Just energy systems: Five questions and countless responses for regenerative energy communities

Matthew J. Burke

An urgent need to rethink renewable energy futures

Any meaningful response to the Anthropocene requires an energy transition. Whether characterized in terms associated with agriculture, fossil fuels, atomic energy, or human labor, the Anthropocene is meant to describe a time of multiple, widespread, and potentially irreversible breaches of ecological limits. As systems of energy provision and use fundamentally enable these breaches (McNeill and Engelke, 2014), the pursuit of a new “age of renewables” (IRENA, 2015) is a necessary response to the accumulating disasters and overshoot of the Anthropocene.

Yet there exist different modes of transition, not all of them just (Jasanoff, 2018; Morena et al., 2020). To simplify the issue, at least two seemingly contradictory approaches are now promoted for taking renewable energy systems to scale. A first approach, popularized among political and economic elites worldwide, is described as a global energy interconnection (GEI), consisting of large-scale, remotely sited renewable electric generation facilities, ultra-high voltage transnational and transcontinental interconnections, regional and national smart grids, and the supporting global cooperative governing mechanisms (Chatzivasileiadis et al., 2017; Liu, 2015). Proposed as a fully developed global energy system by 2050, GEI broadly aligns with three overarching objectives for global energy governance: economic growth, energy access, and environmental sustainability. This pattern of renewable energy development effectively extends an extractivist model of energy provision and use into a new sociotechnical regime, with all its concomitant power dynamics, relations of dominance, and processes of accumulation and enclosure (Angus, 2016).

A distinct pathway for transition reprioritizes or outrightly rejects this prevailing set of objectives for modern energy systems. Characterized largely by decentralized and democratic proposals for renewable energy transition, this second approach is termed regenerative rather than extractive (Movement Generation, 2016), and exemplified by various actions occurring across all levels of society including community-controlled renewable energy (Creamer et al., 2019), civil society organizations, trade unions, municipalities and others organizing to democratize renewable energy systems (Becker and Naumann, 2017), and campaigns to advance globally integrated networks of decentralized, 100 percent renewable energy regions (Boselli and Leidreiter, 2017). Positioning these modes of renewable energy governance as distinct and potentially mutually exclusive trajectories, in view of the resources required for widespread development, underscores the point that renewable energy transition involves not only a shift to renewables, but also a competition among various and innumerable alternatives for renewable energy futures.

This chapter contributes to the understanding and implementation of regenerative energy systems by providing a means to reconsider basic relationships of people to energy, most principally in the context of high-energy societies. The chapter leverages this uniquely prefigurative moment at an early stage of large-scale energy transition as an opportunity to reconsider common assumptions regarding a renewable energy transition—its purpose, functioning, guiding values, and socio-political opportunities. As relevant to this volume, the chapter addresses two critical questions. First, how can energy and environmental justice between and among humans and the rest of nature, within and across generations, be achieved in an age of ecological overshoot? And second, what institutional, economic, and governance innovations can be adopted to promote just transitions in the Anthropocene, an inherently unjust period in its capacity to universalize responsibility and response (Davis and Todd, 2017; Malm and Hornborg, 2014)? The task ahead demands not only shedding the dominance of fossil fuels, but also shedding the fossil-fuel mindset that gave rise to dominant forms of human-energy relations, which remain to a large degree the basis on which renewable energy systems are now envisioned. Efforts to advance an age of renewables, whether centralized, decentralized, or some combination thereof, will likely flounder if they are based on flawed and fossilized foundations and organized around unachievable and unjust outcomes. In short, this project requires new foundations from which to enable renewed human relationships to energy.

