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Essays on Regional Trust Cues in the Context of Green Energy Platform Economics

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Abstract

Leading academics have repeatedly called for research in the field of Information Systems (IS) to address one of the major issues of mankind: global warming. One area in which IS research can contribute to this challenge is the design of digital solutions to support decision-making for more sustainable practices. Addressing this call for research, I engaged in an extensive research agenda on how to design User Interfaces (UI) so that they support user decisions for regional – an thus, commonly more sustainable – products and services. This cumulative dissertation presents the results of this research. I found a very suitable object of study in the electricity market – and thanks to the sector's characteristics, findings should be easily transferable to other contexts. At first, the thesis provides a look at the sector which is currently disrupted by digitization, decarbonization, and decentralization. Subsequently, the consumer perspective is taken to assess whether consumers value regionality when buying electricity. In a next step, this work investigates how regional design elements (i.e., trust cues) are used on UIs in practice. Thereafter, I present the results from multiple experiments in which participants engaged with regional trust cues on UIs. In these experiments, various objective and subjective measures for user attitudes and behavior were collected. I present empirical evidence that regional trust cues positively affect these measures. Throughout, implications for research, practitioners, policy makers, but also the broader society are drawn from this work. I conclude with offering an outlook on recent developments surrounding regional design elements on UI in research and practice.

Key words: *Sustainability, User Interface Design, Information Systems, Human-Computer Interaction, Reginal Trust Cues, Energy Sector, Renewable Energies, Regional Green Power, Digital Business Models, Platform Economy, Experiment, Survey, Eye-Tracking, Content Analysis, Web Scraping*

Zusammenfassung

Führende Wissenschaftler haben wiederholt gefordert, dass die Forschung im Bereich der Informationssysteme (IS) eines der größten Probleme der Menschheit adressieren sollte: die globale Erwärmung. Ein Bereich, in dem die IS-Forschung einen Beitrag zu dieser Herausforderung leisten kann, ist die Entwicklung digitaler Lösungen zur Unterstützung der Entscheidungsfindung für nachhaltigere Praktiken. Diesem Aufruf folgend, habe ich mich auf eine umfassende Forschungsreise begeben, um herauszufinden, wie digitale Nutzerschnittstellen (UI) so gestaltet werden können, dass sie die Entscheidungen der Benutzenden im Hinblick auf die Auswahl regionaler Produkte und Dienstleistungen unterstützen. Mit der vorliegenden kumulativen Dissertation präsentiere ich die Ergebnisse dieses Vorhabens. Der Strommarkt stellt dafür ein sehr passendes Forschungsobjekt dar – und dank der Eigenschaften des Sektors sollten die Ergebnisse auf andere Kontexte übertragbar sein. Zunächst wirft die Arbeit einen Blick auf den Sektor, der derzeit einen tiefgreifenden Umbruch befeuert durch Digitalisierung, Dekarbonisierung und Dezentralisierung durchläuft. Anschließend wird die Verbraucherperspektive eingenommen, um zu analysieren, ob Verbrauchende beim Stromkauf Wert auf Regionalität legen. In einem nächsten Schritt wird untersucht, wie regionale Gestaltungselemente auf UIs in der Praxis eingesetzt werden. Danach stelle ich die Ergebnisse mehrerer Experimente vor, in denen sich die Teilnehmenden mit regionalen Designelementen auf UIs auseinandersetzten. In diesen Experimenten wurden objektive und subjektive Messgrößen für Verhalten und Einstellung der Nutzenden erhoben. Ich präsentiere empirische Belege dafür, dass sich regionale Designelemente positiv auf diese Messgrößen auswirken. In dieser Arbeit werden Implikationen für Forschung, Praxis, Politik wie auch für die Gesellschaft im Allgemeinen diskutiert. Ich schließe mit einem Ausblick auf die jüngsten Entwicklungen rund um regionale Designelemente auf UIs in Forschung und Praxis.

Schlüsselwörter: *Nachhaltigkeit, User Interface Design, Informationssysteme, Mensch-Computer-Interaktion, Regional Trust Cues, Energiewirtschaft, Erneuerbare Energien, Regionaler Ökostrom, Digitale Geschäftsmodelle, Plattformökonomie, Experiment, Umfrage, Eye-Tracking, Inhaltsanalyse, Web Scraping*

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Contents

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List of Abbreviations

Area of Interest (AOI)
Business-to-Consumer (B2C)
Carbon Dioxide (CO_2)
Comparative Fit Index (CFI)
Consumer Ethnocentrism Theory (CET)
Consumer-to-Consumer (C2C)
Consumer-to-Grid (C2G)
Coronavirus Disease 2019 (COVID-19)
Covariance-Based Structural Equation Modeling (CB-SEM)
Dependent Variable (DV)
Design Science Research (DSR)
Electric Vehicle (EV)
European Energy Exchange (EEX))
European Union (EU)
Global Positioning System (GPS)
Green Energy Platform Economics (GEPE)
Heating, Ventilation, and Air-Conditioning Systems (HVACs)
Human-Computer Interaction (HCI)
Hydrogen (H_2)
Hypothesis (H)
Information and Communication Technology (ICT)
Information System (IS)
Internet Protocol (IP)
Least Square Dummy Variable (LSDV)
Ordinary Least Squares (OLS)
Over the Counter (OTC)
Peer-to-Peer (P2P)
Perceived Nature Presence (PNP)
Perceived Regional Presence (PRP)
Perceived Social Presence (PSP)
Photovoltaic (PV)
Research Objective (RO)
Research Question (RQ)
Residential-to-Grid (R2G)
Root Mean Square Error of Approximation (RMSEA)
Standard Error (SE)
Standardized Root Mean Square Residual (SRMR)
System for Guarantees of Regional Origin (SGRO)
Tucker Lewis Index (TLI)
United Kingdom (UK)
United States (US)
User Interface (UI)
Vehicle-to-Grid (V2G)

List of Publications

Chapter II:

Menzel, T., & Teubner, T. (2021). Green Energy Platform Economics – Understanding Platformization and Sustainabilization in the Energy Sector. *International Journal of Energy Sector Management*, *15*(3), 456–475. doi.org/10.1108/IJESM-05-2020-0022

The chapter is based on the accepted manuscript.

Chapter III:

Menzel, T., & Teubner, T. (2021a). But Keep your Customers Closer: The Value of Regionality in Electronic Commerce. *European Conference on Information Systems (ECIS)*, 1–10. aisel.aisnet.org/ecis2021_rip/2/

The chapter is based on the accepted manuscript.

Chapter IV:

Menzel, T., & Teubner, T. (2021e). How Regional Trust Cues Could Drive Decentralisation in the Energy Sector—An Exploratory Approach. *Sustainability*, *13*(6), 3010. doi.org/10.3390/su13063010

The chapter is based on the accepted manuscript.

Chapter V:

Menzel, T., Teubner, T., Adam, M. T. P., & Toreini, P. (2022). Home is where your Gaze is – Evaluating effects of embedding regional cues in user interfaces. *Computers in Human Behavior*, *136*, 107369. doi.org/10.1016/j.chb.2022.107369

The chapter is based on the accepted manuscript.

Chapter VI:

Menzel, T., Teubner, T., (tbd). Signaling sustainability and regionality in the electricity market: An eye-tracking study on labels.

Currently under review. The chapter is based on the initially submitted manuscript.

Chapter I: Introduction

Research Motivation

Addressing climate change is among the key challenges for mankind. Consequently, leading scholars in the field of Information Systems (IS) have called for research on this issue through the use of information and communication technology (ICT; Dedrick, 2010; Melville, 2010; Watson et al., 2010). IS research in this area is critical for the success of many approaches to limit climate change as "all sustainable objectives and targets need ICTs as key catalysts" (Koliouska & Andreopoulou, 2020, p. 4869). Most importantly, research with tangible and implementable results is needed (vom Brocke et al., 2013). In their editorial to a special issue on solutions for environmental sustainability in the Journal of the Association for Information Systems, Gholami et al. (2016) suggest that "too few information systems [...] academics engage in impactful research that offers solutions to global warming despite the fact that climate change is one of the most critical challenges facing this generation" (p.521). According to their editorial, one research avenue in which the IS community could add meaningful value to the efforts against climate change is to **design solutions** that "**support decision-making for more sustainable practices**" (Gholami et al., 2016, p. 527). Addressing this call, my main research motivation is to contribute to the overarching research agenda on how to design IS solutions to support more sustainable decision-making. Within this realm I focus on the design of user interfaces (UI) since it is the gate for human-computer interaction (HCI) and hence a core aspect in consumers' decision-making process.

Within this context a so far mostly overlooked aspect is the "surprisingly understudied" topic of regionality (Herz & Diamantopoulos, 2019, p. 44). Consumer decisions in favor of regional products and services are sustainable in many dimensions such as biodiversity, animal welfare, governance, and resilience (Schmitt et al., 2017)[1]. Related research suggests that trust cues (e.g., images of humans or nature) are powerful design tools for UI design in the sense of affecting consumers' attitudes towards the interface, underlying product, and provider, and ultimately influencing their decision-making (e.g., Gefen & Straub, 2004; Rendell et al., 2021). My work shows that regional cues are frequently used in practice and provides evidence that such cues are used intentionally to promote regionality (Chapter IV). However, academia has to my best knowledge shed little light on whether regional cues actually affect user behavior. Therefore, this thesis aims to evaluate whether the use of regional trust cues on digital user interfaces affects user attitudes and behavior and could hence support decision-making in favor of more regional products and services.

Against this background, I identified the German electricity market as a very suitable object of study for multiple reasons:

- **Relevance of digital UI.** In Germany, the vast majority of electricity plans is sold through digital sales channels (provider websites, comparison portals, etc.; YouGov, 2015). Hence, decisions are made when consumers engage with digital user interfaces.

[1] Regarding other aspects such as carbon footprint, land use, energy, or water consumption, the academic debate on whether to favor regional over non-regional consumption is still undecided as outcomes depend on "a diverse range of system boundaries, produce types, varied assumptions and a multiplicity of foot printing methods" (Rothwell et al., 2016, p. 421).

- **Sustainability of regional decision-making.** In the electricity sector, there is a relationship of making regional consumer decisions and sustainability (beyond the above outlined benefits): Motivating consumers to purchase regional green electricity (i.e., decentrally generated close to their home) is a sustainable practice in the sense that it reduces transmission losses (Bauknecht et al., 2020), contributes to a higher reliability of the system (Zerriffi et al., 2007), and avoids grid expansions (Allard et al., 2020)[2].
- **Transferability of findings:** Electricity represents a homogenous and credence good. Thus, study results are not confounded by quality discrepancies of regional and non-regional products (e.g., driven by shorter transportation distance). Also, it is transported through grids and transmission costs are independent of the distance from generation to consumption. Accordingly, observable effects can be attributed to the very idea of regionality and should be transferable to other contexts.

Structure of the Thesis and Overarching Research Aims

This thesis consists of seven chapters. This first chapter motivates the research, provides an overarching research agenda, gives a high-level description of the seven research projects included in this work, and explains how those seven projects are reflected in the following chapters. Chapter II lays the basis for further research by taking a closer look at the object of study: the electricity sector. This industry is currently undergoing an in-depth transformation of decarbonization, decentralization, and digitalization (di Silvestre et al., 2018). The chapter draws on joint work with Prof. Dr. Timm Teubner and was published in the *International Journal of Energy Sector Management* (Menzel & Teubner, 2021c). We offer a perspective on how this transformation will shape the sector and, in particular, describe how platform business models will disrupt the industry. In brief, the research objective of that chapter is:

RO_1: Provide an overview on how current developments (i.e., decarbonization, decentralization, and digitalization) are shaping the energy sector of the future.

Chapter II assesses the electricity sector from the angle of consumer preferences. The chapter was published in the proceedings of the *European Conference on Information Systems* (Menzel & Teubner, 2021a). As a starting point for further assessments of regional trust cues, the chapter analyzes whether consumers prefer regional product characteristics when purchasing electricity. Hence, the research aim addressed in Chapter III is:

RO_2: Assess whether consumers value regionality in the electricity context.

Next, Chapter IV sheds light on the use of regional trust cues in practice. It represents joint work with Prof. Dr. Timm Teubner which was published in the proceedings of the

[2] A more detailed discussion of regional green electricity is provided in Chapter 6

Internationale Tagung Wirtschaftsinformatik [3] (Menzel & Teubner, 2021b) and in *Sustainability* (Menzel & Teubner, 2021e). The research aim of this chapter is:

RO_3: Understand how regional trust cues are used on user interfaces in practice.

Chapters V and VI are the core of this thesis. They build on findings from the previous chapters that consumers prefer regional electricity and that regional trust cues are frequently used in practice. The section analysis whether and how regional trust cues trigger this user preference for regionality and, in turn, affect user attitudes and behavior. Chapter V analyzes the effects of regional imagery and stems from joint research with Prof. Dr. Timm Teubner, Prof. Dr. Marc Adam, and Dr. Peyman Toreini. The chapter was published in *Computers in Human Behavior* (Menzel et al., 2022). Initial results and research design were also published in the proceedings of the *Internationale Tagung Wirtschaftsinformatik*[4] (Menzel & Teubner, 2021b) and the *European Conference on Information Systems* (Menzel & Teubner, 2021d)[5]. While Chapter V assesses effects of regional imagery, Chapter VI turns to labels as a different incarnation of regional trust cues. The chapter draws on joint work with Prof. Dr. Timm Teubner and is currently under review at an international journal. Both chapters deal with the question whether and how regional trust cues (imagery in Chapter V, labels in Chapter VI) affect different measures of user attitudes and behavior. Hence, the overarching research objective of those two chapters is:

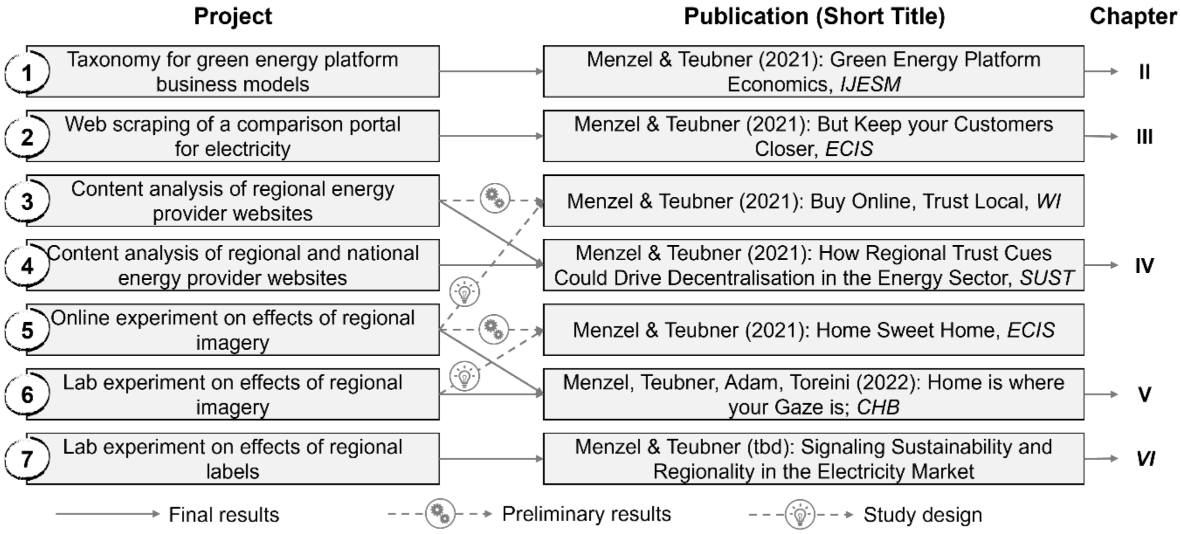
RO_4: Evaluate whether and how regional trust cues (i.e., images, labels) affect user attitudes and behavior.

In the concluding Chapter VII, I revisit these outlined research aims, discuss implications for research, policy, and practice, provide limitations and paths for future work, and give an outlook on current developments in research and practice.

Methodology

As mentioned above, this thesis endeavor consists of seven research projects. Their design, preliminary findings, and final results have been published in seven articles in conference proceedings and journals. The five key publications which cover all major findings are included as chapters in this thesis (see Figure 1).

[3] Please note, however, that this research-in-progress paper is not part of this dissertation as it presents only preliminary results of Chapter IV and research design of one study in Chapter V.
[4] Please note, however, that this short paper is not part of this dissertation as it presents only preliminary results of Chapter IV and research design of one study in Chapter V.
[5] Please note, however, that this research-in-progress paper is not part of this dissertation as it provides only preliminary results of one study and the research design of another study in Chapter V.



Notes: IJESM = International Journal of Energy Sector Management, ECIS = European Conference for Information Systems, WI = Internationale Tagung Wirtschaftsinformatik, SUST = Sustainability, CHB = Computers in Human Behavior

Maik Hesse | Trust in Digital Services

FIGURE 1. RESEARCH PROJECTS AND STRUCTURE OF THIS THESIS

These studies feature a wide range of methodologies and apply different theoretical frameworks. Methodological pluralism adds value in IS research by offering a "richer understanding of a research topic" (Mingers, 2001, p. 241) and drawing attention to different aspects of the object of research (Niehaves, 2005). In addition, combining multiple methodologies may mitigate limitations that a single approach would encompass. For instance, adding eye-tracking to a survey-based experiment mitigates a key shortcoming of self-reported assessments, namely, "that it does not allow us to conclude if a particular characteristic is not relevant for the participant or if it does not catch his/her attention and consequently is not processed" (Meyerding & Merz, 2018, p. 782). For this reason, not all seven research projects led to independent research articles but instead, some of the studies were combined for publication (and resultingly chapters in this thesis). The studies are combined to chapters as follows:

- **Chapter II**: In a first study (#1 Figure 1), an extensive literature (162 papers in the final shortlist) and provider (52) review on platform business models in the energy sector was conducted. The study is presented in Chapter II of this thesis. Most importantly, a conceptual framework for Green Energy Platform Economics and a taxonomy for platform business models in the energy sector is developed.
- **Chapter III:** In the next project (2), we devised a web scraper to crawl data from a German comparison portal for household electricity plans (n=22,890 observations). We evaluated a hedonic regression model with key outcome that consumers value both geographic and entrepreneurial attributes of regional electricity providers. The study is covered in Chapter IV.
- **Chapter IV:** Chapter IV presents the results from two research projects (3 and 4). The first project (3) analyses 318 regional energy provider websites by means of a qualitative content analysis. The study identifies key design elements and categorizes

regional image and text cues. In the other project (4), a new set of regional energy provider websites was compared to national energy provider websites in a quantitative content analysis (n=136). The study highlights that regional trust cues appear significantly more frequent on regional provider websites compared to national provider websites suggesting an intentional use by regional providers to highlight their regional attributes.

- **Chapter V:** The key finding in the next study (5) is that regional imagery appears to trigger regional presence which, in turn, is associated with higher levels of trust. The study included a between-subject online experiment (n=329) in which participants engaged with a fictive energy provider website in which we systematically variated the presence of regional, social, and nature cues. These findings are confirmed in a within-subject lab experiment (6, n=18 participants, 138 observations) in which participants were confronted with another fictive energy provider website with and without regional cues. Eye-tracking and survey data were collected. In addition to the above-mentioned effects on regional presence and trust, findings suggest that regional imagery is also associated with higher levels of visual attention. Both studies are covered in Chapter V.
- **Chapter VI:** The most recent project (7) features another multi-method lab experiment (n=38 participants, 304 observations) and is described in Chapter VI. We collected gaze data, stated trust measures, and time to decision of participants while they engaged with a fictive comparison portal for household electricity plans that featured different labels with regionality and sustainability claims. We find that a label for regional green electricity captures visual attention, reduces time to decision, and increases trust.

A detailed breakdown of methodologies, theories and key results of all research projects is provided in in Table 1.

TABLE 1. SUMMARY OF RESEARCH PROJECTS IN THIS THESIS

#	Methodology	Sample size	Theoretical frameworks	Chapter	Key results/ confirmed hypotheses
1	Literature & Provider Review	161 + 52	N/A	II	Conceptual framework Taxonomy
2	Web Scraping, Hedonic Regression Model	22,890	Consumer Ethnocentrism	III	Geographic regionality → +WTP Geographic x entrepreneurial regionality → +WTP
3	Qualitative Content Analysis	318	Social Presence Theory, Biophilia Hypothesis, Consumer Ethnocentrism	IV	Classification of regional text and imagery trust cues
4	Quantitative Content Analysis	136		IV	# of regional trust cues used by regional providers > national providers
5	Online-Survey	329		V	Regional imagery → +Regional Presence Regional Presence → +Trust
6	Eye-Tracking, Survey	18/138		V	Regional imagery → +Visual Attention Regional imagery → +Regional Presence Regional Presence → +Trust
7	Eye-Tracking, Survey	38/304	Signaling Theory	VI	Regional label → +Trust Regional label → +Visual Attention Regional label → -Time to Decision

Chapter II: An Overview on Green Energy Platform Economics

Paving the ground for further study and discussion, I provide an overview on the energy sector in this section. In particular, the chapter discusses how the recent mega trends digitization and decarbonization may shape the sector in the future. Until recently, the power sector was characterized by a rigid value chain building mainly on centralized generation in nuclear and coal power plants, transmission through monopolized grids, and consumption by customers unenthusiastic about switching providers. But the tide is turning as liberalization, digitization (e.g., smart homes), electrification (e.g., e-mobility), and decentralization (e.g., rise of the prosumer) are changing the rules of the game in the energy industry. But platform business models – having disrupted many industries in recent years – are approaching to fundamentally disrupt the sector. Ultimately, this development could not only turn the industry upside down but also substantially accelerate its green transformation: Platform business models will promote adoption of green technology by providing additional income streams and lowering entrance barriers for new, renewable assets (e.g., rooftop PV, home storage batteries, electric vehicles) and managing increased complexity caused by flexible power generation and demand. This chapter provides a first review of literature on this matter. It describes the upcoming transformation in the sector, presents a taxonomy of platform business models in the energy sector, and describes worthwhile paths for future work.

Tobias Menzel, Timm Teubner[6]

Introduction

Problem Statement

In response to global climate change, the energy sector has to become ecologically sustainable by substituting conventional generation with renewable energy technologies (IPCC, 2014) and by reducing energy consumption (Stankeviciute & Criqui, 2008). Achieving the goals set out in the Paris Climate Change Agreement will require a 70% reduction in energy-related CO2 emissions from 2015 levels by the year 2050 (Aberg et al., 2019). At the same time, digitalization continues to disrupt many industries and represents one of the key challenges for business and politics. The energy sector in particular is expected to be heavily affected by the latest wave of digitalization (Ringel, 2018): by 2025 one out of four energy providers could go bankrupt due to the pressure of digitalization (Schwieters et al., 2016). The industry is therefore facing the challenge of transforming its value chain to become green and digital in order to live up to economic and environmental demands of shareholders and stakeholders alike.

[6] This chapter was published in the *International Journal of Energy Sector Management* with the title "Green energy platform economics – understanding platformization and sustainabilization in the energy sector", doi.org/10.1108/IJESM-05-2020-0022

Digital platforms have already disrupted other industries such as the hospitality sector (e.g., Airbnb) and the retail sector (e.g., Amazon) and their growth has caught the attention of academics and the public at large. At the same time, platform businesses have become increasingly prominent within policy debates (Kiesling et al., n.d.). This prompts the question of how and to what extent this potential could be leveraged in the energy sector to help drive the required transition to a low-carbon energy system.

Study Significance

At present, the main obstacle to achieving the transformation of the energy sector is not the lack of technology, but rather the lack of its application (Flamos, 2010). Platforms can provide a means of addressing this problem and are considered a key element in the transition to a low-carbon energy sector (Weiller & Pollitt, 2016). Digital platforms for green energy are a dynamic combination of powerful economic, social, and technological factors that can disrupt traditional markets (Ilieva & Rajasekharan, 2018). Indeed, some scholars go so far as to claim that these platforms are critical to the successful transformation of the energy sector (e.g., C. Zhang et al., 2018). Up until now, the academic debate around platformization in the energy sector has focused on distinct platform applications, such as local energy markets (C. Rosen & Madlener, 2016), plug-sharing platforms (Matzner et al., 2016), or vehicle-to-grid (V2G) services (Schmidt et al., 2015). However, there has been no attempt to take a more holistic view of platformization and sustainabilization, something this paper will attempt to address.

Assumptions/Definitions

To be as precise as possible, we will use the following definitions:

Platform Market *A platform market is a market where user interactions are mediated by an intermediary, the platform provider, and are subject to network effects. As opposed to a marketplace or trading exchange, a platform intermediary must offer inherent value beyond the simple mediation process for the two sides of the market. This added value usually comes from [information and communication technology] (ICT) and the associated complementary innovation that increases utility and attractiveness of the platform to all user groups.*

(Weiller & Pollitt, 2016, p. 7)

GEPE *Green Energy Platform Economics (GEPE) is the study of digital platform markets that either facilitate the trading of energy from renewable sources or enable the integration of renewable energy into the energy system.*

Own definition

Objectives

As outlined above, a more holistic perspective has been missing from academic debate on the platformization and sustainabilization in the energy sector. Such a perspective would support policy makers, business leaders, and scholars. Therefore, we set out to structure the field with the help of a research framework, leading to our first overarching research objective (RO):

RO$_1$: Develop a framework to research platformization and sustainabilization in the energy sector

In the next step, we dissect the sector along its value chain. Understanding the value chain is critical to identifying the drivers of and challenges to innovation (Ferroukhi et al., 2013), tracing economic value and risk flows (Furlonge, 2011), and responding to technological change (Kolloch & Reck, 2017). Our second research objective can therefore be specified as follows:

RO$_2$: Determine how Green Energy Platforms affect the energy value chain

Finally, to develop the field further, we aim to identify existing research gaps and to derive a corresponding research agenda. Our third and last research objective is therefore reads:

RO$_3$: Uncover research gaps and derive a research agenda

We address these three objectives by means of (1) a literature review, (2) research on the provider landscape, and (3) discussions with scholars and industry experts. We develop a framework to structure Green Energy Platforms and then apply this framework to (a) showcase how it could affect the value chain and (b) derive a research agenda.

Contribution/Originality

Our contribution to understanding platformization and sustainabilization in the energy sector is fourfold. First, we provide a holistic framework for business leaders, policy makers, and academics and describe the relevant terms, concepts, actors, and mechanisms. To the best of our knowledge, this is the first study to provide such a holistic view of this important contemporary trend. Second, we provide a comprehensive aggregated review of the relevant literature and of the platform landscape. Third, we lay out a research agenda to further develop the field. Fourth, the unique characteristics of energy, namely that it is homogenous and intangible (Baye & Morgan, 2001) and that it can be classified as a credence good (Emons, 1997), offer a new perspective on platform economics research in general.

Structure

The remainder of the paper is structured as follows. We discuss related work in Section 2. Our methodology is outlined in Section 3. Section 4 presents the results generated by this methodology: a research framework, a comprehensive overview of the relevant literature and of current platform providers, value chain mapping, and a future research agenda. Section 5 discusses our findings and their theoretical, practical, and policy implications. Our conclusions are presented in Section 6.

Related Work

In this section, we review the academic debate on digital platform markets in the energy sector and structure it in terms of six different platform types.

Energy Comparison Platforms

This platform type includes price comparison platforms for electricity, gas, and hydrogen. These platforms serve as an intermediary between the supply side (energy retailers / utilities) and the demand side (households / industrial consumers). We consider such platforms to be Green Energy Platforms if they exclusively trade in energy from renewable sources (or at least offer an option to purchase it). Green products allow providers to demand price markups over conventional generation (Hast et al., 2014). Beyond matchmaking, these platforms add value by enabling transparent comparison of complex products and pricing structures (Laffey, 2010).

Charging Integrator Platforms

On this type of platform, the product/price-comparison function is enriched by the geographical dimension relevant to mobility applications. These platforms are able to provide value by, for instance, showing users the closest available charging point and navigating them there (e.g., Kuby et al., 2014). It has also been argued that this feature can reduce user reservations towards e-mobility and accelerate its adoption (Bedogni et al., 2014). These platforms generate additional value for users (especially in the domain of e-mobility) by integrating multiple retailers so that users do not have to register with different charging point providers (e.g., Noyen et al., 2013). Kim et al. (2017) introduce a blockchain-based billing platform for this use case. As electric, gas, and hydrogen mobility is considered a key enabler for the integration of renewable energy into the energy system, we include such platforms within the GEPE framework.

Peer-to-Peer (P2P) Energy Trading Platforms

On this type of platform, both demand and supply are provided by non-commercial agents (i.e., ordinary citizens). This is the reason why consumers are often referred to as prosumers in this context, that is, consumers who by owning decentral generation units, such as rooftop solar panels or electric vehicles (EV), are also producers. Accordingly, applications of this type are also referred to as P2P (Sousa et al., 2019) or sharing platforms (C. Park & Yong, 2017). The intermediary is typically a utility who, besides operating the platform, supplies residual energy in case the platform community does not generate sufficient amounts of energy (Mengelkamp et al., 2018). The traded good is often renewable energy generated from rooftop solar panels or residential windmills, but the concept works similarly for sharing hydrogen (Amoretti, 2011; Xiao et al., 2018) or heat (Block et al., 2008). Even though hydrogen and heat may not necessarily be from renewable sources, their inclusion in the GEPE framework is justified, as both technologies can contribute to increasing the share of renewable energy and substitute conventional, emission-heavy sources such as fossil oil, gas, and coal.

A recent body of work has studied community and connectivity aspects of P2P energy trading platforms, such as microgrids, which can be understood as a physically connected community (e.g., Marzal et al., 2018). They have also been regarded as socially cohesive communities connected by a local energy market (e.g., Lezama et al., 2019) and discussed in terms of community-based energy trading (e.g., Koirala et al., 2016). In terms of added value, customers get access to locally produced renewable energy (e.g., Kahrobaee et al., 2014) while the acceptance and adoption of distributed renewable energy can be increased due to the additional value streams created for prosumers (Kiesling et al., n.d.). The research literature focuses primarily on market design and implementation, such as bilateral trading (e.g., Morstyn et al., 2019), broker-based markets (e.g., Chen & Su, 2019), consensus-based approaches (e.g., Sorin et al., 2018), and auction mechanisms (e.g., Paudel et al., 2019). Another frequently discussed topic is the use of blockchain architectures (e.g., S. Wang et al., 2019). Regulatory challenges have also been addressed in a number of publications, such as Soshinskaya et al. (2014) who consider interconnection rules with the main grid as barriers to the further adoption of microgrids.

P2P EV Charging Platforms

In the mobility sphere, P2P platforms are designed to match owners of private EV charging points with drivers (Matzner et al., 2016). According to Madina et al. (2016), this is the first type of mobility platform with a viable business model, as the total cost of ownership is lower than that for public charge points or V2G applications. Even though the electricity used in EVs does not necessarily stem from renewable sources, the technology qualifies as a green energy platform since it is widely considered a key contributor to the decarbonization of the economy (e.g., IPCC, 2014). P2P EV charging platforms provide an income stream for owners of private charging points. Drivers of EVs also benefit as value is added by the opportunity to search for and compare charging points (Plenter, 2017). The most frequently debated topic in this context is the architecture of the information systems (IS) used in such platforms (e.g., Radi et al., 2019), some of which are based on blockchain technology (e.g., Kang et al., 2017).

Residential-To-Grid (R2G) Platforms

R2G platforms are a particular feature of electricity markets. Since the electricity grid is very sensitive to fluctuations in its operating frequency (50 Hz in Europe, 60 Hz in Northern America), grid operators rely on specialist service providers to ensure that demand and supply are balanced at all times. These providers offer products ranging from those with highly responsive supply capacities, such as primary reserve frequency regulation (where the energy providing asset has to be able to ramp production up or down within seconds), to less responsive load-management solutions with ramp-up times of the order of hours. Apart from these services procured by grid operators, grid services also include applications such as peak shaving or load shifting where excess energy is stored and fed back to the grid when needed (López et al., 2015). In contrast to the four platforms mentioned above, in which a certain amount of energy is traded, the commodity traded on R2G platforms is capacity, that is, the flexibility to feed electricity into the grid when demand is higher than supply, and vice versa. Up to now, conventional power plants fueled by coal, gas, or nuclear power have provided these services by flexibly adjusting production. New technology for balancing grid services is thus essential when replacing conventional energy production and transforming the energy system towards renewable sources (Motalleb et al., 2016). Among these new load-management technologies, energy storage assets such as batteries will be critical to the integration of renewable resources (Debia et al., 2019). Ilieva and Rajasekharan (2018) describe how multi-sided platforms can pool, coordinate, and monetize an array of storage assets at the consumer level. Typically, an individual EV or home appliance does not provide enough capacity to be attractive for the demand side and pooling is typically required to generate a marketable product (e.g., C. Rosen & Madlener, 2016). In addition to pooling, these platforms add value by offering an additional income stream to vehicle and homeowners and hence facilitate adoption of EVs or storage systems. The data generated can also be used to optimize demand and supply schedules (e.g., Eid et al., 2016). Flexibility on R2G platforms is provided by residential battery capacity (e.g., C. Rosen & Madlener, 2013), flexible loads such as heating, ventilation, and air-conditioning systems (HVACs) (e.g., Jin et al., 2020), or adjustable residential production units such as solar panels. Batteries can operate in two directions, that is they are able to both store and re-supply excess energy. In contrast, flexible loads and generation units can typically only provide flexibility in one direction by shifting or cutting consumption or generation (Ströhle & Flath, 2016). Most research into R2G platforms has centered around market design, such as hierarchical market models (e.g., Gkatzikis et al., 2013), real-time pricing mechanisms (e.g., Cardell, 2007), and auction mechanisms (e.g., Dauer et al., 2015).

V2G Platforms

V2G platforms offer a similar solution to the R2G platforms described above but differ in that they use the storage capacity of pure and hybrid EVs. In contrast to residential assets, EVs can operate at different feed-in locations (Kempton & Tomić, 2005b). Fuel cell vehicles can also participate in V2G platforms, but with the constraint that only upward regulation is feasible (Kempton & Tomić, 2005a). However, research publications (e.g., Weiller & Neely, 2014) remain skeptical about the viability of V2G platforms because, as things currently stand, the costs of providing balancing services exceed the earning potential in the flexibility market (Brandt et al., 2017). However, this business model will become increasingly attractive as battery costs decline (Uddin et al., 2018). Initially, services with short charging intervals (e.g., frequency regulation services) will become financially viable, while those services with longer charging cycles (e.g., peak shaving, load shifting) will require a further decrease in battery costs before they become economically feasible (Tomić & Kempton, 2007). Research into IS architecture also addresses data privacy concerns (e.g., Ghosh et al., 2013) and the implementation of V2G platforms into the smart grid (Guille & Gross, 2009). Zhao et al. (2016) have even suggested that V2G platforms could facilitate the breakthrough of electric trucks.

Methodology

To develop the framework in this paper, we followed a five-step approach as outlined in Figure 2, starting with the definition of initial research objectives. In the following, we outline and provide specifics for each step.

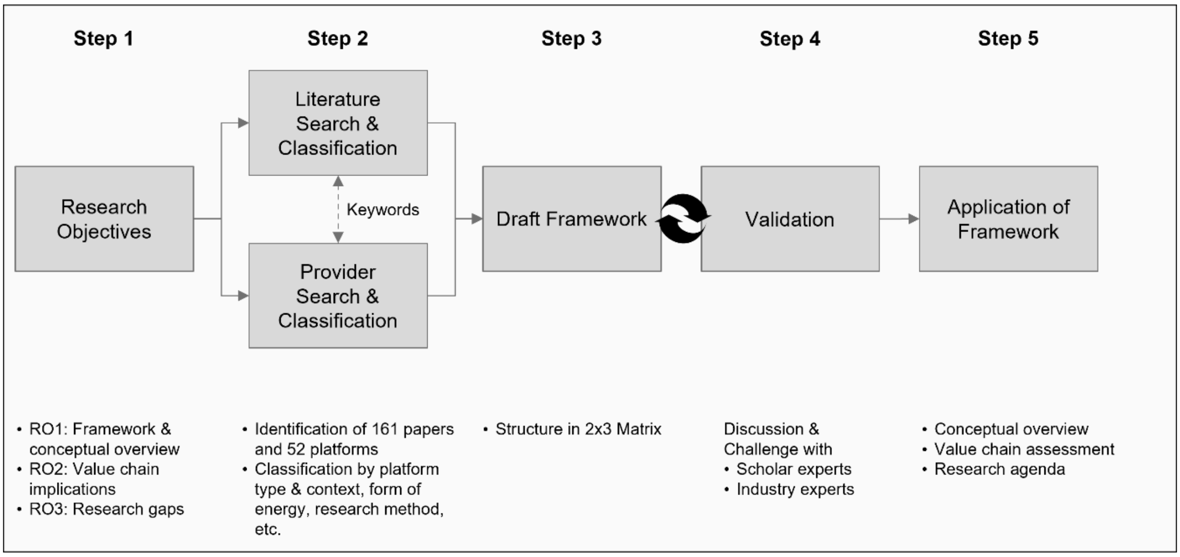


FIGURE 2. RESEARCH METHODOLOGY FOR FRAMEWORK DEVELOPMENT AND APPLICATION

Step 1: Research Objectives

As outlined in the previous section, our research objectives are to develop a conceptual framework for GEPE (RO_1), to assess how platformization in the energy sector affects the value chain (RO_2), and to use these results to derive a future research agenda (RO_3).

Step 2: Literature Search / Provider Search and Classification

We began by identifying relevant literature via keyword searches on Google Scholar with a review of the top 50 search results as well as backward and forward searches of the references. We selected Google Scholar over other databases as it is currently the most comprehensive collection of papers, books, and conference proceedings for academic searches (Gusenbauer, 2019) and is expanding rapidly compared with other databases (de Winter et al., 2014). Google Scholar can be regarded as a combination of multiple databases and offers "substantial extra coverage" (Martín-Martín et al., 2018, p. 1) compared with other services such as Scopus or Web of Science. In addition, we searched for platform providers using a regular internet search. We used keyword combinations that ranged from generic terms such as "platform economics" in combination with different energy carriers (e.g., electricity, hydrogen, gas, etc.) to concrete applications such as "peer-to-peer sharing", "comparison websites", or "vehicle-to-grid". We also used the names of some of the established platforms (e.g., "*Verivox*"). The full list of keywords is provided in the Appendix. We applied the following inclusion/exclusion criteria resulting in a total of 161 publications in the final set:

- **Quality** – As quality criterion, only journals with *SCImago* H-index scores above 50 and conferences with H-index scores greater than 10 are considered (Mengelkamp, Weinhardt, et al., 2019). *SCImago* Journal & Country Rank is a publicly available website providing indicators to evaluate scientific outlets including all major conferences and journals. The H-index provides the "number of articles (h) that have at least h citations" (*SCImago Journal & Country Rank*, 2020, p. 1). Exceptions apply for a low number of highly relevant preprints or publications.

- **Subject** – The platform must be the publication's main subject. We therefore excluded publications in which, for instance, the platform is only the data source for other calculations. We also excluded publications on the (technical) optimization of energy flows, energy management, or voltage control. Moreover, we removed publications that targeted the architecture of physical (non-IS) components, communication protocols, or battery degradation.
- **Market properties** – As defined above, the platform must be a multi-sided marketplace. We therefore excluded publications dealing with monopolistic market structures, such as blink or newmotion, where a single company is both the seller and the platform provider. We also excluded publications on microgrids when the paper focused only on the physics of the grid.

The final set of 161 publications was classified using a cross-sectional approach that involved the following categories (the full classified list is provided in the Appendix).

- **Type of publication** – This distinguishes practitioner journals and conferences (e.g., the IEEE universe) from scholarly publications.
- **Context** – This classifies a paper's content in terms of specific aspects of Green Energy Platforms. Categories are IS architecture (e.g., algorithms), business model, user interface, social interaction and community, and regulatory or policy framework. Further classifications include optimization (e.g., improvement of cost, bidding strategy, and forecasting), the presentation and discussion of concrete artifacts, market design, and publications discussing the acceptance and adoption of such platforms. For a particular research paper, more than one category may apply.
- **Form of energy transmitted** – This identifies which form of energy is being considered: electricity, gas, hydrogen, or heat. It is important to note that the focus here is on the form of energy that ultimately flows between trade partners. For instance, if a hydrogen-powered fuel cell car uses its battery to take part in a power balancing service market, the transmitted form of energy is electricity and not hydrogen. Multiple selections are possible.
- **Research methodology** – This describes the methodological approach used in the paper: case study, conceptual work, design science research (DSR), experiment, expert interview, field study, framework, literature review, model, protocol, prototype, simulation, and survey. Multiple selections are possible.

Step 3: Draft Framework Development

Once Step 2 had been completed, we developed a draft framework that structured papers and platform providers. This framework defines six platform types within a 2x3 matrix. The two rows represent residential applications and mobile applications respectively, while the three columns are assigned to the type of business interaction: business-to-consumer (B2C), consumer-to-consumer (C2C), and consumer-to-grid (C2Grid).

