SURVEY AND CLASSIFICATION OF BUSINESS MODELS OF THE ENERGY TRANSFORMATION

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00 Agenda

01 Motivation

Global Trends

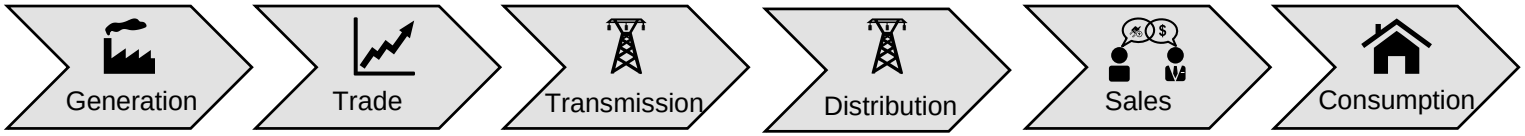
- **Paris Agreement** and the 2°C / 1.5°C goal
- **Energy transition** to decarbonize the **German** energy system
- Fundamental **shift to renewable, CO_2[1] -neutral energies** within global energy supply

Classic structures of the energy industry are subject to massive changes

- Decarbonisation causes a shift to renewable energy production
- Decentralization of the energy system through the use of renewable generation technologies[2]
- Digitization leads to growing linkages between elements of the energy system

➡ **DECARBONISATION, DIGITIZATION AND DECENTRALIZATION** REQUIRE STRUCTURAL CHANGES

- Value chain becomes **value network**
- **Backlog** in the heat and transport sectors



[1] Carbon Dioxide;
[2] Through the use of units with a lower capacity and increasing relevance of distribution networks

02 Status Quo – The current research is focused on single sub-sectors

Authors*	PV[1]	RE[2]	Utilities	Heating	Storage	Grid	Prosumer	Digitization	Mobility
Abdelkafi et al. (2013)									✓
Burger and Luke (2017)	✓				✓		✓		
Giordano and Fulli (2011)						✓			
Kasperk and Drauz (2013)									✓
Löbbe and Hackbarth (2017)		✓	✓						
Loock (2012)		✓							
Okkonen and Suhonen (2010)				✓					
Provance et al. (2011)							✓		
PWC (2016)								✓	
Richter (2012)		✓	✓						
Rodríguez-Molina et al. (2014)						✓	✓		
Strupeit and Palm (2016)	✓						✓		

- Liberalisation, decarbonisation, decentralization and digitization have significantly increased the pace of change
- To analyse the business models, different existing systemizations are used
- Only specific business models are analysed by the listed selection of authors
- The specific value creation networks are often not further analysed

[1] Photovoltaic (Due to its importance for private applications, PV is listed separately.); [2] Renewable Energy;
* The presented literature is an exemplary selection

03 Research Gaps and linked Questions

Business model frameworks

– Existing systematizations are not sufficient to characterize the business models of energy system transformation

➡ **How does a BMF[1] look to illustrate the characteristics of the energy industry?**

Energy business models

– There is no complete overview of energy business models

➡ **What is the comprehensive picture of the current business models of the energy sector?**

