**We need to talk about growth. (And we need to do the sums as well.)**

*In my opinion, the greatest scandal of philosophy is that, while*

*all around us the world of nature perishes – and not just the*

*world of nature alone – philosophers continue to talk,*

*sometimes cleverly and sometimes not, about the question*

*of whether the world exists.*

Karl Popper, *Two Faces of Common Sense*

**1. Why should we talk about growth?**

Growth is a big issue, and getting bigger all the time, but not one that yet generates serious discussion in the community. Nor has it been the subject of mainstream political critique. That economic growth is good is a view unchallenged by any major political party in Australia, with the exception of the Greens – and more than anything else it is their questioning of growth that has seen the major parties condemn the Greens as a fringe political movement.

No doubt there are deep philosophical – or at least ideological – reasons for this, but the problem might also be explained by our simple failure to understand the mathematics of growth. This has been persuasively argued by the US based investment advisor Jeremy Grantham, in a paper [*Time to Wake Up: Days of abundant resources and falling prices are over forever*](http://www.theoildrum.com/node/7853)*.*

Grantham illustrates his claim by reporting a discussion he had with a group of very highly numerate people interested in economics and the environment. He asked them how much stuff the Egyptians would have had at the end of their 3,000-year civilization if they started with a total of just one cubic metre of possessions and grew their stash by 4.5% per year – a pretty standard growth target in our culture’s history. The mathematically minded folk knew it would be a big number but none came near the actual figure. The Egyptians would have needed more than a billion of our solar systems to store their stuff. To be more precise, assuming no loss or recycling, they would have needed 2.5 billion billion solar systems.

Sometimes environmentalists cynically suggest that those who are gung-ho for growth seem to think we will be able to find a new planet once we have trashed or run out of space on this one. A bit of simple mathematics shows that just one more liveable planet – indeed, billions of them - would not begin to solve the problem.

The lesson is that if we wish for our economic system to be long lived then at some point we must give up growth. Growth is simply incompatible with longevity, **for anything physical**. You can see this for yourself by playing with the spreadsheet below.

The first part, *How big will that get*?, allows you to calculate the results of growth for any quantity that you are interested in. You select an initial value – say, the population of Australia - a rate of growth and a period of time, then press return to see the results. I have worked some examples which I will discuss below. But just to whet your appetite for a bit of calculation, you will discover, for example, that if we continue to grow Australia’s population at its current rate for as many years into the future as we have recorded history of Europeans in Australia, our fair land will be home to over 33 billion people in a bit over 400 years time. Not a realistic proposition, and clearly not something that will happen, but one that we are on track for right now and will remain on track for until we change direction.

The second part - *How fast can we grow*? - turns it the other way around, and allows you to set the size of something now, how big you think it should get, how many years of growth you want to consider, and then the spreadsheet calculates the rate of growth that can be permitted. For example, if we wish to limit Australia’s population to no more than doubling in the average Australian lifetime, then we need to more than halve our current growth rate to 0.9%.

Most of the spreadsheet is locked, but you can enter data in the shaded areas and the spreadsheet will calculate the result, and I have left the whole first row of each shaded area unlocked so you can see the formula for calculating the result.

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**2. Are we expecting technological change or stabilising the population to save us?**

I expect some of the examples I have given, and the ones you will work yourself, will surprise you. But since anyone with a mobile phone has the technology to do these sums~~,~~ why aren’t we having a more serious conversation about growth?

Surely one reason for this is that the views of those who are for and against growth appear incommensurable. Those in favour of more growth seem incapable of conceiving how society could be successful unless it grows, in population and material wealth. Those who are opposed to further growth claim it is inconceivable that we can continue to have successful societies unless we can halt the growth of population, or material wealth, or both.

When environmentalists discuss economic growth they typically focus on the increase in the use of raw materials, or the increase in waste, arguing that looming resource scarcity or environmental pollution must cause growth to be halted before we run into big problems.

But when economists or business people discuss growth they (usually) focus on the growth of stuff – food, clothing, houses, cars, home theatre systems, roads, cattle and so on. The growth of stuff is the aim of the whole business. We don’t pursue economic growth to run out of this or that resource, or to make the air unbreathable or the oceans acidic. Businesses want to grow our stuff, and if they can do that by using fewer resources and producing less pollution (when there is a saving to be made), so much the better.

As it happens, this is just what we have managed to do so far. We have increased the efficiency of our industrial processes, using fewer resources and producing less pollution per unit of output of the desired stuff. (In the more advanced economies, we have also shifted from making stuff to providing services as an engine of growth, but we then import stuff from the places we have shifted its manufacture, so from a whole world perspective, this is no solution).

