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EDITOR REVIEWED ARTICLE

Achieving a post-growth green economy

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Abstract

A transformation in human values in a 'post-materialist' direction by middle-class youth around the world may be setting the stage for a new reality of near-zero economic growth and a sustainable and healthy global biosphere. Evidence from the World Values Survey suggests that a global expansion of post-material values and experiences leads to (1) a reduction in consumption-oriented activities, (2) a shift to more environmentally friendly forms of life that include living at higher, more energy efficient urban densities, and (3) active political support for environmental improvement. Such behavioral shifts provide a foundation for a turn to a slow-growth or even no-growth economy in comparatively affluent countries to the benefit of a healthier global biosphere. To set the stage for a 'post-growth green economy' that features climate stability and a substantially reduced ecological footprint, the timing is right for a 'Green New Deal' that focuses on de-carbonizing the global economy and has the side-benefit of fostering an economic recovery from the Covid-19 global recession currently underway. The financing of global decarbonization by the world's wealthiest countries is affordable and could stimulate much needed economic improvements in developing countries by creating within them modern, efficient clean energy systems that can serve as a basis for increased economic prosperity. Such prosperity will in turn accelerate declines in population fertility and result ultimately in reduced global population growth.

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Introduction

In this day and age of existential threats to global social and economic tranquility from the likes of climate change, rising economic inequality, emerging authoritarian populism, and, now, a Covid-19 pandemic, to think about prospects for the future may seem naïve. But the future will come and hope springs eternal. Potentially, Covid-19 will teach us that global problems, climate change in particular, cannot be ignored and that new approaches are needed to arrive at a more just and environmentally friendly world. The purpose of this article will be to suggest a possible path forward by thinking seriously about interconnections between two phenomena: the 'post-material silent revolution' as a key historical event; and a 'post-growth green economy' as a solution to the global environmental crisis. The central thesis offered here is that these phenomena blend together comfortably as a framework for thinking about our economic and environmental future.

The 'post-material silent revolution' amounts to a sea-change in values among middle-class youth around the world away from giving high social priorities to materialist, economic social goals and towards non-economic social purposes such as advancing freedom of expression and increasing social tolerance. This change is accompanied by less emphasis on the pursuit of wealth and material possessions and more emphasis on seeking cultural and social experiences that take place outside the sphere of economic transactions or within the economic arena but for non-economic purposes. We will see that such a shift in outlook and activity brings forth a less entropic and more environmentally friendly way of living and greater political support for sustaining a healthy natural environment that together may well lead to big changes in the way we think about the economy.

A 'post-growth economy' refers here to the empirical phenomena of affluent economies experiencing a slowing of growth in both per-capita incomes and population as they mature and attain a threshold of material affluence. Post-growth is achieved when those economies attain a no-growth status, or even slow decline. Japan in recent years comes close to this status with a 0.8% annual growth in GDP per capita (2000–2018) and 0.0% annual population growth (World Bank, 2019c, 2019e).

Worried about serious degradation of the earth's natural environment by an ever-expanding global economy, ecological economists have begun to consider the somewhat heretical idea of a 'post-growth economy' as essential for halting the over-exploitation of the biosphere caused by the excessive extraction of energy and material resources, damaging emissions of waste materials and gases, and the degrading and destruction of natural habitats. The post-growth idea is heretical simply because continuous global economic growth is taken as a given in the modern corporate-capitalist reality and as a fundamental requirement for bringing the good life to all the peoples of the world. The necessity of economic growth for living well and the compatibility of growth with a sustainable global biosphere has been challenged by a number of authors, challenges nicely summarized a few years ago in Peter Victor's, *Managing Without Growth* and more recently by Tim Jackson's *Prosperity Without Growth* (Jackson, 2017; Victor, 2008 pp.170-174). Simply put, no growth in the world's highly developed countries is essential to halting dangerous degradations of the earth's environment, and a post-growth economy is perfectly compatible with a decent life once a certain threshold of prosperity is achieved. Other than for committed environmentalists, a post-growth economy never has had a substantial political constituency in the past, but with the emergence of increasing numbers of post-materialists around the world, the absence of such a constituency is no longer the case. Post-materialism provides a real-world value-foundation and form of life for a materially and environmentally stable, 'post-growth green economy'. This is the key proposition to be explored in the pages to follow.

