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1.4. Electricity supply security, service valuation, and public perception of energy infrastructure

Johannes Reichl, Jed Cohen, Klaus Moeltner and Michael Schidthaler,

Energieinstitut an der Johannes Kepler Universität Linz, Austria and Dept. of Agricultural and Applied Economics, Virginia Tech, Blacksburg, USA

Abstract

This contribution investigates the socio-economic relevance of electricity supply security, and some challenges to maintaining the current level of reliability in Europe. Thus, firstly, historic evidence of large-scale power interruptions are presented and their socio-economic ramifications are discussed. Secondly, a newly developed analysis tool, blackout-simulator.com, which assesses the social consequences and economic damage from power outages in the European Union (EU) up to now, is presented. This open access analysis model allows, for the first time, an evaluation of the effects of user-specified power interruptions at a fine scale, both geographically (266 Nuts-II regions at state level for 27 EU member states), and for all sectors of the economy and households (10 customer groups in total). This section also contains a damage assessment of the September 2003 blackout in Italy. Thirdly, this contribution contains the first trans-European evidence as to how infrastructure projects such as power grid expansions are seen by the public, and what factors influence these public perceptions. The empirical analysis conducted finds, for instance, that while *a priori* opposition to new grids exists at different degrees across EU member states, auxiliary information regarding the positive effects of a grid development project can have a substantial impact in terms of decreasing the opposition of local stakeholders. This knowledge is paramount in being able to support required energy infrastructures and to ensure a reliable power supply in the future.

1. Introduction

For highly specialized societies in Europe, a reliable electricity supply is more than an amenity and an input factor for productive processes. This is reflected by substantial societal vulnerabilities in the case of a power interruption and by the

Table 4. Overview of historic power interruptions, their dimension and their origin

Date	Country	People Affected	Origin
Mar 2015	Turkey	70,000,000	**Technical problem at transmission level**
Jan 2015	Pakistan	140,000,000	**Militant attack**
Jul 2012	India	620,000,000	**Overload**
Feb 2008	USA (Florida)	6,000,000	**Transformer station**
Jul 2007	Germany (Düsseldorf)	150,000	
Jul 2007	Spain (Barcelona)	350,000	**Defective switchgear**
Jul 2007	Georgian Republic (Tiflis)	1,100,000	
Nov 2006	Germany/NW Europe	10,000,000	**Switching error at high voltage-level**
Nov 2005	Germany (Münsterland)	250,000	**Buckling pylons**
Jun 2005	Switzerland	200,000	**Error in railway grid**
May 2005	Russia (Moscow)	2,000,000	
Nov 2004	Spain	2,000,000	**Fire in transformer station**
Sep 2004	Germany (Rheinland-Pfalz)	1,000,000	**Short-circuit**
Dec 2003	Germany (Gütersloh)	300,000	**Sabotage**
Sep 2003	Sweden / Denmark	4,000,000	**Switching error**
Sep 2003	Italy	56,000,000	**Breakdown of high-voltage line**
Aug2003	USA / Canada	50,000,000	**Computer error / ageing grid**
Aug 2003	UK (London)	1,000,000	**Wrong safety device**
Jun 2003	Italy	6,000,000	**Insufficient KW-capacity**
Jan 2001	India (New Delhi)	200,000,000	
Dec1999	France	3,400,000	**Hurricane "Lothar"**
Dec 1995	USA (Oregon)	2,000,000	**Storm**
Jul 1977	USA (New York)		**Lightning strike**
Nov 1965	USA / Canada	25,000,000	

Source: RWTH Aachen, Verivox, Spiegel, primary research

evidenced level of personal discomfort resulting from power outages. Public attention in this regard has increased in past years, which has brought about a plethora of research dedicated to this topic.

This contribution summarizes recent evidence on the importance of electricity supply security, both economically and socially; it also provides an overview of the societal challenges associated with maintaining the current level of reliability. We first elaborate the dimension and consequences of actual power outages, then evaluate the public perception of energy infrastructures such as power grids.

1. Socio-economic dimension of power outages

One reason for the increasing public and scientific attention to electricity supply security is rooted in the experiences of adverse effects to society from actual power outages. For instance, within a couple of weeks in 2003, a series of blackouts left over 110 million people in Italy, Sweden, Denmark, UK, Canada, and the USA without electricity (Bialek 2004). Not only did social and economic life come to a stop for up to 24 hours, but because of the large-scale incidents, hundreds of thousands were stranded as private and public traffic collapsed, and had to spend the night far from their homes. As another example, Detroit had to ban the drinking of municipal tap water for 72 hours after the restoration of power following a blackout. The threat of epidemic reached a critical level after water pipes could not be rinsed during the blackout, leading to further critical situations, for example, in the medical system (Klein et al. 2005). Thus, it is important to be aware of the scope and damage categories of power outages, especially for long-term planning of the required infrastructures. Table 5 provides an overview of various historic blackouts and highlights their technical or human-induced causes. Only when the origins of power outages are considered in the course of developing countermeasures, can protection against cascading effects and other malfunctioning be developed and the proper functioning of critical infrastructures assured.