The proponents of continued growth hang their hats on the hope that technological change will allow growth to continue as it has in the past by increasing the efficiency of industrial processes. But, to be accurate, technology will have to work much faster than it has in the past: to date, while we have reduced material inputs and waste per **unit** of output, the **growth in units** of output has swamped the efficiency gain. In the technical jargon, we have **relatively** decoupled increasing GNP from increasing resource use, but **absolutely** our resource use and pollution has still increased – e.g., the volume of consumption of fossil fuels and the rise in greenhouse emissions. [Jackson 2009, p. 68ff]

But this is where Jeremy Grantham’s argument about growth is so powerful. He simply avoids arguments about whether future technological development will enable us to keep making more stuff without running out of iron ore or copper or silicon, or without making the land so polluted we cannot feed ourselves, or the air so denuded of oxygen that we cannot breathe (which will take less than 10,000 years at the current rate of depletion). He simply does the maths and shows us that it does not matter how efficient and environmentally benign we make our industrial processes, if we keep growing our stash of stuff we simply run out of space to put it.

Indeed, to bring the problem back closer to now, even if we could use raw materials with 100% efficiency such that all raw materials became stuff and none was wasted, we could not grow beyond turning our whole planet into stuff as at that point we would have run out of all our resources and space at the same time!

How long would that take, if we could turn one cubic meter of planet into one cubic metre of stuff? The problem is worked in the spreadsheet. If we assume that all of Earth’s current population of 7.2 billion people now has on average just 2 cubic metres of stuff, and we grow that stash at the 2014 [predicted world rate of growth of 3.1%](http://www.conference-board.org/data/globaloutlook.cfm), we will consume the whole of the planet in 820 years.

Eight hundred and twenty years is a long time. Perhaps by then we will be able to colonise other planets in our solar system when we have consumed Earth? At that growth rate, one planet the same size as Earth would give us another 23 years before it too was consumed. This does not look like a good plan.

What about if we drastically reduce our population? Suppose instead of staying at 7.2 billion (as I have assumed above), we could halve the world’s population? Again, that would delay arriving at any particular volume of stuff by the time taken for one doubling at 3.1% growth – about 23 years.

It might be suggested by a proponent of growth that to avoid running out of space we simply need to get rid of the old stuff or wait for it to rot away to make way for the new. But where do we put it while waiting for it to rot, where that will occur? The more planet we use to store our waste the less room we have for that new stuff.

It takes just over 800 years to turn the whole volume of the Earth into stuff if we start with two cubic metres each and grow at 3.1% per annum. But of course we cannot make stuff out of ordinary dirt, or seawater, let alone the material that lies beneath the crust of the Earth. So long before we run out of planet we will run out of raw materials. How long? Let’s do some maths again.

Suppose we achieve some incredible technological breakthroughs such that we can make stuff out of 50% of the material that makes up the top 1km of the surface of the Earth, including the sea floor, with the rest becoming waste. How long before we turn the top kilometre of the Earth into 50% stuff and 50% waste at our current rate of growth? The spreadsheet works this out as 540 years.

And the more realistic we make our assumptions – limiting sea mining to depths of less than 100 meters, say, or leaving some land area for food production - the shorter that time becomes. On realistic assumptions we are doubtless more than half way from Columbus’ discovery of the New World to the consumption of all of the world we can access. **And if it is not too far in the past to be interested in, it’s not too far into the future to be concerned about**.

What about total recycling as a source of ‘new’ resources and a way to avoid burying ourselves in stuff and waste? We will never get this to 100% efficiency: driving your old Ford into something like a 25th century car wash and driving out in a new BMW is not science but science fiction. (And even at that level of fiction we have abandoned growth, swapping one old Ford for one new BMW. To maintain a growth rate of 3.1% we need to be able to drive 1000 old Fords into a car wash and come out with 1031 new BMWs.)

Thus we might aim for cradle to cradle manufacturing, and we should (I will come back to this below), but the laws of physics will demand that we waste at least some of the bathwater on the way through, even if we keep the baby. Suppose we can get recycling to 90% efficiency: 90% of everything we make new can be made from old stuff. How much longer will this give us? The answer is easy to find, and depressing. Reducing demand for raw materials by 90% will reduce what previously required 100 tonnes of new materials to make to requiring only 10 tonnes. But with 3.1% growth that 10 tonnes will be 100 tonnes – back to where we started – in about 75 years. So a technological miracle that allowed us to turn 90% of junk into new stuff would only push out our consuming the top 1km of the planet from 540 to 615 years!