To explore these foundations for renewable energy transitions, this chapter follows the authors of *Right Relationship: Building a Whole Earth Economy* (Brown and Garver, 2009) in posing five basic questions in search of energy systems in right relationship with the broader communities of life: What is the global energy system for? How does it work? How big is too big? What is fair? How should it be governed? Thinking through these questions helps point toward regenerative energy systems, systems of human energy provisioning and use that exist in right relationship with the whole community of life. Through this exploration, the chapter makes the case that diverse forms of energy must be allowed to enable highly diverse energy communities. An energy community can be thought of as a collective of human and nonhuman beings spatially and temporally enmeshed and interconnected through flows of renewable energy, and the corresponding relationships that emerge from this collective. Thus, while visions for regenerative energy futures must extend globally in order to decisively end the fossil fuel age, this global perspective must simultaneously resist a universalized response. The following section proposes a brief response to each of the above questions, drawing from understandings of renewable energy, integrated social-ecological systems, and energy and environmental ethics. Implications for different pathways are then discussed, concluding with an appeal for broader engagement with these critical questions among varied energy communities.

Energy systems in right relationship

What is the global energy system for?

The energy transition offers an unprecedented opportunity to collectively reconsider the basic purpose of human energy systems. While modern energy systems are in part intended to provide universal energy access and environmental sustainability, in practice these objectives are constrained when they come into conflict with the overarching agenda of economic growth or its derivatives of energy security and energy intensity. Despite attempts at decoupling, global impact of energy use continues to increase even as billions lack sufficient access (Csereklyei and Stern, 2015; D'Alessandro et al., 2020; Hickel, 2019a; Parrique et al., 2019). The growth agenda of energy systems is failing and deserves to be replaced with a new set of objectives for energy systems.

Developing regenerative energy systems requires recognizing the embeddedness of human economic systems within broader societal and planetary systems. This core perspective draws from ecological economics (Daly and Farley, 2011), understanding the economy as a subset of society, which in turn is a subset of the Earth, with materials cycling within and energy flowing through and throughout (Figure 12.1).

<FIGURE 12.1 HERE>

From this perspective, renewable energy systems can be understood as technologies for guiding continuous Earthly flows of incoming solar energy and outgoing heat. Human economies are some of the countless ways that life on Earth has developed to capture, make use of, and dissipate low-entropy energy as an ultimate means. In a sense, economies, societies, ecosystems, life itself, may be viewed as diverse means for collecting, using, and dissipating energy and materials. From the perspective of these systems themselves, however, energy and materials are means to other ultimate ends such as longevity and well-being. Energy is thus a means to an end for Earth’s living beings, not an end in itself.

To thrive and flourish, all life on Earth must find ways to consistently access primary flows of incoming energy and stocks of cycling materials while safely dissipating waste heat. An energy system in right relationship is one that meets the needs of all members of the Earth community within the means of the planet. Identifying and meeting these needs of the Earth community through renewable energy systems requires broadened recognition, expanded capabilities, and active and ongoing engagement of diverse energy communities (Baxter, 2004; Day et al., 2016; Schlosberg, 2013). The core objective of regenerative energy systems then is not growth, rather the achievement of well-being of the whole Earth community within planetary limits, as implemented through social practices of specific energy communities.

How does it work?

Meeting multiple needs of energy communities within the material and energic means of the planet requires a general understanding of how the Earth’s energy systems function. Conventional energy systems are structured around spatial and temporal divisions that too often conceal the way modern energy systems work and the damaging social and environmental relationships resulting from their use. Spatially, great distances typically separate extraction, delivery, use, and disposal, as well as the patterns of injustice associated with each of these stages (Bouzarovski and Simcock, 2017; Bridge et al., 2013; Fthenakis and Kim, 2009; Huber and McCarthy, 2017; Vallero, 2014). Temporally, fossil energy systems draw from concentrations of ancient sunlight captured by living beings long since deceased, then release the waste from these non-replenishable stocks of high-quality fuels within a very narrow time frame, with consequences spanning generations. Currently, the global energy system provides abundant energy for some and insufficient energy for many (REN21, 2017) while exceeding the planet’s capacity to absorb new streams of waste. Patterns of energy extraction further compel a universalizing influence evident in the Anthropocene, in which methods of energy development and severed energy relations are replicated worldwide, erasing differences across communities. By contrast, because renewable sources are available in very different forms from place to place, the renewable energy transition opens opportunities for dramatically reducing spatial and temporal gaps, bringing into view the functioning of these systems and the consequences of their use and misuse.

