School of Computer Science
University of Windsor

THE ENVIRONMENTAL IMPACT OF LITHIUM MINING

TOOL: ANYLOGIC

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OUTLINE

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PROBLEM INTRO AND MOTIVATION

- The increasing demand for electric vehicles (EVs) has significantly boosted the need for lithium, a critical component in EV batteries.
- The Whabouchi lithium mining project in Quebec aims to address this demand by employing open-pit mining methods.
- However, this operation raises environmental concerns, particularly in terms of CO2 emissions from mining equipment.
- Understanding the environmental impact and optimizing the mining process is crucial for sustainable development.

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HYPOTHESIS

- By using agent-based modeling to simulate an open pit lithium mine based on the Whabouchi lithium mining operation, can we estimate CO2 emissions and evaluate the net emissions impact of lithium mining for EV Battery production.

- **Goal:** Investigate areas for efficiency improvements and emission reductions

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APPROACH

Data Collection:

- Gathered data on mining equipment, fuel consumption rates, lithium refinement, and environmental impact from various sources, including industry reports and official documents.
- Detailed breakdown of equipment consumption rates and behaviors (Haul Trucks, Hydraulic Excavators, Wheel Loaders, Track Dozers, Drill Rigs).

Agent-Based Model Setup:

- Defined agents Haul Truck and Drill Rigs representing simplified key mining equipment
- Created a statechart for each agent to model their behavior, including states like idle, moving, loading, unloading, drilling, and maintenance.
- Implemented dynamic interactions between agents to simulate the entire mining operation, from ore extraction to lithium processing.

