# Advancing Federal Cumulative Effects Research in Canada: Challenges and Lessons Learned

## The Challenge

Canada has now entered a period of energy transition from fossil fuels to clean, renewable energy sources for both domestic use and global export. This transition will see the development of multiple types of clean growth initiatives using renewable energy sources such as wind, solar, biomass, with greater consideration for hydrologic resources and sustainable forestry practices, as well as the development of critical minerals to support the technology to enable renewable energy development and use.

The pace of anticipated development over the coming decade is unprecedented. Many new projects will be in regions with past or existing natural resource development. Given the overlap geographically with past, current, and potential future development areas, the effects of each individual development will interact with other developments in various and potentially poorly assessed ways, broadly referred to as *cumulative effects* (Sinclair et al. 2017)*.* While there are many different definitions, the Canadian Council of the Ministers on the Environment (CCME, 2014) defined cumulative effects as "...changes in the environment caused by multiple interactions among human activities and natural processes, which accumulate across time and space". There is a growing need to better manage cumulative effects as demonstrated by the recent Yahey v. British Columbia (2021) decision, in which the B.C. Supreme Court ruling established that the "cumulative impacts of industrial development meaningfully diminished [Blueberry River First Nation's] exercise of its treaty rights."

The current approach to managing natural resource development in Canada focuses on a single project at a single point in time with the proponent responsible for data collection and analysis on the areas under their care and control (Noble, 2010; IAAC, 2020). Although the *Impact Assessment Act* (IAA, 2019) contains provisions for project proponents to consider cumulative effects in impact assessments, there is often a significant gap in existing cumulative effects scientific data and knowledge on a regional scale. Project level cumulative effects assessments may be insufficient for assessing long-term impacts, as the scope is too narrow, the scale is too small, and often past, current, and potential future projects are not carefully considered, resulting in what has been described as the "tyranny of small decisions" (Noble, 2010). As part of a broader Government of Canada effort to address the national issue of cumulative effects, the *Impact Assessment Act*, 2019 strengthened provisions for Regional Assessment to inform the planning and management of cumulative effects, and as well inform future decision making of project-level impact assessments. Although the IAA came into force 5 years ago, there has only been one terrestrial regional assessment announced (Regional Assessment in the Ring of Fire Area) which has not advanced past the terms of reference.

Access to regional scale information is required for the thorough assessment of cumulative effects that meaningfully considers processes and interactions that occur at different spatial and temporal scales, including past activities, and pressures to understand how a given valued component is affected by the combination of all activities, rather than the effects of a particular activity (Therival and Ross, 2007). To establish a robust baseline and understand the complexity, and interaction of effects, a wide range of scientific research, technical advice, and generation of knowledge on physical, biological, and anthropogenic components is required. Therefore, researchers from many disciplines are needed to identify, predict, and evaluate the potential effects of development activities and climate change on the environment, develop future scenario modelling as well as guide future monitoring (Eddy et al, 2014). Taken together, the science and information generated may be used to support risk analysis, decision making, and land-use planning actions related to natural resource development.

## Approach

With expertise related to geoscience (e.g., minerals, energy, groundwater), forestry (e.g., silviculture, timber supply, and biodiversity), geomatics (e.g., remote sensing, open data platform), and interdisciplinary sciences (e.g., climate change, sustainability assessments, socio-economic structures and considerations, natural resource development), Natural Resources Canada has a broad scientific research portfolio that provides a strong foundation for more comprehensive knowledge generation to support cumulative effects assessment.

Reflective of the diverse and interdisciplinary nature of cumulative effects, a committee of scientists within Natural Resources Canada with expertise in diverse fields (geoscience, forestry, biology, remote sensing, and GIS) was established to provide interdisciplinary perspectives on cumulative effects research issues. Known as the *Selecting Terrestrial Areas for Cumulative Effects Research (STACER)* committee, the committee started to develop a process to identify areas for future cumulative effects research in terrestrial areas of Canada to help focus Natural Resources Canada cumulative effects research in specific geographic areas.