Step 4: Framework Validation

The framework was further refined through an iterative process involving presentations to and discussions with scholars and industry experts. Specifically, we held meetings with two academic experts in the field of platform economics, three research scholars with an interest in the energy sector, an employee of an energy utility, and a partner in an energy sector strategy consultancy. After each meeting, we further optimized the framework by iterating Steps 3 and 4.

Step 5: Application of Framework

Having developed the conceptual framework, we summarized and visualized the results of our review of the research literature and the provider landscape (RO_1). Next, we turned our attention to the value chain. To do this we focused on the electricity value chain because the literature review revealed that electricity is by far the most frequently researched form of energy (i.e., covered in 160 of 161 research publications). Starting with the conventional value chain, we assessed how each of the six platform types can affect or disrupt the value chain (RO_2). In the final stage, we used the classification scheme described above to identify gaps in the research literature and - based on these findings - formulated an agenda for future research (RO_3).

Results

Research Framework, Provider Landscape, and Literature Classification (RO_1)

The framework that we have developed is a 2x3 matrix in which existing platforms and relevant research literature can be presented in a structured manner. The two rows of the matrix are used to distinguish between the spatial characteristics of the platform models: residential and mobile. Residential applications include both household and industry customers and are characterized by a fixed geographic point of consumption or production. In contrast, platforms are treated as mobility applications whenever vehicles are involved. In these cases, the point where energy is consumed or fed into the grid is not fixed and may vary over time. The columns of the matrix distinguish between the platform business models B2C, C2C, and C2Grid. While a number of B2B platforms also exist in this context, they do not satisfy the platform definition used in the present analysis, either because they are used solely for market clearing purposes (e.g., spot exchanges for electricity or gas – such as the *European Energy Exchange* (EEX)) or because they do not represent a multi-sided market. The resulting six fields within the matrix each feature one of the platform types described in Section 2. Figure 3 displays the framework matrix together with a non-exhaustive summary of platform providers.

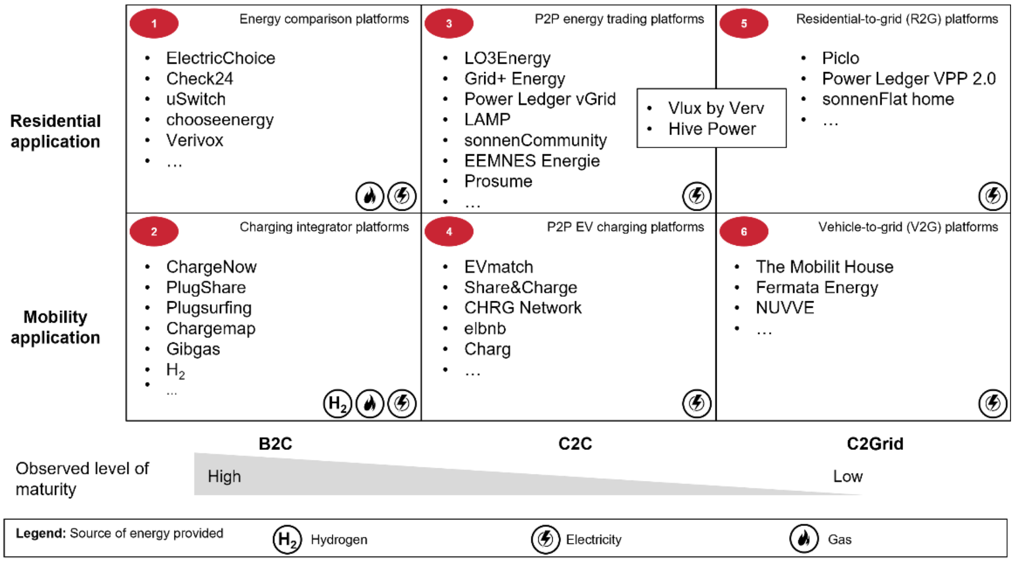


FIGURE 3. GEPE FRAMEWORK AND SELECTED PLATFORM PROVIDERS

- **B2C Residential** (No. 1 in Figure 2 to Figure 4) – Energy comparison platforms feature websites such as *Verivox* and *Check24* in Germany, *uSwitch* in the United Kingdom (UK), and *chooseenergy* in some states of the United States (US). It is worth mentioning that the geographic scope of this business model is limited to liberalized markets (i.e., it is relevant in only 16 US states). Household and business consumers can compare various providers and tariffs for green or conventional electricity and gas contracts. Most comparison websites began as price comparison services for insurance policies, phone or broadband plans, or credit card offers and later expanded into the energy market.
- **B2C Mobility** (No. 2) – In addition to electricity and gas, charging integrator platforms include solutions for hydrogen. However, electricity is still by far the predominant form of energy. Owners of electric cars can use applications such as *Plugsurfing*, *ChargeNow*, *PlugShare* to find the closest public charge point, start the charging process, and execute payments. *Gibgas* and *H2* offer similar services for gas and hydrogen, respectively. The enterprises behind these platforms are typically either start-ups (as in the case of *Plugsurfing*) or mobility incumbents (such as *BMW* and *Daimler* in the case of *ChargeNow*). Energy providers operating their own on-street charge points tend to offer applications that only cover their own assets. Hence, these applications do not qualify as platforms as defined here, as they do not represent a multi-sided market.
- **C2C Residential** (No. 3) – The most prominent example of a P2P energy trading platform is *LO3Energy*, which is the technology partner for the *Brooklyn Microgrid*, one of the earliest and largest pilot programs for local electricity sharing. Platforms of this type include start-ups with a technology-heavy background that often emphasize their capabilities in blockchain or other distributed ledger technologies such as *Grid+ Energy*, *Power Ledger, Prosume*, or *Hive Power*. Other platforms in this area include *SonnenCommunity*, which enables owners of its PV-coupled battery storage systems to trade surplus power.

- **C2C Mobility** (No. 4) – Among P2P EV charging platforms, *EVmatch* is probably the most advanced platform. While platforms like *EVmatch* and *elbnb* focus exclusively on private charging points, *share&charge* and *CHRG network* also integrate public EV charging stations. Electricity is the only form of energy currently traded on both C2C residential and C2C mobility platforms.
- **C2Grid Residential** (No. 5) – The companies active on R2G platforms are essentially the same as those involved in P2P energy trading. They either trade load balancing services via the same platform they use for wholesale energy trading (*vlux, Hive Power*) or they offer different products under the same brand umbrella such as *VPP2.0* by *Power Ledger*. The start-up *Piclo* is the only market player that we identified that focuses exclusively on the flexibility market.
- **C2Grid Mobility** (No. 6) – As noted earlier, electricity is the only form of energy traded on C2Grid applications. Interestingly, our research into V2G platforms shows that the large mobility or energy players are not particularly engaged in this area, with most activity coming from the independent US-based start-ups *Fermata Energy* and *Nuvve* as well as the German start-up *The Mobility House*, all of which were specifically founded with the purpose of exploiting V2G technology.

We have also used our framework to present the descriptive statistics generated from our analysis of relevant research publications (see Figure 4). Overall, the number of publications on GEPE has increased markedly over the last five years compared with the decade before, indicating a significant growth in interest in the field. The distribution of articles is fairly balanced between practitioner research and purely academic research, with a slightly higher share of practitioner literature in papers dealing with mobility applications and a slight excess of scholarly literature concerned with residential applications. Furthermore, electricity is by far the predominant form of energy discussed in the literature. Of all 161 papers, hydrogen is considered in only three studies, trading of gas is covered twice, and heat is considered only once. P2P energy trading platforms (No. 3) are the most frequently researched platform type (69 publications), almost half of which examine market design. V2G platforms (No. 6) and R2G platforms (No. 5) are the next most popular research subjects with 47 and 33 publications respectively. The literature on V2G platforms deals mostly with business models, while the dominant topic in articles on R2G platforms is, again, market design. Charging integrator platforms (No. 2) were the subject of 22 papers, while 17 articles analyzed P2P EV charging platforms (No. 4), where the IS architecture was the most frequently discussed topic. Energy comparison platforms (No. 1) were considered in seven publications with no topic being particularly dominant.

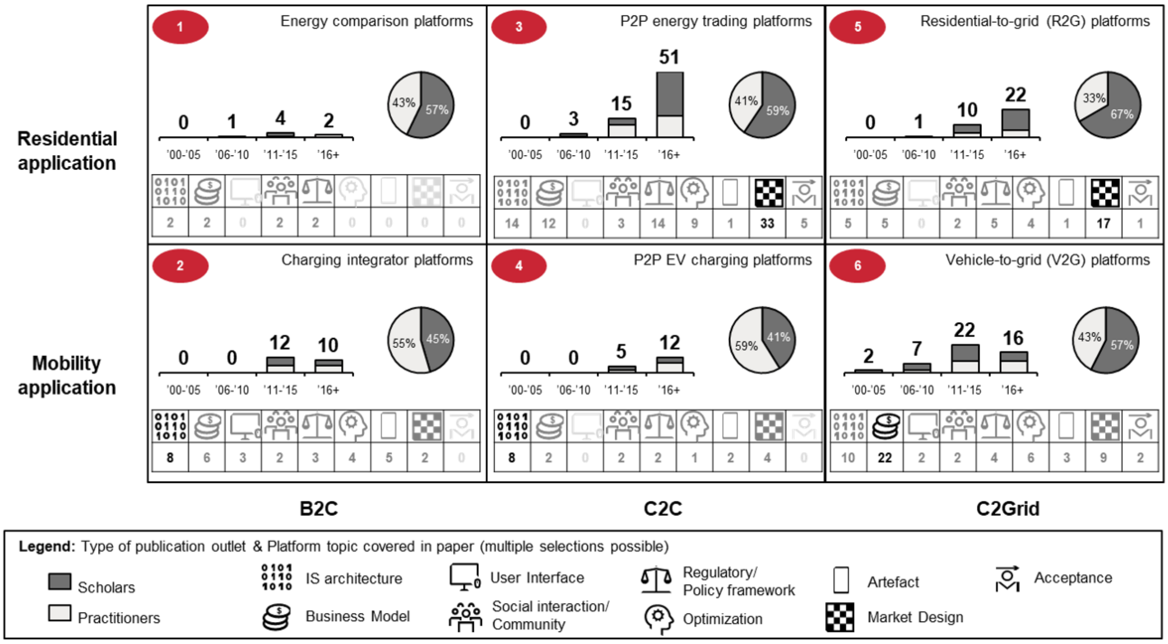


FIGURE 4. GEPE FRAMEWORK AND DESCRIPTIVE STATISTICS OF LITERATURE REVIEW

Value Chain Evolution (RO_2)

In this section we use the framework developed above to study how the electricity value chain is affected by the rise of platform markets. The fact that 1) electricity is considered in all but one of the 161 papers examined and 2) that other energy carriers, such as heat, gas, or hydrogen, are discussed in only four, justifies our focus on the electricity value chain. The conventional electricity value chain (e.g., Simmonds, 2002) starts with conventional, centralized power generation (e.g., in coal or nuclear power plants). Electricity flows via high-voltage transmission grids to lower voltage distribution grids. Traditionally, retailers, often utility companies, controlled practically all aspects of end-customer interaction, which typically included an *over-the-counter* (OTC) contractual relationship and services such as billing and metering. In terms of marketplace transactions and bilateral trading, the conventional value chain involved retailers purchasing electricity from the power generators on the basis of long-term contracts as well as via electricity exchanges to cover short-term and intraday demand. The transmission grid operators responsible for grid stability, purchased balancing services from the power generating companies through balancing service markets. As summarized in Figure 5, this conventional set-up will be affected by Green Energy Platforms at almost every level – a transition that is already underway.

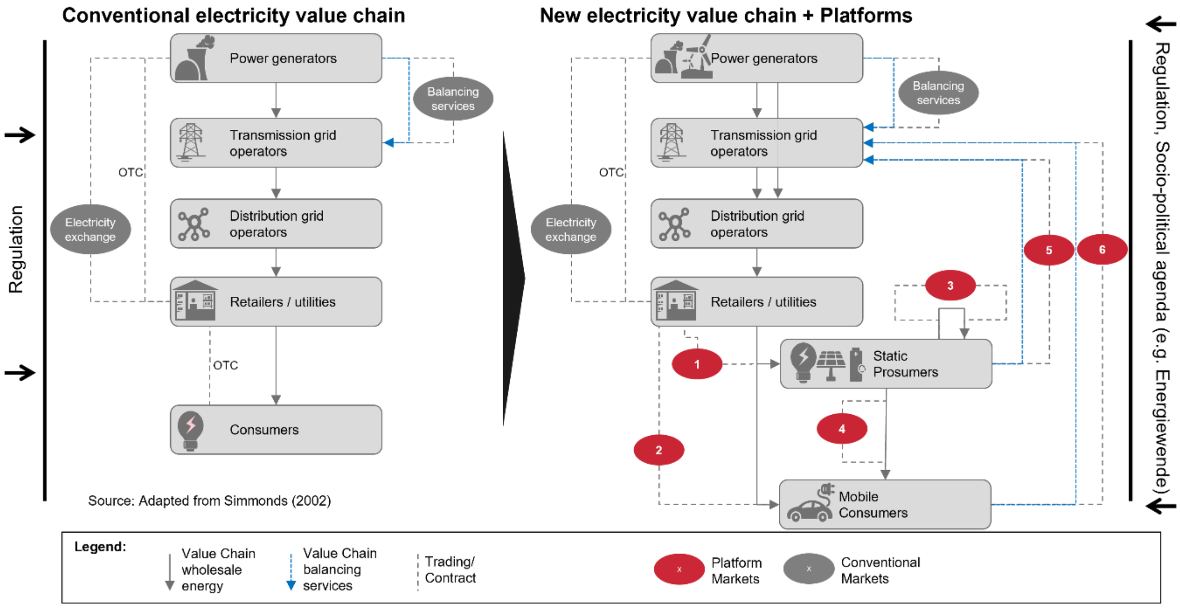


FIGURE 5. EVOLUTION OF THE ELECTRICITY VALUE CHAIN THROUGH GEPE

Looking first at the market players and the structure of the future electricity value chain, new power generation units, such as wind or solar power plants, have entered the market on a substantial scale, feeding into both transmission and distribution grids. In addition, the conventional consumer has evolved into a prosumer who can both provide and consume electricity at different times. During periods of low energy consumption or high self-production (e.g., from solar panels), the prosumer feeds energy into the grid – and vice versa. At the residential level, the rise of the prosumer has been driven predominantly by solar photovoltaic systems, but also by other forms of decentralized generation, battery storage capacities, and smart loads. The increase of EVs is also adding an additional element at the consumer level. With the introduction of a platform economy model, new markets are beginning to arise within the value chain. Lastly, the socio-political context has evolved as well. Although the energy sector has always been subject to extensive regulation, it is now also being confronted by societal and political developments, some of which involve new actors such as the youth-driven Fridays-for-Future movement.

The current state of platformization in the energy sector can be described as follows: B2C platforms (No. 1 and 2) are now situated between retailers and consumers/prosumers (both static and mobile) while the P2P energy trading platforms (No. 3) operate among prosumers. P2P EV charging platforms are used when mobile consumers charge their EVs with energy from prosumer households (No. 4). The two C2Grid platform types (No. 5 and 6), which are located between the prosumers/EVs and the transmission grid operators, are the most complex ones within our framework. As outlined earlier, these markets may well expand to encompass distribution grids, where operators could, for instance, purchase flexibility to avoid congestion losses. Utilities could also procure flexibility from prosumers and EVs either by pooling these providers with their own assets in order to bring them to market or to avoid compensation payments to the transmission grid operator, during periods in which their balancing group is not balanced. In summary, platformization acts a disruptor along the entire electricity value chain by enabling consumers/prosumers to market their assets at basically every level.

Research Agenda (RO_3)

By combining our cross-sectional review and classification of the research literature with the results of applying our research framework we have established a foundation on which we are now able to identify areas where further research is needed.

- **Platform type:** Price comparison websites were the subject of only seven of the 161 papers. Moreover, only four of these papers focused exclusively on comparison websites, while the other three publications also addressed other platform types. This seems somewhat surprising given that comparison websites represent a rather mature business field. Assessing these sites by means of web scraping could deliver novel insights not only for comparison website research, but also for understanding Green Energy Platforms in general.
- **Context**: An aggregated view of articles examined reveals that particular aspects of GEPE, such as market design (60 papers), business models (40), IS architecture (34), and regulatory topics (27), have been addressed quite extensively. In contrast, however, very little research appears to have been done into platform user interfaces (4) and social interactions on such platforms (3). It is worth noting in this regard that research in other sectors has shown that topics of this type, such as trust and reputation mechanisms, are crucial factors in determining a platform's success.
- **Form of energy transmitted:** As discussed earlier, in practically every one of the papers analyzed (160 out of 161) the form of energy traded was electricity. Other (potentially renewable) resources such as hydrogen, heat, and gas are barely considered in studies of platform economy models. Nevertheless, these forms of energy all play an important role in the ongoing transformation of the energy sector and their platformization should therefore be the subject of future research.
- **Research methodology:** Our examination of the research literature also identified a lack of empirical work, especially the analysis of real market data relating to Green Energy Platforms. In contrast, there is an abundance of market simulations (79 papers), theoretical models (44), and case studies (22). This could be due to the fact that those platforms that are most frequently the subject of research, such as P2P energy trading or V2G applications, are to a large extent still at the project stage or in the early phases of their development and hence cannot provide dependable market data at the present time. However, web scraping of energy comparison sites and charging integrator platforms or partnering with them would provide robust insights based on real-life data.

Discussion

Findings

Green Energy Platforms are fundamentally disrupting the energy value chain in multiple ways. These platforms are creating new markets and trading possibilities, introducing new forms of cooperation between market players and thus unlocking the so-far untapped potential of thousands of small-scale generation and storage units through coordination and bundling. The positive impact of platformization can be illustrated by taking a look at how it has influenced other sectors. Take, for instance, the case of the ride sharing platform *BlaBlaCar*. While drivers used to drive an otherwise empty car from A to B, the platform brokers this unused capacity and hence makes an otherwise idle resource available.

At the same time, platformization helps to manage the increasing complexity that is being driven by the decentralization of the energy sector. By boosting transparency, platformization is also helping to make markets more efficient. Finally, enabling new players to enter the markets adds a healthy level of competition in markets that only a few decades ago were dominated by monopolies and that still tend to exhibit oligopolistic characteristics (Strunz, 2014).

Theoretical Implications

In this work, we are attempting to broaden the perspectives typically adopted in the few existing research papers on the platformization in the energy sector. The framework we propose broadens the classification of business models used by Giehl et al. (2019) to discuss the ongoing and future transformation of the energy sector. First, we highlight the "two-sidedness" of markets as a key characteristic of the platform economy. Second, we take into account the importance of (environmental) sustainability of platform models whereas Giehl et al. (2019) did not explicitly account for such environmental impacts. Last, we systematize the various platform types by arranging them within a 2x3 matrix structure. We build on the work of Kupferschmidt et al. (2018), positing that the energy sector's platformization is a key enabler for handling the growing complexity caused by increasing decentralization. Expanding on Kupferschmidt et al. (2018),we attempt to create a comprehensive overview of the field by including C2Grid applications as well as platforms involving mobile prosumers. Our framework contributes to the academic debate by enriching platform-agnostic discussions of such topics as social interactions (e.g., Y. Huang et al., 2015; Skopik, 2014) or technological implementation issues (e.g., Albrecht et al., 2018).

In the broader context of sustainable business models in the energy sector, Richter (2013) has drawn attention to a lack of viable business models for small-scale renewable generational and storage assets, which is an issue directly tackled by GEPE. Green Energy Platforms also address the need for new forms of collaboration to manage the increasing complexity as has been highlighted by other scholars (e.g., Engelken et al., 2016).

Managerial Implications

Managers and business decision makers need to be aware that their business can adopt one of a number of different roles within a platform set-up: seller, platform provider, buyer, or ecosystem partner. It is critical for business leaders to understand which platform type they want to employ and for what purpose and which role they want their company to play within the platform ecosystem. Depending on whether the digital platform is supposed to serve as a revenue stream, act as a sourcing path, or provide access to a customer base will affect the company's role on the platform. Take for instance the case of a traditional utility provider. This type of company might act as a seller on a comparison platform, as a platform provider for a P2P energy trading market, and/or as a buyer on a V2G platform. A start-up on the other hand could develop the platform for a P2P plug-sharing service while simultaneously acting as a buyer on a price comparison website.

For utilities in particular, platformization requires a paradigm shift. To successfully manage the transition to a platform-enabled marketplace, they may need to abandon their currently preferred model of a few large-scale projects (Richter, 2012) in favor of more small-scale customer-side initiatives.

In terms of business strategy and the timing of when best to adopt platform business models, we have identified notable differences in the maturity of the platforms, with decreasing states of sophistication from left to right in our framework matrix. While established comparison platforms such as Verivox have already been operating for years, the providers of P2P applications are predominantly in the test and pilot phases. C2Grid platforms are even further away from launching commercial operations. These observations are in line with other publications. Weinhardt et al. (2019), for instance, report that most local energy market projects are still in the proof-of-concept stage, and Laurischkat et al. (2016) state that V2G is currently only a theoretical concept due primarily to the high degree of sophistication of such projects and the technology and commercial relationships involved (San Román et al., 2011).

Managers looking to develop digital platform business models in the energy sector will also need to acquire a new understanding of risk, as these models are much more technology-driven and dependent on a platform ecosystem than conventional business models in this sector (Dellermann et al., 2017). For instance, monitoring the financial viability of all partners within the platform's ecosystem is significantly more complex than in traditional bilateral business relationships.

Policy Implications

Although energy sector regulation has undergone fundamental changes in recent years (Wagner et al., 2020), a number of important issues still need to be addressed by policy makers if shareholders and stakeholders are to harvest the benefits of platformization and sustainabilization in the energy sector. In a number of cases, current regulations do not provide the reliable legal framework that is necessary for long-term planning and investment decisions (Engelken et al., 2016). However, a reliable legal foundation is critical if decision makers are to take the ambitious steps necessary to achieve the transition to a green and digital energy economy. As a critical element of public infrastructure, the energy sector is subject to extensive regulation which creates bureaucracy, complexity, and numerous operational limitations (Kotilainen et al., 2016). This results in additional challenges that digital business platforms in other sectors may not face. Take the case of P2P plug-sharing in Germany: in an attempt to harmonize billing of EV charging transactions, the German government has issued a law that only allows for quantity-based payment schemes. This poses a severe problem for P2P plug-sharing systems, as it requires plug owners to install specific metering technology. In contrast, P2P platforms such as EVmatch have been successfully implemented in other markets using a time-based remuneration mechanism that is much simpler to administer.

Our review of the research literature and of the current provider landscape also suggests that there is still little interest in other sources of energy beyond electricity. However, hydrogen in particular is projected to become a major factor in achieving sustainability in the energy sector (IEA, 2019). Policy makers should therefore seriously consider funding schemes for research in this area.

Finally, if consumers are to build trust in the Green Energy Platform Economy, policy makers need to establish a clear and transparent legal footing that guarantees data protection.

Conclusion

This paper can be understood as an overview and mapping of the field of Green Energy Platform Economics. The platformization of the energy sector promises to make a significant contribution towards a decarbonized, decentralized, and digitalized energy economy. We propose a two-dimensional framework that structures the field in terms of the spatial characteristics of the application (residential or mobile) and the type of business interaction involved (B2C, C2C, C2Grid). The framework was developed through 1) a careful review of the research literature, 2) an examination of the provider landscape, and 3) insights from academic and industry experts. The framework was then applied in order to structure and classify 161 relevant publications, summarize the provider landscape, and showcase how Green Energy Platforms impact the electricity value chain. Lastly, we identified key research gaps and derived a corresponding research agenda. Our main conclusions can be summarized as follows:

- Green Energy Platforms will fundamentally affect the conventional electricity value chain by enabling prosumers to market their assets, creating new stages for trading and collaboration, increasing transparency, and boosting competition in the sector.
- Further research, especially empirical work, on energy forms other than electricity is needed. In addition, previously underrepresented aspects of Green Energy Platforms, such as user interface and social interactions, should be made the subject of future work.
- Business leaders will be forced to adjust their strategies to identify the most appropriate role for their business in different platform set-ups and will need to acquire a new understanding of risk in order to succeed in any future platformized energy sector.
- Policy makers must strive to decrease complexity and bureaucracy in this highly regulated sector and provide a reliable legal framework that can be used to implement platformization and sustainabilization in the energy sector and thus harvest the associated benefits.

Naturally, this paper is not without limitations. On the one hand, we have restricted our analysis to few core platform topics. Associated aspects such as optimization of energy flows, energy management, or voltage control and the architecture of physical (non-IS) components (e.g., degradation of batteries) may be addressed in future work. On the other hand, our analysis of how digital platforms can influence value chains has been restricted to the electricity value chain. As outlined above, however, other forms of energy – in particular hydrogen – are likely to play a major role in the ongoing transition to a green energy sector and should therefore clearly be the subject of further research.

Chapter III: The Value of Regionality in the Electricity Sector

As a starting point for the discussion on regional trust cues, this chapter analyses whether consumers value regionality when purchasing energy. Hence, I assess whether there is a consumer preference which regional trust cues can attain to. According to the study results, two dimensions of regionality are important to consumers. First, they value regionality in a geographic sense, in other words, electricity sold from providers in proximity to them. Second, regionality can also be understood as an entrepreneurial attribute. The study suggests that consumers value electricity providers with ties to their region.

Tobias Menzel, Timm Teubner[7,8]

Introduction

Climate change is one of – if not the – greatest challenges humanity faces today. While the coronavirus pandemic captures much of the political, business, and academic attention, climate change has not lost its actuality and urgency. In the Information Systems (IS) community, leading scholars have shaped the field Green IS to address climate change through information and communication technology (ICT) (e.g., Dedrick, 2010; Melville, 2010; Watson et al., 2010). In their editorial to a JAIS special issue on solutions for environmental sustainability, Gholami et al. (2016) have ascertained the fact that "too few information systems [...] academics engage in impactful research that offers solutions to global warming despite the fact that climate change is one of the most critical challenges facing this generation" (p. 521). Importantly, also practical research that goes beyond theory is needed (vom Brocke et al., 2013).

According to Gholami et al. (2016), one of the areas in which the IS community could add meaningful value to the efforts against climate change is to design solutions that "support decision-making for more sustainable practices" (p. 527). Addressing this call, we engage in a broader research agenda on how to design user interfaces to support more sustainable decision-making. A so far mostly overlooked aspect in this realm is the "surprisingly understudied" topic of regionality (Herz & Diamantopoulos, 2019, p. 44). Buying regional represents a sustainable choice in many dimensions such as biodiversity, animal welfare, governance, and resilience (Schmitt et al., 2017). With regard to other aspects such as carbon footprint, land use, energy, or water consumption, the academic debate on whether to favor regional over non-regional consumption is still undecided as outcomes depend on "a diverse range of system boundaries, produce types, varied assumptions and a multiplicity of foot printing methods" (Rothwell et al., 2016, p. 421). In this paper, we aim to provide practicable and impactful research on the design of user interfaces to support decision-making in favor of regional products and services. We provide an indication for users in fact valuing regionality in online contexts. Note that this valuation can be triggered by means of regional cues on user

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[8] Acknowledgement: I thank our students Daniel Lawall, Janis Piskol, Stefano Schlinke, and Maximilian Dreyer for their support in building and operating the web-crawler

interfaces (Menzel & Teubner, 2021d). Based on this, we seek to assess how such cues ought to be designed in view of user decision-making.

Purchasing regional products is an established and still emerging trend in many offline markets, in particular in the food sector (Darby et al., 2006). Yet, the question arises whether this trend translates to electronic commerce as the Internet is considered a "window to the world" (Hongladarom, 1999, p. 400) and a means to (explicitly) overcome geographic boundaries (Forman & van Zeebroeck, 2018). Nevertheless, earlier work has shown that regional cues are frequently used in practice and provides evidence that such cues are used intentionally to promote regionality (Menzel & Teubner, 2021e). Academia seems to be lagging behind in studying this trend. Therefore, we investigate whether consumers actually prefer regional products when buying on digital user interfaces and if so, which factors drive such preferences. This yields the following research question:

RQ: Do consumers value regionality in electronic commerce? In other words, are they willing to pay price mark-ups for regional products and services when purchasing on digital user interfaces?

To address this question, we consider actual market data from Verivox, a leading German price comparison platform for electricity and gas plans. This market provides a compelling case to study for multiple reasons. First, as electricity can (with some limitations) be considered a homogenous credence good, other product properties which could explain users' preferences for regional sourcing can largely be ruled out (e.g., consumers may prefer regional strawberries for their higher freshness). Second, electricity is transmitted through networks, eliminating differences in transportation cost for consumers (Obstfeld & Rogoff, 2000) and trade barriers (Wolf, 2000). We can hence assume that any preferences for regional electricity are driven by the very idea of regionality. Note that the German electricity market is highly fragmented and hence offers a large sample of providers. In addition, the historic market genesis has led to a situation in which different types of providers operate (more on this below). Also, the fact that comparison platforms are the most important sales channel for household energy plans in the German market (YouGov, 2015) ensures a certain level of robustness for the analysis. As platform providers are hesitant to share transactional data such as click streams and conversion rates, we consider publicly available price data for our analysis. Applying hedonic pricing models, we assume that providers' pricing strategy reflect consumer preferences (to at least some degree). In other words, hedonic pricing assumes that higher prices for regional offers are related to consumer preferences for such offers. Further, we draw on the theoretical lenses of Consumer Ethnocentrism (Shimp & Sharma, 1987) to describe households' consumption patterns. We find evidence that consumers indeed prefer regional offers if a combination of criteria for regionality is met (i.e., geographic and entrepreneurial).

In the following, we illustrate related work and theory (Section 2), describe the study's methods (Section 3), present results (Section 4), and discuss its findings, implications, and limitations (Section 5).

Theoretical Background and Hypotheses Development

Provider Perspective: Pricing Regionality

The Hedonic Pricing Model, going back to Rosen (1974), assumes that every aspect of a product or service that adds value to customers will – in the long run – be reflected in market prices. Based on observed prices, the model attributes "shadow prices" to product attributes, reflecting their values to consumers (Greening et al. 1997, p.183). These attributes can go beyond tangible product characteristics and include, for instance, branding or market segmentation (Baltas & Freeman, 2001). Applications of the concept are wide-ranging and are applied to evaluate the (monetary) value of criteria such as the energy efficiency of refrigerators (Greening et al., 1997) or the value of accommodation amenities (Teubner et al., 2017). Most frequently, the theory is applied in the context of real estate (e.g., Gibbons, 2004), public goods (Cavailhès et al., 2009; e.g., van Praag & Baarsma, 2005), and tourism (Vanslembrouck et al., 2005). While, to the best of our knowledge, hedonic pricing has not been applied to electricity, it is well-suited for assessing the intangible characteristic of regionality.

Consumer Perspective: Consumer Ethnocentrism and the Value of Regionality

The literature provides several approaches to explain consumers' preferences for regional products and services, including the notion of familiarity (Huberman, 2001), trust toward transaction partners (Lai & Teo, 2008), ambiguity aversion (Boyle et al., 2012), homeland sympathy (Morse & Shive, 2011), sustainability, and support for local businesses (Darby et al., 2006). Importantly, consumers do not necessarily need to be driven by sustainability motives in order to make more sustainable decisions. In this study, we draw on the established theory of Consumer Ethnocentrism (Shimp & Sharma, 1987), developing two perspectives on regionality and narrowing down this multi-faceted term in the following.

Consumer Ethnocentrism explains consumers' preferences for regional products and services with an evolutionary psychological pattern. Throughout the early days of mankind, survival was dependent of cohesion and solidarity within a (geographically bounded) social group such as tribes and families (van den Berghe, 1981). Therefore, the well-being of this group was in the center of decision-making. This pattern is hence deeply rooted within the human brain and today, still leads to ethnocentric consumer behavior (Bizumic, 2019) in the sense that purchasing from the in-group (defined as the group of people with "which an individual identifies" (Shimp & Sharma, 1987, p. 280)) is unconsciously preferred over buying from the out-group. Consumers perceive themselves as "center of the universe" and will therefore avoid buying non-regional products and services because "it hurts the domestic economy, causes loss of jobs, and is plainly unpatriotic" (Shimp & Sharma, 1987, p. 280).

We first consider the (obvious) geographic aspect of regionality. Accordingly, geographic regionality is a preference of goods and services offered by providers in geographic proximity to consumers. Originally, Consumer Ethnocentrism posits that consumers prefer domestic over imported products, but the concept is equally applicable to the regional context (Bryła, 2019). Considering an example from the food sector, Darby et al. (2006) demonstrated that consumers are willing to pay higher prices for strawberries grown nearby compared to elsewhere from (within) their country. In a recent study, one participant stated that regionality was a dominant factor when evaluating energy provider websites (Menzel & Teubner, 2021d).

This fosters our belief that regional preferences in the geographic sense can a) be independent of product quality such as freshness and b) translate into electronic commerce. Accordingly, we hypothesize:

H_1: Consumer preferences for regional products and services are reflected in price mark-ups for electricity plans offered by providers in greater geographic proximity to them.

While Consumer Ethnocentrism is typically interpreted from this geographical perspective, we offer another (less obvious) interpretation of regionality in the sense that the in-group is understood as set of entities "with which a person identifies" (Shimp & Sharma, 1987, p. 280). Looping back to the examples above, the preference for strawberries grown nearby would become even stronger when sold on a farmer's market compared to a grocery store (Darby et al., 2006). In this sense, "the fact that the provider seems to be regionally embedded generates trust" (Menzel & Teubner, 2021d, p. 8). Apparently, consumers not only care about where the product stems from but also from whom they buy it and prefer to buy from entities that they identify with. Hu et al. (2012) laid out how the use of a fictious small farmer association logo on blackberry jam led to increased likelihood of purchase and willingness to pay. We capture this provider attribute by the notion of entrepreneurial regionality. A regional provider in this entrepreneurial sense is strongly connected with and within the region it operates in (e.g., as an employer, charity sponsor, investor, etc.). Typically, these providers are small or medium-sized firms, potentially in public ownership, and the majority of their operations is concentrated within their vicinity (i.e., their home turf). Accordingly, our second hypothesis reads:

H_2: Consumer preferences for regional products and services are reflected in price mark-ups for electricity plans offered by providers with higher entrepreneurial regionality.

Note that the German electricity market is fully liberalized, and providers are free to sell their products nationwide. Therefore, entrepreneurial regionality can be assessed independently from the notion of geographic regionality as providers are free to sell their products outside of their home region too. Yet, these two concepts can be assumed to be interconnected, leading us to the third hypothesis:

H_3: There occurs a positive interaction between geographic and entrepreneurial regionality with regard to consumers' valuations.

Methodology and Data Set

To evaluate our hypotheses, we draw on data from the German electricity retail market. The market is fully liberalized; providers can hence offer in any location and freely vary prices across regions. Also, the market is highly fragmented leading to a large sample of providers, and platformization of the market has evolved to an extent that most providers generate a significant share of sales via comparison platforms such as Verivox (KEARNEY et al., 2019). Figure 6 summarizes our research approach.

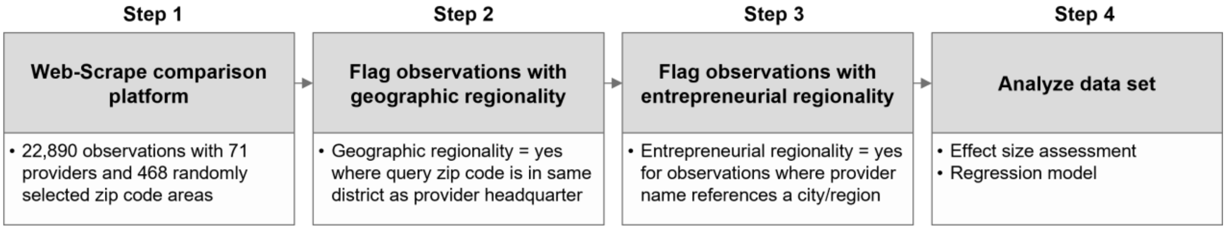

FIGURE 6. RESEARCH METHODOLOGY

Step 1

We devised a web scraper (python) that randomly selected 468 out of the roughly 8,000 German zip code areas (Figure 7). The web scraper issued queries to the Verivox website, searching for electricity plans, using the zip codes and an assumed annual consumption of 2,500 kWh (the typical consumption level for two-person households). From the search results, data on providers, products, and prices were retrieved and stored, resulting in a total of 31,785 observations from 133 distinct providers.

FIGURE 7. SPATIAL SAMPLE DISTRIBUTION

Step 2

Next, we retrieved each provider's address and flagged observations as geographically regional where consumer (i.e., the queried zip code) and provider headquarter were located in the same zip code area. We excluded providers with headquarter outside of Germany, providers that offered in only one zip code area, and those without offers in the zip code of their headquarters as, for these providers, within-comparisons (with vs. without geographic regionality) are not possible. This yielded a set of 22,890 observations from 71 distinct providers. To measure the economic effect of geographic regionality, we employ a hedonic pricing approach and consider the effect of the "geographic regionality" flag on posted prices where the hypothesized valuation of geographic regionality should be reflected in price mark-ups for plans by providers based in the consumer's region.

Step 3

To assess the entrepreneurial interpretation of regionality, we take a closer look at provider characteristics. Again, the hypothesized valuation of entrepreneurial regionality should be reflected in price mark-ups for plans by providers with entrepreneurial regionality over plans by providers without this characteristic. While the grouping in Step 2 is dependent on a combination of zip codes of consumer and provider, this grouping builds on provider characteristics only. Providers of entrepreneurial regionality are characterized by small or medium company size, public ownership, operational focus on, and close ties to a certain region. In the German electricity market, local (i.e., municipal and regional) utilities exhibit these characteristics. Their connection with and within the region is even expressed through a reference to a city or region in the company name (e.g., "Stadtwerke Heidelberg" – that is, Municipal Utilities of Heidelberg). We exploit this circumstance and flag all observations where the company name references a city or region to be regional in the entrepreneurial sense. In addition, provider websites were consulted for all providers without clear reference to identify local utilities which may be using abbreviations or acronyms instead. Overall, 37 of the 71 providers met the criteria for entrepreneurial regionality. Note that despite of their operational focus on a specific region, local utilities are free to sell electricity nationwide. This circumstance allows us to analyze the effect of entrepreneurial regionality independent of geographic properties.

Step 4

Following Steps 2 and 3, observations are structured in four pseudo-treatment groups: Offers from providers without entrepreneurial regionality outside (NN in Figure 8) and inside (YN) the areas in which these providers are considered geographically regional (i.e., their "home turf"), and offers from providers with entrepreneurial regionality, again outside (NY) and inside (YY) of areas of geographic regionality. Note that the two observation groups with geographic regionality are markedly smaller than the other two groups. This is driven by the fact that – by definition – for each provider, only offers in one or a few of all zip code areas are considered regional in the geographic sense. Accounting for this discrepancy, we start the empirical analysis with an effect size assessment using *Cohen's d* as measure for the effect's expressiveness (Cohen, 1988). Since our data offers structural similarities to an unbalanced panel (with geographic instead of time dimension), we apply a Within Fixed Effects model executed as least square dummy variable regression with geography dummies. This enables us to control for omitted spatial effects on zip code level (Wooldridge, 2002) such as purchasing power, population density, and grid fees (which vary across regions and account for a significant cost component in Germany), leading to following model specification:

$$Y_{ij} = \beta_0 + \underbrace{\underbrace{\underbrace{\beta_1 R_{G,ij}}_{I} + \underbrace{\beta_2 R_{E,i}}_{II}}_{IIIa} + \beta_3 R_{G,ij} R_{E,i}}_{IIIb} + \sum_{n=1}^{N(j)-1=467} \delta_n Z_n + u_{ij}$$

In this regression equation, Y_{ij} refers to the annual price with i and j as the indices for providers and zip code areas. Whenever a provider offers an electricity plan in its own region (geographic regionality), the binary variable $R_{G,ij}$ is 1, otherwise it is 0. For the assessment of the mark-up for entrepreneurial regionality, we include $R_{E,i}$ which captures whether provider i exhibits entrepreneurial regionality (=1) or not (=0). The model allows for the interaction of R_G and R_E. Accordingly, coefficients represent mark-up for geographic regionality (β_1), mark-up for entrepreneurial regionality (β_2), and the interaction effect (β_3). The coefficients (δ) and binary variables for zip code areas (Z) capture regional effects, while u_{ij} captures the residual. We performed F-tests to decide whether to prefer the panel model over ordinary least squares (OLS), which is the case for all model specifications (p<.001).

