



How to keep dancing when the party is over: The interplay of policy & corporate strategy in the German solar energy industry

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In the 45 minutes or so, ...

... we will discuss

- ... The **German photovoltaic power sector**
- ... How **deployment policies** affect **industrial evolution** and **dominant designs**



... and we will see

- ... That deployment policy can be the **principal driver of industrial evolution**
- ... That dominant designs can be **policy-dependent**
- ... That—while very effective at promoting technological change—**industrial transition to a post-policy stage needs to be proactively designed**

Some nomenclature

- PV
 - Photovoltaics
-
- Deployment policies
 - Policies that are intended to accelerate the deployment of a technology.
 - Examples: Feed-in tariffs, Standards, Investment Funding, Governmental purchases
-
- Dominant design
 - A configuration of a technology that is
 - Widely adopted by consumers /
 - Accounts for the great majority of sales
 - Diffuses almost completely throughout the industry
 - Fundamentally changes the competitive dynamics of an industry
 - Configuration = design features and performance characteristics

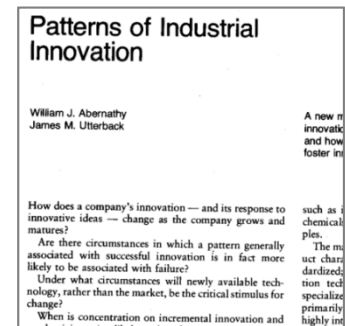
Contents

- **Introduction**
- Theoretical foundation
- Case + Methods
- Results + Implications

Dominant design is a powerful concept to understand industrial evolution – but what if policy is a driver, too?

Dominant design

- Powerful framework to analyze industrial evolution [1]
- Main assumption: Technological change is main driver of industrial change [1]
- Scope: Exclusion of external structure setting mechanisms [3,4]



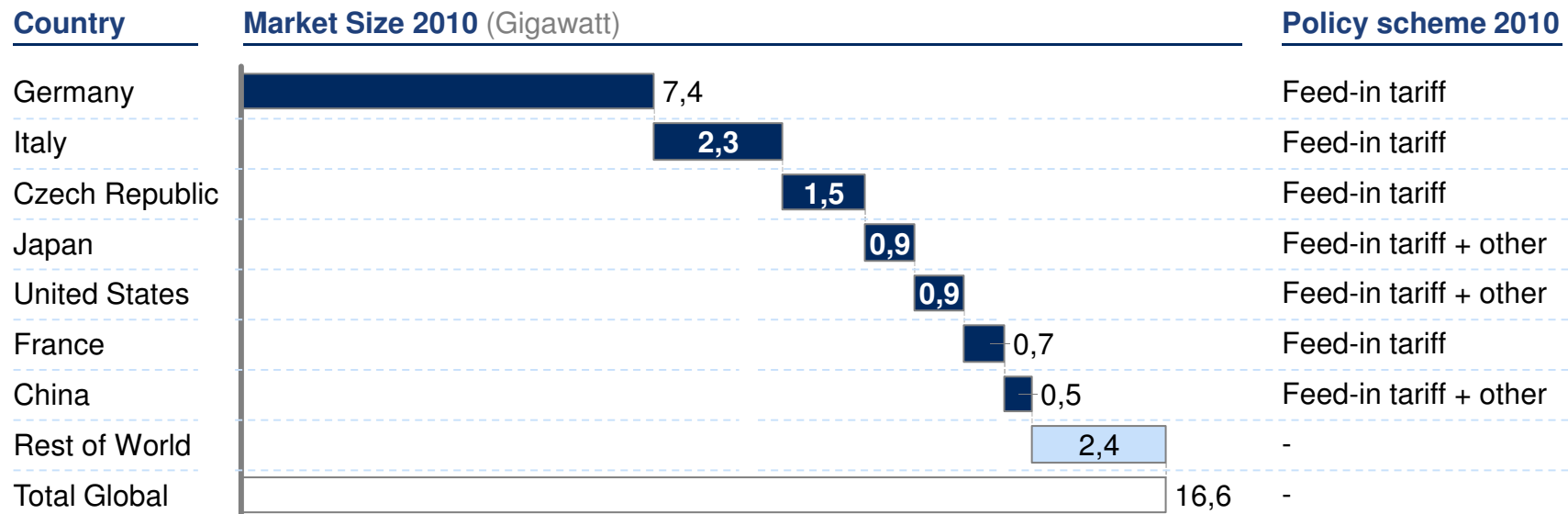
→ *What about policy as an influencing factor?*

- Policy can severely influence or even determine industrial evolution [5]
- Policy is present in many industries: energy, life sciences, swiss watches
- In particular: Deployment policies (as response to climate change, etc)

How does policy influence dominant designs and industrial evolution?

