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Review Article

Energy Transition and Health: Questioning the Underlying Assumptions

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Abstract

The global energy transition is motivated largely by the need to combat climate change. Other reasons include limits to available fossil fuels, energy-related environmental impacts, and societal goals such as health, equity and poverty alleviation. This transition will significantly change the world both technically, economically and socially. It is taking shape with characteristics which prioritise certain types of policy, interventions and solutions, as well as certain actors and institutional forces. This implies underlying assumptions about what constitutes a desirable type of future society; these assumptions need to be questioned. This requires us to look well beyond the field of health sciences itself. It is imperative that health professionals and researchers address this wider picture. If not, the preconditions for health and wellbeing risk being neglected and in some cases directly hampered by the energy transition.

Briefly stated, the transition is being geared to a conventional type of development; including the not unchallenged concept of green growth. Not everyone, however, would agree on those priorities. We discuss limitations and weaknesses in the current approach. Whilst much of the change initiated is positive, we argue that different views, which lie closer to discourses such as strong sustainability, deep ecology and ecological economics would prioritise differently and offer both necessary and desirable outcomes. We argue that achieving global sustainable energy, not least the societal goals, remains unlikely within socio-political frameworks permeated by the imperatives of market-driven growth and the commodification of resources. Building on examples and recent experience we outline some of the objections to the current paradigm and highlight other options in the transition process. Keywords include degrowth, sustainable consumption, lifestyle shifts and community solutions. The relevance of a broad policy paper of this kind is to reflect on the energy transition in the particular light of health and wellbeing.

Keywords: Energy transition, Public health, Wellbeing, Energy policy, Energy and health, Sustainable development goals.

Introduction

This paper offers, necessarily in brief form, critical observations regarding the energy transition. As others have stated: “numerous studies have already estimated and analyzed the litany of co-benefits offered by low-carbon transitions, but very few (if any at all) have carefully calculated the injustices, or the dis-benefits” (1). The global energy transition is motivated largely by the need to combat climate change. Other reasons include limits to available fossil fuels, energy-related environmental impacts of many kinds, and societal goals such as equity, health and poverty eradication. This transition

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Butters C and Jakobsen O., Fortune J Health Sci 2025
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is taking shape with characteristics which prioritise certain types of policy and solutions, as well as certain actors and institutional forces. This implies underlying assumptions about what constitutes a desirable type of future society. These assumptions need to be questioned. This requires us to look well beyond the field of health sciences itself: "the science of medicine can only ever be as robust as its understanding of the social contexts in which disease occurs" (2). It is imperative that health professionals and researchers address the wider picture. If not, the preconditions for health and wellbeing risk being neglected and in some cases directly hampered by the energy transition. Briefly stated, the transition is geared to a conventional type of development. Whilst much of the change being initiated is positive, different views, which lie closer to discourses such as strong sustainability (3), deep ecology (4) and ecological economics (5, 6) would prioritise very differently. Building on examples and recent experience we argue that achieving global sustainable energy, including the societal goals, remains unlikely within socio-political frameworks permeated by market-driven growth and the commodification of resources. Essential goals such as equity, public health and community resilience are at particular risk.

The transition away from fossil fuels offers many positive health outcomes that are widely documented by the WHO (7) and researchers (8). Renewable energy generally poses fewer, yet still significant, health risks, some of which are briefly noted below; however, health as defined in the World Health Organisation's constitution requires "a state of complete physical, mental, and social well-being" (9) – both of individuals and communities. Of concern is the type of social and economic development pursued in the transition as currently conceived. This has very broad implications, especially for the poor and for public health.

Alternative discourses are typically critical of top-down, technocratic and overly market-focused approaches. They emphasize social issues and "values-driven" development. We outline some of the objections to the current paradigm and highlight the interest of (and in our view urgent need for) other options in the transition process. Keywords include degrowth, sustainable consumption, lifestyle shifts and health-focused solutions. Energy is an essential amenity for quality of life, but today's largely technological focus can obscure other, qualitative goals. Energy and climate change (10) are also now vast businesses which can overshadow equally vital necessities such as water, sanitation and health services. This policy paper thus offers a comparative perspective on narratives that address the same problem from deeply differing viewpoints. It highlights our central concern with the underlying assumptions and what we argue are important weaknesses or omissions, in order to raise critical questions as to optimal pathways in the energy transition. To do so we offer a broad-brush review of key issues within energy, economics and consumption as they relate to health and wellbeing. The relevance of a broad policy paper of this kind is to reflect on the energy transition in the particular light of health and wellbeing.

Method and Approach

In order to discuss differing energy transition approaches and their potential or probable outcomes, we highlight key features of prevailing and alternative views, necessarily in brief. We select some few examples of current transition policies and practices, as well as of alternatives. We also draw on social sciences research which as yet receives limited attention in energy transition policy but offers essential insights as to transition processes, drivers and barriers. In section 3 we briefly note some health risk areas related to the energy transition. Both climate change and the energy transition bear health risks of two kinds. As with all technology, there are health risks of a direct kind to humans and environment. Beyond these come broader risks as to social development and wellbeing. Our next sections 4 and 5 address energy. Firstly we provide a brief recapitulation of the emerging awareness about energy and climate and the role of energy. We then outline typical features of the energy transition, noting what we perceive as four problematic features of how the transition is currently framed and implemented. Section 6 addresses four key energy policy issues and their implications in energy transition. Section 7 then presents selected technical, economic and social issues; with cases to exemplify these. This again focuses on current policy directions and on implications for future society; in particular for health and the poor.