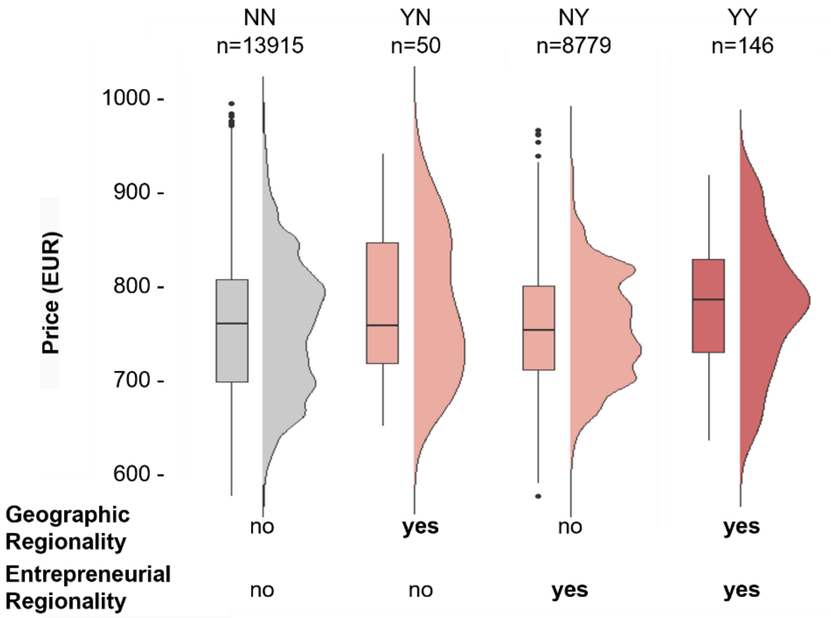

FIGURE 8. FREQUENCY DISTRIBUTION OF OBSERVATION GROUPS

Results

The Value of Geographic Regionality (H_1)

We assess the value of geographic regionality by the price mark-ups for offers by providers headquartered in the same area as the consumer. Table 2 summarizes results of the regression analysis. Our findings confirm our initial hypothesis that consumers value geographic regionality (H_1). We identify a mark-up of around 20€ regardless of controlling for entrepreneurial regionality (Model IIIa, β_1= €20.4, p<.001) or not (Model I, β_1= €19.9, p<.001). Effect size analysis delivers a *Cohen's d* of 0.36 which is in the range between small (0.2) and a medium (0.5) sized effect. On the first look, this effect might not appear as a major influence but considering the market's typical profit margins of one to three percent (Dringenberg, 2020), such relatively small mark-ups already have meaningful effects on profitability. Accordingly, a mark-up of around 20 € (β_1) on the base price of roughly 690 € (β_0) would at least double the regional provider's profit margin.

TABLE 2. REGRESSION RESULTS

DV: Price (EUR), n=22,890	I	II	IIIa	IIIb
Constant (β_0)	692.1*** (14.49)	692.5*** (14.50)	692.5*** (14.50)	692.6*** (14.50)
Geographic Regionality (β_1)	19.94*** (4.09)		H1 20.44*** (4.10)	-2.47 (8.17)
Entrepreneurial Regionality (β_2)		-1.122 (0.76)	H2 -1.381+ (0.76)	-1.590* (0.77)
Interaction (β_3)				H3 30.58** (9.43)
Zip Code Fixed Effects	yes	yes	yes	yes
F	19.3***	19.2***	19.2***	19.2***
Adj. R^2	0.272	0.271	0.272	0.272

Note: *** p<.001; ** p<.01; * p<.05; + p<0.1; DV = Dependent variable

The Value of Entrepreneurial Regionality (H_2)

For the assessment of consumers' valuation of entrepreneurial regionality, we obtain a *Cohen's d* of 0.02 and no (or only weakly) significant coefficients in the regression models (Model II: β_2= €-1.12, n.s.; Model IIIa: β_2= €-1.38, p<.01). This suggests this aspect on its own is negligible both statistically and economically.

Interaction of the two Interpretations of Regionality (H_3)

Considering the interaction of geographic and entrepreneurial regionality, the interaction model (IIIb) adds a relevant perspective. When adding the interaction term, both β_1 and β_2 (denoting the effects of geographic/ entrepreneurial regionality in the absence of the respective other) are either statistically insignificant (β_1= €-2.47, n.s.) or economically irrelevant (β_2= €-1.59, p<.05) while the interaction between them is even larger than the individual mark-ups in the previous models (β_3= €30.6, p<.01).

In essence, these findings suggest that household consumers indeed value regionality in the electricity market under the condition that the provider exhibits both geographic and entrepreneurial regionality (Figure 9).

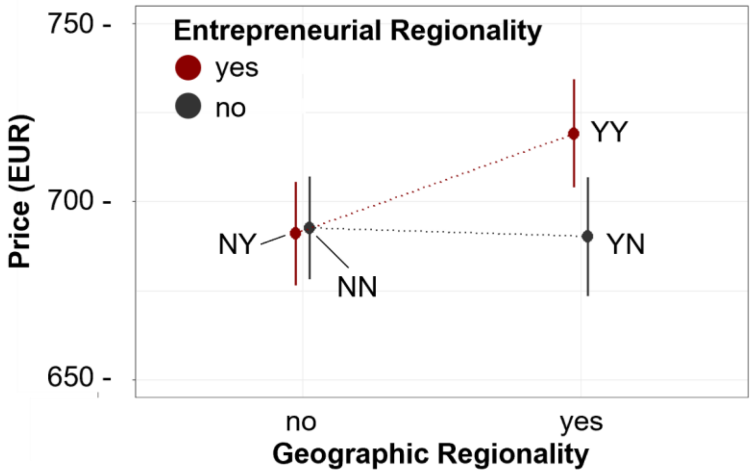

FIGURE 9. OVERALL PRICE ESTIMATES (ERROR BARS INDICATE STANDARD ERRORS)

The absolute price estimate fluctuates noticeably across zip code areas as outlined in Figure 10 (displaying estimates and standard errors (SE)), justifying the inclusion of zip code dummies into the models. For robustness, we have tested further control variables such as share of renewable electricity in the offered products and providers' user ratings. This does not alter the coefficients in terms of magnitude, sign, or significance and has a negligible effect on the R2 values.

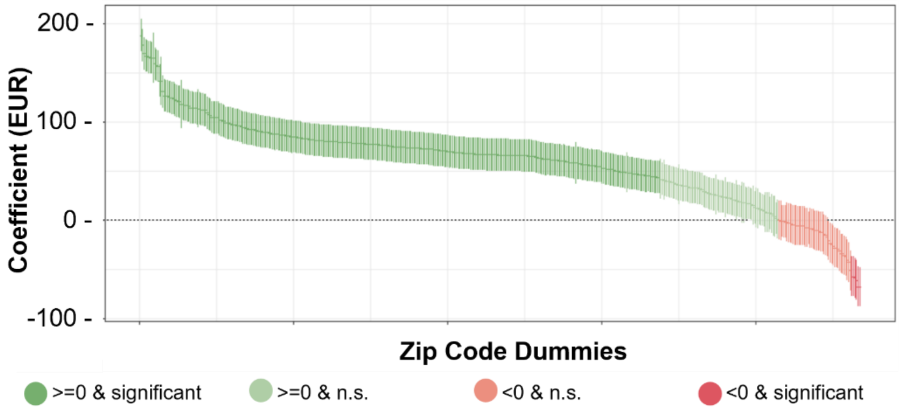

FIGURE 10. DUMMY EFFECT ESTIMATES AND SE ACROSS ZIP CODES

Discussion and Concluding Remarks

Key Findings

Our analysis provides some indication that consumers indeed value regionality. More precisely, they are willing to pay price mark-ups for regional products and services when purchasing through digital user interfaces. In particular, this preference pertains to the geographic interpretation of regionality, that is, proximity of consumer and provider (H_1). In contrast, we did not identify consumer preferences for entrepreneurial regionality per se (H_2). However, the two types of regionality interact in the sense that only geographically regional providers with entrepreneurial regionality are able to achieve mark-ups. Apparently, consumers value providers as long as they are both 1) based in close proximity to consumers (geographic regionality) and 2) strongly connected with and within the region (entrepreneurial regionality). Accordingly, consumers seem to value providers which are located in, owned by, operationally focused on, and tied to their region. To further explore these findings, we sought out conversations with municipal utility employees and industry experts. All interviewees assured that providers indeed consider regionality as a key product characteristic that affects their pricing strategies.

Practical Implications for Design of User Interfaces

These findings carry implications for our above outlined research aim to provide practicable and impactful research on the design of IS solutions to "support decision-making for more sustainable practices" (Gholami et al., 2016, p. 527). Also, we answer calls for IS-driven contributions fostering environmental sustainability (Gholami et al., 2016; Malhotra et al., 2013) and impactful IS research to counter global warming (vom Brocke et al., 2013). In the following, we describe practical implications for the design of two types of user interfaces – direct sales channels (e.g., provider websites) and platforms (e.g., comparison platforms).

For user interfaces with direct customer interaction (e.g., websites), our findings suggest that providers should emphasize regionality when applicable – especially if they are attributed with entrepreneurial regionality. In this context, regional trust cues provide a powerful means to signal regionality which in turn increases trust in the provider and purchase intentions on user interfaces (Menzel & Teubner, 2021d). In contrast to these insights, recent studies of regional energy provider websites unveiled that merely 25% of the providers used pictorial (Menzel & Teubner, 2021b) and only 33% applied textual cues to promote regionality of their products (Menzel & Teubner, 2021e). This is little surprising as those providers often lack the skill or resources to properly optimize their interfaces to the customer. According to our findings, there is a massive optimization opportunity for these entities. Moreover, the study results indicate that the potential of using regional trust cues on user interfaces heavily depends on the geographic position of the user. If a request to a provider's user interface is issued from an area in which this provider is based, regional cues should affect consumer valuation to a larger degree than otherwise. This raises the questions of how to tailor the design of user interfaces in view of user location. Most critically, providers need to capture the users' geographic location in order to adjust their interface design accordingly. Identifying the IP address, the use of cookies, or the processing of user profile and transactional data could be routes to further explore in this regard.

For user interfaces of platform business models (e.g., comparison platforms), our study yields design insights for platform operators to enhance user experience. As per our findings, users prefer regional products and services over non-regional offers. Therefore, providing information on the regionality of offers to consumers could substantiate a competitive advantage over other platforms. To support the decision-making of regionality-aware consumers, multiple design elements are conceivable:

- **Filters:** Platform operators may build filters to sort offers by regional and non-regional providers. Note that users are prompted to provide their zip code on all major comparison platforms which makes dealing with/ filtering by geographic regionality an easy fix. Moreover, platform operators could also assess entrepreneurial regionality and offer filters for this property. Most importantly, a combination of filters should be feasible as our findings suggest an interaction of both effects.
- **Icons/Labels:** In similar fashion, platforms could implement icons or labels to signal the above described attributes to consumers.
- **Text/Pictorial Cues:** Implementing slots on the platform in which providers can outline their (products') regionality via text or images will further enhance the user experience.

Note that these design elements not only improve user experience, they could also develop new income streams for platform operators. Platform operators could skim off some of the mark-ups generated by regional offers through providing sellers the possibility to purchase regional icons, labels, space for regional messaging, or the appearance in certain filters.

Since the beginning of this research project, we have observed how several platforms have implemented some of the above-mentioned measures. Verivox, for instance, has introduced a filter for geographic regionality. When applied, only providers based within a 100 km range from the user's address are displayed. Also, the platform created a label to highlight providers with entrepreneurial regionality that needs to be purchased by the seller.

Theoretical Implications

In terms of theoretical implications, Consumer Ethnocentrism assumes consumer preferences based on geographic match of consumers with product origin. We offer a new interpretation of the in-group, in other words the set of entities "with which a person identifies" (Shimp & Sharma, 1987, p. 280), in the sense that the entrepreneurial regionality of a provider may serve as an identity-establishing feature as well. Referring back to the farmer's market example, this would mean that consumers go and purchase there not only because they consider the farmer someone from here but also one of us. This perspective appears reasonable in view of the evolutionary psychological roots of this theory according to which cohesion of and solidarity within a (geographically bounded) social group was critical to survival (van den Berghe, 1981). Our findings suggest that the notion of "us versus them" (Klein, 2002, p. 1) not only applies in the geographic context but also in the sense of common people (which includes small, regionally focused businesses) against the large corporates. Nevertheless, following this study's results, this entrepreneurial interpretation of regionality does not exist on its own and necessarily needs to be considered in the geographic context.

Implications for Power Sector Sustainabilization

While we chose electricity as subject of this study mainly for its properties (homogenous good, transported in networks, etc.), the power sector also features a pressing need for solutions to support consumers in pro-regional decision-making. With the aim of carbon neutrality, the sector is currently undergoing a drastic transformation in terms of decarbonization, digitization, and decentralization (di Silvestre et al., 2018). Our findings could support this transition in two ways. First, local utilities (i.e., companies with high entrepreneurial regionality) are considered key drivers for the transition of the power sector in their region (Berlo & Wagner, 2011), because they operate decentral renewable generation units such as solar and wind parks, manage heat district concepts, provide energy management solutions (Richter, 2013), and organize local energy markets (Weinhardt et al., 2019). Therefore, nudging consumers into the direction of these companies will accelerate the sector's sustainabilization. Second, the sectors sustainabilization could be substantially accelerated by its ongoing platformization (Menzel & Teubner, 2021c). However, well-designed user interfaces are a perquisite for the swift adoption of platform business models. We suggest that insights gained here on comparison platforms can (with some constraints) be brought to good use also for other platform types in the energy sector and hence contribute substantially to the sectors' overall platformization and, in turn, sustainabilization.

Limitations and Work in Progress

Alike any study, this one is not without limitations. First, the hedonic pricing regression builds on the assumption that consumer preferences are reflected in providers' pricing strategies which may only partly be true in many cases. To strengthen our analyses, we plan to expand our data model by adding secondary data in the spatial dimension (e.g., purchase power, population density, grid fees, etc.) and on company level (e.g., ownership structure, employees, turnover, etc.). Further, we seek to validate this assumption through collaboration with a comparison platform and analysis of actual purchase data (e.g., click rates, conversion rates) rather than just pricing data. Second, we acknowledge that data clusters of geographic regionality are comparatively small. To some degree this is unavoidable, as each provider has only one home region but is free to offer in all other territories. Still, we are in the process of geocoding provider and customer locations which will enable the measuring of geographic regionality as a continuous variable and allow for more fine-tuned, assessments. Third, regional providers do not necessarily generate electricity in their region – even though this is increasingly the case for green technology such as wind, solar, or biomass. Accounting for this aspect, for instance, through adding the share of regionally produced energy into the model, will further strengthen the link between consumers' valuation of regional energy providers and the energy sector's sustainabilization.

Chapter IV: A Descriptive Analysis of Regional Trust Cues on User Interfaces

This section assesses how energy providers attempt to trigger the consumer preference for regionality described in the previous chapter. I provide a review of >450 German energy provider websites illustrating their use of regional, social and environmental trust cues. The study provides insights into the practical use of regional trust cues and suggest that such cues in form of text and imagery play a pivotal role in user interface design (in particular, for providers with regional ties).

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Introduction

Climate change is a global phenomenon with implications on a local level (Borowski, 2020a). Roughly a decade ago, leading scholars in the information systems (IS) community initiated the research field of Green IS to identify solutions to mitigate climate change driven by information and communications technology (ICT) (Dedrick, 2010; Malhotra et al., 2013; Melville, 2010; Watson et al., 2010). More recently, Koliouska and Andreopoulou suggested in this journal that "all sustainable objectives and targets need ICTs as key catalysts" (Koliouska & Andreopoulou, 2020, p. 4869). Gholami et al. pointed out that "too few information systems [...] academics engage in impactful research that offers solutions to global warming despite the fact that climate change is one of the most critical challenges facing this generation" (Gholami et al., 2016, p. 521). Most importantly, the community needs to deliver practical and implementable research results that go beyond theory (vom Brocke et al., 2013).

For the energy sector, this translates into the question of how ICT can contribute to the sector's transition to climate neutrality (Goebel et al., 2014; Watson et al., 2010). This transition will require fundamental disruptive shifts towards decarbonization, decentralization, and digitalization (di Silvestre et al., 2018). While considerable IS contributions have been provided in recent years on the matters of decarbonization and digitalization of the energy sector (Goebel et al., 2014), research on the sector's decentralization has been less emphasized. Therefore, we set out to contribute to the Green IS debate on the subject of decentralization of the energy sector with the aim of providing impactful and practical results.

So far, IS research on the decentralization of the energy sector has mainly focused on the supply of energy (e.g., virtual power plants, decentral generation) or the transmission of

[9] This chapter was published in *Sustainability* with the title "How Regional Trust Cues Could Drive Decentralisation in the Energy Sector—An Exploratory Approach", https://doi.org/10.3390/su13063010,
[10] Preliminary results of Study 1 in this chapter were published as short paper in the proceedings of *Internationale Tagung Wirtschaftsinformatik 2021* with the title "Buy Online, Trust Local – The Use of Regional Imagery on Web Interfaces and its Effect on User Behavior", aisel.aisnet.org/wi2021/PHuman/Track11/1
[11] Funding: I acknowledge support by the German Research Foundation and the Open Access Publication Fund of TU Berlin, who funded this article's processing charges.
[12] Acknowledgments: I thank my student Thanh Ngo Chi for his support in coding the imagery.

energy (e.g., smart grids). In contrast, we focus on the demand side and emphasize consumer decision-making. Gholami et al. suggest that the design of solutions which “support decision-making for more sustainable practices” (Gholami et al., 2016, p. 527) is an area of research where IS can contribute insights to drive environmental sustainability. In the context of decentralization in the energy sector, this translates into the question as to how consumers can be supported in making decisions in favor of decentral – or, in other words regional – energy. The role of consumers in the energy sector is drastically changing and gaining importance (Borowski, 2020b) as they are evolving from passive consumers to “active energy citizens” (Campos et al., 2020, p. 1) – also known as prosumers. Therefore, user-centricity is essential when designing solutions for the future energy sector (Immonen et al., 2020). Today, in liberalized energy markets the majority of consumer energy plans are sold – and hence, decisions are made – via digital sales channels (Dringenberg, 2020; YouGov, 2015). We therefore define energy provider websites as the subject of our study.

When exploring regional energy provider websites, we noticed that these providers frequently use regional textual and pictorial cues (in addition to social and nature cues). An example is provided in Figure 11, which shows a regional energy provider website with a cityscape image of a town within the provider’s geographic area of operation. In IS and marketing literature, the use of social cues (e.g., Gefen & Straub, 2004) and nature cues (e.g., Schmuck et al., 2018) is well established. However, regional cues have to our knowledge not been subject to research in the energy sector and in online contexts. Therefore, the study takes an exploratory approach to shed light on the “surprisingly understudied topic of regionality” (Herz & Diamantopoulos, 2019, p. 44). Our aim is to increase understanding of the use of regional imagery and text cues on energy provider websites, systematically capturing this new phenomenon in IS research (Trauth, 2001), and identifying implications for the design of IS solutions to support decision-making in favor of regional energy. We employ the well-established (Rourke & Anderson, 2004) method of content analysis to address this objective and lay the foundation for future quantitative research (Kruse & Lenger, 2014) such as experiments on the behavioral effects of regional cues. This research promises both impactful and practical results thanks to the high usage of these websites and our desire to provide implementable suggestions.

FIGURE 11. EXAMPLE OF WEBSITE WITH REGIONAL CUES IN THE FORM OF IMAGERY AND TEXT[13]

For a theoretical framework, we draw on social presence theory (Short et al., 1976), biophilia hypothesis (Wilson, 1984), and consumer ethnocentrism (Shimp & Sharma, 1987) to develop the construct of regional presence based on the established construct of social presence. The use of imagery and text as trust cues to affect consumer behavior is well established in marketing and IS literature (e.g., Gefen & Straub, 2004; Hassanein & Head, 2005; M. Kim & Lennon, 2008). IS and marketing research has primarily focused on social cues to generate consumer trust and trigger purchase intentions. Social cues on websites generate the perception of "personal, sociable, and sensitive human contact" (Gefen & Straub, 2004, p. 410), when, in fact, looking at a website on a screen is characterized by a lack of such contact. For an explanation of this effect, we need to go far back in the evolution of humankind: social cues trigger an evolutionary psychological pattern according to which humans increase their chances of survival through collaboration with other humans (K. Lee, 2004; Riva et al., 2015). In other words, as claimed by Aristotle, humans are social animals (Barker, 1968). More recently, similar effects have been attested to using nature cues (Schmuck et al., 2018). In similarity to social presence, nature cues generate a perception of the natural environment in the absence of real nature. This again triggers an evolutionary psychological pattern because natural surroundings were critical for human survival as a source of water and nutrition and also provided "security and defense advantages" (Ulrich, 1993, p. 19). The biophilia hypothesis is a theory with origins in biology and claims that humans are endowed with an affinity to nature (Wilson, 1984). It explains this behavioral pattern as an "urge to affiliate with nature"

[13] Source: Stadtwerke Oberkirch, available online: https://www.stadtwerke-oberkirch.de/ (accessed on 16 February 2021).

(Wilson, 1984, p. 85). The perceived experience of nature reduces stress (Ulrich, 1993) and restores attention (Kaplan & Kaplan, 1989) which ultimately turns into positive brand attitude and purchase intention (Schmuck et al., 2018). In a similar fashion, we explain the functionality of regional cues using evolutionary psychology. In the evolutionary logic, human survival depended heavily on a cohesive social group (van den Berghe, 1981). Following consumer ethnocentrism theory (Shimp & Sharma, 1987), this translates into ethnocentric behavior on a regional or national level in contemporary consumer decisions. Accordingly, consumers prefer to buy from their ingroup, in other words a (geographically bounded) set of people with which "an individual identifies" (Shimp & Sharma, 1987, p. 280). Buying from the outgroup "is wrong because [...] it hurts the domestic economy, causes loss of jobs, and is plainly unpatriotic" (Shimp & Sharma, 1987, p. 280). Based on the similarities with the social presence construct (in other words, the perception of social contact in a human-free setting), we use analogous phrasing for the perception of regionality in an online context that is in fact considered a means of overcoming geographic boundaries (Forman & van Zeebroeck, 2018). Regional presence can therefore be understood as the sensation of regionality in a set-up characterized by geographic independence. Figure 12 provides a website example in which icons highlight pictorial cues to trigger perceptions of social contact, nature experience, and regionality.

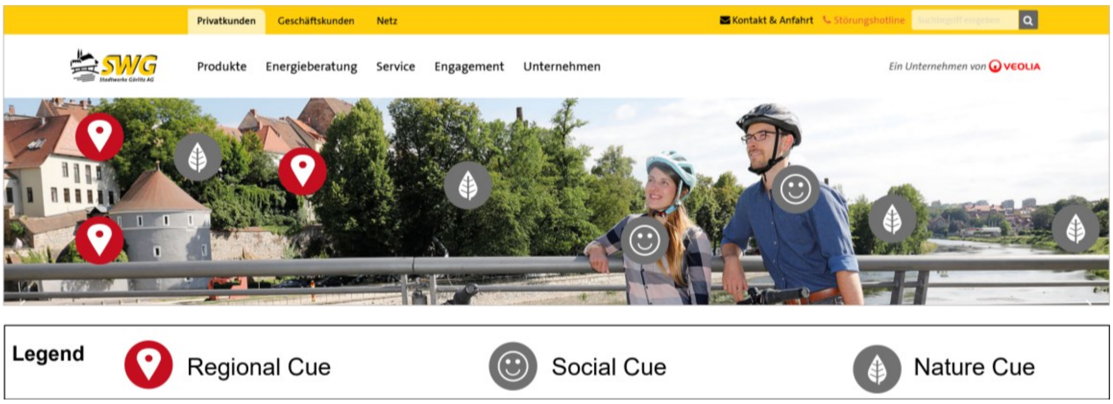

FIGURE 12. EXAMPLE OF A WEBSITE WITH REGIONAL, SOCIAL, AND NATURE CUES[14]

The first step in capturing a new phenomenon involves both demonstrating its existence and classifying its major constituent parts (Vartiainen et al., 2011). We will therefore put our initial observation on an empirical footing by assessing a sample of energy provider websites. Research Question 1 (RQ_1) looks at whether these providers systematically employ regional cues on their websites. And, if this is the case, how providers apply these cues – in other words, what image motifs and text keywords are used. Because we expect energy providers with a regional operational focus to use regional cues more often, this group is the focus of this first analysis. Hence, our first research question is:

[14] Source: Stadtwerke Görlitz, available online: https://www.stadtwerke-goerlitz.de/privatkunden/ (accessed on 5 November 2020).

> **RQ_1:** Do regional providers systematically apply regional cues on their websites? If so, how are they doing it (i.e., what types of regional imagery and text cues are used)?

We address this question through qualitative content analysis of 318 regional energy provider websites to explore the use of regional, social and nature cues in a real-life e-commerce use case. We identified the German household electricity market as a compelling object of study since this market is highly fragmented and therefore offers a large sample of companies. In addition, due to the market's genesis, it features an abundance of regional providers whose operations focus is a particular city or region (Stadtwerke). Nevertheless, these providers have been able to sell energy nationwide since market liberalization in 1998, so their websites target a national audience.

Our analysis addressing RQ_1 shows that almost half of the assessed 318 regional energy providers apply regional cues in the form of either text or images on their websites. Primary motifs are cityscapes and buildings, while frequently used textual cues include direct references to a city or region and the terms "region" and "regional". This frequency suggests but does not prove an intentional use of regional imagery and text by regional providers. To validate these findings and provide empirical evidence for this intentionality, we adjust our research design and analyze a second set of 136 provider websites including both regional and national providers. In order to support the hypothesis that regional providers intentionally employ regional cues on their website to outline their offering's regionality, we must identify a significant discrepancy in the use of regional cues between the two groups. Therefore, our second research question is:

> **RQ_2:** Do regional providers apply regional cues structurally more often than national providers?

Addressing this question, we examine 136 regional and national energy provider websites by means of quantitative content analysis. We find a significantly higher use of regional text and imagery cues by regional providers through a set of Chi-squared tests. Also, national providers tend to use more nature imagery as well as price and quality text cues. However, discrepancies are not statistically significant.

In addition to these findings, the previously described analysis also provided us with an interesting case study about regionality on user interfaces. Since the use of regional cues is still quite a new phenomenon in the online context, analyzing trends may increase our understanding of the direction in which the industry is evolving (Yazdanifard et al., 2011) and provide promising avenues for further research (Watson IV et al., 2015). We therefore conclude this paper with an emerging trend and our third and final research question is:

> **RQ_3**: What is the next trend in the application of regional cues on user interfaces?

To study this question, we describe how a provider tailors its web interface content, including regional imagery and text, to the user's geographic location. This provider appears to possess the tools to trace the location of users when they submit a request to the website and uses this information to adjust the website's imagery and text elements. Apparently, the provider expects that the application of regionality cues positively effects user behavior and provides a compelling template for the application of geo-specific regional references.

The remainder of the paper is structured as follows: Section 2 discusses materials and methods of the three different studies on this matter, while Section 3 outlines their results. In Section 4, we discuss the findings and implications for theorists, practitioners, and consumers. Limitations and future work are discussed in Section 5. Section 6 concludes.

Materials and Methods

As described above, we performed one study for each research question. In each of the three studies, textual and pictorial cues were assessed as outlined in Table 3. Study 1 performs a qualitative content analysis of 318 regional energy provider websites to analyze the use of text and image cues on those websites. In Study 2, we enrich the qualitative investigation with an empirical analysis to test for structural differences in the use of said cues between 65 regional and 71 national providers. We conclude with a case study highlighting the latest trends concerning the use of regional textual and pictorial cues on energy provider websites in Study 3. Using a mixed-method approach provides a greater flexibility in undertaking research and promises better-supported arguments (Borowski, 2021).

TABLE 3. SUMMARY OF RESEARCH DESIGNS FOR RQ1 TO 3

	Study 1	Study 2	Study 3
Research Question	RQ_1	RQ_2	RQ_3
Method	Qualitative content analysis	Quantitative content analysis	Case Study
Sample	318 regional energy providers	136 energy providers (65 regional, 71 national)	1 national energy provider

Study 1

In examining RQ_1, we shortlisted 318 regional energy providers from an online resource (Stadtwerke in Deutschland, 2020) by selecting corporations ("*AG*" or "*GmbH*") referring to themselves as regional utilities ("*Stadtwerke*"). Next, we devised a web-scraper to take screenshots of all 318 landing pages (Step 0 in Figure 13 and Figure 14). We analysed the content of these screenshots with different approaches for pictorial and textual cues as described below.

Imagery Analysis. We draw on Bell (2001), Callahan (2006), Xi et al. (2007), and Vilnai-Yavetz and Tifferet (2013) to develop the approach illustrated in Figure 13.

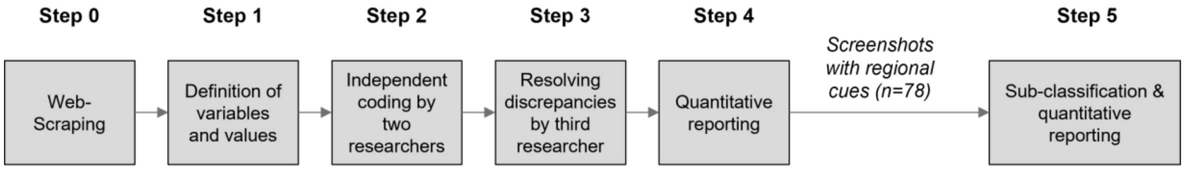

FIGURE 13. METHODOLOGY FOR ANALYSIS OF IMAGERY CUES

- **Step 1:** Define variables and values: in the first step, it was critical to define explicit and unambiguous categories in order to yield meaningful evidence (Bell, 2001). In our case, we utilized the three concepts regional, social, and nature and used a binary scale.
- **Step 2:** Two researchers individually coded the website screenshots following the variables and values defined in step 1 (example provided in Figure 12). We calculated Cohen's kappa (Cohen, 1960) to measure inter-rater reliability. With kappa of 0.74 for regional, 0.75 for social, and 0.68 for nature cues, the inter-rater reliability is in the range of substantial agreement (Viera & Garrett, 2005). We therefore conclude that the coding provides reliable data, and we can proceed with the analysis.
- **Step 3:** Conflicting cases were resolved by a third researcher.
- **Step 4:** Coding results were aggregated and visualized.
- **Step 5:** For imagery classified as regional, we added two layers of detail by classifying them with regard to their content (e.g., riverside cityscape, church, fountain, sports event, etc.) and structured these subclassifications into the following clusters: cityscapes, buildings, monuments and bridges.

Textual Analysis. Concerning textual cues, we drew on Braun and Clarke (2006) and applied their approach for thematic analysis to our context. The approach is outlined in Figure 14.

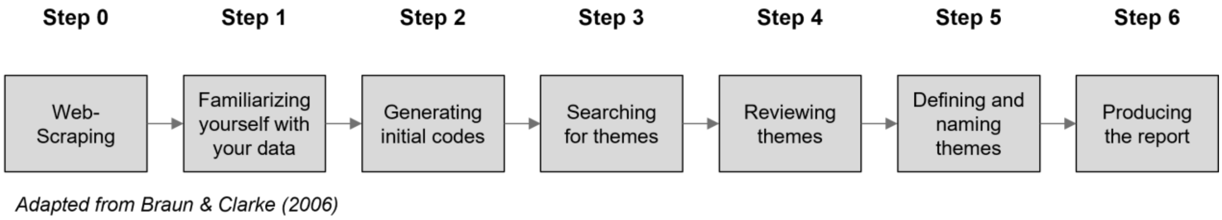

FIGURE 14. METHODOLOGY FOR ANALYSIS OF TEXTUAL CUES

- **Step 1:** The textual analysis involved transcribing each website's tag lines. We therefore focused on the three main messages: headline, subtitle, and company slogan. An example is provided in Figure 15. These text fragments were cleansed of non-contextual words.
- **Step 2:** In the next step, we grouped together words from the same word families (e.g., nature, natural) and with similar meaning (e.g., cheap, low-cost, affordable). We also excluded greetings (e.g., "hello", "welcome") and news items (e.g., "information center closed during holidays"). Further, we introduced a placeholder ("[city name]") where providers referred to a specific city; this enabled us to track this effect as a pattern.
- **Step 3:** Building on the results of imagery analysis and related theory, we started off by grouping keywords into social, nature, and regional cues and a general category.

- **Step 4:** When reviewing step 3, we realized that the remaining keywords could be further grouped and so created two additional clusters for price and quality.
- **Step 5:** After another round of reviewing keywords, we defined our final set of themes consisting of social, nature, and regional cues as well as price, quality, and a general theme.
- **Step 6:** For reporting, we aggregated and visualized the findings in a similar way to the approach for imagery. In addition, we generated bar charts with the most frequent key words.

FIGURE 15. EXAMPLE OF A WEBSITE WHERE TEXTUAL AREAS FOR TRANSCRIPTION ARE HIGHLIGHTED[15]

Study 2

In addressing RQ_2, we generated a set of 136 providers by web-scraping a price comparison portal. Based on how they described themselves (e.g., *Stadtwerke*, similar to Study 1) and their operational focus, this list was divided into 65 regional and 71 national energy providers. We chose this approach over just expanding the list used in Study 1 for two reasons: focusing on the analysis of providers with sales presence on a comparison portal ensures a certain level of digital savviness of all (and in particular the regional) providers. This would ensure that the selected providers are comparable and hence increase the robustness of the findings. Secondly, using a price comparison portal as a source ensures that all relevant national providers would be included. As these portals represent a significant share of all newly signed household energy contracts (YouGov, 2015), this is one of the largest sales channels for energy providers and hence should attract all major players. While national providers might not use specific regional cues (e.g., a specific city name) they can still apply unspecific regional cues such as “regional”, “for your city”, etc.

[15] Source: Stadtwerke Kierspe, available online: https://stadtwerke-kierspe.de/ (accessed on 5 November 2020).

In a similar way to the procedure in Study 1, we devised a web-scraper to take screenshots of all 136 provider websites. For imagery, we repeated steps 0 to 4 as described in Study 1. Again, inter-rater reliability for regional cues was in the range of substantial agreement (kappa = 0.74). For social cues (0.94) and nature cues (0.84), it was in the range of almost perfect agreement (Viera & Garrett, 2005). Textual analysis followed the same steps as described in Study 1 with transcription, cleansing, grouping and classification. Further, we analysed whether each category's frequency was statistically independent from the provider type (regional vs. national) by means of Chi-squared tests in R. The Chi-squared test evaluates the hypothesis (H_0) that the frequency in which regional (and other) cues are used is independent from the provider type. Put in simple terms, H_0 claims that there is no relationship between frequency of cues and provider type. Accordingly, rejecting this hypothesis by means of the Chi-squared test provides empirical evidence that the discrepancies in the use of regional (and other) cues is driven by the provider type (H_1).

Study 3

Regarding RQ_3, we provide a case study on the *Greenpeace Energy* landing page. We explain how a national provider is using information on the geographic origin of a request to tailor textual and pictorial cues to the user's region. This case study provides a fascinating perspective on the use of regional cues on websites.

Results

Study 1

Addressing RQ_1, we assessed 318 regional energy provider websites by analysing imagery and text cues used on those sites. This provides insights how frequently regional providers use regional (and other) cues and offers insights on applied keywords and motifs.

Study 1a: Imagery. As displayed in Figure 16, the majority of the energy providers evaluated (215 of 318) employ at least one of the three constructs. Social imagery is the dominant cue (125) but regional (78) and nature (69) imagery are often used. The most frequent combination of cues is regional and nature imagery (27), while only three websites embed imagery combining all three concepts.

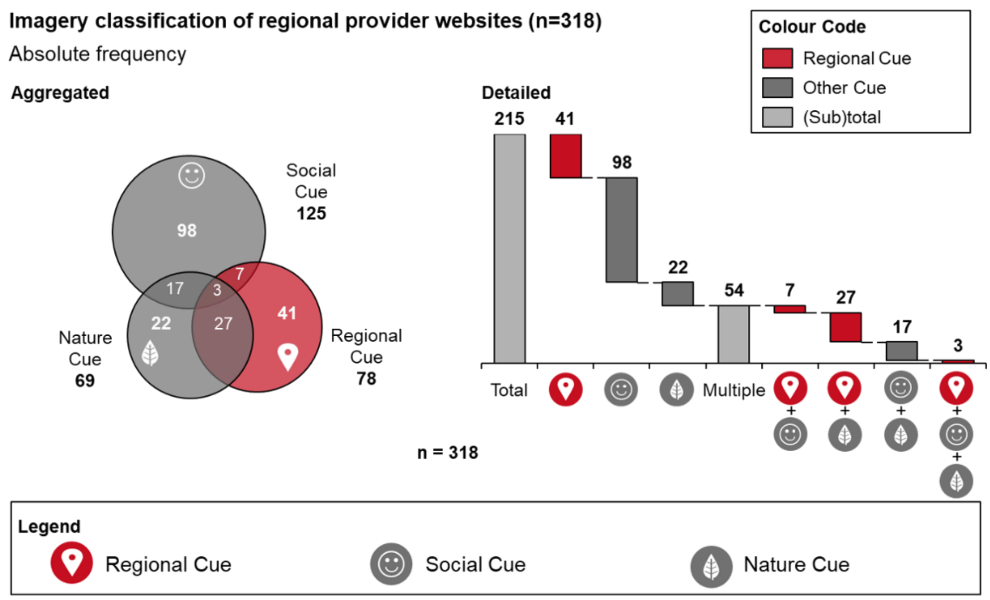

FIGURE 16. CLASSIFICATION OF IMAGERY CUES

Taking a closer look at regional imagery, we identify four clusters of visual motifs (examples provided in Figure 17). Used in more than half of cases (44 out of 78), cityscape is the dominant cluster. Less frequently, providers display buildings (15), monuments (13) and cultural events (6) on their websites.

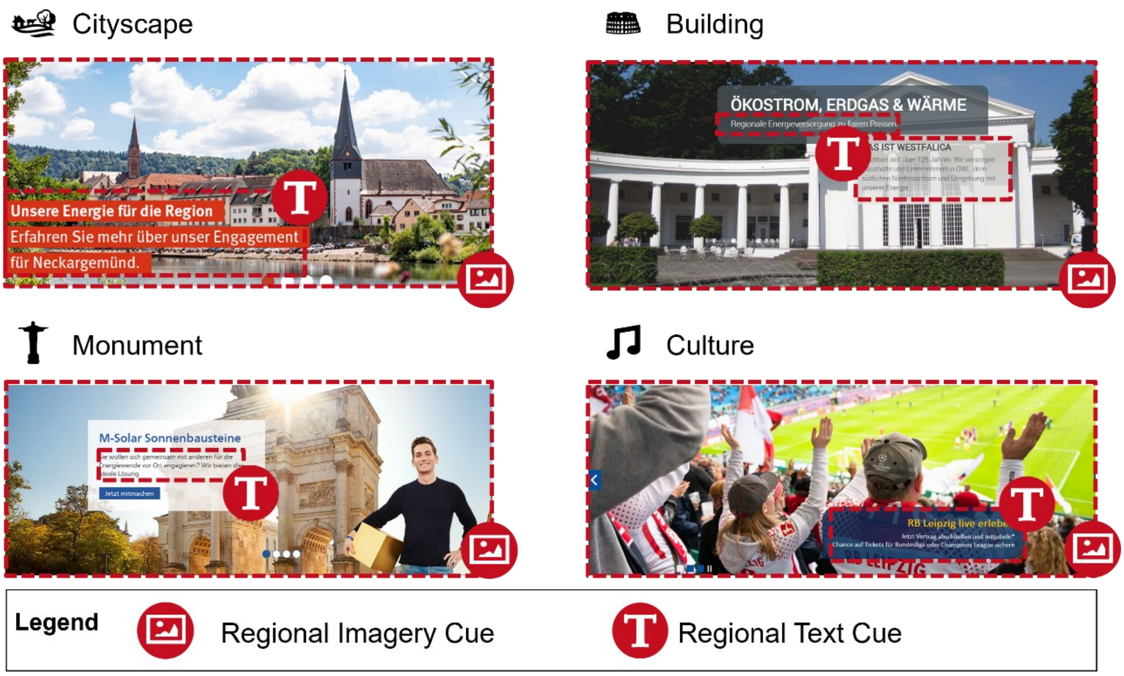

FIGURE 17. WEBSITE EXAMPLES ILLUSTRATING TYPES OF REGIONAL MOTIFS[16]

[16] Sources: Stadtwerke Neckargemünd, available online: https://www.stadtwerke-neckargemuend.de/ (accessed on 5 November 2020); Westfalica Stadtwerke, available online: https://www.westfalica.de/privatkunden (accessed on 5 November 2020); Stadtwerke München, available online: https://www.swm.de/ (accessed on 5 November 2020); Leipziger Stadtwerke, available online: https://www.l.de/stadtwerke/# (accessed on 5 November 2020).

