Lessons of eco-innovation policy for smart specialisation

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Maastricht University

About me

- I am professor of **Innovation and Sustainable Development** at Maastricht University and professorial fellow at UNU-MERIT
- I am well-known for my work on policies for eco-innovation and transition management

Relevant topics I have worked on

- Environmental policy and technical change
- Sustainability transitions
- Green industrial policy
- Innovation Policy
- Organic PV
- Waste transition
- Sustainable mobility
- Urban Labs
- Social innovation
- Eco-innovation measurement

My personal transition

- From econometrics to a **multidisciplinary** researcher
- With a special interest in methods, theory and **policy**
- I am a **critical methodological pluralist** interested in combinging different methods, theories and data
- A quote I very much agree with:
  - *"One has to make up his mind whether he wants **simple answers** to his questions – **or useful ones**… ….you cannot have both."* J.A. Schumpeter (1930)

- I advised the EU on RTD policy for climate change and on eco-innovation on many occasions.
- For the **Environment Council** (= meeting of EU Environment Ministers) in Maastricht in 2004, I wrote a strategy note about eco-innovation, which fed into the council's conclusions.
- Together with Jan Rotmans, I developed the model of **Transition Management**, which, following many discussions with policy makers, was **used by the Dutch national government** as a basis for its innovation policy for sustainability energy.
- In 2013 and 2014 I was member of the **Limburg Chamber of Commerce platform** "Energy, Sustainability and Innovation".
- I am member of Afvalsamenwerking Limburg (ASL)
- With Babette Nevers I authored a chapter/article on green industrial policy

My policy experiences

Overview of talk

- Innovation and evolution
- Inherent difficulties for innovation policy
- Point of intervention for policy
- Multiple value creation as something for Smart specialization (making good use of nature)
- Low risk and high risk policies for Smart specialization
- Transition management principles

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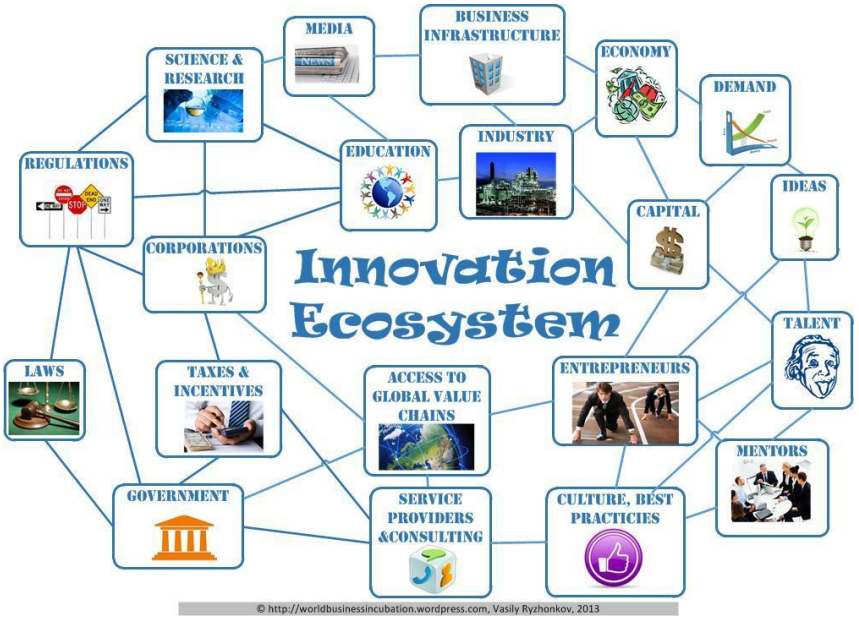
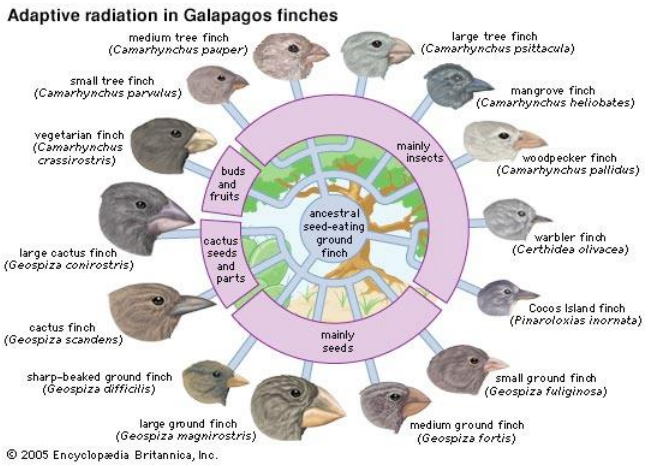
Innovation & evolution

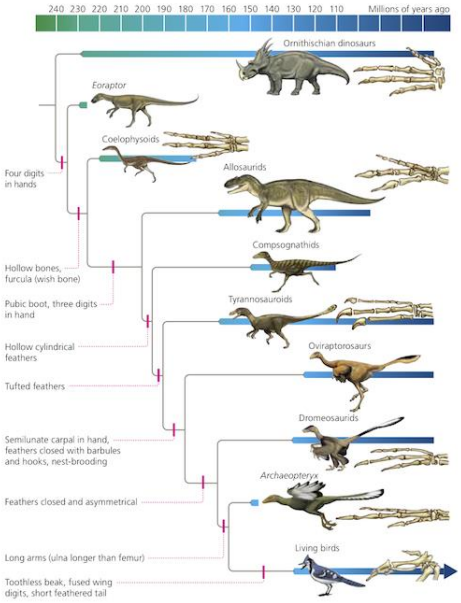
Link #1

- **Innovation requires resources** for its production, distribution, use and post-consumption activities
  Example resources are energy, materials, knowledge, finance
- And involves lots of dependencies and shaping factors (→ eco-system)

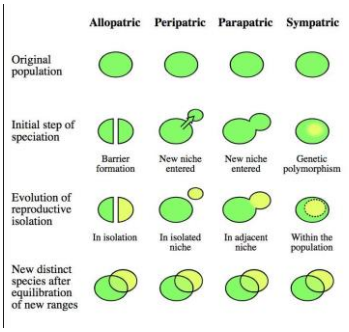


Variation and selection
(link #2)

