GenomeCanada

Request for Applications
2015 Large-Scale Applied Research Project Competition
Natural Resources and the Environment: Sector Challenges - Genomic Solutions

1. Overview

Through the process of developing sector strategies, Genome Canada and the six regional Genome Centres recently brought together industry, academic, and government representatives in order to map out how the sectors could further benefit from the transformative power of genomics and related disciplines and so make a larger contribution to the country's economy and well-being of Canadians. Building upon the input from the Forestry[1] and Energy and Mining[2] sector strategies, as well as further consultations with stakeholders in these sectors, Genome Canada has developed this new competition seeking proposals for large-scale research projects focussed on using genomic[3] approaches to address challenges and opportunities of importance to Canada's natural resources and environment sectors, including interactions between natural resources and the environment, thereby contributing to the Canadian bioeconomy[4] and the well-being of Canadians.

Canada has a vast wealth of natural resources, which contributes significantly to the national and regional economies. Resource industries play a critical role in delivering jobs, growth and prosperity for Canadians. The natural resource industries directly and indirectly account for almost 19% of nominal GDP and around 1.8 million jobs. In addition natural resources exports account for more than half of Canada's merchandise exports and were valued at $235 billion in 2013.

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[1] FOREST SECTOR. Challenges, Genomic Solutions.
http://www.genomecanada.ca/medias/PDF/EN/Forestry_EN.pdf

[2] Advancing Canada's ENERGY AND MINING SECTOR through State-of-the-Art Genomics Applications.
http://www.genomecanada.ca/medias/PDF/EN/Energy_and_Mining_EN.pdf

[3] The term genomics is defined here as the comprehensive study, using high throughput technologies, of the genetic information of a cell or organism, including the function of specific genes, their interactions with each other and the activation and suppression of genes. For purposes of describing Genome Canada's mandate it also includes related disciplines such as bioinformatics, epigenomics, metabolomics, metagenomics, proteomics and transcriptomics.

[4] For the purposes of this competition the bioeconomy is defined as the creation of wealth and sustainability in the production of energy, chemicals, and materials, while improving the quality of the environment, through the use of biological tools and products.

The natural resource sectors make a significant economic contribution throughout Canada. For example, they account for more than a quarter of total GDP in Alberta, Saskatchewan, Newfoundland, the Northwest Territories and Nunavut respectively. Also, for about 200 communities across Canada, the forest sector makes up at least 50% of economic base. http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/files/pdf/10_key_facts_nrcan_e.pdf

Global demand for energy is projected to increase 33% by 2035, which could provide new export market opportunities for the sector but also challenges to increase production efficiencies and develop more environmentally sustainable technologies. Growing environmental and cost pressures associated with resource development and industry processes compel natural resource industries to adopt competitive technologies for sustaining international advantages and socially acceptable operations.

Canada has approximately seven per cent of the world's total renewable freshwater supply and is a steward of many globally significant ecosystems, including 30% of the world's boreal forests and 20–30% of freshwater wetlands. Nature and natural ecosystems are vital to our economy, including pulp, timber, fishing and recreational activities, and serve as the basis for much of the bio-based economy. The impact of environmental changes on natural resources and our economy are significant, e.g., it has been estimated that climate change could cost Canada billions of dollars per year.

The natural resource and environment sectors have a history of using research to assess challenges and develop various solutions. The knowledge and innovations emerging from genomics have the potential to help address the challenges in these sectors and thereby drive sustainability, growth, productivity, commercialization and global competitiveness.

2. Objectives

The 2015 Large-Scale Applied Research Project Competition aims to support applied research projects focused on using genomic approaches to address challenges and opportunities of importance to Canada's natural resources and environment sectors, including interactions between natural resources and the environment, thereby contributing to the Canadian bioeconomy and the well-being of Canadians.

The scope of this funding opportunity will include areas such as genomics research related to energy, mining, forestry, water stewardship, wildlife management/conservation and bioproducts that help conserve natural resources and protect the environment. It also includes the use of genomics to identify key elements that impact ecosystem structure, function and diversity.

Applicants must demonstrate how their proposal holds a high potential for attaining concrete deliverables by the end of the funding period. Proposals that make a strong case that those deliverables will be subsequently translated into significant social and/or economic benefits within as short a time-frame as possible after the end of the project are particularly encouraged, taking into consideration what is reasonable for the different research areas in these sectors.

To ensure that the objectives of the RFA are met, all applications must address the evaluation criteria established for the competition, i.e., quality of the research proposal, social and economic benefits, and management and financial competency (see Appendix 1). Only those proposals demonstrating the highest degree of overall excellence will be funded.

