Sustainable Housing and Investment in Renewable Energy for a better future in Arctic Communities

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Abstract

Construction of housing and energy production in the Arctic cost citizens and governments large amounts of money that are disproportionate to other regions. People there pay taxes just as their counterparts in the south do, but are not entitled to the same services such as access to healthcare, education, and a safe place to live. This perpetuates inequality and contributes to the high cost of living relative to earnings. These regions are also affected by complex social problems that need more funding and professionals to address. Because basic operational costs are high in the Arctic, use of government funds is typically skewed towards subsidizing energy costs and building and maintaining infrastructure, leaving less money for healthcare and social programs for those who need it most. There are many ways that the process of development in the Arctic could be optimized to include renewable energy and sustainable homes, which are already needed as urbanization increases and people leave settlements for larger towns. This will have direct benefits for the people who live in these homes and communities, as well as long-term financial benefits for the governments of these countries who are then able to provide adequate services to citizens in these regions. Planning appropriately and utilizing efficient home design has the potential to remedy many of the social problems that Inuit people in Canada and Greenland face. Creating cheaper and cleaner energy to warm efficient modern houses has the potential to decrease the economic burden of housing and utilities for the government and individual so that social programs can be funded proportional to the demonstrated need.

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Introduction

Up until the the early 20th century, Arctic peoples have lived off the land and in low profile turf homes.[1] But, in the last 100 years or so, people of the Arctic in Canada and Greenland have been rapidly westernized. One of the largest changes to Arctic lifestyles has been in housing.

Climate change due to anthropogenic emissions of CO_2 is causing the Arctic to warm as much as twice as fast as the rest of the world.[2] Although historically Arctic peoples have been completely excluded from the global carbon exchange, they are now part of a system that contributes to further carbon dioxide emissions. Heating costs and other utilities in the Arctic are twice as expensive as in other places with continental climates[3], and it takes more resources to live to a western standard in places that are topographically challenging to build infrastructure and experience cold temperatures most of the year. This leads to difficulties in energy supply that have left most settlements with carbon-intensive energy systems that are burdensome to the governments of the respective countries, leaving less money to fund other social programs.

Most Arctic communities are not connected by roads or pipelines. Despite this, Greenland has come a long way in terms of renewable energy investment, getting 70% of its energy supply from renewable sources, most notably hydroelectric.[4] Greenland has a relatively robust port system and means of moving goods because every settlement in Greenland is coastal,

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[1] (2014, August 29). Who were the Paleo-Eskimos and why did they go extinct? | Tech Times. Retrieved November 12, 2018, from https://www.techtimes.com/articles/14411/20140829/who-were-the-paleo-eskimos-and-why-did-they-go-extinct.htm

[2] (2016, December 14). Arctic Report Card - NOAA's Arctic. Retrieved November 12, 2018, from https://www.arctic.noaa.gov/Report-Card/Report-Card-2016

[3] (2007, August 15). NUNAVUT ECONOMIC FORUM THE TAX SYSTEM THE COUNTRY NEEDS FOR A .... Retrieved December 9, 2018, from http://www.nunavuteconomicforum.ca/public/files/library/nrtd2007/NEF%20Submission%20to%20Commons%20Standing%20Committee%20on%20Finance%20NRTD%20-%20FINAL.pdf

[4] (2015, August 17). Clean, green energy for Greenland - Thin Ice Blog. Retrieved November 12, 2018, from http://arctic.blogs.panda.org/default/green-energy-greenland/

however in Arctic Canada, many communities are landlocked. This means that all of the diesel fuel for the generators must be flown in.[5] As of 2013, every single community in Nunavut was 100% reliant on diesel generators for their energy. The feasibility of transporting diesel to these places is challenging because there is little existing infrastructure and it must be moved by air.

As these diesel generators start to wear out, it makes logistic sense to replace faulty and inefficient systems with ones that are not as resource and labor-intensive to maintain. Diesel generators currently operating are expensive and limit autonomy of small Arctic settlements. The governments of nations with Arctic territory typically provide significant subsidies in order to support these communities (such as a tax credit of up to 20% of yearly income for people who live in Northern Canada),[6] but are currently only producing energy with old technology, resulting in a large economic burden to those forced to buy electricity produced in a more expensive way.

