# INRIX Global Traffic Scorecard

INRIX Research
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INRIX

# ABOUT INRIX RESEARCH

Launched in 2016, INRIX Research uses INRIX proprietary big data and expertise to make the movement of people and goods more efficient, safer and convenient.

We achieve this by leveraging 500 terabytes of INRIX data from 300 million different sources covering more than 5 million miles of road, combined with our other data sources including global parking, fuel, points of interest, public transport and road weather information. Together, our data provides a rich and fertile picture of urban mobility that enables INRIX Research to produce valuable and actionable insights for policy makers, transport professionals, automakers and drivers.

The INRIX Research team has researchers in Europe and North America, and is comprised of economists, transportation policy specialists and data scientists with backgrounds from academia, think tanks and commercial research and development groups. We have decades of experience in applying rigorous, cutting-edge methodologies to answer salient, real-world problems.

INRIX Research will continue to develop the INRIX Traffic Scorecard as a global, annual benchmark as well as develop new industry-leading metrics and original research reports. In addition to our research outputs, INRIX Research is a free and valuable resource for journalists, researchers and policymakers. We are able to assist with data, analysis and expert commentary on all aspects of urban mobility and smart cities. Spokespeople are available globally for interviews.

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## 1.1 INTRODUCTION

Traffic is the sign of a healthy and burgeoning economy. Traffic is the flow of people and goods around the country. More traffic means there are more people, more jobs and more prosperity, resulting in people buying more vehicles, traveling more for work and pleasure and buying more things that need delivering.

But the cost of success is greater congestion with far reaching impact. From the cost of additional fuel and the environmental impact of associated emissions, to the opportunity cost of the time drivers spend stuck in gridlock. Moreover, the extent to which businesses incur costs of congestion, these are usually passed on to consumers in the form of higher prices for goods and services.

The INRIX 2016 Traffic Scorecard is the largest and most detailed study of congestion to date. It includes data on 1,064 cities in 38 countries covering more than 100,000 square miles (250,000 square kilometers) of road and focuses on congestion across all times of the day and week. It confirms, as previous INRIX Traffic Scorecards have found, that congestion is a significant and growing burden on our cities. But for the first time, it also proves that congestion is a global phenomenon. It impacts businesses as well as commuters, small cities as well as large ones and developing as well as developed economies.

Population and economic growth alongside continued urbanization are the root causes of congestion. By 2050 there will be 9.7 billion people in the world, 70 percent of whom will live in cities.[1] Over the same period, the global economy is expected to triple in size leading to more than a doubling in road and rail travel and more than a three-fold increase in the amount of road and rail freight.[2] In our estimation, the share of private cars will continue to increase strongly in developing regions and fall only slightly in developed economies. As a result, vehicle-miles traveled (VMT), i.e. the amount people drive, will likely grow at a slower pace than years prior in developed countries, while per-capita VMT may stagnate or slightly fall. Freight VMT will also continue to rise as urban populations grow along with demand for goods and services.

The challenges faced by households, private companies, transportation officials and all levels of government cannot be understated. Left unchecked, congestion will continue to rise. Good data is the first step in tackling this problem. For most cities, applying Big Data to create intelligent transportation systems will be key to solving urban mobility problems, as adding transportation capacity becomes more expensive and budgets remain constrained. INRIX data and analytics on traffic, parking and population movement help city planners and engineers make data-based decisions to prioritize spending in order to maximize benefits and reduce costs now and for the future.

The key findings of the INRIX 2016 Traffic Scorecard provide a quantifiable benchmark for governments and cities across the world to measure progress in improving urban mobility and track the impact of spending on smart city initiatives. Our new City Dashboard is available for free at **inrix.com/scorecard** and allows users to dive into a great number of congestion metrics that are too detailed to publish in this report.

**1** *United Nations Population Division, World Population Prospects (2015 Ed.): https://esa.un.org/unpd/wpp/Publications/*

**2** *OECD International Transport Forum, Transport Outlook (2015): http://www.oecd.org/environment/itf-transport-outlook-2015-9789282107782-en.htm*

## 1.2 DATA AND METHODS

The INRIX 2016 Traffic Scorecard is a departure from previous editions. As well as being the largest ever study of congestion covering 1,064 cities in 38 countries, the INRIX 2016 Traffic Scorecard adopts a new methodology that provides insights into the scale and impact of congestion at different times of the day, and therefore on different users. For example, congestion during peak hours primarily affects commuters, while congestion during the day tends to impact businesses more.

We continue to measure the impact of congestion on car commuters, but for 2016, this is achieved by estimating the total number of hours that the average commuter spends in congestion in each city. To provide greater insight into how congestion affects different road users, we estimate the percentage of time that drivers would spend in congestion in each city at different parts of the day and week, and on different parts of the road network. These include peak, midday, evening and weekends, and highways into or out of the city compared to the inner-city road network. A weighted average is calculated based on trip volume at different points in time and location and the relative size of cities. This new urban transportation metric is called the INRIX Congestion Index (ICI) and provides an overall measure of the health of a city's road network.

Additionally, for three countries (US, UK and Germany) INRIX Research estimated the total economic cost of congestion to both individual drivers and to cities, encompassing the direct (e.g. time and fuel wasted) and indirect (e.g. lost productivity) costs of congestion in 2016.

Full details of the methodology and data sources are provided in the next section.

## 1.3 KEY FINDINGS

The INRIX 2016 Traffic Scorecard analyses and compares the state of traffic congestion in countries and major urban areas worldwide.

The US had previously topped the country rankings, but the addition of countries in South America and Asia moved the US to fourth place. American drivers on average spent over a full work week last year (42 hours) in congestion during peak (i.e. commuting) hours. Thailand tops the 2016 country ranking with drivers spending an average of 61 hours in peak hours congestion. Other countries in the top five include Colombia (47 hours), Indonesia (47 hours) and Russia (42 hours). The UK comes in 11th (32 hours) and Germany 12th (30 hours).

While the US may be fourth overall, American cities dominate the top 10 most congested cities, led by Los Angeles (first), New York (third), San Francisco (fourth), Atlanta (eighth) and Miami (10th). Commuters in Los Angeles spent 104 hours last year sitting in traffic jams – more than any other city in the world. In Europe, Moscow tops the major city ranking where drivers spent 91 hours in congestion in 2016, followed by London (73 hours), Paris (65 hours) and Istanbul (59 hours).

Across the 1,064 cities studied, drivers spent an average of nine percent of their travel time staring at the bumper in front of them as average traffic speed in congestion was just 8.9 mph (14.4 kph). Dublin was the slowest major city studied at 4.7 mph (7.5 kph) during all congested periods, with peak hour speeds at 3.4 mph (5.5 kph). During the day, Oaxaca, Mexico was the slowest city with average congested speeds of 3.6 mph (5.9 kph).

**Table 1:**
**Top 5 Cities INRIX 2016 Traffic Scorecard**

| RANK | MAJOR CITIES | NORTH AMERICAN CITIES | EUROPEAN MAJOR CITIES |
|---|---|---|---|
| 1 | Los Angeles | Los Angeles | Moscow |
| 2 | Moscow | New York | London |
| 3 | New York | San Francisco | Paris |
| 4 | San Francisco | Atlanta | Istanbul |
| 5 | Bogotá | Miami | Krasnodar |

# 2 DATA AND METHODOLOGY



## 2.1 INRIX REAL-TIME TRAFFIC DATA

INRIX operates the most robust driver network in the world that includes 300 million connected cars and devices, covering more than 5 million miles (8 million kilometers) of roads, ramps and interchanges in more than 40 countries. Our breakthrough technologies enable us to intelligently gather and analyze complex data streams containing nearly 2 billion data points per day to create automotive-grade traffic services.

INRIX combines anonymous, real-time GPS probe data with traditional real-time traffic flow information and hundreds of market-specific criteria that affect traffic – such as construction and road closures, real-time incidents, sporting and entertainment events, weather forecasts and school schedules – to provide the most accurate picture of current traffic flows. The latest INRIX XD™ Traffic technology provides real traffic information at highly granular 100 metre increments, compared to the 1-3 mile road segments typically employed.

This real-time traffic data is at the heart of the INRIX 2016 Traffic Scorecard.

## 2.2 INNOVATIVE CONGESTION METRICS

A key component of INRIX Real-Time Traffic Data is the proprietary INRIX Vehicle Tracking Algorithm, which classifies each second of a single vehicle trip as congested or free flow. Congestion is defined as a speed below 65 percent of the free-flow speed, which is not an arbitrary or unachievable overnight speed, but the typical uncongested speed on that road segment.

The result of this innovation is a measure of congestion that reflects the real-world experience and expectations of drivers. The total drive time can be separated into congested or free flow, and the ratio of these is the congestion rate, or the percentage of driving time that is spent in congestion.

Congestion varies at different times of the day and on different parts of the road network. Traffic congestion is directly related to the supply of road space and the demand for road space. A narrow road, deep in a city center at rush hour, will be heavily congested in comparison to a wide highway in the late evening. It also affects different groups of people. Peak hours of congestion primarily affects car commuters while daytime congestion largely affects businesses.

To balance various aspects of travel to and within an urban area, congestion rates are calculated for seven main periods and travel patterns in an urban area:

- Peak periods on highways in and out of the city
- Peak periods within a city
- Day time travel on highways in and out of a city
- Day time travel within a city
- Late night on highways in and out of a city
- Late night within a city
- Weekend travel on all roads

While the City Dashboard available at **inrix.com/scorecard** provides each of these variables for every city, for the sake of brevity, this report focuses on three headline metrics derived from these congestion rates:

1. **Average Congestion Rate:** The simple (i.e. unweighted) average of the seven congestion rates above, which therefore estimates the percentage of total drive time the average driver spent in congestion averaged across all periods of the day and all sections of the road network. This is a metric for the impact on the typical driver.

2. **INRIX Congestion Index:** The seven congestion rates are weighted by relative volumes to provide a more realistic average congestion rate that reflects typical driving patterns, which is then weighted by the Median Travel Time. This, in effect, adjusts the congestion rate by the city's size and associated average journey times. This is the metric for transportation officials.

3. **Peak Hours Spent in Congestion:** Applying the average peak period congestion rate to travel times allows a derivation of daily time spent in peak period congestion. Assuming 240 working days a year, the average number of hours spent in congestion during peak hours is estimated for every city. This a metric for the impact on the typical car commuter.

Two further methodological innovations are made in the INRIX 2016 Traffic Scorecard. First, relating to the definition of a city (or urban area) and second to the definition of peak hours.

