

MICROMOBILITY HUB

17th February 2026

BATS

Project co-financed by the Polish Ministry of Science and Higher Education under the programme 'Co-financed International Projects'



Interreg
Baltic Sea Region



Co-funded by
the European Union

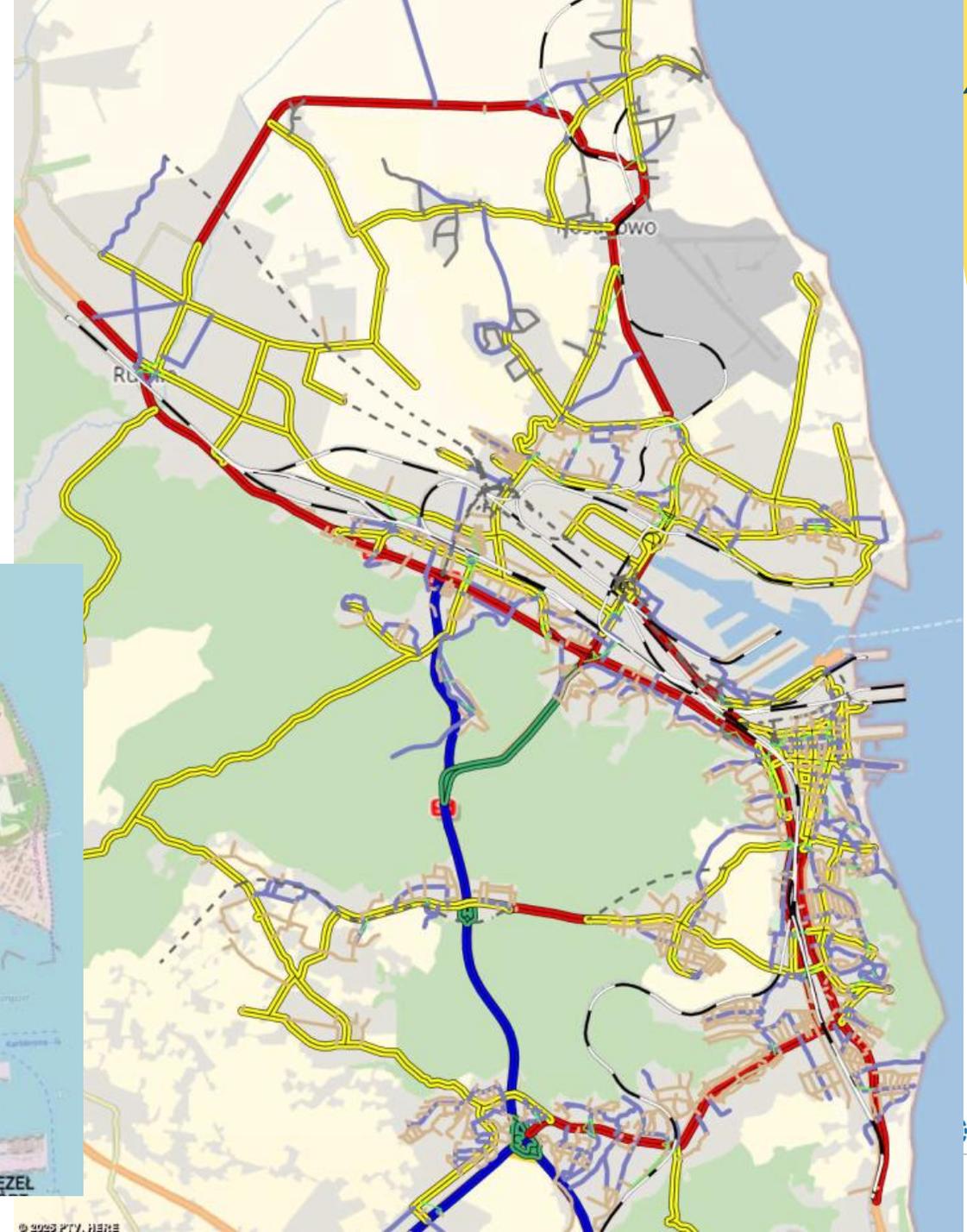
SMART GREEN MOBILITY
BATS



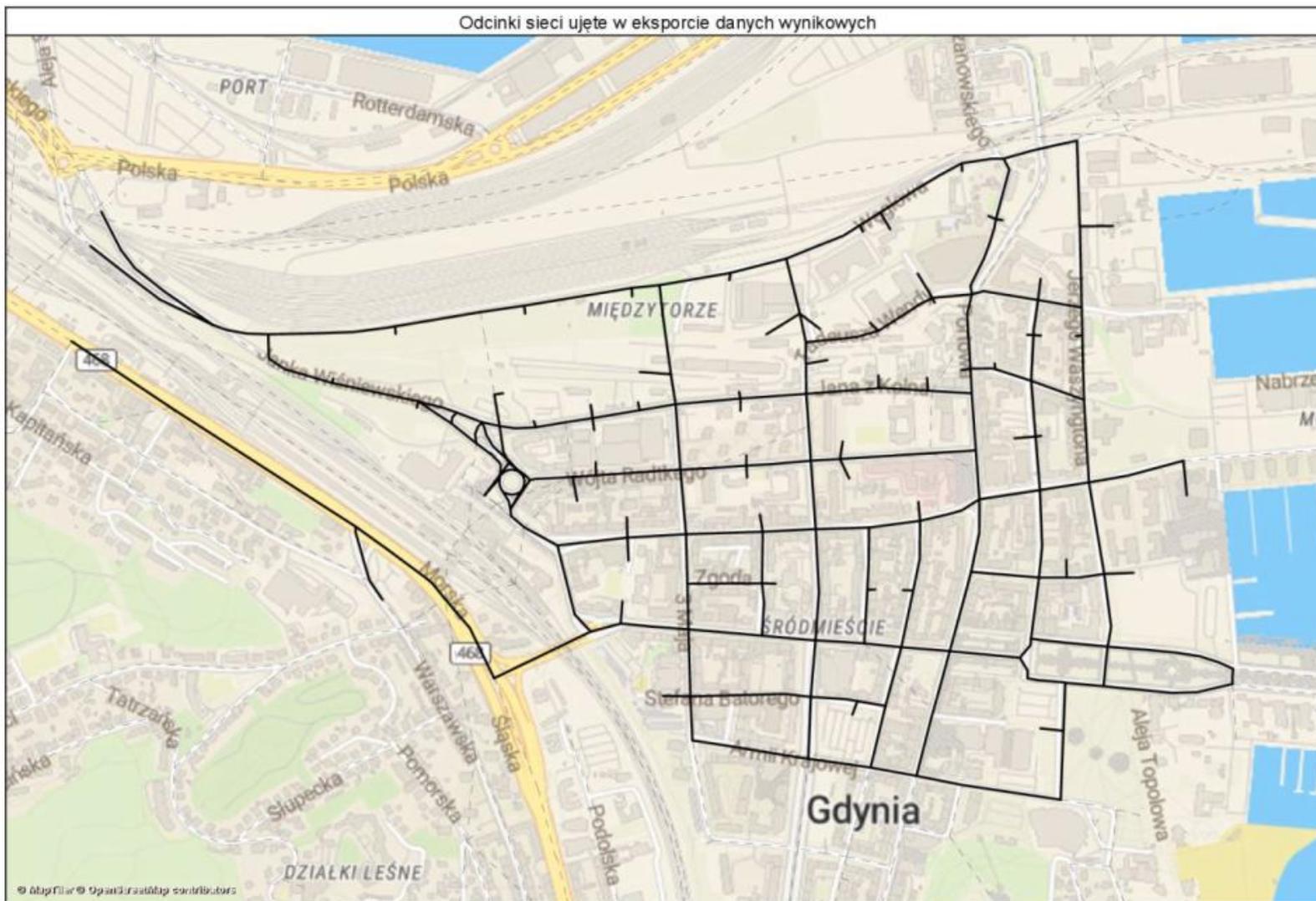
The BATS project, co-funded by the Interreg Baltic Sea Region 2021-2027, helps drive the transition to a green and resilient Baltic Sea Region.
[#madewithinterreg](#) interreg-baltic.eu/project/bats/



