SCHEDULE F – PROJECT COMPLETION REPORT TEMPLATE

VERY IMPORTANT:

Timing: You need to email a report, to your GMF project officer (contact info is in Schedule C), on the dates indicated in Schedule C or whenever FCM asks for such a report.

Copyright: Before you submit a report to FCM, make sure you hold the copyright for the report. If you're hiring a consultant to prepare the report, please make sure to get the copyright (see FCM's copyright tips document), or else FCM will not be able to disburse the Grant Amount.

Accessibility for people with disabilities: Please do not change the format, font, layout, etc. of this report. This template has been specially designed, following FCM's Accessibility Guidelines, in order to be accessible to people with disabilities.

Confidentiality: If your report contains any Confidential Information that you would prefer not be made available to the public (e.g. through a case study or other materials produced by FCM that relate to your Project), please submit two versions of the report:

1. **Complete report including Confidential Information:** Please clearly label this report with the word "**Confidential**" or similar wording and FCM will treat it as confidential.

2. **Abridged report excluding Confidential Information:** This report may be posted on the FCM website and otherwise made available to interested third parties, to help FCM meet its knowledge sharing objectives.

Please contact your project officer to receive an electronic copy of the Completion Report Template.

Upon completion of the project, a copy of the Final Deliverable must be submitted along with this Completion Report.

FCM will post your report on the Green Municipal Fund™ (GMF) website. This is because one of FCM's mandates is to help municipal governments share their knowledge and expertise regarding municipal environmental projects, plans and studies.

How to complete the Completion Report

The purpose of the Completion Report is to share the story of your community's experience in undertaking your project with others seeking to address similar issues in their own communities.

Please write the report in plain language that can be understood by people who are not specialists on the subject. A Completion Report is typically in the range of 5–10 pages, but may be longer or shorter, depending on the complexity of the project.

GMF grant recipients must enclose **final** copies of the Completion Report and the Final Deliverable with their final Request for Contribution. The reports, including all attachments and appendices, must be submitted in PDF format with searchable text functionality. Reports that are not clearly identifiable as final reports, such as those displaying headers, footers, titles or watermarks containing terms like "draft" or "for internal use only," will not be accepted by GMF. Additionally, reports must be dated. If you have questions about completing this report, please consult GMF staff.

GMF number	16774
Name of lead applicant (municipality or other partner)	Bruce County
Name, title, full address, phone, fax and e-mail address of lead technical contact for this study	Jill Roote Manager, Economic Development The County of Bruce 30 Park Street Walkerton, ON N0G 2V0
Date of the report	September 30, 2021

1. Introduction

a) Who was involved in doing the Feasibility Study, and what are their affiliations? Please include name, title and contact information. Those involved could include municipal staff, engineers and other consultants, a representative from a non-governmental organization, and others.

The County awarded Hatch, Ltd. to undertake and conduct a feasibility study to assess the technical, financial, socio-economic opportunities and challenges of hydrogen production, storage, and use in the county with the aim of catalysing the hydrogen economy in the province and positioning the county as a leader in this developing industry.

Those working on the project included:

Bruce Staff Team:
Kara Van Myall, Director Planning and Development (now CAO for the Town of Saugeen Shores)
Jill Roote, Manager Economic Development
Contact: jroote@brucecounty.on.ca / 519-881-1291 / 30 Park Street, Walkerton ON N0G 2V0

Hatch Team:
Mario Pieries, Manager of Projects
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Ash Doman, eGrid / Hybrid Power Ashrith.domun@hatch.com / 289-813-9490

2. The Feasibility Study

a) Describe the process that you undertook to make this feasibility study a reality, from concept, to council approval, to RFP, to final deliverable.

We followed the prescribed project plan as follows:

Milestone 1 **Pre-Application Advisory Support**
- Retained Ernst and Young (FY) as external consultant to review application requirements and co-developed responses ultimately submitting revisions to application.
- Result- led to the successful awarding of the GMF grant from FCM.

