INRIX Global Traffic Scorecard

INRIX Research
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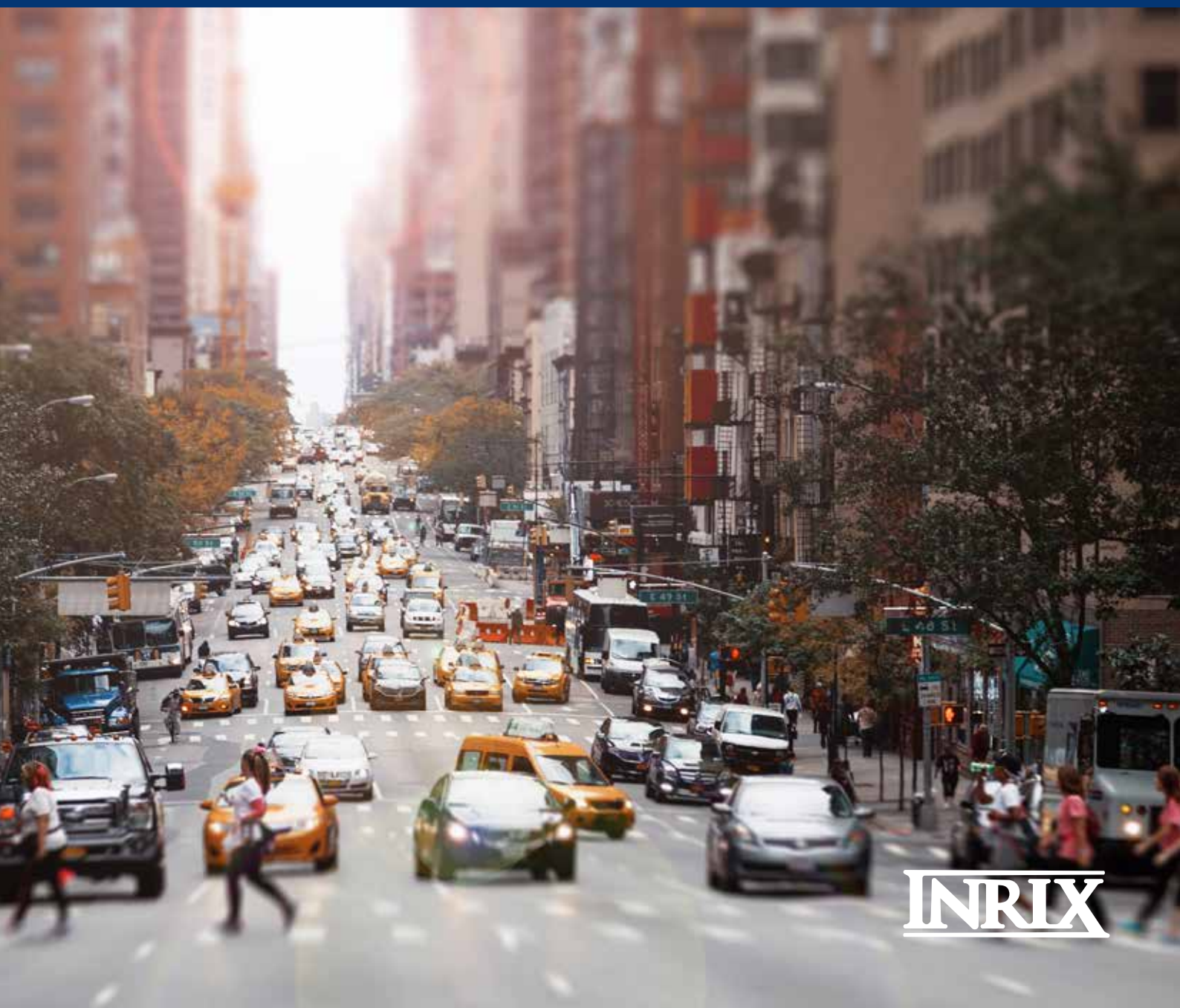

ABOUT INRIX RESEARCH

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.

CONTENTS

TABLES

1

1 EXECUTIVE SUMMARY

2

1.1 INTRODUCTION

The INRIX 2017 Traffic Scorecard is the largest and most detailed study of congestion to date. It includes data on 1,360 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. It is clear that congestion is a global phenomenon, and 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.

For example, in 2017, the Los Angeles Department of Transportation (DOT), City of Calgary, Iowa DOT and Ohio DOT, among others, selected INRIX Roadway Analytics for instant and highly precise road performance analysis. The cloud-based traffic analysis tools help cities, states and countries identify areas that benefit most from road improvements, reduce the cost of operations, and more accurately measure and report the impact of transportation investments.

The key findings of the INRIX 2017 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 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

In 2017, INRIX Traffic Scorecard grows by 33 percent, increasing coverage to 1,360 cities in 38 countries – making it the largest ever study of congestion.

This year's Traffic Scorecard adopted the same methodology as the 2016 edition, which 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, by estimating the total number of hours 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 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 2017.