Scope of the Gdynia City Model

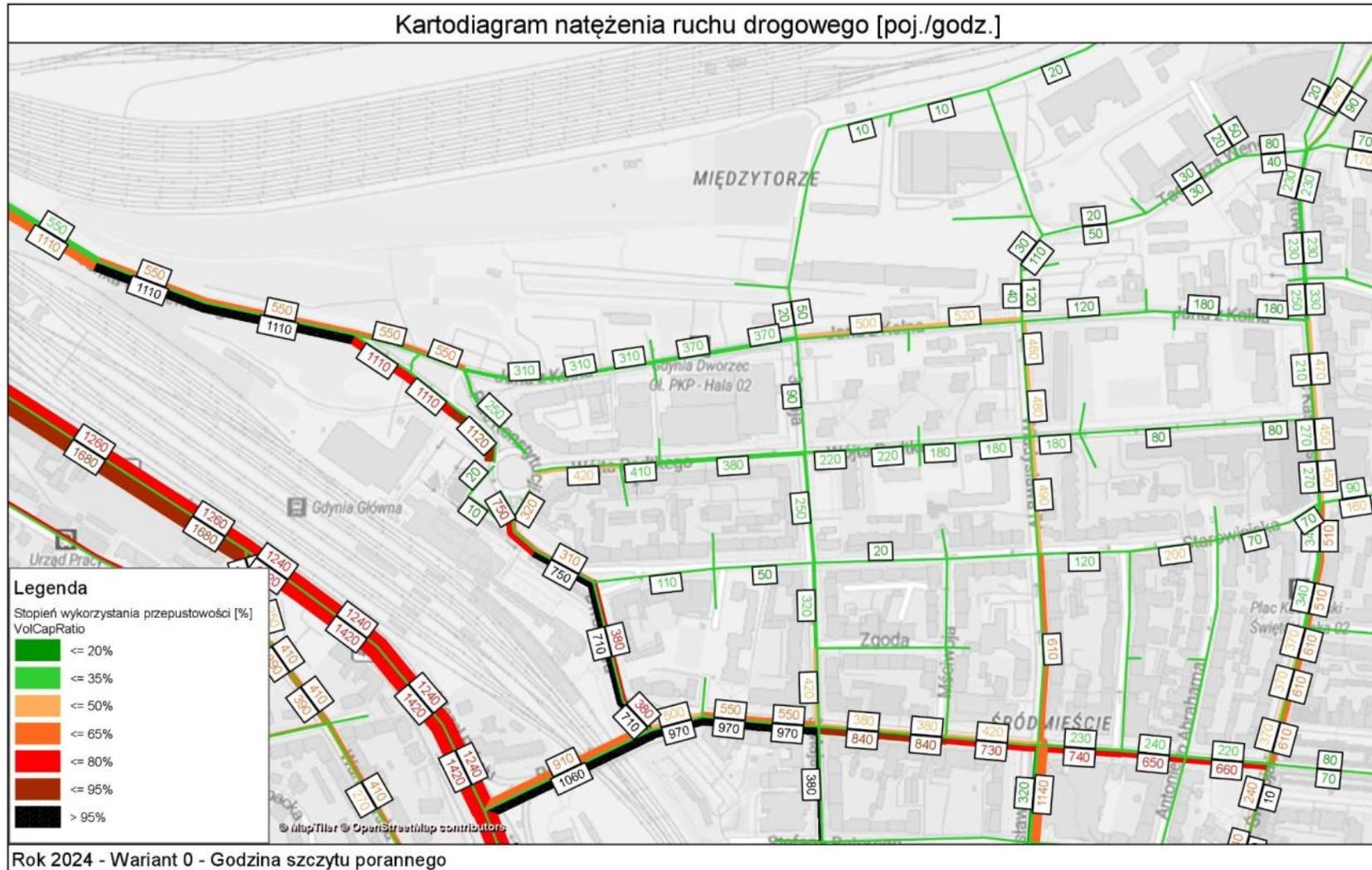


Network for data export



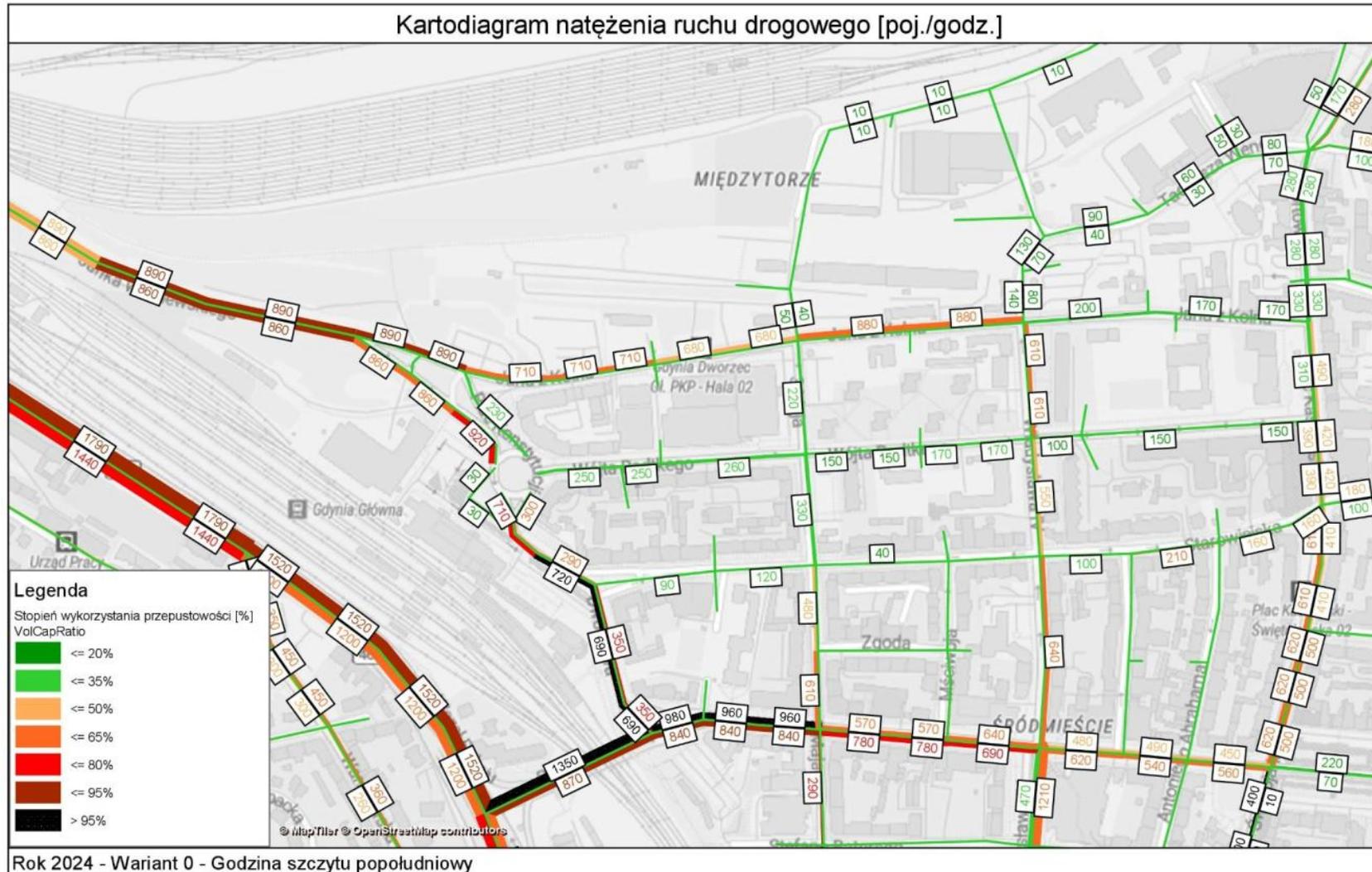


Morning Rush Hour - currently



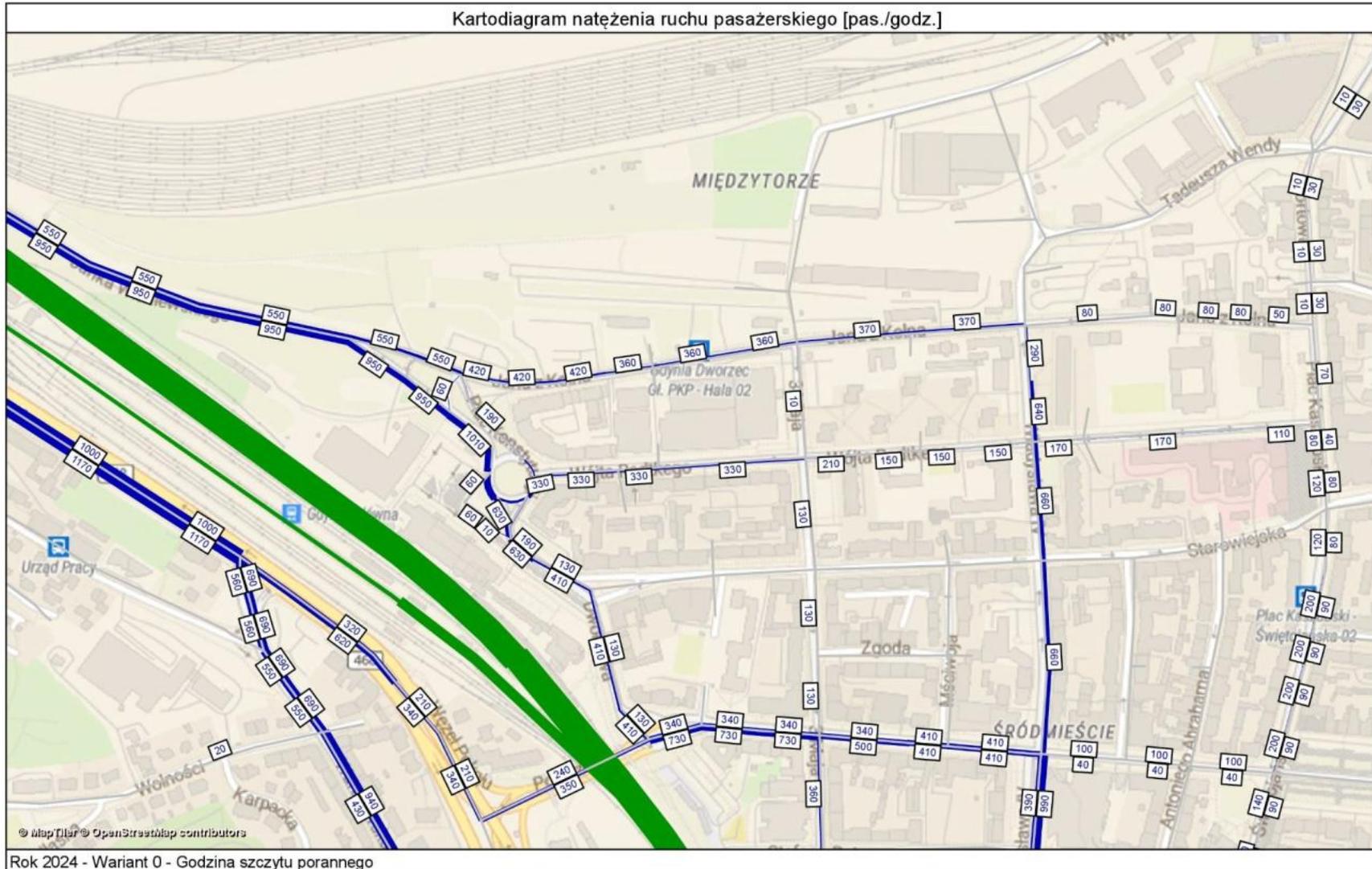


Afternoon Rush Hour - currently

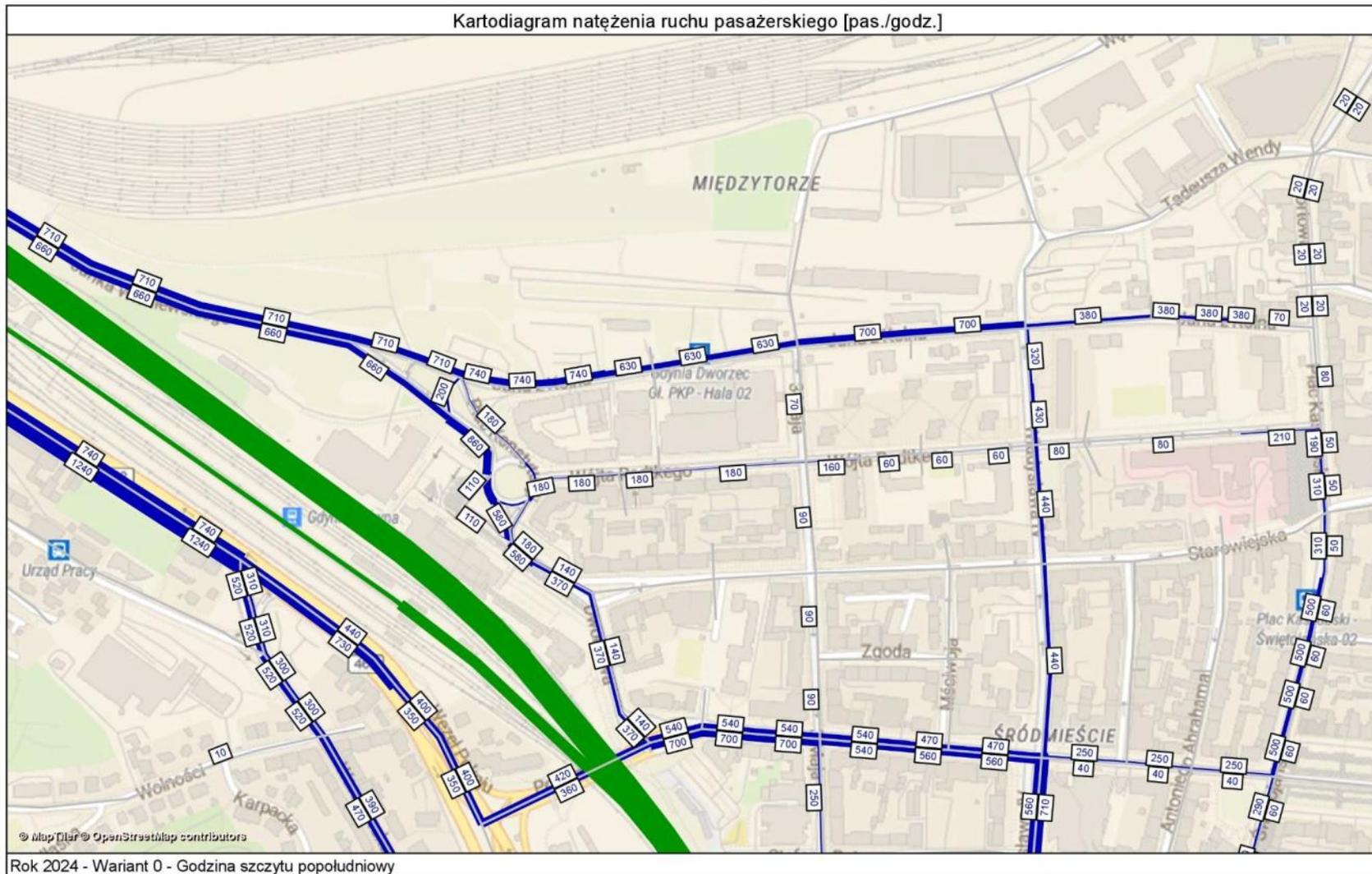




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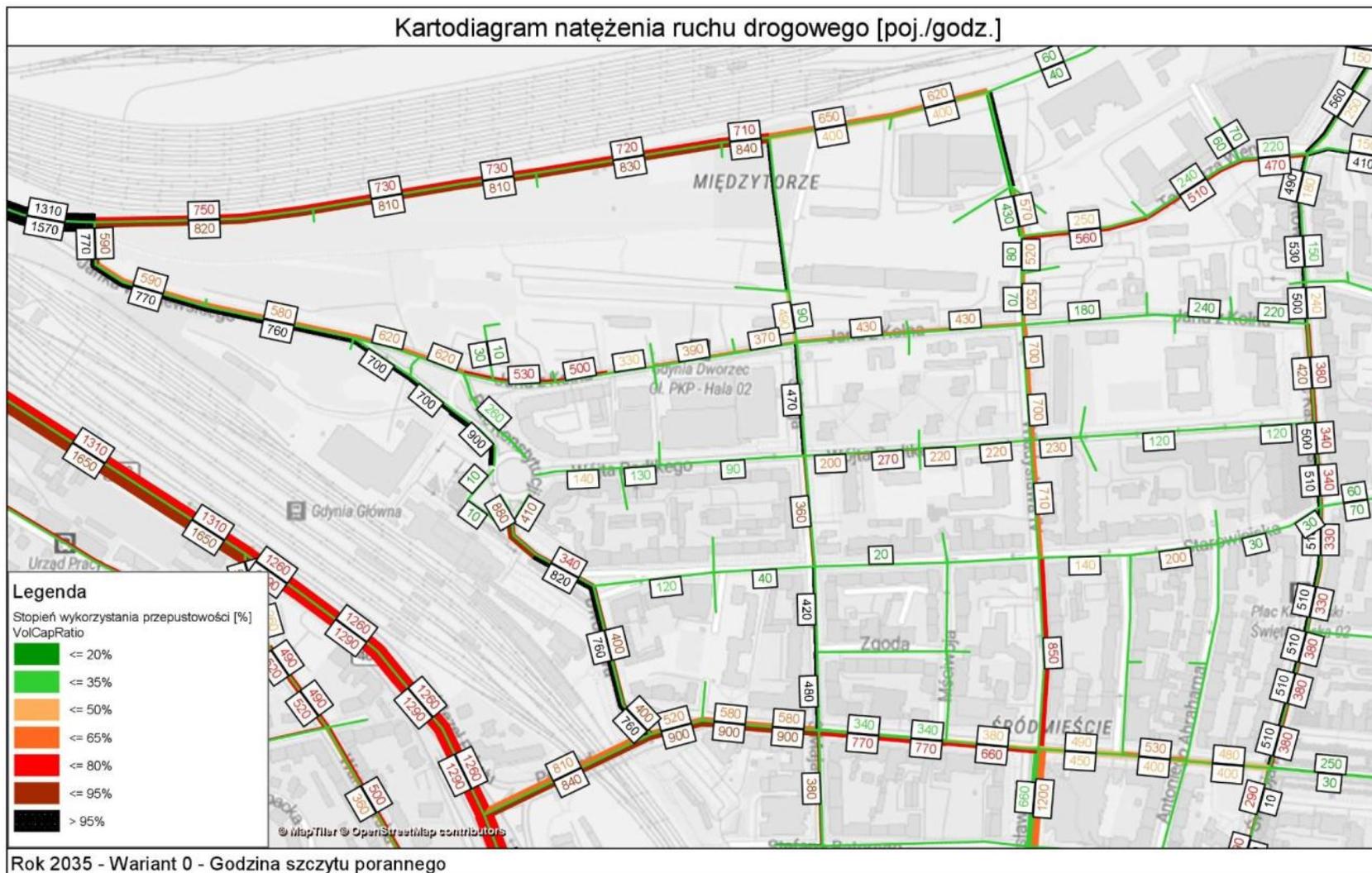


