Critical notes on the UNEP "Bend The Trend" report, 2024.

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This is a first draft being circulated for critical feedback. Please let me know if there are misinterpretations etc.

The detailed report (UNEP 2024) says that world resource use is at present quite problematic and urgent change is needed. However it claims that a sustainable situation can be achieved by 2060 without any need for reduction in economic growth let alone degrowth. In fact the "strong growth" claimed to be enabled will be greater than under continuation of the "Business As Usual" scenario (BAU.) (Pp. 78, 79.) Greater recycling and efficiency gains and design improvements in the energy, land use, transport and construction fields are the main technical fixes that it is claimed will enable the problem to be solved. The claim therefore Is that significant absolute "decoupling" of resource use from economic growth is achievable.

The report is elaborate/detailed; 185 pages and around 50 authors and containing many tables and plots. It provides valuable statistics on the situation but it presents claims about how the problem can be fixed that are not accessible of demonstrated so it is not possible to assess derivations. Although many numerical assumptions and conclusions are given in Appendix 7, the report only states claims and conclusions. It does not demonstrate or establish these.

Consequently I do not see the report as being of significant value for the general debate about growth, limits to growth, resource depletion, degrowth etc. Several assumptions and procedures seem to be quite challengeable or implausible, and there seem to be inconsistencies and confusions. This does not mean that it is wrong; it means that it leaves the degrowth debate far from settled.

Following are some of my concerns.

1. The business as usual expectation?

It is not clear how big a reduction on BAU the claimed 2060 materials use would be. It is often stated that by 2060 BAU could/would be 160 billion tonnes p.a. (bty). "... If we do not change, we could see resource use up by 60 per cent from 2020 levels by 2060." (P. xiv.). But on p. xiv it is said that the present rate of use is increasing at 2.3% p.a. If this rate continued, by 2060 the annual consumption rate would be around 250 bty. (This does not take into account that the materials use growth rate was increasing fast until Covid impacted, as. was GDP, see Lenzen et al., 2022 below, meaning that 2.3.%. could be a low estimate of future growth.) But seven lines below this it is again said that under BAU it will be 160 bty.

These differing figures make it difficult to determine what the claimed reduction on BAU would be.

2. Assumptions.

The main concern is to do with the plausibility of the overall claim that the present resource use of c. 107 bty can be more or less stabilised by 2060 at 160 bty, by recycling, technical improvements, greater efficiency in use, and better design.

Following are the main statements on strategies and reductions for the major domains. It should be noted that almost all relevant summary statements have been reproduced below; these are not selected bits taken from lengthy and substantial accounts explaining in more detail how the reductions will be made.

“Recycling” and “reuse” figures are given on pp. 31 and 32 of Annex 7. These are difficult to interpret. The distinction between the terms is not clear. They seem to overlap, because treating them as separate activities and adding them indicates that for some materials much more becomes available after use than was initially used.

a) Energy

Throughout the report most discussion of possible reductions is not quantified but only offers statements about the strategies that are going to achieve them. For instance the summary on p. 109 says, “Energy: Decarbonizing electricity supply through the scaling up of low-resource renewable energies and increased energy efficiency, as well as decarbonizing fuels. The climate policy package also supports the deployment frequent traveling modalities and decreasing the emission intensity of transport modalities.”

Use is envisaged “...of carbon dioxide removal (CDR) technologies such as reforestation, bioelectricity with carbon capture and storage (BECSS) or Direct Air Capture (DAC).” (P. 109.) No reference is made to the considerable literatures finding that these are highly unlikely to be effective.

It is made clear at various places that renewable energy will make a major contribution, for instance by eliminating fuel material extraction. It will contribute 2/3 of energy by 2060. (P. 95.) There is no discussion of how likely this is, or of limitations or costs. The extent to which renewable sources can replace fossil fuels is highly contested and unsettled.

“Final energy consumption falls ... 21% by 2060 ... Primary energy (measuring energy inputs before generation and system losses) falls ... 27% by 2060.” (P. 96.) There is no discussion of the way renewables are going to meet the 80% of energy demand that is presently not in the form of electricity. We cannot see the reasoning enabling the present 620 EJ of primary energy to go down to 453 EJ, that is to 73% of the present primary energy consumption. There is no discussion of whether transition to high penetration renewables would be affordable; a plausible case can be made that it will not be. There is no discussion of the probable effects on renewable energy supply caused by limits to rare and scarce minerals, seen by some as prohibiting their widespread implementation.

