

Chapter 10

Serious Games in Sustainable Land Management



Jacqueline Maaß

Abstract Over the last few decades, Germany has experienced a trend towards increased suburbanisation and urban sprawl, accompanied by growing distances between residential and commercial areas and growing numbers of the commuting population. These phenomena were made possible in part by cheap energy prices for fossil fuels and have accordingly determined our land use and settlement structures to a major extent. As energy prices for fossil energy rise, we feel the effects in the structures society has built, and these have an impact on land use and sustainable land management.

Keywords €LAN serious game · Land use and transport (LuT) model · Energy price · Land use · Political decision-makers

10.1 Introduction

The correlation between cheap fossil energy and land use has been the subject of several studies worldwide focusing on different aspects and using different methods. The €LAN—energy prices and land use project, funded by the German Sustainable Land Management funding programme, analysed this correlation for the German context. By simulating the complexity of sustainable land management as well as incorporating learning aspects for decision-makers, the project combined a serious game with a land use and transport (LuT) model, thus taking an integrated approach to analysing the effects of high prices for fossil fuels on land use. The €LAN project asked local and regional decision-makers to:

- Identify the effects of rising energy prices for their respective municipalities
- Generate possible responses about how to cope with rising energy prices, and
- Develop their own strategies to counter the negative effects of rising energy prices.

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Fig. 10.1 Participating cities, municipalities and joint communities of both corridors (based on Gertz et al. 2015, p. 125, author's translation)

Participants in the serious game came from two different participating corridors in the Hamburg Metropolitan Region (HMR). The decision-makers of both corridors (northwest from Hamburg to the district of Dithmarschen, and northeast from Hamburg to the district of Northwest Mecklenburg) attended in several meetings to develop their individual strategies on how to cope with rising energy prices (Figure 10.1).

10.2 Post-Fossil Energy in the Twenty-First Century?

€LAN started in late 2010 and ended in 2014, coinciding with a phase of high crude oil prices between 2012 and 2014. Much of the debate on the post-fossil-energy era has been based on the assumption that the global fossil fuel supply was reaching (or had already reached) its peak. Over the course of the project, the debate as well as efforts to move into a post-fossil energy era became much more visible than they had been before. There were several reasons for the strong upwards trend in oil prices on the commodity markets (see also Carollo 2011; EWI and Prognos 2006; Newman 2008); prices went over USD 100 per barrel. This meant a sudden doubling in prices, and many market commentators considered the market to have crossed a psychological barrier.

Decades of cheap fossil energy have influenced our settlement structures: phenomena such as suburbanisation, accompanied by growing spatial distances between relevant destinations and a growing commuting population, is one major example of cheap and abundant fossil energy resources fostering such developments. The questions €LAN posed therefore were: What happens if high energy prices

persist over a longer period of time? How would political decision-makers respond when areas such as transport, traffic and housing come under clear pressure from long-term rising oil prices? What effects might that have on land use?

Even in the 21st century, fossil energy is what keeps our society running in its current form. Germany imports most of its required energy in the form of coal, oil and gas from different countries (Bundesministerium für Wirtschaft und Energie (BMWi) August 2018). Being dependent on foreign energy sources leads to a dependency on the global structure of energy markets. Those energy markets are shaped by various factors, with global political developments playing an important role. The transport sector in Germany in particular depends on fossil energy, as more than 90% of the fossil energy used in this sector is imported (largely petroleum) (Bundesministerium für Wirtschaft und Energie (BMWi) August 2018). This means it is especially vulnerable to price fluctuations on the global crude oil market. Besides being a very car-dependent and car-centred society,¹ heating is commonly considered a major factor for private households in Germany in terms of fossil energy consumption (Deutsche Energie-Agentur GmbH (dena) September 2012).

10.3 How High Energy Prices Affect Communities

Rising energy prices also affect public budgets in Germany in multidimensional ways. This includes immediate versus delayed effects, as well as direct and indirect effects.

As for the present trends, oil prices dropped remarkably quickly, and reached the level of 2003 (less than USD 30 per barrel) in January 2016 (International Energy Agency (IEA) 2016). Both upward and downward movements have fed discussions on the wide range of impacts that energy prices may have on economic activities and social life in general. One of the areas of concern is the resilience of spatial configurations of cities and regions to the effects of high energy prices. Newman and Kenworthy Jr. (1989) for example, were among the first to make a large-scale analysis of the reasons for the statistical connection between higher levels of fuel consumption per capita and lower population densities in urban areas of three continents. Their findings suggested a range of policy strategies for lowering the dependency on fossil fuels, e.g. by increasing urban density, enhancing the attractiveness of centres, and providing attractive public transport options as an alternative to travelling by car (Newman and Kenworthy Jr., 1989). Larson and Yezer (2015) used models to simulate the effects of energy on land consumption. A major policy concern has therefore been to make sustainable urban and regional development less vulnerable to energy price variations.

¹More than 92% of all households with two or more persons have access to at least one car (Frondel et al. 2015); the car density in Germany as of January 2017 was as high as 684 motor vehicles per 1000 inhabitants (Kraftfahrtbundesamt 2017).

