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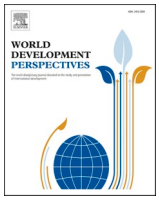

How much growth is required to achieve good lives for all? Insights from needs-based analysis

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A B S T R A C T

Some narratives in international development hold that ending poverty and achieving good lives for all will require every country to reach the levels of GDP per capita that currently characterise high-income countries. However, this would require increasing total global output and resource use several times over, dramatically exacerbating ecological breakdown. Furthermore, universal convergence along these lines is unlikely within the imperialist structure of the existing world economy. Here we demonstrate that this dilemma can be resolved with a different approach, rooted in recent needs-based analyses of poverty and development. Strategies for development should not pursue capitalist growth and increased aggregate production *as such*, but should rather increase the *specific forms* of production that are necessary to improve capabilities and meet human needs at a high standard, while ensuring universal access to key goods and services through public provisioning and decommodification. At the same time, in high-income countries, less-necessary production should be scaled down to enable faster decarbonization and to help bring resource use back within planetary boundaries. With this approach, good lives can be achieved for all without requiring large increases in total global throughput and output. Provisioning decent living standards (DLS) for 8.5 billion people would require only 30% of current global resource and energy use, leaving a substantial surplus for additional consumption, public luxury, scientific advancement, and other social investments. Such a future requires planning to provision public services, to deploy efficient technology, and to build sovereign industrial capacity in the global South.

1. Introduction

International development faces a dilemma. Nearly one-fifth of the world population lives in extreme poverty, unable to access basic goods such as food and shelter,[1] and billions more are deprived of the higher-order goods and services that are necessary for decent living (Kikstra et al 2021). Large gaps in life expectancy and other key social indicators persist between the core and periphery of the world economy. Substantial development is required across the global South if all people are to have access to the goods and services required to live long and healthy lives, with social indicators similar to those presently enjoyed by people in high-income countries. This should be achieved as rapidly as possible. However, it should be done while at the same time reducing emissions to keep global warming to no more than 1.5 degrees, or as close to this limit as possible, and reversing the overshoot of other planetary boundaries (Fanning et al 2022). Failure to adequately mitigate climate change and ecological breakdown is likely to lead to social dislocations that could exacerbate human deprivation (ESCAP 2024; IPCC 2022; Dasgupta & Robinson 2022; World Bank 2012).

Some researchers have speculated as to how much growth is necessary to end poverty at a decent threshold (see the discussion by Malerba & Oswald, 2022). This is an important question, and it is critical to establish at the outset that the benchmark should not be simply access to basic goods like food and shelter (as represented by the extreme poverty line), but also the higher-order goods and services necessary for decent living: nutritious food, modern housing, healthcare, education, electricity, clean-cooking stoves, sanitation systems, clothing, washing machines, refrigeration, heating/cooling, computers, mobile phones, internet, transit, etc., of which billions are deprived.

One approach to addressing this question is to start with a "high" poverty line of $30/day (PPP), which is comparable to those used in many high-income countries. Next, identify a country that is known for relatively low poverty at this threshold, in addition to low inequality and strong social outcomes. Denmark is sometimes used for this exercise,

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[1] As of 2011, the final year of data available for the "basic needs poverty line" (BNPL), 17.3% of the world population lived in extreme poverty, unable to afford a basic subsistence basket. We calculated this figure as the population-weighted average of the country-level data in Allen (2020). Note that the other main BNPL dataset (Moatsos 2021) only has data based on real prices to 2008. See footnote 3 for further details.

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where mean household income per person is $55 per day (and GDP per capita is $46,000 in 2011 PPP). One can then identify all countries with lower mean income than Denmark and calculate how much their household income would need to grow to reach Denmark's level, thus presumably enabling them to achieve similar social outcomes (assuming they distribute income as equitably). Malerba & Oswald (2022) show that this would require increasing global output by at least a factor of four (focusing on household income only, not including government expenditures). In other words, at least four times more aggregate production than the global economy presently generates. From this perspective, a massive quantity of growth is needed to end deprivation.

This approach introduces some very unsavory dilemmas. Achieving this quantity of growth is likely to take a very long time, especially given that growth rates have generally been slowing. Moreover, it raises serious ecological questions. High-income economies use resources at a rate that substantially exceeds sustainable boundaries – indeed, they are the primary drivers of excess global emissions and material extraction (Hickel 2020; Hickel et al. 2022c; Hickel & Slamersak 2022). If the existing relationship between global GDP and throughput were to hold, this scenario would mean a 4x increase in global energy and material use. Even if all countries achieved the current GDP/throughput ratio of the "advanced economies" and converged at the their existing per capita levels, global energy use would be 1,305 EJ per year and global material use would be 240 Gigatons per year (3.1x and 2.5x higher than existing global levels, respectively).[2] Without a dramatic and rapid change in material and energy efficiency, both scenarios would substantially exacerbate ecological breakdown and make the Paris Agreement objectives extremely difficult to achieve (Hickel & Kallis 2019; Vogel & Hickel 2023).

Taking this approach forces us to confront a brutal trade-off between poverty reduction and ecological stability. Those in favour of poverty reduction must call for massive growth even if it risks destroying the biosphere, while those in favour of ecological stability must accept perpetual impoverishment of the masses. Neither of these futures is defensible.

