Safe to Scoot

How Legalising E-scooters Will Save Lives, Bust Congestion and Help the Environment

By Matthew Lesh

BRIEFING PAPER

EXECUTIVE SUMMARY

- Electric scooters — or 'e-scooters' — provide low-cost, environmentally-friendly 'last mile' transport. They are a central plank of the 'micromobility' revolution that is transforming urban transport.
- E-scooters are among the fastest growing technologies in history. Since the first dockless rental scheme in September 2017, they have provided hundreds of millions of rides and are now available in 350 cities worldwide.
- The United Kingdom is the last major European country where it is illegal to use e-scooters on public roads, bike paths, and pavements. This is despite surveys and usage indicating they are overwhelmingly popular where they are legal.
- E-scooters are safe. They have comparable injury rates to bicycles. The legalisation of e-scooters could itself increase safety by providing clear rules and education. It would also provide 'safety in numbers': the higher numbers of a road user type (i.e. pedestrians, bicyclists) associated with proportionally fewer accidents.
- One-third (33%) of e-scooter rides replace car rides, helping reduce CO_2 emissions, NO_x pollutants and busting congestion.
- The UK is missing out on the economic benefits of the e-scooters industry, which is worth billions and responsible for thousands of jobs. E-scooter users also spend in local economies helping struggling high streets and, by reducing travel times and road congestion, boost productivity.
- E-scooters provide a transport option for communities and routes underserved by traditional public transport, helping lower income and minority communities. E-scooters have a complementary relationship with public transport.
- If the UK Government wants to enable technology of the future, help the environment, and reduce congestion, they should:
    - Amend the outdated *Highways Act 1835* and the *Road Traffic Act 1988* to legalise e-scooters;
    - Begin open trials in cities across the UK, with associated data collection and independent studies;
    - Allow cities and councils to develop a locally appropriate regulatory regime;
    - Adopt a liberal approach to regulation, avoiding limits on e-scooter numbers, companies or restrictions such as helmet requirements; and
    - Invest in education and appropriate infrastructure, including parking spaces and separated bike lanes.

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The e-scooter revolution is happening at breathtakingly fast speeds. The first dockless e-scooters rental scheme began in Santa Monica, California in September 2017.[1] In the space of just over two years, e-scooters have become available in over 350 cities, including well over 100 US cities, twenty European countries including Germany, Austria, Belgium, the Czech Republic, Denmark, France, Poland, Portugal, Spain and Switzerland, as well as places as diverse as Israel, Colombia, and Australia.[2] E-scooters are the fastest technology in history to reach 500 million users.[3] E-scooters are part of the global micromobility trend, which includes light, environmentally friendly, congestion busting vehicles such as electric scooters, electric skateboards, and shared electric bicycles. The devices became widely accessible when deployed as part of sharing schemes, with thousands of dockless e-scooters that can be unlocked using a smartphone deployed throughout cities.[4]

E-scooters have proven extremely popular. In 2018, the first full year of operation, there were 38.5 million trips on shared e-scooters in just the United States.[5] Lime, just one of many companies, claims to have provided more than 50 million rides in its first 18 months of operation.[6] This is more annual rides than station-based bike shares (36.6 million) that have existed for many years. An American poll found 70% positively view e-scooters because they expand transport options and enable a car-free lifestyle.[7] One study explained that e-scooters "uniquely [provide] a combination of the most desired attributes of travel: freedom and control of driving, pleasantness of walking, excitement of cycling, and convenience of skateboarding".[8] In May 2019, Germany became the last major European country to legalise scooters other than the UK.

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1 Laura Laker, "Welcome, Watch or Ban: How Should Cities Deal with Electric Scooters?," *The Guardian*, June 18, 2019, sec. Cities, https://www.theguardian.com/cities/2019/jun/18/welcome-watch-or-ban-how-should-cities-deal-with-electric-scooters.

2 Justin Rose , Daniel Schellong , Carsten Schaetzberger , and Jeff Hill, "How E-Scooters Can Win a Place in Urban Transport," *BCG*, Jan 2, 2020, https://www.theguardian.com/cities/2019/jun/18/welcome-watch-or-ban-how-should-cities-deal-with-electric-scooters.

3 Chuck Temple, "Summary of Micromobility Conference 1/31/2019," *Medium*, February 6, 2019, https://medium.com/@chucktemple/summary-of-micromobility-conference-1-31-2019-8c0801cd07ba.

4 Jennifer Huddleston, "What the 'Scooter Wars' Tell Us," *InsideSources*, September 20, 2018, https://www.insidesources.com/what-the-scooter-wars-tell-us/.

