ANTHROPOCENIC LANDSCAPES: "TOPOMIMICRY" AS AN APPROACH TO ENERGY PLANNING IN GREENLAND

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ABSTRACT

Overlaying the findings of AMAP's 'Snow, Water, Ice and Permafrost in the Arctic' with the 'Grønlands Energi 2020' renewable energy planning strategy, this paper explores the relationship between climate change, landscape, and planning for renewable energy in a rapidly transforming Greenland, suggesting that to consider renewable energy is to consider the landscape.

Written from a terra-cultural perspective, it connects scientific and artistic developments, tracing a thread of anthropocenic thought through the natural sciences, social sciences, the arts and architecture. Proposing that conventional energy planning strategies are not sufficient for dealing with the complexity, changeability and unpredictability of the contemporary Arctic in the Anthropocene, the paper introduces the notion of topomimicry as a planning approach: that the local landscape, read as the interrelated practices and traditions between nature and culture, presents a paradigm for a more sustainable, responsive approach.

INTRODUCTION

Overlaying the findings of 'Snow, Water, Ice and Permafrost in the Arctic' published by AMAP in 2011 (abb.SWIPA11), AMAP (2011), and 'Grønlands Energi 2020' (abb.GE2020), Government of Greenland (2005), renewable energy planning strategy, this paper explores the relationship between climate change, landscape, and planning for renewable energy in a rapidly changing Greenland.

SWIPA11 reported extraordinary research – that climate change is impacting the Arctic far faster than predicted and the cryosphere (all forms of frozen areas on earth) is

altering at a pace far exceeding predictions. How can this research be interpreted through the lens of planning landscapes of renewable energy – an activity conventionally founded on predictability, stationarity and extrapolation?

While the buzz around Greenland might currently be focused on fossil fuels and rare earth minerals, Greenland is also, like the rest of the world, making plans for increasing renewable energy production, and in 2005 GE2020 was published, outlining the country's broad strategies for renewable energy. Now this document needs to be reconsidered in light of SWIPA11; it is predicated on assumption of a greater degree of stability and slower change that is now indicated. How could a revised energy plan, a 'Grønlands Energi 2050', respond to such accelerating pace of change, and how can architects and planners contribute to the discussion?

Aiming to trace the correlations between scientific and artistic developments, this paper connects recent techno-scientific data with terra-cultural perspectives and works, tracing a thread of **anthropocenic** thought. Beginning by summarising SWIPA11 and GE2020 and their relationships with the Greenlandic energy landscape, it proceeds by examining contemporary theories and practices that point towards the reconceptualisation of landscape as a natural-cultural hybrid and how this might help construct adaptable energy plans. It then reviews Landscape Urbanism in this context, before drawing on Andrea Branzi's 'Agronica' to develop a theoretical framework for reconceptualising energy planning. The paper ends in a brief discussion of how this might be manifested in the Greenlandic context.

Ultimately this paper suggests that understanding and engaging the landscape is critical to formulating appropriately responsive and sustainable energy production plans in a changing Greenland: **to consider energy planning is to consider the landscape**. Landscape, defined as the entangled interactions between culture *and* nature, is not only the site and source of renewable energy but also provides cue and clues, paradigmatic practices and patterns, of a system organised to respond to change. This paper puts forward the notion of **topomimicry:** that a local landscape – its specific traditions and ecologies – can prototype an approach to creating a local energy plan, moving away from an archetypal one-size-fits-all model to a contextual, incremental, approach to energy planning.

THE CHANGING CLIMATE AND CRYOSPHERE

The publication of SWIPA11 announced the results of recent scientific research into changes to the cryosphere in the Arctic and their broader repercussions. The report caused alarm around the world. It evidenced that during 2005-2010 the arctic was warmer than ever recorded; that the extent and duration of snow and sea ice was decreasing and the permafrost temperature increasing; that the changes were interacting in complex and unexpected feedback mechanisms; that the changes were occurring faster than ever before or predicted; and that there will be significant implications of these changes on ecosystems, habitats, ways of life, commercial activities and infrastructure. In short, this report confirmed, indeed amplified, fears that climate change is accelerating and the Arctic is the frontline. The research states that there will be many further changes in the future: average snow cover duration is expected to decline by up to 20% by 2050, Arctic sea ice to completely disappear within this century, and global sea levels are predicted to rise by up to 1.6m by 2100. The Arctic is attuned to extreme change – familiar with extreme seasonal and diurnal changes in temperature, light, visibility, solidity. However the rate and extent of change in the Arctic is now accelerating beyond both tradition and prediction.