Renewable energy, those forms continuously replenished by the natural environment on a human timescale, include primary sources derived from the sun both directly, such as thermal and photo-electric energy, and indirectly, such as wind and biomass, as well as from other natural movements (Armaroli and Balzani, 2011; Ellabban et al., 2014). Globally, this renewable resource potential is enormous, an order of magnitude or more greater than current global energy demand, mostly through direct solar radiation (Desing et al., 2019). However, at a given point in space and time, the maximum flow of solar energy and its related forms is finite, while the density of these flows is substantially less than fossil and nuclear energy (Smil, 2015).

Regardless of source, systems of energy require both energy and material inputs and produce waste as losses through energy conversions, typically in the form of heat, as well as material waste (Desing et al., 2019). Although renewable sources are replenishable, their capture, storage, movement, and use require energy inputs and use of living materials and non-living physical matter of the Earth. Materials may be recycled using energy inputs, yet thermodynamics hold that energy cannot be recycled but is rather converted to other forms of energy. These processes of recycling and conversion produce waste. Globally, there has existed a relative balance of incoming and outgoing energy. The influence of factors that change this balance is measured as radiative forcing (W/m^2), where radiative forcing greater than zero W/m^2 produces global warming and forcing less than zero produces global cooling. Most outgoing radiation is absorbed by atmospheric greenhouse gases and the Earth's oceans, contributing to the warming of the planet's surface and atmosphere (USGCRP, 2017).

This discussion of energy, while defensible from the perspective of physical sciences, is not intended to exclude other ways of knowing or experiencing energy beyond that of a "resource" for human exploitation (Frigo, 2017). Rather, it is intended to accommodate a view of energies as threads that interconnect all living and non-living phenomena, constituting a human relation to the rest of nature. In the context of right relationships, both an ability to access energy flows and a responsibility to allow the same of other living beings are required. An energy system in right relationship with society and the Earth is one in which energy communities manage to achieve well-being of all members within the common yet limited energic flows, material cycles, and waste assimilative and dissipative capacities of the planet. Understanding these basic processes and parameters then directs attention to questions of physical planetary limits on the one hand, and community needs on the other.

How big is too big?

For genuine ecological well-being, a global renewable energy system needs to operate within the limits of the planet. The climate emergency is a key indicator that current energy systems are failing in this regard. The combustion of fossil fuels and the conversion of forest lands for biofuels are leading sources of greenhouse gas emissions contributing to climate change (Ritchie and Roser, 2020). However, climate change is not the only limit currently being tested by modern energy systems. Biodiversity loss, ocean acidification, and water shortages, to name a few, are all partially driven by modern energy use (Algunaibet et al., 2019; Darby and Fawcett, 2018). While a shift to systems using solar and wind will undoubtedly reduce the overall negative impacts to the planet, a narrow focus on carbon emissions risks shifting impacts to other planetary catastrophes such as mass extinction. When considering the scale of global energy development in aggregate, including the quantities of energy captured and used, the extent of physical infrastructure, and the pace of development, a variety of potential impacts must be kept in view.

Global development of renewable energy systems must therefore include approaches to recognizing the Earth's physical limits across various measures. The planetary boundaries approach (Steffen et al., 2015) offers a useful way of thinking about the appropriate scale of global renewable energy systems (Algunaibet et al., 2019; Desing et al., 2019; Khan, 2019). Planetary boundaries are indicators of sociogenic impacts to key planetary processes. The boundaries define a "safe operating space" within which human societies may safely endure. While nine boundaries provide potentially relevant indicators of planetary limits for modern energy systems, several stand out as most relevant for renewable energy systems. These boundaries include climate change, biosphere integrity, land-system change, freshwater use, ocean acidification, atmospheric aerosol loading, and potential novel entities associated with renewable energy technologies. At a global level, land-system change and biosphere integrity deserve particular attention, given the extinction crisis and loss of habitat that characterize the Anthropocene.

Together, these boundaries offer well-suited indicators for assessing an appropriate scale of modern renewable energy systems, and thus support a move toward right relationship. These limits can be thought of as planetary thresholds or ceilings. These thresholds would constitute the set of planetary limits relevant to energy systems, which when breached will increase the likelihood of undesirable and catastrophic consequences. The boundaries themselves are not immutable, rather they indicate an area of lower risk. For regenerative energy systems, energy communities would seek to meet their needs while preventing the aggregate global scale of energy systems (in both extent and pace of development) from breaching these and other relevant ecological limits.