In section 8 we address the underlying assumptions and present critiques from fields such as ecological economics, wellbeing studies and consumption research. This too is necessarily brief and cannot involve a full review of the theoretical and indeed philosophical basis of those approaches. Our intent is to highlight advantages that they offer, both for effective climate action and for societal goals such as health. This inevitably touches on the debate about whether the current development paradigm itself is fundamentally flawed; it is being seriously questioned today not only by critics but by its own proponents. These are complex, interrelated issues requiring a multidisciplinary approach, and an open mind towards conventional ideas about development. Today's environmental as well as social crisis demands a radical rethink that is to be encouraged within the research community. The most problematic issues lie arguably in the realm of social values and goals for a sustainable future, including public health, energy justice and equity. Finally in section 9 we turn to the alternative approach of values-based development and offer three examples of alternatives

Butters C and Jakobsen O., Fortune J Health Sci 2025
DOI:10.26502/fjhs.263

in practice. In concluding we summarise the need to rethink, modify and improve energy transition policy and practice.

Risk Areas for Health

Risks in a transition from fossil fuels are in many cases outweighed by the benefits of renewable energy, but are still considerable (11). We briefly note a few of these. The broader risks highlighted thereafter relate to the kind of society that will emerge and can be summed up as a concern that maintaining the current paradigm of development amounts to pursuing (with slightly greener means) the same path that has led to the very environmental and social problems that we face.

Some of today's prioritised energy technologies pose potential health risks. These include nuclear energy, use of some very problematic metals, nanoparticles, air conditioning, and energy storage batteries. Some ambitious macro approaches for combating climate emissions, such as carbon capture, geoengineering, weather manipulation, or novel microbial agents to process carbon emissions, may also present major environmental and health risks. Nuclear whilst offering lower climate emissions has long been controversial; we do not enter into that debate, however nuclear energy is also now far more expensive than renewables such as wind and solar. But a major safety concern is that nuclear facilities pose a huge risk to both environmental and human health if situated in regions that may – perhaps unexpectedly – become unstable or conflict-prone: "war and nuclear energy: risks are enormous for the power industry and the world" (12). Recent events around the Zaporizhzhia nuclear plant in Ukraine exemplify this new danger.

Another health concern relates to the global need for special minerals in emerging energy applications, such as lithium, cobalt and rare earth metals (REEs) (13, 14). Many of these critical energy resources are found in regions of high environmental, social and governance risk. There has been wide publicity around unregulated mining, including child labour and other abuses, in certain poor countries. Due to the pressing market need, health and human rights issues tend to be grossly overlooked (15, 16). Here again it is the poorest who are susceptible to the worst conditions – in addition to lacking elementary health services. Lithium battery production may produce adverse respiratory, pulmonary and neurological health impacts; "Mineral extraction has contributed to environmental degradation, population displacement, violent conflicts, human rights violations and other adverse impacts. Managing the downside risks that accompany ETM extraction sits at the core of a just transition" (17).

Another, very major health concern is the increasing mortality from extreme heat events in cities: the urban heat island effect (UHI) which is closely related to energy use and climate change. Cities already have far higher temperatures than the surrounding countryside due to UHI. Notably, UHI especially affects the growing megacities of developing countries; most of them are in hot climates; with millions of poor inhabitants and it is the poor who suffer most from UHI. This is thus also an issue of equity, which is receiving very little attention in energy transition policies (18). Modifying cities is evidently a vast task. We return to this below. We also return below to the concern that the chosen development model, with commodification and marketisation of energy as opposed to non-profit, local and community-based solutions, can render energy inaccessible to the poorest groups. Civil society agency, participation and democracy appear at risk; it seems unlikely that energy justice (19) will receive sufficient priority or funding. Here again it is the underlying assumptions which demand reflection. These have both global implications, and ones of especial concern for the poorest nations, the elderly and groups who are in greatest need of improved health and wellbeing.

Energy: Limits and Goals

Firstly a very brief resume of the energy question. The past century saw a great escalation in energy consumption, mirroring the expansion of economies. Global utilization of fossil fuels is the predominant anthropogenic factor driving climate change. The most extensive IPPC research (10) now indicates an increasingly probable planetary temperature rise with grievous ramifications for the health, or even survival, of both humans and ecosystems. Addressing global environmental crisis has long been on the agenda. The 1972 Club of Rome report Limits to Growth (20) raised much debate and is still seen as having formulated a basically valid warning (21). Subsequent decades added climate change to our awareness of planetary "limits". Whilst this crisis is now acknowledged worldwide and is being addressed, if both inadequately and slowly, many argue that there are major systemic issues driving it, not least that the existing economic paradigm forms an obstacle to sustainability. Energy transition is now a top priority; yet solutions have existed for decades. As long ago as 1985 four leading scientists published the One Kilowatt per Capita study (22). This was followed by Energy for a Sustainable World (23). These showed that the goal of sustainable energy for all (SE4all), championed now by the World Bank (24) and others, was achievable – with the technologies of 1985. Similar studies by Lovins in the USA (25), Meyer and Norgaard in Denmark (26) and Weizsacker (27), offered similar conclusions.

Notably, the goal of those studies was not only technical, but equitable global development. The message was – and is – that there is enough for all, if the high consumption groups reduce their energy use from present levels of typically 5-10 kilowatts per capita to around one kilowatt per capita;

Butters C and Jakobsen O., Fortune J Health Sci 2025
DOI:10.26502/fjhs.263

enabling the poor to raise theirs from typically 100-200 watts to around one kilowatt. These studies gradually led to widespread adoption of an overall goal for richer nations of reducing greenhouse gas emissions by a factor of around 10 (28). Similar studies describe a 2000-watt scenario (29). This research illustrated how a good standard of living can be achieved with a fraction of today's energy use.