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

1.3 KEY FINDINGS

The INRIX 2017 Traffic Scorecard analyzes and compares the state of traffic congestion in countries and major urban areas worldwide.

In 2017, the US moved from fourth place to fifth, tied with Russia, in the global rankings with drivers spending 41 peak hours (i.e. commuting) a year in congestion. Thailand tops the list in 2017 with drivers spending an average of 56 hours in peak hour congestion. Other countries in the top five include: Indonesia (51 hours), Colombia (49 hours) and Venezuela (42 hours). The UK comes in 10th (31 hours) and Germany 11th (30 hours).

While the US may be fifth overall, American cities dominate the top 10 most congested cities led by Los Angeles (first), New York (third), San Francisco (fifth), Atlanta (eighth) and Miami (10th). Commuters in Los Angeles spent 102 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, unchanged from last year, followed by London (74 hours), Paris (69 hours) and Istanbul (59 hours).

Across the 1,360 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), the same speed as 2016. Dublin remains the slowest major city studied at 4.6 mph (7.4 kph) during all congested periods, with peak hour speeds at 3.7 mph (6 kph). Out of the cities studied, Oaxaca, Mexico was the slowest city with average congested speeds of 3.6mph (5.9 kph).

Table 1:
Top 5 Cities INRIX 2017 Traffic Scorecard

RANK	MAJOR CITIES	NORTH AMERICAN CITIES	EUROPEAN MAJOR CITIES
1	Los Angeles	Los Angeles	Moscow
2	Moscow	New York City	London
3	New York City	San Francisco	Paris
4	Sao Paulo	Atlanta	Istanbul
5	San Francisco	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 meter increments, compared to the 1- to 3-mile road segments typically employed.

This real-time traffic data is at the heart of the INRIX 2017 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 were made in the INRIX 2016 Traffic Scorecard, which we continued to use in 2017. 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 rectified this problem and allowed global comparison between urban areas by clustering dense roadways to form an urban boundary. These 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. From 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 Traffic Scorecard, this is very important as there are stark cultural differences in commuting patterns and business hours.

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 2017 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 2017 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	$13.16	£12.33	1.13	1.2	1.37
Business	$25.87	£18.41	1.94	1.8	1.26
Other (e.g. leisure, shopping)	$9.77	£5.62	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 2017 price of fuel, weighted toward the split of diesel and gasoline powered vehicles in the respective countries (US: $2.47/gal[12]; UK: £4.73/gal[13]; Germany: €4.9/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] In 2017, an adjustment was made to the calculation for total city costs by including a multiplier for the number of vehicles per household (in 2016 it was assumed there was one car per household). In addition, no adjustment was made to the number of households that commuted by car because the data sources were not comparable across countries.

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%20CO_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.

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

3 INRIX 2017 TRAFFIC SCORECARD RANKING

3.1 GLOBAL MAJOR CITIES RANKING

The full ranking of all 1,360 cities in the INRIX 2017 Traffic Scorecard are available at inrix.com/scorecard, but Table 3 provides the top 25 major cities ranked by the number of peak hours that drivers spent in congestion in 2017. 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 2017 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.

A number of less-developed cities outside of Europe and North America appear 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 roads 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 102 peak hours in congestion in 2017, followed by Moscow (91 hours), New York (91 hours), San Paulo (86 hours) and San Francisco (79 hours). London (74 hours) ranked seventh out of the 1,360 cities analyzed after Bogota, where drivers spent 75 hours in congestion last year.

US cities take 10 of the top 25 positions in the major city ranking. Beyond Russia and London, only a small number of European cities made the top 25 list, including: Paris at ninth (69 hours), Istanbul 15th (59 hours), Zürich 21st (51 hours) and Munich 25th (51 hours), which jumped four spots since 2016. The INRIX 2017 Traffic Scorecard also includes more than 100 populous Russian cities. The major Russian cities that make the top 25 are Moscow at second (91 hours), Krasnodar 19th (57 hours) and Saint Petersburg 21st (54 hours).

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	102	18.3	12%
2	Moscow	Russia	Europe	91	20.1	26%
3	New York City; NY	USA	North America	91	17.4	13%
4	Sao Paulo	Brazil	South America	86	16.9	22%
5	San Francisco; CA	USA	North America	79	13.7	12%
6	Bogota	Colombia	South America	75	16.2	30%
7	London	UK	Europe	74	14.1	13%
8	Atlanta; GA	USA	North America	70	12.3	10%
9	Paris	France	Europe	69	13.1	13%
10	Miami; FL	USA	North America	64	11.8	9%
11	Bangkok	Thailand	Asia	64	12.5	23%
12	Jakarta	Indonesia	Asia	63	13.4	20%
13	Washington; DC	USA	North America	63	10.8	11%
14	Boston; MA	USA	North America	60	10.6	14%
15	Istanbul	Turkey	Europe	59	12.2	19%
16	Mexico City	Mexico	South America	58	12.4	13%
17	Chicago; IL	USA	North America	57	10.3	10%
18	Medellin	Colombia	South America	57	11.4	21%
19	Krasnodar	Russia	Europe	57	12.4	25%
20	Seattle; WA	USA	North America	55	9.6	12%
21	Saint Petersburg	Russia	Europe	54	11.6	21%
22	Dallas; TX	USA	North America	54	9.3	6%
23	Zurich	Switzerland	Europe	51	9.2	17%
24	Rio de Janeiro	Brazil	South America	51	10.6	15%
25	Munich	Germany	Europe	51	9.1	16%

3 INRIX 2017 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 2017 Traffic Scorecard and their country values are therefore statistically more reliable.

