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Photo on the front cover: Scott Maco

NORDISK ARKITEKTURFORSKNING
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TOWARDS SITE-SPECIFIC RENEWABLE ENERGY PLANNING IN (POST)COLONIAL GREENLAND

SUSAN CARRUTH

Abstract

This paper discusses how the reappropriation of local "material practices" – that is, the everyday practices carried out by people in relation to, and in conjunction with, their material environment – could contribute towards a revised approach to renewable energy planning in Greenland; one that learns from place and culture rather than imported concepts. It begins by reviewing the historical import of a Danish-style planning system into Greenland, linking physical planning, and specifically energy planning, to the political and cultural life of Greenland. After discussing key contemporary energy planning challenges in Greenland, a series of characteristic material practices existing in contemporary Greenland, identified through fieldwork, are described, and their applicability in renewable energy planning exemplified through illustrated research-through-design explorations. The final section of the paper draws parallels with some key theories in the field of planning, namely Traditional Ecological Knowledge and Infrastructural Urbanism, concluding that material practices can help guide and direct a more progressive and culturally-cognisant approach to infrastructure in a (post)colonial era, weaving new technologies and infrastructures into local conditions.

Keywords:
Greenland; renewable energy;
infrastructure; material practices;
physical planning;
research-through-design

Introduction

In 1953 Greenland was decolonised from Denmark. Paradoxically, however, over the ensuing decades the newly recognised county became increasingly subject to Danish planning ideology and methods. This importation of the Danish physical planning model into Greenland has contributed to sociocultural challenges that continue to resonate today despite Home Rule; these include both practical problems such as disparities in living conditions between cities and settlements, and conceptual problems such as a clash between administrative ethos and cultural outlook. As Greenland debates a path towards full independence, a physical planning approach that is aligned with, and appropriate for, the Greenlandic condition rather than the Danish model, is needed, not least due to the vast disparities in nature and culture between these two territories.

A revised physical planning approach is particularly pertinent for energy planning in Greenland, since energy systems, like all infrastructural systems, are critically implicated in sociocultural conditions despite technoeconomic domination: sociology and philosophy of technology (Bijker, Hughes & Pinch, 2012), infrastructural urbanism (Bélanger, 2013; Allen, 1999), landscape architecture (Ghosn, 2009) and cultural anthropology (Star, 1999) have all underlined, via their respective disciplinary leanings, the intimate and reciprocal connections between society and energy. To consider energy planning is to consider the infrastructure for socioeconomic growth and transformation: enabling or disabling settlement patterns; catalysing industrial growth; and of course, impacting quality of life. Energy planning in Greenland has historically been driven by "travelling" ideas and ideologies from Denmark, however this Nordic expansion has been problematic precisely because of energy's entanglement with society and culture – too often more of an imposition than an encounter. Through a triangulation of historiography, on-site fieldwork, and off-site research-through-design, this research seeks to develop a theoretical and methodological framing for more spatially and culturally appropriate planning, asking: how might a more site-specific approach to physical planning in Greenland be manifested, and could such a perspective be employed in the crucial field of energy?

This paper is split into seven short chapters that can be broadly grouped into three sections: the first section provides a historical review of the import and impact of the Danish planning physical model into Greenland, with particular attention paid to energy planning, before summarising vestigial and emerging physical planning challenges in contemporary Greenland. The second section begins by introducing a hypothesis: that the reappropriation of Greenlandic material practices – that is, the everyday practices carried out by people in relation to, and in conjunction with, their material environment – could help inform a revised approach to energy planning in Greenland that learns from local culture and place.

Through the analysis of fieldwork, six material practices in Greenland are identified, before the potential of the hypothesis is exemplified through selected proposals from experimental research-through-design workshops. The final section draws parallels between this theory, Traditional Ecological Knowledge (TEK), and infrastructural urbanism, before concluding that material practices could offer a tool for energy planning that is simultaneously vernacular and progressive.

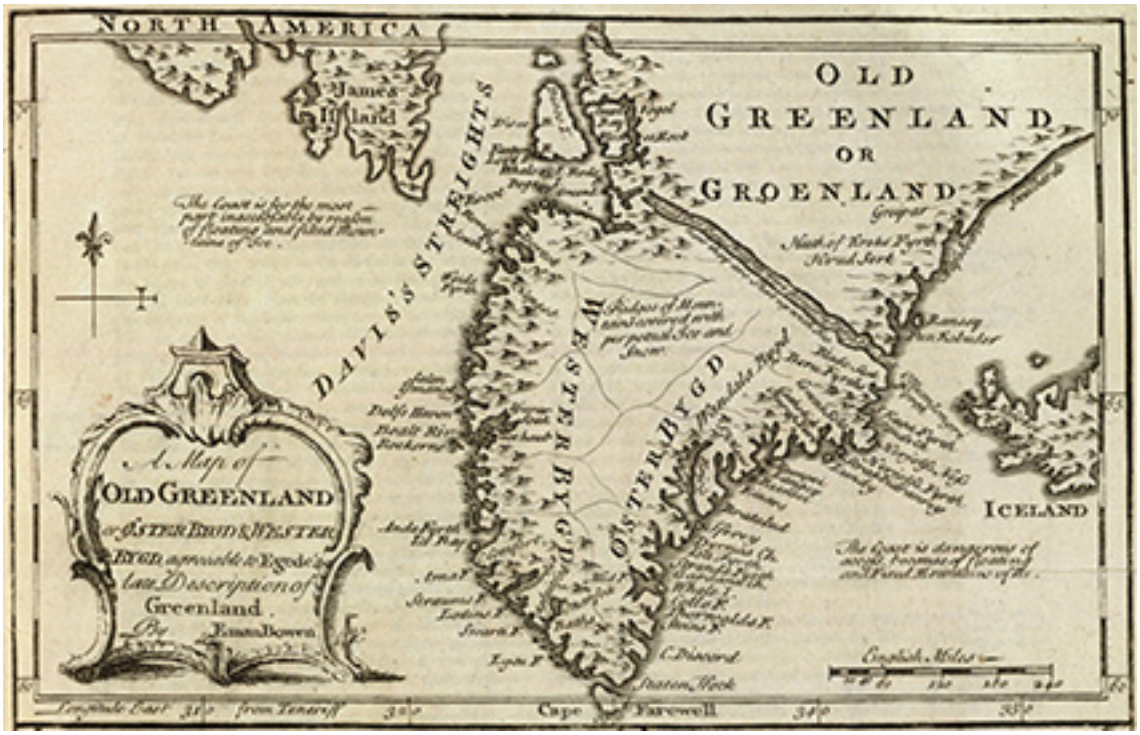
The import of physical planning from Denmark[1]

Colonisation

Greenland is famed for its nature, yet historically it has been planned almost entirely according to commercial-militaristic interests, instrumentalized through the importation of a Danish-style planning system. When Greenland was formally colonised by Denmark in 1721, two types of Danes were deployed: missionaries, and merchants. There was a clash between their respective ambitions, embodied in a physical planning debate; the Christian missionaries wished to concentrate the indigenous population into fewer, larger settlements to render them easy to preach to and monitor, but the merchants, under the auspices of the Royal Greenland Trading Company, wished to maintain the highly dispersed and scattered settlement pattern native to the hunter-gather society in order to maximize seal hunting yields (Skjelbo, 1995, pp.96–97). The country was split into North and South colonial outposts, "dividing and ruling" the population, and colonial settlements were separated from indigenous society (Figure 1). This tension between conflicting wills to concentrate or disperse the population has been a continuous thread throughout Greenlandic planning history.

