

E-destination: the future of e-mobility in the Lake Constance region, Germany

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Abstract

Purpose – This paper aims to focus on the development of a vision for the Lake Constance region, Germany, as an e-destination, i.e. a destination where tourism mobility would be predominantly electric in the future.

Design/methodology/approach – This paper uses a scenario analysis based on factor analysis in addition to empirical data collected in 2016 and 2017 based on surveys and interviews with tourists and stakeholders.

Findings – The scenarios contain the optimistic, pessimistic and realistic models, including one scenario called e-destination, i.e. a projection of the future where tourism mobility consists predominantly of electro-mobility (e-mobility). This specific scenario is supported by the results of the empirical data.

Research limitations/implications – As the study focusses on e-mobility only, it leaves out other forms of mobility e.g. pedestrian or cycling mobility that also contribute to CO₂ reduction. The sampling methods are not strictly randomised, but the tendencies they show are clear and supporting each other.

Practical implications – According to the tourists and stakeholders interviewed, it is quite likely that the region will become an e-destination in the future, but only with government support.

Social implications – The attitude-behaviour-gap was discussed as a possible explanation of tourists' behaviour in the study.

Originality/value – Studies on e-mobility in tourism are rare. (As far as the author knows) this paper presents the first analysis of the future of e-mobility in tourism using a German lake as a destination. Thus, it adds to the existing body of knowledge different possible projections of the future regarding e-mobility in a tourism destination.

Keywords Scenario analysis, Sustainable tourism, e-mobility, Lake Constance region, Mobility turn, Tourism mobility

Paper type Research paper

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1. Introduction

This paper aims to show whether and in what form electro-mobility (e-mobility) can play a bigger role in the future focussing specifically on tourism in the rural region surrounding Lake Constance, Germany. E-mobility comprises all vehicles and connected infrastructure using electric propulsion including full electric vehicle and plug-in hybrids (Gartner, 2020). Although fuel cell technology is mostly linked to an e-engine, it is in this paper considered as alternative sustainable propulsion. Thus, this study focusses specifically on e-mobility which means in the Lake Constance region especially e-cars but also e-trains, e-bikes and e-busses. Tourists' trips to and from their vacation destinations and, to a lesser extent, their mobility within that destination results in the most CO₂ emissions of all tourism-related activities but also offer the greatest potential for reducing emissions (Scott *et al.*, 2010). Thus, cutting CO₂ emissions in tourism mobility is by far the key factor in creating a more sustainable form of tourism (Thiel *et al.*, 2016). E-mobility tends to be seen as a form of sustainable mobility, however, the environmental impact of electric vehicles is strongly related to the electricity mix (renewable energies versus coal, for example), the metals, such

as lithium and cobalt, used to produce batteries, and the energy required to produce the batteries (Döring and Aiken, 2011).

Increasing the share of e-mobility in the Lake Constance region, especially in the remote rural areas, is particularly challenging due to technical, financial and administrative constraints, as well as a discrepancy between many tourists' sustainable attitudes and their actual behaviour (Cohen *et al.*, 2014). The problem of this so-called attitude-behaviour gap has not yet been sufficiently explored (Barr and Prillwitz, 2014). Accordingly, the topics of transportation (new mobility offers) and mobility behaviour (decision-making for e-mobility) are given special attention (Kagerbauer *et al.*, 2015). In this paper, the actual tourism mobility in the Lake Constance region (current situation) is compared with ideal tourism mobility (vision) and possible future tourism mobility (assumption). Based on these findings, this paper presents a vision in the form of a transitional scenario regarding a future e-mobility around Lake Constance, an *e-destination*, that is a destination where tourism mobility is based on e-mobility. The discourse about climate change has long stimulated a debate about the organisation of ecologically and economically viable mobility concepts. The concepts of zero carbon destination, multi-modal traffic and e-mobility overlap in this regard: the idea of zero carbon or carbon neutral destinations are supported by United Nations World Tourism Organisation (UNWTO) via the Davos Declaration and comprises the levels of government, international organisations, tourism industry, destinations, consumers, research and communication (World Tourism Organisation (UNWTO), 2008; Gössling, 2009). E-mobility as a sustainable kind of transportation in tourism forms, thus one component of a zero carbon destination. So does a sustainable modal shift, i.e. a change of means of transportation towards more sustainable options within multimodal trip options (Guiver *et al.*, 2007; Zografos *et al.*, 2009).

