# Diffusion Dynamics of Environmental Product and Service Innovations

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# A key challenge for sustainability transitions

- We identified a key challenge in former empirical investigations:

  ➔ Fichter, K. & Clausen, J. (2016). Diffusion Dynamics of Sustainable Innovation – Insights on Diffusion Patterns Based on the Analysis of 100 Sustainable Product and Service Innovation. Journal of Innovation Management, 4(2), 30-67.

- Two thirds of all environmental product and service innovations remain in a niche and never exceed dissemination rates or market shares of more than 15% (Fichter & Clausen, 2016).

- The central problem of innovation policy in the context of sustainablity transitions is not a lack of environmental innovations, but a lack of diffusion throughout the economy and society!

# Three limitations of diffusion research on eco-innovations

Insights based on extensive literature reviews (Clausen, Fichter & Winter, 2011; Fichter & Clausen, 2016; Karakaya, Hidalgo & Nuur, 2014; Kivimaa & Kern, 2016, Clausen and Fichter 2018):

1. Almost all studies focus on only one sector or technology, which is mostly energy.

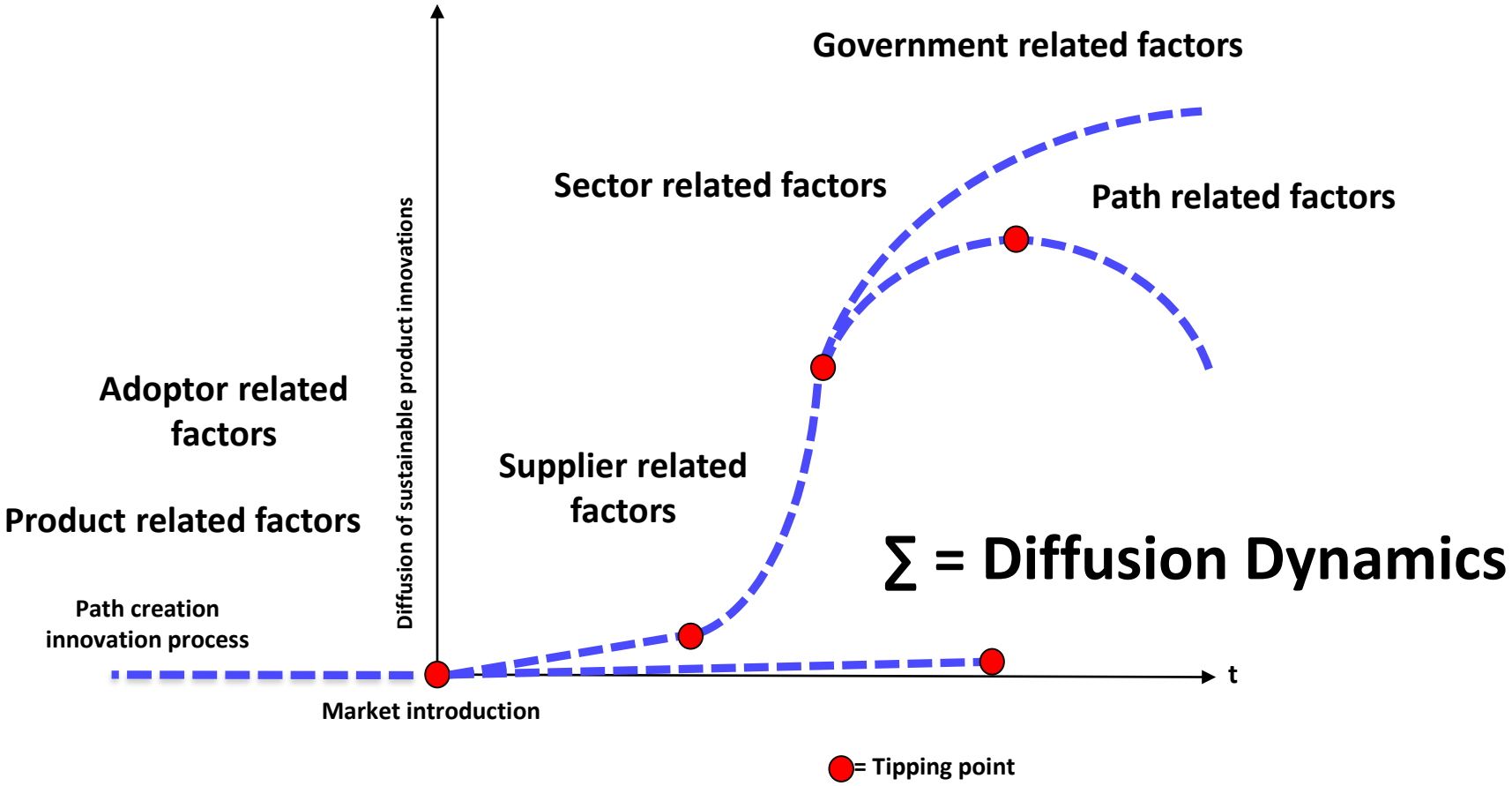
2. Most studies focus on a small number of factors from only two fields of influence