Within these clusters, there is an additional layer of classification for the main motifs used as a regional cue (frequencies provided in Figure 18). The cityscape concept is mainly represented by aerial photographs of a certain city (25). But riverside panoramas (8) and snapshots of market squares (7) are also frequently used. Providers use churches (4) and secular historic buildings (9) like palaces and castles. The monument cluster comprises towers (5), statues (3), fountains (3), and bridges (2), while culture cues feature either sports (3) or cultural events (3, e.g., concerts, carnival parades). Additional website screenshots with examples for each regional motif are provided in the Appendix.

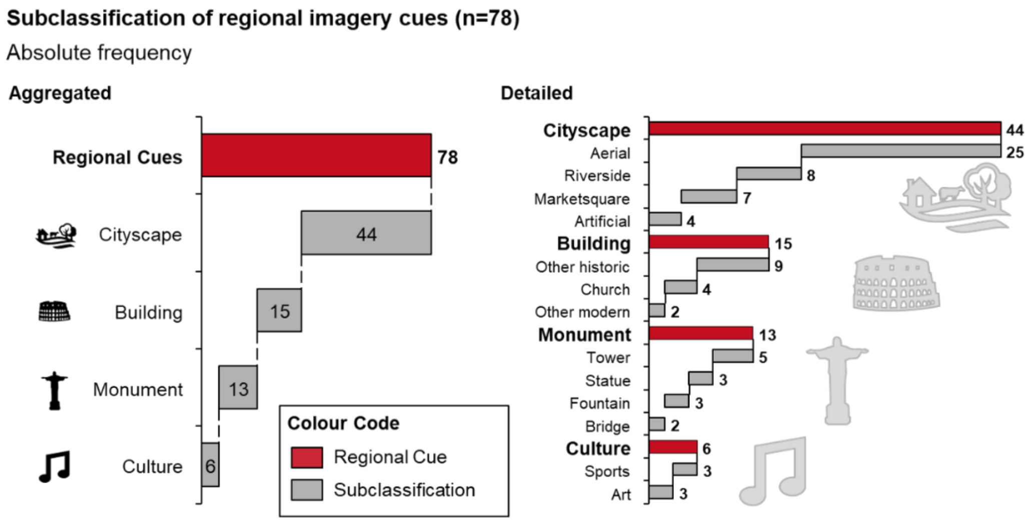

FIGURE 18. SUBCLASSIFICATION OF REGIONAL CUES

Study 1b: Text. Continuing the analysis with a focus on textual cues, we observe an even higher frequency of regional cues (105) on energy provider websites. As shown in Figure 19, almost every third provider applies a textual reference to a city or region on their web interface. In contrast, social (82) and nature (54) cues are less frequently used. The most frequent combination of cues in this context is regional with social keywords (31). We further note that the overall number of providers to use either regional, social, or nature cues or a combination in textual form (174) is lower than the overall number using imagery across those categories (215).

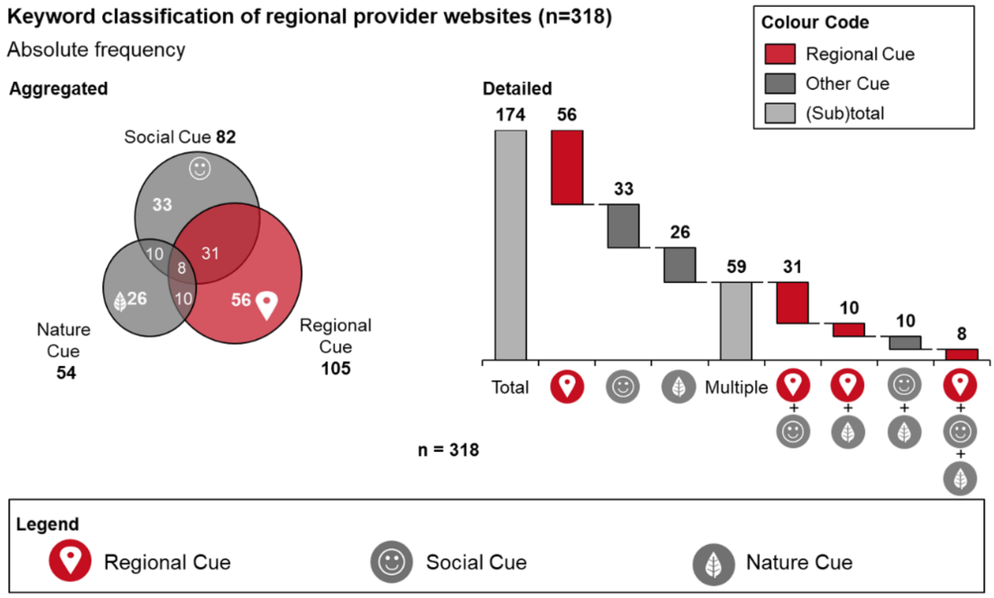

FIGURE 19. CLASSIFICATION OF TEXTUAL CUES

The fact that less providers use regional, social, and nature cues in textual form compared to imagery might also be explained by the additional possibilities available for text. Alongside regional, social, and nature cues, we introduce price and quality as additional categories in textual analysis. The bar chart in Figure 20 illustrates the 20 most frequent keywords with icons highlighting these five categories. Unsurprisingly, the most often used words are general keywords such as the product sold ("energy": 97 websites; "electricity": 49; "gas": 24) and the provider's name (one of the selection criteria for this list of providers was the use of "*Stadtwerke*" – which means "regional utility"– in the company name). Outside the general category, the most frequent keywords are the regional cues "region"/"regional" (35) and a reference to a particular city or region (27). Also frequently mentioned are two keywords with social cues ("for you"/"there for you": 21; "care", 21) and one with nature affiliation ("eco"/"ecological": 17). The most frequent keyword in the price category is "price"/"price stability", (14) while the most frequently used word connoting quality is the term "simple"/"easy" (8, not on the chart).

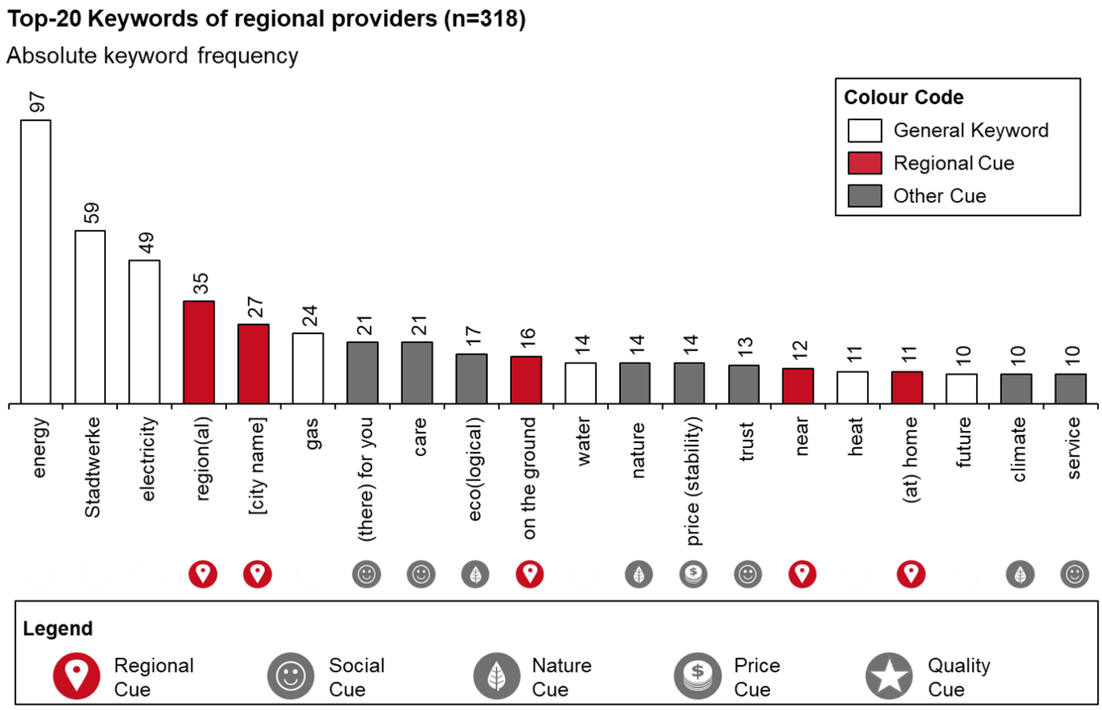

FIGURE 20. TOP-20 MOST FREQUENT KEYWORDS FOR STUDY 1 PROVIDERS

Study 2

With focus on RQ_2, we assessed 65 regional and 71 national energy provider websites to analyse structural differences in the use of regional (and other) trust cues between these provider types. Focusing first on discrepancies in textual cues, Figure 21 shows the relative frequency of keywords used on regional and national provider websites. Notably, regional providers use regional cues most frequently (e.g., a reference to a particular city or region: 25%; "region"/"regional": 14%), while national providers tend to emphasize price competitiveness in their messaging (e.g., "low-cost": 20%; "fair": 9%; "switch": 9%). When using regional cues, regional companies specifically refer to their region (e.g., using the name of their city), while national providers tend to use much more unspecific terms (e.g., "at home", "neighbour", "region"/"regional"). Both provider types embed social and nature cues with similar frequency and employ similar keywords. In fact, the most frequently used keyword in each category is identical for regional and national providers ("there for you"/"for you" appearing on 8% of regional provider websites and 9% of national provider websites; "eco"/"ecological" appearing on 17% and 13% of websites respectively).

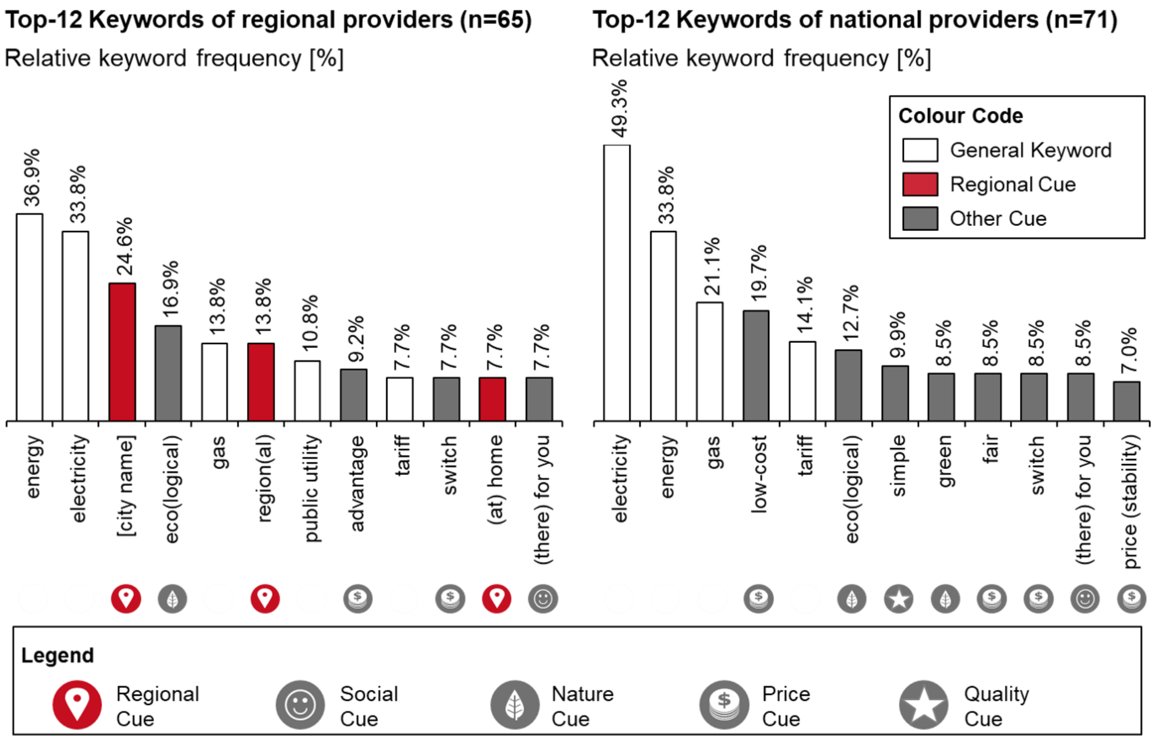

FIGURE 21. TOP-12 MOST FREQUENT KEYWORDS FOR STUDY 2 PROVIDERS

The empirical analysis of text cues supports these findings (Figure 22). However, only the discrepancy in regional cues is statistically significant ($p < 0.01$): while almost half of the regional providers (48%) apply regional text cues on their websites, only 7% of national providers do so. Although the use of price and quality text cues is considerably lower on regional provider sites (price: 22%; quality: 15%) than on national provider websites (price: 35% of websites; quality: 25%), the test statistic fails to reject independence of price (p=0.12) and quality (p=0.22) from the provider type.

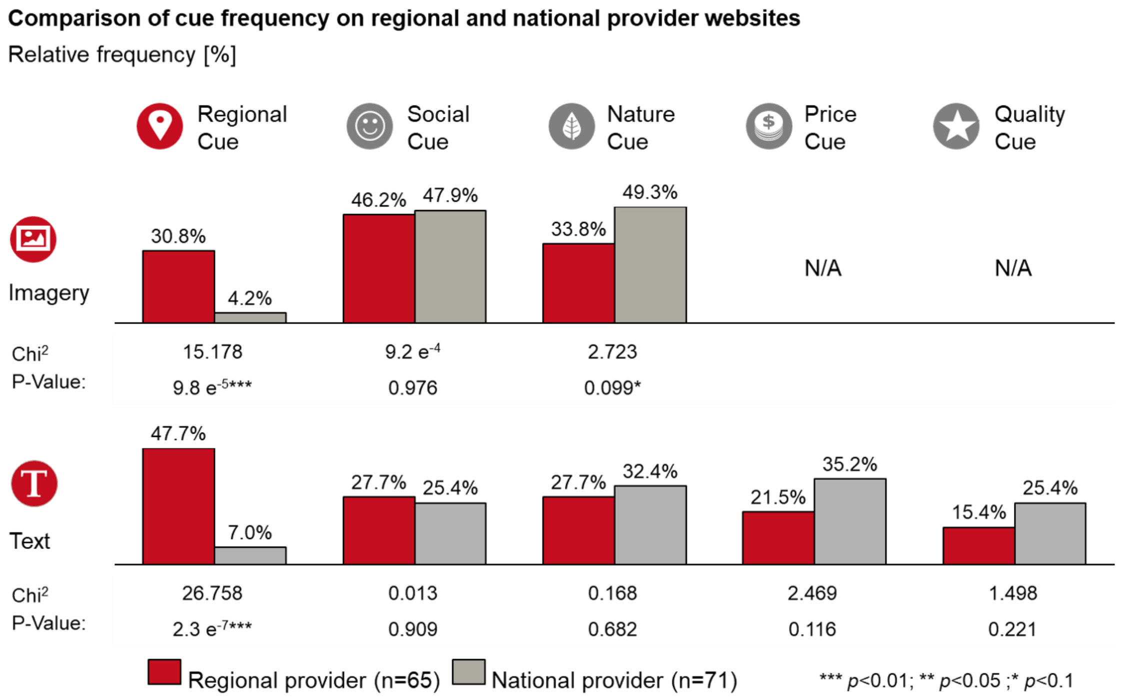

FIGURE 22. COMPARISON OF RELATIVE FREQUENCY OF IMAGERY AND TEXTUAL CUES

The analysis provides similar results for imagery. Discrepancies in the use of regional cues by regional (31%) compared to national providers (4%) are statistically significant ($p<0.01$) and practically relevant. Social cues are used in similar frequencies (46% regional; 48% national). Interestingly, only a third (34%) of regional providers employs nature cues in their imagery versus half of the national providers (49%), which is statistically speaking on the edge of significance ($p=0.099$).

Study 3

Regarding RQ_3, our objective of this study is to highlight upcoming trends in the use of regional trust cues on energy provider websites. During our analysis in Study 2, we noticed that one of the national providers used regional and text cues that were very specific to the researchers' city of residence. This caught our attention because it is counterintuitive to our earlier findings. A national provider using regional and text material for a very particular region would limit the effect of those regional cues to that one specific area in Germany. However, their operations are nationwide. We therefore reached out to a network of researchers in different German cities requesting them to go to this providers' website and send us a screenshot. Interestingly, each screenshot contained imagery and textual cues referring to the user's particular city of origin (see examples in Figure 23). This provider appears to be adjusting the website according to user's geographic location (e.g., by locating the IP address). While the overall layout is identical, the background image as well as text fragments within the headline are tailored to the city of origin. For instance, when accessing the website from a Berlin-based internet connection, users see a cityscape image of Berlin with the headline "Good news from the Spree. Berlin goes green", while a website visitor from Hamburg is met with a Hamburg cityscape with the message "Good news from the Elbe. Hamburg goes green" (the Spree and the Elbe are the main rivers in Berlin and Hamburg respectively). We did not identify a similar provider strategy on any other websites analysed in Studies 1 and 2. We therefore conclude that this seems to be a rather innovative approach which, however, may motivate other providers to follow suit in the near future.

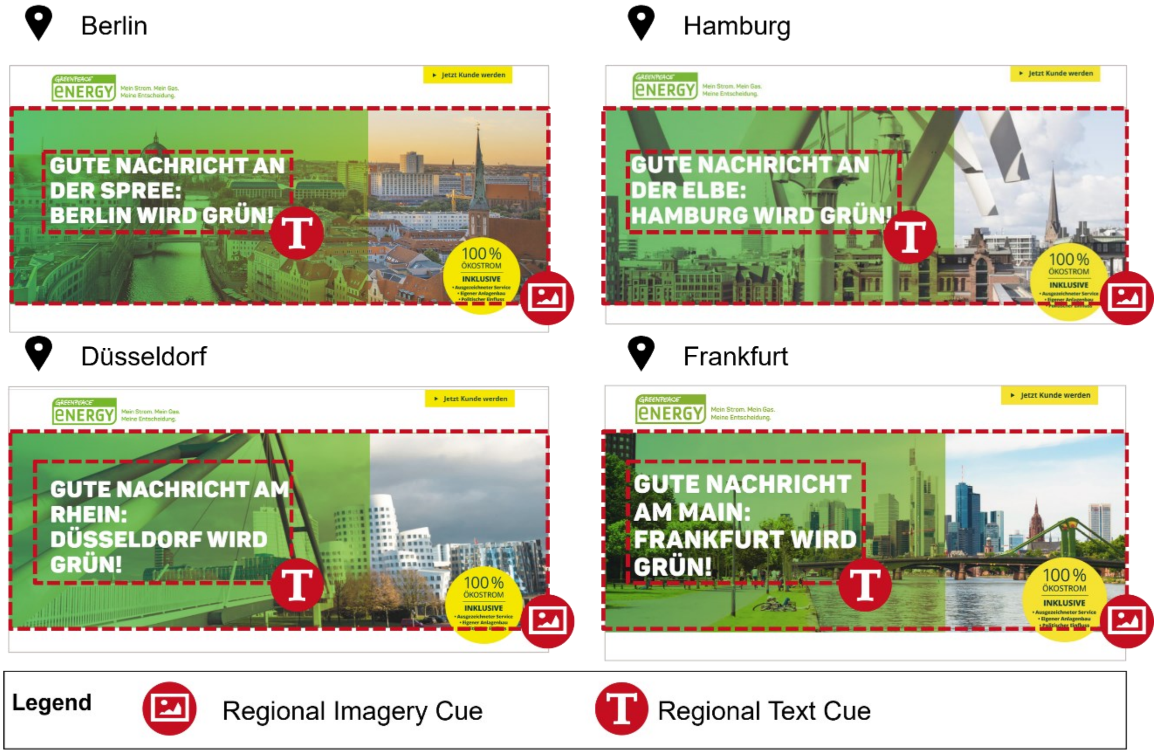

FIGURE 23. WEBSITE EXAMPLES WITH REGIONAL CUES BASED ON LOCATION OF WEB REQUEST[17]

Discussion

Key Findings

In response to RQ_1, we find in Study 1 that almost half of the regional energy providers (47%) use regional cues in imagery and/or text form on their websites. The fact that the use of regional cues is so frequent suggests that it is an intentional strategy on the part of providers to influence consumer behaviour. When using regional imagery (25%), we observe a variety of different motifs, with a slight tendency towards cityscapes (in particular from an aerial perspective). A consensus among practitioners on the types of image that best promotes the desired behaviour appears not to have emerged as yet; this is an area where this study could provide useful insights. Regional providers reference regionality at an even higher rate when it comes to textual cues: one in every three websites (33%) features regional text cues. The most frequent keywords are direct references to a city or region and the use of the term "region"/"regional".

Our findings in Study 2 validate these results and also provide empirical evidence that regional providers intentionally employ regional cues on their websites. The relative frequency of

[17] Source: Greenpeace Energy, available online: https://www.greenpeace-energy.de/privatkunden.html (accessed on 5 November 2020).

regional cues is considerably higher on regional provider websites compared to national provider web interfaces for text (48% vs. 7%; $p<0.01$) and imagery cues (31% vs. 4%; $p<0.01$) (RQ_2). Therefore, we conclude that regional providers apply these cues intentionally, expecting positive effects on user behaviour such as trust in providers and purchase decisions.

Moreover, by comparing relative frequencies among the 318 providers in Study 1 (selected based on how they describe themselves) and the 65 regional providers in Study 2 (selected based on a listing on a price comparison platform), we gain insights into how providers' digital savviness may affect their awareness and use of regional cues. This builds on the assumption that a listing on a comparison platform requires certain digital capabilities within the company. We therefore assume that all regional providers in Study 2 have such capabilities at their disposal. 60% of regional providers in Study 2 use either regional text or imagery (or both), which is even higher than in Study 1 (47%). Text cues are most significant here (48% vs. 33%), but imagery cues are also frequent (31% vs. 25%). We hypothesize that providers with better digital capabilities are either more often aware of the benefits of regional cues or more often capable of implementing these cues on their websites.

Regarding RQ_3, we identified a compelling case study demonstrating how providers are taking the use of regional cues to the next level. National providers typically limit themselves to generic regionality cues (e.g., the use of "regional"/"regionality") when operating one website for a nationwide audience. However, *Greenpeace Energy* has introduced location-specific regional cues tailored to a regional audience. This provides further evidence for our suggestions that providers believe regional cues have a positive effect on user behaviour.

Theoretical Contributions

By analysing the "surprisingly understudied topic of regionality" (Herz & Diamantopoulos, 2019) (p. 44) in the online context, our work has several implications for IS, energy and marketing research.

First, it responds to calls from leading IS researchers and enriches the discussion on ICT-driven solutions to counter climate change (Malhotra et al., 2013; Melville, 2010; Watson et al., 2010). In particular, we provide tangible implications (vom Brocke et al., 2013) for the design of user interfaces in the energy sector. By systematically capturing regional imagery and text cues, we enrich the debate on trust cues in the energy sector as a means to "support decision-making for more sustainable practices" (Gholami et al., 2016) (p. 527).

Second, while the effects of social cues (e.g., Gefen & Straub, 2004; Hassanein & Head, 2005) and, to a lesser extent, nature cues (e.g., Schmuck et al., 2018) on trust and user behaviour are commonly accepted in IS and marketing research, we argue that regional cues should be included in future debates in the field. At first glance, the idea of using regional cues to motivate users' online purchase behaviour may seem somewhat counter-intuitive, because the internet is often considered the "window to the world" (Hongladarom, 1999) (p. 400) and a means of overcoming geographic boundaries (Forman & van Zeebroeck, 2018). However, our observation of the frequent use of regional cues online suggests otherwise. By deriving the concept of regional presence, we offer a new angle to understand ethnocentric consumer behaviour when interacting with web interfaces. Consumer ethnocentrism theory suggests that consumers prefer purchasing products or services from providers based in the same region as the consumer (Shimp & Sharma, 1987). We extend this perspective in the sense that already the *perception* of regionality may cause said provider preference.

Third, we build on the knowledge of regional cues such as labels (Hu et al., 2012) and imagery (Kneafsey & Ilbery, 2001) on packaging (Bruwer & Johnson, 2010) and offline print advertising (Luceri et al., 2016) and expand on the discussion by (a) applying it to the online context and (b) taking it beyond the food sector. Looking at electricity and gas offers new perspectives compared to the marketing of food products. First, electricity and gas are homogenous and credence goods. This allows us to control for potential confounding effects based on product quality. For instance, consumer preference for regional strawberries (i.e., those produced in geographic proximity to the consumer) may be driven by freshness more than anything else. In contrast, it is impossible for consumers to distinguish regional from non-regional electricity or gas as they are physically identical at the point of consumption. Second, electricity and gas are supplied through networks. This eliminates the transportation cost effect since network fees are charged to consumers regardless of the product's geographic origin. For these two reasons, we assume that any observed user preferences for regional products in this context are purely driven by the very idea of regionality.

Fourth, in terms of methodology we enhance the content analysis toolbox by combining two quantitative approaches: using Chi-squared tests to assess statistical differences in the frequency of motifs used on websites (e.g., Hamid, 2017) and analysing differences in the use of website content across two provider types (e.g., Vilnai-Yavetz & Tifferet, 2013).

Practical Implications

Considering practical implications, our study yields new insights for the design of user interfaces in the energy sector. The role of regional products and services is of particular importance in the energy segment since decentralization is one of three major disruptions (alongside digitization and decarbonization) that the industry needs to undergo in order to live up to climate policy ambitions (di Silvestre et al., 2018). In the narrower context of provider websites, a well-designed user interface is important for energy providers as their websites are one of their major sales channels (Dringenberg, 2020). In a broader context, the rise of the platform economy in the energy sector creates a need for trust-building user interfaces in the coming years (Menzel & Teubner, 2021c). New platform technologies such as peer-to-peer local energy markets (Weinhardt et al., 2019), plug-sharing platforms (Matzner et al., 2016), and vehicle-to-grid solutions (Hoang et al., 2017) will become more important in the energy sector and are projected to play a pivotal role in its decarbonization, digitization, and decentralization (Menzel & Teubner, 2021c). However, for these new technologies to be adopted quickly by consumers, trust-building user interfaces will be key (e.g., Hesse et al., 2020) because trust in the (energy) provider is a critical driver for IS adoption (Ableitner et al., 2020; Söllner et al., 2016; Stenner et al., 2017).

Regarding the implementation of regional cues on websites and other user interfaces, a new challenge arises for operators. While social and nature cues can be generically applied, regional cues need to be adjusted according to the physical location of the website user. For instance, a picture of a scenic landscape will trigger similar effects for users in City A and City B, but a picture of the market square in City A may not resonate equally well with users located in City B. The provider must therefore determine how best to ascertain user location. We briefly discuss the advantages and limitations of four approaches:

- **IP address:** Potentially the simplest way is to use IP addresses, but this has significant constraints. For instance, if the users employ VPN tunnels, their IP addresses and locations are not aligned. In addition, in cases where users make purchases online while at work or away from home, a regional cue based on the user's IP address will produce flawed results.
- **Cookies:** Cookies might provide a more accurate estimate of geographic location, but they are often limited by user privacy settings.
- **User data provided during customer journey:** A third option is to collect user data directly. For instance, the shipping or billing address provided during an online shopping process should be a precise estimate of the user location. However, such information is often only provided after the purchase decision has been made.
- **User profile data:** A final option is to use profile data. In particular in platform solutions, providers encourage users to create profiles which typically include geographic details. These details should provide a sound basis for tailoring regional cues to the user. However, this option is also limited to customers deciding to set-up a user profile.

In summary, none of the options mentioned is perfect, and the decision as to whether the advantages outweigh the limitations will depend on the specific application.

Consumer and Policy Implications

While the previous section looked at how consumers could be *supported* in their decision-making in favor of regional products, an improved understanding of regional trust cues could also yield *negative consequences* for consumers: providers could use regional trust cues to deceive consumers through *regional washing*. We derive this term from the idea of "green washing", which is defined as "[companies] misleading consumers about their environmental performance or the environmental benefits of a product or service" (Delmas & Burbano, 2011) (p. 64). Analogously, non-regional providers could regional wash their company image; in other words, they could use regional trust cues to deceive consumers regarding their regionality and decentralization.

Since beginning our research, we have observed such regional washing approaches on user interfaces in the energy sector. In Figure 24, we provide two examples of national suppliers using regional cues to encourage customers to purchase decentrally produced energy – one provider merely pretends to be regional (*Regionale Energiewerke*, on the left in the figure), while the other backs up their claims with actions (*enyway,* on the right).

- **Regionale Energiewerke** (left in Figure 24): This is an example of regional (and also green) washing because the company uses both regionality and sustainability to promote itself on its website, but does not substantiate these claims. First, the company name contains the German word for regional and the term "Energiewerke", which mirrors the phrasing of the German term "Stadtwerke" ("regional utilities"). Second, they use nature imagery to signal ecological sustainability on the website. Third, in the text on their website, they describe themselves as a "regional energy provider", a company that "stands for sustainability" and that their energy plans are "environmentally aware" (*Regionale Energiewerke*, 2020, p. 1). However, following the customer journey to purchase an energy plan shows that the company does not offer energy from renewable sources. The company also has none of the attributes of a typical regional energy provider (e.g., operational focus on a region, public ownership by a municipality or region, historical genesis in a region).

Their claims of regionality and sustainability are therefore a marketing strategy that is not supported by corporate behavior. Both consumers and key policy makers need to be aware of this evolution.

- **Enyway** (right): In contrast, an example of how regional cues can encourage customers to purchase regional energy is provided by the firm enyway. The marketing claim of enyway promotes decentralization in the energy sector in multiple ways. Firstly, the phrase "ecological electricity from your region" (*Enyway*, 2020, p. 1) promotes decentralization through regional energy generation. Secondly, the phrase "Goodbye corporations" (*Enyway*, 2020, p. 1) suggests an interpretation of decentralization as a shift away from large, centralized providers to smaller regional companies. Enyway's claims are backed up by its activities. The company's business model is to provide a platform that matches residential energy generators (e.g., rooftop PV plants, small farmers with wind turbines, etc.) with household consumers in their region.

FIGURE 24. WEBSITE EXAMPLES OF NATIONAL PROVIDERS WITH REGIONAL CUES[18]

In terms of mitigation strategies, research on green washing suggests increased transparency, ethical leadership and employee trainings (Delmas & Burbano, 2011). Other scholars propose eco labels (Gutierrez et al., 2020). These approaches could be adapted to the regional washing context as well.

Limitations and Future Work

This paper is of course not without limitations. First and most importantly, we have analysed provider behaviour by analysing their websites. Our findings suggest that the evaluated providers assume that using regional imagery will have positive effects on customer behaviour (e.g., trust in the provider and purchases). However, this does not necessarily imply that consumers are actually affected by regional cues and, if so, whether they are affected in the way that providers intend. Therefore, further research should shift focus and assess the effects of regional cues on consumer behaviour. We have in this study defined terms and concepts

[18] Sources: Regionale Energiewerke, available online: https://regionale-energiewerke.de/home (accessed on 10 November 2020); Enyway, available online: https://www.enyway.com/de/power (accessed on 10 November 2020).

and systematically captured design elements as a foundation for future work. More specifically, we propose three methodologies and briefly discuss advantages and limitations.

- **Online experiment/survey:** An online experiment could assess how perceived regionality affects trust and purchase intentions. This approach would enable a large sample size and a wide range of control variables. However, only intentions and not actual behavior could be captured.
- **Eye-tracking experiment:** Eye-tracking offers the analysis of cognitive processes of participants by analyzing their eye movement and hence offers a substantial addition to insights gained in a survey. However, for practical reasons the sample would generally be limited. Also, the experiment takes place in a laboratory set-up and hence does still not reflect actual purchase settings.
- **A/B testing field experiment:** In cooperation with an energy provider, research findings should be tested in a field experiment. This could be implemented by means of A/B testing and would provide data on real consumer decisions. However, A/B testing in a live environment provides fewer options to gain control variables.

We propose a combination of these methods for future work.

Second, the link between the energy sector's decentralization and consumer decisions in favor of regional providers hinges on the fact that these providers produce the energy in that region. This is typically the case for regional energy providers (e.g., with waste-to-energy plants) and the share of regionally generated energy is increasing with the expansion of renewable energy technologies. In particular, regional providers are increasingly investing in onshore wind and solar plants within their area of operation. Nevertheless, other examples exist as we have shown in Section 4.4, and this aspect should be considered in future work.

Conclusion

Motivated by the need for ICT-driven solutions to fight climate change, this study offers an exploratory analysis of the use of regional trust cues on user interfaces in the energy sector. The application of regional trust cues on user interfaces in the energy sector could motivate consumers to purchase regional energy products. Decision-making in favor of more regional energy providers would accelerate decentralization in the energy sector and avoid expensive and unpopular power grid expansions. We performed qualitative and quantitative content analysis of energy provider websites. Our findings highlight the relevance of this emerging phenomenon and provide a groundwork for future experimental research by providing terms, concepts, and a theoretical foundation. Further, we contextualised our work within the theoretical conversations around visual trust cues in the IS community as well as text and imagery in regional offline marketing. We drew conclusions for the design of user interfaces in the energy sector and outlined technical approaches that tailor regional cues to the user's geographical location. Next, we explained how providers are using these cues to give an impression of regionality, and we presented strategies to mitigate such examples of regional washing. Last, we pointed to future avenues of research by outlining three potential study methodologies for analysing the behavioural effects of regional trust cues.

Chapter V: On the Effects of Regional Trust Cues on User Behavior –Imagery

This chapter builds on the findings outlined in the previous chapters that a) energy consumers value regionality and b) regional trust cues are a frequently used element in user interface design. Going one step further, the section analysis whether and how regional trust cues can trigger this user preference for regionality. If this were the case, regional trust cues should affect user attitudes and behavior. This section provides the results of two studies in which I assessed the effects of regional imagery on users' attitudes and behavior. More precisely, the findings suggest that regional imagery captures significant visual attention and increases stated trusting intention and belief.

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Introduction

The impact of visual cues in user interface (UI) design is an important aspect of human-computer interaction (HCI). Visual cues such as images, badges, or icons convey information "more directly and with more immediacy than [...] words" (Rogers & Oborne, 1987, p. 99). While research has studied the positive effects of *social* (e.g., images of human faces; Gefen & Straub, 2004) and *nature* cues (e.g., images of natural landscapes; Rendell et al., 2021) in UI design, *regional* cues have received only limited attention. Addressing the "surprisingly understudied topic of regionality" (Herz & Diamantopoulos, 2019, p. 44) in the context of UI design could provide a meaningful contribution for two reasons. First, UI designers appear to frequently use regional cues to trigger consumer preferences for regional products and services in practice (e.g., images of iconic buildings, landmarks, or cityscapes; Menzel & Teubner, 2021). Yet, it is unclear whether, and if so, *how* regional cues influence and interact with these preferences to ultimately affect user attitudes and behaviors. Second, a better understanding of regional cues could facilitate regional consumption decisions and, in turn, more sustainable, transparent, and resilient value chains (Curtis, 2003; Schmitt et al., 2017). We hence pose the following research question:

RQ_1: How does embedding regional cues in UIs affect user attitudes and behaviors?

In this paper, we build on Consumer Ethnocentrism Theory (CET; Shimp & Sharma, 1987) to study the impact of regional cues on visual attention, perceptions of regional presence, and

[19] This chapter was published in *Computers in Human Behavior* with the title "Home is where your Gaze is – Evaluating effects of embedding regional cues in user interfaces", doi.org/10.1016/j.chb.2022.107369

[20] The experiment design of Study 1 in this chapter was published in a short paper in the proceedings of *Internationale Tagung Wirtschaftsinformatik 2021* with the title "Buy Online, Trust Local – The Use of Regional Imagery on Web Interfaces and its Effect on User Behavior", aisel.aisnet.org/wi2021/PHuman/Track11/1

[21] Preliminary results of Study 1 and the design of Study 2 in this chapter were published in a *Research-in-Progress Paper* in the proceedings of the *European Conference on Information Systems 2021* with the title "Home Sweet Home – The Effect of Regional Presence on Trust in Electronic Commerce", aisel.aisnet.org/ecis2021_rip/3/

trust. Our research model is evaluated through a multi-method approach based on objective and subjective measures for user attitudes and behaviors. In Study 1, we conduct a lab experiment to analyze participants' gaze patterns (using eye-tracking) and trust (using a survey) when engaging with a fictive electricity provider website. In Study 2, we conduct an online experiment to investigate the effects of regional cues on trust in greater depth while, at the same time, considering potential interdependencies of regional, social, and nature cues.

Our contribution is threefold. First, this paper is among the first to assess the use of regional cues in UI design and its effects on perceptions of regional presence and trust, suggesting that regional cues can be an effective design element. Second, we discuss practical implications for UI design. Most importantly, regional cues need to be tailored to the users' location. We discuss different options to gather this information and discuss advantages and challenges. Third, we sketch out how the use of regional cues in UIs could contribute to more sustainable consumer decisions. To provide the reader with a better understanding of the paper's constructs and terms, Table 4 summarizes the key definitions upfront.

TABLE 4. KEY TERMS AND DEFINITIONS.

Term	Definition	Source
Perceived Regional Presence (PRP)	The extent to which a UI allows the user to sense a feeling of regionality.	Own definition
Perceived Social Presence (PSP)	The perception that there is personal, sociable, and sensitive human contact in the medium.	(Gefen & Straub, 2004, p. 410)
Perceived Nature Presence (PNP)	The extent to which the website allows a user to experience the natural environment as being present.	(Rendell et al., 2021, p. 2)
Visual Attention	At any given time, the environment presents far more perceptual information than can be effectively processed. Visual attention allows people to select the information that is most relevant to ongoing behavior.	(Chun & Wolfe, 2005, p. 273)
Trust	The willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party.	(Mayer et al., 1995, p. 712)
Trusting Belief	Trusting belief describes the fact that "one believes that the other party has one or more characteristics beneficial to oneself."	(McKnight & Chervany, 2001, p. 46)
Trusting Intention	Trusting intention occurs if "one is willing to depend on, or intends to depend on, the other party even though one cannot control that party."	(McKnight & Chervany, 2001, p. 46)

The remainder of the paper is organized as follows: In Section 2, we provide the theoretical context and develop our hypotheses. Sections 3 and 4 illustrate method and results for Study 1 and 2, respectively. Section 5 discusses overall findings, draws conclusions for UI design, and outlines theoretical and societal implications, limitations, as well as paths for future work.

Background and Theory

Effects of Geographic Cues on User Attitudes and Behaviors

The effects of geographic cues (e.g., images, labels, text referencing a country, a region, etc.) have been studied to some degree by researchers in HCI, psychology, and marketing (e.g., in the form of place-of-origin cues). However, regional cues that adjust UIs in response to the user's location (i.e., the user's city or region) has received only little research attention.

Place-of-origin cues. Place-of-origin cues "reflect the implications that the geographical provenance of the product [origin] has for consumers" and typically manifest as country-of-origin cues or, on a geographic micro-level, as region-of-origin cues (Chamorro et al., 2015, p. 820). Most prominently, the country-of-origin effect (Schooler, 1965) states that cues referencing a product's manufacturing country (e.g., *Swiss made* watches) influence human information processing (Halkias et al., 2021) and product quality perceptions (Hong & Kang, 2006). How such cues affect users depends on the reputation of the referenced country (Diamantopoulos et al., 2021). Country-of-origin cues can increase trust in products and providers (Jiménez & San Martín, 2010), purchase intentions (Verlegh & Steenkamp, 1999), and willingness-to-pay (Bernard & Zarrouk-Karoui, 2014). Similarly, region-of-origin cues reference a city or region with the aim to impact user attitudes and behaviors (e.g., the European Union's designation of origin label). Region-of-origin cues are also considered to increase quality perceptions (García-Gallego & Chamorro Mera, 2018) and, in turn, purchase intentions and willingness-to-pay (Bruwer & Johnson, 2010; Chamorro et al., 2015). Note that these two geographic cues are agnostic of the user's location.

Tailoring UI design to user geography. As for tailoring UIs to users' location, UI designers have thus far mainly considered the user's country (e.g., Reinecke & Bernstein, 2011) or even larger domains (e.g., the Arab countries; Aljaroodi et al., 2020) when adjusting language, imagery, and other design elements. More recently, tailoring UI design to user location has been taken to the micro-level, focusing on specific regions or cities (Menzel & Teubner, 2021e). Despite first accounts describing this practice (e.g., Herbes & Ramme, 2014; Menzel & Teubner, 2021e), there has been no research into whether and, if so, how it affects user attitudes and behaviors.

Consumer Ethnocentrism Theory and Perceived Regional Presence

Scholars often turn to evolutionary psychology when explaining the mechanisms underlying the effects of visual UI cues (e.g., Gefen & Straub, 2004; Rendell et al., 2021). The rationale is that these cues trigger psychological responses deeply rooted in human evolution (Riva et al., 2015). Following this school of thought, CET posits that people consider their own (regional) group as the "center of the universe" and will therefore refrain from buying non-regional products as this "hurts the domestic economy, causes loss of jobs, and is plainly unpatriotic" (Shimp & Sharma, 1987, p. 280). Therefore, they prefer brands considered as local (Ma et al., 2019). This regionality preference seems natural from the evolutionary perspective, as for the greater part of humankind, survival depended on cohesion and solidarity within a geographically-bounded social group, family, or tribe (van den Berghe, 1981). In modern times, this translates into ethnocentric consumer decisions on a regional or national level (Bizumic, 2019). Previous studies have shown that ethnocentrism plays an important role for consumers' readiness to purchase regional products not only in mature, but also in developing countries and markets (Yen, 2018).