Sustainable energy is SDG 7 of the United Nations' 17 Sustainable Development Goals (30). Whilst climate change is a principal concern, the SDGs rightly affirm societal goals such as poverty alleviation, democracy and global equity, just as important for the future of our world. Hence, the energy transition whilst technical must be done in ways that ensure those qualitative, societal goals. As noted by the WHO, health is a key goal of the SDGs (31). Energy is fundamental in society, whether seen in terms of wellbeing, costs, environment or climate; but there is reason to query how the transition is being conceived and implemented. To what extent do the underlying assumptions and priorities neglect or even hinder the realization of societal goals? And how might alternative approaches offer preferable outcomes and solutions?

Together with Information Technology and Artificial Intelligence, the energy transition is one of the major phenomena that will reshape the world in coming decades. The focus of energy transition is firstly, on a major and eventually complete shift of energy supply from fossil fuels to renewable sources; secondly, on increased efficiency of resource and materials throughput, including increased circularity in the economy; and thirdly, on good living quality, equity and wellbeing. Alongside major technological change, this transition demands many institutional and governmental changes. These may greatly affect what kind of society emerges. What kinds of technology? Who decides, who implements, who controls? The energy transition will affect political systems and power relations ranging from individual rights and democracy to global geopolitics (32). The following are four problematic features of present approaches.

Features of the Energy Transition

Top-down

Firstly, the extent and scope of transformation needed is seen as demanding expert-driven and large-scale interventions, with planning and control by international institutions and financial corporations. The urgency of climate action is seen as lending justification to this, though it reinforces what many see as their problematic hegemony in world affairs. Public finances being often strained, there is also increasing reliance on private sector investment – including "philanthropic capitalism" (33) or public-private partnerships, where the profit motive of private actors often bears considerable influence on decisions. Large institutions and corporations certainly have important roles to play; but the "top heavy" characteristics can impact negatively on local initiative, democracy, and the entire role of civil society.

Green growth

Secondly, the energy transition is closely aligned with today's drive towards a "green economy". There are many critics of green growth (34, 35, 36). "Greener" and less polluting production is positive; but to keep "growing" implies producing and consuming more and more green products (37). Consuming and then recycling twice as many products however green can result in just as much total energy use and emissions. In the words of Jackson: "At first sight, green growth itself seems mildly contradictory. Growth means more throughput. More throughput means more impact" (38). Recycling and circular economy (39) are already widely adopted as political goals (40). But every recycling requires at least some energy and emissions. Recycling some products, such as concrete and plasterboard, can even require more energy than is needed to make new (40). Many claimed green products may not reduce emissions at all – for example bamboo straws and some recyclable plastics have been widely debated. This is often confusing for consumers; it is a complex field requiring detailed life cycle assessments. The green economy view also tends to overlook the many aspects of global informal economies, including community health, and their potential role in a transition.

Marketisation

Energy, once considered a basic service, is increasingly privatised (as is health) even in welfare states. Even in countries like the UK, elderly pensioners and poor families now need energy subsidies. This is an example – in a rich country – of energy injustice. The energy transition is now largely framed in terms of markets and commodities. Many of these are "new" – such as renewable energy devices – in other words new objects of industrial production and sales. Achieving energy equity is at risk since energy research prioritises innovations that are marketable, and business "prioritises consumer groups who are able to pay, thus excluding the most defavourised" (41). Equally, this commodification tends to exclude non-technological energy solutions, energy saving and not-for-profit initiatives – solutions especially relevant if not essential for those without purchasing power. As Vandana Shiva stated: "the global economy defines people as poor if they consume the food they have produced themselves rather than buying commercial junk food" (42). The market is certainly an essential component of the transition; but commodification tends to bypass – or indeed impede – downstream, profitless, behavioural solutions such as saving energy and reducing or altering consumption. The current

Butters C and Jakobsen O., Fortune J Health Sci 2025
DOI:10.26502/fjhs.263

approach tends to commodify energy needs which could often be solved without or with minimal technology, or cash. It locks poor communities into new forms of consumption and market dependency. Examples below illustrate these issues.

The technical focus

Fourthly, the energy transition is largely framed as a technological shift. All technology implies impacts on nature, on society and on physiological as well as psychological wellbeing; the technological focus can be at the expense of non-technical considerations. The case of community energy initiatives noted below exemplifies this problem. Qualities of inclusiveness, participation and local control are being damaged. Nor are new energy technologies necessarily well adapted to the vast variety of cultural contexts, in particular poor country contexts. We return below to the longstanding topic of "appropriate technology".

The above four issues reappear throughout the brief examples below.

Energy Policy Issues

Energy efficiency versus energy saving

An often misunderstood question concerns the fundamental difference between energy efficiency and energy saving. Technological efficiency is central to the energy transition; but efficiency improvements alone are not enough to combat climate change (43, 44). Efficiency improvements reduce the energy needed by an item of technology to produce one unit of a useful energy service, such as heat or movement. Energy saving (or energy conservation) on the other hand means reducing the amount of energy activity, i.e. using less of something, whatever the efficiency. One may buy an energy efficient hot water geyser, or keep the old one and shower for five minutes instead of 15. To keep warm one may instal solar panels, or turn down the thermostat from 22 to 19 degrees and put on a pullover. The first of the above solutions all involve more purchases; the second do not – and are often cost free. Further, efficiency advances do not necessarily lead to positive change. A much discussed problem noted in many countries has been the rebound effect (45, 46) where consumers take out energy savings with increased consumption. In Norway the promotion of heat pumps led to almost no overall energy savings (47), with consumers for example raising indoor temperatures to 22 degrees or more; and even using the heat pumps as air-conditioning in summer – creating an entirely new and in Norway unnecessary energy "need".

It is important to state that conventional economic growth with increasing consumption is meaningful in poorer societies. They need more energy; and they cannot be expected to "save" what little energy they consume. But if all the poor gain access to more energy, the increased volume of energy quickly outweighs all efficiency gains (48). In richer societies by contrast, both efficiency gains and energy saving are possible. Downscaling, energy saving and lifestyle change are essential. In brief: improved efficiency is always positive, but not enough; we need efficiency as well as reduced use. But reducing energy use is negative for that overriding drive for economic growth.