Furthermore, given the unequal structure of the capitalist world-economy, it is not possible for all countries to raise their aggregate consumption to the level of high-income countries. High consumption in the core of the world-system depends on the appropriation of cheap labour and resources from the periphery and semi-periphery, which perpetuates deprivation and underdevelopment and precludes the possibility of meaningful convergence (Cope 2019; Patnaik & Patnaik 2021). Input-output data show that 43% of the material resources used by the "advanced" economies is net-appropriated from emerging and developing economies (Hickel et al. 2022a). This arrangement cannot be universalized. It is by definition impossible for *all* emerging and developing countries to rely on this development model (Pérez-Sánchez et al. 2021). Where would the net appropriation come from? Indeed, for more than half a century, economists in the global South have pointed out that universal "catch-up development" is not feasible (excepting some relatively small states that have been integrated into the core for geopolitical reasons, with direct US support, such as South Korea and Taiwan), and that meaningful development in the South will require a structural transformation of the global economy (Amin 1978; Emmanuel 1972; Wallerstein 1999; Patnaik & Patnaik 2021). If ensuring decent living standards for all requires aggregate production and resource use similar to that of high-income countries, we would have to conclude that states can only eliminate poverty within their borders by denying essential resources to people elsewhere.

These are devastating dilemmas, which lead to untenable positions. But the dilemmas are unnecessary. We do not need to accept a trade-off between well-being and ecology, and we do not need to accept the continuation of imperialist arrangements. The problem can be resolved with a different approach to the question of growth and poverty. Good social indicators can be achieved with substantially less aggregate production than what characterizes today's high-income countries, which are highly inefficient at converting throughput and output into human well-being. We argue that strategies for poverty reduction and development should not pursue capitalist growth and increased aggregate production *as such*, but should rather focus on increasing the *specific forms* of production that are necessary to improve capabilities and meet human needs at a high standard, while ensuring universal access to key goods and services through public provisioning and decommodification (Sen 1999; Gough 2017; Max-Neef 2016; Bärnthaler et al. 2021). At the same time, in high-income countries, less-necessary forms of production should be scaled down to enable decarbonization at a rate consistent with the climate and equity commitments of the Paris Agreement (Vogel & Hickel 2023; Barrett et al 2022) and to bring resource use back within planetary boundaries, while organizing production to end deprivation and improve well-being, as demonstrated by scholarship on degrowth in ecological economics (Hickel et al. 2022b; Hickel et al 2021; Kallis et al 2018).

To develop this argument, we show how recent empirical evidence on needs-based poverty opens new, more specific ways of thinking about poverty reduction that challenge standard narratives about the role and objectives of growth in development. This literature demonstrates that there is no definite or fixed relationship between aggregate growth and poverty reduction. Rather, what matters is *what* is being produced and whether people have access to necessary goods. While this literature is focused on the most extreme forms of destitution, we argue it also has broader implications for poverty rates measured at higher standards. We leverage these insights to add clarity and specificity to the question of growth and poverty reduction.

Drawing on recent empirical evidence, we show that ending poverty and ensuring decent living standards (DLS) for all, with a full range of necessary goods and services (a standard that approximately 80% of the world population presently does not achieve) can be provisioned for a projected population of 8.5 billion people in 2050 with around 30% of existing productive capacity, depending on our assumptions about distribution and technological deployment. This would leave a substantial global energy and resource surplus which could be used for additional consumption and invested in additional public luxury, recreational facilities, technological innovation, scientific and creative pursuits, and further human development. While human development requires industrial advancement and increasing total production in lower-income countries, it does not necessitate large increases in global aggregate throughput and output. Achieving this future requires economic planning to transform the content and objectives of production, strengthen public provisioning systems, and build sovereign industrial capacity in the global South.

2. New insights from needs-based poverty research

Since the 1990s, the standard approach to conceptualizing extreme poverty has been to define it in terms of broad-based purchasing power parity (PPP) income. According to this approach, originally developed by the World Bank, people whose income or consumption is less than the equivalent of $1.90 (2011 PPP) per day are considered to be living in

[2] The average energy use of the advanced economies (as per the IMF definition) is 153.6 GJ/cap (final energy data for 2018 from the International Energy Agency, increased according to the average ratio of territorial to consumption-based data for primary energy in EORA over the period 1990–2015, as per Hickel et al. 2022a, to estimate the final energy footprint), and the average material use is 28.28 tons/cap (material footprint data for 2017 from the UNEP International Resource Panel). The calculation assumes a population of 8.5 billion in 2050, to be consistent with the population figure used by Millward-Hopkins (2022), based on SSP1, as discussed below. Note that the figures for energy and material use in the advanced economies are underestimates, as they do not include energy and materials embodied in capital goods embodied in imports (Sodersten et al. 2018).

extreme poverty. Within this framework, any increase in the PPP income of the poor represents a reduction in poverty, as it brings people closer to or over the $1.90 line.

