BUT CAN'T TECHNOLOGICAL ADVANCE SOLVE THE PROBLEMS?

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1. INTRODUCTION

The 'limits to growth' analysis argues that the pursuit of affluent lifestyles and economic growth are the basic causes of the many alarming global problems we are running into. We have environmental destruction, resource depletion, an impoverished Third World, problems of armed conflict and deteriorating cohesion and quality of life in even the richest countries – essentially because the levels of producing and consuming going on are far too high. There is no possibility of these levels being maintained, let alone spread to all the world's people.

The counter argument most commonly raised against the limits case is that the development of better technology will solve the problems. Almost everyone seems to hold this belief.

It is not surprising that this claim is regarded as plausible, because technology does constantly achieve miraculous breakthroughs, and publicity is frequently given to schemes that are claimed could be developed to solve this or that problem. However there is a weighty case that technical advance will not be able to solve our global problems.

The Simpler Way view is that technical advances cannot solve the big global problems and therefore we must change to lifestyles and social systems which do not generate those problems. The Simpler Way argument is that this could easily be done, and it would actually enable a much higher quality of life than most of us have now in consumer society, but it would involve abandoning the quest for affluent lifestyles and limitless economic growth. So it is not at all likely that this path will be taken.

2. THE PROBLEMS ARE ALREADY FAR TOO BIG FOR TECHNICAL ADVANCE TO SOLVE

Most people have little idea how serious the main problems are, or how far beyond sustainable levels we are.

- The 2007 IPCC Report said that if greenhouse gas emissions are to be kept to a 'safe' level they must be cut by 50-80% by 2050, and more after that. (Now, even bigger reductions are generally thought to be required.) The 50% figure would mean that the average American or Australian would have to go down to under 5% of their present per capita emission rate.

- By 2050 the amount of productive land on the planet per capita will be .8 ha (assuming we will cease destroying land.) The present amount required to give each Australian their lifestyle is 8 ha. We are 10 times over a sustainable amount, and there is not the slightest possibility of all the world's people ever rising to anywhere near our level.

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- Australians use about 280 GJ of energy per capita p.a. We are heading for 500 GJ/person/y by 2050. If all the world's expected 9 billion people were to live as we live world energy supply would have to be around 4,500 EJ/y – which is *9 times* the present world energy production and consumption.

- Many of the world's ecosystems are in alarmingly rapid decline. This is essentially because humans are taking so much of the planet's area, and 40% of the biological productivity of the lands. We are causing a biodiversity die-off holocaust mainly because we are taking the habitats other species need. Of about 8 billion ha of productive land we have taken 1.4 billion ha for cropland, and about 3.5 billion ha for grazing. We are depleting most of the fisheries. We are destroying around 15 million ha of tropical forest every year. And if all 9 billion people expected are going to live as we do now, resource demands will be about 10 times as intense as they are now.

There are many other environmental impacts that are either past the limits biologists think are tolerable, or approaching them, including the rate of nitrogen release, ozone destruction and atmospheric aerosol loads (Rockstrom, 2009).

2.1. *Now add the absurdity of economic growth.*

These and many other facts and figures only indicate the magnitude of the present problems caused by over-production and over-consumption. To this alarming situation we must now add the fact that our society is committed to rapid and limitless increases in living standards" and GDP; i.e., economic growth is the supreme goal.

If we Australians have 3% p.a. economic growth to 2050, and by then all 9 billion people will have come up to the 'living standards' we will have by then, the total amount of economic output in the world each year will be about 20 times as great as it is now. The *present* amount of production and resource use is grossly unsustainable, yet we are committed to economic system which will see these rates multiplied by 20 by 2050.

Huge figures such as these define the magnitude of the problem for technical-fix believers. We are far beyond sustainable levels of production and consumption; this society is grossly unsustainable, yet its fundamental determination is to increase these without limit. If technical advance is going to solve the problems caused by all that producing and consuming it must cut resource use and impacts by a huge multiple, and keep it down there despite endless growth. Now ask the tech-fix believers what precisely they think will enable this.