Such research and its results lead to questions about how much space sealed by infrastructure or settlement areas is desirable for our society, and how rising energy prices affect these structures. The answers to these questions should be given by planners and political decision-makers, but may to a certain degree also depend on the responses of private households in the sense of supply and demand.

The immediate and direct effects of rising energy prices on public budgets are to a degree comparable to those of private households. However, the delayed and indirect effects will affect municipalities the most if high energy prices persist over a longer period of time. Land management or questions concerning sustainable planning will therefore become more difficult to anticipate. Forecasting the possibly broad variety of private households' responses to rising energy prices seems necessary. Insofar as planning tries to anticipate and match the future needs of private households with the services and infrastructure provided, planning becomes more difficult as soon as outside influences disturb the current system. Linear projections of known development paths may therefore fail to grasp the effects.

Private households may be able to cover short peaks of higher fuel prices by adjusting their budgets and cutting down on other types of expenses, as shown in Fig. 10.2. Households with a higher income may be able to absorb rises in fuel prices and not change their habits in terms of housing and transport at all. However, households on a tighter budget might be forced to think sooner in more lifestyle-changing terms if energy prices start climbing and remain at a high level. The choices they previously made regarding residential or work locations or their daily travel routines, the mode of transport, etc. might become subject to efforts to minimise rising energy costs. It must be pointed out that rising oil prices affecting fuel prices for car use may lead to higher prices for car travel than for public transport, given

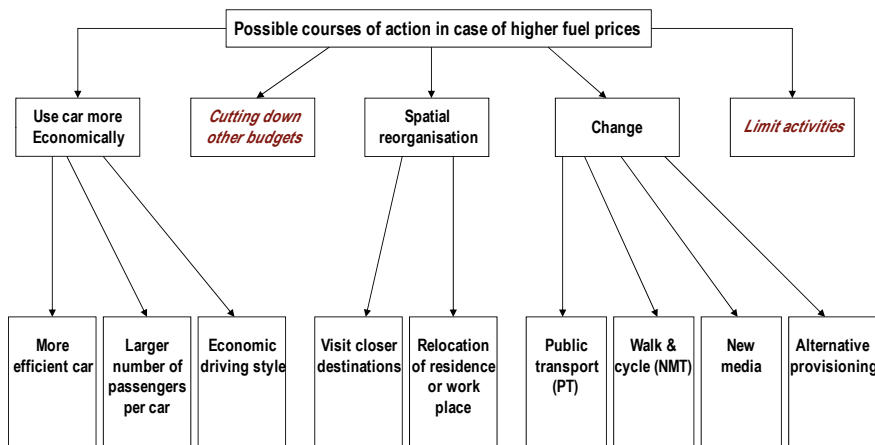


Fig. 10.2 Possible courses of action in case of higher fuel prices (BMVBS/BBSR March 2009, p. 60)

that only a fraction of the ticket price of public transport is directly related to the fuel price itself.

If several private households start changing their common routines or behaviour where the mode of transport is concerned, location choices might also be revised, as well as budgets for other activities. These effects might affect municipalities in various ways.

The two fields of “spatial reorganisation” and “change” (Fig. 10.2) will also lead to land use effects that municipalities must consider.

People might *change* from car transport to public transport or cycle more often for shorter distances. Current infrastructure might not be able to accommodate a rapid increase in public transport users where capacity limits have already been reached. Bike lanes might suddenly be necessary or insufficient in their current state of expansion. People might also tend to buy more items and services online and use delivery services more often, or try to use home office options (where possible) to cut down on (car) trips. Public infrastructures might not be able to accommodate sudden and numerous changes in demand.

Households deciding on *spatial reorganisation* to minimise commuting trips or change their workplaces might intensify current trends for municipalities or influence tax income. Municipalities already suffering population losses due to various causes—e.g. rural areas with fewer possibilities for higher education or work places have already suffered from a drain of younger inhabitants—might experience even faster outflows. Other centres experiencing a rise in the number of inhabitants might experience a stronger influx due to rising energy prices and households’ relocation choices.

Due to all these fields of possible variations, differentiations and changes, municipalities may experience shifts in modal splits, tax revenue, social outlays, infrastructure, etc., which will make planning and hence land use decisions altogether more difficult in the light of rising energy prices.

10.4 Rising Energy Prices and Land Use—A New Research Focus

The stated combination of effects on global energy markets for fossil fuels, societies’ dependency on fossil fuels, the responses of private households, and the physical and topographic municipal landscape as well as existing settlement layouts and transport-related infrastructure, have opened up new avenues for research. Few publications so far have focused on rising energy prices and land management in terms of a combined effect analysis of settlement structure, infrastructure and accessibility. Research in this context has so far focused on the following aspects:

- How to use resources more efficiently and manage changes in land management for a more resilient and sustainable outcome (i.e. Bundesministerium für Bildung

und Forschung (BMBF), April 2013; Beckmann, 2000; Bundesamt für Bauwesen und Raumordnung 1999).