Finally there is a puzzle about the amount of fossil fuel that would still be being consumed. If as stated renewables were to contribute two thirds of the present 418 EJ final energy consumption, then presumably fossil fuels will still be contributing 137 EJ. Assuming a 33% conversion efficiency this would mean burning about 418 EJ of fossil fuels. Fossil fuels currently contribute about 80% of energy used, corresponding to approximately 496 EJ of primary energy. The scenario seems to be saying that there will only be a 19% fall in fossil fuel use. There is no discussion of the resulting carbon emissions situation, apart from the claim on p. 96 that, "Reductions in net emissions per person ...(will fall)... 95% in high-income countries and by 84% for the world as a whole." This is difficult to understand in view of the foregoing figures. This another major puzzle that needs to be clarified.

b) Construction.

We are told little more than that the measures are, "Assuring sustainability of the new building stock, retrofitting the existing building stock, more intensive use of buildings and decarbonization of material production."

There will be, "Reduced resource use through resource efficient production, and longer life cycles for products and buildings. More efficient construction and smaller average building area per person, particularly in regions with larger buildings relative to the global average. Higher density settlements with more shared green space and greater use of active transport (walking and cycling) and public transit systems. A higher share of timber and biomass-based construction materials in new buildings and infrastructure, and lower share of steel and concrete construction materials." "Compact and balanced neighbourhoods using more recycled building content, lifespan extension and other circular economy measures can decrease building material stocks by 25 per cent by 2060, which leads to a 30 per cent decrease in energy demand." The plausibility of such changes enabling such a reduction is open to qurstion.

Lifetimes are expected to increase 30% for long life housing, 90% for short life housing. (Annex 7, p 27.) World average residential floor space per capita increases 30%, and commercial space per capita increases 120%. (Annex 7 p. 27.)

Average materials reductions achieved in residential and commercial buildings are, steel 17% less, concrete 17% and 10% less aluminium, but a 150% increase for wood is stated. No change for copper, aluminium or glass. (Annex 7, p. 28.)

It is not clear whether infrastructures such as roads have been included although these might have been included in the construction category. Factories were probably included in the construction sector, but there is no information given on materials going into the production of goods. This is a large item; Lenzen et al. (2022) say manufacturing accounts for around 25% of material footprint (Fig 1, p 158) but do not indicate whether this includes goods produced.

Thus the text does not provide impressive evidence that the 2060 target for this sector can be reached.

c. Transport: ("Mobility").

“Cities moving towards active mobility and public transportation, reducing carbon-intensive frequent traveling modalities and decreasing the emission intensity of transport modalities.” (P. 109.)

“Partial transition from short-distance aviation to rail. Reduce overall transport demand in person kilometres in line with increased teleworking and alternative tourism (25% reduction in activity) ... Relax link between economic growth and demand for travel and freight.” Number of cars and car mileage increase 20%. Bicycle distance increases 30%. 10% increase in busses, rail, small inland ships, light trucks. No change is anticipated for big ships or big trucks. Vehicle weights overall fall only about 6%.

“... shared and active transport can reduce related material stock requirements (-50 per cent), energy demands (-50 per cent.)” (P. xv.) This would seem to be an implausible claim. As usual no explanation or derivation is given.

Lifetimes of vehicles are assumed to increase; rail by 40%. Ships 3%. Buses, bikes and cars 20%, air and trucks 10% (Annex 7, p. 27.)

The report states that it was decided not to deal with heavy truck transport. This is unsatisfactory. That sector is dependent on diesel, and some analysts do not believe it can be run at acceptable cost by renewable energy via batteries or hydrogen. (Friedmann, and Bossel for instance.)

c) Food and land.

The reduction in this sector is only 5%. (Pp. xv, 89,109.)

“The food and land shift combines measures to promote healthy diets, reduce food system waste, promote protection of native habitat and ecosystems and limit water extraction ...” (P. 102.)