In scientific and political future scenarios, the large-scale expansion of sustainable mobility based on electric or fuel cell-powered engines has long been considered inevitable. With the German Federal Government's publication of the National Development Plan for Electro-Mobility and the designation of eight model electro-mobility regions, the importance of this technology has also increased in public perception. The plan aims to establish Germany as the market leader for e-mobility and to have one million electric and hybrid vehicles on German roads by 2020 (Bundesregierung, 2011). However, the number of e-cars in Europe and specifically Germany is still very low and will not change considerably without massive governmental support (Auvinen *et al.*, 2016). The motivation of the study is thus to link the aspects of e-mobility and destination development to assess possible future scenarios.

2. Literature review

2.1. E-mobility in tourism

The literature on sustainable mobility in tourism, which includes e-mobility in tourism, is extensive and continues to grow. It can be divided into several streams. One focusses on sustainability and the influence of distinct transport options on the energy system and climate change (Scott *et al.*, 2010; Thiel *et al.*, 2016). Another one deals with the mobility behaviour of travellers and their attitudes towards e-mobility (Götz *et al.*, 2003; Becken, 2004; Friedl *et al.*, 2005; Zschiegner and Yan, 2006; Böhler *et al.*, 2006; Dickinson *et al.*, 2011; Lumsdon and McGrath, 2011; Cohen *et al.*, 2014; Barr and Prillwitz, 2014). As the relevance of mobility research has grown, the disciplinary lines have become increasingly blurred and the use of the term "mobility turn" indicates a transdisciplinary increase in importance for the subject (Rolshoven, 2014). E-mobility forms part of such a mobility turn, i.e. in a form of mobility that is completely fossil fuel-free.

Specific literature focussing on e-mobility in tourism is scarce. Hoppe and Thimm (2018) give an overview of the current literature and elaborate important key aspects such as "cruising range anxiety", i.e. the fear of running out of power during a trip (Gössling,

2017) and the price (Dosch, 2012) of implementing e-mobility in tourism. According to Jin and Peter (2017), tourism can be used to promote e-mobility, as first-time e-car drivers on holiday may decide to purchase an e-car for private use afterwards. The authors also mention a project in Oregon that integrates e-mobility in tourism by installing charging infrastructure and electric vehicle rentals close to tourism attractions. Other examples similar to the above mentioned can be found in Hawaii (Shaheen and Cohen, 2013), Orlando, FL (Electric Coalition, 2013), Paris (Lesteven and Leurent, 2016) and Kitakyushu in Japan (Nakamura and Naoya, 2016). All of these pursue the idea of offering electric vehicles (especially e-cars and e-bikes) during holidays to promote them for private use. The option of sharing e-vehicles instead of owning them is even more promising in terms of sustainability since, according to Firnkorn and Müller (2015), electric vehicles-sharers are more inclined to do without a car at all than those who share cars with combustion engines.

In rural areas, drivers often automatically become car-dependent and cannot even imagine using alternative transport options at all (Dickinson *et al.*, 2009; Zhang *et al.*, 2018). According to Ebert (2016), e-mobility in a rural tourism context should therefore form part of a multi-modal traffic concept, as e-mobility forms only a part of the solution regarding CO₂ emissions.

The Hoppe and Thimm (2018) study that examines the current state of e-mobility in tourism around Lake Constance shows a high fragmentation on the supply side and the current state of information, accessibility and conditions of use that make e-mobility in tourism difficult to achieve.

