

Article

Towards a Neutral North—The Urban Low Carbon Transitions of Akureyri, Iceland

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Abstract: Climate change has made urban decarbonisation a global imperative. Cities are both a source of emissions and a leverage-point for the necessary transformation processes. Iceland is blessed with an ample supply of renewable energy sources. Hydropower and geothermal are widespread in the country and they dominate the country's electricity and district heating systems. Despite this huge potential, per capita emissions in Iceland are still way above levels required to meet the 2 degrees target. This is because decarbonisation processes have, so far, fallen short of addressing emissions from sectors such as waste and transportation. Against this background, this paper investigates the low carbon transition in the northern Icelandic municipality of Akureyri. With roughly 18,000 inhabitants, the town of Akureyri is the biggest urban centre in the north of the country. Here, a number of key actors have initiated an ambitious urban transformation process of local carbon flows. Based on 19 semi-structured interviews, we analysed the role of key actors and their resources and strategies. To better explore the transition's underlying mechanisms, we analysed the dynamics through the lens of the multi-level perspective (MLP), applied in a descriptive context. We found that a key factor for success of the urban transition was a strategy that integrated several previously disconnected carbon flows of the community. Important success factors were close community connections, public-private partnerships, the enthusiasm of multiple individuals who drove the process, the establishment of a strong intermediary organisation, and stable political support. The case can teach us about the challenges of transitions that integrate disconnected carbon flows in an urban context. Furthermore, it provides valuable findings on the role intermediary organisations play in these processes.

Keywords: urban transformation; urban sustainability; urban climate governance; Iceland; urban renewable energy; transition champion; green place branding; integrating carbon flows; intermediary

1. Introduction

Climate change and the depletion of conventional sources of fossil fuels have set forth the imperative for decarbonisation processes worldwide. One of the biggest contributors to carbon emissions is the energy sector. This, in turn, means that there is a need for drastic decarbonisation of the energy sector worldwide. In these transitions, urban areas constitute leverage points, as they are places of intense energy consumption [1,2]. The urban metabolism does not only entail the flow of energy, but also of bio-based material such as organic and food waste. Thus, cities constitute hubs of carbon flows in several ways [3]. In addition, considerable transport takes place in cities [4]. These characteristics open the potential for holistic approaches, which tap into the synergies between different sectors and their respective carbon flows. This, in turn, means that urban strategies need to

apply holistic thinking if the complex system of interrelated carbon flows is to be altered in a way that really initiates a low carbon transition of our cities.

One challenge in this regard is that connected aspects of carbon flows are treated in a compartmentalised manner, due to the organisation of urban administrations and the way in which certain aspects fall into the public or private sphere. This underlines the importance of intermediary actors who can bring together those players managing different subsystems of the urban carbon flows. Different authors have highlighted the skills and motivations of intermediaries and other key actors in low carbon transitions [5–8]. Their work grants a number of interesting and relevant insights into the role intermediaries can play in low carbon transitions.

However, the transitions they investigate only represent a certain section of the carbon flows in the respective communities. If low carbon transitions are to lead to a substantial decarbonisation, all carbon flows of the community must be considered. For this to happen, intermediaries must take a holistic approach and tackle the problem of emissions systemically. Of course, such an approach requires specific skills. So far, cases empirically investigating the application of these specific skills are scarce. This article aims to address this research gap by investigating the role of intermediaries in the low carbon transition in the city of Akureyri in Iceland, which affects a complex system of carbon flows.

1.1. Case Background Iceland

Thanks to an abundance of renewable energy sources, Iceland has already reached a high degree of decarbonisation in its electricity and district heating supply. The main sources of energy are hydro and geothermal energy. These rich resources make Iceland an ideal case for the application of renewable energy technology. This provides the country with the unique potential to replace fossil fuels almost entirely from the energy sector, with low emitting energy sources such as hydro and geothermal energy. Indeed, literally all heat and electricity needs are met by energy from these sources [9]. As a result, researchers have previously depicted Iceland as a blueprint for decarbonised energy systems [10,11]. This notion is supported by Icelandic key institutions, such as the country's energy agency Orkustofnun, and national ministries [12]. Drawing on this image, Icelandic governments steered an aggressive industrialisation course as of the 1960s, which aimed at attracting big scale industry, in particular aluminium smelters, by highlighting the low energy prices and the low environmental impacts of the energy production [13,14]. Through the completion of two projects of so far unseen proportions in the 2000s (the Kárahnjúkar hydropower project and the Hellisheiði geothermal power plant; the Kárahnjúkar project consists of a power station with a 690 MW capacity and a number of reservoirs. The Hellisheiði power plant has a capacity of 303 MWe.), the country catapulted itself to the top of the ranking of per-head electricity production globally [15], which in turn makes electricity prices in Iceland very low. The claim of Icelandic achievement, in terms of decarbonising its electricity and heat supply, holds true. However, the same cannot be said for the per-head emissions of Icelanders. Iceland is number 26 of the highest per-head emitters in the world [16], with an 8% increase between 1990 and 2016 [17].

Despite a long-standing history of local energy companies and suppliers [13,14], Iceland is an unlikely place to see an energy transition that does not rely on hydro and geothermal energy and does not focus on electricity and heat. This is because of the cost advantage of these technologies in this setting, as well as the high degree of energy security that the country built in the 1970s, as a reaction to pending oil shortages. Nevertheless, the municipality of Akureyri has initiated an ambitious low carbon transition, that tackles the urban carbon flows, and arguably makes the city the country's leader in terms of climate change mitigation.