Which is not to deny that technological miracles will help us increase the efficiency of our production, reducing both our use of raw materials and the production of waste, as well as miniaturising many things which used to use a lot of resources and take up a lot of storage space. This is powerfully argued (and hopefully spruiked) by Diamandis and Kotler in their analysis of the power of new technological developments to ‘dematerialize’ growth. [Diamandis and Kotler 2012, p. 150ff] But dematerialisation is a slippery concept: **reduction** of material use is not **elimination** of material use, and just as with relative and absolute decoupling, the reduction in unit cost or size can be overcome by the growth in units. So a world of abundance without limit will eventually be a world crammed too full of perhaps tiny stuff, regardless of our technological progress.

The initial size of the population, or the size of their stuff (both individual pieces and in total), or our rate of recycling, or even our current technological limitations in needing high quality inputs to manufacturing, is not the root of the problem. Halving the size of the problem by any of these means only delays arriving at any particular size later on by the time it takes for one doubling, that is, by 23 years. Making the problem one-eighth the size only buys us the time of three doublings, or 69 years, and so on.

The problem is not the **size** of our use of materials and accumulation of stuff and waste now (assuming it is not already too large). The problem is that blasted compound **growth**, and the solution must be to get this under control.

**3. Can’t we leave it to some later generation to solve the problem?**

Of course I am not **predicting** that we will consume our whole planet, no more than I am predicting that Australia’s population will reach 33 billion in some hundreds of years. These things just cannot happen, which is why our simple maths shows us that growth will stop rather sooner than we might have expected, even on very optimistic assumptions about future technological processes.

This will either be in consequence of our hitting some natural (physical or biological) limit, or because we choose to halt growth to avoid hitting such a limit.

It is possible that we will take the first option – going for broke. In doing so we would be acting as if we were incapable of envisaging the future, or accepted nomoral responsibility for the welfare of future humans, let alone the natural world. We would be acting as if we were mere animals who multiply until their impact on their environment causes the collapse of their population, perhaps to the point of extinction.

**But we can envisage the future, and parents in particular do care about the welfare of at least their children and grandchildren**. At the point where we can see that our children or grandchildren are in mortal danger from resource scarcity, overcrowding, or pollution, we will act. (And of course some people have already concluded we are now at or have passed this point, and have done a great deal of work on how society might stop growing its economy - prominently the former World Bank economist, [Herman E Daly](http://steadystate.org/wp-content/uploads/Daly_SciAmerican_FullWorldEconomics(1).pdf).)

Thus we know that at some point we will try to solve the problem of society being successful without growth. The point to be settled, then, is not **whether** we should try to solve this problem, but rather the point is **when** should we embark on this endeavour.

Perhaps it is not urgent. Perhaps **we** do not have to solve the problem of success without growth. Perhaps we can leave this to our children. Or their children, and so on. But what do we gain by waiting? Unless people in the future will be better at solving problems than us, or perhaps will have access to ideas that we don’t have that will be necessary to solve the problem, there is no reason to leave the problem to future generations to solve, especially as the longer we wait the greater the problem to be solved.

Moreover, even if people five or ten generations hence will have better problem solving systems, that seems a poor reason not to work on the problem now and get as close as we can to a solution, even if it remains to later generations to finish the work.

As it often does. Adam Smith wrote *The Wealth of Nations* in 1776, persuasively arguing that communities maximize their wealth by focusing on producing what they are best at, and trading these goods with other communities to procure the range of things they need, rather than trying to do everything and protecting their weaker industries from competition from others. Today, almost 250 years on, Smith’s arguments for free trade are still ignored or disputed, even when the point of the argument is what would be the best strategy to grow the economy.

Thus in the absence of any great shock to society that is undeniably caused by growth beyond the point where it is beneficial (un-economic growth, as Daly calls it), we can expect the argument for separating social success and economic growth to take a very long time to conclude. So best to bring on the argument as fast as we can.

Note that finding a solution to a problem, and agreeing to implement that solution, is not the same thing. We might agree that there is a way for our economy to stop growing – perhaps even shrink in some respects – and for our society still to be successful. But we might decide that such a society is not as desirable as one that grows, and we might then delay implementation of the solution until we think the costs of further growth outweigh the benefits. **But, obviously, until we work out a no-growth solution, we cannot make that choice, and going for broke is our only option**.

**4. Can there be success without growth?**

It is easy to think there cannot be success without growth. As Smith put it

The progressive state is in reality the cheerful and the hearty state to all the different orders of the society. The stationary is dull; the declining melancholy. [Smith 2000, p. 93]

Must this be so? Digging a little more deeply, it is clear that for our society to be successful without continuing growth we will need to find other solutions to the three problems we now attempt to solve with growth: ensuring (a) that everyone has the necessities of life and indeed enough stuff to lead a life which is satisfying to them; (b) that our material standard of living is not reduced by having to share a stock of stuff which grows more slowly than the number of people that we have to support; and (c) that people can have some confidence that our society will provide the possibility of a desirable future for them.