2.2 Scenario analysis in tourism

Scenario analysis, the plausible and practice-based provision of possible representations of the future, is far more common outside the tourism industry than within: the predominant sectors using scenario analysis are international organisations such as the organisation for economic co-operation and development (OECD) or intergovernmental panel on climate change (IPCC), companies in the resource management or finance industries and militaries or planning institutions (Moriarty, 2012). A huge variety of approaches, many of them judgemental, have developed over time (van Doorn, 1982; Bishop *et al.*, 2007; Kosow and Gaßner, 2008; Bradfield *et al.*, 2005). Mietzner and Reger (2005) give an overview of concepts and their respective strengths and weaknesses. Scenarios are never forecasts or predictions – they can only work with current existing knowledge (Postma and Liebl, 2005). Scenario analysis and scenario planning are two technical terms often used interchangeably, but according to Moriarty (2012) “analysis” refers more to the actual construction of sets of possible futures, whereas “planning” refers to practical implications for the industry. Two additional terms, scenario building and scenario development, also appear in the literature, which may be considered steps used to create the scenario before it is analysed (Bishop *et al.*, 2007).

The overall idea behind scenario analysis is to allow planning for the future with only a minimum of surprises and to broaden the span of taking a different future into consideration during decision-making (Mietzner and Reger, 2005). Awedyk and Niezgodą (2018) stress the necessity of scenario planning for any successful form of sustainable tourism or resilience in the tourism industry. For Brand *et al.* (2013), an interdisciplinary approach is key in scenario analysis. Moriarty (2012), furthermore, formulates the following quality criteria for scenario analysis and planning: cogency, coherency, purpose and pragmatism. Yeoman (2012) adds that effective scenarios must be relevant and plausible. There are scenario analyses for e-mobility in general (Brenna *et al.*, 2016; Auvinen *et al.*, 2016; Thiel *et al.*, 2016), as well as for tourism (Carlisle *et al.*, 2016; Daconto and Sherpa, 2010; Enger *et al.*, 2015; Dubois *et al.*, 2011; Müller and Weber, 2008; Pongthanaisawan *et al.*, 2018), climate change (Intergovernmental Panel on Climate Change (IPCC), 2020) or for the digital

economy (Pine and Korn, 2011), however, up to now, no scenario analysis for e-mobility in tourism has been carried out. This paper aims to fill this research gap.

The following research questions can be derived from the literature review and this paper is thus addressing them:

- RQ1.* What do tourists think about Lake Constance region as an e-destination?
- RQ2.* What could the future of tourism mobility in the Lake Constance region (with special consideration given to e-mobility) look like in 20 years?
- RQ3.* What are possible tourism mobility scenarios (with special consideration given to e-mobility) for the Lake Constance region?
- RQ4.* Is a tourism mobility turn (a transition towards an optimistic scenario) possible in the Lake Constance region?

3. Methodology

3.1 Study area

The German tourism destination, Lake Constance region (in German: Bodensee), is branded as the “Four-Country Region Bodensee” (Vierländerregion Bodensee) because of the four countries that share borders on the lake, Germany, Switzerland, Austria and Liechtenstein (www.vierlaenderregion-bodensee.info/de/service/about.html). The largest concentration of tourists is on the German side, where the small cities Constance, Überlingen, Friedrichshafen and Lindau attract large numbers of visitors. Therefore, the destination of the Lake Constance region can be termed multipolar because of its lack of a single urban centre (Thimm, 2011). Due to its size and the cross-border situation, Lake Constance region is a very complex destination and thus difficult to manage (Thimm, 2012).

It is a predominantly rural destination dominated by cars, which are used by tourists to travel to, from and around the destination. This is on the one hand due to a lack of rapid public transport options (Hoppe, 2012; Conrady, 2012) and on the other hand due to behavioural habits such as using the car due to familiarity or simply following the tourist “ant trail” (Thimm and Seepold, 2016).

