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2023 McMaster Energy Week Nexus Case Competition: The Future of Fuel

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Abstract
The theme for the 2023 Energy Nexus Case Competition was “The Future of Fuel”. In 2022, gasoline prices reached record highs in Ontario. Canadians use fuel for transportation, electricity, heating, and cooking, among other things. Given the volatility of fuel and our great dependency on it, what are some steps we can take to aide our dependency on fuel? The following abstracts were selected as the top three finalists amongst the delegates chosen for the Energy Nexus Case Competition taking place during the 6th annual McMaster Energy Week. McMaster Energy Week is Canada's first student-led energy week that aims to take the complex and multi-faceted issue of climate change and present solutions towards building Canada's sustainable future. We are bringing together academia, industry, government, communities, and students to further the dialogue on Canadian environment and energy. For more information on this visit https://www.mcmasterenergyweek.com/ or email chair@mcmasterenergyweek.com.

Keywords: conference; case competition; energy; sustainability; fuel; fossil fuels; environment; industry; decarbonization; smart energy; low emission development; energy storage; artificial intelligence; electrification; manufacturing; pulp and paper industry; research facility; electric vehicles; public transportation; fuel cell vehicles; piezoelectric technology

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Conference Abstracts

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Abstracts from Written Reports

Integrating smart grids

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As the world’s energy requirements continue to increase exponentially, we seem to always be on the edge of a new technology that will change the future. Although this is expected considering the advancements in the field both, preexisting technologies like photovoltaic cells and completely new ones like nuclear fusion show great promise. With so many new advancements in clean technology it can be hard to know which ones with impact our future the most. Regardless of the source or the destination we will need a way to transfer energy between them. As our ability to produce clean energy increases, so should our infrastructure. Smart grids are widely considered the best step forward as they incorporate recent advancements in machine

learning to optimize power output while reducing wasted electricity. In 2016 alone, we wasted enough electricity to power 760 thousand homes (7.6 TWh). This was because of a mismanagement of the grid, and Smart models that look at power usage data for cities and districts can optimize the amount of electricity produced, leading to greatly reduced energy waste. These models can help us determine when and how to expand our energy production and help guide the change to clean energy.

Breaking down electrification barriers

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Given the ongoing challenges posed by climate change, there is an increasingly pressing need to identify ways in which we can reduce our dependence on fossil fuels. In addition to being a finite resource, the combustion of these fuels emits harmful greenhouse gases that contribute to an abundance of environmental risks that must be mitigated. Fossil fuel consumption can be divided into four main sectors: Transport, industrial, residential, and electricity generation. The transport industry has a solid decarbonization plan, centered around electric vehicles and public transit, but energy-intensive processing industries, such as metals, chemicals, cement, and paper, are neglected in research on this transition despite being responsible for 30% of emissions. Technical advancements are not lacking in these industries. In fact, the pulp and paper industry has the potential for a complete net-zero transition and the steel industry may be overwhelmingly transformed by the Corex smelting process. However, significant barriers to the implementation of this research indicate that the best way to reduce dependence on fossil fuels is to find a way to bring breakthroughs out of the lab and into the supply chain.

The future of fuel: Steps to reduce dependence and meet energy needs

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The heavy reliance on fossil fuels has resulted in a multitude of environmental issues that have contributed to climate change and health concerns. While political and economic factors play a significant role in the continued dependence on fossil fuels, electric vehicles, public transportation, fuel cell vehicles, and piezoelectric technology present promising solutions. To accelerate the shift towards renewable energy sources, governments and other organizations can implement policies and incentives that make these sustainable solutions more accessible and affordable to consumers. By reducing the overall cost of ownership and increasing the availability of charging infrastructure, people will be more likely to adopt these sustainable solutions. Additionally, regular monitoring and data analysis are crucial for optimizing the performance of these systems and addressing any challenges that may arise.

Conflicts of Interest

The authors declare that they have no conflict of interests.

Authors' Contributions

Please outline the contributions made by each conference abstract book author using the following format, where each author is referred to by their initials:
PL: served as planning committee for energy week, assisted authors with their abstract submissions, drafted the conference abstract booklet, and gave final approval of the version to be published.
ML: served as planning committee for energy week, developed case competition logistics
KG: served as planning committee for energy week, developed case competition logistics
TC: served as planning committee for energy week

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