Milestone 2 **Develop Evaluation Framework for Design solution for the Demonstration**
- Retained external consultant and subject matter expert Hatch and sub-consultant Bougyes/Plan Group

- Defined the successful outcomes of the study

Milestone 2 **Develop Evaluation Framework for Design solution for the Demonstration**

- Outreach to industry partners to convey project objectives – underway
- Risk workshop – planned for the week of September 14-18
- Technical requirement identification underway
- Financial requirement identification underway
- Methodology for environment, economic and social benefit identification underway
- Design basis and development to commence end of this week
  - Including evaluation matrix, potentials sites identified and evaluated with EES

Milestone 3 **Conduct study for the Demonstration**

- Retain consultant/SME to support in planning and execution of pre-design workshop with industry.
- Host pre-design workshop with interested design teams and SMEs.
- Pre-design workshop to focus on, but not be limited to, EES benefits evaluation, financial analysis, and project risk management consideration.
- Risk workshop info session will focus specifically on risk sharing and risk transfer. It will be important for Bruce Innovates to communicate risk management approach with industry proponents prior to proponents submitting their proposed designs for review.
- Engage local government planning office(s) and permitting office(s) to address any barriers to proposed designs
- Design teams (i.e. industry proponents) develop their solutions proposal, cost estimate, risk approach, and bid on RFP for Demonstration (cost covered by proponents). Proponents to present their own risk registers with their proposed designs; it will be important for Bruce Innovates to understand who owns what risks. Design teams to also include in their solutions proposal a high-level indication of the potential performance (incl. environmental benefits) and requirements of a Full-scale build (i.e. utility scale) of their solution (cost covered by proponents).

Milestone 4 **Evaluate and make recommendations for the Demonstration**

- Assemble jury and evaluate proposals from design teams for the Demonstration. Update risk register based on short-listed proposed designs. The updated risk register and relevant quantitative risk analysis will inform recommendation to FCM.
- Work with partners to finalize selection of bid
- Review business case of bid with advisory panel of regulators, financiers, and suppliers to identify possible barriers to scaling

Milestone 5 **Reporting**

- Preparation of report detailing proposed design solutions received from industry respondents for the demonstration project, summary of environmental and economic metrics, risks and risk management approach, and rationale for business case.

b) What were the objectives of the Feasibility Study (what was it seeking to determine)?

A significant opportunity exists for Bruce County to produce clean hydrogen from off-peak nuclear and renewable electricity generation sources, positioning the region to contribute to, and benefit from, the transition to a low-carbon economy. To take advantage of this opportunity, Bruce County and Saugeen First Nation have launched a partnership called "Bruce Innovates: Foundational Hydrogen Infrastructure Project". Bruce Innovates' goal is to illustrate, by deploying transformational technologies such as hydrogen production and storage, that the Bruce region will become the clean energy capital of Canada and lead the way towards collaboration and training in clean technology development and energy innovation.

Bruce Innovates has the potential to be a ground-breaking and innovative way to pursue multiple objectives simultaneously, including: 1. Demonstrating and scaling-up clean hydrogen-based energy systems; 2. Diversifying and growing the local economy; 3. Supporting SFN and other First Nation communities in building capacity towards greater energy self-sufficiency; and 4. Accelerating the commercial deployment of Canadian-based hydrogen technologies.

Objective and scope:

- The objective of the feasibility study is to better understand the technical (i.e. capacity in terms of MW) and financial requirements for developing **Demonstration-scale** (potentially in the range of 1-3 MW capacity) hydrogen production and storage systems in the Bruce region. The results of the feasibility study will also serve as an initial point of reference for assessing, at a conceptual level, the potential for a Full-scale build (potentially in the range of 25 MW+ capacity) of hydrogen systems within the region and their export both nationally and abroad.
- The study of the Demonstration will consist of 4 distinct phases.

The feasibility study of Bruce Innovates' Demonstration is important for the community:

- This is an excellent opportunity for the Steering Committee to engage with industry proponents and subject matter experts in a methodical assessment of the feasibility of developing clean hydrogen-based energy systems in the Bruce region. The findings from the study will help in determining a Full-scale build.
- At a conceptual level, the findings from the Study will help quantify how hydrogen-based systems can play a significant role in decarbonization, lead clean energy technology advancement and develop a new industrial opportunity that will enhance the economy of the Bruce region, move Ontario into a leadership role in cleantech, and put Canada back on the forefront in fighting climate change.

The results are necessary to pursue the project because:

- The results of the study, which will be based on expert analysis and opinions, will help inform the Steering Committee on how to pursue the Demonstration, given technical, financial, environmental and social considerations and will be critical in deciding on the future of Bruce Innovates' vision for developing a hydrogen-based economy in the region, the province and in Canada.

c) What approach (or methodology) was used in the Feasibility Study to meet these objectives?