The post-material silent revolution

The future spreading of a post-material silent revolution around the world, I will now argue, provides an economic and political foundation for a post-growth green economy, an outcome that may well be essential to prevent the existential threat of climate change to the global biosphere (more on this in the next section). The silent revolution will assist in bringing about such an economy for the following reasons: (1) first and foremost, post-materialists likely consume relatively less over their life-time than materialists with similar economic opportunities; (2) post-material forms of living and experiences tend to be less entropic than materialist ways of life; and most important of all (3) post-materialists are more supportive of environmental protection than others in both their attitudes and political actions.

Post-materialists are individuals whose quest in life has shifted away from the acquisition of material possessions and towards the pursuit social goals and experiences valued for their own sake largely outside the realm of market transactions (Booth, 2018a). This quest is enabled by having grown up in social environments of reasonable physical and material security that permit a lifetime focus on higher ordered purposes at the upper reaches of the hierarchy of human needs (Inglehart, 1971; Maslow, 1987). Such individuals are less interested than others in gaining riches and material possessions and achieving publicly recognized personal success according to analyses of World Values Survey, Wave 6 (2010-2014) data covering 60 countries and more than 85,000 respondents worldwide (Booth, 2018a; World Values Survey Association, 2015). Post-materialists also possess a universalist outlook meaning they desire to take positive actions to the benefit of society as a whole and for the protection of nature and the earth's environment. Adding this all up infers that post-materialists are prone to consume less in the way of material possessions over their lifetime than others with similar economic opportunities. Thus, the silent revolution in post-material values likely serves to dampen life-time consumption and the material throughput that goes with it.

Having attained a basic threshold of economic security and material possessions, post-materialists not only limit their overall demand for material goods, but as a matter of taste seek a comparatively low-entropy, form of life placing less demand on energy and materials flows to the benefit of the environment. Post-materialists are more inclined than others to reside in larger, denser cities that are more energy efficient and thus less entropic than the spread-out suburban areas so attractive to their older peers after World War II (Booth, 2018b). Energy efficiency increases with human density for such reasons as reduced human travel distances; less use of energy inefficient private motor vehicles and more use of energy efficient public transit; and lower per person consumption of private dwelling space and associated heating and cooling energy requirements (New York City, 2007; Newman & Kenworthy, 1999, 2015). In the USA a return to downtown living has been driven in part by Millennials choosing to live in high-density urban neighborhoods as opposed to spread out low-density suburbs (Birch, 2005, 2009). Even in already densely populated countries such as Germany, center-city, dense neighborhoods recently experienced a relative surge in population growth driven by younger generations (Brombach, Jessen, Siedentop, & Zakrzewski, 2017).

Complementary to higher-density living by younger generations in the USA, the rate of car ownership and the miles of driving undertaken by Millennials is less than their older peers (Polzin, Chu, & Godrey, 2014). Higher urban densities support more of the publicly shared experience opportunities afforded by parks, libraries, public squares, museums, art galleries, entertainment and sports venues, spaces for group meetings and public demonstrations, street cafes, and more that provide opportunities for a post-material mode of living (Markusen, 2006; Markusen & Gadwa, 2010; Markusen & Schrock, 2006).

In addition to being oriented to a less entropic form of life, post-materialists exhibit greater support for the environment than others in terms of both their attitudes and actions in the world (Booth, 2017; Inglehart, 1995). This support is not just a matter of personal preferences but includes such overt actions as contributing to environmental groups, attending environmental protests, and in Europe giving support to the Green Party movement.

To summarize, the long-term trend to post-materialism around the world fueled by generational replacement is a good thing for the global biosphere by fostering more energy efficient, less entropic forms of living, taking the pressure off of growing demand for material possessions that threatens the global biosphere, and increasing active political support for protecting the global biosphere. This trend lends support to the emergence of a 'post-growth green economy' as a foundation for stabilizing the global climate in particular and increasing the health of the biosphere in general.