Of the 38 countries covered by the INRIX 2017 Traffic Scorecard, Thailand, for the second year in a row, led with the highest average hours spent in peak congestion (56 hours, down from 61 hours in 2016), outranking Indonesia (51 hours) at second, Columbia (49 hours), Venezuela (42 hours), and the US and Russia (41 hours) tied at fifth. The UK was 10th in the global country ranking, third 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	56	11
2	Indonesia	51	11.1
3	Colombia	49	10.2
4	Venezuela	42	8.2
5	Russia	41	9.2
5	USA	41	7.3
7	Brazil	36	7.3
8	South Africa	36	5.9
9	Turkey	32	6.7
10	UK	31	5.6
10	Puerto Rico	31	5.7
12	Germany	30	5.5
13	Poland	29	5.5
13	Slovakia	29	5.2
15	Luxembourg	28	4.2
16	Canada	27	5.1
16	Switzerland	27	4.5
18	Norway	26	4.3
18	Sweden	26	4.1
20	Austria	25	5.1
21	United Arab Emirates	24	5.3
22	Ecuador	23	5.1
22	Ireland	23	4.2
22	Mexico	23	5.2
25	France	22	4.1
25	Kuwait	22	4.8
25	Netherlands	22	4
28	Belgium	21	3.5
28	Finland	21	4.2
30	Hungary	18	3.4
30	Saudi Arabia	18	4.3
30	Slovenia	18	3.6
33	Spain	17	3.7
34	Czech Republic	16	3.6
34	Denmark	16	3.1
36	Italy	15	2.8
36	Portugal	15	2.8
38	Singapore	10	1.8

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	102	18.3	12%
2	New York City; NY	USA	91	17.4	13%
3	San Francisco; CA	USA	79	13.7	12%
4	Atlanta; GA	USA	70	12.3	10%
5	Miami; FL	USA	64	11.8	9%
6	Washington; DC	USA	63	10.8	11%
7	Boston; MA	USA	60	10.6	14%
8	Chicago; IL	USA	57	10.3	10%
9	Seattle; WA	USA	55	9.6	12%
10	Dallas; TX	USA	54	9.3	6%
11	Houston; TX	USA	50	8.4	7%
12	Montreal	Canada	50	9.2	13%
13	Portland; OR	USA	50	8.1	11%
14	San Diego; CA	USA	48	7.7	10%
15	Toronto	Canada	47	8.9	12%
16	Austin; TX	USA	43	7.4	11%
17	Stamford; CT	USA	41	7.2	13%
18	Tacoma; WA	USA	41	7	11%
19	Minneapolis; MN	USA	41	6.5	7%
20	Philadelphia; PA	USA	37	6.8	8%
21	Honolulu; HI	USA	37	6.7	11%
22	Denver; CO	USA	36	6.5	8%
23	Detroit; MI	USA	35	6	6%
24	Orlando; FL	USA	34	6.4	7%
25	Phoenix; AZ	USA	34	5.8	6%

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 2017, 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 102 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 (91 and 79 hours spent in congestion respectively), have a similar average congestion rate as Los Angeles, but show different commute patterns. San Francisco, for example, had the highest congestion rate (tied with Boston) on arterial and city streets during the peak commute hours at 23 percent. New York businesses suffered the most from congestion with an average of 14 percent of travel time on weekdays congested on the city streets.

While Canadian cities do not make the top 10, both Montreal and Toronto place within the top 25, though Montreal's average congestion rate (13 percent) surpassed every other North American city studied besides Boston. Montreal's congestion rates rank relatively high across the board, generally ranking in the top five during the peak period on arterials and city streets.

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 2017 Traffic Scorecard includes 784 European cities and Table 6 presents the top 25 major European cities ranked by the hours that drivers spent in peak-period congestion in 2017.

Moscow tops the list with 91 hours spent in peak hour congestion, followed by London (74 hours), Paris (69 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 due to relatively little public transport offerings and significant congestion problems. Krasnodar (fifth), Saint Petersburg (sixth), Sochi (ninth) and Nizhny Novgorod (10th) are examples.

Although London takes the number two position, the only other UK cities in the top 25 European ranking are Manchester (19th) and Birmingham (22nd). While the overall congestion rate in London (13 percent), Manchester (10 percent) and Birmingham (9 percent) is similar, peak hours spent in congestion is almost twice as bad in London (74 hours) compared to Manchester (39 hours) and Birmingham (36 hours). This difference is driven by the relative size of the cities and therefore, the average commuting time.