Previous INRIX Traffic Scorecards have relied upon Census Bureau or Eurostat Larger Urban Area statistical definitions of metropolitan areas as the geographic definition of 'city' or 'urban area' in the analysis. While those boundaries continue to serve a vital role, a quantitative definition of an urban area provides a better fit for transportation movement and analytics. The INRIX 2016 Traffic Scorecard rectifies this problem and allows global comparison between urban areas by clustering dense roadways to form an urban boundary. These new urban boundaries allow a fresh and comparable analysis across official city, country and continent boundaries.

Peak hours have historically been defined as 6-9 am and 4-7 pm in previous INRIX Traffic Scorecards. In the INRIX 2016 Traffic Scorecard, peak hours are locally defined based upon the actual driving habits in each city. Given the global scale of the INRIX 2016 Traffic Scorecard, this is very important as there are stark cultural differences in commuting patterns and business hours.

# 2 DATA AND METHODOLOGY

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## 2.3 ECONOMIC COST OF CONGESTION

To understand the burden that congestion places on households and the economy in terms that are readily understood, INRIX Research estimated the total economic cost of congestion in three major countries: US, UK and Germany. Costs were calculated in local currencies using 2016 values and any source data were inflation-adjusted where appropriate, using a country specific measure of inflation.

The total economic cost of congestion to households consists of two types of cost: direct and indirect. The direct costs are borne directly by the car driver through their use of the roads in congestion, and include the value or opportunity cost of the time they spent needlessly in congestion, plus the additional fuel cost and the social cost of emissions released by the vehicle. The indirect costs are borne by households through the increase in the prices of goods and services due to congestion faced by businesses.

Direct costs are estimated by calculating the total hours lost by the average driver in every city in the US, UK and Germany by three distinct types of trips (commuting, business and all other non-work trips) because research indicates that these trips are associated with different values of time and with different vehicle occupancy rates. Indirect costs were estimated separately for light commercial vehicles (delivery vans) and large goods vehicles (trucks).

Hours lost is estimated by using the congestion rate and the average observed congested and uncongested speeds from the INRIX 2016 Traffic Scorecard and applying this to the average distance traveled by car per driver for commuting, business and all other trips in each country.[3]

Hours lost were estimated by country-specific values of time by trip-type, then adjusted by average vehicle occupancy and a multiplier which reflects the additional value people place on avoiding congestion. These values are provided in Table 2. Value of time data were not available for Germany, so UK values were converted to Euros and adjusted based upon the relative median hourly wage rates in the two countries. UK vehicle occupancy rates were also used for Germany. The UK congestion multipliers were used for all countries as data was not available in Germany and the US.

*3 US National Household Travel Survey: http://nhts.ornl.gov/; UK National Travel Survey: https://www.gov.uk/government/statistics/national-travel-survey-2015; and Germany https://de.statista.com/statistik/daten/studie/155725/umfrage/fahrleistung-der-lkw-in-deutschland/*

**Table 2: Economic Source Data**

| | HOURLY VALUE OF TIME | | VEHICLE OCCUPANCY | | |
|---|---|---|---|---|---|
| | US[5] | UK[6] | US[7] | UK[8] | CONGESTION MULTIPLIER[4] |
| Commuting | $12.81 | £11.99 | 1.13 | 1.2 | 1.37 |
| Business | $25.19 | £17.91 | 1.94 | 1.8 | 1.26 |
| Other (e.g. leisure, shopping) | $9.51 | £5.48 | 1.94 | 1.8 | 1.89 |

As journey times are variable, drivers must allow additional time to reach their destination on time. The Texas Transportation Institute provides a measure called Planning Time Index which includes the buffer required to arrive at the destination on time 95 percent of the time. The latest value for this is 2.41.[9] This time is valued at 1/3 of regular driving times for each type of trip according to the UK Department for Transport.[10]

To estimate the loss of fuel to congestion, this study uses an estimate of 0.4747 gallons of fuel consumed per hour in congestion.[11] Fuel is valued at the national average 2016 price of fuel, weighted toward the split of diesel and gasoline powered vehicles in the respective countries (US: $2.53/gal[12]; UK: £4.13/gal[13]; Germany: €6.8/gal[14]). The volume of emissions[15] is also weighted toward the split of diesel and gasoline-powered vehicles in their respective countries, and then valued at the inflation-adjusted, government recommended, non-traded value of carbon.[16] The combination of wasted time, wasted fuel and the value of emissions form the direct cost of congestion to drivers.

Congestion also creates indirect costs that fall on households in the form of higher prices. Freight carriers, for example, sit in traffic, delaying the shipment of goods to and from ports and to households and businesses. Due to data availability the indirect costs were estimated at the national level using data on distance traveled by light commercial vehicles and large goods vehicles. The remaining methodology was identical to the estimation of direct costs but the relevant figures on fuel efficiency and value of time where updated using the same sources. This study assumes 90 percent of the costs to businesses pass through to households.

Summing the direct and indirect costs provides the total cost to each driver in each city. A national average was estimated by weighting the city per driver costs by the size of each city. A cost per household was estimated by using data on average cars per household and then aggregated to city level by using census data on the number of households per city.[17]

*4 The UK Department for Transport multipliers are used for all countries: https://www.gov.uk/government/publications/values-of-travel-time-savings-and-reliability-final-reports*

*5 Inflation-adjusted values from the US Department of Transportation: https://cms.dot.gov/sites/dot.gov/files/docs/USDOT%20VOT%20Guidance%202014.pdf*

*6 Inflation-adjusted values from the UK Department for Transport: https://www.gov.uk/government/publications/values-of-travel-time-savings-and-reliability-final-reports*

*7 US National Household Travel Survey: http://nhts.ornl.gov/*

*8 UK National Travel Survey: https://www.gov.uk/government/statistics/national-travel-survey-2015*

*9 Texas Transportation Institute, Urban Mobility Report (2015) Planning Time Index is used for all countries: https://mobility.tamu.edu/ums/report/*

*10 UK Department for Transport: https://www.gov.uk/government/publications/values-of-travel-time-savings-and-reliability-final-reports*

*11 Texas Transportation Institute, Urban Mobility Report (2012): https://mobility.tamu.edu/ums/archive/#umr2012*

*12 US Energy Information Administration: http://www.eia.gov/petroleum/gasdiesel/*

*13 UK Department for Business, Energy and Industrial Strategy (2016): https://www.gov.uk/government/statistical-data-sets/oil-and-petroleum-products-monthly-statistics*

*14 Statistica: https://de.statista.com/statistik/daten/studie/1690/umfrage/preis-fuer-einen-liter-superbenzin-monatsdurchschnittswerte/*

*15 Volume of emissions per liter of fuel consumed is taken from University of Exeter: https://people.exeter.ac.uk/TWDavies/energy_conversion/Calculation%20of%20$CO_2$%20emissions%20from%20fuels.htm*

*16 US Social Value of Carbon from the EPA: https://www.epa.gov/climatechange/social-cost-carbon, UK Social Value of Carbon from HM Treasury: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/483278/Valuation_of_energy_use_and_greenhouse_gas_emissions_for_appraisal.pdf, and UK values are used for Germany converted to Euros using World Bank Purchasing Power Parity exchange rates.*

*16 US: https://www.census.gov; UK: https://www.ons.gov.uk/census/2011census; Germany: https://www.zensus2011.de*

# 3 INRIX 2016 TRAFFIC SCORECARD RANKING



## 3.1 GLOBAL MAJOR CITIES RANKING

The full ranking of all 1,064 cities in the INRIX 2016 Traffic Scorecard are reported in the appendix, but Table 3 provides the top 25 major cities ranked by the number of peak hours that drivers spent in congestion in 2016. Generally, there is a strong correlation between peak hours spent in congestion and the INRIX Congestion Index. The correlation between the ranking and the overall congestion rate is weaker because the cause of congestion varies across cities. Some cities are very old with narrow inner city streets that suffer significant levels of congestion. Other cities have major strategic roads skirting the city linking many neighboring cities that cause significant congestion on highways.

Unsurprisingly, the cities most affected by congestion are capital cities; known centers of commerce and politics. They typically have the densest road networks combined with large populations of residents, commuters and visitors. Of the top 10 cities in the INRIX 2016 Traffic Scorecard ranking, six of them are mega cities with metropolitan populations – the area that includes the commuting zone – of more than 10 million inhabitants each.

For the first time, the annual INRIX Traffic Scorecard includes cities outside of Europe and North America. A number of cities making their first appearance in the ranking such as Bangkok, Bogotá, Jakarta, Mexico City, Rio de Janeiro and São Paulo. Some of these cities have enormous populations but very poor public road and/or transportation systems and are not making use of the latest intelligent transport systems such as traffic light optimization or dynamic lanes.

At the global city level, Los Angeles tops the list of the world's gridlock-plagued cities, with drivers spending on average 104 peak hours in congestion in 2016, followed by Moscow (91 hours), New York (89 hours), San Francisco (83 hours) and Bogotá (80 hours). London (73 hours) ranked seventh out of the 1,064 cities analyzed in the study after São Paulo, where drivers spent 77 hours in congestion last year.

US cities take 11 of the top 25 positions in the major city ranking. Beyond Russia, and in addition to London, only a small number of European cities made the top 25 list, including: Paris at ninth (65 hours), Istanbul 15th (59 hours) and Zürich 21st (54 hours). For the first time, the INRIX 2016 Traffic Scorecard includes more than 100 populous Russian cities. The major Russian cities that make the top 25 are Moscow second (91 hours), Krasnodar 18th (56 hours) and Saint Petersburg 22nd (53 hours).

No German city makes the list of the top 25 most congested major cities in the world. The highest place German city in the list of 205 major cities (see Appendix 1) is Munich at 29th, or in the entire list of 1,064 cities (see Appendix 2) is Munich at 36th.

