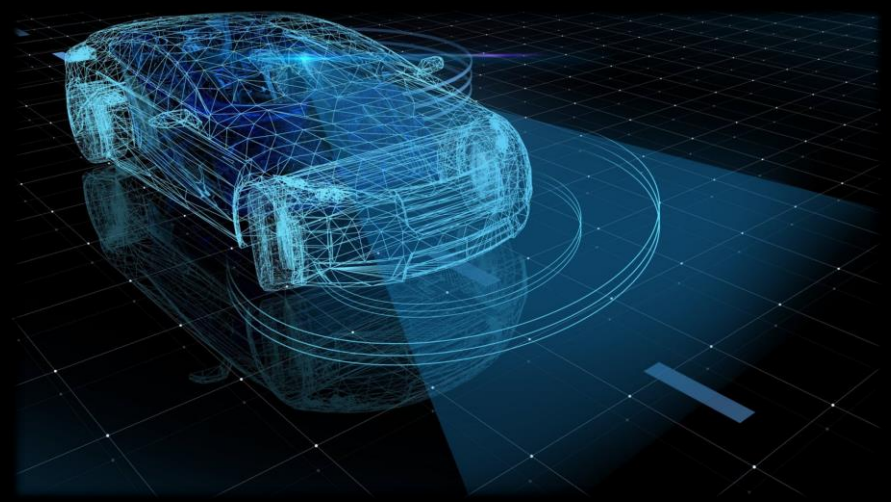
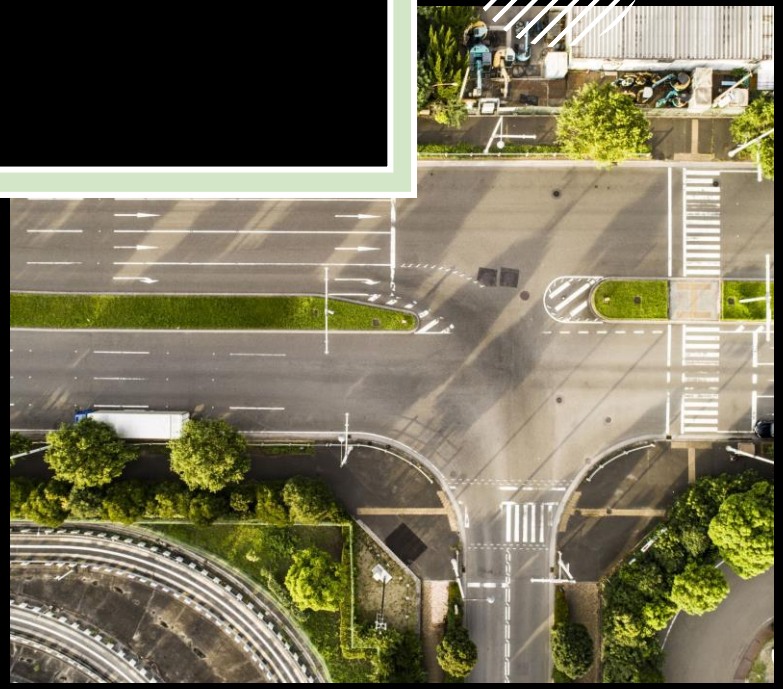


SELF-DRIVING INFRASTRUCTURE

ENGINEER 2PX3 | TEAM 11

Project Scope



- Redesign traditional intersection design [1]
- PERSEID Method
- Traffic delays solutions
- Ethical considerations
- Safety and regulatory considerations

PERSEID: Performance

- Vehicle to X communication[2]
- 3D Mapping and visualization [3]
- Private Sector Collaboration

