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DE-GROWTH VS A GREEN NEW DEAL

CLIMATE CHANGE necessarily presents a profound political challenge in the present historical era, for the simple reason that we are courting ecological disaster by not advancing a viable global climate-stabilization project.¹ There are no certainties about what will transpire if we allow the average global temperature to continue rising. But as a basis for action, we only need to understand that there is a non-trivial possibility that the continuation of life on earth as we know it is at stake. Climate change therefore poses perhaps the ultimate ‘what is to be done’ question. There is no shortage of proposals for action, including, of course, the plan to do nothing at all advanced by Trump and his acolytes. In recent numbers of *NLR*, Herman Daly and Benjamin Kunkel have discussed a programme for a sustainable ‘steady-state’ economy, and Troy Vettese has proposed re-wilding as a means for natural geo-engineering. In this contribution, I examine and compare two dramatically divergent approaches developed by analysts and activists on the left. The first is what I variously call ‘egalitarian green growth’ or a ‘green new deal’.² The second has been termed ‘degrowth’ by its proponents.

Versions of degrowth have been developed in recent work by Tim Jackson, Juliet Schor and Peter Victor. A recent collection, *Degrowth: A Vocabulary for a New Era*, offers a good representation of the range of thinking among degrowth proponents. As the editors put it: ‘The foundational theses of degrowth are that growth is uneconomic and unjust, that it is ecologically unsustainable and that it will never be enough.’³ As is evident

from the fifty-one distinctly themed chapters in their collection, degrowth addresses a much broader range of questions than climate change alone. In fact, as I will discuss, a major weakness of the degrowth literature is that, in concerning itself with such broad themes, it gives very little detailed attention to developing an effective climate-stabilization project. This deficiency was noted by Herman Daly himself, without question a major intellectual progenitor of the degrowth movement, in his recent NLR interview. Daly said he was ‘favourably inclined’ toward degrowth, but nevertheless demurred that he was ‘still waiting for them to get beyond the slogan and develop something a little more concrete.’⁴

Let’s dispose of some red herrings at the outset. First, I share virtually all the values and concerns of degrowth advocates. I agree that uncontrolled economic growth produces serious environmental damage, along with increases in the supply of goods and services that households, businesses and governments consume. I also agree that a significant share of what is produced and consumed in the current global-capitalist economy is wasteful, especially most of what high-income people

¹ I am grateful to John O’Neill at Manchester University for generously bringing me up to date on the degrowth literature, despite our differences on this question; Mark Lawrence of the Institute for Advanced Sustainability Studies, Potsdam, for sharing his current research findings on CO₂ removal proposals; and especially to Mara Prentiss at Harvard for patiently instructing me on the land-use requirements for building a 100 per cent renewable energy economy. The *Review of Radical Political Economics* plans to publish a shorter version of this article in a forthcoming forum.

² My approach is developed in Pollin, *Greening the Global Economy*, Cambridge MA 2015. Underlying the results in that monograph are two more detailed studies: Pollin, Heidi Garrett-Peltier, James Heintz and Bracken Hendricks, *Green Growth*, Center for American Progress, 2014; and Pollin, Garrett-Peltier, Heintz and Shouvik Chakraborty, *Global Green Growth*, UN Industrial Development Organization and Global Green Growth Institute, 2015. Further country-specific studies are Pollin and Chakraborty, ‘An Egalitarian Green Growth Program for India’, *Economic and Political Weekly*, L, 42, 10/17/15, pp. 38–51; Pollin, Garrett-Peltier and Chakraborty, ‘An Egalitarian Clean Energy Investment Program for Spain, 2015, Political Economy Research Institute Working Paper no. 390; and Amanda Page-Hoongrajok, Chakraborty and Pollin, ‘Austerity vs Green Growth for Puerto Rico,’ *Challenge*, 2017, 60:6, pp. 543–73. Unless otherwise indicated, the research findings that I report here can be found in these references.

³ Giacomo D’Alisa, Frederico Demaria and Giorgos Kallis, *Degrowth: A Vocabulary for a New Era*, London 2015, p. 6.

⁴ Herman Daly, ‘Ecologies of Scale: Interview by Benjamin Kunke’, NLR 109, Jan–Feb 2018, p. 102.

consume. It is obvious that growth per se, as an economic category, makes no reference to the distribution of the costs and benefits of an expanding economy. As for Gross Domestic Product as a statistical construct, aiming to measure economic growth, there is no disputing that it fails to account for the production of environmental bads, as well as consumer goods. It does not account for unpaid labor, most of which is performed by women, and GDP per capita tells us nothing about the distribution of income or wealth.

One further general point. Introducing his NLR interview with Daly, Benjamin Kunkel states that ‘fidelity to GDP growth amounts to the religion of the modern world.’⁵ A large number of degrowth proponents express similar views. This perspective makes the critical error of ignoring the reality of neoliberalism in the contemporary world. Neoliberalism became the predominant economic-policy model with the military coup of Pinochet in Chile in 1973, and the elections of Thatcher in 1979 and Reagan in 1980. It has been clear for decades that, under neoliberalism, the real religion is maximizing profits for business in order to deliver maximum incomes and wealth for the rich. The financialization of the global economy under Wall Street’s firm direction has been central to the neoliberal project. As is well known, the concentration of income and wealth in the advanced economies has proceeded apace under neoliberalism even while average economic growth has fallen to less than half the rate that was sustained during the initial postwar ‘golden age of capitalism’ that ended in the mid-1970s. If economic growth were really the ‘religion of the modern world’, then its high priests would be concentrating on how to put capitalism back on the leash that prevailed during the ‘golden age’ rather than on consolidating the victories achieved under neoliberalism.⁶

Returning to climate change, it is in fact absolutely imperative that some categories of economic activity should now grow massively—those associated with the production and distribution of clean energy. Concurrently, the global fossil-fuel industry needs to contract massively—that is, to ‘degrow’ relentlessly over the next forty or fifty years until it has virtually

⁵ Benjamin Kunkel, ‘Introduction to Daly’, NLR 109, Jan–Feb 2018, p. 80.