3. Funding Available and Term

- There is approximately $26 million available for this competition from Genome Canada.
- At least 67% of the requested funding for eligible costs for each project must be obtained through co-funding from other sources.
- Genome Canada will provide support for projects ranging in total size from $2 million to $10 million. The Genome Canada investment cannot exceed more than 33% of the total investment in the project by all parties; the remaining 67% must be secured through co-funding. (Note that projects with a total size that exceeds $10 million will be considered as long as the Genome Canada contribution does not exceed $3.33 million)
- Successful projects will be awarded funding for a term of up to four years.

4. GE^{3}LS[5]

While genomics has the potential to have significant social and economic impact in the natural resource sectors (including interactions between natural resources and the environment), there remain potential barriers to the adoption and uptake of the outcomes from this research. In this competition, the applied GE^{3}LS research should assist in the effective translation of research results into practice and policy, and the uptake of genomic-based applications within the natural resource sectors. GE^{3}LS research may be conducted in two forms:

- **Large-scale GE^{3}LS research projects:** These investigate in a comprehensive, innovative and interdisciplinary manner pressing national and/or international factors affecting genomics advances within the natural resources and environment sectors. Project outputs should be of a scope and depth to make a significant contribution to the potential uptake of genomic applications, while also making significant theoretical and/or methodological contributions to the study of genomics science, technology and innovation. It is expected that large-scale GE^{3}LS research projects will demonstrate active engagement with the genomics scientific community and/or potential end-user communities in the planning of the research as well as its conduct, and that their findings hold a reasonable potential of contributing to, or affecting change in, practices or policies within these communities. This may entail sustained interactions with other large-scale projects and/or their integrated GE^{3}LS components funded through this competition.

- **Integrated GE^{3}LS research:** *All other projects must include an integrated GE^{3}LS research component.* The overarching objective of integrated GE^{3}LS research is to investigate the relevant factors affecting the advancement of the genomics research proposed and to support collaboration between genomic scientists and GE^{3}LS researchers throughout all aspects of the research project (including research management and oversight). Integrated GE^{3}LS research should be closely related to the

[5] The acronym GE^{3}LS stands for "Genomics and its Ethical, Environmental, Economic, Legal and Social aspects". However, it should be understood broadly as genomics-related research endeavors and related activities undertaken from the perspective of the social sciences and humanities. Therefore, it is not strictly limited to disciplines that make-up the acronym but rather encompasses all those that rely on quantitative and qualitative methodologies to investigate genomics in society, and help establish a basis to inform applications, practices and policies. In the context of this RFA, it can also include approaches from a wide range of disciplines including but not limited to: development studies, environmental sciences, geography, innovation studies, political sciences, and population studies.

overall project's objectives, deliverables and potential social and/or economic benefits. The scope should be more targeted than in large-scale GE^{3}LS research, but the depth of the investigation must be sufficient to provide findings that can be applied to the project, as well as the broader sector. Moreover, the nature of the research outputs should have the potential to assist in the likely successful uptake of the project's deliverables.

Following the funding decisions on this competition, Genome Canada will determine if additional mechanisms are required to maximize the GE^{3}LS research and the overall social or economic benefits that can be realized through the translation of the project deliverables. For example, to the extent that integrated GE^{3}LS research components across different projects and/or stand-alone GE^{3}LS research projects are using similar research approaches, are addressing the same sector or are focused on the same overarching objectives, additional support may become available to facilitate exchanges, establish networks or identify and address the gaps in GE^{3}LS efforts that may require additional research attention.

5. Eligible Research Areas

To be eligible for this competition, proposals must:

- respond to the objectives of the competition;
- include genomic approaches as essential components in terms of importance to the overall outcomes of the project;
- be of a scale and scope such that they are able to address challenges requiring a genomics approach;
- be internationally competitive; and,
- have the potential for major impact.

This competition provides an opportunity for research teams to propose large-scale projects that would be part of even larger national and international research initiatives, as long as other eligibility criteria are met.