What is fair?

With these goals, processes, and parameters in view, energy communities can turn to questions of how to define basic needs and how to use energy systems to meet those needs for all. The presently dominant perspective gives priority to increasing energy use, primarily for economic growth and capital accumulation, but also for reducing energy poverty. Beyond a certain point, continued increases in energy demand and economic growth do not contribute to any meaningful gain in well-being, rather they concentrate wealth among the few while undermining the very preconditions for achieving well-being, namely an integrated and resilient natural environment (Clark et al., 2018; Daly, 2014). Instead of seeking to decouple growth and consumption from environmental harm, energy communities would decouple human and planetary well-being from the necessity of unending growth. Because global energy demand and economic growth are tightly associated with increasing planetary environmental impact, regenerative energy systems would target community well-being directly, rather than gambling on an agenda of decarbonized green growth. Dispensing with the universal growth imperative implies giving greater weight to distributional equity and justice among all members of the Earth community.

Fairness therefore requires that all communities have the capacity to meet their needs. Before giving weight to conventional notions of energy security (i.e., increasing supply to meet continuously growing demand), meeting community needs through energy systems requires prioritizing sufficient energy sources to achieve a high quality of life. Equitable access to energy must allow the world's poor people, who experience low levels of average per capita energy use, to increase their levels of non-combustion renewable energy use while ensuring that non-human members of the Earth's communities can meet their energic needs through various natural processes.

These outcomes cannot be accommodated within planetary limits if the world's highest energy users fail to constrain and reduce their overall energy use. Put another way, in the context of existing global overshoot, achieving a good life for all within planetary boundaries is possible only if wealthy societies sharply reduce their biophysical footprints from current levels (Hickel, 2019b; O'Neill et al., 2018), including especially the footprint of modern energy systems. Fortunately, beyond a saturation point, there exists little empirical relationship between increasing energy use and further improvements to human well-being, meaning stabilized levels can be targeted without meaningful reductions in measures of quality of life (Burke, 2020). In this way, the developed world would seek to decouple their well-being from high levels of energy use (Hickel, 2019b). Energy systems and their associated economies would develop so that energy communities can flourish with or without growth (Raworth, 2017; van den Bergh, 2017). Beyond energy provision, energy systems must also support efforts to ensure that other human and non-human needs are met, including access to food, water, shelter/habitat, education, and meaningful work.

Shifting to renewable energy systems offers a key opportunity to redistribute capacity to meet the needs of all. The wide availability of renewable sources can facilitate this redistribution in the present, while a shift to 100 percent renewables can better ensure that future generations will also have this capacity, as non-renewable fuel stocks inevitably diminish and their waste exceeds assimilative capacities of the planet. Abandoning the pursuit of endless growth and accumulation (Alarcón Ferrari and Chartier, 2017; Alexander and Yacoumis, 2018; Brand-Correa et al., 2018; Darby and Fawcett, 2018; Kunze and Becker, 2015), regenerative energy systems would enable energy communities to use renewable sources to more equitably meet diverse basic needs across all members of the broader Earth community now and into the future.

How should it be governed?

A reoriented approach to renewable energy development opens new opportunities for the governance of emerging and future renewable energy systems. Informed by the above discussion, a foundation for governance of renewable energy systems would involve several key characteristics in practice (Orenstein and Shach-Pinsley, 2017). First, governing systems would integrate both top-down and bottom-up initiatives, taking advantage of the strengths of each. Second, governing systems would aim to provide mutual benefit for integrated social-ecological concerns. Third, governing systems would focus on specific outcomes while retaining a more holistic perspective. Finally, energy governance would operate across spatial scales, connecting efforts locally, regionally, and globally.

