



# **Innovation and Sustainable Development**

**Prof. dr. Marko Hekkert**



The image features a dense, overlapping pile of US dollar bills, primarily \$100 bills, filling the entire frame. In the center, a blue rectangular sign with rounded corners is superimposed. The sign has the word "Welfare" in white, sans-serif font on the left and a white arrow pointing diagonally upwards and to the right on the right. The sign appears to be supported by two thin poles, and the background behind the sign shows a clear blue sky with some light clouds.

**Welfare**













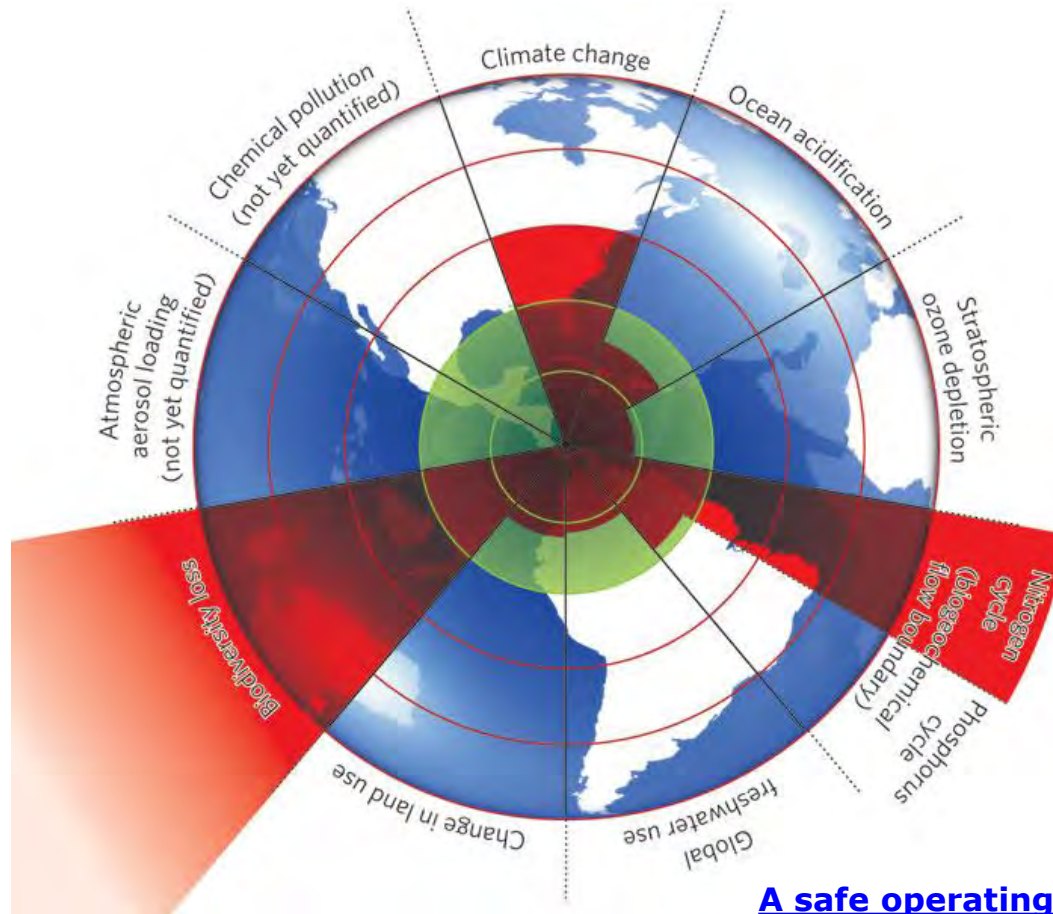


# Innovation brought us also:

- Traffic jams,
- RSI,
- overweight people,
- stress,
- financial crisis,
- etc etc



# No safe operating space



## [A safe operating space for humanity](#)

Johan Rockström et al

*Nature* **461**, 472-475(24 September 2009)



# Carbon budget

- 1 trillion tons of carbon
- We used half
- In 2030 we will have used the budget
- Stil 3 trillions tons in the ground





- Limiting the warming to the agreed-upon target “is technically doable, but at the moment we’re not going in the **right direction**,” Dr. Allen said in an interview. “I don’t think we’ll do it unless we bite the bullet and start talking about what we’re going to do with that extra carbon that we can’t afford to dump into the atmosphere.”



# New direction

- Sustainable development requires a fundamental shift in innovation direction
- Not easy: primary goal of most large firms: creation of share holder value
  - Short term, economic gain
  - No significant attention for other two P's.
  - But also: requires new competences
    - E.g. shift from gas to PV





## 2 changes are necessary

- Production of current products with a fraction of the environmental impact
- Totally new products / services
  - Radical innovation



# New direction – radical innovation

- Often radical innovation comes from new entrants
- Emergence of clean tech industry
- New Kondratieff wave?
  - Industrial revolution – 1770
  - Steam and railways – 1830
  - Steel and electricity – 1875
  - Oil and car – 1910
  - IT – 1970





# Emergence of new field

- Different than previous cycles
- No direct benefit for consumers
- In early phase development is strongly dependent on government policy / support
- Different types of dynamics
  - Competition outside market place
  - Framing / expectations / lobby / fight for legitimacy
    - E.g. climate debate, Clean Air Act, PV debate



# Understanding change

- Innovation Systems perspective
- Perfect framework for studying emergence of new sectors / fields





# The Innovation system

Van de Ven, The Innovation Journey:

- The time, costs and risk incurred by firms in developing an innovation are inversely related to the developmental progress of building an innovation system for the new technology
- More novel innovations require greater change in all system functions and therefore greater development time and greater chance of failure
- Free goodies – positive externalities
  - Skilled labor, well functioning education system
  - Legitimacy, Markets, Knowledge, Standards