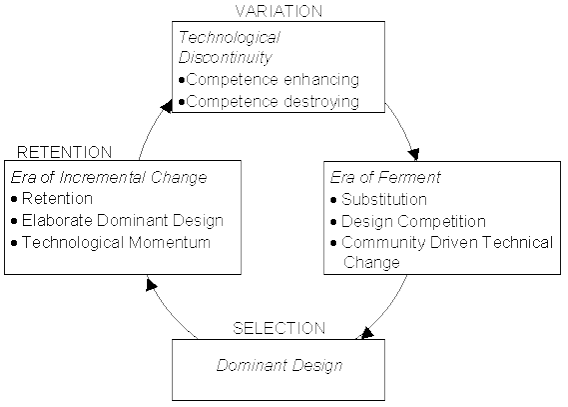




Speciation



The emergence of a dominant (technological) design

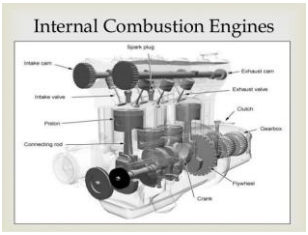


Examples of dominant designs / regimes

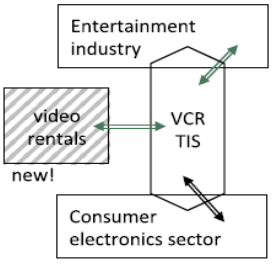
Examples &
how dominant design concept relates to technological discontinuity

Discontinuities in video format industry:

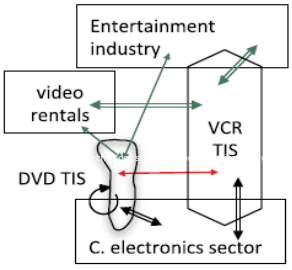
- Betamax → VHS (dominant) →
  - CDV (5 min) → VCD (no copy protection) → CD-R (dominant) →
    - DVD (dominant) →
      - HD DVD → Blu-ray (dominant)



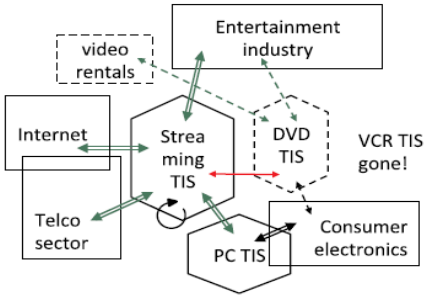
Technology shifts in home entertainment
from a TIS life cycle perspective



a) 90s: Mature VCR TIS with established ties into adjacent context structures (green: complementarities)



b) 2000: Emerging DVD TIS, competing with VCR and building on established structures in entertainment and rental (red: competition)



c) 2016: Streaming TIS in growth phase, competing with DVD TIS which is declining together with rentals (dotted lines)

Source: Markard (2019 The life cycle of technological innovation systems, in TFSC

Different interaction effects (link #3)

Commensal

The Gaudy Leaf Frog, is a poison frog that uses the Vermiliad leaf as shelter from the weather and the leaf is unaffected.

The Bromeliad is a plant grows on trees so it can get sunlight and rain where as if it was on the ground it couldn't and the tree is unaffected.

Mutualistic

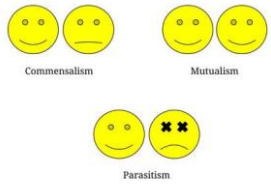
Capuchin Monkeys swing from tree to tree and get the nectar from the flowers but the nectar gets stuck to them as they eat and when they move on it pollinates all the flowers.

Leaf Cutter Ants cut chunks of leaf from trees then they bring it back to there home and protect it from other insects. They eat it and the plant grows there.

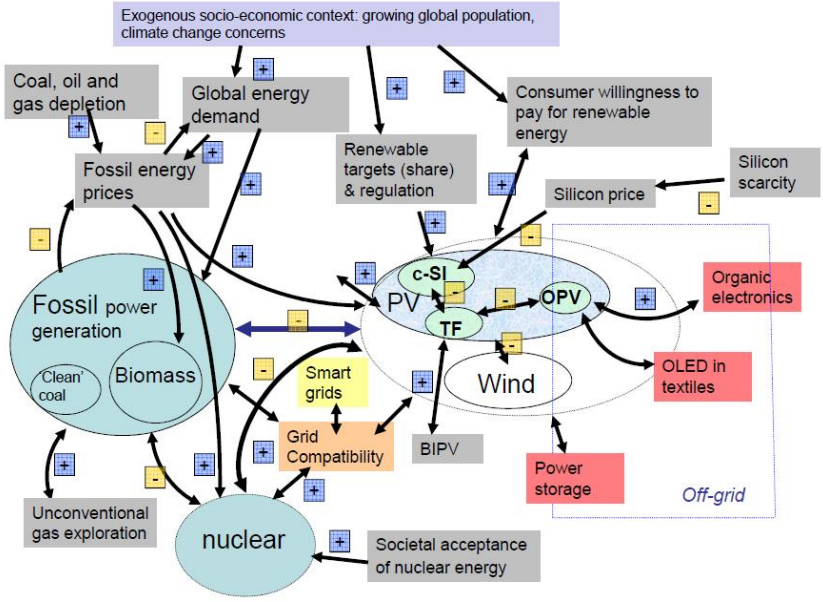
Parasitic

This is a parasitic wasp it injects its eggs into a host plant and when the babies hatch they eat the plant. Which means the plant dies.

Refflesia Arnoldii is the largest flower on earth it attaches itself onto a host vine and takes all its nutrients to live off of. Which kills the vine.