Another significant cost to governments is subsidized housing. During the mid to late 20th century, the approach was to build quickly and cheaply, with little regard for the future occupants and the needs of the community. This approach is expensive in the long term because of the increased energy demands and cost of heating these dwellings that were built from inferior materials. Although there has to be consideration for the cost to move the materials to the location where it will be built, it should not be negotiable whether or not to use the most energy efficient technologies available within reason. People are going to continue living in these communities, and the housing provided to them should stand the test of time instead of being viewed as something short term and disposable.

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[5] (2016). *Fueling Change in the Arctic Pre-Feasibility Study* - WWF-Canada. Retrieved November 12, 2018, from http://awsassets.wwf.ca/downloads/summary_and_prefeasibility_report.pdf

[6] (2017, January 3). Northern residents - Canada.ca. Retrieved December 9, 2018, from https://www.canada.ca/en/revenue-agency/services/tax/individuals/segments/northern-residents.html

Energy demands and housing are inextricably intertwined. In order for communities and the government to achieve a sustainable energy system and economy, the shortcomings in energy production and sustainable housing need to be addressed. Greenland serves as an example of better infrastructure and energy production systems compared to other places in the Arctic, but there is still room for significant improvement.The intersection of sustainable housing, planning, and infrastructure improvements can work to improve the financial problems that Greenland and other Arctic communities currently face. Money is pivotal to addressing the deficits in public health, social services, and education that are necessary to help those who have been traditionally marginalized by colonial powers. Inuit peoples are disproportionately affected by alcoholism, sexual abuse, and suicide which is worsened by decreased access to these rights.

In general, urbanization will help meet energy goals and decrease reliance on diesel. In smaller communities, small scale renewable energy systems can replace outdated technology. However, the question remains: how will urbanization impact Inuit culture? If executed appropriately, tackling these problems could lead to an improvement in wellbeing for thousands of people across the Arctic. The challenge today is to create progressive policy change that can help communities overcome challenges that are currently hindering progress and community cohesion, as well as economic development and independence.

Renewable Energy Integration and Waste Treatment

Greenland is leading the way with investment and conversion to renewable energy, most notably in the form of hydroelectric power. Communities elsewhere in the Arctic have less potential for hydroelectric power because of the same terrain that limits roads and pipelines: flat tundra marshland. This leaves them reliant on diesel generators, but investment in solar and wind could help supplement the energy demand and facilitate the transition to renewable energy.

Small scale independent grids make it easy to integrate energy using a combination of biomass incineration of wood pellets to meet a baseline energy demand. This is limited to where there are seasonal roads and trees, such as in Northwest Territories.[7] Still, 26 out of 33 communities in the Northwest Territories are reliant on diesel for heating their homes. Change in Nunavut seems even harder to initiate, with all of its 25 communities being dependent on diesel, needing 45 million liters of diesel per year costing ~$39 million. Nunavut only has approximately 36,000 people[8], leading to a very high per capita cost of energy. Only one 20 megawatt hydroelectric project would be needed to provide electricity for all of Iqaluit's 7,250 people, which would reduce diesel consumption by up to 30% in Nunavut.[9]

In Greenland, household waste is being turned into energy by using mixed use incineration plants. Other places in the Arctic, mismanagement of garbage is inefficient at best and environmentally harmful at worst. Nunavut's solution for municipal garbage in Iqaluit was to burn it in an open pit, without segregating toxic waste such as batteries beforehand. Citizens sued the city and intentional garbage burning stopped. However, the garbage pit, which is designed to be a landfill (despite the lack of ability to function as one due to being constructed on permafrost) spontaneously combusts from time to time; in 2010 it set the record for one of the worst dump fires in the western hemisphere, taking 36 days to extinguish. A population increase from 3,000 to 8,000 residents in a period of less than 15 years, no recycling, no sorting, and continued use of a temporary landfill from 1999 that has been over capacity since 2004 create a

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[7] (2017, November 24). #449 - Arctic Energy: Science for the People. Retrieved November 12, 2018, from http://www.scienceforthepeople.ca/episodes/arctic-energy

[8] (2018, September 28). 2016 Census of Population – Data products - Statistics Canada. Retrieved November 12, 2018, from https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/index-eng.cfm