⁶ This ‘unleashing’ of capitalism through the ascendance of neoliberalism is powerfully documented in the late Andrew Glyn’s (aptly titled) *Capitalism Unleashed*, Oxford 2006.

shut down. In my view, addressing these matters in terms of their specifics is more constructive in addressing climate change than presenting broad generalities about the nature of economic growth, positive or negative. I develop these points in what follows.

Absolute decoupling

To make real progress on climate stabilization, the single most critical project is to cut the consumption of oil, coal and natural gas dramatically and without delay. The reason why this is so crucial is because producing and consuming energy from fossil fuel is responsible for generating about 70 per cent of the greenhouse-gas emissions that are causing climate change. Carbon dioxide emissions from burning coal, oil and natural gas alone produce about 66 per cent of all greenhouse-gas emissions, with another 2 per cent caused mainly by methane leakages during extraction. The most recent worldwide data from the International Energy Agency (IEA) indicate that global CO₂ emissions were around 32 billion tons in 2015.⁷ The reports of the Intergovernmental Panel on Climate Change (IPCC), which provide conservative benchmarks for what is required to stabilize the average global temperature at no more than 2° Celsius above the pre-industrial average, suggest that global CO₂ emissions need to fall by about 40 per cent within twenty years, to 20 billion tons per year, and by 80 per cent as of 2050, to 7 billion tons.⁸

The global economy is nowhere near on track to meet these goals. Overall global emissions rose by 43 per cent between 2000 and 2015, from 23 to 32 billion tons per year, as economies throughout the world continued to burn increasing amounts of oil, coal and natural gas to produce energy. According to the IEA's 2017 forecasting model, if current global policies remain on a steady trajectory through 2040, global CO₂ emissions will rise to 43 billion tons per year. The IEA also presents what it terms a 'New Policies' forecast for 2040, with the global 'new policies' corresponding closely to the agreements reached at the UN-sponsored 2015 Paris Climate Summit. Coming out of the conference,

⁷ International Energy Agency, *World Energy Outlook 2017*, OECD/IEA, pp. 650–1.

⁸ The IPCC presents its benchmarks in terms of ranges and probabilities, but this would be a fair summary of its *Fourth Assessment Report* (2007) and *Fifth Assessment Report* (2014), both available from the IPCC website.

all 196 countries formally recognized the grave dangers posed by climate change and committed to substantially lowering their emissions. Nevertheless, the IEA estimates that, under its New Policies scenario, global CO₂ emissions will still rise to 36 billion tons per year as of 2040. Moreover, the IEA's forecast takes no account of the fact that the Paris commitments were non-binding on the signatory governments, nor that the United States under Trump has renounced the agreement. In short, there is at present nothing close to an international project in place capable of moving the global economy onto a viable climate-stabilization path.⁹

People still need to consume energy—to light, heat and cool buildings; to power cars, buses, trains and planes; to operate computers and industrial machinery, among other uses. As such, to make progress toward climate stabilization requires a viable alternative to the existing fossil-fuel infrastructure for meeting the world's energy needs. Energy consumption, and economic activity more generally, therefore need to be *absolutely decoupled* from the consumption of fossil fuels—that is, fossil-fuel consumption will need to fall steadily and dramatically in absolute terms, even while people must still be able to consume energy resources to meet their various demands. The more modest goal of *relative decoupling*—through which fossil-fuel consumption and CO₂ emissions continue to increase, but at a slower rate than GDP growth—is therefore not a solution. Economies can continue to grow—and even grow rapidly, as in China and India—while still advancing a viable climate-stabilization project, as long as the growth process is absolutely decoupled from fossil-fuel consumption. In fact, between 2000 and 2014, twenty-one countries, including the US, Germany, the UK, Spain and Sweden, all managed to absolutely decouple GDP growth from CO₂ emissions—that is, GDP in these countries expanded over this fourteen-year period, while

⁹ These projections refer only to net increases in CO₂ emissions through the ongoing combustion of fossil fuels. The climate-stabilization project becomes more challenging still once we recognize that a significant share of the accumulated stock of CO₂ in the atmosphere will need to be removed—that is, the CO₂ removal rate will need to exceed gross emissions, at least by 2050. For careful discussions on this issue, see Mark Lawrence et al., 'Evaluating Climate Geoengineering Proposals in the Context of the Paris Agreement Temperature Goals', 2018, forthcoming from *Nature Communications*; and Kevin Anderson and Alice Bows, 'Beyond "Dangerous" Climate Change: Emission Scenarios for a New World', *Philosophical Transactions of the Royal Society*, vol. 369, no. 1934, January 2011, pp. 20–44.

CO₂ emissions fell.¹⁰ This is a positive development, but only a small step in the right direction.

Basics of a green new deal

The core feature of the Green New Deal needs to be a worldwide programme to invest between 1.5 and 2 per cent of global GDP every year to raise energy-efficiency standards and expand clean renewable-energy supplies. Through this investment programme, it becomes realistic to drive down global CO₂ emissions relative to today by 40 per cent within twenty years, while also supporting rising living standards and expanding job opportunities. CO₂ emissions could be eliminated altogether in forty to fifty years through continuing this clean-energy investment project at roughly the same rate of about 1.5–2 per cent of global GDP per year. It is critical to recognize that, within this framework, a higher economic-growth rate will also accelerate the rate at which clean energy supplants fossil fuels, since higher levels of GDP will correspondingly mean a higher level of investment being channeled into clean-energy projects.