- The vulnerability of low-income households to rising energy costs, known as “fuel poverty” or “energy poverty” in general (e.g. Boardman 1991; Dubois and Meier 2016; González-Eguino 2015; Brunner et al. 2012), or with a supplemental focus incorporating aspects of accessibility, transport, mobility and vulnerability (e.g. Berry et al., 2016; Legendre and Ricci 2015; BMVBS/BBSR, March 2009; Dodson and Sipe 2007; or Roberts et al. 2015).
- Spatial aspects or accessibility questions in combination with scarce energy supplies or rising energy prices (e.g. Büttner 2017; Wegener 2009a; Dodson and Sipe 2008; Fiorello et al. 2006; or Shepherd et al. 2008).
- The social dimension of equity or (in)equality existing in the context of rising energy prices and transport, accessibility or car dependency (e.g. Dubois and Meier 2016; Mattioli 2014; Reames 2016; Walker and Day 2012).

Experience with and knowledge of the resilience of urban settlement areas (city layout) or of accessibility aspects has often been derived from software-based approaches. Using models or GIS tools to visualise or account for effects has been a major approach in the context of land use research (e.g. Fiorello et al. 2006; Wegener 2009b; Buettner et al. 2013).

However, little research so far has focused on administrative levels, the impact of rising energy prices on social-political structures, and the potential effects caused by decision-makers’ responses. There is no research literature on how decision-makers at various levels of government cope with the complex, multidimensional problem of rising energy prices in a society dominated by car transport and the land use strategies associated with it. Timeframes for oil crises and rising energy prices have been rather short. But as the oil crisis in the 1970s showed, drastic effects and responses are possible. Further research in that field is therefore required.

10.5 Serious Games—A Different Approach to Sustainable Land Management

Usually, mathematical models are used to map future trends or evaluate political decisions based on numbers. However, those numeric models cannot include future (political) planning decisions that might arise in the light of high energy prices or (sudden) scarcity of fossil energy.

With fossil energy a major factor in transport, traffic and heating, high energy prices over a longer period of time increase pressure on decision-makers to find more sustainable ways of planning. Policy-makers and administrative decision-makers might therefore be in need of new or additional approaches to cope with such complex phenomena, assuming that fossil energy might (again) become more cost-intensive in the future. To explore which path future developments will take and

to shape strategic decisions for the coming decades, a complex, integrative approach is necessary. €LAN achieved this by simulating the impacts of rising energy prices and capturing the responses of decision-makers through participative methods. The insights obtained during the project suggested this “serious game” as the most suitable approach for simulating sustainable land management decision-making.

The term “*serious game*” has not been precisely defined; different contexts have conceptualised it differently (e.g. Hitzler et al. 2010: 218–219, Rebmann 2001: 9). Definitions and understandings may also vary between the German and the Anglo-American contexts, where the expression “Planspiel” and the terms “simulation game” or “serious game” can be found (e.g. Hitzler et al. 2010: 218–219, Rebmann 2001: 9).

For the €LAN context, the closest definition of the “serious game” is the following: “*The serious game is an activity-oriented method, in which complex economic or social-political functional relationships are simulated within an illustrative modelled gaming scenario.*” (Author’s translation). “Das Planspiel ist eine handlungsorientierte Methode, bei der komplexe ökonomische oder politisch-soziale Funktionszusammenhänge in einem modellhaften Spielszenario simuliert werden.” (Fischer 2008: 137).

This makes a serious game a good methodological fit for the project’s purposes—a combination of modelled scenario in combination with an activity-oriented basic approach.

In the context of €LAN, the term “*Planspiel*” has been used in German publications and “*serious game*” as the direct equivalent to describe the research approach in English publications.

Serious games are not a new tool, and have been used in teaching, learning and evaluation contexts for several decades (e.g. Ebert 1992; Hitzler et al. 2010; Korte and Lehmbrock 2009). For political consulting, serious games have also been known to be a valuable tool for testing the effects of new laws or administrative regulations (e.g. Herz and Blätte 2000; Korte and Lehmbrock 2009; Hitzler et al. 2010; Böhret and Wordelmann 2000; Vissers and van der Meer 2000; Joldersma and Geurts 2000). As shown by way of example in Korte and Lehmbrock (2009), serious games have also a long history in political contexts for urban and transport planning (Korte and Lehmbrock 2009: 11–12). However, as Hitzler et al. (2010) noted, there is no homogeneity of serious games within Germany. Serious games have been designed by many different institutions, companies, universities and individuals for a multitude of different purposes (e.g. Hitzler et al. 2010: 220–221). Nevertheless, the combination of serious games with computer-supported elements is still very rare in the sector of planning or decision support for politicians and planners; one exception is the serious game TAU (Böhret and Wordelmann 2000).

Researchers on the €LAN project also found that, in spite of the potential usefulness of a serious game, there was nothing available to cover all the aspects of the project’s research interest. €LAN researchers therefore chose to illuminate this less-explored object of research by developing a new serious game, supported by scenarios

generated by an integrated land use and transport model (LuT). This LuT was developed within the project as the second pillar of research, and thus was an excellent fit for the serious game.