“... higher yields per hectare, improved food system efficiency, changes in livestock mix (with fewer cattle and sheep and more pigs and chicken) and shifts in diet towards plant-based protein. “ .

On p. 24 of Annex 7 crop productivity increase assumptions are given as .051% p.a. in the North and 0.66% p.a. in the South.)

Enhanced efficiency growth assumed in livestock feed conversion efficiency are small. “Annual feed conversion efficiency increase from 0.10% in the North to 0.26% in the South. (Annex 7, p 24. One reference.) These rates indicate negligible reductions by 2060.

Agricultural waste falls 50%%. (Annex 7, p 24.)

Another puzzling and implausible statement; “... consumption (demand-side) measures such as diets with less animal protein, compact cities and more public transport can reduce GHG emissions by between 40% and 70% by 2050.”

To summarise re assumptions.

Again the above extracts etc. are most if not all of the statements and claims made regarding reduction measures and associated rates and quantities; they are not just a selection.

For the electricity, construction, and transport sectors the report expects steel recycling to go from an already high of around 70-80% to about 95%, cement from 0 to 37%, wood from 25% to 30%, copper from 72% to 90%, aluminium from 84% to 95%. (It is not clear what such figures mean in view of the forementioned uncertainty re “recycling” and “reuse”.)

Again no derivations are given for how these assumed quantities and percentages feed into the overall conclusion that consumption would be 160 bty by 2060.This. lack is especially serious regarding renewable energy.

I do not regard the claims as persuasive or convincing, primarily because the report does not enable their derivations to be examined, and because several do not seem to be plausible. In general one can see that if the reduction rates stated in Appendix 7 were valid then they would produce the 2060 use figures claimed, that is, a 30% reduction. But are those rates sound? How confident can we be that they would hold up for 35 years?

3. **Scenarios**.

The core argument is based on two scenarios, labelled Historical and Sustainability. The former refers to the 2060 situation given continuation of BAU.

In my view scenarios are of dubious value for estimating long term future situations. Everything depends on the assumptions made especially for rates that are taken to continue over decades. Slightly high assumptions in several component factors can multiply to make big differences in conclusions arrive at. Above all it is usually far from clear that assumed rates will turn out to have been sound over decades. Scenarios can therefore easily be quite misleading and warrant limited confidence.

4. **The overall recycling assumption.**

Again, conclusions are hindered by the uncertain distinction made in Appendix 7, pp.31,32 between “reuse” and “recycling”. If these are supposed to be separate and additive factors then some of the totals come to over 100%. I would have thought the latter includes the former.

It is said that recycling can in general probably achieve 30% improvements. But it is also said that recycling rates for crucial things like metals is already high, around 70%.

The 30% overall reduction figure stated (p. 25) for recycling seems to align with estimates in the literature but there are several reasons why all these should be regarded with caution. They are usually statements of the theoretical maximum potential and that is likely to be significantly higher than rates that will be practically

achievable. The causes include the difficulty of separating materials, which are often built into or stuck to others especially plastics, the poorer quality of many recycled materials, and the presence of hazardous material in waste streams. Also achievements in one domain often increase difficulties in another, for example when greater recycling effort raises energy costs.

There is already strong incentive to recycle and presently low rates will be reflecting difficulty and cost factors. There will be knock-on effects, such as increased trucking, machinery, and environmental consequences. This knock-on effect is likely to be of major significance with respect to energy. Technical advances and greater recycling effort often involve higher energy and infrastructure costs. Enthusiasm for the production of green hydrogen in Australia led Twiggy Forrest to set up a large scale facility but the recent awareness of high cost estimates has led to the venture's closure at the cost of 700 positions.

There are two major reasons why recycling rates can be highly misleading. They refer only to materials coming available for dumping or reuse, that is, they refer to amounts of scrap. It is easy to overlook the fact most of a new tonne of steel will go into and remain in the construction etc., and will not be available for reuse at least for many decades. So even if we got to the stage where 100% of steel going into the construction of a house could be eventually recycled this would not mean that no more steel would need to be produced. (The amount of waste material from the construction of a large house is only about 5% of the weight of the house.*) Even in a perfectly "circular economy" resource demand would increase if the economy was growing.