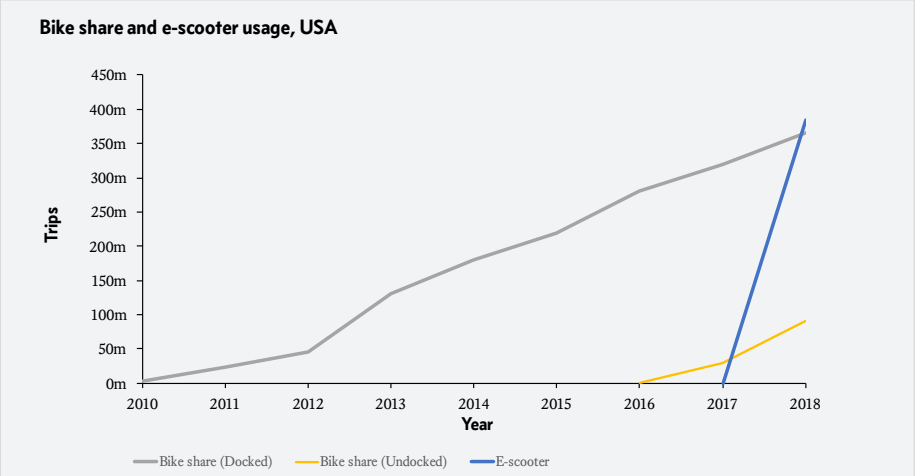
5 NACTO, "Shared Micromobility in the U.S.: 2018" (New York, NY: National Association of City Transportation Officials, April 17, 2019), https://nacto.org/2019/04/17/84-million-trips-on-shared-bikes-and-scooters/.

6 Lime, "Lime Celebrates 50 Million Rides In 18 Months," April 25, 2019, http://v1.li.me/second-street/lime-celebrates-50-million-rides-in-18-months.

7 Populus Insights, "The Micro-Mobility Revolution: The Introduction and Adoption of Electric Scooters in the United States" (Populus, July 2018), https://www.populus.ai/micro-mobility-2018-july.

8 Annie YJ Chang, "TREND OR FAD? Deciphering the Enablers of Micromobility in the U.S.," *SEA International*, July 2020.

Figure 1. Bike share and e-scooter usage, USA



Source: Shared Micromobility in the U.S.: 2018, National Association of City Transportation Officials

E-scooters are a first and last mile low-cost, environmentally-friendly alternative to traditional transport. The devices help to reduce congestion, as well as emissions and car usage. By the end of 2018, there were over 85,000 e-scooters available for public use in the US, serving many cities that never had a bike share scheme.[9] This number is likely to have substantially increased since. Many cities have introduced a permit scheme for e-scooters. Madrid, for example, has granted licences for 8,600 scooters to 18 companies.[10] The devices are typically inexpensive to use, with Uber's Jump in Madrid costing €1 to unlock a scooter and €0.12 for every minute it is in use.[11] The average scooter rideshare cost in the US is $3.50, with providers offering discounts for people with low incomes.[12]

Much of the criticism of e-scooters has been directed not at individual users of the devices, but rather at companies introducing rental schemes before receiving government permits or consent.[13] There have also been concerns raised about safety and street obstacles caused by inappropriate parking. In one case, the Nashville city council prevented Tennessee Mayor David Briley from banning e-scooters.[14] Richard Corbett, the former head of Bird in the UK, however, explained that: "I think when you're innovating and you're disrupting, for better or worse, there's going to be that clash between the way things happened in the past and the way they will happen in the future".[15]

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9 NACTO, "Shared Micromobility in the U.S.: 2018."

10 Ramón Muñoz, "Uber Launches New Electric Scooter Rental Service in Madrid," *El País*, April 9, 2019, sec. Inenglish, https://elpais.com/elpais/2019/04/09/inenglish/1554797032_434337.html.

11 Muñoz.

12 NACTO, "Shared Micromobility in the U.S.: 2018."

13 Rory Carroll, "Are Ride-Share Electric Scooters the Future of Urban Transport?," *The Guardian*, April 25, 2018, sec. Cities, https://www.theguardian.com/cities/2018/apr/25/electric-scooters-urban-transport-bird-santa-monica-uk.

14 Steven Hale, "Metro Council Stops Short of Scooter Ban," *Nashville Scene*, July 3, 2019, https://www.nashvillescene.com/news/pith-in-the-wind/article/21076063/metro-council-stops-short-of-scooter-ban.

15 Laker, "Welcome, Watch or Ban."

The latest public concern is not the first time a new mobility technology has attracted heavy criticism and even bans. In the 19th century, there were substantial efforts to ban bicycles on the basis that they were a dangerous nuisance. San Francisco banned bicycles entirely in the 1880s, and bicycles were banned in New York's Central Park in 1883.[16] Bicycle races were banned on open roads in the UK from the 1880s to 1950s and thousands of cyclists were convicted or fined for dangerous riding.[17] British Cycling's history page explains that bicycles were "seen as a machine of working classes and a strong resistance to racing rapidly emerged from the wealthy ruling classes" and were nearly entirely banned.[18] A letter to *The Times* from a doctor in 1892 called bicycles a "dangerous annoyance".[19] *The Times* also reported that bicycle riders were also arrested for "furious riding" at speeds such as 20mph.[20] There are genuine challenges with e-scooters, which require clear rules on issues such as parking and where and how fast they can be ridden. These questions — which are discussed further in the final section of this paper — are not an excuse to block the technology.

The e-scooter industry is competitive, valued at billions of pounds, and becoming increasingly economical.[21] There has been in excess of $6 billion invested in the industry, across dozens of deals.[22] McKinsey modelling found that the market in the United States, Europe and China could be worth as much as $500 billion by 2030.[23] Individuals can purchase an e-scooter for their personal usage. There are also dozens of companies that offer rentable dockless e-scooters on city streets. These services are provided by the likes of Uber's Jump, Bird and Lime in the United States, Tier and Voi in Europe, and dozens of other providers. The process of renting an e-scooter is straightforward. Users download the relevant company's smartphone app, create an account and enter payment details. Some companies offer a text or call service to unlock devices for users without smartphones. Users can then find nearby e-scooters, scan a barcode on the device to unlock the device and start riding. E-scooters are simple to operate. The user kicks off to create momentum, at which point they can press down the motor button to add speed and pull the brake to slow the device. The e-scooters have a screen to indicate the current speed

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16 James Longhurst, *Bike Battles: A History of Sharing the American Road* (University of Washington Press, 2015).