As part of this, the committee sought to provide strategic guidance in selecting areas to support anticipated need for scientific data, knowledge, and technical advice, focusing on areas in which researchers could:

- Improve our understanding of baseline conditions, trends, and possible future states of Canada’s terrestrial environment in relation to natural resource development;
- Generate information/knowledge that can inform impact assessment processes, in particular regional assessment;
- Generate information/knowledge that can advance federal government and Natural Resources Canada science and policy priorities; and
- Generate information/knowledge that can help Indigenous groups better understand the impacts of cumulative effects on their lands and communities.

To do this, a GIS mapping exercise was carried out to explore mapping areas favourable for cumulative effects research. GIS data layers were first acquired on past, present and future natural resource projects, along with communities, infrastructure, and locations of Indigenous communities. Data layers were weighted and combined in a GIS overlay analysis to favourable regions. Weighting prioritized future project areas, where regional or individual project-level impact assessments would be anticipated, in combination with past and currently active resource project areas. Locations of future project areas were weighted higher where they coincide with the locations of either past or currently active project areas. The highest scores were assigned to locations where all three past, present and future projects coincide. This approach reflected the desire to consider the cumulative effects of different combinations of past, present and future development activities. The map in Figure 1 shows one result that reveals numerous areas in all regions of Canada that could serve as potential cumulative effects research areas (other iterations show comparable results).