While Europe and America introduced utility-scale water mains during the eighteenth century, and electrical grids in the late nineteenth century, there remained low standards of living in Greenlandic settlements in comparison with Denmark and other European countries well into the early twentieth century. Greenland was almost entirely dependent on imported oil and coal for power and heating, the exception to this being the Qutdligssat coal mine and plant (1924–1972), which contributed a modest amount to domestic supply (Heidbrink, 2014, p.35). In the early decades of the twentieth century there were few buildings with electrical supply and no electricity grids in the settlements (Heidbrink, 2014, p.35). Public outcry followed publication of these poor conditions in the Danish national press (Fleischer, 2003, p.60); a response that reflected an international shift in attitudes towards colonisation in the early twentieth century. A growing sense of discontent with the political situation was evident in Greenland too, hastened by World War II, which was a pivotal period in Greenlandic physical planning for two reasons. Firstly, since Denmark and Greenland were forcibly incommunicado dur-

1 The following owes a great debt to "Og så vender vi kajakken? Om bosætning, planlægning og arealforvaltning i Grønland" (And we'll bring the kajak? About settlements, planning and land management in Greenland) by Per F. Skjelbo (Skjelbo, 1995).



ing the war, an ad-hoc centre of authority had to be formed, and Nuuk became the unofficial capital. This was the first time that Greenland had had a centre, and a seat of decision-making, on Greenlandic soil. Secondly, American military bases were set up in various parts of the country, including at the cryolite mine in Ivittuut. This the first time that "outsiders" had been present in this closed colony. During this period, there was a decline in seal populations, leading to a necessary change in livelihood for many Greenlanders, from hunting mammals to fishing. This shift in resource and activity prompted a spontaneous alteration in settlement patterns, since fishing required moderately larger and fewer settlements. In the post-war years, the larger settlements gradually implemented electricity grids supplied by imported fossil fuels (Heidbrink, 2014, p.36).

Figure 1
A 1747 map of old Greenland or "Oster Bygd" and "Wester Bygd" by Emanuel Bowen, agreeable to Egede's late description of Greenland. (David Rumsey Collection, 1747)

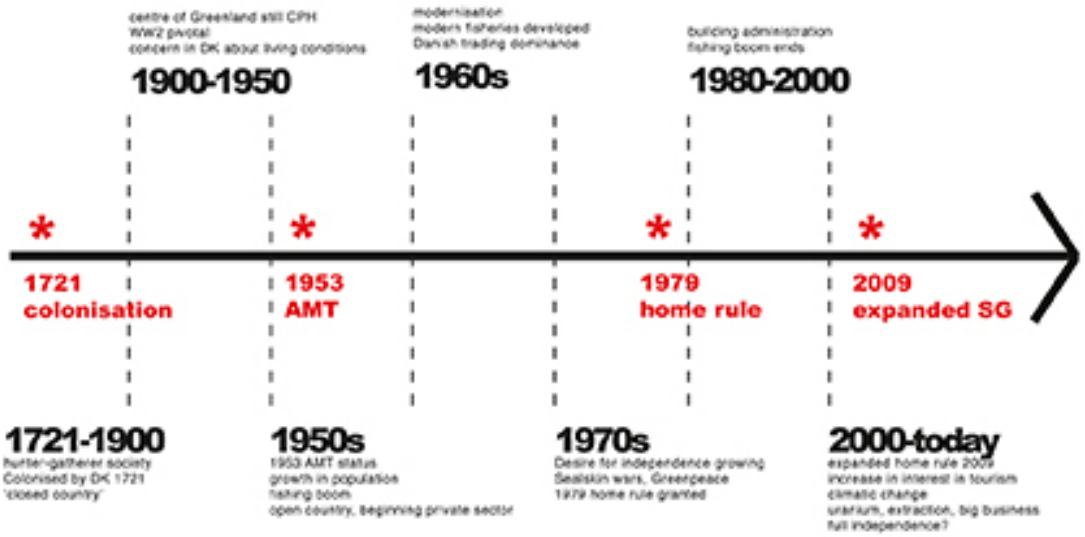


Figure 2
Timeline of key milestones in Greenland's modern history (Carruth, 2015)

Decolonisation

After the publication of the "G50" – a development plan for Greenland authored in Denmark – followed by decolonisation in 1953, there were many new organisations and systems set up in order to "modernise" Greenland "in line" with the rest of The Kingdom (Lyager, 2002, p.20) (Figure 2). Arguably, the most important of these new institutes was Greenland's Technical Organisation (GTO). The GTO was charged with managing and implementing all physical planning and construction activities in the newly decolonised Greenland, including expanding electricity supply. While there was some local input, all of the decisions and plans were made in Copenhagen, and the GTO was a highly technocratic project (Birk, 2012, p.9), with little regard for human, local, or socio-cultural concerns. Functionalism was at high tide in Denmark, and this approach was imported wholesale into the Greenlandic context, imposing – through planning – Danish values and a Danish mentality. GTO's flagship project was the "concentration" policy, whereby people living in small settlements were concentrated in just three or four large open-water towns on the west coast. Migration was first encouraged through propaganda, and later implemented through the economical "starvation" of the small settlements (Skjelbo, 1995, p.111). The concentration policy was driven by commerciality, specifically the development of industrial-scale centralised fisheries and the reduction of construction and infrastructural costs in the small settlements. The highly dispersed small settlements of Greenland were not seen as conducive to the development of efficient and economical infrastructures such as running water, modern plumbing, and electrical supply, all of which cost-benefited from economy of scale and centralisation. These "starvation" tactics led to languishing standards of living for those who remained in the settlements, and a dramatic shift in lifestyle and culture for those who migrated to the cities – translocating from small settlements and sustenance lifestyles to

high rise apartment blocks and commercial fisheries (Figure 3). While the GTO certainly had many positive impacts – the introduction of electricity, heating, sanitation measures, and other modern conveniences and amenities increased comfort, and reduced rates of infection and disease (Birk, 2012, p.8) – there was a sociocultural cost of this dramatic and often imposed transformation in lifestyle, leading to the breakdown of traditional values, structures, and identities (Graugaard, 2009, p.14).[2]

The 1960s saw not just a continuation but an acceleration of GTO's concentration policy. The small settlements were further depopulated and fell into decline, while the chosen larger towns continued to grow. Planning was carried out from Denmark, where architects and engineers, often privately hired by GTO, had scarce experience of Greenland.[3] Consequently, despite their intentions, planning was habitually ill-suited to Greenlandic ways of life, and often reliant on "drawer plans" – off-the-shelf solutions, rolled out regardless of site (Skjelbo, 1995, pp.154, 156). There were however exceptions to this, and buildings of architectural and social merit from this era certainly exist (Vindum, 2012).