Projects funded through this competition must focus on using genomic approaches to address challenges and opportunities of importance to Canada's natural resources and environment sectors, including interactions between natural resources and the environment. Topics of applied research that could be addressed include, but are not limited to, the following:

- genomic solutions to enable increased recovery and greener extraction and processing in the mining and energy sectors (e.g., better understanding of microbial activities related to recovery, recycling and waste treatment);

- genomic solutions to increase forest productivity and sustainability through:
    - selecting commercially desirable trees, e.g., for improved pest resistance, growth, desirable wood characteristics, and resilience to climate change and other stresses;
    - enhancing beneficial plant/microbe interactions as well as understanding and controlling forest pests, diseases, and invasive species;

- development of renewable resources, e.g., forests, agricultural crops or other sources of biomass, for new and cleaner sources of energy, chemicals and other products;

- water (marine and fresh) stewardship to ensure sustainable management and use of water as well as protecting the quality of water so that it is clean, safe and secure for all Canadians and supports healthy ecosystems (defined as a biological community of interacting organisms and their physical environment);

- genomic approaches to a better understanding of the effect of climate change on the ecology, presence, distribution and spread of vectors and vector-borne diseases in natural ecosystems, as well as on the introduction of foreign invasive species into Canada, and how this can negatively impact biodiversity and wildlife populations;

- environmental toxicogenomics - genome-scale analysis of gene or protein activity within organisms in response to environmental exposure to toxic substances, as relevant to impact/risk assessment and other practical applications;

- genomic approaches to a better description and understanding of biological diversity for applications such as enhanced biomonitoring to measure the impact of climate change, provide for early warning systems and/or track the impact of bioremediation in terrestrial and aquatic environments; and,

- accelerating remediation of contaminated environments by, e.g., identifying microbial communities that can break down toxic compounds.

Research topics that could potentially be addressed in this competition through integrated or stand-alone GE^{3}LS research projects include, but are not limited to, the following:

- investigating the effects of the application of genomics on international trade and market access to exports of Canadian natural resource products; and,
- exploring the effects of national policies and/or regulations on the uptake of genomics-based applications and the impact on sector competitiveness and productivity.

NOTE: Studies focussing on human health as impacted by the environment or projects focussed on producing food or food supplements for human or animal consumption are not eligible for support in this competition.

6. Social and/or Economic Benefits for Canada

All applications must describe, with supporting evidence, the deliverable(s) that will be realized **by the end of the project.** Proposals that make a strong case that those deliverables can and will be subsequently translated into significant social and/or economic benefits within as short a time-frame as possible after the end of the project are particularly encouraged, taking into consideration what is reasonable for the different research areas in these sectors.

Applications must include a plan which explains the next steps of how the deliverables from the research will be transferred, disseminated, used, and/or applied to realize the social and/or economic benefits. Once funded, the project teams will be required to further elaborate on this plan as time goes on so as to provide a more substantive business case that will describe the path forward to ensure that the proposed deliverables and benefits are realized in the stated

timeframe and within the approved budget. The project's Research Oversight Committee (see 10.2) will assess this plan on an on-going basis.

See **Appendix 1** for more details on all review criteria.

7. End-User Engagement

All projects must clearly demonstrate end-user engagement in the development and execution of the research plan in order to help ensure receptor uptake of the research. "End-users" in the context of this RFA can be defined as those who are able to use the information generated through research to make informed decisions on issues, policies, programs and product development. Examples of end-user organizations could include industry and industry associations, government departments and regulatory agencies. Individuals from these types of organizations should be included on the project team.

End-users must be clearly integrated into the project team in the form of a project team member, collaborator and/or member of the management team. Co-funding would clearly demonstrate end-user interest in the project's potential deliverables, although it is not a requirement for an end-user organization to contribute to the co-funding required.

8. Competition Timeline

Requests for support of projects must be submitted to Genome Canada through a Genome Centre. The competition timeline outlined below only includes Genome Canada's deadlines. Applications must come through a regional Genome Centre so please contact your Genome Centre for further information on their process and internal deadline dates, as these could be a month or more earlier than the Genome Canada deadline for certain steps of the competition.

July 31, 2015	Deadline for submitting registrations to Genome Centre
August 10 , 2015	Deadline for submitting registrations to Genome Canada
November 10, 2015	Deadline for submitting pre-applications to Genome Canada
Late January, 2016	Applicants notified of results of pre-application
April 14, 2016	Deadline for submitting full applications to Genome Canada
Late May, 2016	Review committee meets (including meetings with applicants)
Late June, 2016	Decisions by Genome Canada and Partners (if applicable)
Late June, 2016	Notification of Decision

9. Application Process

Applicants are required to apply for funding through their regional Genome Centre. The application process is comprised of three steps: Registration, Pre-Application and Full Application.