1.2. Case Background Akureyri

With around 18,000 inhabitants, Akureyri is Iceland's second biggest settlement, after Reykjavik's greater/capital area [18]. It constitutes the main urban centre in the north of the country and is an important hub of services and infrastructure [19]. Akureyri is also home to the University

of Akureyri (UNAK). It is located deep within the scenic fjord Eyjafjörður and, with its calm weather conditions; the city is a popular destination for cruise liners.

In the late 1970s and early 1980s, Akureyri followed other Icelandic municipalities and underwent a first energy transition when the local heating system switched from oil to geothermal. This transition happened fairly late, compared to the rest of the country, as Akureyri does not have optimal conditions for geothermal drilling. In recent years, Akureyri has initiated and kick-started a second energy transition with an ambitious net zero-carbon goal. With electricity production and district heating already coming from renewable sources, the biggest hurdles to overcome to achieve net carbon neutrality are the carbon emissions from the transport and waste streams. Consequently, this transition aims to integrate different carbon flows (household waste, organic waste, wastewater, transport, energy, etc.) to build a more sustainable urban metabolism. Thus, the question becomes if carbon neutrality cannot be achieved in an Icelandic municipality, which has all the above-mentioned advantages, then where can it be done?

1.3. Research Aim and Scope

Our aim with this article is to investigate the local energy transition in Akureyri, which integrates several sectors and takes the full range of carbon flows into consideration. We conduct this research in a national setting that is rather uncondusive to decentralised local decarbonisation processes. This is because of the low energy prices and the presently achieved degree of decarbonisation, which means that the 'low hanging fruits' have already been 'picked'. By choosing this case, we intend to shed light on energy transition success factors that are not favoured by national policies, as is the case of, e.g., Germany or Denmark, where national feed-in tariffs have enabled many local transition processes [6]. Thus, Akureyri constitutes a critical case as it has "strategic importance in relation to the general problem" [20] (p. 229).

2. Theoretical Underpinnings

This study is primarily an empirical study. This means that we focus on describing the case in depth. Contributing to theory development is, rather, a side-product that occurred while we explored the case. Our approach builds on a body of meta-theory on societal transitions [21], the multi-level perspective (MLP) [22], and the work on low carbon transitions [23]. We use this body of literature by referring to its concepts and framings. An intermediary organisation played a major role in the transition in Akureyri. Thus, we used the body of literature on intermediaries in sustainability transitions [5,24–26] to sharpen our understanding of the impact and importance this organisation had. In particular, we relied on the typology developed by Kivimaa et al. [25].

2.1. Urban Low Carbon Transitions

Bulkeley et al [23] introduce a framework to analyse low carbon transitions in cities. Both the scale and the focus on emissions make this framework a suitable tool for the analysis of the energy transition in Akureyri and its interrelated elements. It suggests a systemic approach highlighting the following aspects: System innovation, transition governance, and the interconnectedness of different initiatives. It draws on strategic niche management (SNM) [27,28], transition management [29], and the concept of urban living labs [30].

2.2. Intermediaries in Transition Processes

In recent years, the role of intermediaries in sustainability transition processes has attracted a lot of scientific attention. Intermediaries are actors that take an active role in facilitating transition processes by bringing other actors together, providing or tapping into resources, or disrupting existing configurations of socio-technological systems [5,24,25]. By doing so, intermediaries speed up transitions and act as catalysts of change [25]. Intermediaries usually stand between the 'classical' actors in transition processes, such as niche or regime actors, and take a facilitating role by addressing the challenges of other transition actors. Especially in urban transitions, intermediaries operate

between scales by, e.g., translating national legislation to the city level [31]. Oftentimes, intermediaries are equipped with knowledge that is instrumental for transitions and they can rely on extensive networks of actors from different levels in the MLP. Mignon and Kanda [24] point out that intermediaries can be very diverse. They can be single actors as well as organisations and they can start work based on a mandate or they can grow into the role of being an intermediary [25]. This emphasis on intermediaries and the services they provide to other actors shifts the focus, in transition theory, away from structural factors and towards agency. This is a valuable contribution because the MLP has sparked criticism in the past for its lack of agency [32,33]. Most empirical work on transition intermediaries does not focus on the local level, but rather on the role intermediaries play in a national context. In this article, we apply the concept to the local or city level. We do not view this as problematic as the case is sufficiently complex to warrant the use of the concept.

Kivimaa et al [25] suggest a typology of intermediary actors, which we use in our analysis (see also section 5.2 below for an application of the typology to the case). They describe five different types of intermediaries, as follows:

- *Systemic intermediaries*: It is the agenda of systemic intermediaries to bring explicit change. This, in turn, means that they operate on all the different levels (niche, regime, and landscape). One example are commissions comprised of experts from all levels of the MLP, such as the German commission for the phase-out of coal in energy production.
- *Regime-based transition intermediaries*: These actors act based on a mandate given by the prevalent socio-technological regime. It is their objective to promote transitions. They usually interact with niche and regime actors. Links to landscape actors are not prevalent. National and regional energy agencies often take the role of regime-based transition intermediaries.
- *Niche intermediaries*: Activities in niches can produce niche intermediaries. These actors operate mostly with niche actors and try to influence the system so that the niche actors can flourish. This can be lobby organisation for renewable energy, such as the European Federation of Renewable Energy Cooperatives (Rescoop.eu).
- *Process intermediaries*: These actors focus on the process of a specific niche project or niche company. It is not their aim to work for the benefit of a wider niche. They often operate with a mandate from other actors. This role can be taken by consultancies that help with the implementation of a specific project.
- *User intermediaries*: It is their objective to mediate between a niche technology and users. They communicate user needs to developers and, thus, help improve technology and the frame around its application. They typically interact with niche and regime actors. These can be consumer protection agencies and internet for a, where users can exchange knowledge of products and their application.