- Challenges:
  - Software exploitations
  - Latency
  - Signal interference

PERSEID: Socio-cultural

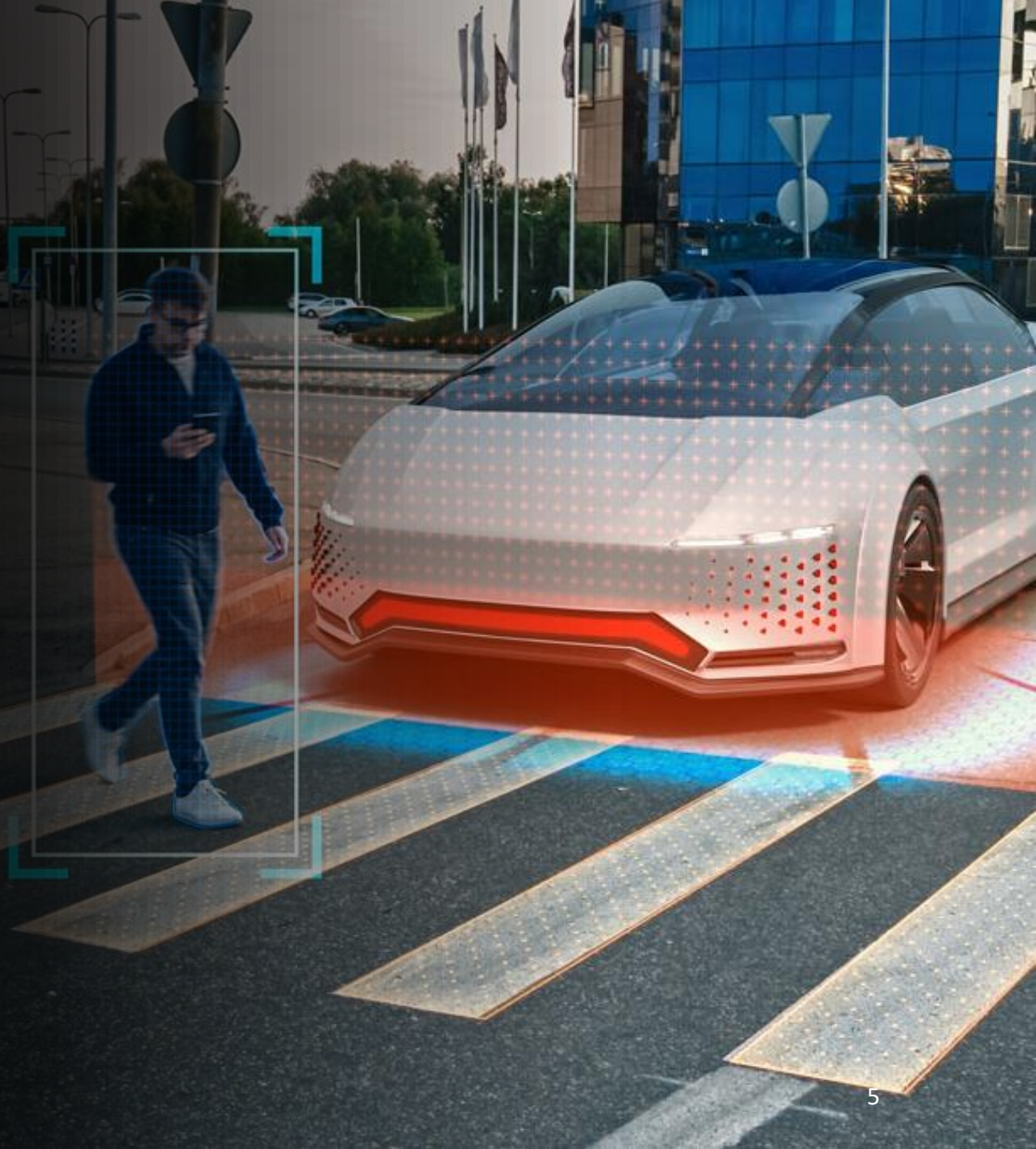
- Reaction time considerations
- Algorithmic bias
- Ethical dilemmas and human life priority

- Challenges:
  - Human driver reaction times
  - Ensuring there is no bias between vehicle passage
  - Self-driving vehicle decision-making

PERSEID: Regulatory

- Speed limits
- Safety structures
- Government policies

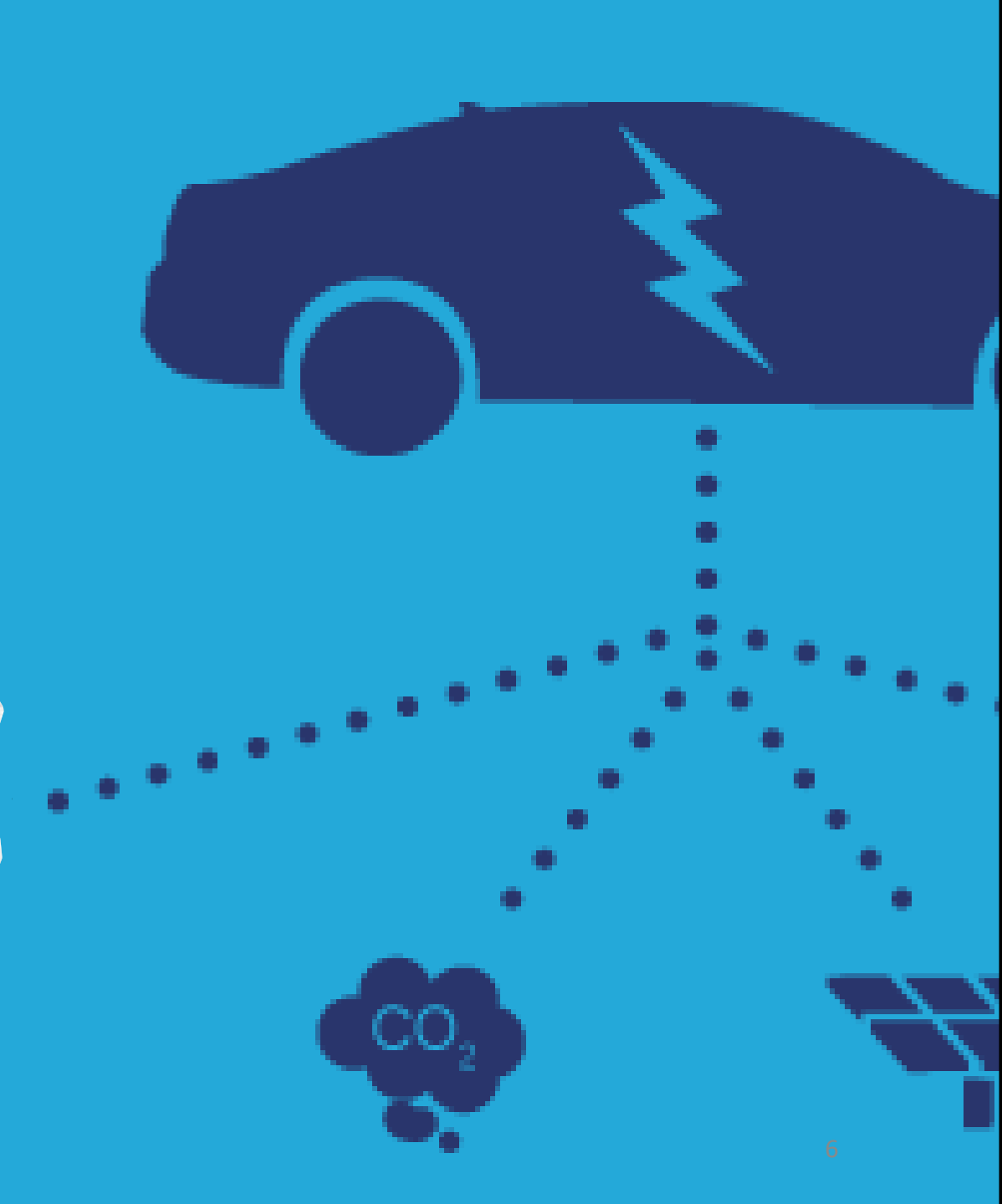
- Challenges:
  - Careful speed limit selection
  - Ethical guidelines (Trolley Problem)
  - Collaborating with self-driving developers7