This approach has been critiqued by scholars for more than a decade, including through the World Bank's own Commission on Global Poverty, as it does not account for the actual costs of meeting basic needs in any given context (Reddy & Pogge 2010; Moatsos 2016; Moatsos 2021; Allen 2017; Allen 2020; Sullivan & Hickel 2023; Atkinson 2016). The main problem is that PPP exchange rates are calculated on the basis of prices across the entire economy – including commercial airfares, luxury cars, and meals at high-end restaurants – rather than the prices of the specific goods that people need to live, such as food and housing. If the price of flights decreases while the prices of food and housing increase, a person who has rising PPP income may nonetheless find themselves less able to meet basic needs. Clearly, when it comes to measuring poverty, what matters is not income *as such* but rather what income can buy in terms of access to essential goods; in other words, what matters is the welfare purchasing power of income. Robert Allen analysed commodity prices around the world for the year 2011 and found that the cost of meeting basic needs, measured in PPP terms, changes depending on the price of food and shelter relative to prices across the rest of the economy. In Zimbabwe a person's subsistence needs can be met with $1.74, PPP. But purchasing a similar basket would cost $3.19 in Egypt, and $4.02 in France (Allen 2017).

In recent years, scholars have developed a more empirically robust approach to measuring extreme poverty, which compares incomes against the cost of basic needs in different contexts (Moatsos 2016; Moatsos 2021; Allen 2017). Allen calculates what he calls a 'basic needs poverty line' (BNPL) in all countries with available data in the year 2011. This poverty line is based on the local price of purchasing specific necessities: 2,100 calories per day, plus 50g of protein, 34g of fat, various vitamins and minerals, some clothing and heating, and 3 square metres of housing. He then compares household income data against the price of this basket in each country, to estimate the share of the population that is unable to meet their basic needs. This approach more closely approximates what the original concept of "extreme poverty" was intended to measure. In a recent paper published by the OECD, Michalis Moatsos extended Allen's estimates, with robust data for the years between 1980 and 2008, although precise coverage varies by country (Moatsos 2021).[3]

The basic-needs approach to measuring poverty sometimes yields dramatically different results from the World Bank method, depending on the provisioning systems that are in place. This is clear in the case of China, which we explored in a recent paper, and which provides an important example (Sullivan, Moatsos & Hickel 2023). The World Bank's method suggests that extreme poverty was very high during the socialist period, and declined during the capitalist reforms of the 1990s, going from 88% in 1981 to zero by 2018. However, the basic-needs approach tells a very different story. From 1981 to 1990, when most of China's socialist provisioning systems were still in place, extreme poverty in China was on average only 5.6%, much lower than in other large countries of similar GDP/capita (such as India and Indonesia, where poverty was 51% and 36.5% respectively), and lower even than in many middle-income countries (like Brazil and Venezuela, where poverty was 29.5% and 32%, respectively). China's comparatively strong performance, which is corroborated by data on other social indicators, was due to socialist policies that sought to ensure everyone had access to food and housing at an affordable price. However, during the capitalist reforms of the 1990s, poverty rates rose dramatically, reaching a peak of 68%, as public provisioning systems were dismantled and privatization caused the prices of basic necessities to rise, thus deflating the incomes of the working classes.

The China example underscores the key role that public provisioning and price controls can play in eliminating poverty. It also reveals an interesting paradox. In 1981 China had a GDP per capita of less than $2,000 (2011 PPP), and yet achieved lower rates of extreme poverty than capitalist countries in the periphery with five times more income. During the following decades, China achieved rapid GDP growth, and PPP incomes increased. This growth was beneficial in many respects, for the general development of China's productive forces. And yet extreme poverty, as measured in terms of access to basic necessities, *worsened*. For all of the 1990s and the first decade of the 2000s, China had a worse poverty rate compared to the 1980s, despite having markedly higher GDP per capita and higher PPP incomes across the board.

The China example is striking but it is not unique. The OECD data on basic needs shows that many countries experienced rising poverty rates alongside GDP growth during the process of forced liberalization in the 1980s and 1990s. Between 1985 and 1998, the share of the Indonesian population in extreme poverty increased from 23% to 71%, even though GDP/cap rose by 66%. Similarly, in Brazil, the extreme poverty rate increased from 11% in 1980 to 15% in 2005, while GDP/cap rose by 37%. In Kyrgyzstan, GDP/cap increased by 17% from 1995 to 2000, suggesting that living standards had begun to recover from the economic crisis of the early 1990s. But the extreme poverty rate continued a steep climb during that period, rising from 36% to 80% (for perspective, the recorded poverty rate in 1991 was 0%).[4] In all these cases, poverty increased because people's gains in PPP-based incomes were outstripped by the rising cost of basic needs (see Figure 1).

The data in Figure 1 demonstrates a major problem with the World

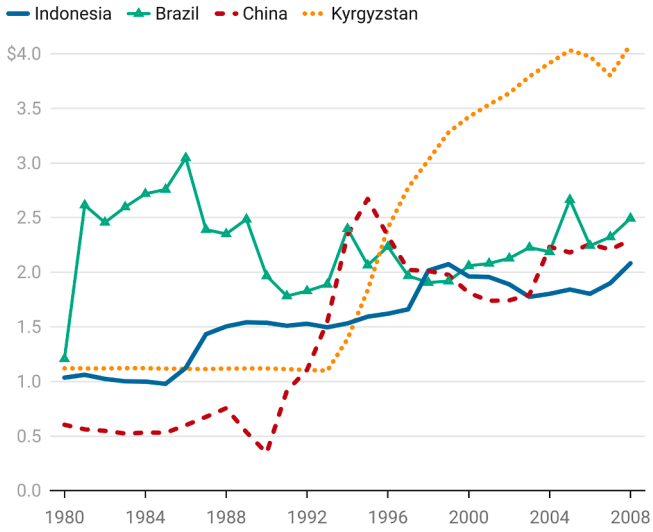

Fig. 1. Cost of meeting basic needs (2011 PPP$), 1980–2008. Based on Moatsos (2021).