The consequences of cascading effects are especially devastating, as evidenced by the Italian blackout of 28 September

Table 5. Summary of historic power outages

	Social impacts		
Country & year	**Number of end-users interrupted**	**Duration, energy not supplied**	**Estimated costs to whole society**
Sweden/Denmark, 2003	0.86 million in Sweden and 2.4 million in Denmark	2.1 hours, 18 GWh	€145-180 m
France, 1999	1.4-3.5 million, 193 million m3 wood damaged	2 days -2 weeks, 400 GWh	€11.5 bn
Italy/Switzerland 2003	55 million	18 hours	
Sweden, 2005	0.7 million, 70 million m3 wood damaged	1 day-5 weeks, 111 GWh	€400 m
Central Europe 2006	15 million households	Less than 2 hours	

Source: Bompard et al. 2011

2003. Triggered by smaller incidents at different parts of the power interconnections with neighboring countries, this outage finally affected 56 million Italian citizens. It is a vivid example of current vulnerability and preparedness patterns. For this and other reasons, this power outage has been intensively researched. The investigation of blackout characteristics helps shed a light on the societal importance of power supplies. Bompard et al. (2011), for instance, compares the Italian blackout with – in total – 34 blackouts (of which an excerpt for Europe is provided in Table 6). The estimated costs, the amount of energy not supplied, and the number of interrupted end-users are discussed in detail.

This summary of various outage characteristics highlights the correlation between the scope of blackouts and the number of residents affected. In addition, an estimate is given with regards to the macroeconomic costs of these power interruptions. However, for a holistic analysis of electricity supply security, various additional damage categories ought to be accounted for. Thus, personal effects, such as stress, mistrust, and other utility losses need to be taken into consideration. In addition to personal effects, the inclusion of business damages is paramount. Even the location choices of businesses are affected by the prevailing level of supply security. Finally, the knowledge of the value of electricity supply security is particularly relevant, as infrastructure investment costs in particular need to be counterbalanced by quantifiable monetary infrastructure benefits.

To provide sound quantifications of the value of supply security, the European FP7 project SESAME[2] conducted a thorough investigation of the socio-economic dimension of large power interruptions. This led to the development of the – open access – analysis tool blackout-simulator.com, which allows an efficient estimation of the ramifications of power outages for all European provinces. The next section briefly shows how objective measurements of the costs of power interruptions can be conducted and highlights how the presented model can be used to elicit the ad hoc costs of power outages.

2. Economic dimension of power outages

Decisions to invest in or maintain the current transmission and distribution infrastructure rely on scientific assessments of the economic worth of supply security.

While developing the necessary measures to enhance supply security is mainly a challenge to the engineering disciplines, it is the task of economic research to support the development of a system of incentives to counterbalance possible market failures. Obviously, supply security constitutes a non-market good and can be purchased only in combination with the product (electricity). Thus the value of supply security cannot be determined directly. That is why the failure of electricity supply, and in particular the costs occurring when electric power cannot be accessed, are usually used to assess the value of supply security (Baarsma and Hop 2009; de Nooij et al. 2007). Generally, the economic costs of power outages can be divided into three categories (Munasinghe and Sanghvi 1988): (i) direct costs, (ii) indirect costs, and (iii) resulting long-term costs of macroeconomic relevance. While in the public eye direct economic losses are typically at the top of the list, they are usually subordinate to indirect economic losses. Indirect costs also arise as a consequence of power outages, yet they belong to that part of the total losses resulting from the absence of electricity supply in the aftermath of the power cut, which includes the cost of production outages or lost value added due to inputs or logistics being unavailable (Centolella, 2006).

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[2] Sesame is a FP7-security project co-funded by the European Commission under grant number 261696, aiming to provide a contribution to the development of tools and a regulation framework for the security of the European power grid against natural, accidental, and malicious attacks. https://www.sesame-project.eu. The views expressed herein are those of the SESAME consortium and can therefore in no way be taken to reflect the official position of the European Commission.