17 Chas Massenger, *Ride and be damned: Chas Messenger's glory years of the British League of Racing Cyclists* (Pedal, 1998).

18 "The Story behind British Cycling's Formation," British Cycling, accessed August 1, 2019, https://www.britishcycling.org.uk/search/article/bc-50th-The-Story-behind-British-Cyclings-formation.

19 Arthur Maude, "The Dangers of the Road," July 14, 1892, https://www.thetimes.co.uk/archive/article/1892-07-14/14/9.html.

20 The TImes, "Furious Bicycle Riding," *The Times*, February 28, 1896, https://www.thetimes.co.uk/archive/article/1896-02-28/10/8.html.

21 Justin Rose , Daniel Schellong , Carsten Schaetzberger , and Jeff Hill, "How E-Scooters Can Win a Place in Urban Transport," *BCG*, Jan 2, 2020; Tom Huddleston Jr, "Uber and Alphabet Just Invested $335 Million in Lime — Here's Why Scooter Start-Ups Are Suddenly Worth Billions," *CNBC*, July 13, 2018, https://www.cnbc.com/2018/07/11/lime-bird-spin-why-scooter-start-ups-are-suddenly-worth-billions.html.

22 Alison Griswold, "Scooter startups aren't raising money like they used to," *Quartz*, September 9, 2019, https://qz.com/1712059/scooter-startups-arent-raising-money-like-they-used-to/.

23 Kersten Heineke, Benedikt Kloss, Darius Scurtu, and Florian Weig Open interactive popup, "Micromobility's 15,000-mile checkup," *Mckinsey & Company*, January, 2019, http://mckinsey.com/industries/automotive-and-assembly/our-insights/micromobilitys-15000-mile-checkup.

and the battery level. To end a trip, the user parks the scooter on a sidewalk, close to the curb and out the way of pedestrians. They can then mark the trip as finished on their smartphone. Many companies require users to upload a photo of the correctly parked e-scooter. The e-scooters are typically picked up at night for charging and maintenance and then redeployed the next day. This process allows for regular safety checks and creates local employment opportunities. The technology behind the scooters continues to be developed as new, more advanced and safer models are regularly coming to market. While first generation e-scooters typically had a lifespan of two to three months, newer models are far safer and more durable, lasting as much as 12 to 24 months.

E-scooters in the UK

E-scooters can be legally purchased and have become an increasingly common sight on the streets in recent months. They are, however, unlawful for use on pavements and roads in the UK under the *Highways Act 1835* and the *Road Traffic Act 1988*.

The Department for Transport (DfT) considers e-scooters a Personal Light Electric Vehicle (PLEV) which, to be used on public roads must comply with "a number of legal requirements, which potential [e-scooter] users will find very difficult".[24] These include insurance, technical standards, vehicle tax, licencing and registration standards. The DfT also states that it is illegal to use a powered transporter, such as an e-scooter, "in spaces which are set aside for use by pedestrians, cyclists, and horse-riders. This includes on the pavement and in cycle lanes."[25] There are also several relevant legal cases — including *DPP v Saddington (2000)*, *Winter v DPP (2002)* and *Coates v Crown Prosecution Service (2011)* — that confirm the unlawful status of powered transport on public roads and pavements.[26] These rules also apply to Segways, hoverboards, go-peds (combustion engine-powered kick-scooters), powered unicycles and u-wheels.

Since April 2019, the Metropolitan Police have announced numerous e-scooter seizures and crackdowns. The Met has warned that "riders face the possibility of it being seized, having points on their licence and/or being fined".[27] In one week in late July, nearly 100 e-scooter users were stopped in London, and ten people were fined or had their scooters confiscated for speeding or ignoring a red light.[28] The penalty can include a £300 fine and six points on a driving licence. In one case, a 15-year-old boy was given six penalty points on his *future* driving licence for using

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24 Department for Transport, "Guidance: Powered Transporters," GOV.UK, August 21, 2019, https://www.gov.uk/government/publications/powered-transporters/information-sheet-guidance-on-powered-transporters.

25 Department for Transport.

26 *North Yorkshire Police v Saddington* [2000] EWHC Admin 409; *Winter v DPP* [2002] EWHC 1524 (Admin); *Coates v Crown Prosecution Service* [2011] EWHC 2032 (Admin)

27 Bonnie Christian, "Police Share Images of Illegal 'seized' Illegal Electric Scooters," *Evening Standard*, May 28, 2019, https://www.standard.co.uk/news/london/police-share-images-of-seized-illegal-electric-scooters-a4153271.html; Ross Lydall, "Electric Scooter Riders on Roads and Pavements in London Targeted in Police Crackdown," London, UK, April 15, 2019, https://www.standard.co.uk/news/london/met-s-safety-team-target-dangerous-electric-scooter-riders-on-the-roads-and-pavements-a4118041.html.