Addressing these qualities, the notion of a “safe and just operating space” (Raworth, 2012, p. 7) demonstrates well the orientation of an energy system governed to achieve well-being of all members of Earth’s communities within the limits of the planet (Darby and Fawcett, 2018). Raworth represents this space using two concentric rings, one indicating an outer environmental ceiling of critical ecological thresholds, and the other indicating an inner social foundation of basic human needs. This rendering forms a life ring[1] that frames an area targeted for safe and fair economic processes. Operationalizing this life ring concept for the practice of governance of energy systems would require a combination of social and ecological indicators as both ceiling and foundation. As humans are fundamentally interconnected with their natural environment, it is increasingly problematic to draw sharp lines between what constitutes “social” and “environmental” foundations and ceilings. For example, Illich (2013 [1973]) asserts that social ceilings exist for maximum per capita energy use, which when exceeded create social disharmony well before an environmental threshold is reached. In sum, a life ring provides a conceptual tool and approach for governing renewable energy systems (Figure 12.2).

<FIGURE 12.2 HERE>

The concept is relevant for top-down and bottom-up initiatives, offers integration of social-ecological systems to guide governance for mutual benefit, places specific issues and concerns within a holistic pattern, and can be adjusted to suit various spatial scales. Accordingly, a life ring provides a focal orientation for the practice of renewable energy governance based on operationalizing a set of metrics relevant to energy communities. The life ring approach allows flexibility for specifying metrics at the local and regional level (Dearing et al., 2014) while integrating globally relevant measures. Application of the energy life ring would require assessments of the points where energy systems threaten to overwhelm planetary thresholds and where they fail to meet basic community needs. Such assessments would become routine practice and constant companions to energy status reports at all levels. The fundamental challenge and objective then for any mode of governance of regenerative energy systems is to achieve well-being for all while respecting planetary limits simultaneously and continuously over time.

Discussion and conclusion

Considering these questions clarifies choices for renewable energy futures. Modes of energy provisioning and use organized around purposes of unending growth and accumulation effectively extend patterns of extraction and their corresponding injustices of the Anthropocene into the renewable age. Systems so oriented will develop by scouring the globe for all available

[1] Raworth uses the term ‘doughnut’ to describe this concept (as in *Doughnut economics* (2017)) but has also suggested the possibility to use alternative terms, e.g., a life saver (Raworth, 2012, p. 7).

renewable and non-renewable energy and material inputs needed to connect and feed expanding energy loads, generating at each step waste heat and other harmful outputs, with few clear mechanisms to respect limits, offering growth as its primary response to global inequities, yielding a homogenizing effect physically, technologically, and socially, and further consolidating decision-making processes already severed from their impacts on the ground.

Regenerative energy pathways are preferred for just transitions as the goals of such systems are not the expansion and use of energy as such, rather the provision and attainment of basic needs and community well-being within limits. Regenerative energy systems exist to support life of all forms, using myriad methods for dissipating energy, at levels of throughput sufficient to ensure system endurance. In practice, these questions will require a multitude of responses based on local context, inspiring equally diverse assemblies of energy communities. How these systems will work will therefore vary widely, as diverse energies must generate diverse energy communities. Multiple modes of provision can be tested and adopted as relevant to unique technical and social-ecological contexts, including self-provision, non-monetary provision, market, public, and commons provision, and more. Participation must not be only as a consumer, rather as a member of a community seeking to provide energy to the whole of that community. Thus, the critical choice is not simply which type of energy to acquire, or even from whom, but rather what mode of social structures can best ensure energy for the intended purpose.

Efforts to institutionalize regenerative energy governance globally would begin at the level of local communities and build outward, guided by the energy life ring, leading to interconnected networks of energy communities. This process requires assessing and improving local capacities for energy governance, expanding organizational diversity (e.g., cooperatives, utilities, trusteeships, energy regions) according to local needs and conditions, and reforming and in some cases dismantling existing institutions. For example, the International Renewable Energy Agency (IRENA) could restructure its membership to center on local, municipal, and regional entities and facilitate cooperation among these actors, supporting nested or polycentric structures of renewable energy governance. Goals for energy access could be broadened to include access to ownership and control of technologies rather than simply to energy services.

