### A socio-technical transitions perspective on sustainability transformations



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#### Sustainability Transitions Research Network (STRN)

2000+ members, annual conference, Elsevier journal (EIST)



(Source: Scopus, January 12, 2019)

# <u>**Reframing</u>**: Socio-technical systems as core driver of environmental problems</u>



Source: EEA (2014).

#### Elements + actors in socio-technical systems

F.W. Geels / Research Policy 33 (2004) 897-920

Production

Application domain, technology-in-use



Fig. 1. The basic elements and resources of socio-technical systems.

#### Existing system is locked-in (resilient, resistant to major change)

#### <u>Economic</u>

- Scale advantages, low cost
- Sunk investments (skills, factories, infrastructure)

#### Social/organisational

- Incumbent firms have vested interests + core capabilities
- Alignment between social groups ('social capital')
- User practices, lifestyles

#### Politics and power

- Uneven playing field
- Vested interests oppose policy change (power struggles)

#### **There are many green innovations** (seeds for transitional change) **But these struggle to break through**

	Mobility	Agro-food	Energy (electricity, heat)
Radical technical innovation	Battery-electric vehicles, (plug-in) hybrid electric vehicles, biofuel cars; hydrogen cars	Permaculture, agro- ecology, artificial meat, plant-based milk, manure digestion	Renewable electricity (wind, solar, biomass, hydro), heat pumps, passive house, biomass stoves, smart meters
Grassroots and social innovation	Car sharing, bike clubs, modal shift to bicycles and buses, tele-working, tele- conferencing	Alternative food networks, organic food, less-meat initiatives, urban farming	Decentralized energy production ('prosumers'), community energy, energy cafés
Business model innovation	Mobility services, car sharing, bike sharing	Alternative food networks, organic food	Energy service companies, back-up capacity for electricity provision, vehicle- to-grid electricity provision
Infra- structural innovation	Intermodal transport systems, compact cities, revamped urban transport systems (tram, light-rail, metro)	Efficient irrigation systems, agro-forestry, rewilding, multi- functional land-use	District heating system, smart grids, bio-methane in reconfigured gas grid

# So, how do transitions happen?

- Co-evolutionary multi-actor processes: technical, economic, social, political, cultural
- Multiple phases with different mechanisms
- Struggles between forces of <u>stability</u> and <u>change</u>
- Regime shifts + punctuated equilibria: Schumpeterian 'waves of destruction' + political struggles/coalitions

#### **Multi-Level Perspective on socio-technical transitions**



→ No single cause, but alignments between multiple processes with different temporalities
→ Bottom-up innovation; external pressures; system destabilisation; reconfiguration

#### Phase 1. Emergence

- Radical innovations emerge in peripheral 'niches' (R&D, experiments, demonstration projects)
- Entrepreneurs, start-ups, local communities, NGOs

Core processes (Schot and Geels, 2008):

- a) learning-by-doing
- b) building new social (shadow) networks (Folke)
- c) articulating new visions

Schot, J.W. and Geels, F.W., 2008, Strategic niche management and sustainable innovation journeys: Theory, findings, research agenda and policy, *Technology Analysis & Strategic Management*, 20(5), 537-554

#### Phase 2: Stabilisation + upscaling

Niche-innovations develop through sequences of projects (Geels/Raven, 2006)

- a) up-scaling: more and larger projects
- b) broadening: include more actors, expand application domains
- c) **stabilisation**: aggregate lessons and articulate rules/best practices



#### Phase 3: Diffusion into mainstream markets

- Price/performance improvements (scale economies, learning-by-doing)
- Growing markets + positive cultural discourses
- Increasing business interest and 'innovation races'
- Growing support coalitions + political lobbies
- Favourable policy adjustments

• But also: Resistance + fight-back from incumbents

# **Phase 4: Reconfiguration**

- Wider system change in institutions, infrastructure, views of normality, professional standards
- Decline of existing systems and exit or reorientation of incumbent actors/industries

# Low-carbon transitions are in different phases (in different countries)



## Future/ongoing research

- Different transition pathways, based on different sequences and kinds of MLP-interactions
- Incumbents: resistance or reorientation?
- Decline: 'just transition', compensation
- Conditions for (political) acceleration
- Whole system change, innovation cascades, spillovers, knock-on effects