Table 6. WTP increasing factors for European households to avoid power cuts

Variable	WTP Increase compared to mean of entire sample
Belonging to country's highest 20% income group	8.6%
Children below 14 in household	4.4%
Spare time is affected	14.6%
Whole country is affected (instead of residential street only)	32.7 %

blackout-simulator.com takes these into account and combines direct and proxy measurements with a third assessment category – contingent valuation methods (CVM) – which forms the cornerstone of the evaluation of household damages. CVM permit the valuation of power outage-related losses incurred from the customers' perspective (Reichl et al., 2013). Thus, the model includes 8,336 interviewees from all EU member states (at least 250 in each country) to evaluate the willingness of households to pay (WTP) to avoid power outages. The chosen sample of survey participants is considered representative of the European population. Results were checked for consistency. For instance, households typically show higher WTP to prevent (geographically) larger interruptions compared to outages, which affect only their neighborhood.[3]

Importantly, the season in which a power interruption occurs is found to significantly influence the damages assigned to an outage. European households have a significantly lower WTP to prevent an outage in the summer than during the winter. This can be explained by lower dependence on electricity for lighting and the fact that crucial services such as heating are likely to be primarily affected during the winter season.[4] Table 7 presents a summary of influencing factors with respect to the valuation of supply security. It should be interpreted in the following way: if a household belongs to the 20% highest income group, then this household is – on average – willing to pay 8.6% more to avoid a power outage than the average household in the European Union. The same applies to the other variables.

To summarize, the combination of household and non-household modeling approaches allows blackout-simulator.com to assess 266 (of the original 271) Nuts 2 regions in the European Union. In total, nine economic sectors, as well as households, are incorporated into the analysis. This high level of detail is important, especially if results are utilized in regional infrastructure planning, regulation, and energy policy. Thus, blackout-simulator.com can assess various outages with different properties. The database was designed to control for the outages' and residents' properties, such as season and time of an outage, household characteristics such as level of education, degree of urbanization, previous blackout experience, age and household income, as well as the geographical extent of the outage. An application of this tool is presented subsequently.

2.1. Demonstration of blackout-simulator.com – Assessment of September 2003 power outage in Italy

A prominent example of a large power outage in Europe occurred on 28 September 2003 in Italy. The outage was due to a series of transmission failures and subsequently affected all of Italy (except Sardinia). Figure 10 and Table 8 show the extent of this power outage and the average time needed to fully restore the electric power supply to different parts of the country. The economic losses are modeled for the period from 3am until full recovery. The total duration was 3 hours in the north, 9 hours in the center, 12 hours in the south, and 16 hours in Sicily. Figure 10 also depicts the characteristics of this outage scenario. In blackout-simulator.com, the affected areas are selected by means of an interactive map function.

The economic losses and effects due to this power outage are presented in Figure 10. The damage to businesses is calculated at €897.5 million. Households' change of utility, both material and non-material amounted to €285 million. This substantial damage corresponds to .08% of the annual Italian GDP.

All damages to the different NACE sectors are reported in million (m) €.

The results were compared with other relevant studies, such as an assessment by a dedicated board of Italian experts and scientists (Commissione di Indagine, 2003) which found the outage caused costs of approximately €640 million and a loss of load of 160 MWh. While this only takes into account non-household damages, it only marginally deviates from the damages of businesses and the public sector calculated using **blackout-simulator.com** as given in Table 8. Figure 11 presents a summary of the power outage assessment with **blackout-simulator.com** and its intuitive assessment procedure.

As shown, blackout-simulator.com provides an intuitive[5] and rational means of evaluating the value of electricity supply

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[3] In absolute terms WTP to prevent a five-hour power outage affecting the entire country increases from €4.4 to €5.9 on average across all 27 member states in the European Union (2012) when compared to smaller blackouts.

[4] The WTP of European households in this case on average decreases from €4.4 (winter) to €2.9 (summer).

[5] Depending on the desired level of detail, the elicitation of power outages is now a matter of about two minutes and five to ten mouse clicks.

Figure 10: Evaluation of the power outage in Italy on 28 September 2003

Date of start of outage	**28 September 2003**
Start time of outage	03:00 am
Duration in hours	3-16h depending on the region
Provinces affected	Italy (except Sardinia)
Public holiday	Yes (Sunday)

Table 7. Total losses across all regions and sectors; summary of blackout-simulator.com