Methodology for identifying Bruce Innovates' environmental, economic and social benefits, for both Demonstration and Full-scale:

- The environmental benefit associated with reduced local GHG emissions will be considered in the context of broader municipal, regional, provincial, and federal climate change goals and evaluated against the cost of the carbon mitigation for this project; there will be secondary environmental benefits owned by SFN (and other First Nations

communities for the potential Full-scale build) and industrial producers that consider life-cycle GHG emissions for their supply chain.

- The potential environmental benefits, namely GHG emission, will be evaluated using a life cycle assessment (LCA; ISO-14064) for the two avenues of hydrogen ('power to gas' and 'storage').
- The social benefits will be identified using a Social-LCA approach (ISO-14064)
- The economic benefits will be identified for the following key groups:
    - SFN and the Bruce region, from developing a hydrogen economy in their community.
    - Industry, from (a) using the hydrogen as an alternative fuel/feedstock for their operations, (b) capitalizing on business opportunities that could come from having a hydrogen infrastructure in the Bruce region, and (c) generating export opportunities for the technology systems being developed by Bruce Innovates.

Methodology for evaluating scope and magnitude of benefits, for both Demonstration and Full-scale build:

- The environmental benefits will be quantified using appropriate boundaries with a standard LCA approach for GHG emissions and other environmental metrics under ISO 14044.
- The economic benefits will be evaluated using an input/output model to determine the effect of (a) utilizing the surplus nuclear/renewable energy, (b) displacement of natural gas and (c) other uses for the hydrogen, as well as (d) the economic benefits associated with hosting the facilities in the Bruce region.
- The social benefits will be qualified and quantified using appropriate boundaries under the United Nations Environment Programme (UNEP) Guidelines for Social Life Cycle Assessment of Products and the Methodological Sheets for Subcategories in Social Life Cycle Assessment (S-LCA) from the Life Cycle Institute.

Methodology for identifying and managing risks, for both Demonstration and Full-scale build:

- Project Management team will develop, maintain and communicate a Project Risk Register. Risk levels will be based on a Risk Matrix that will show 'Impact of risk' and 'Likelihood of risk'. Risks will be tracked, reviewed and discussed on a regular basis with all relevant project stakeholders. Thresholds and decision-making criteria will be established during the planning stage to clearly identify risk management procedures, including roles and responsibilities, contingency plans, risk-related stage-gates, etc.

Methodology for conducting financial analysis for both Demonstration and Full-scale build:

Project Team will develop a cashflow-based financial model that serves as a flexible tool for conducting a value for money estimate using benefit-co-cost ratio as the principal financial metric. Following steps will be taken to develop the financial model:

- Cost analysis: Step 1 includes assessment of full project costs (i.e. capital and operating costs of both Demonstration and Full-scale) over its lifetime. The cash-based costs will then be discounted at appropriated rates to estimate the Net Present Value (NPV) of investment. In addition to value for money calculation, the budgeting exercise relies heavily on the project cash requirements throughout its life.
- Benefit analysis: Step 2 in building the financial model includes incorporating the social, environmental and economic benefits resulting from investment in the hydrogen production and storage system into the model. NPV of benefits will be estimated using a similar discount rate that was applied to project costs.

  Benefit-to-cost ratio: The final step in building the model includes calculating value for money, which is expressed as the benefit-to-cost ratio. In principal, a benefit-to-cost ratio

above 1 is desirable as it shows the total benefits achieved by implementing the project is greater than the total project costs.

d) Please describe any public consultations conducted as part of the Feasibility Study and their impact on the Study.

NA

3. Feasibility Study Findings and Recommendations

a) What were the environmental findings related to the options explored in the Feasibility Study? Please provide quantitative results and summary tables of these results (or the page numbers from the Feasibility Study report).

See page section 6.3 Environmental Impacts page 76 of the study.

b) What were the financial findings related to the options explored in the Feasibility Study (for example, results of a cost-benefit analysis, financial savings identified, and so on)? Please provide quantitative results and summary tables of these results (or the page numbers from the Feasibility Study report).

See section 6.1 Financial Assessment page 50 of the study.

c) Based on the environmental and financial findings above, what does the Feasibility Study recommend?

See section 9 Conclusions and Recommendations page 91 of the study.

4. Lead Applicant's Next Steps

a) Taking the Feasibility Study's recommendations into account, what next steps do you as the municipality plan to take? What potential benefits or internal municipal improvements would result from these next steps?