3. Almost all studies are focussed on a small number of diffusion cases in single sectors.

# Guiding research question

- Which are the key factors driving or hampering the diffusion of environmental product and service innovations?
- To investigate this question, it requires:
  - ➔ Multi sector analysis (not focussed only on one sector or technology)
  - ➔ A holistic and broad set of factors that can potentially influence diffusion
  - ➔ A large number of diffusion cases in order to generalize
- We use the terms „environmental innovation“ and „eco-innovation“ synonymously.
- For the concept of „environmental innovation“ or „eco-innovation“ we refer to the EU Eco-Innovation Action Plan

# Factors potentially influencing diffusion of eco-innovation



# Results from the project „Environmental Innovations and their Diffusion as Driver of the Green Economy“

- Commissioned by


# Sample and Method

# Central attributes of the 130 cases

| Attribute | Characteristics (number of cases) | | |
|---|---|---|---|
| **Degree of Innovation** | Radical Innovation (57) | Incremental Innovation (73) | |
| **Object of Innovation** | Product (60) | Product-Service System (49) | Service (21) |
| **Type of Innovator (at market introduction)** | New Firm (36) | Both Types (20) | Established company (60) |
| **Type of Adopter** | Private Consumers (32) | Both Types (58) | Professional Users (40) |

# The diffusion paths of 130 environmental product- and service innovations have been analyzed

| Field of Products or Services | Degree of Dissemination | | | | Total |
|---|---|---|---|---|---|
| | up to 1% | up to10% | up to 50% | up to 100% | |
| **Mobility** | 5 | 5 | 3 | 1 | 14 |
| **Food and Restaurants** | 2 | 10 | 2 | 1 | 15 |
| **Financial Services** | 4 | 2 | | | 6 |
| **Renting and Leasing** | | | 3 | | 3 |
| **Green conventional Services** | | 2 | | | 2 |
| **Scientific Services** | 2 | 3 | 1 | 1 | 7 |
| **Energy Effciency** | 4 | 4 | 8 | 5 | 21 |
| **Value Selling in Industry** | 1 | 4 | 1 | | 6 |
| **Internet and Computing** | | 3 | 6 | 10 | 19 |
| **Crafts Services** | | 4 | 2 | | 6 |
| **Retail and Trade** | | 3 | 1 | | 4 |
| **Building and Housing** | | 1 | 2 | | 3 |
| **Renewable Raw Material** | 2 | 5 | 2 | | 9 |
| **Renewable Energy** | 7 | 1 | 3 | 4 | 15 |
| **Total** | 27 | 47 | 34 | 22 | 130 |


# Profile for each case with key characteristics and data on independent and dependent variables

- We prepared a qualitative profile for each case, using secondary information.
- Secondary information includes market analyses, life-cycle analyses, websites of inventors, manufacturers, wholesalers, and retailers as well as product- or use-related Internet sources.
- In total, about 7,000 sources of information were accessed and about 1,200 were cited in the 130 case studies.
- The description of the cases in each of the profiles followed a defined format and a given coding system (cf. Appendix 1 in Fichter and Clausen (2016)).
- This included key data on the type of innovation and the diffusion process as well as the 22 in dependent variables and one dependent varialbe (dissemination rate)
- The profile format fulfilled the function of a standardized survey instrument, similar to a standardized observation protocol.