Source: [1] Suarez 2004. [2] Abernathy 1978; Abernathy & Utterback 1978. [3] Cohen 2011. [4] Murmann, Frenken 2006. [5] Cimoli et al. 2006; Pack & Saggi 2006; Rodrik 1995

Deployment policies in particular effectively shape technological change – what are the long-term consequences?



Deployment policies are effective at promoting tech change. But we don't know...

- How deployment policies affect the *long-term* evolution of an industry.
- How a transition from a policy-dependent to a policy-independent industry can be achieved.

... or put simply: „**What happens if you take the honey away?**“

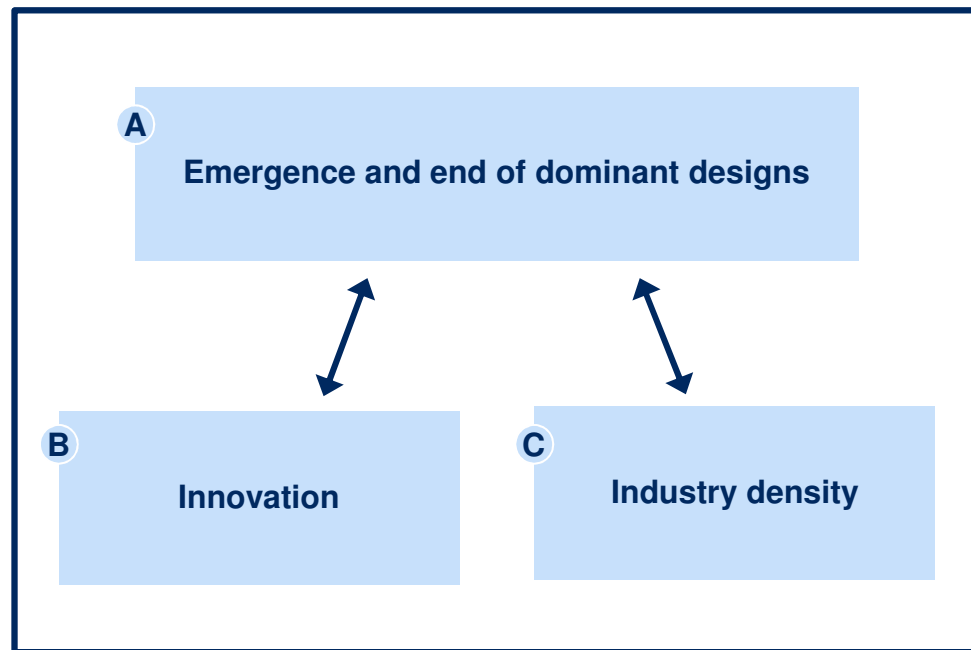
Source: Hoppmann et al. (2013)

Contents

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- **Theoretical foundation**
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To build a theoretical foundation, we will synthesize dominant design and industrial policy literature

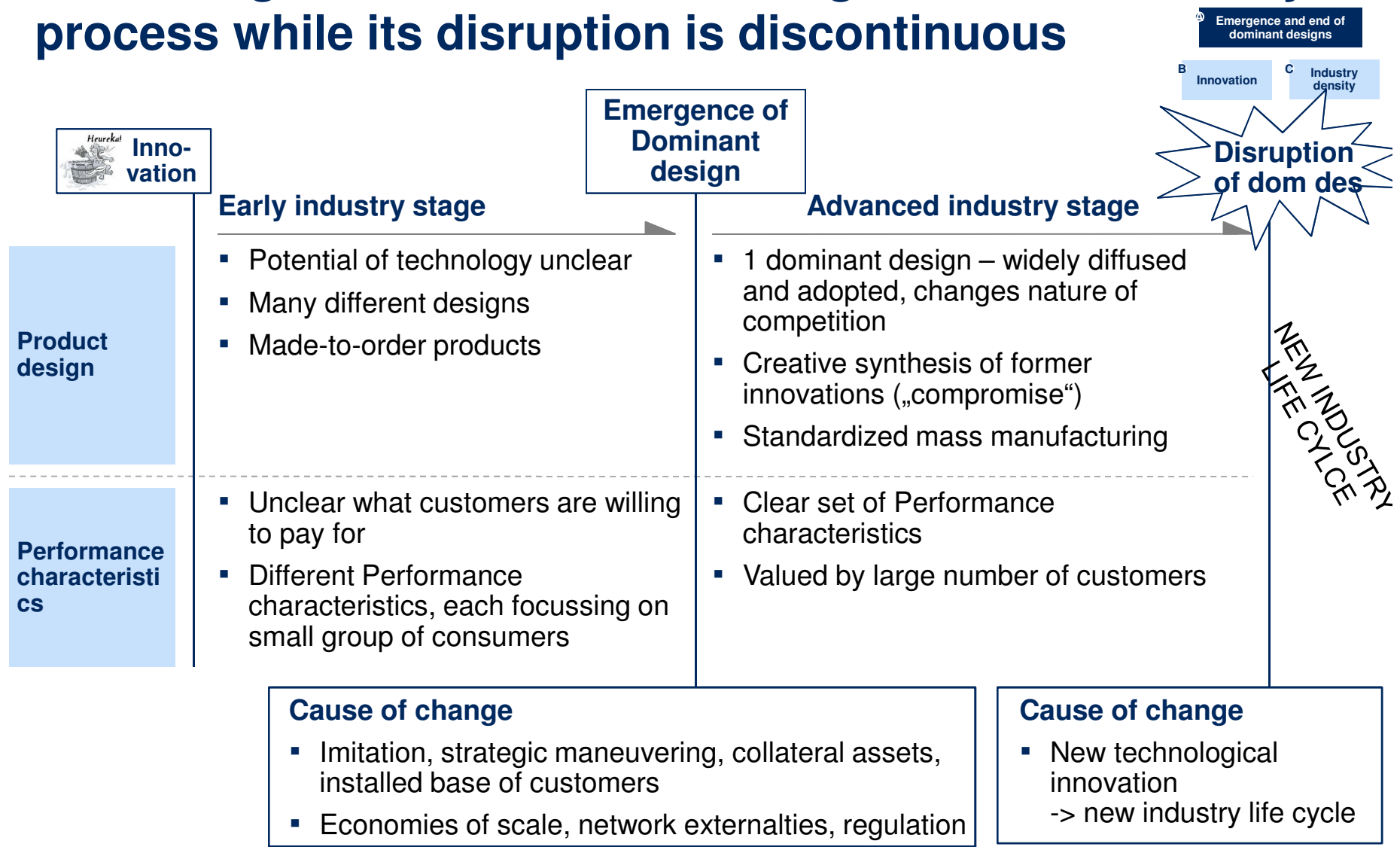
Central statements from **dominant design theory**