E-mobility in the Lake Constance region is still a niche area, as renting or sharing options and charging stations for e-cars or e-bikes are still quite limited. “Emma” (E-mobil mit Anschluss) in Friedrichshafen is a relevant e-mobility-project in the rural Lake Constance region. The websites www.emobil-im-sueden.de/ and www.seewelle.de/ list mobility offers and services in the Lake Constance region.

As Germany has the longest shoreline at the Lake, most of the survey points were located there: Konstanz, Meersburg and Überlingen. These survey points were chosen because they belong to the tourism hotspots at the Lake. In Switzerland, the city of Kreuzlingen, close to Konstanz, was included in the survey because it is heavily affected by tourism mobility into Konstanz.

3.2 Method-mix

A mixed-method approach was applied consisting of an intercept survey, in-depth interviews and a scenario analysis with underlying factor analysis.

The primary data were collected during the months April to June 2016 by student groups identifying the current state, the vision and the expected future (in 20 years) of tourism e-mobility in the Lake Constance region. In total, 781 responses were compiled amongst tourists via a questionnaire, from Germany to Switzerland. The questionnaire was tested in advance by the students and apart from general questions e.g. on age and gender the questions and their respective results are

illustrated in the results chapter. According to the respective variable, numbers of valid responses were sometimes a bit lower than 781. The sampling method can be described as a convenience sample as the students did not approach the interviewees in a strictly random manner. Because of the high sample size, the clear tendency of the collected survey's results are of importance. The data were then analysed in terms of gaps between vision – expected future and vision – present state. In addition, 13 qualitative structured in-depth interviews were conducted in October/ November 2017 with experts from non governmental organisations (NGOs), tourism businesses and administration and transport providers from the Swiss and German part of the Lake Constance region. The selection criteria were their expertise either on tourism or mobility. The interviews were recorded and transcribed. In case of questions regarding the term “e-mobility”, it was explained according to the definition in this paper. Furthermore, a scenario of e-mobility for tourists in the cross-border destination Lake Constance region containing an optimistic (mobility turn), a pessimistic and a realistic scenario was developed based on the existing literature for this topic and Political, Economic, Social, Technical, Legal, Environmental (PESTLE)-based factor analysis. Thus, the underlying methodology to answer the research questions was a scenario analysis in combination with descriptive statistical analysis of the collected data and the evaluation of the qualitative in-depth interviews.

The scenario analysis examines key factors (drivers) from ecological, political, technical-economic, social and legal fields both from a macro level, such as decarbonisation, climate change or divestment and a micro-level such as e.g. fiscal promotion of e-cars, legislation on e-cars, e-car price or the price of petrol. Thus, it loosely follows the idea of PESTLE-analysis (Cadle *et al.*, 2010). These key factors are then analysed to create different future scenarios.

4. Results

The *ideal form of mobility* in the Lake Constance region for the majority of the interviewees that participated in the intercept survey was not necessarily exclusively e-mobility. It also contained high connectivity and was well planned, included the availability of one's own car, generally amended, i.e. expanded and improved, and based on renewable energies (Figure 1).