3. FAITH-BASED TECH-FIX OPTIMISM

At this point we usually find that the belief in tech–fix is nothing but a faith. Because technology has achieved many wonders it is assumed that it will come up with the required solutions, somehow. This is as rational as someone saying, 'I have a very serious lung disease, but I still smoke five packs of cigarettes a day, because technical advance could come up with a cure for my disease.' This argument is perfectly true, but idiotic. If you are on a path that is clearly leading to disaster the sensible thing is to get off it. If technology does come up with solutions then it might make sense to get back on that path again.

The tech-fix optimist should be challenged to show in detail what are the grounds for us accepting that solutions will be found, to each and every one of the big problems we face. What precisely might solve the biodiversity loss problem, the water shortage, the scarcity of phosphorus, the collapse of fish stocks, etc., and how likely are these possible breakthroughs. Does it not make better sense to change from the lifestyles and

systems that are causing these problems, at least until we can see that we can solve the resulting problems?

3.1 *Amory Lovins and Factor 4 or 5 reductions*

Amory Lovins is possibly the best known of several people who argue that technical advances could cut resource use per unit of GDP considerably. He says we could in effect have 4 times the output with the same impact (Von Weizacher and Lovins, 1997). But the above numbers make it clear that this is far from sufficient. If by 2050 we should cut ecological impact and resource use in half (remember footprint and other indices show this is far from enough), but we also increase economic output by 20, then we'd need a factor 40 reduction, not Factor 4.

3.2. *The limiting factors*

It is important to keep in mind that there are several factors which typically determine the gains a technical advance actually enables are well below those that seem possible at first. Engineers and economists make the following distinctions.

- Technical potential: This is what the technology could achieve if fully applied with no regard to cost or other problems.

- Economic (or ecological) potential: This is usually much less than the technical potential because to achieve all the gains that are technically possible would cost too much. For instance it is technically possible for passenger flights to be faster than sound, but it is far too costly. It would be technically possible to recycle all lead used, but it would be much too costly in dollars and convenience to do so. Some estimate that it would be technically possible to harvest 1,400 million ha for biomass energy per year, but when ecologically sensitive regions are taken out some conclude that the yield could only be 250 million ha or less (World Wildlife Fund, 2010, p. 181). The WWF study quotes Smeets and Faiij (2007) as finding that it would be technically possible for the world's forests to produce another 64 EJ/y of biomass energy p.a., but that the ecologically tolerable potential is only 8 EJ/y.

- What are the net gains? Enthusiastic claims about a technical advance typically focus on the gains and not the costs which should be subtracted to give a net value. For instance the energy needed to keep buildings warm can be reduced markedly, but it costs a considerable amount of energy to do this, in the electricity needed to run the air-conditioning and heat pumps, and in the energy embodied in the insulation and triple glazing.

  The WWF Energy Report (2010) claims that big savings can be made in building heating and cooling, but their Figs. 3 – 11 and 3 – 12 show that although their measures would reduce heat used in buildings by 90%, electricity used would increase c. 50% (and there is no reference to what the embodied energy cost of manufacturing the equipment and insulation might be.) The graphs don't seem to show any net reduction in building energy use.

  The Green Revolution doubled food yields, but only by introducing crops that required high energy inputs in the form of expensive fertilizer, seeds and irrigation. One result was that large numbers of very poor farmers went out of business because they couldn't afford the inputs.

  Similarly, it is possible to solve some water supply problems by desalination, but only by increasing the energy and greenhouse problems.

- What is socially/politically possible? Then there are limits set by what people will accept. It would be technically possible for many people in Sydney to get to work by public transport, but large numbers would not give up the convenience of their cars even if they saved money doing so. The energy efficiency of American cars is much lower than what is technically possible, and in fact lower than it was decades ago (because many people want energy-intensive vehicles). Australians are now building the biggest and most energy wasteful houses in the world. A beautiful, tiny, sufficient mud brick house could be built for less than $10,000 – but most people would not want one. These examples make it clear that the problems of over-consumption in many realms are mainly social rather than technical, and that they can't be solved by technical advance. The essential tech-fix issue is to do with whether or not the problems can be solved by technical advances which allow us to go on living and consuming as we were before, or whether we must change to values and behaviour that don't cause problems.