Energy supply versus demand

The current energy transition approach largely addresses the energy supply side, i.e. new (and marketable) energy technologies. Whilst Demand Side Management (DSM) is a long recognised field (49), current policies do not prioritise the demand side of energy needs, consumption and lifestyle – of how and why energy is needed. Here again, reducing energy demand and managing it better imply lower consumption. Demand side solutions are in many cases not ones that require technology but behavioural as well as structural changes in the ways society is designed and organised. They can also be directly cost saving. For example insulating a building may eliminate the need for any renewable energy. Other examples are energy-efficient city planning, car-pooling, or peak load tariffs. Our first question must be: not how much but how little energy do we really need, for what, and of what kind? Significant parts of energy needs do not need commodified technology. Demand side reductions, less attractive to business, offer the greatest potential for achieving energy and climate targets with minimal social impacts.

Energy and employment

Employment is a key factor of development, of health and of wellbeing. Automation has long led to job losses and AI is predicted to replace millions more. This applies equally in the energy sector. Must the energy transition mean fewer jobs? This too depends on the chosen development paradigm and kinds of technology. The energy transition is not currently being designed with a view to maximising employment – especially considering the millions of poor and relatively unskilled workers in developing countries. New technologies such as solar result in new jobs (50) which partly replace jobs in the fossil fuel sector. However, renewable technologies are increasingly automated, often at a large scale, requiring relatively little and mainly skilled labour. An approach of choosing technologies that require a maximum of workplaces – preferably decentralised – is absent from mainstream energy policy. Meaningful work is also a key factor of social identity, resilience and psychological wellbeing. Even if less "profitable", such solutions can outweigh the large economic and social costs associated with unemployment, rural decline, migration and unhappiness. A society with high unemployment will not be a healthy society.

Butters C and Jakobsen O., Fortune J Health Sci 2025
DOI:10.26502/fjhs.263

Formerly championed by economists such as E.F Schumacher (51), the field generically referred to as Intermediate or Appropriate Technology (AT) (52) demands very different policy and design. In mainstream engineering, economies of scale and increasing sophistication are believed to be self-evident for "progress". Yet as Schumacher stated: it takes a good engineer to make something larger and more complicated – but a brilliant engineer to make it smaller and simpler. Examples of labour-intensive solutions including in the field of energy have indeed shown that one can design solutions – in some, not all cases – that employ more people yet are competitive in cost (53). In the field of energy such examples show how the transition is selective in its pathway, and not favourable for a vital concern such as employment.

Energy and debt

Fourthly, the energy transition requires enormous financing, not least for the poorer nations. "Given major economies' already-strained balance sheets, it is unrealistic to expect substantial climate financing for developing countries" (54). In practice, credit and debt mean that we are living off the future; off value that has not yet been created. This may or may not be "sustainable"; an extra strain being times of economic hardship such as caused by the Covid pandemic or the Ukraine conflict. The standard theory is that given renewed economic growth one can "catch up" and pay off debt down to what are considered reasonable levels. Investment in the energy transition depends on the global finance system. As presently configured this means huge amounts of credit, on which interest must be paid. The poorest countries are already spending 15% or more of their total budget in order to service the interest on – not pay off – their debt. "This is equivalent to the typical developing country's combined health care and education budgets" (55). This illustrates the immense implications of this kind of energy transition for health. In addition, developing countries' investment needs include major infrastructures for energy, as well as sewage works, hospitals, bridges and much else which cannot be "repaid"; there is no market incentive in such projects. It is imperative to prioritise energy solutions which minimise or avoid debt. Other avenues such as energy saving, demand side reductions, AT and local non-commodified energy offer more appropriate and equitable solutions.

Examples

Community and Energy

Commodification and marketisation are being cemented into policy and legislation – with wide ranging consequences. A case in point is community energy initiatives. The past three decades saw a proliferation of local, community-led initiatives for renewable energy in many parts of the world. Whilst not without their own challenges, these have generally been based on a commitment to social justice and empowering civil society with an active role in the transition to a healthy, low carbon future (56). Lennon for example notes how citizens remain locked out of the decision-making processes of the energy transition (57). Recent legislation in the European Union, whilst on paper supportive of local community energy, has effectively stifled this type of activity – in particular by strong neoliberal marketisation policies. Opponents argue that marketization is intrinsically hostile to community involvement in the transition: "community energy that is expected to "compete" as a "market actor" has no future" (58). Community-type energy initiatives have declined sharply. Denmark and Germany have been noted as pioneers for local, ecologically sustainable energy initiatives (59). Large scale actors are certainly needed too, but it is argued that a "public goods" energy utility approach, based on real public ownership, away from profit-driven processes, would better promote local engagement, energy conservation and efficiency, and is "the best possible vehicle for broad-based and sustained involvement of individuals, communities, cities and regions in the formidable challenges of the energy transition" (33). This stands in stark contrast to prevailing thinking and policies. We recall the UN's Agenda 21 declaration that sustainability cannot succeed unless it is understood, adopted and owned locally by the stakeholders (60).

UHI and cooling

A very large study from 164 cities in 36 countries found that about 48% of the world's population would be exposed to deadly thresholds of heat for at least 20 days a year by 2100 – even with reduced climate emissions (61). High temperatures cause discomfort, especially if accompanied by high humidity. Pollution exacerbates this further (62). The complex relationship between comfort and temperature, humidity, clothing and activity has long been studied and standards have been developed (63). They do not however allow for the heat adaptation often exhibited by inhabitants of hot climate countries, especially those in the tropics. According to these standards, sustained temperatures exceeding 30°C are deemed to be uncomfortable or to result in low productivity. When air temperatures for many hours exceed human body temperature (37°C), there can be danger of death, as evaporative self-cooling is impeded: it could fail completely if wet bulb temperature exceeded 37°C. Dry-bulb temperatures exceeding 40°C are commonly experienced in tropical cities; 45°C peaks are not uncommon

Three factors cause urban temperatures to increase. These are global warming, urban growth (and changes in urban form) and anthropogenic heat release (64). The weight to be assigned to these three is hard to estimate, but several studies indicate that global warming is the major component (65).

