London’s Freight and Deliveries research project

EDF Old Kent Road deep dive

October 2021

EDF ENVIRONMENTAL DEFENSE FUND®

Freight journey patterns

RESEARCH QUESTION:

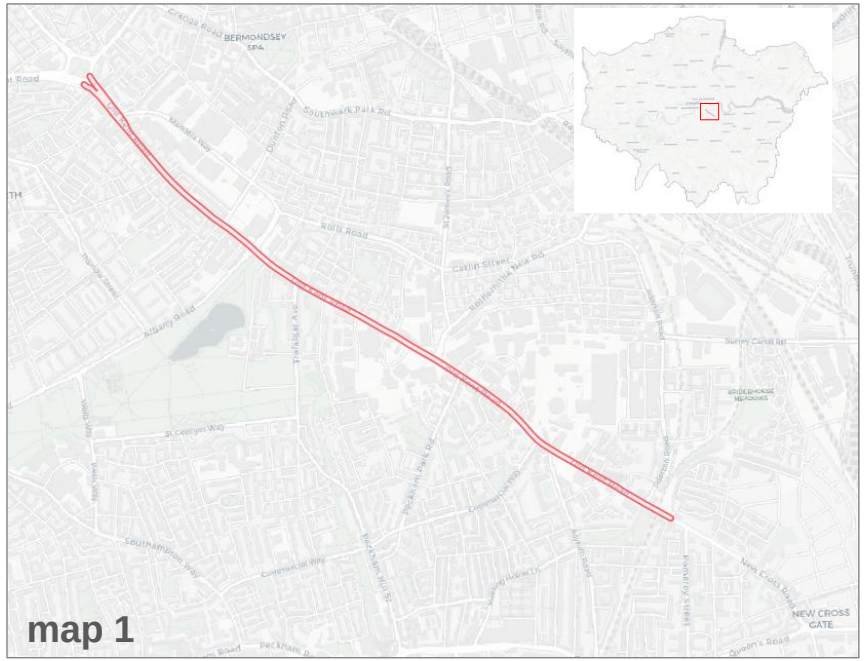
How many heavy-duty vehicle journeys are taking place on Old Kent Road, when do they occur, and are they responding to locally generated demand or just passing through?

Data overview: heavy duty vehicle trips passing through Old Kent Road

This analysis uses data from INRIX* to understand the journey patterns of heavy-duty vehicles, as well as data from Waze for Cities† to understand how these journeys relate to overall levels of congestion.

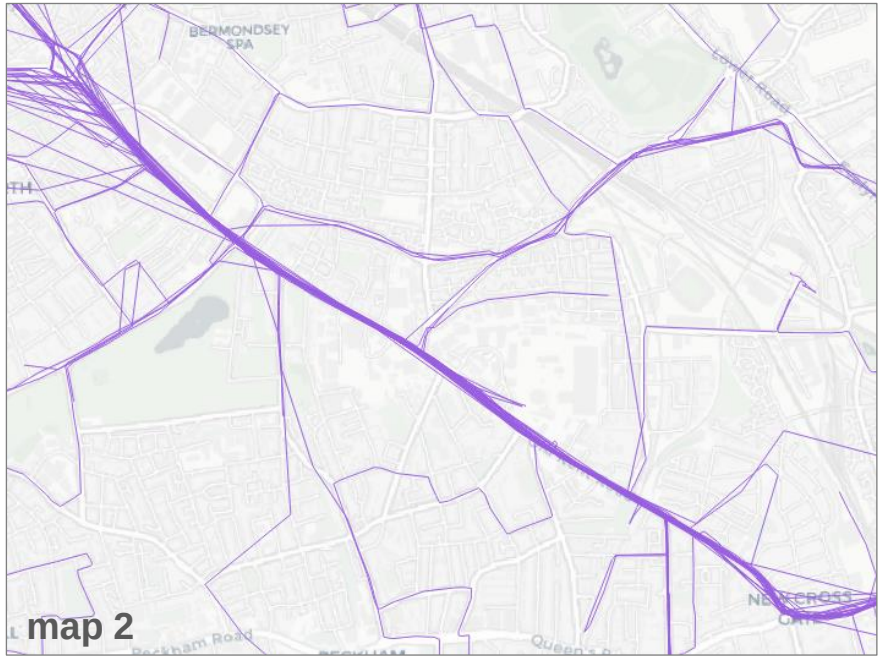
Heavy-duty vehicles in the INRIX datset are vehicles weighing between 14,000 and 26,000 lbs (6.4 – 11.8 tonnes), and the dataset consists of 726,000 trips made by heavy-duty vehicles in Greater London during the week of September 9th – 15th 2019. A trip is recorded as such when the vehicle producing the GPS data makes more than 200m progress within 10 minutes. If the distance travelled is below this threshold the trip ends, and a new one starts if the vehicle starts moving again later. For simplicity, hereafter all references to “trips” are describing trips by these heavy-duty vehicles.

Ordnance Survey data‡ was used to define the road area of the Old Kent Road (**map 1**). This area is then used to identify any trip which crosses over with the Old Kent Road (some random examples of these are shown in **map 2**).



map 1

EDF Europe graphic | Data source: OS Open Roads. Map basemaps © OpenStreetMap contributors, © CARTO



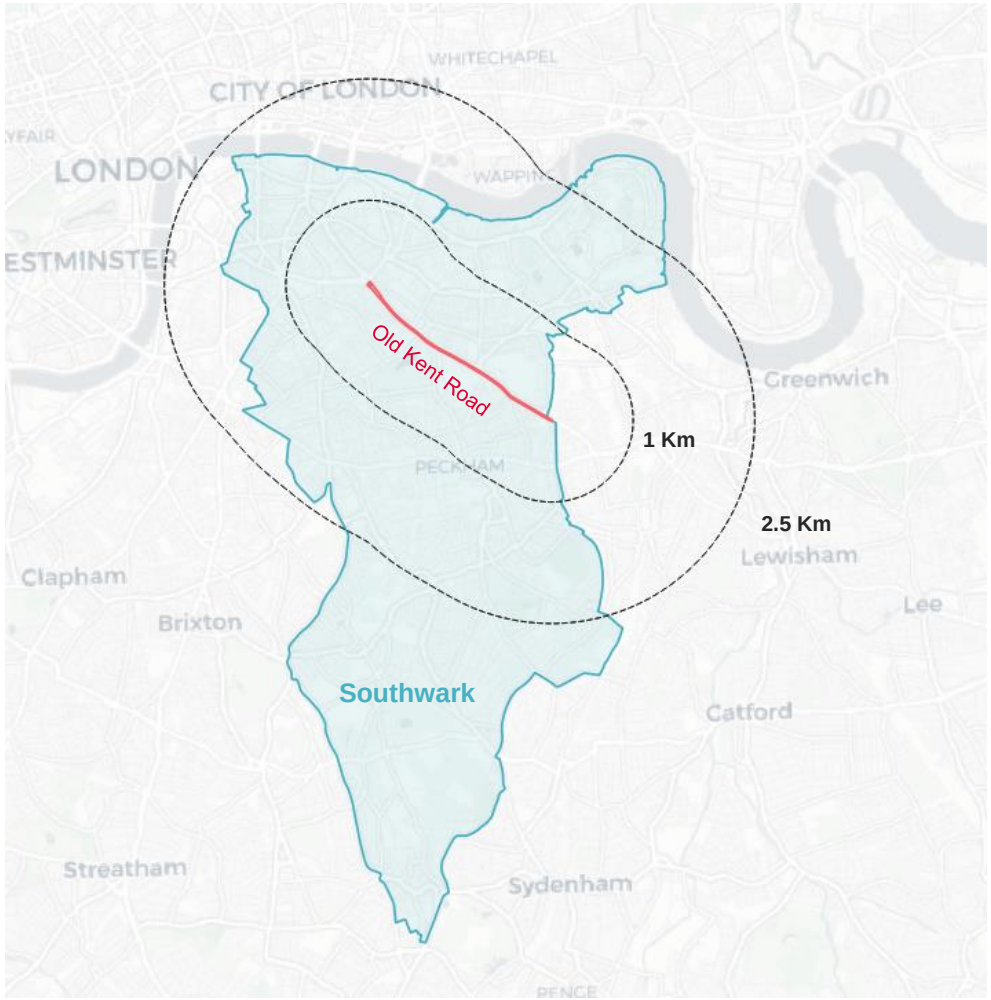
map 2

EDF Europe graphic | Data source: INRIX. Map basemaps © OpenStreetMap contributors, © CARTO

There are ~7.1 thousand trips that travelled on Old Kent Road during the week of Sept 9-15th 2019: it is these trips which will be used as the basis for the analysis.

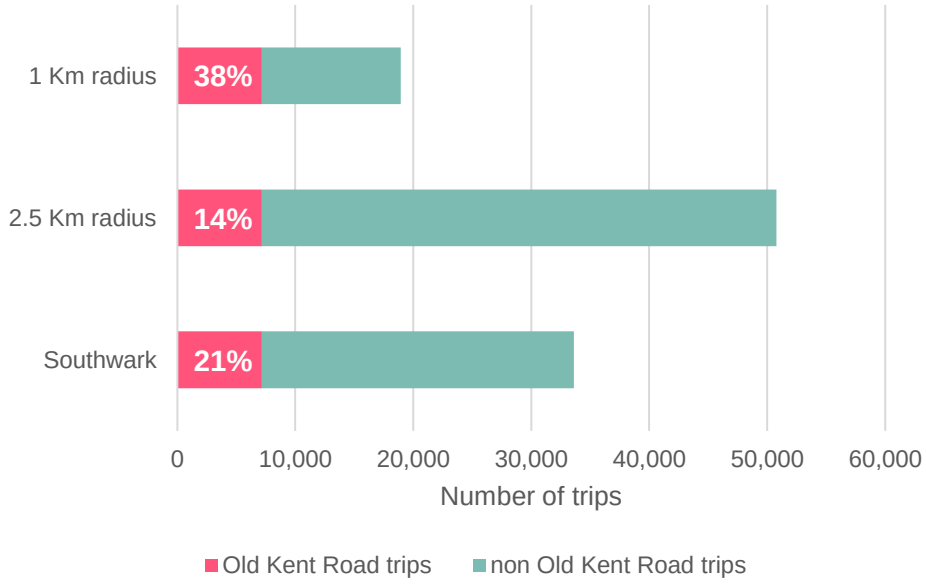
* Data was procured from INRIX. INRIX has no affiliation with the analysis or results
† Data from the Waze For Cities Program by permission
‡ https://www.ordnancesurvey.co.uk/business-government/products/open-map-roads

Data overview: heavy duty vehicle trips passing through Old Kent Road



EDF Europe Graphic | Data source: Greater London Authority, Ordnance Survey. Basemap © OpenStreetMap contributors, © CARTO

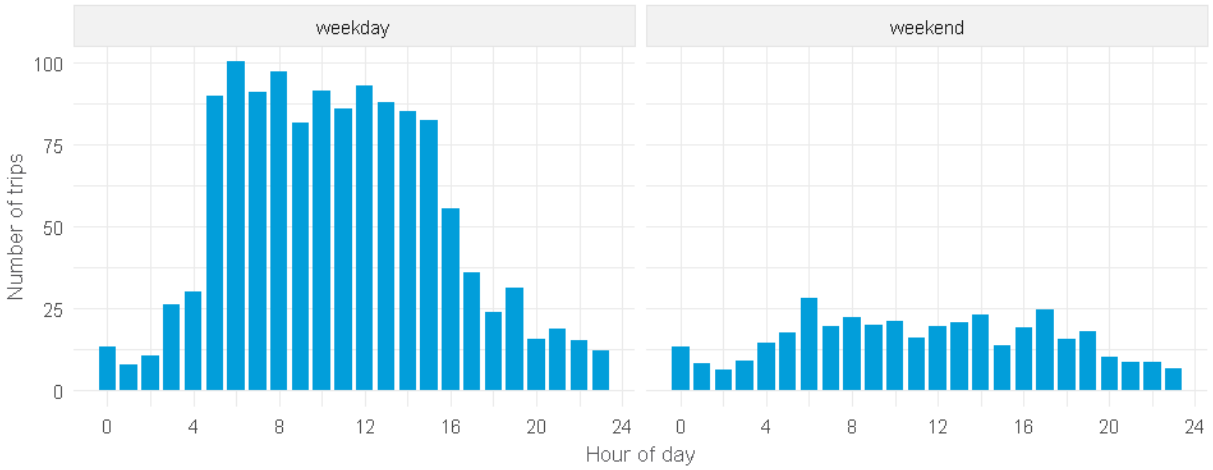
The **7.1 thousand trips** which travelled on the Old Kent Road represent the following proportions of all trips which travelled through the wider areas shown on the map



