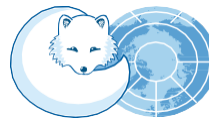


### SDWG PROJECT PROPOSAL

<p><b>Project Title:</b> Sustainable Development Goals in the Arctic: The Nexus Between Water, Energy, and Food (WEF)</p>	<p><b>Lead Country/Project leader(s):</b> Canada: Dr. David Natcher (University of Saskatchewan &amp; Social, Economic and Cultural Expert Group (SECEG) Representative for Canada)</p> <p>Co-leads: Iceland</p> <p>(others TBD)</p> <p>Partner/Supporting Countries and PPs: TBD</p> <p>Participating Observers: University of the Arctic (UArctic) (others TBD)</p> <p>Others: Arctic Economic Council (TBD)</p>
<p><b>Funding Requirements:</b> The total budget for this project will be determined following consultations with respective SDWG Delegates. If supported, it is expected that each State will provide sufficient funding to their research leads to carry out the proposed activities. An estimate of anticipated budget requirements (based on the Canadian context) may include:</p> <ul style="list-style-type: none"> <li>- Personnel Costs (PDF/Research Associate): \$55,000 CAD x 2 years</li> <li>- Domestic Travel (incl. hosting, transportation, accommodations): \$15,000 CAD x 2 years</li> <li>- International Travel (project meetings and collaboration): \$25,000 CAD x 2 years</li> <li>- Support for Indigenous PP participation (where applicable): \$10,000 CAD\yr\organization x 2 years</li> <li>- Technical Services (Decision Support Tool): \$25,000 CAD x 2 years</li> <li>- Conference – Nexus Thinking in the Arctic: \$25,000 CAD</li> <li>- Publications, dissemination, and outreach: \$5,000 CAD</li> <li>❖ <b>Total anticipated costs per country (Y1-2): \$270,000 CAD or \$135,000 CAD annually (added PP support where applicable)</b></li> </ul>	
<p><b>Relationship to other AC Working Groups:</b> TBD</p>	
<p><b>Project Summary, Objectives, and Anticipated Outcomes:</b></p> <p>In 2017, the Arctic Council, under the Finnish Chair, recognized the importance of the United Nations' Sustainable Development Goals (SDGs); noting that the SDGs are global in scope but are amendable to the sustainable development of Arctic regions (Government of Finland, 2017). In that same year the Arctic Council's Sustainable Development Working Group (SDWG) acknowledged that UN Agenda 2030 resonates with its work and that its activities contribute towards achieving SDG targets for advancing its sustainable development agenda (SDWG, 2017). However, before those linkages could be further explored, the SDWG</p>	



emphasized the need to better understand the nexus—or the connections and interactions—that occur between SDG targets themselves. Members of the SDWG cautioned that failing to consider the nexus between SDG targets could result in ill-informed and unintended policy outcomes, whereas an accurate accounting of the synergies and trade-offs between SDG targets could inform more sustainable policy solutions. This research is a response to that call.

This research will examine the nexus between SDG 2 - Ending hunger and achieving Food security for all; SDG 6 – Ensuring the availability and sustainable management of Water and sanitation for all; and SDG 7 - Ensuring access to affordable, reliable, sustainable and modern Energy for all. Over the past decade, WEF-SDG nexus studies have been conducted at the global, national, and regional levels, and all have concluded that WEF nexus research is informative for resource planning and developing effective policies for sustainable development (Pittock et al., 2015).

This research will be the first WEF nexus study conducted in the Arctic and aims to go beyond the production knowledge towards concrete tools, giving both the Arctic Council and the SDWG an opportunity to be innovative in both respects. It will involve collaboration between SECEG representatives and their networks, other Arctic Council Working Groups, Indigenous Permanent Participant Organizations, academic institutions, Arctic Council observers and other relevant circumpolar organizations. Together we will advance integrative thinking that reflects the interconnectedness within WEF systems in ways that will lead to the attainment of the UN Sustainable Development Goals in the Arctic.