The serious game developed by €LAN focused on setting a scenario for the participants in which they would be able to react to rising energy prices according to their actual roles and responsibilities in local government.

10.6 The Serious Game Developed by €LAN—Methodological Outline

To get both elements—the serious game and the LuT model—to work seamlessly together, a translation process between both sides was a very important aspect of the project (Fig. 10.3).

The first step of the iterative process entailed selecting participants (decision-makers) and using various media to present them with the basic trends and developments according to a created scenario (Fig. 10.3, at the top). The scenario was created using an LuT model, which cast the effects of rising energy prices three years into the future² (Fig. 10.3, left-hand side). The scenario was based on the latest

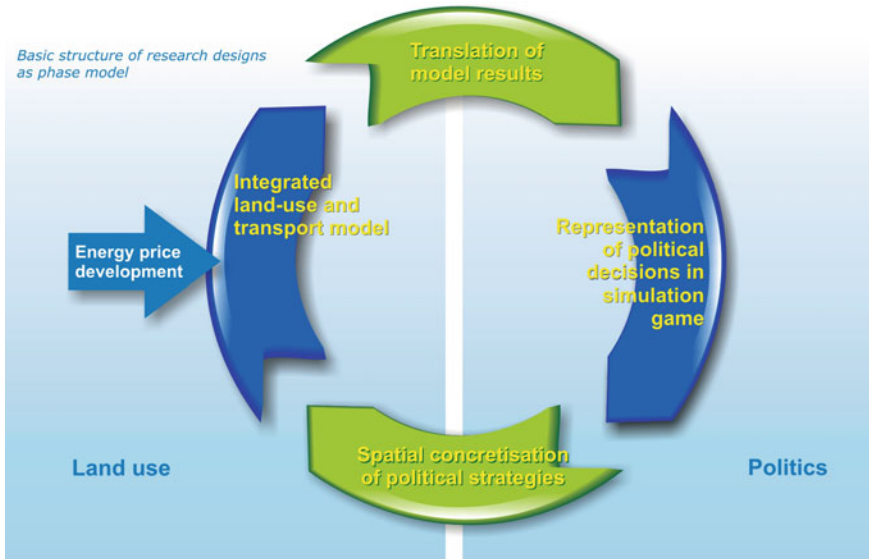


Fig. 10.3 Iterative phase model; €LAN 2014 (also in Guimarães et al. 2014)

²Since the first round took place in 2012, the scenario for the serious game was 2015—close enough in time to prevent a possible response in the direction of “technological evolution will solve the problem”, but also far enough into the future to relate to substantially higher energy prices.

data available on demography, employment patterns, transport infrastructure, residential locations, taxes, household incomes, education and other important aspects (for further information about the model, see Gertz et al. 2015).

The second step of the project attempted to communicate this data via different channels in an effort to make simulation as realistic as possible for the participants. For the professional level, for example, the project created a regional planning report with common facts and figures about commuter data, demographic developments, etc. typically used in such media. Participants were also addressed on a more personal level by media clips and short video clips designed as news reports. The articles for those media clips were produced (based on scenario data) by a professional journalist and imitated the styles and characteristics of layouts of current print media products. The goal was to sensitise the participants to the topic and to enable them to relate to the scenario in different ways on a broad professional and personal basis.

These visualisations were used in the third step to prompt the participants to identify the effects of rising energy prices for their respective municipality and to develop measures, ideas and strategies to respond to such cost developments as decision-makers for their specialisation and/or municipality (Fig. 10.3, right-hand side).

During the fourth step, the participants' ideas were reformulated as far as possible into numeric values according to previously identified parameters, such as the time frame for implementation and financial effort.

The output generated by the serious game was translated and fed back into the model (Fig. 10.3, bottom) to generate a scenario for 2025. The new scenario was then translated into different media and presented to the decision-makers. Confronted with these outcomes, they were asked to respond once again. This created an iterative cycle between the model and decision-makers, and the project simulated a span of 20 years (2010–2030).

10.7 Investigating Energy-Price Effects in the Hamburg Metropolitan Region—How to Integrate Regional Decision-Makers

The study area of the €LAN project is the—still growing—Hamburg Metropolitan Region (HMR). Currently, it is made up of 1177 municipalities in four federal states in Northern Germany,³ with about 5 million inhabitants. It comprises an area of around 26,000 km². The city of Hamburg, with around 1.7 million inhabitants, is the dominant centre in the region and is a hub for key economic activities. The region also contains sub-centres with universities, entertainment facilities, hospitals and

³In €LAN, the Hamburg Metropolitan Region encompasses the city-state of Hamburg, the western part of Mecklenburg–West Pomerania and the southern part of Schleswig–Holstein. The Hamburg Metropolitan Region also includes parts of Lower Saxony, but this area was omitted from the study.

health services, and displays a relatively diverse economic structure with employment opportunities in a variety of sectors.