In 2016, global clean-energy investment was about \$300 billion, or 0.4 per cent of global GDP. Thus, the increase in investments will need to be in the range of 1–1.5 per cent of global GDP—about \$1 trillion at the current global GDP of \$80 trillion, then rising in step with global growth thereafter—to achieve a 40 per cent emissions reduction within twenty years. The consumption of oil, coal and natural gas will also need to fall by about 35 per cent over this same twenty-year period—an average rate of decline of 2.2 per cent per year. Pursuing this same basic investment pattern beyond the initial 20-year programme, along with the continued contraction of fossil-fuel consumption, could realistically achieve a zero-emissions standard within roughly the next fifty years. Of course, both privately owned fossil-fuel companies, such as Exxon-Mobil and Chevron, and publicly owned companies like Saudi Aramco and Gazprom have massive interests at stake in preventing reductions in fossil-fuel consumption; they also wield enormous political power. These powerful vested interests will have to be defeated.

Investments aimed at raising energy-efficiency standards and expanding the supply of clean renewable energy will also generate tens of millions of new jobs in all regions of the world. In general, building a green

¹⁰ Nate Aden, 'The Roads to Decoupling: 21 Countries Are Reducing Carbon Emissions While Growing GDP', World Resources Institute blog, 5 April 2016.

economy entails more labour-intensive activities than maintaining the world's current fossil fuel-based energy infrastructure. At the same time, unavoidably, workers and communities whose livelihoods depend on the fossil-fuel industry will lose out in the clean-energy transition. Unless strong policies are advanced to support these workers, they will face layoffs, falling incomes and declining public-sector budgets to support schools, health clinics and public safety. It follows that the global green-growth project must commit to providing generous transitional support for workers and communities tied to the fossil-fuel industry.

There are major variations in the emissions produced by burning oil, coal and natural gas. To produce a given amount of energy, natural gas will generate about 40 per cent fewer emissions than coal, and 15 per cent less than oil. It is therefore widely argued that natural gas can be a 'bridge fuel' to a clean-energy future, through switching to it from coal. Such claims do not withstand scrutiny. At best, an implausibly large 50 per cent global fuel switch to natural gas would reduce emissions by only 8 per cent. But even this calculation does not take account of the methane gas that leaks into the atmosphere when natural gas is extracted through fracking. Recent research has shown that when more than about 5 per cent of the gas extracted by fracking leaks into the atmosphere, the impact eliminates any environmental benefit from burning natural gas relative to coal. Various studies have reported a wide range of estimates as to what leakage rates have actually been in the United States, as fracking operations have grown rapidly. A recent survey puts that range between 0.18 and 11.7 per cent for different sites in North Dakota, Utah, Colorado, Louisiana, Texas, Arkansas and Pennsylvania. It would be reasonable to assume that if fracking expands on a large scale in regions outside the US, it is likely that leakage rates will fall closer to the higher-end figures of 12 per cent, at least until serious controls could be established. This then would diminish, if not eliminate altogether, any emission-reduction benefits from a coal-to-natural gas fuel switch.¹¹

¹¹ Ramon Alvarez et al., 'Greater Focus Needed on Methane Leakage from Natural Gas Infrastructure', *Proceedings of the National Academies of Sciences (PNAS)*, 2012; Joe Romm, 'Methane Leaks Wipe Out any Climate Benefit of Fracking, Satellite Observations Confirm,' *Think Progress*, 2014; Robert Howarth, 'Methane Emissions and Climactic Warming Risk from Hydraulic Fracturing and Shale Gas Development: Implications for Policy', *Energy and Emission Control Technologies*, 2015:3, pp. 45–54; and J. Peischl et al. 'Quantifying atmospheric methane emissions from oil and natural gas production in the Bakken shale region of North Dakota.' *Journal of Geophysical Research*, 2016, pp. 6101–11.

For some analysts, ‘clean energy’ includes nuclear power and carbon capture and sequestration (CCS) technologies. Nuclear power does generate electricity without producing CO₂ emissions. But it also creates major environmental and public-safety concerns, which have only intensified since the March 2011 meltdown at the Fukushima Daiichi power plant in Japan. Similarly CCS presents hazards. These technologies aim to capture emitted carbon and transport it, usually through pipelines, to subsurface geological formations, where it would be stored permanently. But such technologies have not been proven at a commercial scale. The dangers of carbon leakage from flawed transportation and storage systems will only increase if CCS technologies are commercialized and operating under an incentive structure where maintaining safety standards will reduce profits. An appropriately cautious clean-energy transition programme requires investment in technologies that are well understood, already operating at large-scale and, without question, safe.

Thus, the first critical project for a global green-growth programme is to dramatically raise energy-efficiency levels—that is, using less energy to achieve the same, or higher, levels of energy service through the adoption of improved technologies and practices. Examples include insulating buildings more effectively to stabilize indoor temperatures, driving more fuel-efficient cars—or, better yet, relying on well-functioning public-transport systems—and reducing the amount of energy wasted through generating and transmitting electricity, and through operating industrial machinery. Expanding energy-efficiency investment supports rising living standards because, by definition, it saves money for energy consumers. A major study by the US Academy of Sciences found that, for the US economy, ‘energy-efficient technologies . . . exist today, or are expected to be developed in the normal course of business, that could potentially save 30 per cent of the energy used in the US economy while also saving money.’ Similarly, a McKinsey study focused on developing countries found that, using existing technologies only, energy-efficiency investments could generate savings in energy costs in the range of 10 per cent of total GDP, for all low- and middle-income countries. In *Energy Revolution: The Physics and Promise of Efficient Technology*, Mara Prentiss argues further that such estimates understate the realistic savings potential of energy-efficiency investments.¹²

¹² National Academy of Sciences, ‘Real Prospects for Energy Efficiency in the United States’, 2010; McKinsey & Co., ‘Energy Efficiency: A Compelling Global Resource’, 2010; Mara Prentiss, *Energy Revolution: The Physics and Promise of Efficient Technology*, Harvard 2015, passim.