In contrast to the UK, Germany has eight cities in the Top 25. While Hamburg, Berlin and Stuttgart have identical peak hours wasted (44 hours) and similar overall congestion rates (14, 14 and 13 percent respectively), Munich is significantly higher (51 hours and 16 percent) driven by incredibly high peak hours congestion (27 percent).

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	20.1	32%
2	London	UK	74	14.1	20%
3	Paris	France	69	13.1	21%
4	Istanbul	Turkey	59	12.2	25%
5	Krasnodar	Russia	57	12.4	31%
6	Saint Petersburg	Russia	54	11.6	26%
7	Zurich	Switzerland	51	9.2	29%
8	Munchen	Germany	51	9.1	27%
9	Sochi	Russia	48	10.9	28%
10	Nizhny Novgorod	Russia	48	10.2	26%
11	Oslo	Norway	46	7.6	25%
12	Hamburg	Germany	44	8	24%
13	Berlin	Germany	44	8.3	23%
14	Stuttgart	Germany	44	7.9	22%
15	Madrid	Spain	42	8.2	19%
16	Ruhrgebiet	Germany	40	7.5	16%
17	Vienna	Austria	40	7.9	23%
18	Cologne	Germany	40	7	20%
19	Manchester	UK	39	6.8	18%
20	Brussels	Belgium	39	6.4	22%
21	Rome	Italy	39	7	20%
22	Birmingham	UK	36	6.3	16%
23	Frankfurt	Germany	36	5.9	19%
24	Lausanne	Switzerland	36	5.6	21%
25	Karlsruhe	Germany	34	6.4	21%

4 IN-DEPTH STUDIES

4.1 UNITED STATES

4.1.1 TOP 25 US CITIES

In the US, INRIX analyzed congestion in 296 cities and large urban areas. Congestion cost drivers in the US more than $305 billion in direct and indirect costs in 2017 alone, up $10 billion from 2016 driven by an increase in the cost of motoring rather than an increase of congestion per se. 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 (12-13 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 $2,828 on average, equaling more than $19.2 billion to the city as a whole.

Interestingly, congestion costs New York drivers the most in the US, almost reaching $3,000 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 $34 billion last year – the highest of any urban area studied

Minneapolis and Detroit tie for the lowest cost of congestion among the top 25 US cities at $1,332 and $1,256 per driver respectively. Both cities 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 $2,269, congestion costs the average German driver over $824 (57 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.

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	102	18.3	12%	$2,828	$19.2bn
2	New York City; NY	91	17.4	13%	$2,982	$33.7bn
3	San Francisco; CA	79	13.7	12%	$2,250	$10.6bn
4	Atlanta; GA	70	12.3	10%	$2,212	$7.1bn
5	Miami; FL	64	11.8	9%	$2,072	$6.3bn
6	Washington; DC	63	10.8	11%	$2,060	$6.1bn
7	Boston; MA	60	10.6	14%	$2,086	$5.7bn
8	Chicago; IL	57	10.3	10%	$1,994	$5.5bn
9	Seattle; WA	55	9.6	12%	$1,853	$5.0bn
10	Dallas; TX	54	9.3	6%	$1,674	$4.9bn
11	Houston; TX	50	8.4	7%	$1,623	$4.8bn
12	Portland; OR	50	8.1	11%	$1,648	$3.9bn
13	San Diego; CA	48	7.7	10%	$1,583	$3.1bn
14	Austin; TX	43	7.4	11%	$1,627	$2.8bn
15	Stamford; CT	41	7.2	13%	$1,588	$2.8bn
16	Tacoma; WA	41	7.0	11%	$1,485	$2.4bn
17	Minneapolis; MN	41	6.5	7%	$1,332	$2.3bn
18	Philadelphia; PA	37	6.8	8%	$1,427	$2.1bn
19	Santa Cruz; CA	37	6.9	14%	$1,700	$1.9bn
20	Honolulu; HI	37	6.7	11%	$1,701	$1.8bn
21	Denver; CO	36	6.5	8%	$1,394	$1.6bn
22	San Rafael; CA	35	5.7	11%	$1,394	$1.5bn
23	Detroit; MI	35	6.0	6%	$1,256	$1.5bn
24	Santa Barbara; CA	35	6.2	13%	$1,584	$1.4bn
25	Orlando; FL	34	6.4	7%	$1,366	$1.4bn

4 IN-DEPTH STUDIES

4.1.2
TOP 10 WORST US CORRIDORS

For the third year in a row, the (I-95) Cross Bronx Expressway in New York City tops the INRIX list of worst corridors, with the average driver on the 4.7 mile stretch wasting 118 hours per year in congestion, an increase of 37 percent over last year.