RENEWABLE ENERGY IN GREENLAND

As the climate and cryosphere transforms, previously inaccessible territory is becoming unlocked by climate change, and Greenland has become surrounded by buzz and hyperbole on the suggested wealth of oil, gas, and rare earth minerals. But Greenland also has significant potential for producing renewable energy – potential that will alter and shift along with climatic changes and its correlating terra-cultural affects.

Patterns of production and consumption of energy are both a significant cause of climate change and a major contributor to its mitigation. Like most of the world, Greenland has been considering how to develop its energy infrastructure, with a view to transitioning to renewable forms of energy and a post-carbon world, securing a more sustainable and self-reliant future. In 2005 the Self-Government of Greenland published 'Grønland Energi 2020', a strategy report outlining Greenland's plans for developing energy infrastructure and systems until 2020.

When it was written in 2005, Greenland was already advancing along the large-scale hydropower route towards increasing renewable energy and the report commits to continuing to do so, seeing other renewables like solar and wind, and hydrogen as a carrier - as peripheral or distant. Prior to the 1990s Greenland had very little in the way of renewable energy, relying heavily on imported fossil fuels, supplemented by a mixture of microhydro, small-scale solar and waste-incineration. In the wake of the first oil crisis, it was decided to develop hydroelectricity capacity, and in 1993 a plant at Kangerluarsunnguaq was commissioned. By 2005, the Tasiilaq dam was also completed and the construction of Qorlortorsuaq dam was in progress.

In 2011 'The Kingdom of Denmark's Strategy for the Arctic 2011-2020' (KDSA), Kingdom of Denmark (2011) confirmed that currently 60% of Greenland's energy is from renewable sources, the vast majority of this being from the, now four, hydropower stations (Sisimiut was completed in 2009), with up to 70% being expected after the inauguration of the Illulisat dam in 2013, thereby surpassing its renewable energy target by 10%.

There are some caveats on these impressive figures that hold some sway on their future prospects. GE2020 states that 'this report covers all known and predictable energy supply and demand opportunities. Energy supply for large energy-intensive industries and mining is not treated…' p13, Government of Greenland (2005). Despite ambitions for socio-economic growth, GE2020 also assumes a slow down in energy consumption increases due to substantial energy efficiencies. Despite these qualifications, it is evident that Greenland has made impressive progress towards becoming independent from carbon.

It is significant that the hydroelectric power stations in Greenland are often not orthodox examples of this typology – located inside mountains, or underground in the permafrost, the infrastructure is specifically adapted for the Greenlandic landscape and Arctic climate. In other words, the adaptation has been in both directions; the climate and landscape provoking change in the infrastructure, and the infrastructure then in turn changing the landscape. The interesting subject of how these existing hydroelectric plants will be affected by changes to the cryosphere is outside the remit of this paper and the author's field. However it also raises questions as to the seeming disparity between high capex, permanent infrastructure, and a landscape and climate that is in accelerating change. When the landscape is changing as such pace, this 'close-fit' between energy and landscape is complicated and challenged. This is further exacerbated by parallel cultural and

technological changes: patterns and demands for energy are bound to alter as populations increase and diversify through migrating workers for industry accompanied by increasing standards of living. Furthermore, energy transitions, historically, make many u-turns and detours while technology is tested and refined, some methods becoming obsolete, others becoming viable, Smil (2010). All of the above fuels the common dilemma of choosing between waiting for technology to sufficiently mature / become more economical, versus acting as soon as possible to begin the energy transition. In climate, cryosphere, culture and technology; change is inevitable in Greenland, and the landscape is central to these changes, bridging scientific-techno and socio-cultural matters.