2 There were also unforeseen variables: in the late 1950s there was a revival in the seal count in north Greenland leading to certain small settlements that had been branded as "doomed" actually producing some of the biggest commercial contributions of the county. Furthermore, GTO policy was implemented not by Greenlanders but by Danish tradesmen flown in to build this modernisation project, rather than train local Greenlanders. The justification was that this "upgrading" was to be completed quickly and discretely so there was no reason to train Greenlanders outside of their traditional livelihoods (Skjelbo, 1995, p.153). This division in employment between Danes and Greenlanders has resonated for many decades, de-skilling a generation of Greenlanders for planning related work.

3 Research delegations were sent out to learn about Greenland (Lyager, 2002, p.19), however these field trips proved insufficient in the face of Functionalism and colonialism.

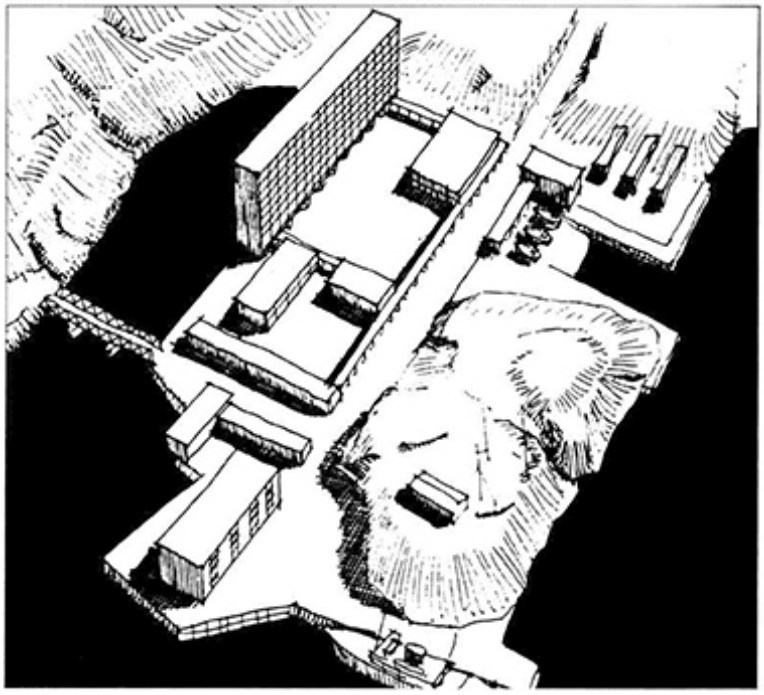


Figure 3
A mid-century plan for Maniitsoq – a stark contrast to the small homes in settlements that residents were previously living in. (Skjelbo, 1995)

Home Rule

The 1970s witnessed a rising political consciousness in Greenland, and criticism of GTO's planning regime was rife. Culture and settlement patterns were also being influenced by global political shifts: changing attitudes towards and legislation for seal hunting pushed the fur trade into steep decline, causing catastrophic and continuing effects on Greenlandic livelihoods (Speca, in press). As well as instigating social and financial problems, this exogenous shift transformed the physical planning of Greenland in favour of fishing, necessitating a move towards fewer, larger settlements, which in turn altered energy patterns through the changed use of transport and the appearance of larger factories. The first formal planning act was introduced in Greenland in 1977,[4] two years before Home Rule was won, and for the first time there was a legal basis for planning (Skjelbo, 1995, pp.158–159). Following Home Rule, administrative departments were transferred from Copenhagen to Nuuk, and planning was one of the first to be reassigned. Such a quick handover meant little time to generate new planning approaches better suited to Greenland, and consequently the existing GTO system – itself essentially a continuation of the former colonial system – was broadly adopted (Skjelbo, 1995, pp.167–169). The new administration put an end to concentration policy in favour of solidarity and cultural heritage, and for the first time in decades money was invested in settlements. Sector plans were introduced to cover nationwide issues, including infrastructure, yet despite these improvements, planning remained patchy, and silent on many key issues – no local involvement in sector planning; a lack of regulation covering "open" land outside of urbanised areas; and limited environmental conservation measures.[5]

4 For comparison, the first *Act on Spatial Planning* was passed in Parliament in Denmark in 1925.

5 With poignant irony, this period saw a sharp decline in the fish stocks, particularly cod, leaving many living in the "concentrated" open water towns without the livelihood that concentration policy has been predicated upon, and while fishing remained Greenland's largest export by far, the country became less secure in this important resource. It can be seen therefore that alongside tensions between centralisation and decentralisation, fluctuating resources are another key characteristic of Greenlandic planning.

From Home Rule to self-government

Following the 1970s global oil crisis, Greenland recognised its dependence on imported hydrocarbons, and began to draw up plans for the introduction of large scale hydroelectricity. Hydroelectricity was an obvious choice in a land rich in mountains and lakes, but there was, and remains, a hurdle – utility scale hydroelectric plants are best suited for centralised energy production. Buksefjord, the first utility scale hydropower plant, was inaugurated in 1993 to supply Nuuk, and since then another four plants have come online. These five hydroelectric systems combined generate approximately seventy per cent of electricity supply – an impressive figure. However, in practice they supply only half a dozen of the largest towns (Kingdom of Denmark, 2011). The remaining thirty per cent largely represents electricity supply for the settlements, which remain dependent on expensive imported hydrocarbons, and are not geographically or economically suited to utility scale hydroelectric generation. The introduction of hydroelectricity has therefore enabled Greenland to become significantly less dependent on external, non-renewable, sources of energy, while simultaneously reinforcing disparities between settlements and towns, aggravating latent cultural-political tensions.