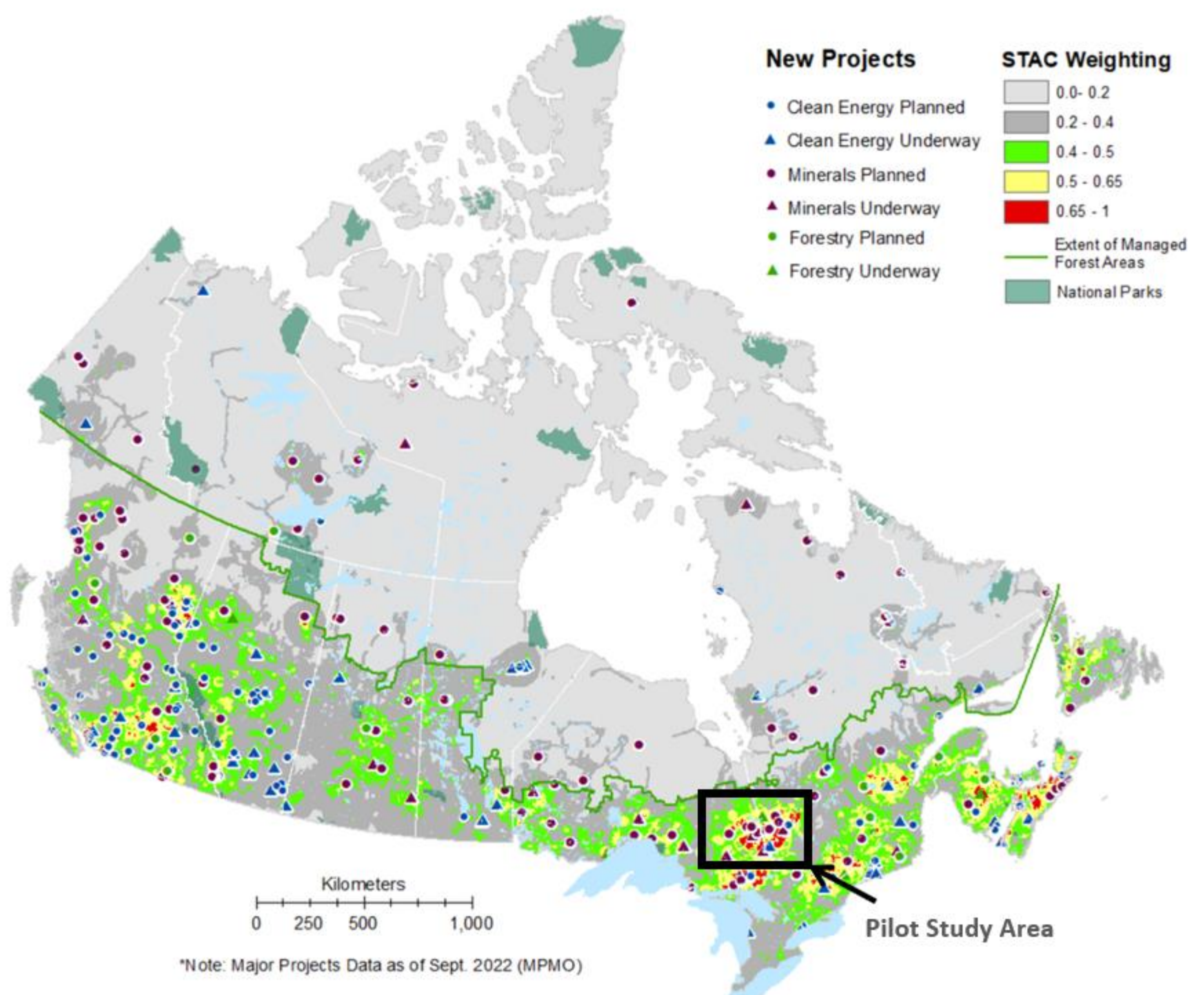


*Figure 1. GIS analysis revealing numerous areas favourable for cumulative effects research in the vicinity of anticipated future resource development projects.*

**Discovery**

Although the mapping exercise proved helpful in identifying favourable areas, the committee uncovered several challenges from the development and implementation of the GIS mapping exercise. Given the national distribution of potential areas of implementation, the STACER committee attempted to refine the list at this stage to only a few candidate areas to further evaluate the proposed STACER process. However, agreement on selection of a smaller number of candidate areas proved difficult due to the range of resource development settings and issues related to limited resources and other organizational factors. Creating an environment that would appeal to researchers to participate in a few areas proved to be difficult to reconcile as the department lacks a framework to support interdisciplinary research between groups. Many researchers have their own nuanced criteria for selecting their study areas and remained focus on their own areas of expertise. Committee members felt that cumulative effects researchers with specific areas of expertise may not feel comfortable committing to an intersectoral/multidisciplinary initiative without such aa intersectoral research framework in place.

Realizing the need for different types of cumulative effects research (e.g., baseline data vs. the development of a cumulative effects framework), the committee were introduced to an Adaptive Management with Information Ecology (AMIE) framework, published previously by Natural Resources Canada (Figure 2; Eddy et al, 2014). The AMIE framework makes clear how diverse types of cumulative effects research are needed to support decision-making in both regional and project level assessments and decision-making. The primary level pertains to the realm of fundamental cumulative effects and other natural and social scientific research. The secondary level pertains to integrative cumulative effects research and decision support components that align with the three major steps in an adaptive management decision making process. The tertiary level is the realm of actual IA decision making and engagement.