Digital interfaces often have no distinct regional context as the Internet provides "a window to the world" (Hongladarom, 1999, p. 400), that is, a tool to overcome borders and geographic constraints (Forman & van Zeebroeck, 2018). Here, we investigate whether regional UI cues can induce Perceived Regional Presence (PRP), referring to the extent to which a UI allows the user to sense a feeling of regionality[22]. In the following, we theorize on how the use of regional UI cues can trigger PRP and, in turn, affect user attitudes and behaviors.

Disentangling Regional from Other Cues in UI Imagery

Beyond regional cues, the most frequent cue type in UI design are social and nature images (Menzel & Teubner, 2021e). Positive behavioral effects of social cues are established in the HCI literature (e.g., Gefen & Straub, 2004). Social Presence Theory describes the ability of a communication medium to transmit social cues and has its origins in social psychology (Short et al., 1976). It describes how social cues provoke perceptions of "personal, sociable, and sensitive human contact" which in fact lack such contact (Gefen & Straub, 2004, p. 410). An explanation for this behavioral pattern is provided by evolutionary psychology. Interactions with other humans have been critical throughout human evolution as chances of survival increased through cooperation – and cooperation is inherently social (K. Lee, 2004; Riva et al., 2015). Unsurprisingly, already Aristotle understood that humans are *social animals* (Barker, 1968). In modern humans' brains, this underlying pattern is still at work and lets social imagery reduce anxiety towards online transactions which, in turn, promotes trust (Hassanein & Head, 2005). Importantly, this evolutionary pattern can be triggered by artificial social cues, that is, in the absence of actual social interaction or humans (Gefen & Straub, 2004).

Positive effects on trusting belief and intention have also been attributed to nature cues (Rendell et al., 2021; Schmuck et al., 2018). While explanations for this phenomenon also link to evolutionary psychology, the underlying rationale is different. Edward Wilson (1984) argued in his *Biophilia Hypothesis* that humans are endowed with a biological attraction to nature. Others pointed out that (perceived) nature has the ability to restore attention (Kaplan & Kaplan, 1989) and reduce stress (Ulrich, 1993). This is because nature was (and is) a critical factor for survival, for instance, as a source of water, nutrition, and shelter (Ulrich, 1993). Crucially, this psychological pattern can be triggered also by *virtual* nature experience (Hartmann & Apaolaza-Ibáñez, 2008, p. 821). Rendell et al. (2021) introduced the concept of Perceived Nature Presence (PNP), referring to "the extent to which the website allows a user to experience the natural environment as being present" (p. 2). They demonstrated that the use of nature imagery engenders perceptions of visual aesthetics, as well as trusting belief and intention.

Note that these cues often appear in combination. For instance, iconic public parks (e.g., *Tiergarten* in Berlin, *Central Park* in New York City, or the *Gardens by the Bay* in Singapore) are likely to affect perceptions of both regional *and* nature presence. Images of humans in

[22] The concept of *Local Presence* describes a UI's ability to "create the illusion of the product being present in the consumer's physical environment" which can, for instance, be increased by using 360-degree spins or virtual mirrors instead of plain photos on e-commerce websites (Verhagen et al., 2014, p. 271). This concept is hence not related to our context.

traditional clothing or regional celebrities (e.g., the quarterback of the high-school football team) potentially raise both regional *and* social presence perceptions. Therefore, we include PSP and PNP in our assessment to disentangle the three effects.

Hypotheses Development and Research Model

We draw on CET to theorize how regional cues affect user attitudes and behaviors, focusing on visual attention (integral component of human information processing; e.g., Just & Carpenter, 1980) and trust (key success factor for HCI; e.g., Beldad et al., 2010) as main outcome variables. Figure 25depicts our research model.

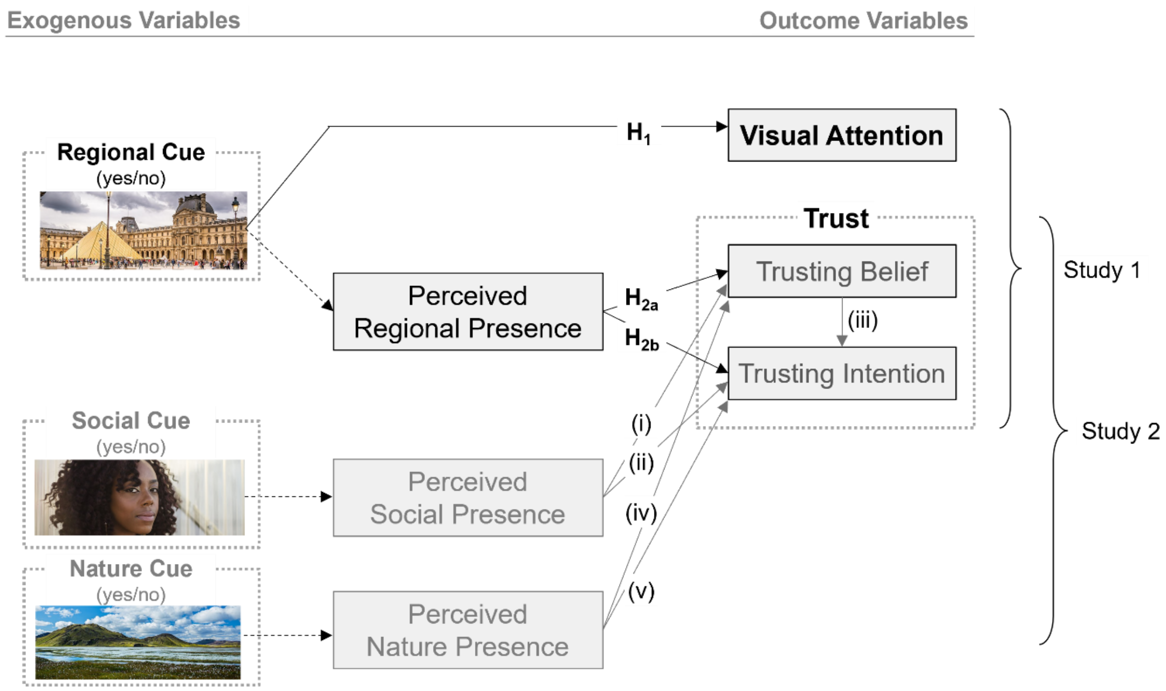


FIGURE 25. RESEARCH MODEL[23]

Effects of regional cues on visual attention. First, we consider visual attention as an integral component of human information processing (Just & Carpenter, 1980; Kowler, 2011). Assessing visual attention can uncover unconscious effects that self-reported measures may not be able to reveal (Dimoka et al., 2012). As outlined above, CET explains consumer preferences for regional goods and services through an underlying evolutionary psychological pattern. Viewing a regional cue should hence trigger this pattern. This, in turn, should be reflected in visual attention to the cue as human information processing and visual attention are closely associated (Schulte-Mecklenbeck et al., 2017). This link is based on assumptions on the interplay of eye movements and cognitive processes (Just & Carpenter, 1980): First, the *eye-mind assumption* suggests a strong connection between line of gaze and thought. Second, the *immediacy assumption* claims that visually-apprehended information is immediately processed and hence, the fixation duration on a visual object is in line with the duration of

[23] Sources: Regional cue: commons.wikimedia.org/wiki/File:The_Grand_Louvre_(235493607).jpeg; Social cue: commons.wikimedia.org/wiki/File:Confident_Eye_Contact_(Unsplash).jpg ; Nature cue: commons.wikimedia.org/wiki/File:Fjallabak_Nature_Reserve.jpg

information processing. Higher visual attention on an object suggests that this object is important (Poole & Ball, 2006) or interesting (Cyr et al., 2006) to the viewer and actively used for decision-making (Gloeckner & Herbold, 2011). Previous studies showed that social cues attract higher visual attention than control imagery (Djamasbi, 2014; Sivaji et al., 2011). Similar effects on visual attention have recently been presented for nature cues (T. C. Wang et al., 2018). Therefore, we hypothesize:

H_1: The presence of regional cues embedded in UIs captures more visual attention than control images.

Effects of regional cues on PRP and trust. Second, we turn to trust as a key success factor for HCI design (e.g., Beldad et al., 2010; Y. Wang & Emurian, 2005). While H_1 considers whether regional cues affect decision-making at all, the following deals with the question *how* human information processing is affected. For this purpose, we conflate our reasoning with the e-trust model (Gefen & Straub, 2004). In its pure form (paths (i–iii) in Figure 25), the e-trust model studies the effect of PSP on different aspects of trusting belief and, in turn, trusting intention. While the focus of the present study is on PRP, we also include PSP and PNP to our model to disentangle these effects as many cues may affect more than one construct. Considering path (i), it is commonly accepted that PSP drives trusting belief (e.g., Gefen & Straub, 2004; Hassanein & Head, 2005; Lu et al., 2016). Further, PSP (ii) as well as trusting belief (iii) are commonly accepted to drive trusting intention (e.g., Gefen & Straub, 2004; Lu et al., 2016; Oliveira et al., 2017). We hence tested a model variation including PRP and PNP as well as their effects on trusting belief and intention. More recently, Rendell et al. (2021) found empirical evidence for the role of PNP for trusting belief, too (path iv). Also, Schmuck et al. (2018) and Rendell et al. (2021) suggested that PNP is positively associated with trusting intention (path v).

Drawing on CET, consumers prefer buying products and service from their region (Bizumic, 2019; Ma et al., 2019; Shimp & Sharma, 1987). This is, for instance, reflected in higher levels of trust and willingness-to-buy (Guo et al., 2018). Expanding on this, we hypothesize that using regional cues in a UI increases PRP which, in turn, drives trusting belief and intention:

H_{2a}: Higher PRP is associated with increased levels of trusting belief.

H_{2b}: Higher PRP is associated with increased levels of trusting intention.

Study 1: Eye-Tracking Lab Experiment

To evaluate how regional cues affect visual attention (H_1) and to gain first insights on their effect on trust (H_{2a} and H_{2b}), we conducted an eye-tracking lab experiment. In this experiment, we tracked participants' gaze patterns while they engaged in a set of fictive electricity provider websites. Further, we surveyed participants on trusting belief and intention. Such multi-method approaches are useful to capture the full richness of a phenomenon (Niehaves, 2005, p. 4). While self-reported measures rely on users' subjective ratings, analyzing gaze patterns provides a more objective measurement (Djamasbi, 2014). We use the context of electricity for two main reasons. First, electricity can (to a certain degree) be considered a homogenous credence good. Potential confounding effects due to product properties are hence eliminated (e.g., strawberries from one's region are actually likely to be fresher and tastier due to faster delivery etc.). Second, considering electricity eliminates the confounding effect of transportation cost as network fees are charged to consumers regardless of the electricity's physical origin. Given this high abstractness of electricity as a product, it can be assumed that observable effects are driven by *the very idea* of regionality.

Materials and Methods

Scenario & Task. Participants were shown an e-commerce scenario with fictive electricity provider websites. The stimulus material was integrated into the website. To achieve a realistic setup, we developed the materials based on actual provider websites, adapting the imagery and product information for the experimental conditions. Also, we eliminated all provider details and logos to avoid that participants' evaluation would be biased by associations with actual providers. As the experimental task, we asked participants to evaluate several electricity plans (in randomized order), featuring different prices, contract lengths, and imagery.

Treatments & Stimulus Material. We applied a within-subjects design with the presence of a regional cue as treatment condition (neutral imagery as control condition). We chose a within-subjects design as it allows us to control for potential participant-level effects and increases statistical power (Neuman et al., 2019). Aiming for a realistic scenario, we provided four different electricity plans sourced from actual provider websites with variations in price (between 73.35 and 78.09 €/month) and contract length ("short", 24 months, flexible, 12 months). Using a full-factorial design, each participant was asked to evaluate 8 combinations in randomized order (2 treatment conditions × 4 electricity plans). Stimulus imagery was drawn from real provider websites and randomly assigned to the electricity plans. We surveyed participants on how realistic they deemed the scenario (average of 5.7 on a 1-7 Likert scale). High internal validity was ensured by identical size and similar style of treatment and control imagery (Orquin & Holmqvist, 2018).

Apparatus. We used a Gazepoint GP3 HD eye-tracker with a sampling rate of 150Hz to record gaze data and 5-point calibration (Gazept, 2022).

Eye-Tracking Measures. Eye movement data is frequently used as a proxy for visual attention (Djamasbi et al., 2008) and well-established to study consumer behavior (Ho, 2014; C. Liu et al., 2017; Luan et al., 2016). In this study, we draw on two eye-tracking metrics to assess the effects of regional cues on visual attention. First, we consider the number of fixations (or *fixation count*). This metric refers to a pattern in which the eye focus rests motionless on a certain area of interest (AOI) for some time – typically lasting 200-300 milliseconds (Djamasbi, 2014) – and is an established measure for user attention (Ahn et al., 2018; Q. Wang et al., 2014). This information can be used to distinguish between superficial information scanning and active consideration for decision-making (Gloeckner & Herbold, 2011). The number of fixations on a certain design element hence indicates the element's importance to the viewer (Poole & Ball, 2006). Second, we measure *fixation duration*, where longer fixations suggest that an object is of interest to the viewer (Cyr & Head, 2013). We pre-defined three AOIs as non-overlapping rectangles for regional/control images (AOI1 in the example in the Appendix), electricity plan details (AOI2), and website header (AOI3). The screen layout and AOIs are depicted in the Appendix.

Survey Measures. We used single-item 7-point Likert scales for all constructs. To measure PRP we drew on the social presence instrument provided by Gefen and Straub (2003) and adapted it to the PRP context. For trusting belief and intention, we drew on validated scales with adjustments to the electricity context (Everard & Galletta, 2005; Gefen & Straub, 2003). A comprehensive list of these items is provided in the Appendix. Also, we measured disposition to trust (Gefen, 2000), disposition to ethnocentric consumer behavior (Shimp & Sharma, 1987), attitude towards city (derived from Lentz et al., 2006), duration of residence, experience level, age, gender, and employment status as control variables.

Sample & Procedure. Typically, eye-tracking studies feature smaller sample sizes than most surveys and behavioral lab experiments (Riedl et al., 2020). Caine (2016) reports a mean of 21 participants in HCI studies using eye-tracking. We scheduled 20 participants with two dropping out on short notice due to Covid-19 quarantine requirements (Age avg: 33; Age min: 22; Age max: 43; 50% female). This resulted in 18*8=144 observations, of which we excluded six due to failed manipulation checks (resulting in 138 observations for analysis). Average experiment duration was 9.6 minutes (range: 7 to 14 minutes). All participants were recruited from the city in which the lab is situated to tailor the regional stimulus material to one single area. After welcoming them to the lab, participants were seated in a room with negligible ambient lighting approximately 60 cm from a 21 inch screen. Following eye-tracking calibration and validation, participants were provided with the experiment instructions. Then, the actual experiment started in which participants evaluated the eight websites. After each website, the measurement items appeared upon participant request. Participants did not face any time constraints as this provides the most realistic scenario and more accurate task completion (Cyr & Head, 2008). Last, we surveyed participants on demographic and other control variables and asked for a brief textual explanation of their evaluation. We also surveyed participants for whether they had an eye health condition as this could potentially affect the eye-tracking (none mentioned by any participant).

Results

For a first qualitative analysis, we visualized participants' gaze patterns using heat maps (Figure 26). In line with H_1, participants paid more attention to the treatment (left) than to the control imagery (right). Also, the experimental task of evaluating electricity plans worked as desired as a considerable share of visual attention was allocated to the respective AOI. On average, participants spent 28% of their viewing time on the imagery (AOI1), 61% on product information (AOI2), and 11% on the website header (AOI3).

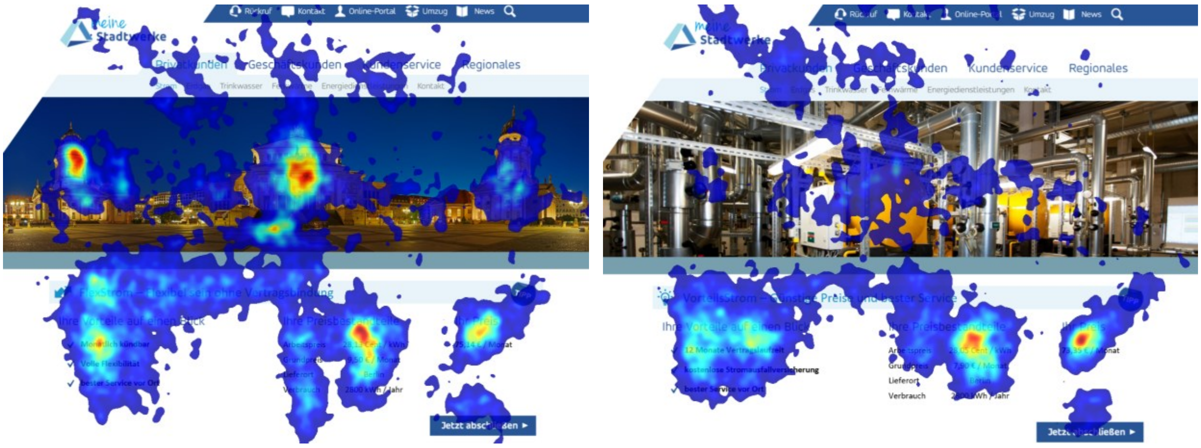
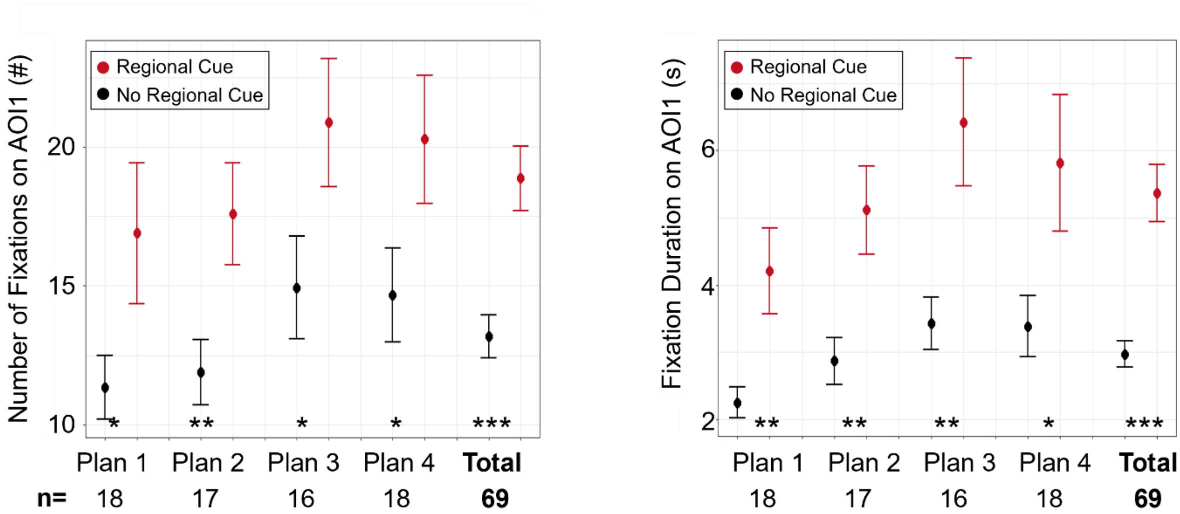


FIGURE 26. EXAMPLE HEATMAP OF TREATMENT (LEFT) AND CONTROL IMAGERY (RIGHT)[24]

Following up this first visual assessment, Figure 27 shows average number of fixations and duration on AOI1 (regional/control imagery). After Levene's tests indicated variance heterogeneity for both attention measures (Number of Fixations: F-value=5.8, p<0.05; Fixation Duration: F-value=14.3, p<0.001), we employed one-tailed Welch's t-tests to assess whether the means of the treatment observations are significantly higher than the means of the control group. Supporting H_1, for all electricity plans, visual attention to the regional cue was significantly higher than on the control image, reflected both in number of fixations and fixation duration.



Notes: * p<0.05; ** p<0.01; *** p<0.001; p-values calculated with Welch's t-test for means of observations with regional cue > without regional cue; Error bars display standard errors.

FIGURE 27. BREAKDOWN OF VISUAL ATTENTION METRICS PER ELECTRICITY PLAN

[24] Outlier Filter = 5%.

In addition, we conducted a set of multivariate regressions with number of fixations (Model A in Table 5) and fixation duration (Model B) as dependent variables and participant fixed effects to capture personal idiosyncrasies. Substantial R^2 and Adjusted R^2 values speak to the models' overall fit. We found that the use of regional cues positively affects visual attention in terms of fixations and fixation durations compared to control imagery (supporting H_1).

For an initial analysis of H_{2a} and H_{2b}, we first conducted a manipulation check and compared the levels of PRP of websites *with* regional cue (6.11 on a scale from 1 to 7) to websites *without* (1.10). The difference is statistically significant (Welch's *t*-test with $p<0.001$) and practically relevant. Hence, we conclude that the manipulation was successful. Respective regression models for trusting belief (Models D in Table 5) and trusting intention (Models F and H) provide initial evidence for a positive relationship between PRP and trusting belief (supporting H_{2a}) and intention (supporting H_{2b}). The effect of PRP on trusting intention is partially mediated by trusting belief (Model H). These relationships also hold when we use the (binary) regional cue variable instead of the PRP measure as independent variable (Models C, E and G).

TABLE 5. EYE-TRACKING REGRESSION SUMMARY

n = 138 observations		Dependent Variable							
		NF	FD	TB		TI			
		A	B	C	D	E	F	G	H
Model	Regional Cue (yes=1, no=0)	**5.86***** (1.12)	**2.42***** (0.40)	**1.21***** (0.15)		**1.23***** (0.18)		**0.46*** (0.19)	
	PRP				**0.23***** (0.03)		**0.24***** (0.03)		**0.10**** (0.04)
	TB							**0.64***** (0.10)	**0.62***** (0.10)
Control	Visual Aesthetics	-0.46 (0.52)	-0.09 (0.19)	-0.02 (0.07)	-0.06 (0.07)	**0.21*** (0.08)	0.17⁺ (0.08)	**0.22**** (0.07)	**0.20**** (0.07)
	Price	**-0.67*** (0.29)	**-0.25*** (0.10)	-0.07⁺ (0.04)	-0.08⁺ (0.04)	**-0.16**** (0.05)	**-0.16**** (0.05)	**-0.11**** (0.04)	**-0.11**** (0.04)
	Contract Length	0.02 (0.06)	0.02 (0.02)	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
	Participant FE	yes	yes	yes	yes	yes	yes	yes	yes
	Constant	**69.6**** (22.5)	**22.7**** (7.91)	**10.2***** (2.94)	**10.3***** (2.95)	**15.4***** (3.57)	**15.5***** (3.54)	**8.96**** (3.21)	**9.21**** (3.19)
	R^2	0.52	0.49	0.61	0.61	0.59	0.60	0.70	0.71
	Adjusted R^2	0.43	0.40	0.54	0.54	0.52	0.53	0.65	0.65

Notes: $^+$ p<0.1; * p<0.05; ** p<0.01; *** p<0.001; FD: Fixation Duration (in seconds); NF: Number of Fixations; PRP: Perceived Regional Presence; TB: Trusting Belief, TI: Trusting Intention; FE: Fixed Effects. Standard error in parentheses.

We observe consistent effects of the control variables across the models. Specifically, higher prices are associated with lower trusting intention, while higher perceived visual aesthetics are associated with higher trusting intention (Models E to H). Further, when replacing participant fixed effects dummies with the participant-level control variables, we find a positive relationship of disposition to trust with trusting belief ($p<0.05$) and lower trusting intention for female participants ($p<0.05$). All other control variables (i.e., disposition to ethnocentric consumer behavior, attitude towards city, duration of residence, experience level, age, and employment status) are insignificant. Moreover, all coefficients of the research model are robust in terms of sign, magnitude, and significance.

Study 2: Online Survey

To validate and expand the findings of Study 1, we conducted a follow-up experimental online survey (n=329) to disentangle the effects of PRP from those of PSP and PNP. We again used the context of electricity for the reasons outlined in Study 1.

Materials and Methods

Scenario. We presented a fictive purchasing scenario for an electricity plan, including five steps. First, participants were welcomed and introduced to the scenario. On the second page, they stated their city of residence, the duration they have been living in that city, and demographic variables. Third, participants faced the fictive provider website with a request to provide household size (i.e., number of persons) and to indicate whether they want to search for ecological plans only. This input was used to populate the fourth view (see Appendix) in which participants saw four different electricity plans. This forth view was individually adjusted to each participant based on the provided information and a randomly assigned treatment combination. In this view, they responded to items below the image (randomized order). Last, participants were asked to provide additional control variables and to provide a brief (textual) explanation of their choices made in the experiment.

Sample & Treatment Structure. We used the large online participant pool Prolific.ac (Palan & Schitter, 2018) to recruit 350 participants, residing in Germany at the time of the experiment. Three incomplete submissions were excluded. Moreover, 18 participants failed to correctly answer attention checks. The final sample size hence was 329 (35% female; age between 18 and 65 years with an average of 29 years). Participants were compensated with an average payment of 7.32 €/h. Average completion time was 8.6 minutes. We applied a full-factorial 2 (regional cue: present/ not present) × 2 (social cue: present/ not present) × 2 (nature cue: present/ not present) between-subjects design. Participants engaged on the electricity provider's website with randomly assigned stimulus material combinations. The distribution of stimulus combinations across the sample is shown in Table 6. Note that we recruited an entirely new set of participants for Study 2.

TABLE 6. EXPERIMENTAL CONDITIONS: DISTRIBUTION OF STIMULUS COMBINATIONS

n=329 participants	Social Cue = Yes		Social Cue = No	
	Nature Cue = Yes	**Nature Cue = No**	**Nature Cue = Yes**	**Nature Cue = No**
Regional Cue = Yes	**YYY** 53 participants	**YNY** 41 participants	**NYY** 39 participants	**NNY** 39 participants
Regional Cue = No	**YYN** 43 participants	**YNN** 39 participants	**NYN** 40 participants	**NNN** 35 participants

Stimulus Material. Social and nature imagery was drawn from actual provider websites while regional imagery was tailored to each participant's home region. To achieve this, participants were asked to state their city of residence in the experiments' first step. To be able to customize the survey to the participant's actual city of residence, we prepared a library of landmark images for the largest 360 German cities. For example, a participant stating to be from the city of Heidelberg would have been shown an image of Heidelberg's iconic castle. To ensure a realistic experiment setting, we selected a real provider website as starting point and then adjusted the design to our setup. Also, actual electricity prices fluctuate significantly across regions. Hence, we retrieved price data for all 360 cities and different variables (household size, with/without ecological preferences) from the price comparison website *verivox.com* to make sure that the price information shown on the fictive website was plausible. We included two items to evaluate as how realistic participants perceived this scenario (5.1 on the 1-7 point Likert scale on average).

Measures. For all measurement items, we used 7-point Likert scales. To measure PRP, PSP, and PNP, we drew on the social presence instrument provided by Gefen and Straub (2003), adjusting it to the electricity plan context. For trusting belief and intention, we also drew on validated scales with slight adjustments (Everard & Galletta, 2005; Gefen & Straub, 2003). The full list of all measured instruments is provided in the Appendix. Further, we measured demographic data (i.e., age, employment status, gender, nationality), online experience, participants' perceptions of the website's aesthetics (Cyr et al., 2006), trusting disposition (Gefen, 2000), environmental concerns (Schuhwerk & Lefkoff-Hagius, 1995), and attitude towards city of resident (derived from Lentz et al., 2006).

Results

Consistency, Validity, and Manipulation Checks. Table 7 provides summary statistics for all constructs. All constructs exhibit internal consistency with Cronbach's alpha values within the generally accepted lower (0.70) and upper (0.95) bounds (Taber, 2018). Also, HTMT ratios (Henseler et al., 2015) were below the generally accepted threshold of 0.85 indicating discriminant validity (e.g., Voorhees et al., 2016). As a second norm for discriminant validity, also the Fornell-Larcker criterion is met (Fornell & Larcker, 1981). We conducted manipulation checks to confirm that the stimulus material yielded differences in PRP, PSP, and PNP. Participants scored higher levels of PRP in response to stimulus combinations involving regional cues (average PRP score of 4.35for websites with regional cue and 3.21 for websites without). The analysis provides similar results for PSP and PNP on the respective scales (social cue/PSP: 3.74 vs. 3.46; nature cue/PNP: 4.81 vs. 3.88). Welch's tests confirmed statistically significant differences for the regional (t=7.50, *p*<0.001), social (t=1.94, *p*<0.05), and nature stimuli (t=6.10, *p*<0.001). We conclude that the manipulation was successful.

TABLE 7. CONSTRUCT DESCRIPTIVE STATISTICS, CONSISTENCY, AND VALIDITY

	Statistics			HTMT Matrix					Fornell-Larcker Matrix				
	M	SD	α	PRP	PSP	PNP	TB	TI	PRP	PSP	PNP	TB	TI
PRP	3.81	1.49	0.84	1.00					*0.80*				
PSP	3.61	1.28	0.82	0.66	1.00				0.55	*0.77*			
PNP	4.48	1.43	0.88	0.52	0.77	1.00			0.44	0.65	*0.84*		
TB	4.47	1.07	0.79	0.59	0.69	0.54	1.00		0.48	0.56	0.46	*0.75*	
TI	4.09	1.34	0.83	0.52	0.63	0.45	0.84	1.00	0.43	0.52	0.39	0.68	*0.85*

Notes: TB: Trusting Belief; TI: Trusting Intention; M: Mean, SD: Standard Deviation; α: Cronbach's alpha; HTMT Matrix: Heterotrait-Monotrait ratios; Fornell-Larcker Matrix: square root of average value extracted (AVE) on the diagonal in italic and correlation coefficients off-diagonal.

Randomization Checks. We ran a set of ordinary least squares (OLS) and logit regressions to ensure that participants were adequately randomized into the eight treatment groups (Nguyen & Kim, 2019). To do so, we tested whether the key participant demographic variables are independent from treatment conditions. We used age, employment status (full-time = 1, other = 0), gender (female = 1, other = 0), and nationality (German = 1, other = 0) as dependent variables and the three treatment conditions (regional, social, nature cue present or not) as independent variables. The results are displayed in Table 8. As expected, all key participant variables are statistically independent from the treatment conditions. We hence conclude that the randomization worked as intended.

TABLE 8. RANDOMIZATION CHECKS.

	Dependent Variable			
n = 329 participants	**Age**	**Employment Status = Full-Time**	**Gender = Female**	**Nationality = German**
Regional Cue (present/not present)	-0.56 (0.98)	0.03 (0.05)	-0.06 (0.05)	0.03 (0.04)
Social Cue (present/not present)	0.24 (0.98)	0.08 (0.05)	-0.004 (0.05)	-0.01 (0.05)
Nature Cue (present/not present)	0.10 (0.98)	0.02 (0.05)	-0.04 (0.05)	-0.01 (0.04)
Constant	**28.86***** (1.00)	**0.29***** (0.05)	**0.40***** (0.05)	**0.79***** (0.05)

Notes: + *p*<0.1; * *p*<0.05; ** *p*<0.01; *** *p*<0.001; Standard error in parentheses.

Structural Equation Modelling. To evaluate our research model (Figure 25), we used covariance-based structural equation modeling (CB-SEM). Results are displayed in Figure 28. The model exhibits good fit according to common indicators (Comparative Fit Index (CFI)=0.976; Tucker Lewis Index (TLI)=0.968; Root Mean Square Error of Approximation

(RMSEA)=0.053; Standardized Root Mean Square Residual (SRMR)=0.045). Our analysis confirms H_{2a} as PRP is positively related to trusting belief (0.19, $p<0.01$). Trusting belief, in turn, is significantly associated with trusting intention (0.96, $p<0.001$). Moreover, the model indicates significant and positive relationships between PSP and trusting belief (0.38, $p<0.01$) and, to a lesser degree, trusting intention (0.27, $p<0.05$), and no significant effects involving PNP ($p>0.1$). To test H_{2b}, we excluded trusting belief from the model (Figure 29). Doing so reveals significant direct effects of PRP (0.17, $p<0.05$) and PSP (0.63, $p<0.001$) on trusting intention. In terms of model fit, this adjusted, parsimonious model performs even better (CFI=0.988, TLI=0.983, RMSEA=0.043, SRMR =0.023). Hence, our findings provide support for H_{2b}, suggesting that higher levels of PRP are associated with higher levels of trusting intention (where this effect is fully mediated via trusting belief).

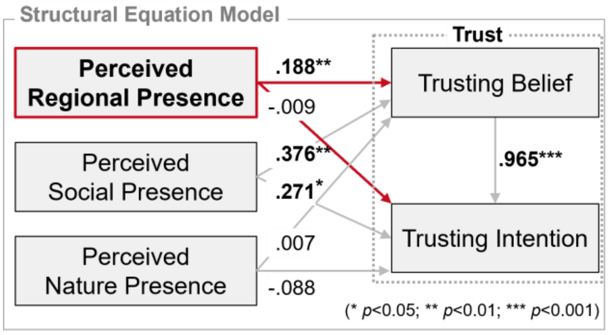


FIGURE 28. RESULTS OF STRUCTURAL MODEL

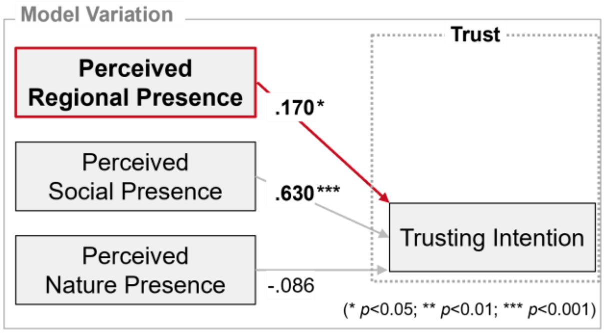


FIGURE 29. MODEL VARIATION

We corroborate the above findings by including the control variables into the model (i.e., visual aesthetics (Model 1 in Table 9), disposition to trust (2), nature care (3), and attitude towards city (4)). We find that visual aesthetics (0.43, $p<0.001$), disposition to trust (0.83, $p<0.001$), and nature care (0.20, $p<0.01$) have positive and significant relations with trusting belief, while not so with trusting intention. Importantly, the positive and significant relationships between PRP, trusting belief, and trusting intention remain robust across all model variations in terms of sign, magnitude, and significance.

TABLE 9. SUMMARY CB-SEM RESULTS FOR VARIATIONS OF CONTROL VARIABLES.

n=329 participants		Dependent Variable							
		TB	TI	TB	TI	TB	TI	TB	TI
		1		2		3		4	
Independent Variables	PRP	**.153****	-.008	**.122***	-.011	**.179****	-.009	**.178****	.009
	PSP	.120	.242	**.374*****	**.271***	**.395*****	**.286***	**.383****	**.254***
	PNP	-.010	-.090	-.014	-.088	-.009	-.093	.008	-.089
	Visual Aesthetics	**.425*****	.862						
	Disposition to Trust			**.383*****	.017				
	Nature Care					**.195****	.088		
	Attitude towards City							.022	-.040
	Trusting Belief		**.898*****		**.959*****		**.943*****		**.972*****
Fit	CFI	.980		.965		.974		.976	
	TLI	.973		.955		.967		.967	
	RMSEA	.045		.053		.045		.050	
	SRMR	.041		.049		.043		.044	

Notes: * p<0.05; ** p<0.01; *** p<0.001; CFI: Comparative Fit Index; TB: Trusting Belief; TI: Trusting Intention; TLI: Tucker Lewis Index; RMSEA: Root Mean Square Error of Approximation; SRMR: Standardized Root Mean Square Residual

Further, we controlled for demographics and experience levels (including the above-mentioned constructs). For trusting intention (as DV), the dummy for German nationality (p<0.05) and the gender dummy are significant (yes = female, p<0.05). All other control variables (e.g., age, employment status, duration of residence in the city, online shopping experience) did not exhibit significant coefficients. Again, the positive and significant relationships of PRP with trusting belief and, in turn, trusting intention remain robust across all models in terms of sign, magnitude, and significance.

Supplementary Analysis: Drivers of PRP. Aiming to better understand the stimulus characteristics that drive PRP, we now inspect the regional stimulus images in greater detail. Specifically, we enriched our model by secondary data based on these images. First, we conducted a color decomposition analysis (example provided in Figure 30) using web tools that decomposed each image's colors, extracted the five most frequent colors' hexadecimal codes, and matched these codes to a palette of eight principal colors[25]. The respective shares of these colors were then included into OLS regression models with PRP as dependent variables.

[25] Web-tool for color decomposition: www.geotests.net/couleurs/frequences_en.html; Web-tool for clustering and color coding: mkweb.bcgsc.ca/color-summarizer; Web-tool for aggregation: https://encycolorpedia.com.

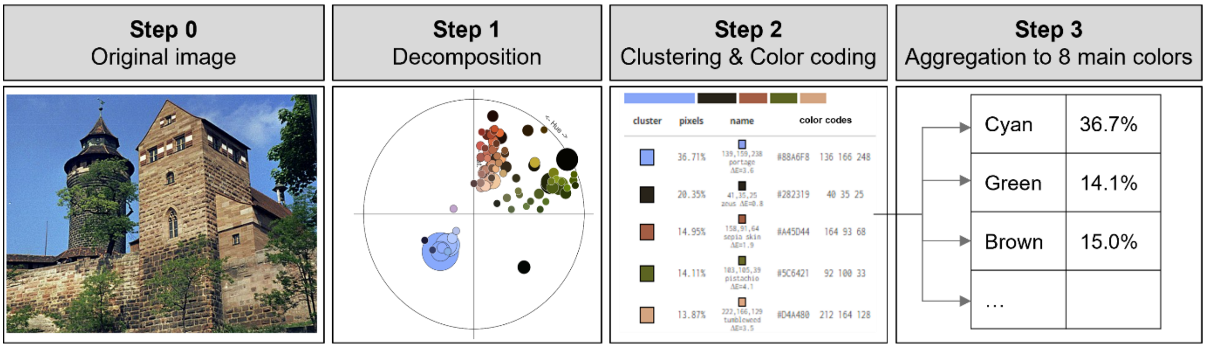


FIGURE 30. DECOMPOSITION OF REGIONAL STIMULUS IMAGERY.[26]

Second, all images were manually coded for light conditions (daylight, night/twilight), perspective (panoramic, close-up), type of sight shown (church, monument, palace, etc.), and other sight attributes (modern/historic). Third, we collected data from the online travel platform *TripAdvisor.com*. We used the number of ratings and the aggregated star rating as a proxy for the popularity of the displayed sight. To assess a sight's popularity relative to other sights within the same city, we used the rank of a sight compared to others in the city (e.g., "No. 3 of 67 activities in Heidelberg"). To control for popularity in the model, we used binary dummies if 1) the sight was ranked first in the city or 2) within the city's top 5%. This enables us to assess four different dimensions (Table 10): Image colors, image style, sight characteristics, and sight popularity (absolute and relative to other sights in the city).

[26] Source for image: commons.wikimedia.org/wiki/File:Nuernberger_Burg_0154.jpg

TABLE 10. DRIVERS OF PERCEIVED REGIONAL PRESENCE REGRESSION SUMMARY

n = 75 images with region cues	Dependent Variable: Perceived Regional Presence							
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
Image Colors[1]	n.s.						n.s.	n.s.
Image Style[2]		n.s.					n.s.	n.s.
Sight Characteristics[3]			n.s.				n.s.	n.s.
Sight Popularity								
5-Star Score				n.s.				
Number of Ratings[4]				n.s.				
Rank within City				n.s.				
Top 1 ranked					**1.33***** (0.32)		**1.28**** (0.47)	
Top 5% ranked						**0.80**** (0.30)		**1.10**** (0.35)
Constant	3.31 (2.18)	**4.55***** (0.27)	**4.45***** (0.64)	3.81 (2.21)	**4.11***** (0.16)	**4.10***** (0.20)	2.55 (2.27)	4.69 (2.41)
R^2	0.15	0.01	0.02	0.001	0.19	0.09	0.33	0.35
Adjusted R^2	0.05	-0.02	-0.10	-0.04	0.18	0.08	0.09	0.12

Notes: * p<0.05; ** p<0.01; *** p<0.001; n.s. = not significant; Standard error in parentheses.
[1]Image Colors: %-share of cyan, blue, magenta, red, orange, yellow, green, and brown in the image.
[2]Image Style: Dummy variables for light conditions (daylight, night/twilight), perspective (panoramic, close-up).
[3]Sight Characteristics: Dummy variables for type of sight (church, monument, palace, etc.), age of sight (modern/historic).
[4] centered and normalized

We find that image colors (shares of 8 main colors in the image, Models I, VII, VIII), image style (perspective, light conditions, Models II, VII, VIII), and sight characteristics (type of sight, age of sight, Models III, VII, VIII) all seem to be unrelated to perceptions of regionality. Also, the absolute popularity of the displayed sight does not seem to play a role in this context (Model IV). However, what jumps out is the strong effect of highly ranked sights on regionality perceptions (Model V, β= 1.33, p<0.001 for images with top 1 ranked sights; Model VI, β= 0.8, p<0.01 for top 5% ranked sights). Apparently, to effectively trigger PRP, it makes a big difference whether just any sight out of a city is displayed or instead (one of) *the* representative sight is shown. The effect size is quite remarkable (1.3 points on a 7-point scale for images showing the top 1 ranked sight). For additional robustness checks, we ran all OLS regressions in isolation. Further, we controlled for city-related demographic data of survey participants (duration of residence, attitude towards city) and the size of the city. None of these checks changed outcomes in terms of sign, magnitude, or significance.