PERSEID: Environmental

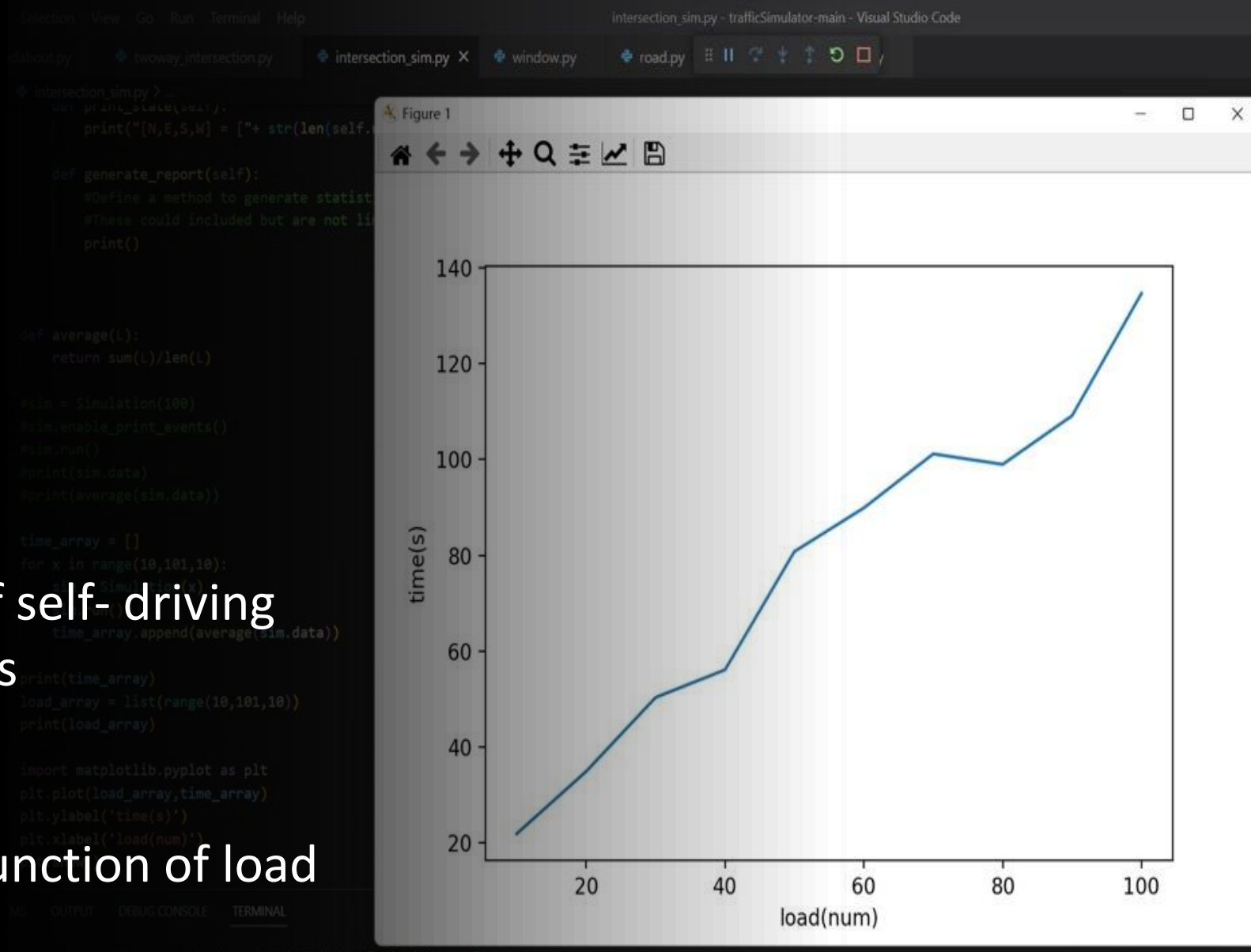
- Sustainable sources
- Vehicle emissions
- Urban sprawl and expansion