[3] The OECD provides estimates for other years as well (covering 1820–2018), however these are not based on direct data. For the vast majority of countries, household survey data does not exist for the period 1820–1980. Instead, the OECD figures use historical GDP growth rates as a proxy for changes in household consumption during this period. This approach faces significant limitations, however, as GDP growth rates do not adequately represent changes in non-commodity forms of consumption, particularly during periods of colonization and liberalization. Moreover, in the OECD dataset food prices are generally not available after 2008. For the post-2008 period, figures are calculated on the assumption that food prices moved in line with CPI, which is quite often not the case. These figures must therefore be treated with caution. For more, see: Hickel, Moatsos, & Sullivan (2024).

[4] For these examples, we use extreme poverty data from Moatsos (2021), and GDP/cap data from Bolt & van Zanden (2020).

Bank's method, as it indicates the $1.90 line is not comparable across countries or over time. It is crucial to note that while this research has primarily focused on extreme poverty, this problem applies to any poverty line measured in broad-gauge PPP terms – whether it is $5.50 per day, $10, or $30. At any given PPP threshold, human welfare will vary with the price of food, housing, education, healthcare and other necessary goods and services, *relative to* prices across the rest of the economy.

This research sheds important light on dynamics of growth and poverty reduction. It reveals that efforts to raise PPP incomes, without focusing on the *specific* goods and services that can be purchased with that income, cannot be relied upon to reduce basic-needs poverty. The use of PPP-income as a measure of poverty obscures this problem. Indeed, the relationship between economic growth and 'poverty reduction' as measured by PPP-income is in effect tautological. Growth will generally always increase the PPP-income of the poor, unless there is a countervailing increase in inequality. According to this way of viewing the economy, the answer to poverty is therefore virtually always just more growth. It does not matter growth *of what* – an increase in *any* form of production will do, conducted under any conditions, regardless of whether it helps meet human needs, and regardless of any negative social or ecological consequences it might entail. For instance, if capital mobilizes production in the global South to increase sweatshop output for Zara, or sugar for Coca Cola, this increases the GDP, and increases PPP income, and leads to what appears to be "poverty reduction" even if people remain unable to access decent food and housing.

As the China story shows, from a poverty-reduction perspective this strategy is inadequate. Aggregate growth does not guarantee that people's access to necessary goods will improve. At best, it may be a slow and inefficient way of achieving that goal. At worst, it may *never* achieve that goal, as the level of PPP income required to meet basic needs may grow faster than the incomes of the poor. Indeed, the flaw in this approach is evident even in the richest countries in the world. The UK has a GDP/cap of $38,000 (2011 PPP), representing very high levels of aggregate production and consumption, and yet 4.7 million people in that country do not have secure access to nutritious food (Francis-Devine et al 2023). Despite sustained GDP/cap growth in recent decades, most high-income countries have witnessed an increase in extreme poverty, as measured by the BNPL.[5]

The needs-based poverty metric illuminates much smarter strategies for development. Once we understand that ending poverty is a matter of ensuring people can access the goods and services necessary to meet their needs, then the objective should be to increase production of those specific goods and services. So far we have referred to the goods that comprise the basic needs poverty line (food, shelter, clothing, fuel), but – as we will see in the next section – the same principle applies to the higher-order goods that are required to achieve decent-living standards (nutritious food, modern housing, healthcare, education, electricity, clean-cooking stoves, clothing, washing machines, sanitation systems, refrigeration, heating/cooling, computers, mobile phones, internet, transit, etc), which requires a higher level of industrial output.

In addition to drawing our attention to *specific forms of production*, the needs-based approach to poverty also draws our attention to *prices*. At any given level of production, poverty can be reduced by lowering the prices of essential goods, such as food, health care, and public transit. As the case of China illustrates, this can be achieved through policies of public provisioning and price controls, to ensure universal access to essential goods and services. This is critical to successful development strategy, and opens up important new possibilities. Of course, the objective of ensuring accessible prices is inseparable from the objective of shifting output from luxury items toward necessary goods, as this shifts the relevant supply curve to the right.

These strategies were understood by the socialist and anti-colonial movements of the mid-20th century, and indeed by the architects of the welfare state in the core economies during the same period. It was also understood by Simon Kuznets, the economist who invented GDP, who noted: "given the variety of qualitative content in the over-all quantitative rate of economic growth, objectives should be explicit: goals for 'more' growth *should specify more growth of what and for what*. It is scarcely helpful to urge that the over-all growth rate be raised to x percent a year, without specifying the components of the product that should grow at increased rates…" (Kuznets 1962, emphasis added). This is a clarity that urgently needs to be recovered.

It is worth highlighting that the World Bank's approach to poverty is convenient, from the perspective of capitalism, because it celebrates *any* increase in *any* form of production as a "solution" to poverty. Of course, for capital, the primary objective of production is not to meet human needs, or to achieve social progress, but to maximize profit, including by constantly increasing commodity production (Wallerstein 1996; Wood 1999). According to the World Bank method, this will "reduce poverty" even if human needs remain unmet, and indeed even if people's access to essential goods is sabotaged through processes of enclosure and privatization. In this sense, the World Bank's method is aligned with the general ideology of capitalism – the narrative that capitalist growth is *always good* and *always delivers progress.* Needs-based approaches raise substantial questions about the efficacy of capitalist growth and draw attention to the power of public provisioning.