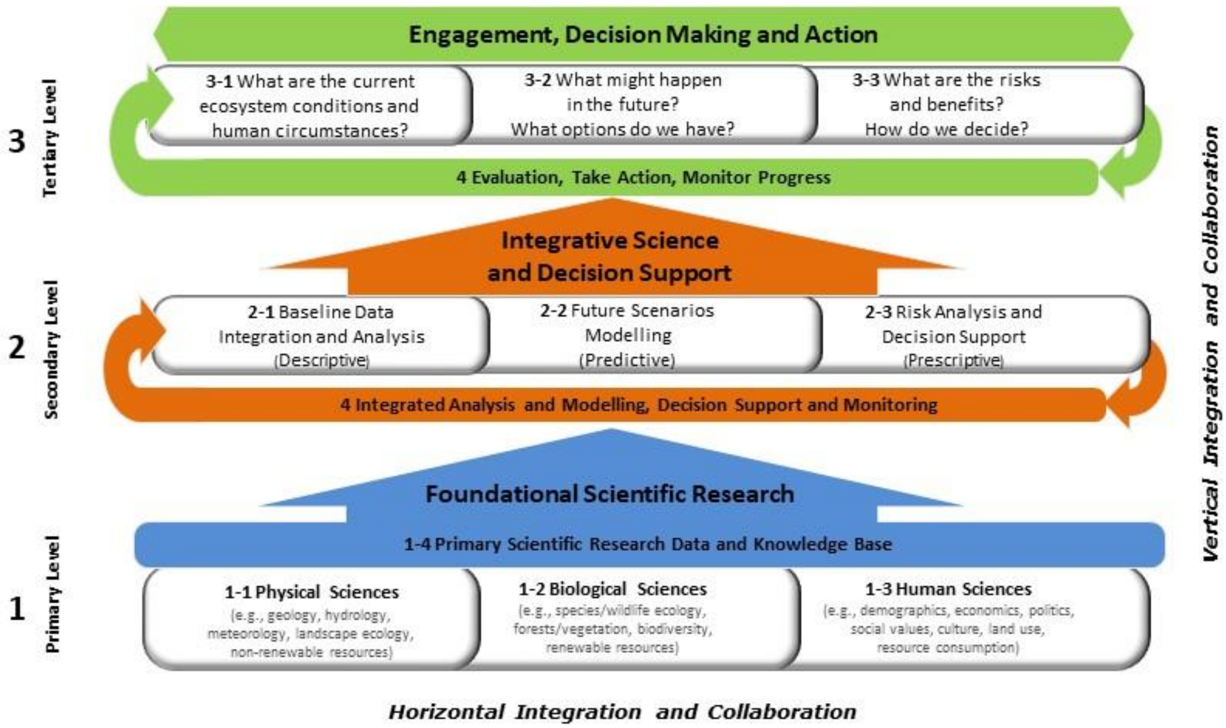


*Figure 2: Schematic of the AMIE Framework from Eddy et al. (2014)*

As a result, the committee implemented a staged approach following the guidance provided by the AMIE framework. It was agreed that priority should be given to orienting individual cumulative effects research projects on the primary level towards working in geographic areas of anticipated future projects. Issues surrounding potential secondary level collaborative cumulative effects research could be addressed through the initiation of a pilot study to explore both scientific and organizational considerations would need to be considered towards the development of an intersectoral framework. Moving forward, the committee has begun two initiatives to address these recommendations.

## Moving Forward

The STACER committee will continue with the implementation of an on-line GIS map that will be used to collect information on current cumulative effects research projects (Figure 3). The on-line map, known as the STACER map, will be available to cumulative effects researchers to support identifying locations for research projects in relation to resource development areas. The map contains multiple layers of information on past, present, and future resource projects, along with information of communities, infrastructure, Indigenous communities, and some environmental themes. A corresponding survey is being sent to cumulative effects researchers to capture the location and other pertinent information related to how their research project may support future regional and project-based impact assessments. This information will be collected in a database which will be used for reporting to senior management and will also be used for researchers to share information to foster potential collaborations in geographic areas where projects overlap.