9.1. Registration

A brief Registration form will be used to provide early guidance on elements such as who is applying, what they are planning to do, research areas including integrated GE^{3}LS, expected deliverables, approximate budgets and suggested reviewers. This will allow for screening for eligibility by the Genome Centres and facilitate the early selection of reviewers for the peer review process. Information from eligible Registrations (i.e., name of project leader(s), lead institution, title of project, research areas and keywords) will be posted on the Genome Canada website to facilitate the identification of areas of potential synergy between applications from across the country so that applicants can consider engaging with other researchers on a common project. This will also make possible the exchange of required information between project teams and genomics technology service providers such as the Genome Canada supported Genomics Innovation Network Nodes.

9.2. Pre-Application

For the **Pre-Application,** applicants will be asked to submit a short description of the following:

- the proposed research, including an integrated GE^{3}LS research plan;
- expected deliverables of the research;
- the potential social and/or economic benefits of the research; and,
- how the team will engage end-users in the project.

Pre-applications will be reviewed in a two stage process. The first stage involves an initial review that will be done “at-home” by a College of Reviewers who will evaluate the Pre-Applications, focussing on the quality of the research plan and the potential for social and/or economic benefits. College reviewers will provide a rating for the quality of the research proposal and potential for social and/or economic benefit, and the mean score for each of these categories will be calculated separately. Only those Pre-Applications with an equivalent of a mean rating of “B” for each category will be considered further. A list ranking the Pre-Applications, based upon the mean of the scores for both criteria (quality of the research proposal and social and/or economic benefits) will be prepared.

The second stage will involve review by a Pre-Application Review Committee (PARC) with broad expertise in research including GE^{3}LS, technology development, research management and the translation of research results in areas relevant to the competition. This committee will consider the College reviews and make a final recommendation to Genome Canada on which Pre-Applications should be invited to submit a Full Application.

The proposals will again be checked for eligibility to the program. Only the most competitive Pre-Applications will be invited to submit full applications. It is expected that approximately 30 Pre-applications will proceed to the full application stage. Information from approved Pre-

applications (i.e., name of project leader, lead institution, title of project, research areas and keywords) will be posted on the Genome Canada Website to further facilitate the exchange of information between project teams and genomics technology service providers such as the Genome Canada supported Genomics Innovation Network Nodes.

9.3. Full Application

Those applicants successful at the Pre-Application stage will be asked to submit a full application. Full applications must address the evaluation criteria established for the competition, i.e., quality of the research project, social and/or economic benefits, management and financial competency. A final check for eligibility will be carried out. A multidisciplinary committee of experts, with expertise in assessing all of the review criteria, will be established to review applications. The review committee will meet with and interview representatives from each project through a face-to-face meeting. Only those proposals demonstrating the highest degree of overall excellence will be funded.

The evaluation processes may be adjusted where warranted by the complexity of proposals received or other relevant factors. Any changes will be communicated through Genome Canada's website and through the Genome Centres.

10 Project Management and Oversight

10.1. Project Managers

All approved projects must have a dedicated project manager. Project managers coordinate administrative and reporting requirements and support the project's research enterprise.

10.2. Research Oversight Committees

All Genome Canada funded projects will have a Research Oversight Committee (ROC) constituted by, and reporting to, the Genome Centre(s). The ROC reports to the Genome Centre on the progress being made by the project and makes recommendations to the funders regarding continued funding, as well as providing advice and guidance to the research team to help ensure that the project achieves its stated objectives and milestones. The membership of the ROC must be completely independent from the project, with no real or perceived conflicts of interest and should be composed of experts who will work with the Genome Centre and the funders to maximize the successful outcomes of the project. A portion of the funds awarded to each project will be designated to cover costs associated with the project's ROC.

11. Co-Funding

Genome Canada requires that at least 67% of the requested funding for eligible costs for each project be obtained through co-funding from other sources. The Genome Centres, working with the applicants, are responsible for securing co-funding. Co-funding for this competition must be for research activities that are an integral part of the Genome Canada approved project and must be for eligible costs specifically requested in the Genome Canada budget form in order to be considered as an eligible co-funding source. See the **Guidelines for Funding Research Projects** for more details.

12. Contacts

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Appendix 1. Evaluation Criteria

Proposals submitted to Genome Canada are evaluated via a rigorous independent peer review process to assess their research merit and potential for social and/or economic benefits for Canada, as well as to ensure that sound management and financial practices are implemented. Excellence and innovation at the very highest of international standards must be demonstrated for funding to be awarded.