Complex problems in planning require a comprehensive approach. This is why the project undertook a policy analysis to identify which stakeholders played which roles in the processes of decision-making and developing strategies pertaining to land use and regional development. The logic for coming to decisions was based on an analysis of the incentives or constraints, the relationships between stakeholders and the administrative-institutional system.

This led to identifying two central dimensions in that context: the “*role*” and the “*region*”. The former contained three scopes, which were important as both descriptive and selective factors for potential participants and were called “*selection dimensions*” (Projekt €LAN, 30 June 2011, p. 11):

- Political power (in the sense of the separation of powers)
- Policy
- Administration (Projekt €LAN 30 June 2011, p. 11); author’s translation).

The latter dimension, “*region*”, led to the classification of five types of affectedness within the HMR (Fig. 10.4).

The dimensions of “*role*” and “*region*” were then cross-referenced to identify which stakeholders were relevant for the serious game at the municipal level. The project then approached these stakeholders to participate themselves or recommend suitable representatives to participate in the serious game.

The feedback to the first contact through the project was very positive overall. The actual circumstances of rising energy prices during the project might have also pushed stakeholders’ interest in the project’s favour. The mix of participants covered a wide range of knowledge relevant for planning (especially concerning transport, housing, energy and economics) at all three political levels (municipal, federal state (*Länder*) and federal government). The decision-makers participating

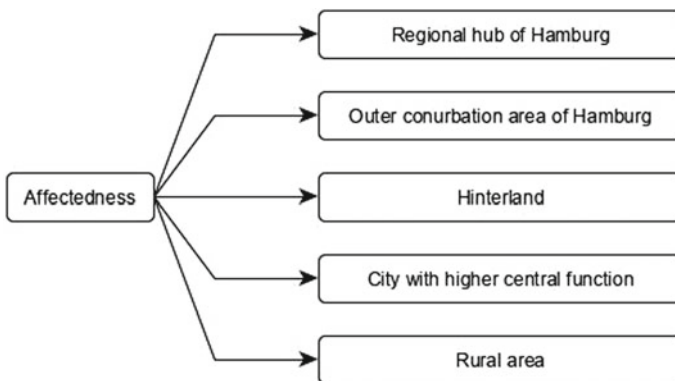


Fig. 10.4 Five communal classes of affectedness by rising energy prices within the HMR (according to Projekt €LAN, 30 June 2011, p. 11, author’s translation)

in €LAN represented their own local, state or federal level and were chosen from different types of areas in the HMR, including parts of the city-state of Hamburg, the western part of Mecklenburg-West Pomerania and the southern part of Schleswig-Holstein. Thus the selected representatives of communal classes varied according to population, economic structures and degree of vulnerability to fluctuations in (fossil) energy costs. Unfortunately, no secondary city as a counterpart to Hamburg was able to participate, which led to one classification to be omitted in the project.

Since Mecklenburg-West Pomerania and the southern part of Schleswig-Holstein are very different in their settlement as well as administrative structure, the project constructed two corridors for the serious game. The Eastern Corridor (Hamburg to Mecklenburg-West Pomerania) and the Western Corridor (the southern part of Schleswig-Holstein to Hamburg) addressed these differences and made it possible to compare different structures for the serious game.

Continuity was a central factor for the project during the different parts of the serious game. The sessions were held over a period of one-and-a-half years, between April 2012 and October 2013. The long duration of the intervals between sessions was in part necessary for the project to be able to additionally incorporate the federal level. This was relevant for regional stakeholders' decisions, as the federal government sets the overall framework for possible responses at the regional level.⁴ In order to most realistically simulate regional decision-making, the regional level actors and stakeholders therefore had to interact with the federal level to explore the relationship between both levels, and to develop an exchange between them.

The result is a two-tier serious game as shown in Fig. 10.5.

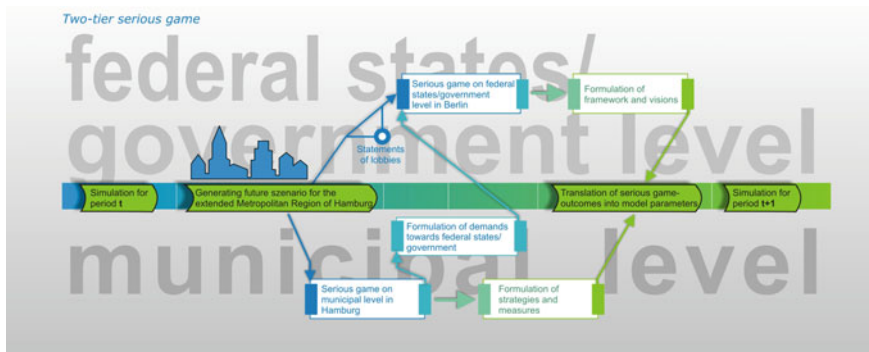


Fig. 10.5 The two-tier serious game of €LAN (€LAN 2014, also in Guimarães et al. 2014)

⁴I.e. The German Renewable Energy Sources Act—*Das Erneuerbare-Energien-Gesetz (EEG)*—which sets the frame for electricity to be preferentially produced by regenerative energy sources and refunded by certain mechanisms. For the German federal states, important also for electrical vehicles and transport modes.