3. Materials and Methods

As we were interested in uncovering underlying causalities of the transition process in Akureyri and the role actors played in it, we applied a qualitative methodology in this study. We conducted and analysed 19 semi-structured interviews with key actors involved in the transition process. We identified 13 informants through purposive sampling and 6 through snowball sampling. The interviews took place in Iceland in 2017. The informants were politicians, public servants, and private business managers. We conducted the interviews in Icelandic and translated them to English before coding them. In addition to the interviews, we analysed grey literature and further sources on the case, e.g., planning documents, websites, and policy briefs.

In this article, we take a critical-realist stance [34]. This implies that it is important to keep in mind that primary data for this article are accounts of our interviewees' perceptions. They are by definition biased and perhaps even inaccurate and have to be subject to interpretation. This is countered by the fact that relevant actors' perception of the dynamics of the transition are important and relevant in the analysis of this process. These insights enable us to see and describe the patterns that underlie the phenomena we can observe. Additionally, the assumption is that interviewees speak

honestly and information gathered from them is pertinent to their specialty and/or role in the transition.

Our study is limited in that it only has a limited geographical reach. More specifically, we focus our analysis on what happens within the borders of the Akureyri municipality. This means that the scope is limited to the system boundaries of the energy system in Akureyri and we do not consider what happens on the national level in Iceland. This, however, does not mean that the development here does not affect the national level. A second limitation is that the project which we investigate for this research is unfolding during the time of writing. Consequently, we cannot currently assess the long-term success of the energy transition. Finally, the data collection for this article mostly took place in the form of interview data. As stated above, we conducted these interviews in Icelandic and they were, thus, subject to translation, which in turn is subject to some degree of interpretation.

4. Results

In the following, we briefly present the historical development of the low carbon transition in Akureyri. Then we shed light on the transition process and the main institutional arrangements and actors, before turning to the reasons for success.

4.1. The Transition of Akureyri

In 1999, the municipality started drawing its local Agenda 21. This engagement with sustainability issues laid the foundation for all subsequent environmental policies. Following this, municipal bodies, local utilities, and private companies initiated a multitude of local environmental projects. An overview of these projects can be found in Figure 1. Nowadays, the political heart of the transition is the “carbon neutral Akureyri strategy” (in this article hence given the acronym CNAS). The CNAS is part of the municipality’s Environment and Transport Policy from 2016.

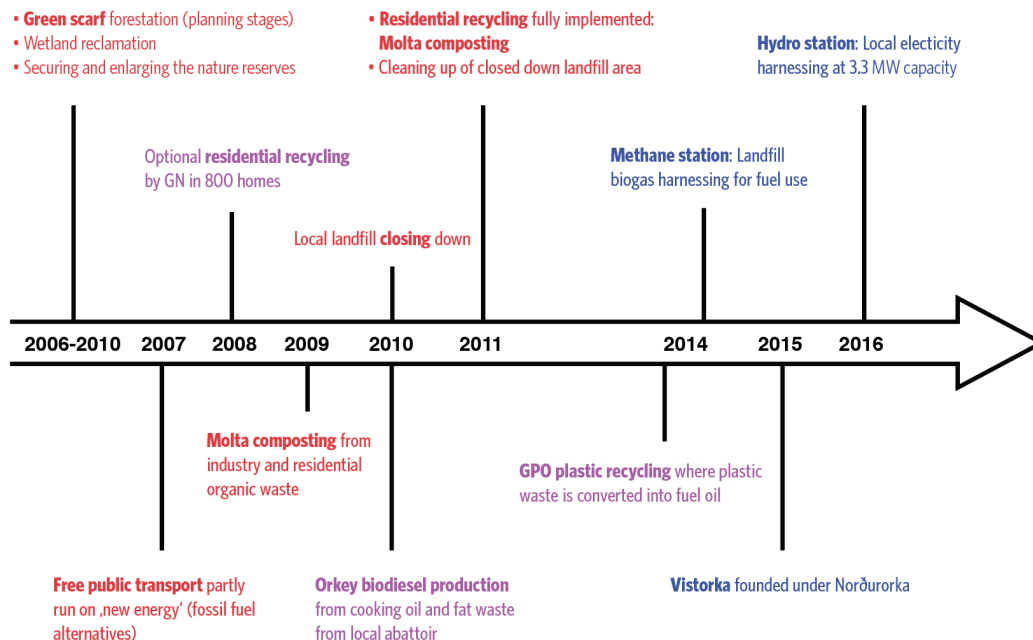


Figure 1. Overview of projects prior to the official formation of the carbon neutral Akureyri strategy (CNAS0, which then were combined under the banner of the strategy). The CNAS serves as a unifying vision for the previously unconnected projects. Red indicates projects carried out by municipal bodies. Blue stands for initiatives by the local energy and utility company Norðurorka (NO). Purple indicates projects by private companies.

