Hello. I'm Pavlo Radiuk, Thanks for having us here. I am presenting 'U\_CAN: Ukraine towards Carbon Neutrality.' from the Khmelnytskyi team, specifically from Khmelnytskyi National University. We have developed a new AI framework for traffic management. Our work provides a simulation-based justification for its feasibility.

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

We aim to reduce urban emissions. We integrate two key AI concepts: advanced clustering and adaptive signal control. This establishes the theoretical groundwork for smarter, more sustainable transport systems in Ukraine.

# Slide 2: Background and Motivation

Urban traffic is complex. Conventional models often fail. To create adaptive solutions, we must first model these complex patterns accurately. This project proposes a robust theoretical foundation for traffic control, supporting Ukraine's climate goals.

# Slide 3: Methodology 1: Adaptive Cascade Clustering

Existing clustering methods have limits. We introduce the Adaptive Cascade Clustering algorithm. Our hypothesis: no single algorithm is optimal for all traffic data. Our model combines HDBSCAN's structure detection with k-means' boundary refinement for best results.

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

Effective AI control depends on quality state representation. We enrich a Deep Reinforcement Learning agent's state with our clustering patterns. This provides the basis for a more context-aware, efficient policy. It enables strategic optimization over simple reactions.

# Slide 5: Experimental Setup & Simulation

We validated our framework using the SUMO simulation tool. A high-fidelity model of Khmelnytskyi, Ukraine, served as a realistic test environment. A 22-hour dataset covering diverse scenarios was used to assess our model's effectiveness.

# Slide 6: Key Results & Performance Analysis

The simulation provided strong evidence supporting our hypotheses. We achieved an 18% reduction in CO₂ emissions, based on the simulations. We also observed up to 95% accuracy in scenario identification. These results serve as a proof-of-concept, confirming our integrated approach is feasible and effective.

# Slide 7: Conclusions & Implementation Roadmap

In conclusion, our research establishes a sound theoretical foundation for synergistic AI systems in traffic management. The results provide a compelling justification for feasibility. Our roadmap now moves from this theoretical validation to real-world pilot deployments.

# Slide 8: Authors & Contact Information

For deeper discussions or potential collaborations, please contact the corresponding authors, Prof. Eduard Manziuk or me, Dr. Pavlo Radiuk.

To wrap up, the U\_CAN project offers a justified and validated pathway for using AI to meet environmental goals. This principled approach to managing traffic helps build a foundation for healthier, more efficient cities.

Thank you for your time. I am now ready for your questions.