THE LANDSCAPE AND ENERGY PLANNING: CONNECTING DISCIPLINES

The central precept of this paper is that renewable energy planning and landscape are intricately related and bound together; to consider one is to consider the other. The relationship between energy and landscape is profound and prolific, and understanding how this relationship functions is critical to forming intelligent, sustainable, future energy planning strategies.

Firstly, it is essential that what is meant by 'landscape' is clear in order to understand its agency. This has been the subject of some debate, however here its scope is defined beyond the natural aspects of a territory, and used to describe the complex entanglements of natural *and* cultural processes and forms. Landscape in this paper is understood to mean any natural territory that influences, and is influenced by, humans, whether through directly intervening in it, indirectly altering its contextual conditions (such as displaced effects of pollution or climatic change), or even through its cultural framing and representation:

'A landscape, then, is the land transformed, whether through the physical act of inhabitation or enclosure, clearance or cultivation, or the rather more conceptual transfiguration of human perception, regardless of whether this then becomes the basis for a map, a painting, or a written account.'

p.13, Dean and Millar (2005)

The concept of landscape as a hybrid cultural-natural phenomenon is an important one, developed in the natural sciences, social sciences and the arts, and although fully tracing this conceptual development in details is outside the scope of this paper, some seminal examples are illustrative.

The term 'Anthropocene', popularised by Paul Crutzen, the Nobel Prize winning atmospheric chemist, Crutzen (2011), succinctly describes the new geological epoch many scientists suggest we have now entered whereby anthropogenic interventions on earth have reached such a level that there is now complete natural and cultural intertwinement; even in relatively remote places like Greenland, there is no such thing as pure, untouched 'nature' anymore.

This Anthropocenic thesis is mirrored in the social sciences, including environmentalism, political philosophy and sociology. In 'Technonatures: Environments, Technologies, Spaces and Places in the Twenty-first Century', White and Wilbert (2009), the concept of a natural-cultural hybrid environment is examined from various perspectives, exploring the idea that technonatural landscapes underpin all aspects of our lives. And philosophers and thinkers, from Bruno Latour (2005), to Felix Guattari (2005), have theorized on this connectivity between the human and non-human environments providing a wealth of ideas and concepts.

The Canadian photographer Edward Burtynsky, (2009), epitomises the visual arts interest in 'technonatures'. Burtynsky has spent decades capturing the landscapes of oil – from drilling fields and tar sands, to multi-lane highways and drive-through restaurants, to tanker dismantling yards. His work beautifully illustrates the pervasiveness of energy in our landscapes, how it shapes our everyday lives and culture, transforming our landscapes: energy not only consumes space, it also creates place. While it can be described abstractly in terms of logistics and global networks of supply-and-demand, energy production is undeniably also about local, physical, places and people.

In view of this substantial, cross-disciplinary agreement that the boundaries between natural and manmade systems have been blurred, if not dismantled altogether, it is outmoded to view the relationship between landscape and energy infrastructure as merely additive or positional, where the most optimised-efficient technology for a site is chosen and the standard format just tweaked to be acceptable to local communities. Energy and the landscape are part of the same 'technonatural' system, a highly complex web of

interconnections, inputs, outputs, causes, effects and feedback loops. It is highly influential in re-forming place and culture, and therefore to consider renewable energy planning is to consider planning the landscape.

All energy systems, whether fossil, nuclear or renewable, organise and instruct our lives: from mines, riggs, roads and pipelines, to company towns, migration patterns, and local identities. Renewable energy in particular is intimately related to local landscapes - compared with fossil fuels, they are low-efficiency and low- density, rendering these forms particularly space-greedy and explicitly place-transformative. In addition, whereas hydrocarbon energy extraction today takes place in highly centralised and often relatively remote locations – far-flung oil fields, rarely seen offshore oil platforms, inaccessible pipelines - most renewable sources command far higher visibility, in far more many landscapes, as they directly harvest energy from the weather, land, skies, and water.