The post-growth green economy

The concept of a post-growth green economy is inspired by the recognition that a global economic system functioning within a fixed biosphere cannot expand forever without doing substantial harm to the latter (Daly, 1991, 2018). The biosphere receives energy but only miniscule amounts of materials from the solar system of which it is a part. The economic system is totally dependent on the biosphere for both energy and matter. The laws of thermodynamics tell us that, while neither energy nor matter can be destroyed, their quality declines with human use. The economic system extracts high quality energy and materials from the biosphere and returns waste heat and low-quality waste materials back to it. The supply of energy and matter is ultimately limited as is the capacity of the

biosphere to absorb resulting wastes without undue harm to biotic functioning. Accounting for this limitation, a post-growth green economy is founded on the principle that energy and materials flows in particular, and the environmental scale of the economy in general, should be capped at sustainable amounts consistent with an ecologically healthy biosphere (Booth, 1998).

Paradoxically, the problem with a post-growth green economy is not so much attaining zero growth but realizing a green economy such that energy and material flows and waste emissions are capped at sustainable levels consistent with the maintenance of global ecosystem health. The next section will focus on bringing waste emissions down to environmentally sustainable levels within the context of a post-growth economy, and the current section will address the seeming inevitability of realizing a post-growth economy.

For those countries at the upper-end of the human development hierarchy, the notion of a zero-growth economy is quickly coming to fruition. If we look at the world's high-income countries, their population fertility rate has already reached 1.6 children per female and their annual population growth rate is down to 0.64% per year and will eventually turn negative (Table 1). For the most affluent countries of the world, zero population growth or even population decline will be a fact of life in the not too distant future assuming an absence of a significant upsurge in immigration. Moreover, for this same group of countries, real GDP growth per capita is slowing as well and is down to 1.2% a year between 2000 and 2018 from 2.4% between 1980 and 2000, a 50% drop (World Bank, 2019c). With zero or even negative population growth and with the GDP annual growth rate per capita closing in on 1% or less, a no-growth economy looks to be on the way for the world's most affluent countries.

This prospect leaves us with important unresolved questions: Why are the wealthiest economies in the world tending towards zero economic growth? Is this a problem for human well-being in wealthy countries? In a world where many countries need human development and expansion of their economies to achieve a minimum threshold income necessary for the good life, is there a path to forestalling excessive climate change by mid-century and ultimately attaining sufficient economic security for all the world's citizens that would enable a global post-growth green economy?

Growth in constant dollars GDP divides into two factors: (1) growth in population, and (2) growth in real GDP per capita. Growth in population ultimately depends on the fertility rate, the number of births per female, of which the population replacement level is approximately 2.1. Over the long-run, fertility rates above this number result in population growth and below it in population shrinkage. Fertility rates appear to be heavily dependent on the level of human and economic development. Basically, as material affluence increases, fertility diminishes as shown in the data in Table 1. Approximately half the world's population (High Income plus Upper Middle Income, Table 1) now possesses a fertility rate below replacement levels at approximately 1.81 and the other half (Lower Middle Income plus Low Income, Table 1) has a fertility of approximately 3.0. With global fertility at 2.4, long-run population stability is within reach. By roughly doubling the GDP per capita for the lower half of the world's population, their fertility rate can probably be driven below 2.1. Doing so would result in an average GDP per capita for the lower half at least equal to the GDP per capita of the upper-middle income (\$8,537) countries who currently possess a fertility rate of 1.9, which is below the population replacement level (Table 1). At the current GDP per capita growth rate for the lower half, a more than doubling of GDP per capita will occur in less than 30 years.

As shown by Table 1 data, in both high-income and OECD countries, GDP per capita is growing at a historically modest rate just above 1% annually. Such growth theoretically occurs from a combination of increases in the number of hours worked per capita and in output per hour worked (constant \$ GDP/hours worked). Between 2000 and 2018, OECD hours worked per capita remained unchanged, while output per hour (labor productivity) has grown 1.2% annually (OECD, 2019a, 2019b, 2019c). Growth in GDP per capita is consequently due entirely to productivity growth, but at a rate that over the long run has been in decline for wealthy countries. As Tim Jackson notes, labor productivity in the world's most advanced economies has fallen steadily from a high in the 4% range just after World War II to around 2% in the 1980s and 1990s, and now to less than 1% since the turn of the century. As he also notes, the reasons for this are a matter of some contention and include a slowing in the pace of technological innovation placing a drag on the supply side of the economy and stagnant growth on the demand side of the economy dampening productivity improving investment in new production facilities (Jackson, 2017 pp. 43-46). Slower growth