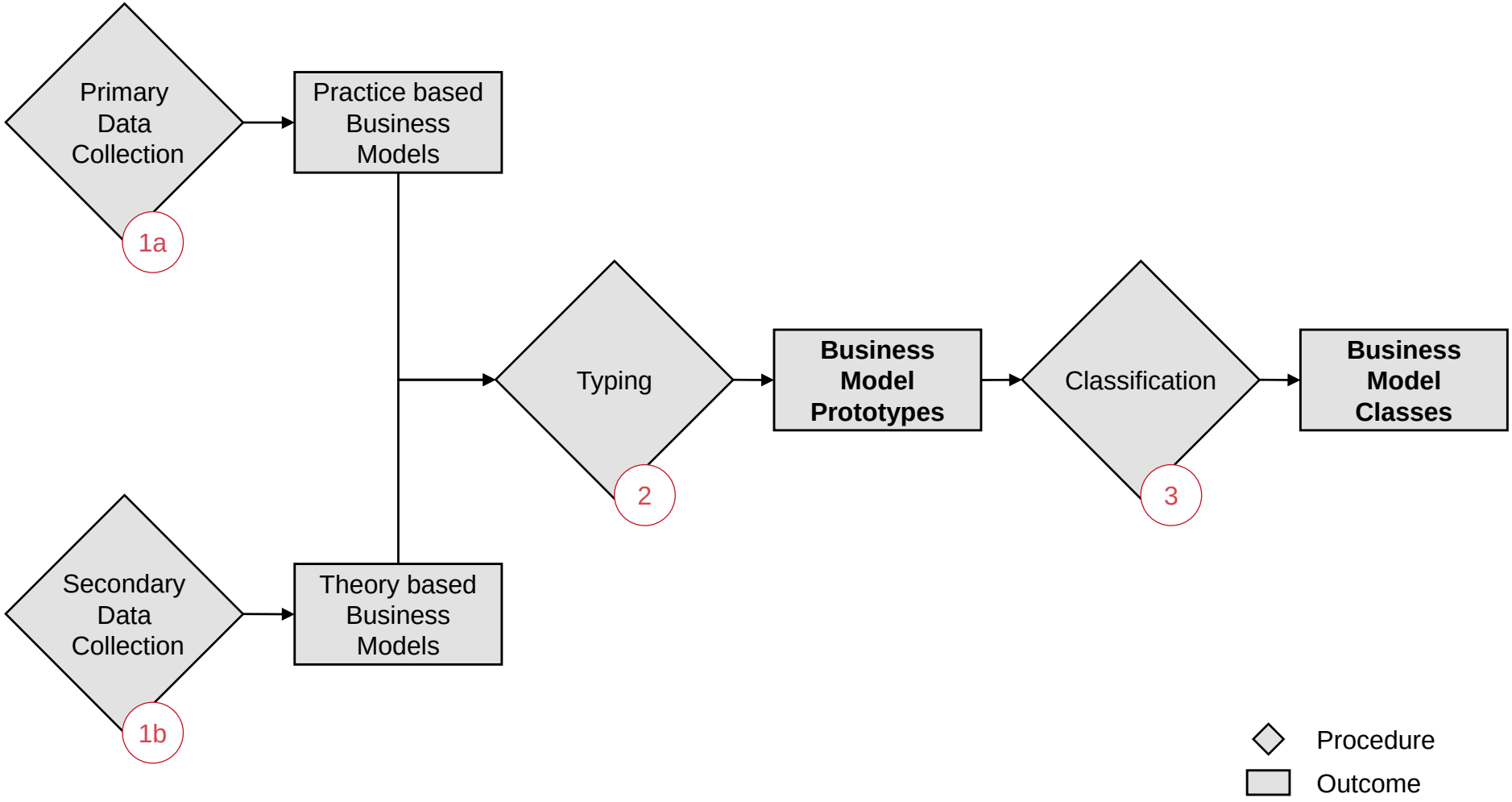
Structure of the energy industry

– There is no adequate approach to describe the effects of energy system transformation on the interactions between business models and the structure of the energy industry

➡ **What is the structure of the current energy value chain?**

[1] Business model framework

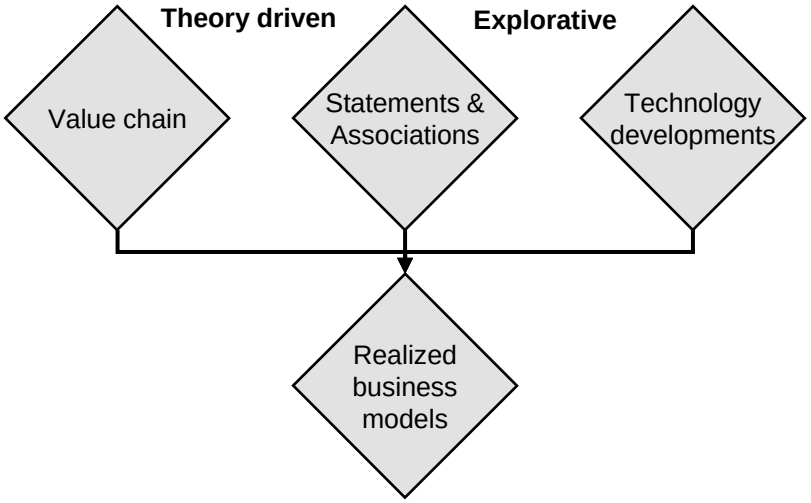
04 Methodology – Search and analysis process