28 BBC News, "Nearly 100 E-Scooter Users Stopped in One Week," *BBC News*, July 26, 2019, sec. London, https://www.bbc.com/news/uk-england-london-49127427.

an e-scooter on the road in Cleveland.[29] E-scooters can be legally used on private property. Bird operates over 50 scooters in Olympic Park, which is private property, since late 2018 without incident – with more than 1,000 rides taken in the first week of operation.[30] Lime, Uber's Jump and other companies operate dockless electric bicycles in London.

The Department for Transport's *Future of Mobility: Urban Strategy* review is currently considering whether new micromobility options including electric bikes and scooters are "safe and fit for purpose".[31] The review's green paper also flagged the possibility of "limited trialling" and explicitly stated that:

> "It is essential that people have the chance to make the most of the opportunities from micromobility, in a way that is safe for both the users of these new vehicles and road users more generally."[32]

Jesse Norman MP, the transport minister at the time, said the government would "look quite closely" at e-scooters and "How these things might be either permitted or licenced or regulated to go on to the road, or other forms of land."[33] Transport Minister George Freeman indicated in January 2020 that the government would shortly be launching a consultation on legalising e-scooters on roads and cycle lanes.[34]

This paper puts the current discussion about e-scooters in the context of the emerging evidence base about the potential costs and benefits of the new micromobility devices. As a matter of public policy principle and enabling entrepreneurship and innovation, new technologies should not be pre-emptively banned unless there is substantial evidence of danger.[35] A variety of studies reveals the extent to which e-scooters are safe, what kinds of trips they replace, their environmental and economic impact, and potential to support communities underserved by existing public transport.

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29 Damien Gayle, "Boy Gets Six Points on Future Driving Licence for Scooter Speeding," *The Guardian*, November 14, 2018, sec. World news, https://www.theguardian.com/world/2018/nov/14/boy-gets-six-points-on-future-driving-licence-for-scooter-speeding.

30 This trial was extended in early 2019, see James Cook, "Electric Scooter Start-up Bird Extends Olympic Park Trial," *The Telegraph*, March 8, 2019, https://www.telegraph.co.uk/technology/2019/03/08/electric-scooter-start-up-bird-extends-olympic-park-trial/.

31 Department for Transport, "Future of Mobility: Urban Strategy" (London, UK: HM Government, March 2019), https://www.gov.uk/government/publications/future-of-mobility-urban-strategy.

32 Department for Transport.

33 James Tapper, "Coming to a Street near You? UK's e-Scooter Road Ban Set to End," *The Observer*, March 9, 2019, sec. UK news, https://www.theguardian.com/uk-news/2019/mar/09/electric-scooters-uk-road-ban-set-to-end.

34 Steven Swinford, "E-scooters on UK roads set for the green light," *The Times*, January 28, 2020, http://thetimes.co.uk/article/e-scooters-to-get-green-light-on-uk-s-roads-cz2vxhm6b.

35 For further discussion of the principle of 'permissionless innovation,' see Matthew Lesh, Sam Dumitriu, and Philip Salter, "Safeguarding Progress: The Risks of Internet Regulation" (London, UK: Adam Smith Institute, June 21, 2019), https://www.adamsmith.org/research/safeguarding-progress-the-risks-of-internet-regulation.

The international evidence points to the substantial potential for e-scooters to achieve urban mobility and environmental goals. Francie Stefan, the Acting Chief Mobility Officer for the City of Santa Monica, has said that "E-scooters fulfill a demand for short, quick trips and were quickly absorbed into the mobility ecosystem, and our values of innovation and sustainable transportation enabled us to incorporate them and craft our Shared Mobility Pilot Program, where we continue to learn and innovate."[36] Tel Aviv deputy mayor Meital Lehavi has said that:

> "Micro-mobility is part of our vision of transitioning to green alternative transportation as it helps reduce traffic congestion and pollution. Even more so, shared micro-mobility decreases the need for car ownership and enables mobility as a service."[37]

The final section of this paper investigates the potential regulatory models for the legalisation of e-scooters in the UK.

2. SAFETY

The number one concern about e-scooters is their safety and fitness to be on the road. In June 2019, then-Transport Secretary Chris Grayling MP responding to a question from the SNP's Douglas Chapman MP on legalising e-scooters said that:

> "We will always look carefully at new technologies, but any new technologies introduced on and around our roads need to be safe. We need to be confident that they will continue to be safe for not only those who use them, but those around them."[38]

This question has been raised in the UK following two highly publicised incidents. In one tragic case, television presenter Emily Hartridge died when her e-scooter collided with a lorry at a roundabout in Battersea in London during July 2019.[39] In another case in the same month, a 14-year-old boy was rushed to hospital after a collision with a lorry.[40] These accidents have led calls for e-scooters to remain illegal.[41]

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36 NACTO, "Shared Micromobility in the U.S.: 2018."

37 "A Conversation with Deputy Mayor of Tel Aviv-Yafo, Meital Lehavi," *Bird*, July 23, 2019, https://www.bird.co/blog/a-conversation-with-deputy-mayor-of-tel-aviv-yafo-meital-lehavi/.

38 Chris Grayling, "Topical Questions - Hansard," *Hansard*, June 13, 2019, https://hansard.parliament.uk/commons/2019-06-13/debates/A59BCBE2-E90E-4C35-B76D-E3076D59746C/TopicalQuestions.