Supplementary Analysis: Interplay of PRP, PSP, PNP. For a better understanding of interdependencies between PRP, PSP, and PNP, we analyzed *spillover* and *interaction* effects. Results of the spillover analysis are displayed in Table 11. Beyond all cue types' (regional, social, nature) effectiveness in triggering outcomes *within* their respective category, we observe a negative cross-category effect of regional cues on PNP. This is reasonable since the regional cues typically display man-made objects and hence present an opposite to nature. To shed light on the interactions between cue types, we conducted OLS regressions with all two-way interactions (i.e., PRP×PSP, PRP×PNP, PSP×PNP). All interactions were insignificant.

TABLE 11. SPILLOVER EFFECTS

n = 329 participants	Dependent Variable		
	PRP	PSP	PNP
Regional Cue [present=1, otherwise=0]	**1.15***** (0.15)	-0.04 (0.14)	**-0.28*** (0.14)
Social Cue [present=1, otherwise=0]	-0.20 (0.15)	**0.28*** (0.14)	-0.02 (0.15)
Nature Cue [present=1, otherwise=0]	-0.008 (0.15)	0.01 (0.14)	**0.93***** (0.15)
Constant	**3.32***** (0.16)	**3.48***** (0.15)	**4.05***** (0.15)
Adjusted R^2	0.14	0.003	0.11

Notes: $^+$ p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Discussion

In this study, we investigated the impact of embedding regional cues in UIs. In Study 1, we evaluated how regional cues affect users' information processing by means of an eye-tracking experiment. Our findings suggest that regional cues capture a significant amount of visual attention compared to neutral imagery. The increased visual attention to regional cues suggests that these cues were important (Poole & Ball, 2006) and of interest to participants (Cyr & Head, 2013). Further, higher visual attention on a design element signals that the information provided by this element is actively made use of, for instance, for decision-making (Gloeckner & Herbold, 2011). Diving deeper into the matter, in Study 2 we conducted an online experiment, assessing the effects of regional cues on perceptions of regional presence and, in turn, on trust. Our findings confirm that embedding regional cues in UIs increases PRP with positive effects on trusting belief and trusting intention.

Theoretical Implications

Our findings have theoretical implications for the broader research community. First, while the effectiveness of social and nature cues is commonly accepted (e.g., Gefen & Straub, 2004; Lu et al., 2016; Rendell et al., 2021), our findings suggest that future research should consider regional cues as well. We shed first light on the rather novel concept of PRP which may capture an important aspect of user perceptions in the interaction with UIs. In doing so, we extend the academic debate on the use of visual cues in UIs and their effects on user attitudes and behaviors. Alike social and nature cues, regional cues seem to be capable of triggering evolutionary psychological patterns. We confirm established relations between PSP and visual aesthetics with trusting belief and intention (e.g., Gefen & Straub, 2004; Li & Yeh, 2010; D. Zhang et al., 2010) which corroborates the robustness and validity of the overall model and approach. However, unlike earlier studies (e.g., Rendell et al., 2021; Schmuck et al., 2018), we did not find significant relationships of PNP. This could be caused by the relatively small image size in the survey, stalling any meaningful virtual nature experience. In contrast, it is reasonable to assume that seeing a face or a regional landmark in small size may be sufficient to trigger PSP and PRP. In conclusion, regional cues seem to be a potent design element for UIs and should receive more attention in future research and practice.

Second, we provide a new perspective on CET which assumes favorable consumer attitudes towards products, services, and providers based on a match of product/service/provider origin and consumers' own geographic location (Shimp & Sharma, 1987). However, a geographic match may not always be clear or a dichotomous matter – and the line between region and non-regional products/services/providers becomes even more blurry online. Our findings extend CET by suggesting that already the *perception* of regionality (rather than an actual geographic match) may be sufficient to trigger ethnocentric consumption patterns. Interestingly, the analysis of the open-ended responses in Study 2 showed that none of the participants directly stated the products'/providers' regionality as a factor that influenced their evaluation. In contrast, most participants pointed to product properties (e.g., price, contract length) or website design (e.g., overall aesthetics) as reasons for their assessment. This circumstance further nourishes the assumption that the regional cues trigger some form of *unconscious* psychological effect. Our analysis also provides insight into which image characteristics trigger ethnocentric consumer behavior. Specifically, PRP is primarily driven by the most iconic sights of a city and less so by less famous landmarks. This finding provides an indication that the recognition of or familiarity with the object shown in the image alone may not be sufficient to trigger ethnocentric consumption patterns. It rather seems that a reference to a truly iconic, identity-establishing landmark is required to trigger this evolutionary psychological effect.

Implications for UI Design

Our study shows that regional cues represent an effective design element for online trust building, visual attention, and – ultimately – behavior. This has an important implication: In contrast to social and nature cues, regional cues require a user-specific design tailored to the user's location. We addressed this challenge for the experimental design of Study 2 by compiling a database of images with regional cues and using region-specific stimulus material for participants depending on their city/ region as provided earlier in the process. However, asking users for their location is typically not feasible in practice. Therefore, we take a brief look at some approaches to assess user location, along with the most striking advantages and shortcomings:

- **IP address.** A common approach to localize users is to match their internet protocol (IP) address in geolocation databases (Shavitt & Zilberman, 2011). This is a convenient method because the IP information is easy to capture and can quickly be matched to location data using geolocation services. As a disadvantage, this procedure is not accurate if people use virtual private networks or at times when they are not at home (e.g., at work, travelling).

- **Cookies**. Providers may also generate insights on user geolocation by analyzing earlier user transactions through cookies. Cookies enable providers to identify users without them going through log-in procedures (Englehardt et al., 2015). Therefore, providers can link the current session to earlier ones and use the data collected during historic user interactions to draw conclusions on the user's location. Yet, this approach is limited as users may manually deny the use of Cookies. Also, this procedure is limited to repeat users.
- **User profile data**. Potentially the most accurate path in this context is to ask users what area they consider their home region (e.g., by providing their address). This can be implemented via user profiles. Still, the method hinges on users' willingness to create a profile and provide this information.
- **Third party services**. Third party services such as *Google Ads* can predict user preferences with high accuracy (Castelluccia et al., 2012). Such a service can also be used to gain insights on user geolocation. However, these services will typically come at a cost and are subject to public headwinds due to their interference with data privacy.
- **GPS data**. For applications on mobile devices, geo-location can be gained via the device's global positioning system (GPS; Al-Suwaidi & Zemerly, 2009). However, users may choose to deny access to this information.

In summary, there seems to be no one-size-fits-all approach and future work should further analyze which method is best suited for specific circumstances.

Societal Implications

While not the primary focus, this paper also contributes to the debate around the design of UI and information systems in general to foster sustainability. Leading scholars have called for research to fight climate change by means of developing and designing better information systems (e.g., Watson et al., 2010). Most importantly, practical research with implications beyond theory is needed (vom Brocke et al., 2013). In recent years, this topic has caught increasing scholarly attention. One way research could contribute is the design of solutions that "support decision-making for more sustainable practices" (Gholami et al., 2016, p. 527). *Buying regional* is usually considered as a sustainable choice in many dimensions such as biodiversity, animal welfare, governance, and resilience (Schmitt et al., 2017). Regarding other aspects such as carbon footprint, land use, energy, or water consumption, the debate is still out on whether to favor regional over non-regional consumption. After all, outcomes depend on "a diverse range of system boundaries, produce types, varied assumptions and a multiplicity of foot printing methods" (Rothwell et al., 2016, p. 421). In contrast, other researchers claim that only a shift towards a more regional economy will enable us to reach ecologic sustainability (Curtis, 2003). We provide starting points for UI design to nudge consumers towards more regional and hence – potentially – more sustainable decisions.

Limitations and Future Work

Like any empirical study, this one is not without limitations. First, both studies are somewhat limited in that they survey intentions and perceptions rather than actual behavior. To increase external validity, future work should expand on our design and analyze actual user behavior. For instance, researchers could cooperate with electricity providers to analyze their website design by A/B testing with/without regional cues. Second, we have focused on imagery in this paper, but other cue types such as badges, labels, or icons are frequently used in practice, too.

As future work, we suggest investigating them and their effects on user attitudes and behaviors. Third, the sample in the eye-tracking study featured 65% male participants which are generally more affected by the issue of color blindness. While we had surveyed all eye-tracking participants for eye health conditions (none indicated by any participant), we did not specifically check for color blindness and hence cannot judge how this potentially affected our results. However, since the supplementary analysis in Study 2 suggests that image colors do not drive PRP, we believe this risk is negligible. Nevertheless, it should be included in future eye-tracking studies on this subject. Fourth, future work could further disentangle the concept of regionality. In our studies, we interpret regionality as the geography in which the experiment participant is living at the time of the experiment. In Study 1, this interpretation was implemented by drawing participants from one city. In Study 2, we surveyed participants for their current area of residency and tailored the stimulus material to this geography. However, users may also feel a sense of regional belonging to other cities, such as, their place of birth, the city they grew up, the city they spent their semester abroad, and so forth. In some cases, these effects even overlap (e.g., if city of birth and current city of residence are identical). In our analysis of Study 2, we tackled this issue to a certain degree by controlling for the duration of residence (did not have significant effects). To shed further light on this matter, future work could, for instance, repeat Study 2 but use the city of birth instead of the city of residence as trigger for the stimulus material generation.

Conclusions

The present study is one of the first to investigate the impact of embedding regional cues in UI on user attitudes and behaviors. Drawing on CET, we developed a theoretical model and evaluated it by means of a multi-method approach – including an eye-tracking lab experiment and an experimental online survey. As regional cues in fact capture visual attention and increase trust, the results of our study have important implications for UI researchers and practitioners. Accordingly, regional cues emerge as a powerful tool for UI design in a wide range of application areas.

Chapter VI: On the Effects of Regional Trust Cues on User Behavior – Labels

While the previous section focused on regional imagery, this chapter assesses how regional labels affect user attitudes and behavior. Again, the findings suggest that a regional trust cue (this time the label) captures significant visual attention and increases trusting intention and belief. In this case, the study further indicates that the use of the label reduces consumers' time to decision.

Tobias Menzel, Timm Teubner[27,28]

Introduction

Decarbonizing the electricity market is a pivotal challenge in the efforts to limit global warming (IPCC, 2014). This requires replacing fossil fueled generation assets by renewable energy technologies such as wind, solar, and hydro power plants (W. Huang et al., 2017). In recent years, major progress has been made in this area. For example, in 2020, the share of electricity from renewable sources has reached 28% of total power generation globally, where country-specific figures range between 20% in the US, 29% in China, and 39% in the EU (IEA, 2021). Nevertheless, major social hurdles persist in the further and faster expansion of the renewable technology roll-out (Fait et al., 2022): While the general support for the power sectors' green transformation is high, people resist to renewable power assets being installed in close proximity to them (e.g., Dimitropoulos & Kontoleon, 2009; Dugstad et al., 2020; Kalkbrenner et al., 2017; Ki et al., 2022; Thomas et al., 2022).

Aiming to address this issue, Germany – being considered a leader in this transformation (Fait et al., 2022; Grimm et al., 2021) – has introduced a new classification system in 2019. It enables power suppliers to market green energy generated in close proximity to consumers as *regional green electricity*[29] (BMWK, 2016; UBA, 2019). Through this approach[30], the "legislator intends to promote the identification of consumers with renewable electricity installations in their region, in particular to avoid negative attitudes to the expansion of renewable energies" (UBA, 2019, p. 1). A recent representative survey indicates that, on the one hand, consumers indeed appreciate this approach (UBA, 2021): A large majority of consumers considers regional green electricity an important contribution to a successful energy transition and a potent means to increase local acceptance. On the other hand, however, the survey also unveils a lack of transparency and credibility of the current communication of regional green electricity (UBA, 2021). With electricity being a homogenous good, it is virtually impossible for consumers to monitor the product quality of their electricity

[27] This chapter was submitted to a major international journal, is currently in the review process, and carries the title "Signaling sustainability and regionality in the electricity market: An eye-tracking study on labels". This version is based on the initially submitted manuscript.

[28] Acknowledgement: I thank my student Catayoun Azarm for her support in the experiment execution.

29 While local green electricity would be a more accurate translation for the German regionaler Grünstrom, we stick with regional green electricity in this article as this terminology is predominantly used in related work (e.g., Fait et al., 2022; Lehmann et al., 2021, 2022).

30 see Appendix for a detailed explanation on the definition and certification process.

supply (Rommel et al., 2018): At the point of consumption, the physical flow of electricity generated in regional renewable power plants is identical to that from nuclear or coal power plants far away. Hence, consumers are confronted with the issue of information asymmetry around sustainability and regionality of their power supply.

Research in related contexts has explored the use of visual labels as a means to overcome such information asymmetry (e.g., Atkinson & Rosenthal, 2014; Bougherara & Combris, 2009; Markard & Truffer, 2006). In fact, 71% of participants in the aforementioned survey state that an official (visual) label would be useful for their decision-making and increase the classification's transparency and credibility (UBA, 2021) . However, the use of visual labels has, to our best knowledge, not been studied in the context of regional green electricity and it is hence unclear whether and how such a label would actually affect consumer attitudes and behavior. A better understanding of this relationship could contribute to reducing the outlined information asymmetry and, in the long run, to mitigating this hurdle to further and faster roll-out of renewable energy generation. We hence pose the following research question:

RQ: Can a visual label for regional green electricity affect consumers' attitudes and behavior?

In this paper, we draw on Signaling Theory (Spence, 1973) to hypothesize on the label's effects on consumers' visual attention, time to decision, and stated trust in supplier and product. We present results from a multi-method lab experiment (38 participants, 304 observations), including survey and eye-tracking data. In a nutshell, we find that a (hypothetical) visual label for regional green electricity captures significant visual attention, reduces time to decision, and has positive effects on trust-related response variables. Further, the label's effect on visual attention and trust is moderated by participants' familiarity with the label. Our findings suggest that policymakers and regulators should explore the introduction of visual indicators for regional green electricity and invest such labels' propagation and popularity.

The remainder of the paper is organized as follows: Section 2 presents related work and develops the research model. Section 3 describes the methodology for the multi-method lab experiment followed by its empirical results in Section 4. Section 5 discusses findings, theoretical implications, and limitations. Section 6 concludes with policy implications.

Background and Research Model

Regional Green Electricity

With the aim to "promote the identification of consumers with renewable electricity installations in their region" (UBA, 2021, p. 1), Germany introduced a *system for guarantees of regional origin* (SGRO) in 2019 (BMWK, 2016; UBA, 2019). This system allows operators of renewable generation assets to receive *guarantees-of-origin* certificates for their electricity production. These *proof-of-origin* certificates enable energy providers to market *regional green electricity* if a) the generation asset is situated within a 50-kilometer range of the consumer's location and b) the energy supplier has a contractual relationship with the generation asset operator (Fait et al., 2022; Lehmann et al., 2022).

Note that this concept differs considerably from other geography-related certifications. In the realm of electricity, the European Union's system for guarantees-of-origin (European Union, 2009) provides a proof-of-origin for *renewable* electricity but lacks the *geographic* component (see Lehmann et al., 2021 for a short discussion). Outside the electricity domain, guarantees-of-origin (e.g., the Swiss-made label for watches, a designation-of-origin certificate, etc.) build on geographic areas of production (e.g., Ham from Parma, Bourbon Whiskey from Kentucky) but are independent of the *consumers'* location. In contrast, the regional green electricity certification requires a match of the locations of supply and demand.

It has become evident that consumers appreciate electricity from renewable sources (e.g., Amador et al., 2013; Borriello et al., 2021; Buryk et al., 2015; Dimitropoulos & Kontoleon, 2009; Koto & Yiridoe, 2019; Xie & Zhao, 2018), generated in some geographic proximity (i.e., not necessarily the 50km range: Groh, 2022; Kaenzig et al., 2013; Kalkbrenner et al., 2017; K. S. Lee et al., 2021; Mengelkamp, Schönland, et al., 2019). Most recently, several studies have confirmed these findings in light of the regional green electricity classification (Fait et al., 2022; Lehmann et al., 2022). Also, energy providers have started to embrace the advertisement and marketing opportunities that regional electricity production presents (Herbes & Ramme, 2014; Menzel & Teubner, 2021e).

However, consumers are skeptical regarding the credibility and transparency of the current communication of regional green electricity (UBA, 2021). This comes to no surprise, as the product's sustainability and regionality can be considered *credence* features (Nelson, 1970, 1974). While many product characteristics can be verified either through search or experience, credence claims must be accepted at face value by consumers (Atkinson & Rosenthal, 2014). Nelson (1970, 1974) provides the example of tuna cans for which consumers can verify claims about its taste by consuming it. Yet, claims about other attributes such as the fishing method or the catch location cannot be verified by consumers per se (Bottega & de Freitas, 2009). The same applies to the features of regionality and sustainability in the context of electricity: The origin and production technology of electricity are, at the point of consumption, physically undiscernible. Accordingly, consumers face an information asymmetry regarding these features.

Regional and Green Labels

Addressing the issue of information asymmetry between consumer and producer generated by credence features, visual labels can serve as both a quality assurance for consumers and a communication tool (Markard & Truffer, 2006; Truffer et al., 2001).

Regarding regionality claims, designation-of-origin labels are considered means to overcome information asymmetry between producers and consumers regarding a product's origin (e.g., Halkias et al., 2021). Designation-of-origin cues "reflect the implications that the geographical provenance of the product [origin] has for consumers" and include country-of-origin or, on a smaller level, region-of-origin labels (Chamorro et al., 2015, p. 820). Most prominently, the *country*-of-origin effect (first described by Schooler, 1965) explains that respective labels can influence human information processing (Halkias et al., 2021) and perceptions of product quality (Hong & Kang, 2006). Similarly, *region*-of-origin labels are considered to affect user attitudes and behavior in the sense of increasing quality perceptions (García-Gallego & Chamorro Mera, 2018), purchase intention, and willingness-to-pay (Bruwer & Johnson, 2010; Chamorro et al., 2015).

Considering sustainability features, eco labels can provide a relevant signal to consumers holding concerns about the environmental qualities of a good or service (Atkinson & Rosenthal, 2014; Bougherara & Combris, 2009). An eco label is "any symbol appearing on [a] product […] that seeks to inform consumers that a particular product is in some significant way less harmful to the environment than purchase alternatives" (Tang et al., 2004, p. 87). Eco labels have been shown to effectively affect consumer attitudes and behavior (Jain et al., 2018; Murray & Mills, 2011; J. Y. Park, 2017; Z. Wang et al., 2019; Ward et al., 2011). The combination of sustainability and regional features, however, has thus far received little research attention.

Signaling Theory and Hypotheses Development

Signaling theory provides a suitable theoretical framework to explain how eco and regional labels affect user attitudes and behavior in situations of information asymmetry around a product's quality (Erdem & Swait, 1998). First employed in the economic context by Spence (1973), the theory considers markets with information asymmetry (in Spence's example job seekers and employers). According to the theory, the more informed side can use signals to unveil their otherwise unobservable quality (e.g., talent, skills, product quality). A fundamental principle for signaling to function properly is that obtaining those signals is inherently costly and associated with prohibitively high cost for owners of low-quality traits and (comparatively) low cost for owners of high-quality traits. This ultimately results in a market equilibrium in which only the owners of high-quality traits have an incentive to acquire the signal ("separating equilibrium"; Bergh et al., 2014, p. 1335). In turn, the signal itself becomes a quality differentiator (Dann et al., 2022). Applied to situations in which producers hold better information on credence claims around product quality, consumers draw on information cues (e.g., labels) in their evaluation of product quality (Basoglu & Hess, 2014; Kirmani, 1997; Kirmani & Rao, 2000; Nelson, 1970, 1974). In this sense, a label becomes "a marketer-controlled, easy-to-acquire informational cue, extrinsic to the product itself, that consumers use to form inferences about the quality or value of that product" (Bloom & Reve, 1990, p. 59).

In the case of regional green electricity, the preconditions for effective signaling are met in the sense that certification requires a lengthy process. Accordingly, producers of regional green electricity will be able to obtain the certificate at manageable cost, while other producers can only obtain the certification through fraud, which, in turn, goes along considerable legal and reputational risks and associated costs. Therefore, labels tied to the regional green electricity certification should be a powerful tool to overcome the information asymmetry between suppliers and sellers around the electricity's regionality and sustainability claims. Drawing on this theoretical groundwork, we focus on three dimensions to provide a holistic assessment of whether and how a visual label for regional green electricity affects consumer attitudes and behavior (Figure 31).

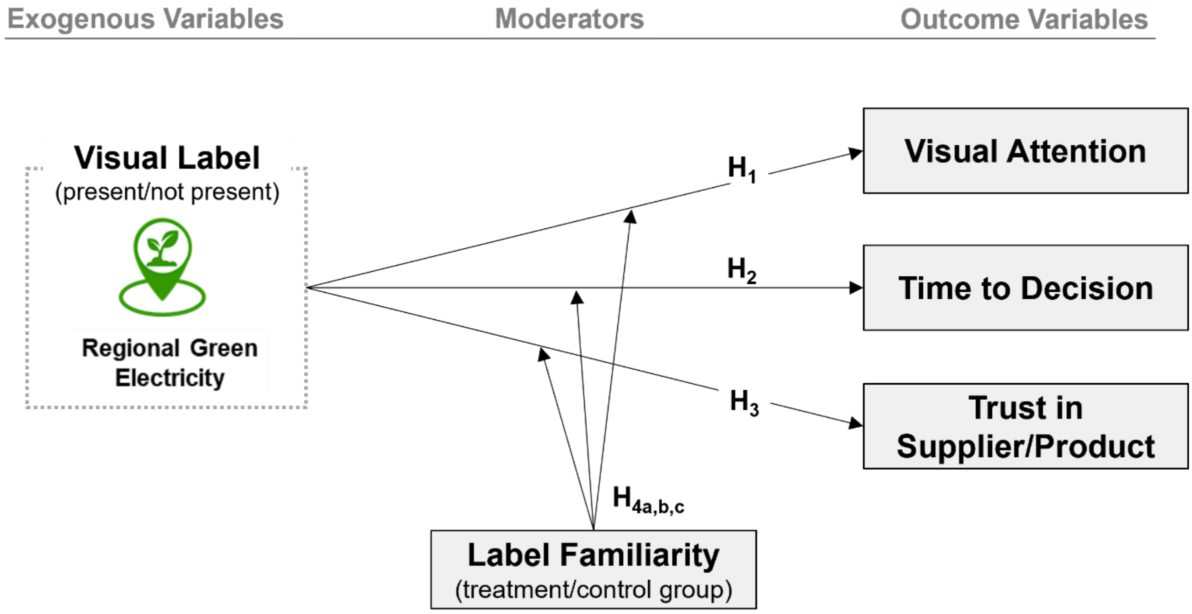


FIGURE 31. RESEARCH MODEL (NOTE: LABEL TRANSLATED)

First, we consider visual attention (path H_1 in Figure 31): If the label were to be effective in the sense of signaling theory, it should influence consumers' decision-making processes in some form. In this regard, attention to visual elements such as labels is associated with human information processing (Schulte-Mecklenbeck et al., 2017). The idea of drawing on visual attention to understand cognitive processes builds on two established assumptions (Just & Carpenter, 1980). First, the *eye-mind assumption* claims a strong connection between thoughts and line of gaze. Second, the *immediacy assumption* suggests that information received through the eyes is immediately processed and hence the visual attention to an object is in line with the time of information processing of the object. Put in simpler terms, if a label attracts significant visual attention, it is considered to be of some sort of interest to the consumer (Cyr et al., 2006), important (Poole & Ball, 2006), or even actively influences the decision-making process (Gloeckner & Herbold, 2011). Some recent work showed that eco and regional labels can attract visual attention (e.g., Fabianek et al., 2020; Halkias et al., 2021; Song et al., 2019). Therefore, we hypothesize:

H_1: A label for regional green electricity captures significant shares of consumers' visual attention.

Second, we evaluate whether a label affects consumers' time for decision-making (H_2). While the previous hypothesis reflects on whether a label affects decision-making at all, this (and the next) hypothesis covers the question *how* consumers decision-making is concerned. In light of signaling theory, labels are considered as a "simplifying strategy for consumers" in situations of asymmetric information (Atkinson & Rosenthal, 2014, p. 34). The use of a label is considered to be convenient (Narayanan & Huebscher, 1998) and reduce complexity for the recipient of a message (Rogers, 1986). Accordingly, a potent label should reduce complexity for the consumer. Following Hick's law (Hick, 1952) this should, in turn, reduce the time needed for decision-making. We hence hypothesize:

H_2: A label for regional green electricity reduces consumers' time for decision-making.

Third, we assess consumers' trust in supplier and product (H_3). Trust is a perquisite for basically any human interaction, but in particular so for commercial relationships (e.g., Mayer et al., 1995; McKnight & Chervany, 2001). From the viewpoint of signaling theory, labels are a means to overcome the information asymmetry between sellers and buyers and hence increase consumers' trust in seller and product quality (Kirmani & Rao, 2000). In particular, when faced with sustainability-related product features, consumers are often skeptical whether producers are truthful about their quality claims (Kalafatis et al., 1999). Therefore, their intention to make sustainable purchase decisions is often hindered by their lack of trust concerning green product claims (Leire & Thidell, 2005). In such situations, a label generates trust and "acts as a lubricant" for decision-making (Atkinson & Rosenthal, 2014, p. 34). Related studies suggested that eco labels and designation-of-origin labels are drivers of trust in supplier and product (e.g., Atkinson & Rosenthal, 2014; Jiménez & San Martín, 2010) which ultimately drives business-relevant outcome variables such as purchase intention and willingness-to-pay (Bernard & Zarrouk-Karoui, 2014; Bruwer & Johnson, 2010; Chamorro et al., 2015; Z. Wang et al., 2019).

H_3: A label for regional green electricity increases consumers' trust in supplier and product.

Capping the holistic assessment, we intend to address a common critique of labels: An frequently raised argument against using eco labels builds on the preconception that they are limited by their familiarity to consumers (Song et al., 2019; Teisl et al., 2002; van Amstel et al., 2008). Hence, eco labels are assumed to require extensive "brand building" (Tang et al., 2004, p. 101) and efforts to increase consumer knowledge to effectively alter consumers' attitudes and behavior (Rex & Baumann, 2007) – after all, people tend to trust what they know and, vice versa, tend to be skeptical of what they don't. Against the background of signaling theory, a signals' credibility is critical for its function in overcoming information asymmetry (Atkinson & Rosenthal, 2014; Sun et al., 2021). Accordingly, we hypothesize that consumers' familiarity of a label for regional green electricity will enforce its effects on visual attention (even higher), time to decision (even faster), and trust (even more; paths $H_{4a,b,c}$):

H_4: Consumers' familiarity with the label for regional green electricity will moderate the label's effect on visual attention (H_{4a}), time to decision (H_{4b}), and trust in supplier and product (H_{4c}).

Materials and Methods

We evaluate the proposed research model by means of a scenario-based lab experiment. In this scenario, participants were asked to evaluate electricity contracts on a fictive price comparison website. On this website, we systematically varied whether the described label was shown or not as the main treatment variable. Such an experiment provides a high degree of control and allows for assessing the causal effects by the exogenous treatment variable (in this case the label; Cassar & Friedman, n.d.).

Scenario and Treatment Design

Participants acted as consumers seeking to book a household electricity plan. As the majority of electricity contracts in Germany is purchased via price comparison platforms (YouGov, 2015), we based our experiment on this sales channel. To evaluate the label's effects on visual attention, time to decision, and trust (H_1, H_2, and H_3), we used a within-subject design as it allows controlling for between-subject variations which improves the power to identify differences and reduces error (Neuman et al., 2019). Aiming for a realistic scenario, we provided two different electricity plans with variations in price and contract length drawn from an actual comparison website (plan 1: 46.79€ per month, 12 months contract duration; plan 2: 49.81€ per month, variable contract duration). All tariffs were based on the consumption of a 2-person household (2,200 kWh p.a.). As treatment condition, a label for regional green electricity was either present or not. We also included labels for regional (but not green) and green (but not regional) electricity. This enables us to disentangle the effects of regional and green claims and provides a somewhat more realistic search-and-comparison scenario. Applying a full-factorial design, all participants were hence asked to evaluate 2 × 2 × 2 = 8 electricity plans in randomized order (i.e., [plan 1, plan 2] × [no label, regional label component] × [no label, green label component]).

In addition, we included a between-subject design element to evaluate how the label's familiarity moderates the aforementioned outcome effects (H_4). Half of all participants (at random) were briefed with information on the labels prior to engaging with the comparison website (familiarity group). The other half did not receive any information on the labels (control group). Since the labels were developed deliberately for this experiment, the control group is not familiar with the labels (by design).

Stimulus Material and Label Design

For a realistic setup, we based the stimulus material on an actual price comparison website for household electricity plans (*verivox.com*). We changed the website provider name, blurred adjacent offers, and replaced the electricity supplier logo with a generic logo to avoid that associations with real providers would affect participants' evaluation. Building on this setup, the eight stimulus conditions were produced by variations of contract details and price as well as the addition of the 3 different labels (see Figure 32).

Regarding label design, we conducted a pre-study collecting green and regional labels through content analysis of 318 energy supplier websites and 8 leading price comparison platforms. In addition, earlier work indicates that eco labels are most effective if they combine visual and text elements (e.g., M. Kim & Lennon, 2008; Tang et al., 2004). To ensure high internal validity, labels should further be prominently placed on the screen (Faraday, 2000) and be of similar style and size (Orquin & Holmqvist, 2018). Finally, labels should differ sufficiently from existing ones to avoid confounding effects due to associations with existing labels. Taking this into account, we created the stimulus material as displayed in Figure 32. We included a realism check in the measurement instrument as part of the experiment. The average participant score of 5.9 on a 7-point Likert scale indicates that the stimulus material provided a fairly realistic scenario.

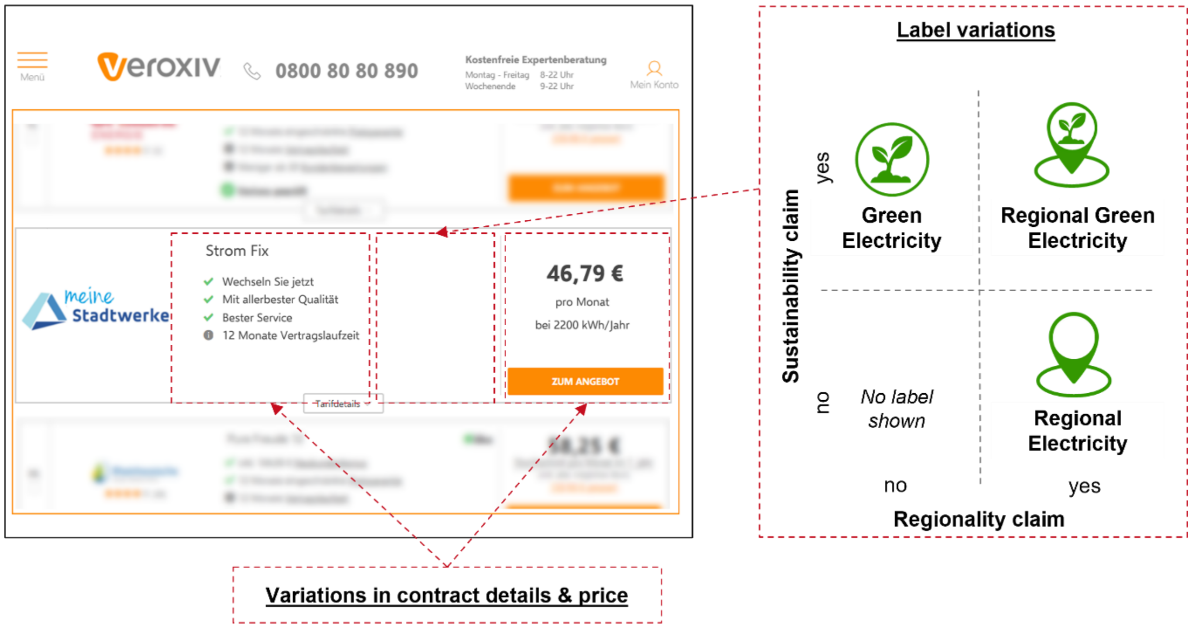


FIGURE 32. STIMULUS MATERIAL (NOTE: LABELS TRANSLATED)

Measures

To assess visual attention, we draw on eye-tracking measures. Analyzing eye-movements is a frequently used method to evaluate consumer behavior in general (e.g., Meyerding & Merz, 2018; Song et al., 2019) and visual attention in particular (e.g., Djamasbi et al., 2008). Therefore, we defined four areas of interest (AOI) in our stimulus material. These none-overlapping rectangles cover the areas in which label (AOI_label), supplier logo (AOI_logo), contract details (AOI_text), and price details (AOI_price) are situated. Using an eye-tracking device, we measured participants' fixations of those AOIs. A fixation is "a period of relative stability during which an object can be viewed" (Jacob, 1995, p. 260). It refers to a gaze pattern in which the eyeball stays motionless for a certain period of time (typically 200-300 milliseconds; Rayner, 1998). Fixation data offers insights on whether information is merely scanned or actively made use of for decision-making (Gloeckner & Herbold, 2011). As measures, we collected the fixation count (i.e., how often an AOI is viewed) and fixation duration (i.e., how long an AOI is viewed). Since we hypothesize a relationship of label and time to decision, we use relative values for the visual attention measures (i.e., fixation count and fixation duration as share of all fixations and total fixation duration) to control that systematically shorter or longer time to decisions distort the measurement of visual attention. Gaze data was collected with a Gazepoint GP3 HD eye-tracker with sampling rate of 150 Hz.

To measure time to decision, we collected participants' response time. For each of the eight stimulus combinations, participants were at first presented with the stimulus material without survey items. Only upon participants' request, the items would appear, and participants could fill in their responses. We extracted the time from appearance of the stimulus material to the request for the survey items from the system to generate a proxy for time to decision.

For the measurement of trust, we draw on validated scales for trusting belief and trusting intention with adjustments to the electricity context (Everard & Galletta, 2005; Gefen & Straub, 2003). Since the within-subject design requires participants to score each item multiple times, we condensed the scales to a single item in order to manage the overall volume (Trusting Belief: “This electricity provider is trustworthy”; Trusting Intention: “I am very likely to buy an electricity plan from this website”; details provided in the Appendix). We used 11-point Likert scales for both items.

We further collected control variables at the end of the experiment. Specifically, we control for disposition to trust (Gefen, 2000), disposition to ethnocentric consumer behavior (Shimp & Sharma, 1987), nature concern (Schuhwerk & Lefkoff-Hagius, 1995), age, gender, profession, and prior experience with buying electricity plans via comparison websites. Also, addressing potential spill-over effects, the order in which a stimulus combination appeared during the experiment (from one to eight) is used as control variable.

Sample and Procedure

Caine (2016) reports an average sample size of 21 for eye-tracking lab experiments in a literature review of 560 articles. As we divide the sample in two groups (with label briefing, and without) we aimed to roughly double this mark and scheduled 40 experiment participants – with two dropping out short notice. The resulting participant sample of 38 participants consists of 40% female participants and 50% students. Age ranged between 18 and 85 years with an average of 31 years. Details are provided in Table 12. With each participant responding to 8 stimulus conditions, the total number of observations is hence 304. The sample was drawn by approaching people on and around campus in August and September 2021. No renumeration was offered to participants.

TABLE 12. SAMPLE CHARACTERISTICS

	Treatment Group	Control Group	Total
Participants	19	19	38
Observations	152	152	304
Age – avg	31.11	31.84	31.47
Age – range	18 - 85	18 – 69	18 - 85
Female participants	8	7	15
Students	11	8	19

The entire experiment was run under a strict Covid-19 protocol. The procedure is described in Figure 33. Upon arrival, we welcomed participants and placed them approximately 60 cm from a 21-inch screen on which the experiment was conducted. Next, the eye-tracker was calibrated and validated by the experimenter. Participants were then provided with welcome message, instructions, and terms of participation on the screen. The familiarity group received additional information on the labels at the end of this step. After that, the actual experiment was conducted in which participants engaged with the fictive comparison platform while we tracked their eye-movement and surveyed trust-related items. Participants first saw the stimulus without items and formed their evaluation. Then, the items appeared upon participants’ request and participants provided their input. After a short break, the next stimulus appeared. We refrained from setting any time constraints for the sake of realism (Cyr

& Head, 2008). Last, participants were surveyed for demographic and control items as well as a short textual explanation of their evaluation.

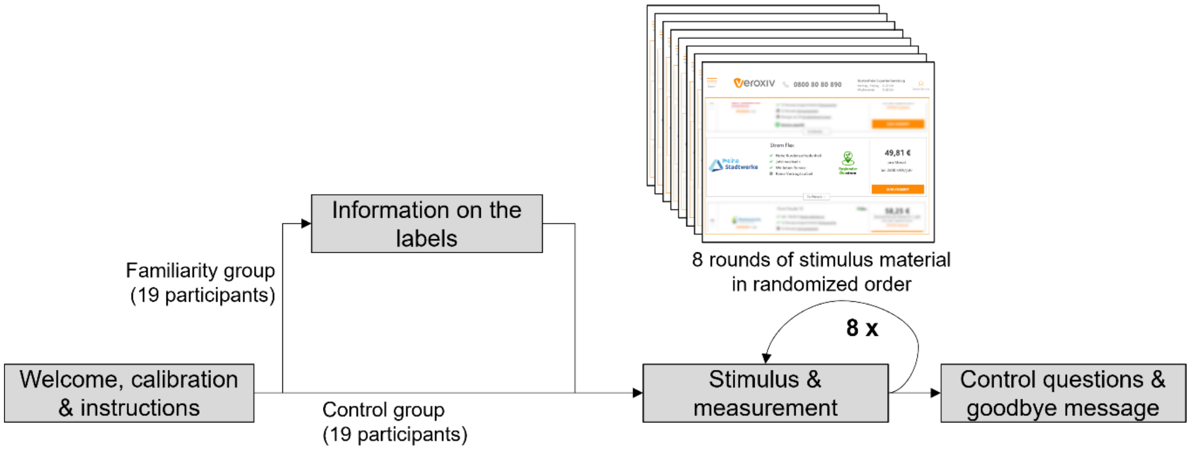


FIGURE 33. EXPERIMENT PROCEDURE

Randomization Check

To check whether the random assignment of participants to the two groups (with label briefing, and without) actually worked, we consider key demographic variables using a set of OLS and logit regressions (Nguyen & Kim, 2019). Assuming successful random assignment, participants' characteristics should not systematically differ across the two groups (Atkinson & Rosenthal, 2014). The analysis (see Table 13) suggests no statistical effects of the group assignment. We hence conclude that the randomization was successful.

TABLE 13. TESTS FOR RANDOM CONDITION ASSIGNMENT

n = 38 participants	**OLS**	**Logit**	
	DV: Age	**DV: Gender = Female**	**DV: Profession = Student**
Familiarity group [assigned/not assigned]	-0.74 (4.80)	0.05 (0.16)	0.16 (0.16)
Constant	**31.84***** (3.40)	**0.37**** (0.12)	**0.42**** (0.12)
R^2	0.001	-	-
Log Likelihood	-	-27.66	-28.10

Notes: + *p*<0.1; * *p*<0.05; ** *p*<0.01; *** *p*<0.001; Standard error in parentheses.
DV = Dependent variable, OLS = Ordinary least squares

Results

As a first visual assessment of the data, we consider heat maps. We then go on using multivariate regression models to evaluate our hypotheses. Supplementary analysis breaks down the labels' effect into regionality and sustainability claims.

A summary of all outcome variables is shown in Table 14. As expected, the two measures for visual attention (i.e., fixation count and fixation duration, $r = 0.9$) are highly correlated which speaks to dependability and robustness of the experiment. The same applies to the measures for trust (i.e., trusting belief, trusting intention, $r = 0.7$).