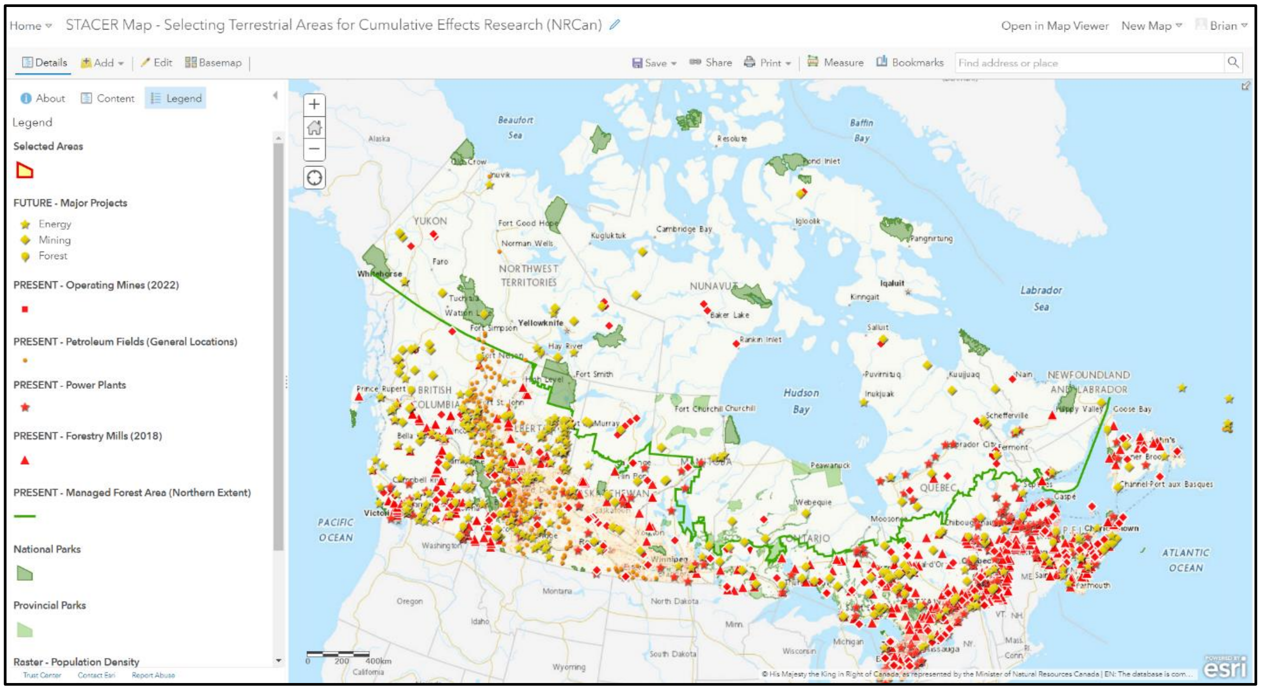


*Figure 3. Screen capture of the on-line GIS-based map 'STACER' (Selecting Terrestrial Areas for Cumulative Effects Research). This view shows locations of current and potential future resource project locations along with parks, communities and selected administrative boundaries.*

Additionally, the STACER committee recommends initiating a pilot project in the Abitibi Resource Belt region between northern Ontario and Quebec (see box insert in Figure 1). This region was selected because of its intense past and current resource development activity in minerals, forestry, and energy, and more than a dozen new projects, including critical mineral mines, identified for future development. The cumulative effects of future projects are expected to compound effects from the numerous past and current project activities in complex ways. Past and present cumulative effects could be identified through analysis of existing project impact assessments along with other sources. This information could then be used to report back to the committee and consult with both scientists and management to examine scientific and organizational requirements surrounding what is needed to develop a research framework and program.

As a department, Natural Resources Canada is committed to improving the quality of life of Canadians by ensuring the country's abundant natural resources are developed sustainably, competitively, and inclusively. Recognizing the anticipated pace of development over the coming decade, cumulative effects will continue to grow as a "wicked problem" (Kawa et al. 2021). A wide range of scientific research, technical advice, and generation of knowledge on physical, biological, and anthropogenic components are needed as the foundation to understand cumulative effects. The interactive STACER map provides researchers with pertinent information and considerations to help shape and inform their research program and overall rationale for their work. Through this lens, there is potential to put greater emphasis of how the work of individual research scientists connects to each other and encourage intersectoral collaboration, foster better use of resources and enable better linkages to federal decision making to support sustainable resource development.

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