Butters C and Jakobsen O., Fortune J Health Sci 2025
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Heat events are having major effects; about 70 000 excess deaths resulted from the European heat wave of 2003 (66), of these over 2000 in London alone (67). Similar excess mortality is documented in many major medical studies – even in quite temperate climates; which have better living conditions and resources to assist those in need.

UHI is well documented although much less so in developing countries, where many of the fastest growing and hottest (and poorest) cities lie. A critical public health issue is that excessive urban heat is inequitable in its impact (18); most of the unwanted heat in cities is caused by the rich, by their vehicles, appliances and air-conditioning (AC). The poor suffer disproportionately for several reasons. They occupy crowded, low-quality housing and workplaces that are rarely shaded, insulated or well ventilated; they have fewer or no household cooling amenities and spend more time working or walking outdoors, on two-wheelers or in non-air-conditioned vehicles and overall more time in air pollution, which exacerbates the health impacts of heat. They

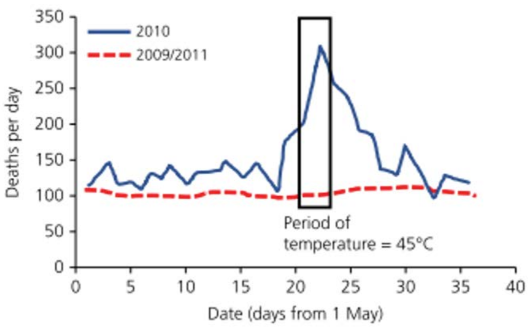

Figure 1: Daily deaths from all causes in a severe heat wave in Allahabad, May 2010. The year 2010 is compared with the 7d running average for 2009 and 2011. Source: data from Azhar, 2014 (69).

have less means, or permission, to shelter during heat waves. They often have weaker defences against heat stress due to poor nutritional or health conditions. Vulnerable groups include both the poor, the elderly and the young, as well as a rising number of people with asthma and other respiratory problems. In Malaysian factories, typically 40% of total power consumption is for cooling which is needed all year round. Many factories use old, Inefficient AC equipment – if any (68). The use of AC has been spreading very rapidly, for example 70% of Chinese urban homes now have some installed AC. A study of one heat wave, in Allahabad, where temperatures exceeded 45°C for 4 days (69) showed a 40% increase in the May mortality over the average of the previous and following years. Figure 1 shows the dramatic short-term impact with an excess of around 1300 deaths over a 13-day period.

Cooling a building is more complex than heating it, and per joule of energy moved it is generally more expensive. Cooling with AC in individual buildings is inefficient and worsens UHI. In hot climates, energy-conscious architectural design can reduce cooling needs, as can good city planning with green spaces and street configurations that maximise urban ventilation (70). There are many options using natural or 'passive' cooling to create a comfortable indoor climate. As opposed to prioritising urban planning solutions, the energy transition is creating huge new markets for cooling appliances. This *assumes* rising incomes; and avoids the well-studied issues of cultural influences on cooling habits (71); that cooling may often be quite unnecessary, often unhealthy, and can instead be largely avoided by better buildings and city design (70). In addition, every increase in AC only adds further heat to the city.

People in hot climates who have for generations accepted temperatures of around 30 degrees as comfortable are now encouraged to "expect" 22 degrees – and to buy AC. A new "need" has been created: for something that is energy intensive, and often unhealthy. However efficient the type of AC, energy use and climate emissions *increase* – and rapidly. Understanding energy behaviour requires social sciences research into lifestyles and the dynamics of social change (72, 73, 74, 75) and this is essential for successful transitions. The current approach however, encourages more, not less consumption. There is growing awareness about the importance for urban climate and wellbeing of green infrastructures – trees, vegetation and water bodies (76). However, addressing UHI demands very major changes to city planning; this is to date hardly addressed in the energy transition. Two rare cases – from France and China (77, 78) – signify a new concern with the crucial links between cities, energy and health. The lack of attention to UHI will imply high mortality in coming years.

Electrification

A notable priority in current energy policy is electrification; including for space climatization and electric transports. Electricity – as long as it is produced with renewable sources – has many positive health outcomes, for example by replacing cooking with firewood or paraffin. However electrification also has problematic implications. Electrification implies commodification, mainly by large companies, of an amenity that can often be provided locally and for free, for the average household (though not for large-scale industries and similar). An equity concern with solar electricity already noted, in rich countries too (79) is that it is only accessible for those with good purchasing power. Electrification is both socially problematic and inaccessible for the poorest. It also assumes operation and maintenance skills and money which those communities often do not have. Further: half or

Butters C and Jakobsen O., Fortune J Health Sci 2025
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more of our energy needs are not for electricity, but for heat. This applies to many industrial processes, space heating, cooking, washing and other activities (the term heat includes low temperatures for cooling). Electricity is not always technically optimal either; solar water heaters for example are twice as efficient as solar photovoltaics producing electricity (80). Heat in contrast to electricity can often be provided with local, non-commercial sources such as firewood, biomass and simple solar devices. The energy needs can also be reduced by energy-saving design such as passive solar heating in buildings as opposed to a *technology* of active solar systems. In the widely successful "passivhaus" type architecture (81), almost no heating technology at all is needed even in very cold climates. Space cooling can similarly be largely addressed by passive architecture as opposed to costly air-conditioning, which is again based on electricity, and can be far from healthy.

