**Research Opportunities**

**MSc Project: Life Cycle Assessment of Net Zero Energy Housing Technology for the Canadian Egg Industry (2 years @ $20,000 annually)**

As much as 30% of greenhouse gas (GHG) emissions are attributable to the building sector, largely due to energy use over the lifespan of buildings (UNEP 2009). Net zero energy building technologies aim to create buildings that produce at least as much renewable energy on site as they consume on an annual basis. Little work has been advanced to date to evaluate the feasibility and mitigation potential of net zero energy building technologies in the intensive animal agriculture sector (also a key GHG emitter), where housing is typically employed for confined poultry, pork and dairy production. A net zero energy layer (egg) barn pilot project - the first of its kind in Canada - is currently underway in Alberta. This MSc project will quantify the life cycle resource use and emissions reduction benefits associated with application of net zero energy technologies in this context, as well as undertake scenario modelling to evaluate potential technology optimization strategies.

This project will commence in January, May, or September, 2018. Interested students should e-mail a description of research interests (referring, in particular, to how your interests and experience relate to this project), a CV (including two academic and/or professional references), and copies of unofficial transcripts to Dr. Nathan Pelletier (nathan.pelletier@ubc.ca). Please also indicate your interest in particular degree programs at UBCO, including in Biology, or through the Interdisciplinary Graduate Studies Program. This project will be co-supervised with Dr. Rehan Sadiq and Dr. Kasun Hewage (UBCO School of Engineering).

For more details, visit the Food Systems PRISM Lab website (www.prismlab.weebly.com). Also visit the UBC Okanagan College of Graduate Studies website for more information about graduate studies at UBC Okanagan, including information on how to apply.

Application deadline to the UBCO College of Graduate Studies is June 2 for January admission, October 1 for May admission and January 31 for September admission. Prospective students are advised to correspond with Dr. Pelletier well in advance of this date in order to discuss their candidacy.

**MSc Project: Life Cycle Assessment of Net Energy Requirements and GHG emissions for the Supply and Use of Irrigation Water in the Okanagan Valley, Canada (2 years @ $20,000 annually)**

Irrigation can contribute a significant share of the total life cycle (i.e. supply chain) greenhouse gas emissions associated with food products from irrigated production systems. Irrigation water in the Okanagan Valley in British Columbia, Canada is predominately derived from either upland (gravity flow) or valley lake (pumped) sources. Delivery infrastructure varies with source and, depending on target crop and management strategy, irrigation water may ultimately be applied using a range of irrigation technologies (for example, drip line, rain gun, spray boom, etc.). Net energy requirements and greenhouse gas emissions will therefore vary with source and technology. This two year funded MSc research project in the Food Systems PRISM Lab ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)) at the University of British Columbia – Okanagan will focus on characterizing the comparative life cycle greenhouse gas emissions associated with the predominant irrigation water delivery and application patterns in the Okanagan Valley. The outcomes will support future development of best management practice guidelines for reducing the carbon footprint of the Okanagan irrigation water systems.

Project outputs will include: (1) An MSc thesis; (2) life cycle inventories for predominant irrigation water delivery systems and application technologies in the Okanagan Valley (these inventories will be contributed to the forthcoming Canadian Agri-food Life Cycle Data Centre); (3) peer-reviewed journal articles describing the life cycle assessment study methods and results; and (4) presentation of findings at academic conferences and industry meetings.

This project will commence in September, 2018. Interested students should e-mail a description of research interests (referring, in particular, to how your interests and experience relate to this project), a CV (including two academic and/or professional references), and copies of unofficial transcripts to Dr. Nathan Pelletier (nathan.pelletier@ubc.ca). Please also indicate your interest in particular degree programs at UBCO, including in Biology, Management, or through the Interdisciplinary Graduate Studies Program. For more details, visit the Food Systems PRISM Lab website ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)). Also visit the UBC Okanagan College of Graduate Studies website for more information about graduate studies at UBC Okanagan, including information on how to apply.

Application deadline to the UBCO College of Graduate Studies is January 31 for September admission. Prospective students are advised to correspond with Dr. Pelletier well in advance of this date in order to discuss their candidacy.