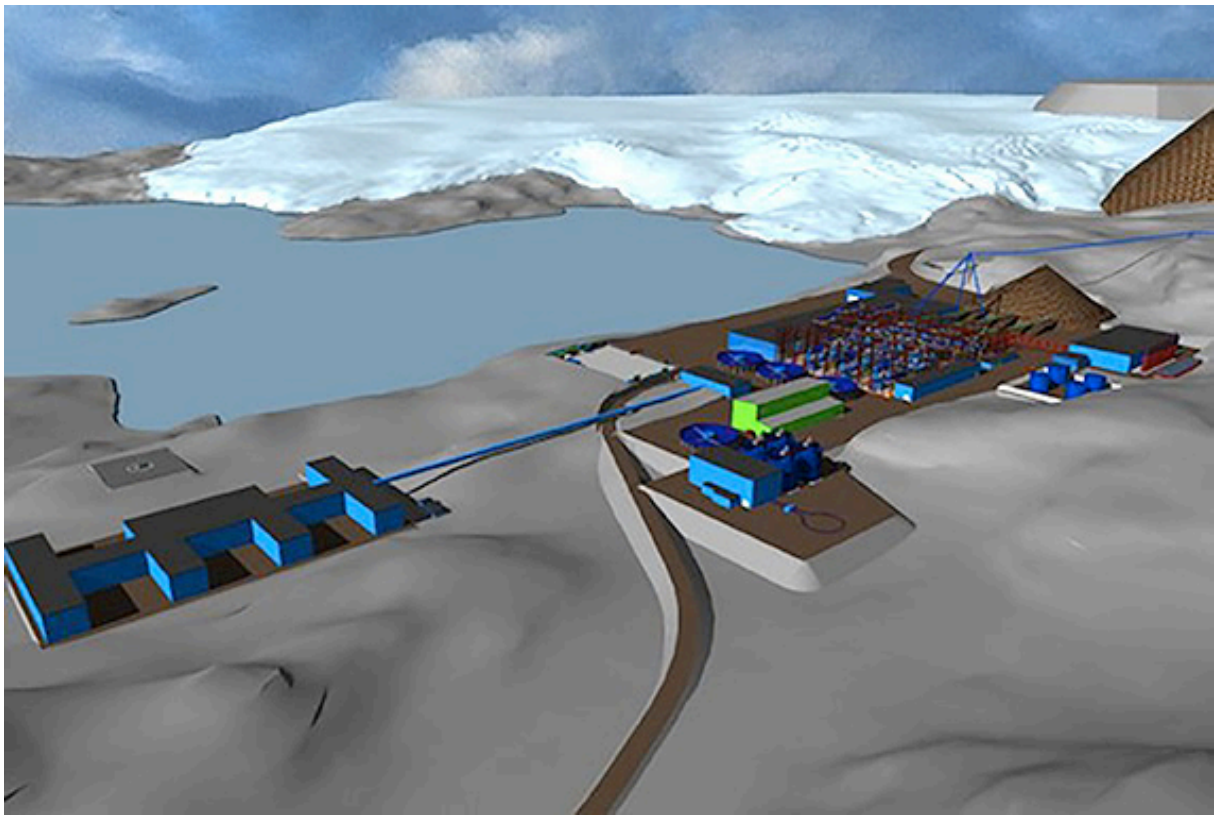


Figure 4
London Mining's rendering of plans for Isua Iron Mine (London Mining, n.d.)

Climatic change, current and projected, has amplified interest, globally and locally, in the "open land" areas of Greenland over the last five years.[6] As the ice slowly melts, the "white spaces" on the map are now being reviewed as infrastructural possibilities, ripe for development (Figure 4), and in 2009, following extended self-government powers, planning legislation governing development in the "open" landscape was introduced. It is however noteworthy that many of the potential industrial activities, centred around extraction and hydroelectric powered heavy industry, are not subject to current planning legislation, and viewed as separate from normal conditions and physical planning.

Contemporary energy planning challenges

Several energy planning challenges exist in contemporary Greenland, stemming from the inheritance of an imported planning culture, exacerbated by emerging global climatic conditions. Firstly, tensions remain between local and central perspectives on development, manifested at varying scales – national versus local, global versus local, settlement versus city. Following the structural reform of 2009,[7] the substantially larger agglomerated municipalities have the power to approve their own local plans, meaning that planning control is devolving not just from Copenhagen, but also from Nuuk. However, generations-old questioning of the viability of maintaining highly dispersed urban "islands" (Greenland has

6 Following many unsuccessful drilling attempts through the 1990s, Cairn Energy successfully discovered hydrocarbons in Greenland in 2010, and the Greenlandic government awarded its first round of offshore exploration licenses in 2011. In 2012 Greenland witnessed a thirty-year record in the extent of the summer ice melt, prompting speculation about rising sea levels globally, but also ice-free summer sea access in the Arctic.

7 It is worth mentioning here that this municipal restructuring in Greenland in 2009 came in the wake of a parallel Structural Reform in Denmark in 2007, in which 271 existing municipalities were merged into larger units to create 98 new municipalities. Greenlandic municipal organisation continues therefore to echo what happens in Denmark. ‹http://english.sim.dk/responsibilities/economics-of-municipalities-and-regions/structural-reform.aspx› [accessed July 2015].

no national grids) is rising again, loaded with political and cultural sensitivities following decades of colonial pressure to centralise. Currently energy is more expensive in the small settlements despite subsidisation and price limitations. Larger towns question this system, while the settlements struggle with higher costs of living and lower standards of infrastructure. Greenland has to decide if its uncontiguous pattern of small settlements is not only possible but desirable, and how to sustainably plan infrastructure accordingly.

Secondly, it could be said that Greenland is still suffering a "hangover" from Functionalist planning. While deindustrialising Denmark, like many Top-of-the-Pyramid countries, is trying to move towards more horizontal modes of planning – through participatory processes, interdisciplinary approaches and so on – the planning system of Greenland, as the country stands on the cusp of industrialisation, has been criticised (Riis, 2012, pp.208–213) for a persistence of silo thinking, techno-economic domination, and a lack of transparency. This is arguably also evident in its energy planning, which is often managed independently from broader planning decisions

Lastly, Greenland is on the frontline of climatic change. The Arctic is warming and changing at a relatively accelerated rate, shouldering the impact of anthropogenic climate change wrought from far away.[8] In a region where many livelihoods are tied closely to the physical environment, and which have historically suffered failures related to changes in natural conditions, Greenland again has to be resilient to change. Greenland is in a difficult position – history teaches that socioeconomic development in the West inevitably came hand-in-hand with a huge increase in energy demand alongside centralisation and urbanisation (Jazairy and Benachenhou, 2009). In an era of pressure to reduce CO^2 emissions and ubiquitous sustainability discourses, Greenland must find a way to develop that benefits its people today, while not leaving itself caught between playing catch-up with the "Western" development paradigm, and at the same time negotiating relationships with the strong Arctic strategies of Russia and China.

To address these challenges, I will argue that a Greenlandic domestic energy solution – one that is appropriate and relatable to contemporary, modern Greenland – is needed, rather than an imported solution. This does not mean a search for a "return to innocence" or a prosperity sacrifice, rather, it is a search for a vernacular, regional modernity that is simultaneously progressive and rooted, providing an alternative paradigm of "sustainable development" that is not imported from Denmark by default. The potential for hydroelectricity production to fuel industrial activities and potentially imbue Greenland with an economic base for development and political independence is much discussed and debated (Heidbrink, 2014, pp.37–40). However, leaving such industrialisation

8 "Anthropogenic climate change" is used to describe significantly altered climatic conditions resulting from or produced by humans. The Intergovernmental Panel on Climate Change states that: "Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. The global increases in carbon dioxide concentration are due primarily to fossil fuel use and land use change, while those of methane and nitrous oxide are primarily due to agriculture." ‹https://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmsspm-human-and.html› [accessed July 2015].

questions to one side, it is clear that domestic energy planning focused solely on hydroelectricity points inevitably towards centralisation and the decline of small settlements once more. This de facto shift towards centralisation demands examination in light of the on-going international debate in energy planning about the benefits of centralising super-grids (such as the RoadMap 2050) versus decentralising self-sufficiency (as supported by organisations like The Transition Network). Indeed, Greenland's decentrality, and the culture that birthed and supported such a settlement pattern, could present an alternative model for sustainable development, and a counterweight to the risk of the Arctic becoming merely a resource colony in the era of peak oil. In response, it is hypothesised that the reappropriation of vernacular material practices could contribute to a revised approach to energy development in Greenland in a way that creatively learns from local culture and place while addressing these issues, instead of automatically importing strategies and systems ill-adopted to this context.