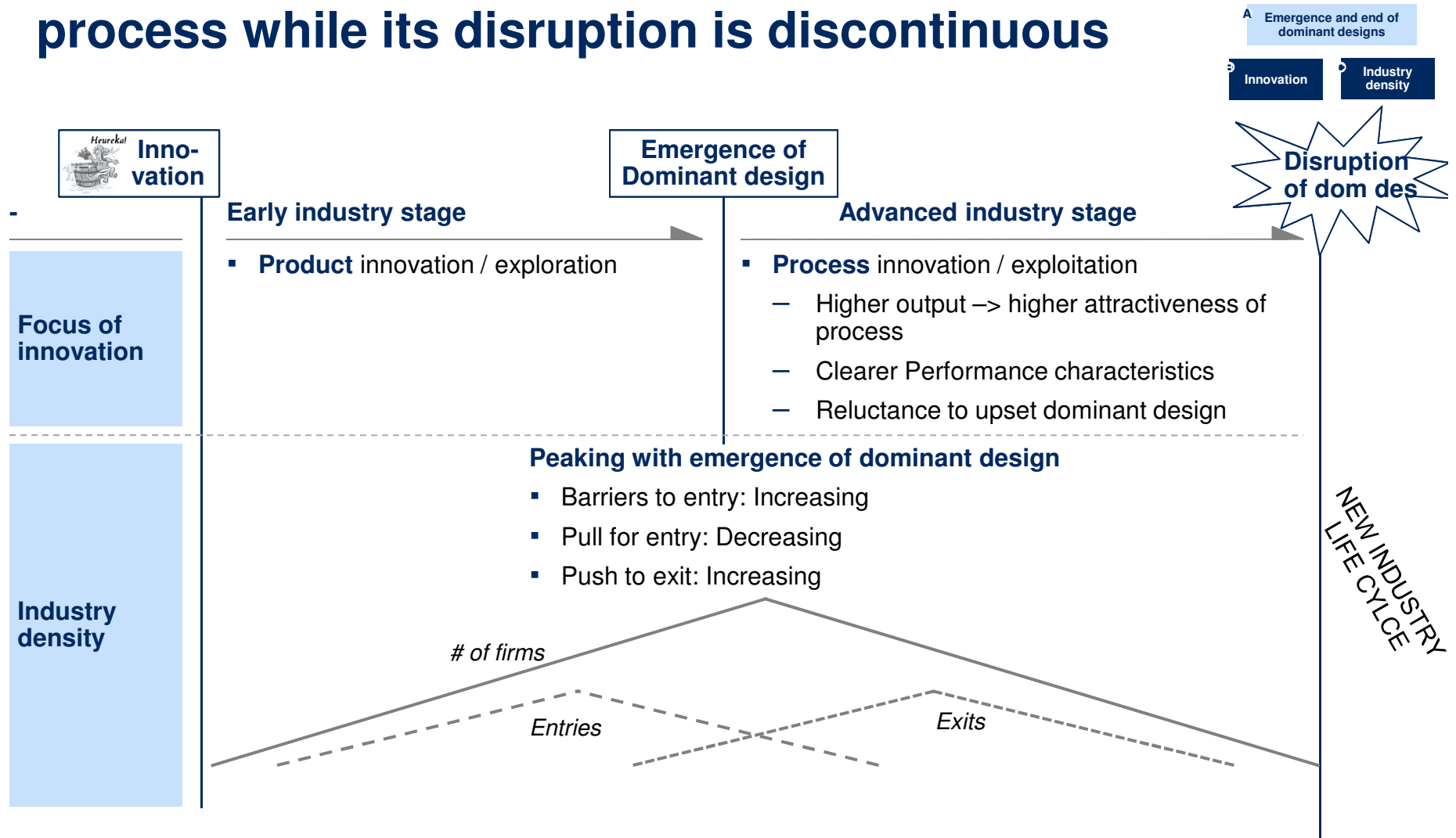
Central statements from **industrial policy literature**