Afternoon Rush Hour - currently

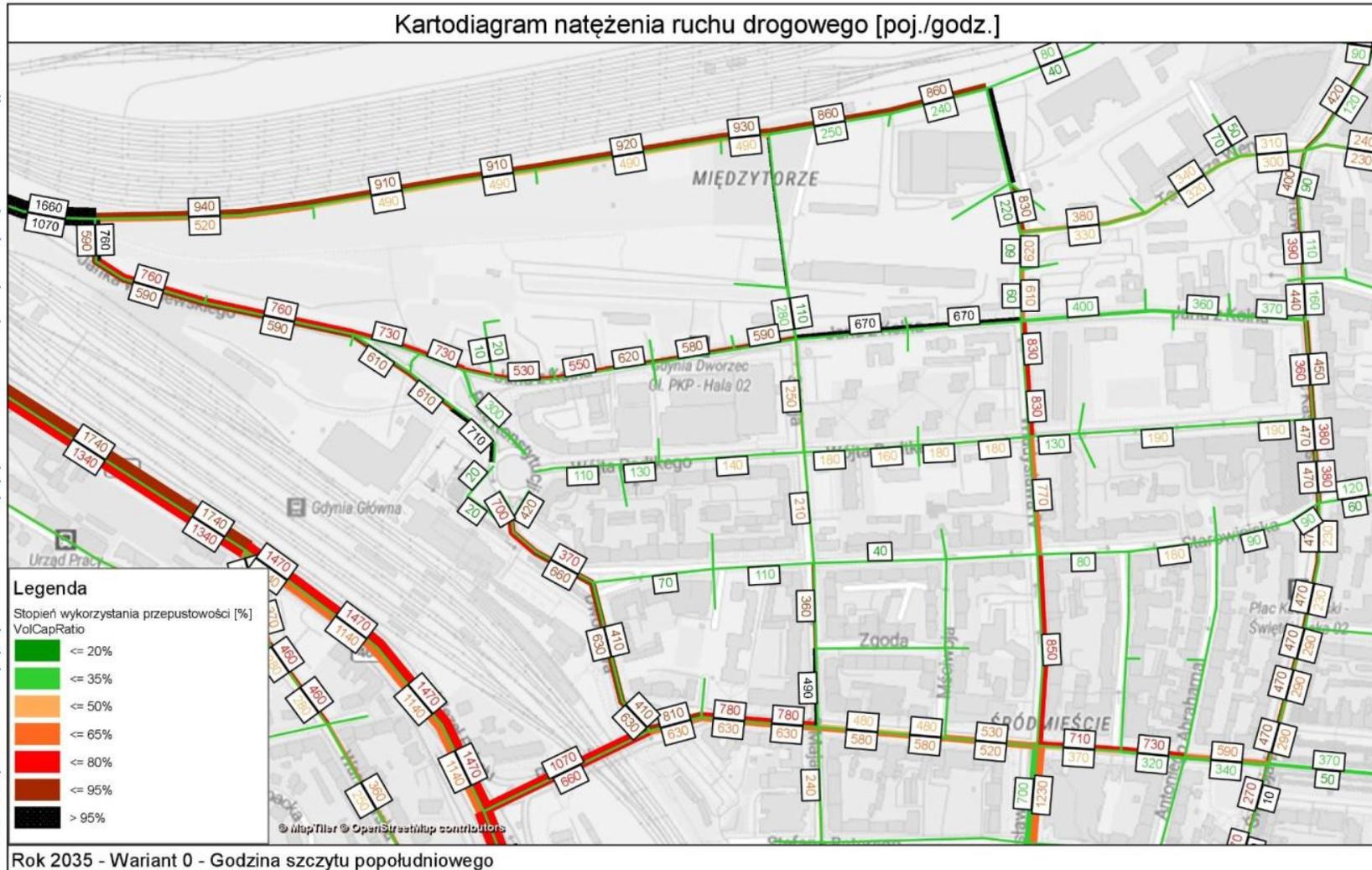




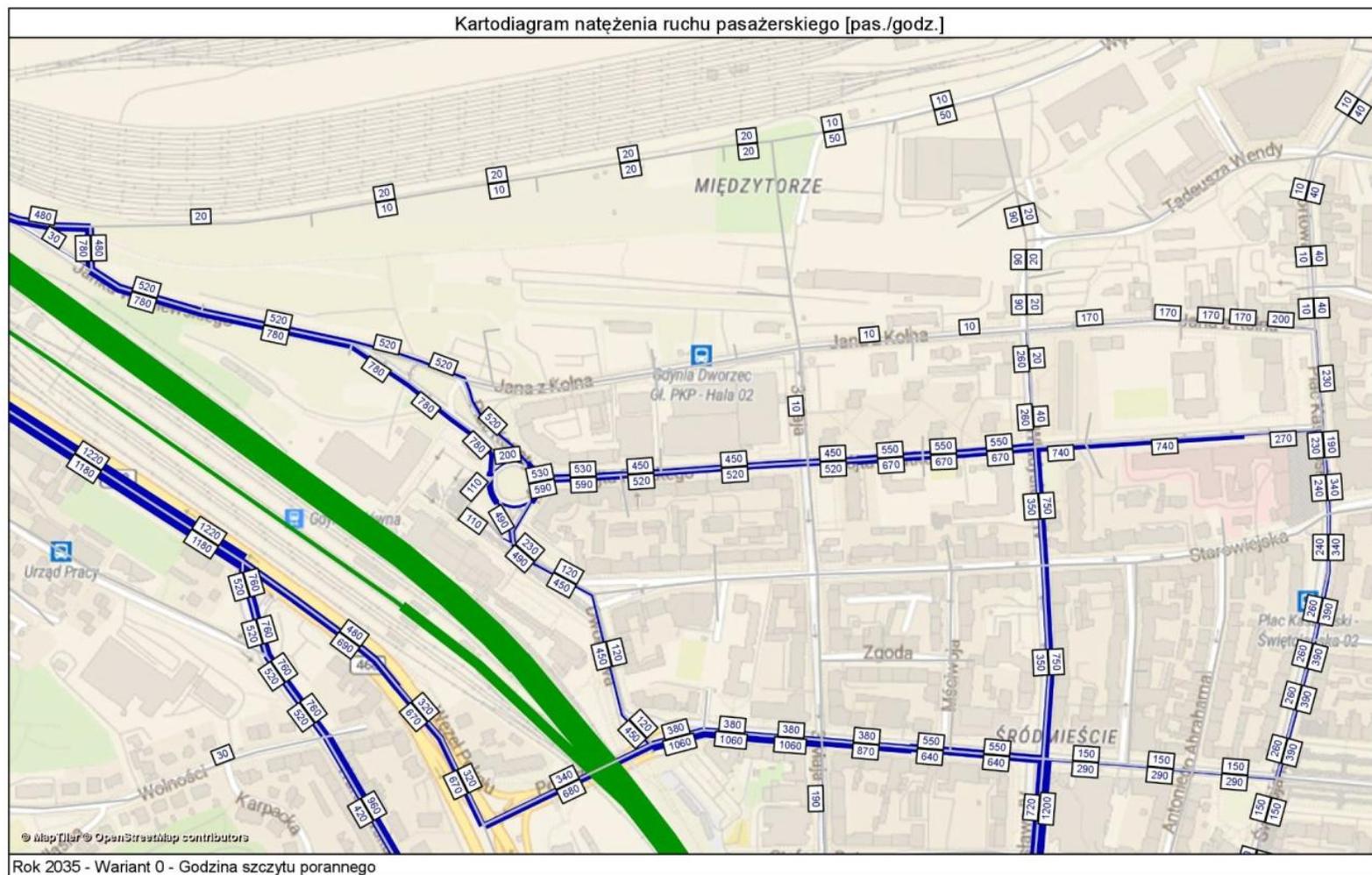
Morning Rush Hour – Forecast 2035 S0



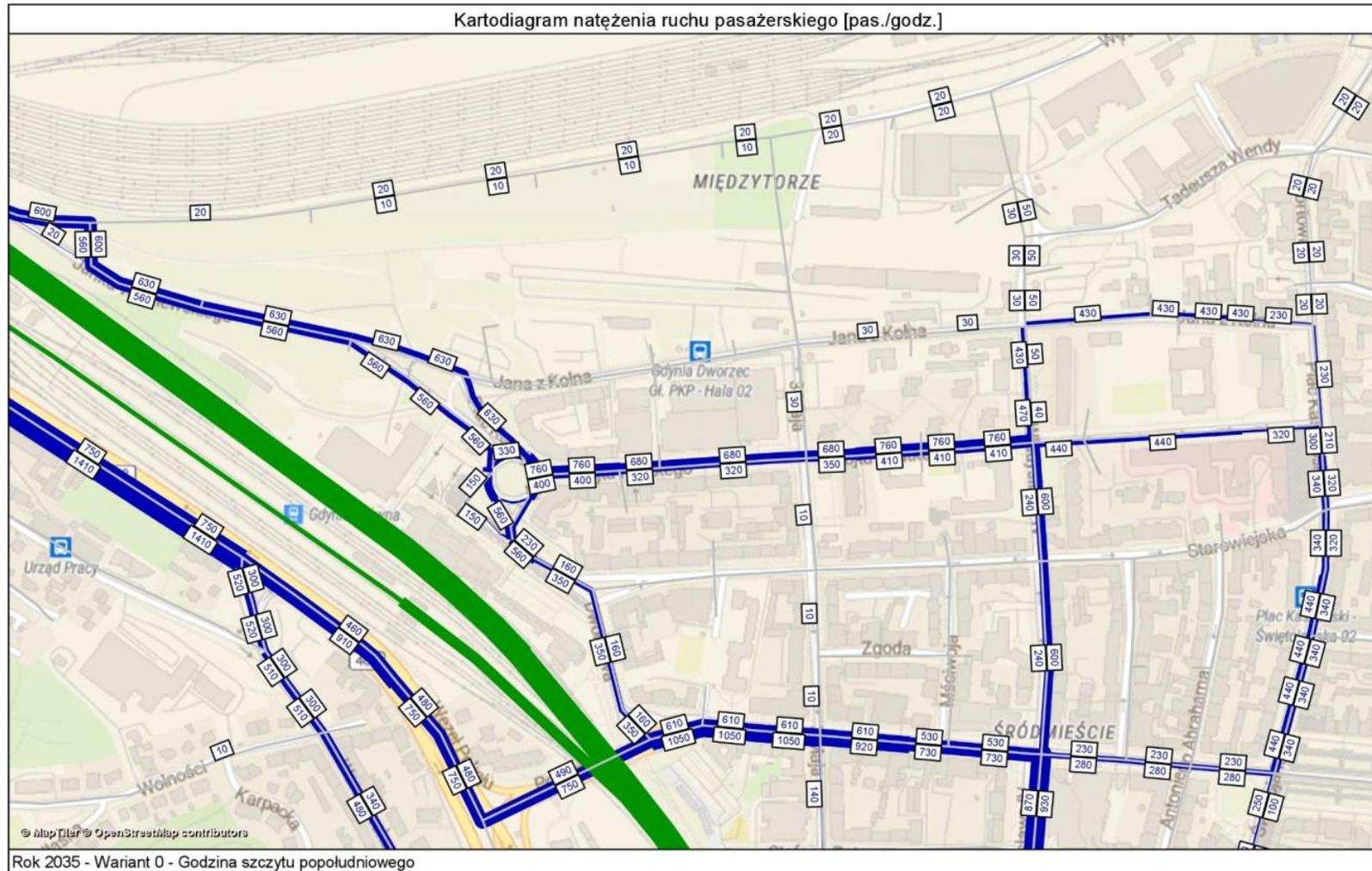
Afternoon Rush Hour – Forecast 2035 S0



Morning Rush Hour – Forecast 2035 S0

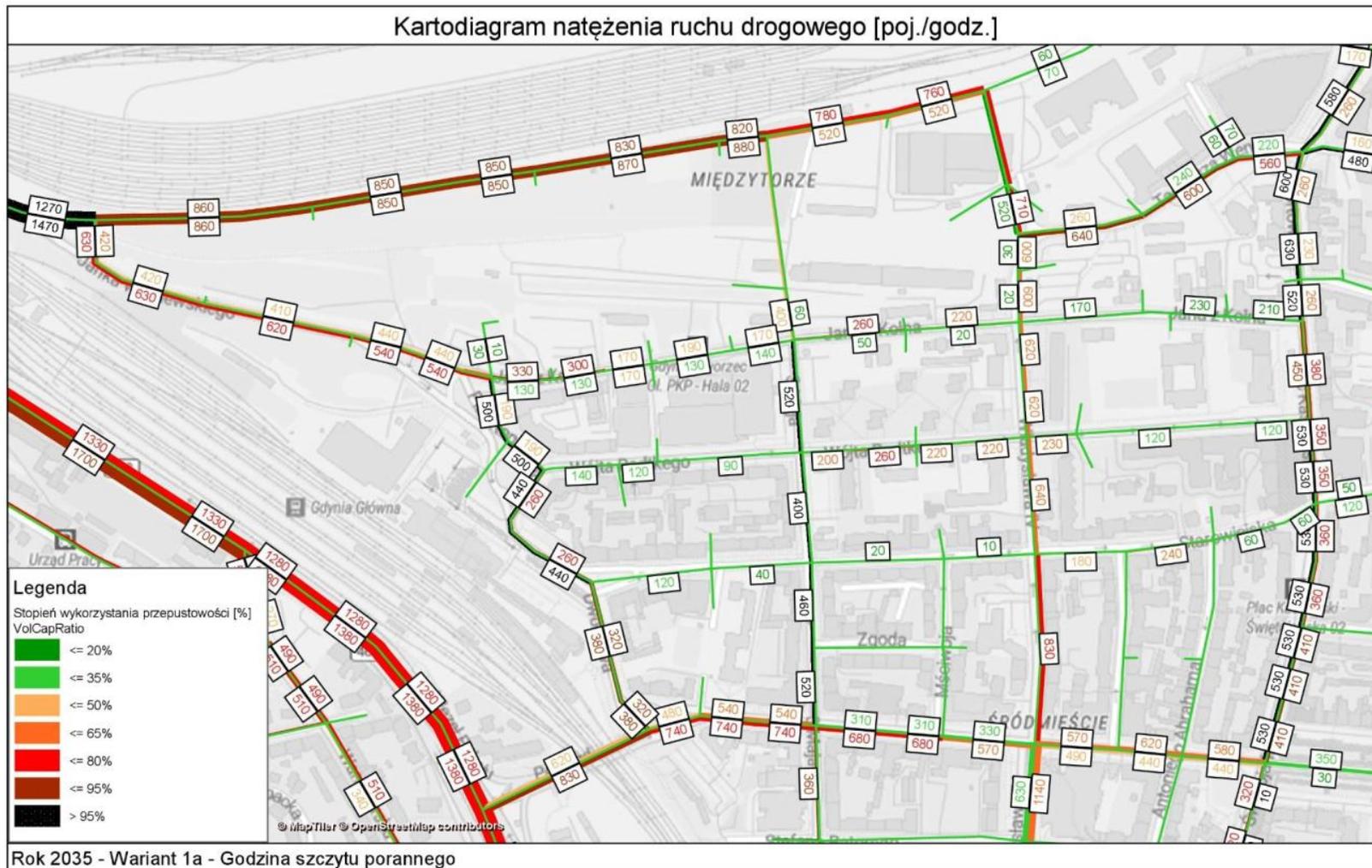


Afternoon Rush Hour – Forecast 2035 S0



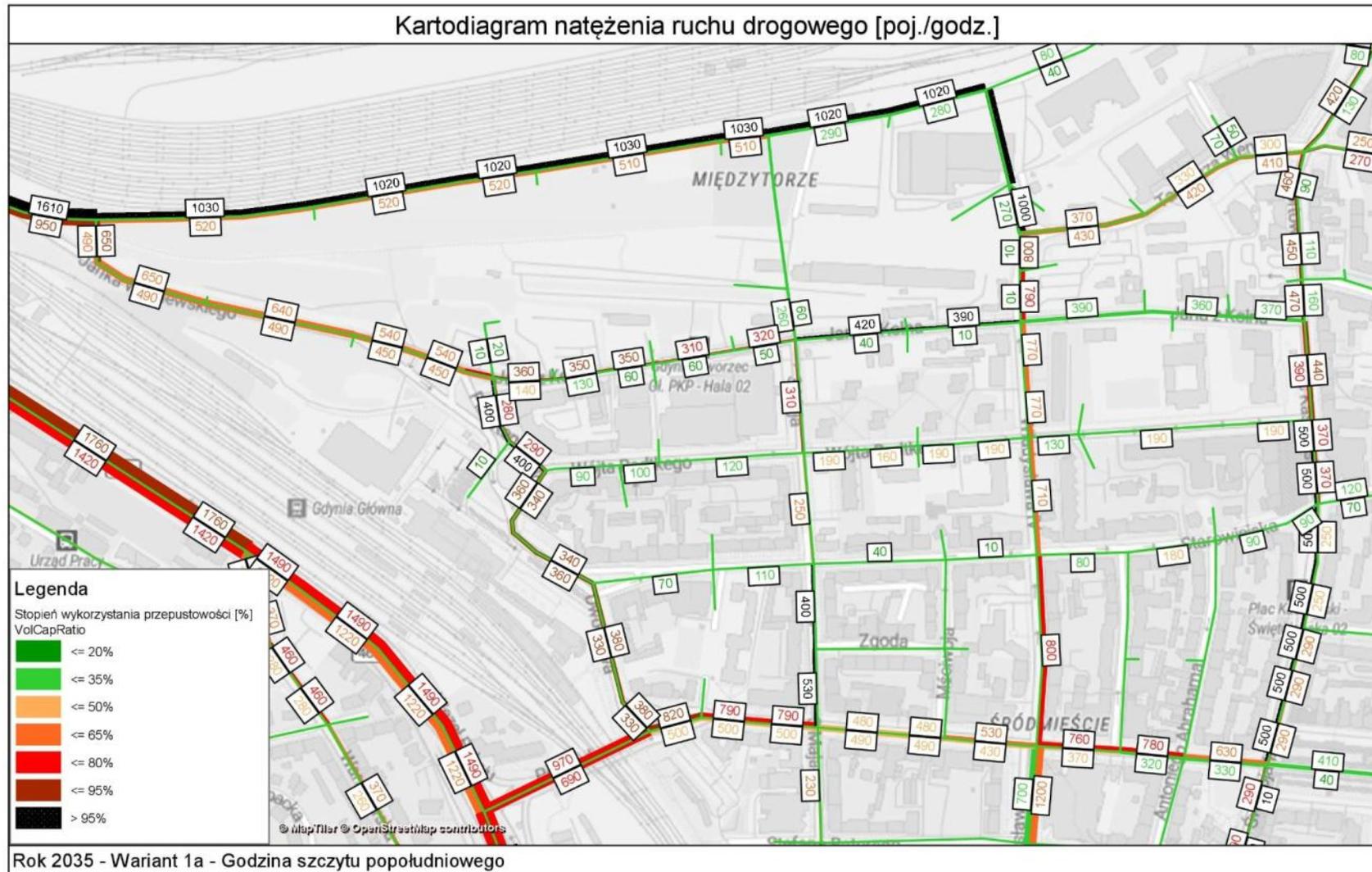


Morning Rush Hour – Forecast 2035 S1a

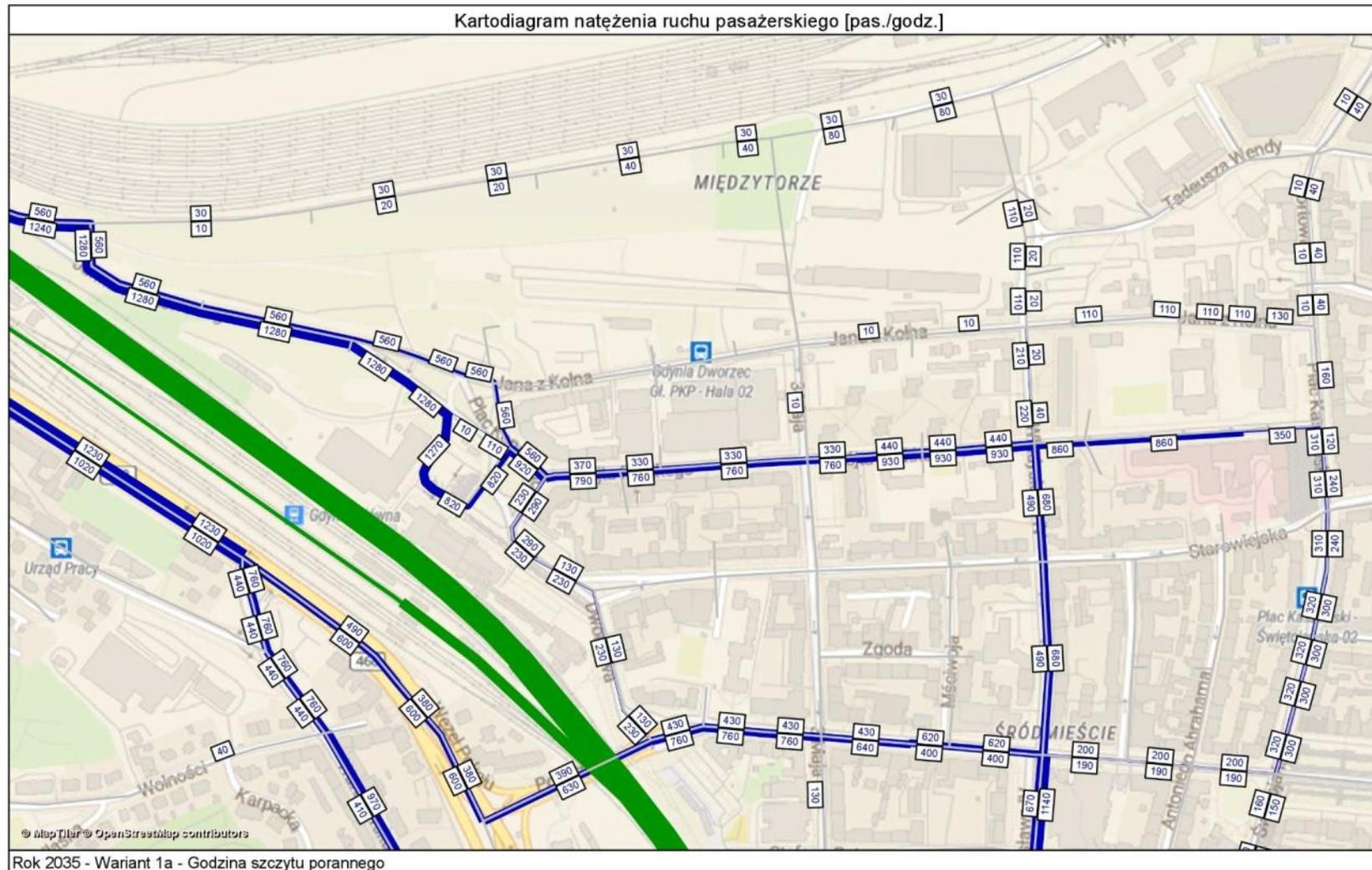