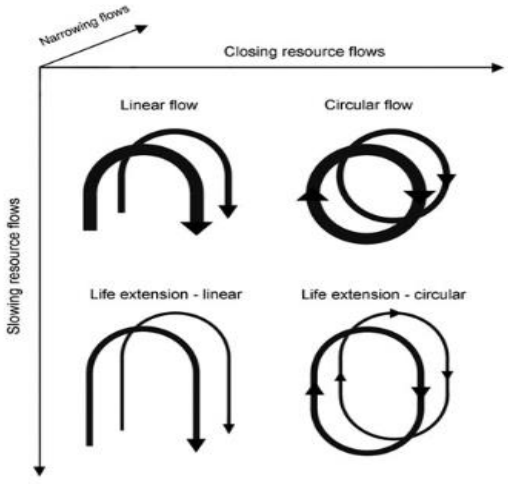


Positive (+) and negative (-) **interaction effects**



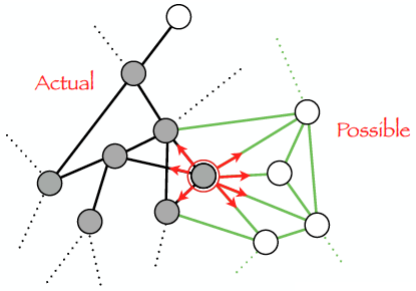
Inspired by nature (link #4)

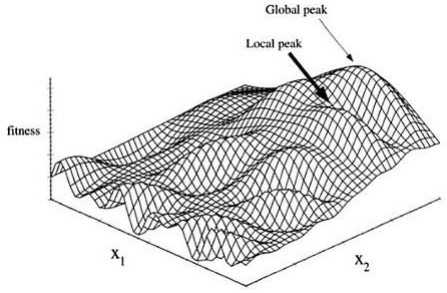
Cradle to cradle
bio-mimicking



Source: Bocken et al. 2016)

The adjacent possible
(link #5)





ELECTRIC CARS

HYBRID

Toyota Prius, Ford C-Max

Switches between a gas engine and an electric motor for higher gas mileage; no plug-in needed

PLUG-IN HYBRID

Chevy Volt, Toyota Prius Prime

Runs on electricity first, with the gas engine used as a backup

ELECTRIC VEHICLE

Nissan Leaf, Chevy Bolt EV, Tesla models

Runs on battery power only

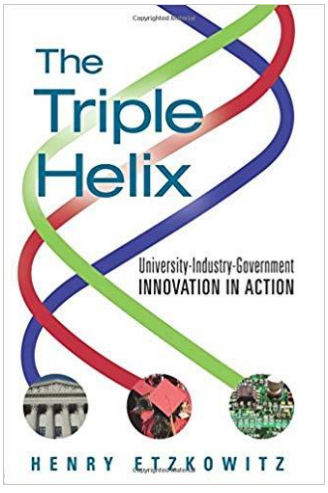
The role for policy is **context and phase-dependent** and requires **capabilities** for learning and defining good policies

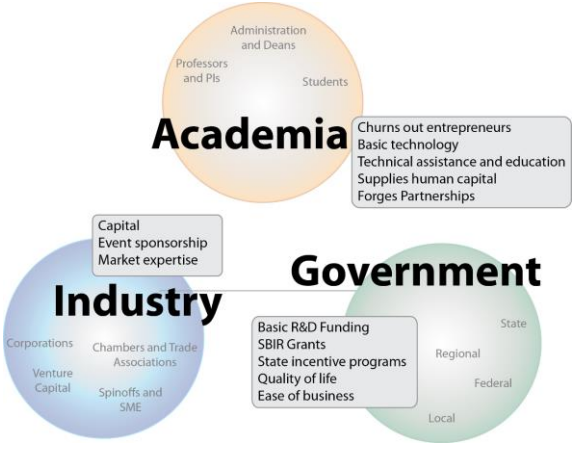
Inherent difficulties in innovation policy

- Innovation is surrounded by uncertainty, creating a problem for effective policies
- Contradicting requirements of innovation: support and selection
- Danger of regulatory capture by innovation actors (scientists, companies, …)
- A world full of policies (with different rationales) that interact with each other (competition policy, environmental policies, innovation policies, …)
- Unhelpful ideologies (government cannot pick winners, …
- …

Points of intervention *for innovation policy*

- The national system for innovation (education, **finance**, knowledge vouchers for SMEs, …)
- Sectoral systems for innovations
- Specific technological innovation systems (e.g., wind power, bioenergy, …)
- **Sustainability transitions through STIR and solution design**





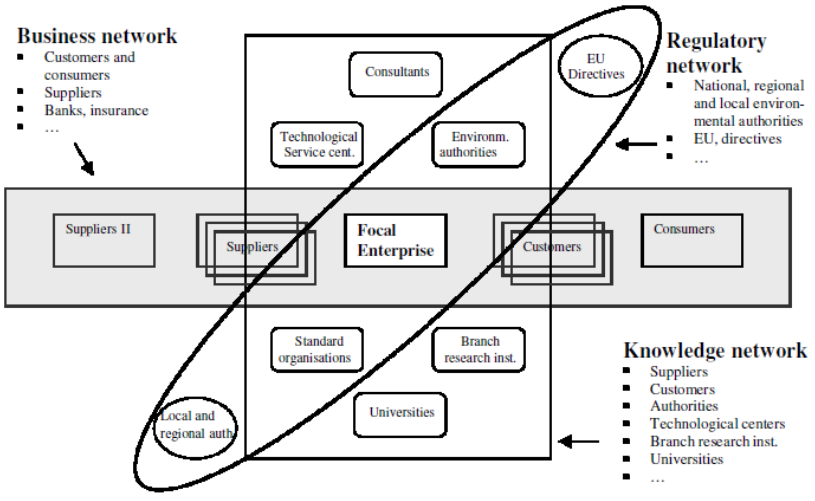
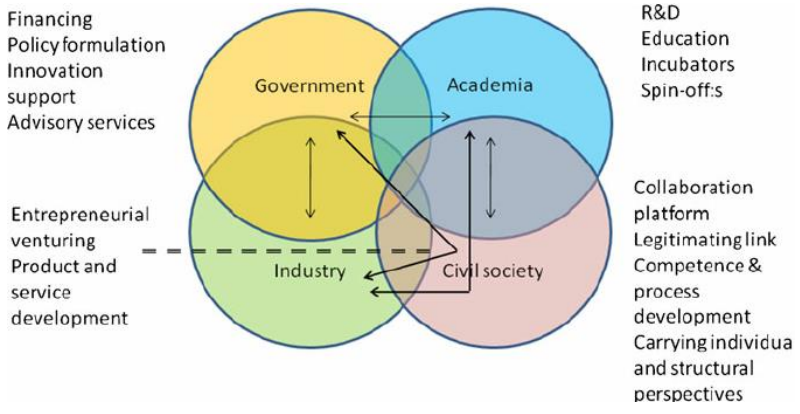
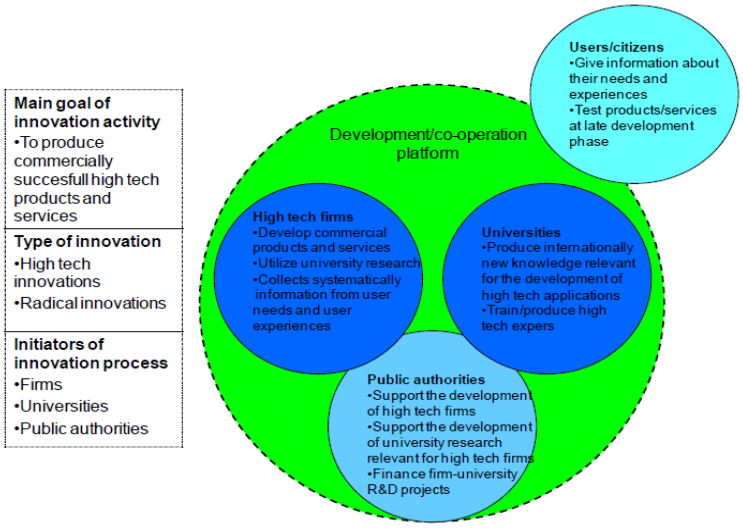