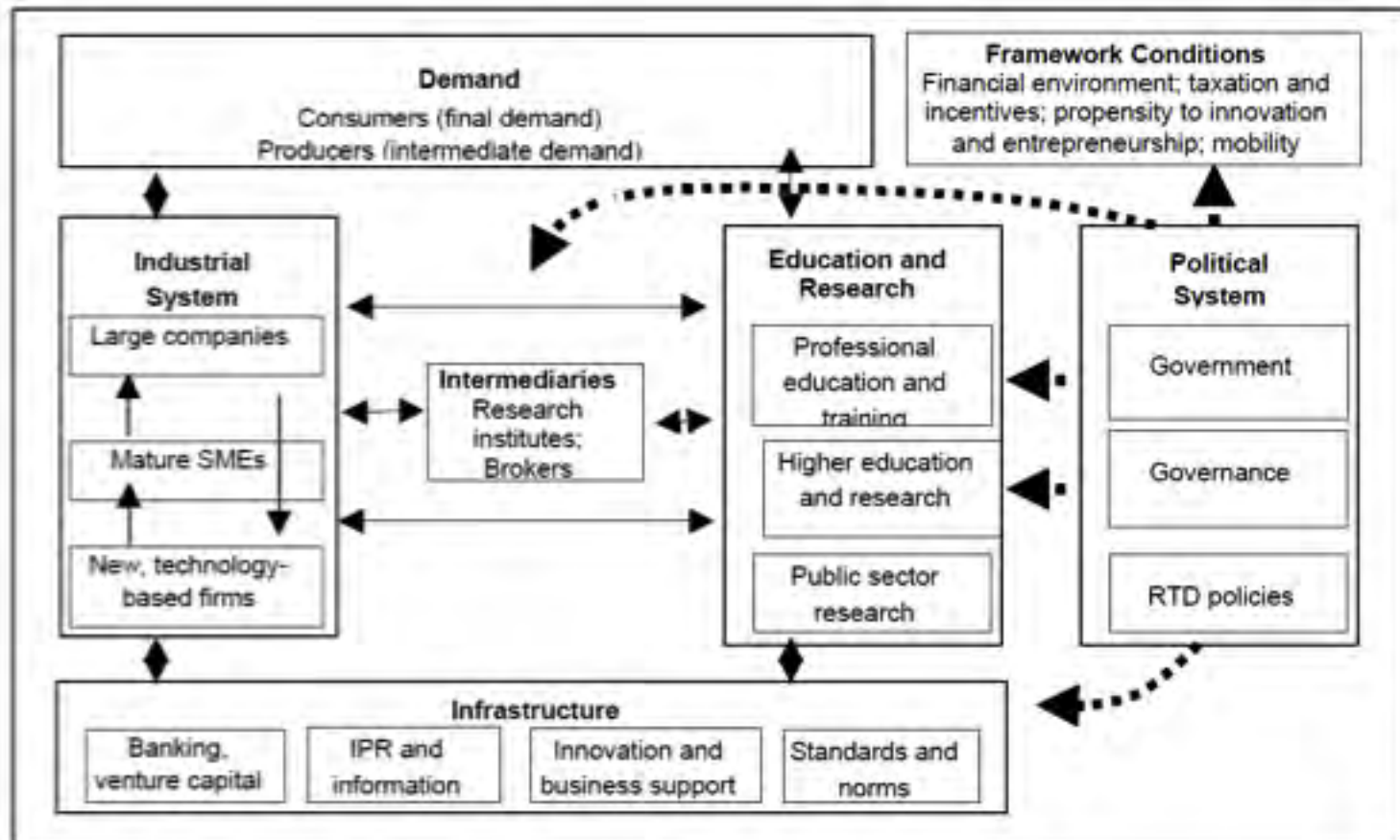
## Thus:

- Radical innovations require a focus on building new innovation system / require a well functioning innovation system
- Seven key processes are central in system build up & functioning
  - entrepreneurial experiments,
  - knowledge development
  - Knowledge exchange,
  - guidance of the search,
  - resources mobilization,
  - market formation,
  - counteract resistance to change





# Well functioning system -> structural change



Stolen from: Kuhlmann and Arnold



# Typical clean tech dynamics

- Guidance: climate change needs solutions
- S&T push motor: knowledge development, expectations, resources mobilization
- Market formation: system building activities of innovation system actors vs power play by incumbents
  - Problem is challenged
  - Solutions are challenged
  - Modest self-organization of innovation system
  - Short election cycles – non stable policies
  - Problematic growth of innovation system



# Entry barriers

- Incumbent actors develop range of strategies aimed at slowing down change
  - Kicking the can down the road
  - Defensive patenting
  - Standardization without new entrants
  - Killer hugs





# Emerging field strategies

- Institutional change
  - Framing, creation of legitimacy
    - Hype cycles – algae
    - Framing of viable business venture – biomass entrepreneurs
  - Collective vs individual institutional work
    - PV vs CCS



# Regional dynamics

- Some regions are different
- Large scale market formation
- Accelerates global innovation system
- Steep learning curves
- Fundamentally changes level of competition
  - PV adoption in NL
  - Huge losses of utilities
- Thus differences in institutional thickness (Coenen & Truffer, 2012) influence industry dynamics



# Wrap up

- Sustainable innovation = change of direction
- Emergence of new fields
- Innovation system perspective perfect
- Opportunities for further theory development
  - Inclusion of sociological view on institutions and institutional change
  - Geographical focus





# Warning!

- institutions & institutional change dominant in business literature
- No systems thinking!
- Cross overs will be difficult