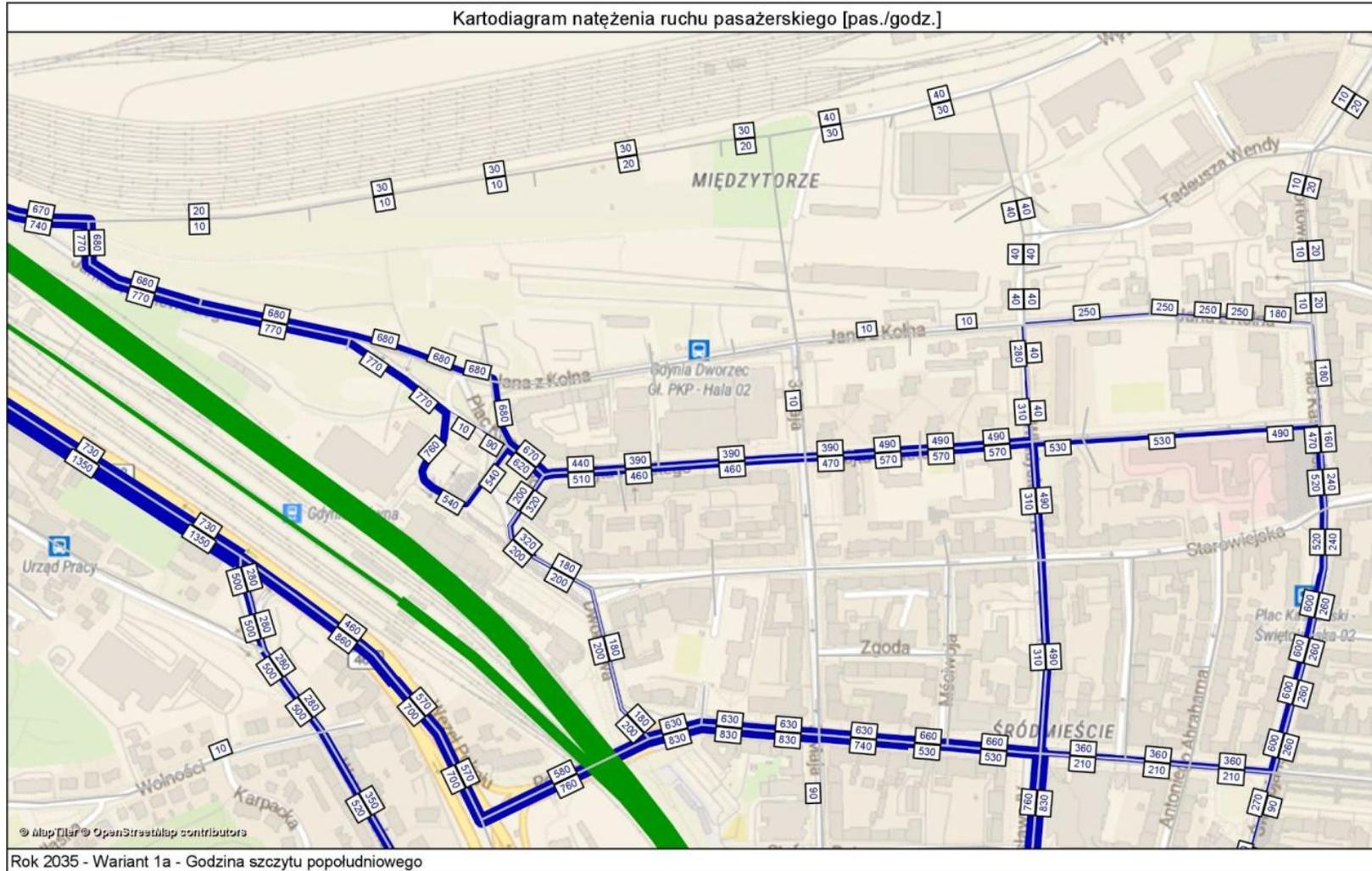
Afternoon Rush Hour – Forecast 2035 S1a



Morning Rush Hour – Forecast 2035 S1a

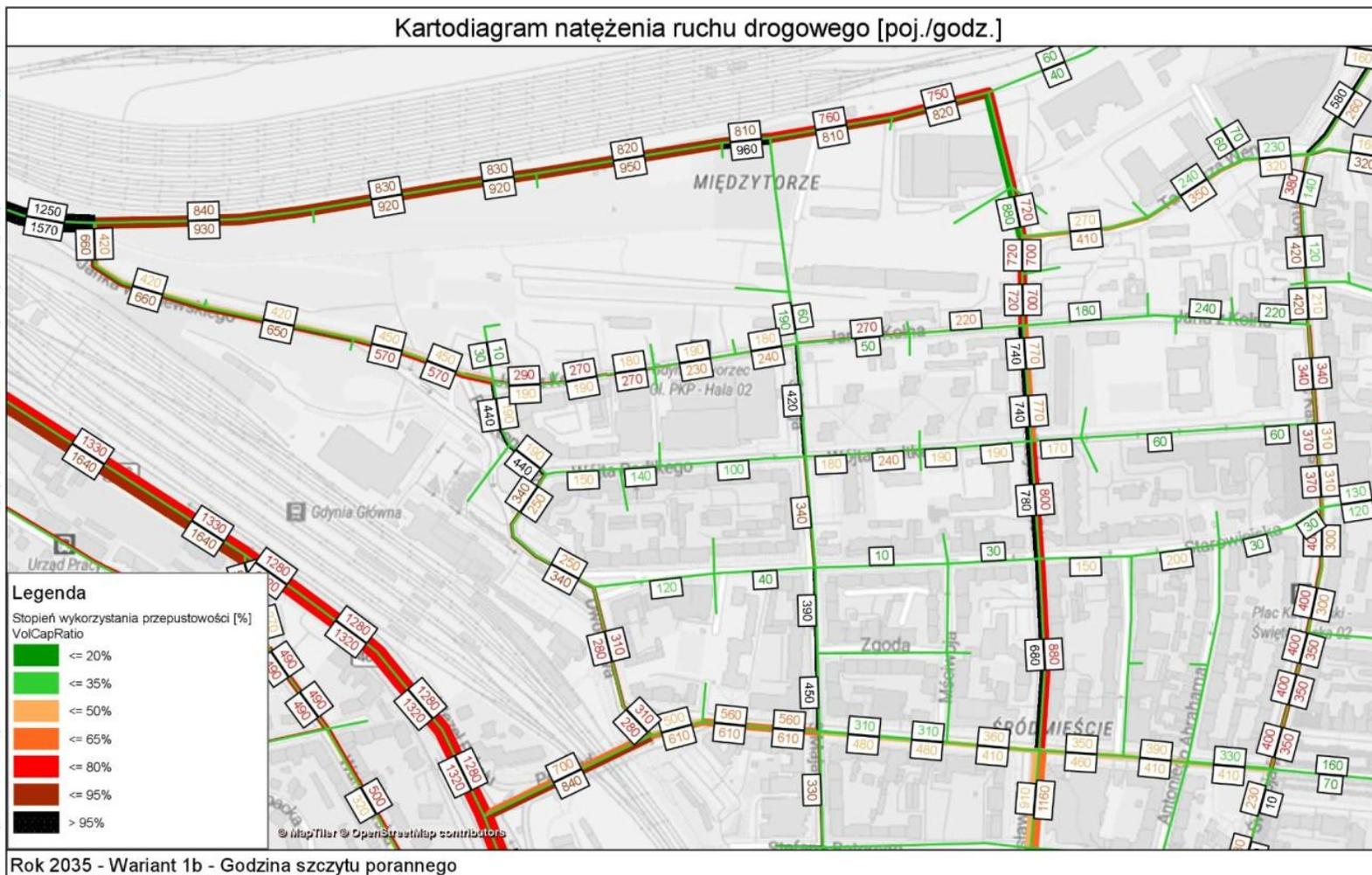


Afternoon Rush Hour – Forecast 2035 S1a

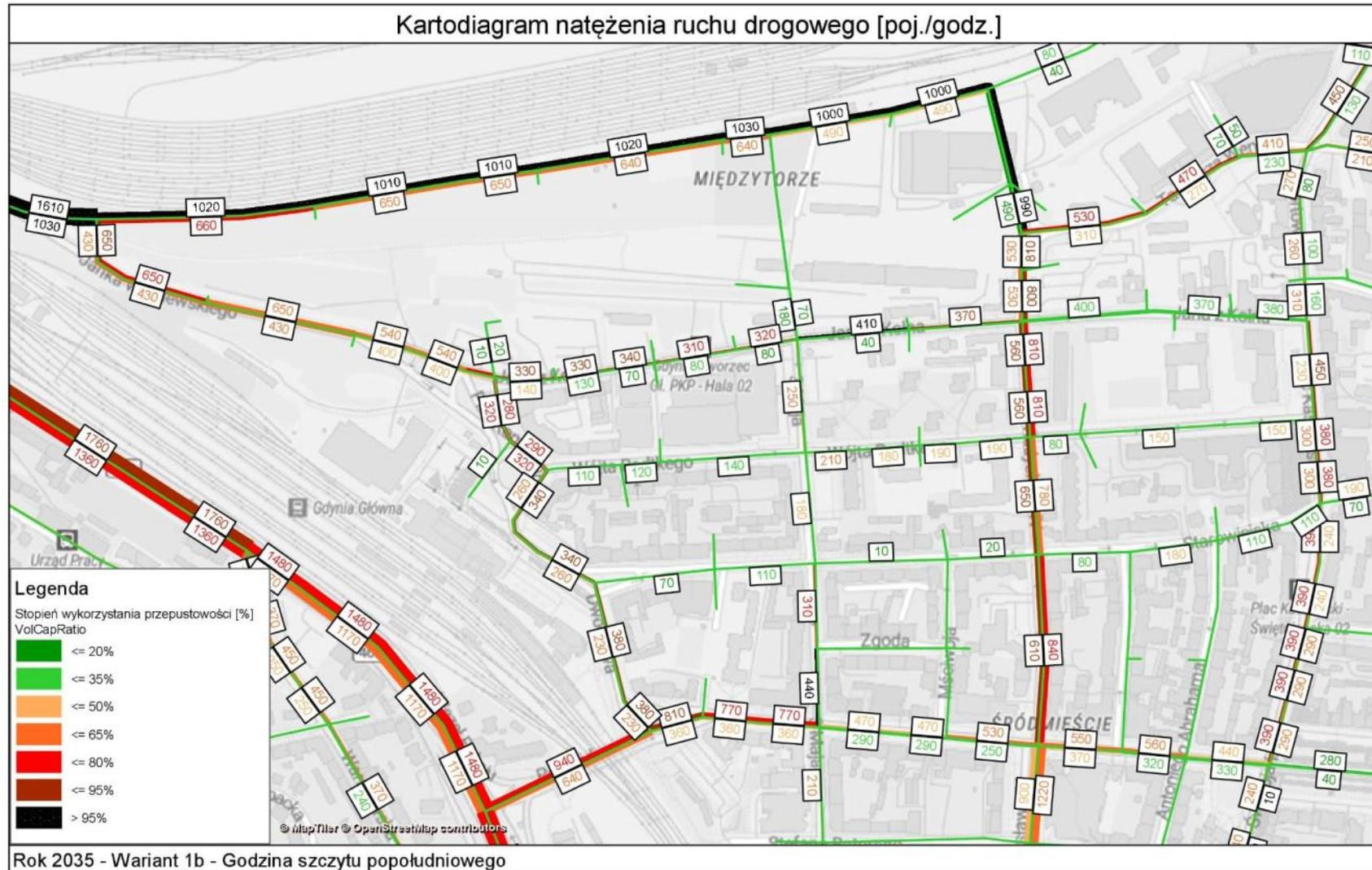




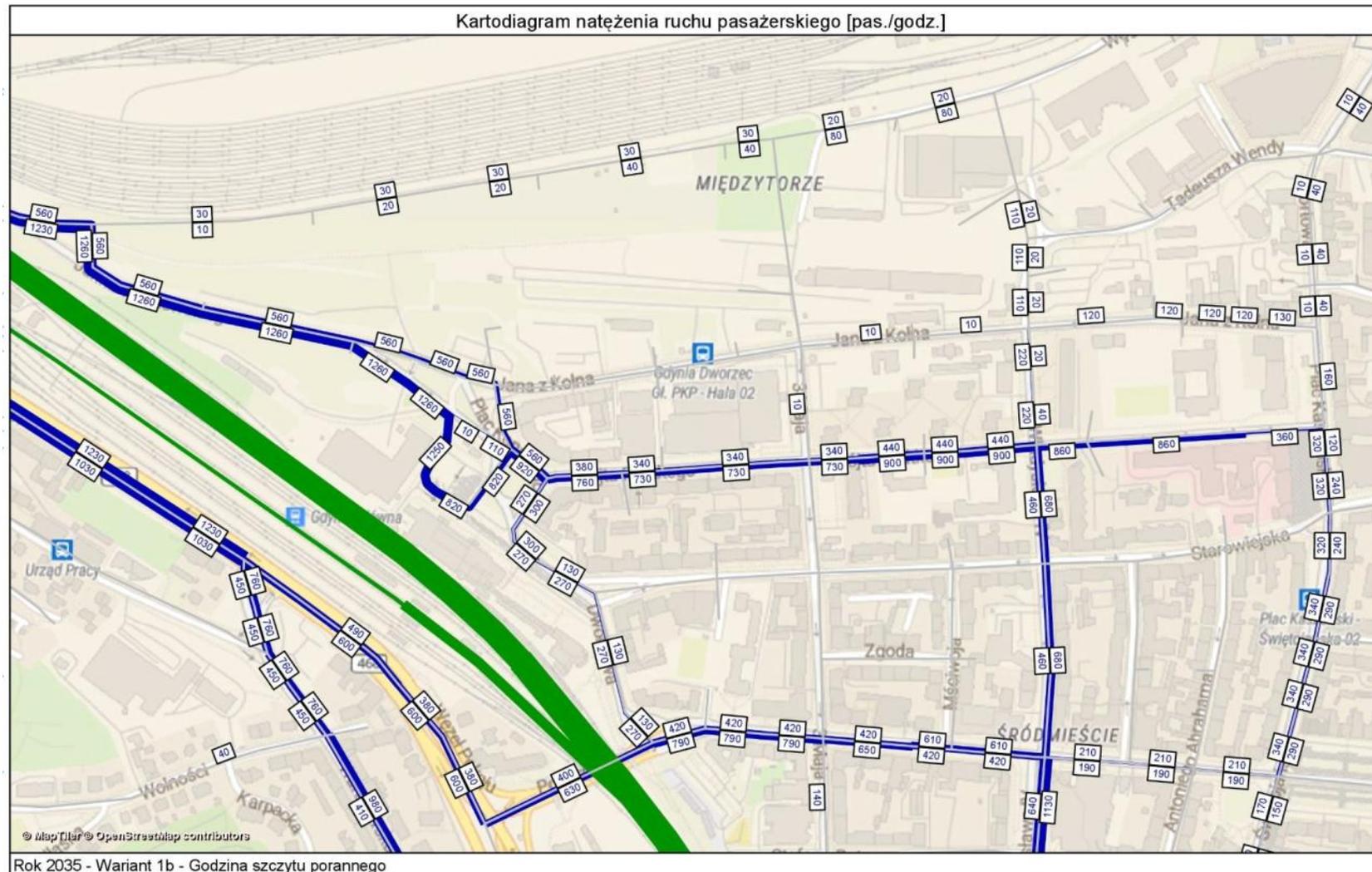
Morning Rush Hour – Forecast 2035 S1b



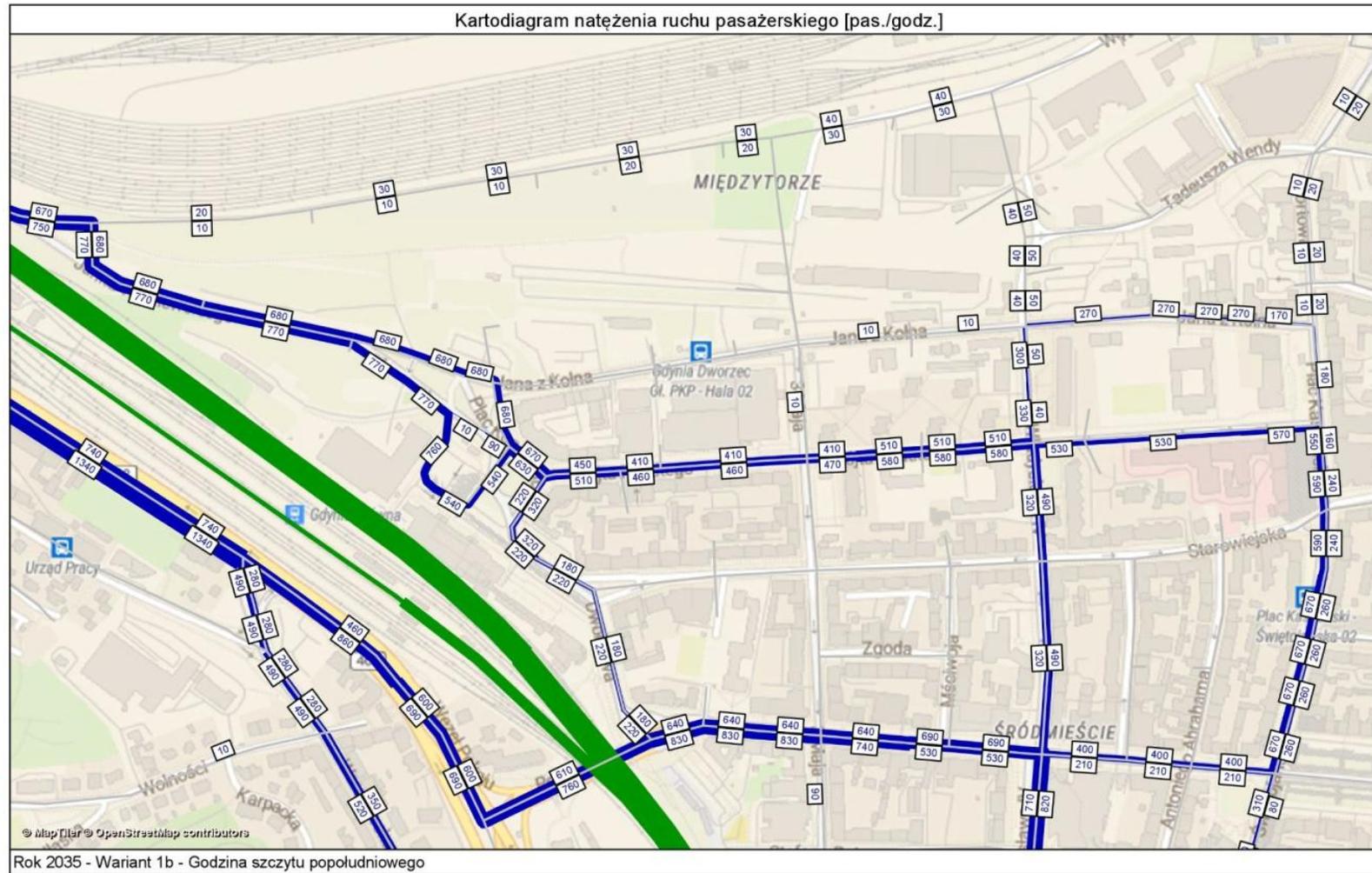
Afternoon Rush Hour – Forecast 2035 S1b



Morning Rush Hour – Forecast 2035 S1b



Afternoon Rush Hour – Forecast 2035 S1b