Material practices: Learning from the practice of place

The notion of material practices descends from several disciplines, notably archaeology, where the concept describes how individual human activities are not discrete but connected to, and bound up with, larger practices (Tarlow, 1997), and how material artefacts are used to perform or embody larger cultural values. In archaeology, these practices are analysed in order to understand processes of and strategies for living, moving beyond the limitations of "Material Culture", which focuses solely on the role of completed artefacts and what they signify. This interpretation resonates with Russian psychologist Lev Vygotsky's assertion that thinking and learning are connected to "communities of practice" (Wenger, 1998), whereby a number of people form a community through mutually exercised practices, often related to common resources or other necessities for flourishing in a particular environment (Vygotsky, 1978).

Building on these definitions and associations, material practices are here simply defined as commonplace practices carried out by people in relation to, and in conjunction with, their material environment. Such material practices structure behaviour in ways that are consonant with the values of society, demonstrating the inter-agency of people and the material world. They differ from cultural practices in their interdependence with the material world. However, like cultural practices, they do concretize particular values, norms and attitudes. Such a definition of material practices relates to Doreen Massey's reading of "place" as an on-going construction, formed through multiple spatio-temporal practices and actions (Massey, 2005), rather than the more static meaning accorded by Norberg-Schulz, where "place" is embodied through architectonic motifs or morphologies (Norberg-Schulz, 1980). This approach is

therefore not about mimicking vernacular styles, but a method of engaging with the underlying continuous construction of "place" and culture through repeated practices carried out by citizens.

It might seem rather a large leap from archaeological and cultural geographical definitions of material practices that pertain to everyday artefacts to the planning of energy infrastructure – a field that deals with technical obduracy, large-scale works, and the "professional" concerns of engineers and economists, and which is usually considered from a "top down" perspective. However, in "The ethnography of infrastructure", Susan Leigh Star proposes that infrastructure is "a fundamentally relational concept, becoming real infrastructure in relation to organized practices" (Star, 1999, p.380). By way of example she argues that water infrastructure is viewed differently depending on whether you are a cook, a planner, or a plumber; in this way infrastructure is not about independent technologies but "braided in with thought and work" (Star, 1999, p.380). Therefore, viewing infrastructure from "the ground" and drawing upon the existing material practices of a culture might offer cues and clues as to how to design energy infrastructures to be more place-specific.

In 2013 and 2014, I carried out fieldwork in Greenland in Nuuk, Sisimiut, and Kapisillit – sites chosen because of their varying sizes and "centrality", where Nukk is the capital, Sisimiut a large town, and Kapisillit a settlement – and at Bukserfjorden hydroelectricity plant. This fieldwork consisted of first person phenomenological observations combined with semi-structured interviews with planners and other local experts in energy and/or planning. The collected information was formed into a Thick Description[9] and indexed for existing, commonly found material practices. This is an abductive and dialogical interpretation (Bakhtin, 1981) of the material rather than the uncovering of "fact" in the tradition of Grounded Theory, and it is therefore critical to make clear that this analysis of material practices is not an attempt to "explain", exhaustively describe, or condense the region into definitive categories, but, using a disciplinary lens, to provide a reading of the existing situation. The following section presents the results of this fieldwork analysis.

Six material practices in contemporary Greenland

1. Collectivity

All land in Greenland is collectively owned: there is no legal or cultural structure for private ownership of land. This stems from the country's hunter-gatherer background – unlike in Denmark and many other countries, Greenland is not an agrarian society that depends on bounded, privately owned land; instead it is formed from the traditions of mobile hunter-gatherers, thereby relying less on demarcated plots. This collectivity goes far beyond the strictly legislative, and resonates through Greenlandic society in many ways. For example; private houses are not

9 The research blends architectural site analysis, as commonly found in disciplinary practice, with ethnographic phenomenological observational methods, in order to better understand and, importantly learn from, how people interact with their material environment in contemporary Greenland. Rather than a simple registration of site, this entails studying existing phenomena and practices and using these as starting points and "logics". The Thick Description is a rich and detailed account of the fieldwork combining field notes, photographs, diagrams, and excerpts from the interviews. The term was popularised by the anthropologist Clifford Geertz in the 1970s.

generally demarcated by fences and private gardens (Figure 5); in small settlements, a large hunt is pragmatically shared within the community; small settlements have shared "service houses" for communal washing and cleaning; and in Spring there is a collective effort to clean up the debris left behind after snow has melted.

Figure 5
*Collectivity: h*ouses are not separated by fences and the land is commonly held (Carruth, 2015).

2. Bricolage

Undoubtedly, contemporary Greenland relies on imports – food, building materials, building typologies, and skills – to a large extent. Yet closer scrutiny reveals that this reliance on imports is in dialogue with resourceful uses of what is immediately and locally available and "to hand" – what might be termed bricolage. In Greenland bricolage is practiced as a matter of course, and is particularly prevalent in the settlements, of necessity. For example, dog sheds and other outbuildings are assembled from demolished building materials, packaging materials, ostensible rubbish and so on (Figure 6). Similarly, pathways are made passable by using metal grates, or ad-hoc water diversion with plastic piping. It has also been recorded that kerosene – aeroplane fuel – has been burned for heat in some settlements, as it is more readily available than the officially sanctioned fuels.

Figure 6
Bricolage: an outbuilding in the city centre constructed from packaging material and demolished building materials (Carruth, 2015).

3. Seasonality

Living with the seasons is a necessity in Greenland. Historically, Greenlanders had seasonal settlement patterns – in winter small groups of families lived in stone or turf houses, but in summer they migrated to large summer camps living in stretched skins tents. This practice of seasonality remains evident in the contemporary landscape: it is very common for Greenlanders to have a winter job and a summer job, or a day job and a night job (Figure 7). This "wearing of multiple hats", according to seasonal or diurnal shifts is a common aspect of everyday life. The physical infrastructure also sometimes practices seasonality – for example, jetties are stretched into the water during summer but then retracted and stacked on land when the water is frozen in winter.

