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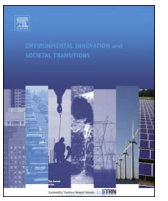

Original Research Paper

Incumbent energy companies navigating the energy transitions: Strategic action or bricolage?

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ABSTRACT

The behaviour of incumbent energy companies is critical for a transition to a sustainable energy system. We address the recent call for closer conceptualisation of power and agency within transition studies by combining concepts of strategic action fields (Fligstein and McAdam, 2012) and the flat-ontology perspective of arenas of development (Jørgensen, 2012) to identify potential ruptures emerging on the micro scale in the field of sustainable energy. We investigate how new actor configurations in new experimental arenas open field rules for renegotiation. We provide a long-term analysis on how traditional energy field rules have emerged, how two of the most powerful energy companies in Finland have responded to the emergence of sustainable energy and how new forms of collaborations are emerging in the space created by new arenas of development that create ruptures within the incumbent energy coalition.

1. Introduction

The behaviour of incumbent energy companies is critical for a transition to a sustainable energy system. In the medium term, they control most of the fixed capital, including infrastructures like distribution grids, and the existing customer base. The role of incumbent energy companies has hitherto presented itself mainly in the classical terms of strategic action fields, where incumbent coalitions defend the status quo against challengers (Kungl, 2015; Wassermann et al., 2015). While this portrayal is likely to aptly represent the dominant logic in the field, there are signs of different, perhaps more collaborative logics emerging in the margins.

The need for closer conceptualization of power and agency in sociotechnical transitions is widely recognized, and conceptual tools for this purpose have been sought in several directions (Avelino et al., 2016; Geels, 2014; Geels et al., 2016). In order to contribute to this discussion, we draw on two sets of concepts that have been proposed as viable alternatives for investigating agency in transitions (Jolly and Raven, 2015; Späth and Rohracher, 2015; Weber and Rohracher, 2012): the concepts of strategic action fields (SAFs) (Fligstein and McAdam, 2012) and the flat-ontology perspective of arenas of development (AoD) (Jørgensen, 2012).

We use these perspectives in a sequential manner to both understand how SAF rules emerge, but also to investigate potential ruptures and novel logics emerging on the micro scale in two cases from the urban energy field, today challenged by climate and sustainability issues. In particular, we focus on cases of collaboration between incumbent energy companies and diverse challengers (ICT startups, civil society organisations, renewable energy entrepreneurs). Strategic action field theory posits that the success of challengers in disrupting the status quo depends on destabilization of the incumbent coalition's power due to changes in proximate or higher-order fields (Fligstein and McAdam, 2012). The arenas of development (AoD) perspective contributes by offering a practical

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approach for mapping actor-network configurations and identifying emergent features of arenas (Jørgensen, 2012; Pineda and Jørgensen, 2016).

Our research questions are: (1) What has been the dominant response of the incumbent energy coalition to the emergence of sustainable energy within past 20 years? (2) What new collaborations with challengers are emerging in the space created by new arenas of development in sustainable energy? (3) Are there signs of broader ruptures in strategy, discourse and investments within the incumbent energy coalition?

We draw on an embedded, multiple case study design on recent collaborative projects by two of the most powerful municipally owned energy companies in Finland, an interesting country because a small circle of incumbent elites has ruled the energy field, but the country has also been early in, for example, liberalizing its energy market. We investigate these cases through multiple levels of analysis, starting with the energy field on the city and national levels and the case histories of each of the companies. We investigate the types of new actor configurations and micro logics emerging in temporary, sometimes even playful, collaborations originating in new experimental arenas, and trace the ways in which new actor configurations might reshape the role of incumbents in the ongoing energy transition. Through this analysis we highlight the value of combining a long-term analysis of how field rules emerge with an analysis of how such rules can be challenged from within in arenas constructed at the intersection of several fields.

2. Conceptual framework

The multi-level perspective on sociotechnical transitions has become one of the most popular approaches to investigating transitions in energy and other sustainability-related issues (e.g., Kern and Smith, 2008; Verbong and Geels, 2007). Yet this perspective has also been criticized for lacking conceptualizations of agency and power in the transition (Hess 2013; Hess, 2016; Jørgensen, 2012), though such conceptualizations have started to emerge (Geels, 2014; Geels et al., 2016). For example, Geels (2014) has conceptualized relations between policymakers and incumbent firms as a “core regime level alliance”, which often resists fundamental change. We present our own contribution to surmounting this challenge by drawing on two theoretical perspectives that investigate how agency and power are wielded: the notion of strategic action fields (Fligstein and McAdam, 2012) and the concept of arenas of development (Jørgensen, 2012).

2.1. The strategic action fields (SAF) perspective on incumbents in the energy transition

The concept of strategic action fields (SAF) is highly relevant for investigating energy transitions, since it conceptualizes fields as constituted by an incumbent coalition (such as incumbent energy companies and supporting regulators) and challengers attempting to change the rules of the game. Strategic action fields (SAFs) are meso-level social orders where social actors compete and cooperate for power, but also craft collective identities to mobilize others and to render their everyday practice meaningful. The SAF concept refers to many different kinds of social orders: from educational systems to social movements and industries. SAFs are located within a network of other similar SAFs, thus given them a ‘Russian doll’-nature (Fligstein, 2013). Thus, the energy field is set within a higher-order field of the macro-economy and global finance, for example, and dependent on proximate fields, such as energy-using industries or urban systems.

Within each SAF, there is common knowledge of the rules of the game. While players in the field are conceived of as strategic, their interpretations of the field are shaped by their own perspective. This means that conflict is normal in fields, which are frequently less settled than they appear to be on the surface. Moreover, it means that many fields have forums to define and communicate field rules (formal and informal), which function as internal governance units (IGUs), such as trade associations or standards-setting organisations.

SAF conceptualizes the power of incumbents as dependent (a) on a common understanding of the field rules, and (b) on the status of higher-order and proximate fields. Hence, while SAF accounts for both stability and change, it conceives of change as dependent on the coincidence of two conditions: (a) social mobilization by challengers to overturn the rules of the field, (b) destabilization of the power bases of the incumbent order in the field due to changes in higher-order or adjacent fields. Social skill, wielded by challengers for social mobilization, is a critical part of Fligstein’s (2013) explanation of change in fields. Yet, from the SAF perspective, social movements are usually ineffectual unless their challenges to the existing social order are simultaneously supported by changes in the higher-order or proximate fields that maintain the stability of the focal SAF (Fligstein, 2013; Fligstein and McAdam, 2012). “The stability of a given field is largely a function of its relations to other fields” (Fligstein, 2013, p. 44).