# 22 independent variables (factors)

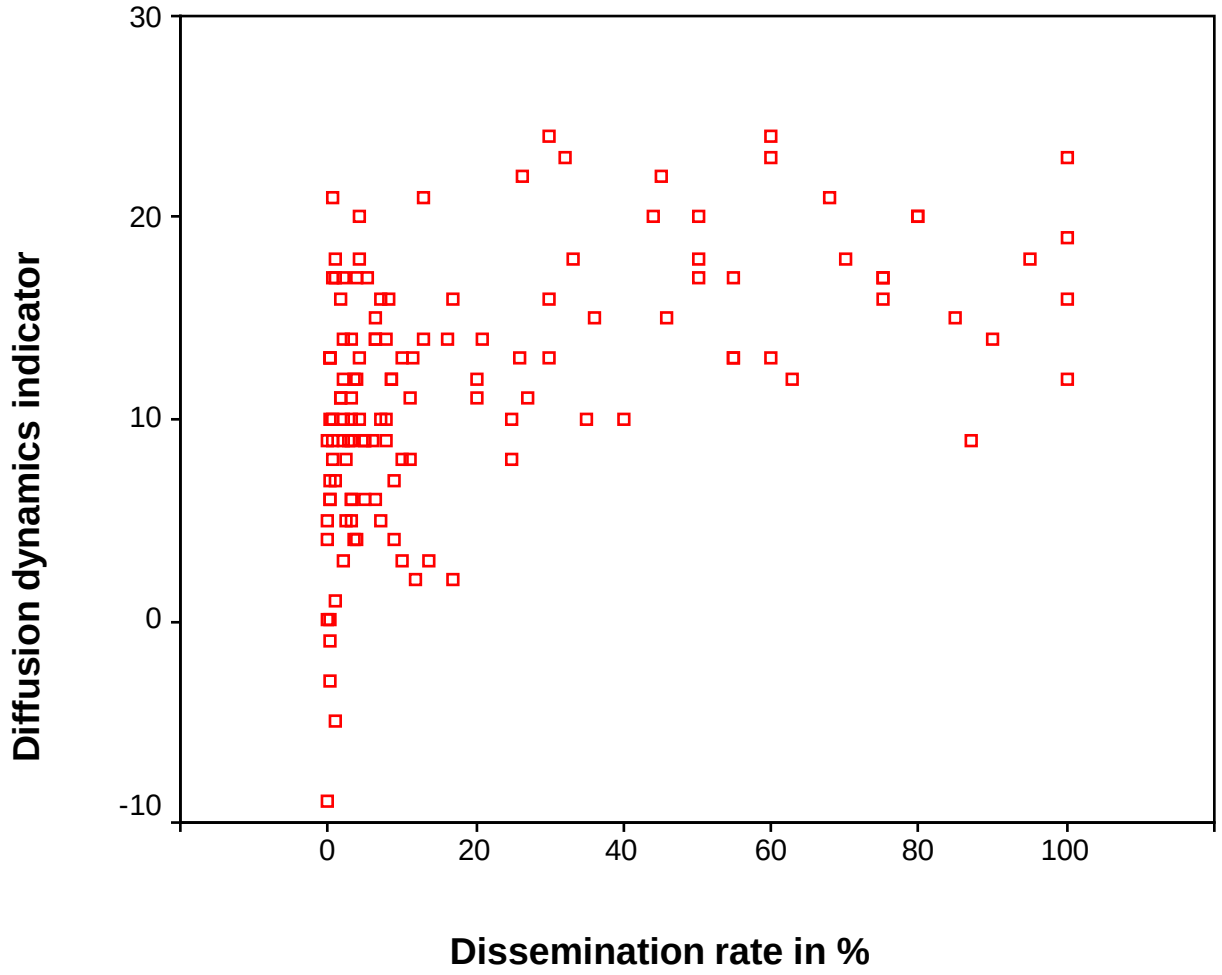
| Factor Group | Independent Variable | |
|---|---|---|
| **Product-related factors** | Relative advantage of the innovation | |
| | Perceptibility | |
| | Compatibility | |
| | Low complexity | |
| | Trialability | |
| **Adoptor-related factors** | Involvement of user innovators | |
| | Low need for behavior modification | |
| | Uncertainties on the part of adoptors | |
| | Financial (dis-)advantage (price, costs, cost-effectiveness) | |
| **Supplier-related factors** | Necessary training efforts for staff (formerly “Green Pio-neers”) | |
| | Renown and reputation of suppliers | |
| | Completeness and availability of service | |
| **Sector-related factors** | Degree of support by industry trade association | |
| | Degree of support / resistance by market leaders | |
| | Degree of support by intermediaries as change agents | |
| **Policy-related factors** | Institutional obstacles | |
| | Governmental push and pull activities | |
| | Lead market policies | |
| | Media and campaigns | |
| **Path-related factors** | Role of path dependencies | |
| | Price development | |
| | Self-reinforcing effects | |