[9] (2011, July 1). Canada's North struggles to ditch diesel. Retrieved November 12, 2018, from https://web.archive.org/web/20131004232450/http://www.albertaoilmagazine.com/2011/07/canada's-north-struggles-to-generate-a-cleaner-electricity-future/

toxic chemical waste site that jeopardizes the health of the residents and the surrounding environment.[10] This problem is not unique to Iqaluit. Along Greenland's coast, there are many places that lack municipal waste treatment for garbage and other items. Only 6 towns have incineration plants, while half of the remaining towns have to resort to open air burning. Electronic waste and other toxic chemicals are collected and returned to Denmark, where they can be processed. The focus now is on controlling hazardous waste in small towns and investigating the viability of moving garbage to other towns for incineration.[11] Greenland has overcome significant challenges, but as it remains garbage is left outside and can end up in the ocean. Most communities lack adequate sewage treatment, and human waste goes directly into the ocean as well.

Although garbage is a largely modern issue, it is unlikely that Greenland can reduce the amount of packaging that contributes to large amounts of household garbage. This is because the packaging allows for lower shipping costs and increased longevity of food products, which is overall less carbon intensive than food spoiling en route and shipping heavy glass and metal containers. "Regardless of strategy, plastic packaging plays a significant and often major role in reducing food loss and waste in every stage of the food production process: farming, processing, distribution, storage, retail, and households."[12] Nevertheless, Greenland is overcoming barriers to reducing waste by recycling glass and plastic bottles on the west coast, with about 25% percent of household waste overall being recycled.[13] Going forward, it would be prudent to integrate

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[10] (2014, July 24). https://www.vice.com/en_ca/article/bn5dmz/russian-roulette-the .... Retrieved November 22, 2018, from https://www.vice.com/en_ca/sitemap/articles?page=25

[11] (2012, June 4). Waste in Greenland - European Environment Agency - europa.eu. Retrieved November 22, 2018, from https://www.eea.europa.eu/signals/signals-2012/interviews/waste-in-greenland

[12] (2014, August 6). Plastic Packaging and the War on Food Waste | Plastics Make it Possible. Retrieved November 12, 2018, from https://www.plasticsmakeitpossible.com/plastics-at-home/food/prep-storage/plastic-packaging-and-the-war-on-food-waste/

[13] (2011, October 21). Managing Greenlands Waste: An EEA Film - Waste Management World. Retrieved November 12, 2018, from https://waste-management-world.com/a/managing-greenlands-waste-an-eea-film

incineration of sewage and other household garbage into the energy grid in order to provide heating, as well as dealing with garbage in a safe way and expanding recycling programs.

Housing

Many of the buildings in Arctic towns and cities were initially built by the governmental organizations to meet the need for housing. Subsidized home design and construction in the Arctic typically does not cater to the needs to Inuit people and often sacrifices efficiency and quality of materials used.[14] However, Canada has examples of how this can be done well. Alain Fournier designed a duplex for a village in Nunavik that is both efficient and takes into account the cultural heritage of the Inuit. These homes include improvements recommended by community members, such as "a second exit, a balcony, increased soundproofing, more storage space including a locked cabinet for hunting rifles and ammunition …. and large cold and warm porches for storage of hunting gear and harvested animals … During a feast, the kitchen's island counter is moved and high-density polyethylene panels, stored in the kitchen and far more durable than the cardboard typically used as a cutting surface, snap in place on the floor like puzzle pieces." These projects are important because in Nunavik alone, there is a shortage of 1,028 homes. "If northern buildings are more energy efficient, it means the SHQ, which pays for social housing in Quebec, can save money in the long term – and that could lead to more homes." It costs $4,200-$5,365 USD per year to heat a conventional duplex in Nunavik, but with the more efficient design, it costs $2,550.[15] This is without using the most efficient materials that were deemed cost prohibitive. There is an immediate need for housing in these communities,

[14] (2016, September 15). Arctic House Design Saves Energy and Embraces Inuit Culture .... Retrieved November 12, 2018, from https://www.newsdeeply.com/arctic/articles/2016/09/15/arctic-house-design-saves-energy-and-embraces-inuit-culture

[15] (2016, September 15). Arctic House Design Saves Energy and Embraces Inuit Culture .... Retrieved November 12, 2018, from https://www.newsdeeply.com/arctic/articles/2016/09/15/arctic-house-design-saves-energy-and-embraces-inuit-culture

with 55% of the existing housing in Nunavut being social housing. There are very few homeowners and a large demand for rental property that is too expensive for most to afford.[16]