Electric mobility is a pillar of today's energy transition policy. This again fits with the business model of new forms of consumption. But it is evident that rapid transitioning to electric mobility in poor countries, especially in rural, cashless economies, appears a distant prospect in view of the planning, costs, roads and recharging stations required. Studies have also shown how electrification can lead to disempowerment of local communities as well as gender issues. As Wilhite stated: "Energy needs Anthropology" (82). In an example from Africa (83), whereas women were in control of firewood-based energy, it is the men who took control of the electricity, both because 'technology is the man's domain' and because it is the men who control interaction with electricity officialdom and administrators – women being excluded from doing so. Many similar examples can be found where such cultural and social impacts pose a bigger challenge than the engineering. Alongside its advantages, electrification appears in other cases far from ideal in terms of costs, inclusivity, equity, or health.

Energy and Equity

In poor societies, lack of energy amenities such as lighting, heating, cooking fuel and vehicles impacts deeply on human health and wellbeing. Problematic implications of the energy transition to renewables are observed in both rich and poor countries. Research on the energy transition in Sri Lanka (84) exemplifies poor societal outcomes of energy transitions as currently conceived. The setting is a post-conflict state which in addition to a weak economy and institutions has unresolved regional and ethnic tensions. Sri Lanka has agreed to climate ambitions in line with international trends: but given these weaknesses, in practice external and geopolitical forces play a powerful role. The agenda of those forces is to maximise their own geopolitical influence and/or profit. Renewables projects (solar and wind) have been executed with little or no local consultation or participation, and the energy goes to the centralised grid. Both the technical choices and financial instruments largely favour the external actors. Various new conflicts have been created. Local democracy and equity are weakened.

Further, despite its climate commitments, lack of finance in Sri Lanka as in many countries has led to increased, not decreased, reliance on the cheapest options such as coal. This then takes the conventional form of large-scale power plants with centralised control of energy. Interventions towards energy saving, non-commercial energy, community initiatives and local empowerment are hardly on the agenda. Similar scenarios are emerging in many countries, due to similar economic and geopolitical pressures. In South Africa, a Just Energy Transition plan (JETS) (85) claims to address both renewables as well as equity, but there is still a strong backing for coal, the major local resource. Large international renewable projects also imply increased debt and at worst, opportunities for massive corruption. By contrast, local initiatives have hardly been encouraged. The approach again tends to be top-down, centralised and geared to an assumed goal of ever-rising consumption.

Paradigms: Growth, Enough, Degrowth?

Above we have with brief examples noted criticisms of the paradigm which underlies current energy transition policies and choices. Drawing on what is a large body of thought and research, we urge the need for other approaches. In the words of Nobel laureate and economist Joseph Stiglitz: "If we measure the wrong thing, we will do the wrong thing" (86). Our ultimate goal is not consumption but wellbeing. Health and energy share the common-sense principle that our priority is avoid problems and the need for solutions. The priority question should be: *how little* energy – or medicine – do we need in order to achieve wellbeing? Long life products, repairing things, using less, are by far the most sensible options. Reducing energy needs, of all kinds, is favourable *on virtually all counts.* Stated in more philosophical terms: sages have said that happiness is easiest found if one's needs and desires are small. That would also offer wellbeing for the environment. However, the word *satisfaction* – from the Latin *satis*, meaning enough or sufficient – finds no place in the world of unlimited growth and consumption. Historically speaking, this is quite recent; a very different culture of frugality characterised the 19th century in western countries and has been a central tenet in many religions and cultures. The paradigm of endless growth (on a finite planet) has resulted in a pervasive global consumer culture. In the words of Jackson, "We are trapped in an iron cage of consumerism. But the cage is of own making. We are locked in the myth of growth" (37).

Butters C and Jakobsen O., Fortune J Health Sci 2025
DOI:10.26502/fjhs.263

In energy as elsewhere, key questions include not only the "what" but also the "who" and the "how", the modalities and agencies of decision making and control. Many argue that the present paradigm is an obstacle (87, 88, 89, 90). Others argue that we only need to improve today's system through a more "caring" version, with tighter regulation. Hence the "philanthropic capitalism" of billionaires such as Bill Gates and Warren Buffett, or Paul Collier's *The Future of Capitalism*, who assert that "capitalism must be constrained, rather than be allowed to operate unfettered" (91, 92). They add the proviso (vague at best) that we need to care more for each other – as states, businesses or individuals. There remains the risk of the immense power of a few extremely wealthy corporations and individuals over civil society. In the field of health, the market-based paradigm is criticised for problems including relative neglect of research on tropical diseases, lack of affordable vaccines, promotion of unhealthy products, crops for export rather than local food, and investments in health-damaging fossil fuels. Many of these reflect the lack of profitability in addressing the needs of the poor (93). As is the case with energy: finance gravitates towards fossil fuel investments because they tend to be more profitable than renewable alternatives. Whereas Aid towards the transition is far too little and entails conditionalities, or debt, or both.

Opposing movements such as Eco-socialism (94, 95, 96) face the well-known criticisms of socialist economics. Energy, like health, is unavoidably political. Yet today's China, much like the former Soviet Union, has followed the same economic-industrial growth path – if in theory with a more distributive tinge. The Scandinavian social democracies too, if in a more moderate version. Ecological economics for its part seeks to exit the left-right dichotomy altogether and poses a more fundamental system critique (97). In Korten's words "to create an economic system that works for all, we need a different design grounded in different understanding of wealth, our human nature, and the sources of human happiness and well-being" (98). We do not here engage further on that complex debate; but it is essential within the energy transition. Terms including degrowth and energy descent recognise the need – for the rich at least – to drastically reduce consumption, whether of non-renewable or renewable resources. Replacement of fossil fuels with renewables does not eliminate the environmental impacts of vastly increased *throughput* of materials and resources (48). To simplify: four times as many "sustainable" electric cars might have as much impact as the present fleet of fossil-fuel vehicles. Neither solar panels nor the batteries to store wind and solar power are impact free – far from it. The production of materials to replace all the world's tin and cardboard slums with decent small houses would hugely increase climate emissions. In short: eradication of global poverty implies *increases* in global emissions *however efficient or green* the technologies. A drastic reduction of our energy use, or "energy descent" is fully achievable as shown in the 1985 research described above; and by the recent Swedish "One Tonne" example below.