# Dependent variable: Dissemination rate

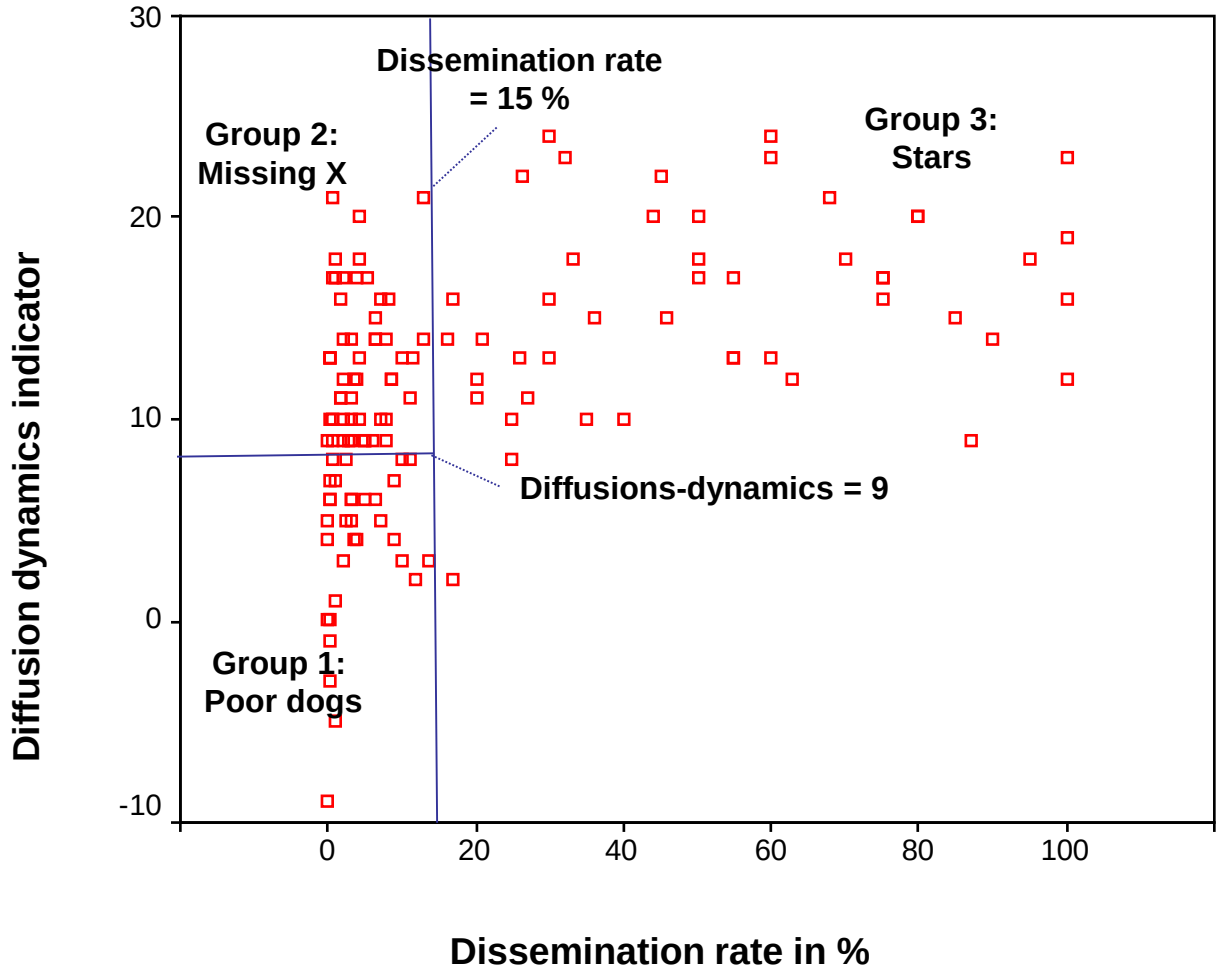
- Share of turnover in the respective market
  - ➔ e.g. high-efficiency fridges: share of A++ (an better) fridges of all sold fridges
- Stock data
  - ➔ e.g. absorption coolers: share of absorption coolers of all installed coolers
- Data relating to available potential
  - ➔ e.g. wind power: realized wind power as share of the all over potential of wind power in a given region