This approach implies an indeterminate a priori position to energy technologies. Because regenerative agendas begin from needs of local communities, more diverse sets of technologies may be deployed. These technologies would relate closely to needs as identified by the communities themselves; for example, prioritizing increased deployment of off-grid and micro-grid solutions or open-source options allowing local repair, maintenance, and development. Technological diversification may help avoid lock-in of infrastructures that fail to support the energy life ring, while better positioning communities to respond to crises and uncertainties. The pace of renewable energy transitions would proceed in a manner attentive to various integrated social-ecological measures. The proportion and date of renewable energy targets would be secondary to the ongoing achievement of ultimate-end outcomes constituting the life ring. This approach also implies decreases in total energy use among the energy-affluent, increases among the energy-poor, and rational, targeted, and decreasing use of fossil fuels, channeling their unique qualities toward genuine needs and replacement technologies, while respecting planetary limits.

Worlds of experimentation and sociotechnical diversity can thus be imagined, employing unique, creative, idiosyncratic, and social-ecologically integrated approaches for capturing, storing, moving, and using renewable energy sources. These approaches rest upon a coherent view of regenerative systems that reorients energy and associated development toward mutual well-being of people and planet. Current practices offer evidence of such approaches already available, including just transition programs, community energy and micro-grids, island energy systems, and indigenous-led renewable energy (Burke and Stephens, 2017; MacArthur and Matthewman, 2018; Morena et al., 2020; Smith and Scott, 2018). Beginning at the community level implies less control over energy transition pathways and possibly a messier, flexible approach to sociotechnical development. As such, a variety of decentralized energy transitions would employ many different technologies, financing instruments, organizational forms, and so on, reflecting their social-ecological diversity yet holding a basic commitment to caring for and sharing energy systems designed to achieve well-being for all within the means of the planet.

Accordingly, this chapter seeks to advance a foundation for renewable energy futures through a whole Earth perspective, at once integrating distributed sources of agency, social-ecological responsibility, specific and holistic measures, and multiple scales of governance. More broadly, this work offers an invitation to reconsider common assumptions regarding renewable energy transitions, in an effort to break collective mental and physical dependencies on dangerously inadequate logics of the fossil fuel age and renew human relationships to energy systems. As a core contributor to the disaster and injustice that is the Anthropocene, the age of oil has served to heighten the human disconnect from the rest of nature, enabling self-reinforcing patterns of extraction, while universalizing relations to energy and place. A just transition then not only requires shifting to renewable energy but doing so in multitudes of ways that care for, respect, and give back to the broader communities of life from which these modes of energy arise.