Scope of Microscopic Simulation





Summary

Macroscopic simulation – Insights targeting strategic level

Shaping the network, planning new investments (e.g. new roads, traffic generators)

Microscopic Simulation – Insights targeting local level

Analysing solutions in detail (e.g. traffic light programs, dedicated turn lanes on interseccions)



ESTIMATING EMISSIONS IN TRAFFIC MODELS

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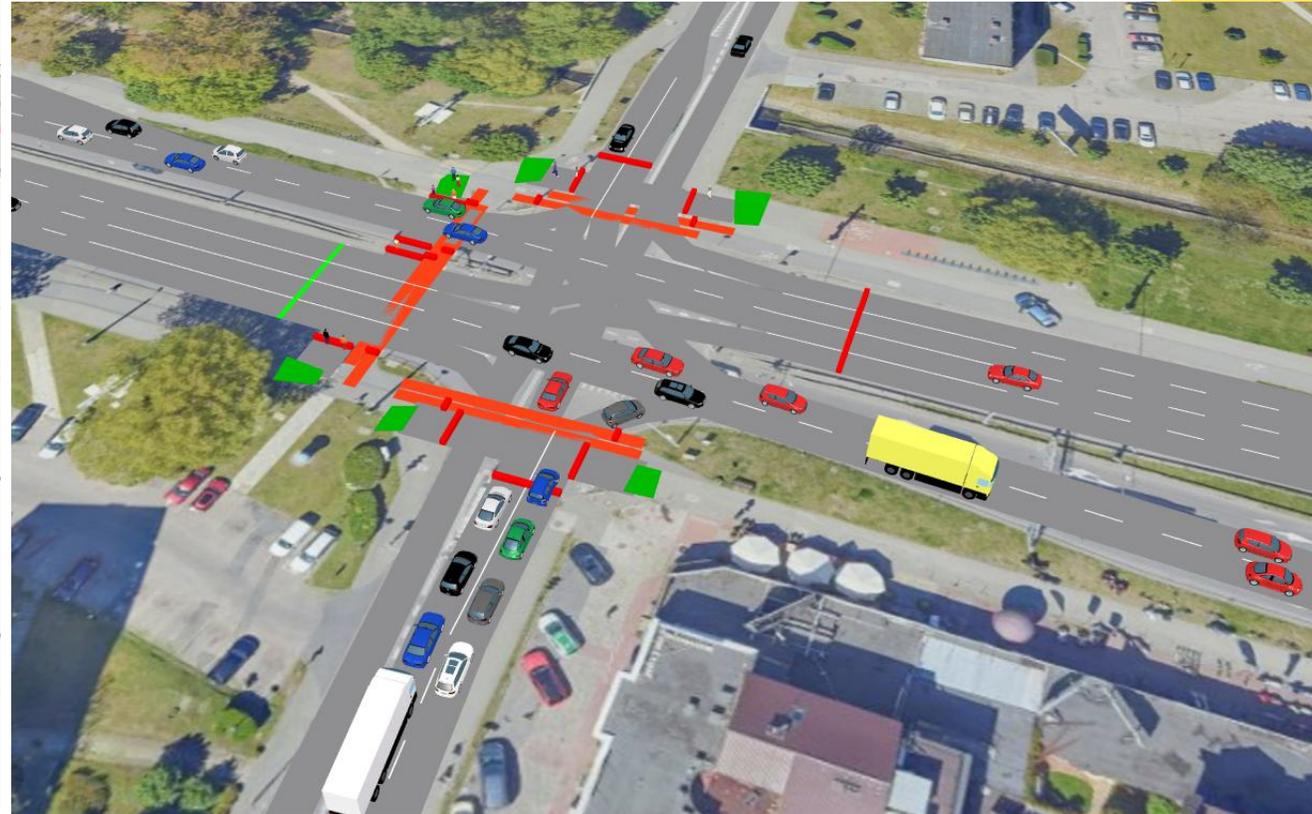