# Results

# Dissemination rate of 130 eco-innovations



# Groups of eco-innovations



# Relation of the independent variables and the dependent variable „degree of dissemination“ (n=130)

| Factor Group | Independent Variable | Kendall-Tau-b and approximate significance<br>Dependent Variable: Degree of dissemination |
|---|---|---|
| **Product-related factors** | Relative advantage of the innovation | 0,177* |
| | Perceptibility | |
| | Compatibility | 0,159* |
| | Low complexity | |
| | Trialability | |
| **Adoptor-related factors** | Involvement of user innovators | **-0,203**** |
| | Low need for behavior modification | **0,329**** |
| | Uncertainties on the part of adoptors | **0,199**** |
| | Financial (dis-)advantage (price, costs, cost-effectiveness) | 0,130* |
| **Supplier-related factors** | Necessary training efforts for staff (formerly “Green Pio-neers”) | **Not analysed** |
| | Renown and reputation of suppliers | **0,332**** |
| | Completeness and availability of service | **0,349**** |
| **Sector-related factors** | Degree of support by industry trade association | **0,234**** |
| | Degree of support / resistance by market leaders | **0,214**** |
| | Degree of support by intermediaries as change agents | |
| **Policy-related factors** | Institutional obstacles | 0,145* |
| | Governmental push and pull activities | |
| | Lead market policies | 0,177* |
| | Media and campaigns | |
| **Path-related factors** | Role of path dependencies | |
| | Price development | **0,336**** |
| | Self-reinforcing effects | **0,278**** |

**Characteristics of Kendall-Tau-b: 0 to 0.05: no correlation; to 0.2: weak correlation; to 0.5: medium correlation; above 0.5: strong correlation. Only significant correlations are presented. Significant at 5% level; ** significant at 1% level; n=130.**