Raising energy-efficiency levels will generate ‘rebound effects’—that is, increased energy consumption resulting from lower energy costs. But such rebound effects are likely to be modest within the context of a global project focused on reducing CO₂ emissions and stabilizing the climate. Among other factors, energy-consumption levels in advanced economies are close to saturation point in the use of home appliances and lighting—we are not likely to clean dishes more frequently because we have a more efficient dishwasher. The evidence shows that consumers in advanced economies are more likely to heat and cool their homes and drive their cars when they have access to more efficient equipment—but again, these increased consumption levels are usually modest. Average rebound effects are likely to be significantly larger in developing economies. It is critical, however, that all energy-efficiency gains be accompanied by complementary policies (as discussed below), including setting a price on carbon emissions to discourage fossil-fuel consumption. Most significantly, expanding the supply of clean renewable energy will allow for higher levels of energy consumption without leading to increases in CO₂ emissions. It is important to recognize, finally, that different countries operate at widely varying levels of energy efficiency. For example, Germany presently operates at an efficiency level roughly 50 per cent higher than that of the United States. Brazil is at more than twice the efficiency level of South Korea and nearly three times that of South Africa. There is no evidence that large rebound effects have emerged as a result of these high efficiency standards in Germany and Brazil.

As for renewable energy, the International Renewable Energy Agency (IRENA) estimated in 2018 that, in all regions of the world, average costs of generating electricity with clean, renewable energy sources—wind, hydro, geo-thermal, low-emissions bioenergy—are now roughly at parity with fossil fuels.¹³ This is without factoring in the environmental costs of burning oil, coal and natural gas. Solar-energy costs remain somewhat higher on average but, according to IRENA, as a global-weighted average, solar photovoltaic costs fell by over 70 per cent between 2010 and 2017. Average solar photovoltaic costs are likely to fall to parity with fossil fuels as an electricity source within five years. Adnan Amin of IRENA summarizes the global cost trajectory: ‘By 2020, all mainstream renewable power generation technologies can be expected to provide average costs at the lower end of the fossil-fuel cost range. In addition, several solar PV

¹³ IRENA, *Renewable Capacity Statistics*, Abu Dhabi 2018.

and wind power projects will provide some of the lowest-cost electricity from any source'.¹⁴

Land-use requirements

In the last number of *NLR*, Troy Vettese argued that it would be unrealistic to expect that a global renewable-energy infrastructure could be the foundation for a viable climate-stabilization project because, at present consumption levels, it would take up enormous amounts of the earth's land surface. Vettese writes: 'A fully renewable system will probably occupy a hundred times more land than a fossil-fuel powered one. In the case of the US, between 25 and 50 per cent of its territory, and in cloudy, densely populated countries such as the UK and Germany, all of the national territory might have to be covered in wind turbines, solar panels and biofuel crops to maintain current levels of energy production.'¹⁵ The primary focus of Vettese's article is not renewable energy and land use. Instead he presents an extended case for what he terms 'natural geo-engineering' as a climate solution, with global 'afforestation' being the main driver. This involves increasing forest cover or density in previously non-forested or deforested areas, with 'reforestation'—the more commonly used term—as one component. The case Vettese makes for afforestation is valuable, but it is undermined by his initial discussion on renewables and land use.

Vettese provides virtually no evidence to support his claims on the land-use requirements for renewables. In fact, his claims cannot be supported, as a review of the relevant evidence makes amply clear. A critical contribution here is Mara Prentiss's *Energy Revolution*, which offers a rigorous account. Focusing on the US economy to illustrate the main issues, Prentiss shows that, relying on existing solar technologies, the US could meet its entire energy consumption needs through solar energy alone, while utilizing just 0.8 per cent of the total US land area.

¹⁴ The figures I am citing from the 2018 IRENA study are for 'Levelized Costs of Electricity', which include: levelized capital costs; fixed operations and maintenance; variable operations and maintenance, including fuel costs; transmission; and the capacity factor for the equipment in use. IRENA reports LCOE figures on a national, regional, and global basis.

¹⁵ Troy Vettese, 'To Freeze the Thames', *NLR* III, May–June 2018, p. 66. Vettese goes on to argue that energy consumption must therefore be cut to 2,000 watts per capita per day, in a programme that would marry E. O. Wilson's 'half-earthing' with 'egalitarian eco-austerity'.

If we allow that energy-efficient investment, as described above, can cut US per capita energy consumption by roughly 50 per cent over twenty years, this would then mean that solar energy could supply 100 per cent of US energy demand through utilizing 0.4 per cent of the country's total landmass. Moreover, with the US as a high-efficiency economy, more than half of the necessary surface area could be provided through locating solar panels on rooftops and parking lots throughout the country.¹⁶ If this is taken into account, solar-energy sources using existing technologies could supply 100 per cent of US energy demand while consuming somewhere between 0.1 and 0.2 per cent of additional US land area.