39 James Tapper, "Television Presenter Emily Hartridge Dies in Electric Scooter Crash," *The Observer*, July 14, 2019, sec. UK news, https://www.theguardian.com/uk-news/2019/jul/13/tv-presenter-emily-hartridge-dies-in-scooter-crash.

40 Adam Forrest, "Boy Fighting for Life after Second Electric Scooter Crash in London in Days," *The Independent*, July 15, 2019, https://www.independent.co.uk/news/uk/home-news/electric-scooter-crash-london-beckenham-emily-hartridge-death-battersea-a9005416.html.

41 See, for example, Sophia Money-Coutts, "The Two-Wheeled Revolution Is Hitting Our Streets — but I Won't Be e-Scooting into the Sunset Quite Yet," *Evening Standard*, July 22, 2019, https://www.standard.co.uk/comment/comment/the-twowheeled-revolution-is-hitting-our-streets-but-i-won-t-be-escooting-into-the-sunset-quite-yet-a4195326.html.

It is crucial, however, to not rush to judgement based on a small number of cases. We do not, for example, respond to every car accident related death – of which there are dozens every week – to say that cars should be banned. A negative over-reaction to e-scooters has been shown to have the characteristics of a moral panic.[42] To assess their safety it is necessary to consider e-scooter accidents as a proportion of individuals using the devices, the distance they travel, and in comparison with other comparable transport technologies.

The meta-level evidence appears to be quite favourable for e-scooters in the United States. In 2018, a year in which there were 38.5 million rides on shared e-scooters and likely millions more on personally owned devices, there was a total of 1,545 accidents and four deaths.[43] This equates to the low number of one death per 9.6 million shared *rides*. Most of these accidents involve a rider being hit by a motor vehicle driver. By comparison, the National Safety Council estimates that there were over 40,000 car deaths in the United States during 2018, and a further 5,000 deaths on motorcycles and 840 on bicycles a year.[44]

Several independent studies have sought to ascertain e-scooter safety. In July to November 2018, Portland, Oregon undertook a 120-day e-scooter pilot program. Participating companies provided extensive data to the Portland Bureau of Transportation (PBOT) for preparation of the 2018 E-Scooter Findings Report. In the four months, there were 700,000 trips and over 801,887 miles ridden on 2,043 e-scooters. The report concluded that "E-scooters have the potential to advance Portland's transportation goals". These goals include reducing traffic congestion by encouraging shifting away from private motor vehicle use; preventing fatalities and serious injuries; expanding opportunities for underserved; and reducing air pollution:

> "This report demonstrates that as Portland grows and traffic congestion gets worse, e-scooters can move more people safely and efficiently in the same amount of space. This helps reduce reliance on automobiles and shift trips to an efficient, potentially less-polluting travel option."

The report included data from a rider survey, citywide poll, focus group, online complaint form, and further consultation. On the topic of safety, the study found that the availability of scooters did increase injuries; however, few were severe enough to require emergency transport. There were a total of 176 emergency room

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42 Milica Kolakovic-Bojovic and Ana Paraušic, "ELECTRIC SCOOTERS - URBAN SECURITY CHALLENGE OR MORAL PANIC ISSUE -," *TEME* (January 17, 2020): 1045–61.

43 Ryan Felton, "E-Scooter Ride-Share Industry Leaves Injuries and Angered Cities in Its Path," *Consumer Reports*, February 5, 2019, https://www.consumerreports.org/product-safety/e-scooter-ride-share-industry-leaves-injuries-and-angered-cities-in-its-path/.

44 "Facts + Statistics: Motorcycle crashes," *Insurance Information Institute*, https://www.consumerreports.org/product-safety/e-scooter-ride-share-industry-leaves-injuries-and-angered-cities-in-its-path/; "Traffic Safety Facts: 2016 Data," *National Highway Traffic Safety Administration*, May 2018, https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812507.
Ryan Beene, "Traffic Deaths in U.S. Exceed 40,000 for Third Straight Year," *Bloomberg*, February 13, 2019, https://www.bloomberg.com/news/articles/2019-02-13/traffic-deaths-in-u-s-exceed-40-000-for-third-straight-year.

and urgent care e-scooter related visits during the period: 146 (83%) individuals falling off a scooter, 22 (13%) car collisions, three pedestrian collisions, two truck collisions, two pedestrians hit by a scooter, and one scooter user collision with another scooter. These visits accounted for 5% of all traffic crash injuries during the period. There were no deaths. The number of e-scooter related injuries was lower than the number of bicycle-related visits (429); however, there is no comparable data on the number of trips taken or distance travelled. There were concerns raised by pedestrians about e-scooter users on the sidewalk, which was most common on streets with no bike facilities. E-scooter users themselves said they preferred to ride on bikeways and other protected infrastructure. Users also rarely used helmets. Poland's Environmental Health Director Dr Jae Douglas concluded that "We did not find a disproportionate risk that would discourage the city from allowing a scooter ride-share pilot."[45]

A similar pilot study by the City of Santa Monica, between January 2017 and September 2019, found a total of 122 reported collisions, with a device crash rate of roughly .015 per 1,000 trips, typically impacting less than 1% of riders on a monthly basis.[46] About 10% (12) of crashes resulted in severe injuries, while 80% were minor. The report found that crash rates declined over time, as people became more aware of how to use the technology. There was no attempt to compare this to other modes of transport.

