Topic: Emerging Technologies and Sustainability with an emphasis on carbon footprint reduction

Name(s) of the fellow(s) taking part:

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Summary of the project focus

Companies are adopting emerging digital technologies to increase efficiency and productivity, enhance customer experience, and create value. This also enables insights to help decision-making [1]. In addition to the above-mentioned goals, emerging technologies can contribute to the sustainability of corporations and organizations. One of the most crucial aspects of sustainability is reducing carbon footprint to combat climate change. The digital economy has considerable promise for lowering carbon footprints and represents the future of scientific and industrial growth [2]. Despite the progress in using new technologies to minimize carbon footprints, more research is still needed to fill the gaps and know how those technologies can contribute more to sustainability and carbon footprint reduction [3]. The increasing need for sustainable business and management, particularly in decarbonization and carbon neutrality, drives this project to investigate innovative sustainable solutions based on emerging technologies.

This project aims to critically analyze how emerging technologies contribute to the sustainability of organizations and corporations, focusing on reducing carbon footprints. By focusing on artificial intelligence (AI), blockchain, Internet of Things (IoT), and renewable energy innovations, the research will assess their impact on corporate sustainability strategies across various sectors, emphasizing the education sector.

After this conceptual/contextual phase, perhaps at the end of year 2, a specific project focused on greening and decarbonizing university campuses will be proposed **(See the project summary in Appendix 1)**. During the conceptualizing phase, the project team will seek funding sources for that project to be tested and implemented for a European-based university campus (i.e., Gisma University of Applied Sciences, Arden University, or both).

Likely or potential impact that is to be expected from the project

The project's focus on how new emerging technologies affect sustainability has the potential to transform the social, economic, and environmental spheres through promoting the implementation of inventive approaches like sustainable transportation, energy-efficient technologies, and renewable energy sources, it seeks to greatly lower carbon emissions while promoting economic expansion, job creation, and social equity.

This research could provide a valuable synthesis of existing knowledge on the role of technology in corporate/organizational sustainability, highlighting effective practices and identifying gaps where further innovation or research is needed. It can guide companies in refining their sustainability strategies, influence policy discussions on technology and environmental regulation, and examine underexplored academic areas.

Some other potential innovative impacts might be providing companies and organizations, academic institutions and policy makers with forward-looking insights, helping them to plan more effectively for long-term sustainability and carbon neutrality goals. By identifying and analyzing technologies on the horizon of adoption, the research can stimulate investment and innovation in new areas, potentially leading to breakthroughs in sustainability practices. There are also are few allied potential outcomes that can be expected from this project on how emerging technologies can help and contribute in the followings,

1. Increased Efficiency in Renewable Energy Technologies: Emerging technologies could lead to significant improvements in the efficiency and cost-effectiveness of renewable energy sources, such as solar photovoltaics (PVs), wind turbines, and bioenergy.

2. Development and Adoption of Carbon Capture, Utilization, and Storage (CCUS) Technologies: CCUS technologies are emerging as a crucial component in the efforts to reduce global CO2 emissions. The successful deployment of CCUS technologies could significantly mitigate carbon emissions from industrial sources and power generation

3. Advancements in Energy Storage Technologies: Emerging technologies in energy storage could lead to higher capacities, longer lifespans, and lower costs, making renewable energy more competitive and reliable, and enabling a significant reduction in carbon emissions by phasing out fossil fuel-based peak power plants

4. Smart Grids and Energy Efficiency Solutions: The development of smart grids and energy efficiency technologies, including advanced metering infrastructure, demand response technologies, and energy management systems, can lead to significant reductions in energy consumption and carbon emissions.

5. Sustainable Transportation Solutions: Electric vehicles (EVs), hydrogen fuel cell vehicles, and advances in public transportation systems are part of emerging sustainable transportation technologies aimed at reducing carbon emissions.

6. Agricultural Innovations for Carbon Sequestration: Emerging technologies in agriculture, including precision farming, genetically modified organisms (GMOs) that require less fertilizer, and carbon sequestration techniques (such as biochar), could lead to a reduction in agriculture-related carbon emissions.