It is important to note here that increasing production of socially necessary goods to meet human needs still represents growth in the affected sectors. In other words, it still represents an increase in production, even as measured by GDP. The difference has to do with the content, purpose and quality of growth. Rather than growing total production in the hope that some of it will 'trickle down' to those in poverty, the needs-based approach seeks to grow *specific* outputs to meet *specific* social goals. Production and growth along these lines is focused on human well-being and social progress, rather than capital accumulation, and pays attention to the question of whether people have access to necessary goods. This approach can be faster and more efficient in terms of human development, as it allows better social outcomes to be achieved at any given level of aggregate output (Dreze & Sen 1989; Vogel et al 2021; Lena & London 1993; Cereseto & Waitzkin 1986).

3. How much growth is required to ensure good lives for all?

The extreme poverty line, including the BNPL, should not be used as a benchmark for social progress. As we have established elsewhere, extreme poverty is a sign of severe social dislocation and it should not exist anywhere (Sullivan & Hickel 2023; Hickel & Sullivan 2023). It is necessary to use a much higher threshold consistent with access to the full range of modern goods and services necessary for decent living. As we described in the introduction, one approach has been to use a $30-a-day (PPP) line comparable to that used in many rich countries. One can then determine how much additional output is needed for all countries to reach the average income levels of rich countries that have relatively low poverty at this threshold. This would require increasing global output by at least a factor of four. But this approach suffers from several methodological problems.

First, as with the World Bank's extreme poverty line, the $30-a-day line is a metric of broad-based purchasing power. It has no empirical grounding in human needs or the costs of essential goods. Whether or not someone on $30/day lives in poverty depends on the prices and accessibility of essential goods. People living in the United States on $30/day (roughly $900 per month) may be unable to afford adequate healthcare, housing and transportation, to say nothing of higher

[5] In the United States, for instance, the extreme poverty rate has increased from 0.5% in the mid-1980s to 1.5% today, and in the UK, poverty has increased from 0.1% to 1%. Even Denmark, which had 0% of its population in extreme poverty in the 1980s and 1990s, has up to 0.4% of its population in extreme poverty now. The experience of these countries illustrates that even high levels of growth and aggregate output cannot be relied upon, in and of itself, to eliminate extreme poverty.

education, because these goods are privatized, affected by profiteering, or (in the case of public transit) may not be available at all. In such a context, $30/day would not be enough to ensure decent living and cannot be used for this purpose. By contrast, people living in a country with higher levels of public provisioning (e.g., public housing, rent controls, public healthcare, transit, higher education, etc) may be able to access necessary goods with substantially less income. Applying a fixed $30 poverty line to all countries ignores this issue.

Second, using high-income economies as a benchmark is problematic, because they are highly inefficient when it comes to the relationship between aggregate production and social outcomes. They tend to be characterized by high levels of resource-intensive and socially unnecessary forms of production and consumption, such as SUVs, private jets, cruise ships, fast fashion, mansions, industrial meat, weapons, advertising, and artificially accelerated product turnover through practices like planned obsolescence. This is why, despite high levels of aggregate output and throughput in high-income countries, large portions of their working classes are nevertheless deprived of affordable housing, nutritious food, and other essential goods. Importantly, research in ecological economics indicates that high-income countries could achieve *better* social outcomes at *lower* levels of aggregate production by scaling down less-necessary output and focusing production on what is required for human well-being (Barrett et al 2022; Creutzig et al 2022; Hickel 2023; Lettenmeier et al 2014; Kuhnhenn et al 2020). These possibilities are obscured by a preoccupation with PPP incomes and GDP.

The standard approach is therefore inadequate to answer the question at hand. $30/day is an empirically meaningless way of defining poverty. Relying on broad-based PPP incomes casts what Michail Moatsos (2016) calls a "veil of dollars" over the economy and obscures the specific forms of production and consumption that are necessary for meeting human needs. It also assumes away the possibility that poverty can be reduced through public provisioning systems. And the core economies, including Denmark, cannot reasonably be used as a benchmark for development, because they have high levels of excess production and consumption, they dramatically exceed sustainable boundaries, and – as we described in the introduction – they rely on imperialist appropriation. If we take this approach, then yes a massive amount of growth would be needed to end poverty, by definition. And even if this was ecologically and structurally possible, people may still be unable to meet decent-living standards (as in the USA, which has higher GDP/cap than Denmark and still suffers widespread social misery), even if we assume Denmark's levels of income inequality.

We must take a more rational approach. As we established in the previous section, eliminating poverty and improving human welfare requires focusing on *specific types* of outputs, and ensuring universal access to these things. PPP-based metrics of aggregate output (such as GDP) measure the production of all goods, including those that have limited relevance to poverty and human welfare. This ignores important questions about *which sectors* need to grow, and whether this could be achieved by reallocating productive capacities from other sectors. Labour and materials that are currently used to produce mansions and casinos can instead be shifted to producing affordable housing; farmland used to produce beef for consumers in the global North can instead be used to produce nutritious foods for workers in the global South, and so on.

