

# **MISSION 2050 - RESEARCH AND INDUSTRY INFRASTRUCTURE IN THE YEAR 2050**

**(A Conceptual Framework)**

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*“The greatest challenge in the 21<sup>st</sup> century will be the human-induced changes in the environment “(NRC, 2003).*

## **INTRODUCTION**

Mission 2050 is an endeavor to replace the animal research facilities currently operated under contract by the University of Guelph for the Agricultural Research Institute of Ontario and the Ministry of Agriculture, Food and Rural Affairs. The project envisions a complex that has the flexibility to answer many current and future challenges and opportunities that face a majority of the livestock industries in Ontario and elsewhere. The planning has involved various academic and industry stakeholders, and is being discussed with government officials. There is no final master plan that fully accommodates all of the stakeholder needs, but we are continuing to work toward this objective so that the scope of the project can be properly assessed.

## **MISSION 2050**

Mission 2050 (M 2050) will establish a new model of sustainable animal agriculture systems with broad ramifications and applicability at local, regional and global scales. It will establish Ontario at the forefront of agri-food research, innovation and technology development, advancing an agenda of improved sustainability for animal plant ecology systems that flow from the ‘total resource recovery’ approach, with embedded environmental, economic and social objectives. It will serve as an integrated laboratory for the research and development and transfer of next generation primary based ‘eco-products’, ‘green’ technologies and renewable energy systems that will augment traditional agricultural production and provide the economic foundation for the development of ‘next generation’ animal production systems. At Mission 2050, the integration of economic and environmental stewardship objectives will promote sustainable, rural communities in Ontario, through income augmentation, diversification and independence from commodity and energy price fluctuations.

M 2050 is designed as a facility for world-class dairy, poultry, swine- production environmental research, innovation, and new technology development; connecting people and ideas, and a program to create inventive and economically viable opportunities for new

agricultural based industries. The M 2050 program is envisioned as a leading edge research facility designed to bring scientists from many disciplines to converge and work on integrated solutions to rural/urban environmental, social and economic issues.

### **AN INTEGRATED AGRI-ECOLOGY CAMPUS**

As the centre for research on environmentally based, high production dairy, poultry and swine systems, M 2050 will serve as a ‘rural economic incubator’ that links broad areas of agriculture, and ecology with bio-engineering to foster synergistic research opportunities and innovative technology development.

The facility provides a robust backbone of infrastructure along with cutting-edge technologies that facilitates “plug and play” research and the integration of life sciences, bio-engineering and renewable energy investigations.

Unprecedented globally, M 2050 will establish an agri-ecology campus and world’s leading research centre that adopts a ‘total resource recovery’ approach. The planned program focuses on the science and solutions for economic and environmental footprints of animal enterprises, while generating new knowledge in many related fields of research. It will serve as the testing ground for new animal and eco-products, green technologies and renewable farm-based energy that will provide new life to rural communities.

### **ENERGY RESEARCH / HARVESTING AND FACILITIES**

M 2050 will be Canada’s leading research centre for studying and developing the integration of farm-based renewable energy systems, incorporating biogas, solar and wind power production capabilities and will be a net producer of grid based and/or mobile fuel energy. Facilities and infrastructure to develop novel energy, stationary and mobile fuel products will offer innovative fossil fuel replacement products derived from otherwise environmentally problematic organics streams.

Energy research will focus on increased utilization of farm based renewable energy to transform agriculture production systems from a heavy fossil fuel consumer to a net generator of renewable energy. This component addresses the comprehensive system of crop production and energy intensive fertilizer production, mobile energy usage and equipment re-powering with bio-based fuels.

At M 2050, energy, fuel generation and storage technology will be developed that captures and transforms rural geographic and bio-based energy into next generation energy and carbon products. Technology development will occur throughout the animal enterprise, with scalable systems relevant to small and larger scale animal operations. The integration of on-site wind, solar and bio-fuels production optimizes the full on-site potential for green powering in response to diverse and intermittent energy production and demands. Farm based renewable energy will be a key driving force behind creation of these ‘rural economic incubators’.

## **REDUCING THE ENVIRONMENTAL FOOTPRINT**

The primary sphere of focus is the ‘green powering’ of animal operations, resource delivery, crop production, and farm-based renewable energy generation to advance rural social, economic and environmental sustainability, through multidisciplinary research.

Conversion of organics into new products, before they become waste that compromises environmental, human and animal health, presents exceptional research opportunities. Reverse engineering, geared to transformation of waste products through natural processes, allows under utilized resources and nutrients to be turned into new products and novel foods including pharma- and nutraceuticals. Novel industrial bio-products, such as bio-based fossil fuel and fossil carbon alternatives and bio-based energy storage systems yield on-farm direct replacements for imported and transport-intensive fossil carbon products.