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STATE CHART OF AGENTS

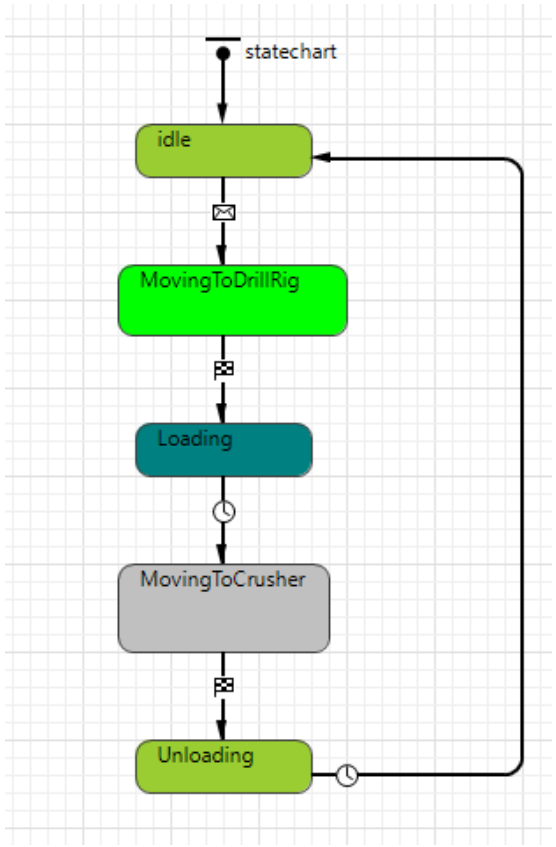


Figure 1: Haul Truck logic

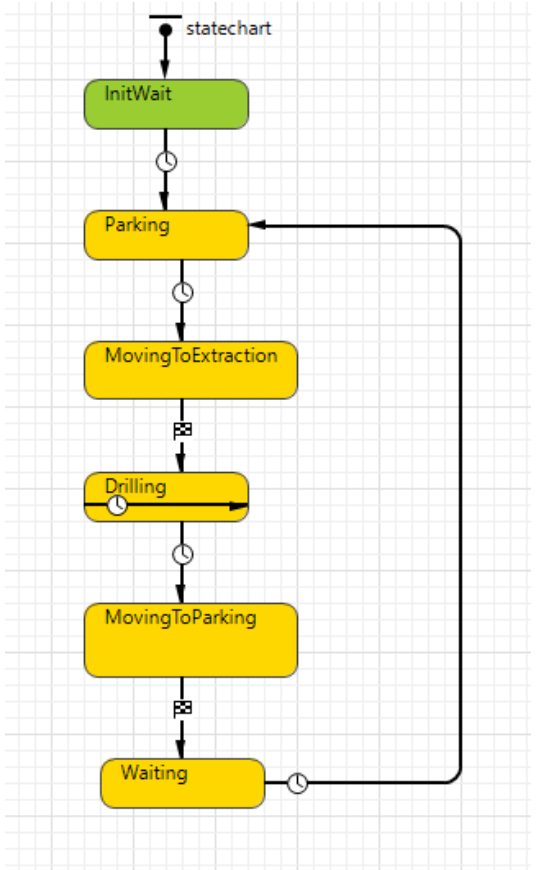
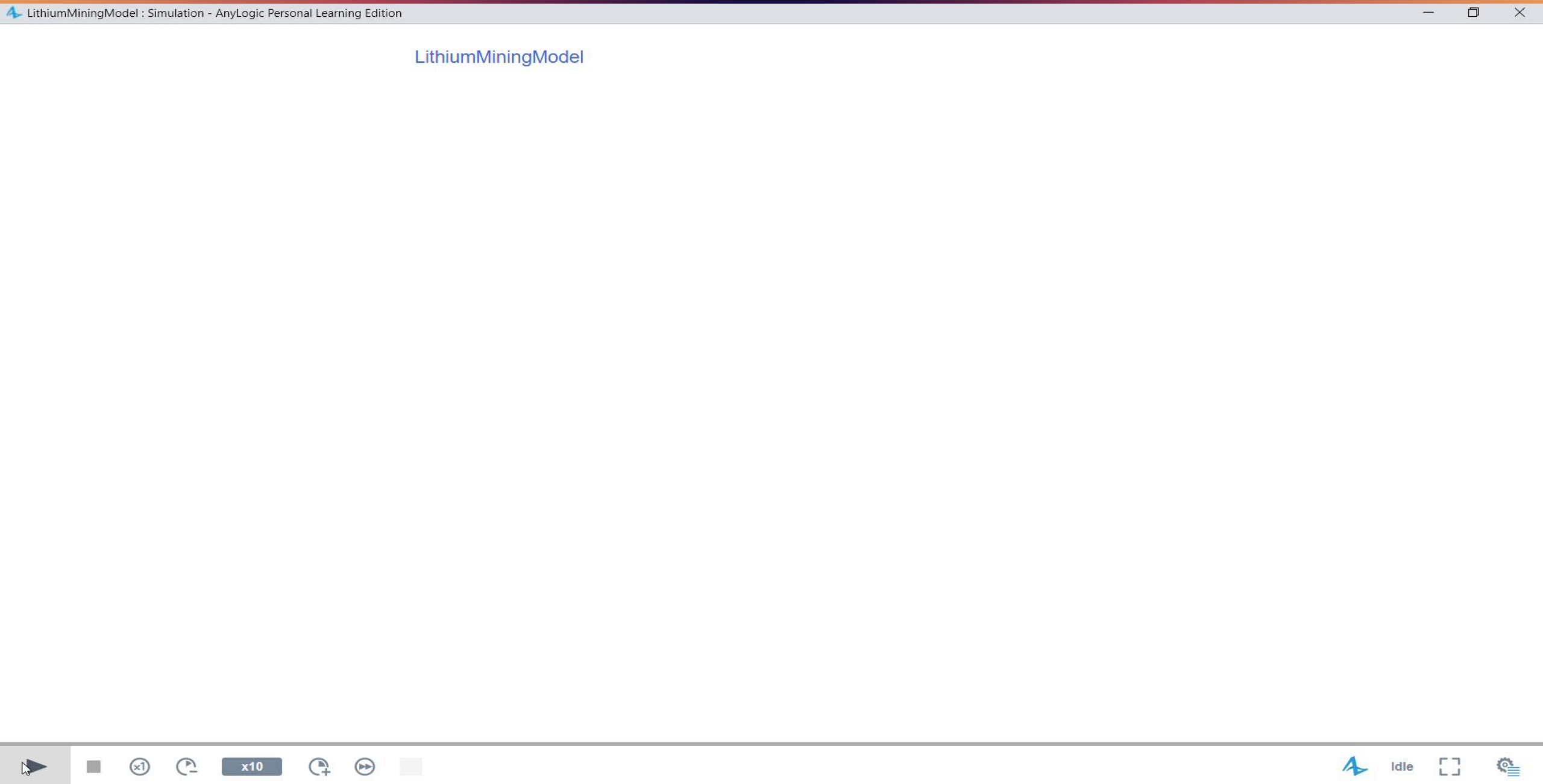


Figure 2: Drill logic

DEMO


LithiumMiningModel : Simulation - AnyLogic Personal Learning Edition
LithiumMiningModel
x10
Idle

EXPERIMENTS

Base Case Scenario:

- Run the simulation under standard operating conditions to establish baseline values for lithium production and CO2 emissions.

Optimization Scenarios:

- Implement potential improvements in equipment efficiency and operational strategies to evaluate their effectiveness in reducing emissions.
    - List Vs. Queue Dispatch Structure

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RESULTS

Base Case Scenario:

- Total Lithium Ore Mined: 17,789,600 tonnes
- Lithium Concentrate: 239,519.174 tonnes
- Tonnes of Li_2O: 3,664.643 tonnes
- Tonnes of Lithium: 1,702.593 tonnes
- Total CO2 Emissions: 38,036.336 tonnes
- Number of EV Batteries Produced: 154,490
- Emissions Saved from EVs: 617,960 tonnes
- Net Emissions Saved: 579,923.664 tonnes

- Identification of the most effective strategies for reducing emissions and increasing efficiency.

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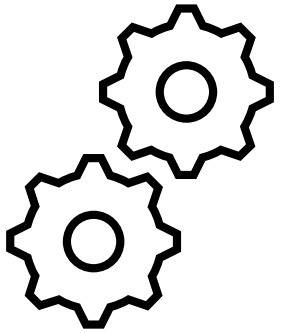
DISCUSSION

- Implications for sustainable lithium mining

- Incorporate Further real life data



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CONCLUSION

- The Lithium Mine agent-based model provides a prototype for the environmental impact of lithium production for EV batteries.

- The simulation results demonstrate potential for CO2 emissions savings through optimized mining operations

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QUESTIONS?

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9. Additional Mining Technology and Canadian Mining Journal articles as referenced throughout the report.

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THANK YOU

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