04 Methodology – Survey

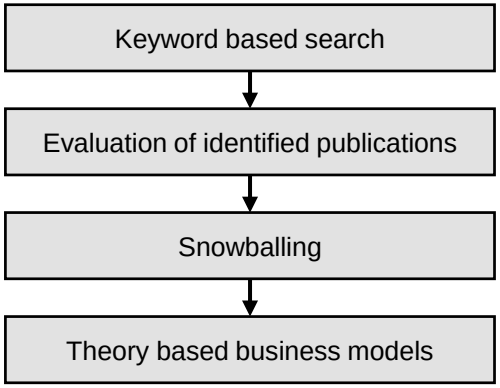
1a Practice based analysis

- **Primary** data collection
- **Case study** approach based on design possibilities according to Yin (2013)
- Prerequisite: One company can combine various business models
  - E.g. Integrated municipal utilities



1b Theory based analysis

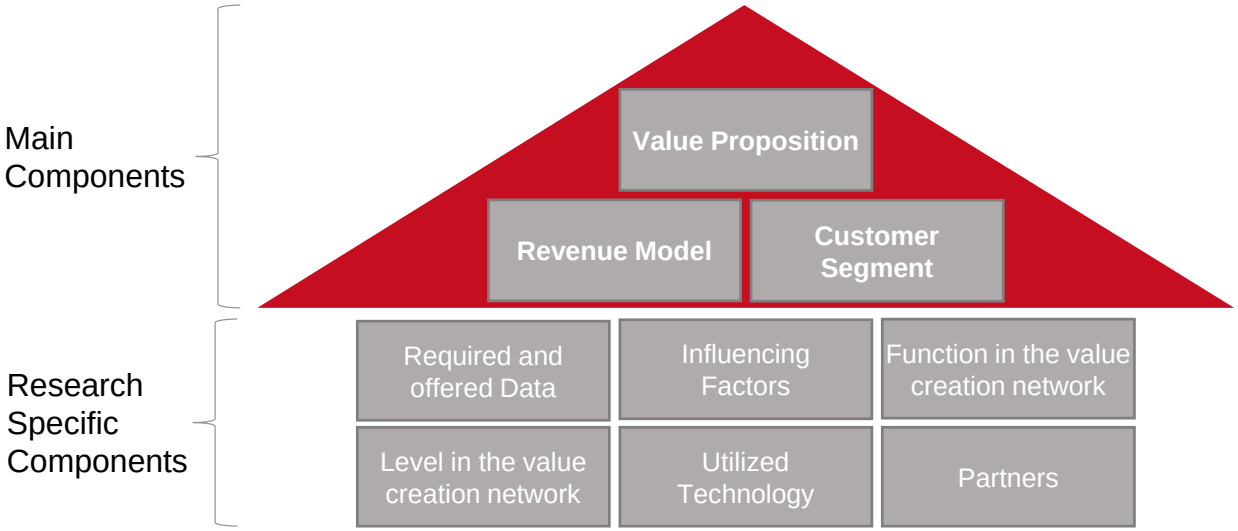
- **Secondary** data collection
- **Literature analysis** according to Kitchenham and Brereton (2013)
- Keywords: **energy system transformation and business models**
  - Complemented by equivalent and related terms
  - Combined into appropriate search strings



04 The business model framework for the energy industry (BMFE)

Business Model Framework for the Energy Industry

- Synthesis of literature on business model frameworks
- Illustration of relevant dimensions of the energy industry
- Structuring of generally valid and energy-related business model components



Value Proposition

- describes the value a company generates for its clients

Customer Segment

- defines which customer groups are addressed by the value proposition

Revenue Model

- describes how cash flows are generated out of customer relationships

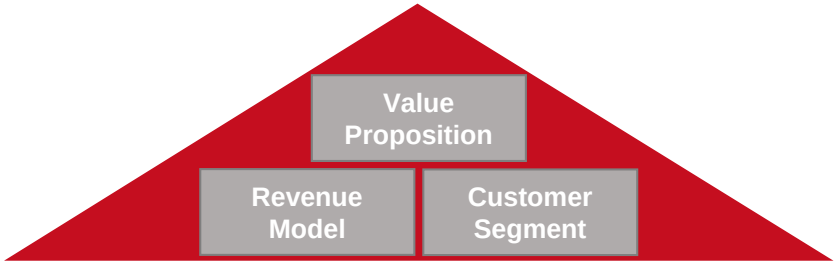
➡ **Mean to characterize the business models** found in the survey process by systematic collection of company data