**Table 3: Top 25 Global Ranking of Major Cities**

| RANK | CITY | COUNTRY | CONTINENT | PEAK HOURS SPENT IN CONGESTION | INRIX CONGESTION INDEX | AVERAGE CONGESTION RATE |
|---|---|---|---|---|---|---|
| 1 | Los Angeles; CA | USA | North America | 104 | 18.6 | 12.7% |
| 2 | Moscow | Russia | Europe | 91 | 19.9 | 25.2% |
| 3 | New York; NY | USA | North America | 89 | 17.4 | 12.8% |
| 4 | San Francisco; CA | USA | North America | 83 | 14.4 | 12.8% |
| 5 | Bogotá | Colombia | South America | 80 | 17.0 | 31.8% |
| 6 | São Paulo | Brazil | South America | 77 | 15.8 | 20.8% |
| 7 | London | UK | Europe | 73 | 13.9 | 12.7% |
| 8 | Atlanta; GA | USA | North America | 71 | 12.2 | 10.0% |
| 9 | Paris | France | Europe | 65 | 11.8 | 11.4% |
| 10 | Miami; FL | USA | North America | 65 | 11.8 | 8.7% |
| 11 | Bangkok | Thailand | Asia | 64 | 12.6 | 23.2% |
| 12 | Mexico City | Mexico | North America | 62 | 12.9 | 13.3% |
| 13 | Washington; DC | USA | North America | 61 | 10.5 | 11.3% |
| 14 | Dallas; TX | USA | North America | 59 | 9.9 | 6.6% |
| 15 | Istanbul | Turkey | Europe | 59 | 12.2 | 18.6% |
| 16 | Boston; MA | USA | North America | 58 | 10.2 | 13.4% |
| 17 | Chicago; IL | USA | North America | 57 | 10.1 | 10.2% |
| 18 | Krasnodar | Russia | Europe | 56 | 12.0 | 24.3% |
| 19 | Jakarta | Indonesia | Asia | 55 | 11.8 | 17.3% |
| 20 | Seattle; WA | USA | North America | 55 | 9.6 | 12.6% |
| 21 | Zürich | Switzerland | Europe | 54 | 9.5 | 18.2% |
| 22 | Saint Petersburg | Russia | Europe | 53 | 11.3 | 20.0% |
| 23 | Montreal | Canada | North America | 52 | 9.7 | 14.0% |
| 24 | Houston; TX | USA | North America | 52 | 8.5 | 7.1% |
| 25 | Rio de Janeiro | Brazil | South America | 51 | 11.1 | 15.8% |

# 3 INRIX 2016 TRAFFIC SCORECARD RANKING



## 3.2 COUNTRY RANKING

For each country, the peak hours spent in congestion and the INRIX Congestion Index is a weighted average of the cities in that country. The city values are weighted by their relative size as measured by their area. There is significant variation in the number of cities included in each country. In general, developed countries have more cities included in the INRIX 2016 Traffic Scorecard and their country values are therefore statistically more reliable.

Of the 38 countries covered by the INRIX 2016 Traffic Scorecard, Thailand leads with the highest average hours spent in peak congestion (61 hours in 2016), outranking Columbia (47 hours) and Indonesia (47 hours) tied at second, and Russia (42 hours) and the US (42 hours) tied at fourth. The UK was 11th in the global country ranking, fourth among developed nations, and the third-most congested country in Europe behind Russia and Turkey. Interestingly, the developing countries represented in the dataset have a small number of very large and heavily congested cities; cities with little public transportation infrastructure and often-chaotic road networks. By comparison, many of the developed countries have many more cities, however, outside of a small number that are world leading in terms of their congestion, the average developed nation city has relatively low levels of congestion.

**Table 4: Country Ranking**

| RANK | COUNTRY | AVERAGE PEAK HOURS SPENT IN CONGESTION | AVERAGE INRIX CONGESTION INDEX |
|---|---|---|---|
| 1 | Thailand | 61 | 10.6 |
| 2 | Colombia | 47 | 8.8 |
| 2 | Indonesia | 47 | 9.3 |
| 4 | Russia | 42 | 8.7 |
| 4 | USA | 42 | 7.4 |
| 6 | Venezuela | 39 | 6.3 |
| 7 | South Africa | 38 | 4.7 |
| 8 | Brazil | 37 | 7.5 |
| 8 | Puerto Rico | 37 | 5.5 |
| 10 | Turkey | 34 | 6.3 |
| 11 | UK | 32 | 5.0 |
| 12 | Germany | 30 | 4.6 |
| 12 | Slovakia | 30 | 4.5 |
| 14 | Canada | 28 | 4.6 |
| 14 | Luxembourg | 28 | 3.2 |
| 14 | Mexico | 28 | 5.7 |
| 14 | Norway | 28 | 3.7 |
| 14 | Poland | 28 | 4.7 |
| 14 | Switzerland | 28 | 4.0 |
| 20 | United Arab Emirates | 27 | 5.9 |
| 21 | Ecuador | 26 | 4.9 |
| 22 | Austria | 25 | 4.2 |
| 22 | Sweden | 25 | 3.6 |
| 24 | Saudi Arabia | 24 | 5.4 |
| 25 | France | 23 | 3.5 |
| 25 | Ireland | 23 | 3.8 |
| 27 | Belgium | 22 | 3.1 |
| 27 | Kuwait | 22 | 4.7 |
| 29 | Finland | 21 | 4.0 |
| 30 | Netherlands | 20 | 3.0 |
| 30 | Spain | 20 | 4.1 |
| 32 | Czech Republic | 18 | 3.2 |
| 32 | Hungary | 18 | 3.3 |
| 34 | Denmark | 17 | 2.7 |
| 34 | Portugal | 17 | 2.7 |
| 34 | Slovenia | 17 | 3.3 |
| 37 | Italy | 15 | 2.6 |
| 38 | Singapore | 10 | 1.4 |

## 3.3
## NORTH AMERICA RANKING

**Table 5: Top 25 North American Major City Ranking**

| RANK | CITY | COUNTRY | PEAK HOURS SPENT IN CONGESTION | INRIX CONGESTION INDEX | AVERAGE CONGESTION RATE |
|---|---|---|---|---|---|
| 1 | Los Angeles; CA | USA | 104 | 18.6 | 12.7% |
| 2 | New York; NY | USA | 89 | 17.4 | 12.8% |
| 3 | San Francisco; CA | USA | 83 | 14.4 | 12.8% |
| 4 | Atlanta; GA | USA | 71 | 12.2 | 10.0% |
| 5 | Miami; FL | USA | 65 | 11.8 | 8.7% |
| 6 | Washington; DC | USA | 61 | 10.5 | 11.3% |
| 7 | Dallas; TX | USA | 59 | 9.9 | 6.6% |
| 8 | Boston; MA | USA | 58 | 10.2 | 13.4% |
| 9 | Chicago; IL | USA | 57 | 10.1 | 10.2% |
| 10 | Seattle; WA | USA | 55 | 9.6 | 12.6% |
| 11 | Montreal | Canada | 52 | 9.7 | 14.0% |
| 12 | Houston; TX | USA | 52 | 8.5 | 7.1% |
| 13 | Portland; OR | USA | 47 | 7.7 | 10.4% |
| 14 | Austin; TX | USA | 47 | 8.0 | 11.9% |
| 15 | San Diego; CA | USA | 46 | 7.5 | 9.8% |
| 16 | Toronto | Canada | 46 | 8.4 | 11.8% |
| 17 | Minneapolis; MN | USA | 40 | 6.4 | 6.9% |
| 18 | Stamford; CT | USA | 39 | 7.1 | 13.8% |
| 19 | Philadelphia; PA | USA | 38 | 6.8 | 7.9% |
| 20 | San Juan | Puerto Rico | 37 | 6.6 | 11.4% |
| 21 | Tacoma; WA | USA | 37 | 6.4 | 10.0% |
| 22 | Phoenix; AZ | USA | 37 | 6.0 | 5.7% |
| 23 | Baton Rouge; LA | USA | 36 | 6.1 | 10.6% |
| 24 | Denver; CO | USA | 36 | 6.4 | 8.3% |
| 25 | Detroit; MI | USA | 33 | 5.9 | 6.1% |

North America is home to approximately 560 million people in approximately 9.5 million square miles, with the majority residing within the United States. With nearly 86 percent of work commute trips taken by car and annual vehicle miles traveled surpassing 3.2 trillion miles in 2016, an all-time high, it is unsurprising that many US cities lead the global rankings.

Topping the global rankings, Los Angeles' high peak commute congestion rates on both limited access freeways and arterials, boost its INRIX Congestion Index score to among the highest of the top cities. Coupled with long commute times, drivers in the Los Angeles urban area spent 104 hours sitting in congestion last year during peak periods.

Interestingly, both New York and San Francisco, the second- and third-ranked cities in North America (89 and 83 hours spent in congestion respectively), have a similar average congestion rate as Los Angeles, but show different commute patterns. San Francisco, for example, has the highest congestion rate of all US cities studied on arterial and city streets during the peak commute hours, while New York has the highest daytime congestion rate on arterials and city streets among the major US cities studied.

While Canadian cities do not make the top 10, both Montreal and Toronto place within the top 25, though Montreal's average congestion rate (14 percent) surpassed every other North American city studied. Montreal's congestion rates rank relatively high across the board, placing second during the peak period on arterials and city streets, and highest on arterial/city streets during the day.

# 3 INRIX 2016 TRAFFIC SCORECARD RANKING



## 3.4 EUROPEAN RANKING

Europe is a continent of 743 million people in a little more than 10 million square kilometers of land, approximately 50 percent more people in half the space of North America. Therefore, it is unsurprising that many of Europe's major cities made it into the top 25 global ranking. The INRIX 2016 Traffic Scorecard includes 628 European cities and Table 6 presents the top 25 major European cities ranked by the hours that drivers spent in peak-period congestion in 2016.

Moscow tops the list with 91 hours spent in peak hour congestion, followed by London (73 hours), Paris (65 hours) and Istanbul (59 hours). Comparing the INRIX Congestion Index to the peak hours spent in congestion illustrates that smaller, densely populated cities like Zürich and Munich have lower overall levels of congestion, but their peak hours of congestion are significant. A number of major Russian cities enter the European ranking for the first time in this enlarged Traffic Scorecard. Russia has many populous cities that have relatively little public transport offerings and significant congestion problems. Krasnodar (fourth), Saint Petersburg (sixth), Sochi (eighth) and Nizhny Novgorod (10th) are examples.

Although London takes the number two position, the only other UK city in the top 25 European ranking is Manchester (18th). While the overall congestion rate in London (13 percent) and Manchester (10 percent) is similar, peak hours spent in congestion is almost twice as bad in London (73 hours) compared to Manchester (39 hours) in terms of annual peak hours spent in congestion. This difference is driven by the relative size of the two cities and therefore, the average commuting time.

In contrast to the UK, Germany has eight cities in the Top 25. Munich, Cologne and Stuttgart have almost indistinguishable levels of total congestion with ICI's of 8.5, 8.3 and 8.4 respectively, but Munich has slightly more peak hours spent in congestion (49 hours compared to 46 hours) due to its relative size.