Compared to the problems we will face if we don’t halt growth these look pretty trivial, even (a), which is the most difficult of the three.

If people in the present do not have sufficient means to provide the necessities of life and a bit more to make life pleasurable, it is hard to argue that we should stop our economy growing in order to avoid future disaster. But equally, **this is an argument for growth which works only until that point**. Once the total stock of wealth is large enough to provide for all, (a) provides no case for further growth. And as we shall see shortly, we are very near if not at this point already.

Nor should it be hard to solve (b) if we adopt policies that do not discourage zero population growth – rather than the recent bizarre return (in Australia) to policies which encourage couples to have three children or even more. Without intervention by government it seems fertility declines to replacement level or below in wealthy societies, as is already the case in [most developed and many developing countries](http://yaleglobal.yale.edu/content/low-fertility-rates-just-phase). Of course this will lead to and require other changes, such as elderly people working longer before they are able to be supported by the younger working age population, but since we are living longer and most work does not involve hard labour, that does not seem such a bad thing.

As for (c), continuing economic growth for an indefinite time would only be required for people to believe that their future will be a desirable one, if people’s life satisfaction – happiness for short – increases in the same way as compound annual growth. But research does not show this at all: rather, it shows that people’s happiness increases with their wealth to a certain point, and then the curve flattens off and further increases in wealth bring little increase in happiness. Where the curve flattens off is more controversial. [Some research in the US](http://content.time.com/time/magazine/article/0,9171,2019628,00.html) suggests that people (and presumably their dependents) become happier with increasing incomes up to $75,000 pa. Other studies suggest that while happiness does increase with income, the curve flattens out somewhere around $25,000 [Wilkinson and Pickett 2010, p. 8] - which, coincidentally, is not much greater than the world’s [current average wage](http://www.bbc.co.uk/news/magazine-17512040). Diamandis and Kotler are even more modest, suggesting that

On average, across the globe, the point on the chart where well-being and money diverge is roughly $10,000. That is how much the average global citizen needs to earn to fulfil his or her basic needs and gain a toehold toward much greater possibility. [Diamandis and Kotler 2012, p. 238]

But even if we accept the higher figure as the income that is needed for universal happiness, then growing the current average wage for a further 43 years at the current world growth rate will provide enough for all to be happy. And if the world can sustain that, perhaps that is all we need to say on the matter.

**5. Why have we made this problem so hard?**

One way to make the problem of stopping growth while maintaining a successful society **seem** insoluble is to **define** success as growth. And this is pretty much what we have done. A standard measure for whether a country is successful, whether it is, say, a place people would want to emigrate to, is the size of its GNP per capita and its rate of growth, with the rate of growth getting the attention of the media (and most certainly of politicians) every time new data is released. Certainly there have been critics of measuring a society’s success by GNP since the development of national accounts [in the 1930~~’~~s](http://www.foreignpolicy.com/articles/2011/01/02/gdp_a_brief_history), including by  [Kuznets, the economist primarily responsible for the measure](http://en.wikipedia.org/wiki/Gross_domestic_product). But so far as the popular press and our political leaders are concerned, growth is good and no off-market cost of growth is rigorously brought to account.

Nonetheless we do not universally experience growth in GNP as an improvement in our own lives. This paradox led the French President, Nikolas Sarkozy, to establish a [Commission on the Measurement of Economic Performance and Social Progress](http://www.stiglitz-sen-fitoussi.fr/en/index.htm). As President Sarkozy said in his foreword to the resulting report, he was particularly concerned that

All over the world, people believe they are being lied to, that the figures are false, that they are being manipulated…And there are good reasons for their feeling this way. For years, people whose lives were becoming more difficult were told that their living standards were rising. How could they not feel deceived? [Stiglitz, Sen and Fitoussi 2010, p.viii]

The Commission concludes that while GNP is an important measure of economic activity, we need to broaden our measures of success if we are not to ‘mis-measure our lives’. In particular, a **revised measure of GDP** which takes account of the depreciation of productive assets, and the character of some expenditures as defensive rather than productive (such as cleaning up an oil spill or fixing the damage caused by a natural disaster), should be supplemented by

Measures that reflect more broadly what is happening to most citizens (measures of median income), what is happening to the poor (measures of poverty), what is happening to the environment (measurements of resource depletion and environmental degradation) and what is happening to economic sustainability (measurements of debt). [Stiglitz, Sen and Fitoussi 2010, p. xxvi]

Clearly, all of these measures will not necessarily move in the same direction at the same time, and all might decline while the classic measure of GDP, which aggregates the value of all (final) market purchases, increases. It is hard to see how such a situation could be considered progress, or even growth that is worth having. Perhaps, as the as organizers of the OECD Conference *Beyond GDP* observed, we would have been less mesmerised by GDP and more able to think about whether increasing that one measure would indeed provide a more desirable future if we had[heeded Kuznets’ warning that](http://www.oecd.org/site/worldforum06/38433373.pdf)

Distinctions must be kept in mind between quantity and quality of growth, between costs and returns, and between the short and long run. Goals for more growth should specify more growth of what and for what.