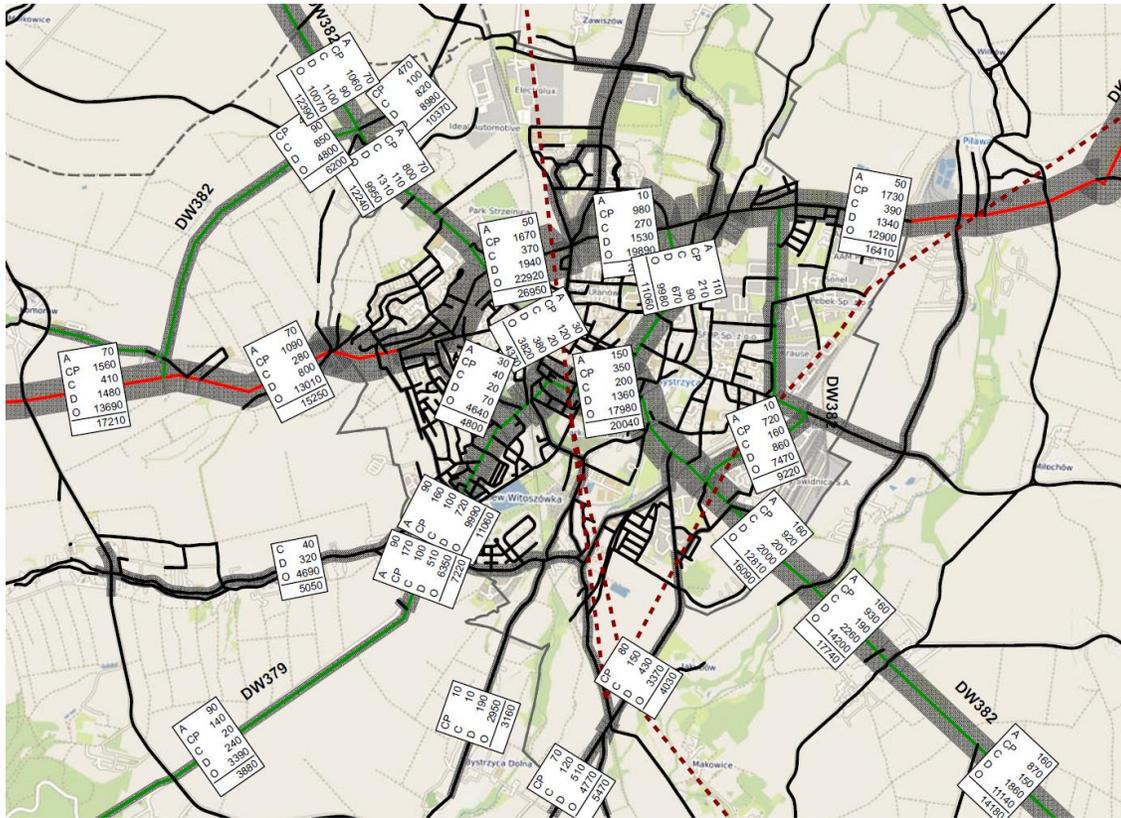
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Macro vs Micro





Macro vs Micro

Macroscopic models:

- Aggregated values (sum of vehicles going through a section during day/hour)
- Average speed based on total number of vehicles and assumed section capacity

Microscopic models:

- Every vehicle simulated as an separate object
- Speed calculated every timestep (e.g. in 0.1s interval) depending on the current state of the traffic conditions