## 3.4
## EUROPEAN RANKING

**Table 6: Top 25 European Major City Ranking**

| RANK | CITY | COUNTRY | PEAK HOURS SPENT IN CONGESTION | INRIX CONGESTION INDEX | AVERAGE CONGESTION RATE |
|---|---|---|---|---|---|
| 1 | Moscow | Russia | 91 | 19.9 | 25.2% |
| 2 | London | UK | 73 | 13.9 | 12.7% |
| 3 | Paris | France | 65 | 11.8 | 11.4% |
| 4 | Istanbul | Turkey | 59 | 12.2 | 18.6% |
| 5 | Krasnodar | Russia | 56 | 12.0 | 24.3% |
| 6 | Zürich | Switzerland | 54 | 9.5 | 18.2% |
| 7 | Saint Petersburg | Russia | 53 | 11.3 | 20.0% |
| 8 | Sochi | Russia | 49 | 11.0 | 24.4% |
| 9 | Munich | Germany | 49 | 8.5 | 14.5% |
| 10 | Nizhny Novgorod | Russia | 47 | 10.0 | 19.7% |
| 11 | Oslo | Norway | 47 | 7.6 | 12.7% |
| 12 | Cologne | Germany | 46 | 8.3 | 13.2% |
| 13 | Stuttgart | Germany | 46 | 8.4 | 13.6% |
| 14 | Brussels | Belgium | 41 | 7.1 | 12.3% |
| 15 | Hamburg | Germany | 41 | 7.6 | 13.9% |
| 16 | Berlin | Germany | 40 | 7.5 | 12.7% |
| 17 | Madrid | Spain | 40 | 7.7 | 12.7% |
| 18 | Manchester | UK | 39 | 6.7 | 9.9% |
| 19 | Frankfurt | Germany | 39 | 6.5 | 10.8% |
| 20 | Vienna | Austria | 39 | 7.3 | 12.9% |
| 21 | Lausanne | Switzerland | 36 | 5.8 | 11.0% |
| 22 | Ruhrgebiet | Germany | 36 | 6.8 | 8.7% |
| 23 | Hanover | Germany | 36 | 6.7 | 11.3% |
| 24 | Rome | Italy | 35 | 6.2 | 11.1% |
| 25 | Stockholm | Sweden | 35 | 5.9 | 10.7% |

# 4 IN-DEPTH STUDIES



## 4.1 UNITED STATES

### 4.1.1 TOP 25 US CITIES

In the US, INRIX analyzed congestion in 240 cities and large urban areas. Congestion cost drivers in the US more than $295 billion in direct and indirect costs in 2016 alone. Direct costs include the value of fuel and time wasted in congestion while indirect costs include the increase in prices to households from freight trucks sitting in traffic.

Los Angeles is a large and sprawling, but overall dense, urban area with relatively little alternative to car travel. As a result, Los Angeles tops the ranking of US cities by both peak hours spent in congestion and the INRIX Congestion Index. A large part of this is due to the relatively long average commute times in Los Angeles. In comparison, New York and San Francisco have similar levels of overall congestion (all 13 percent) but their smaller geographic areas result in shorter commute times and therefore lower numbers of peak hours spent in congestion. Last year, congestion cost Los Angeles drivers over $2,400 on average, equaling more than $9.6 billion to the city as a whole.

Interestingly, congestion costs New York drivers the most in the US, exceeding $2,500 per driver. While the cost of commuting is less for New Yorkers than Angelenos, New Yorkers face higher business and leisure costs due to congestion during those periods, pushing the total costs of congestion higher. As a result, congestion cost the New York City urban area as a whole nearly $17 billion last year – the highest of any urban area studied.

Phoenix and Detroit tie for the lowest cost of congestion among the top 25 US cities at $1,062 per driver. Phoenix and Detroit also rank among the bottom 25 of all three categories of costs analyzed: commuting, business and leisure/other. Despite the high costs of congestion in New York and other cities, American drivers, in general, have it easier than their German counterparts. At $1,938, congestion costs the average German driver over $538 (38 percent) more than the average American driver, after adjusting for exchange rates and the cost of living.

Americans continue to increase the amount they drive as a whole. Vehicle miles traveled have continued to increase since the Great Recession, surpassing 3.2 trillion miles traveled, a record high. As the demand for driving continues to exceed the supply of roadway, congestion will likely continue to rise. While many cities, like Seattle and Los Angeles have acted locally on transportation funding, challenges exist at the federal and state level, as the Highway Trust Fund continues to require general fund bailouts to stay afloat and traditional.

At the state level, traditional funding sources like the fuel tax continue to lose spending power due to fuel efficiency gains and inflationary pressure.

**Table 7: Top 25 US City Ranking**

| RANK | CITY | PEAK HOURS SPENT IN CONGESTION | INRIX CONGESTION INDEX | AVERAGE CONGESTION RATE | TOTAL COST PER DRIVER | TOTAL COST TO THE CITY |
|---|---|---|---|---|---|---|
| 1 | Los Angeles; CA | 104 | 18.6 | 12.7% | $2,408 | $9,680m |
| 2 | New York; NY | 89 | 17.4 | 12.8% | $2,533 | $16,949m |
| 3 | San Francisco; CA | 83 | 14.4 | 12.8% | $1,996 | $2,535m |
| 4 | Atlanta; GA | 71 | 12.2 | 10.0% | $1,861 | $3,140m |
| 5 | Miami; FL | 65 | 11.8 | 8.7% | $1,762 | $3,576m |
| 6 | Washington; DC | 61 | 10.5 | 11.3% | $1,694 | $2,963m |
| 7 | Dallas; TX | 59 | 9.9 | 6.6% | $1,509 | $2,904m |
| 8 | Boston; MA | 58 | 10.2 | 13.4% | $1,759 | $2,864m |
| 9 | Chicago; IL | 57 | 10.1 | 10.2% | $1,643 | $5,158m |
| 10 | Seattle; WA | 55 | 9.6 | 12.6% | $1,590 | $1,995m |
| 11 | Houston; TX | 52 | 8.5 | 7.1% | $1,374 | $2,478m |
| 12 | Portland; OR | 47 | 7.7 | 10.4% | $1,358 | $1,017m |
| 13 | Austin; TX | 47 | 8.0 | 11.9% | $1,453 | $810m |
| 14 | San Diego; CA | 46 | 7.5 | 9.8% | $1,345 | $1,412m |
| 15 | Minneapolis; MN | 40 | 6.4 | 6.9% | $1,109 | $1,191m |
| 16 | Stamford; CT | 39 | 7.1 | 13.8% | $1,421 | $67m |
| 17 | Philadelphia; PA | 38 | 6.8 | 7.9% | $1,236 | $2,522m |
| 18 | Tacoma; WA | 37 | 6.4 | 10.0% | $1,163 | $92m |
| 19 | Phoenix; AZ | 37 | 6.0 | 5.7% | $1,062 | $1,466m |
| 20 | Baton Rouge; LA | 36 | 6.1 | 10.6% | $1,196 | $271m |
| 21 | Denver; CO | 36 | 6.4 | 8.3% | $1,182 | $1,150m |
| 22 | Santa Barbara; CA | 36 | 6.2 | 12.7% | $1,417 | $101m |
| 23 | Nashville; TN | 34 | 5.8 | 11.4% | $1,308 | $517m |
| 24 | Detroit; MI | 33 | 5.9 | 6.1% | $1,062 | $1,537m |
| 25 | Pittsburgh; PA | 33 | 5.6 | 11.0% | $1,272 | $944m |

4 IN-DEPTH STUDIES



## 4.1.2
## TOP 10 WORST US CORRIDORS

The Cross Bronx Expressway in New York City again tops the INRIX list of worst corridors, with the average driver on the 4.7 mile stretch wasting 86 hours per year in congestion.

Three other New York corridors fill out the top 10. Surprisingly, Los Angeles, with the top spot in terms of peak hours sitting in congestion, only holds one spot on the list – I-10 Eastbound between I-405 and I-110. San Francisco, the third highest ranking city in the US for peak time spent in congestion, does not appear on the US worst corridors list until number 31.

**Table 8: Top 10 Worst US Corridors**

| RANK | CITY | ROAD | FROM | TO | WORST PEAK PERIOD | AM PEAK AVERAGE SPEED (MPH) | PM PEAK AVERAGE SPEED (MPH) | TOTAL HOURS OF DELAY (P.P.P.A) |
|---|---|---|---|---|---|---|---|---|
| 1 | New York | I-95 Westbound | Exit 6A (I-278) | Exit 2 (Trans-Manhattan Expressway) | PM | 21.3 | 15.3 | 86 |
| 2 | Chicago | I-90/I-94 Northbound | Exit 53A (I-55) | Exit 34B (I-90/I-94) | AM | 20.2 | 21.1 | 85 |
| 3 | New York | I-95 Eastbound | Exit 70A (I-80) | Exit 7A (I-695) | AM | 30.2 | 31.6 | 76 |
| 4 | Boston | I-93 Northbound | Exit 5A/MA-24 | Exit 16/ Southampton Street | AM | 27.7 | 43.5 | 72 |
| 5 | Los Angeles | I-10 Eastbound | Exit 3A (I-405) | Exit 12 (I-110) | PM | 42.3 | 27.0 | 66 |
| 6 | Austin | I-35 Southbound | Airport Boulevard | East Slaughter Lane | PM | 58.7 | 23.4 | 63 |
| 7 | New York | 5th Avenue Southbound | 120th St | 40th St | PM | 9.5 | 6.8 | 61 |
| 8 | New York | NJ-495 Eastbound | I-95 Junction | 12th Ave (Through Lincoln Tunnel) | AM | 13.4 | 15.8 | 60 |
| 9 | Philadelphia | I-76 Southbound | Exit 332/West Conshohocken | Exit 343/ Spring Garden Street | PM | 38.6 | 35.0 | 58 |
| 10 | Chicago | I-90/I-94 Southbound | Exit 34B (I-90/I-94) | Exit 50B/ West Ohio Drive | AM | 28.5 | 35.2 | 57 |

4 IN-DEPTH STUDIES



## 4.1.3
## CASE STUDY: LOS ANGELES

The Los Angeles metro area, home to over 15 million people, takes the top spot in INRIX 2016 Traffic Scorecard. Drivers in Los Angeles spent 104 hours sitting in congestion last year, beating cities like Moscow (91), New York (89), San Francisco (83), London (73) and Munich (49).