There are also studies on accident numbers. A study by Austin, Texas, in collaboration with the Centres for Disease Control and Prevention (CDC), looked at emergency service and hospital reports in relation to 936,110 e-scooter trips between September and November 2018.[47] The study found a total of 190 injured e-scooter riders, of which less than half (80) were severe injuries, and only 8% spent more than 48 hours in a hospital. This equates to about 20 injuries per 100,000 e-scooter trips, or one injury for every 5,000 miles ridden. There were also two non-rider pedestrian injuries. Relatively few (10%) of incidents were related to collisions with cars, and one-third were injured on their first ride. A review of three Level I trauma centres found 103 patients between September 2017 and October 2018, with almost half having some alcohol in their system.[48] Just 8 of the cases required ICU admission, while one-third required surgery. A review of emergency data in Kansas City, Missouri found that of 96,850 emergency services calls between July and October 2018, just 19 calls related to e-scooters.[49] Eleven led to hospital visits, five refused treatment or transport, and the caller cancelled two. None of the incidents

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45 Portland Bureau of Transportation, "2018 E-Scooter Findings Report" (Portland, Oregon: The City of Portland, Oregon, January 15, 2019), https://www.portlandoregon.gov/transportation/78431.

46 City of Santa Monica, "Shared Mobility Pilot Program Summary Report" (Santa Moncia, CA: City of Santa Monica, November, 2019), https://www.smgov.net/uploadedFiles/Departments/PCD/Transportation/SantaMonicaSharedMobilityEvaluation_Final_110419.pdf.

47 Austin Public Health, "Dockless Electric Scooter Study" (Austin, TX: City of Austin, April 2019), https://www.austintexas.gov/sites/default/files/files/Health/Epidemiology/APH_Dockless_Electric_Scooter_Study_5-2-19.pdf.

48 Leslie M. Kobayashi et al., "The E-Merging e-Pidemic of e-Scooters," *Trauma Surgery & Acute Care Open* 4, no. 1 (July 1, 2019).

49 "Few injuries related to electric scooters" *City of Kansas City, MO*, November 6, 2018, https://www.kcmo.gov/Home/Components/News/News/60/16?arch=1.

reported in Kansas were life threatening. Kansas is now undertaking a year long scooter and e-bike pilot program, due for completion in May 2020.[50] A New Zealand study estimated the e-scooter injury rate to be 60 per 100,000 trips, after finding identifying 770 e-scooter associated injury presentations.[51] Two-thirds of these incidents were treated by primary care physicians, while one-third were treated in hospitals, with 75 patients requiring hospital admission. One study estimated a relatively higher number of injuries between September 2017 and December 2018 by e-scooters (346 per million trips) compared to bicycles (114 injuries per million trips).[52]

Several studies outline the absolute number of incidents or types of injuries in a city or at a hospital — but *without* putting this data in the context of the number of rides, distance travelled or other emergencies. A major study released in January 2020 reported an estimated 39,113 hospital incidents in the United States between 2014 and 2018, and noted an increase over time, but did not consider the growing number of rides.[53] A study of two UCLA hospitals in Los Angeles and Santa Monica found a total of 249 emergency room visits attributable to e-scooters between September 2017 and August 2018, with most (92%) related to falling off, colliding with an object or car.[54] None of the injuries were fatal. This study did not quantify the number of rides in the same period, which likely amount to millions of trips in the respective areas. Similarly, a Salt Lake City emergency room e-scooter study found a total of 8 incidents between June and November in 2017 and 50 incidents in the same period in 2018, as riding was becoming substantially more common.[55] Of these incidents, 16% of patients required hospital admission. Some studies have only looked at a part of hospital operations. A study of Auckland, New Zealand hospitals between August and December 2018 found a total of 64 patients referred to emergency department imaging.[56] George Washington University Hospital found eight patients required an orthopaedic operation following an e-scooter accident in 2018.[57] A Singaporean study found 36 mostly minor cases between 2015 and 2016.[58] A Danish study of Copenhagen from January 2016 to July 2019 found 468

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50 "Scooter and eBike Pilot Program Launched" *City of Kansas City, MO*, May 9, 2019, https://www.kcmo.gov/programs-initiatives/scooters-and-ebikes.

51 Mark Nagy Zaky Bekhit, James Le Fevre, and Colleen J. Bergin, "Regional Healthcare Costs and Burden of Injury Associated with Electric Scooters," *Injury*, October 15, 2019, https://doi.org/10.1016/j.injury.2019.10.026.

52 Heather Watson et al., "Patient Demographics and Injury Characteristics of ER Visits Related to Micro-Mobility Modes," SAE Technical Paper (Warrendale, PA: SAE International, April 14, 2020), https://www.sae.org/publications/technical-papers/content/2020-01-0933/.

53 Nikan K. Namiri et al., "Electric Scooter Injuries and Hospital Admissions in the United States, 2014-2018," *JAMA Surgery*, January 8, 2020.

54 Tarak K. Trivedi et al., "Injuries Associated With Standing Electric Scooter Use," *JAMA Network Open* 2, no. 1 (January 4, 2019).

55 Austin Badeau et al., "Emergency Department Visits for Electric Scooter-Related Injuries after Introduction of an Urban Rental Program," *The American Journal of Emergency Medicine*, May 16, 2019.