Recent empirical studies have established the minimum set of specific goods and services that are necessary for people to achieve decent-living standards (DLS), including nutritious food, modern housing, healthcare, education, electricity, clean-cooking stoves, sanitation systems, clothing, washing machines, refrigeration, heating/cooling, computers, mobile phones, internet, transit, etc. This basket of goods and services has been developed through an extensive literature (e.g., Rao & Min 2017; Rao et al. 2019) and is summarized in Table 1, following Millward-Hopkins (2022).

It is important to understand that DLS represents a minimum floor for decent living. It does not represent an aspirational standard and certainly does not represent a ceiling. However, it is also a level of welfare that is not presently achieved by the vast majority of people. A new paper by Hoffman et al. (under review) finds that 96.5% of people in low- and middle-income countries are deprived on at least one DLS dimension. This study covers 66% of the population of low- and middle-income countries. If we assume the same level of deprivation holds across that whole country group, and if we ignore deprivation in high-income countries (which has not yet been quantified using this method) we can conclude that at least 6.4 billion people, more than 80% of the world population, are deprived of DLS.[6] Ending DLS deprivation would therefore radically improve the lives of the majority of the world's population.

Table 1
DLS minimum requirements (Millward-Hopkins 2022). Note that per-capita values (for food, living space, clothing, mobility) are averaged across ages. Averages are reduced by the relatively lower requirements of infants and children.

DLS dimension	Material requirements	Minimum activity levels
Nutrition	Food	2000–2150 kcal/cap/day
	Cooking appliances	1 cooker/household
	Cold storage	1 fridge-freezer/household
Shelter & living conditions	Sufficient housing space	60 m2 for 4-person household (e.g., two adults with two children)
	Thermal comfort	Climate dependent
	Illumination	2500 lm/house; 6 h/day
Hygiene	Water supply	50 Litres/cap/day
	Water heating	20 Litres/cap/day
	Waste management	Provided to all households
Clothing	Clothes	4 kg of new clothing/cap/year
	Washing facilities	100 kg of washing/cap/year
Healthcare	Hospitals	200 meters^2 floor-space/bed
Education	Schools	10 meters^2 floor-space/pupil
Communication & information	Phones; Computers; Networks + data centres	1 phone/person over 10yrs old 1 laptop/household
Mobility	Vehicle production	Consistent with pkm travelled
	Vehicle propulsion	4,900–15,000 pkm/cap/year
	Transport infrastructure	Consistent with pkm travelled

Several studies have quantified the level of real resources necessary to achieve and sustain DLS for all. Millward-Hopkins (2022) estimates that the annual energy requirements average 14.7 GJ per person if we assume global deployment of the most efficient technologies that are presently available (which is how the primary DLS scenario is defined), or 21.5 GJ per person per year using "current technology" (i.e., widely used best-practice technology).[7] These figures are based on a projected population of 8.5 billion in 2050 (consistent with SSP1), whereby extending DLS to all would require 125–183 EJ per year. This amounts to 30–44% of current annual global energy use (which was 418 EJ in 2019[8]). Note that these are total annual requirements. To cover DLS *gaps* requires much less. Kikstra et al. (2021) estimate that building out the infrastructure needed to cover DLS gaps by 2040 would require cumulative energy inputs of around 290 EJ. This would mean approximately 19 EJ per year from 2025 to 2040, which is less than 5% of current global energy use.

Regarding materials, data from Vélez-Henao & Pauliuk (2023) indicate that DLS can be provided with 3.27 tons per capita, summed across a variety of material categories, with similar technology to that

[6] These high deprivation figures are corroborated by data from the Multidimensional Poverty Index, which shows that 68% of people in 110 surveyed countries are deprived on at least one of ten key indicators of basic welfare - including access to primary education, clean cooking fuel, adequate sanitation, and drinking water - which together represent a lower standard of living than DLS. This figure was calculated from 'Data Table 2: Other k values 2023' in OPHI & UNDP (2023).

[7] This study provides an update to the DLS figures in Millward-Hopkins et al (2020).

[8] According to the IEA (2021).

assumed by Millward-Hopkins. We derive this figure using the published reference scenario and assuming a shift toward renewable energy, vegetarian diets, efficient appliances, multi-family residential buildings, increased wood as a share of construction materials, and 54% of mobility presently provided by private cars shifted to public transit.[9] Note that requirements can be reduced further, to as little as 1.9 tons, with additional dietary changes.[10] For comparison, we also assess a less ambitious scenario with a 4.74-ton requirement, using the published reference scenario and assuming only a shift toward renewable energy, efficient cooking appliances, and 27% of mobility presently provided by cars shifted to public transit. For a population of 8.5 billion, provisioning DLS would therefore require 28–40 gigatons of material per year, representing 29–42% of current global annual material use (which was 95 gigatons in 2019[11]).

These results are illustrated in Figures 2 and 3 and compared to current global energy and material use, which represents energy and materials that are processed into final uses, real goods and services, buildings, and infrastructure, and therefore serves as a useful proxy for productive capacity. This demonstrates that global poverty can be eliminated and decent-living standards can be extended to all with a modest share of existing global productive capacity, and less energy and materials than the global economy presently uses, if production is organized around this objective. This leaves substantial surplus that can be used for various purposes: for additional public luxury, recreational facilities, technological innovation, scientific and creative advancement, and increasing the DLS threshold (for instance with additional housing space, more computers, etc). To illustrate, the level of development represented by DLS can be multiplied by a factor of three and still extended to everyone in 2050 within existing global capacity (see Figures 2 and 3).

