Chapter 2
What Political Economy Adds to Transformation Research

> The continuous striving for improvements in material welfare is threatening to surpass the limits of the natural resource base unless there is a radical shift towards more sustainable patterns of consumption and production and resource use. Persistent inequalities and struggles over scarce resources are among key determinants of situations of conflict, hunger, insecurity and violence, which in turn are key factors that hold back human development and efforts to achieve sustainable development. Business as usual thus cannot be an option and transformative change is needed. As the challenges are highly interdependent, a new, more holistic approach is needed to address them.
> UN System Task Team on the Post-2015 UN Development Agenda, *Realizing the Future we Want for All* (2013: 1).

> Particular narratives are produced by particular actors and so co-construct particular pathways of response. Some are dominant; shaped by powerful institutions and substantial financial backing—these are the 'motorways' that channel current mainstream environment and development efforts. But these can often obscure and overrun alternatives; the smaller by-ways and bush paths that define and respond to different goals, values and forms of knowledge.
> Leach, Scoones, und Stirling, *Dynamic Sustainabilities: Technology, Environment, Social Justice* (2010: 5).

So, if the changes envisioned by the 2030 Sustainable Development Agenda are supposed to be transformational in quality, how do we work toward this quality? This chapter provides the analytical perspective of a system-thinking, environmentally aware political economist with a sober appreciation of technological innovation. It defines two concepts and one heuristic that lie at the core of this view: engaging with the *materiality of ideas* and *radical incremental transformation* strategies enables a *repurposing* of our current development systems. This analytical framework emerged from my transdisciplinary quest to find out why humans collectively create societies that individually they would like to change. This quest has always been connected with sustainable development: no one I know is not in favor of peace, of letting nature thrive and enabling every person and animal to live a life of dignity. So why is this not possible?

My search for answers led me to combine academia and research with political engagement and activism. For a long time it seemed that this made me something of

an outsider: too keen on systematic and nuanced argumentation to fit into a media-driven world of punchy slogans and easy scapegoats, but also too interested in changing the real world to become an expert who dug deep into one scientific discipline. Given the rapidly growing popularity of transformation research over the last five to ten years, in particular in the field of sustainable development, my notion of being an outsider has fundamentally changed: transdisciplinary approaches have become the new thing for tackling the persistent problems that sustainable development strategies face. This means that scholars not only connect different scientific disciplines, but also integrate the insights of practitioners on the ground. The goal is to create robust knowledge that not only refines existing theoretical hypotheses about how humans and the world work, but also has relevance for the people enacting change on the ground.

The term 'transdisciplinary research' was first introduced in 1970 by Erich Jantsch, a Club of Rome member, to encapsulate the notion that inherited scientific knowledge needs frequent confrontations with the 'real world' in order to test, amend and form new assumptions. Only with such an approach would science support the ability of a society to continually self-regenerate. This approach has not been very popular in the Enlightenment-influenced sciences, however. Here, the dominant ideal is of the positivist paradigm whose goal and premise it is that universally true 'laws' governing human behavior and natural evolution can be identified and fit into quantitative models and experiments with which future developments can be predicted and managed. This still does, of course, require researchers to make decisions about what they observe, how they quantify aspects that cannot simply be tallied, and how they interpret their observations. This is why, in scientific terms, paradigms are divided into assumptions that are epistemological (what can we know), ontological (what can be said to exist and how we group those things), and methodological (what guiding framework is suitable in solving a problem). Some scientists also add axiological aspects, encompassing the choice of relevant values. Depending on how these various aspects are defined, a single event can be interpreted very differently. Likewise, proposed solutions for the problem will vary significantly.

The transdisciplinary paradigm differs considerably from positivist ones in its epistemology. For example, it does not involve the ambition of finding universal laws that could be true forever. In its ontology it is constructivist or reflexive and thus does not see 'reality' as something objective that can be observed by researchers at a distance but instead as something intersubjectively created by sense-making actors and thus subject to change. Meanwhile the current state of reality will also impact the way humans—including researchers—make sense of how the world objectively 'is.' As a result, no researcher or truth claim can declare itself separated from reality. Our world, as quantum physics affirms, is constantly evolving. German has a great word for 'reality' to capture this information-based interplay: *Wirklichkeit*. *Wirken* means to 'seem' and 'appear' but also 'have an

effect' or 'operate.' The word 'reality' on the other hand has its Latin roots in the term 'res,' which means 'thing,' 'matter.'

A reflexive research approach therefore views humans as both the object and the subject of making history: today's interactions do not happen in a vacuum but under the circumstances created by us and the generations before us. As a consequence, humans experience individual freedom within frameworks for action laden with beliefs, norms, social roles, typical procedures, rules and distribution patterns that are not necessarily of their choosing but still shape their sense-making and behavior. Thus, my personal opinions and behavior are influenced by my surroundings but also influence those of others with whom I am interacting, my counterparts and observers. And humans are arguably the only species on the planet that can apply reflexivity in order to discover, assess and creatively work with or against the frameworks for action that we encounter.

This point was foregrounded in parts of the 2013 *World Social Science Report* (WSSR) with the introduction of the concept of 'futures literacy':

> The complexity of these processes of transformation raises a number of questions, most notably about people's capacity to imagine futures that are not based on hidden, unexamined and sometimes flawed assumptions about present and past systems. 'Futures literacy' offers an approach that systematically exposes such blind spots, allowing us to experiment with novel frames for imagining the unknowable future, and on that basis, enabling us to critically reassess actions designed in the present (ISSC and UNESCO 2013: 8).

Not everyone within the transformation research community works with a transdisciplinary approach and reflexive paradigm. The community combines a wide array of scientific disciplines and is still sorting out where exactly paradigmatic agreements lie. So within this book I pulled together the work of leading scholars who do at least reject the positivist epistemology and ontology that one finds in the mainstream economic paradigm and its methodological individualism. In this paradigm, humans do not reflect on more than the costs and benefits of the choice set with which they are confronted. So each person in their economic system behaves similarly (representative actors), regardless of where they happen to live. This is very convenient because individual behavior assumptions are aggregated into extrapolations of how the system will work as a whole and what knock-on effects it will have—e.g., the prediction that markets will balance themselves.

However, even within allegedly objective, positivist/standard economics, it has been recognized that such additive approaches risk a fallacy of aggregation, ending in incorrect predictions. For example, American economist Alfred E. Kahn warned of *The Tyranny of Small Decisions* as early as 1966. He stressed that market equilibrium theory must remain cautious about the reliability of its methodological individualism: small decisions by rationally calculating actors may well lead to misallocation effects on the macro scale that produce outcomes which the same individuals would not choose (Kahn 1966: 23). One prime example of this tyrannical effect in natural sciences is the way that climate change results from the cumulative effect of what seem to be negligibly small entities of additional CO_2 emissions made on the individual scale.

The tyranny of small decisions makes perfect sense to those who conduct the complex system research used both to examine the Earth's ecosystems and in social sciences. Here the main thrust of the research lies in understanding relations between single elements and the dynamics of the whole in order to understand why single elements behave the way they do and how this might change. As a result, the emphasis when searching for sustainable development solutions is less on improving single technological products or economic incentives, and more on understanding the dynamics of wider socio-technical or socio-ecological systems (STS or SES) before thinking about which interventions could improve sustainability.

Most reflexive transdisciplinary methodologies work with what has been called a problem-driven approach. The research is designed around a specific problem or challenge that scholars seek to address or produce answers for. Collecting information about its emergence, including talking to people, allows mapping which actors, but also which institutional, technological, economic, environmental, and socio-cultural conditions are relevant factors of its persistence. From this information one can draw a system that is relevant to dealing with the challenge. Often this system will cut across official demarcations of organizations, sectors, disciplines or even nations.

The 2015 OECD *System Innovation* report explicitly defines 'system innovation' as a way of analyzing and innovating that will transgress the boundaries of established containers: "The appeal of system innovation today is closely linked to the pressing issue of meeting the 'grand' or global challenges of today. These global challenges require policy actions across technological, economic and social structures and boundaries, as well as national borders" (OECD 2015: 8).

> Returning to the *Brundtland Report*, we realize that this is not really a new insight: The integrated and interdependent nature of the new challenges and issues contrasts sharply with the nature of the institutions that exist today. These institutions tend to be independent, fragmented, and working to relatively narrow mandates with closed decision processes… The real world of interlocked economic and ecological systems will not change, the policies and institutions concerned must (WCED 1987: 17).

It seems that such structural change implications were among those demands considered too radical at the time and that they thus need persistent reiteration. The transformation and system innovation discourse brings the need for encompassing structural change to the forefront and to the titles of flagship reports, while slowly delegitimizing the narrow emphasis on adaptive market magic, money printing and technological breakthroughs.

To me, this is part of the window of renewed opportunity for sustainable development. The rapidly growing transdisciplinary transformation research community could become instrumental in helping to use this window strategically. It promises the most telling insights into how the infamous integration of ecological, social and economic dimensions of development can be achieved in practice.

2.1 Digging into Societal Transformation and System Innovation Research

I begin with a few definitions from influential sources that illustrate what transformation research leaders say about the challenge of turning development toward sustainability. The Intergovernmental Panel on Climate Change (IPCC), for example, foresees "the altering of fundamental attributes of a system (including value systems; regulatory, legislative, or bureaucratic regimes; financial institutions; and technological or biological systems" (IPCC 2012: 5).

The primarily European Sustainability Transition Research Network (STRN), founded in 2005, says in its mission statement that "incremental change in prevailing systems will not suffice. There is a need for transformative change at the systems level, including major changes in production, consumption that were conceptualized as 'sustainability transitions'" (STRN 2010).

The German government's *Advisory Council on Global Change* (WBGU) published the report *A World in Transition: A Social Contract for Sustainability* in 2011 and defined its viewpoint as follows: "This major transformation will require technological advances, new concepts of welfare, diverse social innovations, and an unprecedented level of international cooperation" (WBGU 2011b, 1).

My contributions to the field focus on concepts that foreground mind-sets because these will inform the purpose that the technological advances, new concepts and innovations of all kinds will serve. And I argue for a Great Mindshift because I feel that willingness to reassess old assumptions and convictions for their validity seldom involves the degree of radicalness required. The definition of transformation proposed by the Stockholm Resilience Centre comes closest: "Transformation or transformability in social-ecological systems is defined as the capacity to create untried beginnings from which to evolve a fundamentally new way of living when existing ecological, economic, and social conditions make the current system untenable" (Stockholm Resilience Centre 2012). To create untried beginnings we need new social imaginaries, sets of ideas including values, institutions, laws and symbols through which people imagine their social whole and envisage how alternative systems would differ from the current situation—and the courage to let go of that to which we have grown accustomed.

In order to develop my foundational analytical concepts of how to achieve the large system change to which the 2030 Sustainable Development Agenda aspires, I will first present a selection of popular transition research concepts from three thick, multi-scholar reports that are also seeking answers to this question. They are all part of the rapidly growing community adopting systemic and transdisciplinary approaches. At the same time, they differ with regard to certain basic ideas and departures for research design and can be systematized as examples of 'the three camps' within transformation research, distinguished by the disciplinary homes from which the new agenda is approached: *innovation management*, *natural sciences*, and *political economy*.

The three camps are certainly not the only possible systematization of the field; they are simply one way of approaching issues discussed within the community itself. Transition scholars should not be upset to come across categories that they reject but are instead invited to read what follows in the spirit of cultivating awareness about framing effects that emerge when we (including myself) choose the lenses and terms with which we decipher the world.