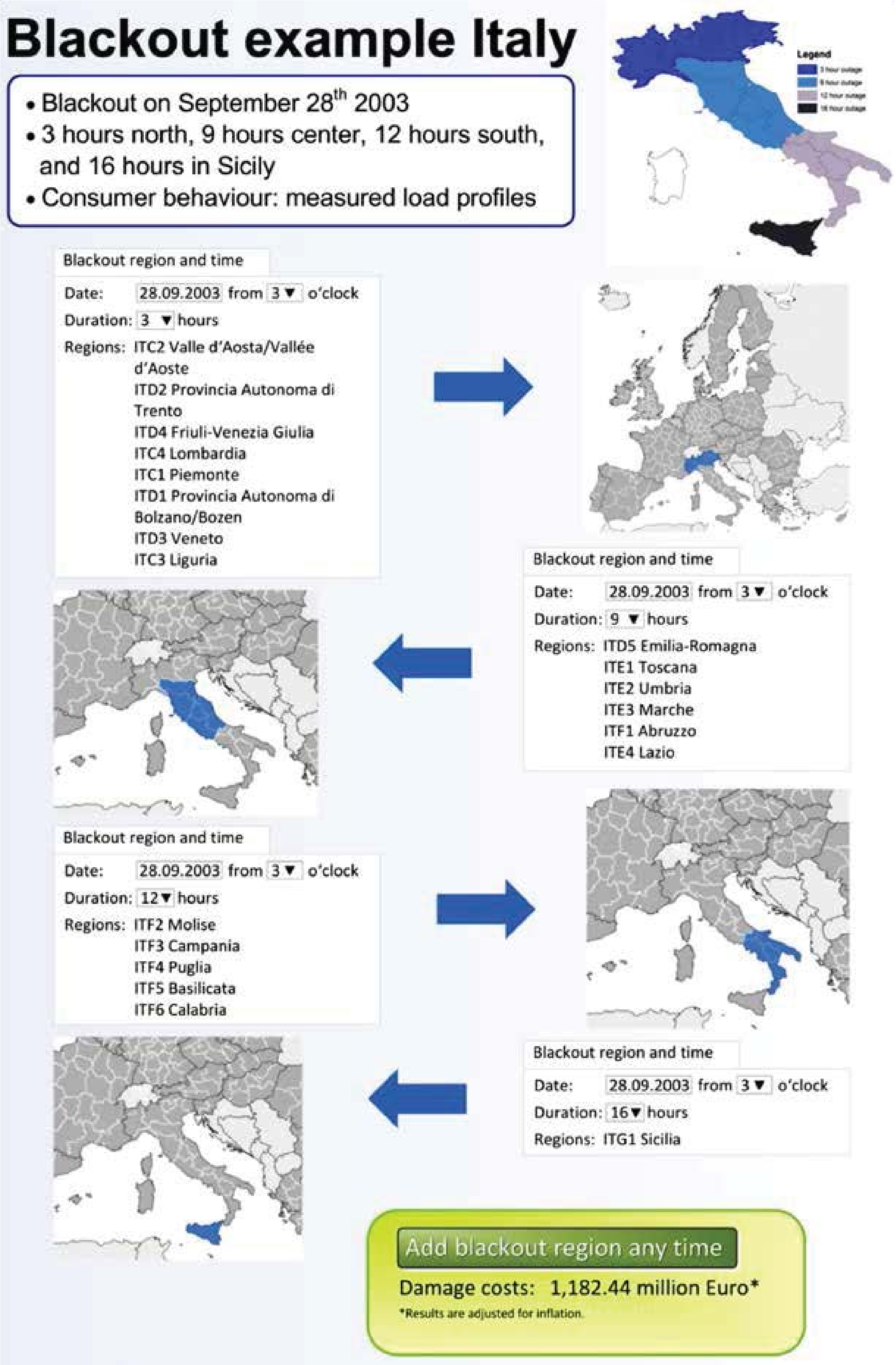
	Primary sector	**Secondary sector**	**Tertiary sector**	**Total losses**	**WTP Households**	**Total losses in region**
Region North	5.3	136.7	60.8	202.8	43.0	**245.8**
Region Center	20.6	217.6	154.6	392.8	98.2	**491.0**
Region South	20.9	82.8	97.5	201.2	94.3	**295.5**
Region Sicily	12.4	33.7	54.6	100.7	49.5	**150.2**
Total	**59.2**	**470.8**	**367.5**	**897.5**	**285.0**	**1182.5**
% of GDP	0.004%	0.031%	0.025%	0.060%	0.019%	0.079%

stability-enhancing investments and other energy policy decisions. In making this tool available for the broader public, the model allows the economic valuation of supply security on the basis of blackout costs for companies, institutions, and households' willingness to pay (WTP). For its development, an unprecedented survey incorporating over 8,300 households in all EU member states was conducted. In the light of the presented – substantial – value of electricity supply security, measures to secure this amenity have gained increasing public attention. In this regard, social factors such as the perception of grid developments are highly important to ensure a smooth interaction with the public when investing in a secure network infrastructure of the future. The following section thus presents a novel assessment approach making use of a trans-European quantitative framework, which has recently become available.