Hatch has shared a supportive and realistic overview of the growth in the hydrogen sector, its role in contributing to Provincial, National, and worldwide climate reduction targets and the potential for development of a production and storage hub in the Bruce region. There are several key take-aways from both the feasibility analysis and from the market assessment. The list below represents a few of the main points and although it is not an exhaustive list.

1. The demand for hydrogen in Ontario can be expected to grow significantly in the next thirty years to meet Ontario and Canada's climate goals. Several hundreds of megawatt capacity of electrolysis is anticipated to match the forecasted demand.

2. The market assessment highlighted that there is very little demand for hydrogen at this time locally in the county.

3. Sectors identified as possible export opportunities for green hydrogen consumption primarily outside of the Bruce Region include: a. Industry & Ammonia Production b. Transportation c. Power-to-Gas
4. A 5MW demonstration plant, as considered in this study, has been deemed to be technically feasible. However, it is not financially viable today with the current grid electricity pricing in Ontario and market prices of grey and blue hydrogen. At present there are no incentives for consumers to purchase green hydrogen at a premium in Canada.

5. Environmental Impact: A hydrogen generation plant will not cause any negative environmental impacts. The use of hydrogen to decarbonize various sectors will lead to positive environmental impact by displacing fossil fuels. a. The greatest environmental benefits are realized by displacing gasoline and diesel in the transportation sector, with the potential to reduce emissions by 89% and 85% respectively for every Liter of fuel displaced.

6. Economic Impact: A hydrogen facility in the county will provide economic benefits for the county both during construction and operations. The growth of hydrogen production beyond a 5MW plant in the sector will enhance the existing job mix in the county to close the gap between those in the sales/service sector and utilities.

7. Social Impact: A hydrogen plant has the potential to advance investment in training and education facilities in the county, retain and attract professional talent and position the county as a vital player in Ontario's green hydrogen industry if successfully executed.

8. Underground Storage: Underground formations within the county were identified to hold potential for gas storage but these opportunities would need to be further studied and tested for suitability with Hydrogen.

9. Site Selection: Several potential sites within the Bruce region were identified for the demonstration facility that meet the selection criteria such as land, access to utilities and the potential for expansion to support a growing production hub.

10. Key Recommendations:
    a. Consider a larger (20 MW or greater) starting facility size with vehicle refueling and a contracted off-taker/sponsor for improved financial, economic, environmental, and social impacts.
    b. Negotiate lower fixed electricity price with the IESO and ensure high plant utilization to minimize LCOH.
    c. Seek out sources of funding and determine requirements for applications.
    d. Establish MOUs and LOIs with interested parties to quantify demand, the frequency, cost and mode of supply.

From the analysis provided by Hatch, it is evident that hydrogen can be considered an emerging market in Canada and that the Bruce Region is a prime location to initiate and take advantage of 'first on the market' positioning. Doing so would grow the existing energy sector in the county, stimulate innovation and initiate an opportunity to capitalize on spin offs, next generation job creation and training. As represented in the Bruce Innovates Foundational Hydrogen Infrastructure Overview, a production hub and storage site could act as a catalyst to further sector expansion.

The 5 MW demonstration facility, the focal point of the Hatch report, is identified as an initial step to realizing a hydrogen economy in the county. From the analysis, this facility has the potential to create approximately 15-21 direct and indirect full-time employment opportunities over the two-year construction period and a Gross Value Add (GVA) of between 3.1 M – 4.3 M. Building a larger 20 MW facility would increase both the GVA and the full-time job creation by upwards of 2 times. A 100 MW facility would see that increase further to 5 times.

The operation variance of these facilities would see these same impacts range from starting with the 5 MW at $.4 - $.6 M and 2 FTE job creation annually. The 20 MW would see these numbers multiple by 4 and the 100 MW facility by 11. The job creation potential is a catalyst to evolving training, retaining and attracting skilled workers, entrepreneurial activity and securing the high paying jobs forecasted in NRCAN's federal Hydrogen strategy.

Key markets for the distribution of county produced Hydrogen include transportation, buildings (first by blending with Natural Gas) and industry (ammonia and urea). These markets serve as a

near-term opportunity that can also accommodate a facility scale-up in the mid to long-term. It is noted that the two main cases for Hydrogen in an industrial context are in refining and chemical production. A focus on chemical industrial off-takers in Southwestern Ontario, namely the ammonia and urea industries and by extension fertilizer production. This market serves and will continue to serve the county's strong Agriculture sector. This poses an opportunity to leverage this connection and attract investment in green ammonia. In doing so, relationships to widen and the potential for additional off takers is realized. As demand increases, the potential to export to Sarnia, GTA and the tricity areas, all within a 3-hour transport radius, represents a growth position.