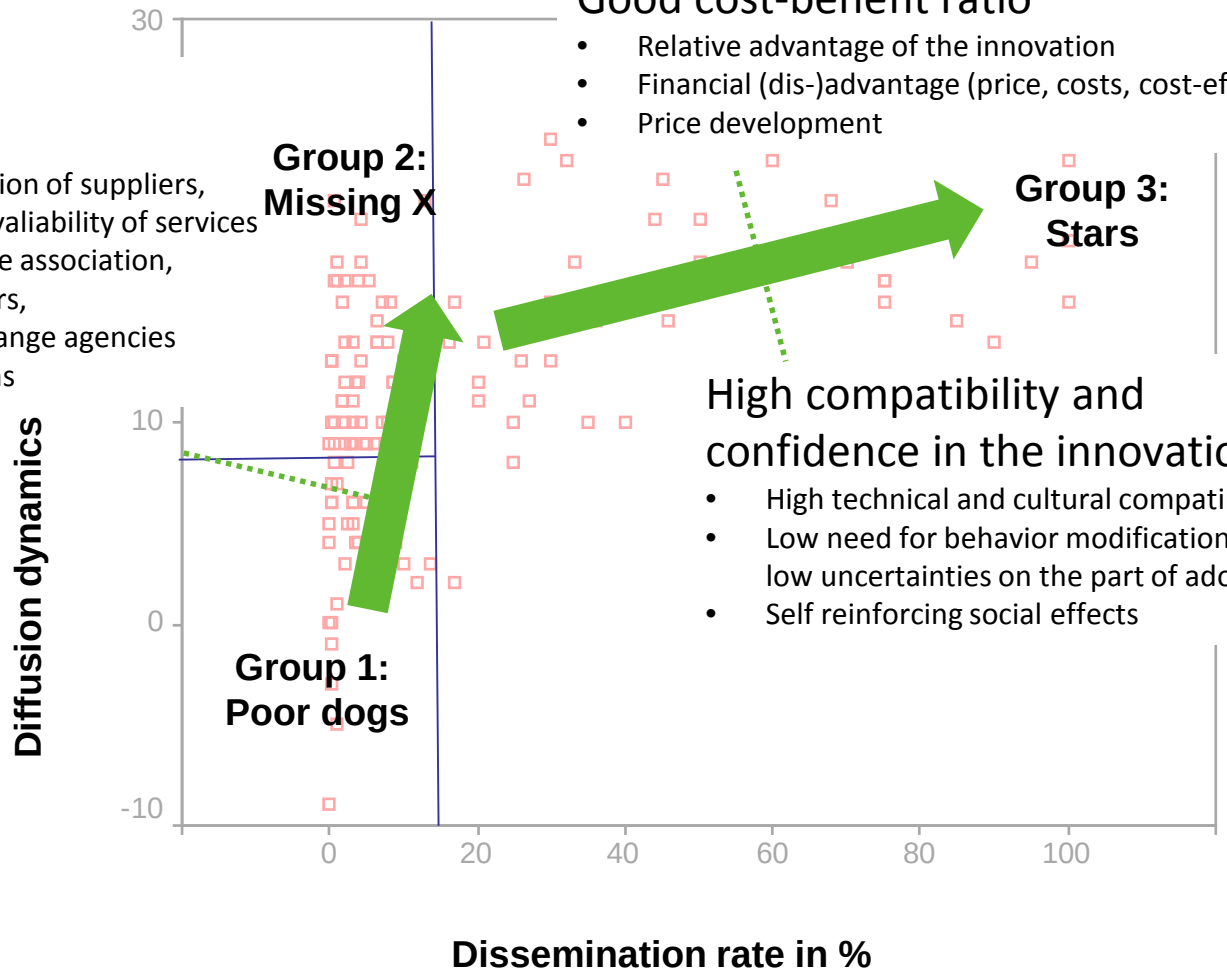
# Central „factor groups“ of diffusion

## Market Push

- Perceptability
- Renown and reputation of suppliers, completeness and avaliability of services
- Role of industry trade association, role of market leaders, intermediaries as change agencies
- Media and campaigns

## Good cost-benefit ratio

- Relative advantage of the innovation
- Financial (dis-)advantage (price, costs, cost-effectiveness)
- Price development