- Challenges:
  - Land development
  - Effects on natural environment



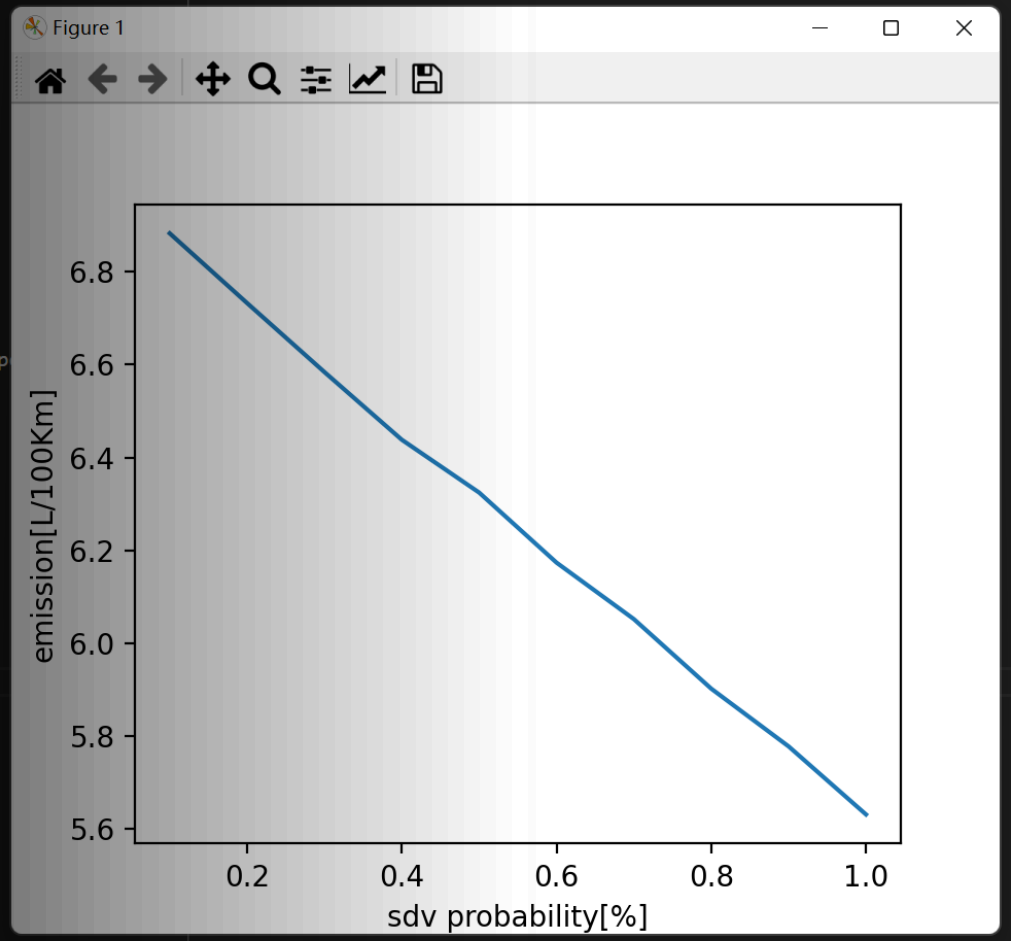
Client Requests

- Client request #1:
  - Performance difference of self- driving and human driven vehicles
- Client request #2:
  - Average travel time as a function of load on the system



Client Requests

- Client request #3:
  - Measure estimated emissions with our code
  - Constraint: energy consumption dependent on the type of driving



Decision Making

Determined the stakeholders and their concerns

- Self-driving vehicles, human-driven vehicles, pedestrians, manufacturers, governing body
- PERSEID method to determine concerns

Progressively research about each PERSEID layer

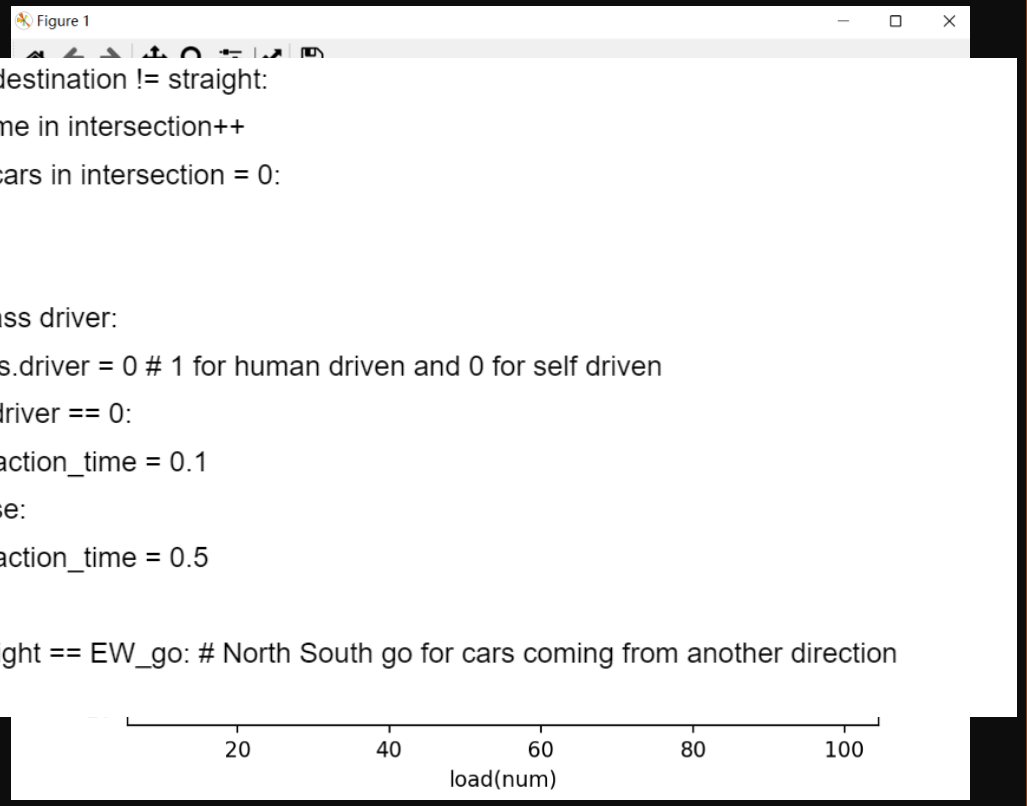
- Discuss about our findings and narrow them