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, NY	I-95 Eastbound	Exit 1C/Alexander Hamilton Brdg W	Exit 6A/I-278	PM	16.32	10.80	118
2	Chicago, IL	I-90/I-94 Southbound	Exit 53C/I-55	Exit 34B/Lake Ave E	AM	24.18	25.77	98
3	Chicago, IL	I-290 Eastbound	Exit 15A/I-88	Exit 28B/Paulina St	AM	31.33	29.75	89
4	Los Angeles, CA	I-10 Eastbound	Exit 3A/S Figueroa St	Exit 13/I-110	PM	38.21	22.61	74
5	Pittsburgh, PA	I-376 Eastbound	Exit 65/Academy St	Exit 77/Edgewood	AM	37.26	29.93	66
6	Chicago, IL	I-90 Southbound	Exit 50A/N Ogden Ave	Exit 43C/Montrose Ave	AM	23.88	29.04	66
7	New York, NY	E 34th St	FDR Dr	5th Ave	AM	5.81	5.79	59
8	New York, NY	Belt Pkwy E	Exit 3/I-278	Exit 17/Cross Bay Blvd	PM	47.00	28.83	57
9	New York, NY	E 42nd St	FDR Dr	7th Ave	PM	6.31	5.81	56
10	Boston, MA	I-93 Southbound	Exit 20B/Albany St	Exit 8/Furnace Brook Pkwy	PM	39.61	25.10	55

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 once again in INRIX 2017 Traffic Scorecard. Drivers in Los Angeles spent 102 hours sitting in congestion last year, beating cities like Moscow (91), New York (91), Sao Paulo (86) and San Francisco (79).

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 eighth-worst congestion rate among US cities studied during the peak period at 21 percent, faring better than cities like San Francisco, Seattle, Boston and Portland. Los Angeles ranked sixth when averaging daytime congestion rates at 11 percent. One bright spot is nighttime travel, where Los Angeles city streets ranked 36th.

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	22%	20%	10%	13%	3%	8%	10%	12%
Congested Speed (mph)	13.36	7.40	14.10	6.62	11.81	5.64	10.36	9.90
Uncongested Speed (mph)	38.95	27.12	46.65	31.01	57.26	38.85	43.53	40.48
Speed Differential (mph)	25.59	19.71	32.55	24.39	45.44	33.21	33.17	30.58
% Reduction in Speed during Congestion	66%	73%	70%	79%	79%	85%	76%	76%

Similar to 2016, 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 74 hours of delay in 2017, up 12 percent from the year before. The 8.9-mile corridor ranks fourth nationally in terms of delay and ranks highest on the West Coast.

US-101 Southbound takes the second spot, up two from 2016. This stretch of road saw average afternoon peak speeds of just 16 mph, leading drivers to waste 51 hours a year.

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	I10	Exit 3A	Exit 13	PM	38.21	22.61	74
2	CA-101	Exit 7	Exit 4A	PM	18.23	15.93	51
3	I110	I105	Exit 20B	AM	21.83	44.79	49
4	I-605 S	Exit 18	Exit 18	PM	36.68	32.63	45
5	CA-101	Exit 30	Exit 19B	AM	40.59	41.15	44

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 91 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 City businesses suffer the most in the U.S., with an average of 14 percent of weekday travel times are gridlocked. In addition, drivers in New York travel at much slower speeds. Overall congested speeds in New York are 7.4 mph, versus 9.9 and 10.5 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 (17 percent versus 22 percent and 19 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	17%	20%	8%	14%	5%	12%	12%	13%
Congested Speed (mph)	10.61	6.43	8.66	5.12	7.32	5.40	8.10	7.38
Uncongested Speed (mph)	41.46	23.64	48.32	25.50	53.68	30.08	38.39	37.30
Speed Differential (mph)	30.84	17.21	39.66	20.38	46.37	24.68	30.28	29.92
% Reduction in Speed during Congestion	74%	73%	82%	80%	86%	82%	79%	80%

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 in Manhattan also see delays of more than 50 hours average across the busiest corridors.

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	I95	Alexander Hamilton Brg W	I278	PM	16.32	10.80	118
2	E 34th St	FDR Drive	5th Ave	AM	5.81	5.79	59
3	Belt Pkwy E	Exit 3	Exit 17	PM	47.00	28.83	57
4	E 42nd St	FDR Drive	7th Ave	PM	6.31	5.81	56
5	8th Ave	Hudson St	W 30th St	AM	7.52	7.82	53

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 fifth worst delay of the 1,360 cities studied, and third worst in the US cities studied in the INRIX 2017 Traffic Scorecard. Congestion cost San Francisco drivers $2,250 last year, or $10.6 billion city-wide.

Though San Francisco's overall congestion rate is similar to Los Angeles and New York City, San Francisco has the highest U.S. congestion rates on arterial and city streets during the peak commute hours (23 percent) joint with Boston. 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 seventh 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	19%	23%	7%	13%	2%	9%	11%	12%
Congested Speed (mph)	13.94	10.13	14.05	7.64	12.55	5.96	9.07	10.48
Uncongested Speed (mph)	40.91	29.85	50.32	34.38	59.89	41.11	44.74	43.03
Speed Differential (mph)	26.97	19.72	36.27	26.74	47.34	35.15	35.66	32.55
% Reduction in Speed during Congestion	66%	66%	72%	78%	79%	86%	80%	76%

San Francisco commuters ranked fourth by peak hours sitting in congestion, but their worst corridor, eastbound on State Route 24, rings in at 48th on the worst corridors ranking. Unfortunately for travelers on this stretch of road, drivers wasted an average of 39 hours in 2017 on the stretch of road between I-580 and I-680.