These affects of energy infrastructure on landscape have attracted architectural and design analysis in recent years. Rania Ghosn's editing of Harvard GDS's 'New Geographies 2: Landscapes of Energy', Ghosn (2010) and Aleksandar Ivančić's 'Energyscapes', Ivančić (2010) being two of the most engaging**.** But while this analytical work is very important, this paper concentrates on the future, going beyond how energy planning has shaped landscape, to consider just how landscape might shape energy planning, and how architects can therefore contribute to renewable energy strategies.

THE ARCHITECTURAL CONTEXT: LANDSCAPE URBANISM AND ANDREA BRANZI

'…architecture is just as likely to provoke change (transformative architecture) as it is to respond to it (responsive architecture).'

Cohen and Naginski, (2010)

How has architectural practice and theory reflected upon and responded to this heralding of the Anthropocene and how might this transform energy planning? Over the last 40 years the fields of planning and design have engaged in discourse on the role of landscape, and the relationship between nature and culture, instigated by the publication of Ian McHarg's seminal book Design With Nature, McHarg (1971). His work examined in detail the ecological processes that form the 'natural' landscape, imploring planners and designers

to work with these dynamic, fragile processes rather than against them. McHarg's works have been a source of great reference to his successors, permeating much planning theory and practice since. This paper discusses one particular branch of this discourse in more detail – the Landscape Urbanism movement, closely aligned with its offshoot Ecological Urbanism. Pioneered in the early 1990s by James Corner, Charles Waldheim, Alan Berger and Stan Allen, amongst others, Landscape Urbanism continued McHarg's interest in the workings of landscape but, crucially, includes humans and human influences as part of the landscape.

Charles Waldheim's influential essay published in The Landscape Urbanism Reader – outlines why Landscape Urbanism considers landscape, rather than buildings, as the appropriate framing of contemporary planning, emphasising that landscape is not a picture or a static state but the connecting of active processes and flows:

"(landscape is) …uniquely capable of responding to temporal change, transformation, adaptation, and succession... a medium uniquely suited to the open-endedness, indeterminacy, and change demanded by contemporary urban conditions."

Waldheim (2006)

Landscape Urbanism is multi-faceted and far-ranging, but there are some key principles of the movement that are highly relevant to developing an understanding of landscape's relationship to energy planning. Unlike many before them, Waldheim and his colleagues view landscape an *active* participant in planning. Bound up with ideas of sustainability and environmentalism, Landscape Urbanism seeks to be sustainable by *enduring-by-changing*. In common to many of its projects is direct engagement with the *connectivity and community* of landscape, dealing with processes that change over time, interrelated and adapting in feedback loops, rather than imposing a rigid, unchanging pattern or form on the landscape. The very name – Landscape Urbanism – conflates the 'natural' and the cultural' traditions in planning.

Allied with Landscape Urbanism, architect and designer Andrea Branzi's work with infrastructural landscapes point in a promising, genuinely Anthropocenic, direction. His writings are provocative and radical, calling for an end to Modernism's search for truth, unity and solidity, instead advocating 'weak and diffuse modernity', that embraces meshes

of changing connections, and is 'anti-typological' and 'non-compositional'. For example his 'Ten Points for a New Athens Charter' includes the commandments for 'weak urbanisation', 'faint and crossable borders' and 'reversible and light infrastructure', all of which are highly intriguing ideas in light of energy planning in a changing climate and the seeming disparity between high-investment permanent infrastructure and accelerating change as discussed above, Branzi (2010) and (2006).

Branzi's 1993/94 project 'Agronica', Branzi (2006), demonstrates his theories by using agricultural practices as a paradigm for planning landscape. Agronica was conceived as an experimental territory where the differing programmes – food production, livestock grazing, leisure etc – were all moveable and shifting according to demand. It follows the agricultural metaphor through into practice: enabling landscape to become fallow; for functions to change with the seasons; and for the productivity of the land increased or decreased over time in response to changing demands etc. Agronica is revolutionary for two reasons. Firstly, it uses a natural-cultural understanding of landscape as a model, rather than only drawing on the purely natural, 'ecological' processes within the landscape. Secondly, it looks at a specific, defined landscape topography and system rather than universal principles.