The SAF perspective has been applied to the energy market in an increasing number of studies, which focus on the power of incumbents and the terms of the conflict between challenges and incumbents. For example, Kungl (2015) analysed German incumbents’ long-term resistance and slow adaptation to the Energiewende, highlighting the role of changes in higher-order and proximate fields for their eventual shift to an adaptation mode (see also Wassermann et al., 2015). Hess (2016) has analysed the ways in which energy incumbents in the USA have attempted to block and subvert the growth of distributed solar power. Schmidt et al. (2016), analysing the German Energiewende from a SAF perspective, concluded that decentralized (challenger) and centralized (incumbent) configurations of the energy system are incompatible from an actor perspective, and even more incompatible from an institutional perspective, since the rules of the game cannot simultaneously provide for a decentralized, polycentric governance system and a highly centralized governance system (Schmidt et al., 2016).

The SAF perspective aptly describes long-term changes in power relations and the way in which they draw on shifts in the balance of higher-order fields, on the one hand, and social skill on the micro-level, on the other. It can also be fruitfully used to analyse the emergence of new fields (Fligstein and McAdam, 2011; Canzler et al., 2017). The dichotomy between incumbents and challengers,

Table 1
Comparison of the SAF concept and the AoD perspective.

Similarities between SAF and AoD	Specific interests in AoD
1. Focus on agency, power and conflict in institutional (in AoD, sociotechnical) change	1. AoD focuses on emerging fields, hence less focus on field rules than in the case of SAF
2. Conception of differential power/resources with the field/arena	2. AoD focuses more on sense making than rule-following or rule-overturning behaviour (than SAF)
3. Relationality of fields/arenas to each other	3. AoD focuses on a temporally bounded space ("project")
4. View of agency as consisting of the ability to enrol others by framing (in AoD, also sociotechnical framing) action	4. AoD subscribes to a flat ontology: networks rather than institutions (cf. SAF) constitute the fabric of society; artefacts and natural objects have agency
5. Incomplete/partial knowledge of agents	5. AoD focuses on cross-arena work – active manipulation of boundaries to other arenas

however, might make it difficult to see smaller shifts in power balances and recognize the roles of other actors in field reconfiguration at a given time. The arenas of development perspective offers an alternative tailored to analysing the micro-politics, materialities and surprises involved when fields collide and are in flux.

2.2. Arenas of development as temporally bounded spaces of renegotiating local orders

An alternative, more fluid perspective on strategic (or tactial) action by incumbents and challengers is provided by the Arenas of Development (AoD) perspective (Jørgensen and Sørensen, 1999; Jørgensen, 2012). The AoD concept focuses our attention to temporally and socially bounded arenas where field rules are renegotiated. They are not necessarily intentionally created, but can also arise out of conflicts (Jørgensen, 2012). An arena consists of actors re-configuring networks and engaging in new network constellations. It is a "spatial imagery that brings together heterogeneous elements that seem distant in geographical and conventional cultural space" (Jørgensen and Sørensen, 1999, p. 192), constituted around a "project" (Jørgensen and Sørensen, 1999) or a controversy involving sociotechnical change (Jørgensen, 2012). The AoD perspective is deemed particularly relevant for periods of crisis, when alternative practices and conflicting views and visions emerge that lead to controversies and dialogues among the actors and open for changes in the socio-technical configuration (Jørgensen, 2012).

The AoD perspective shares many features with the SAF concept (Table 1). Similarities (Jørgensen and Sørensen, 1999; Jørgensen, 2012; Pineda and Jørgensen, 2016) include the focus on agency, power and conflict – indeed, AoD highlights the importance of controversies over the direction of sociotechnical change. Similarly, the AoD conceives of agents as having differential power within the arena and it also embodies a conception of arenas as existing in relation to each other (Pineda and Jørgensen, 2016). AoD also has a similar conception of agency as exists in the SAF framework – agency arises from the ability to enrol others (cf. Fligstein, 2001; Fligstein and McAdam, 2012). Also, as in the concept of SAF, agents in AoD only have a partial understanding of what is going on in the field/arena (Pineda and Jørgensen, 2016).

Yet there are also differences in emphasis. The AoD perspective focuses on a temporally bounded analysis of emerging fields. In particular, the AoD perspective has been used to investigate the interaction between existing and emerging sociotechnical systems (Pineda and Jørgensen, 2016; Valderrama and Jørgensen, 2008). For example, Späth and Rohracher (2015) have investigated how the creation of new AoDs can provide opportunities for challenging formerly hegemonic positions, particularly in urban contexts where the interactions between different systems of provision create ambivalence, and hence opportunities for the contestation of established positions and boundaries. In Späth and Rohracher's (2015) example, conflicts over whether passive houses in a new model development in Freiburg should be connected to the district heating system highlighted broader long-term threats to the local district heating system, which had until then been viewed as highly progressive.

While a field as a concept consist of actors and commonly acknowledged rules (Fligstein and McAdam, 2012), an arena is constituted somewhat differently. Because of the emerging nature of the arenas, the focus is more on sense making than on reasoning based on following, or attempting to change, field rules. According to Jørgensen (2012), the analysis takes as it starting point, "situated actor's conflict-ridden sense-making within temporarily stabilised actor-worlds and arenas, configured to cope with experienced tensions between established institutional components" and "motivated by conflicting interpretations of challenges, aims, measures, and anticipated outcomes." Hence, in an arena as opposed to an (established) field, not only is there conflict over whether commonly recognized rules of the game are appropriate, but there can also be confusion about what the rules might be.

Unlike the concept of SAF, the AoD perspective subscribes to a flat ontology (no hierarchically "higher-order" fields) and highlights the importance of technology as a social force, drawing on actor-network theory (Callon, 1999; Latour, 1996) and notions of sociotechnical assemblages (Jørgensen, 2012; Pineda and Jørgensen, 2016). Hence, it is networks rather than institutions that constitute the fabric of society in the AoD perspective; in these networks, artefacts and natural objects have agency and hence, outcomes can be surprising for the agents themselves (Jørgensen and Sørensen, 1999).

This flat ontology allows for an analytical perspective that spans across several arenas and attributes agency to technical systems. The participants and boundaries of an arena are continually changed by the performances of actors seeking to stabilise or change relations. Actors may even be enrolled in several arenas at the same time and do not necessarily need to coordinate and solve either conflicting views or practices as long as these are not colliding (Jørgensen, 2012). For example, Pineda and Jørgensen (2016) discuss the creation of a new arena, spanning across three existing arenas, to develop the Copenhagen metropolitan area, and in particular,

Table 2
Research design, methods and data sources.