- How do deployment policies effect industrial evolution?
 - In general
 - In particular for A, B and C?

The emergence of a dominant design is an evolutionary process while its disruption is discontinuous

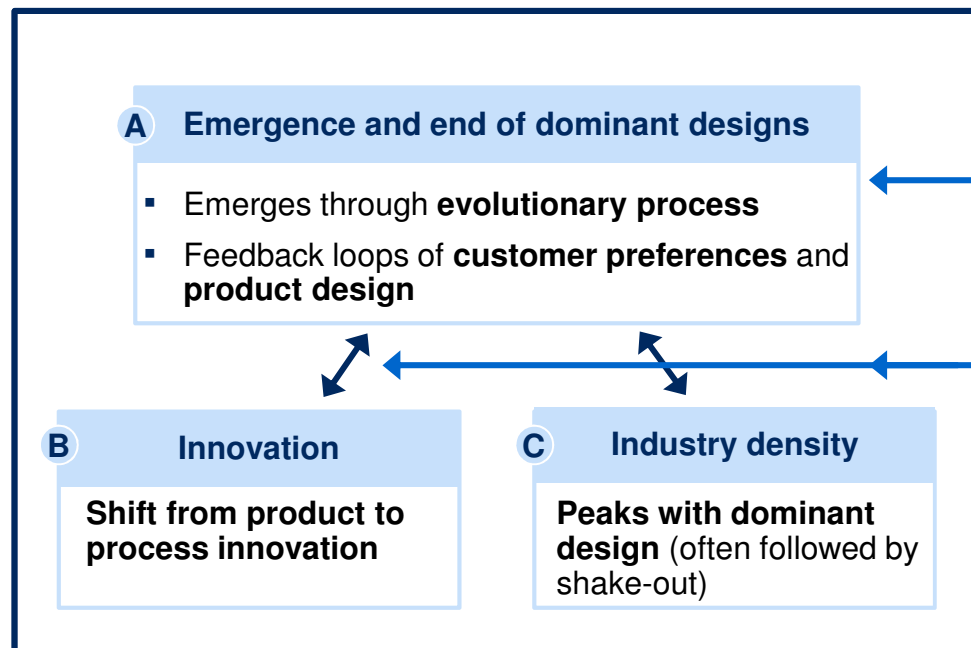


The emergence of a dominant design is an evolutionary process while its disruption is discontinuous



Industrial policy literature provides basic insights into how policy can interfere with these central statements

Central statements from dominant design theory



Research question

(i) How does policy interfere with the emergence and end of a dominant design?

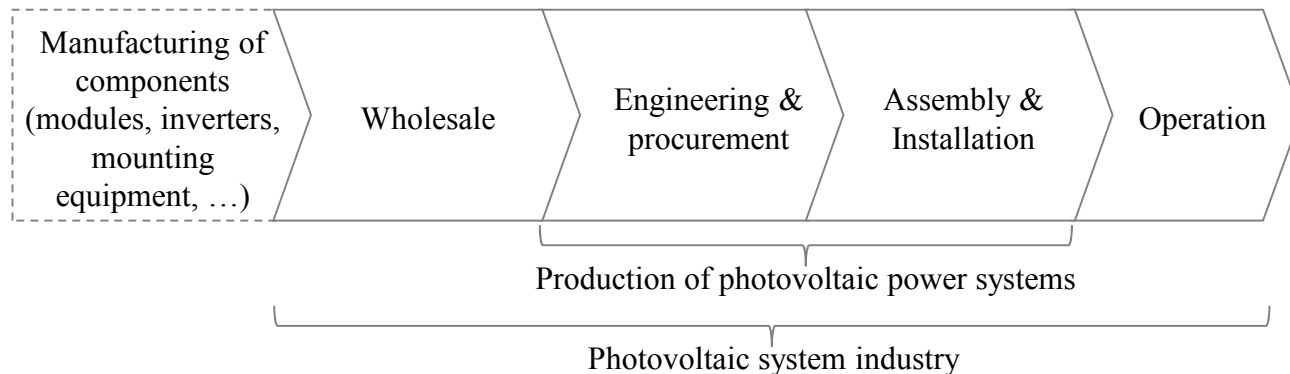
(ii) How does policy influence the interplay of the dominant design with innovation and industry density, respectively?