How could it be put more plainly? Rather than put ourselves in thrall to increasing GNP as the one measure of the success of our endeavours and chances for the future, we need to ask

What do we want to grow?

And what do we want to stop growing?

Or even shrink?

How can we do these things?

And how can we grow this and hold that steady at the same time?

Clearly these are the questions that we really should be asking, and our doing so should not cause panic among investors or politicians.

**6. What needs to change for society to be sustainable?**

What panics politicians is that voters will be unhappy enough to vote against them at the next election. We need to respect this concern, not least because if people are not generally satisfied with their situation and hopeful for their futures, whatever new ‘sustainable’ economic and social arrangements we implement will not last long.

Accordingly, let us adopt as our first test of whether a society (which incorporates but is more than an economy) is sustainable, that

1. Members of the society are generally satisfied with their situation and expect their future to be at least as good as their present.

What else will we need to achieve to ensure that our society is sustainable? We have already seen that

2. The accumulation of material things must end before we run out of space to accommodate our possessions, without compromising the use of the habitable land and productive seas for other things we need and want to do.

No doubt this is not the first limit to growth we will hit, but it is an immovable barrier, and we will hit it in a surprisingly short period at our current rate of growth, as we have already seen. So it is good to have it in the front of our minds as an unarguable mathematical inevitability as we move on to consider what have been contested criteria for social sustainability.

3. Population growth must end.

This can be derived immediately from (1) and (2) and the additional premise that people will not expect their future to be at least as good as their present if their future stock of stuff is reduced, as would be the case if they share a fixed total with an increasing population. That premise is surely uncontroversial.

4. For each resource, its rate of use must be reduced to the rate at which it can be renewed (if renewable), or substitutes can be developed (for non-renewable resources).

This proposition (and the next) are core findings of the discipline of [ecological economics](http://steadystate.org/wp-content/uploads/Daly_SciAmerican_FullWorldEconomics(1).pdf) founded by Herman E Daly and others, but in our argument it follows immediately from (1) and the assumptions (a) that in general people will not expect their future to be at least as good as their present if the resources needed to maintain their situation will not be able to be provided in the future to the same extent as in the present, and (b) that if this is the case, people will know this to be so. Again, (a) is surely obvious, but (b) will be contingent on the quality of the relevant science and its effective communication to the public. We will return to this below.

5. The rate at which our industrial, agricultural and other processes pollute natural systems is limited to the rate at which those systems can absorb those pollutants, without degrading their capacity to continue to provide this service or other services important to our well-being.

Again this follows from (1) and the assumptions (a) that people in general will not expect their future to be at least as good as their present if the pollution we add to the natural environment increasingly prevents them gaining services – be they fish from unpolluted seas, or enjoyment from spending time in unpolluted environments – that they now enjoy, and (b) that if this is the case, people will know this to be so. And again (a) is obvious, while (b) needs further discussion as below.

**7. Can WE achieve these things?**

Are we the problem? Will our natures as human beings prevent us from dealing with the problem of growth? Will we always want more and more stuff? Are we really *homo shopper* rather than *homo sapiens*?

If the condition of (1) above being true – that is, members of society are generally satisfied with their situation and expect their future to be at least as good as their present – is that people generally are consuming as much as they are able to do and expect to have a higher level of consumption in the future, then it appears this is so.

In that case, there is surely no long-term hope for our societies, perhaps even little hope for our species. We will consume and pollute until we run out of space, or resources, or we poison ourselves. Then, as an inescapable fact of the arithmetic of compound growth, *homo shopper* will become extinct in the space of a few hundred years of continued total growth in resource depletion, pollution and expansion of stuff.

But without turning to psychological/economic studies of happiness and income, or to sociological analyses of how our identities as consumers are shaped by advertising and cultural norms [Jackson 2009], or even to anthropology for accounts of the great variety of cohesive and enduring human societies, we know from our own history that even if in general we are *homo shopper*, in periods of recognised crisis such as war or natural disaster, we are able to restrain our personal desires for more and more in order to advance the common welfare of our communities.