➡ **Possibility to describe the structure** of a concrete business model

04 Methodology – Typing and Classification of business models

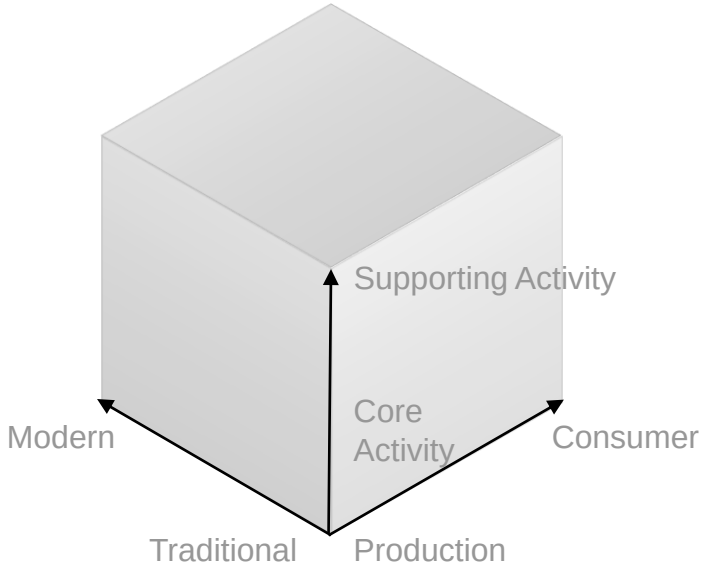
2 Typing

- **Differentiation by main components** (value proposition, revenue model and customer segment)
  - Identical main components within one business model prototype
- Other components **used to describe** the business models in detail
- Result: **Business Model Prototypes**



3 Classification

- Prototypes are **grouped based on their position in the value creation**
- Consideration of **disruptive character** of the energy system transformation
- Result: **Business Model Classes**