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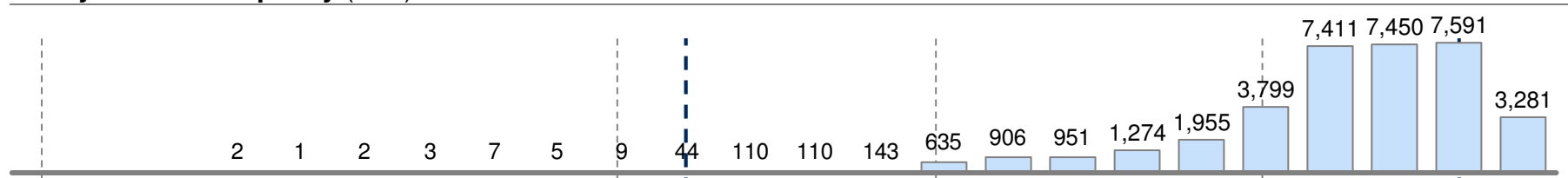
We conduct a case study in the German PV system industry

- *Industry:* **German PV system industry**
- *Time focus:* **1990-2014**
- *Method:* **Case study, Analytical induction**

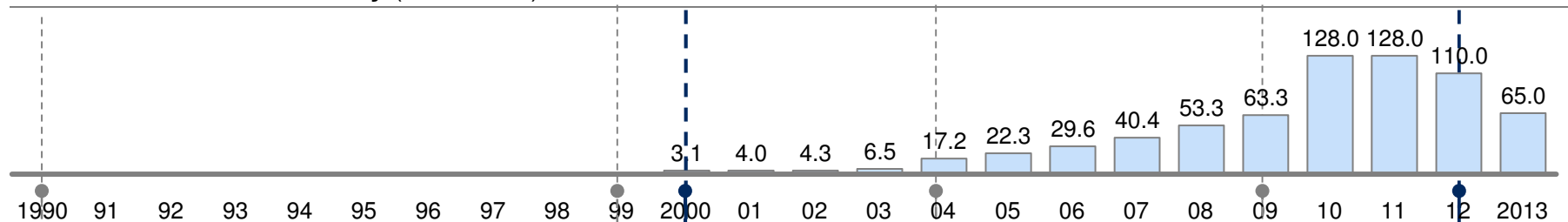


The German PV industry has undergone rapid development with strong policy interference

Newly Installed Capacity (MW)



Jobs in German PV industry (thousands)