Purpose	SAF analysis in this study	AoD analysis in this study
Research design	Historical research design	Contemporary case studies
Types of data collected	Published research on the socio-political and economic structure of the field	Interviews with company staff, city officials and politicians (23 Helsinki, 10 Tampere)
		Participant observation
		Company material, material produced by the cities
		Websites and press releases
	Histories of the case companies and of the Finnish energy industry	
	Primary documents: annual reports, press releases and media coverage	
Time frame	130 years, emphasis on recent decades	8–10 years
Types of questions addressed	Relations between energy utility and city, between utility and the national energy industry and relations to social movements and technological challengers	Shaping (and reshaping) of a temporarily bounded space where field rules are suspended
		New players from other fields engaged in the arenas
	Field rules, their emergence and sources of stability	Controversies and tensions
	Changes in higher-order and proximate fields	Types of collaborations emerging
	Sources and mechanisms of stability and change	Ways in which participants (in particular, the incumbents) cope with tensions

the new public transport system in the city. They emphasize that space can be created for novelty through a new configuration of actors across public administrations and governance scales, private firms, existing infrastructures, funding mechanisms and technologies. They also stress that the participants and existing arenas engaged in such a new AoD influence the character of the principles, tensions, controversies and objectives that shape the novel technological system under construction. This notion of an AoD as a junction where diverse technical systems collide is also highlighted by Späth and Rohracher (2015).

3. Research design, methods and data sources

Our research design aims to develop a sequential analysis that combines the strengths of the strategic action fields concept (Fligstein and McAdam, 2012) with the special focus of the AoD (Jørgensen, 2012) on emergent sociotechnical fields to study potential ruptures and novel logics emerging on the micro scale in the ambiguous field of sustainable energy (Table 2).

We draw on an embedded, multiple case study design (cf. Bengtsson and Hertting, 2014; Tellis, 1997) that represents recent collaborative projects by two municipally owned energy companies in Finland: *Helen* in the capital of Finland, Helsinki, and *Tampere Electricity Utility* in Tampere, Finland's second largest urban area. We start with an analysis of the case histories of each of the companies over the past decades, and how the SAFs of urban energy were shaped and reshaped by incumbents, challengers and relations to higher-order and proximate fields. We then turn to investigating the types of new actor configurations and micro logics emerging in temporary collaborations originating in new experimental arenas, and trace the ways in which new actor configurations might reshape the role of incumbents in the ongoing energy transition.

SAF analyses typically draw on historical sources, secondary data and statistics (Fligstein and McAdam, 2012; Fligstein 2013) to describe the broad contours of the development of a particular field, its social structure, as well as its dependence on higher-order and proximate fields, while complementing this with a close analysis of the mechanisms of social mobilization, such as bargaining, coalition formation or elite defection (McAdam et al., 2008). The AoD perspective focuses on more proximate data, such as first-hand documents (e.g. government bills and committee reports), and real-time observation and interviews (Lunde et al., 2016; Späth and Rohracher, 2015). Since the arena creates the focus of the study, it can span across several different SAFs, which are defined by the actors involved in the arena – hence, the actors or a particular controversy, rather than the field, are the starting point for the analysis. Accordingly, our empirical material draws on and triangulates a wealth of material: historical and secondary data sources, corporate communications material, statistics on investments, and interviews with incumbent and challenger representatives and other stakeholders.

Our analysis relies on historical analysis of the development of strategic action fields, mapping of the arenas of development, categorization of the types of collaborations emerging among incumbents and challengers in these arenas, and critical and contextual analysis of participants' and field representatives' views on the potential consequences of such collaborations. We use the particular strengths of the SAF perspective to trace the emergence, stability and gradual destabilization of the strategic action field of urban energy provision. Here, we pay attention to how incumbents in this field gained their position and how this field configuration has been supported by higher-order and proximate fields, while also noting incursions made by challengers, with a focus on recent decades. This creates the setting or stage for closer analysis of how actors navigate the transition in a temporally bounded space where different ideas about development collide. We use the AoD perspective to investigate a potentially disruptive junction, or new arena of development, emerging when the urban energy provision field is confronted with other fields and logics in a concrete urban development project.

4. Incumbent energy companies in the SAF

In the following, we first briefly present the histories of the companies (see Appendix A and B for full timelines). We then turn to identifying the main strategic action fields for these companies, the rules that have developed in these fields, and the events that have recently lead to an erosion of these rules.

4.1. The development of SAFs in Helsinki and Tampere

4.1.1. Helen

Helsinki Electricity Works was established in 1906 to replace entrepreneur-driven block energy stations, which had started to cause local problems in the form of extensive wire lines, poor air quality, fluctuating prices and slow and costly electricity deployment. Centralizing electricity production into the hands of one actor carried a promise of profitable, stable and affordable energy to citizens (Turpeinen, 1984). Electric lighting quickly replaced oil and gas lighting (Herranen, 1985). The city's own electricity production soon proved to be inadequate for the growing electricity needs, and thus electricity was purchased from the state-owned eastern hydro power plants, which covered up to 90% of the city's electricity needs in 1930–1945. The situation changed drastically after the Second World War when Finland lost, in the cession of territory, two of the four eastern hydro power plants. Helsinki suffered severe shortages and electricity had to be rationed.

The city's second power plant was based on new large-scale combined heat and power (CHP) production, which brought a new energy form to the city: district heating. Electricity needs continued to grow and the district heating network expanded rapidly. During the next four decades, five CHP plants, three coal-based and two natural gas based plants were constructed. By 1990, Helsinki had created a highly energy efficient (over 90%), profitable and centralized urban energy system.

At the turn of the 21st century energy field in Finland started to change, causing three types of destabilizing pressures on Helen. First, the economic environment changed in the electricity market liberalization, which ended Helen's 90 years of electricity monopoly. Competition increased and new retailers entered the market. Second, the institutional environment changed through the ratification of the Kyoto Protocol, which delegitimized the use of fossil fuels. Third, the central location of the power plants at the valuable coastal line contradicted with the city's space needs and created pressure to shift the location of the power plants.

Helen responded to pressures by defending the status quo, e.g. stating that its natural gas CHP plants were an example of already complying with Kyoto. As the pressures increased, Helen began to reorient by introducing a new green electricity product, purchasing new shares of hydro, nuclear and wind power, and constructing underground coal silos to reduce its city space usage. In 2006, Helen established a new underground cooling and heating power plant, which utilized heat pumps to produce district cooling from seawater.

In 2008, the city council committed to the EU 20-20-20 by 2020 targets and Helsinki signed the Covenant of Mayors to reduce CO_2 emissions. These events placed Helen, at that time producing 6% of Finland's CO_2 emissions, in a central position in reaching emission reduction targets. Responding to city requests, Helen formulated a long-term development strategy, which included the option of closing down the largest coal power plant (Helen, 2010). The city council was hesitant about the early closure of the coal plant, because Helen was a major source of income to the city, and postponed the decision several times during the next five years. Helen continued its reorientation by mixing wood pellets with coal and introducing electric vehicle charging and solar power solutions. In 2015, the city council finally decided to close down the coal power plant by 2025, and shift to a partially decentralized energy system.