- The Jevons or 'rebound' effect: Then there is the strong tendency for savings made possible by a technical advance to be spent on consuming more of the thing saved or something else. For instance if we found how to get twice the mileage per litre of petrol many would just drive a lot more, or spend the money saved on buying more of something else. The Indians have recently developed a very cheap car, making it possible for many more low income people to drive, consume petrol and increase greenhouse gases.

So it is always important to recognise that an announced technical miracle breakthrough probably refers to its technical potential but the savings etc. that it is likely to enable in the real world will probably be well below this.

4. WILL RENEWABLE ENERGY SAVE US?

Probably the strongest assumption underling tech-fix faith is the widespread belief that renewable energy resources such as the sun and the wind can replace fossil fuels, enabling access to abundant energy while solving the greenhouse problem.

Many renewable energy technologists make this claim. However there is a strong case that it is mistaken. Trainer (2012a) sets out a numerical case that to supply 2050 world energy demand via renewables would require investment totals that are at least 10 times the present proportion of GDP that goes into energy. (For a short summary of the limits to renewables see Trainer, 2012b.)

This is not an argument against renewable energy sources; we must move to full dependence on them as soon as possible. But it is an argument that we cannot run an energy-intensive affluent society on them, let alone one that insists on limitless growth.

4.1. *Some evidence*

It should not be assumed that in general rapid, large or continuous technical gains are being routinely made, especially in crucial areas such as energy efficiency. Mackay (2008) argues that little gain can be expected for air transport, and Ayres notes that for many decades there have been plateaus for the efficiency of production of electricity and fuels, electric motors, ammonia and iron and steel production. The efficiency of electrical devices in general has actually changed little in a century (Ayres, 2009, Figs. 4.1 and 4.19, p. 127). '…the energy efficiency of transportation probably peaked around 1960 (p. 126).' Ayres' Fig. 4.21a shows no increase in the overall energy efficiency of the US economy since 1960 (p. 128). He notes that reports tend to publicise particular spectacular technical advances and this can be misleading regarding long term average

trends across whole industries or economies. We tend not to hear about areas where technology is not solving problems, or appears to have been completely defeated. Not long ago everyone looked forward to super-sonic mass passenger flight, but with the demise of Concorde this goal has been abandoned. It's just too difficult and costly, even without an energy crunch coming up. Sydney's transport problems cannot be solved by more public transport; more rail and bus would improve things, but not much because the city has been build for the car on 50 years of cheap oil. Yes you could solve all its problems with buses and trains, but only at an infinite cost. The Murray-Darling river can only be saved by drastic reduction in the amount of water being taken out of it. The biodiversity holocaust taking place could only be avoided if humans stopped taking more and more of nature, and returned large areas of farmland and pasture to natural habitat.

Most indices of efficiency and technical progress do not show big leaps. Typically there is long term tapering towards a ceiling. 'But what about Moore's law, where by computer chip power has followed a steep upward curve?' Yes in some realms this happens, for a time, but it is highly atypical. (By the way, the advent of computers has not made much difference at all to the productivity of the economy; indeed in recent decades productivity growth indices have fallen. This is identified as 'The Productivity Paradox.')

So ask the tech-fix optimist, 'If technology is going to solve our problems, when is it going to start? They all seem to be getting worse at present.'

Most decisive would seem to be the predictions by the Australian Bureau of Agricultural Economics that the energy efficiency of energy-intensive industries is likely to improve by only .5% p.a. in future, and of non-energy-intensive industries by .2% p.a. (ABARE, 2008.) In other words we can expect it to take 140 years for the energy efficiency of the intensive industries to double the amount of value they derive from a unit of energy.

Perhaps the most meaningful indication would come from comparing the rate of GDP growth with the rate of growth of material inputs into the economy. In a normal/good year GDP increases 3% p.a. (For the last decade or so the Australian average has been closer go 2.2% p.a.) However Australian energy use is increasing at about 2.1% p.a. In other words if national income is not increasing much faster than the rate of increase in use of energy then the productivity of energy is not increasing much.