The CNAS aims for net zero emissions from the processes within the borders of the municipality. This means that emissions are reduced where possible and remaining emissions are sequestered

locally. Akureyri is in the fortunate situation that both electricity (hydro) and district heating (geothermal) are virtually emission free. This leaves waste and transport as the two carbon flows that need to be tackled.

4.2. The Main Institutions of the Transition

The main actor to coordinate and drive the transition in Akureyri is the company Vistorka. Founded in May 2015, Vistorka is a Ltd. company owned by Norðurorka PLC (hence, NO), the local energy and utility company which is, in turn, largely owned by the Akureyri municipality (see Figure 2). Two locals developed the concept of Vistorka, Guðmundur Haukur Sigurðarson (hence referred to as Guðmundur), now the CEO of Vistorka, and Sigurður I. Friðleifsson (hence referred to as Sigurður), now a board member of Vistorka. From 2007 onwards, Guðmundur was involved in the design and development of many projects that are now part of the CNAS. At this time, he worked for an engineering firm which worked as a contractor for many of the projects. Many of these projects became part of Vistorka when the company was founded in 2015. His previous involvement in, and inside knowledge of, several of the projects in Akureyri made him an ideal candidate to lead an organisation that aimed to bring different transition projects together under one umbrella organisation. Sigurður is the CEO of a public institute called Orkusetur. This independent and autonomous entity promotes and assists energy efficiency projects, explores new concepts for energy production, and provides educational material. The institute has a nationwide focus, but its office is located in Akureyri.

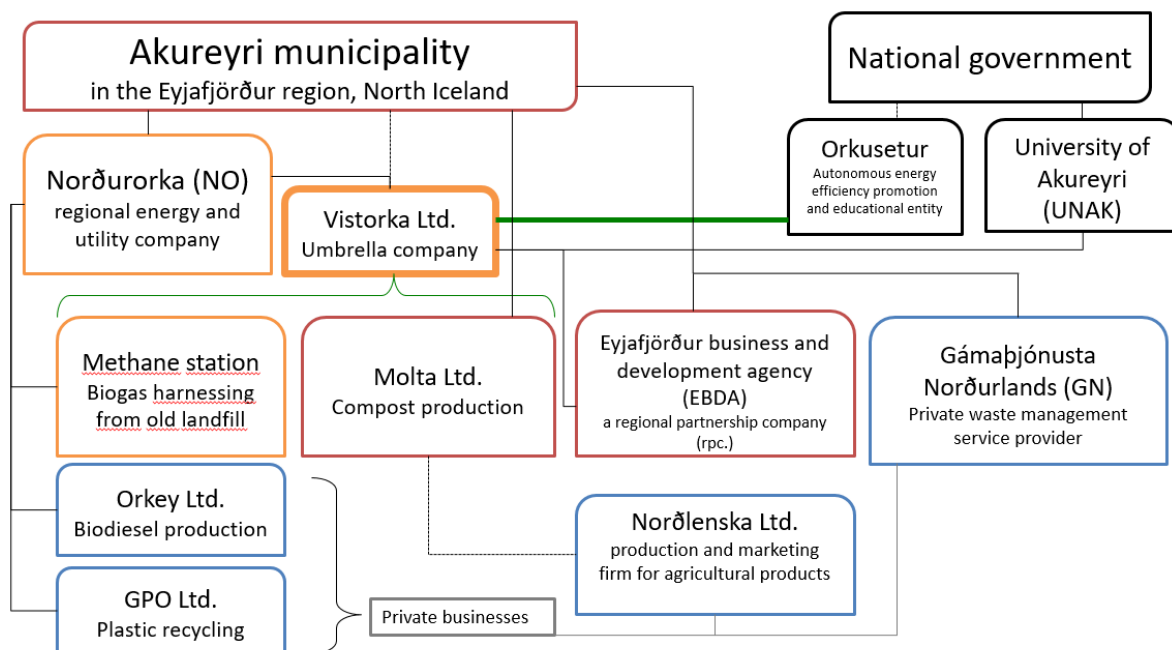


Figure 2. Overview of institution and company roles and their connections (through board membership or shareholding) to main entities in the CNAS in Akureyri. We interviewed representatives from the main entities displayed here. Red are municipality led businesses. Orange indicates projects led by the energy and utility company Norðurorka PLC (NO). Blue are private businesses. Black are state institutions. The figure highlights the multitude of links between the different institutions and projects.

4.2.1. The Vistorka Concept and its Organisational Entanglement

Vistorka works towards aligning innovations and projects in Akureyri that lower carbon emissions through recycling and, thus, advance carbon neutrality. It does so by assisting local initiatives which all recycle material and produce new products, such as compost or fuel. Through this, Vistorka helps reduce waste and lower carbon emissions. In our interview,

Guðmundur defines the company's role as the following, "to lower waste, improve utilisation and increase production in Akureyri and the neighbouring Eyjafjörður area".