Los Angeles is a "driving city," with more than 84 percent of commuters in the Los Angeles-Long Beach-Anaheim metropolitan area choosing to drive alone or carpool to work. Just over five percent choose public transit. Within the city proper, 77 percent of people choose their car keys to get to work, nine percent take public transit and nearly six percent work from home.

Known for freeways, Los Angeles had the ninth-worst congestion rate among US cities studied during the peak period at 23 percent, faring better than cities like Austin, Seattle, Boston and Portland. Los Angeles ranked eighth on arterial and city street congestion at 20 percent, and ranked third when averaging daytime congestion rates at 12 percent. One bright spot is nighttime travel, where Los Angeles city streets ranked 38th.

Los Angeles voters passed a November 2016 ballot measure to expand transit capacity and improve highways throughout the region. The $120 billion Measure M ballot measure seeks to reduce time in traffic by 15 percent a day by 2057.

**Table 9: City Dashboard – Los Angeles**

| | PEAK IN/ OUT | PEAK WITHIN | DAY IN/ OUT | DAY WITHIN | LATE IN/ OUT | LATE WITHIN | WEEK END | OVERALL |
|---|---|---|---|---|---|---|---|---|
| Congestion Rate | 23% | 20% | 10% | 13% | 4% | 8% | 11% | 13% |
| Congested Speed (mph) | 14.70 | 8.27 | 16.20 | 7.40 | 13.88 | 6.23 | 10.81 | 11.07 |
| Uncongested Speed (mph) | 40.62 | 29.17 | 50.64 | 34.03 | 60.82 | 42.91 | 46.34 | 43.51 |
| Speed Differential (mph) | 25.93 | 20.90 | 34.44 | 26.63 | 46.94 | 36.68 | 35.53 | 32.44 |
| % Reduction in Speed during Congestion | 64% | 72% | 68% | 78% | 77% | 85% | 77% | 75% |

The stretch of I-10 between I-405 and I-110 takes the top spot in Los Angeles as the busiest corridor, with travelers on that stretch of highway experiencing 66 hours of delay. The 8.9 mile corridor ranks fifth nationally in terms of delay and ranks highest on the West Coast.

Interstate 5 Southbound holds the next two spots on the worst corridors in Los Angeles with only one freeway exit in between. Combined, travel times on those stretches of roadway take over 37.5 minutes when congested, compared to just 16.3 minutes at free flow.

**Table 10: Top 5 Worst Corridors – Los Angeles**

| RANK | ROAD | FROM | TO | WORST PEAK PERIOD | AM PEAK AVERAGE SPEED (MPH) | PM PEAK AVERAGE SPEED (MPH) | TOTAL HOURS OF DELAY (P.P.P.A) |
|---|---|---|---|---|---|---|---|
| 1 | I-10 Eastbound | Exit 3A (I-405) | Exit 12 (I-110) | PM | 39.4 | 25.2 | 66 |
| 2 | I-5 Southbound | Exit 144A (CA-134) | Exit 139 (CA-2) | AM | 35.2 | 36.2 | 54 |
| 3 | I-5 Southbound | Exit 138 (CA-2) | Exit 133 (I-10/CA-60) | AM | 25.7 | 26.0 | 53 |
| 4 | US-101 Southbound | Exit 6B (North Vermont Avenue) | Exit 3B (CA-110) | PM | 22.9 | 16.4 | 51 |
| 5 | I-110 Northbound | Exit 14A (I-105) | Exit 20C (I-10) | AM | 24.0 | 41.8 | 46 |

4 IN-DEPTH STUDIES



## 4.1.4
## CASE STUDY: NEW YORK

New York drivers spent the second-most hours in congestion in North America and the third-most globally, behind Los Angeles and Moscow, sitting in traffic 89 hours last year on average.

Despite a nearly identical congestion rate as Los Angeles and San Francisco, the city ranked third in the US as both commuters and freight movers face different local challenges. For example, New York has the highest daytime congestion rate on arterials and city streets among the major US cities studied. In addition, drivers in New York travel at much slower speeds. Overall congested speeds in New York are 8.23 mph, versus 11.07 and 11.54 in Los Angeles and San Francisco respectively.

However, New York's highway system generally serves travelers better than Los Angeles and San Francisco. Peak congestion rates on freeways is significantly lower (16 percent versus 23 percent and 21 percent respectively), likely due to land use and unique transportation successes like the XBL, a 2.5-mile contraflow dedicated bus lane open during the AM peak, which carries over 60,000 people a day.

Heavily dependent on subways, New York officials opened the Second Avenue Subway in January 2017. Officials expect daily ridership to reach 200,000. In 2015, nearly 4.27 billion trips were taken on transit in the New York urbanized area, more than 41 percent of the entire nation's transit ridership.

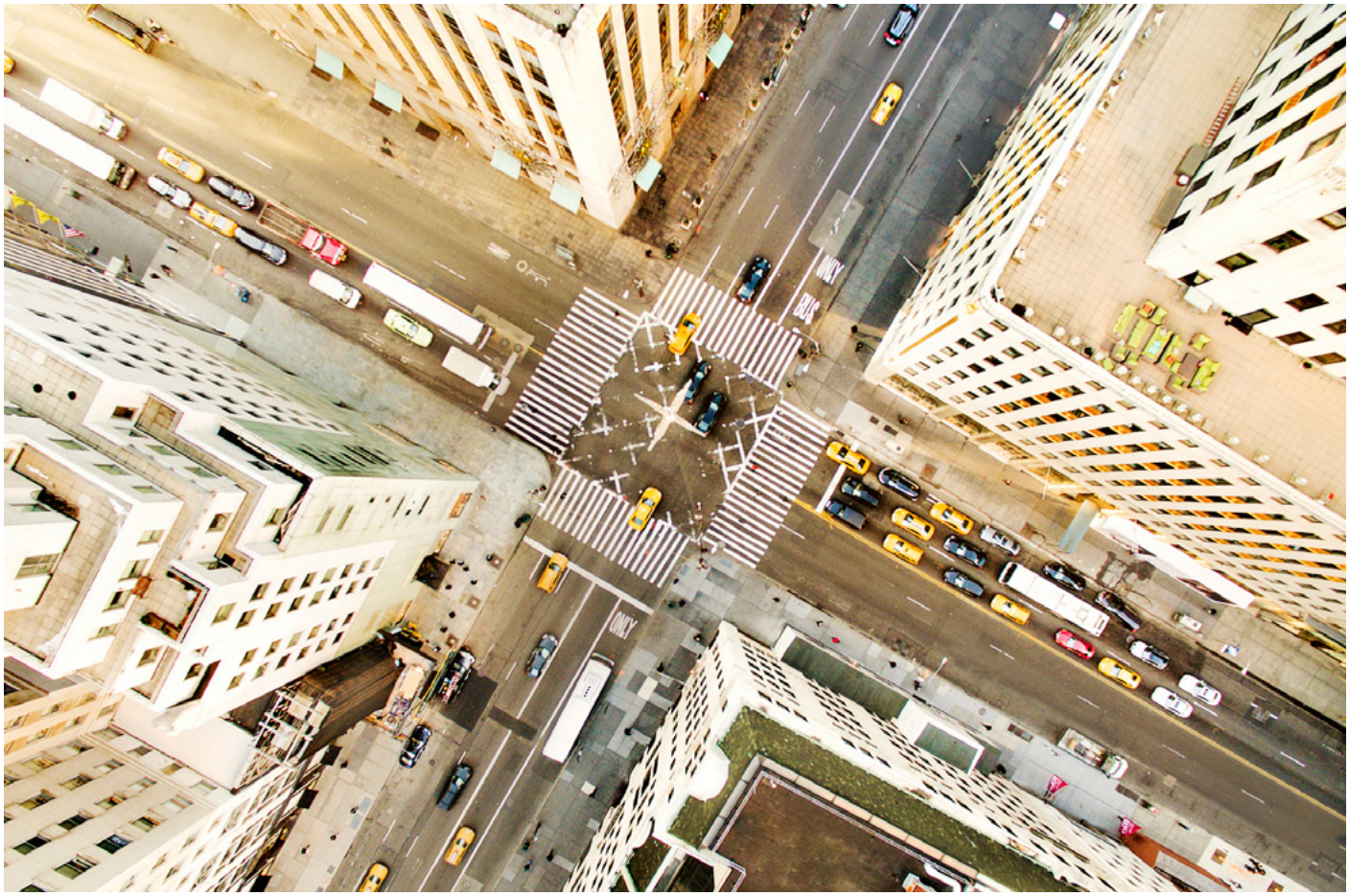

**Table 11: City Dashboard – New York**

| | PEAK IN/ OUT | PEAK WITHIN | DAY IN/ OUT | DAY WITHIN | LATE IN/ OUT | LATE WITHIN | WEEK END | OVERALL |
|---|---|---|---|---|---|---|---|---|
| Congestion Rate | 16% | 21% | 9% | 15% | 4% | 12% | 12% | 13% |
| Congested Speed (mph) | 11.68 | 6.86 | 10.00 | 5.52 | 9.56 | 5.59 | 8.37 | 8.23 |
| Uncongested Speed (mph) | 45.28 | 25.31 | 52.48 | 27.22 | 57.86 | 31.97 | 40.70 | 40.12 |
| Speed Differential (mph) | 33.60 | 18.44 | 42.48 | 21.71 | 48.30 | 26.38 | 32.33 | 31.89 |
| % Reduction in Speed during Congestion | 74% | 73% | 81% | 80% | 83% | 83% | 79% | 79% |

The I-95 Westbound corridor between Exit 6A and Exit 2 the toughest stretch of road in the United States back to the INRIX 2007 Traffic Scorecard. But it's not just freeway drivers feeling the pain. Those driving on 5th or 6th Avenue in Manhattan also see large delays of 61 hours per year and 60 hours per year respectively.

Interestingly, New York has the highest daytime congestion rate on arterials and city streets among the major US cities studied. This causes significant financial impact on businesses and commercial traffic.