Secondly "recycling" often refers to material "available for reuse in some form", and the form is often grossly degraded. For instance the Annex states that around 30% of concrete can be recycled, but this will only be in the form of "crushed road bed". It is not going to reduce at all the amount of limestone needed to become cement to make a bridge. It could reduce the concrete needed for that only by reducing the amount of gravel going into the mix. (And it might not be used at all for making new concrete because it has much less strength than blue metal.)

Reusing the wood scraps left over when a house has been built would make little difference to the amount of wood going into the next house. Reuse of plastics typically results in lower quality and thus limits applications.

So there must be serious reservations concerning the claims in Annex 7 that the average concrete recycling rate for the electricity, building and vehicle sectors can be raised to 18% and the rate for wood to 33%.

5. **No reference to possible interfering factors.**

The report says there has been no attempt to include consideration of the effects of possible disruptions in natural systems or due to geo-political events. Recently costs of resources, energy and supermarket products have risen significantly in large part because of the Ukraine conflict. Nor has the report referred to a possible peaking in oil availability within 5 years, (Sainsbury, 2024) or the coming (probably highly destructive) "resolution" of the accelerating global debt situation.

It is stated that the possible effects of ecological deterioration have not be included. Thes are likely to be extreme, adding resource costs for restoring damage and for protecting against future damage to resource producing sources and equipment and damage to non-resource associated assets (roads, housing etc.).

6. **Domains that seem not to have been included.**

There is no reference to manufacturing infrastructures or to the material content of the vast quantity of their products. This category also includes the goods produced and consumed (and the materials required for the associated waste treatment), and the vast amounts of resources and energy embodied in the equipment. (The above notes on transport and construction seem to refer only to the materials and energy etc. used in construction or to operate, not those in the machinery doing these things.) What about infrastructures such as bridges, dams, sewer systems, electricity grids, and especially roads, including the maintenance of these? They might have been included in construction. Have the energy and materials costs "embedded" in the associated machinery been taken into account? Lenzen. At al 2022) Fig. 1 indicates that manufacturing accounts for about 25% of th4 total footprint.

7. **The (confusing) decoupling implications**.

The report constitutes a major statement that resource demand can be sufficiently decoupled from economic growth, so there will be no need for degrowth. The Sustainability scenario explicitly foresees absolute decoupling by 2060. (p. 78.)

It is stated that to date there has been no absolute decoupling achieved in any domain, and that continued BAU will not achieve any. (Pp. xiv, 4, 53, 84.) Note that this is despite the constant pressure on producers to reduce resource use in order to minimise costs.

It is said that, "Resource efficiency and supporting policies can reduce material resource use and dramatically reduce environmental impacts in high and upper middle-income countries (absolute decoupling) while improving well-being and boosting economic growth." (P. xiv.)

A key claim is that "Global resource extractions peak in 2045 and then stabilize (falling slightly) to around 20% above 2020 levels by 2060." This would mean that in 2060 resource demand will be about 128 bty. But that conflicts with the often-stated 160 bty conclusion; "Results indicate substantial global relative decoupling of resource use (up around 60%) from economic growth (up around 150%), as shown in Figure 4.19."

These growth figure and materials use figures would mean that for a 1% increase in GDP resource use would have risen 0.6%, which is the same rate (Wiedemann et al., 2014) found 10 years go. This is confusing; it seems to mean there will have been no absolute decoupling, and no improvement on the present, erven though resource use is now increasing at a significantly higher rate than 10 years ago; 2.3% p.a. (When it was rising 0.6% for every 1% rise in GDP.)

The main problem is that these figures seem to show that the decoupling needed would be very large and highly implausible. From above, if the present 2.3% p.a. rate of growth in resource use continued 2060 then the BAU would be about 250 bty. To reduce that to 160 bty indicates a reduction of 90 bty from BAU in 35 years, i.e., about an average (not exponential) absolute decoupling of 2.75 bty. Because the present use rate is around 107 bty this would be a reduction rate of about 2.7% p.a. This means we would have to go from a 2.3% p.a. increase rate to a 2.7% p.a. decrease rate, indicating a total reversal in coupling of about 5% p.a. If this arithmetic is more or less correct, that is far from plausible.