The main companies organised under Vistorka are Orkey Ltd., GPO Ltd., Molta Ltd., and NO's Methane station (henceforth all referred to without the use of Ltd.). Orkey is a production plant that converts used cooking oil (from households, institutions, and restaurants) and animal fat (from local abattoirs) to biodiesel. Currently, Orkey sells the largest proportion of their products to local fishing trawlers as combustion enhancer. GPO is a small plastic recycling company that converts waste plastic to oil for fuel use. The company's main source of plastic comes from the agricultural sector. Molta is a composting plant that handles organic waste from residents, public institutions, and local food producers in north and north-east Iceland. Molta's largest shareholder is the Akureyri municipality. Further stakeholders are other municipalities in the Eyjafjörður area. Some private entities hold smaller shares. Private food production companies from Akureyri created Molta to recycle organic waste. The need for this practice arose because EU and national legislation banned the practice of disposing of organic waste in landfills.

NO built a methane station, harnessing biogas from the old local landfill at Glerárdalur. The gas serves as fuel in combustion processes. This way, a recycled fuel becomes available while methane emissions from the landfill are reduced (Methane is a very potent greenhouse gas, so burning it and turning it into CO₂ helps mitigate climate change.). This complex network of organisations enables Vistorka to bring together the stream of organic waste and fuel production (see Figure 3). However, the companies connect not only through the flow of carbon, but also through their institutional set up (see Figure 2). In addition, Vistorka supports a number of other municipal projects that play a role in the CNAS.

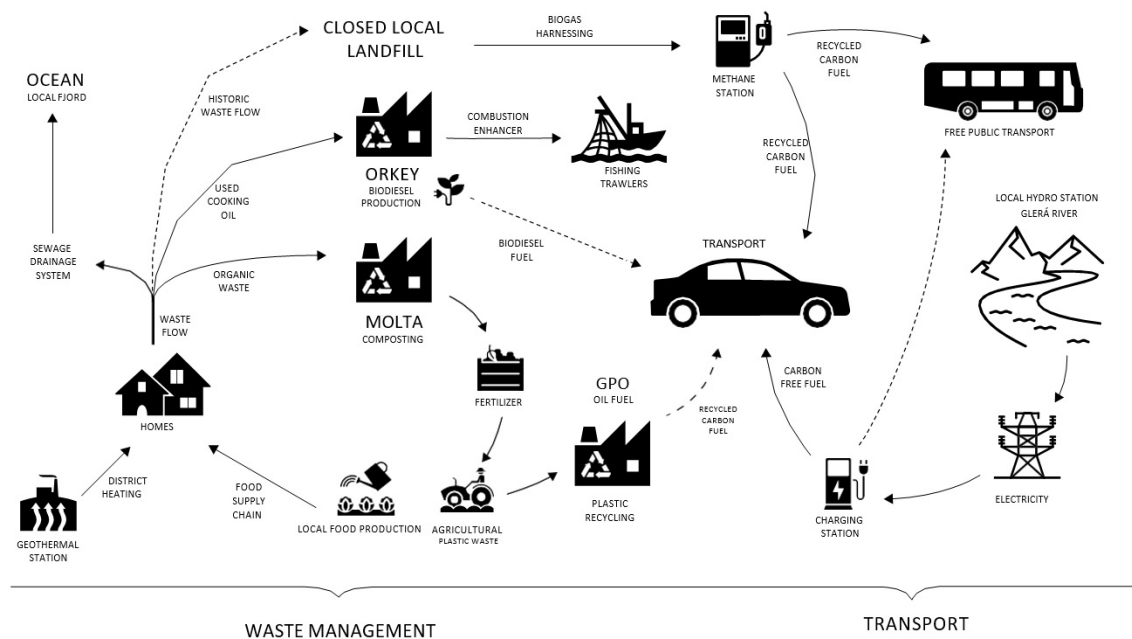


Figure 3. Simplified illustration of the socio-technical system of carbon flows in Akureyri. It shows the interlinkages between the two regimes, waste management and fuel production. Dashed lines represent those connections that are currently not active but have a possibility of being utilised. We excluded the local carbon offsetting program, as it does not directly affect the flows of carbon or energy within the socio-technical system. (Source: Author's intellectual property, illustration by Ragnar P. Kristjánsson).

Apart from the projects and companies depicted in Figure 2, Vistorka, in coordination with the municipality, has also put forth plans for the carbon offsetting afforestation program. Carbon offsetting is a necessity to achieve net zero carbon emissions in a system that is not (yet) fully

decarbonised, as is the case in Akureyri. Forestry offsetting projects have attracted considerable attention by academics in recent years. Critical investigations into offsetting projects have shown that these projects can lead to the unfolding of drastic negative effects on local populations by enclosing resources, especially if the source of emissions is far from where offsetting takes place [35,36]. The carbon offsetting project in Akureyri avoids falling into this trap. The project is local and the ‘green scarf’ that will surround Akureyri will be open to the public as a recreational area. In addition, the ‘green scarf’ will shelter the municipality from strong winds. Initially, the afforestation plans were not intended for carbon sequestration, but to create this wind shelter as well as to create an attractive outside recreational area, according to public officials. The sequestration framing came later when the CNAS was formed by Vistorka. One section of the forest is dedicated to offsetting the emissions from domestic flights. This ‘flight forest’ helps to make emissions tangible and less abstract for people visiting the forest. NO manages a second local afforestation-offsetting project that aims to indicate the company’s ambition to establish itself as a local climate leader.

4.3. Drivers

In the following, we present the drivers for the transition in Akureyri. Drivers differ from success factors in that they actively drive the transition forward, instead of only providing favourable conditions as success factors do.