Devised pseudocode then modified code to increase realism of model

- Client requests
- Assumptions

Analyze challenges and conclude design decisions

- PERSEID Analysis



Final Recommendations (Performance)

Vehicle-to-everything (V2X)

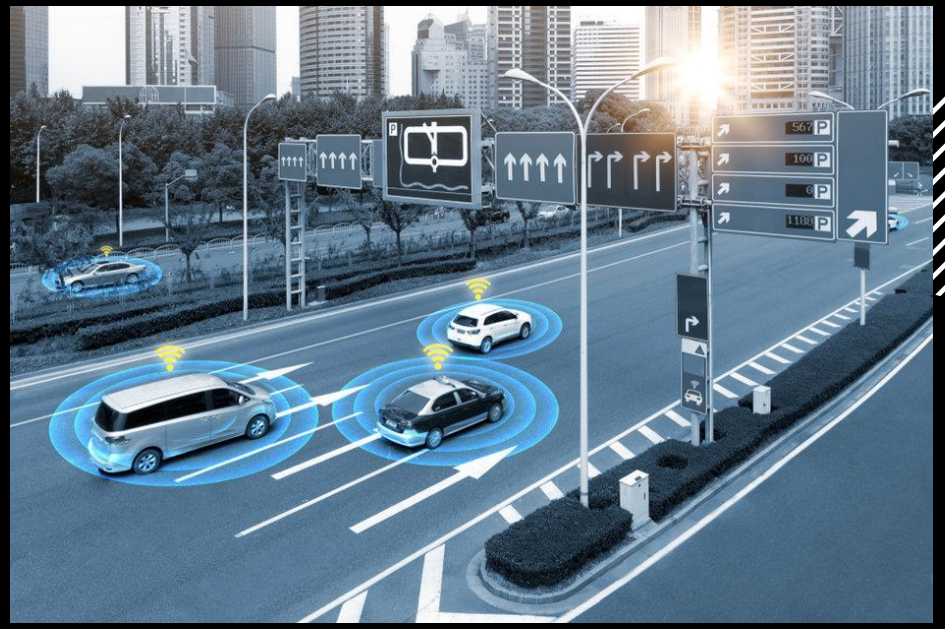
- Broadcast critical information (i.e., speed, direction, hazards)
- Using unmanned aerial vehicles (UAVs)
- 5G-FR expected to have <1ms latency

Directional antennas

- Redirects signals away from areas of interference [4]

3D-Mapping and Visualization

- Using LiDAR
- Feasible in an urban setting

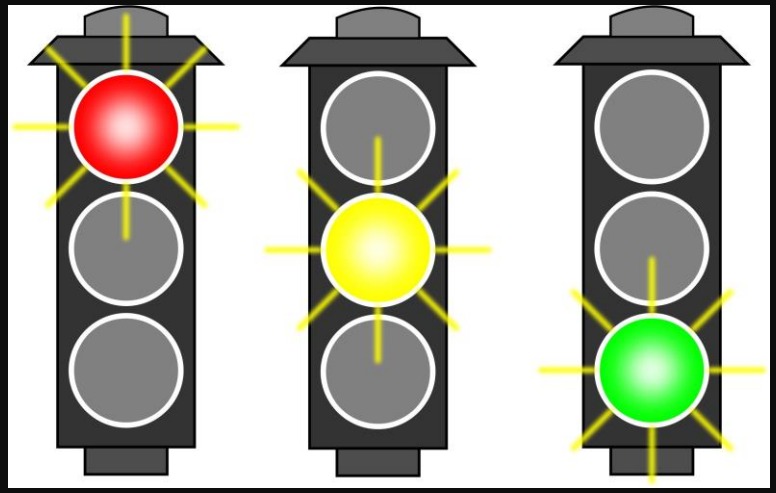


Final Recommendations
(Performance Continued)

Traffic Volume
- Wider roads
- Higher speed limits

Traffic Signal Timing
- Implementing SCATS/SCOOT
- Adjusts timing based on conditions

Private Sector Collaboration
- Using data from Lyft, Uber, etc.
- Adjusting intersection timing accordingly.