The first camp of transition research tends to contain social scientists with an evolutionary economics or innovation management background. They are primarily interested in understanding how technological advances change the way communities and societies organize themselves and which potentials for sustainable development emerge from that. Their main unit of observation is the STS. The second camp is deeply rooted in natural and earth systems sciences and argues that new knowledge of Planetary Boundaries and ecosystem services needs to be the reference frame for the identification of solutions to sustainable development. Their main unit of observation is the SES. Political economists who engage with the systems frameworks highlight the need to understand unsustainable structural drivers embedded in current economic processes and the effects of increasing marketization and commodification on systemic governance proposals. They would apply these to both the socio-technical and socio-ecological relations and thus I grouped them into *socio-ecological-technical systems* (SETS).

In line with these different views, the descriptions of transition processes also vary. Scholars with an evolutionary economics, innovation and management background tend to speak of repeated learning cycles in which the results of pilot projects and niche innovations are monitored for their effect and the most convincing ones, i.e., the most resource-efficient, become part of a transformed system. More recently, aspects of interest and power have been taken into consideration, but agency remains a less important variable, as the following characterization of "main features of system innovations" shows: "(1) disrupting or complementary types of knowledge and technical capabilities; (2) fundamental changes in consumer practices and markets; and (3) novel types of infrastructures, institutional rules and skill sets" (OECD 2015: 6).

Scholars with a natural science background will tend to search for dynamics, feedback loops and tipping points in the reproduction circuits of ecosystems and develop extraction or pollution targets and principles to help societies stay within safe operating spaces. Often less attention is paid to the question of how the governing frameworks and economic processes needed to stay within the boundaries can be implemented. One important contribution toward this has been the concept of 'pathways' to show that there are multiple possible solutions to governing a safe operating space and that each one implies different distribution and participation patterns. Here the power relations and interests behind the emergence or maintenance of one pathway in particular receive explicit attention (Leach et al. 2010).

Finally, political economy approaches are making their way into the transformation research community. Traditionally they do not have a strong track record in ecological literacy or the relational innovations that technology breakthroughs might engender. The sub-camps that engage with transition research mostly consist

of ecological economists and behavioral economists. They place their chief emphasis on understanding the emergence and perpetuation of capitalist economic path dependencies that keep on pushing SETSs out of sustainable development paths (Göpel 2016). Political economists tend to reject win–win narratives and argue that both transformational changes and the status quo involve winners and losers, and that these should be exposed.

Thus, while all researchers foresee that transition or transformation will involve discontinuities in the current systemic setups and dynamics, their notions of where transformational changes originate differ. The typical terms for explanations thus also differ: 'diffusing technologies' or 'disruptive innovations' tend to be socio-technical terms, 'feedback loops' or 'tipping points' stem from a socio-ecological view, and political economists speak about 'struggles' and 'structural crises.'

Some scholars explicitly prefer the term 'transformation' to the evolutionary term 'transition' because it makes the conflicting aspects of change more clear. But when it comes to defining what constitutes a transition versus what constitutes a transformation, the quotes above demonstrate that there is not much difference. Here, I use the terms interchangeably and wish to map the commonalities rather than the differences between the camps. Each of the three larger studies reviewed here can be roughly grouped into one of the camps. My own bias in what I select will be that of an environmentally aware political economist who appreciates the potential of technological breakthroughs.

Given its conceptual leadership in the field, I start by reviewing the 2010 book *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change* edited by John Grin, Jan Rotmans and Johan Schot. It was the first conceptual milestone of the STRN network mentioned above. This network and its annual International Sustainability Transitions conferences have been the epistemic community development locus for the STS camp.

Its work has influenced my second example: the SES-driven WBGU and its 2011 flagship report to the German chancellor, the transition viewpoint of which is cited above. Here the starting point is less an understanding of transitions as such and more the avoidance of disastrous climate change (one important Planetary Boundary), which is deemed only possible with a great transition. To this end the report has a set of recommendations for policy and science at its core. The Stockholm Resilience Centre cited above is a strong convening player of this camp; the biannual Transformations and Resilience conferences are key exchange platforms.

The third study I will examine was published in 2002 as the outcome of longer discussions of the Global Scenario Group convened by the Stockholm Environment Institute and the Tellus Institute in the 1990s. The report, *Great Transition: The Promise and Lure of the Times Ahead* defines transitions as "complex junctures, in which the entire cultural matrix and the relationship of humanity to nature are transformed" (Raskin et.al. 2002: 3). It states that the world is in transition to a planetary phase and sketches six possible development pathways for the future that combine narratives with quantitative data. The scenarios differ according to the degree of change in human values, paradigmatic thinking and therefore policies

adopted; economic thinking plays a central role. Discussions of *The Great Transition* continue online at http://www.greattransition.org.

Please bear in mind that naturally I can only present selective reviews that are mere snapshots of hundreds of pages. They will not do justice to the entire work but instead provide an insight into the core concepts and basic assumptions underlying these hallmark publications and their respective camps, at best triggering an appetite for more.

2.1.1   Socio-technical Systems and Their Innovations

The goals of STS thinking as developed in the STRN community could be summarized as follows: how can we understand innovations systemically—and apply this knowledge for sustainability purposes. It fits firmly into what I call the reflexive ontology. The status quo of our world is viewed as a constant reproductive process in which "internal dynamics, external influences and the resulting feedback loops keep on rearranging the ordering" (Grin et al. 2010: 6). Technologies are therefore not viewed in isolation but in conjunction with the social practices, norms, and institutions that enable or hamper their use and influence choices between the options on offer. Meanwhile, adopting certain technological solutions rather than others will also influence which institution, infrastructures or business models seem promising and sensible to make good use of.

The diversity of energy systems highlights these co-evolutionary properties. The availability of resources on a particular territory and in geopolitical relations with potential delivery partners will make some fuels and raw materials for harvesting technologies more desirable then others. The availability of investments depends on the desirability of proposed solutions, while existing market and ownership structures will play an additional role in these judgments. Meanwhile, knowledge about the negative pollution effects and risks of some fuels compared to others will impact citizen opinions, while consumer acceptance of technological solutions depends on consumer budgets and habits. Policymakers navigate this set of information and preferences in order to shape governing solutions that find support from lobbyists and voters—which will in turn impact geopolitical relations and investment expectations. Breaking out of a particular system of energy supply therefore depends on changes in all of these dimensions rather than only in the availability of alternative technologies.

The highly political battles over the ongoing renewable energy transition in Germany and the fierce opposition of powerful incumbents of the fossil energy system are good examples of this. Transitions are therefore always "intrinsically social, full of uncertainties, ups and downs, twists and turns" and should best be viewed as a dynamic, multidimensional, multi-actor and multilevel challenge that cannot be planned and predicted in a linear manner (Grin et al. 2010: 6). In order to get a grip on how to meet this challenge, the 2010 book provides some key conceptual frameworks of the STRN community and I picked out the two most popular ones to make my case. They seek to explain and improve understanding of

processes of transformation and thus can be applied for many outcome goals of transformations, like moving toward a safe operating space or institutionalizing a Second Enlightenment with a new economic paradigm.

The STS transition research community was born in the Netherlands when professors Jan Rotman, Johan Schot and John Grin combined their respective research backgrounds for a programmatic approach toward understanding larger system changes. These scholars primarily study medium-sized systems, often on a sectoral basis like energy. The duration of transformational changes in these systems is estimated to take about 40–50 years (Grin et al. 2010: 3–7). One of the key iconographic outcomes of this endeavor is the Multilevel Perspective (MLP) presented in Fig. 2.1. It was developed by Jan Rotman and his student Frank Geels and highlights the interplay between different societal subsystems across space and time. It differentiates qualitative levels of resistance to intentional and spontaneous change in order to identify multiple upward and downward causalities of influence behind large system change processes. It is important to note that these are functional scale levels and do not represent spatial or geographical hierarchies.
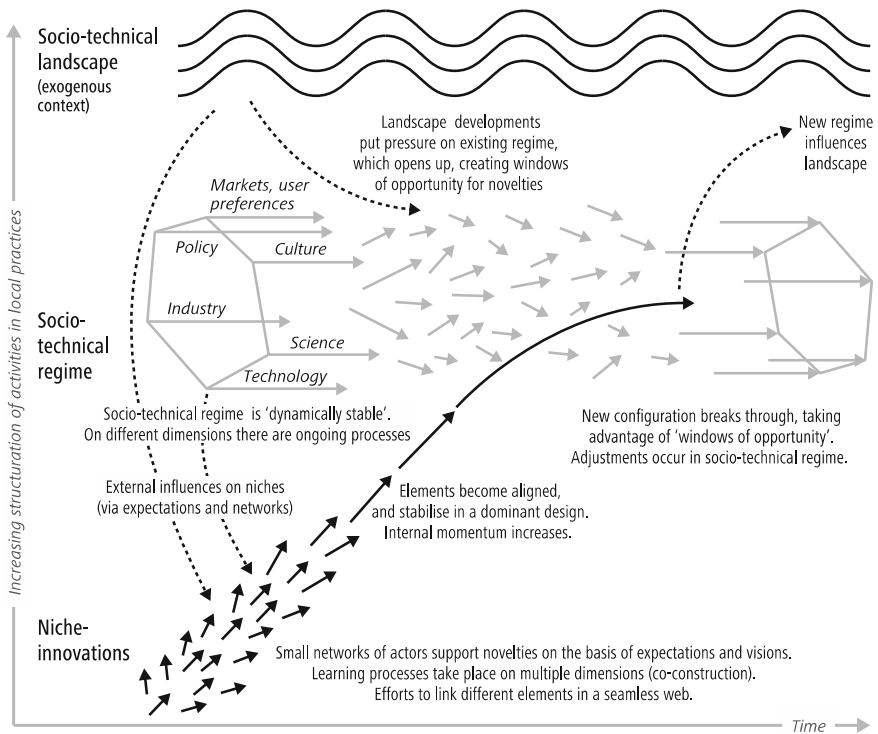
Fig. 2.1 The multilevel perspective on system transformation. *Source* Geels and Schot (2010: 25)

Figure 2.1 shows that the most innovation-friendly level is the *niche* or *micro-level* where small units or 'situated groups' experiment easily with alternative solutions, as long as the degree of interdependencies with overarching or neighboring systems is not too strong. Examples here range from single technology innovations like mobile phones to empowering local food production (e.g., Community Supported Agriculture or CSA). Their initial development often takes place under conditions shielded from the overarching regime logic. These can be laboratories for research and development in science, experimental pilots introduced by businesses, direct or indirect government subsidies for desired solutions, or the emancipatory initiatives of citizens.

Higher levels of structuration characterize the *regime* or *meso-level* because it hosts structures in the form of well-established institutional setups in governments and markets, scientific standards and technologies or infrastructure. They change much more slowly and define a framework for action that tends to stabilize the status quo because it limits the scaling and multiplying of alternative solutions.

Yet, the MLP is not intended to present a hierarchical ordering but rather embedded systems. It could and often is read as a bottom-up theory of change, in particular because the arrows that represent change-inducing pioneering activity in the graph emerge from the niche level. But it is important to point out that change can emerge on all levels. Pioneering initiatives can be little hubs of deviation and innovation within entities that fall into the *regime* grouping—for example, research and development units in big corporations or inter-ministerial units in government. An activity is pioneering if the solutions it promotes differ radically from the status quo. And typically, niche actors depend on support from pioneering actors within the regime institutions in order for their solutions to become part of an adapted or transformed system configuration.