EDF Europe Graphic | Data source: INRIX

Number of trips and congestion on Old Kent Road

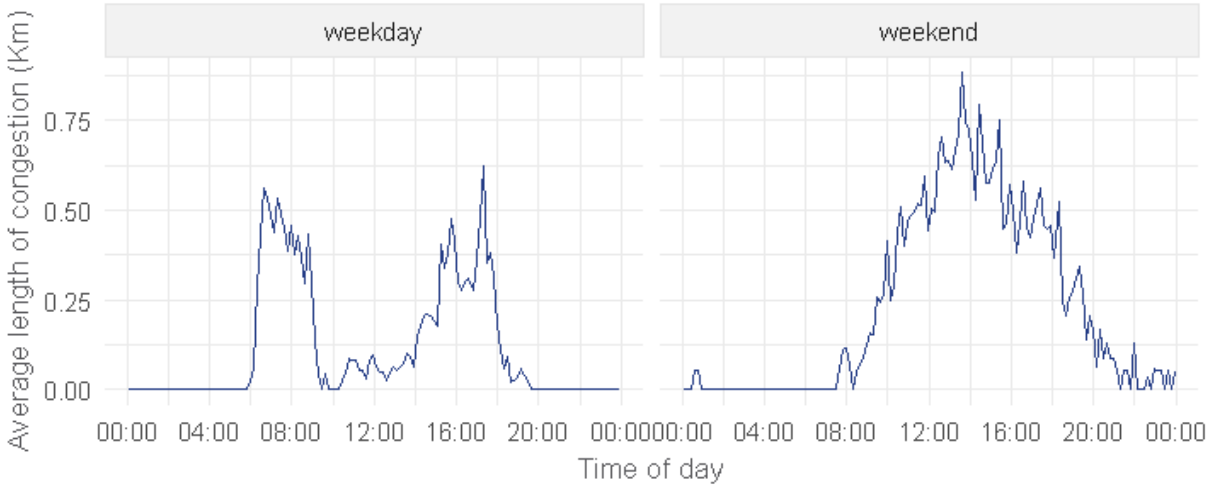
Average no. of trips on Old Kent Road by hour – w/c Sept. 9th 2019



EDF Europe Graphic | Data source: INRIX

The number of trips spikes early in the day at 05:00 during the week, and stays consistently high until 15:00, when it starts to drop off.

Average length of congestion on Old Kent Road - w/c Sept. 9th 2019



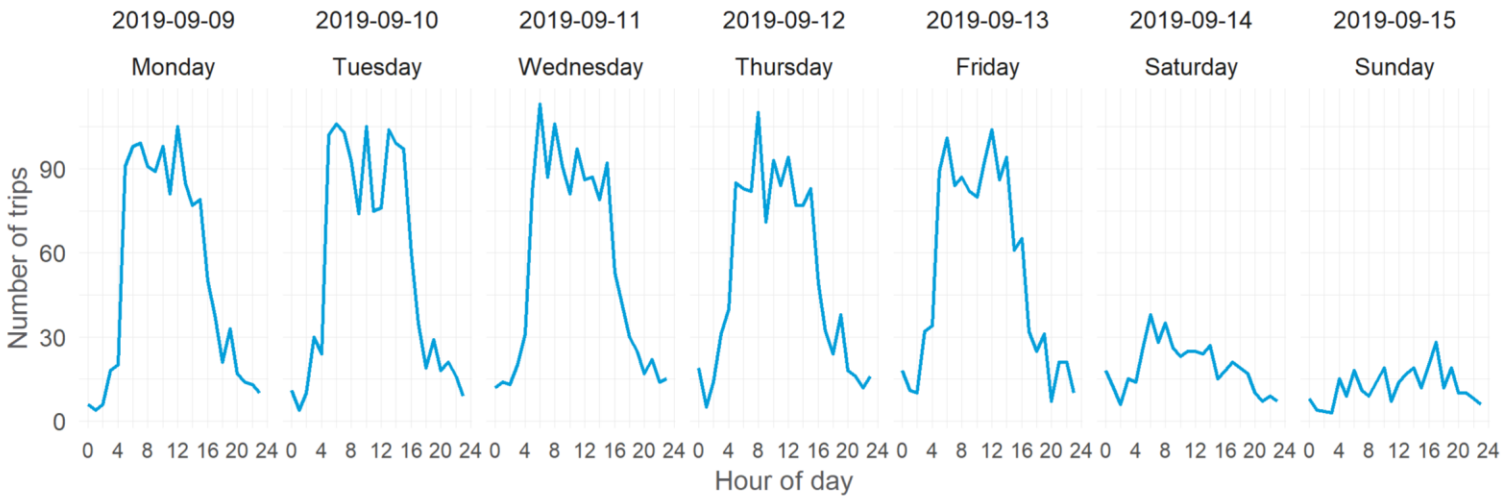
EDF Europe Graphic | Data source: Waze for Cities

Congestion jumps from almost non-existent to its early morning peak a little later at 06:00. It drops off quickly from about 09:00 then slowly builds back to another peak in the late afternoon between 15:00 17:00.

Note: zero in this chart doesn't mean no traffic, it means that any traffic is flowing freely.

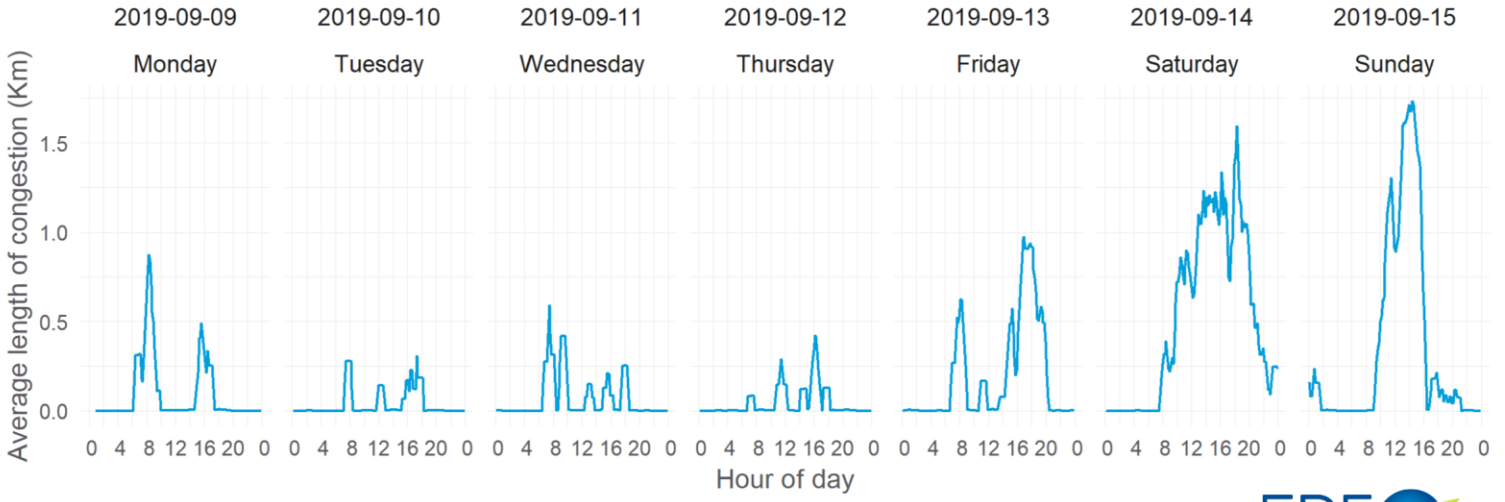
Hourly trips and congestion on Old Kent Road

Heavy-duty vehicle trips on Old Kent Road by hour



Peak activity is consistently between 05:00 – 15:00 during the week, though both Monday and Friday have slightly less activity at 15:00 than during the middle of the week.

Congestion on Old Kent Road by hour



Congestion levels have clear peaks on Monday and Friday morning and early evening, but throughout the rest of the week appear quite sporadic. The weekend exhibits far higher levels of congestion, sustained through Saturday, and with a very high peak on Sunday.

EDF Europe Graphics | Data source: Top graphic: INRIX; Bottom graphic: Waze for Cities

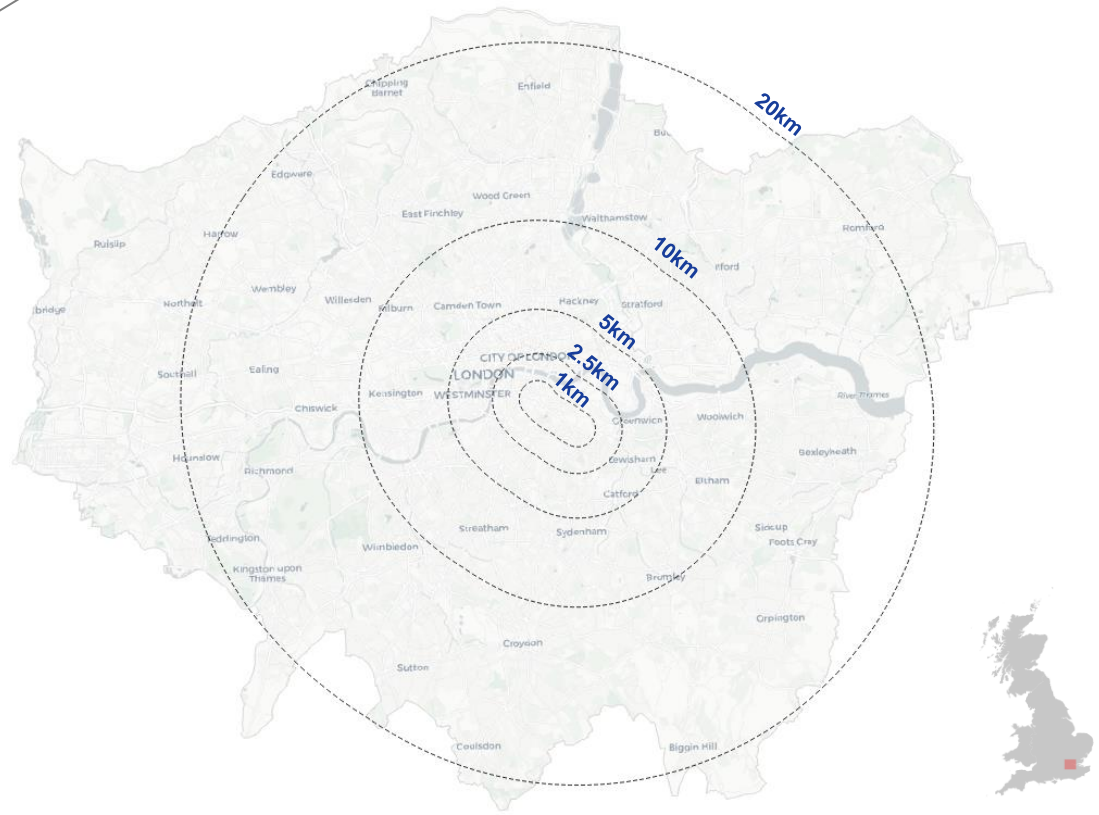
Patterns of demand

3% of all Old Kent Road trips have an origin within 1km and a destination beyond 20km of Old Kent Road