4.3.1. The CNAS—The Municipal Strategy

It is not fully clear how active a role the CNAS, the municipal strategy, played in the transition. On the one hand, it helps to bring things together. It acts as the glue to the single transition initiatives and shows the bigger picture of carbon flows. On the other hand, most initiatives that form the different steps of the local transition already existed before the CNAS was formulated and communicated. In our interview, Guðmundur describes this situation as follows: “This is a typical example of the strategy being made afterwards. Partly it’s a coincidence that companies with these projects were here. Then people realised this and the strategy [the CNAS] was formed”.

4.3.2. Environmental Concerns and Climate Change

With Vistorka and the CNAS now in place, the connections between projects become explicit and the idea of lowering carbon emissions is gaining traction. Before this, reducing emissions was, at best, a minor consideration, according to public officials. Although many actors identified climate issues as being an important environmental problem, particularly at the national level, it did not become an important argument in the debates in the city prior to the CNAS. Several researchers have concluded that climate change by itself is often not sufficient motivation for transitions [37]. Proponents of local sustainability transitions should, rather, focus on the tangible advantages when promoting initiatives [7]. Guðmundur and Sigurður realised this and they adapted their approach by lobbying for the transition accordingly. They presented the initiatives as economically beneficial projects, rather than solutions to the global climate crisis.

4.3.3. Costs

The economic benefits arose because of changes in legislation on the handling of organic waste by the EU and on the national level. The legislation change set incentives for reducing the amount of organic waste that went into landfills and, thus, served as an additional driver for the transition in Akureyri. Iceland’s strategy for nationwide handling of waste, published by the Ministry for the Environment and Natural Resources [38], sets a target to reduce landfilling to no more than 5% of the total waste handled annually. By measure of current trajectories and development in the waste sector, these targets will not be met, as landfilling is still the most common waste handling measure in Iceland. According to the CEO of Molta (the company working with composting), a further factor was that the city’s landfill at Glerárdalur was closed, which means that waste now needs to be

transported to a landfill much further away. This increases the transport costs for landfilling waste and increases the incentive for composting and transforming organic waste to fuel.

4.3.4. The Role of Local Champions

The literature on local renewable energy transitions often refers to local transition champions, who take a leading role and push the community in the direction of the transition [6,39]. Our interviewees confirm this pattern for Akureyri. They identified two main champions in this setting, namely Guðmundur and Sigurður. Actors describe them as having a “burning interest” and “deep passion” for working on environmental matters, in addition to being experts in terms of emission reduction and general environmental matters. Moreover, they are the intellectual parents of Vistorka, as mentioned above. As NO’s CEO explains, having powerful spokespeople for this strategy is what sets Akureyri apart, further disclosing that Guðmundur’s position as the CEO of Vistorka was specifically tailored for him, as he showed such enthusiasm and energy in selling the idea. Our informants describe Guðmundur and Sigurður as people with a clear vision. This vision enabled them to see the full picture and apply a systemic approach to the transition in Akureyri. Both invested considerable time and effort into lobbying with important decision-makers for the founding of Vistorka, thus, creating a strong consensus for the idea. In addition, they contributed to the local and national debate on climate policies in public media. This engagement helped to establish a public perception of the two as experts in the field who openly voice their opinion. The two have established a clear working relationship between each other that enables them to tap into each’s strengths and skills, or as Guðmundur puts it in our interview: “Sigurður is the one that creates the ideas and my job is to implement solutions. He is the academic idea building side and I am the technical implementing side”.

4.3.5. The Green Image

In recent years, many cities have adopted strategies to brand themselves globally [40,41]. Green policies have increasingly become a factor for city branding [42]. Frontrunner cities such as the Danish capital of Copenhagen, the Swedish city of Malmö, or the German Freiburg have all invested considerable resources in creating a green image based on ambitious sustainability policies. These places attract thousands of ‘policy tourists’, who are interested in learning about ways to green a municipality [43]. At the same time, companies might relocate to cities with leading sustainability policies to gain legitimacy for their products and services. Finally, a green image is often associated with a high degree of liveability, which in turn can attract new citizens [44]. Prior to the transition in Akureyri, no municipality in Iceland had made serious attempts at green place branding. Only in recent years, the capital Reykjavík has increased its green policy and branding efforts. As our informants pointed out, actors in Akureyri were happy to fill this vacuum and establish the city as a spearhead for sustainable municipality branding in Iceland. This development was further supported by the fact that municipalities found themselves forced to create local economic growth to attenuate the impacts of the financial crisis, which hit Iceland hard. During our interview, Guðmundur describes the motives of the city as follows: “Then there was an interest to make Akureyri competitive somehow. [...] One of my ambitions is to attract well-educated young people to live here.” This plan appealed to decision makers in the city as the benefits of this approach were obvious. One particular plan was to attract people who could help strengthen the local biorefinery sector in Akureyri and contribute to economic growth.

4.4. Success Factors

A number of success factors provided the environment for the aforementioned drivers to find fertile ground.

4.4.1. Size Matters: The Goldilocks Principle

Many scholars have pointed out that cities are a good place to generate sustainability transitions (e.g., [3,45–47]). One of the reasons for this is that cities possess the right size, which enables direct communication because of the proximity of the actors involved in the transition [48]. The development in Akureyri confirms this view during our interview. The chair of Vistorka's specialists advisory council saw the optimal size of the municipality as beneficial, "Akureyri is big enough to have all the infrastructure [all levels of managerial complexity], yet it is small enough to utilise the proximity and the connection between people, tighter holdings and shorter communication channels". An additional advantage is the limited size of the utilities that take an active role in the transition. The fact that they are comparably small prevents them from developing organisation inertia, which is often attributed to bigger institutions.