Wind power does require more land. Prentiss estimates that wind power could provide 100 per cent of existing US energy demand through using 15 per cent of the country's land area. Again, assuming investment in energy efficiency lowers per capita energy consumption by half, then only 7.5 per cent of total US land area would be needed to produce 100 per cent of energy demand through wind power. Further, wind turbines can be placed on land currently used for agriculture with only minor losses of agricultural productivity. The turbines would need to be located on about 17 per cent of the existing farmland to generate 100 per cent of US energy supply with high efficiency. Farmers should welcome this dual use of their land, since it provides them with a major additional income source. At present, the states of Iowa, Kansas, Oklahoma and South Dakota generate more than 30 per cent of their electricity supply through wind turbines.

Of course, neither solar nor wind power need to be the sole energy source, in the US or elsewhere. The most effective renewable-energy infrastructure would combine solar and wind, along with geothermal, hydro and clean bioenergy as supplemental sources. Overall land-use requirements can be minimized through an integrated renewable-energy infrastructure. For example: roughly half of all US energy supply could be provided by solar panels on rooftops and parking lots, another 40 per cent by wind turbines mounted on about 7 per cent of US farmland and the remaining 10 per cent by geothermal, hydro and low-emissions bioenergy. This is without including contributions from solar farms in desert areas, solar panels mounted on highways or offshore wind projects, among other supplemental renewable energy sources.

¹⁶ For a detailed analysis, see the US National Renewable Energy Research Laboratory study, *Rooftop Solar Photovoltaic Technical Potential in the United States*, 2016.

Moreover, it is through combining these sources that we can effectively address some of the real challenges in building a renewable-energy infrastructure: intermittency, transmission and storage. Intermittency refers to the fact that the sun does not shine and the wind does not blow 24 hours a day. Moreover, on average, different geographical areas receive different levels of sunshine and wind. As such, the solar and wind power that are generated in the sunnier and windier areas of the US—such as Southern California, Florida and the Midwest farm belt—will need to be stored and transmitted at reasonable cost to the less sunny and windy areas. Investments in advancing storage and transmission technologies therefore need to be included in the overall clean-energy investment programme at roughly 1.5 per cent of annual GDP.

It is true that conditions in the United States are more favourable than those in some other countries. Germany and the UK, the two countries cited by Vettese, have population densities seven or eight times greater than the US and receive less sunlight over the course of a year. As such, these countries, operating at high efficiency levels, would need to use about 3 per cent of their total land area to generate 100 per cent of their energy demand through domestically produced solar energy. Wind power would require a significant share of their land area. But here again, farmlands could be converted to dual use with only minor reductions in productivity. The UK and Germany could also supplement their solar and wind supply with domestically produced geothermal, hydro and clean bioenergy. Using cost-effective storage and transmission technologies, they could also import energy generated by solar and wind power in other countries, just as, in the United States, wind power generated in Iowa could be transmitted to New York City. Any such import requirements are likely to be modest. Both the UK and Germany are already net energy importers in any case. With respect to population density and the availability of sunlight to harvest, and factoring in likely global energy consumption levels over the next forty years, average requirements for renewables are much closer to those in the US than to Germany and the UK. Overall then, the work by Prentiss and others demonstrates that, in fact, requirements for land use present no constraint on developing a global clean-energy infrastructure.¹⁷

¹⁷ The late David MacKay provided the most detailed arguments on the heavy land-use requirements associated with renewable energy in his *Renewable Energy without the Hot Air* (2009). But, as Prentiss has pointed out (private correspondence), some of MacKay's key assumptions—including those on solar conversion rates and costs—are significantly in error.

Vettese is correct to emphasize the importance of afforestation as a climate-stabilization project, because forested areas naturally absorb significant amounts of CO₂. He does not present estimates as to how much of the CO₂ already accumulated in the atmosphere afforestation would be able to absorb, nor for how far it could offset newly generated emissions produced by ongoing fossil-fuel consumption. Recent analysis by Mark Lawrence and colleagues at the Institute for Advanced Sustainability Studies in Potsdam concluded that afforestation could realistically reduce CO₂ levels by between 0.5 and 3.5 billion tons per year through 2050, with the figure rising to 4–12 billion tons per year from 2051–2100.¹⁸ As noted above, current global CO₂ emissions levels are at 32 billion tons per year, and the IEA estimates this figure rising through 2040, even if the Paris Agreement is fully implemented. As such, the figures provided by Lawrence demonstrate that afforestation can certainly serve as a critical complementary intervention within a broader clean-energy transition programme, because it is a natural and proven method of absorbing a significant share of the accumulated stock of CO₂ in the atmosphere. But afforestation cannot bear the major burden of a viable climate-stabilization project in the absence of global clean-energy investments at the scale I have described above—that is, about 1.5 per cent of global GDP per year until new emissions have been driven to near-zero within roughly forty years.

Job creation and a just transition

Countries at all levels of development will experience significant gains in job creation through clean-energy investments relative to maintaining their existing fossil-fuel infrastructure. Our research at the Political Economy Research Institute, cited below, has found this relationship to hold in Brazil, China, Germany, India, Indonesia, Puerto Rico, South Africa, South Korea, Spain and the United States. For a given level of spending, the percentage increases in job creation range from about 75 per cent in Brazil to 350 per cent in Indonesia. For India, as a specific example, we found that increasing clean-energy investments by 1.5 per cent of GDP every year for twenty years will generate a net increase of about 10 million jobs per year. This is *after* factoring in job losses resulting from retrenchments in the country's fossil-fuel industries. There is no guarantee that the jobs being generated through clean-energy

¹⁸ Lawrence et al., 'Evaluating Climate Geoengineering Proposals in the Context of the Paris Agreement Temperature Goals'.

investments will provide decent compensation to workers. Nor will they necessarily deliver improved workplace conditions, stronger union representation or reduced employment discrimination against women, minorities or other under-represented groups. But the fact that new investments will be occurring will create increased leverage for political mobilization across the board—for improving job quality, expanded union coverage and more jobs for under-represented groups.