All over the Arctic, homes will need to be more resilient to withstand alterations to the underlying ground and many existing structures will have to be reconstructed due to permafrost melt. This example of smart Arctic architecture is built on piles to prevent future damage due to permafrost, with extra insulation, triple glazed windows, and a raised profile to minimize heat loss. The state of housing for Canada's First Nations is shameful, with "44% of the existing housing stock needing major repairs and another 15% requiring outright replacement. Mould contaminates almost half of all First Nation households."[17]

Pictures from Google street view (© 2013) in Iqaluit Left: Cracks in structure, windows shifted within frame Right: Structure in state of disrepair, no windows. Unit is likely uninhabited, but the other unit in the duplex seems to be occupied. Many other buildings have no windows, only plywood.

[16] (2003, April). Addressing the Cost of Living in Nunavut Retrieved December 9, 2018, from http://www.nunavuteconomicforum.ca/public/files/library/LABOURFO/COSTOFLI.PDF

[17] (n.d.). FACT SHEET - Quality of Life of First Nations - Assembly of First Nations. Retrieved November 12, 2018, from https://www.afn.ca/uploads/files/factsheets/quality_of_life_final_fe.pdf

Left: Another typical duplex in Churchill, MB (Google street view © 2013). Right: Alain Fournier's smart arctic house design in Quaqtaq is a duplex built with the needs of Indigenous people and resiliency to a changing climate in mind (used with permission from EVOQ Architecture)..

Addressing the housing need with efficient and sensible design directly benefits the residents of these communities and creates a healthier environment both inside the home and out. There will be a sharp increase in demand for housing in Greenland, with some towns experiencing over 10% growth per decade. This will necessitate more housing that will inevitably be financed in part by the Danish government. Currently, the home rule government is not granting housing subsidies for new buildings.[18] Focusing on renovation will not be enough to meet the rising population in some towns. Many houses built in the last 50 years will become uninhabitable as the permafrost melts and disrupts the foundation of these dwellings.

The capital, Nuuk, is seeing a very large increase in population, over 21% just since 1990.[19] This trend is being mirrored in Tasiilaq and Sisimiut. Although Nuuk has largely met its energy needs with hydroelectric and district heating, urbanization elsewhere will require an increase in construction and energy demand that needs to be thoroughly thought out. Some of the original social housing projects in Nuuk such as the infamous Blok P are being torn down to

[18] (n.d.). Boligstøtte huse. Retrieved November 12, 2018, from https://www.ini.gl/Boligstoette-huse.aspx
[19] (2015, January 1). Population 2015.pdf. Retrieved November 12, 2018, from http://www.stat.gl/publ/en/be/201501/pdf/Population%202015.pdf

make way for newer developments that are more culturally thoughtful.[20] Most of the criticisms about Nuuk are that it does not reflect the cultural heritage of the Greenlandic people, which was the problem with unwelcoming 1960s apartment blocks that had no space to store fishing gear, hallways too narrow to enter and exit with winter clothes on, and no space for processing hunted or fished meat. Modern and efficient building technologies have not become pervasive yet, with Nuuk being the outlier in this example. Newer buildings in the Nuuk suburbs are additional examples of success in architecture and sustainability, a model that can hopefully be translated to development in Sisimiut, Ilulissat, and Tasiilaq.

There has been quite a lot of variation in housing for Greenlandic Inuit over the past 200 years. Turf homes were replaced when colonial Denmark introduced prefabricated homes; now more and more people are living in apartments. Simultaneously, changes to the way of life that came with industrialization resulted in a rapid loss of culture and tradition. This is an underreported issue facing the Inuit community today.

Social Problems

The aforementioned loss of identity contributes to social challenges present in many First Nations and Indigenous communities. Greenland continues to struggle with many social issues including suicide, unemployment, HIV, and substance abuse, although generally fares better than other Inuit nations in the US in Canada. More funding and resources are needed to address these problems, as current contributions are not enough.