**Table 12: Top 5 Worst Corridors – New York**

| RANK | ROAD | FROM | TO | WORST PEAK PERIOD | AM PEAK AVERAGE SPEED (MPH) | PM PEAK AVERAGE SPEED (MPH) | TOTAL HOURS OF DELAY (P.P.P.A) |
|---|---|---|---|---|---|---|---|
| 1 | I-95 Westbound | Exit 6A (I-278) | Exit 2 (Trans-Manhattan Expressway) | PM | 19.8 | 14.2 | 86 |
| 2 | I-95 Eastbound | Exit 70A (I-80) | Exit 7A (I-695) | AM | 28.2 | 29.5 | 76 |
| 3 | 5th Avenue Southbound | 120th St | 40th St | PM | 8.9 | 6.3 | 61 |
| 4 | NJ 495 Eastbound | I-95 Junction | 12th Ave (Through Lincoln Tunnel) | AM | 13.4 | 15.8 | 60 |
| 5 | 6th Ave Northbound | Houston St | 58th St | PM | 10.2 | 8.8 | 60 |

4 IN-DEPTH STUDIES



## 4.1.5
## CASE STUDY: SAN FRANCISCO

The San Francisco Bay Area, home to more than 4.6 million people and a major technology hub, had the fourth worst delay of the 1,064 cities studied, and third worst in the US cities studied in the INRIX 2016 Traffic Scorecard. Congestion cost San Francisco drivers $1,996 last year, or $2.5 billion city-wide.

Though San Francisco's overall congestion rate is similar to Los Angeles and New York City, San Francisco has the highest peak-period congestion rate on of any US city studied at 23.4 percent within the city, indicating inner-city travel continues to be a challenge on arterial and city streets. However, San Francisco highways fare better in the peak period than 10 other cities studied, including Seattle, Boston, Portland and Los Angeles.

In general, while peak period travel on highways and city streets is more congested than Los Angeles and New York City, travel speeds are higher and speed reduction is lower. Speeds within the city during peak period congestion, for example, drop 66 percent versus uncongested speeds, versus a 72 percent drop in LA and 73 percent drop in New York. This indicates that congestion intensity is lower in San Francisco than the other two US cities in the global top 5.

If ranked by ICI, San Francisco would be ranked eighth among major cities.

Bay Area voters have recently passed ballot measures to repair BART – the region's heavy rail line. In addition, numerous Bay Area counties have passed their own local ballot measures to fund transportation improvements.

**Table 13: City Dashboard – San Francisco**

| | PEAK IN/ OUT | PEAK WITHIN | DAY IN/ OUT | DAY WITHIN | LATE IN/ OUT | LATE WITHIN | WEEK END | OVERALL |
|---|---|---|---|---|---|---|---|---|
| Congestion Rate | 21% | 23% | 8% | 13% | 2% | 9% | 12% | 13% |
| Congested Speed (mph) | 15.30 | 10.49 | 16.15 | 8.28 | 14.61 | 6.55 | 9.41 | 11.54 |
| Uncongested Speed (mph) | 41.75 | 31.30 | 52.84 | 37.05 | 63.02 | 43.65 | 45.04 | 44.95 |
| Speed Differential (mph) | 26.45 | 20.81 | 36.69 | 28.77 | 48.41 | 37.10 | 35.63 | 33.41 |
| % Reduction in Speed during Congestion | 63% | 66% | 69% | 78% | 77% | 85% | 79% | 74% |

San Francisco commuters ranked fourth by peak hours sitting in congestion, but their worst corridor, northbound on State Route 1, rings in at 31st on the worst corridors ranking. Unfortunately for travelers on this stretch of road, both directions of travel on this road are congested: northbound in the morning, and southbound in the evening.

San Francisco's position between the sea and hillside causes considerable problems to laying an effective road network.

**Table 14: Top 5 Worst Corridors – San Francisco**

| RANK | ROAD | FROM | TO | WORST PEAK PERIOD | AM PEAK AVERAGE SPEED (MPH) | PM PEAK AVERAGE SPEED (MPH) | TOTAL HOURS OF DELAY (P.P.P.A) |
|---|---|---|---|---|---|---|---|
| 1 | CA-1 Northbound | I-280/Exit 49B | US-101/Exit 438 | AM | 22.2 | 22.8 | 42 |
| 2 | I-880 Northbound | Exit 31 (I-238) | Exit 44 (7th Street) | AM | 36.5 | 54.2 | 34 |
| 3 | CA-1 Southbound | US-101/Exit 438 | I-280/Exit 49 | PM | 25.2 | 23.1 | 32 |
| 4 | CA-24 Eastbound | Exit 2 (I-580) | Exit 15B (I-680) | PM | 65.0 | 36.7 | 32 |
| 5 | 3rd Street | 16th St | Broadway | AM | 9.6 | 9.9 | 31 |

## 4.2 UNITED KINGDOM

### 4.2.1 TOP 25 UK CITIES

In the UK, INRIX analyzed congestion in 87 cities and large urban areas. Congestion cost drivers in the UK more than £30 billion in 2016 alone. London remains the UK's most congested city and ranks second in Europe after Moscow, and seventh in the world. Drivers in London spent an average of 73 hours in gridlock during peak hours. This contributed to congestion costing London drivers £1,911 each and the capital, as a whole, £6.2 billion from direct and indirect costs. Direct costs relate to the value of fuel and time wasted in gridlock, and indirect costs relate to freighting and business fees from company vehicles idling in traffic, which are passed on to households through higher prices.

Outside of the capital, Manchester, Aberdeen, Birmingham and Edinburgh make up the top five most congested cities in the UK Drivers in Manchester spent 39 hours in congestion during peak hours, and spent almost 10 percent of their total drive time (including non-peak hours) in gridlock, costing each driver £1,136 and the city more than £230 million, in 2016. In Birmingham, motorists spent more than 12 percent of their total drive time in congestion, costing drivers £990 each and the city as a whole £407 million.

Major cities in Scotland feature high-up in the UK ranking, with Aberdeen and Edinburgh placing third and fifth respectively and Glasgow ranked as the UK's 11th most congested city. Drivers in Aberdeen spent more than 12 percent of their total drive time in congestion, costing them more than £1,300 each in 2016. The average annual cost of congestion for each driver in Edinburgh was £1,009 and in Glasgow £766. The combined cost of congestion to all three major Scottish cities amounted to £582 million last year.

The UK government recently announced £1.1 billion investment to tackle congestion across the UK and an additional £220 million to be spent on Highways England roads to improve road safety and alleviate congestion. The UK has been a pioneer in the introduction of Smart Motorways that have largely been a success, adding additional capacity to the worst sections of highway. Miles traveled per capita continues to decline but congestion still grows. The challenge moving forward for the UK is dealing with the growth in commercial vehicles in urban centers as e-commerce continues to grow in popularity.

**Table 15: Top 25 UK City Ranking**

| RANK | CITY | PEAK HOURS SPENT IN CONGESTION | INRIX CONGESTION INDEX | AVERAGE CONGESTION RATE | TOTAL COST PER DRIVER | TOTAL COST TO THE CITY |
|---|---|---|---|---|---|---|
| 1 | London | 73 | 13.9 | 12.7% | £1,911 | £6,242m |
| 2 | Manchester | 39 | 6.7 | 9.9% | £1,136 | £233m |
| 3 | Aberdeen | 35 | 6.3 | 12.3% | £1,331 | £138m |
| 4 | Birmingham | 34 | 5.9 | 8.5% | £990 | £407m |
| 5 | Edinburgh | 31 | 5.4 | 9.8% | £1,009 | £225m |
| 6 | Guildford | 29 | 4.5 | 8.6% | £812 | £44m |
| 7 | Luton | 29 | 5.2 | 10.7% | £964 | £72m |
| 8 | Bournemouth | 27 | 5.5 | 10.8% | £1,019 | £84m |
| 9 | Hull | 27 | 4.8 | 9.4% | £970 | £109m |
| 10 | Bristol | 27 | 4.7 | 8.8% | £845 | £154m |
| 11 | Glasgow | 27 | 4.2 | 5.9% | £766 | £219m |
| 12 | Reading | 26 | 4.2 | 8.3% | £836 | £53m |
| 13 | Cambridge | 26 | 4.3 | 8.6% | £834 | £39m |
| 14 | Leeds | 25 | 4.2 | 6.6% | £764 | £245m |
| 15 | Exeter | 25 | 4.6 | 9.8% | £926 | £46m |
| 16 | Newport | 24 | 3.9 | 7.4% | £722 | £44m |
| 17 | Ipswich | 24 | 4.2 | 8.1% | £810 | £46m |
| 18 | Southampton | 24 | 4.0 | 7.8% | £748 | £74m |
| 19 | Coventry | 24 | 4.0 | 7.1% | £767 | £99m |
| 20 | Leicester | 24 | 3.8 | 7.5% | £745 | £92m |
| 21 | Warrington | 24 | 4.0 | 7.1% | £730 | £62m |
| 22 | Chelmsford | 23 | 3.8 | 7.4% | £722 | £50m |
| 23 | Winchester | 23 | 4.4 | 9.1% | £799 | £37m |
| 24 | Stoke-on-Trent | 23 | 3.8 | 7.2% | £746 | £80m |
| 25 | Newcastle upon Tyne | 23 | 4.0 | 6.5% | £761 | £89m |

# 4 IN-DEPTH STUDIES



## 4.2.1 TOP 25 UK CITIES

The ability to investigate congestion rates (i.e. the percentage of drive time spent in congestion) across different parts of the road network and at different times provides some fresh insights. Heading north of the border is the key to avoiding congestion in the UK, with the Scottish towns of Irvine, Falkirk, Bathgate, Stirling, Kilmarnock and Dunfermline all having average congestion levels of four percent or less in 2016. The exception is Aberdeen which is the UK's second worst city across both peak and non-peak hours combined, with drivers spending 12 percent of their total drive time in gridlock. Aberdeen eclipses London at peak hours and was the hardest city to get in to or out of with drivers stuck in gridlock for 24 percent of the time, moving at an average speed of 5.5 mph.

Business suffers the most from traffic in Cardiff with daytime congestion within the city occurring for 15 percent of the time on average. Businesses moving about the city centers of Exeter and London also suffer badly from congestion, sitting in traffic in the city center 17 percent and 16 percent of the time respectively, during the day. Exeter's city center was the busiest to get around across all of the UK during peak hours, with drivers spending 25 percent of their time in congestion with an average speed of just 4.6 mph.

Blackpool and London have the highest weekend congestion rates of 13 percent of drive time, but drivers cruise at their slowest in Brighton and Belfast where weekend congested speeds are just 4.3 mph.

## 4.2.2 TOP 10 CORRIDORS OUTSIDE LONDON

Outside of the capital, the A1 Southbound from College Gardens to Wallace Park in Belfast was the most congested, and the fourth-worst congested road in the UK, with drivers spending an average of 49 hours in gridlock.

Belfast and Bristol make up half of the top 10 worst corridors outside of the capital. Their small size and high density results in the majority of their commuting traffic being confined to a smaller number of major corridors in comparison to larger, more sprawling urban centers such as Manchester, Birmingham or Leeds.