At the same time, workers and communities throughout the world whose livelihoods depend on oil, coal and natural gas will lose out in the clean-energy transition. In order for the global clean energy project to succeed, it must provide adequate transitional support for these workers and communities. Brian Callaci and I have developed a ‘just transition’ policy framework in some detail for the US economy; and Heidi Garrett-Peltier, Jeannette Wicks-Lim and I have developed more detailed approaches around these issues for the US states of New York and Washington.¹⁹ Considering the US as a whole, Callaci and I estimate that a rough high-end cost for such a programme is a relatively modest \$600 million per year, which is less than 0.2 per cent of the 2018 US Federal budget. This level of funding would provide strong support in three areas: income, retraining and relocation support for workers facing retrenchments; guaranteeing the pensions for workers in the affected industries; and mounting effective transition programmes for what are now fossil-fuel dependent communities. Comparable programmes will need to be implemented in other country settings.

Industrial policies and ownership forms

Increasing clean-energy investment by 1.5 per cent of global GDP will not happen without strong industrial policies. Even though, for example,

¹⁹ Robert Pollin and Brian Callaci, ‘A Just Transition for US Fossil Fuel Industry Workers’, *American Prospect*, 2016; Pollin and Callaci, ‘The Economics of Just Transition: A Framework for Supporting Fossil Fuel-Dependent Workers and Communities in the United States’, *Labor Studies Journal*, 2018, pp. 1–46; Pollin, Garrett-Peltier and Jeannette Wicks-Lim, *Clean Energy Investments for New York State*, Political Economy Research Institute (PERI), University of Massachusetts Amherst, 2017; Pollin, Garrett-Peltier and Wicks-Lim, *A Green New Deal for Washington State*, PERI, 2017. Sasha Abramsky reports on the progress of the Green New Deal movement in Washington State in ‘This Washington State Ballot Measure Fights for Both Jobs and Climate Justice’, *The Nation*, 20 July 2018.

energy-efficiency investments generally pay for themselves over three to five years, and the average costs of producing renewable energy are at rough parity with fossil fuels, it is still the case that some entities—public enterprises, private firms or a combination of both—will have to advance the initial capital and bear the project risk. Depending on specific conditions within each country, industrial policies will be needed to promote technical innovation and, more broadly, adaptations of existing clean-energy technology. Governments will need to deploy a combination of policy instruments, including research and development support, preferential tax treatment for clean-energy investments and stable long-term market arrangements through government-procurement contracts. Clean-energy industrial policies also need to include emission standards for utilities and transport, and price regulation for both fossil fuel and clean energy. The widely discussed tool of pricing carbon emissions through either a carbon tax or a cap on permissible emissions certainly needs to be a major component of the overall industrial-policy mix. A carbon tax in particular can raise large amounts of revenue that can then be used to help finance clean-energy investments as well as redistributing funds to lower-income households. Germany's experience of financing is valuable here, since it has been the most successful advanced economy in developing its clean-energy economy. According to the International Energy Agency, a major factor in Germany's success is that its state-owned development bank, KfW, 'plays a crucial role by providing loans and subsidies for investment in energy efficiency measures in buildings and industry, which have leveraged significant private funds.'²⁰ This Germany development banking approach could be adapted throughout the world.

Another critical measure in supporting clean-energy investments at 1.5 per cent of annual global GDP will be to lower the profitability requirements for these investments. This in turn raises the issue of ownership of newly created energy enterprises and assets. Specifically: how might alternative ownership forms—including public ownership, community ownership and small-scale private companies—play a role in advancing the clean-energy investment agenda? Throughout the world, the energy sector has long operated under a variety of ownership structures, including public or municipal ownership, and forms of private cooperative

²⁰ International Energy Agency, *Energy Efficiency Market Report, 2013: Market Trends and Medium-Term Prospects*, OECD-IEA, Paris 2013.

ownership as well as private corporations. Indeed, in the oil and natural-gas industry, publicly owned national companies control approximately 90 per cent of the world's reserves and 75 per cent of production, as well as many of the oil and gas infrastructure systems. These national corporations include Saudi Aramco, Gazprom, China National Petroleum Corporation, the National Iranian Oil Company, Petroleos de Venezuela, Petrobras in Brazil and Petronas in Malaysia. There is no evidence to suggest that these publicly owned companies are likely to be more supportive of a clean-energy transition than the private corporations. National development projects, lucrative careers and political power all depend on continuing the flow of fossil-fuel revenues. In and of itself, public ownership is not a solution.