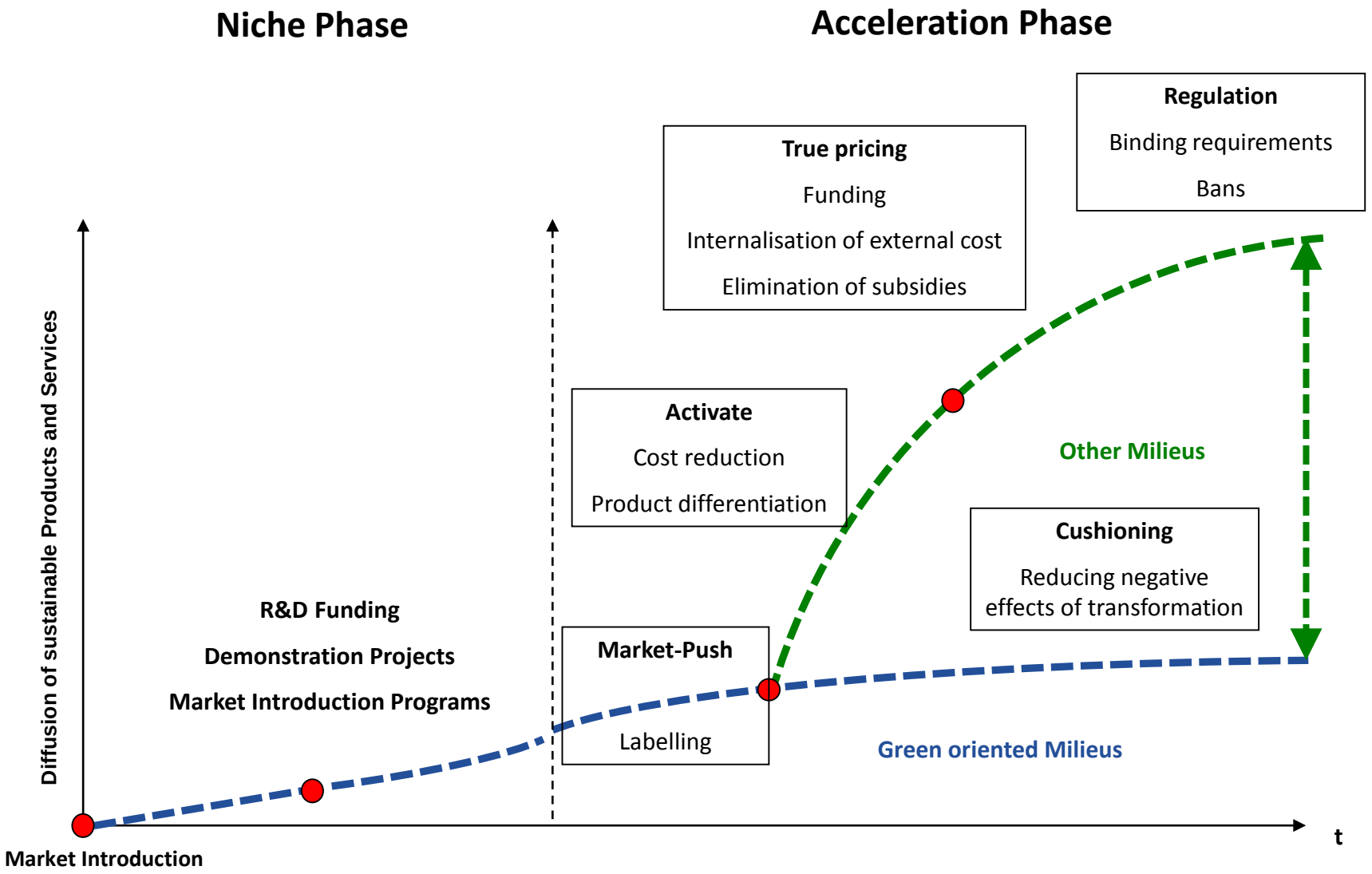



## High compatibility and confidence in the innovation

- High technical and cultural compatibility
- Low need for behavior modification, low uncertainties on the part of adoptors
- Self reinforcing social effects

# Possible Strategies

# Political recommendations



Thank You!

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More about the project at www.borderstep.de:

Clausen, J. & Fichter, K. (2018). Umweltinnovationen 2: Faktoren und Dynamiken der Verbreitung grüner Dienstleistungen und Produkte in der Gesellschaft. Im Erscheinen. Dessau-Roßlau: Umweltbundesamt (im Erscheinen).

Clausen, J. & Gandenberger, C. (2018). Umweltinnovationen 1: Grundlagenanalysen. Im Erscheinen. Dessau-Roßlau: Umweltbundesamt (im Erscheinen).

Fichter, K. & Clausen, J. (2016). Diffusion Dynamics of Sustainable Innovation - Insights on Diffusion Patterns Based on the Analysis of 100 Sustainable Product and Service Innovations. Journal of Innovation Management, 4 (2), 30–67.