Of course even in the aftermath of a natural disaster, there are a few who see an opportunity for looting rather than a need to pull together with their fellows to ensure the repair of their community. But such people are a few, not the majority, once the threat to our continuing way of life and the need to face this collectively is accepted by the majority. We should no more allow the greedy few, who refuse to restrain their consumption, to define our capacity to respond to the need to put our society on a sustainable footing than we allow looters to define what is acceptable behaviour following a bushfire or storm. Even if these greedy few are the wealthy or a current crop of political leaders, for as Adam Smith put it long ago

All for ourselves, and nothing for other people, seems, in every age of the world, to have been the vile maxim of the masters of mankind. [Smith 2000, p. 444]

On this basis I conclude that once most of us understand the need to get our society to a sustainable state, almost all of us will agree to changes in the nature and quantity of the things we consume as we transition to a new economy. The task then will be to educate our politicians and business leaders to ensure they do not get in the way of our securing our future.

Of course the likelihood of this conclusion being proved correct by future circumstances will depend at least in part on the nature and scale of the changes we are obliged to accept. If, as critics of the idea of sustainability derisorily suggest, we will need to go back to living in caves and eating raw meat then our prospects are bleak. But this is far from a realistic future prospect – unless we are foolish enough to allow society to collapse.

**8. How we will stop growth and live happily ever after**

We have already stated the changes we need in our society/economy to make it sustainable, in (2), (3) and (4) and (5) above.

Without forgetting that the mathematics of compound growth will be a hard barrier if we manage to run up against it in the form of lack of space for more stuff, let us put (2) to one side for the moment.

We can also dispense quickly with (3). Essentially, while parents see the production of more children as an economic benefit, it will be hard to constrain our population. But when parents see the production of children as a cost, and the government does not step in to subsidise them to the point where larger families are actually encouraged, parents look to limit the size of their families, with birth rates falling to below replacement level in developed economies. Thus while population growth is a **big** problem, it is not **hard** to solve once people expect their future to be economically secure, they have access to affordable and effective contraception, and women have the knowledge and freedom to control their own fertility.

This allows us to focus on the harder problems, (4) and (5).

Let us notice two obvious points about both (4) and (5).

First, if we do not limit our resource use and pollution to a sustainable level, we will suffer very serious consequences for continued production. Far from living within these constraints being a **threat** to future production, therefore, they are its **best hope for future development**.

Second, since we will require scientific research and technological innovation to make it possible to fulfil these two conditions, the sooner we begin and the greater our efforts, the less likely we are to find meeting these constraints requires a substantial reduction in the production of desired goods and services.

From the perspective of humanity as whole, therefore, we have much more to gain than to lose by seriously committing to meeting (4) and (5) and on that basis making our economy sustainable, which will encourage our achieving (3) and (1), and finally put us in a position where we can realise (2).

From the point of some privileged individuals and perhaps some privileged whole communities, however, it might seem possible for some time to push the problems of growth onto others while still enjoying the benefits. But even this beggar-thy-neighbour strategy of the future-looter will not work for very long. While the wealthiest societies may be able to win the bidding war for increasingly scarce resources, they will have to organise production at some remove from their community to avoid the problem of local pollution, and with that distance comes problems of retaining control in an increasingly stressed global environment. Moreover, some of the most serious pollution problems, ozone depletion, global warming and ocean acidification, are by their nature global in impact even though they may be local in origin. And of course it’s not much fun owning a whole lot of stuff if you have to store it in some impoverished distant land.

Thus while those with the largest stake in the fossil economy keep insisting that there is no alternative to further growth and increased population - such as our own recently elected national government in Australia, whose signature policies to date seem to be expanding coal exports and increasing family size by generously funding maternity leave - we should be hopeful that even they will finally realise that it will be **easier to solve the problem** of developing a sustainable economy **than it will be to avoid the problem**. Especially since many organisations and individuals are forging the way, taking the argument directly to leaders of business.

Two vital lines of related research and development that might help us leave the fossil economy behind are the ideas of [designing for zero waste](http://www.unisanet.unisa.edu.au/staff/Homepage.asp?Name=Steffen.Lehmann), and the circular economy. The latter idea is the core of the [Ellen MacArthur Foundation](http://www.ellenmacarthurfoundation.org/), described thus:

The circular economy is a generic term for an economy that is regenerative by design. Materials flows are of two types, biological materials, designed to reenter the biosphere, and technical materials, designed to circulate with minimal loss of quality, in turn entraining the shift towards an economy ultimately powered by renewable energy.

The Foundation is supported by many businesses that are internationally leading in their fields, including the Foundation’s Global Partners: Cisco, Kingfisher, Phillips, Renault and Unilever. The attraction for business is that moving to a circular economy requires us to re-think what is a business opportunity, and how value can be created from business activities that conserve rather than waste natural resources and systems. Those businesses involved with the Foundation have a first mover opportunity to learn from each other, and engage with bright young people attracted to the Foundation’s work.

