DIGITAL TRANSFORMATION OF THE ENERGY SYSTEM – COUNTRY SPECIFIC STRATEGIES FOR MARKET IMPLEMENTATION OF TECHNOLOGIES

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Overview

Digitalization offers countless answers and solutions to the increasing challenges of sustainable energy supply. The need for suitable technologies, processes, and business models to cope with the major transformations in the energy system is increasing worldwide. This is due to ongoing megatrends such as urbanization, connectivity, and security, as well as political developments such as the Green Deal Initiative and the EU's Circular Economy Action Plan. These measures are also intended to counter current crises such as pandemics, energy security and import dependency, climate change and structural change.

Governments, city administration, utilities, and companies need a clear strategy based on a profound knowledge basis to shape the smart and sustainable energy future, one that is ambitious, grounded to reality, and that leverage unique local assets. The work focuses on challenges and opportunities to implement digital technologies with relevance to the energy supply system. Digitalisation trends in the below listed fields with relevance to the energy system are considered. Impacts of implementing digital technologies are e.g., increasing the resilience of energy system, interconnected mobility services, building technologies with significant potential to reduce carbon emissions.

- Information and communication technologies (ICT)
- Open data
- Data platform technologies
- Security technologies
- Urban mobility and new energy vehicles (NEV)
- Artificial intelligence
- Internet of things (IoT)

Methods

The paper introduces a practice-oriented systematic to identify challenges and opportunities to implement smart technologies with relevance to the energy system to reach sustainability goals.

		Iberia		UK	Central Europe				
		Spain	Portugal	UK	Italy	France	Austria	Swizerland	Netherlands
Relevant key figures	Gross domestic product per capita in USD$_{2020}$	27.132	22.489	40.285	31.288	39.907	48.652	88.071	52.248
	R&D-Expenses in Mio. USD$_{2020}$	17.412	33.535	52.471	38.756	72.769	14.665	24.668	22.309
Economy and politics	Economic situation	high	high	very high	high	very high	very high	very high	very high
	Marktgröße und Entwicklungsmöglichkeiten	high	middle	very high	very high	very high	middle	middle	middle
	Political stability	high	very high	high	high	very high	high	very high	very high
Innovation character	Technological leadership	middle	middle	very high	high	high	middle	high	very high
	Diffusion of relevant technologies	middle	middle	very high	middle	high	high	very high	very high
	Degree and speed of innovation	middle	middle	very high	middle	high	high	very high	very high
Innovation promoting structures	Landscape of actors conducive to innovation	middle	middle	very high	high	very high	very high	very high	very high
	Conducive regulatory framework	high	high	high	very high	very high	very high	very high	very high
	Compatibility of policy frameworks	very high	very high	middle	very high	very high	very high	high	very high
	Rating (weighted criteria)	56%	56%	85%	70%	89%	74%	85%	93%

Fig. 1: *Evaluation matrix (example for European countries)*

First an evaluation matrix is applied to analyse important target markets for digital technologies, services, and business models. The evaluation of the potential target markets is based on weighted criteria. These are divided into the areas of "economy and politics", "innovation character" and existing "innovation-promoting structures" (*Fig. 1*). By applying the described systematic to specific circumstances of 21 countries, a holistic and sustainable approach to evaluate the country specific opportunities for implementing digital technologies in the energy system is guaranteed.

Based on the results of the evaluation matrix (*Fig. 2*) a qualitative analysis of the structure of five target countries in the EU is conducted. The paper and presentation will cover four steps to evaluate country-specific challenges and opportunities to implement digital technologies with focus to the energy system in the market.
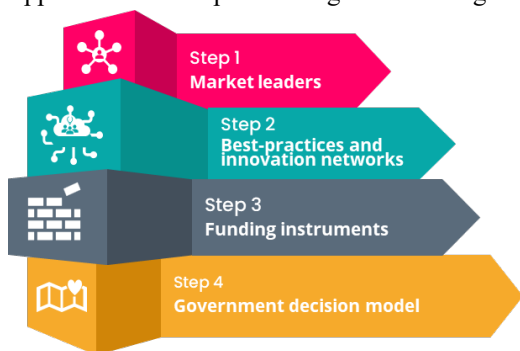
Fig. 2: *Four steps of the market analysis approach*

- Step 1: The market leaders (key players) are identified and arguments for further digitalisation of the energy sector and the feasibility of technology implementation are investigated.
- Step 2: Best practices for smart city solutions and a network analysis of the relevant actors in selected cities, municipalities and regions will be carried out.
- Step 3: Regarding the market implementation of technologies suitable funding instruments are identified as they also influence implementation strategies
- Step 4: A government decision support model is introduced to enable decision makers to keep up with disruptive and complex technology developments.

Results

The introduced methodology of the market analysis demonstrates how the country specific landscape – constituted by market leaders, best-practices, innovation networks and funding instruments - would be decisive to have mass-market adoption of digital technologies in the energy system. Results will be presented for the European countries Spain, France, Austria, Switzerland, and UK which were analysed in detail. With the help of a SWOT-Analyses initial country specific circumstances are also considered. (*Fig. 3*)

One key challenge is the current pace at which disruptive technologies proliferate rapidly increase, faster than what decision makers could keep up with. Administration often indicates they have limited

STRENGTHS
- ☐ Territorial development is one of the priorities of public administrations
- ☐ France's commitment to digital technology has become a global reference through the "French Tech" brand.
- ☐ France's urban policy has always been user-oriented.
- ☐ Franco-German cooperation promoted both culturally and politically

OPPORTUNITIES
- ☐ Green movement in recent local elections forcing smart city actors to evolve
- ☐ Secondary cities are much more attractive in the post covid context and tend to become smart cities (agile development)
- ☐ The infrastructures of the historical cities are outdated and thus there is a great need for restructuring
- ☐ All major French cities have entered the race to develop artificial intelligence
- ☐ E-democracy and participatory citizen platforms are very popular in the "land of human rights".

WEAKNESSES
- ☐ Despite its recognised technological know-how, France has been slow to structure its research and experimentation centres and focus them on smart city issues.
- ☐ A delay due to a non-business oriented policy is noticeable and the backlog in the field of smart city currently has to be made up for

THREATS
- ☐ Historic market leaders are difficult to force into competition as they are very well connected
- ☐ Innovations change processes and have a direct impact on the labour market in France
- ☐ Many public decision makers are not aware of digital solutions
- ☐ Social acceptance problems and political risk aversion

***Fig. 3:** SWOT-Analysis for France (example)*

capacity and internal structure is not ready for increasingly rapid technologies cycles. The comprehensive up-to-date BABLE platform for smart city and energy related use-cases, solutions, and technologies provides an overview of the full market landscape. Based on this a factsheet review about best-practice examples for a specific challenge is executed, incorporating specific opportunities i.e., funding landscape, market leaders and available networks. Applying the government decision support model, the administration refines the scope and is enabled to a decision making grounded on best suitable solutions. These steps will be presented based on current projects which have proven to accelerate decision making in city administration by integrating digital technology in the energy system according to specific city related challenges.

Conclusions

Several initiatives at regional, national, and local level are laying the groundwork for achieving climate neutrality targets and increase the resilience of the energy supply system. E. g. Austria's goal to become carbon neutral by 2024 has a strong impact on local policies, which from now on all have to contribute to the overall national goal. Measures in the energy, building and mobility sectors must significantly reduce carbon emissions immediately. In this context, a disruptive development can begin when some specific digital applications (e. g. ICT, open data, data platforms, security technologies, artificial intelligence, IoT) with relevance to the energy systems become standards.

References

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