05 Findings

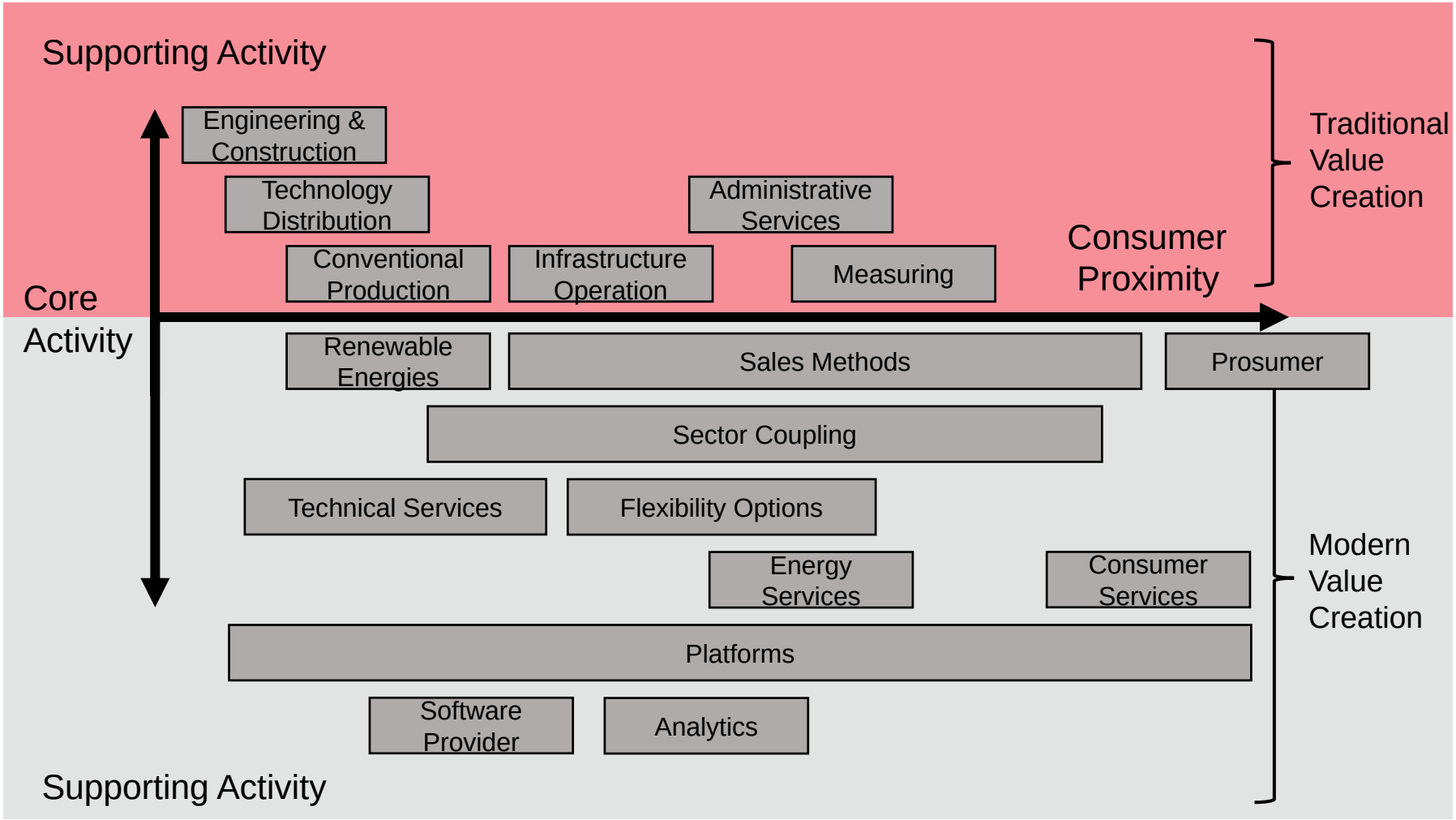
Practice based analysis

- Coverage: **134 companies**
- Identification of **242 business models**
- **Integrated and municipal utilities** cover many business models
- **Start-Ups** with new technologies do not describe their business models precisely
- Business Models are **fragmented**
  - e.g. safety technology or app-controlled consumers in the Smart Home
- **New business models** for the energy industry
  - Software provider
  - Plant manufacturer
  - Analytics
- **Realized sector coupling concepts**: power-to-mobility predominant