4.1.2. Tampere electricity utility

Tampere was the first industrial city in Finland, and also the first place where municipal electric works were established, based on hydropower from local rapids. Electricity was distributed not only for street lighting and municipal buildings, but also sold to consumers and companies. This rapidly led to a shortage of electricity, resulting in the establishment of new plants. Yet, by the 1960s, electricity consumption had more than tripled, and the city's own electricity production amounted to less than one-third of all power sold, making the company reliant on northern large hydro plants.

The following decades saw investments in new production, including the first district heat plant in 1963, followed soon by others. New plants were fuelled by natural gas once the gas grid was extended to Tampere in 1986 (Anttila 1993). Like Helsinki, Tampere's two largest plants are based on CHP (Karppi, 2007). By 2004, natural gas accounted for 80% of the energy sources in Tampere and hydro power, less than 6%. As late as in 2007, natural gas was considered the environmentally best fuel due to lower CO_2 emissions than from coal (Karppi, 2007). The main expectation of the city at that time was economic profitability. The city environmental strategy was not viewed as exerting significant influence, since the company felt it lived in "the energy world" rather than within the city administration. Having invested in new CHP, low-NOx combustion and (later) district cooling, the company felt there was not much to improve without reorganizing the entire mode of operating (Karppi, 2007).

However, such reorganization soon became necessary. First, in order to meet the EU 20-20-20 targets as well as to cover a fiscal deficit from reducing employer charges, the Finnish state introduced an energy tax in 2011, which sharply raised the cost of natural gas (Sairinen, 2011). Second, cities became active in climate policy, which was supported by the EU by introducing a Covenant of Mayors pledging to meet and exceed the 20-20-20 targets, which Tampere signed in 2009. In 2010, Tampere launched ECO2, a strategic programme to reduce greenhouse gas emissions and "make Tampere one of the world's leading climate-conscious cities" (Välimäki et al., 2013, p.9). This initiative soon gave rise to the ambitious goal of reducing CO_2 emissions by 40%.

Fig. 1 summarizes the development of urban energy provision field of Helsinki and Tampere. Even though this development has

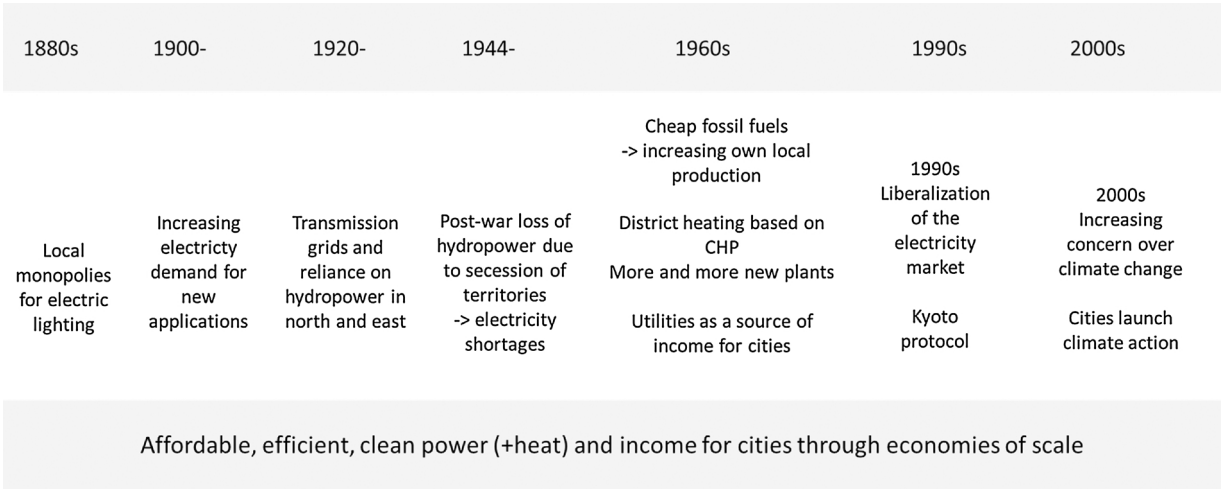

Fig. 1. Development of the urban energy provision SAF in Helsinki and Tampere.

been characterised by periods of upheaval, the basic structure of the field has remained the same for almost one hundred years, ever since the cities established their own electricity companies as local monopolies. Some field rules have changed, with competition overriding public provision in electricity since liberalization of the market, yet the city-owned companies have maintained their dominant position in Helsinki and Tampere and many other cities. Until the war, the companies had to purchase a large share of their electricity since demand quickly surpassed local supply, but after this, there was a strong move toward local production, mainly based on scale economies.

4.2. Incumbent companies within the SAFs of city energy provision and the domestic energy industry

Both companies can be seen as part of the same SAF: that of urban energy provision, which is embedded in the higher-order SAF of the Finnish energy industry. The city-level energy provision SAF consists of the companies, their owners in the city administration and political governance, as well as suppliers of technologies and competences for the provision of power and district heat (companies, consultancies and higher education institutions). These latter suppliers are shared by the higher-order SAF of the energy industry, which is managed by an internal governance unit (IGU), the Finnish Energy Industries.[1] The domestic energy SAF has been closely linked to the Finnish energy elite: a cohesive, unitary, and self-conscious group consisting of the political decision makers, the Ministry of Employment and Economy, city energy companies, industry-owned energy companies and former state-owned energy companies, as well as large energy-intensive businesses (Ruostetsaari, 2010a). Members come from the same schools, share the same ideals, and throughout history, have created common field-level rules, which emphasize security of supply, affordable energy, an engineering ethic and the importance of economies of scale (Ruostetsaari, 2010b; Salo, 2014).

The main urban energy SAF rules for Helen and Tampere Electricity Utility are to provide reliable and affordable energy for the city, which has been an important source of legitimacy for the local monopolies (which emerged after an initial upheaval, and have survived many controversies since). The histories of both companies show a rapidly increasing demand for electricity (later also heat), which led to shortages, dependence on power purchasing, and investments to secure local energy supply. This has been accomplished through centralized, mostly fossil-fuel based production, which was reinforced at the city level through investments in a district heating network and CHP production, and at the national level by low prices of fossil fuels in the 1960s and energy consumption outpacing domestic energy supply (Salo, 2014). The incumbent energy companies have been closely connected to the cities that own them, and up until 1995/1998 they were local monopolies. For decades the incumbents expended their efforts in securing local self-sufficiency by building new plants as the cities grew and standards of living rose.