As opposed to "active" technology, the essence of "passive" approaches is that they utilise intelligent design and natural energy flows. Such buildings require almost no energy; the construction itself provides the solution without added technology (99). Similarly, a well-designed city creates a favourable microclimate with far less need for heating or cooling – as well as far less noise and pollution. Such solutions are extremely well documented. Both zero energy buildings and very low energy neighbourhoods have existed for decades (70). But by reducing the need for *any* technology, renewable or not, passive solutions again undermine the drive for production and consumption. As currently framed, the energy transition is geared towards ever more production and consumption, of energy – as a marketed commodity.

Values and Wellbeing

Overdevelopment?

Economic growth in its conventional form of rising incomes and increased production is truly beneficial in a phase where poor societies genuinely need more in the sense of basic material needs: energy, transport, housing, food. Richer societies are now arguably well beyond "enough"; using far more energy than needed, and exceeding the planetary limits. We recall the hierarchies of human needs as developed by Max-Neef, Seligman and others (100, 101). By around the mid-1970s the richer nations enjoyed most basic amenities; in material terms quite "enough". The well-known Easterlin paradox (102) has (briefly stated) shown in many studies that people's wellbeing does not necessarily increase above a certain middle class income level. We have written elsewhere about the concept of "Overdevelopment" (103). It is ironic that the ideal of ever-increasing consumption drives us from one form of suffering – hunger – towards the opposite kind of suffering – obesity. There is therefore no blanket critique of economic growth, but of a narrow conception of what is meant by growth as opposed to meaningful human and social development. Nor is it to reject economics tools such as GNP; they are useful for many purposes. Most economists are well aware of these shortcomings, and the need to include environmental and other externalities; nevertheless the energy transition is framed and implemented within the dominant paradigm. We recall Daly's notion of the common good (104). The fundamental goal of economics is not consumption but wellbeing – of both people and planet – on a long-term basis – with as little effort, cost or negative impacts as possible. Similarly, the goal of the energy transition is to drastically reduce climate impacts and ensure wellbeing with useful energy for all – with as little effort, cost or impacts as possible. Three brief examples of alternative approaches

Butters C and Jakobsen O., Fortune J Health Sci 2025
DOI:10.26502/fjhs.263

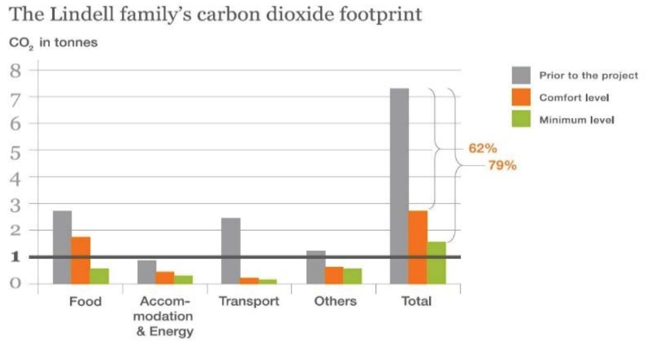

Figure 2: One Tonne Life: footprint reductions after 3 and 6 months. Source: (105).

now follow. The first is a real-life experiment in low impact living. The second is a practical tool for sustainability choices and decisions, Value Mapping. Thirdly we briefly present the quite unique example of Bhutan.

Same lifestyle with 1/4 Resources

Scenarios for drastically reduced energy use and emissions have existed for decades; but business and politicians tend to avoid messages about changing habits or reducing consumption, which many believe would mean restricting their lifestyle. In the Swedish *One Tonne Life* study (105), an average Swedish family was provided with an energy-efficient house and car and asked to see, in two phases over a six-month period how much they could reduce their energy use and climate emissions. They reduced emissions by around three quarters – *without* significant feelings of a loss of life quality or wellbeing. In addition, with solutions such as less travel, more cycling, less meat, they both saved money, and experienced better health. Reduced consumption can lead to increased, not decreased, wellbeing. This positive message needs to be far more widely disseminated.

Value Mapping

Secondly: how can we formulate policies and make choices in a more holistic manner? Value Mapping illustrates how one may reframe decision-making. This is a practical tool that takes a wellbeing approach (106, 107). One variant, the Consumption Value Map illustrated here, provides a basis (for both individuals and policy makers) to evaluate and make decisions. Here, all three types of considerations – ecology, economy and society – are integrated. It is important to note that the selection of parameters is not like some fixed "software" but can and indeed should vary depending on the context and the users. The topic can be an activity, a policy, a city plan, an energy system, or something one is thinking of buying. One assesses the value or "worth" of each of the parameters some of which are objective and quantifiable, others subjective and qualitative. By filling out each segment – from 0 = poor to 5 = excellent, the resulting "star", large or small, illustrates how weak or positive the chosen project or activity is, and in what areas it has particular merits or impacts. Value mapping provides a method to compare different options; it may be done in a simple or detailed version. The intuitive graphic form is simple to use, compels active reflection, and fosters integrated thinking. Note how this process shifts the basis of decision-making from purely technical or cost-benefit to social and qualitative considerations – yet also incorporates the objective, quantifiable factors such as emissions, costs, resource use.