Alcoholism has drastically improved since the second half of the 20th century,[21] however it still remains an issue that ultimately stems from the collapse of communities and the traditional

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[20] (2012, July 18). Blok P-beboere genhuses i Qinngorput. Retrieved November 12, 2018, from https://archive.is/20120718061631/http://sermitsiaq.ag/indland/article110015.ece

[21] (2012, December 17). Alcohol in Greenland 1951–2010: consumption, mortality ... - NCBI - NIH. Retrieved November 12, 2018, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3525923/

way of life brought on by forced relocation. In 2014, 21.5 percent of parents reported having problems with alcohol.[22] Aside from this, the largest societal problem in Greenland by far is child abuse. Sexual abuse of minors and sexual assault in young people is an especially disheartening issue that plagues all levels of Greenlandic society.[23] One in 3 children in Greenland has experienced sexual abuse,[24] while 33 percent of 18 to 29-year-olds reported experiencing sexual assault in 2014, which has not improved over the last 10 years since the previous study was conducted. "Over 30 percent of young people have experienced sexual assaults, and there has been much focus on the problem, so it is especially worrying that there has been no progress." says Christina Larsen from Denmark's National Institute for Public Health.[25]

When focusing on smaller communities, the statistics only get worse. A study that surveyed 269 young people in Northern Greenland, found that with 14% of girls and 3.5% of boys report being raped.[26] Societal taboos against abuse mean that many instances of sexual abuse go unreported. There is little to no police presence in smaller settlements, where victims are forced to interact with their abusers and the time between reporting and disciplinary action is often weeks to months. In addition, the local authorities are not acting in the best interest of the youth by allowing community members who are convicted sex offenders to continue to interact with children. The emotional burden of abuse on Greenland's youth is hard to fathom and even harder to put into perspective. Simply put, sexual abuse affects a disproportionate amount of

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[22] (2016, March 30). Greenland: A society in peril – The Post - cphpost. Retrieved November 12, 2018, from http://cphpost.dk/general/greenland-a-society-in-peril.html

[23] (2016, March 30). Greenland: A society in peril – The Post - cphpost. Retrieved November 12, 2018, from http://cphpost.dk/general/greenland-a-society-in-peril.html

[24] (2018, February 13). Anti-Molestation Campaign Teaches Greenlanders Not to Touch .... Retrieved November 12, 2018, from https://sputniknews.com/europe/201802131061615641-greenland-denmark-child-molestation/

[25] (2016, March 30). Greenland: A society in peril – The Post - cphpost. Retrieved November 12, 2018, from http://cphpost.dk/general/greenland-a-society-in-peril.html

[26] (2015, September 8). Greenland has the highest number of rapes in the world - cphpost. Retrieved November 12, 2018, from http://cphpost.dk/news/greenland-has-the-highest-number-of-rapes-in-the-world.html

people in Greenland, and they largely suffer alone without the help of professional therapists, due to the geographical isolation of their country.

Thoughtful urbanization would do a considerable amount to help alleviate the burden of abuse felt by so many of the Greenlandic youth living in settlements, but doing this without repeating the mistakes of the past will be difficult. In Nuuk, there are resources to help youth who are affected by alcohol-related abuse through community centers.[27] Children can spend time there to escape bad home environments and also stay overnight or permanently until they are placed into a foster home. This assistance and resource is not available other places in Greenland, where children are largely left to deal with whatever family situation they have been born into.

Governments only have so much money in the national budget, and most people in the Arctic cannot afford to pay the upfront costs associated with building homes and buying necessities. Subsidy schemes in Canada have not been adjusted for inflation since 1987, which stood at 68% in 2007. These are some of the only measures to even out the cost of living, which is 75% higher than in Southern Canada.[28] Much of the funding goes to moving goods and building infrastructure, with insufficient funding in areas such as healthcare and social services. The Danish government and the home rule government of Greenland have a dilemma. Ultimately, people have every right to live where their families and ancestors have lived and raise their own family there. The issue lies in the lack of social services and not having an effective way to remove children from abusive environments. There will likely always be

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[27] (2008, December 27). Greenland To Step Up Fight Against Sexual And Physical Abuse In Kids. Retrieved November 12, 2018, from https://www.medindia.net/news/Greenland-To-Step-Up-Fight-Against-Sexual-And-Physical-Abuse-In-Kids-45652-1.htm

[28] (2007, August 15). nunavut economic forum the tax system the country needs for a .... Retrieved December 9, 2018, from http://www.nunavuteconomicforum.ca/public/files/library/nrtd2007/NEF%20Submission%20to%20Commons%20Standing%20Committee%20on%20Finance%20NRTD%20-%20FINAL.pdf

shortcomings in this area because paying foreign professionals is cost prohibitive and not feasible for every town. Neither forcing people to relocate nor incentivizing people to move are particularly good options. Both punish those who are upstanding citizens and could contribute to another generation of physically and culturally displaced people.