TABLE 14. DESCRIPTIVE STATISTICS

Measure	OV	AVG	SD	Correlation Matrix				
				FC	FD	RT	TB	TI
Fixation Count [a]	VA	12.37	0.009	1.00				
Fixation Duration [b]	VA	12.29	0.12	0.90	1.00			
Response Time [c]	TD	13.9	6.74	-0.24	-0.22	1.00		
Trusting Belief [d]	TR	5.8	1.88	0.23	0.27	-0.10	1.00	
Trusting Intention [d]	TR	5.6	2.04	0.27	0.26	-0.12	0.69	1.00

Notes:
[a] Fixation Count of label AOI as percentage of all fixations on the stimulus; [b] Fixation duration of label AOI as percentage of total fixation duration on the stimulus; [c] in seconds; [d] Likert scale from 0 to 10.
OV= Outcome variable, AVG = Average, SD = Standard deviation, FC = Fixation count, FD = Fixation duration, RT = Response time, TB = Trusting belief, TI = Trusting intention, VA = Visual attention, TD = Time to decision, TR = Trust

Visual Attention (H_1)

For an initial assessment of visual attention, we visualize participants' gaze patterns with the help of heat maps (Figure 34; outlier filter = 10%, gaze duration = 20 seconds). Overall, the scenario of evaluating electricity plans seems to have worked as desired as the large majority of participants' attention is attributed to areas on the screen with electricity plan information while other elements of the comparison website have received very little attention (90.3% of fixation duration attributed to the 4 AOIs). As shown in Figure 34, the regional green electricity label captures significant shares of participants' visual attention while the same area in the control image (i.e., without label) basically draws no attention at all.

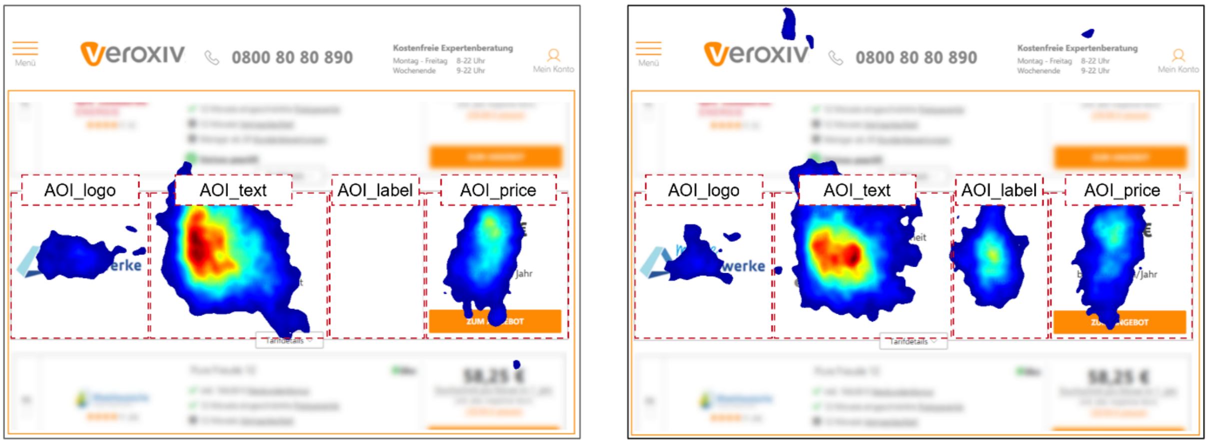


FIGURE 34. HEAT MAP EXAMPLES WITHOUT (LEFT) AND WITH REGIONAL GREEN LABEL (RIGHT).

For a quantitative analysis, we conduct two regression models. First, we employ an ordinary least square model (OLS in Table 15) including participant-level control variables. In the second model, we include participant fixed effects to capture participant-driven idiosyncrasies (least square dummy variable, LSDV). The findings are in line with the previous analysis and confirm H_1. The presence of the regional green label increases visual attention in terms of fixation count (β = 14.1%, $p < 0.001$ in both models) and fixation duration (β = 16.1%, $p < 0.001$ in both models). Consistency of both models and high R^2 values speak to the overall robustness and credibility of the analysis. Note that minor spill-over effects exist, but the effect size is rather small. Apparently, visual attention shifted towards the label during the course of the experiment (i.e., the effect of the experiment round (1 to 8) on fixation count and fixation duration is positive and significant: e.g., β = 0.7%, $p < 0.01$ in the fixation count OLS model). This seems reasonable since other elements such as the supplier logo or the overall design do not change over time while the label is presented in varying versions along the course of the experiment (within-subject design).

TABLE 15. REGRESSION RESULTS

n = 152	Visual attention				TD		Trust			
Measure/DV	DV: FC		DV: FD		DV: RT		DV: TB		DV: TI	
Model	OLS	LSDV	OLS	LSDV	OLS	LSDV	OLS	LSDV	OLS	LSDV
Regional Green Label [present/not present]	**.141***** (.012)	**.141***** (.012)	**.161***** (.014)	**.161***** (.014)	**-2.28*** (1.12)	**-2.28*** (.975)	**1.86***** (.282)	**1.86***** (.240)	**2.70***** (.309)	**2.70***** (.268)
Price [low/high]	.009 (.012)	.009 (.012)	.008 (.015)	.008 (.014)	-.064 (1.12)	-.056 (.976)	-.143 (.282)	-.148 (.240)	-.179 (.309)	-.179 (.268)
Experiment Round [1-8]	**.007**** (.003)	**.006*** (.003)	**.006*** (.003)	.005 (.003)	**-1.10***** (.241)	**-1.04***** (.217)	.012 (.061)	-.026 (.053)	-.066 (.066)	-.063 (.060)
Age [years]	.001 (.001)		.001 (.001)		.027 (.053)		.002 (.013)		-.010 (.015)	
Gender [female=1/ male=0]	.010 (.014)		.029+ (.014)		.144 (1.25)		-.552+ (.314)		-.240 (.345)	
Profession [student=1]	.016 (.016)		.009 (.019)		-.192 (1.48)		.250 (.371)		.249 (.407)	
Disposition to Trust	.007 (.006)		.006 (.007)		.637 (.569)		**.450**** (.143)		**.435**** (.157)	
Ethnocentrism	-.005 (.006)		-.003 (.007)		.620 (.517)		.233+ (.130)		.025 (.143)	
Nature Care	.009 (.011)		.003 (.013)		-1.04 (.969)		-.241 (.244)		-.091 (.267)	
Experience	.009 (.015)		.020 (.018)		-2.41+ (1.347)		.202 (.339)		.008 (.371)	
Participant dummy	—	yes	—	yes	—	yes	—	yes	—	yes
Constant	-.111+ (.060)	-.006 (.039)	-.095 (.071)	-.037 (.045)	**20.3***** (5.43)	**27.4***** (3.19)	**2.91*** (1.37)	**6.99***** (.785)	**3.25*** (1.50)	**6.23***** (.878)
R²	.507	.647	.486	.649	.205	.526	.311	.607	.386	.635
Adj. R²	.472	.519	.450	.522	.148	.355	.262	.465	.343	.504
F statistic	**14.5*****	**5.08*****	**13.3*****	**5.13*****	**3.63*****	**3.08*****	**6.36*****	**4.28*****	**8.88*****	**4.83*****

Notes: + *p*<0.1; * *p*<0.05; ** *p*<0.01; *** *p*<0.001; Standard error in parentheses.
TD = Time to decision, DV = Dependent variable, FC = Fixation count, FD = Fixation duration, RT = Response time, TB = Trusting belief, TI = Trusting intention

Time to Decision (H_2)

Our second hypothesis (label's effect on time to decision; H_2) is also supported by the data. On average, participants responded more than two seconds faster when the label was present (i.e., 13.03 sec vs. 15.35 sec). The effect is significant in both regression models ($p < 0.05$ in both models). Expectedly, we also observe a learning effect (i.e., decreasing response time over the course of the experiment; experiment round: $\beta = -1.10$ in OLS, $\beta = -1.04$ in LSDV, $p < 0.001$ in both models).

Trust (H_3)

According to our analysis, the label for regional green electricity is also a driver of trust (H_3). Drawing on regression results, participants attributed almost two additional points on a 0-10 point Likert scale of trusting belief when engaging with stimulus combinations with regional green label compared to control material ($\beta = 1.86$, $p < 0.001$ in both models) and close to three points for the trusting intention measure ($\beta = 2.70$, $p < 0.001$ in both models). Considering control variables, participants' disposition to trust increases stated trust levels as expected (trusting belief: $\beta = 0.45$, $p < 0.01$; trusting intention: $\beta = 0.44$, $p < 0.01$). Note that we do not identify spill-over effects in this context (experiment round: $p > 0.1$ in all four trust-related models).

Moderating Role of Label Familiarity ($H_{4a,b,c}$)

Next, we turn towards the moderating role of label familiarity. As displayed in Figure 35, briefing participants with label information prior to engaging with the comparison website appears to strengthen the regional green label's effect on visual attention (H_{4a}) and trust (H_{4c}).

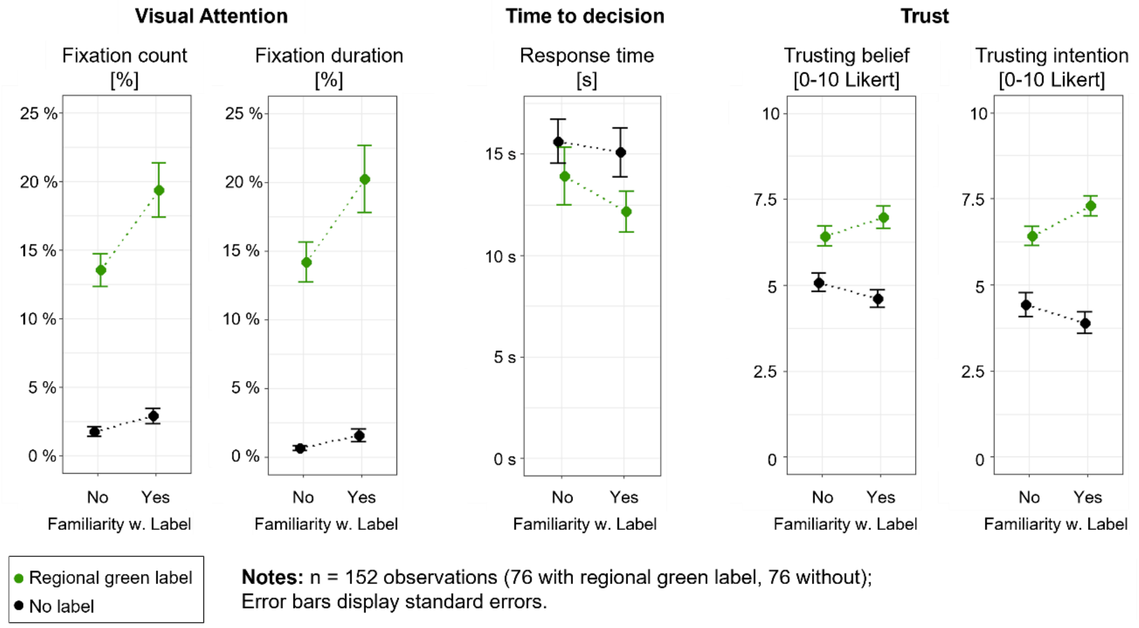


FIGURE 35. INTERACTION EFFECTS OF REGIONAL GREEN LABEL VS. NO LABEL WITH LABEL FAMILIARITY

We deep dive into the analysis by means of interaction regression models (Table 16). For the sake of simplicity and since OLS and LSDV models produced very similar results in the previous analysis, we focus in LSDV models in this analysis. We find that familiarity indeed moderates the label's effect on visual attention (fixation count: $\beta = 4.8\%$, $p < 5.2\%$; fixation duration: $\beta = 1.38$, $p < 0.1$) and on trust (trusting belief: $\beta = 1.02$, $p < 0.05$; trusting intention: $\beta = 1.38$, $p < 0.01$). However, the interaction effect in the context of time to decision is not significant ($p > 0.1$).

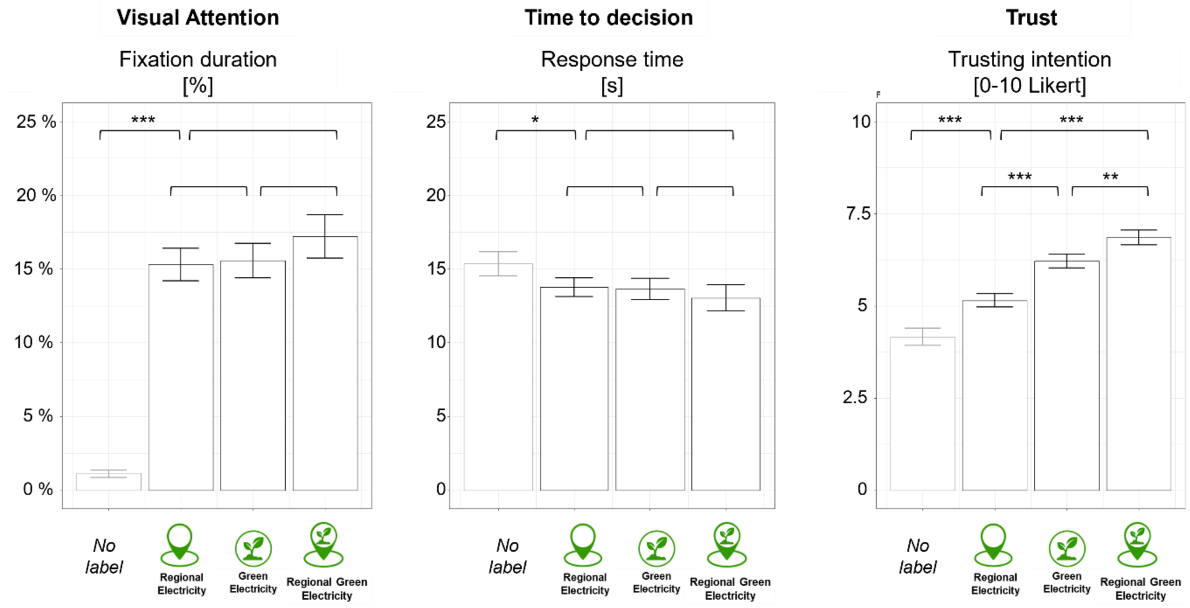
TABLE 16. INTERACTION EFFECT REGRESSION MODELS

n = 152	Visual Attention		TD	Trust	
Measure/DV	FC	FD	RT	TB	TI
Model	LSDV	LSDV	LSDV	LSDV	LSDV
Regional Green Label [present/not present]	**.117***** (.016)	**.135***** (.019)	-1.58 (1.38)	**1.35***** (.334)	**2.01***** (.370)
Label familiarity [Familiarity/control group]	-.034 (.053)	-.042 (.061)	5.45 (4.372)	1.48 (1.05)	1.79 (1.17)
Label × Familiarity	**.048*** (.023)	**.052⁺** (.023)	-1.40 (1.96)	**1.02*** (.472)	**1.38**** (.523)
Price [low/high]	.009 (.012)	.008 (.014)	-.057 (.978)	-.147 (.236)	-.178 (.261)
Experiment Round [1-8]	**.006*** (.003)	.005⁺ (.003)	**-1.04***** (.217)	-.023 (.052)	-.060 (.058)
Participant dummy	yes	yes	yes	yes	yes
Constant	.016 (.039)	-.009 (.045)	**22.3***** (3.25)	**5.24***** (.784)	**4.08***** (.868)
R^2	.660	.660	.528	.623	.657
Adj. R^2	.533	.533	.352	.482	.529
F statistic	**5.20*****	**5.20*****	**3.00*****	**4.29*****	**5.14*****

Notes: + *p*<0.1; * *p*<0.05; ** *p*<0.01; *** *p*<0.001; Standard error in parentheses.
TD = Time to decision, DV = Dependent variable, FC = Fixation count, FD = Fixation duration, RT = Response time, TB = Trusting belief, TI = Trusting intention

Supplementary Analysis: Disentangling Regional and Green Effects

Last, to disentangle the effects of regional and green label components, we consider both components as well as their combination. For the sake of readability, we here focus on one measure per outcome variable in this analysis (fixation duration, response time, and trusting intention, Figure 36). All three labels attracted more visual attention than the control stimuli ($p < 0.001$) and reduced time to decision ($p < 0.05$). We do not identify significant differences between the three labels concerning these two outcome variables ($p > 0.1$). However, there are significant differences with regard to trust. Stimulus material with the regional green label facilitated significantly higher trust scores than when the green component was present, but the regional component was missing ($p < 0.01$), which again received higher scores than stimuli with the regional label (vs. regional green label: $p < 0.001$; vs. green label: $p < 0.001$). All three labels received higher trusting intention scores than control condition (i.e., no label at all; $p < 0.001$).



Notes: $^{+}$ p<0.1; * p<0.05; ** p<0.01; *** p<0.001; n = 304 observations (76 per label type); p-values calculated with regular t-tests for time to decision and trust and Welch's t-test for visual attention. Error bars display standard errors.

FIGURE 36. COMPARISON OF NO LABEL, REGIONAL LABEL, GREEN LABEL, AND REGIONAL GREEN LABEL.

Discussion

In this study, we aimed to address the issue that consumers prefer to purchase green electricity generated in their region but face uncertainty about energy providers' regional and green marketing claims. A label based on the recently implemented classification of regional green electricity could address this information asymmetry. We investigate whether and how such a label provides a capable tool to affect consumers attitudes and behavior. We find that the label in fact captures significant amounts of visual attention, suggesting that it is of interest to consumers (e.g., Cyr & Head, 2013) and actively influences decision-making (Gloeckner & Herbold, 2011). Further, we observe faster decisions. This is particularly relevant as quicker time to decision is associated with higher ease of use of a user interface (Lin et al., 2017). Also, participants reported higher trust in provider and product when the label was present. Trust is a perquisite for basically any commercial relationship (e.g., Mayer et al., 1995; McKnight & Chervany, 2001). In addition, familiarity with the label moderated the effects on visual attention and trust. These findings carry relevant implications for theory and practice.

Theoretical Implications

This study contributes to three streams of literature. First, we employ Signaling Theory (Spence, 1973) to theorize how the label for regional green electricity affects consumers' attitudes and behavior. Our findings suggest that visual labels can provide a meaningful signal in this context. In other words, the label represents a means to overcome the information asymmetry concerning the source of electricity (both geographically and technologically) between providers and consumers.

Second, literature on eco and regional labels has thus far mainly assessed each dimension in isolation. In this study, we differentiate the effects of regional, green, as well as regional *and* green labels and find that also the individual components are capable of capturing some visual attention, enable faster decisions, and engender trust (as compared to neutral stimulus material). This finding is in line with earlier work on eco labels (e.g., Atkinson & Rosenthal, 2014; Song et al., 2019) and regional labels (e.g., Halkias et al., 2021; Jiménez & San Martín, 2010). However, while visual attention and time to decision are on similar levels for regional, green, and regional green labels, our findings suggest that the combination of both components can foster these outcome variables even further than each component can in isolation (see Figure 36).

Third, this is the first study in the nascent field of regional green electricity research with a focus on signaling the product's underlying qualities by means of visual design elements. Earlier work has highlighted that consumers appreciate green electricity generated in geographic proximity to them (e.g., Kalkbrenner et al., 2017; Mengelkamp, Schönland, et al., 2019) and are willing to pay a premium for electricity when classified as regional and green (Fait et al., 2022; Lehmann et al., 2022). We expand on those studies by putting a specific label for regional green electricity to the test and studying its effects on consumers' attitudes and behavior.

Policy Implications

These findings carry the following implications for policymakers. First, our findings suggest that establishing a label for regional green electricity is a potent policy initiative to accelerate the transition towards a carbon neutral energy sector. Second, promoting and brand building of the label should be emphasized as familiarity with the label is a critical success factor for this policy initiative. Implementing this policy measure in Germany could be executed in a (rather) timely manner as the classification processes for regional green electricity have already been established.

However, the question arises whether promoting regional green electricity through labels is the most effective policy measure towards the legislator's declared goal of increasing "the identification of consumers with renewable electricity installations in their region" (UBA, 2019, p. 1). The political toolbox features other means to foster regional green electricity generation such as, community energy projects (e.g., Mirzania et al., 2019; Zade et al., 2022), peer-to-peer energy platforms (e.g., Cortade & Poudou, 2022; Sousa et al., 2019), and co-ownership models (Johansen & Emborg, 2018). Future work should assess which scheme is most effective regarding both environmental as well as economic impact and assess potential trade-offs.

Takeaways for Practitioners

The generation of renewable electricity in or close to urban areas is considered a core lever to reach the goals of CO_2 emission reduction (Schenone & Delponte, 2021). From a micro-economic perspective, this translates into a marketing challenge for providers in that they need to convince consumers to make sustainable decisions (Herbes & Ramme, 2014). A successful transition towards a carbon-free system requires "effective branding and marketing communications strategies designed to enhance consumers' benefit perception" (Hartmann &

Apaolaza-Ibáñez, 2012, p. 1254). Our findings suggest that a label for regional green electricity can play a role in that transition where it may serve as a powerful communication tool for marketing practitioners and user interface designers. Our results indicate that the label's effects are consistent across demographic parameters and experience levels (i.e., with and without prior electricity comparison portal usage), rendering them a promising device for broader audiences.

Applicability of Findings

This study investigates the use of a label for regional green electricity in the context of comparison websites in the German electricity retail market. Yet, our findings may also provide insights beyond this scope. First, while comparison portals are the predominant sales channel for electricity providers especially in Germany (YouGov, 2015), a label for regional green electricity could be used in other sales channels too, including provider websites and customer letters. Second, regional green electricity labels could offer similar benefits in other liberalized electricity retail markets (i.e., where consumers can choose between multiple electricity providers: e.g., the United Kingdom and 18 states in the United States of America). Third, even in non-liberalized electricity markets (e.g., China), a label for regional green electricity may be applied to some applications outside of the traditional electricity retail. For example, regionality and sustainability of electricity supply have been identified as a key criterion in the evaluation of electric vehicles charging services (Fabianek et al., 2020). Charging station operators could hence use a label for regional green electricity as a differentiator in the market.

Limitations and Paths for Future Work

Like any empirical study, this one is not without limitations and the nascent field of research on regional green electricity offers numerous paths for future work. First, our study does not emphasize the source of the label which, in practice, is typically issued by either a governmental organization, the providers themselves, or an independent third party. Prior work on eco labels suggests that governmental labels are most effective (e.g., Banerjee & Solomon, 2003), but future work should evaluate whether these results apply to the regional green electricity context.

Second, the study does not investigate different provider properties. For example, earlier studies suggest that consumers prefer energy providers with ties to their region (Kalkbrenner et al., 2017) or headquarters in their region (Sagebiel et al., 2014). Also, providers in municipal (Rommel et al., 2016) or local (Ndebele et al., 2019) ownership are preferred by consumers. Future work could assess whether and how the label's effects on consumer attitudes and behavior differ between those provider attributes.

Third, this study focuses on trust in provider and product. Other targets of trust could consider the label itself. If consumers fail to trust the label, they are not likely to use it as source of information for decision-making (Boulding & Kirmani, 1993). Future work could investigate what drives consumers' trust in the label (e.g., whether it is issued from a governmental or private institution as outlined above) and whether and how trust in the label mediates the label's effects on consumers attitudes and behavior.

Fourth, this study is built on an experimental footing. External validity could be enhanced in future work by investigating real consumer behavior – for example through A/B testing in cooperation with price comparison portals.

Chapter VII: Conclusion and Outlook

I conclude this thesis by revisiting the research objectives outlined in the introduction, discussing big picture implications, and giving an outlook on recent developments in research and practice.

Re-visiting the Research Objectives

In this thesis, I investigate regional trust cues in the context of green energy platform economics. Therefore, four overarching research aims were derived in the introduction. In the following, I will briefly discuss main findings to each research objective:

RO_1: Provide an overview on how current developments (i.e., decarbonization, decentralization, and digitalization) are shaping the energy sector of the future.

As discussed in Chapter II, platform business models are emerging in the sector and promise to shape its transformation. These business models will fundamentally affect the conventional electricity value chain by enabling prosumers to market their assets, creating new stages for trading and collaboration, increasing transparency, and boosting competition in the sector. This work provides a two-dimensional framework (Figure 3) along the spatial characteristics of the application (residential or mobile) and the type of business interaction involved (B2C, C2C, C2Grid). Further, an in-depth discussion how platform business models will affect the value chain is provided (Figure 5). Also, an analysis of existing literature suggests that future work should address so far underrepresented aspects of GEPE, such as, for example, user interfaces and social interactions.

RO_2: Assess whether consumers value regionality in the electricity context.

The analysis in Chapter III concludes that consumers indeed appear to value regionality when purchasing electricity via digital UIs and are willing to pay a premium for it (Table 2). Most importantly, the interaction of 1) geographic proximity of an electricity supplier to the customer (i.e., *geographic* regionality) and 2) the supplier's attachment to the customer's region (i.e., *entrepreneurial* regionality) is what drives this preference. In other words, consumers seem to value providers which are located in, owned by, operationally focused on, and tied to their region.

RO_3: Understand how regional trust cues are used on user interfaces in practice.

Chapter IV offers a look at design elements on real provider websites in the German electricity market. According to this snapshot, images with regional cues but also witch social and nature cues are frequently embedded on energy provider websites (Figure 16). When it comes to text cues, the websites also use those three cue types along with price and quality key words (Figure 19). Interestingly, the chapter unveils that regional energy providers use regional image and text cues significantly more often than national providers (Figure 22). Note that the analyzed websites use regional cues referencing one particular region (typically the region around their headquarters. E.g., *Stadtwerke Heidelberg* show an image of Heidelberg on their website) or unspecific cues (e.g., the text cue: "from your region"). Hence, the same region is referenced regardless of the user location. A recent trend in UI design is taking this concept one step further: Chapter IV discusses a case study in which an energy provider website is customized to the user location (i.e., a user from Hamburg is shown an image of Hamburg while a user from Berlin will see an image of Berlin; Figure 23).

RO_4: Evaluate whether and how regional trust cues (i.e., images, labels) affect user attitudes and behavior.

This thesis provides initial evidence that regional trust cues indeed affect user attitudes and behavior. The experiments in Chapter V provide data insinuating that the use of regional imagery is associated with higher visual attention and trust (Table 5, Table 9). In Chapter VI, the findings offer evidence that regional labels also increase visual attention and trust, and, in addition, decrease time for decision-making (Table 15). The increased visual attention to regional cues hints that these cues are important (Poole & Ball, 2006) and of interest to the users (Cyr & Head, 2013). Also, it suggests that the information provided by these design elements is actively made use of for decision-making (Gloeckner & Herbold, 2011). The observed quicker time to decision is associated with higher ease of use of the UI (Lin et al., 2017). Trust is important because it is a perquisite for basically any commercial relationship (e.g., Mayer et al., 1995; McKnight & Chervany, 2001).

Implications, Limitations, and Future Research

This work at hand analyses platformization, regionality, and regional trust cues in the energy sector with multiple methodologies (e.g., content analysis, eye-tracking, online experiment, etc.) and across various UI types (e.g., homepages, comparison portals, etc.). This section takes a bird's eye perspective to summarize the key implications of my thesis:

Societal Implications

Regarding my overarching research motivation, which is contributing to the knowledge on how to design IS solutions to support more sustainable decision-making, the thesis offers the general insight that regional trust cues seem to provide an effective tool to nudge consumers towards more regional decision-making. This implies societal benefits on multiple levels: First, on a general level, consumer decisions in favor of regional products and services are considered sustainable in many dimensions such as biodiversity, animal welfare, governance, and resilience (Schmitt et al., 2017). Second, zooming in on the electricity sector, regional decision-making is sustainable in the sense that regional providers (i.e., companies with high entrepreneurial regionality) are viewed as driving forces for the power sector's transformation (Berlo & Wagner, 2011): They install and operate renewable assets such as solar and wind parks in their region, provide heat district and energy management solutions (Richter, 2013), and coordinate local energy markets (Weinhardt et al., 2019). Therefore, nudging consumers into the direction of these companies may accelerate the sector's sustainabilization. Third, zooming in even further on a particular product within the electricity sector, promoting regional green electricity contributes to the sectors sustainabilization as follows. The supply of renewable electricity in or close to urban areas is a core lever to reduce carbon emissions (Schenone & Delponte, 2021). It reduces transmission losses (Bauknecht et al., 2020), contributes to a higher reliability of the system (Zerriffi et al., 2007), and avoids grid expansions (Allard et al., 2020). Our findings suggest that a label for regional green electricity can play a role in this transition where it may serve as a powerful communication tool.

Policy Recommendations

From a policy perspective, the work at hand offers three recommendations. First, in response to the overall transition in the energy sector, policy makers should aim to decrease complexity and bureaucracy in this highly regulated sector and provide a reliable legal framework that can be used to implement platformization and sustainabilization in the energy sector. Second, the findings suggest that introducing a label for regional green electricity is a powerful policy tool to accelerate the green transformation in the sector. Especially so, if it goes along with a marketing campaign for the label as familiarity with such a label is critical for its effectiveness. Third, policy makers should also consider potential adverse effects that regional trust cues may carry. As discussed in Chapter IV, providers may use regional cues to deceive consumers and *regional wash* their company image. Just like in the green washing context, companies could apply regional trust cues to pretend regional attributes of their products and services.

Theoretical Contributions

From a theoretical lens, I will focus on how this work contributes to two established theoretical concepts. First, this work provides a new wrinkle to CET (Shimp & Sharma, 1987). The theory assumes consumer preferences for regional products and services through triggering an underlying evolutionary mechanism. This mechanism is based on a match of consumer location and the product's geographic origin. This work derives the concept of Regional Presence to display that activating this evolutionary pattern does not necessarily require an *actual geographic match* but instead can be triggered already by the *perception* of regionality. Second, this thesis is among the first to apply Signaling Theory (Spence, 1973) to the context of regional green electricity. In doing so, this work shows that a single label may simultaneously provide a meaningful signal (in the sense of generating a "separating equilibrium"; Bergh et al., 2014, p. 1335) in two dimensions of product claims, namely, generation technology *and* location of generation asset.

Advice for UI designers

This work also features tangible recommendations for UI designers. The findings in this thesis insinuate that regional trust cues are effective design elements in UI design across different types of UI (e.g., websites, comparison portals, etc.). When embedding regional image cues on UIs, it appears that the most iconic sights of a city have larger effects on user attitudes and behavior than less famous landmarks. Further, we discuss a critical challenge for geographically customized UI design: Adjusting UI design to a user's geography requires knowing the user's location. This work discusses different approaches to capture a user's location (Chapters IV and V) and in the outlook, a peek into how a real platform operator is approaching this challenge is provided.

Limitations and Paths for Future Research

Like any research endeavor, this one is not without limitations. First and foremost, no real behavior was observed in the studies. Future research should enhance external validity through investigating actual user actions. I provide a glimpse into an ongoing research project in the outlook. In that project, we cooperate with a comparison website outside the electricity context to perform an A/B test on regional imagery. The project will also address a second limitation, namely, that this work focuses on the electricity industry. As discussed in the thesis, findings should be transferable to other contexts as electricity is a homogenous and credence good which is transported though networks. However, future work should thrive to produce the evidence for this assumption. Third, *regionality* is an abstract concept and I believe that this work has just scratched the surface of understanding it. There are still many facets to explore in future research, such as, for instance, isolating whether the associated effects are driven by living in a certain area (i.e., place of residence) or being entrenched in it (i.e., a feeling of *Heimat*). Another aspect to explore is the different geographic levels. For example, the Brandenburg Gate offers an object of geographic identification for residents of the city of Berlin but also for all Germans. Fourth and last, the experiments in this thesis have focused on imagery and labels. Future work could investigate other trust cues, such as, for instance, text. Further, a combination of different cue types and their interaction effects would be worthwhile investigating.

Outlook

Recent market trends

Since I started my work on this dissertation, geographic UI customization has gained traction in and beyond energy sector. While Greenpeace Energy may be considered the pioneer in this regard (see Figure 23), other providers have followed suit. A recent example is the regional utility *entega* (Figure 37). This provider has elected the simplest but also most accurate approach to identifying the user location: they simply ask the users for their location. Users are requested to click on a city name and are then redirected to a customized page for that city. Note that both imagery and text cues are embedded.

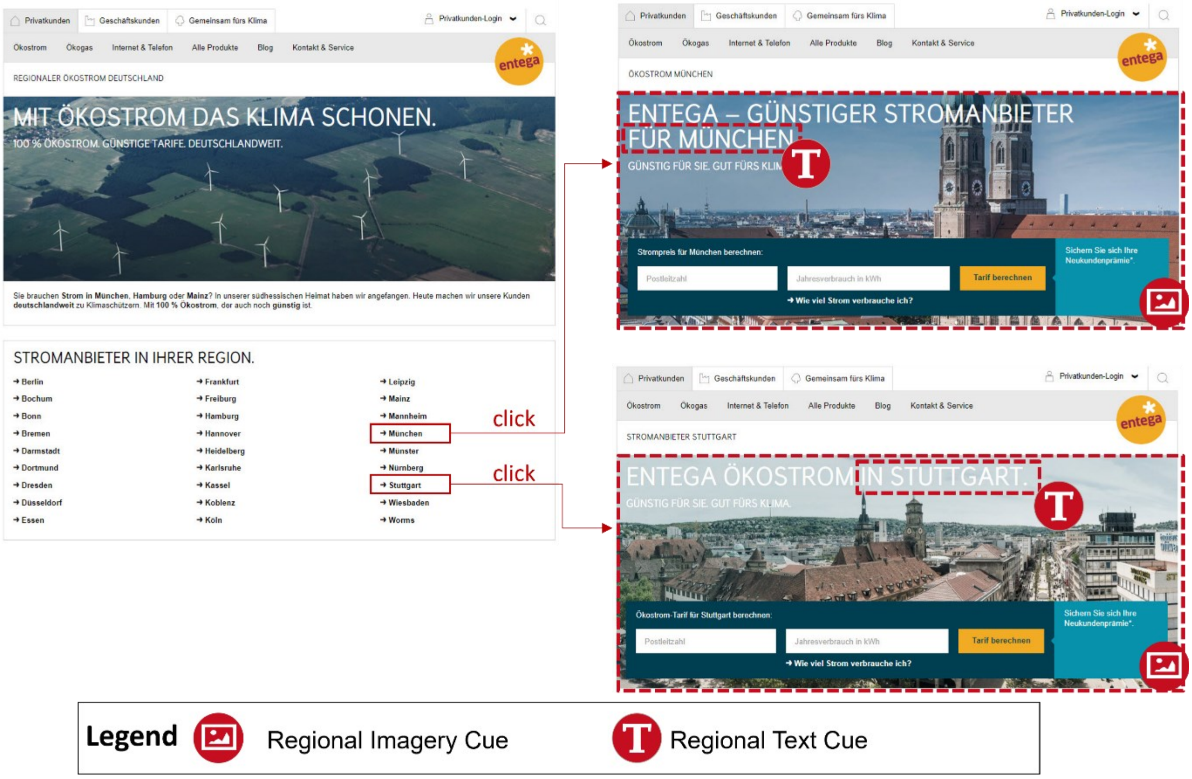


FIGURE 37. EXAMPLE FOR GEOGRAPHIC UI CUSTOMIZATION ON WEBSITE[31]

Ongoing research projects

Building on the research presented in this thesis, two research projects have been initiated by me and my colleagues with the aim to take our research to practice. The first project coincides with the recent market trend outlined in the previous paragraph. In cooperation with the leading German prices comparison website (*idealo.de*) we are evaluating how regional imagery affects click rates in an A/B test setting. This addresses two major limitations of this thesis by measuring real user behavior and targeting a use case outside of the electricity sector. Preliminary stimulus material is provided in Figure 38. *Idealo.de* has implemented a feature called "in your region" which limits the displayed offers to vendors with brick-and-mortar store within a certain distance to the user (the standard setting is 50km). The idea is to buy the product online and picked it up in the store. The aim of the A/B test is to evaluate whether click rates can be increased by adding regional trust cues in the form of an image or a map to the UI.

31 Source entega, available online: https://www.entega.de/regionaler-oekostrom/; https://www.entega.de/regionaler-oekostrom/stuttgart; https://www.entega.de/regionaler-oekostrom/muenchen; accessed on 31.07.2022 (accessed on 30 July 2022).

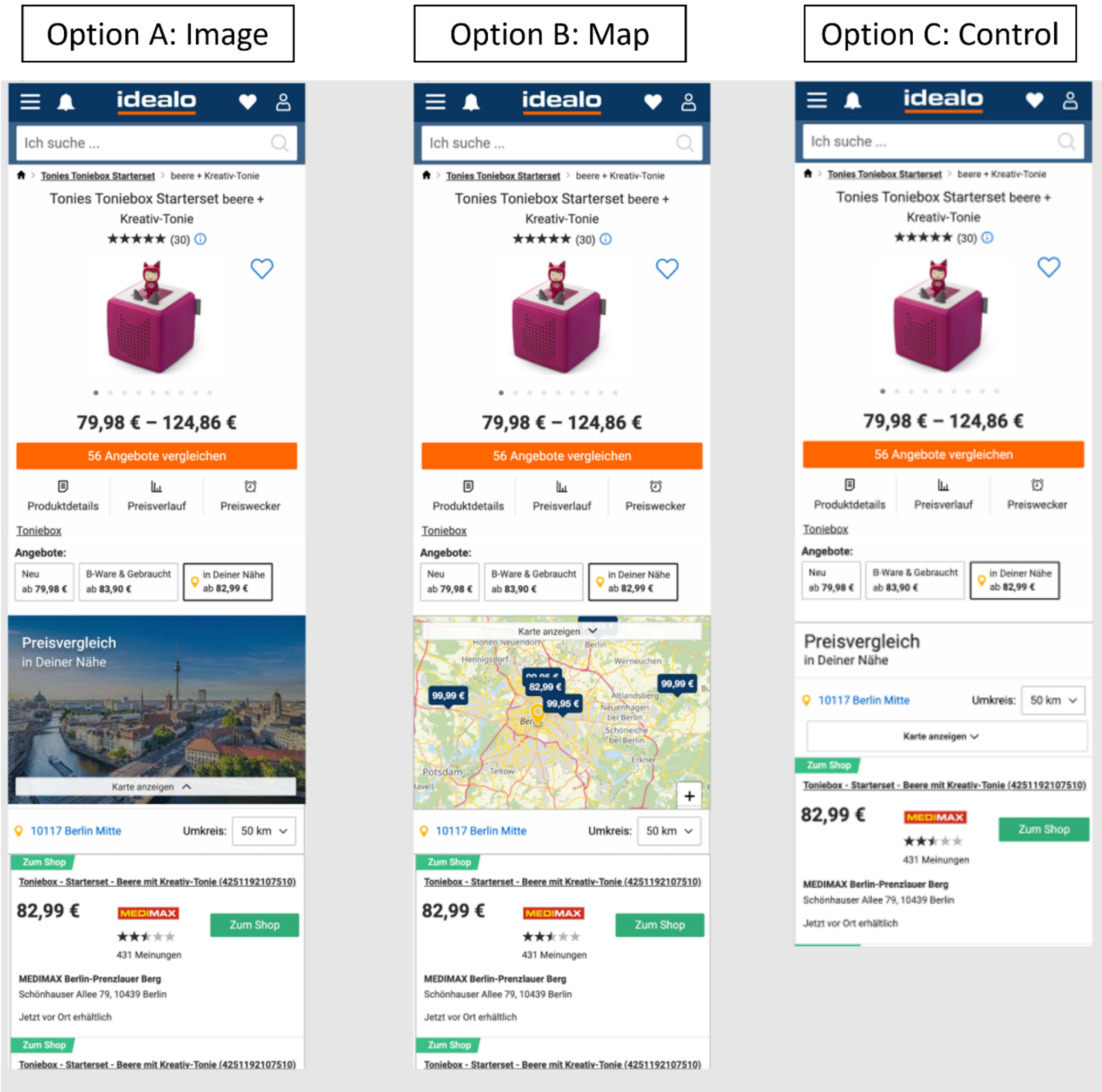


FIGURE 38. STIMULUS MATERIAL FOR FIELD EXPERIMENT

Again, the question arises how to gain the information on each user's location when the feature is requested. As hypothesized in this thesis (see Chapters IV and V), a combination of approaches is applied in this use case (Figure 39). When available, the zip code from the user account is considered to calculate which brick-and-mortar stores are within range. If this data is not available in the account or the user does not have an account, users have the option to manually entry their zip code outside of the feature – for example, in an earlier shopping process on this website. If available, this data is used. Otherwise, the website tries to estimate the user location based on the IP address. If all three approaches fail, a pop-up window appears when the user requests the feature, and the zip code needs to be entered into this window before the user can proceed to the feature. Once using the feature, users still have the option to manually override the results from this calculation and provide another zip code.