For this to happen, an important role is given to the *landscape* or *meta-level*. It harbors all those aspects that intentional action will likely not be able to change in the short- or medium-term. These are natural developments like climate change but also deeply anchored human-made institutions like the market system or hegemonic paradigms, social values and cultural beliefs. This level forms the backdrop, or deeper structuration, of lower-level developments. Sudden expressions of ongoing changes here, like natural disasters, a massive financial crisis or an outbreak of right-wing violence against refugees, have the quality of shocks for the subsystems and their self-stabilizing processes. These shocks tend to be windows of opportunity for change, a point I will return to below.

Depending on the author, one finds slightly diverging descriptions of the level at which single aspects like market patterns or policy orientation rest, i.e., regime or landscape level. This choice often depends on the actual case researched and the individual view of the researcher as to what should and can be changed intentionally. The joint message is that the higher the level, the slower the change processes and the more difficult for individual actors to imbue transformational missions. But it also means the higher the level the higher the transformational

impact: changes in overarching systems always reshape the framework of action for smaller units, whereas only a critical number of changes on lower levels are likely to impact higher levels.

The other joint message is that despite the good intentions of many actors involved, unsustainable trends persist, a phenomenon that can best be understood through a systemic view that recognizes not only economic and technological dimensions of innovation but also institutional and sociocultural aspects. The latter affect not only which solutions take off but also whether their adoption will transform or perpetuate system dynamics. One great demonstration of the added value of such a holistic systemic approach is the search for answers for the widely observed 'rebound effect,' namely, while resource efficiency goals and standards reduce the relative resource use per product or service, overall resource use is not coming down.

This observation was originally made by William Stanley Jevons in 1865 regarding coal extraction. The steam engine alleviated the need for coal in one sector but the fall in prices then made it economically viable to use coal in many other contexts, which increased overall extraction again. This example is now known as the Jevons Paradox and he generalized it into the statement that a more economic use of a resource must not be confused with its sparing use (Jevons 1866). More recent examples include the technological advances in transport technologies for cars and planes, which have made each kilometer of distance traveled more efficient and therefore economically cheaper. The consequence was a spurt in kilometers traveled and rising emissions from the transport sector.

Thus, without checking holistically for the driving factors behind resource extraction, we cannot change the overexploiting trajectory. If we begin with the most obvious drivers, we must consider the number of people: population levels (landscape) are still growing and at the same time a significant percentage of people live with fewer material goods than they need for a decent life. But this can hardly explain the persistence of rising resource consumption in countries with saturated material needs and stable population levels. Here, when we examine the regime level, we find, for example, business models based on constantly increasing outputs embedded in market patterns geared at constant competitive growth of national output. As a consequence, billions are spent on marketing measures to ensure that a consumer culture (landscape level) guarantees demand for, or at least acceptance of, what could count as oversupply. This culture then runs counter to solutions that involve raising prices for resources that would in turn make products expensive: people have become used to rapidly changing fashion or technology trends and the short product-lives in throw-away use patterns and business models (regime). As a consequence, absolute resource use increases despite impressive technological efficiency advances in pioneering products or firms (niches).

Transition research therefore starts with one particular persistent problem or undesirable trend and seeks to find and understand the key reasons, drivers and stabilizers of the system to which it is host. The overarching term used for multifarious different stabilizers of certain system dynamics or development in

institutionalism theory is 'path dependencies.' All transformation researchers use it, albeit giving different degrees of attention to the technological, economic, institutional, sociocultural and ecological dimensions that path dependencies combine. So depending on the camp and also the individual researcher, such path dependencies include more directly visible political laws and regulations, infrastructural or technological limitations, market patterns and scientific knowledge, but also consumer behavior, power plays, firm strategies and economic transaction cost considerations (WBGU 2011a: 418–419). Moreover, socio-psychological aspects like norms, role expectations, lifestyles and self-images or shared beliefs play important yet less tangible roles (Welzer 2011). Complex system theory would say that path dependencies harbor important 'feedback loops' in that particular system. All of these usages of path dependencies capture processes within a system that hamper a change of course. So at least some of them need to be 'unlocked' if the problem or undesirable trend should discontinue.

Path dependencies also form the link between the MLP and the second concept for explaining transformational change, the *s-curve or multiphase concept*: path dependencies behind one particular problem do not necessarily adhere to one of the levels but might cut across them. The set of path dependencies behind the rebound effect was one example of this. And each context shows a different, historically grown setup of path dependencies, which means that one niche proposal or initiative may work in one region but not in another. And here we depart from any notions of and demands for blueprinting. Even if a solution is doing magic in one place, this does not mean that replicating it in another will lead to success.

Hence, the starting point of strategic transformative research designs is always one particular wicked problem in one defined context. After the challenge has been defined, the system that is relevant for understanding its existence and persistence is mapped, including aspects or elements from any MLP level if suitable. The results portray unique system boundaries: constellations with different scope, dynamics, impulses, agents, and room for maneuver. The next step then lies in developing ideas on how to intervene in these system constellations so that desired outcomes—like avoiding the rebound effect—become likely. This is where the multiphase concept as another key iconography of the transition community comes in. It is basically a very coarse model of a theory of change for complex systems and shows at which stages which intentional change initiatives seem promising.

The multiphase concept illustrated in Fig. 2.2 shows that transformational changes in complex systems do not unfold in an obvious and linear manner where the dosage of change-input equals that of change-output. Unless they are triggered by some drastic shocks from neighboring or overarching systems, system transformations require a build-up in which not much is visibly happening before tipping points are reached, after which a lot of change happens in a short period of time. After this chaotic and contested phase either a restabilization of the system or its collapse can follow. When this change pattern is captured in an illustration it resembles an 's', which is why the multiphase concept is also called the 's-curve.' Sequencing is typically divided into four stages:
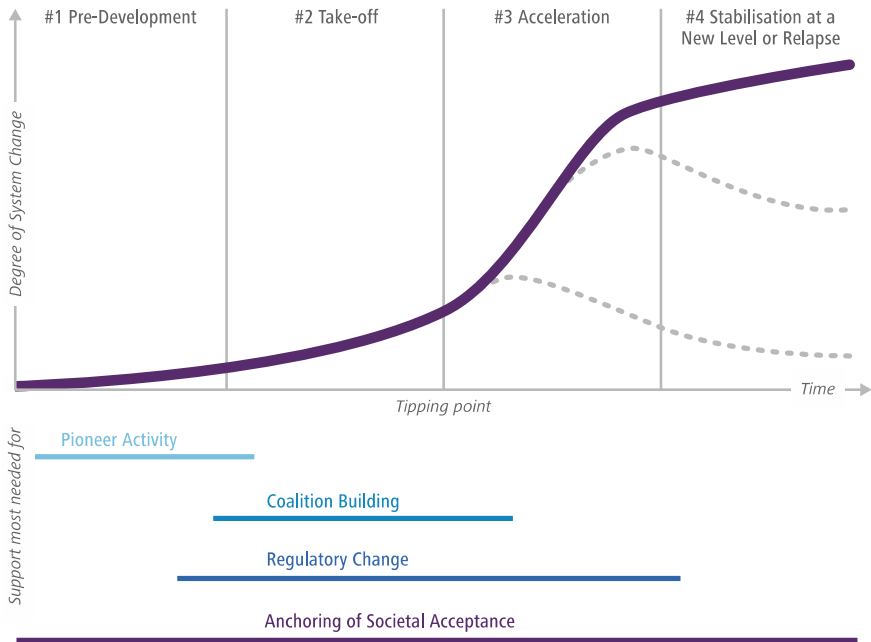
Fig. 2.2 The four-phase pattern of transformation processes. *Source* Based on Mersmann et al. (2014: 34)

1. *Pre-development*, in which a system is in a dynamic state of equilibrium and changes slowly but unobtrusively.
2. *Take-off* or point of ignition during which more coordinated niche activity and regime reactions gain momentum. These may lead to the tipping points followed by an…
3. *Acceleration* or *navigation* phase in which structural changes become possible and visible but hard to control. Eventually, at the stage of…
4. *Stabilization*, a new dynamic system setting emerges. This can be a transformed system in which the overall development trajectory is different, because it is informed by many niche elements and ideas. However, this can also be an adapted version of the old dynamic in which most of the challenges have been absorbed or subjugated by the old regime structures, so that some aspects are amended but the general development trajectory stays the same. In a third alternative, the system can collapse when it falls out of the order imposed by the former dynamic, should restabilizing feedbacks and activities be insufficient (Grin et al. 2010: 3–7).

The phase pattern was originally observed in natural systems but proves very insightful for social changes as well. It is part of all the reports reviewed in this chapter. Figure 2.2 provides an example illustration drawn up for a climate change financing project by myself and my colleagues at the Wuppertal Institute

(Mersmann et al. 2014). It has been labeled with ideas about which type of activities seem promising in each phase if a donor would like to support intentional transformational changes. In our particular case these have been climate mitigation and adaptation strategies with transformational impacts.

The basic message behind this phase concept is that stable systems, i.e., those whose path dependencies work in smooth dynamic alignment, will be immune to any attempts at trans*form*ational change. Their form is well supported by ongoing, often slightly adaptive activities that maintain stability. Only through increasing irritations do the alignments become brittle enough to provide space for more radical changes: those that challenge this form.

Such irritations can be new challenging knowledge (e.g., on climatic change), growing niche activities (e.g., around new renewable energy technologies), or emerging landscape changes (e.g., increasing droughts and floods). If these prevail despite adaptive calibrations, the alignments eventually stop running smoothly—hence the term tipping points. These tipping points are highly political because they mean that the feasibility, support and legitimacy of the old form has ceased, so struggles about what should replace it are intense. This replacement outcome could be a transformed one that embeds a new system goal or purpose—but could also be re-formed to accommodate some of the irritations but stay on a similar development trajectory. The multi-phase graph encapsulates this view: only with significant changes of path dependencies on the regime level will there be lasting transformations of the system's dynamics.

The thick purple line should not give the impression that the phases are unfolding in a linear fashion. Transformations are a rocky and highly contested ride. This graph is a gross simplified model of what would, in reality, zigzag considerably if viewed in more detail. The energy transition in Germany is a good example of how this simplified sequencing can help understand and inform the intentional transformation of large systems. The following provides a rough tour through important developments over the last few decades and groups them according to the phases. It also shows that all dimensions of path dependencies from cultural to technological are playing a role.

The important landmarks indicating the rising awareness in Germany that energy systems would need to be transformed were the 1970s oil crises and the reports about limits to the exploitation of natural resources. These first regime crises were reined in but the sociocultural anchoring of the awareness that a fossil energy development path was contested and risky prevailed. This fed into an already ongoing anti-nuclear movement that led to the creation of The Greens as a political party. The Greens got enough votes to enter the German parliament, the *Bundestag*, in 1983 and the 1986 Chernobyl nuclear power plant disaster worked like an accelerating shock from the landscape level for its political agenda. Environmental concerns became much more mainstream.

Meanwhile, from the early 1980s onward, technological developments slowly but surely made the idea of significant renewable energy production seem feasible. Niche players acted in a pre-development phase under favorable civil society and public discourse conditions. Some regime pioneers in the political and investment

community understood the potential and started to support these developments through targeted research initiatives into technological opportunities and transition pathways. In the political discourse these became solutions to what was established as a societal challenge and the first small feed-in tariff regulation in 1991 encouraged credit for technology pioneers.

Following Germany's 1998 elections, a new coalition government incorporating the Green Party started to develop renewable energy support schemes and the anti-nuclear agenda became a fully-fledged Renewable Energy Act. By 2000 this included not only an agreement on phasing out nuclear power plants over the following 25 years, but also differentiated support schemes for different renewable energy technologies. These were available to all end users of electricity who wanted to become producers by installing small-scale solar, wind or biomass power plants. The 'feed-in tariff' scheme provided guaranteed prices per kilowatt-hour of renewable energy fed into the national energy grid over 20 years. It obliged electricity utilities to purchase this energy but allowed for them to push the cost onto the final consumer bills.