Greenland has had a rocky half century socially, with marked highs and lows, but the issue of child sexual abuse and sexual assault has yet to drastically improve, despite the amount of money spent on this very issue.

If Greenland hopes to accomplish the goal of becoming a fully independent nation, it needs to put the youth first, and this comes with giving everyone the same opportunities to live a happy, healthy life. "For young people in Nuuk, the pain of assimilation and modernization still exists but is less acute. And while mental health resources are far from adequate, there are more than there used to be. But in the smaller towns, remote communities, the situation is as bad as ever."[29]These challenges in upbringing could explain the high suicide rate, and possibly the discrepancy between boys and girls because they feel more alone in their struggles. Greenland has the highest rate of suicide in the world,[3031]with 1 in 5 people having attempted suicide according to the government. The majority of victims are teenage boys ages 15-19. It is hard to say whether or not the reason so many young people are choosing to take their own life is societal or merely a result of Danish neocolonialism, namely the Danish government's G60 relocation of Greenlandic people. "It's especially difficult for young men, whose fathers and grandfathers were hunters, and who struggle to understand what it means to be an urban Inuit

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[29] (2016, April 21). The Arctic Suicides - NPR. Retrieved November 12, 2018, from https://www.npr.org/sections/goatsandsoda/2016/04/21/474847921/the-arctic-suicides-its-not-the-dark-that-kills-you

[30] (2010, September 24). Rising suicide rate baffles Greenland | | Al Jazeera. Retrieved November 12, 2018, from https://www.aljazeera.com/blogs/europe/2010/09/2629.html

[31] (2010, September 23). Suicides blight Greenland life | News | Al Jazeera. Retrieved November 12, 2018, from https://www.aljazeera.com/video/europe/2010/09/201092393514508644.html

man. Without strong families and communities to help them cope, some of them are so overwhelmed and lost, they take their own lives."[32] The idea of what it means to be traditionally masculine dictates parental behavior, adult friendships, and ultimately attachment styles. This societal shift away from tight knit communities has disproportionately harmed young men who feel alone and are often overly dependent on their romantic partners. "They think that this one person, they can only love him and [he] is the only one who will ever love them. And when they break up, the person feels like their life is over." says Atsa Schmidt, a volunteer for Greenland's suicide hotline who lost her son to suicide and has helped thousands of people contemplating taking their own life. Suicide rates have largely normalized but are still 5 times higher than in Denmark.

Although Nuuk contains almost one third of the population of Greenland, suicide is disproportionately a problem outside of the capital. "Despite having the highest suicide rate — more than 400 per 100,000 — of any town in Greenland, Tasiilaq does not have a psychologist. Nurses and social workers and therapists there do their best to counsel suicidal residents, as do psychologists 500 miles away in Nuuk, who can talk to patients over a video connection." Tasiilaq has seen large growth as other smaller settlements on the east coast are slowly depopulated and people choose to move to a town with more services. Rapid loss of Inuit culture during the last half of the 20th century has been attributed the forced relocation of native peoples, but could the natural trend of urbanization lead to the same consequences? These conditions exacerbated the social problems and led to the high suicide rate that allowed the next generation to be raised in an environment where poverty and abuse were rampant. It is

[32] (2016, April 21). The Arctic Suicides - NPR. Retrieved November 12, 2018, from https://www.npr.org/sections/goatsandsoda/2016/04/21/474847921/the-arctic-suicides-its-not-the-dark-that-kills-you

impossible to predict what effect the coming changes will have on the cultural identity and heritage of the Inuit.

Education

Despite these issues, Greenland is leading the way for Inuit nations, with its citizens faring better than their counterparts in Canada in every statistic except for suicide and child abuse. This also demonstrates that although Greenland has more money per person to spend on essential services, it is not enough to meet the needs of its people. There is room for investment everywhere, but it should not be discredited that there has been unprecedented amounts of money spent on ensuring access to basic medical care and education, regardless of location.