4.4.2. Culture in Akureyri

Several of our informants described the local culture of Akureyri as particularly beneficial for sustainability transitions. In particular, they named two characteristics that many of the local inhabitants share. The first is the high regard for environmental values. This has shaped the political discourse and helped to build a consensus for the transition. Our informants also pointed out that these environmental values become visible when one considers the general cleanliness of the town. They related these values to Akureyri's location at the fjord and generally the beautiful nature surrounding the town. The second characteristic in the local culture is a widespread entrepreneurial spirit several of our interviewees spoke about. This helped with finding support for innovative projects, which were part of the transition.

4.4.3. Political Support

According to many of our informants, environmental policies have become increasingly depoliticised in the last two decades. Stable support for environmentally friendly projects was an important success factor in Akureyri. This support is shown in the municipality's investments in many of the key projects and the political willingness to support others through other means. Key actors spoke of the importance of people experiencing their involvement in, and the linking of, carbon flows through their recycling efforts and transportation habits. Our informants highlighted the use of compost from organic waste by citizens as a way to make the carbon flows tangible to the local population. The same goes for the municipality's decision to provide free public transportation in 2007 and partly switching to methane fuel harnessed from the landfill in 2014. Cutting all charges for bus fare was an important political decision in the municipality, as is the investment for all municipal buses to be run on alternative fuels (recycled fuels) in the near future.

5. Discussion

In this section, we link the findings presented above to the guiding theories and elaborate on a number of interesting findings.

5.1. Akureyri as a Seedbed for Ideas

Socio-technical transitions are always relative to scale [49]. A transition that is completed within a specific sub-system can simultaneously be regarded as in its early stage on a wider scale, or, put differently, what role does Akureyri's transition play in a wider national context in Iceland? The socio-technical changes in the town are primarily a local transition. This is because the municipal systems that manage carbon flows are only indirectly connected to national, regional, or other local systems. This is different for energy transitions in which renewable energy producers feed into a national grid that is otherwise dominated by electricity from fossil fuels. In Akureyri, the electricity system was not part of the transition and even if it were, the Icelandic electricity system is not in need of a transition from fossil to renewable energy. However, the local transition has had impacts outside of the narrow system boundaries of the municipality. This is because Akureyri served as a seedbed for ideas. The case demonstrates solutions that other municipalities can adopt [37]. In addition, the

local transition helped to push debates that take place on, e.g., the national level, and it exports ideas even beyond Iceland, as Akureyri is an important tourist destination.

5.2. Vistorka—Regime Intermediation with a Systemic View

Vistorka's role is to act as an intermediary in Akureyri's transition process. However, it is not a straightforward task to apply the typology suggested by Kivimaa et al. [25] to this case. This is because Vistorka unites characteristics of both a *systemic* and a *regime intermediary*. The municipality, as the owner of the town's utilities (or in other words a regime actor), founded the organisation. It got a clear mandate to facilitate the local transition from the CNAS. These two features would suggest that Vistorka could be categorised as a *regime intermediary*. Simultaneously, it does not share some of the features of *regime intermediaries*, namely, the focus on incremental change or the active role in intermediating between the national and the city level. One role that *systemic intermediaries* have is to align the interests of different niches and even the regime. Vistorka clearly has this task. At the same time, Vistorka ties different projects together according to a vision, based on an analysis that considers the bigger picture. However, *systemic intermediaries* usually do not develop vision as Vistorka does. Rather, they create room for innovations by also taking a disruptive role. Thus, they function as catalysts of transitions by destabilising dominant regimes. This is most certainly not the case for Vistorka. How can Vistorka's hybrid role be explained? One important explanation is certainly the nature of the transition in Akureyri. As described above, organisations and companies owned, or related to, the municipality were the main entities of the transition. Community ownership, as in the case of NO, made it possible to implement a top-down transition that did not focus on the particular interests of specific (niche) actors, but instead took a holistic perspective. Guðmundur and Sigurður developed this holistic perspective, or vision, and formed Vistorka according to the local needs to achieve this vision. This setup enabled the establishment of a local institution that can operate free from the restrictions and inflexibilities municipal bodies usually experience.

5.3. The Ex-Post Strategy

The transition in Akureyri first followed the principle of 'let a thousand flowers bloom'. Initially, no unifying policy was in place that communicated a clear vision. This is remarkable as the literature on transitions often underlines the importance of a clear vision [27,28]. Kronsell, for example, explains that the German city of Freiburg was only able to achieve its world-leading status in terms of climate policies by creating "a common vision based on broad legitimacy" [50], (p. 965). The CNAS has certainly filled this vacuum, but it has done so in an ex-post way. Two questions arise now. First, which role does the CNAS play in the transition process? Second, how was the vacuum of a missing vision addressed before the CNAS? The CNAS certainly now helps to tie the multitude of initiatives together and present them as parts of a coherent picture. The CNAS is also enabling a shift in the understanding of the different initiatives. Originally, these projects and companies were seen as separate entities, which all drew legitimacy from the specific purpose they had (e.g., reducing costs or creating fuel). Now, as part of a wider system, the perspective shifts towards the contribution to reducing emissions and, thus, combatting climate change. In this point, Akureyri shows similar patterns to cases of renewable energy development elsewhere. These cases started their transition for reasons other than climate change, e.g., local economic development or soil contamination, that could be addressed through a renewable energy project [6,7]. In all these cases, climate change became part of the local narrative around the local renewable energy projects after the projects had been implemented. This becomes obvious in Akureyri as the two main actors, Guðmundur and Sigurður, framed this vision around its benefits for the municipality, rather than to mitigate climate change, which, to many people, is too abstract and too large a problem to tackle. Co-benefits and the costs of maintaining a status quo also are important factors in contexts other than Akureyri. For example, Antosiewicz et al. found that these framings could become powerful arguments in the context of Poland, a country with a very strong fossil fuel sector and tradition [51].