While Branzi's work is theoretical and highly conceptual it is critical to the progression of Landscape Urbanism discourse - it suggests radical strategies and tactics for planning a relationship between landscape and infrastructure beyond normative modes and habits. It assumes the intertwinement of nature and culture, and engages directly with, and learns from, the specifics of a specific landscape, moving past pure metaphor or representation, and by doing so suggests a strategic foundation for planning for adapting energy landscapes.

EXPANDING BIOMIMICRY TO TOPOMIMICRY: A PROPOSED APPROACH TO PLANNING RENEWABLE ENERGY

Following the conceptual lead of Branzi, and referencing the research directions of other disciplines, how exactly could consideration of the landscape – the natural-cultural processes and practices of the terrain – benefit the planning of energy production landscapes in the hyper-transforming landscapes of Greenland? In other words, how can considering the landscape itself help us to overcome the ostensible disparity between the

fixed, high capex, obduracy of energy infrastructure, and the task of planning energy in a radically changing landscape?

Planning is a discipline predicated on stationarity – fixed, preformed goals and linear paths to reaching them, and energy planning exemplifies this, as is clear in GE2020. Branzi's work is critical of this conventional notion of sustainable development, suggesting that stationary notions are outmoded. This aligns with contemporary pioneers of planning in the face of climatic change: Vicki Arroyo – USA environmental lawyer and advisor on federal policy for adapting to climate change - stated in her TED talk at the June 2012 TEDglobal conference, Arroyo (2012), that 'stationarity is dead'. In this era of unprecedented climate change, traditional energy planning has lost its power.

An increasingly compelling candidate for the succession of stationarity is biomimicry, explored in Landscape Urbanism and in many engineering and design fields. This movement, led by biologists like Janine Benyus, (2002), examines the elegant functions and processes present in nature and borrows them to create sustainable design solutions. This intriguing approach to design is however, arguably, at odds with the multiple-evidenced Anthropocenic context as discussed, prioritising and dividing nature and culture into two separate categories, limiting its paradigmatic scope. Furthermore, many of the characteristics of successful 'biosystems' – diversity, closed loops, connectivity, patches etc – are just as true for successful 'anthrosystems' like cities, even without the metaphors. As much as biomimicry is a fascinating and productive field, this paper proposes that we expand it to become *topomimicry*: borrowing from the Ancient Greek notion of Topos meaning place or landscape, learning from how people and nature have coexisted and mutually adapted to each other in the terrain.

An immediate question might be how such a planning approach is valid when clearly not all landscapes are a good model of sustainability. But many landscapes that have either been slower to become 'globalised', remaining more local and traditional in their cultures, or other contemporary landscapes that have fought to become sustainable leave breadcrumbs of ideas. Indeed there are some projects, internationally, that exemplify such an approach to planning, which serve as references for potential terra-inspired energy planning in Greenland.

Barcelona's Natural Park of Garraf by Batlle i Roig Architects, (2010), was formerly a landfill site for Barcelona's urban waste for decades. By considering the local agricultural

landscape practices in the Garraf landscape – modifying valleys, terracing hills and hydraulic cultivation for example – the architects have transformed the landfill into a beautiful, localised, productive landscape. They capped the site in terraces, zigzagged with paths and bordered by rubbish-filled gabions, which then regulates rainwater collection to irrigate the land while the gas from the landfill is captured to produce electricity. The resultant landscape is not only productive and pragmatic but it also slowly remediates this polluted environment. Similarly, the Fog Garden in the Chilean desert by the Atacama Desert Centre and architect Rodrigo Pérez de Arce, builds upon the traditional local practice of suspending large sheets of plastic in the desert to capture water vapour through condensing cool night air, Perez de Arce (2011). Through architectural reinterpretation this practice has been extended and further developed to make sculptural and fertile garden landscapes; small, shaded oases in the desert that harvest drinking water and irrigate the land. Both these productive landscapes are made by, and for, humans but in ways that work with nature and local traditions: topomimicry.