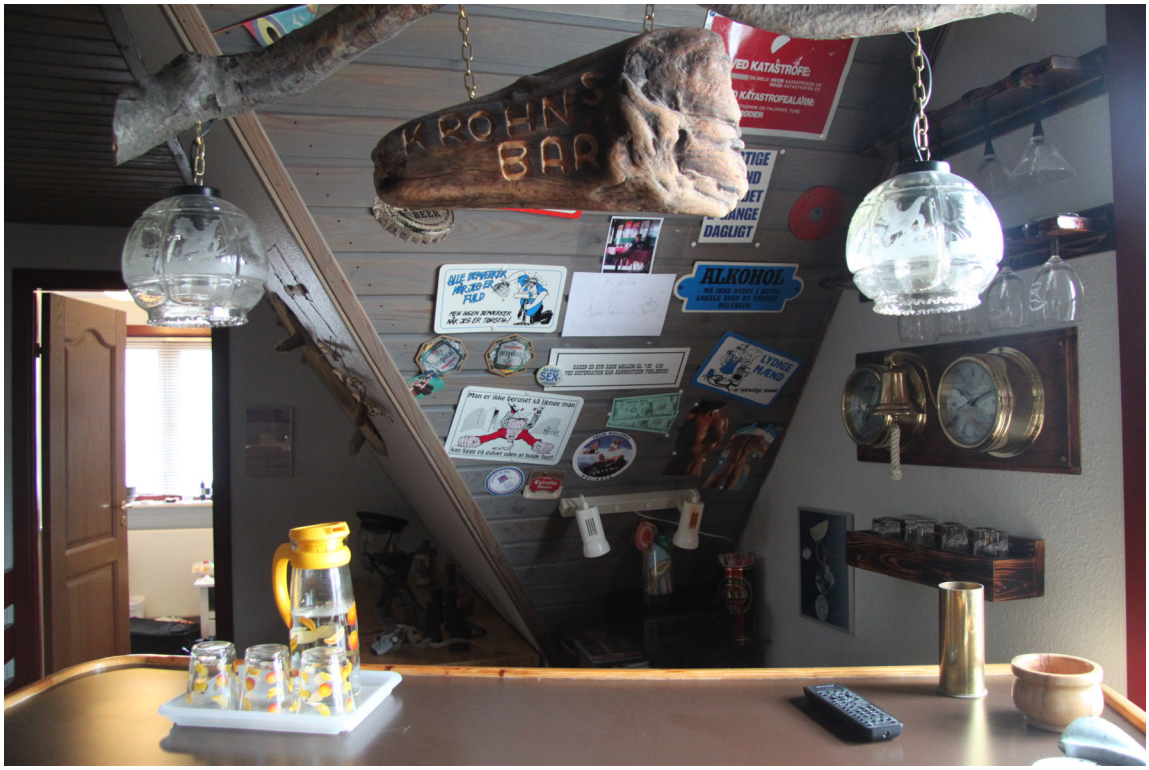


Figure 7
Seasonality: During tourist season Paula and Poul run a bed & breakfast in their home, however this simply supplements their other income as harbour masters of one of Nuuk's mooring sites (Carruth, 2015).

4. Modularity

Many structures and pieces of equipment in Greenland have been designed to be repeatable, broken down into smaller units. This cellular approach, for example simple timber frames used to stretch skins, allows for borrowing, lending, redistributing and moving. It also enables the easy replacement of one part without putting the whole system into disrepair, and the gradual growing or shrinking of the system over time. Housing also practices modularity as a catalogue system of housing typologies enables self-builds even in remote settlements, as does the reproduction of a public stair typology used throughout Greenland (Figure 8).

Figure 8
Modularity: a timber public stair design is repeated throughout Greenland, simplifying and streamlining this transport infrastructure (Carruth, 2015).

5. Wait-and-see

The principle of wait-and-see in Greenland is imperative. Whether it may be waiting to find out whether a flight can take off, whether weather will allow an excursion, whether the local shop has imported a certain item: all aspects of life require monitoring before decisions are made just-in-time (Figure 9). The practice of wait-and-see is not about "living for the moment"; it is about looking forward and making canny judgements. This practice is seen in some planning practices already: in Nuuk, there is a large vacant building plot,[10] but rather than rushing to design and construct something here, the local authority planning department has a loose plan that allows ad-hoc, temporary activities to take place, for example a children's skating park. Their "plan" is then to watch, learn, monitor, and find out what activities are most successful on this site before translating them into permanent plans.

10 This vacant plot in fact has an important history as it includes the former site of Blok P. Blok P was a residential apartment block constructed in the mid-1960s as part of the G60 campaign. It was the largest building in Greenland and for a time housed one per cent of the entire Greenlandic population. The building was in equal parts maligned and loved by Greenlanders and became not just a local landmark but also a symbol of imported Modernism. In 2012 it was demolished and local opinions on its demise are still divided.

Figure 9
Wait-and-see: The sole shop in Kapisillit, closed on a Saturday (Carruth, 2015).

6. Blending

In many developed countries, technical infrastructure is routinely separated from urban space, and often concealed altogether, but Greenland has a more pragmatic attitude toward blending the infrastructural and the urban together. Drainage ditches in Nuuk – used as conduits for snow, ice and rain – are open, and are a highly visible part of the public urban landscape. Likewise, due to the rocky terrain, towns and settlements in Greenland frequently use urban staircases to traverse the topography and, for similar reasons, electrical and water cables and conduits are almost always surface-laid rather than the more commonly seen subterranean approach. It is common to see these different infrastructures – stairs, official conduits, and pipelines, plus unofficial additions – blending together; creating thickened urban-technological infrastructural lines (Figure 10).

Figure 10
Blending: A public urban stairway with conduits running underneath and alongside (Carruth, 2015).

While these material practices are not necessarily unique to Greenland individually, collectively they describe the practices of place and the material-cultural landscape of Greenland in a way that focuses on actions, everyday life, and pragmatic tactics, rather than formalist symbolism, or bird's-eye-view cartography.

Exemplifying theory – research-through-design

These material practices are intended to act as tactics in the generation of design proposals. In order to probe the potential of the material practices to be operationalized and spatialised in particular sites in Greenland, I carried out experimental design workshops[11] and have selected two proposals to illustrate the results:

Generating a greenhouse, Kapisillit

This first example addresses the challenges of increasing the resilience of small settlements while decreasing their dependence on imported fossil fuels, using Kapisillit as a site. This proposal was suggested by a group of four students during a four-week workshop at the Aarhus School of Architecture, Denmark, in April 2014. Initially interested in simply replacing the existing diesel generator with a bio-gas digester,[12] these students recognised that to jettison another closed infrastructural "box" into the village would not have any cultural, civic, or aesthetic benefits to the community beyond the environmental benefits of reducing waste and hydrocarbons. Upon investigation, they realised that

11 In total, there were three workshops. The first involved only me, whereas for the second and third I collaborated with large groups of second year students at the Aarhus School of Architecture.

12 A biogasdigester is a plant that processes organic waste, transforming it into either thermal or electrical energy.

both the existing diesel generator and the proposed bio-gas generator produce heat as a by-product, and yet the heat produced by the diesel generator is currently untapped.[13] The students responded by proposing a bio-gas generator placed immediately adjacent to the existing diesel generator, with both structures enveloped in a glass skin, constructed of simple, lightweight, modular components to create a community greenhouse (Figure 11). This greenhouse, to be collectively managed, is heated by both generators, allowing residents to grow vegetables in the harsh climate (Figure 12).

13 Heating represents a large percentage of energy consumption in Kapisillit, and, as thermal energy is a lower grade of energy than electricity, the transformation of electrical energy into thermal energy is inefficient and wasteful.

Figure 11
Generating a greenhouse: the existing diesel plant is the blue building on the left (Josefsen, et al., 2014).

This design strategy exemplifies how the material practices of *collectivity*, *bricolage*, and *blending* can be operationalised to confer greater viability of the decentralised settlement pattern, mitigating strain on cross-country infrastructures, and introducing synergistic relationships. Further, it lessens fossil fuel dependence, increases resilience to globally shifting energy markets, and addresses the high cost – in money and CO^2 – of importing fresh vegetables. Although drawing on existing material practices, the design strategy inherently suggests the introduction of a new material practice – small scale community agriculture – that while common in many other regions is not yet established in Greenland (except in the far south), and as such raises the question of whether this proposal would be welcomed by local people, and if it would ultimately be used by everyone and for the intended purpose. Nevertheless, it points towards possible pragmatic yet creative energy strategies that reframe place-based material practices.