To turn to the second question about what filled the missing role, Martiskainen [52] points out that a vision is indeed important. However, she describes it as an important factor that leaders in transitional energy projects need to share. Similarly, Geels writes about visionary individuals who play a major role in transition processes [37]. In Akureyri, a number of key actors apparently shared a vision. Sigurður states during our interview, “This vision is ours [...] we both have this ideology and we are [now] in a position to work on these ideas”. Even if he only refers to himself and Guðmundur, the managing director of the waste management utility GN also refers to a shared vision. He explains how he sees their role as looking at the big picture and seeing the system holistically. To sum up, in the case of Akureyri, an internal vision shared by a number of key actors was sufficient in the initial phase of the transition. Once the local transition had reached a certain point of maturity, an explicit and publicly communicated vision became a helpful, if not necessary, tool in the eyes of the key actors.

5.4. Policy Implications

This research shows the importance of policy that creates a stable political base for systemic intermediaries and it highlights the significance of proper leadership by regime intermediaries, such as Vistorka. This is so such intermediaries can connect private and public entities and form an overarching strategy, such as CNAS. The policy design is not explicitly laid out in Akureyri, but it has been implicitly formed by Vistorka’s presence and all the active entities agree on the channelling of carbon neutralisation through Vistorka as a systemic and regime intermediary. A more ‘thought through’ policy plan can emerge from the case of Akureyri, which can be adapted to other municipalities for the advancement of their own carbon neutral strategies.

Of course, some specific factors that play a significant part in Akureyri’s success. These local conditions are often not given in other, and especially larger, municipalities and cities. Actors in such settings might find it difficult to reproduce the transition process of Akureyri in every detail. Factors, such as the close connection between people facilitating easy communication and strengthening private public partnerships, financial support from a locally owned utility company, as well as enthusiastic transition champions, might not be present everywhere. Sustainability transitions always have to consider the local context. Local resources, institutions, culture, and needs have to be part of individual solutions that go beyond generic panaceas and “one-size-fits-all” solutions [53].

This is not to say that useful lessons to be implemented on a larger scale cannot be drawn from this case. The value of the case is its ability to demonstrate the working of a hub of transition on a small scale. Therein lies Iceland’s greatest contribution, to function as a ‘test bed’ for carbon neutral solutions and even as a knowledge hub for low carbon transitions. Furthermore, the importance of small municipalities should not be neglected, as they present a potential for testing new ambitious governance models in transition [54].

Additionally, it can be argued that the efforts of transition champions Guðmundur and Sigurður, through lobbying and pushing carbon neutrality to the fore, renders the transition as a whole more vulnerable as it is not likely to continue as strongly were they to quit or otherwise stop. This undermines the resilience of Akureyri’s transition and leaves CNAS dependent on individual actors. In our view, it is important to illuminate the importance of such strategies to become mainstreamed in policy and not be dependent on individual actors and their agency.

6. Conclusions

With this article, we shed light on the low carbon transition in the Icelandic town of Akureyri. By doing so, we investigated a case in which the material conditions are not overly favourable to such a transition. Finally, we analysed the role intermediation played in this case. The case of Akureyri shows that managing carbon flows holistically in an urban context requires a high degree of cooperation and integration. The local success would not have been possible without a holistic approach, which considers and integrates all the carbon flows in the system. This means that a stronger compartmentalisation and privatisation of municipal services would most probably have affected the transition negatively. This is because the single entities and companies managing part of

the flows did not necessarily have an incentive to tap into the potential synergies of a transition of the entire carbon flow system. Here, intermediation played a crucial role, first by Guðmundur and Sigurður, and later in a more institutionalised form by Vistorka.

Our research has shown that conventional approaches to transitions can be limiting, in that they often break down systems into sub-systems. This approach is necessary to gain a perspective that makes the investigated transitions operational for the analytical framework, but it does so at the price of losing sight of complexity. The case of Akureyri, however, demonstrates that embracing the complex interactions between different systems, as is the case for carbon flows, is key to successful low carbon transitions.

We hope that our findings are valuable for researchers and practitioners alike. We acknowledge that our findings are specific to Akureyri and that this limits their applicability to other contexts. No single case study can produce a “silver bullet of decarbonisation” and sustainability solutions always have to consider the local context of their application [55]. Nevertheless, our work can help in the search for patterns underlying social developments. It sheds light on the “human factor” in decarbonisation pathways [56]. In the academic sphere, these insights can inform and complement other ways of knowledge generation in the field of decarbonisation processes [34,57]. At the same time, practitioners from other parts of the world can find inspiration in the case of Akureyri, even if they can and should not reproduce the local transition step-by-step. By this, we hope to make our small contribution to finding solutions to the ongoing climate crisis.

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