**Table 16: Top 10 Worst Corridors Outside of London**

| RANK | CITY | ROAD | FROM | TO | WORST PEAK PERIOD | AM PEAK AVERAGE SPEED (MPH) | PM PEAK AVERAGE SPEED (MPH) | TOTAL HOURS OF DELAY (P.P.P.A) |
|---|---|---|---|---|---|---|---|---|
| 1 | Belfast | A1 Southbound | College Gardens | Wallace Park | PM | 20 | 16.5 | 49 |
| 2 | Bristol | A431/A420 Westbound | Bryants Hill | Lawrence Hill Roundabout | AM | 10.7 | 15.3 | 45 |
| 3 | Belfast | A24/A20 Northbound | Ormeau Road | Ann Street | AM | 10.5 | 10.8 | 45 |
| 4 | Manchester | A6 Northbound | Macclesfield Road | Heaton Lane | AM | 14.1 | 14.4 | 44 |
| 5 | Birmingham | A34 Both Directions | Shaftmoor Lane | Camp Hill Circus | PM | 12.4 | 11.3 | 40 |
| 6 | Glasgow | A82 Northbound | St George's Cross | Anniesland | PM | 14.5 | 11.6 | 40 |
| 7 | Newcastle upon Tyne | A19 Southbound | A189 | A1058 | PM | 31.5 | 30.2 | 38 |
| 8 | Belfast | M1/A12 Eastbound | M1/J8 Sprucefield Park | M3/M2 Yorkgate | AM | 35.3 | 50.3 | 38 |
| 9 | Bristol | A4 Westbound | Hicks Gate | St Philips Causeway | AM | 15.6 | 15.7 | 35 |
| 10 | Birmingham | A41 Northbound | Soho Hill | The Hawthorns | PM | 14.6 | 9.8 | 35 |

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## 4.2.3 TOP 5 CORRIDORS IN LONDON

INRIX also identified the UK's most congested roads as well as the worst times to travel. London roads were busiest during the evening rush hour with the A406 Northbound from Chiswick Roundabout to Hanger Lane identified as the UK's most congested, with motorists each spending 62 hours a year in congestion on this road – 11 hours more than the next worst, the A2 Eastbound from New Cross to Blackheath in London.

**Table 17: Top 5 Worst Corridors – London**

| RANK | CITY / LARGE URBAN AREA | ROAD | FROM | TO | WORST PEAK PERIOD | AM PEAK AVERAGE SPEED (MPH) | PM PEAK AVERAGE SPEED (MPH) | TOTAL HOURS OF DELAY |
|---|---|---|---|---|---|---|---|---|
| 1 | London | A406 North Circular Road Northbound | Chiswick Roundabout | Hanger Lane | PM | 15.5 | 13.3 | 73 |
| 2 | London | A2 Eastbound | New Cross Gate | Prince Charles Road | PM | 15.5 | 7.6 | 62 |
| 3 | London | A3211 Victoria Embankment Eastbound | Westminster Bridge | London Bridge | PM | 11.97 | 6.65 | 57 |
| 4 | London | A102 Northbound | A2/Kidbrooke | Blackwall Tunnel | AM | 15.5 | 24.2 | 51 |
| 5 | London | A4200 Southbound | Russell Square | Aldwych | PM | 8.2 | 6.9 | 50 |

## 4.2.4 CASE STUDY: LONDON

London is undoubtedly one of the most-congested cities in the world, frequently topping or placing highly on congestion ranks. Transport for London (TfL) estimated that the cost of congestion to drivers was £5.5 billion in 2014/15.[18] INRIX Research estimated that the total cost to drivers in London in 2016 was £6.2 billion, with the cost to the average driver being £1,911. The vast majority of this cost relates to the direct cost of congestion – £1,792 resulting from wasted time and fuel. The new methodology allows a greater insight into the causes of congestion in cities like London. Table 18 presents the City Dashboard for London and provides and number of insights.

Overall, London is the worst city for congestion in the UK across the board, with drivers spending an average of 13 percent of their time in congestion. Peak hours within the capital is the worst time and place in London for drivers, where they spent an average of 23 percent of their time in congestion managing an average speed of 4 mph during this period. Getting into the city was slightly easier at peak hours where drivers achieved an average congested speed of 14.6 mph and only spent 15 percent of their time in congestion.

While London drivers are congestion free most of the time, when congestion hits it is severe. Congested speeds fell by 80 percent (from 20 mph to 4.3 mph) in the city center in the day when congestion hit in 2016 and by 83 percent (from 24 to 4 mph) during the evening. But businesses moving about the city centers of London suffer from congestion, sitting in traffic in the city center 16 percent of the time respectively during the day. London also has one of the highest weekend congestion rates of 13 percent of drive time.

Comparing 2016 and 2015 reveals some interesting findings. While congestion at both peak and daytime hours got significantly worse on major roads into and out of the city, there was a large improvement in the congestion levels within the city at both peak and off-peak times. A number of factors can account for this, but the most likely explanation is the 15 percent reduction in the hours lost to planned roadworks in 2016 compared to 2015.[19]

Interestingly, while the total distance traveled by private cars is stagnating or decreasing (in parts of London), this is being offset by significant growth both in the number of and distance traveled by light goods vehicles (delivery vans) across the capital. London has been incredibly successful at encouraging modal shifts away from private vehicles, but the mechanisms used to achieve this (e.g. public transport investment, cycle promotion, congestion charging) will have little impact on the growth of LGV related congestion.

**Table 18: City Dashboard – London**

| | PEAK IN/ OUT | PEAK WITHIN | DAY IN/ OUT | DAY WITHIN | LATE IN/ OUT | LATE WITHIN | WEEK END | OVERALL |
|---|---|---|---|---|---|---|---|---|
| Congestion Rate | 15% | 23% | 8% | 17% | 3% | 10% | 13% | 13% |
| Congested Speed (mph) | 14.63 | 5.47 | 14.25 | 4.40 | 12.13 | 4.04 | 6.33 | 8.75 |
| Uncongested Speed (mph) | 49.15 | 20.39 | 55.02 | 22.05 | 62.80 | 24.32 | 31.37 | 37.87 |
| Speed Differential (mph) | 34.51 | 14.92 | 40.77 | 17.65 | 50.67 | 20.29 | 25.03 | 29.12 |
| % Reduction in Speed during Congestion | 70% | 73% | 74% | 80% | 81% | 83% | 80% | 77% |

**18** *Transport for London, Total Vehicle Delay (2015): http://content.tfl.gov.uk/total-vehicle-delay-for-london-2014-15.pdf*

**19** *Transport for London, Streets Performance (2016): http://content.tfl.gov.uk/street-performance-report-quarter3-2016-2017.pdf*

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## 4.3 GERMANY

### 4.3.1 TOP 25 GERMAN CITIES

In Germany, Munich tops the city ranking by peak hours spent in congestion with 49 hours, yet Heilbronn, Cologne and Stuttgart are close behind with 46 hours each. Interestingly, Munich, Cologne and Stuttgart are also largely indistinguishable when compared by the INRIX Congestion Index, yet Heilbronn, a relatively minor city by population, moves to the top of the German rankings. Drivers in Heilbronn they face the highest per driver cost of congestion at €2,581 – but the costs in Munich are similar at €2,418. The total cost of congestion in the top five German cities was over €7 billion in 2016.

On average, congestion costs German drivers €1,531 each per annum. When totaled nationally, congestion cost over €69 billion in 2016. After adjusting for exchange rates and the cost of living, Germany faces the highest average per-driver cost compared to the US and the UK Within Germany, Berlin faced the largest total cost of congestion at €4.3 billion due to the combination of reasonably significant congestion (12.7 percent of the time is congested) and the size of the city. Due to the large number of households, Hamburg faced the second-largest total cost of congestion at €2.4 billion, ahead of the more-congested cities of Munich, Cologne and Stuttgart.

Germany's geography provides enormous benefits and unique traffic problems. Many goods manufactured in southern and eastern Europe are being transported by road either through German ports (e.g. Hamburg) or by traveling to other European ports through Germany (e.g. Antwerp). To improve the movement of goods in the long-term, transportation officials have invested in significant road infrastructure programs across Germany. Yet in the short term, construction has reduced road supply and exacerbated congestion.

Being able to investigate congestion rates (i.e. the percentage of drive time spent in congestion) across different parts of the road network and at different times provides some fresh insights. The average peak congestion rate (among all roads analyzed) is highest in Heilbronn (28 percent) and Munich (25 percent). However, the congestion rate during the peak period in and out of the city is 35 percent in Heilbronn, versus 23 percent in Munich. Thus, while drivers in Munich, on average, spend more time in congestion than in Heilbronn, commuting in and out of Munich is much less stressful.

The lowest average congested speeds in Germany where in Freiburg 6.2 mph (9.9 kph) and Munich 8.0 mph (12.9 kph). Munich has the lowest congested speeds in the evenings within the city 4.9 mph (7.9 kph). Interestingly, though Heilbornn (15 percent), Hamburg (12 percent) and Munich (9 percent) drivers spend more of their trip in congestion than most, speeds are lowest in Leipzig and Berlin 6.2 mph (9.9 kph).