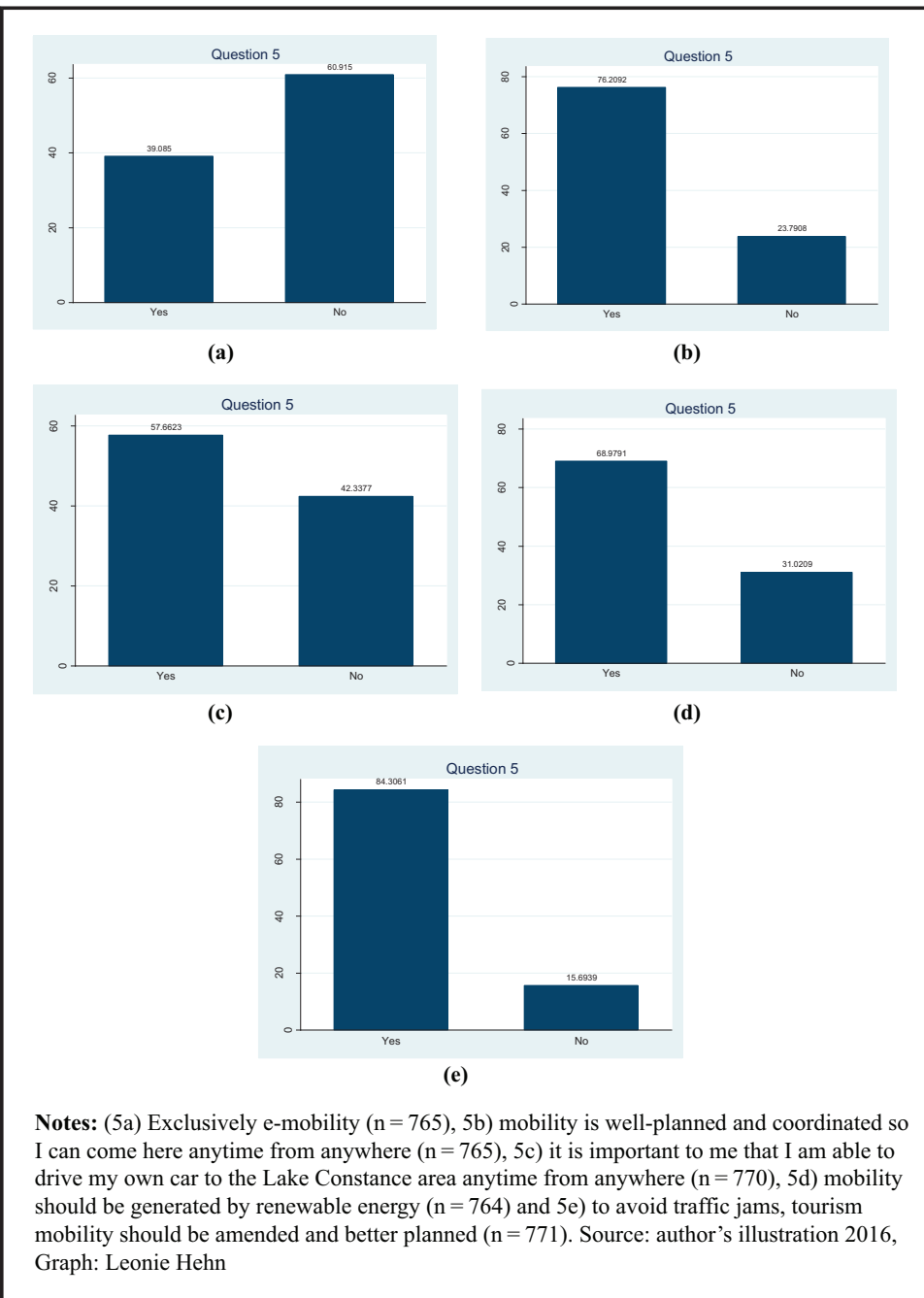
Almost 70% of survey participants view the *current state of mobility* at Lake Constance as “not so far from that ideal” (Figure 2).

Regarding the *future form of mobility* in the Lake Constance region in 20 years, the majority of interviewees assumed that there would only be e-mobility, that mobility would be well-planned and coordinated, use of individual cars would still be dominant and mobility would be based on renewable energies, amended and better planned. In summary, the tourists were very optimistic and expected more or less an e-destination in the future, although this does not necessarily represent their ideal form of mobility.

These findings from the intercept surveys were supported by the in-depth interviews which focussed in a more general way on possible futures of tourism mobility around Lake Constance. Most of them mentioned e-mobility and the necessity of better coordination, planning and amendment as possible futures for Lake Constance as a cross-border destination. They also stressed that real e-destination would offer new and interesting marketing options.

In addition to the tourists' assessment, the scenario analysis is used to discuss different future mobility scenarios for the Lake Constance region. Firstly, the relevant factors were identified based on a PESTLE-analysis and rated by the author based on secondary analysis (Table 1).