Figure 1. The separate networks of the enterprise.

The quadruple helix

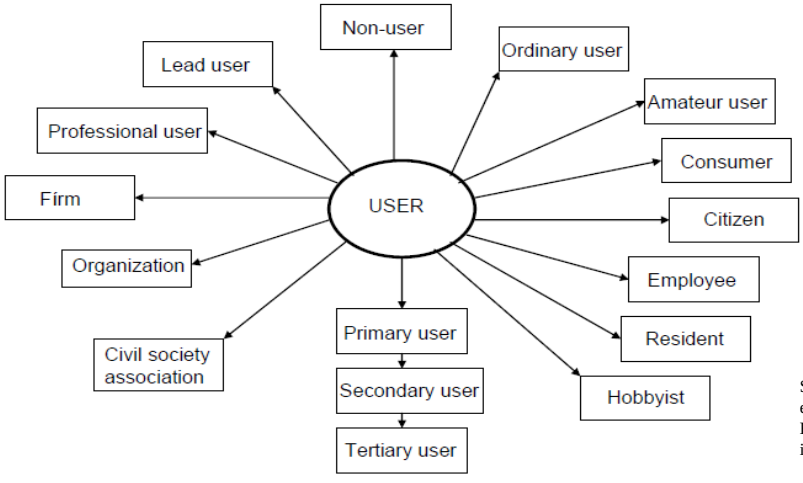


The Triple Helix+ users model



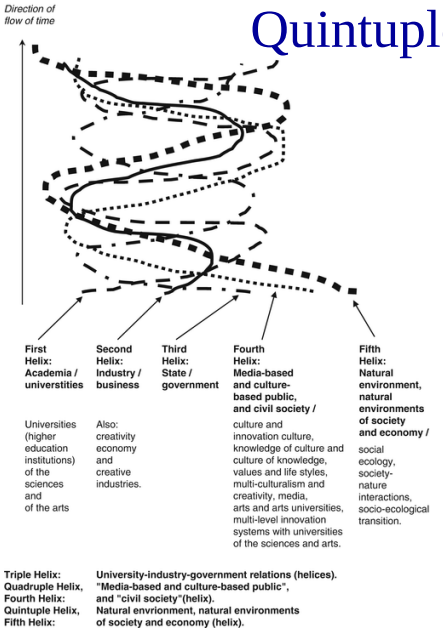
Source: Arnkil, R., Järvensivu V., et al. (2010). Exploring Quadruple Helix. Outlining user-oriented innovation models.

Different types of users



Source: Arnkil, R., Järvensivu V., et al. (2010). Exploring Quadruple Helix. Outlining user-oriented innovation models.

Quintuple helix: 4H + intermediaries



Intermediaries / intermediation

- Intermediaries fulfill **critical functions** wrt *mediating, informing, connecting, coordinating*
- The intermediary can be an individual actor, an **organisation**, such as a market research agency or the Industrial Biotechnology Innovation Centre (IBioIC) in Scotland, a **network**, as in van Lente et al's (2003) example of the Californian Fuel Cell Partnership, and a **programme** (Moss, 2009)
- In a strategic action field there may be *multiple* intermediaries and forms of intermediation
- Next to connecting organisations, they may help them find new roles and strategies (boundary change)

Concrete examples of innovations with sustainability benefits
(candidates for a smart specialisation approach)

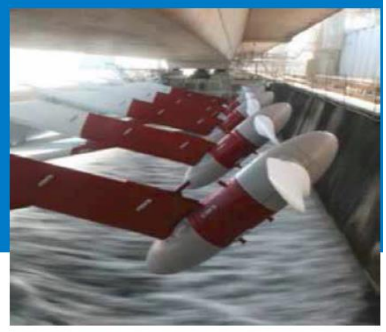
Multiple value creation
as an innovation *goal* and *outcome*

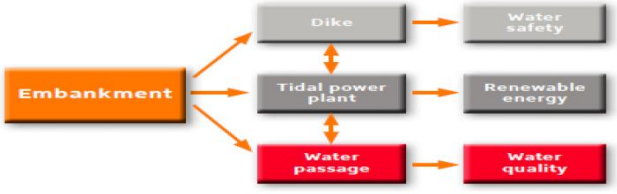
- Competing on costs is a losing game for European companies (as illustrated by the example of Zara sourcing its apparels from Morocco and Turkey)
- Fashion and new functionalities help Europeans to protect themselves against low-cost products
- Waste could be used as an input (especially if landfilling is forbidden and discouraged)
- **Making use of nature**: Connecting and combining seemingly disparate environmental problems with open-source scientific solutions based upon physical processes common in the natural world, to create solutions that are both environmentally beneficial and which have financial and wider social benefits (Gunther Pauli)