This mechanism effectively created a return on investment security that attracted conventional banks and risk-averse investors into lending small enterprises, farmers and citizens money to install renewable energy technology. For the first time there was a technology market in a sector previously dominated by a few big companies whose long-subsidized centralized coal and nuclear energy infrastructure seemed more like oligopolies. Since these older business models had rendered the transaction costs of switching to renewable energy solutions prohibitively pricey in the past, no pioneering movement had been possible. The Renewable Energy Law hedged the risks of a plethora of new, decentralized energy producers and unleashed the competitive activity of many small- and medium-sized enterprises (SMEs) active in technology development.

By the mid-2000s the tipping point into the acceleration or navigation phase had been reached, and pioneering activities had become mainstream considerations. Fossil energy suppliers now felt threatened and tried to fight the regulation at all levels, e.g., attempting to make the EU declare feed-in tariffs incompatible with energy market integrations. But the renewable energy sector grew very quickly, created many jobs in rural areas with high unemployment and turned Germany into an international technology leader that inspired other countries. Thus, an environmental issue had found technology solutions and became solidly economic when it served the export interests of the German economy and found wide, bottom-up citizen support.

The share of renewable energy in the electricity mix increased steadily, debunking the strongly spun narrative that renewable energy systems were technologically unfeasible—although concerns about black-outs remain. However, a new narrative was established in which a transformation of the energy sector was both possible and in progress, drawing in many new participants.

However, unexpected side effects—like rapidly dropping prices for solar technologies; changes in international production relations (solar panels imported from China were much cheaper and their German purchasers were also entitled to the

feed-in-tariff support scheme); problems with the functioning of the electricity market (renewable energy has no fuel costs and therefore does not fit a spot market sales scheme); and some resistance to the alternative electricity grid infrastructure from civil society—led to a new and critical phase that required legislative changes.

Actors with vested interests in the fossil energy system inevitably used this strategically. When the government changed to a conservative party coalition with a very industry-friendly liberal party in 2009, a window of opportunity to open the Renewable Energy Act and terminate the agreements to phase out nuclear power plants emerged. This in turn boosted the revenues and stock values of the incumbent energy players. These had entered the renewables production and lobbied for electricity market regulation that would favor big suppliers over small ones and compensate conventional energy plant owners for being fall-back providers in periods when renewables could not deliver.

Although the flipflop on the long-standing nuclear exit encountered much public and political resistance in 2010, it was the Japanese nuclear catastrophe in Fukushima in March 2011 (a shock from the landscape level) that caused the conservative Chancellor Merkel not just to return to the nuclear-exit strategy but also to go even further by fostering a cross-party consensus on an energy transition roadmap. This consensus foresees tackling issues in electricity markets, compensation injustices and electricity provision infrastructure that are all in line with the goal of a renewable energy system. Yet, at the same time, the former plan for rapid transformation was also watered down when the priority to get as much renewable energy as possible was replaced by a target of 45 % by 2020.

Its proponents argue that this is due to safety of supply and better cost management, but it is clearly also less disruptive to the incumbent business models, whose champions get public money to dismantle the previously lucrative nuclear power stations. Nevertheless, these providers have been hard-hit by a plunge in stock market value and revenues. So the German example clearly shows that each transformation involves changes in who is winning and who is losing—and that incumbents will not easily give up on status quo solutions.

So it is no surprise that Germany is still grappling with putting the energy transition commitment into practice and will be for decades to come. It seems that the radical vision of a renewable energy system will not be reversed: its purpose has been changed from 'as much energy as possible at lowest costs' to 'climate-friendly and long-term secure energy.' The cost effects are often used and misused in arguments against the transition but its sociocultural anchoring is still firm and broadly based. But the regime restabilization actually required to achieve this goal is far from complete: intense struggles are taking place in the social, economic, cultural, technological and political dimensions of the energy system. Who is paying how much for which type of electricity? Which business models receive which type of financial support? Where can wind turbines and solar panels be located so that they fit the landscape? Which storage capacities will be available to smoothly provide irregularly harvested renewable energy? Which party coalition is supporting which business sector and how do Germany's European neighbors react to a transition that also impacts their energy grids?

Large-scale system transitions take time and are full of political battles and small steps. The actors that steer or influence a transition are, at the same time, part of it. Their freedom is a structured one, framed by the existing path dependencies. Here we find the basis for the concept 'radical incremental transformations': no deep and wide changes will happen without pre-development and build-up leading to frictions and crises that provide the space for them.

2.1.2   Socio-ecological Systems and Their Safe Operating Spaces

From an ecosystem perspective, the main question for the SES camp could be summarized thus: how can we best understand sustainable human societies and apply system innovations to achieve them? Important institutional research in this field is carried out at the Stockholm Resilience Centre in Stockholm, Sweden, and also the STEPS Centre in Brighton, United Kingdom.

One report that made significant waves in Germany was the WBGU's 2011 *World in Transition: A Social Contract for Sustainability*. The WBGU was founded just before the 1992 UN World Summit on Sustainable Development with the mandate of providing independent scientific advice. A key idea promoted by the WBGU in an earlier report was that of "planetary guard rails" similar to the "Planetary Boundaries" introduced by Rockström et al. (2009). While acknowledging other environmental domains and their overuse, the main emphasis of both the WBGU guard rails and the 2011 transition or transformation report (the German title uses 'Transformation' but the English translation is 'transition') lies on climate change (WBGU 2011a).

Overall, the single most important issue and overarching goal of the different measures and strategies discussed, is the avoidance of catastrophic climate change with all its implications for "the world's ecosystems and their ability to sustain human life." Given the wide-reaching consequences of the carbon cycle for life on earth, a transformation toward "climate compliance" is declared an "ethical imperative" similar to that of the abolition of slavery and child labor (WBGU 2011c: 1).

Climate change is introduced as the most important environmental global challenge and the report discusses other global megatrends in order to understand interlinkages: economic development; democratization; global energy supply and demand; urbanization; and patterns of increasing competition for land use between food, bio-energy and forests. It also seeks to identify how these and ecological earth system trends interrelate. As a result, the three areas with the highest transformative impact are identified. These are the sustainable design of future energy systems, urbanization trends, and land use patterns. The programmatic gist of these required transformations is to turn current carbon-based economies into ones based on renewable, or at least recyclable resources. The magnitude of this remodeling is

equated with "the two great revolutions which have crucially shaped world history: the Neolithic Revolution (the diffusion of arable farming and animal husbandry) and the Industrial Revolution (the transition from an agrarian to an industrial society)" (WBGU 2011b).

In line with the focus on the fossil fuel foundations of our current development model, one part of the *World in Transition* report provides detailed information about how these megatrends impact energy use. It also discusses the technological and economic feasibility of decarbonizing our economies and concludes that decarbonization is possible if a supportive "social contract" between state, civil society, business, science, and research is agreed. In essence this contract involves the agreement that new rules are necessary for the economic system, and also conclusions on how development could subsequently proceed.

While many of the contract's rules will impact on very structural technological, economic, political and ecological path dependencies, the prime root for its conclusion lies in the sociocultural domain: the ethical basis that can bind such diverse interests could lie in our responsibility toward future generations, combined with ecological responsibility and a culture of democratic participation. If the contract were based on such a visionary agreement (read: a better purpose for development), it would provide the legitimizing backdrop from which a 'proactive state' engaged to change the rules and incentives so that sustainability transformations could proceed. As a potent manifestation of the contract the country could embed sustainable development or climate protection into the constitution.

Wide discussion of such a new social contract is intended to generate the political will and public support necessary to break some of the current barriers to policy change, namely powerful interests vested in the fossil-fuel-based infrastructures and consumption patterns of our economies today. The antidote to powerful lobbyists is public opinion, which the authors claim has undergone a significant shift in the direction of environmental awareness and post-materialist value sets. The Gallup Institute's *World Values Survey* is cited as one important base of evidence for this, as are the ongoing initiatives on new measures of progress, wealth and well-being. Thus, the new social contract would find its expression not primarily on paper but rather in people's consciousness: it changes what they judge to be appropriate and desirable policy and product options (WBGU 2011c: 2).

Adopting the STRN concepts, the report foresees that extended participation of enlightened citizens would not only legitimize but also improve policy implementation, which creates new room for pioneering sustainable business and citizen practices that test prototype practices for a sustainable society. These may turn into niche solutions, like an eco-village, a car-sharing business or a renewable energy cooperative but also possibly set a new trend. Such pioneers of sustainability practices operate in all parts of society, business, non-governmental organizations, culture and even in political decision-making.

These emerging solutions put visions into practice and provide proof to policymakers that alternatives to fossil-based energy dependence are not only thinkable

but actually possible. Through strategic niche management the state could therefore create more spaces in which social and technological experiments are protected from immediate market exposure. Meanwhile, the niche players can also increasingly press for policy changes in the regulatory regime so that their solutions are able to expand instead of being held back by the current path dependencies on the regime level, like vested interests and structures of production and consumption.

Following citizen pressure, supportive regime-level changes are also proposed. Institutionalized foresight and long-term orientation expresses the spirit of the contract because it counters the dominance of short-term orientations in democracies with frequent voting cycles: the immediate costs to one's core voters are very unpopular, even if they help prevent much higher costs in the future. In addition, improved democratic participation in the formulation of policy changes is supposed to up their acceptance and legitimacy. Some possible accountability mechanisms to these ends include a future chamber of parliament that frequently reports on the long-term effects of policies and programs, and also ombudspersons whom citizens can address in cases of perceived maladministration or with whom civil society organizations can work before bringing cases of environmental damage to the courts.

Thus, transformation occurs when regime structures are changed to a meaningful degree, accelerating the spread of existing pioneer solutions and incentivizing even more radical ones. Taken together, the "requisite transformation encompasses profound changes to infrastructures, production processes, regulation systems and lifestyles, and extends to a new kind of interaction between politics, society, science and the economy" (WBGU 2011c: 1).

In summary, the emergence of the Great Transition is described as a rather evolutionary learning process, in which more knowledge and sustainability values will make things better and bring down powerful vested interests. Key interlinked processes mentioned here can be summarized as:

- Learning about technical performance, market demand, infrastructure requirements, policy instruments and symbolic meaning.
- The articulation and adjustment of expectations or visions that guide innovation activities and help attract attention and funding from additional actors.
- The building of social networks that expand resources and capabilities (WBGU 2011c: 1).

In this way the authors of the 2011 WBGU report put strong emphasis on the overarching role of joint ideas and visions in encompassing change processes, and add these sociocultural aspects to the STRN perspective. They also discuss at length what the role of science itself should be in these processes. As the WBGU is firmly in the SES camp, this includes understanding the carrying capacities of our ecosystems. The WBGU also draws attention, however, to the role that transformative science plays in this context, and promotes a notion that science should become part of bringing sustainability solutions to life. The theory of change is summarized as follows:

> In co-operation with policymakers, business and society at large, the scientific community is tasked with developing visions for a low-carbon society, exploring various development pathways, and supporting sustainable technological and social innovations. Education should help to create problem awareness and promote systemic thinking, thus empowering people to participate in and shape the transformation process (WBGU 2012: 1).

When considering the redesign of energy systems, urbanization trends and land use patterns, a study of the wider setting of correlations and side effects will enable people to not only think about more efficient cars but also to explore how mobility can be delivered in the most sustainable way (WBGU 2011a: 342–343).