Of course, it is reasonable to allow for some degree of inequality in the distribution of real resources. Millward-Hopkins estimates that a distribution consistent with public preferences ("fair inequality") requires allocating an additional 40% on top of DLS requirements. This would entail total global requirements of 175 EJ of energy and 39 gigatons of materials (see Figures 1 and 2), which is still well within existing productive capacity, and still leaves a large surplus that can be used for additional consumption and other social investments. Note that future technological developments between now and 2050 (and beyond) could make it possible to provision higher living standards with less energy and materials, and this objective should be actively pursued.

The data above indicate that ending poverty and ensuring good living standards for all does not require large increases in global aggregate production and throughput. It clearly does require substantial industrial development and increased total output in lower-income countries, while in higher-income countries it can be achieved while at the same time reducing less-necessary output. But in all cases – North and South alike – the key is to focus on increasing certain *types* of production, including by redirecting productive capacities and reallocating energy and materials to different final uses (e.g., to produce housing and healthcare rather than casinos and fast fashion). It also requires deploying and disseminating efficient technologies internationally, including by suspending patents where necessary. Further research is underway to more precisely quantify the energy and material requirements of transitional pathways toward universal decent-living, differentiated by world-system region, with attention to sufficient

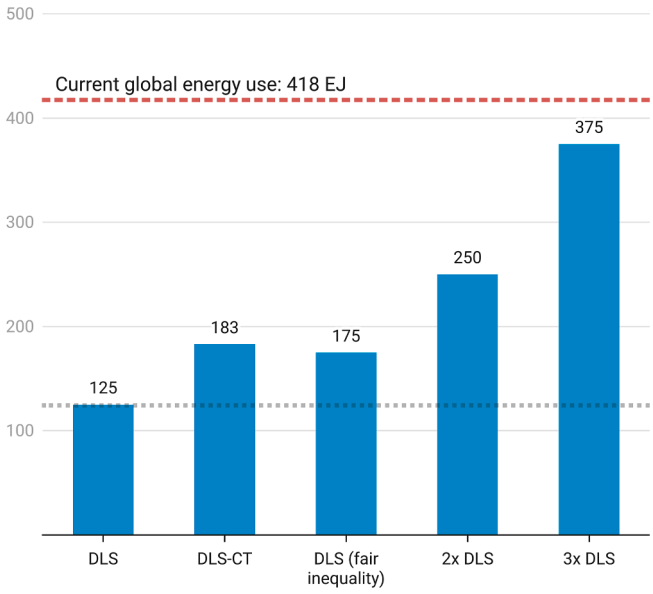

Fig. 2. Global energy requirements (EJ) to ensure decent living standards (DLS) for 8.5 billion people in 2050. Based on Millward-Hopkins (2022). DLS assumes global deployment of efficient technology; DLS-CT assumes current technology as described in the text.

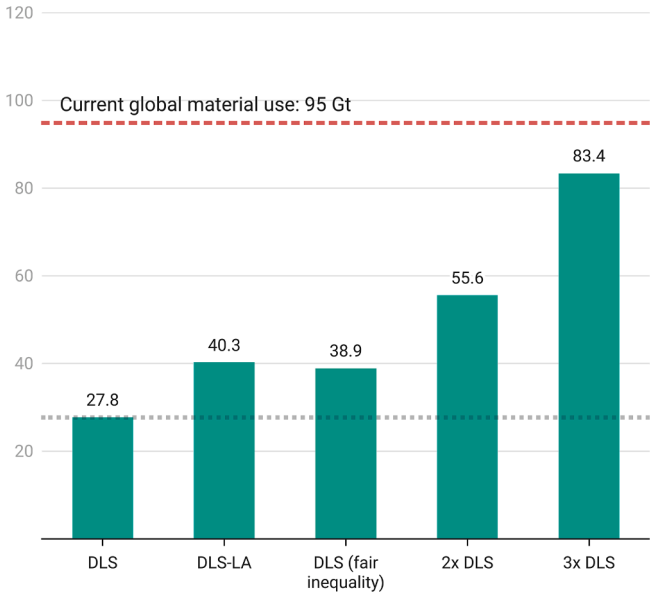

Fig. 3. Global material requirements (Gt) to ensure decent living standards (DLS) for 8.5 billion people in 2050. Based on Vélez-Henao & Pauliuk (2023). DLS-LA is a lower-ambition scenario as described in the text.

production corridors (Bärnthaler & Gough, 2023).

Asking how much global GDP is needed to end poverty is not a particularly helpful question. If human well-being is the objective, it is not GDP (aggregate output in market prices) that matters, but specific goods and services, and whether people have access to them. It is not about *generic* production but the content and purpose of production. To determine what the level of global GDP would be in a transition toward a universal decent-living scenario would require sophisticated modelling. It depends on what sectors are increased and what sectors are reduced, how provisioning systems are changed, the kinds of technologies that are deployed and the uses to which they are put, and it depends on how prices shift under these conditions and related processes such as an increase in the bargaining power of labour and a reduction in unequal

[9] This assumes efficient cooking appliances, washing machines, and water heating, as well as a 10% shift of wheat and rice to potatoes. We consider this scenario to be a closer approximation of DLS than the published "lower-bound" scenario, which assumes a vegan diet and a shift from rice and wheat to potatoes.