**Table 19: Top 25 German Cities Ranking**

| RANK | CITY | PEAK HOURS SPENT IN CONGESTION | INRIX CONGESTION INDEX | AVERAGE CONGESTION RATE | TOTAL COST PER DRIVER | TOTAL COST TO THE CITY |
|---|---|---|---|---|---|---|
| 1 | Munich | 49 | 8.5 | 14.5% | €2,418 | €1,990m |
| 2 | Heilbronn | 46 | 9.3 | 17.9% | €2,581 | €143m |
| 3 | Cologne | 46 | 8.3 | 13.2% | €2,141 | €1,180m |
| 4 | Stuttgart | 46 | 8.4 | 13.6% | €2,121 | €680m |
| 5 | Hamburg | 41 | 7.6 | 13.9% | €2,172 | €2,360m |
| 6 | Berlin | 40 | 7.5 | 12.7% | €2,127 | €4,344m |
| 7 | Frankfurt | 39 | 6.5 | 10.8% | €1,671 | €694m |
| 8 | Ruhrgebiet | 36 | 6.8 | 8.7% | €1,661 | €1,458m |
| 9 | Hanover | 36 | 6.7 | 11.3% | €1,758 | €522m |
| 10 | Düsseldorf | 34 | 5.7 | 10.4% | €1,650 | €580m |
| 11 | Würzburg | 34 | 7.0 | 13.8% | €2,033 | €171m |
| 12 | Sindelfingen | 31 | 5.3 | 10.2% | €1,467 | €89m |
| 13 | Karlsruhe | 30 | 6.1 | 11.9% | €1,792 | €323m |
| 14 | Wiesbaden | 29 | 4.7 | 8.2% | €1,273 | €358m |
| 15 | Nuremberg | 28 | 5.3 | 10.6% | €1,580 | €446m |
| 16 | Pforzheim | 28 | 5.7 | 11.6% | €1,646 | €95m |
| 17 | Bonn | 28 | 4.5 | 8.0% | €1,262 | €209m |
| 18 | Freiburg | 27 | 5.6 | 11.4% | €1,941 | €222m |
| 19 | Mannheim | 26 | 4.5 | 7.6% | €1,256 | €225m |
| 20 | Bielefeld | 25 | 4.5 | 9.1% | €1,418 | €112m |
| 21 | Darmstadt | 24 | 3.9 | 7.6% | €1,129 | €53m |
| 22 | Krefeld | 24 | 4.2 | 8.2% | €1,226 | €145m |
| 23 | Wuppertal | 24 | 4.1 | 7.5% | €1,203 | €217m |
| 24 | Regensburg | 23 | 4.2 | 8.5% | €1,257 | €63m |
| 25 | Bremen | 21 | 4.1 | 8.1% | €1,251 | €385m |

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## 4.3.2 TOP 10 WORST GERMAN CORRIDORS

Germany's worst corridors are largely inner city routes and ring roads that have significant levels of commuter traffic.

Unlike the UK where the top 10 routes are dominated by the capital, Germany's worst corridors are fairly evenly spread across the most congested cities. Cologne holds three spots in the top 10, including the worst corridor along the A3. The A3 passes to the east of Cologne and connects with the A1, a major tributary to Düsseldorf and Wuppertal.

**Table 20: Top 10 Worst Corridors – Germany**

| RANK | CITY | ROAD | FROM | TO | WORST PEAK PERIOD | AM PEAK AVERAGE SPEED (KPH) | PM PEAK AVERAGE SPEED (KPH) | TOTAL HOURS OF DELAY (P.P.P.A) |
|---|---|---|---|---|---|---|---|---|
| 1 | Cologne | A3 Northbound | J28 | A1 | PM | 59.1 | 52.1 | 37 |
| 2 | Munich | Hohenzollernstrasse Westbound | Hohenzollernplatz | Landshuter Allee | PM | 19.4 | 17.0 | 34 |
| 3 | Berlin | B96 Northbound | Tempelhof | Mehrinbrucke | AM | 21.9 | 22.8 | 34 |
| 4 | Cologne | B264 Northbound | Stadtwaldvierte | Universitatstrasse | AM | 19.1 | 20.8 | 33 |
| 5 | Stuttgart | B27 Northbound | Degerloch | Holtzstrasse | PM | 30.6 | 26.3 | 32 |
| 6 | Berlin | Chausseestrasse Southbound | Sellerstrasse | Mehringplatz | PM | 17.8 | 15.7 | 32 |
| 7 | Hamburg | Sierichstrasse Southbound | Braamkamp | An der Alster | PM | 31.7 | 20.8 | 31 |
| 8 | Frankfurt | Wachtersbacher Strasse Eastbound | B8 | Bebraer Strasse | PM | 35.6 | 21.9 | 31 |
| 9 | Cologne | A1 Northbound | A57 | A59 | PM | 54.6 | 36.8 | 30 |
| 10 | Stuttgart | Boheimstrasse Southbound | Fangelbachfriedhof | B14 | PM | 19.9 | 17.8 | 30 |

## 4.3.3
## CASE STUDY: MUNICH

Munich is Germany's most congested city by hours spent in congestion in 2016, narrowly beating Cologne and Stuttgart – two cities which often take the top spot.

Munich is a large, dense city and is a significant economic hub with major employers such as BMW. Table 22 presents the City Dashboard data for Munich, providing interesting insights.

Munich was Germany's most congested city in 2016 with 49 hours wasted in congestion and an average congestion rate of 15 percent. This is more than, for example, London's average congestion rate of 13 percent but Munich ranks 36th in the ranking of 1,064 cities in comparison to London at seventh. This is driven by the relative sizes of the two cities and the significantly shorter average commute times in Munich than London.

Munich's congestion problem is most extreme within the city, where average congested speeds in 2016 were just 5-5.5 mph (8-9.0 kph) across peak and off-peak periods. Congestion rates are relatively low on the major highways in to and out of city during the day (eight percent) and at night (three percent). Generally, congestion rates are always high, with an average of 15 percent. On the weekend, speeds rose slightly to 7.2 mph (11.6 kph). Munich has the third highest congestion rate at weekends (nine percent) after Heilbronn (15 percent) and Hamburg (12 percent).

While drivers are free from congestion most (85 percent) of the time, in comparison to uncongested speeds, congested speeds were a quarter of the uncongested speeds on average. Drivers in Munich experience a severe reduction in speeds during congestion, creating significant delay and resulting in Munich ranking at the top across German cities by hours spent in congestion.

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## 4.3.3 CASE STUDY: MUNICH

**Table 21: City Dashboard – Munich**

| | PEAK IN/ OUT | PEAK WITHIN | DAY IN/ OUT | DAY WITHIN | LATE IN/ OUT | LATE WITHIN | WEEK END | OVERALL |
|---|---|---|---|---|---|---|---|---|
| Congestion Rate | 23% | 27% | 8% | 19% | 3% | 12% | 9% | 15% |
| Congested Speed (kph) | 20.48 | 8.76 | 18.17 | 8.19 | 14.88 | 7.92 | 11.57 | 12.85 |
| Uncongested Speed (kph) | 62.44 | 28.69 | 78.06 | 31.06 | 86.87 | 35.34 | 58.35 | 54.40 |
| Speed Differential (kph) | 41.97 | 19.93 | 59.89 | 22.87 | 71.99 | 27.41 | 46.77 | 41.55 |
| % Reduction in Speed during Congestion | 67% | 69% | 77% | 74% | 83% | 78% | 80% | 76% |

The center of Munich has a number of pedestrian zones and numerous narrow streets. While significant investments have been made to improve the traffic along the main inner city ring road (B2R) in recent years, traffic in Munich continues to rise. The westbound route along Hohenzollernstrasse from Leopoldstrasse to Landshuter Allee is the most congested route in Munich and the remaining four worst corridors are very similar in terms of hours lost each year.

However, comparing the levels of impact caused by these roads compared to Germany's worst corridors, provides an interesting insight. Munich's individual roads are not among the worst in the entire country – the entire road network is more congested – meaning that drivers spend a greater proportion of their time in congestion.

**Table 22: Top 5 Worst Corridors – Munich**

| RANK | ROAD | FROM | TO | WORST PEAK PERIOD | AM PEAK AVERAGE SPEED (KPH) | PM PEAK AVERAGE SPEED (KPH) | TOTAL HOURS OF DELAY (P.P.P.A) |
|---|---|---|---|---|---|---|---|
| 1 | Hohenzollernstrasse Westbound | Leopoldstrasse | Landshuter Allee via Leonrodstrasse | PM | 19.4 | 17.0 | 34 |
| 2 | Belgradstrasse Northbound | Hohenzollernstrasse | Am Hart via Knorrstrasse | PM | 22.9 | 22.3 | 28 |
| 3 | Paul-Heyes Strasse Southbound | Arnulfstrasse | Kolumbusplatz via Humboldtstrasse | PM | 22.6 | 18.8 | 27 |
| 4 | Leopoldstrasse/ B13 Northbound | Universitat | Frankfurter Ring | PM | 26.1 | 21.9 | 26 |
| 5 | Nymphenburg Strasse Southbound | Südliche Auffahrtsallee | Konigsplatz | PM | 20.3 | 20.1 | 24 |

# 5 SUMMARY



The INRIX 2016 Traffic Scorecard measures the state of congestion in 1,064 cities across 38 countries, making this the largest study of congestion to date. As well as measuring the impact of congestion on commuters at peak times, this is the first study to measure the impact of congestion across all types of car trips, and at all times of the day.

For drivers, the INRIX 2016 Traffic Scorecard therefore provides the first, holistic measure of the impact of congestion on all drivers within cities and countries, and for all of the cities in the UK, US and Germany, the total economic cost of this congestion is measured for the first time. The full results for all 1,064 cities are available in the appendix and on the INRIX Traffic Scorecard website (**inrix.com/scorecard**). The key insights for drivers are:

- Congestion across the UK, Germany and US cost almost $450 billion in 2016 or $971 per capita.
- The average cost per driver was $1,400 (US), £968 (UK), and €1,531 (Germany), and while the cost of congestion per driver was similar in the UK and US after adjusting for price levels the cost per driver in Germany was 38 percent higher.
- Comparing peak hours wasted to the population weighted average will provide a reasonable measure of whether your city is heavily congested or not. For example, in the UK cities with more than 32 hours wasted, or in the US more than 42 hours wasted. Peak hours spent in congestion is a good measure of commuters suffering from congestion.
- The overall congestion rate of the city provides a quick and easy metric into the average amount of time drivers spend in congestion. As the congestion rate increases over 10 percent, hours spent in congestion become noticeable.

For cities, policy makers and transportation professionals, the INRIX 2016 Traffic Scorecard provides significant levels of detail on congestion rates (percent of time spent in congestion) at different times of the day and at different parts of the road network as well as combining these into a new, industry leading transportation metric – the INRIX Congestion Index. The new detailed City Dashboard available on the INRIX 2016 Traffic Scorecard website (**inrix.com/scorecard**) provides the in-depth city level results and the cloud-based, on-demand analytics application, INRIX Roadway Analytics, provides near real time analytics capabilities for cities. The key insights for cities are:

- There are two reasonable benchmarks for cities to adopt:
  - Comparing INRIX Congestion Index for comparable cities by population and stage of economic development. For example, Los Angeles and New York City may be comparable with London or Paris. In those terms, London and Paris have higher performing road networks, but Los Angeles and New York City are similar.
  - Comparing the overall percentage of time spent in congestion to cities within your own country provides a measure of competitiveness across all road users, but focusing on the day time within the city congestion rate provides a quick guide to the impact of congestion on businesses.
- Both developed and developing countries have cities with heavy congestion putting them in the top 25 cities in the world. Yet on average, congestion across developing countries is higher than in developed countries. This may be the result of urbanization being higher in developing countries or due to better public transport in developed nations.


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