56 Laura J. Mayhew and Colleen Bergin, "Impact of E-Scooter Injuries on Emergency Department Imaging," *Journal of Medical Imaging and Radiation Oncology* 0, no. 0, accessed July 30, 2019.

57 Michael Webber and James DeBritz, "Incidence of Fractures Requiring Orthopedic Operative Intervention Following Electric Scooter Injuries," *GW Research Days 2016 - Present*, May 1, 2019, https://hsrc.himmelfarb.gwu.edu/gw_research_days/2019/SMHS/96.

58 Yee Kent Liew, Choon Peng Jeremy Wee, and Jen Heng Pek, "New Peril on Our Roads: A Retrospective Study of Electric Scooter-Related Injuries," *Singapore Medical Journal*, July 30, 2019.

scooter-related incidents, though most of these were from younger users of *manual scooters* (338) rather than electric scooters (51).[59] One study looked at a *single* individual who faced injury following a collision with an e-scooter (this is despite other studies showing pedestrians are very rarely injured).[60]

While the evidence base is still developing, the existing figures do not appear to indicate a disproportionate risk from e-scooters compared to other transport options and activities. In 2018 there were 124,933 skateboard injuries, 424,346 bicycle injuries, and even 218,527 playground equipment injuries in the United States.[61] As stated above, this compares to 1,545 accidents involving e-scooters. Safety researchers Dr Ralph Buehler and Dr John Pucher found in their 2017 study found 2.25 cyclist deaths per 100 million miles on their bikes, and 5 deaths per 100 million miles on bike-shares.[62] Kay Tscheke, a public health researcher at the University of British Columbia, concluded that the US death rate for e-scooters is between about 2.25 and 5 deaths per 100 million miles.[63] "If these data are correct, the death rate seems to be within the range of death rates for similar modes of travel," she told *StreetsBlog*.[64]

A report prepared by Bird under the oversight of David Strickland, the former head of the US National Highway Traffic Safety Administration, concluded that e-scooters are equally as safe as bikes.[65] Bird riders reported one incident resulting in any injury for every 27,000 miles ridden (or in less than 0.01% of trips). Bird claimed that most of these injuries were minor, resulting in abrasions or minor contusions. Bird claims 37.2 injuries per million miles or one per 26,881 miles ridden. By comparison, the bicycle rates are 58.9 emergency department visits per million miles cycled, or one emergency department visit per 16,885 miles cycled. Bird's calculation includes all types of injuries, not just emergency department visits, and is still lower. They found there were fewer accidents in cities with a higher score on measures of bicycle infrastructure.

Legalisation would improve safety

Legalisation can improve safety by providing for clear rules, greater awareness among drivers, reducing car usage.

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59 Stig Nikolaj Fasmer Blomberg et al., "Injury from Electric Scooters in Copenhagen: A Retrospective Cohort Study," *BMJ Open* 9, no. 12 (December 1, 2019).

60 N. Sikka et al., "Sharing the Sidewalk: A Case of E-Scooter Related Pedestrian Injury," *The American Journal of Emergency Medicine*, June 8, 2019.

61 United States Consumer Product Safety Commission, "National Electronic Injury Surveillance System (NEISS) Data Highlights - Calendar Year 2018" (Maryland, US: US Government), https://www.cpsc.gov/Research--Statistics/NEISS-Injury-Data.

62 Ralph Buehler and John Pucher, "Trends in Walking and Cycling Safety: Recent Evidence From High-Income Countries, With a Focus on the United States and Germany," *American Journal of Public Health* 107, no. 2 (December 20, 2016): 281–87.

63 Angie Schmitt, "E," *Streetsblog USA*, December 19, 2018, https://usa.streetsblog.org/2018/12/19/deep-dive-are-e-scooters-unsafe-at-any-speed/.

64 Schmitt.

65 David Strickland, "A Look at E-Scooter Safety: Examining Risks, Reviewing Responsibilities, and Prioritizing Prevention" (Santa Monica, CA: Bird, April 2019), https://www.bird.co/wp-content/uploads/2019/04/Bird-Safety-Report-April-2019-3.pdf.

The relatively small, but growing, number of e-scooters on UK roads in itself increases the risks they face on the roads. This is because motorists are not used to seeing the devices on the road, leading to a risk of a disproportionate number of accidents. This reflects the 'safety in numbers' phenomenon, the finding that as the number of pedestrians and bicyclists increases the likelihood of accidents declines.[66] The explanation for this finding is that a higher prevalence of a particular road user leads to more instinctive, faster response times by drivers – that is, they are less surprised to see them on the road and therefore respond swiftly. This is the classic finding of public health consultant P L Jacobsen's 2003 paper, which found, from analysis of five large data sets, that:

> "The likelihood that a given person walking or bicycling will be struck by a motorist varies inversely with the amount of walking or bicycling. This pattern is consistent across communities of varying size, from specific intersections to cities and countries, and across time periods."[67]

Jacobsen noted that this "result is unexpected" and that it "appears that motorists adjust their behaviour in the presence of people walking and bicycling." Subsequent research has confirmed this finding and indicates that doubling the number of people walking or bicycling increases the number of people struck by only one-third.[68] The same phenomenon has also been found for motorcyclists and buses.[69] By contrast, motorist crashes grow linearly: more cars leads to an equal proportion of more accidents.