[10] Starting with the 3.27-ton scenario, and shifting to vegan diets and switching wheat and rice to potatoes brings the requirement down to 1.9 tons.

[11] According to current data from the International Resource Panel of UNEP.

exchange between core and periphery. Indeed, precisely because GDP is a fungible indicator, in which real material outputs are measured by something as ephemeral as market prices, it is not a useful tool for assessing how production needs to change in order to end poverty and achieve specific social goals. To answer this question, we need to pay attention to physical production and final use-values, distinguishing between what is important for human wellbeing and what is not.

4. Conclusion

Narratives that assume deprivation can only be eliminated if all countries achieve the levels of GDP per capita that presently characterize high-income countries are increasingly at odds with ecological reality and ignore the real constraints that developing countries face within the existing structure of the capitalist world economy. Fortunately, research on needs-based poverty and development advances important alternative solutions, and resolves the false dilemma between human well-being and ecology. The question of how much production is necessary to end poverty cannot be answered by assessing PPP-based incomes or aggregate GDP. It is necessary to assess *what is being produced*, and *whether people have access to necessary goods and services*. Development strategy should focus on ensuring the efficient production of and universal access to the *specific goods* that people require to achieve decent lives and good social outcomes, including nutritious food, safe housing, healthcare, education, sanitation, transit, information technology, and household durables. This can be done while also reducing less-necessary forms of production, particularly in high-income countries, in order to bring resource use back to sustainable levels. For a discussion of how such a transformation can be financed, see Olk et al (2023).

Ending global poverty and ensuring good lives for all while meeting ecological objectives at the same time requires a new framework for conceptualizing convergence. Excess energy and material use must decline in the core to achieve ecological objectives, while in the periphery productive capacities must be reclaimed, reorganized, and in most cases increased to meet human needs and achieve human development objectives, with throughput converging globally to levels that are sufficient for universal well-being and compatible with ecological stability.

For the core, this requires sufficiency-oriented strategies (reducing less-necessary forms of production and consumption, extending product lifespans, reducing the purchasing power of the rich, transitioning from private cars to public transit, etc.), while improving and securing access to necessary goods and services, alongside efficiency improvements and feasible technological change. These strategies can enable high-income countries to decarbonize fast enough to stay within their fair-shares of Paris-compliant carbon budgets (Vogel & Hickel 2023). This is challenging within a capitalist market economy, however, because capital generally requires increasing aggregate output (GDP) to stabilize accumulation (Magdoff & Foster 2011; Gordon & Rosenthal 2003; Binswanger 2009; Binswanger 2015; Hahnel 2013) and because in capitalist economies any reduction of aggregate output triggers social crises characterized by mass layoffs and unemployment. Furthermore, under capitalism, decisions about production are made by wealthy investors with the primary goal of maximizing private profits, rather than meeting social and ecological goals. Necessary goods and services that are not profitable are often underproduced (e.g., Christophers 2022). Post-capitalist approaches are therefore needed, including public finance for urgently necessary forms of production (e.g., public transit, renewable energy, insulation, efficient appliances), establishing universal public services to ensure access to necessary goods, planning to reduce less-necessary output in a just and equitable way, and guaranteeing universal access to employment and livelihoods through a public job guarantee and income floor (Olk et al 2023; Durand et al 2024; Foster 2023).

For the global South, a different set of challenges must be overcome. During the past forty years, developing economies have been structured – by policies imposed by international financial institutions and foreign capital – to focus production on exports to the core in subordinate positions within global commodity chains, at artificially depressed prices and with unfavourable terms of trade, while remaining dependent on imports of necessary technologies and capital goods (Smith 2016). As a result of this arrangement, labour, land and resources in the global South are devoted to producing, say, fast fashion and consumer technologies for Northern firms – overwhelmingly consumed in the global North – instead of producing nutritious food, housing, sanitation systems and hospitals for national needs. To reclaim productive capacities for national development, governments need to use progressive industrial and fiscal policy, public works programmes, and public investment in innovation to plan production of necessary goods, services and technologies (Hickel & Sullivan 2023). At present, these steps are largely precluded by the conditions imposed by structural adjustment programmes and international creditors. Escaping these constraints requires reducing dependence on imports from the core – and therefore on foreign capital – including through South-South trade and swap lines, and cancelling external debts where necessary. Southern governments can and should take unilateral or collective steps toward sovereign industrial development and should be supported toward this end (Ajl 2021; Hickel 2021; Kaboub 2008; Sylla 2023).

Poverty is not an intractable problem that requires complex solutions, long timeframes and large increases in production and throughput that conflict with ecological objectives. The solution is straightforward. We need to actively plan to shift productive capacities away from capital accumulation and elite consumption in order to focus instead on the goods and services that are necessary to meet human needs and enable decent living for all, while ensuring universal access through public provisioning systems. We have framed this work around the concept of human needs, following the recent literature. However it is important to underscore that this approach is ultimately about far more than just satisfying material requirements for human well-being. Achieving decent-living for all is critical to enabling broader human capabilities, individual and collective self-realisation, full participation in society and politics and, ultimately, freedom.

CRediT authorship contribution statement

Jason Hickel: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Dylan Sullivan:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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