10.8 How to Play the €LAN Serious Game

To implement the serious game, a series of moderated workshops was held in which key stakeholders from the case study area were asked to react to scenarios of rising energy prices. They were asked to act according to their best intentions and knowledge as they would in reality, and thus to decide on measures and strategies to counter the negative effects of rising energy prices identified for their municipality or their respective sphere of action.

Several serious game sessions were held during the €LAN project between 2012 and 2013. Decision-makers from different administrative levels reacted to a scenario of constantly high energy prices, which would stress the public purse through costs for providing transport, social services and energy for heating, street lights, etc. If energy prices consistently rose and were not a peak event that ceased after a few days or weeks (like in the 1970s or in 2008), stakeholders would be more likely to be forced to take action to counter the noticeable effects of increased fuel and heating costs. One possible option was to directly subsidise fuel costs for consumers. Another option would be a systemic option for hardship cases to improve their financial situation, strained by rising energy prices. Those were two possible strategies decision-makers might decide on. These and other possible answers were anticipated by the project as possible outcomes of the serious game.

For the project's starting scenario, "2015", a price of USD 200 per barrel of crude oil (Brent) was set. This was calculated to result in a pump price of EUR 2.20 per litre. The average additional cost per household paid for energy (heating, transport and electricity) in the scenario was subsequently calculated to be EUR 130 per month compared to prices in 2010. For the later scenario, "2025", the prices were set at USD 400 per barrel of crude oil (Brent), which amounted to an additional EUR 340 compared to 2010 prices.

To formulate decisions, measures, etc., decision-makers were provided with LuT model results translated into figures, tables and maps, as well as newspaper articles. These materials consisted of an easily understandable multifaceted set of information, which gave tangible meaning to abstract model numbers. The aim behind providing and distributing information in this way was to simulate the real conditions in which policymaking occurs as closely as possible.

Suggested policies by decision-makers were constrained by their current powers within the German federal system as well as by current municipal budgetary restrictions. The restrictions were defined to be as realistic as possible to prevent participants from pursuing "unrealistic" responses, e.g. in the sense of spending more on measures than they would be able to in reality. The project also attempted to prevent the inclusion of more measures or ideas in their policy portfolio than they would if the scenario was true.

The outcomes of the sessions were then quantified, translated into parameters for the LuT model and fed back into it. For a more detailed explanation of the serious game design, see Gertz et al. (2015).

During the first session in the Eastern Corridor, the participating decision-makers were presented with the results generated from the integrated land use and transport model as a first step, which was intended to aid them in relating to the scenario on a more personal basis. Through (custom-produced) newspaper articles, they got an impression of how rising energy prices might influence daily life. A report presenting statistics relating to the development scenario—a regional monitor—presented them with key facts and figures in a familiar format to relate to the scenario on a more professional and planning-oriented level. In the second step, the decision-makers identified likely effects on their respective municipality, and were then asked to devise actions and measures to counter the (adverse) consequences of rising energy prices.

On the regional level, participating decision-makers were split into two groups according to their regional affiliation or corridor. One group represented the Eastern Corridor; the other the Western Corridor. The project took different methodological approaches to each region in the serious game, varying in the number of sessions and therefore also in the depth of analysis of the effects for each participating municipality. This paper concentrates on explanations about the serious game within the “East” group, which had more sessions and a longer and therefore deeper phase of analysis. This gave participants more time to analyse the effects of rising energy prices on their own municipality and identify the resulting areas in which there would be a need to act. In the Western Corridor, the first phase of identifying such areas as well as the depth of analysis and time for developing appropriate policies was shorter. The results from both corridors are summarised in the following section.

10.9 The Resulting Policy Agenda

After two iterative cycles of the serious game, each decision-maker came up with proposals on how to minimise the negative effects of rising energy prices by 2030. The actions and policies developed by each decision-maker were clustered and labelled according to the general direction the measures implied. Depending on the municipal classification (e.g. small town with a rural context or larger city) for which each decision-maker acted, there was no consensus among stakeholders about the general direction that the proposed measures took, and in some cases they were even contradictory. But in some areas, they also complemented each other. An overview of the direction of measures and strategies the municipal representatives came up with is given in Table 10.1.

When taking a closer look at the various measures that decision-makers chose, it is remarkable that they largely come from five policy fields:

- Housing
- Transport
- Energy
- Technical and social infrastructure
- Comprehensive approaches.