on the demand side of the economy is driven in part by growing economic inequality, a lack of real wage growth, and the disruptions of the 2008–2009 Great Recession (Alvaredo, Chancel, Piketty, Saez, & Zucman, 2017; Saez, 2009; Stiglitz, 2010; Wisman, 2013). A shift in the structure of modern post-industrial economy in the direction of services and away from goods can make a difference as well. Face-to-face human services intrinsically lack opportunities for labor productivity improvements, meaning that overall productivity growth is likely to shrink as the service sector expands relatively (Jackson, 2017, 170-174). In addition, since many service jobs are low-paying, a relative expansion of services can place a drag on earnings at the lower end of the social class structure (Storm, 2017) adding to economic inequality. These reasons for slower growth in productivity imply that modern capitalism possesses critical inner flaws that taken together will ultimately bring economic growth as we know it to an end.

A slowing of growth in the world's most affluent economies could also be occurring for positive reasons below the radar as a matter of public choice, and not entirely as the result of dis-functional economic arrangements. The post-material silent revolution described above amounts to a turning away from the pursuit of more material possessions to other purposes once a threshold of material security is achieved. For the total World Values Survey, Wave 6 sample, 31% of the respondents selected a majority of post-material social options for the questions behind the construction of the Inglehart post-materialism index instead of economically focused materialist options (Booth, 2018a; World Values Survey Association, 2015). This number rises to 39.8% for affluent countries in the top 25% of the human development hierarchy as measured by the Human Development Index (United Nations Human Development Program, 2018). A substantial proportion of the population in wealthy countries subscribes to post-materialist social goals, and many of those same individuals participate in post-materialist experiences outside the arena of market transactions. Engaging in such experiences likely dampens consumer spending and could well lead to a slowdown in aggregate demand growth and in economic expansion. The point is a simple one; achieving a decent and satisfying life is contingent on a minimum threshold of material wealth but 'not' on continuous economic growth once that minimum is achieved.

Table 1: Global population, gross domestic product, fertility, and carbon emissions data

Countries	Population: 2018 Millions (% World)	GDP per Capita: 2018 Constant 2010 US \$	GDP: 2018 Constant 2010 US Trillion \$ (% World)	Population Fertility: 2017 Births per female	Population Annual Compound Growth Rate %: 2000–2018	GDP per Capita Annual Compound Growth Rate %: 2000–2018	CO ₂ Emissions: 2014 Million metric tons	80% CO ₂ Decarbonization Cost per year over 30 yrs. At \$32 per mt./yr Bil. US \$ (% 2018 GDP)
World	7,594	10,891	82.7	2.4	1.21	1.61	36,138	925.1 (1.1%)
High Income	1,210 (15.9%)	43,559	52.7 (63.7%)	1.6	0.64	1.20	12,940	331.3 (.6%)
Upper Middle Income	2,656 (35.0%)	8,537	22.7 (27.4%)	1.9	0.75	4.50	16,827	430.8 (1.8%)
Lower Middle Income	3,023 (39.8%)	5,198	15.7 (5.3%)	2.6	1.16	4.10	4,185	107.1 (1.6%)
Low Income	705 (9.3%)	740	.5 (0.6%)	4.6	2.66	2.30	1%	5.0 (0.9%)
OECD	1,304 (17.2%)	39,974	52.1 (62.9%)	1.7	0.67	1.10	9,551	244.5 (0.5%)
USA	327 (4.3%)	54,579	17.8 (21.5%)	1.7	0.83	1.11	5,254	134.5b (0.76%)
China	1,393	7,753	10,799	1.7	0.54	8.55	10,292	263.5 (2.2%)

SOURCES: (HEAL, 2017; WORLD BANK, 2019A, 2019B, 2019C, 2019D, 2019E)