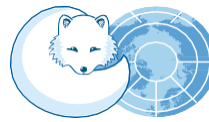
Our specific research objectives include:

- Develop and deploy an Arctic Water-Energy-Food (WEF) Security Index to provide a basis for sustainable resource management strategies based on the quantification of specific resource requirements.
- Provide a dynamic model to enable decision-makers and stakeholders to systematically integrate policy preferences based upon comparative scenarios of WEF-SDG targets.
- Advance an understanding of the interaction between WEF-SDGs and the rights and livelihood interests of Indigenous and other resource dependent peoples in the Arctic.
- Develop and operationalize an online Decision Support Tool (DST) that integrates WEF-SDG data in ways that are easily interpreted and manipulated by decision-makers.
- Enhance systems thinking through education, research, and professional development.

The research described below is ambitious and will undoubtedly be influenced by a host of logistical (including those posed by Covid-19), technical, ontological, and integrative challenges. However, the current challenges experienced in WEF systems in the Arctic, and the implications posed on Arctic residents, demand ambitious efforts. We are confident that through integrative thinking, informed by government, Indigenous and stakeholder engagement, our research will yield invaluable insights that will lead to the attainment of WEF-SDGs and the securitisation of Arctic livelihoods in the future.

#### Anticipated Outcomes

This research will investigate the complex and integrated dimensions of WEF-SDGs. In doing so, our research will produce new insights that would otherwise go unobserved in research focused on food, energy, water, or Arctic livelihoods alone. By examining the synergies between WEF systems, and their



influence on the livelihoods of Arctic peoples, we will create innovative pathways for the co-production of new knowledge, novel technologies, and predictive capabilities informed by both western and Indigenous knowledge systems. Specific outcomes from this research include:

**Enriched public discourse and improved public policies:** This research will inform the efforts of the SDWG by: identifying and addressing knowledge and data gaps to support the SDWG's efforts to meet the SDG targets in Arctic regions; facilitating collaboration between various levels of government in managing resource trade-offs across WEF-SDGs; introducing new technologies to support integrated decision-making; and exchanging knowledge on WEF-SDGs, including Indigenous knowledge and practices, in relation to the sustainable development in the Arctic.

**Indigenous rights outcomes:** The United Nations Thematic Report on the Accelerated Delivery of Agenda 2030 calls upon State Governments to enact concrete measures for the inclusion of Indigenous peoples in the pursuit of SDGs at all levels. This research responds to that call by enhancing the role of Indigenous peoples in the analysis of WEF-SDGs and their potential implementation in Indigenous territories. With the full and effective participation of Indigenous Permanent Participants, this research represents a unique opportunity to respond to the United Nations' call to locate the rights and interests of Indigenous peoples to the center of the SDG agenda.

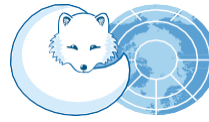
#### Project Oversight

This project will involve members of the Social, Economic and Cultural Expert Group (SECEG) and their respective networks. SECEG members will contribute by participating directly in the conduct of the research and/or helping to assemble multidisciplinary research teams within their respective countries. Other members of the research teams will be drawn from other Arctic Council Working Groups, Permanent Participants, academic institutions, Arctic Council observers and other relevant circumpolar organizations. Providing general oversight for the project, SECEG will ensure our methodologies are consistent, the approaches are collaborative, and the research findings are disseminated broadly and in ways that are most relevant to the information needs of the SDWG and the interests of all Arctic residents.

## Background

In 2015, the United Nations introduced Transforming the World: the 2030 Agenda for Sustainable Development. The 2030 Agenda was endorsed by the world's leaders to serve as an action-oriented road map for safeguarding the welfare of current and future generations (Lim et al., 2018). At the core of the Agenda are 17 Sustainable Development Goals (SDGs) that serve as benchmarks for achieving equality, prosperity, and environmental sustainability. Each of these 17 SDGs has specific targets (N=169) and associated indicators (N=232) that are used to measure advancements towards the attainment of each SDG.

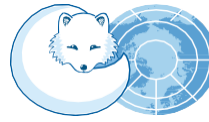
While Agenda 2030 has been heralded as a platform for protecting the environment for current and future generations, some (e.g., Nilsson et al., 2016) warn that simply "ticking off" SDG targets without considering cross-sectoral interactions may result in ill-informed and unintended outcomes. For example, Lim et al. (2018) argue that there is an inherent risk in global goal formation, whether in the case of SDGs or its predecessor, the Millennium Development Goals, when targets are