Table 10.1 Policy measures suggested by decision-makers within the €LAN serious game

Direction of measures	Description	Examples of measures
More efficient, car-based society	(Small) Municipalities highly dependent on structures for private car use do not see any way of replacing the car. They attempt to increase car use efficiency through technological improvements as well as a higher degree of occupancy per car	<ul style="list-style-type: none"> • Promotion/development of electric transport • Online ride-sharing services
More efficient housing	Almost all municipalities see the housing sector as one with a high potential to save energy	<ul style="list-style-type: none"> • Energy-efficient renovation of houses • Energy advice for tenants and owners • Construction of new housing • Setting higher energy standards for urban land use planning
Public transport as the saviour of mobility (“Stepping out of the comfort zone”)	Municipalities close to main public transport corridors see public transport as the saviour of mobility. Significant improvements can make public transport more attractive, but these investments are only worthwhile if their inhabitants discover sympathy for them	<ul style="list-style-type: none"> • Capacity improvements on existing public transport routes • Traffic management and combination of transport modes • Park & Ride options • Regional network expansion of public transport (including rail)
New happiness on two wheels	Many municipalities view electric bicycles and especially the potential connection with public transport as a major opportunity	<ul style="list-style-type: none"> • Mobility management • Combination of transport modes • Promotion and development of electric mobility (suggested by participants in the Western corridor)
Self-sufficiency on various levels	As climbing energy prices increase spatial resistance, some municipalities strive for self-sufficiency on multiple levels: energy supply (wind power stations, bio-energy village, ...), attractiveness to businesses (of their own municipality), infrastructure, binding purchasing power	<ul style="list-style-type: none"> • Combined heat and power plants as the standard for urban land use planning • Promotion of bio-energy villages • Cooperation between heat producers and heat users through a “heat stock market”

(continued)

Table 10.1 (continued)

Direction of measures	Description	Examples of measures
Compensation of energy price—disadvantages of the location	Some (more peripheral) municipalities try to compensate for their location disadvantage (worsened through increased energy prices) by strengthening their local advantages (subsidised land for building, affordable and high-quality child care options, good reputation, green spaces, ...)	<ul style="list-style-type: none"> • Attractive day care (nursery school) • Increased promotion of attractive housing areas • Citizen survey: What do we want? • Attracting businesses (to their own municipality)
Maintain short distances, coupled with the topic of “adaptation to demographic change”	Strategies for adaptation to demographic change. Especially when talking about retaining shops and services (social infrastructure, retail) through reorganisation, subsidies or restructuring	<ul style="list-style-type: none"> • Establishment of a health centre • Establishment of a cooperative town hall • Local supply of goods through a “marketplace shop”
E-Everything with local ties	Many municipalities acknowledge the potential of digital media in enabling more energy-efficient mobility for their residents This idea is tied together by purpose-built components (e.g. online ride sharing platforms in combination with safe and well-designed commuter parking spots) as well as social elements (e.g. municipal initiatives to use ride sharing, mentor programmes for using online services, etc.)	<ul style="list-style-type: none"> • Broadband and telecommunications • “E-Everything” (local supplies and all municipal services online) • Telemedicine (online medical services)
Services on wheels—services come to us	In very rural areas, mobile services and supplies are experiencing renewed popularity. Thus another thread of the discussion and strategies linked to demographic change debate has continued. The reality of implementation so far has yet to culminate to a significant amount	<ul style="list-style-type: none"> • Local supply of goods through a “marketplace truck”, mobile medical services, Combi-Bus (bus taking on passengers as well as mail and goods)

(continued)

Table 10.1 (continued)

Direction of measures	Description	Examples of measures
Make space and avoid overheating	Due to rising energy prices, central urban areas enjoy additional popularity, adding another element to trends of reurbanisation. At the same time, communities fear an overheating of housing markets and look for possibilities to handle the sometimes significant needs for infrastructure expansion (e.g. along the main axes and main nodes of public transport). The remaining question of how those expansions are to be paid for still needs to be answered	<ul style="list-style-type: none"> • Capacity improvements on existing public transport routes, advertising new housing sites and inner-city development
There is still life in old regional centres	Model outcomes suggest that the attractiveness of medium-sized regional centres will rise along with increased energy prices. This advantage should be exploited by regional centres	<ul style="list-style-type: none"> • Capacity improvements on existing public transport routes • Advertising new housing sites and inner-city development

Interestingly, none of the participants suggested that subsidising energy costs directly should be part of their respective strategies or policies.

The majority of the measures suggested by decision-makers belonged to either the housing or transport field. One reason is certainly that decision-makers at all municipal levels believe the housing sector to have great potential for saving energy, e.g. by renovating existing buildings to save energy, and/or by setting higher energy standards for new buildings. The large number of measures suggested in the field of mobility is mainly caused by the assumption that travel as such should still be possible for their citizens or residents, but perhaps by a different mode of transport than before—such as switching from, e.g. car to public transport. Many measures tended to improve public transport services or promote a switch of transport modes. Where travelling by car is the only viable option, participants mentioned ridesharing programmes or related ideas as ways forward. The overall aim is to keep the level of mobility for their residents at least constant, or improve the existing options of transport means for necessary trips.

The results of the €LAN model reveal that the current social disparities within the Hamburg Metropolitan Region will deepen in line with rising energy prices. This result is in part a consequence of a higher car dependency in rural areas and a reasonably well developed mass public transport system in urbanised areas. Not only are different regions differently affected by rising energy prices, but different types of

municipalities also experience different effects. Regional centres will face an overheating housing market, as increasing energy prices create additional demand along with the noticeable trend of reurbanisation. One consequence of this development will be that existing mass transport infrastructure will experience increased demand along the main axes and at the main connecting nodes.