Starting in the mid-1990s, the rules of both the urban energy provision SAF and the broader domestic energy industry SAF have been challenged by successive changes in the higher-order fields. First, the energy market was liberalized and deregulated, leading to declining energy prices and reduced revenues. The local energy companies were thus placed into direct competition with larger national energy producers (and indirectly, larger producers within NordPool) (Ruostetsaari, 2010b). Changes in the higher-order field of EU energy policy have reduced the power of the national energy SAF (Ruostetsaari, 2010b), and the higher-order field of city planning has started squeezing the urban energy SAF away from prime land. The entry of a proximate field (the ICT sector) into grid technology has challenged the energy industry to develop “smart grids” (Erlinghagen and Markard, 2012) and social movements

[1] The Finnish Energy Industries represents a fairly new IGU, created through a merger of previous IGUs in 2005, in response to a need for more unified representation vis-à-vis the EU (Ruostetsaari, 2010b). Yet it carries the legacy of decades of careful balance of power (and provisional solution of former controversies) between three groups of energy companies: industry-owned energy producers, the state-owned IVO and municipally owned energy companies. Since the oil crises in the 1970s, and the advent of nuclear power in the 1980s, the Energy Department of the Ministry of Trade and Industry has gained a key role in governance of the SAF, though it is highly responsive to industry positions.

promoting renewable energy have opposed large-scale solutions based on nuclear power and fossil fuels (Salo, 2014).

Since the domestic energy SAF and the urban energy SAF represent a close elite, with close connections with the main regulating authority and main political parties, they have been successful in protecting the status quo (Ruostetsaari, 2010b). As a result, Finland was quite late to introduce a feed-in-tariff for some forms of renewables in 2011, and even then, small installations (< 100 kVa) were excluded. Finland has been the only country in Europe that has offered no dedicated support for domestic solar panel installations.

External challengers representing distributed renewable energy solutions have tried to enter the city energy SAF in different forms and coalitions. First, specialized companies offering green electricity products, attempted to make a breakthrough, which remained modest, and incumbent companies soon countered with their own green electricity products. Second, companies marketing distributed energy solutions such as small-scale heat pumps and PV panels have attempted to gain market share, but have largely been either fended off from the core of the SAF with counterarguments about efficiency and emissions (Heiskanen et al., 2014) or incorporated into the incumbent SAF (Apajalahti et al., 2017).

Challenges to the local energy companies thus remained modest, and the companies managed to maintain most of their customer base and justify their established mode of operating for a decade. The challengers for Helen and Tampere Electricity Utility arose in the late 2000s from within the city (politicians and administration), drawing on mainly non-local arguments concerning climate change, new technologies and a global energy transition. The challengers gained momentum from global developments, which led the owners of the companies, the cities, to place new expectations on local energy production. In both cases, however, the city challengers were as reliant on the company as the company was on the city: revenues contribute to the municipal budget. Sunk costs, and the physically sunk infrastructure of the power distribution and the district heating network have made it very difficult to demand rapid changes in the system. Personal relations, a shared local reputation and a general local interconnectedness have contributed to a relatively 'low-key' challenge where the challengers have encouraged and coaxed rather than openly attacked the local energy company.

5. Arenas of development and bricolage in experimental spaces

External challengers have not been successful in making significant dents in the dominance of incumbent city energy providers. We employ the AoD perspective to explore how within-city challengers have created new spaces for energy incumbents to encounter challengers in a temporary, experimental context that spans across several fields and engages novel sociotechnical configurations. In the following, we first describe the experimental spaces created by new urban developments: Smart Kalasatama and ECO2. We then turn to exploring how these experimental spaces created new arenas of development enabling (or forcing) the incumbent companies to navigate the energy transition.

5.1. Smart Kalasatama for digital smart solutions for Helsinki

The broader Kalasatama area in Helsinki, where Helen has started it operations, has recently become the site where they city transforms itself and its infrastructures, including energy infrastructures. The former industrial site is in the process of being redeveloped into a home for approximately 20,000 residents and jobs for 8000 people. At the same time, the city has developed Smart Kalasatama into an open innovation platform that offers a place to co-create new smart services in a real environment with the users and inhabitants. (Appendix C provides a timeline of the developments in the Smart Kalasatama district.) We analyse these developments from an AoD perspective below. We recognized three AoD's including Helen that have emerged in different times but coexist still within the Kalasatama development area.

5.1.1. Portal of your life arena

The initial visions of Kalasatama becoming a test bed for digitalized smart energy services began with the collaboration of five big companies: Helen, Mitox, ABB, Nokia Siemens Network (NSN) and Fingrid (the national transmission grid operator). The initiator of creating an experimental site in Kalasatama was ABB, inspired by the Royal Seaport in Stockholm. These companies envisioned creating a large experimental area for their business development in grid infrastructure and smart solutions.

The purpose of Helen Ltd. was first to pilot solutions for the development of the electricity grid and, therefore, the network business unit of the company was the main actor on the site representing Helen. The initial AoD of Helen included piloting with grid atomization, hoop tension network, electricity storage and digital electric station. Later, the focus of the company started shifting towards developing services related to energy efficiency and renewable energy, which lead to the construction of the first crowdfunded solar plant in the metropolitan area. In spring 2017, Helen is testing how solar energy jointly produced in condominium buildings could be used and billed in the individual apartments, which until recently has been impossible in Finland due to the local energy companies' lack of interest in finding solutions for such billing.

The interests of ABB and NSN in the area were in demonstrating and piloting open data and the development of Internet of Things solutions (IoT). Due to new funding from the Finnish Funding Agency for Innovation (Tekes) in 2013–2015, the partners in this AoD also engaged in new emerging arenas with different foci, emphases and actors. While the partners have changed within the AoD, Helen still continues piloting novel services in Kalasatama for example with the SunZEB project focusing on combining passive solar energy in buildings with district cooling.

5.1.2. Local construction arena

The increased interest of the city of Helsinki in the Kalasatama area lead to new funding from Tekes's Smart City programme. Due

to the start of a new project, the city involved a new actor in Kalasatama to coordinate the project, an innovation intermediary Forum Virium Helsinki (FVH). It is an innovation department of the City of Helsinki with the aim to support the development of new digitalized solutions in Helsinki area and within the city administration. This replaced Helen as the lead actor in Kalasatama as now FVH represented the interests of the city in the area.

In addition to the city organization, the focus of this AoD is mainly influenced by the interests of the funder Tekes as well as the builders in the area, which include practically all in Finland operating large construction companies (Skanska, SRV, NCC, Lemminkäinen, etc.) as well as quite a few smaller ones, such as e.g. Ryhmärakennuttajat Oy, a citizen lead association acting as builder. The aim of Tekes in Kalasatama project has been to develop open data and related services. Important for the funder has been to support the active commitment of the city into the development of urban environments. Especially in Kalasatama, the focus has been in creating a model for the city of Helsinki for how the city can act as a partner with the inhabitants and how to include all city departments into innovation activities with the citizens. The local construction AoD currently continues within a project mySMARTLife, which is financed by the EU and managed by the city department Environment Centre. Helen and FVH continue as partners in the project as well.