Hatch identified the production facility as having the potential to be a hydrogen industry catalyst. As a "first on the scene" exporter, this would position the county to encourage industry growth and supply a range of markets with a low-carbon hydrogen option to meet their needs and reduce their environmental impacts. Doing so would enable the county to evolve into a major player within the hydrogen space and stands to gain longer-term economic and social benefits, encouraging investment and growth of the energy sector while leveraging its existing nuclear presence and facilitating the energy industry's further shift to decarbonization.

Conclusion: Establishing a Long-Term Production Hub: Establishing a large-scale hydrogen production hub is considered by Hatch to be a parallel and independent task from the initial demonstration facility. High hydrogen demand is forecasted in Ontario (that could be supplied by multiple production hubs) and although no key technical barriers were identified to prevent the county from contributing to or even catalyzing this hydrogen market growth, a substantial amount of work must still be done in order to realize this goal and to de-risk pursuing a large-scale production hub. Hatch has identified two key areas that pose the highest risk to this vision and recommends the following actions to allow for a more informed decision on the program:

1. Socialize with critical program stakeholders
    - Promote and bring to the forefront of public and industry stakeholders (IESO, government, vendors and sponsors) awareness and inform companies that they should act and plan for their hydrogen adoption or carbon reduction strategy.
    - Understand if there is interest and to what level.

2. Gauge specific hydrogen demand interest
    - The low-carbon gaseous hydrogen market still needs to be established or incentivized to make this venture viable. Limited and inadequate hydrogen demand exists in the county today and new demand opportunities would need to be coordinated locally (e.g., an ammonia plant) or exported to other demand centers to support a production hub. Identifying specific hydrogen off-takers will provide insight into the deployment roadmap and de-risk the endeavor for more informed decision making.

Points for Consideration in Determining Next Steps: Hatch has presented a professional overview of the Bruce Innovates concept with recommendations and considerations in moving the initiative forward. With the completion on this work, staff are seeking Council's direction on next steps with the following considerations:

- Share the completed feasibility study with potential commercial developers to advance the potential production hub and storage capability.
- Continue to entertain supports for firms in the hydrogen space aside from involvement in the Bruce Innovates initiative as key economic drivers in filling the energy diversification gap and current labour gaps.
- Begin discussions with the NII and the Centre for Next Generation Nuclear Technology to work together an align efforts avoiding duplication in advancing the hydrogen sector in the county.
- Facilitate and support Private Sector Partnerships with the Bruce County Federation of Agriculture as an important future industry growth initiative.

5. Lessons Learned

In answering the questions in this section, please consider all aspects of undertaking the Study — from the initial planning through each essential task until the Final Study was prepared.

a) What would you recommend to other municipalities interested in doing a similar Feasibility Study? What would you do differently if you were to do this again?

Conducting a fulsome feasibility study is an important first step in any project especially a large scale one like hydrogen production and storage. Carefully construct the weighting for the evaluation of the proposals submitted through a tender process to ensure the most capable consultant is hired and not necessarily determined by the lowest cost. Hire a firm that was experienced in both the technical aspects but also in the triple bottom line and economic impact. We received this in the end but it was a difficult road.

b) What barriers or challenges (if any) did you encounter in doing this Feasibility Study? How did you overcome them?

The cost associated with this kind of endeavour is always a challenge. One that we would not have been able to do without the support of FCM. We do feel that the other levels of government need to quickly get on board with projects in support of reducing climate change impact and reaching a net zero reality.

6. Knowledge Sharing

a) Is there a website where more information about the Feasibility Study can be found? If so, please provide the relevant URL.

Our project overview can be found here: https://www.brucecounty.on.ca/business/bruce-innovates-foundational-hydrogen-infrastructure-project

We can distribute the full report via email.

b) In addition to the Feasibility Study results, has your Feasibility Study led to other activities that could be of interest to another municipality (for example, a new policy for sustainable community development, a series of model by-laws, the design of a new operating practice, a manual on public consultation or a measurement tool to assess progress in moving toward greater sustainability)? If so, please list these outcomes, and include copies of the relevant documents (or website links).

No, not at this time.

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