3. Social perception of electricity infrastructures

The challenge to maintain high levels of reliability will require an adaptation and modernization of energy infrastructures. Furthermore, the current European Union vision for a low-carbon electricity system requires the large-scale expansion of overhead transmission lines to integrate renewable energy sources (RES) while ensuring a secure electricity supply for the future. However, especially in the recent past, new installations – for instance, of overhead transmission lines – across Europe have been stymied by local opposition which causes long delays in project completion and occasional cancellations. However, the implementation of renewable electricity sources in particular hinge on increased grid connectivity (ENTSO-E, 2012). To overcome this dilemma, knowledge of the public perceptions of infrastructures and the influential factors of such perceptions is paramount. This is the case not only for the electricity system.

To this end Cohen et al. (2016) present the first empirical assessment of the social acceptance of electricity infrastructures with a focus on transmission lines. They find substantial differences across Europe, with a strong tendency of locals to initially oppose nearby grid development in the Western European countries, and a more welcoming view in the new (Eastern) EU member states. In many cases, the resistance against power infrastructure is understandable from a personal perspective, yet a profound assessment of this problem has so far been missing. The importance of taking into account these perception patterns has nevertheless been acknowledged. For instance, a recent ENTSO-E report states, with respect to grid enhancement, that "overall, there has been material delay to the delivery of one third of the investments, mostly because of social resistance" (ENTSO-E,



Blackout example Italy

- Blackout on September 28th 2003
- 3 hours north, 9 hours center, 12 hours south, and 16 hours in Sicily
- Consumer behaviour: measured load profiles

Blackout region and time

Date: 28.09.2003 from 3 ▼ o'clock
Duration: 3 ▼ hours
Regions: ITC2 Valle d'Aosta/Vallée d'Aoste
ITD2 Provincia Autonoma di Trento
ITD4 Friuli-Venezia Giulia
ITC4 Lombardia
ITC1 Piemonte
ITD1 Provincia Autonoma di Bolzano/Bozen
ITD3 Veneto
ITC3 Liguria

Blackout region and time

Date: 28.09.2003 from 3 ▼ o'clock
Duration: 9 ▼ hours
Regions: ITD5 Emilia-Romagna
ITE1 Toscana
ITE2 Umbria
ITE3 Marche
ITF1 Abruzzo
ITE4 Lazio

Blackout region and time

Date: 28.09.2003 from 3 ▼ o'clock
Duration: 12 ▼ hours
Regions: ITF2 Molise
ITF3 Campania
ITF4 Puglia
ITF5 Basilicata
ITF6 Calabria

Blackout region and time

Date: 28.09.2003 from 3 ▼ o'clock
Duration: 16 ▼ hours
Regions: ITG1 Sicilia

Add blackout region any time

Damage costs: 1,182.44 million Euro*

*Results are adjusted for inflation.

Figure 11. Implementation of the assessed power outage in Italy on 28th September 2003 using blackout-simulator.com (own depiction).

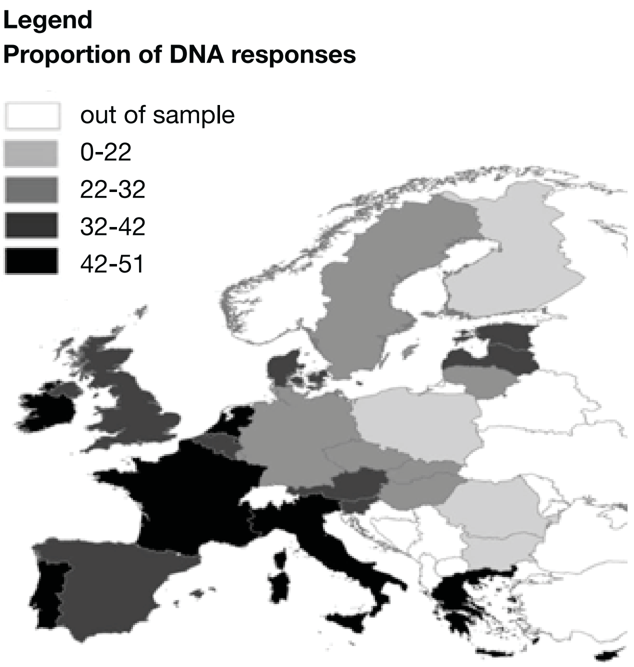


Figure 12. Social acceptance of power infrastructure and grids in Europe

Source: Cohen et al. 2016

2012). The tendency whereby a general acceptance – namely, of the transition towards a low-carbon society – meets resistance for nearby, yet necessary, development is often referred to as a "not-in-my-backyard," or NIMBY issue. An analysis of this "NIMBY-Status-Quo"[6] as provided by Cohen et al. (2016) is presented in Figure 12. This depicts the general perception of electricity networks being built 250 m from the home of surveyed residents.