This is exactly the same point made by both Jackson and Victor in their separate works on no-growth economics (Jackson, 2017; Victor, 2008). Both note that neither happiness nor genuine social progress necessarily occurs as a consequence of GDP growth. Happiness does increase with income up to a certain minimum, but after that the rate of increase flattens out. A minimum country-level GDP per capita threshold is required to achieve relatively high life expectancy and a decent education, both essential to life-satisfaction. Beyond this threshold, post-materialists shift gears towards supporting non-economic social goals such as freedom of self-expression, having more say in all of life's arenas, and supporting a more humane society based on ideas rather than money. Post-materialism around the world bears a strong positive correlation to such basic values as being creative and doing something for the good of society and the environment (Booth, 2018a). Those who engage in post-materialist experiences desire connections with others in voluntary organizations, creative and independent activity in their work, and active political participation in the pursuit of valued social goals. These are 'intrinsic' purposes, as opposed to materialist 'extrinsic' ends sought in market transactions, and bear a strong relationship to the intrinsic values of "self-acceptance, affiliation, and a sense of belonging in the community" mentioned by Jackson as important for flourishing in a prosperous world where economic growth ceases to be a fundamental social premise (Jackson, 2017). In support of a basic human desire for realizing intrinsic values, Jackson points to a 'quiet revolution' of people accepting lower incomes to leave room in life for the simple pleasures (reading, gardening, walking, listening to music), getting involved in the *voluntary simplicity* movement, or taking part in creative and engaging activities characterized by a sense of flow (a state of heightened focus). These are exactly the kinds purposes sought by those possessing post-material values and engaging in post-material experiences, phenomena that find substantial empirical support in the World Values Survey (Booth, 2018a, 2018b).

To sum up, the world's richest countries are tending towards annual rates of economic expansion in per capita income below 1% and annual rates of population growth likely to fall below zero in the not too distant future absent significant immigration. Potential explanations for the decline in per capita income growth include a mix of structural problems on both the demand and supply side of the economy. Alternatively, the decline may not be a problem at all but

simply reflect a movement by a portion of the population beyond extrinsic materialist pursuits in life to more satisfying post-materialist intrinsic purposes. Future population declines follow from fertility rates below replacement levels that have in turn resulted from relatively high rates of affluence and human development.

Climate change and achieving a green global economy

An essential environmental virtue of a post-growth economic system is the stabilizing of the extraction of energy and materials from, and waste emissions into, the global biosphere. A post-growth economic system has other environmental benefits as well including limitations on the human damage to ecosystem functioning required for both human and nonhuman species survival. Such stability in energy and materials throughputs and ecological harms doesn't necessarily mean a healthy and sustainable biosphere since existing (stable) rates of human environmental intrusions may well lead to continuing ecological degradation. In other words, certain human-caused environmental harms will have to be reduced below existing levels for a healthy and sustainable biosphere in a post-growth economy. A simple steady state in the human use of the environment will not be enough. The Global Footprint Network, for example, reports that the worldwide ecological footprint in terms of hectares of land needed to supply the world with the 2016 volume of ecological resources consumed on a sustainable basis is approximately 1.7 times the amount of land available globally. In brief, this rate of consumption is above the sustainable level, and the earth's resources will continue to degrade under steady-state consumption at the 2016 rate (Global Footprint Network, 2020). For future reference, note that if the global economy were 80% decarbonized as will be describe below, then worldwide ecological footprint would decline to approximately 0.9 times the amount of land available based on the 2016 numbers. Decarbonization would in effect eliminate the huge land requirements for carbon absorption and bring the ecological footprint into sustainability.