Greenland has created solutions and overcome barriers to rural education. While secondary and postsecondary education are only offered in certain towns in Greenland, every town has a school and every child receives at least 10 years of compulsory education, regardless of where they live.[33] They are also entitled to free university as citizens of Denmark. This is in stark contrast to Canada, where "There are 40 First Nation communities without schools, and … First Nation communities where children haven't been to school in more than two years."[34] It is likely hard to focus on education when there are other basic needs that are not being met. Over 5,000 homes are without sewage and over 25% do not have safe drinking water. These statistics are deplorable, and have a lot to do with the way that Canada has decided to build housing. It is

[33] (2006, August 15). Education in Greenland - Alaska Native Knowledge Network. Retrieved November 12, 2018, from http://www.ankn.uaf.edu/IEW/edgreen.html

[34] (n.d.). FACT SHEET - Quality of Life of First Nations - Assembly of First Nations. Retrieved November 12, 2018, from https://www.afn.ca/uploads/files/factsheets/quality_of_life_final_fe.pdf

difficult to fix the disparities between First Nations and other groups in Canada if they are not entitled to the same education or quality of life.

Conclusion

Comparisons have mostly been drawn between Greenland and Arctic Canada, specifically Nunavut because they have very similar geographies and demographics. These are two different countries, colonial histories, governments, and people groups, but they both share the same struggles. Westernization has permanently changed their way of life, bringing new struggles that create social and economic burdens. The current economy undervalues the skills unique to Inuit workers, even though they are more productive and self-reliant than communities elsewhere in Canada and Denmark.[35] The governments of Denmark and Canada have perpetrated innumerable social injustices against Inuit people, and in trying to remedy them have created a solution that leaves people entrenched in a system of disproportionately high costs of living and housing. "In Nunavut, the major causes of poverty for people who are working (the "working poor") come from the high cost of living, inadequate wages or payments to cover these high costs, and large family size."[36] There is a chance to overhaul this system during the next period of development in the upcoming 10 to 15 years by investing in renewable energy and meeting the housing need with thoughtfully designed, efficient homes. There is a chance to break out of a vicious cycle of high energy costs, poor living conditions, and and community health issues.

Although Greenland has its struggles, in many ways it serves as an example of how native peoples can overcome colonial injustices of the past and how sustainable economic

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[35] (2007, August 15). NUNAVUT ECONOMIC FORUM THE TAX SYSTEM THE COUNTRY NEEDS FOR A .... Retrieved December 9, 2018, from http://www.nunavuteconomicforum.ca/public/files/library/nrtd2007/NEF%20Submission%20to%20Commons%20Standing%20Committee%20on%20Finance%20NRTD%20-%20FINAL.pdf

[36] (2003, April). Addressing the Cost of Living in Nunavut Retrieved December 9, 2018, from http://www.nunavuteconomicforum.ca/public/files/library/LABOURFO/COSTOFLI.PDF

development can be executed in the Arctic on the model of social democracy, as proven by improvements in social outcomes over time. Not every community will look like Nuuk, but features of housing development can be adapted to suit each of the growing towns in Greenland. In Canada, small towns in Greenland can serve as an example of small scale renewable energy implementation and new designs for social housing can be used. Each of these cases are different and therefore require unique solutions, but there is so much room for improvement in places that do not currently have community-scale energy production and are experiencing a severe housing shortage.

Change in all of these areas can work together to reduce government and individual expenditure on energy, therefore reducing poverty and increasing expenditure on social programs to give everyone the same opportunities, regardless of where in their respective countries they live. This will enable greater access to education and healthcare, which will improve outcomes from alcoholism and abuse and increase future earning potential. Modern homes will reduce overall energy consumption and contribute less to CO□ emissions, all while providing a cleaner environment without contamination from mold and other pollutants.

In general, the world is much more connected today than it was even 20 years ago, especially in the Arctic. More people in Arctic Canada and Greenland are moving to population centers that offer more services. Some of the immediate benefits of the natural trend of population centralization is that energy production can be optimized to bring down costs, leaving more money for social programs. This population trend is unprecedented in this region, therefore development should be carefully and thoughtfully executed with the future in mind. Past mistakes with regards to energy systems and housing have contributed to poverty in Arctic communities and denied citizens equal access to healthcare, social services, and education.

Addressing the financial shortcomings of government budgets in these key areas will lead to investment in critically underfunded sectors, improving economic and social outcomes across the Arctic.

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