This paper suggests two key proposals, both founded on connecting dots between the array of research and examples discussed. Firstly, that while biomimicry is a significant and rich development, expanding it to become topomimicry – gaining inspiration from the best practices of natural+cultural, the human+environment, whether traditional or contemporary – opens up sources of references. Secondly, it builds on and progresses Branzi's legacy by suggesting that rather than just examining the practices and processes of particular landscape *topologies*, the local landscape, a particular place and culture, is taken as a model for local energy planning, bringing a consideration of *place* and *people* back into the Landscape Urbanism discourse. In many ways this closes the loop between the planning tradition of using nature as a metaphorical inspiration, and our increasing awareness of the importance of site-specific analysis and understanding.

DISCUSSION: THE GREENLANDIC COAST AS AN ENERGY PLANNING MODEL

This paper culminates in an explorative discussion of two preliminary examples of how the topomimetic approach could be manifested in the planning of Greenland's energy future, illustrating that the landscape, both natural *and* cultural, can be learned from, and that the local landscape, rather than general attributes of Landscape, is most important. Due to limits

of space this section is intended to be explorative rather than definitive – theoretical in nature and aiming to provoke a conceptual rethink rather than developed designs.

The Greenlandic landscape is a blend of traditional, local practices and 'modern', global processes and technologies, connected by an intimate awareness of, and connection to, the landscape by its local inhabitants. This close-knit interchange between human-nonhuman, culture-nature, and global-local provides a wealth of ideas for organising energy production landscapes, two of which are outlined below:

Landscape of Points not Lines: Pioneering Plant H2

As described by David Turnbull in his essay 'Trails and Tales: Multiple Stories of Human Movement and Modernity', Turnbull (2011), Greenlandic society is founded on the importance of moving through the landscape rather than remaining static – instead of roads and railway lines, Greenlanders travel in a network of sled, snowmobile, helicopter, boat and plane: methods without the necessity of fixed, 'hard' infrastructural routes. Such lack of predetermined paths has meant that Greenlanders can expand/contract their territories with a high degree of flexibility, responding to seasonal changes as solidity enables or erases routes; an endangered capacity in the face of climatic change.

Greenland currently does not have an extensive national energy grid, unlike many temperate climate countries. Rather than attempt to 'remedy' this, as the changing climate may allow and political norms dictate, decentralised energy, enabled by Hydrogen as a carrier and store of energy as already being piloted by H2 Logic outside Nuuk, ref is a compelling strategy, allowing for retention of open, changing patterns of inhabitation rather than attempting to 'pin-down' the landscape.

Such a strategy would require a network of hydrogen stations across the landscape, one in every 'bygd' (a small settlement, of which there are more than 60 in Greenland), connected to wind turbines to convert melt water into hydrogen through electrolysis. The station can provide hydrogen as a fuel for ATV transportation needs or create fuel cells ready to heat and power buildings. But, rather than be purely a technological fix – a piece of plant on the edge of the settlement – it could also provide cultural infrastructure. There are many precedents for energy buildings in the landscape that go beyond purely functional infrastructural requirements, for example, NL Architect's WOS8 Heat Transfer Station in Utrecht, NL (1997). Described by the architect as a village square wrapped around a piece of

energy infrastructure, the PU skin is textured with bird nesting ledges, and the facades host seating areas, climbing walls and a basketball court. It is proposed that such an approach could work in Greenland's hydrogen network too: the architectural cladding of the hydrogen could be designed to host and offer place-specific functions; a snowmobile workshop, foldable shelter, integrated postboxes, climate and air monitoring devices etc. Such hybridity in Greenland's hydrogen network could reinforce the importance of decentralised, fluid mobility, facilitating open-network nomadism and meeting in the landscape, as is traditional in Greenland. Perhaps the network might expand to also include SOS stations at intervals along trails, to not only offer refuelling of ATVS but to integrate infrastructural meeting points for local and tourists that might also include emergency shelter and sustenance, light, WIFI, wind break etc, the external skin hosting acting as a 'fire' to gather around when needed. Each node in this network, smaller or larger depending on context, is multipliable and connectable, blending energy and culture.