Reinventing Multifunctionality

Flood safety and tidal energy

Tocardo Turbines Oosterschelde Storm Surge Barrier





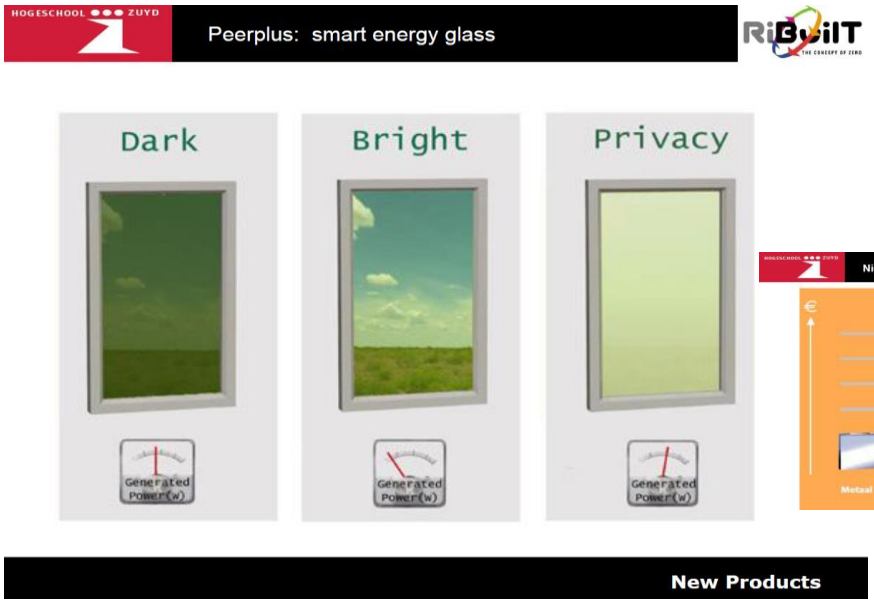
Innovative energy dam → Export

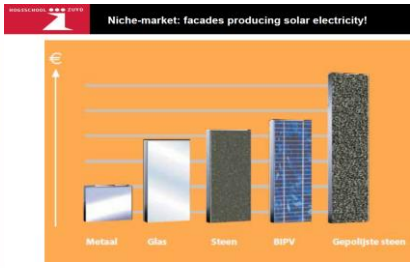
Source: Presentation Jacques Kimman at ICIS day

Multi-functionality: roof integration!

New Energy, a different way of thinking

Source: Presentation Jacques Kimman at ICIS day



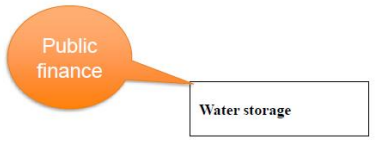


Source: Presentation Jacques Kimman at ICIS day

Combining different functionalities may **encounter problems of financing**

KRISTALBAD, WATER STORAGE

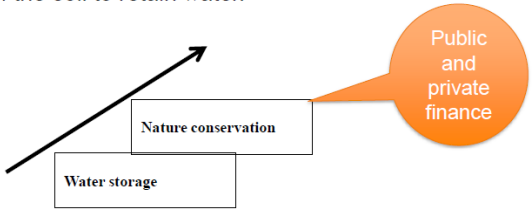
Kristalbad is situated between the two easternmost cities in the Netherlands, Enschede and Hengelo. In case of heavy rainfall, water runs from Enschede to Hengelo. Kristalbad is a water storage area to prevent flooding of Hengelo.



Source: Jurgen van den Heijden, AT Osborne

KRISTALBAD, NATURE CONSERVATION

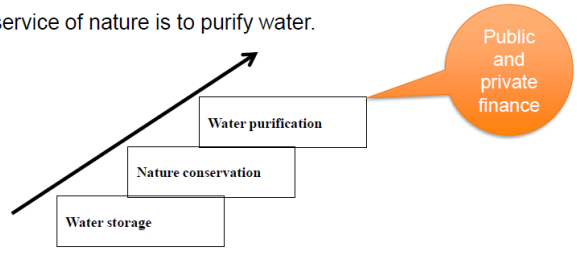
Eco system service of nature is to enhance the capacity of the soil to retain water.



Source: Jurgen van den Heijden, AT Osborne

KRISTALBAD, WATER PURIFICATION

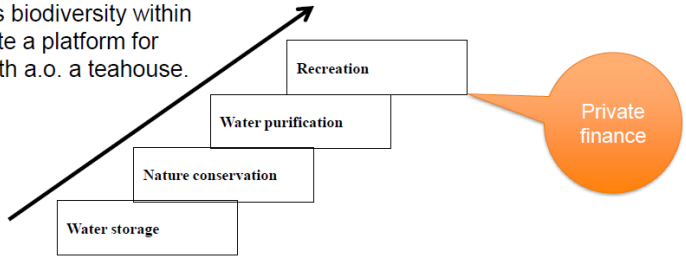
Eco system service of nature is to purify water.



Source: Jurgen van den Heijden, AT Osborne

KRISTALBAD, RECREATION

Nature and its biodiversity within the area create a platform for recreation, with a.o. a teahouse.



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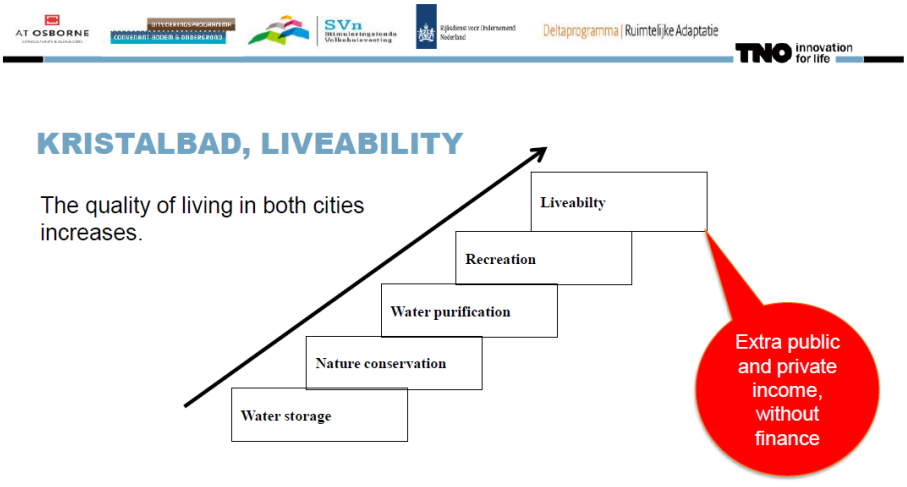