Policy evolution

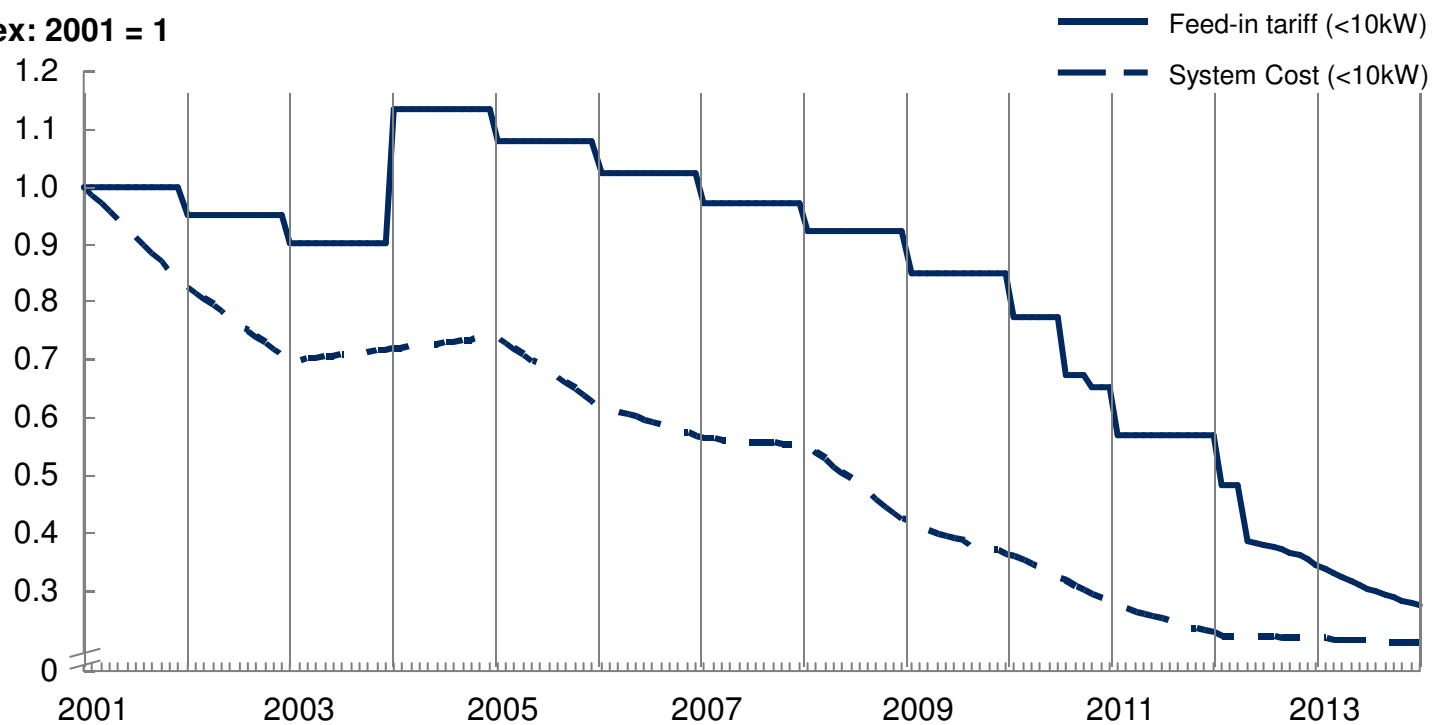


Source: BSW 2012; BSW 2013; IEA PVPS 2001; IEA PVPS 2014; Hoppmann et al. 2014

Both system costs and feed-in tariffs have decreased rapidly, yet at varying pace

Evolution of feed-in tariffs and system costs

Index: 2001 = 1

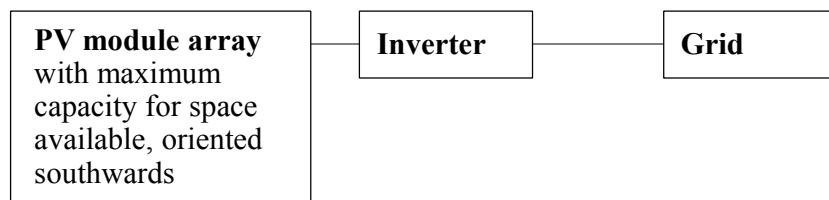


Different merit dimensions require different photovoltaic power system designs

Feed-in optimized

«... produce and feed into the grid as much as you can»

- Maximize power output & capacity
- Largest area possible
- Oriented southwards
- Potentially with tracking system



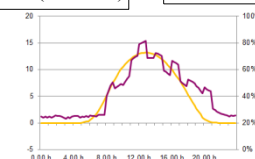
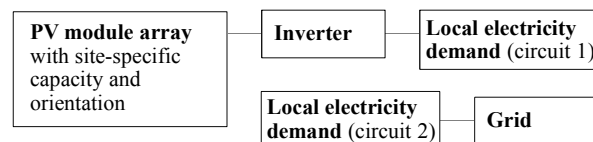
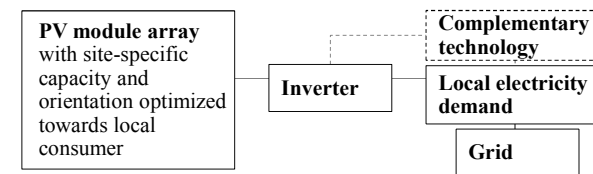
Implications for

- Choice of components
- System architecture / topology
- System dimension
- Siting
- Aesthetics
-

Autarchy / savings optimized

«... produce enough at the right time to satisfy your own demand»

- Align production and consumption
- Optimize capacity for autarchy
- Detailed knowledge for local demand needed
- Oriented east- / westwards