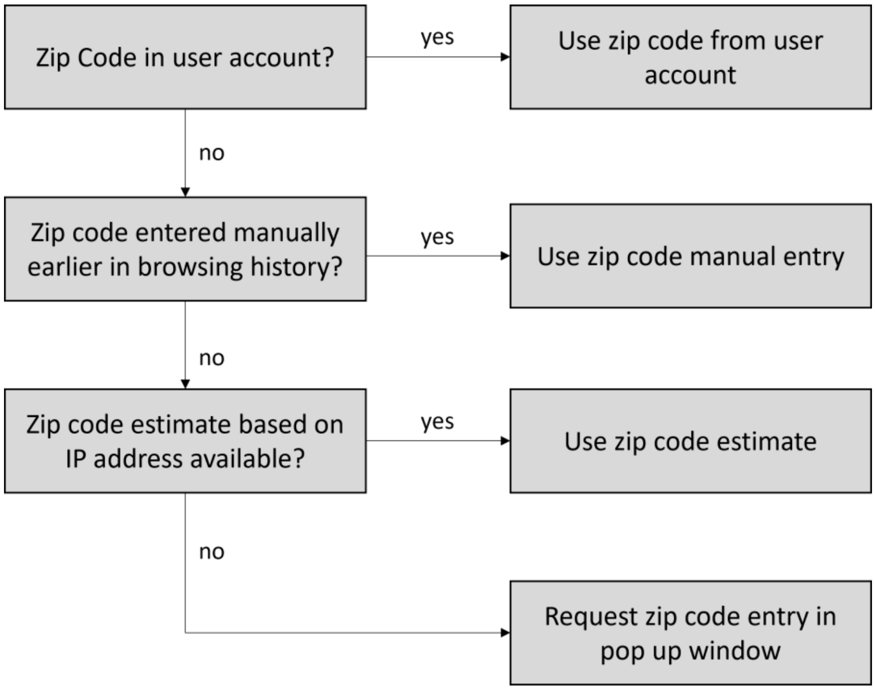


FIGURE 39. STRATEGY TO OBTAIN USER LOCATION

I conclude with an outlook on a second research project. Reverting all the way back to Chapter II, we are partnering with a strategy consulting firm to discuss platform business models in the energy sector. We aim to derive tangible implications for business leaders and publish them in a leading outlet for management practitioners.

Conclusion

This work at hand responds to a call for IS research on the design of solutions that support decision-making in favor of more sustainable practices. Having explored different regional trust cues and their effects on user attitudes and behavior, I come to the conclusion that such cues provide an effective design element in this regard. In particular, the context of green energy platform economics offers an intriguing field of application as regional trust cues could play a role in accelerating the energy sector's transformation into a carbon free system. Accordingly, regional trust cues should receive more attention among academics and practitioners within the context of green energy platform economics and beyond.

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APPENDIX

Appendix to Chapter II

Literature Classification

GEPE Matrix: As per framework numeration
Outlet Type: S= Scholar, P= Practitioner
Source of energy: E= Electricity, G = Gas, H2= Hydrogen, H= Heat
Platform Topic: AR = IS Architecture, BM = Business Model, UI = User Interface, SI = Social interaction (community), RF = Regulatory/Policy Framework, OP = Optimization, AT = Artefact, MD = Market Design, AD = Acceptance
Methodology: LR = Literature Review, MO = Model, PR = Protocol, CS = Case Study, SI = Simulation, FW = Framework, CW = Conceptual work, PT = Prototype, DS = Design Science Research, SU = Survey, EI = Expert interviews, EX = Experiment, FS = Field Study

TABLE A1: LITERATURE CLASSIFICATION

Author (year)	Outlet	GEPE Matrix	Type	Source of energy	Context	Methodology
Alam et al. (2019)	Applied Energy	3	S	E	OP	MO, SI
Albrecht et al. (2018)	Hawaii International Conference on System Sciences (HICSS)	1 to 6	P	E	AR	EI
Amoretti (2011)	International Journal of Hydrogen Energy	3	S	E, H2	AR	PR, SI
An et al. (2020)	Applied Energy	3	S	E	OP	CS, SI
Andersson et al. (2010)	Energy Policy	6	S	E	BM	CS
Bedogni et al. (2014)	International Conference on Next Generation Mobile Applications, Services and Technologies, NGMAST	2	S	E	AR, UI, AT	PT, SU
Bessa & Matos (2014)	Electric Power Systems Research	6	S	E	OP	MO, SI
Bessa et al. (2011)	IEEE Transactions on Smart Grid	2, 6	P	E	OP	SI
Block et al. (2007)	Hawaii International Conference on System Sciences (HICSS)	3	P	E, H	MD	CW
Brandt et al. (2012)	International Conference on Information Systems (ICIS)	6	S	E	MD	LR
Brandt et al. (2017)	Transportation Research Part D: Transport and Environment	6	S	E	BM	SI
Bremdal et al. (2017)	International Conference on Electricity Distribution (CIRED)	3	P	E	MD	CW
Broneske & Wozabala (2017)	Manufacturing and Service Operations Management	6	S	E	BM, MD	MO, SI
Cardell (2007)	IEEE Lausanne Power Tech 2007	5	P	E	MD	SI
Chen & Su (2019)	IEEE Transactions on Smart Grid	3	P	E	MD	MO, SI
Ciuciu et al. (2012)	2012 6th IEEE International Conference on Digital Ecosystems and Technologies (DEST)	3	P	E	AR	CW
Clairand et al. (2018)	IEEE Access	2	P	E	OP	SI
Cui et al. (2014)	IEEE PES Innovative Smart Grid Technologies Conference, ISGT	3	P	E	MD	MO, SI
Da Silva et al. (2014)	IEEE Transactions on Smart Grid	3	P	E	OP	MO, SI
Dallinger et al. (2011)	IEEE Transactions on Smart Grid	6	P	E	BM, RF	SI

Dauer et al. (2015)	International Conference on Information Systems (ICIS)	5	S	E	AT, MD	MO, SI
Eid et al. (2015)	International Conference on the European Energy Market, EEM	5	P	E	BM, RF	CS
Eid et al. (2016)	Energy	3	S	E	RF	CS
Eid et al. (2016)	Renewable and Sustainable Energy Reviews	5	S	E	MD	LR
Fanti et al. (2017)	IEEE International Conference on Service Operations and Logistics, and Informatics (SOLI)	2	P	E	RF	FW
Ferreira & Afonso (2010)	Sustainable Mobility Revolution: The 25th World Battery, Hybrid and Fuel Cell Electric Vehicle Symposium & Exhibition	6	P	E	AR, UI, AT	CW
Ferreira et al. (2011)	IEEE 3rd International Conference on Electronics Computer Technology	2	P	E	AR, UI, AT	PT
Ferreira et al. (2014)	IEEE Transactions on Industrial Informatics	2, 6	P	E	UI, AT	PT
Fluhr et al. (2013)	IEEE International Conference on Networking, Sensing and Control (ICNSC)	2, 4, 6	P	E	AR	CW
Foti & Vavalis (2019)	Applied Energy	3, 5	S	E	MD	SI, CW
Gamper (2012)	Journal of Consumer Policy	1	S	E, G	BM, RF	CW
Gao et al. (2012)	IEEE International Conference on Smart Grid Communications	6	P	E	MD	MO, SI
Gao et al. (2018)	IEEE Network	6	P	E	AR	CW
Gao et al. (tbd)	reserachgate.net	4	S	E	MD	SI
Gerding et al. (2013)	International Conference on Autonomous Agents and Multiagent Systems 2013, AAMAS	2, 4	S	E	MD	SI
Ghosh et al. (2013)	Hawaii International Conference on System Sciences (HICSS)	6	P	E	AR	FW
Giordano & Fulli (2012)	Energy Policy	5	S	E	BM	CS
Gkatzikis et al. (2013)	IEEE Journal on Selected Areas in Communications	5	P	E	MD	MO, SI
Goebel & Jacobsen (2016)	IEEE Transactions on Power Systems	6	P	E	MD	MO, SI
San Roman et al. (2011)	Energy Policy	2, 4, 6	S	E	BM, RF	FW
Gonzales et al. (2014)	IEEE Transactions on Power Systems	2	P	E	OP	SI
Guille & Gross (2009)	Energy Policy	6	S	E	AR, BM	FW
Hackbarth & Loebbe (2020)	Energy Policy	3	S	E	RF, AD	SU
Hahnel et al. (2019)	Energy Policy	3	S	E	RF, AD	SU
Hast et al. (2014)	3rd European Energy Conference	1	S	E	RF	LR
Hermana et al. (2016)	IEEE Intelligent Transportation Systems Magazine	4	P	E	OP, MD	SI
Hill et al. (2011)	Energy Policy	6	S	E	BM	SI
Hoang et al. (2017)	IEEE Access	6	P	E	BM, OP	MO, SI
Huang et al. (2015)	IEEE 12th International Conference on Networking, Sensing and Control 2015	1 to 6	P	E	SI	SI
Hvelplund (2006)	Energy	3	S	E	RF	CW

Ilieva & Rajasekharan (2018)	IEEE International Energy Conference and Exhibition, EnergyCon	5, 6	P	E	BM	CW
Jargstorf & Wickert (2013)	Energy Policy	6	S	E	BM, RF	SI
Jin et al. (2020)	Applied Energy	5	S	E	MD	LR
Jogunola et al. (2017)	Energies	3	S	E	AR	PR, SI
Johanning & Bruckner (2019)	International Conference on the European Energy Market, EEM	3, 5	P	E	AR	CS
Johansson & Deniz (2017)	European Battery, Hybrid and Fuel Cell Electric Vehicle Congress	2	P	E	BM	CS
Jones (2016)	Proceedings of the Australian Summer Study on Energy Productivity	1	P	E		CS
Kahrobaee et al. (2014)	Electric Power Systems Research	3	S	E	OP	MO, SI
Kang et al. (2017)	IEEE Transactions on Industrial Informatics	4	P	E	AR, MD	MO, SI
Kempton & Tomic (2005)	Journal of Power Sources	6	S	E	BM	SI
Kempton & Tomic (2005)	Journal of Power Sources	6	S	E	BM	CS
Khorasany et al. (2019)	IEEE Transactions on Industrial electronics	3	P	E	MD	MO, SI
Kiesling et al. (2017)	TILEC Workshop on Economic Governance of Data-driven Markets	3	S	E	MD	MO
Kim & Thottan (2011)	Bell Labs Technical Journal	3	P	E	RF, MD	MO
Kim et al. (2017)	19th Asia-Pacific Network Operations and Management Symposium (APNOMS)	2	P	E	AR	CW
Kirpes & Becker (2018)	American Conference on Information Systems (AMCIS)	4	S	E	AR	PT
Knirsch et al. (2018)	Computer Science - Research & Development	2	S	E	AR, MD	CW
Knirsch et al. (2019)	8th Dach+ Conference on EI	3	S	E	OP	SI
Koirala et al. (2016)	Renewable and Sustainable Energy Reviews	3	S	E	BM, SI, RF	LR
Kuby et al. (2014)	International Journal of Hydrogen Energy	2	S	G, H2	OP, AT	PT
Laffey (2010)	The Service Industries Journal	1	S	E	BM	CS
Laurischkat et al. (2016)	Procedia CIRP	2, 6	S	E	BM	LR, FW, EI
Lee & Cho (2020)	Energy Policy	3	S	E	RF	SU
Lezama et al. (2019)	IEEE Transactions on Power Systems	3	P	E	MD	MO, SI
Linnenberg et al. (2011)	IEEE International Conference on Emerging Technologies and Factory Automation	5	P	E	MD	MO, SI
Liu et al. (2017)	IEEE Transactions on Power Systems	5	P	E	MD	MO, SI
Liu et al. (2018)	IEEE Access	6	P	E	AR, MD	SI, CW
Liu et al. (2019)	The Electricity Journal	3	S	E	MD	CW
Loisel et al. (2014)	Energy Policy	6	S	E	BM	SI
Long et al. (2017)	Energy Procedia	3	S	E	OP	MO, SI
Long et al. (2019)	Energy Procedia	3	S	E	MD	MO, SI

Lopez et al. (2015)	International Journal of Electrical Power and Energy Systems	6	S	E	OP	SI
Lund & Kempton (2008)	Energy Policy	6	S	E		SI
Lund & Münster (2006)	Energy Policy	3	S	E	RF	SI
Madina et al. (2016)	Energy Policy	2	S	E	BM, RF	CS
Majumder et al. (2014)	IEEE Symposium on Computational Intelligence Applications in Smart Grid, CIASG	3	P	E	MD	SI
Martín et al. (2016)	Renewable and Sustainable Energy Reviews	3	S	E	AR, BM	LR
Marzal et al. (2018)	Renewable and Sustainable Energy Reviews	3	S	E	AR	LR
Marzband et al. (2013)	Energy Conversion and Management	3	S	E	OP	SI
Matamoros et al. (2012)	2012 IEEE 3rd International Conference on Smart Grid Communications, SmartGridComm 2012	3	P	E	MD	SI
Matzner et al. (2016)	Hawaii International Conference on System Sciences (HICSS)	4	P	E	AT	DS
Mengelkamp et al. (2017)	International Conference on the European Energy Market, EEM	3	P	E	MD	SI
Mengelkamp et al. (2017)	International Conference on the European Energy Market, EEM	3	P	E	MD	MO, SI
Mengelkamp et al. (2017)	Applied Energy	3	S	E	AR, BM, RF, MD	LR, CS
Mengelkamp et al. (2018)	e-Energy ACM International Conference on Future Energy Systems	3	S	E	MD	SI
Mengelkamp et al. (2018)	Computer Science - Research & Development	3	S	E	MD	SI
Mengelkamp et al. (2019)	Energy Policy	3	S	E	RF, AD	SU
Mengelkamp et al. (2019)	it-Information Technology	3	S	E		LR
Mengelkamp et al. (2019)	Applied Energy	3, 5	S	E	BM	EI
Michaels & Parag (2016)	Energy Research & Social Science	5, 6	S	E	AD	SU
Mihaylov et al. (2014)	International Conference on the European Energy Market, EEM	3	P	E	MD	CW
Minniti et al. (2018)	Energies	5	S	E	RF	CW
Monteiro et al. (2010)	IEEE Conference on Intelligent Transportation Systems, Proceedings, ITSC	6	P	E	AT	CS
Morstyn et al. (2018)	Nature Energy	3, 5	S	E	RF, MD	FW, CW
Morstyn et al. (2019)	IEEE Transactions on Smart Grid	3	P	E	MD	MO, SI
Morstyn et al. (2019)	IEEE Transactions on Power Systems	5	P	E	MD	MO, SI
Motalleb et al. (2016)	Energy Conversion and Management	5	S	E	AR, OP	MO, SI
Mwasilu et al. (2014)	Renewable and Sustainable Energy Reviews	6	S	E	AR	CW
Niesten & Alkemade (2016)	Renewable and Sustainable Energy Reviews	5, 6	S	E	BM	LR, CS

Noor et al. (2018)	Applied Energy	5	S	E	AR, OP	MO, SI
Noyen et al. (2013)	International Conference on Mobile Business, ICBM	2	S	E	AR, AT	PT
Olivella-Rosell et al. (2018)	Energies	5	S	E	MD	MO, SI
Parag & Sovacool (2016)	Nature Energy	3, 5	S	E	MD	CW
Parag (2015)	ECEE Summer study proceedings	5	S	E	RF	FW
Park & Yong (2017)	Energy Procedia	3	S	E	BM	CS
Parsons et al. (2014)	Energy Economics	6	S	E	BM, AD	EX
Paudel et al. (2019)	IEEE Transactions on Industrial electronics	3	P	E	MD	MO, SI
Paukstadt et al. (2019)	European Conference on Information Systems (ECIS)	2	S	E	BM	LR, CS
Plenter (2017)	IEEE Conference on Business Informatics	2, 4, 6	P	E	BM	CS
Plenter et al. (2018)	Transportation Research Part D: Transport and Environment	4	S	E	AT	SU
Quinn et al. (2010)	Journal of Power Sources	6	S	E	AR	SI
Radi et al. (2019)	IEEE International Conference on Communications, ICC	4	P	E	AR	PR
Ramos et al. (2016)	Utilities Energy	5	S	E	MD	CW
Rassaei et al. (2018)	IEEE Transactions on Smart Grid	6	P	E	MD	MO, SI
Roberts et al. (2017)	IEEE International Conference on Mobile Ad Hoc and Sensor Systems	4	P	E	AR	PR
Rocha et al. (2019)	International Conference on the European Energy Market, EEM	3	P	E	BM, RF	CW
Rosen & Madlener (2013)	Decision Support Systems	5	S	E	MD	MO, SI
Rosen & Madlener (2016)	The Energy Journal	5	S	E	RF	CW
Saad et al. (2012)	IEEE Signal Processing Magazine	3	P	E	MD	CW
Siano et al. (2019)	IEEE Systems Journal	3	P	E	AR	CW
Skopik (2013)	Journal of Systems and Software	1 to 6	S	E	AR, SI	SI, FW
Sorin et al. (2018)	IEEE Transactions on Power Systems	3	P	E	MD	MO, SI
Sortomme & El-Sharkawi (2012)	IEEE Transactions on Smart Grid	6	P	E	OP	MO, SI
Soshinskaya et al. (2014)	Renewable and Sustainable Energy Reviews	3	S	E	BM, RF	CS
Sousa et al. (2019)	Renewable and Sustainable Energy Reviews	3	S	E	MD	LR, SI
Stroehle & Flath (2016)	European Journal of Operational Research	5	S	E	MD	MO, SI
Tomic & Kempton (2007)	Journal of Power Sources	6	S	E	BM	CS
Torbaghan et al. (2016)	International Conference on the European Energy Market, EEM	5	P	E	MD	MO
Tushar et al. (2018)	IEEE Access	3	P	E	MD, AD	MO, SI
Tushar et al. (2019)	Applied Energy	3	S	E	MD, AD	MO, SI

Uddin et al. (2018)	Energy Policy	6	S	E	BM, RF	CW
Vanrykel et al. (2018)	Competition and Regulation in Network Industries	4	S	E	RF	CW
Wang et al. (2019)	IEEE Transactions on Systems, Man, and Cybernetics: Systems	3	P	E	AR, OP	SI
Weiller & Neely (2014)	Energy	6	S	E	BM	EI
Weiller & Pollitt (2013)	Cambridge Working Paper in Economics	5, 6	S	E	OP, MD	LR, CS
Weinhardt et al. (2019)	e-Energy ACM International Conference on Future Energy Systems	3	S	E	AR, BM, RF, MD	CS
White & Zhang (2011)	Journal of Power Sources	6	S	E	BM	SI
Wörner et al. (2019)	International Conference on Information Systems (ICIS)	3	S	E	MD	FS
Wu et al. (2012)	IEEE Transactions on Smart Grid	6	P	E	MD	MO, SI
Wu et al. (2015)	IEEE Transactions on Industrial Informatics	3	P	E	OP	SI
Xiao et al. (2018)	IEEE Transactions on Power Systems	3	P	E, H2	MD	MO, SI
Yoon et al. (2016)	IEEE Transactions on Vehicular Technology	6	P	E	MD	MO, SI
Zhang et al. (2016)	Energy Procedia	3	S	E	AR, BM	MO, SI
Zhang et al. (2017)	Energy Procedia	3	S	E	BM	CS
Zhang et al. (2018)	Applied Energy	3	S	E	AR, AT, MD	MO, SI
Zhang et al. (2018)	IEEE Transactions on Smart Grid	3	P	E	MD	MO, SI
Zhang et al. (2019)	IEEE Transactions on Intelligent Transportation Systems	4	P	E	AR	PR, SI
Zhao et al. (2016)	Applied Energy	6	S	E	BM	SI
Zhou et al. (2017)	Energy Procedia	3	S	E	BM	SI
Zhou et al. (2018)	Applied Energy	3	S	E	BM	MO, SI
Zhou et al. (2018)	Energy	5	S	E	OP	MO, SI
Alam et al. (2019)	Applied Energy	3	S	E	OP	MO, SI
Albrecht et al. (2018)	Hawaii International Conference on System Sciences (HICSS)	1 to 6	P	E	AR	EI

Search Tags

TABLE A2: LITERATURE SEARCH TAGS

Topic	GEPE Matrix	Search Tags	Search results
Green Energy Platform Economics	general	“platform economics” AND electricity	222
	general	“platform economics” AND gas	133
	general	“platform economics” AND hydrogen	13
	general	“platform economics” AND energy	279
Comparison website	1	“comparison website” AND energy	672
	1	“comparison website” AND electricity	439
	1	“comparison website” AND gas	335
	1	“comparison website” AND hydrogen	28

	1	“web aggregator” AND energy	37
	1	“web aggregator” AND electricity	28
	1	“web aggregator” AND gas	21
	1	“web aggregator” AND hydrogen	118
	1	“comparison platform” AND energy	417
	1	“comparison platform” AND electricity	334
	1	“comparison platform” AND gas	139
	1	“comparison platform” AND hydrogen	44
	1	“Verivox”	637
	1	“Check24”	418
	1	“Uswitch”	645
	1	“Bulb.co.uk”	6
	1	“energywatch uk”	11
	1	“chooseenergy.com”	24
	1	“electricchoice.com”	66
Charging integrator	2	*EV charging AND “information service provider”	34
	2	“charging information service”	18
	2	“charging integrator”	11
	2	*EV AND “charging aggregator”	73
	2	“charging aggregator”	77
	2	“comparison website” AND *EV charging	41
	2	“Roaming platform” AND *EV charging	20
	2	“charge point map” AND *EV charging	17
	2	“comparison website” AND hydrogen	29
	2	“*Roaming platform” AND hydrogen	60
	2	“fuel station location” AND hydrogen	53
	2	“*Roaming platform” AND CNG	0
	2	“fuel station location” AND CNG	33
	2	“140lugsurfing”	66
	2	“GoingElectric”	64
	2	“chargeNow”	99
	2	“plugshare”	288
	2	“chargeyourcar”	25
	2	“chargemap”	146
	2	“chargepoint”	781
	2	“electromaps”	163
	2	“CNG Trip Planner”	1
	2	“gibgas”	57
	2	“h2.live”	98
P2P energy trading	3	“Local energy market*” AND “Platform”	421
	3	“Microgrid” AND “Platform”	21500
	3	“P2P energy trading” AND “Platform”	359
	3	“P2P electricity trading” AND “Platform”	133
	3	“Peer to Peer energy trading” AND “Platform”	574
	3	“Peer to Peer electricity trading” AND “Platform”	325
	3	“Sharing economy” AND energy	15800
	3	“Sharing economy” AND electricity	10700
	3	“Brooklyn microgrid”	1390

	3	“Power Ledger”	337
	3	“Grid+” AND Energy	35
	3	“LO3 Energy” OR “LO3Energy”	447
	3	“Suncontract”	44
	3	“Eemnes Energie” OR “EemnesEnergie”	1
	3	“Elecbay”	23
	3	“Hive Power”	37
	3	“Verv VLUX”	4
	3	“Sonnenbatterie” AND P2P	44
	3	“Dajie” AND P2P	38
P2P EV charging	4	P2P EV charging	2920
	4	“Sharing economy” AND “*EV charging”	247
	4	“*EV charging” AND “peer to peer”	891
	4	“*EV charging” AND “P2P”	365
	4	“charger sharing”	28
	4	“plug sharing”	14
	4	“Share & charge” OR “share&charge”	94
	4	“Evmatch”	11
	4	“wecharge” OR “charg coin”	26
	4	“CHRG network”	1
	4	“Elbnb”	11
	4	“Wattpop”	2
Home to grid	5	“Home to grid”	227
	5	“Home 2 grid”	6
	5	“Building to grid”	444
	5	“Building 2 grid”	7
	5	“Residential to grid”	1
	5	“Residential 2 grid”	1
	5	“smart home” AND “frequency regulation”	730
	5	“smart home” AND “ancillary services”	1340
	5	“smart home” AND “grid regulation”	112
	5	“smart home” AND “demand response”	8040
	5	“Local flexibility markets”	165
	5	“Sonnenbatterie” AND “grid”	218
	5	“Sonnenflat”	22
	5	“Verv VLUX”	4
	5	“Power Ledger”	337
	5	“Piclo flex”	16
	5	“Hive Power”	37
Vehicle to grid	6	“vehicle to grid” AND platform	6360
	6	“vehicle 2 grid” AND platform	87
	6	“V2G” AND platform”	5110
	6	“electric vehicle” AND “frequency regulation”	6490
	6	“electric vehicle” AND “ancillary services”	7850
	6	“electric vehicle” AND “grid regulation”	1140
	6	“electric vehicle” AND “demand response”	16600
	6	*EV AND “frequency regulation”	7840
	6	*EV AND “ancillary services”	10800

	6	*EV AND “grid regulation”	1110
	6	*EV AND “demand response”	17100
	6	“Fermata Energy”	7
	6	“Nuvve”	195
	6	“the mobility house”	112

Note: Google scholar search area: all; excluding patents

Appendix to Chapter IV

Additional Website Examples

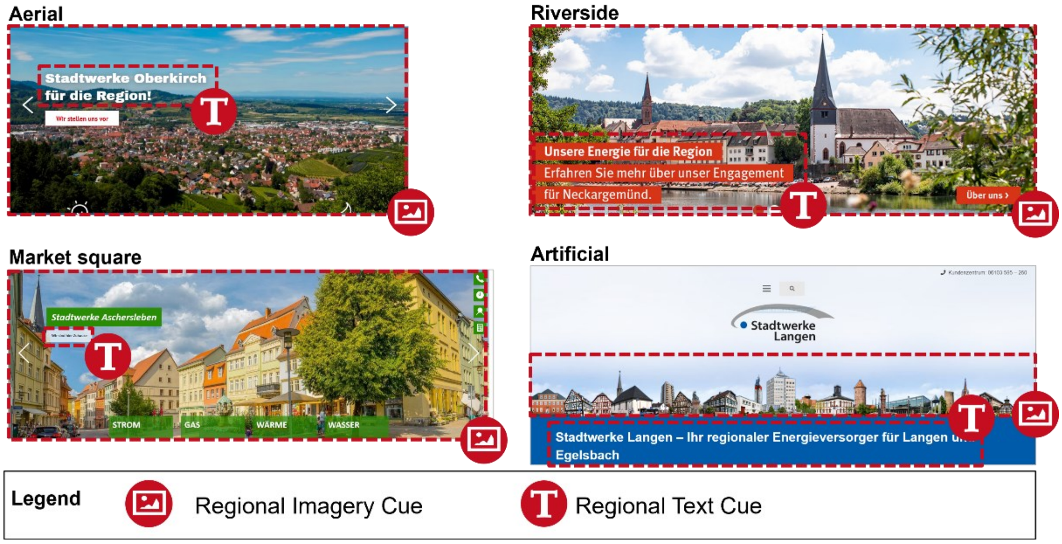

FIGURE A1: REGIONAL IMAGERY WEBSITE EXAMPLES: CITYSCAPES[32]

FIGURE A2: REGIONAL IMAGERY WEBSITE EXAMPLES: BUILDINGS[33]

[32] Sources: Stadtwerke Oberkirch, available online: https://www.stadtwerke-oberkirch.de/ (accessed on 16 February 2021); Stadtwerke Neckargemünd, available online: https://www.stadtwerke-neckargemuend.de/ (accessed on 5 November 2020); Stadtwerke Aschersleben, available online: https://www.sw-aschersleben.de/startseite.html (accessed on 10 November 2020); Stadtwerke Langen, available online: https://stadtwerke-langen.de/ (accessed on 10 November 2020).

[33] Sources (all accessed on 5 November 2020): Westfalica Stadtwerke, available online: https://www.westfalica.de/privatkunden; Stadtwerke Düsseldorf, available online: https://www.swd-ag.de; Stadtwerke Güstrow, available online: https://www.stadtwerke-guestrow.de

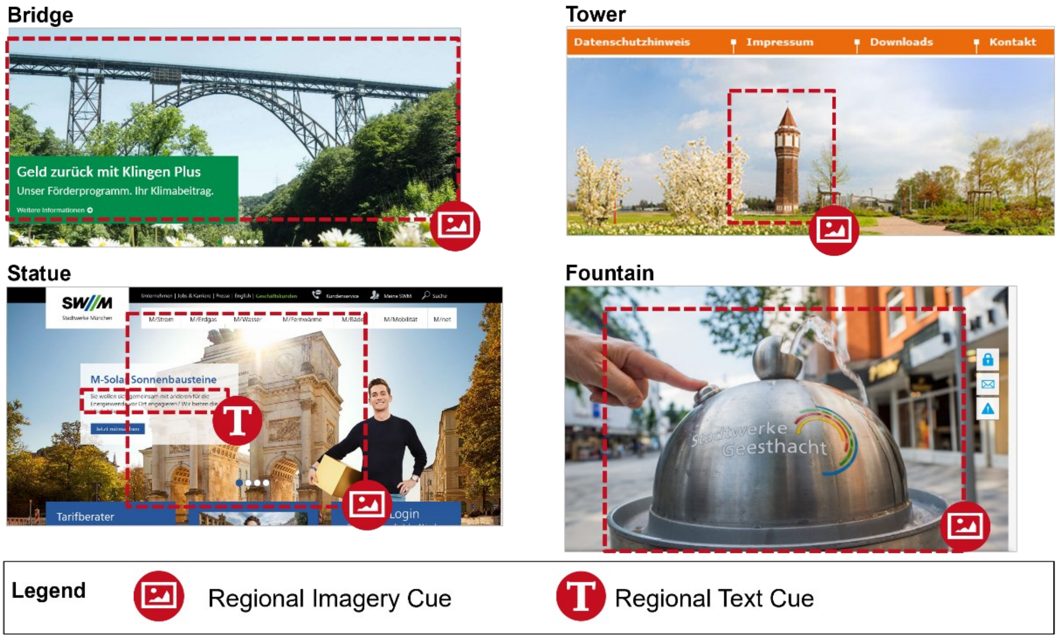

FIGURE A3: REGIONAL IMAGERY WEBSITE EXAMPLES: MONUMENTS[34]

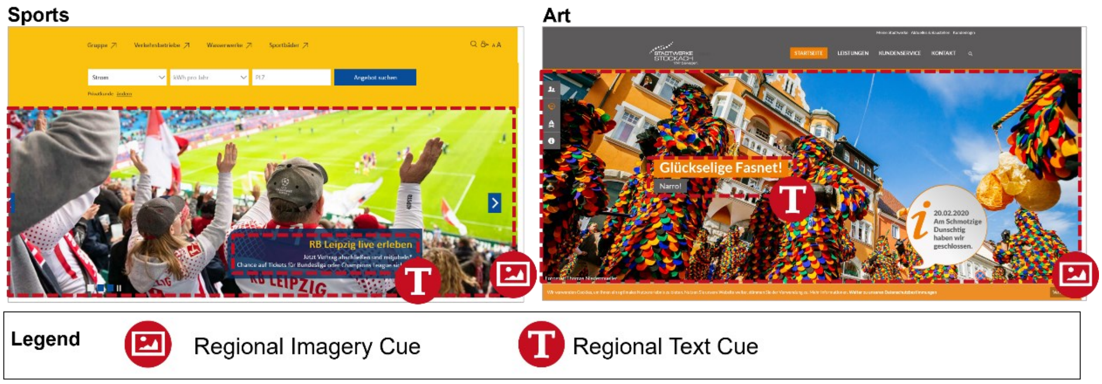

FIGURE A4: REGIONAL IMAGERY WEBSITE EXAMPLES: CULTURE[35]

34 Sources: Stadtwerke München, available online: https://www.swm.de/ (accessed on 5 November 2020); Stadtwerke Solingen, available online: https://www.stadtwerke-solingen.de/privat-gewerbekunden/kundenservice/foerderprogramm-klingen-plus/haushalt/ (accessed on 10 November 2020). Stadtwerke Lehrte, available online: https://www.stadtwerke-lehrte.de/ (accessed on 10 November 2020). Stadtwerke Geesthacht, available online: https://www.stadtwerke-geesthacht.de/startseite (accessed on 10 November 2020).

35 Sources: Leipziger Stadtwerke, available online: https://www.l.de/stadtwerke/# (accessed on 5 November 2020); Stadtwerke Stockach, available online: https://www.stadtwerke-stockach.de/startseite.html (accessed on 10 November 2020).

Appendix to Chapter V

Stimulus Example and Measurement Items Study 1

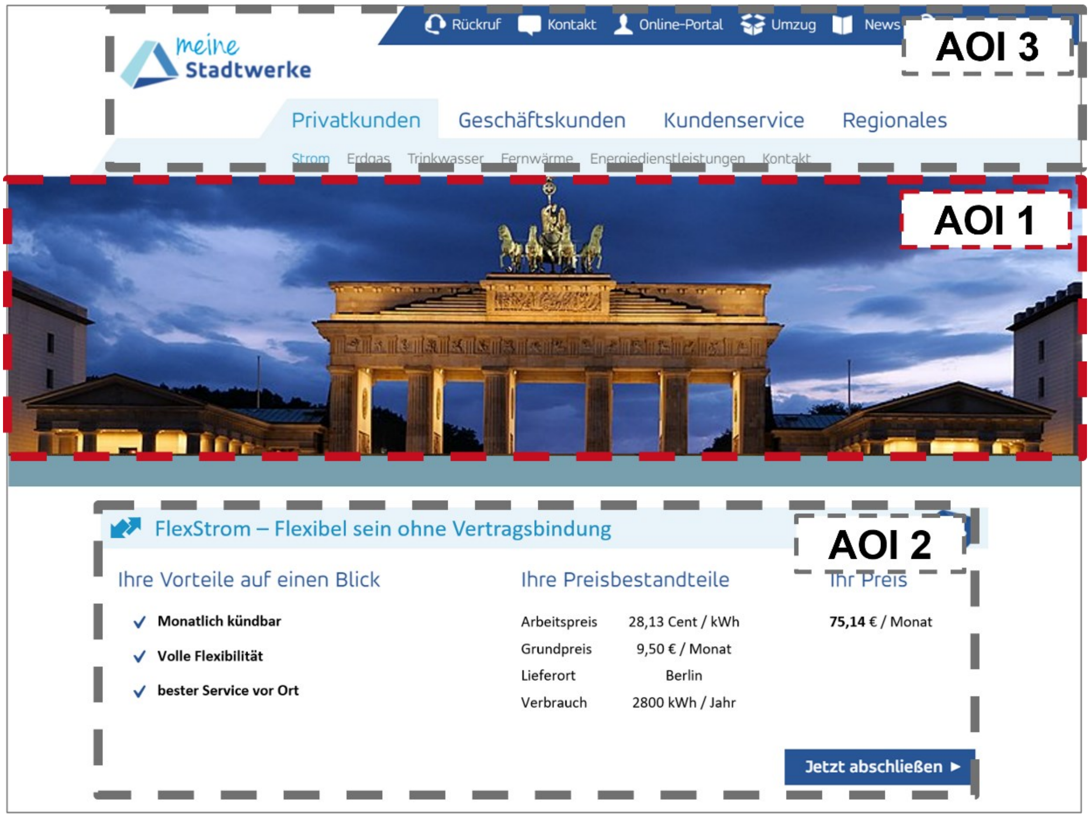

FIGURE A5. SAMPLE STIMULUS UI WITH EMBEDDED REGIONAL CUE IN STUDY 1[36]

Notes: For copyright reasons, we display a different image here (creative commons licensed – public domain). We used different (but similar) images in the experiment. AOIs highlighted via dashed boxes.

TABLE A3. MEASUREMENT MODEL ITEMS STUDY 1.

	Item	Mean (SD)
PRP	Looking at this website makes me think of the region I live in.	*3.61 (2.67)*
TB	This electricity provider is trustworthy.	*4.70 (1.28)*
TI	I am very likely to buy an electricity plan from this website.	*4.28 (1.52)*

Note: SD: Standard Deviation, PRP: Perceived Regional Presence, TB: Trusting Belief, TI: Trusting Intention, Items were translated to German for the experiment

[36] Source for website layout: www.stadtwerke-karlsruhe.de/de/; Source for image: commons.wikimedia.org/wiki/File:Conspiracist_protest_Brandenburg_Gate_Berlin_2020-08-29_03.jpg

Stimulus Example and Measurement Items Study 2

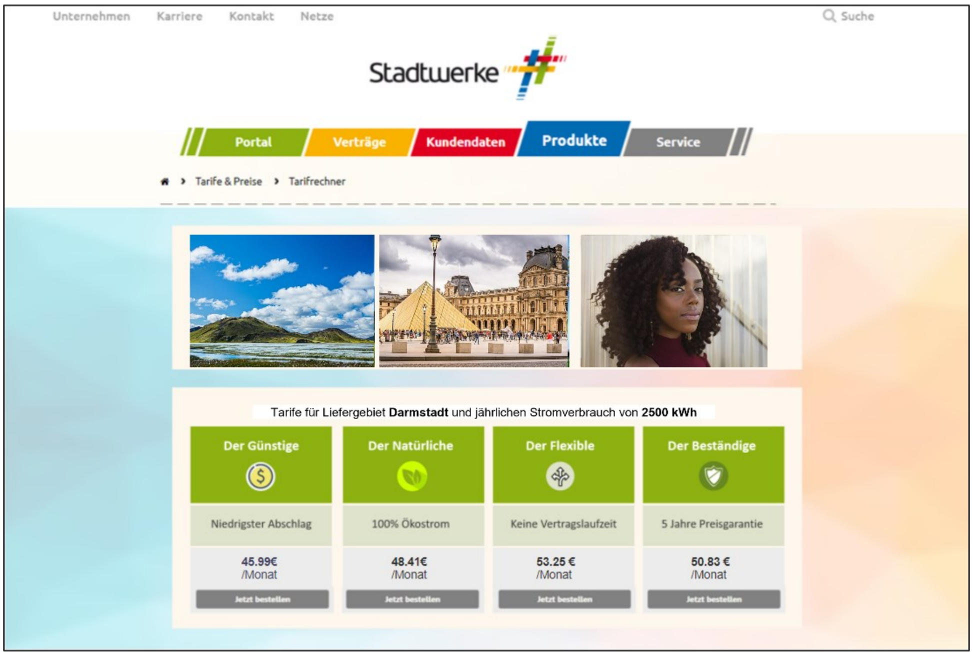

FIGURE A6. SAMPLE STIMULUS UI WITH EMBEDDED SOCIAL, NATURE, AND REGIONAL CUES IN STUDY 2[37]

Note: For copyright reasons, we display the images from the research model here (creative commons licensed – public domain). We used different (but similar) images in the experiment.

TABLE A4. MEASUREMENT MODEL ITEMS STUDY 2

	Item	Mean (SD)
Perceived Regional Presence (PRP)	**PRP1:** There is a sense of regionality in the website.	*4.16 (1.61)*
	PRP2: Looking at this website makes me think of the region I live in.	*3.75 (1.83)*
	PRP3: This website conveys a sense of regionality.	*3.53 (1.66)*
Perceived Social Presence (PSP)	**PSP1:** There is a sense of human contact in the website.	*3.43 (1.52)*
	PSP2: There is a sense of sociability in the website.	*3.52 (1.49)*
	PSP3: There is a sense of human warmth in the website.	*3.89 (1.48)*
Perceived Nature Presence (PNP)	**PNP1:** There is a sense of closeness to nature in the website.	*4.28 (1.64)*
	PNP2: The website makes me think of nature.	*4.33 (1.57)*
	PNP3: The website evokes the sensation of being in nature.	*4.53 (1.55)*
Trusting Belief (TB)	**TB1:** This electricity provider is trustworthy.	*4.58 (1.20)*
	TB2: I trust this electricity provider keeps my best interests in mind.	*4.27 (1.40)*
	TB3: I would trust this electricity provider.	*4.55 (1.22)*
Trusting Intention (TI)	**TI1:** I am very likely to buy an electricity plan from this website.	*4.15 (1.46)*
	TI2: I would not hesitate to purchase electricity from this website.	*4.04 (1.42)*
Note: SD: Standard Deviation, Items were translated to German for the experiment		

37 Source for website layout: https://www.stadtwerke-hef.de/; Sources for regional cue: https://commons.wikimedia.org/wiki/File:The_Grand_Louvre_(235493607).jpeg; social cue: https://commons.wikimedia.org/wiki/File:Confident_Eye_Contact_(Unsplash).jpg; nature cue: https://commons.wikimedia.org/wiki/File:Fjallabak_Nature_Reserve.jpg

Appendix to Chapter VI

Measurement Items

TABLE A7. ITEM STATISTICS

Measure	Question	Scale	Mean	Standard Deviation
Trusting Belief	This electricity provider is trustworthy.	0-10 Likert	5.83	1,88
Trusting Intention	I am very likely to buy an electricity plan from this website.	0-10 Likert	5.59	2,04

TABLE A8. ITEM INFORMATION

Trusting Belief	
Original Item (Everard & Galletta, 2005)	This online store is trustworthy
Adapted to context	This electricity provider is trustworthy
Translated to German	Dieser Stromanbieter ist vertrauenswürdig
Trusting Intention	
Original Item (Gefen & Straub, 2003)	I am very likely to buy tickets from Travelocity.com
Adapted to context	I am very likely to buy an electricity plan from this website
Translated to German	Ich kann mir vorstellen, diesen Tarif abzuschließen