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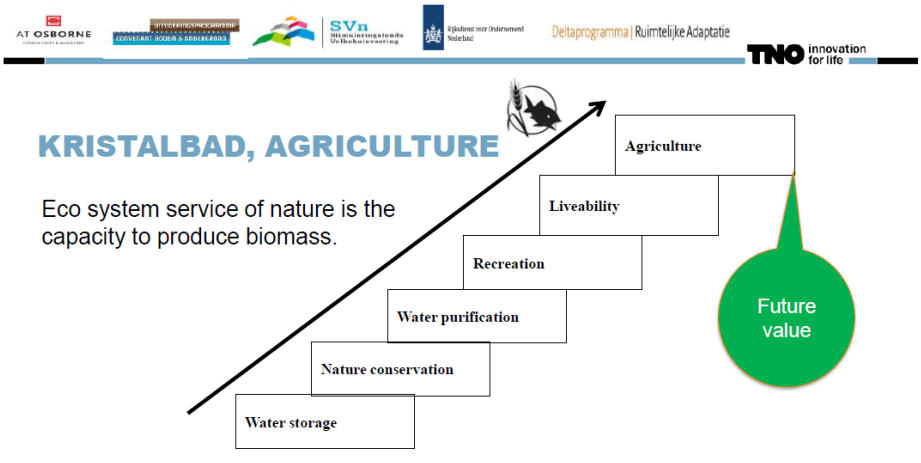


Source: Jurgen van den Heijden, AT Osborne

MULTIPLE BENEFIT BUSINESS CASE, LESS COSTS

- Kristalbad is a multiple benefit business case wherein:
  - Each benefit shares building and maintenance costs with the other benefits.
    - E.g. water storage, purification and recreation share assets / space.
- This makes a stronger business case for each single benefit than working on this benefit apart.

Source: Jurgen van den Heijden, AT Osborne

Making use of nature
Regeneration via innovation

Paludiculture

Peat restoration and preservation for ecological landscape reasons and climate protection benefits
(drained peat responsible for 5% of human induced GHG emissions) financed by product revenues and the selling of carbon credits

Making use of the water cleaning aspects of **mangrove** offering a habitat for many types of fish and plants

Instead of feeding shrimps with shrimp waste and using chemicals and anti-biotics (as a non-sustainable and less resilient approach)

Source: Gunther Pauli

Seaweed for food, energy, clothes, storing carbon and for keeping oceans alkaline (necessary for corals)

It does not require fresh water (which is getting more and more scarce in many areas)

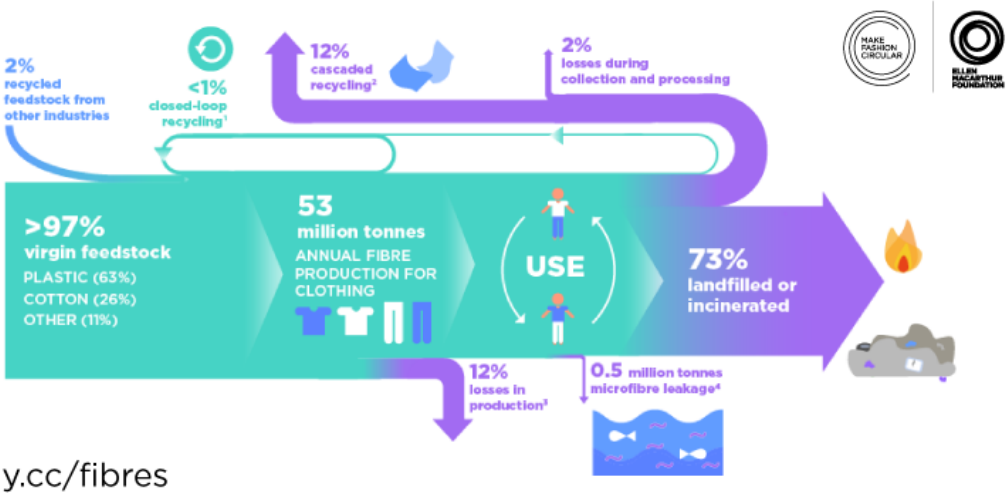
Source: Gunther Pauli

Circular fashion

AREA	OPPORTUNITIES	EXAMPLES
SOURCING	• Alternative materials • Design for biodegradability • Waste as a raw material	evrnu FUTURE OF APPAREL
MANUFACTURING	• Water/Energy use reduction • Avoid toxicity • Recycling and zero waste	RR Reverse Resources
OPERATIONS	• Renewable energy • Clean transport • New packaging	RePack originalrepack.com
RETAIL	• New store lighting • New store designs • New business models	
CONSUMER USE & END OF LIFE	• Recycling/Upcycling • Share/Re-sell • Re-use/Maintenance	patagonia

Source: Circular Fashion Workshop 'Identifying High-Value Solutions

Source: Circular Fashion Workshop 'Identifying High-Value Solutions



tiny.cc/fibres

Recycling of mixed plastics of low quality

A collaborative project of SABIC in the Netherlands and Plastic Energy (UK) to produce 'Tacoil' a polymer (based on a patented process)

Asia Will No Longer Tolerate Being a Plastic Waste Dump

China set the trend of refusing foreign plastic waste. Now other Asian countries are following suit.