Leading universities all over the world are engaged in the same project in diverse ways, a prime example being the University of Cambridge’s [Program for Sustainability Leadership](http://www.cpsl.cam.ac.uk/Home/About%20Us.aspx), which has supported the work of the [Prince of Wales](http://www.cpsl.cam.ac.uk/Executive-Programmes/The-Prince-of-Wales-Business-and-Sustainability-Programme.aspx) with business leaders.

So too are peak scientific bodies, like the Australian Academy of Science, through their [Negotiating our Future](http://www.science.org.au/policy/australia-2050/volume1.html) project.

Communities themselves are also providing leadership in inventing a better future for their economies and societies. A worldwide example is the [Transition Towns movement](http://www.transitionnetwork.org/), which supports community-led responses  to climate change, now active at over 1,000 sites in more than 40 countries.

As are environmental organisations and related NGOs, such as the Australian Conservation Foundation, which has assembled a [valuable primer](http://www.acfonline.org.au/sites/default/files/resources/ACF_BetterThanGrowth.pdf) on the new economic thinking we will need to reshape our business activities if we are to get off the path of unrewarding growth.

And at the global level, the [UN Environment Program](http://www.unep.org/) provides information on attempts to reconcile economic development and environmental sustainability worldwide.

All of this thinking is focused on reforming rather than replacing the market economy, perhaps most importantly because, as Jonathon Porritt powerfully argues in [*Capitalism as if the World Matters*](http://www.jonathonporritt.com/blog/capitalism-if-world-matters) , there is no alternative in prospect, and what has been tried in the past has been even more destructive of the environment than capitalism.

Indeed, what we learn from these sources is that a future in which we might reasonably expect humans to live exciting and fulfilling lives into an indefinite future need look not so much different from the present for those of us of average means in the developed world, and very much better for most in the developing world.

But there would be some important changes.

Without population growth, in countries like Australia we will have no need to build new housing, as most of us will inherit a home from grandparents or great-grandparents, and this will serve us well or we may wish to sell it and buy something more to our taste or requirements.

IKEA will offer 100-year guarantees on its furniture, and likewise for all material things we now think of requiring regular repurchase as they become obsolete. Firms which cannot match this durability standard will be rapidly driven out of the market.

Of course things will suffer wear and tear, so we will get used to repair and refurbishment as a normal part of owning things that are long lasting. And this work will be a major part of the economy.

Innovation will focus not on the merely novel, but on increasing the longevity of products, reducing the non-renewable resource requirements of their manufacture, and increasing the capacity for their components to be completely re-used when they are beyond repair.

With such greatly reduced consumption we will not have any need to work for as many hours a week – or weeks a year, or however we arrange our employment – as we simply will not have to fund the regular round of purchasing and mortgage repayments that currently keep most adults in a cycle of work and spend. That will enable employment to be spread more widely across the population.

Reduced working hours will allow us to re-invent ourselves, to re-create our human natures as beings whose identity is not a collection of brand name consumables, but is rooted in developing our capacities for relationships, art, sport, music, travel, indeed, whatever gives us joy without costing us the earth!

In short, we can have [prosperity without growth](http://en.wikipedia.org/wiki/Prosperity_Without_Growth), as Tim Jackson argues, since

Beyond the provision of nutrition and shelter, prosperity consists in our ability to participate in the life of society, in our sense of shared meaning and purpose and in our capacity to dream. We’ve become accustomed to pursuing these goals through material means. Freeing ourselves from that constraint is the basis for change. [Jackson, 2009, p. 192]

Best of all, if we stop trying to increase our consumption, and kick the habit of working more hours and incurring more debt to fund our growing consumption, we will find that many of the things we most enjoy - the **quality** of the things around us, of our food and drink, music, recreation, love – need not be limited at all.

While as the above quick survey shows, there are plenty of bright people and leading organisations working on how we get from where we are now – consumer capitalism – to capitalism as if the world, and people and communities mattered, this is still not a topic which is ‘in the news’, or debated by mainstream political parties, at least in Australia. It needs to become front and centre of political debate, rather than be dismissed on the basis that it would be political suicide to question the desire of voters to commute on ever more congested roads and work ever-longer hours to purchase more and more stuff that gives them ever-diminishing satisfaction. In particular we need to be debating how we can intervene in the market, with the lightest possible hand of regulation and changed taxation, to encourage growth of what we value and can sustain, and eliminate the growth of what we need to curtail – in sum, to develop a regulatory regime which will **prevent the market consuming the very conditions of its continuation, and support its potential to supply new pleasures which can be enjoyed for an indefinite future.**

Our political leaders should not be fearful of this debate, assuming that they will be punished by the electors for reducing living standards, for as the authors of the Sarkozy commission put it,

Taxes and regulations may be imposed that will discourage production. However, it would be a mistake if, as a result of these measures, we were to conclude that living standards have fallen when leisure time (and environmental quality) has increased. [Stiglitz, Sen and Fitoussi,

2010 p. 52]

In short, our political leaders must stop treating us as if we were too stupid and too selfish a species to survive another millennium.