Here of course we find a strong link with the emphasis on mind-sets in this book, and my call to integrate political economy stems from what I find to be a slightly naïve conception of the origin and roles that ideas and paradigms play in political processes and their relation with power. While hardly anyone would explicitly argue against values like the protection of future generations or our environment, the devil lies instead in the detail—in this case the worldviews held. The same value set might lead to very different proposed solutions, given differing worldviews and their focuses. Mainstream economic mind-sets tend not to support the regulation of markets precisely because this would hamper individual freedom, happiness, creativity and meritocracy—values to which most people would subscribe.

In one paragraph, the report mentions that Karl Polanyi's interpretation of the industrial revolution, *The Great Transformation* (1944), describes how "attitudes and considerations inspired by personal benefit maximisation have established themselves" and that with mass production, "the 'good life' has increasingly become synonymous with material wealth" (WBGU 2011a: 67). The proposals for change in the report, however, leave this deep cultural wiring and its mental path dependencies unchallenged. Hence, it does not say how the observed value shifts can be implemented if there is no discussion of the paradigm behind the evidence and narratives used to argue which policies are suitable to embed the shift.

2.1.3   Socio-ecological-Technical Systems and Their Repurposing

The discussion of paradigms and mind-sets is an important aspect of the 2002 report *Great Transition: The Promise and Lure of the Times Ahead*, which primarily explores the question: how do we best understand human choices and apply this understanding in times of transformation? It is the result of seven years of collaborative efforts between the Stockholm Environment Institute and the Tellus Institute in the United States. The goal was to describe and model scenarios for potential future development paths, including one that would be a Great Transition toward sustainable development.

Making reference to two former "sweeping macro-transformations" from the Stone Age to early civilization about ten thousand years ago and from there to the modern era in the last one thousand years, such transitions, says the report, were

marked by a change in the "entire cultural matrix and the relationship of humanity to nature" (Raskin et al. 2002: 3). With this definition the report combines an *ecologically embedded socio-technical view* (SETS) with an economic lens on relationships. The authors describe social organization, the character of the economic system, and capacity for communication as the three core dimensions that have been transformed.

The modern era is seen as beginning with the advent of nation states as the social and political forms of organization that interacted with the establishment of capitalist-industrialist forms of production and consumption. In parallel, communication also expanded its geographical scope and became more widely accessible through printing. The ongoing twenty-first century transformation toward what the report calls the "planetary phase" is marked by the globalization of all three dimensions: governance beyond nation states, multinational economic relationships and information technology communication connecting almost all parts of the world. Another pattern observed is increasing social complexity, an accelerating pace of change and spatial connectedness, so that few places are immune to what takes place elsewhere. From this the authors conclude that the next transition should not last ten thousand or a thousand years, but around a hundred.

The 2002 report locates the origins of the modern era transition in the characteristics of the modern capitalist industrialist system that overthrew the authority of a society based on birthright, economic traditionalism and rigid class divisions. Instead, law-governed institutions, market economies and a society based on scientific ingenuity and mass production emerged. The authors also observe that these institutions were designed to primarily harness some aspects of human potential, those for accumulation, acquisition and innovation: "A permanent revolution in technology, culture and desire spawned an explosion of population, production and economic complexity. Ever hungry for new markets, resources and investment opportunities, the self-expanding and colonizing industrial system began its long march toward a world system" (Raskin et al. 2002: 7).

The planetary phase was a necessary outcome of this explosion because the fate and relationships of peoples in different parts of the world are now too connected for anyone to think that developments in one part of the world can happen without impacting others. In addition, the fate of and relationships between people and nature are too intertwined for anyone to believe that the destruction of ecosystems can leave humanity unscathed.

So the report focuses not on *whether* there will be a transformation but instead on the fact that one is already underway. It is up to purposefully acting people to influence which path this transformation will take. In terms of what drives conscious human action, the authors distinguish several different mind-sets. Each of them embodies beliefs about the potentials and qualities of technological, human and natural changes. They amount to paradigmatic differences regarding the assumptions of what we can know about the world, what we say the world is like and how we presume it ought to be. This broad categorization distinguishes three typical lenses through which to anticipate the future:

- *Evolutionists* foresee conventional worlds because they are convinced that the dominant patterns of the modern era can be adjusted to deliver prosperity, stability and ecological health.
- *Catastrophists* foresee a future of barbarization because they predict that environmental, social and economic crises will lead to a perfect storm.
- *Transformationists* share these concerns but still believe that a Great Transition toward sustainable solutions is possible.

The authors describe two development scenarios for each of the three world-views in the event that each type of thinking—evolutionist, catastrophist, trans-formationist—guides people's actions and decisions in consumption, production and policymaking. Examples include whether or not societies will elaborate policies aiming to decouple resource use from economic growth or if they might, at the same time, aim to reduce overall resource use. Other paradigmatic crossroads look at what might happen if we continue to pursue more GDP per capita as a means for better living or, by contrast, if the consumption-based welfare idea is challenged. Still others examine whether the financial markets are perceived as efficient drivers of economic development or not, and so on.

In a massive modeling endeavor, the study substantiates the narratives with quantified estimates on resource use and availability, economic output numbers and some social criteria in each scenario. This is done by estimating how selected indicator developments—e.g., emission or resource extraction patterns—would be impacted by the combined consumption, production and policy choices described as likely for each of the different worldviews. The table in Fig. 2.3 summarizes the scenarios and the predicted quantitative trends.

Fig. 2.3 Great transition scenario structure with illustrative patterns of development. *Source* Based on Raskin et al. (2002: 16)

In a 2010 paper, some of the report's leading authors updated the framework by reducing the number of scenarios to four—market forces, policy reform, fortress world and a Great Transition—and fitting them with data from 2005 (Raskin et al. 2010). They also developed a Quality of Development Index (QDI) with updated data from 2005. This combines sub-indices on human well-being, community cohesion, and environmental protection to "consider the quality of development— the degree of well-being in human lives, the strength of communities, and the resilience of the biosphere—rather than gross domestic product, the misleading conventional measure of 'development'" (Raskin et al. 2010: 2631). The website *greattransition.org* also has an animated short film highlighting the key messages.

In both report and paper, only the Great Transition or new paradigm scenario leads to long-term prosperity within Planetary Boundaries. This scenario involves "profound historical transformations in the fundamental values and organizing principles of society. New values and development paradigms ascend that emphasize the quality of life and material sufficiency, human solidarity and global equity, and affinity with nature and environmental sustainability" (Raskin et al. 2002: 15). Here we find a strong overlap with the WBGU report, including the urge for a conscious repurposing of what development is about (like the social contract on climate compliance). Yet, this report does not start the reflexive change process with the spread of knowledge about planetary guardrails, but by asking what purpose economies should have in the first place. This question precedes the assessment of how this can be done sustainably and in this scope comes close to a Second Enlightenment discourse.

In order to highlight the influence of basic paradigmatic questions concerning 'being in the world' on the more specific mind-sets that guide policy choices, the Global Scenario Group combined each development scenario with one 'archetypical worldview' by referring to one well-known philosopher and his core ideas about the world. Many of these 'patrons' are economists. The list of the key attributes in their thinking of course emphasizes the fundamental differences, so the nuances of each view get lost:

- Adam Smith and John Maynard Keynes are the main protagonists for the evolutionist worldview but differ hugely on the question of how best to run economies smoothly: The invisible hand of the market is the best allocation tool for Smith (scenario *market forces*) whereas Keynes emphasizes the role of government interventions to secure demand when capitalist relations lead to crises (scenario *policy reform*).
- Among the catastrophists we find Thomas Robert Malthus and Thomas Hobbes, neither of whom were very optimistic about the human capacity to become more civilized. Malthus is connected with a *breakdown* scenario because of his claim that limited resources will necessarily mean that people die if the population becomes too big. Hobbes stands for an armed defense or *fortress world* scenario because he depicted the natural state of the world as one of warfare between humans resembling beasts.

- For the transformationists, the authors refer to William Morris, E. F. Schumacher and Mahatma Gandhi as well as John Stuart Mill. All of these thinkers question whether humans really need to be selfish, endlessly accumulating competitors. The first three formulate ideas about a decentralized variety of small and beautiful communities in self-determination (the *eco-communalism* scenario), while Mill sticks with larger units but envisions a post-industrialist and post-scarcity development model (a *Great Transition* or *paradigm shift* scenario). All three aim for human development rather than material acquisition once subsistence needs are met (Raskin et al. 2002: 17).

The main message of the Great Transition report thus lies in assessing the combination of worldviews and values in order to understand differences in ideas, imaginaries and convictions about the best way forward. The Global Scenario Group labeled these 'soft' aspects of values and needs, knowledge and understanding, power structures and culture as the "ultimate drivers" of transitions. The more readily observable trends in politics, economics, technology and governance are by contrast mere "proximate drivers" (Raskin et al. 2002: 50).

Most of the time, as the concept of futures literacy cited in the introduction indicates, humans operate without much awareness of their ultimate drivers. It is at the moment of conscious reflexivity that unstated ideas and assumptions about the world—possibly flawed—are revealed and contested. Here we find another reason why transformation researchers herald the moments of crisis or increasing irritation as moments of potential. They are not dismissive of the terrible consequences that potential runaway effects might have when feedback loops turn trends into uncontrollable developments, but, as the Global Scenario Group points out and the s-curve in Fig. 2.2 illustrates, they are instead 'branch points' where conscious human action can have very meaningful influences on the future of the planetary system.

While many transformation researchers discuss the role of crises in structural changes, few make such an explicit link to the ideas to which humans will revert when searching for strategies to deal with them. One rather unexpected ally is Nobel laureate Milton Friedman, one of the leading thinkers of the mainstream economic paradigm. His theory of monetarism was instrumental in transforming the governance structures of many countries and he is clear about the role it played as a political tool: "Only a crisis—actual or perceived—produces real change. When that crisis occurs, the actions that are taken depend on the ideas that are lying around. That, I believe, is our basic function: to develop alternatives to existing policies, to keep them alive and available until the politically impossible becomes the politically inevitable" (Friedman 2002: xiv).

Karl Polanyi was another thinker who was very clear about this interplay. Since I believe that Friedman's ideas are more of a problem for sustainable development than a solution, this last subchapter is a quick excursion into the thinking of Polanyi, who could also be called the father of the idea of a Great Transformation: his 1944 book carried this title and he is often referred to in contemporary transition

and transformation writings. But reference is seldom made to the fact that his work already contains much of today's critique of the way in which mainstream economics deals with issues of sustainability. It does, however, provide a very good understanding of why systems built on these principles have severe blind spots when it comes to delivering on human needs and respecting the quality and dignity of nature.

2.1.4 The Economic Paradigm Shift Behind Today's World: Karl Polanyi's Heritage

In *The Great Transformation. The Political and Economic Origins of our Times*, Polanyi described what he saw as the complete overhaul of the core operating principles of societies, which took place when feudal agriculture was replaced by the capitalist industrialist market model. He used the term "Great Transformation" because it demarcated the change from one civilization to another through a process of continuous change of values, knowledge, norms, rules and regulations, starting in the late eighteenth century (Polanyi 1957: 3).

His analysis focuses on Great Britain as the origin of industrialization. While applying a historical point of view, his work does not reconstruct a sequence of events in a perfectly chronological manner, but seeks to identify trends in the emergence of institutions and social technologies and to track which philosophical and economic ideas or reasoning lay behind them. To shed some light on these ties, Polanyi describes real world developments as well as core theoretical concepts and the explanations of influential thinkers of the time. This account therefore paints a picture of how creative and reflective actors provide ideas and explanations for real world developments and in so doing influence sociopolitical responses, sometimes very explicitly.