Final Recommendations (Socio-cultural)

Urban Sprawl

- Minimize expansion into greenery

Preference

- Minimize bias of different vehicles in algorithm

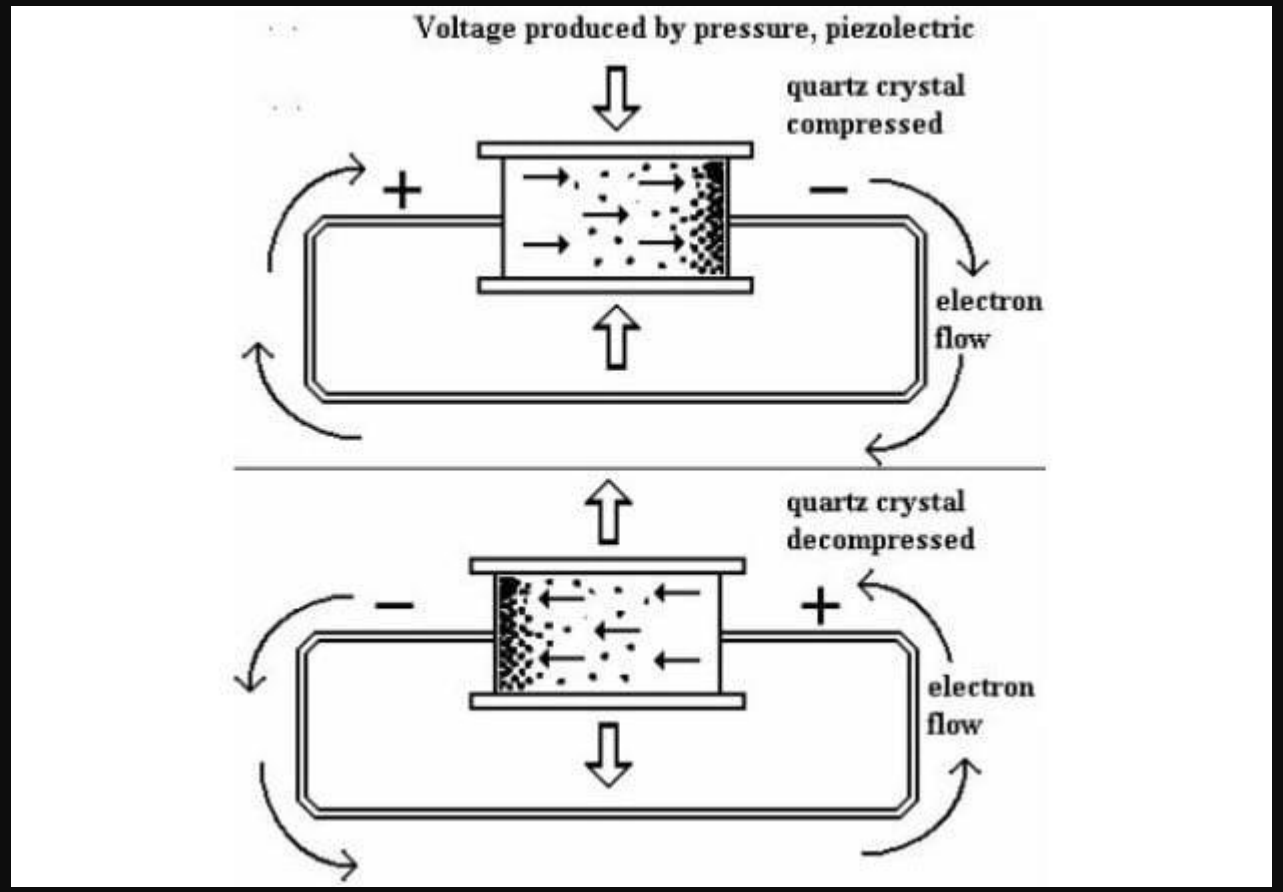
Final Recommendations (Regulatory)

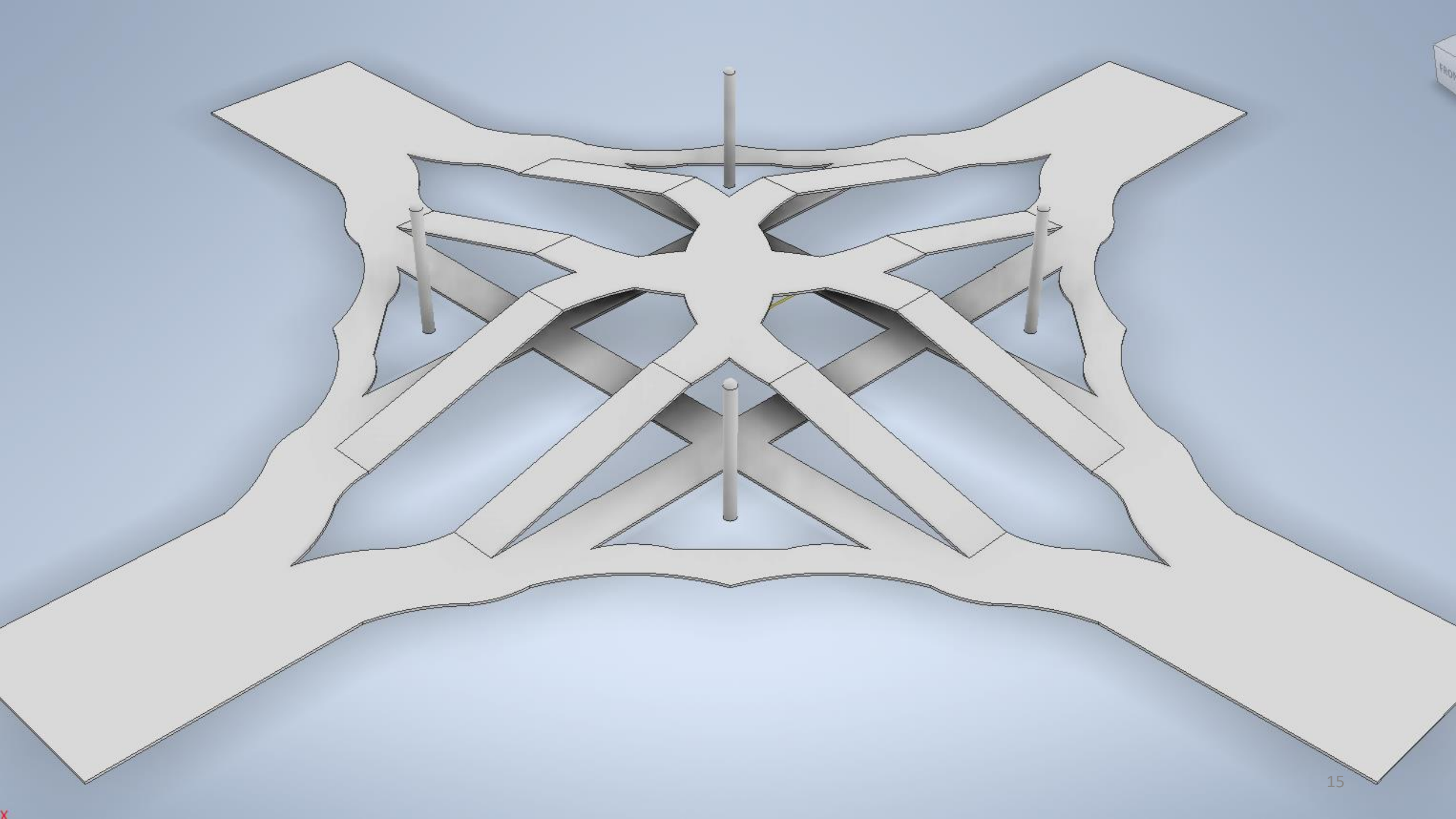
- Speed limit must conform to local legislation.