Figure 1 Answers to the question “What do you think is the ideal form of tourism mobility for the destination Lake Constance?”

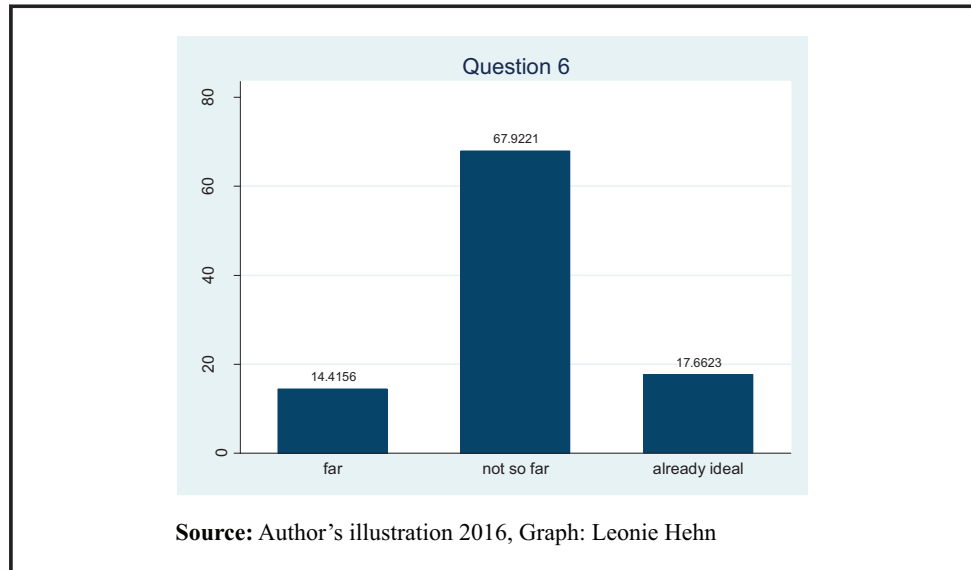


Some factors fit in more than one field, e.g. divestment, referring to cancelling investments in fossil fuels, belongs to the economic, social and ecological sectors.

According to their influence on other factors, the interdependencies of the factors were analysed. A scale of 0–3 was used, with 0 meaning no influence and 3 a high influencing effect on the other factor:

The higher the active sum, the more influential the factor is; the higher the passive sum, the more the factor is influenced by something else. Legislation and a possible renouncement of climate

Figure 2 Answers to the question “How far away is the destination Lake Constance from the ideal tourism mobility? (n = 770)



change are the most influential factors. Decarbonisation and e-mobility innovations are the most influenced factors.

A scenario analysis based on the importance of the factors of Table 2 then delivers the following future scenarios (Figure 3).

The underlying key factors for the respective tourism mobility scenarios are as follows:

- *Scenario I trend extrapolation:* tourism-dependent traffic increases, but engines stay the same, factors neutralize or are not strong.
- *Scenario II e-destination:* e-mobility is the predominant form of tourism mobility, dominant factors: legislation, divestment, e-mobility innovations, decarbonisation, e-car price.
- *Scenario III rollback:* tourism mobility reverts back to the combustion engine, dominant factors: gasoline price, renouncing climate change, legislation, e-car price.
- *Scenario IV CO₂ neutrality:* tourism mobility reverts back to combustion engine, but CO₂ is fully compensated for, dominant factors: gasoline price, legislation, CO₂ harvesting/conversion.