5.1.3. Innovation arena

The shift of coordination of the development of the site to the intermediary FVH has led to a gradual replacement of Helen as the main actor in the area. First, Helen was engaged in the steering group of the project of Smart Kalasatama led by FVH, but in later stages it is no longer a member in the group (although it remained a member of the steering group of FVH). The aim of the AoD with FVH as a key actor has been to expand the network of actors in Kalasatama area and to forge new partnerships with actors in order to create new digital innovations in the area. FVH has initiated an experimental group called the Innovators' Club, which includes several kinds of stakeholders active in Kalasatama, in which the parent company Helen is an active member. Such staging of temporary spaces by the intermediary FVH is a way for bringing new actors together and reframing conceptions of novel services based on digital solutions (cf. Clausen and Gunn, 2015). Nevertheless, this forging of new partnerships has raised questions of loyalty, responsibilities and fears of changing the rules of the markets within the incumbent company. A representative of Helen stated:

"*I just feel that if companies started such operations from their own starting points they would not engage in such collaborations*".

The interests of Helen Ltd in Kalasatama have developed from piloting grid-based solutions towards more service development in this AoD. According to our interviews a representative of Helen stated that the developments in Kalasatama and the societal pressure towards low carbon solutions has led to the development of a separate business area within the parent company focusing on services and solutions related to flexible demand response of energy. In this AoD, emphasis has been placed on continuous and active innovation activities for example through an "Agile Piloting" initiative, which invites small innovations from a variety of actors to be experimented in Kalasatama, in living lab conditions with local residents.

5.2. ECO2 programme for a low-carbon Tampere

ECO2 was a long-term (2010–2015) and wide-ranging strategic project endorsed by the political leadership of the city. The aim was to find measures to meet the European Covenant of Mayors target in Tampere (20% CO_2 reductions by 2020, later raised to 40% by 2030), but aims included place branding and the development of local cleantech business, as well. Unlike Smart Kalasatama, ECO2 does not have a specific location in the city, but has intermediated projects in both old city-centre districts (densification and renovation) and low-carbon planning and development for greenfield and brownfield districts, as well as public buildings and public transport (see Appendix D for a summary timeline). It has been deemed a success, since carbon dioxide emissions have declined by 43% annually since the start of the project, in spite of continued population growth.

Analytically, we can discern in the ECO2 activities a governance arena, a new district development arena, and a retrofit arena, though these are not temporally distinct as in the case of Helen. In various ways, these interconnected arenas encouraged Tampere Electricity Utility to make what they call their "energy transition".

5.2.1. Governance arena

At the start of the ECO2 project, two regular city-wide forums were established to govern the project. The ECO2 Steering Group was a forum for senior officials in the city administration, which has discussed targets and measures and monitored progress. The ECO2 Advisory Board was a similar, more high-level forum chaired by the Mayor, with representatives from the administration, politicians and local business as well as a national funding body, Sitra. Tampere Electricity Utility was represented by senior directors in both groups. The importance of decisions by the energy company for CO_2 emissions in Tampere were discussed on multiple occasions, alongside other types of measures (such as investments in public buildings). These discussions and calculations served to highlight the relative importance of the energy company's decisions for the city-wide emissions, and on the other hand, offered rapid public acknowledgement when the company did decide to take measures.

5.2.2. Development arenas

ECO2 involved several projects to develop new city districts using low-carbon urban plans and investigation of alternative, renewable-based heat and power options, including distributed production based on heat pumps and solar heat and power. Tampere Electricity Utility was involved – together with ECO2 experts, research institutes and other companies – in the hands-on work in these projects, i.e., feasibility studies and calculations of various energy options. The studies found distributed systems to have CO_2

advantages vis-à-vis the existing district heat fuel mix, but they were also found to imply significant up-front costs and limited advantages for the energy company. Only a small portion of the original renewable energy investments envisaged have been implemented until now.

5.2.3. Retrofit arena

In order to combat urban sprawl, ECO2 (and in particular, a local agency called Ecofellows) started several retrofit and infill projects in the city centre. In these projects, building owners have been engaged in investigating and contracting various kinds of energy renovations, including insulation and other façade measures, solar power and exhaust air heat pumps. Tampere Electricity Utility has been involved as a co-funder in the projects (and co-owner of Ecofellows), as well as actively participating in the workshops with building owners and other businesses. As a result, the company developed in-house expertise in exhaust air heat pumps and has offered consultancy to customers. It has also piloted a new business model, purchasing heat from an apartment building, and has thus taken a first step toward a two-way district heating system. People within the company welcomed this as an important step toward a new business model:

> *During the last years, we've done these kinds of paper exercises of how a district's energy system should be made … But maybe we have now moved on to the next version, where we get to do concrete pilots … real experimentation. And this two-way district heating is the first thing, and I really hope it will be taken into production.*

Over the duration of ECO2and immediately after it, Tampere Electricity Utility made significant changes to both its strategy and fuel mix. In its energy transition strategy, the company committed to reduce CO_2 emissions by over 45% from 1990 levels by 2020. Investments totaling almost 200 m€ were made in several new facilities: A pellet heating plant, heat recovery in existing plants, a large waste-to-energy plant and a large wood-chip heating plant. Thanks to these investments, almost 30% of power and almost 50% of heat were produced from renewable sources by 2016 (Kahilaniemi et al., 2016).

These changes in local energy production were the single largest contributor to the CO_2 reductions achieved in the ECO2 programme. They are generally attributed to the energy tax reform and the rising cost of natural gas, but participants in ECO2 believe that the programme has contributed to these changes by highlighting the centrality of the energy fuel mix to all city decision makers, as well as by offering recognition of the benefits gained from decisions and investments. From an AoD perspective, one might also suggest that ECO2 has served to "trouble" the energy incumbent by regularly forcing the company, in various contexts, into close and public contact with competing technologies and solutions (e.g., distributed RES solutions, exhaust air heat pumps). Most of the company's response has been to incorporate renewable energy into the dominant, centralized mode of operating, but there are small (but potentially consequential) steps out of the dominant mode of operating in the opening up the district heating network to other providers, including customers.

5.3. Arenas of development as experimental sites for internal challengers

Our cases are examples where the relationship between challengers and incumbents is complex and mutually dependent. They are part of the same organization, but the energy incumbents have operated relatively autonomously, following their logic of providing affordable and reliable energy to meet (imagined) growing needs of growing cities. Within this logic, centralized, fossil-based energy has for long been the cheapest and most convenient option. Yet internal challengers, drawing on non-local logics, have bricolaged to combine diverse elements, creating spaces where these rules are temporarily suspended and new rules emerge. Even though they are pushed outside their comfort zone, the incumbents have no choice but to participate, since the arenas are "on their turf" − they are within the city and deal with energy; hence they are obviously a concern for the energy incumbents. And because the experimental spaces are labelled "innovative", and no one wants to resist innovation, the incumbents must engage in innovation alongside the other participants. They even employ new people, who then become advocates of new solutions within the companies.