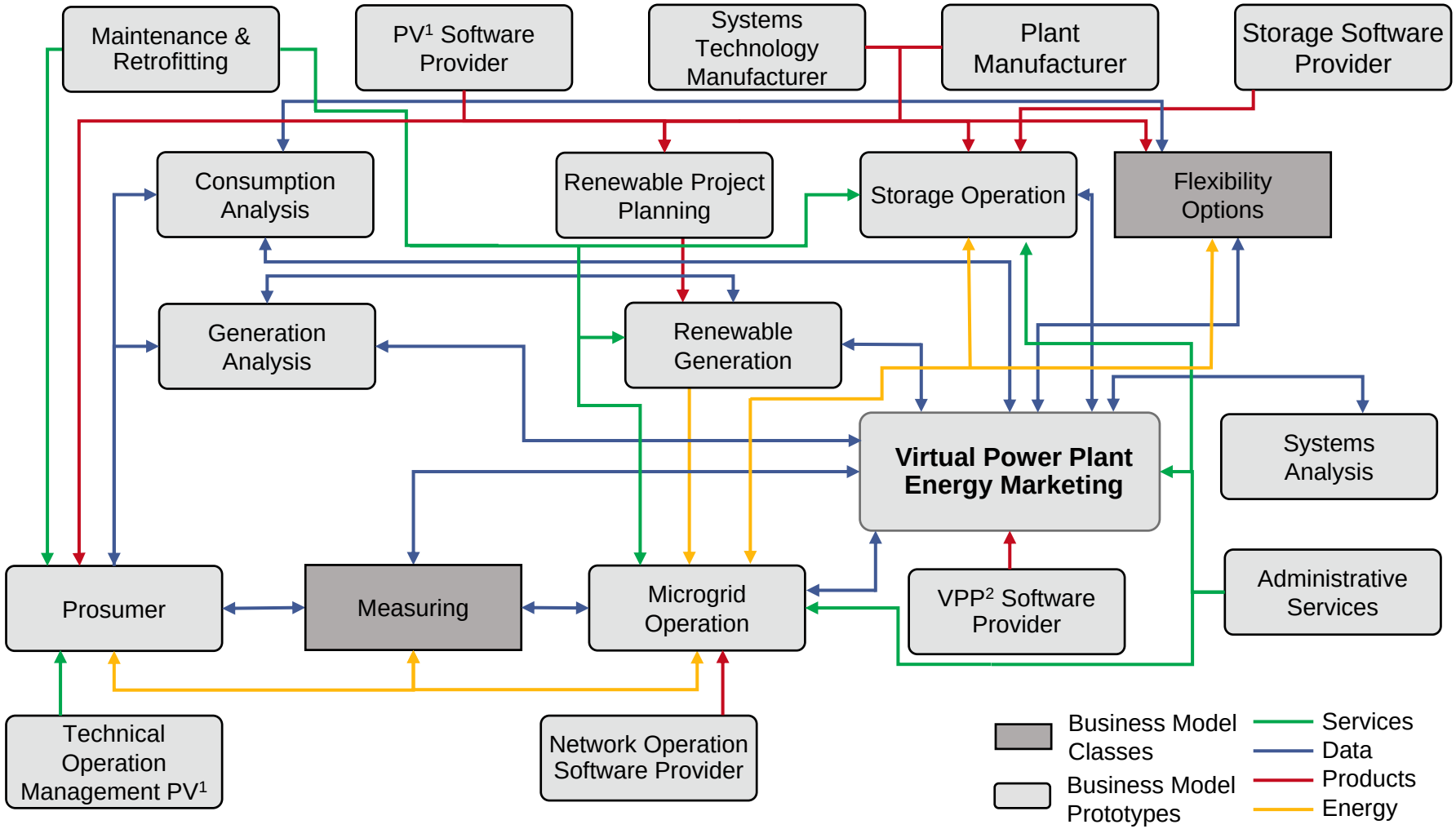
Theory based analysis

- Coverage: **166 publications**
- Identification of **396 business models**
- **Dominance of traditional business models** of the energy industry for
  - Generation
  - Transportation
  - Distribution and sales
- **Prosumer** as part of the new energy system explicitly mentioned
  - In practice this business model is not found
- **Future sector coupling concepts**: power-to-gas, power-to-heat and smart grid concepts are presented in detail (and not found on the market yet)
  - Cross-industry and cross-sectoral concepts
  - Influence of renewable energies affects the majority of business models

05 Results – The classification results in 17 business model classes



05 Results – Example of a value creation network for a Virtual Power Plant



[1] Photovoltaic; [2] Virtual Power Plant
* Opposed to the flow directions, payments are assumed between the business models

06 Conclusions and Further Research

Summary

- A total of **638 business models** have been identified
- **69 business model prototypes** were extracted and described by the BMFE[1]
- Business model prototypes represent a summary of business models with the same value proposition, revenue model and customer segments
- Grouping into **17 business model classes** according to the dimensions of customer proximity and position in the value creation
- **Value creation networks** emerge due to new and more complex interdependencies between business models

Further Research

- **Review and complementation** of business model prototypes to frequently update the status quo of the business models and business model classes of the energy industry
- **Extension of the analysis instrument by a quantitative evaluation (e.g. cash flow)**
  - Ongoing development, at our department, of a quantitative model-based evaluation system
- **Identification of the market players and recording the regional scalability of a business model prototype**
  - Ongoing work, at our department, for regionalized assessment of energy related business models

[1] Business model Framework for the energy industry

Thank you for your attention

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07 Literature (1/2)

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07 Literature (2/2)