Methodologically, we conduct a case study using archival data and interviews

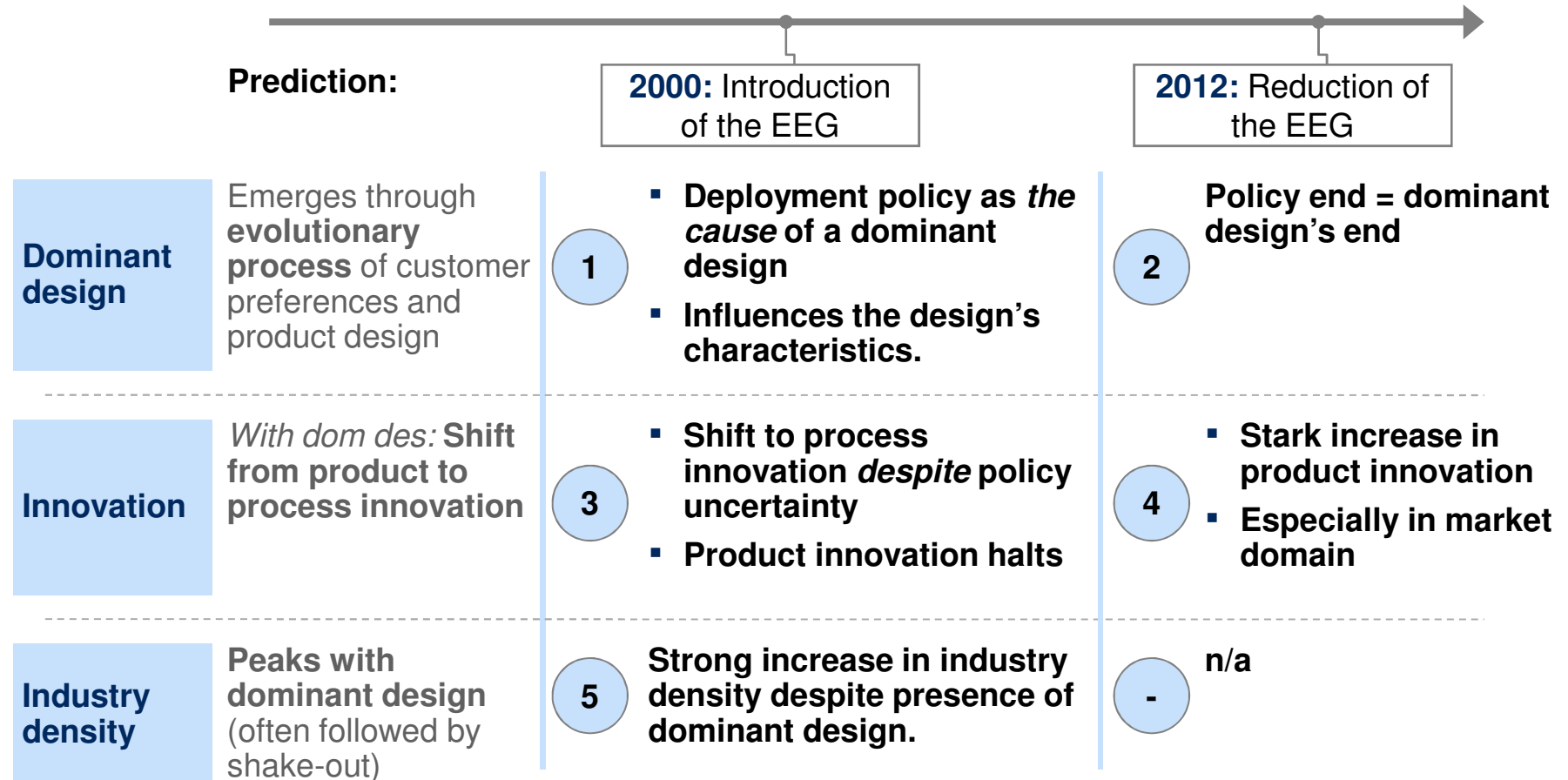
- *Method:* **Case study, Analytical induction**
- *Data:*
 - Archival data (press clippings, reports, company documents, websites, etc)
 - **31 interviews with mgmt and industry experts**

Category	Intervi en	Description	Code	
PV system producing firms	1	Firm 1, Head of sales (SP1)	PD 1	
	2	Firm 2, Chief Executive Officer + founder (SP2)	PD 2	
	3	Firm 3, Head of strategy (SP4)	PD 4	
	4	Firm 3, Head of Policy Department (AS3)	EM 3	
	5	Firm 4, Chief technology officer (SP3)	PD 3	
	6	Firm 5, Chief Executive Officer + founder (SP5)	PD 5	
	7	Firm 5, Chief technology officer	PD 9	
	8	Firm 6, Chief Executive Officer + founder	PD 6	
	9	Firm 7, Board member and head of strategy	PD 8	
	10	Firm 8, Head of Sales	PD 10	
	11	Firm 9, Chief Executive Officer + founder	PD 11	
Firms from adjacent industries	12	Firm 10, Chief Executive Officer + founder	PD 12	
	13	Firm 11, Analyst in strategy department	EM 4	
	14	Chief Executive Officer of solar storage firm	EM 1	
	15	Chief Executive Officer of solar focused engineering firm	EM 2	
	16	Chief Executive Officer and founder of solar power marketing firm	PD 7	
	17	Chief Investment Officer and founder of Renewable Energy Investment Fund	I 1	
	18	Managing Director of Renewable Energy Investment Fund	I 2	
	Association	19	Head of Policy Department of industry association 1	AS 3
		20	Chairman of industry association 1	AS 5
		21	Chairman and founder of industry association 2	AS 4
		22	Board Member of industry association 2	AS 1
23		Chairman of industry association 3	AS 6	
Market analyst/ consultant	24	Renewable energy expert of German association of cooperatives	AS 2	
	25	Solar expert in strategy consultancy	MA 1	
	26	Chief executive officer and founder of solar energy consultancy	MA 2	
	27	Chief executive officer and founder of marketing consultancy for renewable energy	PD 8	
Policy Maker	28	Former Member of the German National Parliament; co-author of EEG	PM 1	
Scientist	29	Scientist for Renewable Energies at German Research Institute	SC 1	
Journalist	30	Editor of industry magazine 1	JO 1	
	31	Editor of industry magazine 2	JO 2	

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Summary of findings



1:

Introduction of the policy -> Effect on dominant design

What happened?