How the project is going to engage GUS institutions/communities/stakeholders and which

The project will include GUS institutions, communities, and stakeholders by means of cooperative research endeavours, initiatives for sharing information, and outreach programs. Interdisciplinary research partnerships will be made easier by working with academic institutions in the GUS network, and outreach initiatives, conferences, and seminars will be used to engage communities and stakeholders and promote discussion and idea sharing.

The key investigators are three GUS fellows, two form UCW and one from Gisam University of Applied Sciences. For the phase of Campus decarbonization, the University of Simon Fraser, the second large university in BC Canada will be involved. The principal investigator (Dr. Mohsen Saeedi) already started the Campus decarbonization for one of UCW campuses in Downtown Canada with the partnership of SFU.

Small research groups will be formed from the beginning both in Europe (Gisma) and Canada (UCW) involving researchers and faculty members from both universities and probably other institutions. Some graduate and undergraduate students will also be involved as research assistants to work with the faculty members.

The specific project (see the appendix 1) will engage other stakeholders like local communities, transportation system, campus operators, staff, and academic schedulers of the institutions that will be studies as cases (e.g. UCW, Gisma, and/or Arden). Masters and PhD students of SFU will also be working with the team in the decarbonization project.

Possible resource implications

The project's resource implications include paying for research, paying publishing costs, and providing logistical assistance for engagement events. Coordination work and staff time set aside for research contributions may be necessary when collaborating with GUS universities. Strategic alliances and effective resource management will be essential to ensuring that the project is completed on schedule and within the allotted budget.

In the phase of the specific project on campus decarbonization, IoT sensors, graduate researcher scholarships, AI and data driven modellers labour cost, transportation and trips, and many other costs might be needed which will be estimated and proposed in a separate proposal in the end of year two.

Work plan

Please indicate briefly and as concrete as possible what you expect the project to have achieved after,

6 Months:

- Literature review
- Initial manuscript (s) drafting

12 Months (Interim Report):

- Research progress update

- Manuscript refinement
- Preliminary publication plan
- Identify and define refined and more specific projects to be researched

24 Months (Second Interim Report):

- Finalize manuscript (s)
- Peer review process
- Initiate Publication (s)
- Clarify and identify funders for the real case project (Green Campus decarbonization)
- Detailed proposal for the real case project based on the findings.

36 Months (Final Report):

- Knowledge mobilization through attending conferences, seminars and workshops.
- Publication of an edited or authored book.
- Journal or book chapter publication (s)
- Start the multi campus project for decarbonization and green campus through combined technologies upon the approval.

Appendix 1. Specific project summary to be started from year 3

Title: Green Campus: A Holistic Approach to Decarbonize University Operations

The collaborative initiative titled "Green Campus: A Holistic Approach to Decarbonize University Operations" brings together University Canada West (UCW), and Gisma University of Applied Sciences, (possibly Arden University), and Simon Fraser University (School of Sustainable Energy Engineering) as the academic partner of Professor Dr. Saeedi and UCW.

The partnership aims to develop an integrated green campus strategy focused on curbing energy usage and CO2 emissions within academic institutions. The project acknowledges the nature of variable occupancy rates and emphasizes the significant impact of student/staff/faculty commuting, and other factors on emissions.

The project's significance lies in its holistic approach to enhancing energy management and academic scheduling, targeting reductions in both on-campus and off-campus CO2 emissions. The objective is to generate and calibrate a **physics-informed data-driven** modelling tool for academic institutions.

This integrated modeling platform will demonstrate sensitivity to academic schedules, weather patterns, city topography, and built environment features of the campus. It will offer tailored emission reduction scenarios to suit each institution's specific requirements, thereby embedding sustainability practices at the core of university operations, utilizing the campus itself as a practical testing ground.

The project's outcomes will extend to designing a graduate-level curriculum on sustainability management tailored for workplace environments.