At the other end of the scale, rural areas will struggle to compensate for their car dependency by using various strategies to offer other benefits. Developing additional independent structures for energy production or even attracting more jobs are some of the measures municipalities are looking for, depending on their own requirements and capacities.

The effects of increasing energy prices simulated for distances travelled in €LAN show that while the City of Hamburg will experience an increase in traffic, the average distance travelled per day and per person in rural and low-income municipalities will drop by approximately 20 km in comparison to 2010. This sharp reduction in distances travelled affects whole regions, such as Harburg, Storman and Segeberg. Interestingly, inhabitants of some municipalities (mostly in the east) would be less affected or would even drive more than in the reference year. This would occur due to a lack of employment, because high energy prices (among other factors) help to contribute to turning part-time or small-income jobs unprofitable, if commuting costs consume a large fraction of that income. Coupled with the relatively low overall income levels in these areas already, these effects would deepen social inequities in the region.

The results indicate that it is not possible for all municipalities to compensate for the effects of rising energy prices in full. Moreover, some effects might cause already existing trends (demographic change, migration trends, etc.) to increase or to progress at a faster pace.

10.10 Future Options for Using New Modes of Integration

The participants agreed that the biggest value of the project came from the opportunity to discuss the effects of rising energy costs and possible responses in an unusual setting and with an unprecedented combination of decision-makers. They stated that the views from all regional classifications and different federal bodies enabled them to investigate the problem from multiple angles, and that they rarely had the opportunity to meet in such constellations in their professional setting or field of responsibility.

They also considered the presentation of their strategies incorporated into a model to be valuable, because it allowed them to gain an overview of possible developments and effects of policies, even when there was no numeric output to quantify the effects of individual policies or measures.

The serious game created an interface in which the decision-makers were able to freely discuss a complex problem with other stakeholders that was not (yet) on the agenda but deemed very important. The value added by the serious game to the discussion about new ways for the co-design and co-production of knowledge for

land use governance can be seen as an approach for taking a broader view on a complex subject. Serious games can be used as a tool to come to better informed conclusions; the idea of co-design in the context of land use as a scarce resource and in meeting sustainability goals was especially fruitful. This was true not only within various administrative levels—to broaden the view on one specific problem—but also in a context, e.g. with local stakeholders, to use serious games as a participatory co-creation tool. As an example to actively involve additionally practical experience for a broader view on a complex subject, serious games can involve farmers in the process of agroecosystem design and identify factors and patterns of local-level decision-making to openly discuss and share their ideas (Speelman et al. 2014).

This is just one option how serious games can add value to sustainable land management due to their discursive design and the wide selection of participants. The serious game enabled the participants as a group to come to a better understanding of the problem by combining views from different (occupational) backgrounds, public institutions, panels, or other more formalised structures that would not meet in the traditional course of planning and policy; this thus enhanced the formal process at an early stage.

A broader understanding of the problem via serious games does not necessarily lead to a “better” solution for a problem in the sense of increased efficiency, but it may enable decision-makers to consider more facets and thus raise the group’s level of knowledge through the inherently communicative design of a serious game.

To determine all important aspects of a complex problem, planning in such a broad context is necessary, but it depends on many variables. Exploring such problems with tools such as serious games, which are not standard procedure or formalised, can add value to the whole process. Nevertheless, the non-standard design requires individual commitment. To embed such commitment into more formal structures or procedures might in some sense be counterproductive, but should be understood as acknowledged evidence for the usefulness of serious games as a tool for improving administrative and political processes.

The complex context of sustainable land use also lends itself to serious games. Many serious games utilise dynamic computer-based elements to create scenarios for the participants or to demonstrate decision results or the outcomes of the session. Participants of €LAN stressed the need for more exchange about complex problems. Another example of exchange and format on complex land use problems was LandYOUs, where participants explored dimensions of sustainability with respect to economic, social and environmental conditions, while being continuously threatened by global trade fluctuations and limited resources as described in Schulze et al. (2015) and Seppelt et al. (2014).

Different formats for exchange and exploration besides the standard methods and boards of professional planning must still be discussed further to facilitate cross-border solutions adequate for the problem. The developments of the past ten years have shown that serious games are increasingly seen as collaborative tools to enhance planning decisions and sustainable land management. Research by den Haan and van der Voort (2018) has offered a glimpse of the possibilities, citing examples of more than 40 serious games around the world in the field of sustainable land management.

These results reinforce the idea of serious games as a platform for this necessary and desired exchange as part of the preparatory process for policymaking. This is especially the case in the complex fields of planning and policymaking, where planners and politicians need a combination of the opportunities to process complex information and respond to the possible effects of their decisions. In such circumstances, an integrated computer-supported serious game like €LAN can be a valuable tool of support at all levels of government and administration.

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