Trip destination distance from OKR

Trip origin distance from OKR	<1 km	1 - 2.5 km	2.5 - 5 km	5 - 10 km	10 - 20 km	20 km +
<1 km	8%	5%	4%	3%	3%	3%
1 - 2.5 km	6%	4%	3%	2%	2%	2%
2.5 - 5 km	5%	3%	3%	2%	2%	2%
5 - 10 km	3%	3%	3%	2%	2%	2%
10 - 20 km	3%	2%	2%	1%	1%	0%
20 km +	4%	3%	4%	2%	0%	0%

EDF Europe Graphic | Data source: INRIX



Distance range from Old Kent Road

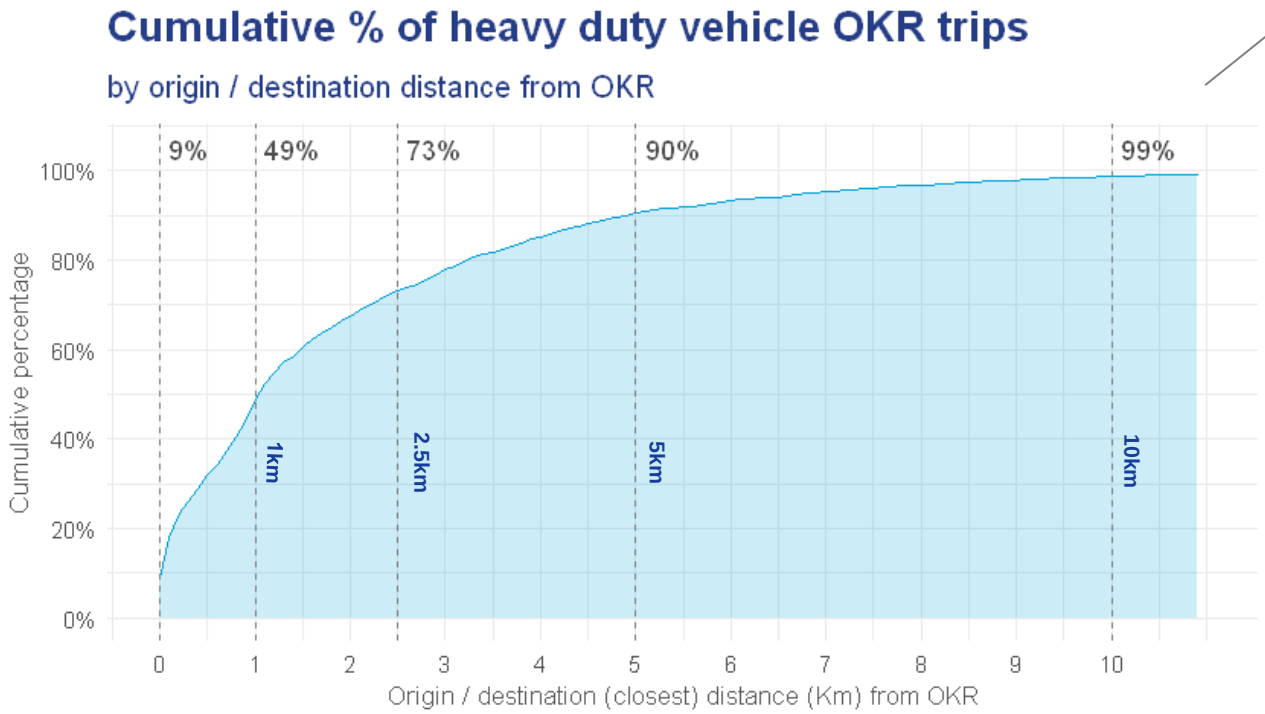
EDF Europe Graphic | Data Source: Ordnance Survey. Basemap © OpenStreetMap contributors, © CARTO

Breaking down the proportion of total trips by the distance of their origin and destination from Old Kent Road shows a large proportion of trips start or finish close to Old Kent Road, suggesting that much of this traffic is driven by local demand.

Patterns of demand

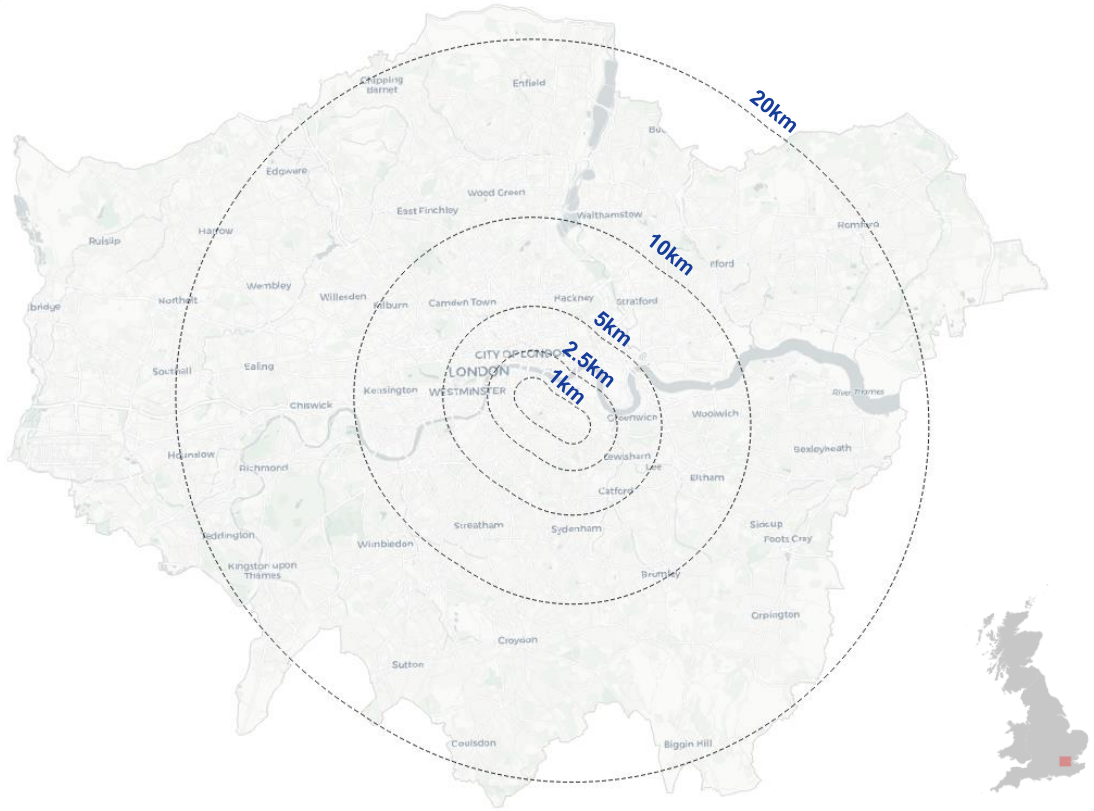
49% of all trips have either an origin or destination **within 1km of Old Kent Road**.

And **73%** have either an origin or destination **within 2.5km of Old Kent Road**.



EDF Europe Graphic | Data source: INRIX

The proportion of total trips which have either an origin or destination within a certain distance of Old Kent Road increases steeply up to 1km, then slows down and slowly flattens out beyond 5km. This illustrates the high proportion of total trips which either start or finish within a relatively short distance of Old Kent Road.



Distance range from Old Kent Road

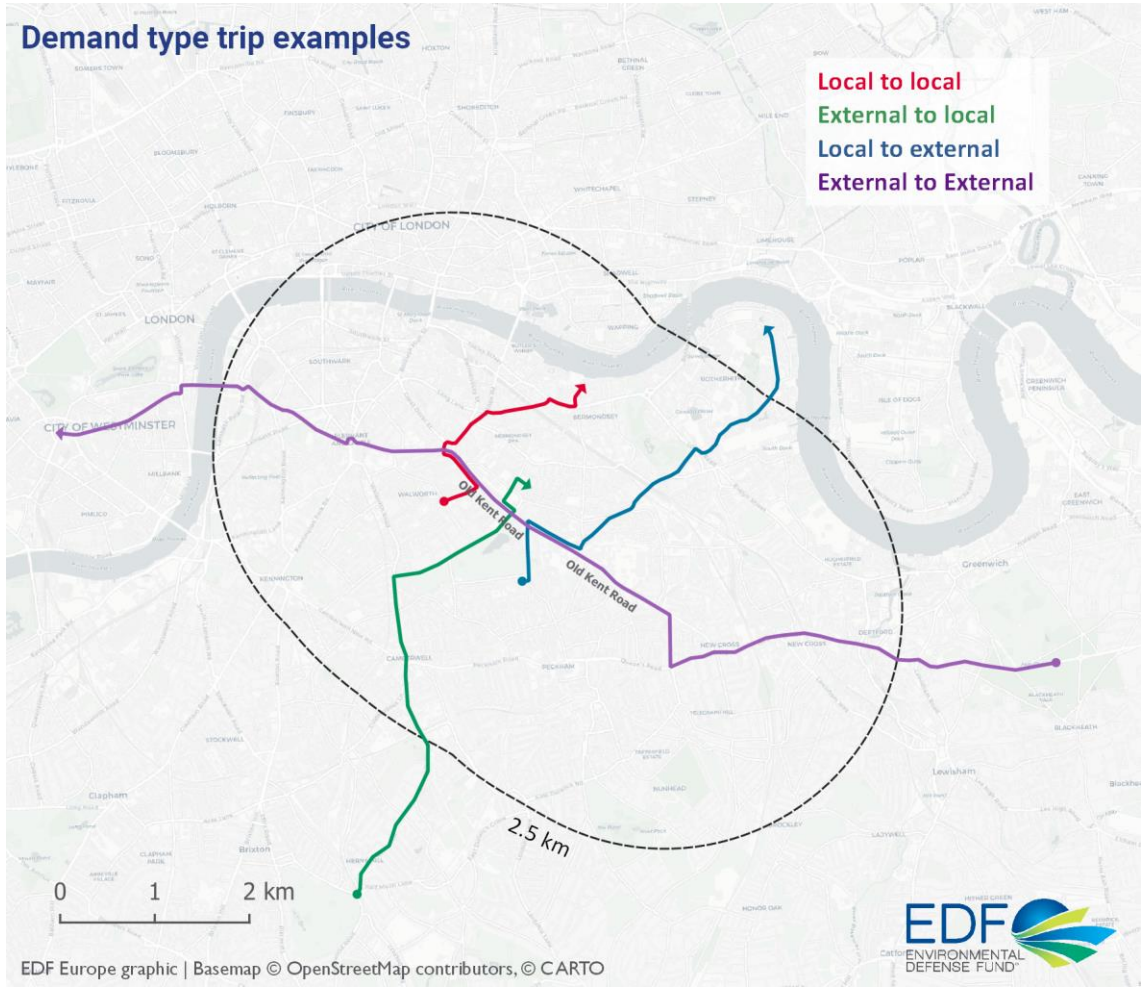
EDF Europe Graphic | Data Source: Ordnance Survey. Basemap © OpenStreetMap contributors, © CARTO

Patterns of demand

Trip origin distance	Trip destination distance: <1 km	1 - 2.5 km	2.5 - 5 km	5 - 10 km	10 - 20 km	20 km +
<1 km	8%	5%	4%	3%	3%	3%
1 - 2.5 km	6%	4%	3%	2%	2%	2%
2.5 - 5 km	5%	3%	3%	2%	2%	2%
5 - 10 km	3%	3%	3%	2%	2%	2%
10 - 20 km	3%	2%	2%	1%	1%	0%
20 km +	4%	3%	4%	2%	0%	0%