Before EEG:

- **No clear merit dimensions.**
Consumers were „aficionados, pioneers, idealists, technology freaks“
- **Many different product designs.**
Island buildings, cash registers, camping tools, parking automats

With EEG:

- **Clear merit dimension: Return on investment.**
PV became a „financial return model“
- **Dominant design: Output-maximizing design.**
„In the moment the EEG started [...] other designs disappeared“

How does this relate to literature?

- **1) Policy is *the* cause, not a cause of the dominant design.**
Not just institutional pressure
- **2) Policy influenced characteristics**
Dominant design mirrored structure of policy
- **3) Discontinuous emergence of dominant design**
Step-change instead of evolutionary process

2:

Reduction of the policy -> Effect on dominant design

What happened?

After EEG reduction:

- **Dominant design no longer economically viable**
„After 2012 the feed-in model was dead“
- **Merit dimensions unclear**
„We need to awake completely different needs in a customer“
- **Experimentation with new designs**
„Self-sufficiency“, „energy-independence“, „savings“

How does this relate to literature?

- **1) Dominant design ended by policy, not innovation**
Dom Des ended within same industry life cycle

3:

Introduction of the policy -> Effect on innovation

What happened?

Before EEG:

- **Much product innovation**
Need to „understand customers' requirements“, „filling the gaps“, „being able to improvise“

With EEG:

- **Focus on process innovation**
„Automation, less parts, standardization, material savings, experience“
- **Almost NO more product innovation**
„No time to worry about new markets“

How does this relate to literature?

- **1) Shift to process innovation**
Consistent with dominant design literature
Inconsistent with industrial policy literature
→ **Incentive for process innovation outweighed incentive for product innovation**
- **2) HALT of product innovation**
Normally, product innovation never ceases

4:

Reduction of the policy -> Effect on innovation

What happened?

After EEG reduction

- **Return to product innovation**
 - > Consequence of unsettled dominant design
- **Innovation needed mostly regarding market competences**
 - „The technological side evolved. But the market side got turned on its head“*
 - „People with 10 years of PV sales experience are not usable for sales today“*

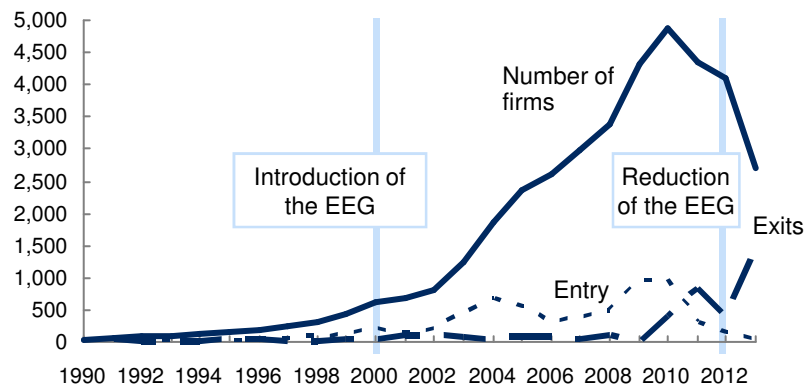
How does this relate to literature?

- **1) Rise in product innovation in advanced life cycle stage**
 - No comparable case in literature
- **2) Unbalanced innovation need: market competences more needed than tech competences**
 - Lit describes this case only for niche creation innovation

5:

Introduction of the policy -> Effect on industry density

What happened?

In presence of EEG

- **Strong increase in density**
 - Strong pull for entry. „This was a gold rush“
 - Low barriers to entry.
- **Peak in 2010**
 - Increased economic pressure

How does this relate to literature?

- **1) Stark contrast to typical pattern**
 - Dramatic industry density increase in presence of dominant design

Implications

For the literature

1) A *policy-dependent* dominant design

- Policy = cause of emergence and end
- Design characteristics mirrored policy

2) Policy driven industries have *domestic life cycle stages*

- Policy can determine evolutionary stage of tech
- Consequently, tech can be in different stages simultaneously in different countries → Wechselwirkung with tech evolution!

For policy makers

1) Risk of creating *overspecialized industry*

- Policy effective for deployment, but risk of policy-dependence

2) Transition to non-policy era should be proactively designed

- Early on include measures to induce product innovation, especially in market domain

Policy makers need to worry not only about growth, but also about policy dependence

For managers

1) Need to be aware of path-dependencies when designing your strategic posture

- Post-change capabilities often cannot be bought

2) When addressing policy-induced business opportunities, policy uncertainty capabilities are important