The most threatening of all human induced environmental harms clearly is the unsustainability of waste greenhouse gases being emitted into the global atmosphere. Even in a global no-growth economy, such emissions would continue at climate threatening rates, although these would slowly diminish over time because of improvements in energy efficiency and resulting reductions in

CO₂ emissions per unit of global GDP (currently approximately 0.6% per year) (Jackson, 2017 p.97). Currently, worldwide CO₂ emissions stand at around 36 billion metric tons annually (Table 1). To drive these emissions down by 80% at mid-century over a thirty-year period would require an annual rate of decline of approximately 5.2%. Without any concerted action to cut emissions further, no-growth global economy emissions would only decline by about 20% over 30 years to 29 billion at a 0.6% annual rate. In brief, a no-growth economy globally would not be enough to come anywhere near decarbonizing the economic system as a whole. A global no-growth economy would be a help, but it is not the final solution to the existential threat of a warming global climate. In a no growth economy, a 4.6% (5.2 - 0.6) annual reduction in emissions will be needed for 80% decarbonization in 30 years. This is indeed less than required in a 'normal-growth' global economy with GDP per capita projected to expand over the next 30 years at a rate of around 1.3% per year and population projected to grow at 0.8% per year (Jackson, 2017, p. 97). In this case the annual percent decline in emissions would need to be 6.7% per year (5.2-0.6+1.3+0.8) to achieve 80% decarbonization.

While there is nothing new or unfamiliar in the Table 1 statistics, a number of interesting messages can be gleaned from them. First, as just noted, if current trends continue the world's high-income countries are on track to be 'no-growth economies' with GDP per capita income growth trending towards zero and population growth moving into negative territory. Second, population fertility remains above the magic 2.1 stabilization rate for roughly the poorest half of the world's countries, and an annual GDP per capita above \$8,500 apparently results in fertility dropping below this number. Simply put, per capita income growth of 2% per year or more over the next 30 years for the poorest half of the world's population appears to be a feasible route to bringing fertility down to population stabilizing levels. Because of the age structure of populations in low income countries, actually reaching population stability will take time and could be accelerated with a greater current commitment to family planning efforts (Sachs, 2008). Growth in per capita income for the poorest half would also be a help in getting to a basic economic security threshold capable of bringing on a shift to the pursuit of post-material values and experiences as opposed to further acquisitions of material possessions. Third, an 80% decarbonization of the global economy in the next 30 years appears to be a relative bargain, costing a bit

more than 1% of global GDP per year. Setting China aside as capable of paying its own way, high-income countries could finance 80% decarbonization for the entire world (excluding China) at a cost of roughly 1.3% of their GDP per year for 30 years.²

The term 'Green New Deal' originated in the UK with a proposal to tackle the 2008 'Great Recession' with a large-scale program of public investments and economic reforms to expand employment, reduce economic inequality, and to create a clean energy sector for the purpose of bringing climate change to heel (Green New Deal Group, 2008). More recently, in reaction to the Trump administration's attack on USA environmental regulations and with the return of the Democratic Party to power in the House of Representatives in 2018, a Green New Deal resolution with similar purposes passed the House (U.S. House of Representatives, 2019). While the global economic future after the Covid-19 pandemic at this point is murky, the global economy will most likely enter an economic recession or even a depression with a dramatic decline in economic activity as a result of business shutdowns to bring spreading of the virus under control. To foster an economic recovery will surely require an unprecedented global economic stimulus of which investment in clean energy and other forms of decarbonization could be quite popular given that a second crisis in the form of climate change and its devastating consequences will be staring at everyone on the horizon. The beauty of a Green New Deal is its probable high degree of political acceptability. It gives environmentalists and post-materialists a project around which they can coalesce and gain political momentum; it will create large numbers of well-paying working-class jobs and potentially bring working-class disaffected populists on board

2 The decarbonization cost estimates are based on numbers for the USA in (Heal, 2017). Heal estimates 30-year decarbonization costs to fall in a best-case to worse-case range from \$1.3 trillion to \$4 trillion. Using the worst-worst-case figure this equals about \$952 per mt for 4.2 million mt USA emissions reduction over 30 years, or about \$32 per ton annually. These cost figures are likely to be similar to those faced by other high-income economies. Costs are likely to be somewhat less for countries with lower wage rates such as China. China is included in the World Bank, Upper Middle-Income country category, but that country possesses a sophisticated clean energy equipment industry already and can likely afford to achieve decarbonization using its own resources. China is already a major exporter of solar panels and other clean energy equipment and will thus benefit substantially from a global decarbonization effort. Looking at the cost estimate as a percentage of the current year GDP means that the annual cost in absolute terms will increase annually by the growth rate of GDP more than accounting for GDP related possible growth in emissions.