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Figures

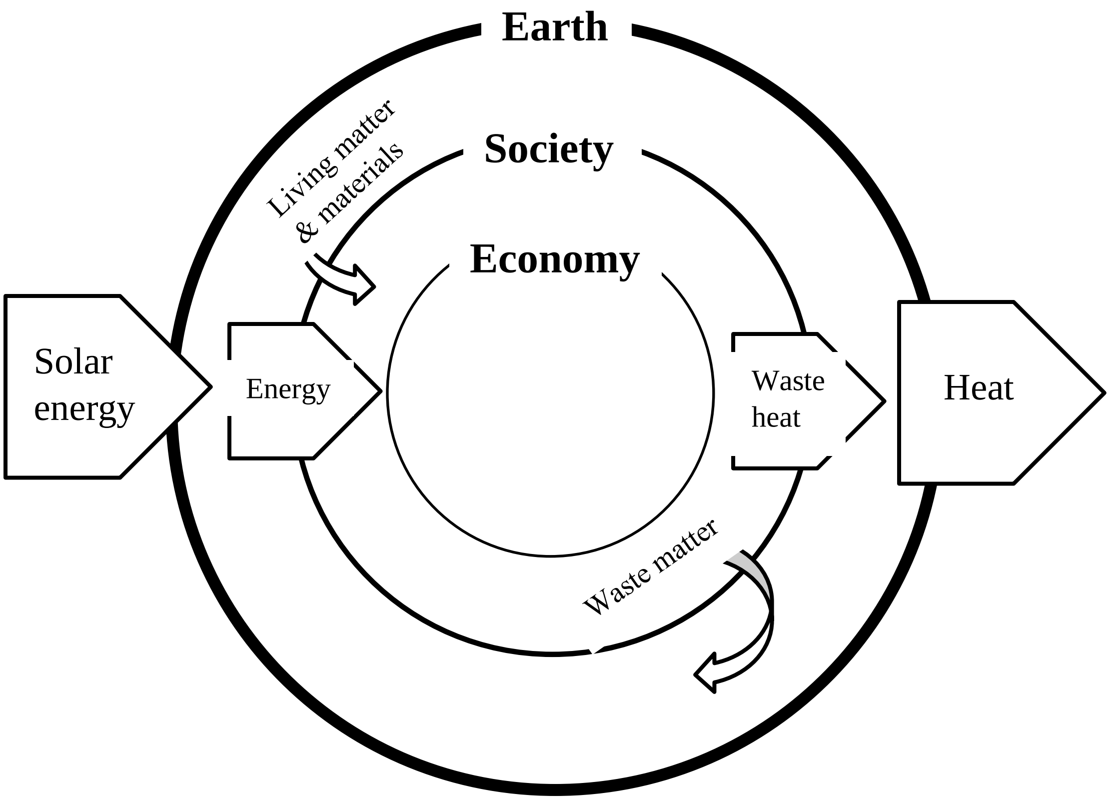

Figure 12.1 A Whole Earth Energy System (based on Daly and Farley, 2011; and Raworth, 2017).

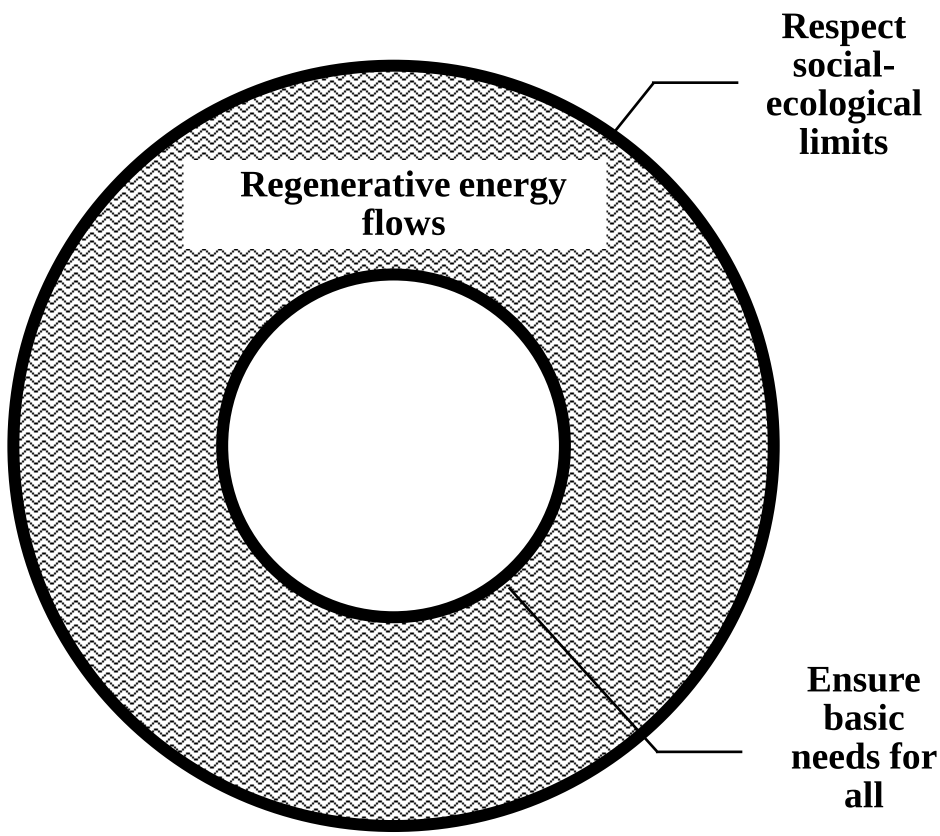

Figure 12.2 Energy life ring: conceptual orientation for just energy transitions (based on Darby and Fawcett, 2018, p. 9; and Raworth, 2017, p. 62)

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