His analysis shows how the basic ideas of what I will describe as the mainstream paradigm started emerging in the eighteenth century, and have since underpinned a massive reorganization of the social technologies and institutions guiding human development. To Polanyi, the most powerful of those ideas was the substitution of the economic motive of subsistence with that of gain. Polanyi discusses how the philosophers and scholars of that time were instrumental in presenting this perspective as a more accurate description of reality, one that was even natural or at least desirable. He singles out Adam Smith as particularly influential with his argument that it is a deeply natural human inclination to barter, trade and exchange in order to maximize gain. Smith also made self-interest the fundamental human drive behind the pursuit of those activities (Polanyi 1957: 68–70). Polanyi adds frequent references to other influential thinkers like Thomas Malthus, Jeremy Bentham, David Ricardo and Joseph Townsend, who nurtured the view that this inclination would need to be unleashed fully if man were to escape the fetters of poverty and starvation. Over time the new concept of 'interests' replaced what the

church had condemned as greed. The invisible hand of the market was the proper solution for facilitating this natural rewiring efficiently and for punishing those who were not contributing valuable assets or skills.

By spanning the differences and similarities in the work of thinkers of the period, Polanyi found that the common new imaginary for progress had become what he called the "stark utopia of a market system" or the "matrix of the self-regulating market" (Polanyi 1957: 57). He offers many quotes from key philosophers and politicians of the time when describing how, inspired by this new vision for progress, both economic theory and policymakers occupied themselves with seeking out and resolving the barriers standing in the way of the efficient and profitable running of market societies. Some of the leading thinkers even established factories or other institutions to that end. Another important theme involved outwitting the limitation that nature had put on production by applying increasing amounts of energy, machinery and capital.

Polanyi does not describe these changes as a smooth rolling out of a blueprint, but as a conflict-ridden process which involved multiple changes in technology, social groupings and regulation, all influencing each other in a paradoxical pairing of unprecedented material production capacity with unprecedented poverty. He describes intricate correlations between technological developments, new sources of energy and the introduction of big machinery and factories, land enclosures for mass wool production and a new financier class providing capital for those investments while brokering increasing international trade, which in turn incentivized even more mass production.

Instrumental in all this were state and local government regulations that either accelerated or slowed down certain trends and developments. These concerned, for example, land enclosures, definition and protection of private property, poor protection laws or their abolition, or allowing capitalist merchants access to local markets. Important also was the invention of the gold standard behind the emerging monetary system, which in turn fuelled the trend of internationalization.

Polanyi's historical observations describe how societal relationships became increasingly focused on profit in the form of money as the general expression of value. Increasingly, processes of collaboration were governed by newly created monetary tokens, social relationships, payments and newly calibrated ownership structures. Eventually most income was derived from the sale of something or other. This, combined with the structural developments of mass production, impelled a highly differentiated division of labor that would be more efficient in terms of the generated output.

So in line with the big philosophers of the period, constant economic gain became the new image for successful societal organization, supplanting culture, custom and religion. The effect was indeed transformational: 'Ultimately,' Polanyi sums up, "that is why the control of the economic system by the market is of overwhelming consequence to the whole organization of society: it means no less than the running of society as an adjunct to the market. Instead of economy being embedded in social relations, social relations are embedded in the economic system" (Polanyi 1957: 57).

It is important to note that Polanyi's critical view of the market system does not lead him to neglect the existence and importance of markets in history. Indeed, he analyzes at length how these were organized by different principles at different times and in different places. The Great Transformation lay precisely in turning away from these long-approved principles of collaboration like reciprocity, redistribution or property ownership. In his view, "nineteenth century civilization alone was economic in a different and distinctive sense, for it chose to base itself on a motive only rarely acknowledged as valid in the history of human societies, and certainly never before raised to the level of a justification of action and behavior in everyday life, namely gain" (Polanyi 1957: 30).

This interplay between theory, power and policy is the underlying theme in Polanyi's opus. Following the overarching imaginary of the market system, the key mindshift that he put center stage was the view of humans, nature and capital as that market system's input factors: successful development strategies needed to ensure that labor, natural resources and investments were available for the continuous and smooth expansion of production and consumption. In effect this meant conceiving of humans, land and money as what he calls "fictitious commodities." The frame with which their governance is approached becomes one of economic production.

Polanyi is clear that from his point of view this transformation inevitably leads to unsustainable developments. Human life, the environment and money are conceptualized and organized as if they have no other existence or purpose than to be sold for profit. To him this alone renders the market society idea 'utopian' and inherently destructive for subjects robbed of their real qualities. 'Labor,' he wrote,

> is only another name for a human activity which goes with life itself, which in its turn is not produced for sale but for entirely different reasons, nor can that activity be detached from the rest of life, be stored or mobilized; land is only another name for nature, which is not produced by man; actual money, finally is merely a token of purchasing power which, as a rule, is not produced at all, but comes into being through the mechanism of banking or state finance. None of them is produced for sale (Polanyi 1957: 72).

To Polanyi, the logical consequences of this were poverty for most workers needing to sell their skills and an overexploitation of nature. Political interventions were frequently necessary to prevent this inbuilt tendency of market systems from destroying its real basis.

Social history in the nineteenth century was thus the result of a double movement: the extension of the market organization in respect to genuine commodities was accompanied by its restriction in respect to fictitious ones… Society protected itself against the perils inherent in a self-regulating market system—this was the one comprehensive feature in the history of the age (Polanyi 1957: 76).

The influential nineteenth-century philosophers or economists whom he cites, however, see the origin of the misery precisely in these regulatory efforts. They believed that without public interference and by shedding former organizational patterns, market dynamics and their tendency toward equilibrium would lead to the most efficient allocation of resources—from which everyone would prosper eventually. Some structural adjustment costs for some groups or ecosystems might

emerge in the short- and medium-term but the less policy interfered, the faster the adjustments would be (Polanyi 1957: 135–150). Seeking an explanation for this interpretation he describes a "blind faith in spontaneous progress" that would be brought about by the freeing of the market system from the constraints of treating everything as a commodity (Polanyi 1957: 76).

Most of today's discourse around progress, successful development and individual-cultural aspirations still holds 'gain' as the overarching goal, and fictitious commodification is still expanding, even though voices are increasingly raised over its negative impacts. The imaginary of fictitious commodities is also very much alive and kicking when political decisions around environmental protection or social welfare are judged by how much 'the (financial) markets' will accept and when a society's or businesses 'productivity' or 'competitiveness' is hampered.

Under current political and economic structures—i.e., the manifestation of the market system utopia—this is of course a rational way of looking at what is likely to happen. This is why former chief economist of the UK Sustainable Development Commission Tim Jackson and other scholars speak of the "Growth Dilemma," in which the current type and rate of economic growth threatens ecosystems and social well-being alike, although the current system dynamics also mean that discontinuing it will lead to unemployment, drying up of investments and broken social protection systems (Jackson 2009: 46).

2.2   Summary: Paradigm Shifts and Large System Change: Humanity's Structured Freedom

To summarize the findings of this chapter, I will introduce a few concepts I find key to understanding how to work toward system innovation without risking system collapse or intensified rejection of change attempts. These concepts place humans as sense-making actors at the locus of intentional change. After all it is people who argue, evaluate and struggle over which purpose any SETS should fulfill, how this could best be done and whether any updates are necessary or desirable.

At its outset, the sustainable development agenda called for a repurposing of the overarching development goal, away from economic gain as an end in itself. Yet, the agenda primarily ended up positioning it as the crucial means to the higher ends of poverty alleviation and the ability to afford environmental protection. In effect, this meant that most of the sustainable development strategies actually kept it as an end in itself and tried to provide it more efficiently or in a 'dematerialized' manner. The prime agenda became that of decoupling economic growth from environmental destruction, or doing more with less. Doing less was and is simply not in the cards, anywhere or for anybody. Implementation thus sought to improve an otherwise mainly uncontested way of thinking, planning and conceptualizing development. The mental model continued to be blind to any possible solutions that would imply 'sufficiency' or 'enough' as possible goals. Poverty remained defined solely by

material possessions and monetary income. This fell short of causing the upset to the human self-image that the *Brundtland Report* had predicted would result from seeing Earth from space.

This upset to the human self-image is what system-thinking scholars like Donella Meadows call paradigm shifts. She also calls them "high leverage points" for transforming systems. To me, paradigm or mind shifts are the bridge between the radical and incremental aspects of transformation strategies: radically different imaginaries of potential future developments influence the formulation of new goals for the system that can then be implemented step by step, changing the rules, procedures, roles and norms accordingly.

This strategy is in line with Meadow's approach to working on system innovations. In a seminal article about *Places to Intervene in a System*, Meadows proposed a hierarchical list of possible leverage points for system change. As illustrated in Box 2.1, it is ordered by increasing effectiveness for transformative change, coupled with the possibility of actually influencing it. The more embedded the identified points are within the deeper or resilient structurations of a system, the more difficult they will be to change. The resulting change however, will also be more lasting.

Box 2.1: Places to intervene in a system ranked by increasing order of effectiveness. *Source* Meadows (1999: 3).

12. Constants, parameters, numbers (such as subsidies, taxes, standards).
11. The sizes of buffers and other stabilizing stocks, relative to their flows.
10. The structure of material stocks and flows (such as transport networks, population age structures).
9. The lengths of delays, relative to the rate of system change.
8. The strength of negative feedback loops, relative to the impacts they are trying to correct against.
7. The gain around driving positive feedback loops.
6. The structure of information flows (who does and does not have access to what kinds of information).
5. The rules of the system (such as incentives, punishments, constraints).
4. The power to add, change, evolve, or self-organize system structure.
3. The goals of the system.
2. The mind-set or paradigm out of which the system—its goals, structure/rules, delays, parameters—arises.
1. The power to transcend paradigms.

This list of leverage expressed in their abstract systems-thinking language works for society-wide change as much as for small systems like, for example, families or communities. The examples in brackets refer to political systems and I am most
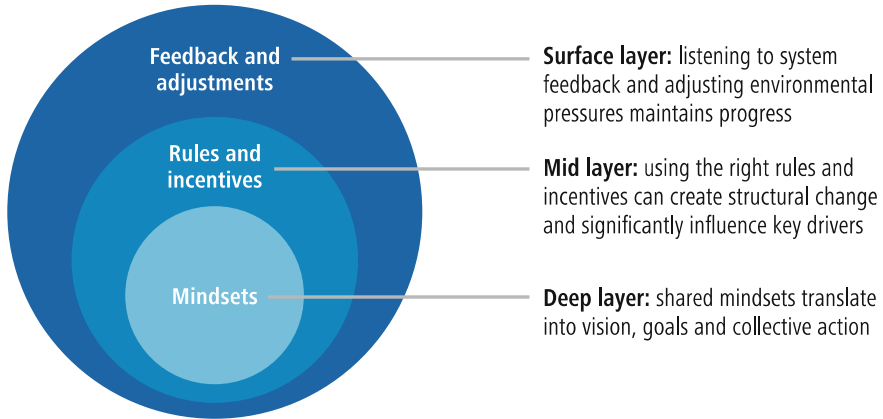
Fig. 2.4 Layers of leverage in system innovations. *Source* Based on Meadows (1999), illustration from UNEP (2012: 422)

interested in the top three points. The reasons are illustrated by the United Nations Environment Program *GEO-5* report for the UN Conference on Sustainable Development in 2012 (Fig. 2.4).

Here we see that the outer layer (or low-ranking adjustments in Meadows' list), will change little in the overall dynamic of development: Putting different people in charge of making political or managerial adjustments is not going to bring about a system innovation as long as the levers they pull are the same as before. They can only use them with the same information and the same rules as before and thus keep on pursuing the same old goal. Thus, while the exchange of CEOs or political leaders is often sold as a radical measure, it may not turn out to be radical in effect unless the new leaders start repurposing the system by tackling the high leverage points.