EDF Europe graphic | Data source: INRIX

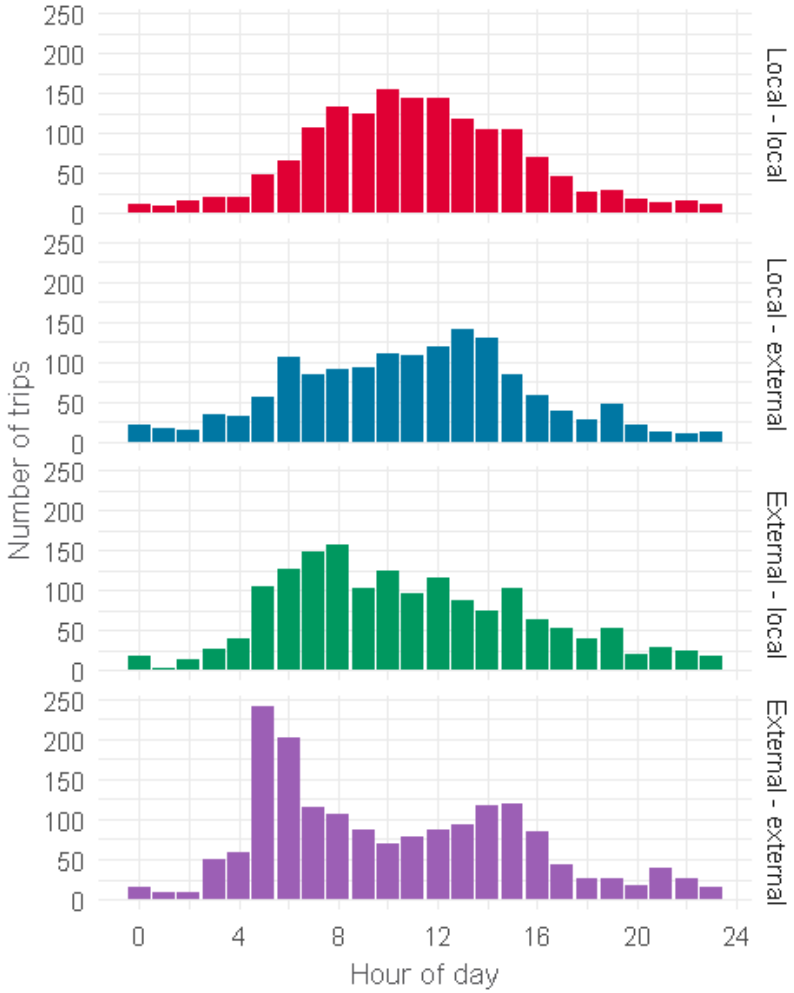
Here trips are grouped into 4 different classes using the distance matrix. These groups each represent a similar proportion of total heavy-duty vehicle trips and all display distinctive characteristics (examined further on the next slide).



Patterns of demand

Number of trips

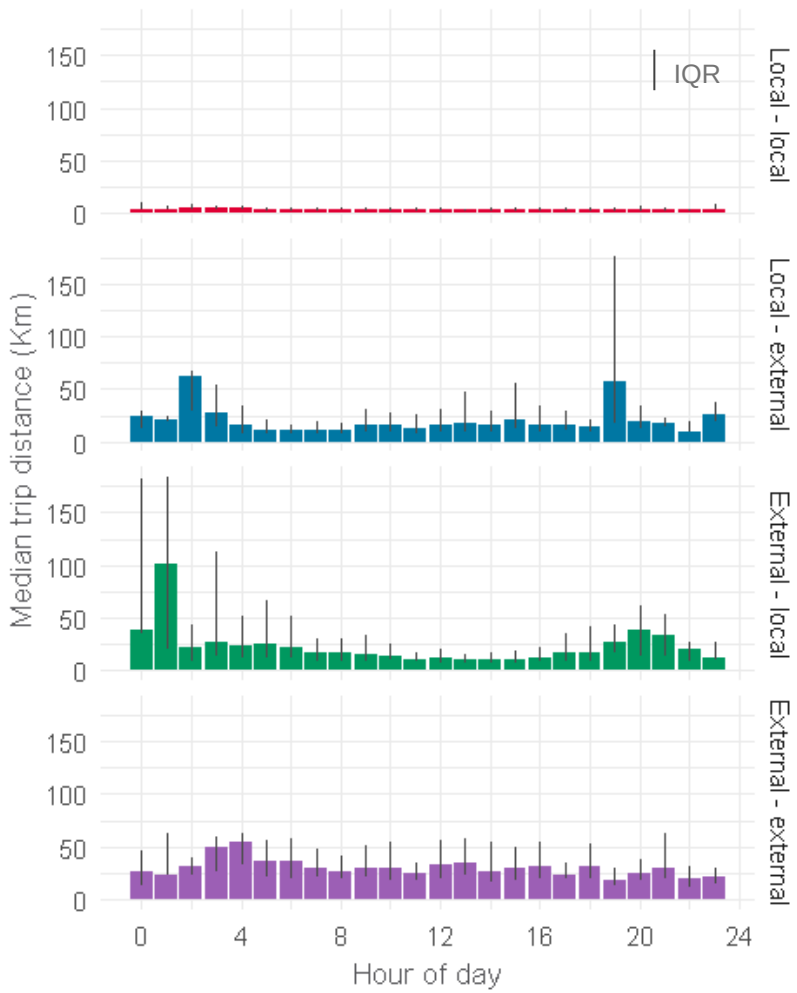
By time of day and trip origin/dest proximity



EDF Europe graphic | Data source: INRIX

Average trip distance

By time of day and trip origin/dest proximity



EDF Europe graphic | Data source: INRIX

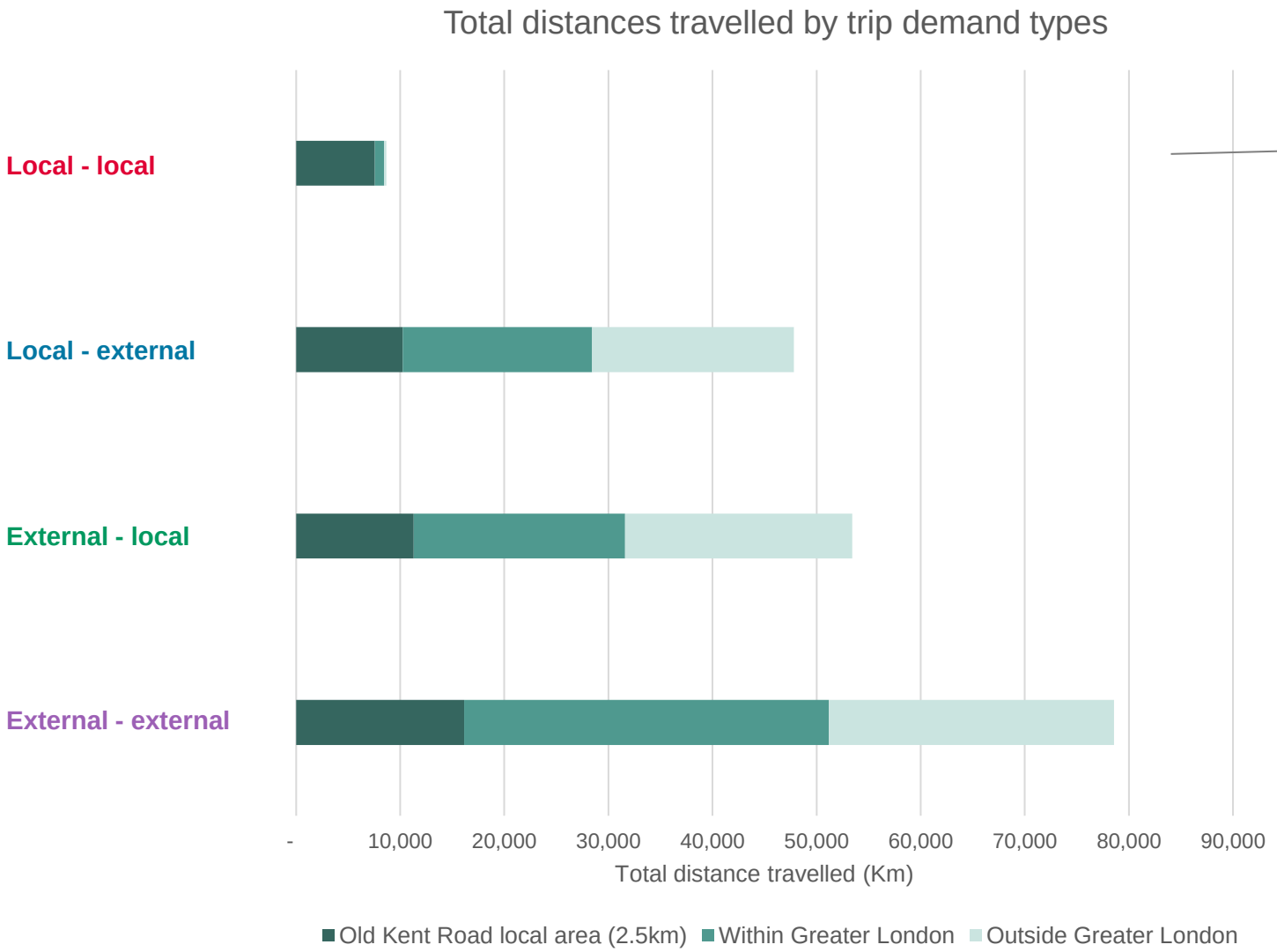
Local - local trips peak during the middle of the day when Old Kent Road is least congested, and have a consistently low average distance, of 3.6 km overall throughout the day.

Local - external
There is a clear build up to peak activity for these trips in the early afternoon after which they sharply drop off. The median distance is higher than local – local trips, at 15.8km

External - local
These trips follow an inverse pattern of activity to the Local – external trips. Average distance is very similar at 15.2km overall, though there is more variation early in the morning and late evening.

External - external
These trips have two distinct peaks of activity: highest in the early morning and then smaller early in the afternoon. Trip distance has some variation but is consistently much higher than the other trip types, 30km median overall.

Patterns of demand



Local – local trips represent **17% of the total distance driven within the Old Kent Road local area** by heavy-duty vehicles, but just **5%** of the total distance travelled overall.

External – external trips are responsible for the greatest number of Km driven in the Old Kent Road local area (36% of the total), and are therefore also likely responsible for the greatest amount of pollution.

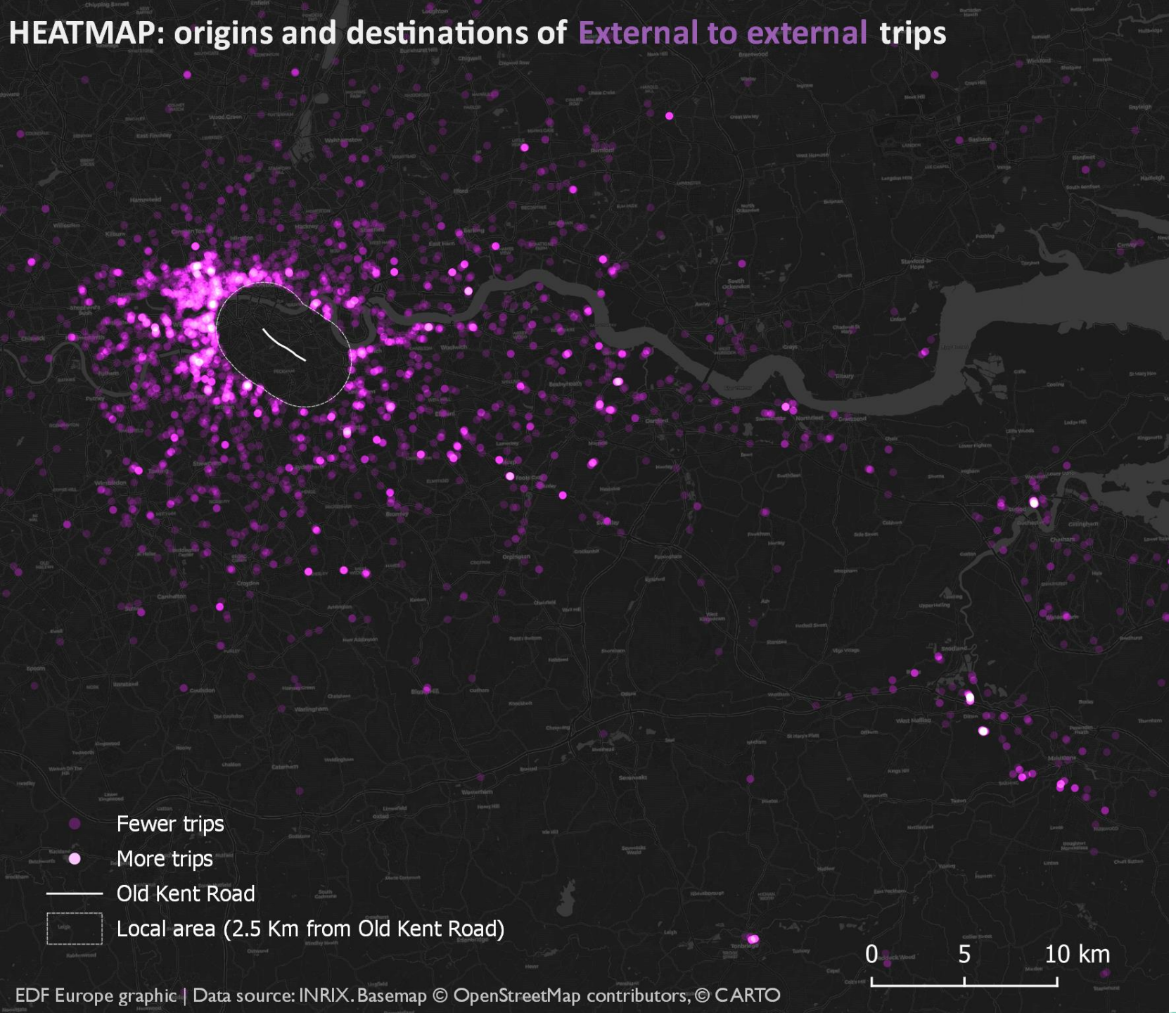
EDF Europe Graphic | Data source: INRIX

HEATMAP: origins and destinations of Local to local trips

Activity hotspot around Asda, B&Q, business parks and builders warehouses.