Figure 12
Generating a greenhouse: vegetable-growing in heated interior (Josefsen, et al., 2014).

Supplementing with solar, Nuuk

The capital city of Nuuk is one of six towns supplied by hydroelectric power. Located in Buksefjorden, the plant supplies almost all Nuuk's electricity. However, it is expected that by 2030 the growing population and prosperity of Nuuk will outpace the supply (Bizopoulos and Koutsos, 2013).[14] This proposal considers solar energy as a supplement and complement to the hydroelectricity supply. The solar energy plan is approached as a family of three separate but linked ideas, each progressively more committed and "permanent" than the last: firstly, shipping containers are retrofitted with solar panels and placed at the harbour side in summer to serve cruise ship tourists, while in winter they are stacked with just the photovoltaic panels visible, contributing to generating energy for refrigerated harbour storage. Secondly, existing timber public staircases are augmented with photovoltaic canopies and solar thermal collector balustrades, producing energy for urban lighting, de-icing and other civic needs. Lastly, and most committedly, a network of neighbourhood geosolar systems[15] provides interseasonal thermal storage, and crucially, the proposal suggests integrating a public space above the borehole field, expressing the underground infrastructure via a matrix of public lighting and solar thermal columns, while the associated plant is exposed as part of a café or other public space. This portfolio of interventions (Figure 13) is designed to have the capacity to be deployed at various speeds and scales, dependent on contextual drivers and adaptations, with the interventions learning from one another, building on previous experience and "feedbacking" skills and materials where possible.

14 One option in response to this is to extend the hydroelectric plant, but this is prohibitively expensive, estimated at around one billion Danish Kroner.

15 A geosolar system is a field of fluid filled underground boreholes fed by solar thermal panels. Due to the heat differential underground, the boreholes keep the fluid heated. When needed the still-heated fluid is transferred to a plant where it is used to heat either space or water.

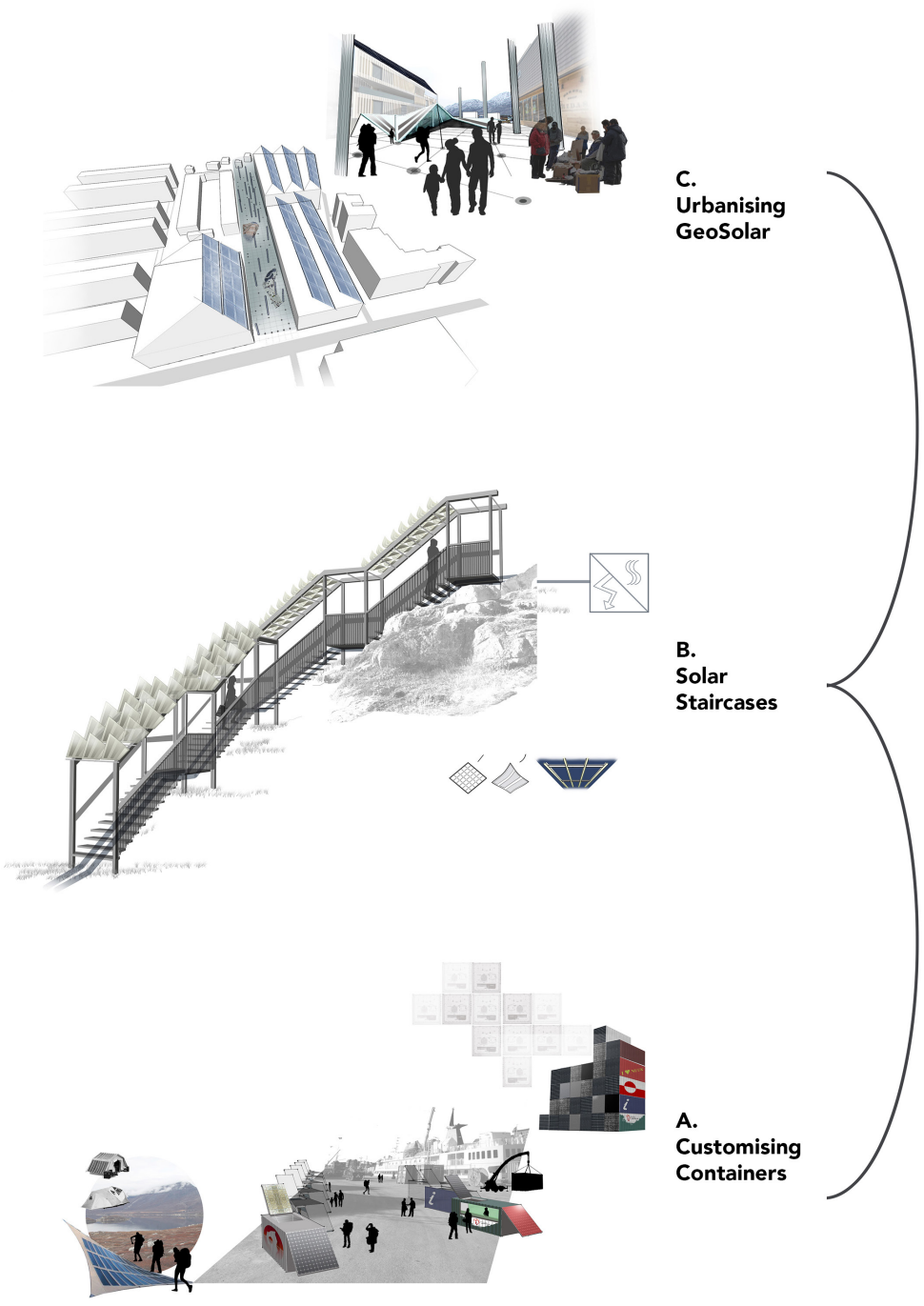


Figure 13
Supplementing with solar, Nuuk: a portfolio of interventions, bottom, adapted harbour side shipping containers; middle, augmented urban stair case; top, geosolar system integrated with public space (Carruth, 2015).