compartmentalized, siloed, and viewed through a reductionist lens (e.g., Costanza et al., 2015; Nilsson and Costanza, 2015). In these cases, the complexities of individual SDGs may be obscured and critical interactions in the global system can go unnoticed (Lim et al., 2018). The United Nations acknowledges the risks of treating SDGs as discreet and unrelated and has called for greater attention to be given to the interactions between SDG targets. This includes careful consideration of both the synergies and trade-offs associated with SDG attainment. Synergies include the positive effects of achieving multiple SDG targets through simultaneous interventions, for instance through mutually beneficial infrastructure developments, whereas trade-offs occur when advancements towards one target have a negative impact on the ability to reach other targets, whether due to environmental degradation or intensive use of resources (Fader et al., 2018). For example, Pradhan et al. (2017) found that SDG 1 (Ending poverty) has synergetic relationships with most of the other SDGs, while SDG 12 (Responsible consumption and production) is most commonly associated with trade-offs. Accounting for the positive and negative spillover effects of SDG attainment is therefore considered essential to formulating sustainable solutions to global challenges (Rasul, 2016; McCollum et al., 2018).

Various methodologies have been developed to systematically map and rank the level of interactions between SDG targets (Nilsson et al., 2016). These approaches have generally been referred to as nexus research and are used to define, measure, and analyze the connections and interactions between SDGs. There are multiple fields of nexus research but the relationship between SDG 2 - Ending hunger and achieving food security for all; SDG 6 - Ensuring the availability and sustainable management of water and sanitation for all; and SDG 7 - Ensuring access to affordable, reliable, sustainable, and modern energy for all, has received considerable research attention (Endo et al., 2017). This focus has been attributed in large part to the pervasive interactions that occur between Water, Energy and Food (WEF) systems (Bhaduri et al., 2015; Biggs et al., 2015). Over the past decade, WEF nexus studies have been conducted at the global (Fader et al., 2018), national (Mainali et al., 2018), and regional levels (Liu, 2016; Kulat et al., 2019), and all have concluded that WEF nexus research is informative for resource planning and developing effective policies for sustainable development (Pittock et al., 2015).

As informative as these studies have been, critics note that too often WEF nexus research prioritizes the maximization of resource use and extraction over the livelihoods of resource dependent communities (Hoff, 2011). Livelihood security refers to the challenges of sustaining key societal and cultural values under variable resource constraints (Béné et al., 2019). By focusing on the securitisation of WEF resources, WEF nexus studies tend to negate the potential for constructive dialogue around broader objectives such as wellbeing, equity, and justice (Stirling, 2015). This oversight is particularly problematic in some regions of the Arctic where Indigenous communities remain heavily dependent on WEF systems to meet their livelihoods needs, yet experience higher rates of WEF insecurity relative to their respective national average (see Egeland, 2010; CCA, 2014; Poppel, 2015; Natcher et al., 2016). **These inequalities have been made even more apparent during the current Covid-19 pandemic (Spence et al., 2020). Yet by improving our understanding of WEF interactions and how they relate to Indigenous livelihoods, we may be in a better position to increase resiliency within these systems and respond more effectively to future Covid-like shocks.**



This research will serve as the first WEF nexus study conducted in the Arctic. We will evaluate the current state of WEF security in the Arctic and will identify the synergies and trade-offs between WEF-SDG targets. This research will also advance a novel approach to WEF nexus research that explicitly includes the livelihoods of Arctic residents into a system where socio-ecological interactions are prevalent and sustainable solutions are found. By including the livelihoods of Indigenous and other resource dependent peoples as a critical dimension of the WEF nexus system, we will identify a suite of indicators that can be used to assess synergies and trade-offs with WEF security targets. This will then allow for the co-development of dynamic models and participatory processes that enable decision-makers and Indigenous leaders to systematically integrate policy preferences based upon comparative scenarios and their respective resource requirements for the future.

## Methods

In this research we explicitly account for the multi- and inter-scalar dimensions of WEF nexus systems. Our focus is directed to regional and sub-regional scales and the feedbacks that occur within these complex systems. However, due to the multi-scalar dimensions of WEF systems, there exists no single 'nexus methodology' to draw from. Therefore, in order to illuminate nexus interactions, we will employ a range of multidisciplinary methods.