San Francisco's position between the sea and hillside causes considerable problems 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-24 E	2B	14B	PM	65.39	33.38	39
2	3rd St	16st	Market St	AM	8.44	9.38	34
3	I80	Exit 9	Exit 22	PM	63.99	35.95	34
4	6th St	I280	Market St	AM	8.51	8.84	30
5	CA 1	I280	CA 101	AM	21.69	24.06	29

4 IN-DEPTH STUDIES

4.2 UNITED KINGDOM

4.2.1 TOP 25 UK CITIES

In the UK, INRIX analyzed congestion in 111 cities and large urban areas , an increase of 28 percent from 2016. Congestion cost drivers in the UK more than £37 billion in 2017 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 71 hours in gridlock during peak hours. This contributed to congestion costing London drivers £2,430 each and the capital, as a whole, £9.5 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.

Manchester and Birmingham take the second and third spots respectively, with drivers in each city spending 39 and 36 hours stuck in peak hour congestion last year. Drivers in these cities spent 10 and 9 percent of their time in congestion overall in 2017, costing them £1,403 and £1,281 respectively. The inclusion of new urban areas in 2017 changed the UK ranking significantly with new entrants, Lincoln (36 hours) and Braintree (33 hours) rounding out the top 5.

In Scotland, Aberdeen and Edinburgh drivers spent 28 hours (10th and 11th, respectively) in peak hours congestion making them the most congested cities north of the border, and significantly more than the next worst Scottish city, Glasgow at 30th (23 hours).

Newport (24 hours) narrowly beat Cardiff (23 hours) for the most congested Welsh city in 2017, but because overall congestion is higher in Cardiff (10 percent) than in Newport (8 percent) the total economic impact on drivers is £205 a year more in Cardiff.

The UK government is rolling out a £1.1 billion investment program 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. Both 2016 and 2017 saw record highs for new van (light commercial) sales with more than four million vans on the UK's roads. In many cities, the growth of e-commerce is driving congestion despite slow or stalled car growth.

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	74	14.1	13%	£2,430	£9.5bn
2	Manchester	39	6.8	10%	£1,403	£345m
3	Birmingham	36	6.3	9%	£1,281	£632m
4	Lincoln	36	7.1	15%	£1,790	£127m
5	Braintree	33	5.3	10%	£1,264	£52m
6	Aylesbury	32	5.3	10%	£1,331	£110m
7	Guildford	29	4.6	9%	£980	£63m
8	Bath	29	5.8	12%	£1,543	£120m
9	Luton	29	5.2	11%	£1,143	£102m
10	Aberdeen	28	5.5	11%	£1,422	£176m
11	Edinburgh	28	5.0	9%	£1,155	£309m
12	Cambridge	27	4.5	9%	£1,039	£58m
13	Bristol	27	4.7	9%	£1,028	£225m
14	Southend-on-Sea	27	5.9	13%	£1,633	£103m
15	Bournemouth	27	5.6	11%	£1,225	£121m
16	Reading	26	4.1	8%	£996	£75m
17	Kidderminster	26	4.9	10%	£1,242	£96m
18	Norwich	26	5.0	11%	£1,300	£132m
19	Royal Leamington Spa	25	3.7	7%	£876	£62m
20	Basildon	25	4.2	8%	£997	£131m
21	Chelmsford	25	3.8	7%	£908	£76m
22	Chesterfield	25	5.3	12%	£1,408	£109m
23	Hull	24	4.3	9%	£1,067	£144m
24	Newport	24	4.1	8%	£914	£67m
25	Exeter	24	4.4	10%	£1,068	£63m

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 three percent or less in 2017. The exception is Aberdeen which is the UK's 10th worst city across both peak and non-peak hours combined, with drivers spending 11 percent of their total drive time in gridlock. Aberdeen eclipses London at peak hours and was the hardest city to get into or out of with drivers stuck in gridlock for 20 percent of the time, moving at an average speed of 4.8 mph.

Business suffers the most from traffic in Lincoln 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 during the day. During the day, drivers during peak congestion crawled across the city centers of Belfast and Brighton at 3.3 and 3.8 mph respectively, while drivers getting into and out of Folkestone during the day moved the slowest at 2.7 mph on average during congestion.

Southend-on-Sea and Southport have the highest weekend congestion rates of 16 percent and 13 percent of drive time respectively, but drivers cruise at their slowest in Belfast, where weekend congested speeds are just 4.2 mph

4.2.2 TOP 10 CORRIDORS OUTSIDE LONDON

Outside of the capital, the A34 in Birmingham has the top two worst congested sections of road in the UK, with drivers wasting an average of 44 hours a year on the section from Robin Hood Lane to A41 and 42 hours from A4540 to the A41.