The fact that Western European countries tend to exhibit greater tendencies to reject energy infrastructures is clearly visible. Apart from this analysis of the Status-Quo, Cohen et al. (2016) also provide an assessment of the effects of information regarding an infrastructure project's advantages. Interestingly, a strong effect of upfront information campaigns is found. As soon as locals are informed that power lines will have a positive economic or environmental impact, these projects will generally meet less resistance than those having only compensatory benefits to the community (e.g., building public infrastructure). In particular, emphasizing any long-term carbon reduction potential or economic benefit of a particular project will, on average, decrease the likelihood that a locality is strongly opposed to the project by 10-11%. The relative effects of different information campaigns are displayed in Figure 13.

It can therefore be concluded that, in fact, it does matter what kind of information regarding the – possibly – posi-

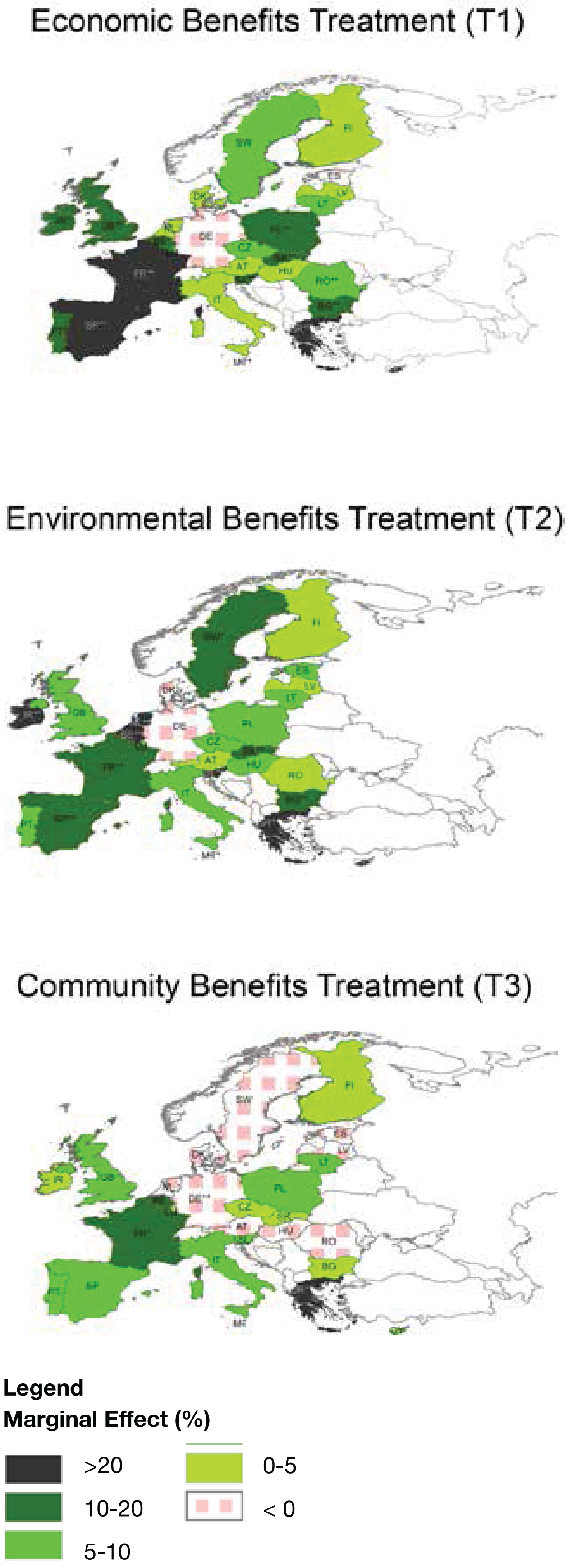


Figure 13. Evaluation of perception-changing information campaigns

Source: Cohen et al., 2016

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[6] In particular, this concerns the share of residents who strictly oppose the presented development. In this regards DNA corresponds to "Definitely not accept" as shown in the figure.

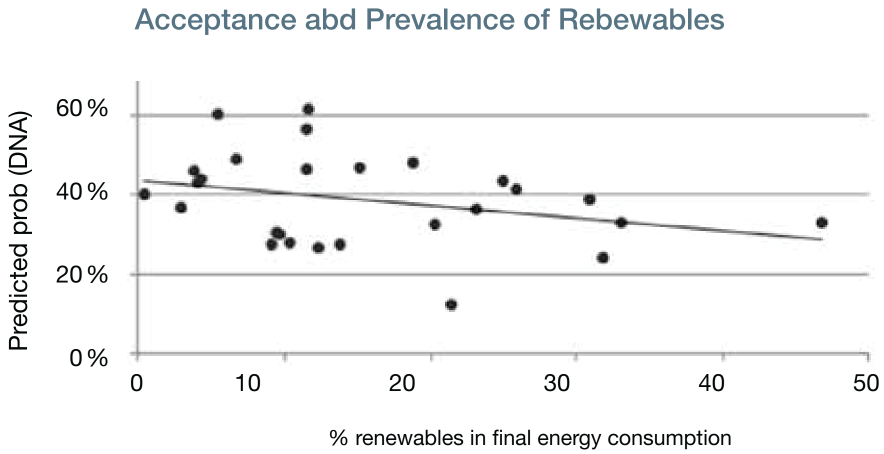

Figure 14. Acceptance of energy infrastructures and share of renewable energy utilization