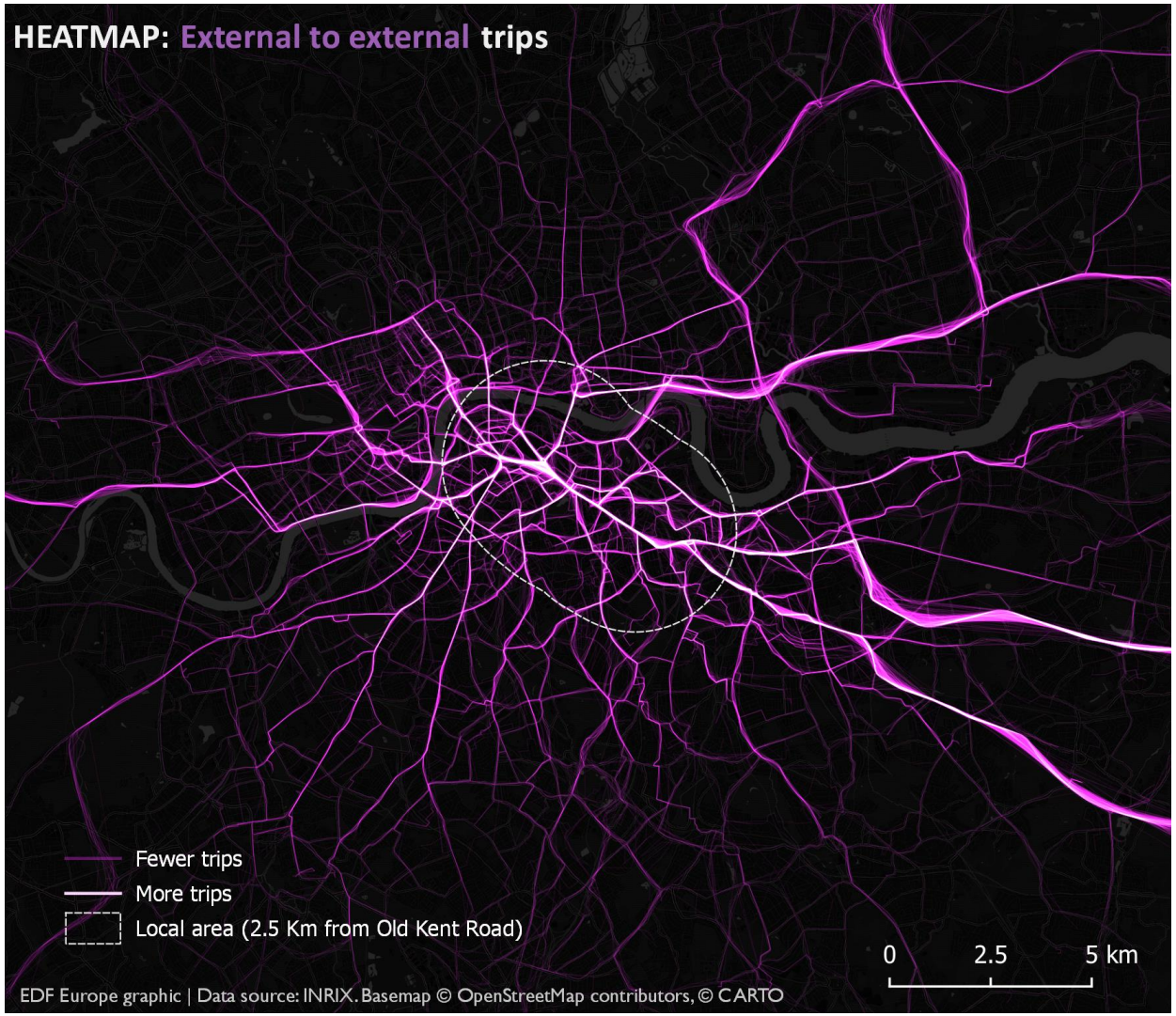
Landmann way, many industrial sites.

B214 / B204 intersection, Tesco, Carpetright



Here there is a real focus of activity starting or ending in central London, with some scattered focus points further afield like Maidstone and Ditton.


HEATMAP: Local to local trips
Fewer trips
More trips
Local area (2.5 Km from Old Kent Road)
0
2.5
5 km
EDF Europe graphic | Data source: INRIX. Basemap © OpenStreetMap contributors, © CARTO


HEATMAP: External to external trips
Fewer trips
More trips
Local area (2.5 Km from Old Kent Road)
0
2.5
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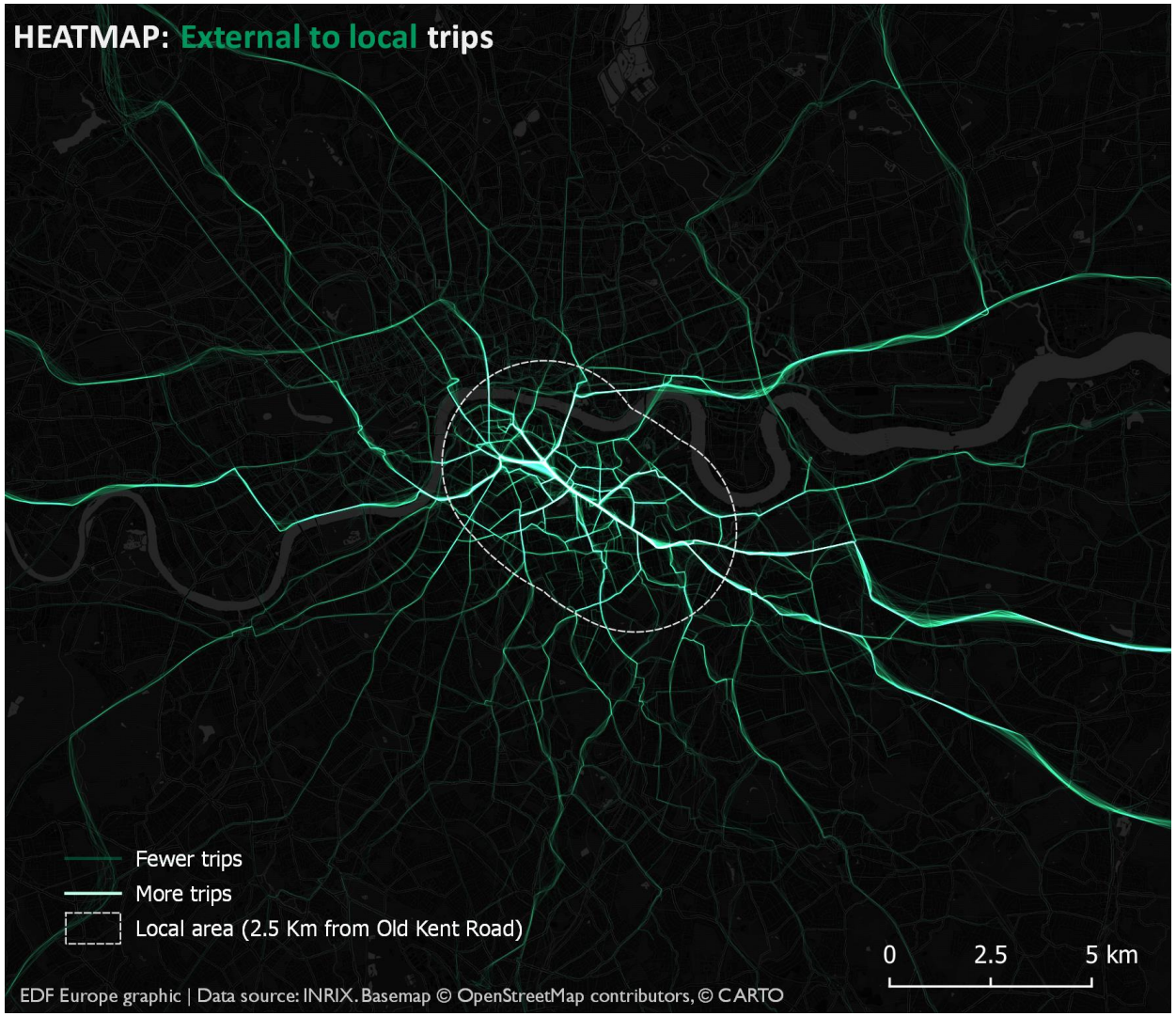
EDF Europe graphic | Data source: INRIX. Basemap © OpenStreetMap contributors, © CARTO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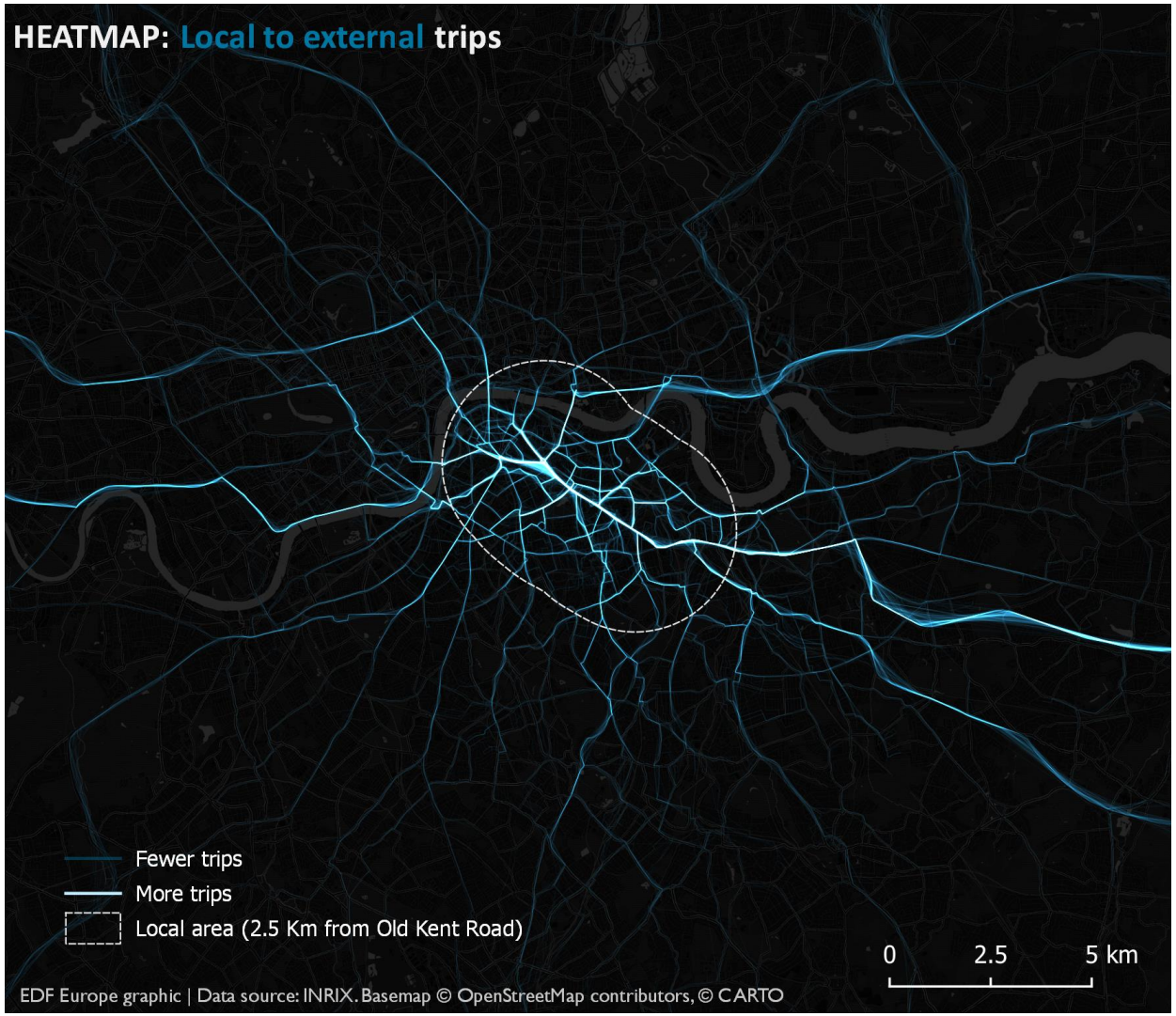