Unsurprisingly, outside of the capital, it's the UK's major cities that have the worst corridors. Birmingham, Leeds and Manchester take up 70 percent of the top 10 worst roads in 2017 with the main commuting roads being worst affected.

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	Birmingham	A34	Robin Hood Lane	A41	PM	15.78	12.67	44
2	Birmingham	A34	A4540	A41	PM	15.26	8.32	42
3	Leeds	A657	A658	Victoria Street	PM	15.68	15.60	40
4	Leeds	A638	B6117	A644	PM	18.47	16.47	36
5	Manchester	A56		A6044	PM	18.72	11.10	33
6	Newcastle upon Tyne	A19	A189	A191	PM	30.57	27.44	33
7	Belfast	A1	Bruce St	A512	PM	19.05	16.92	32
8	Manchester	A6	A523	B6171	PM	15.27	15.81	32
9	Birmingham	A461	New Road	A4123	PM	15.01	12.10	32
10	Preston	A6	Newsham	M55	PM	15.38	16.61	32
11	Manchester	A580/A6	Blackfriars Road	Worsley Road	PM	25.59	18.07	30

4 IN-DEPTH STUDIES

32

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 56 hours a year in congestion on this road – a six-hour improvement on this stretch of road since 2016.

Table 17: Top 5 Worst Corridors – London

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	A406	A205 Chiswick Roundabout	A40 Hangar Lane	PM	16.54	9.27	56
2	A23	Kennington Park	Norbury Station	PM	15.20	11.56	50
3	A4200/A4	Russell Square	New Fetter Lane	AM	6.64	7.24	47
4	Earls Court Road	Kensington High St	A308	AM	9.01	10.23	42
5	A406	Finchley Road	Colney Hatch Lane	PM	23.40	15.53	42

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.[13] 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. In 2017, INRIX calculates that the cost of congestion in London has risen to £9.5 billion, or £2,430 per driver. 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 20 percent of their time in congestion managing an average speed of 5 mph during this period. Getting into the city was slightly easier at peak hours where drivers achieved an average congested speed of 12.8 mph and only spent 16 percent of their time in congestion. Compared to 2016, congestion and speeds have improved slightly within the city center, but gotten worse on arterials into and out of London.

While London drivers are congestion free most of the time, when congestion hits it is severe. Congested speeds fell by 81 percent (from 18.3 mph to 3.9 mph) in the city center in the day when congestion hit in 2017 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 2017 and 2016 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.[14]

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	16%	23%	8%	17%	2%	10%	13%	13%
Congested Speed (mph)	12.83	4.97	12.50	3.88	10.09	3.69	5.96	7.70
Uncongested Speed (mph)	45.02	18.33	50.40	20.19	58.15	22.28	29.56	34.85
Speed Differential (mph)	32.18	13.36	37.90	16.31	48.06	18.59	23.61	27.14
% Reduction in Speed durng Congestion	71%	73%	75%	81%	83%	83%	80%	78%

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

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

4.3 GERMANY

4.3.1 TOP 25 GERMAN CITIES

In Germany, Munich tops the city ranking by peak hours spent in congestion with 51 hours. Second ranked cities, Hamburg, Berlin and Stuttgart – all with 44 hours of peak hours spent in traffic – had 16 percent less congestion than Munich. The total cost of congestion in the top five German cities was over €16.4 billion in 2017.

On average, congestion costs German drivers €1,770 each per annum. When totaled nationally, congestion cost over €80 billion in 2017. 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 €6.9 billion due to the combination of reasonably significant congestion (14 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 €3.5 billion.

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 lowest average congested speeds in Germany are in Reutlingen 5.5 mph (8.8 kph) and Munich has the lowest congested speeds in the evenings within the city 4.2 mph (6.8 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	Munchen	51	9.1	16%	€ 2,984	2.9bn
2	Hamburg	44	8.0	14%	€ 2,646	3.5bn
3	Berlin	44	8.3	14%	€ 2,811	6.9bn
4	Stuttgart	44	7.9	13%	€ 2,386	918m
5	Ruhrgebiet	40	7.5	10%	€ 2,129	2.2bn
6	Cologne	40	7.0	11%	€ 2,107	1.4bn
7	Heilbronn	38	7.6	14%	€ 2,317	154m
8	Frankfurt	36	5.9	10%	€ 1,820	906m
9	Würzburg	35	7.3	14%	€ 2,382	241m
10	Karlsruhe	34	6.4	12%	€ 2,166	468m
11	Dusseldorf	33	5.5	10%	€ 1,823	769m
12	Wiesbaden	32	5.2	9%	€ 1,604	542m
13	Pforzheim	32	6.5	13%	€ 2,310	159m
14	Reutlingen	31	5.9	12%	€ 2,514	203m
15	Sindelfingen	31	5.1	10%	€ 1,628	118m
16	Hanover	31	5.6	10%	€ 1,752	624m
17	Nuremberg	30	5.7	11%	€ 1,889	640m
18	Mannheim	28	5.0	8%	€ 1,500	323m
19	Bonn	28	4.5	8%	€ 1,482	295m
20	Bielefeld	28	5.0	10%	€ 1,793	170m
21	Wuppertal	27	4.7	8%	€ 1,557	337m
22	Krefeld	27	4.6	9%	€ 1,554	220m
23	Regensburg	26	4.8	10%	€ 1,652	99m
24	Darmstadt	26	4.0	8%	€ 1,354	76m
25	Freiburg	24	4.7	10%	€ 1,835	251m