Source: Cohen et al. 2016

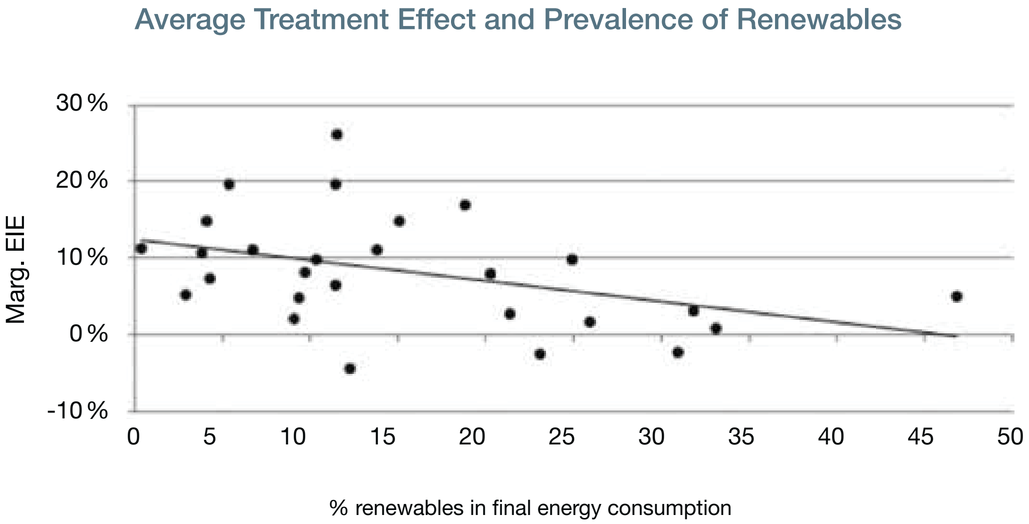

Figure 15. Average effects of information campaigns vis-a-vis renewable energy presence.

Source: Cohen et al. 2016

tive effects of a certain infrastructure project are transmitted to residents. This is very important for project managers to know so that they can adapt and plan their information strategy accordingly.

Overall, the results show that if the positive benefits of a proposed energy infrastructure can be presented to locals, acceptance of a project raises substantially. The strong positive effect on acceptance induced by two out of three benefit packages suggests that many locals can overcome NIMBY sentiments when presented with the proper information.

In addition to the country-specific analysis, particular attention has been paid to the effects and prevelance of electricity greening strategies. Recent findings dwell upon the fact that the national use of renewable energy sources (RES) influences both acceptance levels and the efficacy of treatment effects to change a potentially negative (i.e., rejecting) precondition. Figure 14 shows that the larger the proportion of RES in final energy consumption, the lower the chance of outright opposition to new grid projects (Cohen et al. 2016).

The same is the case for the efficacy of information campaigns. When compared and correlated to the share of RES, they are found to have less – positive – effect.

The summarize, the data suggest that if renewable sources are already heavily used, the likelihood of immediate rejection is reduced, but also that information campaigns have less of an effect once residents are strictly against an energy infrastructure project. More generally, research on social acceptance of electricity networks has shed light on the driving factors behind people's perceptions regarding new infrastructures. The empirically rooted results emphasize the need for developers to tailor their acceptance strategies to the specification of projects and the special situation of nearby residents. As already discussed by Cohen et al. (2014), the development of nearby energy infrastructure incurs a real cost to local stakeholders; thus, acceptance strategies should be focused on facilitating quick and efficient negotiations between locals and infrastructure developers, and not on ignoring the claims of locals.

This contribution shows which information strategies will have the largest positive effect in terms of reducing outright opposition, which would make reaching a compromise with local residents difficult. This is available for each country in the European Union separately and enables project managers to tailor specific information campaigns with particular features. Thus, for instance, any economic ramifications of new transmission lines should be flagged in France and Spain, whereas any benefits to the environment should be the focus in the Netherlands and Belgium.