**MSc Project: Life Cycle Assessment of Nitrogen Efficiency Strategies for the Canadian Egg Industry (2 years @ $20,000 annually)**

Nitrogen use efficiency is important in terms of the net energy, nitrogen, and carbon footprint balance of egg production. For farms producing their own feeds and cycling manure nitrogen on-farm, minimizing N loss is also economically important. Several variables are influential in nitrogen use efficiency and cycling, such as feed composition, feed conversion efficiency, moisture content of hen excreta, and manure management strategies. The former includes collection and handling technologies, residency in storage, storage cover, and land application and incorporation methods. Manure belt systems and manure drying have been proposed as a strategy to reduce losses of nitrogen as ammonia from layer hen manure, as well as to improve air quality. A project will be undertaken by Alberta Agriculture and Forestry in cooperation with Egg Farmers of Alberta in early 2017 to evaluate energy inputs required for use of manure belts and manure drying, as well as N losses under different manure drying regimes.

This two year funded MSc project in the Food Systems PRISM Lab ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)) at the University of British Columbia – Okanagan will build on the Alberta research, using the collected data in the context of a full supply chain model to estimate net energy, nitrogen, and carbon footprint trade-offs associated with specific management interventions (i.e. alternative feed compositions and manure management strategies, including use of manure belts). The project will identify optimum management configurations for supporting reduced energy use, improved nitrogen efficiency, and carbon footprint reduction.

This project will commence in January, May or September 2018. Interested students should e-mail a description of research interests (referring, in particular, to how your interests and experience relate to this project), a CV (including two academic and/or professional references), and copies of unofficial transcripts to Dr. Nathan Pelletier (nathan.pelletier@ubc.ca). Please also indicate your interest in particular degree programs at UBCO, including in Biology, Management, or through the Interdisciplinary Graduate Studies Program. For more details, visit the Food Systems PRISM Lab website ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)). Also visit the UBC Okanagan College of Graduate Studies website for more information about graduate studies at UBC Okanagan, including information on how to apply.

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**MSc Project: Design of the Canadian Agri-food Life Cycle Data Centre (2 years @ $20,000 annually)**

The Canadian Agri-food Life Cycle Data Centre (CALDC) will provide a publicly accessible, web-based repository of life cycle inventory (LCI) data to support food system life cycle sustainability assessment, management and reporting initiatives in Canada. The CALDC will host a database and user interface that will enable users to both access and contribute data to a digital commons subject to a suite of data management protocols that are consistent with international best practice and recommendations for life cycle inventory databases. These protocols will promote data quality and consistency, which is essential to robust and reproducible life cycle sustainability modelling, as well as interoperability with other LCI databases. This two-year funded MSc project in the Food Systems PRISM Lab ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)) at the University of British Columbia – Okanagan will review and advance international best practices with respect to life cycle inventory database design and access, culminating in the creation of the CALDC database.

This project will commence in January, May or September 2018. Interested students should e-mail a description of research interests (referring, in particular, to how your interests and experience relate to this project), a CV (including two academic and/or professional references), and copies of unofficial transcripts to Dr. Nathan Pelletier (nathan.pelletier@ubc.ca). Please also indicate your interest in particular degree programs at UBCO, including in Biology, Management, or through the Interdisciplinary Graduate Studies Program. For more details, visit the Food Systems PRISM Lab website ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)). Also visit the UBC Okanagan College of Graduate Studies website for more information about graduate studies at UBC Okanagan, including information on how to apply.

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**PhD Project: Data uncertainty and quality management protocols for agri-food life cycle assessment research (4 years @ $25,000 annually)**

Life cycle inventory (LCI) databases provide valuable resources for life cycle assessment (LCA) researchers undertaking to model specific supply chain activities, as the availability of “background system” data for processes that are common across many supply chains obviates the need for every researcher to create full supply chain models from scratch. However, poor quality data and inconsistent data uncertainty reporting for such processes greatly undermines the predictive power of life cycle models. For this reason, data contributions to a common pool LCI data repository must necessarily be subject to strict data uncertainty management and quality protocols. Data uncertainty management for life cycle inventory modelling and impact assessment is a rapidly evolving research area. Broad consensus as to best practices in the field has not yet coalesced. Guidance and protocols specific to food system life cycle modelling are underdeveloped to date.

This four-year funded PhD project in the Food Systems PRISM Lab ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)) at the University of British Columbia – Okanagan will focus on advancing statistical methods and best practices for data uncertainty and quality management in life cycle inventory and impact assessment research for food systems. The project will provide the core data uncertainty and quality management protocols for the Canadian Agri-food Life Cycle Data Centre.

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This project will commence in January, May or September 2018. Interested students should e-mail a description of research interests (referring, in particular, to how your interests and experience relate to this project), a CV (including two academic and/or professional references), and copies of unofficial transcripts to Dr. Nathan Pelletier (nathan.pelletier@ubc.ca). Please also indicate your interest in particular degree programs at UBCO, including in Biology, Management, or through the Interdisciplinary Graduate Studies Program. For more details, visit the Food Systems PRISM Lab website ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)). Also visit the UBC Okanagan College of Graduate Studies website for more information about graduate studies at UBC Okanagan, including information on how to apply.