**9. How will we know when growth should stop?**

If we accept that at some point we will want society to be sustainable, then we can say immediately that growth must stop while that is still possible. As we have seen, that means growth must stop while we can achieve (4) and (5). Whether we can achieve (4) and (5) is a question entirely answered by science and engineering, because they are assertions about what resources are available, which can be used to produce stuff that we want, and what will be the biological and physical impact of pollution. These are not questions about anything but physical and biological systems, and in particular they are not questions about the costs of things.

This leads to an interesting and perhaps surprising conclusion: **the question of when we should stop growing is not one which can be answered by economics**. Economic facts – at least as the discipline is currently practiced - are simply irrelevant to the issue.

So how will we know when it is time to stop growing? Only by heeding the conclusions of scientists studying the relevant fields – resource use, technological development, and the impacts of pollution on ecosystems. This is the important issue I noted above that we would return to: the need to move to a sustainable economy will only be accepted by the population if we are in possession of information about the true state of the reserves of the raw materials on which our consumption depends, and likewise the true state of the natural systems which absorb our waste.

Mainstream economics assumes that the first of these issues is handled by prices: a future shortage will be reflected in increased prices. But we can have little confidence that this price signal is effective. Indeed, the Sarkozy Commission authors observe that ‘it is unlikely that current prices fully reflect this future-oriented dimension, due to market imperfections, myopia and uncertainty’. [Stiglitz, Sen and Fitoussi 2010, p. 119]

Worse, mainstream economics ignores the second problem altogether, treating damage to ecological systems that our economy in fact depends upon as outside the economic system – witness the opposition to pricing carbon pollution. This blind spot goes right back to Adam Smith, but right back then, it would have seemed that nature was inexhaustible and thus:

nature labours along with man; and though her labour costs no expence, its produce has its value, as well as that of the most expensive workmen. [Smith 2000, p. 393]

And that is how mainstream economics as a discipline has made itself all but irrelevant to the question of the future of the economy, (though work like that of the Sarkozy Commission, and the development of [ecological economics](http://www.isecoeco.org/), is attempting to rescue the discipline from its current state of denial in relation to the dependence of the health of the economy on the health of the environment).

Accordingly, if the public is to have a true understanding of the future possibilities for production in relation to resource availability and ecosystem services, we will need to be informed by the relevant sciences rather than the economics (or indeed the politics) of the moment, and this science will have to be as ubiquitously available in the press as the current daily reporting of stock prices and exchange rates.

Then we will ignore this advice at our peril, for essentially science tells us what the laws of nature will **make** the consequences of our economic actions, regardless of what we **intended** to be their outcomes.

That is important, because when we think about our economic performance to date we are likely to be dazzled by our capacity to invent technologies which have given our species a capacity to use resources and multiply on a scale never before seen in nature. Certainly we have been magnificently successful in bending nature to our will, and may realistically hope to continue on this path, but it would be foolhardy to confuse this with technology giving us the power to **transcend the laws of nature**.

10. **Conclusion**

Thus, to summarise my argument in a few lines

It is a mathematical impossibility that our economy can grow without limit (in consumption of resources and output of stuff and waste) in a finite space.

Most of us will want to stop growing when we accept that further growth puts the futures of our descendants at risk.

Avoiding that risk requires ending growth of the population and the economy while it is still possible to achieve a sustainable level of production high enough to meet the reasonable desires of the population.

For how long this will remain possible – if it is not already too late – is a question entirely answered by science and engineering.

We need to be paying attention to these disciplines, rather than to those who speak on behalf of economics or politics.

Otherwise, we will be simultaneously ignoring science while hoping that technological development can save us from the laws of nature, which is at the very least foolhardy.

But even worse, **imagining that technological development can save us from the laws of mathematics is insane.**

And to complete my case, consider the words of Brian Medlin, on the political spectrum a philosopher apparently as far from Karl Popper (with whom I began) as can be imagined (Brian was for many years a proponent of Marxism-Leninism), but one who shared Popper’s concern for the fate of the natural world, and also the belief that philosophy must engage with the task of rescuing the environment from destruction.

*We are not going to evade our peril without careful thought.*

*Not without setting our philosophy in order, without rethinking*

*and refeeling our own nature and our relation to the rest of*

*the world. Nor without strenuous and disinterested scientific enquiry…*[Medlin, 1992, p. 39]

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