Unfortunately, most of the attention in sustainable development thinking has focused on adjusting to system feedbacks or tackling the symptoms of environmental degradation and of extreme poverty. Most of the resource efficiency agenda remained within this remit, as did a poverty alleviation agenda that declares yet more growth for the richest to be a precondition for redistribution measures. This is understandable given that these changes are easily visible and can be measured in quantitative numbers, both of which are important standards in project planning and evaluation under the current short-term, cost–benefit paradigm. This is also not very surprising in political and economic systems in which having more than others is seen as an indicator of merit and superiority and where the avoidance of short-term costs for voters and stakeholders is what counts most for election purposes or investment decisions. It is also very understandable in situations in which the bare necessities for life must be met and path-dependent solutions are the easiest, fastest or economically cheapest remedy for disaster prevention.

The problem is that staying on lower leverage point levels rarely translates into transformational change of the overall system dynamics. One metaphor for this has been "arranging the deck chairs on the Titanic" (Meadows 1999: 6). Only if changing these lower parameters results in ramifications higher up the leverage point list can they lead to successive, wider-reaching changes. If a government increases the minimum wage by 10 %, for example, is this because people need social security payments on top of what jobs pay and this risks ruining the state budget? Or does it advance the goal of limiting the maximum differential in income between different people working the same hours? Is it simply a measure to keep the low paid out of poverty statistics, or is it a move to lower inequality as a benchmark for sustainable societies? The first means no more than dealing with the symptoms of a remuneration pattern in which people are unable to pay their rent, even if they work full-time. The latter examples, however, stand for a qualitatively new goal according to which barriers are removed.

Thus, changing the third highest leverage point in Meadows' list—the system goal—usually means that many of the lower leverage points will have to be acted upon to adjust the system's development paths accordingly. Yet, support for a deeper paradigm shift (the top two of the leverage point list) is still not readily visible in the SDG agenda. The prime benchmark for reducing inequalities, for example, still excludes any limits to the gains of the already very rich, but instead aims to produce a comparatively faster gain for those with less. Gross Domestic Product should continue to grow everywhere, including in rich countries with stagnant population levels.

Yet, the goal of sustainable development was defined as meeting the *needs* of the people today and in the future, not as meeting rising per capita GDP. Repurposing a system accordingly raises the questions of what human needs are, how they are best understood and served, and not simply extrapolating the old unstated idea that more economic gain means more need satisfaction. If this paradigm goes unaltered, the imaginaries, narratives, models and proposals based on it simply do not capture the idea that much damage is caused only *because of the type and speed of growth to which we aspire*.

Meadows herself also makes reference to the growth example when she points out that this phenomenon is typical. People sense where leverage points are but often tend to push them into the wrong direction. Everyone sees that growth is critical, but most people push for more of it instead of thinking about the damage which would be spared if we had slower, selective, differently defined growth, or even a steady-state economy (Meadows 1999: 8).

Polanyi included this future-forward effect of a hegemonic paradigm in his analysis of the effects of the stark utopia of a capitalist market system:

> The usual 'long-run' considerations of economic theory are inadmissible; they would prejudge the issue by assuming that the event took place in a market economy. However natural it may appear to us to make that assumption, it is unjustified: market economy is an institutional structure which, as we all too easily forget, has been present at no time except our own (Polanyi 1957: 37).

A proper repurposing or system innovation process therefore begins with what the WSSR 2013 called "futures literacy": identifying and exposing "hidden, unexamined and sometimes flawed assumptions about present and past systems" (ISSC and UNESCO 2013: 8). Changing the way we see the world also changes the way we are in the world—and how we imagine promising development paths and their governance. In the words of Meadows: "Paradigms are the sources of systems. From them form shared social agreements about the nature of reality, come system goals and information flows, feedbacks, stocks, flows and everything else about systems" (Meadows 1999: 16).

This is what I seek to capture with the concept *materiality of ideas* as illustrated in Fig. 2.5. It describes how humans are both subject and object of making history, how reality today shapes the imaginary of how reality could be in the future.

As a purposefully acting species, humans create relationships and physical technologies as well as social institutions to engage with each other and with nature in the creation of goods and services deemed necessary or desirable. Thus, prevailing paradigms and their key ideas are embedded into very tangible structural outcomes that in turn confront and embed individuals within processes and systems
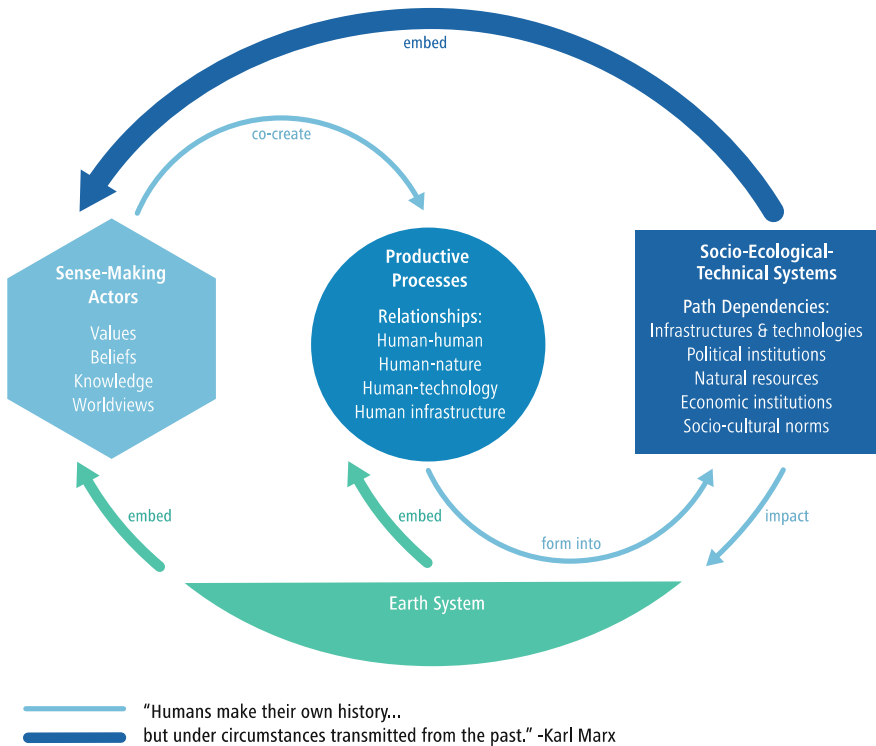
Fig. 2.5 The materiality of old ideas in today's systems. *Source* Own illustration

that shape their mind-sets and limit their scope of action. Karl Marx summarized this patterned freedom with the critical eye for which he is famous:

> Men [sic] make their own history, but they do not make it as they please; they do not make it under self-selected circumstances, but under circumstances existing already, given and transmitted from the past. The tradition of all dead generations weighs like a nightmare on the brains of the living (ibid. 1852: 5).

No one is asked to share Marx's interpretation of the past as an inevitable nightmare. But everyone is invited to acknowledge the ideational background of what we call reality today. Once we do this we see that of course reality cannot be replaced by simply thinking differently. Humans live in structured freedom. Reality does influence how humans imagine what is possible, right or just for the future. But at the same time the way we think, believe and act today will shape future reality. History becomes an open-ended process—the status quo determined not by any human or social laws but created by sense-making and purposefully acting humans.

Civilization did not cease to evolve after the first Enlightenment and modernity. Sense-making, learning and purposeful acting continues. The quantification and marketization of our world might be an incredibly strong trend now, but does not mark 'the end of history.' Human freedom lies exactly in becoming literate in deconstructing the emergence and perpetuation processes and patterns behind the trend toward economic totalitarianism and in starting to change it. Ideas and beliefs play an instrumental role in these reflection processes. They are the elements of inspiration, rationalization and argumentation and hence function on the individual as well as societal level.

The reflexive ontologies applied by most transformation researchers track the co-evolutionary interplay between actors and the structures that surround them. Some might explore behavior changes while others go deeper into analyzing changes in peoples' values and identity. The latter is what, for example, figuration or process sociology—a term often associated with Norbert Elias (1897–1990)—stands for. The German sociologist wrote about the connection between social developments and human psychology. His book, *The Civilizing Process* (also published under the title *On the Process of Civilization*), explores the relationship over time between power, behavior, emotion and knowledge and became one of the most influential sociology books of the twentieth century. In Elias' theory, status quo or circumstances are not portrayed as phenomena that occur and which humans encounter. He sees them instead as manifestations of changing human relationships. His term 'sociogenesis' thus describes the emergence of social practices, norms, rules, procedures and institutions over time. Elias links it with the process of 'psychogenesis' to capture the molding effects that prevailing circumstances have on individual learning and identity formation. The latter, explains Harald Welzer, a contemporary German sociologist in Elias' tradition, is the prerequisite of identity, of being in control of one's own fate. It carries values, habits and aspirations alike (Welzer 2011: 15).

This ontology finds application in other scientific disciplines as well. Political economist Robin Hahnel, for example, also makes this point when arguing that the mainstream economic paradigm is not objective or value-free but through its dominance in decision-making bodies and public discourse shapes future relationships and people: "When we fulfill needs through particular activities we are induced to mold our thoughts to justify or rationalize both the logic and merit of those activities, thereby generating consciousness-personality-structures that can have a permanence beyond that of the activities that formed them" (Hahnel 2002: 4–5).

Thus, ideas are both inherent in less conscious individual sense-making processes but also frequently expressed in the efforts of creating relations with others. This is what the definition of paradigms stands for in Meadows' analytical framework presented above: "The shared idea in the minds of society, the great big unstated assumptions—unstated because unnecessary to state; everyone already knows them—constitute that society's paradigm, or deepest set of beliefs about how the world works" (Meadows 1999: 17). Other researchers use the term 'worldviews' and define them as "inescapable, overarching systems of meaning and meaning-making that to a substantial extent inform how humans interpret, enact, and co-create reality" (Hedlund-de Witt 2012: 18).

Personally, I prefer the term 'mind' to 'paradigm' when speaking about social rather than scientific contexts because it expresses the way that seeing and believing differently goes beyond an update of information. It also means changes in attention, consciousness, instinct, imagination, judgment, power, sense, spirit, and psyche. 'Mind' emphasizes not so much the facts or ideas in themselves but the processes of knowing, believing and arguing in which they are embedded. This encapsulates the many ways in which our manner of thinking influences human existence.

Moving from the individual-psychological level to the sociopolitical research designs for explaining transformation we find, as one example, Polanyi-inspired political economist Nancy Fraser. She highlights how widely spread ideas, like the mainstream economic paradigm, function as the "discursive face of politics," mediating structure and agency by providing "the social imaginaries through which social conditions are experienced, interpreted and evaluated by social beings" (Fraser 2013: 125). The analytical term 'narratives' captures something similar, sometimes defined in a rather instrumental way: "Narratives reduce complexity, creative collective perspectives, support reliability of expectations, build a basis for current and future-oriented action plans, and are a foundation for the cooperation between actors" (Messner 2015: 263). Here, the emphasis lies more on understanding how humans choose communities and get energized for collective action and less on the effects that this may have on their future identities.

Both the individual-psychological and the sociopolitical are important to the transformative leverage of a *Great Mindshift*: an understanding of the imaginaries, identities and narratives that guide individual and collective actions provides explanations for the perpetuation of the status quo, an understanding of which alternative solutions might find support and who might bring them about.

A deconstruction of the overarching ideational frameworks or paradigms behind the institutions, technologies and economic instruments in place provides an understanding of which path dependencies will be particularly difficult to unlock and which pioneers and change agents are more likely to help—or block—that process.

