Hello, everyone, and thank you for having us today. It's a pleasure to be here to discuss our joint project: 'U\_CAN: Ukraine towards Carbon Neutrality.' We are excited to share how integrating advanced AI can lead to smarter and more sustainable cities.

# Slide 1: U\_CAN: Ukraine towards Carbon Neutrality

Today, we present an initiative designed to reduce urban emissions by integrating two key technologies: advanced clustering for traffic pattern recognition and AI-driven signal control. Our goal is to create smarter, more sustainable transportation systems for Ukraine, paving the way for a greener future.

# Slide 2: Background and Motivation

Urban transportation is a primary source of CO₂ emissions, a problem worsened by inefficient traffic management. Our work tackles the challenge of analyzing complex, dynamic traffic data to create truly adaptive solutions. This project directly supports Ukraine's national goals for carbon neutrality and sustainable development.

# Slide 3: Methodology 1: Adaptive Cascade Clustering

At the core of our work is the novel Adaptive Cascade Clustering algorithm. It synergizes the strengths of HDBSCAN and k-means to accurately identify traffic patterns in real-time. A unique weighted voting mechanism ensures the model adapts to changing conditions, delivering superior accuracy and robustness.

# Slide 4: Methodology 2: AI-Driven Traffic Signal Control

Building on this, we use AI for intelligent traffic control through Deep Reinforcement Learning. An AI agent learns optimal signal timings by observing the traffic state, including patterns from our clustering model. The system uses a multi-objective reward function to reduce emissions and improve traffic flow.

# Slide 5: Experimental Setup & Simulation

We validated our approach using the SUMO simulation environment, a powerful tool for traffic modeling. A high-fidelity model of Khmelnytskyi, Ukraine, featuring 15 major intersections, provided a realistic testbed. We generated 22 hours of data covering diverse scenarios for comprehensive evaluation.

# Slide 6: Key Results & Performance Analysis

The results were very promising, showing an 18% reduction in total CO₂ emissions and up to 95% accuracy in identifying traffic scenarios. Our integrated U\_CAN approach consistently outperformed existing methods. It successfully reduced travel times, minimized queue lengths, and lowered total vehicle emissions.

# Slide 7: Conclusions & Implementation Roadmap

In conclusion, our research validates a robust system for reducing urban traffic emissions through synergistic AI. The results demonstrate a clear path toward more intelligent and sustainable transport systems. Our roadmap includes pilot deployments in Ukrainian cities, with future work focusing on real-world data and GNNs.

# Slide 8: Authors & Contact Information

This research is the result of a collaboration between several leading Ukrainian institutions and a team of dedicated experts. For any further questions or potential collaborations, please feel free to contact the corresponding author, Pavlo Radiuk. We are eager to continue this important work.

To wrap up, the U\_CAN project offers a tangible and powerful pathway for leveraging artificial intelligence to meet critical environmental goals. By making our traffic systems more intelligent and responsive, we can create healthier, more efficient cities for everyone.

Thank you very much for your time and attention. I would now be happy to answer any questions you may have.