing emissions. After all, plants need carbon to live and have always acted as natural reservoirs. An excellent place to start is by being serious about massively reducing deforestation. And we should also be planting a massive amount of trees all over the world.

Yes, it sounds too simplistic but the best solutions often are. It can be done quickly if we commit to it and costs a fraction compared to replacing our energy infrastructure for the sole purpose of reducing carbon emissions. Moreover, it is way more consensual than trying to convince an Indian not to build a coal-fired power plant when her country badly needs energy, or a German to foot the bill of a cleaner alternative. And there plenty of other low-hanging fruit solutions out there.

That is not to say that clean energy is useless. Absolutely the contrary. It offers a great number of vital benefits, such as reducing all kinds of air pollution, increasing self-sufficiency, revitalizing industrial production and R&D and minimizing the risk of geopolitical conflict over fossil fuels, which evidently will not last forever. These are all things we can agree on without getting too philosophical.

Unfortunately, the debate over climate and carbon emissions has become extremely political, even litigious. This is toxic for the advancement of science and above all finding a credible, cost effective, balanced and fair solution that can benefit global society without overly
constraining growth.

But since political expedienece trumps reality, where taxing people and spending the money on expensive “white elephants” appears to be the path of least resistance, we’re not holding our breath here - even if that might end being the only way to finally reduce those ever growing carbon emissions.

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