Finally it has long been understood that gains in the energy intensity of the economy have been significantly due to 'fuel switching,' i.e., moving to sources which are of "higher quality" and enable more work per unit of energy. (Stern and Cleveland, 2004, p. 33, Cleveland et al., 1984, Kaufmann, 2004, Office of Technology Assessments, 1990, Berndt, 1990, Schurr and Netschurt, 1960.) For instance a unit of energy in the form of gas enables more value to be created than a unit in the form of coal, because gas is more easily transported, switched on and off, or converted from one function to another, etc.

These are some of the reasons for not being overly impressed by apparently declining figures for energy intensity per unit of GDP. They certainly cannot be taken as showing that energy will not be a major negative factor determining future productivity trends, if only because the price of energy is likely to rise significantly in the near future.

5. WHAT ABOUT PRODUCTIVITY IMPROVEMENTS?

It is commonly thought that the power of technology is evident in the constantly improving productivity of the economy. The dollar value of output from a given amount of labour and capital inputs increases around 1.6% p.a. But this is misleading for a number of reasons.

Firstly, the productivity growth rate seems to be in long term decline. Most importantly, most of the productivity gains seem to have been due to increasing use of

energy and materials inputs (and energy of higher quality, e.g., electricity rather than oil or coal). So if we measured productivity in terms of increased dollar value of output achieved per unit of materials and energy inputs, (rather than capital and labour inputs as the economists do), we might find little improvement or a deterioration. Some analysts say any gains occurring now will probably disappear with the coming rises in energy scarcity and cost (E.g., Ayres, 2009).

'But isn't the energy-intensity of the economy improving, the dollar output value divided by energy used?' The answer is probably no. Crude measures of GDP and energy used within a country do indicate a declining ratio over time, but this is misleading. We have to take into account the fact that rich countries now import most of the energy-intensive goods and machinery they use, and the movement from low 'quality' energy sources like coal to higher quality sources like oil, gas and electricity. Appropriately inclusive indices do not seem to have been worked out.

5.1. *This is not an argument against technology*

Research and development are obviously important and in The Simper Way vision we would have *more* resources going into technical research than we have now despite a much lower GDP, because we would have phased out the enormous waste of resources that occurs in consumer-capitalist society. But it is a mistake to think that in order to solve our problems we must look to better technology. That is to misunderstand the magnitude of the problems, and secondly to fail to realise that the main problems derive from our faulty social systems and values. Their solution is to develop ways and systems that don't generate the problems, and The Simpler Way argument is that this requires movement away from affluent, high energy, centralised, industrialised, globalised etc., systems and standards.

We knew how to produce beautiful food, houses, clothes, concerts, villages and communities hundreds of years ago, using little more than hand tools and crafts. Of course we should use modern technologies including computers (if we can keep the satellites up there) where these make sense. But we don't need much high-tech to design and enjoy high quality communities.

5.2. *Social cohesion and quality of life*

Some of our most concerning problems are to do with social breakdown, depression, stress, and falling quality of life. These problems will not be solved by better technology, because they derive from faulty social systems and values. Technical advances often make these problems worse, e.g., by increasing the individual's capacity to life independently of others and community, and by enabling machines to cause unemployment.

6. CONCLUSIONS

There is therefore a considerable case that global problems cannot be solved by technical advance, mainly because the drive for affluence and growth has now created resource and environmental costs that are far too big. The problems can only be solved by moving to far less affluent ways and quite different social systems which do not generate them.

The Simpler Way argument is that the pursuit of ever increasing wealth is a serious mistake, thwarting the development of satisfactory societies. These are more likely to be achieved if people cooperate in running stable local communities geared to meeting social and 'spiritual' needs, from local resources without any concern to get rich or raise the GDP.

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(For more detail on The Simpler Way vision of a sustainable and satisfactory society The Simpler Way website: http://socioalscoiences.arts.unsw.edu.au/tsw/)