### *Regional Scale: Country Profiles (Arctic Regions)*

At the regional scale we will compile a WEF Security Index for each Arctic state. The Index will be calculated from an aggregation of existing publicly available data. Our approach will be informed by the Pardee RAND Assessment Strategy (Willis et al., 2015) and made compatible with the global WEF Nexus Platform which will allow for inter- and intra-regional comparisons to be made (<https://www.water-energy-food.org>). The total WEF Security Index will be comprised of three sub-indices that will be combined using an unweighted, geometric mean:  $\text{WEF Security} = (\text{Water Sub-Index}) \times (\text{Energy Sub-Index}) \times (\text{Food Sub-Index})$ . Our approach will build on Nhamo et al. (2019) whose novel methodology enables an estimation of the total quantitative relationship between WEF indices and their interactions over time. The WEF Security Index will allow intra and inter-regional differences to be ascertained and will identify possible entry points for policy interventions and integrative planning. This analytical approach has proven effective in evaluating synergies and trade-offs in a holistic way in order to improve efficiency and productivity in resource use and management for sustainable development (Nhamo et al., 2019). The WEF Security Index will provide a single and comprehensive source for informing policy prescriptions based on the current state of WEF security in the Arctic.

### *Sub-Regional Scale*

Sub-regional analyses will build on the previous research of Natcher and Ingram (2020) and Fader et al. (2018) and will involve to a Stepwise Comparison between WEF-SDG targets. In this approach, positive interactions between WEF-SDG targets occur when common infrastructure requirements are required to achieve each target and when the targets have a positive net impact on ecosystem services. Conversely, negative interactions occur when two targets require the same scarce resource inputs and if the target pair imposes a negative net impact on ecosystem services. The magnitude of

the synergy or trade-off between any two targets is then represented by the sum of the positive and negative interactions between the two targets, where positive sums indicate synergies and negative sums indicate trade-offs (see Natcher and Ingram, 2020). This methodology will however be expanded to include an evaluation of the potential impacts on cultural ecosystem services, environmentally based livelihoods, and the territorial rights and interests of Indigenous peoples (Figure 1). This modified Stepwise Comparison will allow us to calculate the degree of interaction between WEF-SDG targets and the potential implications on the livelihoods of Indigenous and other resource dependent communities in the Arctic. For example, wind energy may have a positive net effect on SDG 7 (Sustainable Energy) but a negative net effect on SDG 13 (Climate Action). The value of this approach rests in its transparency between WEF-livelihood systems in policy and collaborative decision-making.



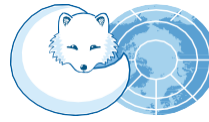
Figure 1. WEF-Livelihood Nexus

net effect on SDG 7 (Sustainable Energy) but a negative effect on the livelihoods of herding peoples. The value of this approach rests in its transparency and for illustrating the synergies and trade-offs between WEF-livelihood systems in ways that will facilitate communication in policy and collaborative decision-making.

## WEF Systems Governance

Understanding how governance either constrains or facilitates policy solutions is critical for mitigating WEF insecurities while accounting for the rights and interests of Indigenous Peoples. Governance refers to the diffuse networks of actors, institutions, and actions within WEF systems (Pahl-Wostl, 2009). In this research we will employ the Inter-Institutional Gap Analysis (IIGA) Framework developed by Rahman et al. (2017), who is a member of the Canadian research team, to examine WEF governance and the coordination gaps that may constrain innovative policy solutions to WEF-SDG goals. These gaps are multi-scaler and emerge when governing institutions insufficiently interact when developing mutually agreed upon rules and policies. For example, the compartmentalization of WEF government silos (e.g., separate Ministries of Energy, Environment, and Community Development) can impede nimble policy responses that are necessary for addressing the inherent complexities of WEF insecurities (Sharmina et al., 2016). In addition, Indigenous WEF system governance practices that are locally developed may significantly differ from regional and sub-regional governance. The political organization and decision-making capacity of governments directly affect Indigenous livelihoods and the capacity of communities to adapt successfully to future disturbances. Kelly and Adger (2000) argue that institutional constraints are a key determinant of vulnerability by controlling the access to resources, influencing resilience, and constraining or enabling adaptation. The IIGA framework will use the regional and sub-regional data collected above to explicitly account for the organizational role of actors and institutions in achieving WEF-SDG





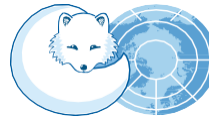
targets. The application of the IIGA framework will be informative for the sustainable management of WEF systems in the Arctic and globally as well.