Successful cases of Circular Economy policy

Fly ash in cement

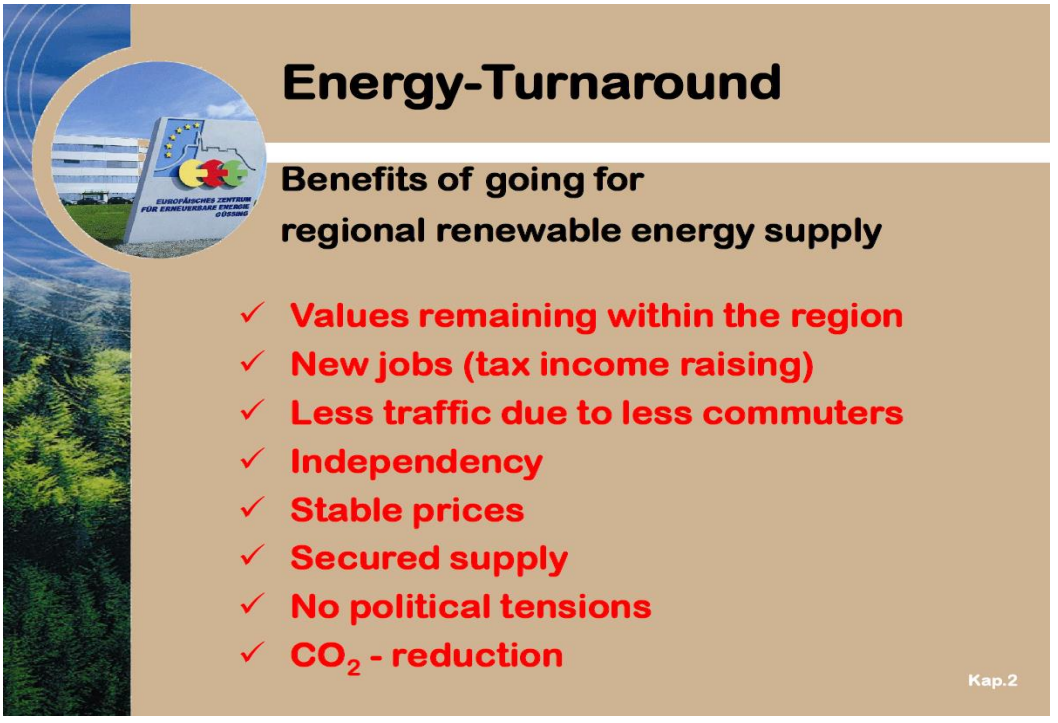
Success factors

- A special intermediary (Vliegasunie) was created for the use of fly ash in cement
- Co-determinants:
  - The use of fly ash is related to the oil crisis which prompted power producers to invest in coal-fired plants
  - The Netherland's specific geographical conditions with open water landscapes and moist and salty environments, require cements with high durability, and especially better resistance to aggressive substances (Global Cement, 2012). It is indeed mainly in marine environments where the BFS cement has demonstrated its superior characteristics as compared to OPC, within long life projects such as roads, bridges and tunnels, as well as in buildings near the sea.
  - The CEM III standard helping blast furnace slag to diffuse

Sewage sludge as a fuel

- The burning of sewage sludge in cement kilns (as a minor innovation) is the direct result of a collaboration between the water sector and the ENCI (which was motivated by the ban on sewage sluge as a fertilizer)
- After dewatering and drying the sludge at municipal waste-water treatment sites, the organic material is being grinded in a special plant of BioMIll, a joint venture of the Limburg association of water management boards (Zuiveringsschap Limburg) and ENCI
- Presently alternative types of uses are investigated

Local energy policy



Low risk potential success cases

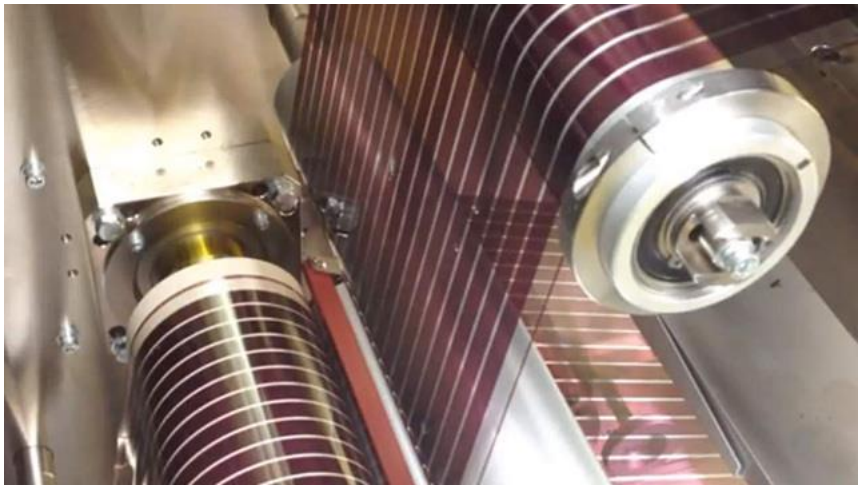
Radical energy renovation in Kaalheid (NL)

Conditions for success

- Those involving **locally available knowledge and resources** (including waste and land)
- Actors who are willing to collaborate thanks to **attractive value propositions for all relevant actors**
- **A good functioning innovation network** → product and price improvements
- No competition from cheap imports
- First-mover advantages

Higher risk cases

Organic solar cells (flexible polymers)



Factors contributing to higher risks of failure

- Relative ease of **imitation**
- Stronger networks of innovations elsewhere
- **Open trade**
- Government support is needed for **a long time**
- Poor capacities for system building and institutional change
- Continuous progress in incumbent technologies (for example silicon-based solar cells)
- Poor anticipation of external developments such as sustainability demands and good behaviour pressures

System building activities to create proficient backbones

Strategic collective system building to commercialize sustainability innovations

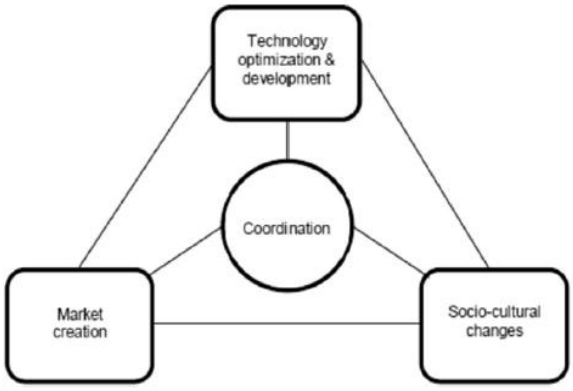


Fig. 1. Strategy framework for collective system building by entrepreneurs.

Source: Planko et al. (2019) Strategic collective system building to commercialize sustainability innovations, in *Journal of cleaner Production*

Strategy framework for **system-building activities**

Technology development & optimization

Developing, testing and optimizing the technology and complementary products and services.

- Testing new technologies, applications and markets
- Knowledge development
- Knowledge exchange
- Development of commercially viable products
- Co-creation of products and services
- Feedback loops with user-groups

Coordination

Coordinate and align all individual and collective system building efforts, to bundle forces and use resources efficiently

- System orchestration
- Creating a shared vision
- Defining a common goal
- Standardization of the new technology
- Providing a platform for open innovation
- Thinking in system building roles
- Creating transparency of all activities going on in the field

Socio-cultural changes

Embed the new technology in society; changing values and norms in favor of the new technology

- Creating new facilitating organizations
- Establishing collaboration-prone organizational cultures
- Change user behavior
- Changing the education system
- Generation of a skilled pool of labor