Emissions: declared vs real-world

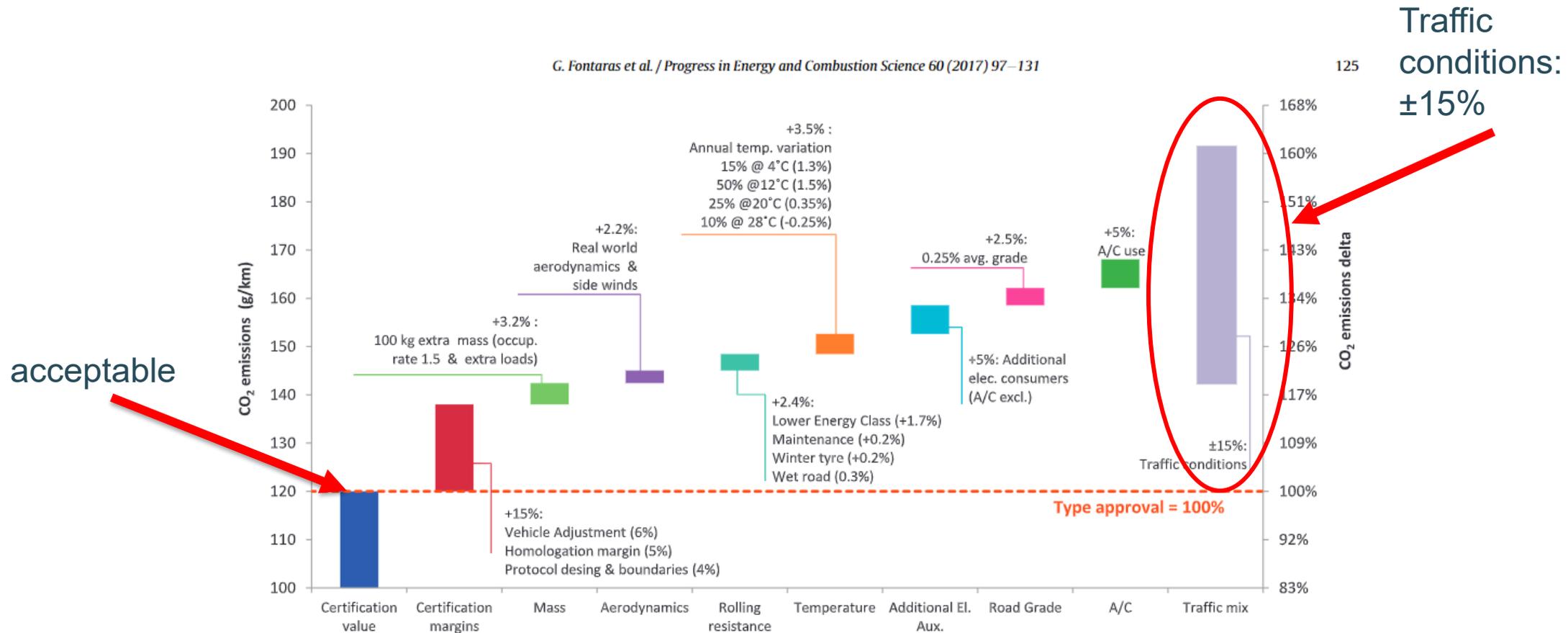
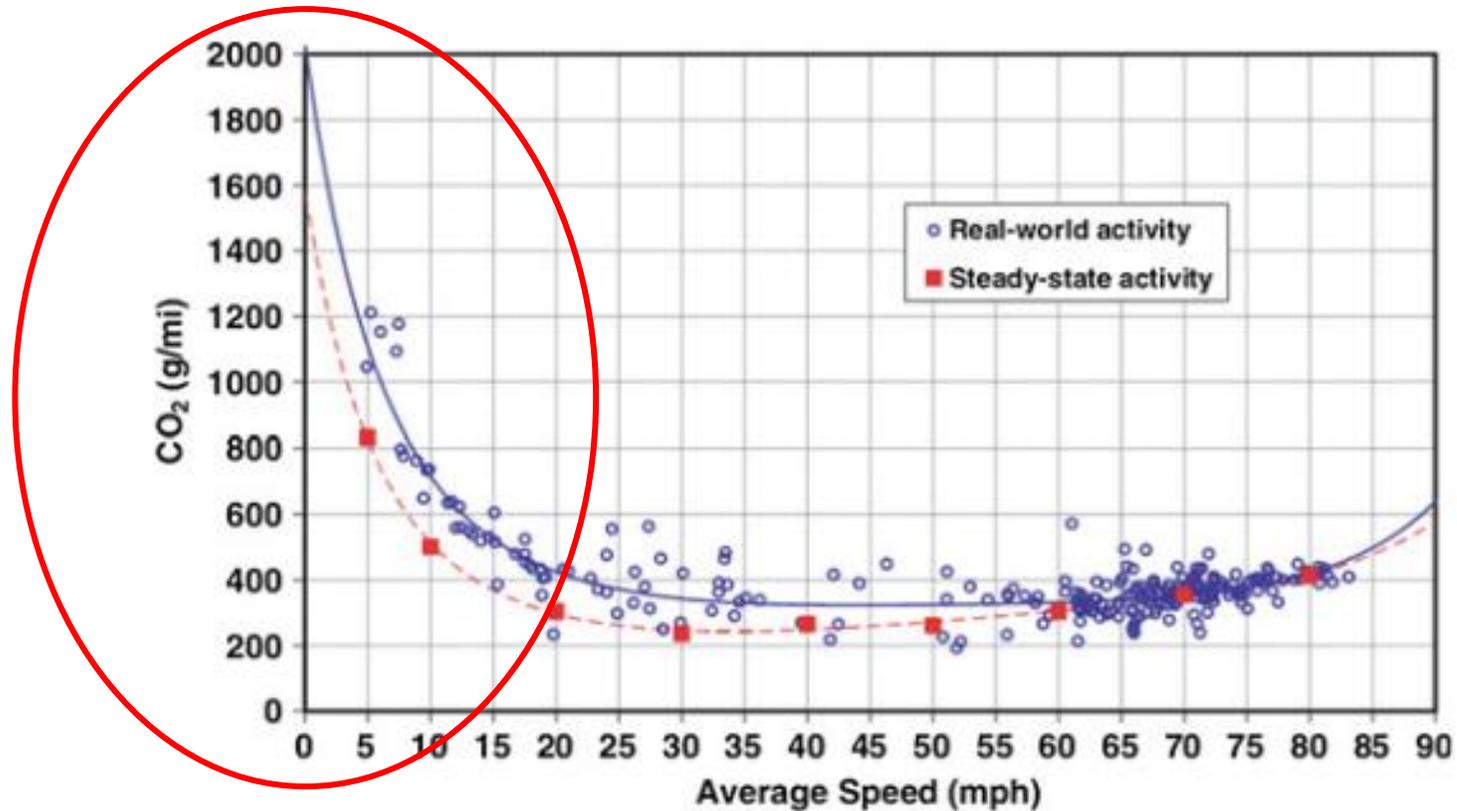


Fig. 7.1. Reality vs Certification gap estimation for an average 2015 passenger car; breakdown of factors contributing to the gap.

„Fuel consumption and CO₂ emissions from passenger cars in Europe – Laboratory versus real-world emissions” – Fontaras et al, 2017



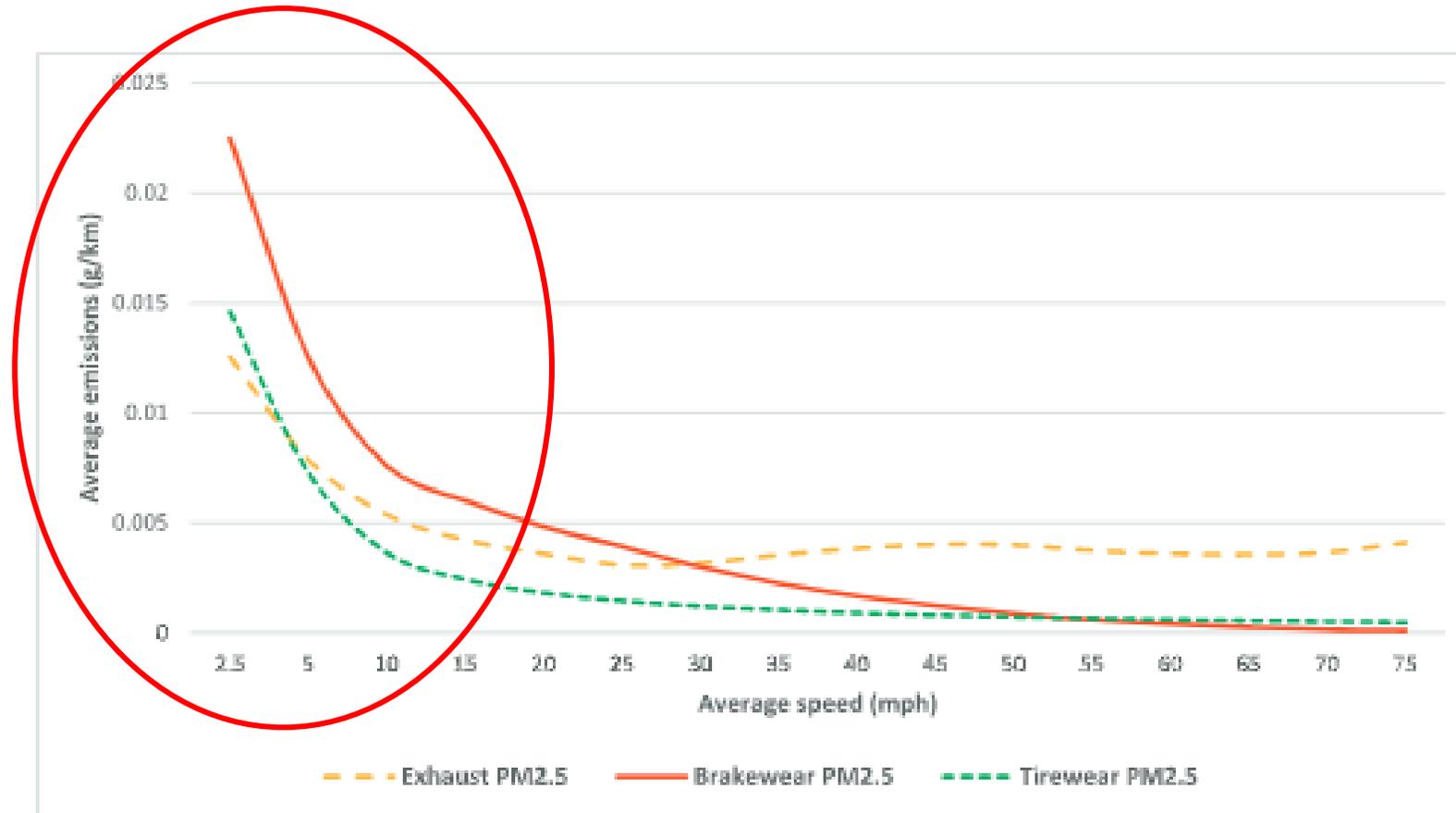
Emissions in low speed scenarios



„Real-world carbon dioxide impacts of traffic congestion“ – Barth, Boriboonsomsin 2010



Emissions in low speed scenarios



„The health impacts of weekday traffic: A health risk assessment of PM2.5 emissions during congested periods” – Requia et al 2018



Emissions in low speed scenarios

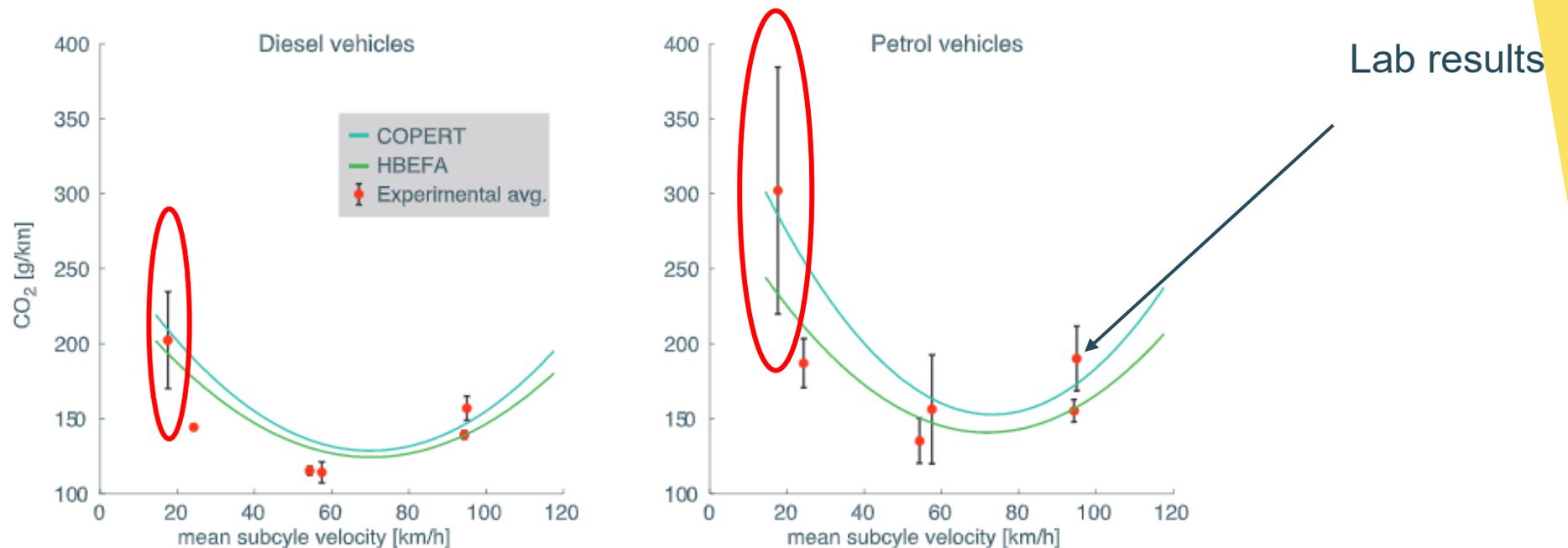


Fig. 4.4. Impact of average driving speed on CO₂ emissions of Euro 5 vehicles [262].