Table 1 Factor classification for factor analysis

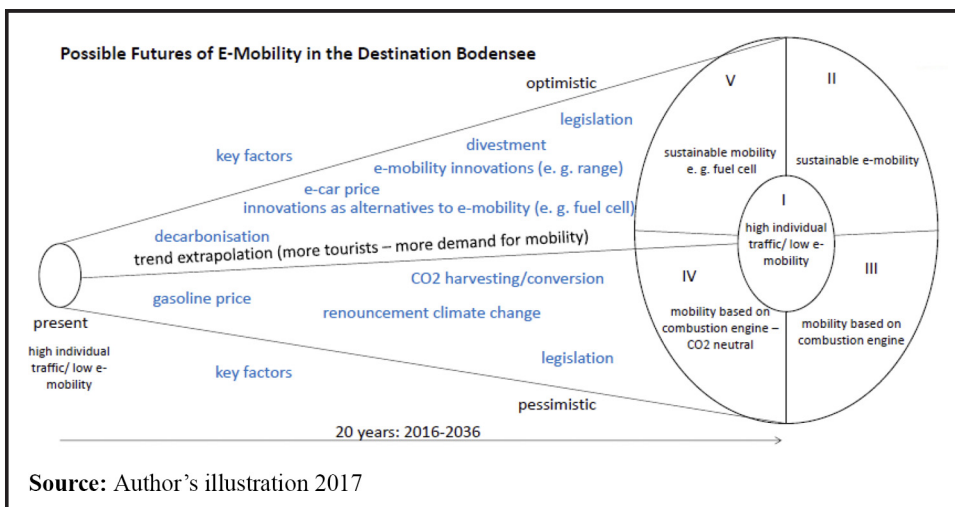
Political	Economic	Social	Technological	Legal	Ecological
Renouncing climate change	Divestment	Divestment	e-mobility innovations (e.g. range)	Legislation	Divestment
Decarboni-sation	Gasoline price		Innovations as alternatives to e-mobility (e.g. fuel cell)		Decarbonisation
	e-car price		CO ₂ harvesting/conversion		

Source: author’s illustration 2017

Table 2 Factor analysis (influence of factors on each other)

Effect on by	Legis- lation	Renounce- ment cc	e-car price	CO ₂ con- version	Gasoline price	Decarbo- nisation	Alterna- tives	e-mobility innovations	divestment	Active sum
Legislation		3	2	2	2	3	2	2	3	17
Renouncing climate change	3		2	3	1	3	2	2	2	16
e-car price	2	0		1	1	2	3	3	1	13
CO ₂ conversion	1	0	1		2	3	2	2	1	11
Gasoline price	1	0	0	2		2	1	2	1	9
Decarbonisation	1	0	1	3	2		2	2	3	13
Alternatives	1	0	2	1	2	2		3	1	10
e-mobility innovations	1	0	3	0	2	2	1		2	8
Divestment	2	1	1	0	2	3	3	3		14
Passive sum	10	4	11	11	11	18	13	16	13	

Source: author's illustration 2017

Figure 3 Scenario analysis: pessimistic, optimistic scenario and trend extrapolation

Source: Author's illustration 2017

- *Scenario V new sustainable mobility*: another innovative engine-based e.g. on fuel cell or CO₂ conversion becomes accepted, dominant factors: legislation, innovations as alternatives to e-mobility (e.g. fuel cell or CO₂ conversion), divestment, decarbonisation, e-car price.

Scenario II would be an actual e-destination, a result that is also possible according to the data of the intercept survey and the in-depth interviews. The scenarios V and II are the optimistic scenarios regarding e-mobility, as both combine technological progress and sustainable destination development. Scenarios IV and III are rather pessimistic in this regard and, additionally, from the current perspective rather unlikely, as e-mobility already started to transform the mobility sector. A Scenario I just extrapolates the present into the future and states an unchanged situation, which also is more unlikely.

5. Discussion

The results show that tourists are predominantly interested in a mobility that is well-planned and coordinated, does not have traffic jams, and allows them to be independent and to use

their own car. E-mobility as such is secondary for them although they are in favour of mobility that is based on renewable energies. This contradiction may either be an attitude-behaviour gap – being in favour of green energies, but not wanting to use them for their actual mobility – or due to a lack of knowledge of what mobility based on renewable energies looks like. However, they expect to have an e-destination in the future which is in line with the results of the in-depth interviews with stakeholders from tourism business and administration and complies with Scenario II.