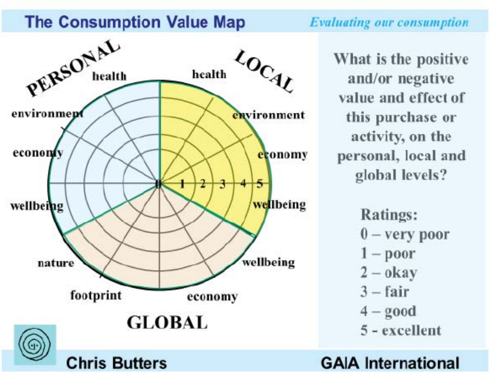

Figure 3: Value Mapping: Energy and other Consumption may be assessed on three levels: personal, local and global. Source: Butters and Jakobsen 2023,(107).

As simple examples of decision-making considerations: buying a car has positive effects for our (personal) convenience, but negative impacts such as noise (local) and climate emissions (global). Cycling is positive on many counts including health (individual), pollution (local) and climate (global). But context is important: cycling in the heavily polluted air of Mexico city is not such a good idea. Wise decisions are always relative to context; and this is why Value Mapping cannot be forced into a "standard" or software. The question must moreover be posed for myself as individual, for my community and for the planet. Sustainable solutions, for energy as for health, need to be considered on all three levels. Value Mapping is applied in many contexts. It incites fascinating discussions and enables us as users to

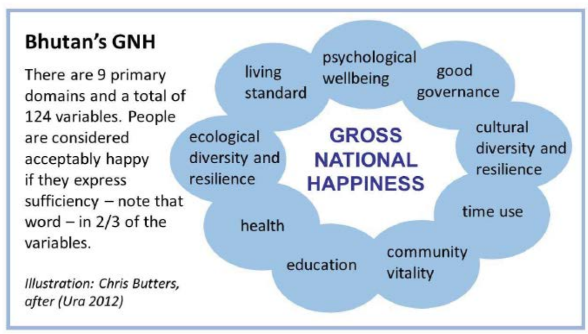

Figure 4: Bhutan's Gross National Happiness model. Source: Butters after Ura (115)

Butters C and Jakobsen O., Fortune J Health Sci 2025
DOI:10.26502/fjhs.263

develop integrated thinking. Value mapping can be applied both at the level of individual or local community and at the level of project planning and policy making.

Wellbeing: Bhutan and Gross National Happiness

The field of wellbeing studies (108, 109), is a key to values-based development. Indicator sets for wellbeing are now many (110, 111, 112). These often highlight solutions that are behavioural or involve moderating rather than increasing consumption, such as of energy (113). Keywords are social capital, community cooperation and non-monetary solutions (114). The one country implementing a Wellbeing approach is the small Himalayan kingdom of Bhutan (where author CB worked for 10 years). This model is now much discussed worldwide (115, 116). Bhutan has replaced Gross National product with Gross National Happiness. GNH adopts a values-focused stance and has been developed into an entire approach to national budgets, accounting and economic policy.

In conventional terms Bhutan is a very poor country. However if, as in Bhutan, most basic needs (food, shelter etc.) are covered, as well as free basic services such as education and health care – and social qualities such as good governance, safety and cultural identity – then Bhutan is not poor *except* in financial terms. It has been shown that some quite "poor" countries such as Bhutan and Costa Rica have quite high levels of wellbeing (116). As illustrated, GNH includes conventional living standard metrics such as income, education and health; but it addresses human and social development in a values-based framework which is in line with the broad spectrum of the SDG goals. With a particular focus on the poor, the overarching focus of GNH is to achieve wellbeing and social equity as well as sustainable economic activity and environmental quality. The social sciences and wellbeing research provide key insights towards such policies, technological and economic choices in the energy transition. Bhutan's GNH approach offers many pointers towards a more equitable and health-promoting energy transition.

Conclusions

In discussing the global energy transition we have not focused on many questions of a strictly technical and economic nature. Our focus has been on the implications of the prevailing approaches and policies both for health and for the broader health – i.e. wellbeing – of future society. Of particular concern is the fate of poorer nations and population groups. In a health perspective it is useful to remember that high energy use in general has many health implications: whether it is excessive driving, excessive consumption of energy-intensive foods such as meat, air travel, heating or cooling to excessive temperatures, and other high energy activities. Good health is, rather, related to as low energy use as possible to achieve wellbeing.

In question are the often unspoken, underlying assumptions about what kind of development – what kind of society – is being promoted. The prevailing discourse may be briefly summarised as the "business as usual" model of global market-based growth. We have discussed critical aspects of the energy transition. The need for reduced production and consumption is emphasized, supported by examples demonstrating improved well-being with much lower energy use, and positive effects of reduced consumption on individual, community, and planetary levels. The energy transition is framed and implemented in ways that tend to encourage more consumption, bypass local and non-monetary solutions and disempower civil society. It excludes or directly hinders important – we argue essential – avenues of energy saving, behavioural change and degrowth, despite evidence that these latter offer in many cases greener and cleaner solutions, at lower and in some cases zero cost. These options are in addition more easily tailored to varied cultural contexts especially in poorer contexts. The paradigm underlying the energy transition is also capital-intensive, favourable to the most powerful financial interests as well as rendering poorer countries and population groups liable to an increasing debt trap. Energy technology and efficiency are not alone sufficient to achieve the needed reductions in climate emissions. We have argued that the energy transition is directed in what are not necessarily the most effective, or equitable, or even most cost-effective directions. Whilst many current initiatives are positive, the underlying development paradigm needs to be challenged. If not, the transition risks falling short of both our climatic and our social goals. It is imperative that not only environmental scientists but also the health sciences engage on these underlying issues, in order to refocus far more attention on health and community wellbeing.

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