Clean-energy investments will nevertheless create major new opportunities for alternative ownership forms, including various combinations of smaller-scale public, private and cooperative ownership. For example, community-based wind farms have been highly successful for nearly two decades in Germany, Denmark, Sweden and the UK. A major reason for their success is that they operate with lower profit requirements than large-scale private corporations. On this point, my Green New Deal perspective converges with positions supported by degrowth proponents. For example, Juliet Schor describes in *True Wealth* (2011) what she calls 'a prima facie case that the emerging green sector will be powered by small and medium-size firms, with their agility, dynamism and entrepreneurial determination'. Over time, Schor writes, 'these entities can become a sizeable sector of low-impact enterprises, which form the basis of animated local communities and provide livelihood on a wide scale.'²¹

It is one thing to conclude that all countries—or at least those countries with either large GDPs or populations—should invest about 1.5 per cent of GDP per year in energy efficiency and clean renewable investments. But it is another matter to determine what standard of fairness should be applied in allocating the costs of such investments among the various people, countries and regions of the globe. What would be a fair procedure? If the global clean-energy investment project sketched here

²¹ Juliet Schor, *True Wealth: How and Why Millions of Americans Are Creating a Time-Rich, Ecologically Light, Small-Scale, High-Satisfaction Economy*, London 2011, pp. 156–57. More generally, this aspect of the clean-energy investment project is very much in the spirit of E. F. Schumacher's classic *Small is Beautiful* (1973).

is successful, average per capita CO₂ emissions will fall within twenty years from its current level of 4.6 tons to 2.3 tons. This corresponds to a fall in total emissions from 32 to 20 billion tons. Still, at the end of this 20-year investment cycle, average US emissions will be 5.8 tons per capita, nearly three times the averages for China and the world as a whole, and five times the average for India. At a basic level, this is unfair—particularly given that, over the past century of the fossil-fuel era, US emissions have exceeded those in India and China combined by around 400 per cent. As a standard of fairness, one could, with good reason, insist that the United States and other rich countries be required to bring down per capita CO₂ emissions to the same level as low-income countries. We could also insist that high-income people—regardless of their countries of residence—be permitted to produce no more CO₂ emissions than anyone else.

There is a solid ethical case for such measures. But there is absolutely no chance that they will be implemented. Given the climate-stabilization imperative facing the global economy, we do not have the luxury to waste time on huge global efforts fighting for unattainable goals. Consider the US case: on grounds of both ethics and realism, it will be much more constructive to require that, in addition to bringing its own emissions down to about 6 tons per capita within twenty years, the US should also provide large-scale assistance to other countries in financing and bringing to scale their own transformative clean-energy projects.

Problems with degrowth

As I emphasized at the outset, degrowth proponents have made valuable contributions in addressing many of the untenable features of economic growth. But on the specific issue of climate change, degrowth does not provide anything like a viable stabilization framework. Consider some very simple arithmetic. Following the IPCC, we know that global CO₂ emissions need to fall from their current level of 32 billion tons to 20 billion tons within twenty years. If we assume that, following a degrowth agenda, global GDP contracts by 10 per cent over the next two decades, that would entail a reduction of global GDP four times greater than during the 2007–09 financial crisis and Great Recession. In terms of CO₂ emissions, the net effect of this 10 per cent GDP contraction, considered on its own, would be to push emissions down by precisely 10 per cent—that is, from 32 to 29 billion tons. It would not come close to bringing emissions down to 20 billion tons by 2040.

Clearly then, even under a degrowth scenario, the overwhelming factor pushing emissions down will not be a contraction of overall GDP but *massive growth* in energy efficiency and clean renewable-energy investments—which, for accounting purposes, will contribute towards increasing GDP—along with similarly dramatic cuts in fossil-fuel production and consumption, which will register as reducing GDP. Moreover, the immediate effect of any global GDP contraction would be huge job losses and declining living standards for working people and the poor. During the Great Recession, global unemployment rose by over 30 million. I have not seen a convincing argument from a degrowth advocate as to how we could avoid a severe rise in mass unemployment if GDP were to fall by twice as much.

These fundamental problems with degrowth are illustrated by the case of Japan, which has been a slow-growing economy for a generation now, even while maintaining high per capita incomes. Herman Daly himself describes Japan as being ‘halfway to becoming a steady-state economy already, whether they call it that or not.’²² Daly is referring to the fact that, between 1996 and 2015, GDP growth in Japan averaged an anemic 0.7 per cent per year. This compares with an average Japanese growth rate of 4.8 per cent per year for the 30-year period 1966 to 1995. Nevertheless, as of 2017, Japan remained in the ranks of the large, upper-income economies, with average GDP per capita at about \$40,000. Yet despite the fact that Japan has been close to a no-growth economy for twenty years, its CO₂ emissions remain among the highest in the world, at 9.5 tons per capita. This is 40 per cent below the figure for the United States, but it is four times higher than the average global level of 2.5 tons per capita that must be achieved if global emissions are to drop by 40 per cent by 2040. Moreover, Japan’s per capita emissions have not fallen at all since the mid-1990s. The reason is straightforward: as of 2015, 92 per cent of Japan’s total energy consumption comes from burning oil, coal and natural gas.

Thus, despite ‘being halfway to becoming a steady-state economy’, Japan has accomplished virtually nothing in advancing a viable climate-stabilization path. The only way it will make progress is to replace its existing, predominantly fossil-fuel energy system with a clean-energy infrastructure. At present, hydro power supplies 5 per cent of Japan’s total energy needs, and other renewable sources only 3 per

²² Daly & Kunkel, ‘Ecologies of Scale’, p. 102.

cent. Overall then, like all large economies—whether they are growing rapidly or not at all—Japan needs to embrace the Green New Deal.

A green great depression?