Connecting this reflexive ontology with the MLP (Fig. 2.1) and multi-phase concept (Fig. 2.2) of transformation research leads me to conclude this chapter with the concept of *radical incremental transformation*. The MLP situates mind-sets on the landscape level. Following the discussion of the crucial role of ideas on the individual as much as on the societal level, I would like to differentiate the three layers a bit more by adding two: the mini-level of individuals that makes up any institutional setup and the meta-level of mind-sets that cut across and mediate between the structurations on the niche and regime level and individual actors (Fig. 2.6).

The purple and blue arrows illustrate how ideas function as the glue that holds societies together. The purple ones stand for the hegemonic paradigm and common sense framework that serves as a reference for individual strategies and narratives. It is embedded in regime structures as well as in niche projects. At the same time, individual mind-sets (the light blue arrows) might carry alternative paradigms that influence their pioneering strategies. In addition to trying to showcase new solutions in line with the new paradigm, all individuals can also engage in general paradigm-busting work that influences the perpetuation or challenging of the dominant paradigm. In this way, prevailing ideas also influence the way societies
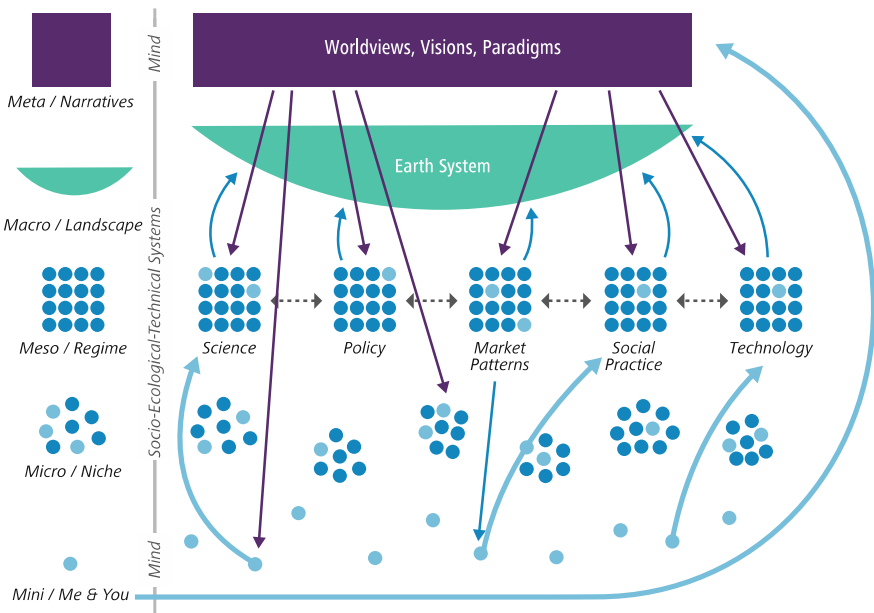
Fig. 2.6 Mind-sets in the multilevel perspective on transformations. *Source* Own illustration

decide to deal with the landscape-developments that they observe but cannot change through direct action in the short term. Their most important role, however, lies in providing the new imaginary and binding narratives necessary to ignite change initiatives and galvanize support for them.

Charlie Leadbeater, a UK-based system innovator connected with the innovation foundation Nesta, presented a list of ingredients for successful sustainability transformations that embeds this view nicely. He makes reference to the MLP when considering five successive features of successful regime transformation.

The following is my summary:

1. Failures and frustrations with the current system multiply as negative consequences become increasingly visible. This is inherent in the sustainability discourse.
2. The landscape on which the regime operates shifts as new long-term trends emerge or sudden events drastically impact the general availability or persuasiveness of particular solutions. This could be peak oil signaling an approaching end to fossil fuel availability.
3. Niche alternatives start to develop and gain momentum, coalitions start forming and coalesce around the principles of a new approach. Local Agenda 21, for example, was a program emerging from the UN Conference on Environment and Development in 1992, in which many local initiatives for implementation were linked into a network.
4. New technologies give impetus to alternative solutions, either in the form of alternative products or communication and connection possibilities. Renewable energy solutions especially, but also information technologies, form part of many sustainability projects.
5. For far-reaching regime change rather than small adaptations and cooptation into the old regime, dissent and therefore fissures inside the regime itself are key. Possibly called 'niches' within the regime, by joining coalitions for change they will help bring the system down (Leadbeater/Mulgan 2013: 31–32).

A core functional ingredient in this sequence is the 'new approach' mentioned in point 3, the new principles. In Leadbeater's example they are the principles agreed in the 1992 Rio Declaration on Sustainable Development. They provide the radical vision for a repurposed development system and inspire niche initiatives with the goal of putting the declaration into practice. As some of the quotes in the introduction showed, the Agenda 21 vision foresaw very radical institutional changes, and many different groups started experimenting with new ways of bringing them to life. The discussion of path dependencies in this chapter has provided some good insights into why these processes were not easy and were subsequently sometimes discontinued or explicitly opposed.

Writing in 2013, Leadbeater however declares that tipping points have been reached in some aspects like the energy systems, especially on the local level. Not many make explicit reference to Agenda 21 anymore, but new narratives like Transition Towns or 100 % renewable communities, etc., have gained more

momentum. Also, renewable technologies are at a completely different stage of availability and pricing, climate change impacts have become tangibly noticeable and increasing conflicts in areas with big fossil fuel reserves have added impetus to the feeling that turning away from unsustainable forms of energy is a good idea.

So it takes time, a certain degree of irritation, a critical mass of alternatives and their supporters to bring radical visions to life. The multi-phase concept captures this process well. Unless the system dynamics show a certain degree of friction or an existing willingness to change, experiments that propose to change too much in too short periods of time will cause rejection or resistance.

This pattern matches Thomas Kuhn's account of the development of scientific advancements for which he coined the term 'paradigm shift.' His 1962 book, *The Structure of Scientific Revolutions*, describes changes in patterns of thinking and basic assumptions (epistemology and ontology) behind scientific analysis. To this end, he demonstrated the parallel existence of different paradigms to be the normal state of affairs. These determine which questions will be asked when assessing a certain issue, how they will be asked, what will be required to answer them and how the results will be interpreted. Kuhn showed that there is usually one paradigm that comes to predominate and does not evolve steadily by adding insights but is rather overturned in an intellectual battle whose phases resemble those of the multi-phase pattern. Dominant ideas and research premises tend not to cede gradually and smoothly but instead to be amended until critique simply becomes too strong to justify more exceptions to the rules. After such tipping points, the situation is fundamentally altered, even if no consistent or coherent alternative explanations and solutions are yet in place to fill the emerging gap and search processes.

Unsurprisingly, the navigation or transition phase in shifting paradigms as well as governance solutions is marked by chaos, politicization, unease and power-ridden struggles. The Global Scenario Group called them 'branch points' and stressed the role of science and intellectuals in providing narratives that can galvanize enough support to become institutionalized. Thus, change agents are well advised to be mindful that the diverse changes necessary to achieve a radically different scenario will emerge from multiple sources, and might feel impossible for a long time, before a window of opportunity opens and much change happens in a short period.

At the same time, one should not assume that radical changes will emerge from less-than-radical intentionality. Reflecting on Meadow's list of leverage points and Kuhn's account of paradigm shifts, we see that only by checking which key assumptions inform which change initiatives can we get a better grip on the transformational potential they carry.

From this perspective, paradigms or mind-sets play two important roles in transformations that differ with the 4 phases (Fig. 2.2): in the pre-development and acceleration phase the role of new paradigms and ideas lies in creating or increasing irritations in the system by deploying the alternative meanings and knowledges around which pioneers develop experiments. Here the role is to create frictions in common sense and accepted justifications to create openness to change. It is about delegitimizing the status quo explanations and solutions, about defining no-go answers or views when discussing decisions on the way forward.

When forging toward tipping points in the navigation phase, however, the function of a paradigm also changes: it needs to reduce frictions and uncertainties by enabling single pioneers and followers to see and understand their common will and to highlight which regime changes align with the paradigm, thus helping the pioneers scale or multiply to become the new normal.

The mainstream economic paradigm serves as a great example here. As long as it remains a legitimate reference framework for development, conventional growth solutions remain difficult to defeat. The science and models it informs, as the next chapter will discuss, allow only for analyses and predictions that subjugate sustainable outcomes under the old economic growth development path. Or they justify a continuation of this path in the short term because they predict that changing course in the future will be less costly and thus a fairer allocation of costs and benefits. It is only since the big financial crisis in 2008 that the credibility of this paradigm and its linear extrapolations from historic trends have been severely challenged, even in the corridors of power. Yet, until now no new paradigm has found enough support to fill its place.

Kuhn stated that a new paradigm can only establish itself if it overcomes stubborn adherences to intellectual vested interests. Political economists point out that one should also be aware of practical vested interests when assessing why a theoretical framework or the worldview it informs persist. In periods prior to tipping points, those individuals and groups benefiting most from a system's development path have mainstream scientific evidence, canonized knowledge and public discourse readily available to rationalize and justify the logic and merit of their path over others.

The next 10–15 years will be very decisive for the outcome of this navigation phase: stabilization around a new, consolidating paradigm, relapse into the old dynamics with technological fixes and financialization, or even collapse because this model has exhausted its adaptive capacities. Human history-making is an emergent process of co-creation and political struggle, compromise and domination. Yet, only if the stabilization phase is oriented around a shifted paradigm will the new development dynamic of the system be radically different—or transformed. Put differently: transformation means changing the default. Ideas and solutions that have to justify their appropriateness and argue their legitimacy today will become the new normal.

This chapter gave an overview of what different strands of *transformation science* offer in response to the question of how to strategically work toward the transformative quality that the 2030 Sustainable Development Agenda foresees. This summary started fleshing out the way in which the different starting points of STS, SES, and political economy research designs can be combined into very insightful *transformative science* frameworks: concepts and heuristics for the design and conduct of transformation processes. My own filter in selecting and combining insights has been one that places human inspiration and will to act at the origin of understanding and explaining SETS's. By embedding humans into systemic models like the MLP and multi-phase concept we can see that even when we are talking about global transformations, the source of intentional change is human

thinking, feeling, and acting. SETS's are created, ordered and stabilized through human decision-making and (often) conscious creation of regime structures.

Searching for more efficient technologies and more effective economic incentives is not enough when looking for sustainability solutions. It is the institutional setups and sociocultural frameworks that define the purpose for which technologies and economic instruments are used. Here is where we find the root causes of trends. Incentives and technologies mostly function as accelerating or balancing feedback, but not in themselves as game changers. This is why the multi-phase concept as I posit it here gives the sociocultural anchoring of alternative proposals and pioneering solutions a crucial role in all phases of transformation.

In the amended MLP it is the purple and blue arrows that make the link. They indicate how mind-sets mediate between agents and structures and how the dominant paradigm functions as a reference framework for justifications and narratives of change. The big arrow on the right hand side of the graph also shows, however, that each individual is constantly involved in shaping the future paradigm. By providing reason, opinions, arguments and experiences as well as non-verbal reactions and behavior we can all participate in paradigm shifts and thus in changing reality.

Polanyi demonstrated this link in his account of the Great Transformation. The classical economic paradigm played a crucial role in making today's default solution the growth-fixated development path. This paradigm survived over two centuries of criticism by amending itself into a neoclassical version. But today its basic assumptions are challenged from so many angles and the institutional solutions and processes based on it deliver so many crises that the time is ripe to shift from diversified irritation to unifying consolidation: which insights on human needs and natural resource reproduction in today's scientific debates could become the foundational ideas of a new development paradigm?