Eligibility Criteria

Each proposal will be reviewed for eligibility at each stage of the application process. The following criteria will be used:

- Does the proposal respond to the objectives of the Genome Canada competition?
- Does the proposal include genomics approaches as essential components in terms of importance to the overall outcomes of the project?
- Is the proposal of a scale and scope such that it is able to address challenges requiring a genomics approach?
- Is the proposal internationally competitive?
- Does the proposal have the potential to have major impact?

If considered eligible, the proposal will be reviewed using the criteria described below:

Review Criteria

The review criteria fall into three categories:

1) Research Proposal;
2) Social and/or Economic Benefits; and,
3) Management and Finance

Note that the descriptive phrases which follow the criteria below are not all-inclusive.

1. Research Proposal

Including Research on Ethical, Environmental, Economic, Legal and Social Aspects of Genomics (GE^3LS)

- Research Context and Originality
  - To what extent does the proposed research lead, extend and/or complement national and international work in the area?
  - To what extent does the proposed research reflect creative and original thinking?
  - To what extent is the research relevant to the end-users identified?

- Research Plans
  - How appropriate are the methods and approaches proposed (including handling of data and resources) in terms of the research objectives?
  - How feasible is the research, given the projected resources and timelines?

- Research Expertise
  - How appropriate is the expertise and track record of the research team in terms of realizing the research goals?
  - How well will different types of expertise be integrated?

- Research Support
  - How suitable are the available facilities, equipment and services (including services to be provided by Genome Canada's GIN Nodes and/or other technology service providers)?

- Specific criteria related to Integrated GE^3LS research (in addition to the GE^3LS aspects which are included in the criteria above):
  - Does the GE^3LS research address the most salient aspects of the project and is it closely related to the overall project's objectives, deliverables and potential social and/or economic benefits?
  - Is the integrated GE^3LS research plan closely aligned with, and complementary to, the overall project milestones?
  - Is the GE^3LS research plan sufficiently robust and systematic to advance generalizable knowledge in relevant academic fields?

2. Social and/or Economic Benefits for Canada

- Deliverables
  - To what extent have the applicants identified appropriate deliverables in terms of their potential to have impact on the sectors relevant to the competition?
  - What is the likelihood that the deliverables will be achieved by the end of the funding period?

- Expected Benefits
    - How significant are the anticipated benefits described in terms of their potential of contributing to the sectors relevant to the competition?
    - Will the benefits be realized within a short time-frame after the end of the project, taking into consideration what is reasonable for the different research areas in these sectors?

- Strategy for realizing benefits
    - How persuasive is the strategy set out by the applicants for realizing benefits from their research?
    - How strong is the plan for knowledge translation and development of benefits, i.e., how well does the plan explain the next steps of how the deliverables from the research will be transferred, disseminated, used, and/or applied to realize the social and/or economic benefits?
    - How closely aligned is the plan for knowledge translation with the GE^{3}LS research and the overall deliverables and outcomes of the project?

- Expertise for realizing benefits
    - How appropriate is the expertise and track record of the team that will further develop and implement the strategy for realizing benefits?
    - To what extent are likely end-users involved in the project and the strategy to realize benefits?
    - If the strategy includes commercialization, to what extent has appropriate technology transfer expertise been included?

3. Management and Finance

- Management plans and expertise
    - How well does the management plan cover project governance, accountabilities of personnel and finance, and processes for decision-making on research direction and strategy for realizing benefits?
    - How realistic is the project schedule given the likely need to “ramp-up” activities at the front end?
    - How credible is the management plan in terms of coordination of current and future partnerships?
    - How appropriate are the plans for making the research results accessible to the research community?
    - Are the proposed arrangements with Genome Canada’s GIN Nodes or other technology service providers sufficiently articulated to ensure that the provider is able to complete the requested service(s) in the timeframe required by the applicant?
    - To what extent do the project leaders have experience in managing large-scale projects involving research and the application of results?
    - How appropriate are the plans to ensure that an adequate number of highly qualified personnel (HQP) (i.e., support personnel such as technicians and trainees such as post-doctoral fellows), are available to meet the needs of the proposed research through recruitment and/or training?

- Budget and expenditure controls

- How reasonable is the proposed budget in terms of the anticipated level of effort and deliverables?
- To what extent are the budget and proposed expenditures well-documented and eligible per the guidelines?
- To what extent does the proposal provide assurance that expenditures from a funded project would be closely and critically monitored?

- Financing from co-funders
  - To what extent is the proposed co-funding plan well-documented, eligible and feasible?
  - Does the proposed co-funding directly support the objectives of the project?
  - How likely is it that the project will be able to secure at least 75% of the co-funding for eligible costs before the deadline for release of funds?