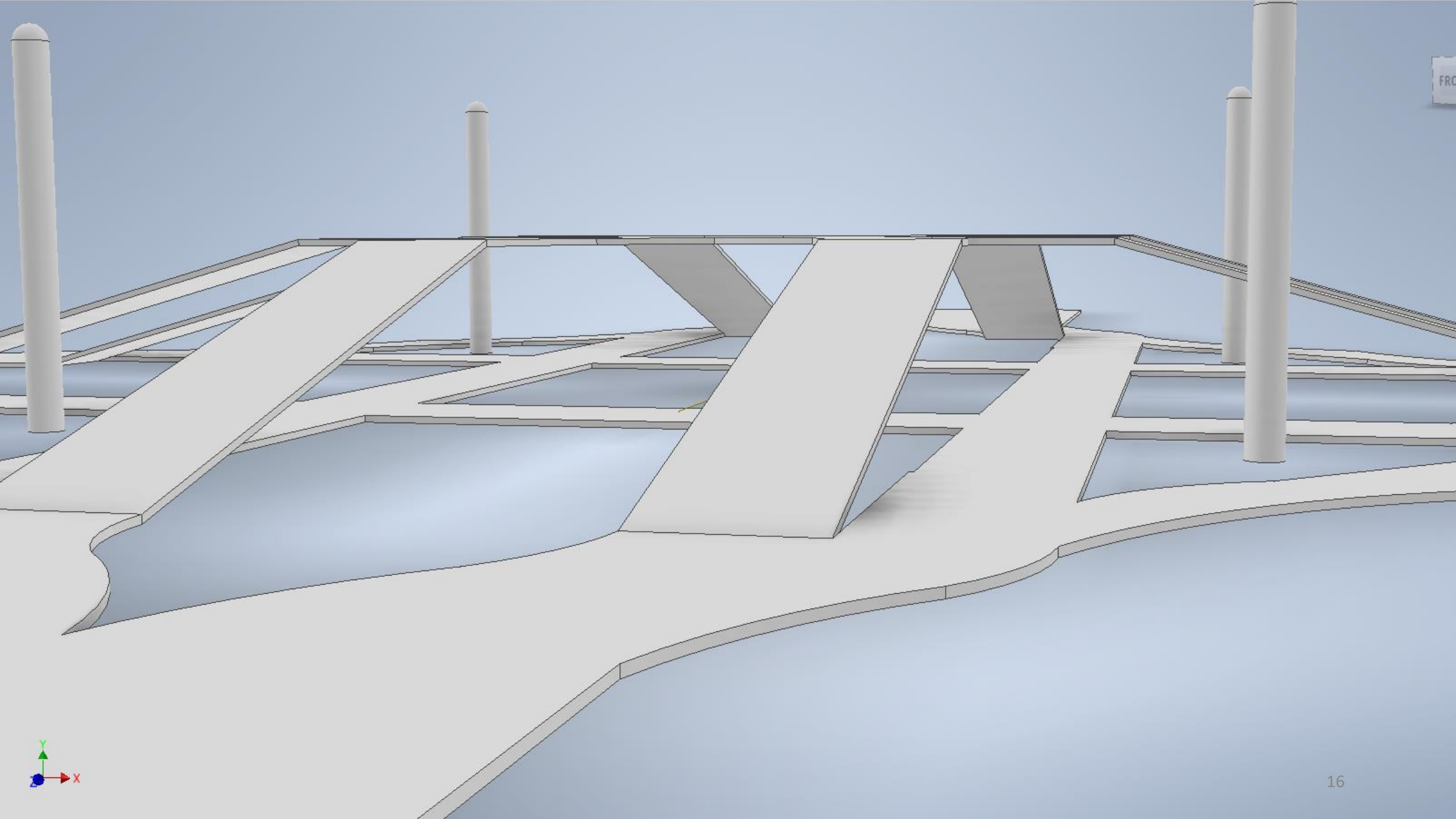
- Safety structures to mitigate dangerous collisions.