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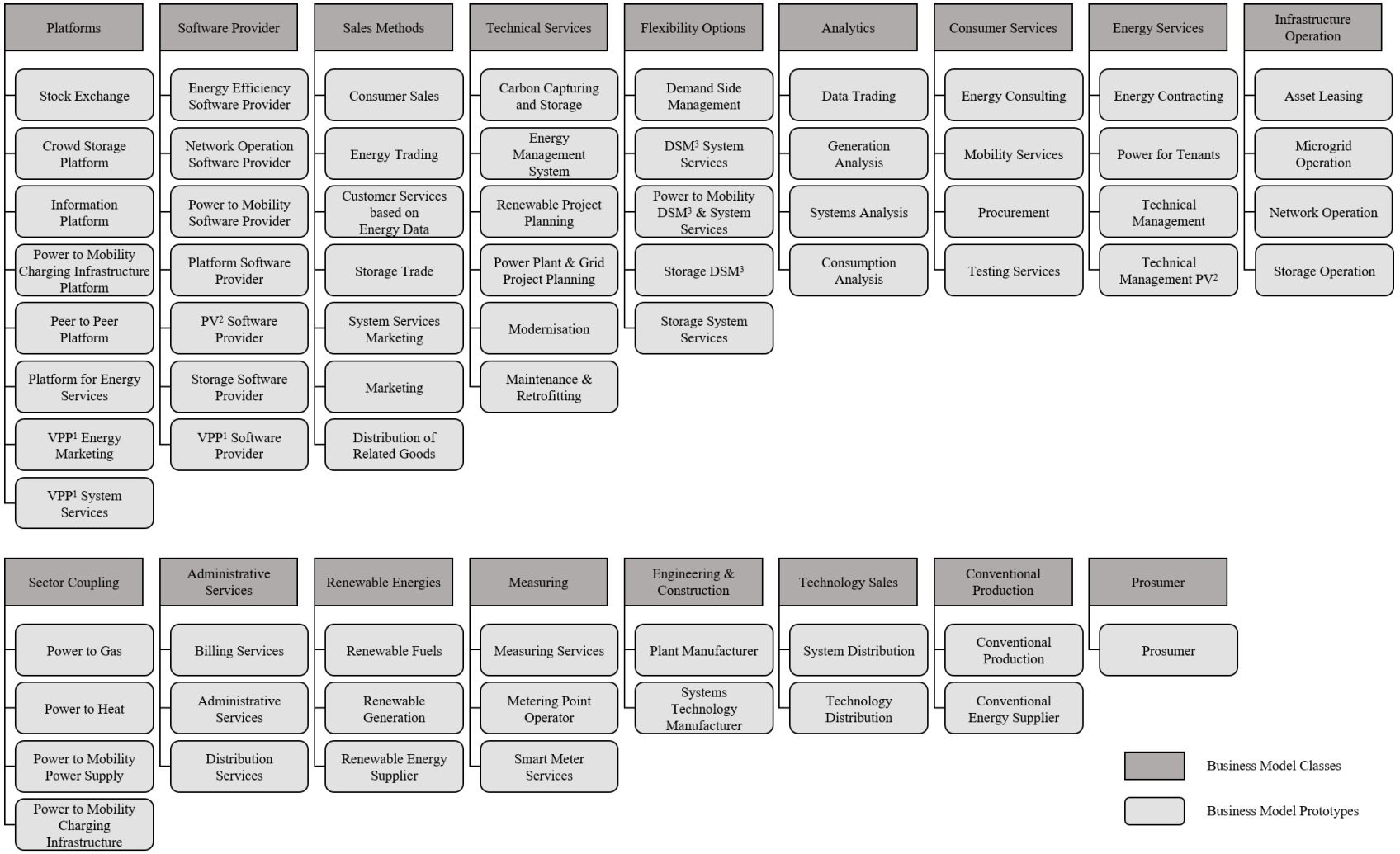
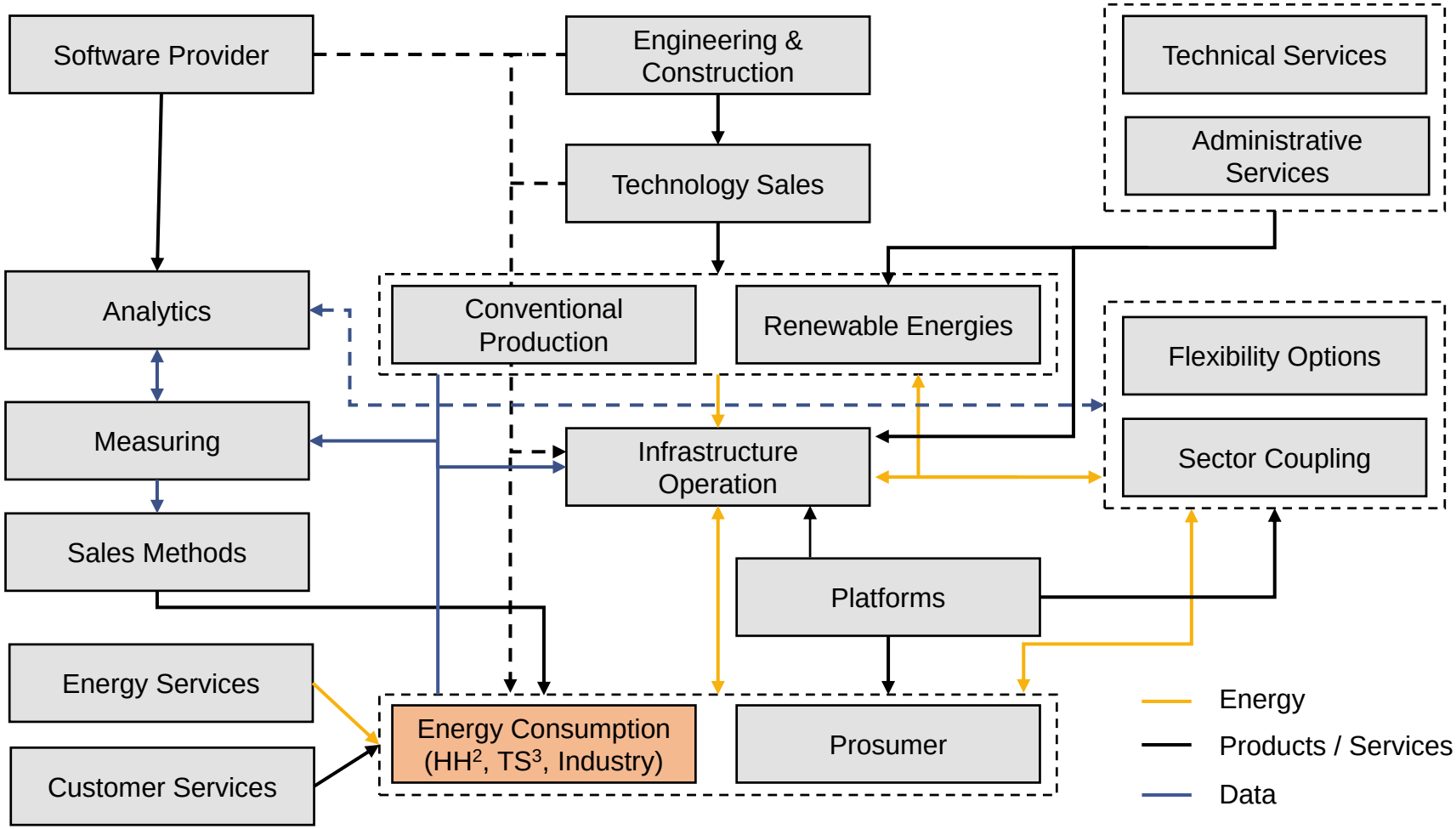
A Appendix