4 IN-DEPTH STUDIES

36

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. A stretch of the A6 near Mannheim was Germany's worst corridor in 2017 with drivers wasting an average of 61 hours. However, this result was skewed by a period of extensive roadworks.

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	Mannheim	A6	J25	J24	PM	63.42	24.35	69
2	Stuttgart	B27	Sigmaringer Str	Bopser U-Bahn	PM	28.55	27.01	31
3	Karlsruhe	B3	A5	Bulacher Str	PM	24.31	30.31	30
4	Berlin	B96	Alter Park	Platz der Luftbrucke	AM	20.16	25.12	30
5	Karlsruhe	A5	J43	Landstraße	PM	72.25	71.88	30
6	Stuttgart	A8	J55	A831	PM	81.66	71.96	29
7	Hamburg	Poppenbutteler Weg	A433	Sasaler Samm	PM	34.25	33.26	27
8	Wuppertal	A46	J29	J31	PM	67.76	51.19	27
9	Berlin	Mullerstraße/ Friedrichstraße	B96	River Spree	AM	17.07	17.30	27
10	Munich	B2R	B304	A96	PM	42.32	32.30	27

4.3.3
CASE STUDY: MUNICH

Munich is Germany's most congested city by hours spent in congestion in 2017, beating the next closest cities by 16 percent. Hamburg, Berlin and Stuttgart all average 44 hours peak hours spent in congestion, compared to Munich's 51.

Munich is a large, dense city and is a significant economic hub with major employers such as BMW. Table 21 presents the City Dashboard data for Munich, providing interesting insights.

For the second year in a row, Munich was Germany's most congested city with 51 hours wasted in congestion and an average congestion rate of 16 percent. This is more than, for example, London's average congestion rate of 13 percent but Munich ranks 35th in the ranking of 1,360 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. Also noteworthy, traffic conditions have been fairly stable in 2016 and 2017, while other German cities have somewhat improved.

Munich's congestion problem is most extreme within the city, where average congested speeds in 2017 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 (12 percent) and at night (three percent). Generally, congestion rates are always high, with an average of 16 percent. On the weekend, speeds rose slightly to 8.3 mph (13.5 kph). Munich has the third highest congestion rate at weekends (11 percent) after Heilbronn (12 percent) and Hamburg (12 percent).

While drivers are free from congestion most of the time (84 percent), 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.

4 IN-DEPTH STUDIES

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	26%	28%	12%	20%	3%	14%	11%	16%
Congested Speed (kph)	19.76	8.52	17.14	8.01	17.99	6.88	13.48	13.11
Uncongested Speed (kph)	64.62	30.26	75.78	32.54	85.98	36.00	62.07	55.32
Speed Differential (kph)	44.86	21.74	58.64	24.52	67.99	29.12	48.59	42.21
% Reduction in Speed during Congestion	69%	72%	77%	75%	79%	81%	78%	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. While avoiding the worst corridor rankings in 2016, the B2R returns to the top spot. The stretch between the B304 and A96 saw drivers waste an average of 27 hours in 2017.

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 with the exception of the B2R, which creeps in at number 10 – the entire road network is more congested – meaning that drivers spend a greater proportion of their time in congestion. Also noteworthy, is that the total delay on Munich's worst corridors are significantly lower than that experienced by drivers in the other cities considered in this report. Drivers in London, New York, San Francisco and Los Angeles are all much worse off.

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	B2R	B304	A96	PM	42.32	32.30	27
2	A99	J17	J14	AM	69.10	66.66	26
3	Arnulfstraße	Romanplatz	B2R	AM	22.74	23.11	22
4	Prinzregentenstraße	A94	Prinzregentenbad	AM	24.18	24.77	22
5	Leonrodstraße	Dachauer Strasse	s	PM	20.55	18.80	19


50
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5 SUMMARY

The INRIX 2017 Traffic Scorecard measures the state of congestion in 1,360 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 study measures the influence of congestion across all types of car trips, and at all times of the day.

For drivers, the INRIX 2017 Traffic Scorecard therefore provides holistic measures 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. The full results for all 1,360 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 US, UK and Germany cost almost $461 billion in 2017 or $975 per capita.
- The average cost per driver was $1,445 (US), £968 (UK), and €1,168 (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 57 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 31 hours wasted or in the US more than 41 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 2017 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 industry leading transportation metric – the INRIX Congestion Index. The detailed City Dashboard available on the INRIX 2017 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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