Application deadline to the UBCO College of Graduate Studies is June 2 for January admission, October 1 for May admission and January 31 for September admission. Prospective students are advised to correspond with Dr. Pelletier well in advance of this date in order to discuss their candidacy.

**PhD Project: Life Cycle Assessment of Renewable Energy and Waste Valorization Options for Canadian Egg Supply Chains**

Direct energy inputs to layer facilities for lighting, heating, ventilation and other processes make a non-trivial contribution to life cycle resource use and emissions for egg production. Similar energy inputs are also required upstream along egg supply chains for breeder facilities, hatcheries, and pullet facilities. Integration of renewable energy systems both for layer facilities and along egg supply chains may therefore provide significant opportunities for improving the life cycle sustainability performance of the Canadian egg industry. Canadian egg supply chains also produce waste streams, along with valorization opportunities that may similar leverage more sustainable outcomes.

 A variety of renewable energy and waste valorization technologies are currently being employed at a subset of egg production facilities across the country or are otherwise being developed. To date, however, there has been no systematic accounting of the distribution, scale, feasibility, mitigation potential and scalability of these technologies for egg production supply chains. With respect to the latter considerations, any such accounting must necessarily consider geographical and climatic factors including the spatial and temporal distribution of solar and wind resources. In the case of waste valorization, the magnitude, distribution, and current fate of important waste streams such as spent hens, mortalities, manure, and egg shells must also be considered. Opportunities for net metering and associated environmental offsets relative to provincial electricity grid mixes must similarly be taken into account.

 This four year, funded PhD project in the Food Systems PRISM Lab ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)) at the University of British Columbia – Okanagan will focus on elucidating the current state of play with respect to renewable energy opportunities for wind/solar and waste valorization for Canadian breeder, pullet and layer facilities. The student will work with Egg Farmers of Canada (EFC) staff to identify and document existing instances of renewable energy/waste valorization technologies in use in Canadian facilities or currently under development via survey and follow-up interviews. A sub-set of example technology applications will be selected for detailed life cycle assessment research. ISO 14044-compliant LCA models will be constructed so as to evaluate the contribution of specific technology configurations to mitigation of life cycle resource use and emissions for Canadian egg supply chains, as compared to the 2012 national average benchmark. The student will also work with EFC staff to develop an anonymized, GIS resource describing Canadian breeder, pullet and egg farm locations. This resource will contribute to developing a national model for regional best-fit technology deployment scenarios to evaluate industry level sustainability gains potentially associated with wide-spread implementation of regionally-appropriate renewable energy and waste valorization technologies. The student will subsequently work with Egg Farmers of Canada to use this information to develop initiatives to support adoption of these technologies in the Canadian egg industry.

 Project outputs will include a PhD dissertation, presentation of results at egg industry association professional meetings, industry-targeted briefs providing regional-scale recommendations for technology deployment, conference presentations, and submission of study results for publication in peer-reviewed venues.

This project will commence in January, May or September 2018. Interested students should e-mail a description of research interests (referring, in particular, to how your interests and experience relate to this project), a CV (including two academic and/or professional references), and copies of unofficial transcripts to Dr. Nathan Pelletier (nathan.pelletier@ubc.ca). Please also indicate your interest in particular degree programs at UBCO, including in Biology, Management, or through the Interdisciplinary Graduate Studies Program. For more details, visit the Food Systems PRISM Lab website ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)). Also visit the UBC Okanagan College of Graduate Studies website for more information about graduate studies at UBC Okanagan, including information on how to apply.

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**PhD Project: Development of a Sustainable Poultry Feed Formulation Decision Support Tool**

The largest share of supply chain resource use and emissions associated with contemporary egg production is attributable to the feeds supplied to pullets and layers. Data collected for a Canadian 2012 national LCA benchmark study indicated considerable diversity in the range and geographical origin of feed inputs from agricultural, livestock, fisheries, and other production systems.

 Each feed input that may potentially be sourced for use in poultry feeds is characterized by a distinctive life cycle resource use and emissions profile, with considerable variability between specific feed materials. Each material is similarly distinct in terms of its nutritional value for poultry, as well as its cost. Feed formulation is currently informed primarily by nutritional and cost considerations. However, “least environmental cost” feed input sourcing is the most critical lever for supply chain sustainability management for egg production. The rapid emergence of supply chain sustainability measurement and reporting programs suggests that consideration of the resource and environmental dimensions of feed sourcing will likely garner increased attention in the egg and other livestock industries.