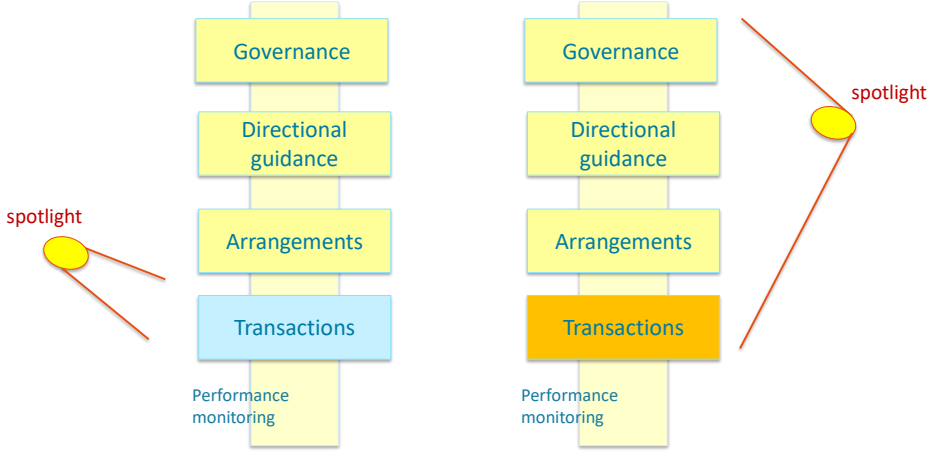
Market creation

Creating a market for the technology; raising user awareness and demand for the product

- Generate new business models
- Creation of temporarily protected niche market
- Collaboration with government for enabling legislation
- Collaborative marketing to raise user awareness
- Collaborative competition against other technology clusters

Source: Planko et al. (2019) Strategic collective system building to commercialize sustainability innovations, in *Journal of cleaner Production*

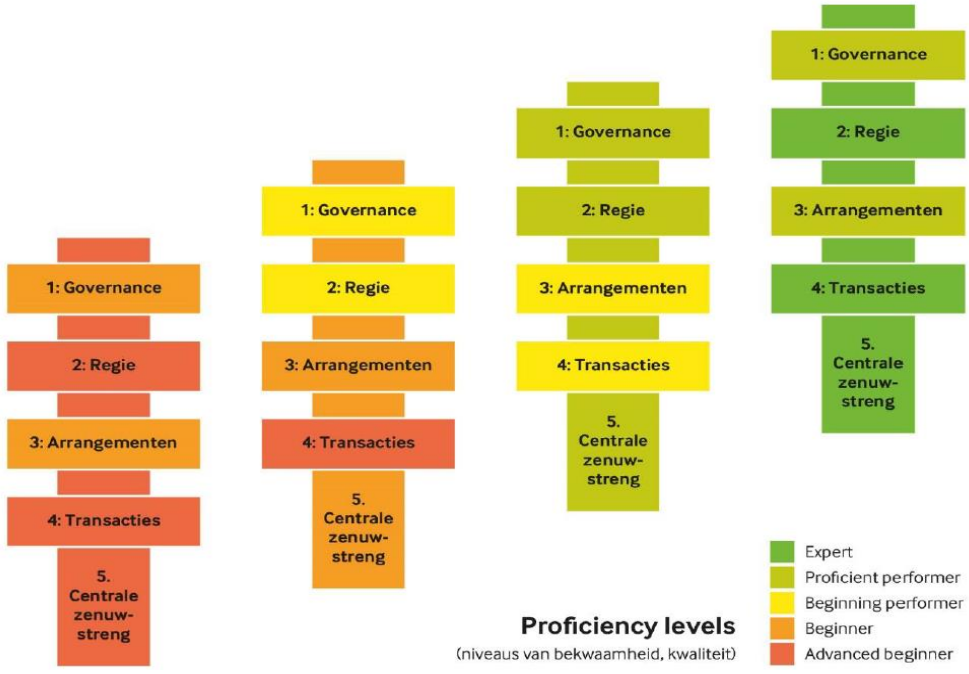
Fostering institutional change and programmatic adaptation



Focus on transactions and performance monitoring

Focus on whole backbone, *transactions as logical consequence*

- The elements of the backbone should be dynamically monitored and evaluated wrt:
  - Proficiency level
  - Coherence
- In an **actor specific way** (to allocate responsibilities, adapt policies and foster institutional change)
- Role for **benchmarking** of inputs, activities, outputs, processes and outcomes across regions aids learning (about transition processes to a circular economy, renewables based energy system, sustainable agriculture, …)
- Green industrial policies (based on smart specialization) should be updated in the light of international competition and policy evaluation (**policy adaptation**)



Dani Rodrik on green industrial policy

- **The prime task for policy makers is** *to learn where the constraints and opportunities lie and respond appropriately to these*.
- Regarding the *interaction with business*, he favours a model of "**embedded autonomy**" consisting of '*strategic collaboration and coordination between the private sector and the government with the aim of learning where the most significant bottlenecks are and how best to pursue the opportunities that this interaction reveals*' (2014, p. 485).
- To prevent regulatory capture & inefficiencies, Rodrik advocates "**discipline**" in the use of policy support.
- For safeguarding the public interest and obtaining buy in, policy agencies should be publicly **accountable** as to their failures and successes. "Accountability not only keeps public agencies honest it also helps legitimize their action" (Rodrik, 2014, p. 488).

Transition management *as guided evolution by exploiting the* ***adjacent possible*** *in a forward-looking, adaptive way*

Key elements of TM

- **Forward-looking thinking** (visions of alternative systems and new business)
- **Learning and experimentation** by actors interested in alternative systems
- Putting pressures on non-sustainable regimes (easier to do in case of well-developed alternatives)
- Adapting policies and portfolios that receive support
- Government as facilitator (not a director or just a funder)
- Institutional support for transition endeavours

Readings about TM, green industrial policy and solution design

- Rotmans, J., R. Kemp, and M. van Asselt, 2001: More evolution than revolution: Transition management in public policy. *Foresight*, 3(1), 15-31
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- Kemp, R., D. Loorbach and J. Rotmans (2007) Assessing the Dutch energy transition policy: how does it deal with dilemmas of managing transitions? *Journal of Environmental Policy and Planning* 9(3-4): 315–331.
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- Kemp, R., Never, B. (2016) Green transition, industrial policy, and economic development, Oxford Review of Economic Policy, 33(1): 66–84. https://doi.org/10.1093/oxrep/grw037
- Ramani, S., Kemp, R. (2019) **Solution design for Green Development and SDGs**, contribution for the book *New Research Directions in Environmental Economics* edited by Matthias Ruth (to be published by Edward Elgar).