4. Summary

The supply of electricity is considered highly reliable in Europe. However, maintaining this degree of reliability in the future involves a number of challenges. Despite high levels of supply security, large scale interruptions – which are shown to occur even in Europe – bring about substantial challenges for societies, businesses, and every individual.

Efficient decisions regarding investment in energy infrastructures are possible only if the value of electricity supply security to households and businesses can be determined. To obtain a holistic valuation of supply security, a model-based approach is presented: blackout-simulator.com. This includes precise information from over 8,300 European households and accounts for damages to businesses, administration, and public institutions using a split accounting approach.

As a result, not only particularly vulnerable sectors, such as the semiconductor industry, papermaking, or data-generating processes, but all branches of the economy (NACE 2008 economic classification) can be modeled. It is thus possible for the first time to judge subsectors of the European economy province by province with respect to their degree of dependence on a reliable supply of electricity.

This contribution contains a demonstration of this tool, which analyzes the effects of the 2003 power outage in Italy affecting over 55 million people. It lasted for three hours in the north, nine hours in the center of Italy, 12 hours in the south, and up to 16 hours in Sicily. The macroeconomic damage of this power outage in its entirety was calculated to be €1.18 billion (in 2003 €). The level of detail is unprecedented and includes economic damage data for every sector and for households (€897.5 million and € 285.0 million, respectively).

Finally, a presentation of the public perception of power infrastructures highlights the differences among European countries and presents opportunities to support appropriate information campaigns. It was found that environmental and economic advantages should be presented in most of the EU member states in order to bring affected – and mainly opposing – residents to the table for further discussions and explanations of a project's specifications. Generally, however, although energy infrastructures are regarded as necessary, the challenge of social acceptance is among the main causes of big delays in European grid infrastructures. Using novel evidence, this can now be addressed and best-practice information campaigns can thus be developed based on country-specific preference structures.

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5. Appendix

1.1. Economic Sectors

Based on data availability we determined nine economic sectors, which are based on the NACE Rev. 2 System.

- (A) Agriculture, forestry and fishing
- (B,D,E) Mining and quarrying;

Electricity, gas, steam and air conditioning supply;
Water supply, sewerage, waste management and remediation activities

- (C) Manufacturing
- (F) Construction
- (G,H,I) Wholesale and retail trade, repair of motor vehicles and motorcycles;

Transporting and storage;
Accommodation and food service activities

- (J) Information and communication
- (K) Financial and insurance activities
- (L,M,N) Real estate activities;

Professional, scientific and technical activities;
Administrative and support service activities

- (O,P,Q,R) Public administration and defence, compulsory social security;

Education;
Human health and social work activities;
Arts, entertainment, and recreation

1.5. Transition to a renewables-based power system: Why public participation has an important role to play in power grid planning

Rotraud Haenlein, Germanwatch

Summary

An upgrade of the European electricity infrastructure is crucial for the future renewables-based low-carbon power system that will ensure energy security and sustainability. We see more and more evidence that a power system based on fluctuating energy sources such as wind and solar can provide a secure, low-carbon supply even in a highly industrialized Europe. But at the same time, these new renewable energy sources pose a challenge in terms of network integration. At the same time, transmission grid projects have turned out to be at the center of the public debate on the local level.
Enhanced stakeholder engagement, public dialogue on corridor finding and technology, and a transparent planning procedure based on high environmental standards may help overcome public concerns about new transmission grid projects. Several European transmission grid operators (TSOs) have tested different innovative approaches to achieve early cooperation with environmental groups and to involve the public at a very early stage in the planning procedure. Their experience shows that it is worth cooperating early with local stakeholders. At the same time, this remains a field of continuous learning.

Figure 16. The future renewables-based power system in Europe requires new interconnections to transmit renewable electricity from remote generation sites to consumption centers and storage sites.

Source: Germanwatch 2015

Power grids of the future

Power grids form an integral part of energy transition in Europe and have an important role to play in the future European low-carbon power system based on renewables (Balke 2014). They are cost- and energy-efficient compared to other infrastructure options such as storage technology. More and smarter power grids can help balance fluctuations in renewable energy supplies. Therefore, the upgrade of European power grids is an important part of restructuring our energy system.

In the context of this ongoing transition, we are facing both technical and social challenges. Often, when large transmission lines are being planned or constructed there are local protests. Those conflicts should be addressed through early and meaningful participation with affected communities and other stakeholders. This article outlines general principles for meaningful public participation with reference to experiences from the European BESTGRID project. Within this project, five European TSOs have closely cooperated with environmental NGOs and over the period 2013-2015 have tested different approaches of early cooperation with civil society stakeholders in Belgium, the UK, Italy, and Germany. Other examples throughout Europe support their learning that early stakeholder engagement may help in finding planning options that have better local acceptance (Sander et al. 2012).