„Development and review of Euro 5 passenger car emission factors based on experimental results over various driving cycles” – Fontaras et al, 2014

COPERT5

COPERT is the EU standard vehicle emissions calculator. It uses vehicle population, mileage, speed and other data such as ambient temperature and calculates emissions and energy consumption for a specific country or region.



Furthermore, COPERT is:

- Internationally recognised — used by many European countries for reporting official emissions data.
- A research tool — calculate emissions at a national, regional or local scale, and for annual to daily estimates.
- Technologically advanced and transparent — COPERT's methodology is published and peer-reviewed by experts of the UNECE LRTAP Convention.
- Includes all main pollutants: greenhouse gases, air pollutants and toxic species.





The problem with average speed

- Average speed = 30km/h



- Distance is the same, travel time is the same, so average speed is also the same!





Calculating emissions on microscopic level – resistance approach:

$$F_c = \gamma \times EC + \beta Z_t$$

$$Z_t = Z_d + Z_r + Z_a + Z_e$$

$$Z_d = 2,36 * 10^{-7} v^2 M$$

$$Z_r = (3,72 * 10^{-5} v + 3,09 * 10^{-8} v^2) M$$

$$Z_a = 1,29 * 10^{-5} C_d A v^3$$

$$Z_e = 2,78 * 10^{-4} (a + g \sin \theta) M v$$

F_c —fuel consumption

EC – engine capacity

γ, β – equation coefficients

v —vehicle speed (km/h);

M —vehicle mass (kg);

C_d —aerodynamical drag coefficient;

A —vehicle frontal area (m²);

a —acceleration of vehicle (m/s²);

θ —road gradient.

Emissions are typically estimated based on fuel consumption. Fuel consumption can be calculated using the power the engine needs to generate for the vehicle to move.

Z_t is the sum of the powers needed to overcome the resistances:

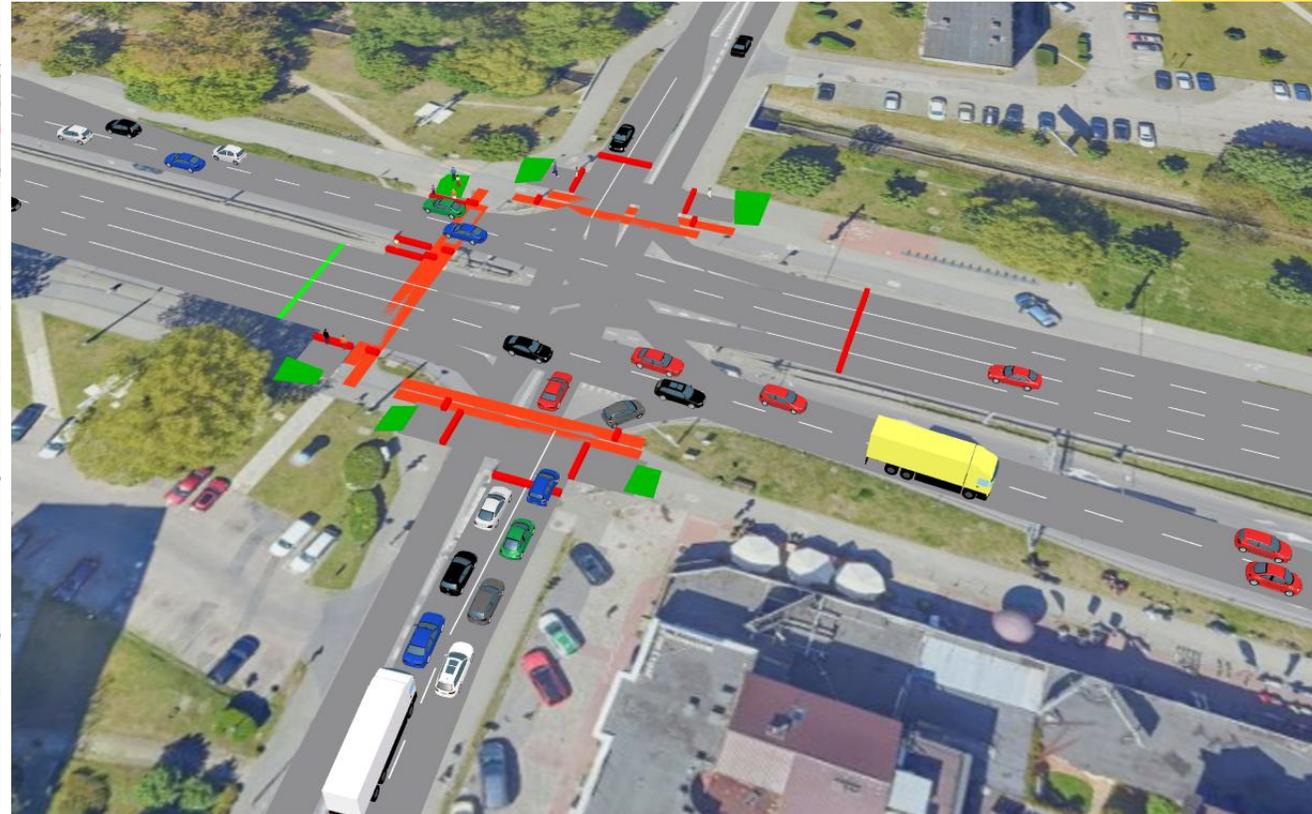
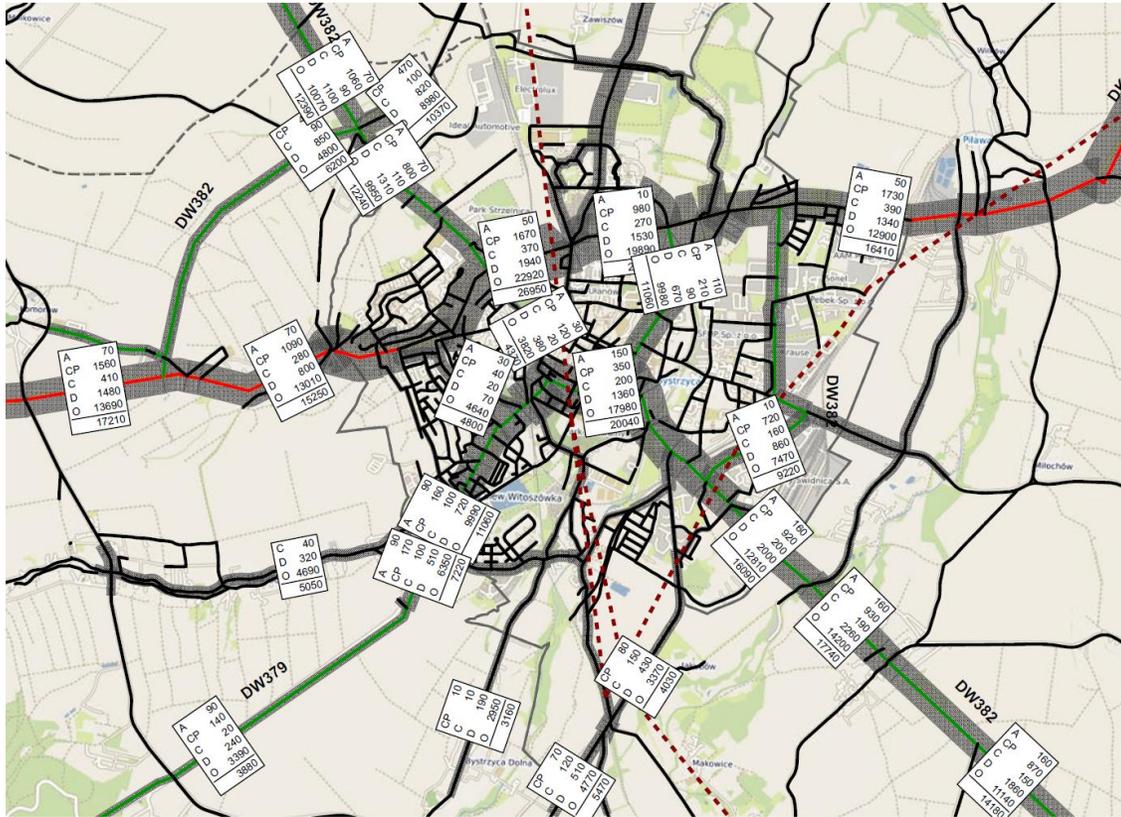
Z_d is the resistance of the vehicle's propulsion system.

Z_r is the tire rolling resistance.

Z_a is the resistance coming from aerodynamic drag and

Z_e is the gravitational and inertial resistance.

Macro vs Micro





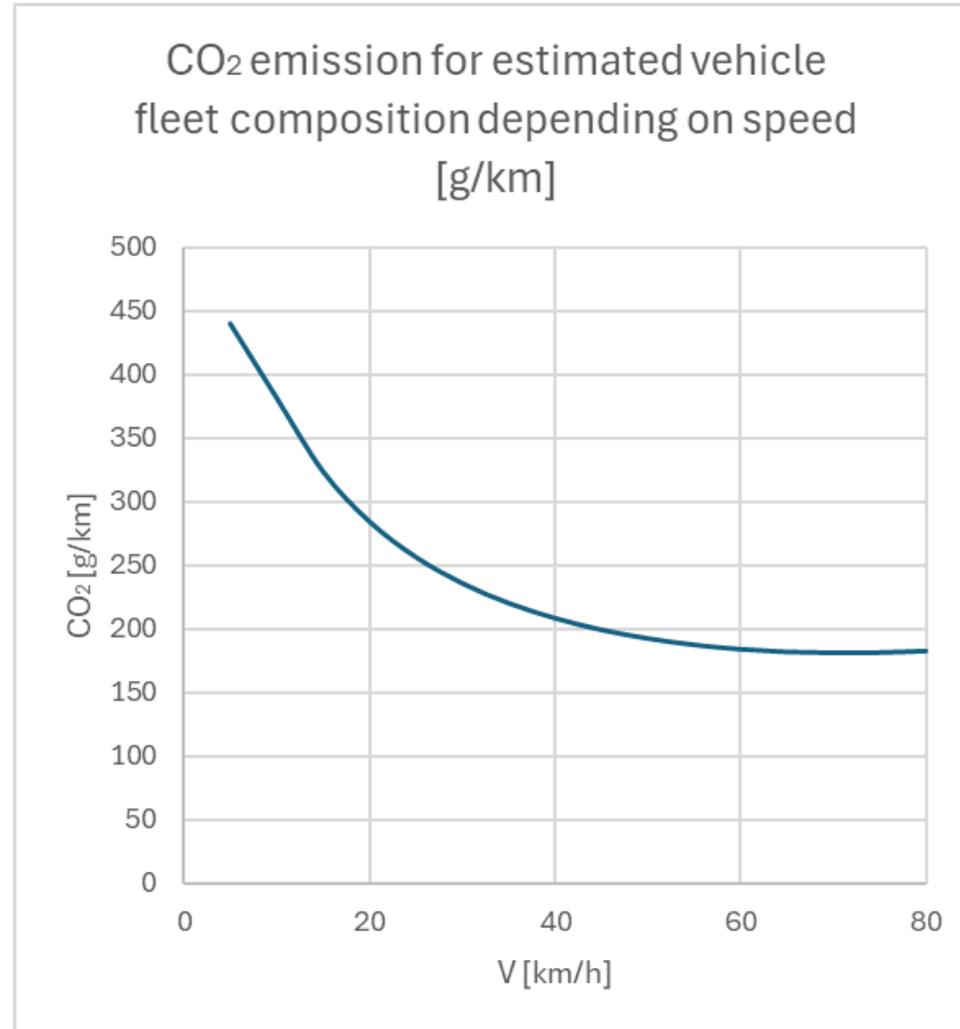
Problem with emissions estimation

- Full microscopic approach required a lot of complex calculations.
- There are multiple methods, but there is no „gold standard“
- Research with results open to public is required
- Many companies offer their own solutions, but they function as black box model
- COPERT5 is probably the most recognized method currently, but it is based on average speed values
- Microscopic models can still be utilized to give more accurate results of average speed values that will serve as an input to COPERT5





COPERT5 with microscopic simulation



THANK YOU!