weaning them away from a currently emergent anti-environment authoritarian populism (Norris & Inglehart, 2019) in the process; and, last but not least, such a project could bring the majority of global business interests (fossil fuels excepted) on board by causing the global economy to flourish with a boom that creates a new clean energy sector and brings about economic recovery. The process of replacing fossil fuel with clean energy will create jobs on two counts: First, clean energy alternatives such as solar and wind will be more labor intensive than the fossil fuels they are replacing, meaning that employment in the energy sector will permanently increase as a result of the shift; and secondly, the initial investment in clean energy facilities will mean a temporary boom in employment and a surge in economic growth lasting over the transition period (Garrett-Peltier, 2017; Wei, Patadia, & Kammen, 2010).

My primary purpose here is to comment on the possible role of a Green New Deal in setting the stage for a stable and healthy global biosphere. Others have done a good job in describing how Green New Deal decarbonization can be implemented (Heal, 2017; Sachs, 2019). First and foremost, a global decarbonization project could set us on track for climate stabilization at an affordable cost, one that could easily be fully borne by the world's high-income countries, setting them back about 1.3% of their annual GDP as noted above. The financing of a global Green New Deal by high-income countries would have to be coordinated globally, perhaps through the Green Climate Fund established by the Paris Climate Accord (Green Climate Fund, 2019). An obvious virtue of such an approach to financing would be to foster greater economic equity at a global level between rich and poor as well as gaining support for decarbonization from all low and middle-income countries.

Second, in a Covid-19 economic recovery, debt-financed expenditures on decarbonization will help high income countries get back to their original levels of economic activity and also foster economic expansion in the world's middle and

low-income economies.³ The recovery of high-income economies will be advanced by producing much of the world's clean energy equipment, and the middle and low-income economies will be boosted by not only the work of installing such equipment, but by the creation of a modern energy sector that for many countries did not previously exist and can serve as a point of departure for other development projects. For the world's developing countries, decarbonization and a global Green New Deal can help push per capita GDP towards thresholds necessary to bring about zero population growth and provide enough economic security to make a 'post-material silent revolution' globally feasible.

Conclusion

The essential hypothesis here is this: The 'post-material silent revolution', enabled by the attainment of a critical level of material and physical security that permits lives less-focused on further economic achievements, sets the stage for a 'post-growth economy' that ultimately can bring the global economic system into a sustainable balance with the global biosphere. Currently, this is just a hypothesis, but one that is consistent with a shift by a significant share of the global population beyond an emphasis on materialist to post-materialist values and modes of life. This hypothesis is also consistent with, but not necessarily the entire cause of, a reduction in economic growth rates to 1% or less for many of the world's most affluent economies. Paradoxically, a Green New Deal is proposed here that will actually stimulate worldwide economic growth in the short-run and at the same time put humanity on a path to bring a halt to the existential threat of climate change. Such a stimulus will help foster recovery of the global economy from the Covid-19 economic downturn and set developing economies on a path to reasonable material security for all of humanity. More importantly, if 80% global decarbonization had already occurred, the ecological footprint as measured in

3 To finance the *Green New Deal*, high-income countries would be advised to issue long-term government backed debt-obligations to avoid the drag on economic recovery that tax-financed spending would bring. Once recovery has occurred, then debt-obligations could be slowly retired, perhaps funded by a small 'automated payment transactions' tax that would be progressive and at the same time would dampen overall financial transactions and thus contribute to sustaining a 'post-growth economy' (Feige, 2000). Such a tax would likely have a mild negative effect on consumer expenditures but could well diminish the volume of financial transactions significantly, especially those undertaken for speculative purposes. Since the bulk of payment transactions are undertaken in association with financial assets disproportionately held by the wealthy, the redistributive effects of payments transactions tax would probably be progressive.

2016 would actually have been about 0.9 rather than 1.7 due to the reduction in requirements for carbon absorption, bringing the footprint into sustainability. Whatever the level of the ecological footprint turns out to be in 2050, it will be substantially less than otherwise because of decarbonization. In brief, short-run green economic growth is needed to set the stage for a green post-growth economy consistent with a stable and healthy global biosphere. Hope does spring eternal.

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