While there are differences between our two cases, from the AoD perspective (Jørgensen, 2012) there are some clear similarities in the experimental spaces created and intermediated by Smart Kalasatama and ECO2:

- The experimental spaces have forced the incumbent into interaction with new actors – in the case of Smart Kalasatama, in particular, ICT startups and citizen-innovators and in the case of ECO2, distributed renewable energy designers and providers and active housing associations – and in both cases, with external parties like researchers. In this way, the city-internal challengers have destabilized established market alliances and long-held rules in the city energy SAF.
- They have created a temporarily stabilised space involving repeated interaction among the different parties, but where ordinary rules are inversed or suspended in order to conduct research, innovation or experimentation. While the spaces have been temporary (and in the case of Smart Kalasatama, also physically bounded), they have involved long-term interaction that has engaged several levels of management in the company and they have involved the creation of concrete, physical structures in the city. This interaction has also served to surface new voices within the companies, as new positions have been established to manage co-creation, innovation and customer relations.
- The experimental spaces have involved, indeed focused, on controversies. The main controversy in Smart Kalasatama has been the question of open data and the ability of new entrants to gain markets in energy monitoring and control. In ECO2, the controversy has pertained to decentralized renewable energy systems. Incumbent actors have engaged in the experimental spaces in order to influence the direction of development, but by engaging, have also exposed themselves to influence, including local interpretations of visions of a global energy transition.

- There has been a strong focus on coping with tensions between established field logics. The incumbents have been pushed or forced into interaction with players with which they would otherwise have not co-operated and into situations where they are not incumbents any more (getting smart solutions into real estate construction and developing cloud computing services in the case of Kalasatama and applying distributed RES in the case of ECO2). But this pushing and forcing has been quite friendly by nature, and it has been done in the context of attempting to create a network of actors which share the same vision and take part in joint project activities.

The extent and way in which the incumbent companies have been taken outside their comfort zone has varied at different periods. Helen was originally a key player and investor in Smart Kalasatama, was then pushed into the margins, and has recently re-emerged as a participant among others in the development of innovative smart energy solutions. Tampere Electricity Utility appeared to be at a disadvantage when energy autonomous solar districts were actively being planned, but managed to regain the initiative with its (centralized but renewable) energy transition, yet has retained an interest in developing local services and opening up the district heating network. Hence, the arenas have rendered "surprises" (Jørgensen and Sørensen, 1999) for both incumbents and challengers.

6. Discussion and conclusions

Most of the existing research on energy transitions employs a socio-technical transitions perspective (Geels et al., 2016; Kern and Smith, 2008; Verbong and Geels, 2007). In order to extend previous work, we have attempted to capture the role of agency in transitions by combining the SAF perspective (Fligstein and McAdam, 2012) with close-up cases of experimental spaces created by city-internal challengers, drawing on the AoD perspective (Jørgensen 2012; Pineda and Jørgensen 2016). This combination offers an approach to address both the long-term and real-time dynamics of change. It allows for an understanding of why the incumbent SAF rules are so powerful, but also for breaking down a monolithic view of incumbents (or, in socio-technical transitions terminology, "the regime").

Our case studies have attempted to analyse (1) the dominant response of the incumbent energy coalition, (2) collaboration with challengers emerging in the space created by new arenas and (3) potential signs of broader ruptures within the incumbent coalition. Our answer to question 1 is not particularly surprising. Our focus has been on the city energy field (a subset of the national energy field), and we find that the original justification for the existence of municipal energy companies – the provision of reliable and affordable energy – has prevailed over the decades, and serves as a field-level rule that excludes challengers promoting renewable and distributed energy sources (which might not be reliable or affordable, at least at first). Nonetheless, in response to question 2, our AoD analysis of experimental spaces created by city-internal challengers showed how such spaces can serve to suspend SAF rules temporarily and create unexpected encounters and combinations of actors working together for a joint purpose. In this way, our case company Helen is continually (though locally) confronted with demands to provide open data and Tampere Electricity Utility has gained experience of working with customers to co-provide new heating solutions. In both cases, the long-term experimental development has also established and empowered staff within the companies who are committed to new lines of business, which partly compete with the established incumbent logic.

Instead of challengers "out there" (as they are often presented both in the SAF and in the sociotechnical transitions literatures), the image of change emerging from our analysis is one where internal challengers within the city administration create spaces which then breed internal challengers within the municipally owned energy companies. Our analysis highlights how experimentation with new collaborations, outside the incumbent energy SAF, gradually serves to generate new interpretations, or new combinations of new and old interpretations, of SAF rules.

From this, we derive some answers to our research question (3) – whether there are signs of broader ruptures in strategy, discourse and investments within the incumbent energy coalition. In the case of Helen, their work in Smart Kalasatama involves both innovation work that serves their established interpretations of their strategic interests (such as extensions of the district cooling concept), but also work to support e.g. apartment buildings in deploying solar power and co-development of new software that draws on open energy data. Both lines of work legitimate each other, and bring the incumbent and challenger logics closer together. In the case of Tampereen Sähkölaitos, the largest response has been to change to renewable fuels but retain the centralized structure of the energy system. In the wake of this shift, which has been branded their "energy transition" (and legitimized by its success), there are also attempts to develop new services and a two-way, open district heating system.

Our case studies have implications for the analysis of energy incumbent strategies on a wider level, for example, in Europe or internationally. We contribute to attempts to conceptualize power and agency in sociotechnical transitions by combining two theoretical perspectives that have been proposed as relevant. Through this combination, we extend and qualify SAF analyses of energy transitions, which usually emphasize resistance by incumbents to attempts by new entrants to challenge field rules (Hess, 2016; Kungl, 2015; Schmidt et al., 2016). Our case studies highlight how city-internal challengers work to change the rules of the game by setting up experimental spaces where SAF rules are temporarily suspended. Such close-up analysis highlights how such locally created spaces can force incumbents to encounter and gradually form some kind of new social contract with the challengers. This observation can be of interest in other countries where cities own energy companies, such as Germany (see Canzler et al., 2017). Further research might explore whether cities also manage to influence incumbents that are not in their ownership through the creation of arenas of development (see Sengers et al., 2016).

Yet our contribution also highlights the value of combining the AoD perspective (Jørgensen, 2012) with a broader analysis of the relevant fields and their dependence on higher-order and proximate fields. The close-up AoD perspective encourages a fine-grained analysis of actors, where incumbent and challenger coalitions are not necessarily monolithic, but can involve a plurality of interests

and institutional components. However, without the destabilization of higher-order and proximate fields, such bricolage would probably not be taken seriously. In our cases, issues like the entry of the ICT sector into smart grids, the decision to raise the tax on natural gas to cover budget deficits, and political commitments to carbon neutrality have played a key role in precipitating field-level change. Hence, a SAF perspective can be critical to understanding the conditions for field-disruptive agency within bounded arenas of development. Our contribution is to suggest that a combination of both perspectives can offer new insight on real-time attempts to promote a sustainable energy transition.