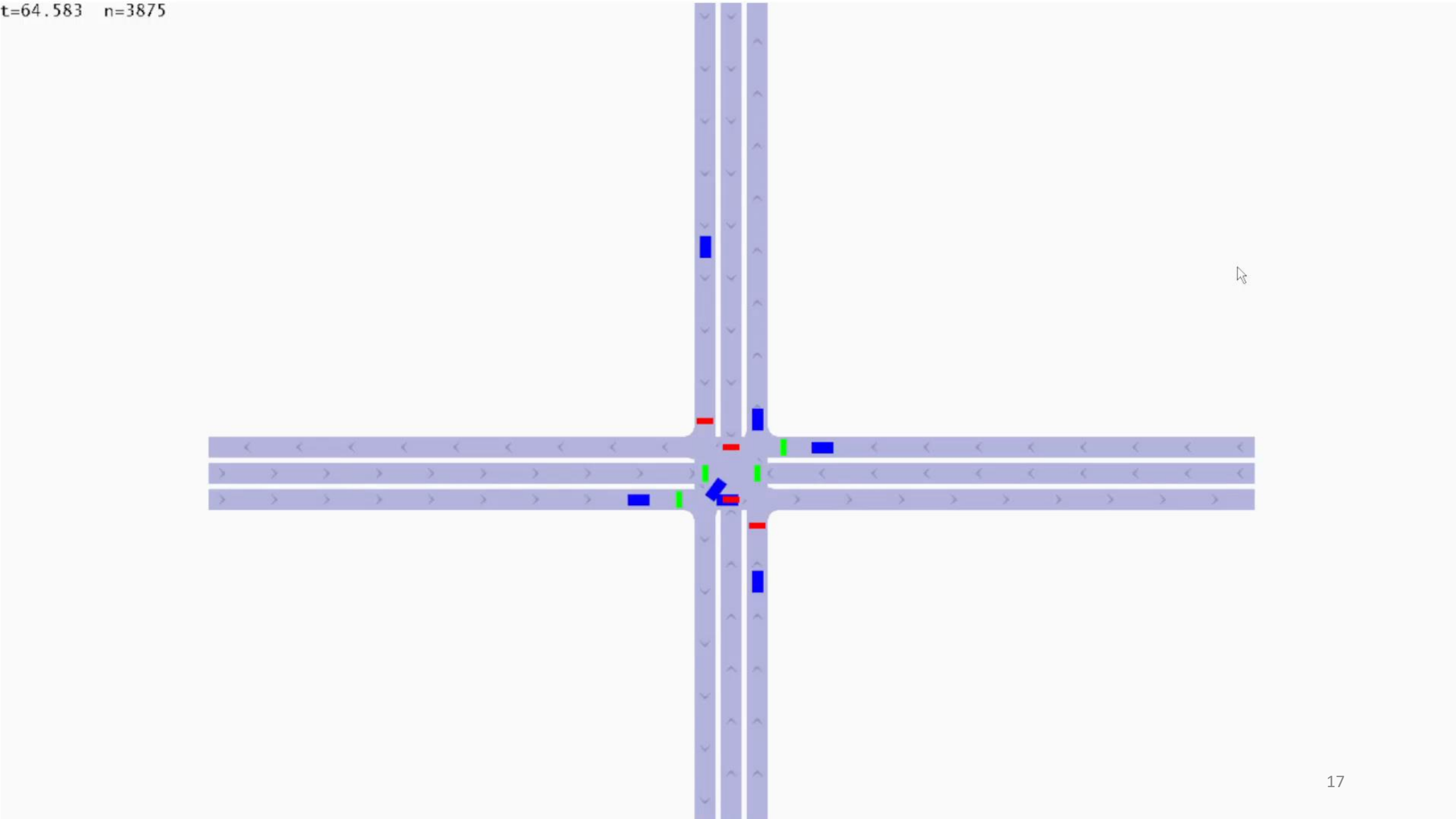
Final Recommendations (Environmental Impact and Resources)

- Piezoelectric generators in the asphalt.
- Idle time and emissions minimized.
- Sustainable, long-lasting materials.





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Final Recommendations
Client Next Steps

- Explore effective locations for intersection.
- Specific materials and components should be selected.
- Construction and maintenance teams should be created.
- Hold referendum on private sector collaboration.
- 1/6/12/24 month plan should be created:
  - Environmental monitoring.
  - Polling for local satisfaction.
  - Research on effectiveness for future intersections.

References

[1] “2022-2023 Self Driving Infrastructure Project Summary,” class notes for ENGINEER 2PX3, Faculty of Engineering, McMaster University, Winter, 2023.

[2] NXP Semiconductors. (n.d.). V2X Communications. [Online]. Available: https://www.nxp.com/applications/automotive/connectivity/v2x-communications [Accessed March 30, 2023]

[3] J. Gwak, J. Jung, R. D. Oh, M. Park, M. A. K. Rakhimov, and J. Ahn, “A review of

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[4] K. K. Nagalapur, E. G. Ström, F. Brännström, J. Carlsson, and K. Karlsson, “Robust connectivity with multiple directional antennas for vehicular ...,” IEEE, 09-Dec-2019. [Online]. Available: https://ieeexplore.ieee.org/document/8928957. [Accessed: 03-Mar-2023].