The interviewees' responses furthermore show that the understanding of e-mobility is very often limited to e-cars and e-bikes, leaving out e-trains, e-ships and e-busses as well as e-planes. Trains generally run on electricity anyway, e-busses are gaining ground, especially in cities, and the conversion of all domestic flights to e-flights and the implementation of e-ships is forcefully being pursued e.g. by the Norwegian Government ([The Guardian, 2018](#); [Hockenos, 2018](#)). Still, the idea of e-mobility for many people is often a reduced one, reduced to e-cars and not necessarily linked to the idea of a zero carbon destination.

Regarding practical implications, tourists consider Lake Constance region as an e-destination (Scenario II) very possible in the future but they are also quite content with the current state of the mobility situation. The stakeholders in the Lake Constance region from business and government also consider e-destination as a possible future scenario and especially see the marketing options related to that. Applying a scenario analysis, Lake Constance region as an e-destination is just one of five possible futures. Regarding climate change, Scenarios II and IV are the most desirable. As the tourists' attitudes towards these scenarios are positive, it should be possible to make a transition towards them. Therefore, a mobility turn towards one of the optimistic scenarios is in essence possible. The problem – as is often the case in this regard – is on the implementation side. It needs a strong governmental lead in transition management and funding to put insights of the necessity of an e-destination in the face of climate change into practice, as stakeholders may be stuck in choice overload and thus remain inactive ([Gössling et al., 2012](#)). This is a necessary requirement to attain Scenario II, an e-destination.

This paper has some limitations, too, as the intercept surveys were not strictly randomised. The in-depth interviews were also based on a convenience sample. However, these disadvantages are compensated to a certain degree via triangulation, i.e. the use of three different approaches to address the research questions.

6. Conclusion

In terms of the first research question, tourists think that e-destination is the future of tourist mobility, although they do not consider this the ideal form of mobility. Scenario analysis – with an underlying factor analysis based on PESTLE – in the form of Scenario II, the interviews with tourists and stakeholders all lead to the same result regarding the near future of tourism mobility in the Lake Constance region and thus deliver a clear answer to research question number two: it will become an e-destination. Thus, all other scenarios presented in this study are hypothetically possible, but rather unlikely: although several scenarios, including trend extrapolation (Scenario I), rollback (Scenario III), CO₂ neutrality (Scenario IV) or new sustainable mobility (Scenario V) are thinkable (RQ3), the interviewed target groups all opted for Scenario II. The RQ4, addressing the likelihood of a transition towards an optimistic scenario, a real mobility turn, requires a decisive and strong governmental transition management, assuring the implementation and involving tourists and stakeholders in that process alike.

The pressure for this real mobility turn is currently becoming more and more intense, as the negative effects of climate change are noticeable and the governments in Europe understood, that the longer they wait ([EC, 2020](#)), the more costlier it becomes to pay for the

damages caused by climate change effects ([Intergovernmental Panel on Climate Change \(IPCC\), 2020](#)). Thus, further research should include specific transition management options for regions or/and scenarios for other, alternative, thinkable future projections that are not covered in this paper.

List of interviews

20-NOV-2017, interviewee 1, NGO
20-NOV-2017, interviewee 2, tourism business
23-NOV-2017, interviewee 3, administration (business development)
20-NOV-2017, interviewee 4, administration (transportation)
27-OCT-2017, interviewee 5, administration (transportation)
14-NOV-2017, interviewee 6, administration (transportation)
15-NOV-2017, interviewee 7, administration (transportation)
22-NOV-2017, interviewee 8, administration (economic development)
28-NOV-2017, interviewee 9, transport provider
10-NOV-2017, interviewee 10, transport provider
22-NOV-2017, interviewee 11, transport provider
23-NOV-2017, interviewee 12, transport provider
30-NOV-2017, interviewee 13, transport provider

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