Conflict of interests

None.

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Appendix A. Timeline of Helen history

1884	Establishing first electric lighting company
1906	City council decides to establish municipal electricity facility
1909	Opening of Suvilahti (fuel: coal, wood sources when coal was not available)
1909	Acute shortage of coal
1928	Opening of IVO hydro power plant in eastern Finland
1928–1940	Abundance of electricity produced outside Helsinki was available
1940	Severe shortage of electricity
1940–1941	Dry years, hydro power availability decline
1945	Loss of Enso and Rouhiala hydro power plants (200 MW)
1953	Salmisaari A power plant (fuel: coal)
1957	District heating began
1960	Hanasaari A (fuel: coal)
1974/1977	Hanasaari B (fuel: coal
1984	Salmisaari B (fuel: coal)
1991	Vuosaari A (fuel: natural gas)
1995/1998	Liberalisation of electricity markets, for industrial customers in 1995, for households in 1998
1997	Vuosaari B (fuel: natural gas)
1997	Helen joins Nordpool
1999	First green electricity product: ympäristöpenni
2004	Constructing underground coal storage at Salmisaari
2005	Finland ratified Kyoto Protocol
2005	EU Emission Trading Scheme began
2006	Demolishing Hanasaari A
2006	Opening new underground cooling and heating power plant, Katri Vala
2008	City commits to EU 20-20-20 by 2020 targets
2008	Helsinki signs the Covenant of Mayors
2008	Extraordinary warm winter, year's average temperature 6 ° higher than normally
2008	Finland's new National Climate and Energy Strategy → 38% share of renewable energy by 2020
2010	Helen's "towards carbon neutrality by 2050" development strategy
2012	New City Council approves Helen's development programme towards carbon neutrality
2012	Helen starts to burn wood pellets in addition to coal at Hanasaari and Salmisaari
2015	City Council decide to close down Hanasaari B and shift partially to a separate heat production and decentralized energy system
2015	Suvilahti solar power plant
2016	Kivikko solar power plant
2016	Helen builds Nordic's largest grid-connected electricity storage (1,2 MW)

Sources: Turpeinen (1984), Herranen (1985), Helen Group Annual Reports, 1990–2015.

Appendix B. Timeline of Tampere electric utility history

1882	Electric light first used in Finlayson factory in Tampere
1888	First municipal electric board established in Tampere, municipal lighting started
1891	Hydro power plant started
1920	Due to power shortage, new steam power plant opened (fuel: wood logs and coal)
1933	New hydro power plant opened
1938	High-voltage cable built and power purchased from national power company Imatran Voima Oy, connection to the emerging national power grid
1945	Post-war power shortage leads to power rationing
1963	First district heat plant constructed
1971	Opening of Naistenlahti 1 district heat plant (fuel: oil)
1977	Opening of Naistenlahti 2 CHP district heat plant (fuel: peat, later also wood-based fuels)
1986	Natural gas pipeline extended to Tampere
1988	Natural gas power plant opened in Lielahti ensuring energy self-sufficiency
1990	Acquisition of Dry Low Nox turbines
1995/1998	Liberalization of the electricity market
2000	Naistenlahti 1 power plant converted to natural gas CHP
2005	Unbundling of power production and sales from distribution and network maintenance
2007	80% of energy produced using natural gas
2010	Tampere commits to Covenant of Mayors (to reduce CO_2 emissions by 20% from 1990 levels by 2020)
2011	Energy tax on natural gas increases, gas prices rise by 37%
2015	Tampere makes commitment to reduce CO_2 emissions by 40% from 1990 levels by 2030

Sources: Kahilaniemi et al. (2016); Anttila (1993); Karppi (2007).

Appendix C. Timeline of the developments in Smart Kalasatama

2008	The metrostation in Kalasatama is finalised, initial discussions between companies about a smart grid pilot in the area
2009	Formation and planning of a business co-operation between Helen, Mitox, ABB and NSN
2010	Start of the project of the smart grid business consortium (Helen, Mitox, ABB, NSN, Fingrid)
2011	First apartment building is ready, start of the construction of the shopping centre ”REDI”
2012	First residents move to the area, a daycare centre is completed
2013	Smart Kalasatama −project is being prepared and starts as part of the Smart city −programme of Tekes (the Finnish Funding Agency for Innovation) (funding 2013–2014), FVH takes the lead of the project's management
2014	Tube-waste-collection-system is taken in use, experimentation and pilot projects are initiated (e.g. smart container, Piggy baggy etc.)
2015	Funding for the period of 2015–2017 is granted from the 6Aika-strategy, the Innovators’ Club is initiated, first experiences with Helen's smart home service “Hima” is experimented, Helen's crowdfunded solar plant is constructed in Suvilahti
2016	Programme for Agile Piloting starts, 2 rounds (Toop, Foller against food waste, Smart waste basket, Button Neighbour, Fitnesspals, Auntie), the Innovators’ Club adjourns 4 times a year, Helen's energy storage (Europe’s largest battery) is taken in use, Flex spaces are piloted
2017	The 3rd and 4th rounds of Programme for Agile Piloting (Green House Effect, Smart minigrid, Rentapark, Solar energy for residents, Homecoal), the Innovators’ Club continues with focus on novel urban services enabled by IoT, Flex spaces −pilot continues and expands with new funding
2018	The shopping centre REDI is completed, the health care centre is finalised
2033	The construction in the Kalasatama district is completed: last buildings are finalised in Verkkosaari

Appendix D. Timeline of ECO2

2009	City of Tampere signs European Covenant of Mayors
2010	ECO2 programme is started as a strategic city project under the Mayor Research on low-carbon city plans and urban densification in various areas, research on low-carbon construction alternatives, city-wide climate campaign, work starts on city’s own facilities
2011	Solar city study (Nurmi-Sorila), several low-carbon city plans, calculations on alternative heating systems, RESCA project to promote renewable energy (city’s own and other buildings) Renovation and densification projects continue

2012 Housing Fair in Vuores district, Finland's first net-zero-energy building displayed
Work on city's own facilities, low-carbon urban plans, renovation and densification continues
2013 Co-ZED project in new district Härmälänranta: comparison of renewable local energy production alternatives
RESCA project to promote renawable energy continues, renovation gains new boost (TARMO project)
2014 More low-carbon urban plans, new renovation project for city centre, City purchases old industrial area to build new district, Hiedanranta
2015 More low-carbon urban plans, another new renovation project for city centre
ECO2 project ends successfully: CO_2 emissions reduced by 43% annually and renewable share in district heating raised to 50%

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