

Table 1. Ways of thinking about transition

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				Based on the Multilevel Perspective (MLP)					
	The Techno-Economic Approach	Socio-Ecological Transitions Approach	Technological Innovation Systems	Historical co-evolution of social and technological systems	Active management of on-going transition processes	Reflexive governance	Social Practices	Resilience approach	Human Geography approach
Focus	<p>Evolutionary economic theory (after Kondratieff / Schumpeter)</p> <p>Long-term economic development cycles (40–60 years)</p> <p>Clusters of new technologies</p>	<p>History of fundamental patterns of interaction between human society and natural systems</p> <p>Social organisation of energy and material flows from and into the natural environment</p> <p>Decoupling human development from resource consumption</p>	<p>Social and institutional conditions for the emergence of new technologies</p> <p>Interplay between firms and other actors</p>	<p>Social and technological systems co-evolve through interaction between Micro level(niches), Meso level(regimes) and Macro level (landscape)</p>			<p>Everyday social practices</p> <p>Consumer behaviour</p> <p>Actor networks</p>	<p>Social-ecological systems as a complex adaptive systems characterised by uncertainty and non-linear feedback loops</p> <p>Systematic learning approach to the way societies interact and manage the natural environment</p>	<p>Politics of environmental decision-making across space and time (incl. environmental justice)</p> <p>Issues of social and ecological context</p>
Findings	<p>Explains how major technological change induces macro-economic cyclical movements, at national level</p> <p>Identifies five techno-economic eras in last 250 years</p> <p>Distinguishes different phases within an era</p> <p>Incremental innovation is important to diffuse technology deriving from disruptive innovation</p>	<p>Gives consideration to the natural environment in macro-economic development through material flow analysis.</p> <p>Transitions only occur when there is a structural change in a society's energy flows.</p>	<p>Identifies key processes that need to run smoothly for the innovation system to perform well</p> <p>Pinpoints obstacles to radical technological innovation for sustainability</p>	<p>Patterns of change from below (niches)</p> <p>Describes strategic niche management</p>	<p>Multiple sources and patterns of change and how they may be sequenced</p> <p>Prescribes “transition management” as practice-oriented model (doing by learning/learning by doing)</p>	<p>Different ways in which power is present at the different levels</p> <p>Insights on how strategic agency comes about</p>	<p>Innovation in social practices comes about through networks of people, circulating ideas, and notions of appropriate behaviour</p>	<p>Resilient social-ecological systems are characterised by adaptability and transformability at multiple scales of social organisation</p> <p>Role of agents of change and their networks, working simultaneously at different spatial scales</p>	<p>Beyond national innovation</p> <p>Interactions between regimes operating across multiple spatial scales (eg the influence of global forces in local decision processes)</p> <p>Important to strengthen capabilities of local government authorities</p>
Implications for a transition to renewable energy	<p>Capability of the state is key to extend access of new energy production technology beyond elites</p>	<p>Technological innovation should target the provision renewable sources of energy</p>	<p>Government incentives to incumbent business actors are important for the emergence and consolidations of technological innovation hubs</p>	<p>Emergence of technology as a result of consumer demand, and then embedded in social practices</p>	<p>Energy transition steered towards a pre-defined goal by government actors and scientists (eg Dutch energy transition)</p>	<p>More inclusive and conscious decision processes, considering alternatives and sources of uncertainty</p>	<p>Changes in what is valued results in wholesome behavioural change (new consumption practices)</p>	<p>Emphasises the importance of social and institutional innovation in the management and governance of renewable energy</p>	<p>transition unfolds differently according to geographic context and spatial scale</p> <p>Incentives need to be tailor-made and their impact closely monitored</p>
Critique	<p>Inability to identify causes behind long-wave cycles (eg over-deterministic view of macro-economic phenomena)</p> <p>Not able to analyse processes of change at smaller scales of social organisation</p>	<p>Given its macro-economic focus, it does not consider the role of individual actors, belief systems, culture and political interests (such as those associated with fossil fuel production and consumption)</p>	<p>Marginalises cultural and social aspects of technology</p> <p>Unable to understand why obstacles are there and therefore how to remove them</p> <p>Excessive emphasis on large corporates and government actors</p>	<p>Does not consider all pressures of change</p> <p>Insufficient understanding of the role of power and politics</p> <p>Concept of “levels” leads the observer into hierarchical understanding of reality; insufficient attention to the role of actor networks spanning multiple spatial scales</p> <p>Spatial bias towards national innovation</p>	<p>Little understanding of how problems are framed and how policy and research priorities are politically and socially constructed</p>	<p>Not reflexive enough about processes through which power imbalances are replicated</p> <p>Neglects demand side actors such as consumers and social movements</p>	<p>May lose track of political and economic incentives and mechanisms behind circulation of ideas (eg government educational campaigns)</p>	<p>Weaker in the analysis of technological innovation issues</p> <p>Difficulties in operationalising adaptability and transformability in different contexts</p> <p>Does not fully explore the role of power asymmetries and how they may preclude adaptability and transformability</p>	<p>May not fully grasp obstacles for change within government and business organisations</p>