### Knowledge Mobilization Plan (KMP)

Our KMP involves traditional strategies used to communicate research results, including publishing in high impact journals, plain-speak community reports\posters, and making presentations at national and international conferences. In addition to these KM strategies, we will employ several novel strategies for mobilizing knowledge in ways that will leave a legacy from our research efforts.

The output of this research will be operationalized through an online Decision Support Tool (DST) that will integrate WEF and livelihood data in ways that are easily interpreted and manipulated by our collaborators and decision-makers. The development of the DST will be informed by a number of existing online 'Nexus Toolboxes' but will be tailored to include livelihood indicators and will be reflective of the unique climatic conditions of the Arctic. Rose et al. (2016) notes that many of the existing DSTs have limited uptake and too often are of little practical use to decision-makers. This is due in large part to the exclusion of end-users in the design and development process. In these cases, decision makers need to acquire significant technological capacity and are then expected to fit their data into a pre-existing system. These requirements often limit the usefulness of DSTs by setting up obstacles that limit access, which soon render these systems obsolete. In this research we will engage end users at the outset of the project and will use an iterative user-centered design approach, which will engage users in the development of the DST in order to enhance its effectiveness, ensure its relevance, and instill trust among users (Verweij and Thompson, 2006; Blackwood et al., 2014). By developing a science-practice-policy interface, we will be better positioned to design scenario capabilities that capture the complexities within WEF systems (Hoolohan et al., 2018) while also enhancing its future application and accommodation of new and emergent WEF systems data (Howarth and Monasterolo, 2017). The DST will house baseline data and will support simulation scenarios of change. The DST will be centrally available online through an interactive web application housed in the Canadian Hub for Applied and Social Research at the University of Saskatchewan, which decreases the technical requirements needed to access the tool. This will also allow continued improvement iterations to be centrally released and immediately available to all end users. Support for the simulation scenarios will be based on stored data, and when data are incomplete, probabilistic and machine learning models will be used to make recommendations based on the data that are available. The DST will also house the WEF Security Index, and the web application will allow exploration of the data through maps and charts or downloading of the data for offline analysis. We also envision that links to the DST will ultimately be available on the SDWG and Arctic Council websites.

A new on-line WEF Nexus course will be developed and delivered through the University of the Arctic. The course will provide foundations and tools for facilitating community responses to WEF related challenges and will be tailored to undergraduate students, as well as government and industry professionals who work in WEF related areas. The overall objective of the course is to develop professional competencies in order to find scalable solutions to nexus challenges. This will include: 1) conceptual thinking that instills a deeper understanding of interactions between WEF insecurity

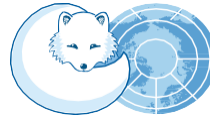


and potential management responses; and 2) capacity building that strengthens technical skills and knowledge concerning WEF assessments and planning.

It is also the intention of the Canadian project leads to approach the Arctic Economic Council (AEC) once the SDWG has endorsed the project proposal. Initial efforts will be made to scope out what role the organization might play in advancing the priorities outlined within the recently signed MOU between the AEC and the Arctic Council.

This project will culminate in an international conference – Nexus Thinking in the Arctic. This conference will address linkages between water, energy and food security in Arctic regions. Keynote presentations will be made by international experts from in and outside the Arctic. Conference sessions will examine WEF nexus accomplishments and challenges associated with knowledge mobilization, methodological advancements, governance, gender mainstreaming, scalable innovations, and knowledge and information gaps. The conference will facilitate transdisciplinary collaboration between academics, community leaders, government, and industry, all leading to sustainable solutions to WEF nexus challenges.





## Project Timeline

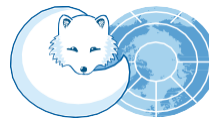
	2020		2021												2022												2023		
Activity	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Assemble National Research Teams																													
National & International Project Meetings																													
Regional and Sub-Regional Data Collection\Analysis																													
Stepwise Analyses																													
Interinstitutional Gap Framework Analysis																													
On-Line Decision Support Tool																													
Final Reporting																													
Nexus Thinking in the Arctic (Intern. Conference)																													

- In-person project meetings will ideally coincide with SDWG meetings and other Arctic scientific conferences but will depend on Covid-related travel restrictions.

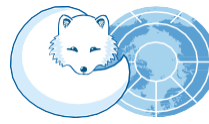


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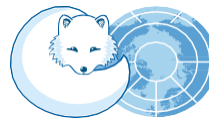
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