This four year funded PhD project in the Food Systems PRISM Lab ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)) at the University of British Columbia – Okanagan will focus on the development of a feed formulation decision support tool that will integrate nutritional, cost and environmental impact data for major feed input supply chains for the Canadian poultry industry. Integration of nutritional and cost criteria with environmental impact data is essential, since feed input sourcing recommendations based on environmental criteria alone may result in feeds that are uneconomical or that result in poor feed conversion efficiency (hence negating any gains associated with lower environmental cost feed inputs).

Working with Egg Farmers of Canada staff, the student will survey and conduct follow-up interviews with Canadian feed mills in order to identify the current geographical distribution of feed input sourcing and feed formulation strategies for the Canadian poultry industry. Data for feed input origins, volumes, and cost will be collected. ISO-14044 compliant life cycle assessment models will subsequently be created for each major feed input supply chain, differentiating by production region, technology, and transportation modes. These models will employ data from Statistics Canada, Agriculture and Agri-Food Canada, industry association and consultant reports, and peer-reviewed literature in order to develop the necessary life cycle inventory models on a consistent methodological basis. Working with experts in poultry nutrition and poultry feed formulation, a decision-support tool will be developed and trialled with a subset of Canadian feed mills. The student and EFC will subsequently work with egg producers (many of whom produce their own feeds) and feed mills to support implementation of the decision support tool.

Project outputs will include a PhD dissertation, presentation of results at egg and feed industry association professional meetings, conference presentations, submission of study results for publication in peer-reviewed venues, and a ready-to-use decision support tool for poultry feed formulators.

This project will commence in January, May or September 2018. Interested students should e-mail a description of research interests (referring, in particular, to how your interests and experience relate to this project), a CV (including two academic and/or professional references), and copies of unofficial transcripts to Dr. Nathan Pelletier (nathan.pelletier@ubc.ca). Please also indicate your interest in particular degree programs at UBCO, including in Biology, Management, or through the Interdisciplinary Graduate Studies Program. For more details, visit the Food Systems PRISM Lab website ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)). Also visit the UBC Okanagan College of Graduate Studies website for more information about graduate studies at UBC Okanagan, including information on how to apply.

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**PhD Project: Life Cycle Sustainability Measurement and Management Program for Canadian Egg Producers**

Evolving marketplace expectations – in particular from food processors and retailers – are placing increasing pressure on agricultural producers to measure, report, and demonstrate continuous improvement with respect to sustainability indicators. Current and emerging programs and requirements are heterogeneous in terms of specific indicators employed, associated methods and data requirements, and rigor. A common approach based on best-available life cycle sustainability measurement science and data is lacking.

This four year, funded PhD project in the Food Systems PRISM Lab ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)) at the University of British Columbia – Okanagan will answer this challenge by developing and implementing a rigorous, life cycle sustainability assessment platform (SAP) for the Canadian egg industry. The platform will integrate other research outputs in the Food Systems PRISM Lab, including: (1) a full egg industry supply chain LCA model based on a 2012 baseline model; (2) research regarding sustainability best management practices; (3) research regarding green technology options for Canadian egg farms; and (3) a sustainable feed formulation decision support tool. The platform will enable individual egg farmers to evaluate, monitor, and report the supply chain resource requirements and waste emissions attributable to their products relative to regional, national and housing system average benchmarks across a range of relevant resource and environmental impact domains. The calculator will also provide for assessment of the mitigation potential associated with farm-level achievement of industry best practice benchmarks or implementation of specific green technology options. This will allow farmers to set individual goals and define strategies for goal achievement.

The student will subsequently work with Egg Farmers of Canada to develop programing to incentivize implementation of the tool industry-wide, and to develop industry-level targets and milestones.

Project outputs will include a PhD dissertation, presentation of results at egg industry association professional meetings, conference presentations, submission of study results for publication in peer-reviewed venues, and a ready-to-use sustainably assessment tool for egg farmers.

This project will commence in January, May or September 2018. Interested students should e-mail a description of research interests (referring, in particular, to how your interests and experience relate to this project), a CV (including two academic and/or professional references), and copies of unofficial transcripts to Dr. Nathan Pelletier (nathan.pelletier@ubc.ca). Please also indicate your interest in particular degree programs at UBCO, including in Biology, Management, or through the Interdisciplinary Graduate Studies Program. For more details, visit the Food Systems PRISM Lab website ([www.prismlab.weebly.com](http://www.prismlab.weebly.com)). Also visit the UBC Okanagan College of Graduate Studies website for more information about graduate studies at UBC Okanagan, including information on how to apply.

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