Apart from that issue, the report says that strong economic growth will be enabled. So what is supposed to happen after 2060? The report's figures seem to mean that materials use will continue to increase at 0.6% p.a. for every 1% rise in GDP.

Lenzen et al. (2022) note that despite slowing in the rate of growth of the material footprint since 2000, for metal ores there has been a significant increase. Whereas Widemann et al. (2014) found that in 2014 a 1% rise in GDP would be accompanied by a 0.6%, increase in consumption, by 2019 the rate had increased to 1.9%. They say their findings agree with a recent study by Zheng et al (2018) that a 1% rise in GDP increases the metal ore footprint by 1.9%", (when GDP is measured in PPP.) They say widespread near-future absolute decoupling "appears unlikely ". The UNEP report references these two studies but does not comment on the above significance of their findings.

What about dwindling resource availability?

Surprisingly the report does not consider the implications of declining resource quality and availability. Ore grades are falling, land is being cleared, agricultural soil quality is deteriorating, water is a serious problem, fisheries are over exploited, forests are being damaged and even sand is a problem. As ecosystems deteriorate the availability of biological resources is becoming more problematic, resulting among other things in rising food prices.

Meanwhile demands on resources are increasing, due to population growth and rising "living standards". These trends will inevitably greatly decrease the availability of resources over the next 35 years.

Consider the depletion pressure likely to be generated by BAU growth of copper demand. In 1990, 35 years ago, the amount consumed totalled about 3 mty. It is now 26 mty, indicating that in that 35 year period about 507 mt were consumed. If demand rises at the 660,000 ty average rate (electrification will make it rise much faster than that) by 2060 demand will be 47 mty, and in that 35 year period total consumption will have been 1,295 mt. But estimated reserves are currently only 886 mt.

Reserves tend to increase over time due to new discoveries but the presently estimated volume for copper would be exhausted by 2060. Again this does not take into account the major increase in copper demand likely to be created by electrification of many functions.

Australian copper consumption in 2023 was about 25 kg /pp/y. If the projected 9.6 billion people were to rise to that level consumption would be 240 mty, and presently estimated reserves would last less than 4 years.

These numbers would seem to constitute a strong case that many crucial resources will have been totally exhausted by 2060.

8. **“Justice”.**

The report is concerned with improving the justice of global resource access, and claims that the Sustainability scenario improves this, raising use in low income countries. But by 2060 the report says low income countries will have risen to 7 t/pp/y and high income countries will be on16 t/pp/y, meaning a marked inequality remains. It is not clear if this is supposed to diminish after 2060.

The report does not envision any structural change in the grotesquely unjust global economic system which has developed poor countries into a form that can be described as legitimate plunder. Because “development” has been defined as becoming like the rich societies, they have to strive to prosper in the global economy through competing (against each other) to export resources to the rich countries, and to entice and enable foreign investment by rich world corporations. These want infrastructures, ports and power stations, so poor countries must borrow heavily to build them, and they soon find themselves in impossible levels of debt. The IMF and World Bank rescue them... by lending them more, on condition that they open their economies more to foreign interests, drive welfare and wages down and gear national resources to paying off the debt. etc. They are then irretrievably locked in to a form of development that prevents the application of abundant basic resources such as soil, water, timber and traditional skills to the building of cooperative, self-sufficient and resilient villages, and transfers several trillion dollars in net wealth from them to rich countries every year. (Hickel et al., 2021. See the critique of conventional capitalist “development”.)

Conclusions.

The foregoing discussion indicates that at least many questions would have to be clarified before the report could be taken as having provided a significant case for its claims. There seem to be major uncertainties regarding assumptions, visibility/accessibility of reasoning, puzzling and incoherent aspects, scenarios and the plausibility of elements and of the overall case. It certainly does not provide a plausible or impressive case that sufficient decoupling can be achieved, or that degrowth will not be required.

Hickel, J., D. Sullivan and H. Zoomkawala, (2021) “Rich countries drained $152tn from the global South since 1960”, Aljazeera, 6 May. https://www.aljazeera.com/opinions/2021/5/6/rich-countries-drained-152tn-from-the-global-south-since-1960

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