This portfolio design strategy exemplifies how the material practices of *seasonality*, *bricolage*, *modularity*, *wait-and-see* and *blending* can be re-appropriated in the capital city's energy plan, helping the city to thrive, and mitigating against a return to hydrocarbons. It looks to move away from silo thinking and monofunctionalism, proactively addressing resilience to potential scenarios and shifts in the wake of climatic change and global migration patterns. While even collectively the strategy would not "solve" Nuuk's potential energy problem – including technical hurdles[16] and investment commitments[17] – by piggybacking on the existing system and existing material practices, Nuuk avoids a single-track road, using what exists locally as a starting point.[18]

Relations with TEK and infrastructural urbanism

Traditional Ecological/Environmental Knowledge (TEK) (Freeman, 1992) demonstrates parallels with this research. TEK is a reaction against the dominance of Western Scientific Ecological/Environmental Knowledge (SEK) which asserts that native, local, informal, forms of knowledge relating to the bio-physical world – knowledge that is often not formally recorded – are equally valid and useful in environmental management. TEK has largely focused on building "folk taxonomies" (Freeman, 1992) of how communities have traditionally managed living resources, and while this research is allied to such epistemologies, it is distinguishable in two key ways. Firstly, where TEK research seeks an understanding of a particular socio-ecological system and harnesses knowledge *directly in the management of that system, this research studies vernacular traditions* in a broader, less domain-specific manner, and then translates those customs into another domain – in this case energy planning. Secondly, this research does not separate TEK from SEK, or see TEK as being only about low-tech or historically continuous traditions. The focus is squarely on the contemporary conditions of Greenland, which are acknowledged as a mix of the global and the local, the new and the old, and on how modern Greenlanders approach their environment today. While some of the material practices do have long heritages, they all place contemporary manifestations at the forefront.

A second connection is with Infrastructural Urbanism, born of the Landscape Urbanism movement. In his seminal essay on the subject, Stan Allen states that architecture itself is a material practice, and as such, does not concern the expression of meaning or a point of view, but rather the condensing, transforming, and materialisation of concepts (Allen, 1999, p.53). Allen proposes that architecture is not about "the production of autonomous objects, but rather (...) the production of directed fields in which program, event, and activity can play themselves out" (Allen, 1999, p.52), thereby wishing to reframe all architecture as "infrastructural". This prioritisation of process over object, however, is specifically in reference to techno-politico-eco flows: Allen acknowledges that cultural and

16 The question of how to deal with snow and heavy ice build-up on panels (and indeed wind turbine blades) in cold climates is one with which engineers continue to grapple. While very cold, snowy conditions have some benefits for photovoltaics due to increased reflectivity from snow and a higher efficiency in colder conditions, and advances in PV technology mean that they function even with some snow or ice coverage, there remains a need to find ways of moving beyond the manual removal of heavy snow loads. There are some high-tech solutions, such as "flexmats" or coatings which prohibit the formation of snow in the first place. However, in this proposal it is speculated that the combination of steeply-angled PVs with vertical STCs work together – the vertical STC balustrades do not provide a surface for snow to build up upon. STC produced thermal energy therefore could potentially be used to provide low temperature heating on the underside of the PV canopy.

17 As geosolar systems require the blasting of rock, which is expensive and consequential in Greenland, this is not an option to be rushed into, hence why it is the last step of the proposal.

18 While this is not a conventional participatory project and the proposals have not been taken back to Greenland to discuss with local groups to date, this solar project was discussed at a conference in Sisimiut, Greenland in April 2014 that was attended by representatives from the planning department in Nuuk. The proposals were well received by the planners who showed interest in such ideas for the municipality and were very helpful in suggesting further references and information sources.

social factors are in play and are part of the architect's "toolbox", but, critically, he implicitly brackets them as another tool in the box, not as relevant, active processes themselves (Allen, 1999, p.53). Similarly, Pierre Bélanger advocates what he terms "Landscape Infrastructure – a synthetic alignment of landscape architecture, civil engineering and urban planning" (Bélanger, 2013, p.50) and argues that infrastructure is a central driving force of urbanity that requires redefinition. However, Bélanger's assertion of the importance of interconnectivity, flows, and processes is manifested primarily in the geographical scale, focusing on the economical and the ecological, side-lining micro-scale, citizen-led material practices. While whole-heartedly allied with the aims and philosophies of Infrastructural Urbanism, this research asserts that existing material practices – such as the practice of *collectivity* manifested in shared wet-rooms in service houses, or the practice of *blending* spatialised in combining different forms of infrastructure in urban staircases – are part of the same infrastructure as the "professionally" framed techno-ecological flows, and are worthy of equal attention (Carruth, 2016).

Conclusions: Material practices as contemporary infrastructure

This paper has sought to demonstrate how a more site-specific approach to physical planning – and in particular to energy planning – in Greenland might be conceived. Beginning by reviewing how planning in Greenland has historically been driven by "travelling ideas" from Denmark, and the continuing physical and sociocultural repercussions this one-way imposition has had, a theory of incorporating and reappropriating material practices has been advanced. Primarily, this is a methodological contribution, suggesting that a dialogical interpretation of existing practices can guide and direct the spatial, material, and operational characteristics of renewable energy infrastructures; weaving new technologies and infrastructures into local conditions through culturally-relevant practices, tactics, and customs rather than by stylistic means.

The illustrated research-through-design strategies are not suggested as comprehensive, developed solutions, nor do they address all the challenges Greenland faces. The ambition is more modest: to exemplify and make concrete how material practices can be reappropriated and made directional in energy planning. Such visual speculations that concretise abstract theories render future possibilities discussable, and open debate in a way that is more accessible than text-based theory alone. Working iteratively between fieldwork and generative research-through-design explorations, it is evident that there are plentiful material practices in contemporary Greenland, which can offer directions in energy planning while also resonating with contemporary sustainable development approaches more broadly. For example, *blending* increases the visibility and legibility of energy production and distribution, characteristics that

have been noted as important for developing more responsible resource use (Jakob, 2001, pp.7–31), and, similarly, *bricolage* aligns with the rise of "upcycling" and the burgeoning "fixer economy" (Sung, Cooper and Kettley, 2014). Nevertheless, it is critical to underline that material practices are posited here as an additional perspective "from the ground" to complement traditionally "top-down" infrastructural planning – in other words, as an important piece of the puzzle, but always within the context of, and in conversation with, larger geopolitical systems and techno-economic framings.

It can be seen from the historical review of physical planning in Greenland that the import of planning approaches from Denmark has had a significant and enduring impact on the development of the country, including multifarious implications for cultural and political life. Greenland, like every country, must adapt and respond to larger global shifts and paradigms, and the exchange and circulation of theory and practice brings progression and new perspectives. Nevertheless, at this critical crossroads in its development, and in an era of splintering sustainability discourses circling around the respective merits and draw-backs of joined-up centralisation versus self-sufficient independence, it seems pertinent to pause and consider if the existing decentralised Greenlandic model, and its associated material practices, might in fact present the most relevant paradigm for development. Indeed, such an approach may well provide a lesson for Denmark – ideas travelling in the other direction – particularly in regard to Denmark's rural fringe, which is suffering depopulation. However, the reappropriation of material practices stands to have particular value for peripheralized and (post)colonial regions where there is a history of suppression of the local and the importation of external models. Employing local, contemporary material practices in such regions can contribute to asserting the viability and richness of vernacular culture in a way that does not resort to romanticism and acknowledges cultural hybridity in the postcolonial era (Bhabha, 1994, p.162). This hybridity, and the related problematic nature of seeking "indigeneity", emerges through many methodological and theoretical interstices in this research – the inherently dialogical nature of the fieldwork (carried out by a European "outsider"), the resonance of this theory of more localised thinking and acting with other international theories and approaches, and, critically, the inevitably mixed and entangled heritage of the material practices themselves. As such, the notion of an *encounter* is returned to, suggesting infrastructural and physical planning's need for progressive correspondence between global, regional, and local scales and perspectives.

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