At M 2050 research into enhanced utilization of resources, such as feed, water and energy, will result in radical and ongoing reductions of the environmental footprint of animal operations and will transform intensive animal facilities into bio-energy production and ‘rural knowledge centres’ for bio-based products and green technologies.

## **CO-PRODUCTS FROM ORGANICS**

‘Closing the loop’ on environmental organic waste streams means ‘up-engineering’ and ‘reverse engineering’ of resources and nutrients by allowing natural processes to transform problem organics into products. This waste-cycle thinking leads to a paradigm shift that suspends the need to use large amounts of energy, resources and emissions, while stimulating major opportunities for new eco-based technology development.

Renewable animal sourced co-products provide important fossil fuel and carbon-free products for on-site generation of needed crop and animal enterprise inputs, and provide new sources of farm based income through the production of bio-based co-products.

New photo- and bio-reactor technologies that generate specialty industrial oils, pigments, acids, fertigation and other bio-products are further profit centres for direct transfer and use as bio-based fossil fuel and fossil carbon alternatives in industrial green-twinning interconnected systems. Bio- and nutraceuticals can be incorporated on site as novel metabolic modifiers enhancing animal function and productivity. In addition, bio and nutraceuticals represent eco-driven solutions for industrial and urban applications. The E/D 2050 facility will ensure that new advances made by advancing knowledge and integration reach speedy application within Ontario’s farm community and the global marketplace.

## **EMISSIONS MONITORING / MITIGATION RESEARCH AND FACILITIES**

A comprehensive program of emissions measurement, mitigation and sequestration is planned, which addresses the complete cycle of animal feeds production, conversion to milk,

meat or eggs and organics transformation. This includes studies of individual cow, sow, hen and facility emissions and farm-wide emission sequestering.

Creating a pleasant animal environment through solar-based emission sequestration fosters long-term compatibility and coexistence of rural livestock and emerging residential communities. Sequestering noxious emissions proactively provides a healthier environment for animals and staff.

The ‘scalability’ of the renewable energy systems and organics cycling programs developed at M 2050 will have broad applicability to rural Ontario and broad implications for Canada’s multifaceted air quality emission reduction strategies.

## **MULTIDISCIPLINARY RESEARCH AND PARTNERSHIPS**

The integrated nature of the M 2050 facility design provides the conditions and opportunities for broad-based partnerships in interdisciplinary research, entrepreneurship, industrial partnering and collaboration between educational institutions and government. Systems innovations necessary to cluster agricultural, life science and bio-engineering research with technology development and primary companies in the agricultural / animal sector will be developed.

Research facilities are organized in a campus like setting that promotes on-going interdisciplinary collaboration and provides a sense of innovation that will be attractive to leading researchers, diverse partnership, funding opportunities and the public.

Complementing its primary role as a multidisciplinary research instrument, M 2050 will also serve as an active campus for post secondary education, including a full range of environmental and educational programs, technology transfer activities, workshops and field trips. Public outreach and conference facilities are provided to stimulate ‘next generation’ producers, transfer technology to rural and urban communities and provide a unique, environmentally focused public destination.

## **ANIMAL-SIDE RESEARCH**

‘High Performance’ animal design focuses on animal health, comfort, hygiene, productivity, reproduction and operational procedures using state of the art, future-driven facility innovation throughout, with a focus on high quality research and education.

Designed for health and ongoing productivity enhancement, the facility includes a full suite of innovative next generation technologies, to assure contemporary and future relevance in advancing the state of animal science, operational management and achieving sustainable dairy eco-systems. The integration of nanotechnology and digital monitoring assure attention to animal health and quality of food production.

The radial-linked functional components are ensconced in a layered system of bio-security that promotes the participation and interaction of allied researchers without compromising animal and food quality health standards. The dairy herd is managed through the ‘Nucleus’, which provides for efficient, centralized animal handling, treatment, and segregation, controlled animal flow and exceptional research flexibility.

## **ANIMAL CO-PRODUCTS**

The objectives for development of novel animal products and innovative ecosystem-linked marketing strategies offer opportunities to create new consumer desired products with unique health and sustainable attributes. Neutra-ceutical sourced products and pharmaceutical product development provide opportunities to meet specific diet and health needs.

Development and implementation of small footprint novel products will allow farm-scale production of high value animal-sourced products to meet emerging and future organic-, eco-, health-, and environ-focused markets.

Specialty product generation provides rural Ontario career track opportunities for highly trained technologists and professionals. Rural artisan and specialty products provide an important opportunity for connecting consumers with the culture, science and technology of food production. This instills new confidence in, and support for, rural Ontario sourced animal enterprise centered food, fuel and industrial products.