HEATMAP: Local to external trips
Fewer trips
More trips
Local area (2.5 Km from Old Kent Road)
0
2.5
5 km
EDF Europe graphic | Data source: INRIX. Basemap © OpenStreetMap contributors, © CARTO

Method notes

Patterns of demand: defining demand types

In order to define the trips by different types of demand the distance from both origin and destination for each trip to the Old Kent Road was determined. This operation measured the Euclidian distance from each origin or destination point to the nearest origin or destination point of Old Kent Road. The origin and destination distances for each trip was then categorised into bands: 0-1km, 1-2.5km, 2.5-5km, 5-10km, and 10-20km. Counting the number of trips which fell into each combination of origin and destination distance band and then representing this sum as a proportion of the total number of trips allowed the matrix on slide 8 to be created.

The distance matrix was then used as the basis to define sub groups of trips based on the distances of their origins and destinations from Old Kent Road, and then examine each group's patterns of activity and average trip distances. After a process of trial and error the 2.5km distance band was used to define the 4 different demand types described on slide 10.

In order to calculate the total distances travelled by trips of each demand type in different areas (shown on slide 12) a linestring record for each trip (representing the full journey) was intersected with both a polygon representing the 2.5km buffer distance from Old Kent Road and one defining the boundary of Greater London. This allowed the total length of each trip line within each of these areas to be calculated.

Waze congestion levels

Data was obtained from the Waze For Cities Programme by permission. Waze congestion alerts are created through a combination of user-generated reports and geolocation data from the million monthly active Waze users in London. We define a congested road segment as one exhibiting 80% or less of each road's free flow speed. Note that this data represents unique traffic congestion based on Waze-generated anonymous incident and slow-down information, and should thus be considered as an indicator of overall congestion rather than a true measure.

When examining congestion occurring on the Old Kent Road the total length in km of all congestion records falling within the road area shown on slide 4 (map 1) was calculated for every 10 minute period during the week commencing September 9th 2019. This data was then summarised, either by calculating the mean congestion length for each 10 minute period by weekdays or weekends (slide 6) or by calculating an hourly rolling average of the 10 minute total length (slide 7).

Freight traffic and emissions

Research Questions:

“Understanding what proportion of traffic on the Old Kent Road is generated by freight vehicles”

“Drawing estimates on the proportion of air pollution emissions caused by freight vehicles”

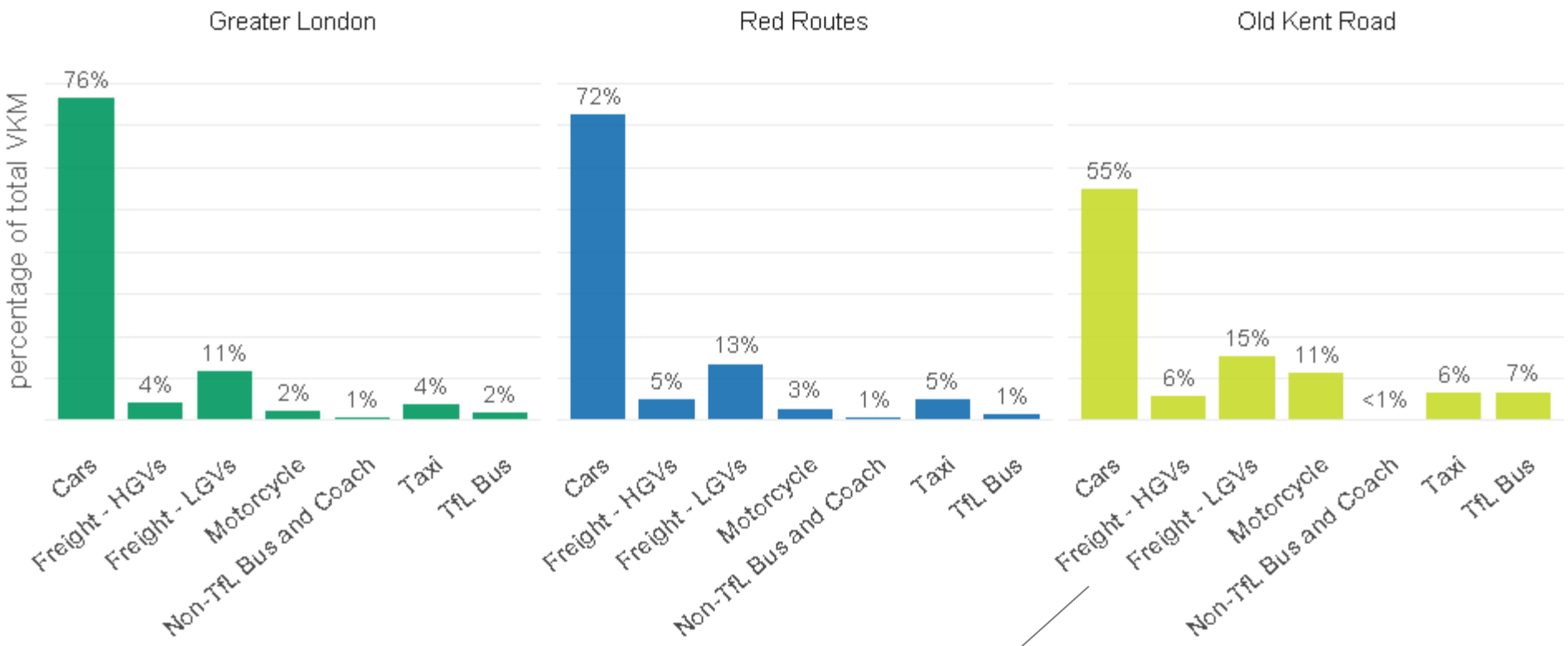
Data overview

Modelled data on total **Vehicle Kilometres** (VKM) travelled by different vehicle types, as well as **emissions** can be gathered from the 2016 London Atmospheric Emissions Inventory (LAEI). Although a few years old, this is the most up-to-date source of vkm and emissions data for London at a fine spatial resolution currently available and can still give valuable insights into the volume and types of vehicles on London's roads as well as which sources are contributing most to air pollution.

This LAEI data is used for the breakdowns of VKM by vehicle type on slide 19.

We can also complement this picture using modelled source apportionment data produced by Cambridge Environmental Research Consultants (CERC) using the ADMS-Urban model as part of the Breathe London pilot project (shown in slides 21 and 22), which estimates the **concentration** of pollutants from different sources at a fine spatial resolution across London. The CERC model uses emissions data from the 2013 LAEI (the most recent pollution data with forward projections) as an input, then combines it with information on weather, pollutant dispersion, urban topography etc. to estimate the concentration of pollutants at particular locations. These estimates are for the year 2019, which means they more accurately reflect some changes in emission sources since 2016, such as the TfL bus fleet which has been made a lot cleaner.

Traffic proportion by vehicle type on the Old Kent Road



EDF Europe graphic | Data source: London Atmospheric Emissions Inventory 2016

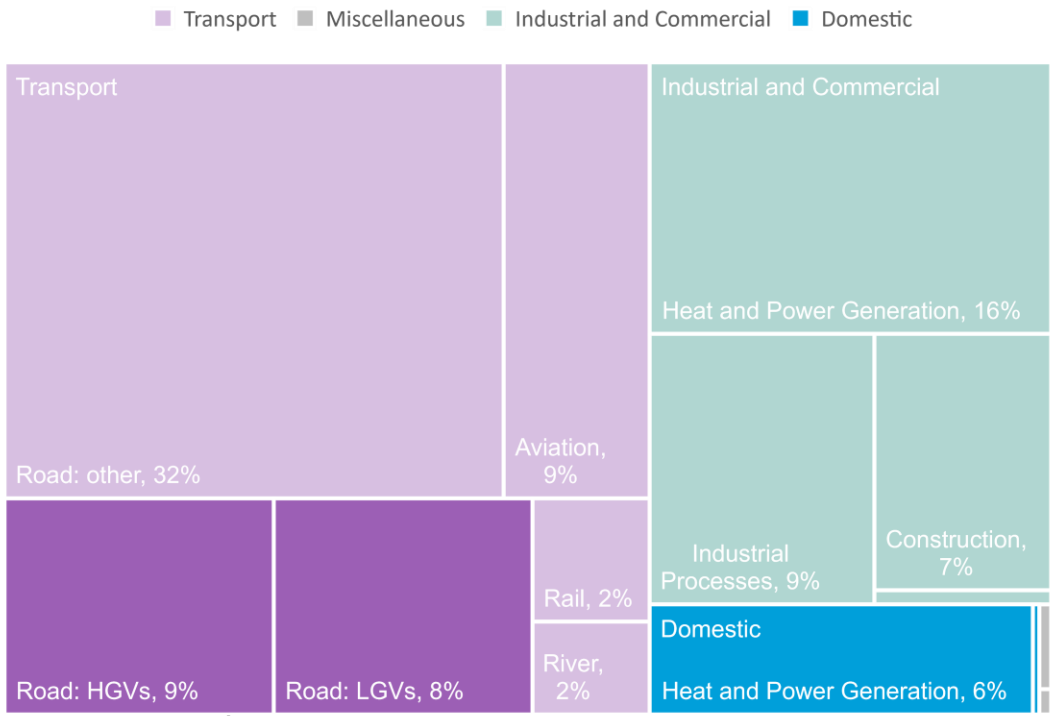
21% of all vehicle kilometres (VKM) travelled along the **Old Kent Road** are from **freight vehicles**.

This is higher than the **16% total across Greater London**, and the **18% total on all Red Routes**.

There is a much greater proportion of bus traffic on the Old Kent Road than across Greater London and on all other Red Routes, while car traffic is a much smaller proportion.