A Appendix – The 17 BM classes and 69 BM prototypes



 [1] Virtual Power Plant; [2] Photovoltaic; [3] Demand Side Management

A Appendix – BMC[1]-based networks show macroeconomic relations



[1] Business Model Class; [2] Households; [3] Trade & Services
*Opposed to the flow directions, payments are assumed between the business models within the classes

A Appendix - Examples of the variants of the BMFE components (1/2)

Value Proposition	Customer Segment	Revenue Model	Required and Offered Data	Influencing Factors
Data Collection	Households	Asset Sale	Generation Data	Subsidies
Renewable Power	Utilities	Asset Leasing	Industrial Production Data	Regulation
Power	Industry	Asset Rent	Capacity Data	Market Risks
Renewable Heat	Businesses	Connection Fees	Metering Data	Market Development
Heat	Agriculture and Farming	Feed In Tariff	Mobility Data	Competitive Technologies
Renewable Gas	Mobility Service Provider	Licence Fees	Network Data	Data Protection and Privacy
Gas	Public Companies	Pay per Use	Usage Data	Technological Development
Flexibility	Grid Operator	Service Fees	Price Information	CO_2[1]-Price
Billing	Prosumer	Network Charge	Storage Data	Infrastructure Development
Data Collection	Smart Home Provider	Energy Price	Location Data	Development of E-Mobility[2]
Data Processing	Storage Operator	Trading Gains	Weather Data	Development of Energy Prices
Risk Reduction	Towns and Municipalities	Basic Fee	Consumption Data	
Plant Maintenance	Car Owner	Shared Savings	Transaction Data	
Power Plant Planning	Energy Trader	Software Rent	Plant Data	
Contribution to Climate Protection	Power for Tenants Provider	Kilometre price	Availability Data	

[1] Carbon Dioxide; [2] Electro mobility

A Appendix - Examples of the variants of the BMFE components (2/2)

Function in the value creation network	Level in the value creation network	Utilized Technology	Partners
Data Platform	Generation	Battery Technology	Billing Service Provider
Enabler	Trade	CHP[1]	Plant Operator
Energy Provider	Information Provider	Biogas Plant	Plant Sales
Producer	Capacity Management	Fuel Cell Technology	Car Manufacturer
Information Platform	Load Management	E-Mobility Technology	Construction Industry
Information Provider / Processor	Measuring	Renewable Generation Technology	Authorities
Market Maker	Mobility	Gas Storage	Biomass Providers
Market Coupler	Platform	Heating Technology	Stock Market
Market Platform	Service	Artificial Intelligence	Data Platform
Orchestrator	Storage	Measuring / Control Technology	Energy Consulting
Platform	Technology Provider	Network Infrastructure	Utilities
Prosumer	Consumption	Photovoltaics	Charging Infrastructure Operator
Layer Specialist	Distribution	Charging Infrastructure	Agriculture and Farming
Service Platform	Sales	Heat Pump	Measuring Point Operator
Technology Provider	Housing	Smart Meter	The Public/NGOs[2]

[1] Combined Heat and Power; [2] Non governmental organization