The majority of degrowth proponents pay almost no attention to emission levels. Thus the introduction to a special issue of *Ecological Economics* focused on degrowth, edited by leading contemporary degrowthers Giorgos Kallis, Christian Kerschner and Joan Martinez-Alier, devoted precisely one paragraph to the issue. This described a proposal for ‘cap-and-share’ which, the authors explained, would involve placing ‘a declining annual global cap on the tonnage of CO₂ emitted by fossil fuels’ and ‘allocating a large part of each year’s tonnage to everyone in the world on an equal per capita basis’.²³ Kallis, Kerschner and Martinez-Alier recognize that the political economy of such a proposal would be highly complex; but they do not take it upon themselves to examine any of these complexities. In the same issue of *Ecological Economics* Peter Victor, author of *Managing without Growth* (2008), did develop a series of models for evaluating the relationship between economic growth and CO₂ emissions for the Canadian economy. Under Victor’s baseline scenario, Canadian GDP would grow by an average of 2.3 per cent between 2005 and 2035, resulting in a doubling of per capita GDP, while CO₂ emissions would rise by 77 per cent. Victor then presented both low-growth and degrowth scenarios for the same period. He reports that, under degrowth, greenhouse-gas emissions would fall by 88 per cent, relative to the 2035 ‘business-as-usual’ growth scenario. But he also concludes that Canada’s per capita GDP under degrowth would fall to 26 per cent of the business-as-usual scenario by 2035.²⁴

Victor does not flesh out his results with actual data on the Canadian economy, but it is illuminating to do so. In 2005, Canada’s per capita GDP was \$53,336 (expressed in 2018 Canadian dollars). Thus, under the business-as-usual scenario, per capita GDP rises to about \$107,000 as

²³ Giorgos Kallis, Christian Kerschner and Joan Martinez-Alier, ‘The Economics of Degrowth’, *Ecological Economics*, vol. 84, 2012, p. 4. The special issue of *Ecological Economics* collected contributions from the second International Conference on Economic Degrowth, held in Barcelona in 2010.

²⁴ Peter Victor, ‘Growth, Degrowth and Climate Change: A Scenario Analysis’, *Ecological Economics*, vol. 84, 2012, p. 212. Victor’s *Managing without Growth: Slower by Design, not Disaster*, Cheltenham 2008, presented his models in a broader degrowth framework.

of 2035. Alternatively, under the degrowth scenario, Canada's per capita GDP in 2035 would plummet to \$28,000. This per capita GDP level for 2035 is 48 per cent below Canada's actual per capita GDP for 2005. In other words, under Victor's degrowth scenario, the emissions reduction achieved over a 30-year period would be only modestly greater than what would be achieved under a clean-energy investment programme at 1.5 per cent of annual GDP, but with this fundamental difference: under the clean-energy investment project, average incomes would roughly double, while under degrowth, average incomes would experience a historically unprecedented collapse. Victor doesn't ask whether an economic depression of this magnitude under degrowth, in Canada or elsewhere, is either economically or politically viable. He doesn't examine what impact this loss of GDP would have in funding for health care, education or, for that matter, environmental protection. Nor does he explain what policy tools would be deployed to force Canada's GDP to halve within thirty years. Victor's article is further remarkable in that, in an analysis focused on the relationship between economic growth and climate change, it includes only one brief mention of renewable energy and no reference whatsoever to energy efficiency.

Perhaps the most influential contemporary discussion on the economics of climate change and degrowth is Tim Jackson's *Prosperity without Growth*.²⁵ Jackson begins by emphasizing that a viable climate-stabilization path requires absolute decoupling between growth and emissions on a global scale, not merely relative decoupling. This point is indisputable. Jackson then reviews data for 1965–2015, showing that absolute decoupling has not occurred either at a global level or among, respectively, low-, middle- or high-income countries. Again, there is no disputing this evidence—although, as noted above, several individual countries did achieve absolute decoupling between GDP growth and CO₂ emissions for 2000–14. In fact, there are only two major issues to debate with Jackson. The first is whether absolute decoupling is a realistic possibility, moving forward. Jackson is dubious, writing that 'the evidence that decoupling offers a coherent escape from the dilemma of growth is, ultimately, far from convincing. The speed at which resource and emissions efficiencies have to improve if we are going to meet carbon targets are at best heroic, if the economy is growing relentlessly.'²⁶

²⁵ Tim Jackson, *Prosperity without Growth: Economics for a Finite Planet* [2009], London 2017.

²⁶ Jackson, *Prosperity without Growth*, p. 87.

But is it really the case that absolute decoupling requires ‘heroic’ advances in building a clean-energy economy? It is true that absolute decoupling on a global scale is a highly challenging project. But we can be fairly precise in measuring the magnitude of the challenge. As discussed above, it will require an investment level in clean renewables and energy efficiency at about 1.5–2 per cent of global GDP annually. This amounts to about \$1 trillion at today’s global economy level and \$1.5 trillion average over the next twenty years. These are large but realistic investment goals which could be embraced by economies at all levels of development, in every region of the globe. One reason why this is a realistic project is that it would support rising average living standards and expanding job opportunities, in low-income countries in particular. For nearly forty years now, the gains from economic growth have persistently favoured the rich. Nevertheless, the prospects for reversing inequality in all countries will be far greater when the overall economy is growing than when the rich are fighting everyone else for shares of a shrinking pie. How sanguine, for example, would we expect affluent Canadians to be over the prospect of their incomes being cut by half or more in absolute dollars over the next thirty years? In political terms, the attempt to implement a degrowth agenda would render the global clean-energy project utterly unrealistic.

The second issue to raise with Jackson is still more to the point: does degrowth offer a viable alternative to absolute decoupling as a climate-stabilization project? As we have seen, the answer is ‘No.’ Jackson himself provides no substantive discussion to demonstrate otherwise. Indeed, on the issue of climate stabilization, Jackson offers no basis for disputing Herman Daly’s characterization of degrowth as a slogan in search of a programme. Overall, then, if the left is serious about mounting a viable, global, climate-stabilization project, it should not be losing time seeking to build an all-purpose, broad-brush degrowth movement—which, for the reasons outlined, cannot succeed in actually stabilizing the climate. This is even more emphatically the case when a fair and workable approach to climate stabilization lies right before us, by way of the Green New Deal.