Freight emissions across Greater London

NO_x Emissions in Greater London (2016)

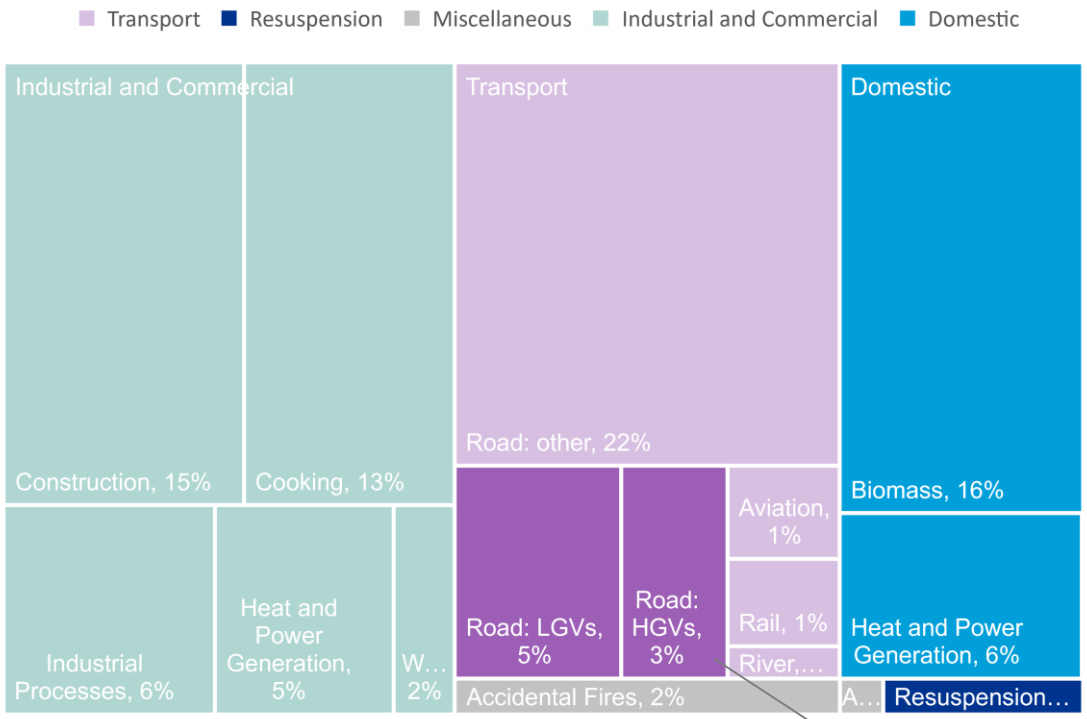


EDF Europe graphic | Data source: London Atmospheric Emissions Inventory 2016

HGVs and LGVs combined are responsible for **7,170 tonnes** of **NO_x emissions per year** in Greater London.

This is **17% of total local emissions**, and **34% of all road transport emissions**.

$PM_{2.5}$ Emissions in Greater London (2016)



EDF Europe graphic | Data source: London Atmospheric Emissions Inventory 2016

LGVs and HGVs combined are responsible for **312 tonnes** of **$PM_{2.5}$ emissions per year** in Greater London.

This is **8% of total local emissions**, and **27% of all road transport emissions**.

Air pollution from freight sources on Old Kent Road

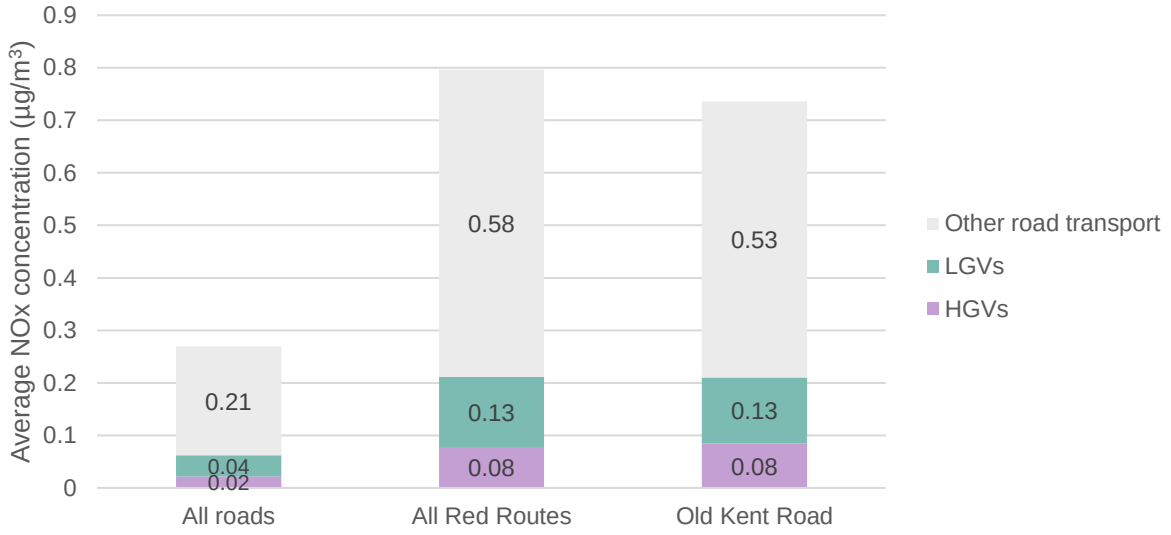
Average NO_x from road transport sources on London roads (2019)

EDF Europe graphic | Data source: EDF Europe analysis of modelled data produced by Cambridge Environmental Research Consultants (CERC) as part of the Breathe London Pilot Project.

The average concentration of NOx from road transport sources is dramatically higher on Red Route roads than the average across all London roads.

Old Kent Road is similar to the Red Route average, though the contribution from HGVs is higher. Together, **HGVs and LGVs contribute more than a third** to the total concentration from road transport.

Average $PM_{2.5}$ from road transport exhaust sources on London roads (2019)



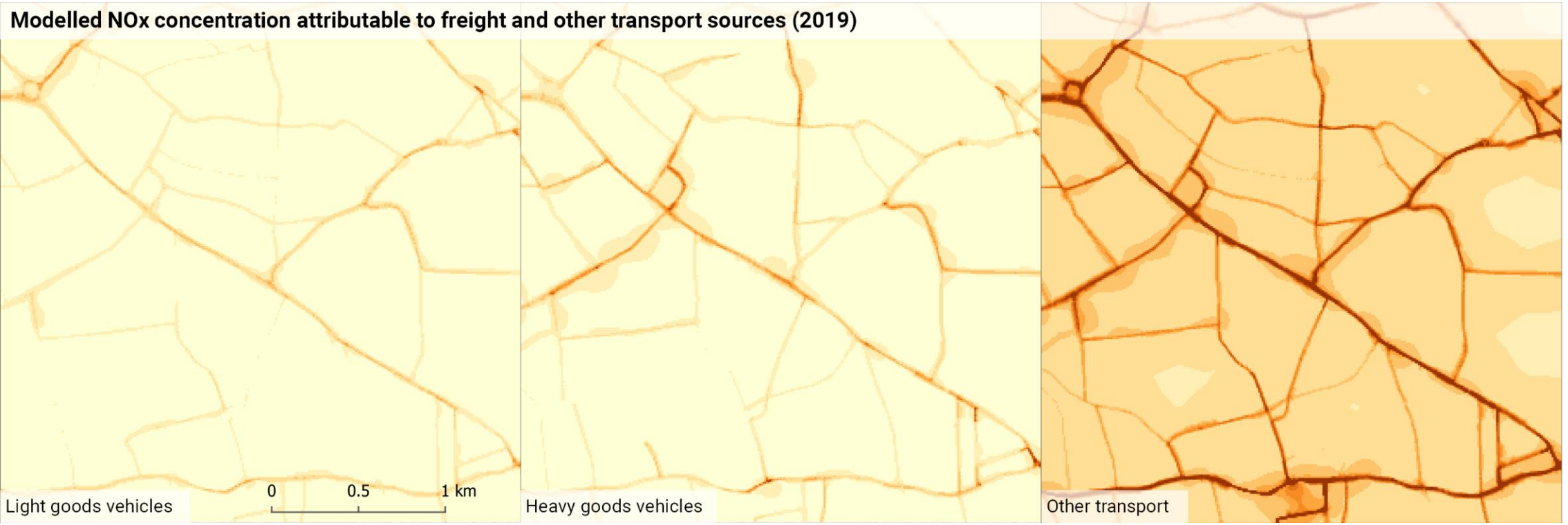
EDF Europe graphic | Data source: EDF Europe analysis of modelled data produced by Cambridge Environmental Research Consultants (CERC) as part of the Breathe London Pilot Project.

The average concentration of PM2.5 from road transport exhaust sources is slightly lower on the Old Kent Road than on Red Routes on average, but still far higher than the average across all London roads.

Note: these average concentrations do not include PM2.5 from brake and tyre wear, which can make up a large proportion of the concentration from road transport sources. This is because the data we have unfortunately does not allow us to isolate brake and tyre wear from specific road sources.

Note: All other transport includes the following sources: Diesel Cars, Petrol Cars, Non TfL Buses and Coaches, TfL Buses, Taxis, Motorcycles.

Modelled NOx concentration attributable to freight and other transport sources (2019)



EDF Europe graphic | Data source: modelled data produced by Cambridge Environmental Research Consultants (CERC) as part of the Breathe London Pilot Project

HGVs are responsible for 6% of all VKM on Old Kent Road compared to 15% for LGVs, but it is clear they are responsible for a higher concentration of NOx along Old Kent Road than HGVs.

Method notes

Calculating air pollution from different sources across different road types

Ordnance Survey Open Roads data* was used to identify the approximate central alignment of the road carriageway for all roads of the following types in Greater London: A, B, Minor, and Local roads, as well as Old Kent Road itself. A dataset from Transport for London that identifies the geographic boundary of the GLA road network (Red Routes) was used to identify those which are Red Routes†; all defined Red Routes are of A road type. Next, a buffer area to each side of the road's central alignment was created of 10m for A roads and 5m for all other road types.

High resolution source apportionment modelling data at a 10m grid resolution, produced by CERC using the ADMS-Urban model for the Breathe London pilot project ‡ , were then used to calculate the average NO_x and $PM_{2.5}$ pollution levels from Heavy Goods Vehicles, Light Goods Vehicles, and all other road transport sources (Diesel Cars, Petrol Cars, Non TfL Buses and Coaches, TfL Buses, Taxis, Motorcycles). This was carried out by summing the concentration at each grid cell within the road type buffer and dividing the total by the count of all grid cells within the same road type buffer area, for each source type and road type in turn (i.e. all London roads, just Red Routes, and Old Kent Road).

* https://www.ordnancesurvey.co.uk/business-government/products/open-map-roads

† https://tfl.gov.uk/info-for/open-data-users/our-open-data#on-this-page-4

‡ See Appendix 6 of the Breathe London technical report: https://www.globalcleanair.org/files/2021/02/BL-CERC-Final-Report.pdf

London-wide COVID-19 impacts

Initial analysis overview

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Data overview: heavy duty vehicle trips across London, 2019 & 2020

This analysis uses INRIX data for vehicles which have travelled in London during two weeks: 9th-15th September 2019 and 7th-13th September 2020*. INRIX collect vehicle movement data from a number of different providers, and the datset is considered to be a representative sample of London traffic. As for the Old Kent Road case study, these have been restricted to heavy-duty vehicles, and in this case only those where the Provider (who supplies the data to INRIX) is present in both the 2019 and 2020 data sets – this is to ensure that changes in trip volumes are not caused by changes in the data supply.

From hereon, 2019 and 2020 are used to refer to the two September weeks, and trips to refer to trips made by heavy-duty vehicles.