The Spontaneous Landscape: Blossoming Solar Flora

Accustomed to responding to extreme diurnal and seasonal changes, Greenlanders react, fast, to unexpected, unseasonable opportunity. If unpredictably mild weather occurs, Greenlanders may well deviate from everyday work and life patterns to hunt or travel, and flora similarly is quick to capitalise on clement weather conditions – to miss this opportunity would be illogical in this landscape. Converging with this is that a key issue with almost all renewable energy planning is intermittency. Wind and solar production fluctuates according to weather and season and in Greenland such fluctuation is amplified. Solar panels would obviously be no use during the long winter where the sun never rises above the horizon, but could potentially be very productive during the season of the midnight sun and even in the shoulder seasons, as already shown at the Summit research station on the Greenlandic ice sheet. Indeed, to discount investment and research into solar, because it doesn't comply with international preconceptions of a solar energy landscape, runs contrary to Greenland's tradition of spontaneously responding to advantageous environmental conditions.

There is growing research into solar panels – Photovoltaics and Solar Thermal Heaters – that exist outside of the conventional architecturally mounted or fixed large array models. Small scale folding solar panels, street lamp or back-pack size, are also already commercially available and the development of 'power fabrics' – flexible materials that harvest solar

energy are also in progress. The military in fact already use fabric tents with integrated PVs to create pop-up military stations that can also power their communication technology. Such hybrid power-fabric structures are of particular relevance in Greenland where there is a long tradition of living in tents in summer. This summer tent-life, which blooms in response to weather conditions, serves as an interesting model for a new lightweight solar architecture typology. It also corresponds to a spike in energy consumption during the summer season – the influx of tourists, a growing phenomenon, particularly by cruise ship. Summer-season solar pavilions, canopies, tents, and lighting could all be 'points' on a seasonal solar landscape, the energy and the space created serving increased tourist demands, perhaps particularly focused on harbour side landscapes. This multitude of small-scale, flexible approaches to solar energy all could, combined, play a role in enabling Greenland's landscape to spontaneously blossom into a solar production landscape in summer months, capable of growing or shrinking in response to change, and, critically, capable of being packed-up and closed-down during the harsh winter climate to be protected.

By approaching solar in the arctic in an informal, small scale, experimental manner capex costs are limited and changes more easily responded to over time; working with 'if…then…' rather than stationarity planning. Such a direction in solar production is not intended to usurp hydroelectric power but to supplement it and act as a testing ground for future conditions, placing Greenland in the avant guard of renewable energy research and development.

CONCLUDING REMARKS

This paper has charted the connections and relationships between the extreme and unpredictable changes to the arctic cryosphere caused by climatic change, Greenland's renewable energy plans and current movements and directions in the sciences, arts and landscape and urban planning, connected by the notion of the Anthropocenic Era. It proposed that beyond energy infrastructure shaping landscape, landscape can be used to shape energy infrastructure, and that landscape has the potential to provide cues and clues for energy planning through expanding the notion of biomimicry to topomimicry. It suggested that the notion of stationarity in landscape planning is no longer viable, and

instead posited that the local landscape itself – conceptualised as a natural/cultural hybrid system - is a paradigm for the planning of adaptive, responsive, 'if…then…', energy landscapes, referencing Andre Branzi's work on Agronica.

Ultimately, this paper proposes a more place-specific approach, examining the natural-cultural processes and practices of a local landscape for clues on how to organise renewable energy landscape plans. By being local, considering place and context, continuity with the past can be combined with a progressive attitude to the future, drawing on global and local knowledges and practices.

A number of final observations: firstly, such an approach as posited here requires imaginative, creative views to be developed closely alongside natural and social sciences work, proposing an experimental, reiterative method of research. Secondly, in order to be more than metaphor, the landscape-model must be place specific and change according to site. In order to fully develop theories and strategies a mature understanding of a local landscape must be gained through extensive analysis. Thirdly, is should be noted that a model is different than an image; while images are indeed important when discussing landscape, for matters of ontological planning, principles, underlying systems and patterns rather than mimicking 'pictures' is the key. Lastly, it is noted that Greenland is quite remarkable in that it models a particularly 'loose-fit', flexible approach, which is less prescriptive than many European or North American landscapes. As such Greenland is already less attached to stationarity and has a head-start on developing a progressive, pioneering vision of future landscapes of energy.

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