The number of trips included in the analysis for each year is:

- 2019: 345,046
- 2020: 316,669

Waze congestion data

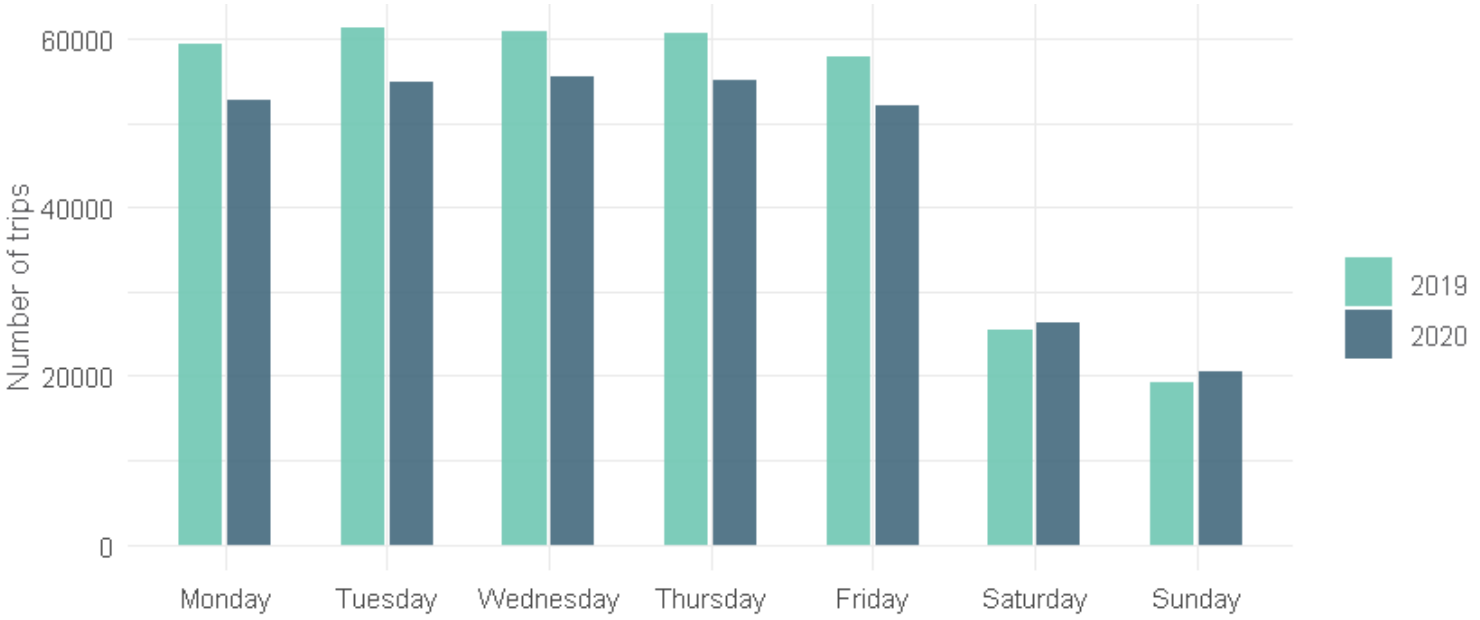
The analysis of congestion in London uses data from Waze for Cities†. Waze congestion alerts are created through a combination of user-generated reports and geolocation data from the million monthly active Waze users in London. We define a congested road segment as one exhibiting 80% or less of each road's free flow speed. Note that this data represents unique traffic congestion based on Waze-generated anonymous incident and slow-down information, and should thus be considered as an indicator of overall congestion rather than a true measure.

In the following analysis the total length of all congested road segments in London was calculated for each 10 minutes during the weeks of interest. This was then used to calculate an hourly average.

* Data was procured from INRIX. INRIX has no affiliation with the analysis or results
† Data from the Waze For Cities Program by permission

Changes in daily trip activity: 2019 vs. 2020

Daily activity – Year on Year

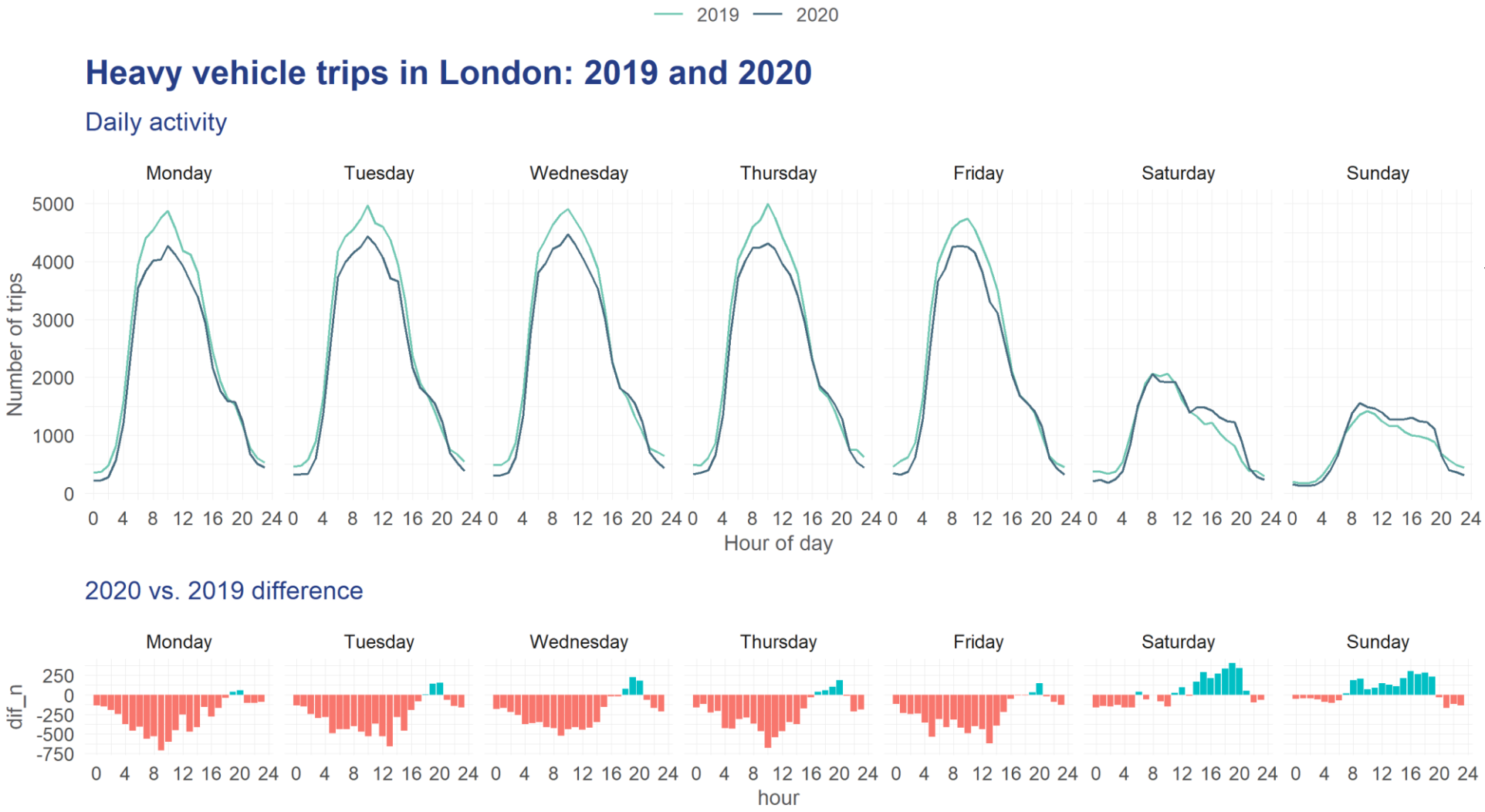


EDF Europe Graphic | Data source: INRIX

For both 2019 and 2020 weeks the pattern of activity is fairly similar, with trips building to a peak on Wednesday and Thursday, then dropping off on Friday and into the much smaller volumes at the weekend.

The number of trips is much lower throughout the week in 2020, but the pattern is reversed at the weekend where there are more trips on both days than in 2019.

Changes in hourly trip activity: 2019 vs. 2020



On weekdays, the greatest reduction in activity occurs during the middle of the day, where 2020 levels do not reach the same high peak as in 2019.

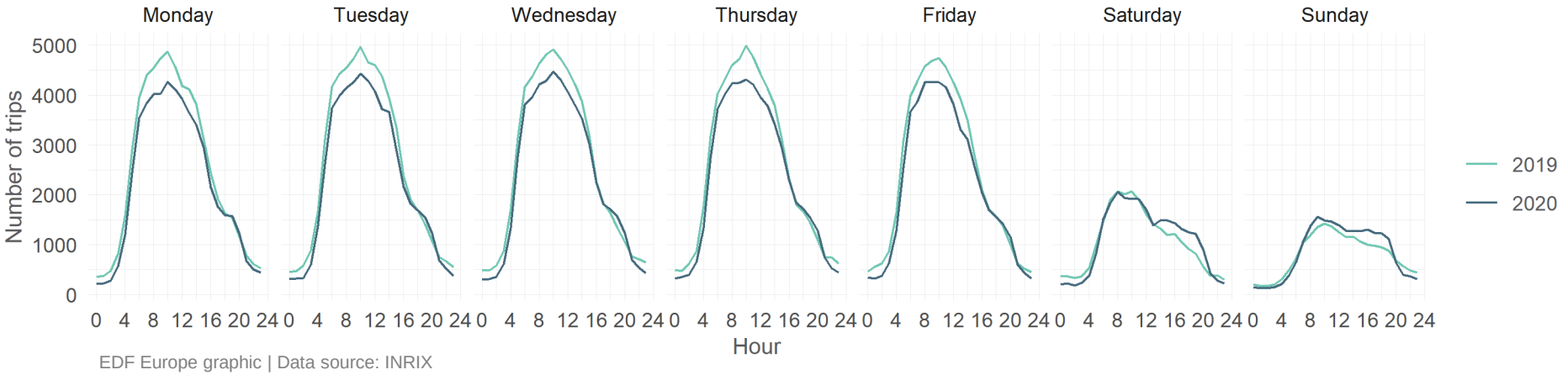
During the evening hours for 2020 there appears to be a consistent spike back up above 2019 levels.

And on the weekend the increased activity in 2020 occurs largely in the afternoon.

EDF Europe graphic | source: INRIX

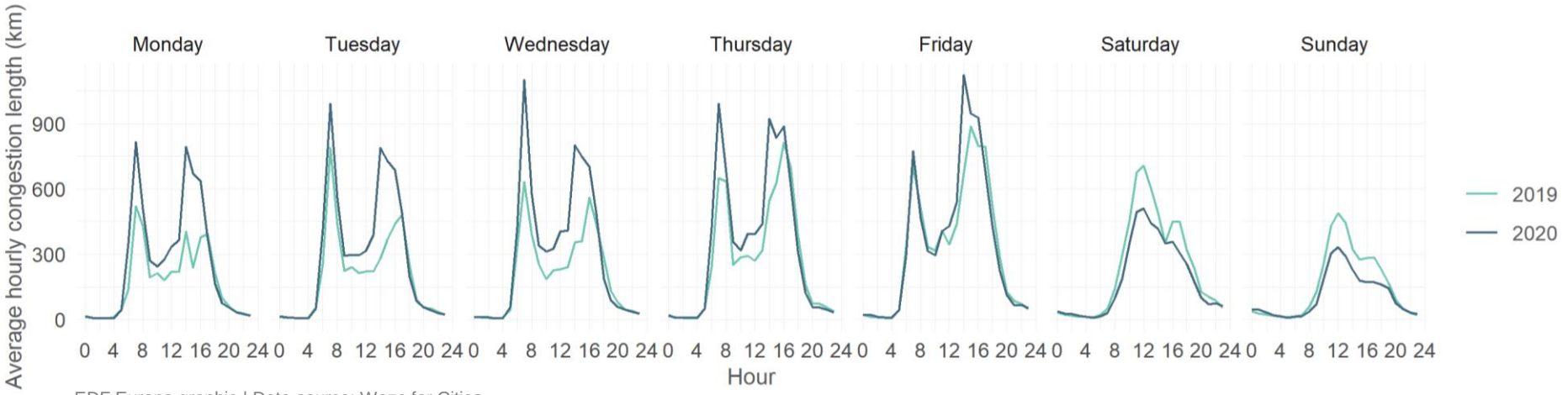
Hourly activity: trips and congestion

Heavy-duty vehicle trips in London – 2019 and 2020



EDF Europe graphic | Data source: INRIX

Waze congestion in London – 2019 and 2020



EDF Europe graphic | Data source: Waze for Cities

The reduction in heavy-duty vehicle trips seen in 2020 is not mirrored in the congestion data, which shows higher levels of congestion in 2020 compared to 2019 throughout weekdays. However, this pattern is again reversed at the weekend where 2020 congestion drops below 2019 levels.

The different diurnal patterns of heavy-duty vehicle trips and congestion, and the different year-on-year changes seem to suggest there isn't a strong link between these types of trips and overall congestion.

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