In the UK case, Cambridge academic James Woodcock and colleagues found that following the introduction of London's bike share scheme: "there has been a trend towards fewer fatalities and injuries than expected on cycle hire bicycles."[70] In a follow up article on the question of 'safety in numbers', Woodcock explained that drivers operate beyond their visual and perceptual capabilities, and use:

> "mental models based on their expectations and experience. Thus, if the motorist mostly encounters motor vehicles, their model will be of motor vehicles… Stated more simply, the rarity of people walking and bicycling makes them harder to detect and to require more response time than more common objects."[71]

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66 Rune Elvik, "The Non-Linearity of Risk and the Promotion of Environmentally Sustainable Transport," *Accident Analysis & Prevention* 41, no. 4 (July 1, 2009): 849–55.

67 P. L. Jacobsen, "Safety in Numbers: More Walkers and Bicyclists, Safer Walking and Bicycling," *Injury Prevention* 9, no. 3 (September 1, 2003): 205–9.

68 Peter Lyndon Jacobsen, David R. Ragland, and Charles Komanoff, "Safety in Numbers for Walkers and Bicyclists: Exploring the Mechanisms," *Injury Prevention* 21, no. 4 (August 1, 2015): 217–20.

69 Vanessa Beanland, Michael G. Lenné, and Geoffrey Underwood, "Safety in Numbers: Target Prevalence Affects the Detection of Vehicles during Simulated Driving," *Attention, Perception, & Psychophysics* 76, no. 3 (April 1, 2014): 805–13.

70 James Woodcock et al., "Health Effects of the London Bicycle Sharing System: Health Impact Modelling Study," *BMJ* 348 (February 13, 2014): g425.

71 Jacobsen, Ragland, and Komanoff, "Safety in Numbers for Walkers and Bicyclists."

Woodcock says this could also be explained by "*intentional blindness*, the failure to detect unexpected object," which "is more likely when the unexpected target differs from the focus of attention in size, colour, shape and location". The danger of an unexpected object leading to slow response times and even lack of detection applies to e-scooters. In other words, it is likely that the small number of e-scooters is creating a disproportionately risky situation on the roads, since drivers are entirely unprepared to see the devices, leading to tragedy. If e-scooters became a regular sight for motorists it would increase responsiveness and substantially reduce the likelihood of crashes.

A further conduit for improved on-road safety from e-scooters comes from lower car usage. Despite the falling number of road accidents, as infrastructure and car technology improves, the World Health Organisation has estimated there are around 1.25 million road deaths globally per year.[72] The vast majority of road accidents are related to cars, leading to arguments that reducing car dependency is essential to reducing road fatalities.[73] In 2017, there were 1,770 road fatalities, of which 1,105 (62%) deaths included a car in the UK.[74] From 2007 to 2016, 99% of pedestrians killed or seriously injured were hit by a motor vehicle.[75] To the extent that e-scooter usage decreases car usage, it will also lead to a proportionate reduction in the risk presented by car accidents, particularly to pedestrians. The existing evidence indicates that approximately one-third of e-scooter usage is a replacement of a car trip.[76] Therefore, higher e-scooter usage in itself can serve to help to reduce car-related deaths. The specific statistics on trip replacement will be discussed in the next section, particularly in the context of the congestion and environmental benefits that derive from lower car usage.

3. THE ENVIRONMENT, CONGESTION, AND TRIP REPLACEMENT

Micromobility, small-human powered transport on e-scooters, bikes and mopeds have been proven to be an alternative to congestion-causing, emissions-intensive car trips. This is particularly important in the context of increasingly congested streets. By 2050, road traffic is projected to grow between 17% and 51% compared to

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72 "Road Traffic Deaths," World Health Organization, accessed July 30, 2019, http://www.who.int/gho/road_safety/mortality/en/.

73 Hamed Ahangari, Carol Atkinson-Palombo, and Norman W. Garrick, "Automobile-Dependency as a Barrier to Vision Zero, Evidence from the States in the USA," *Accident; Analysis and Prevention* 107 (October 2017): 77–85.

74 Department for Transport, "Statistical Release: Reported Road Casualties in Great Britain: 2017 Annual Report" (London, UK: HM Government, September 27, 2018), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/744077/reported-road-casualties-annual-report-2017.pdf; Department for Transport, "Statistical Data Set: Reported Accidents, Vehicles and Casualties (RAS40)" (London, UK: HM Government, September 27, 2018), https://www.gov.uk/government/statistical-data-sets/ras40-reported-accidents-vehicles-and-casualties.

75 Cherry Allan, "What are Cycling UK's views on regulating cyclists' behaviour?," *Cycling UK*, September 10, 2018, https://www.cyclinguk.org/article/what-are-cycling-uks-views-regulating-cyclists-behaviour.

76 This will be discussed further in the next section.

2015 levels, leading to more emissions, more congestion and slower travel times.[77] The United Nations' Intergovernmental Panel on Climate Change report released in October 2018 highlighted the contribution of transport, and in particular car usage, to climate change.[78]

Car emissions are a significant environmental challenge. Transport accounts for 27% of all UK greenhouse emissions – including carbon dioxide, methane and nitrous oxide.[79] The primary source of transport emissions is petrol and diesel in road transport, which makes up 93% of total domestic transport greenhouse gas emissions.[80] Cars are the most popular transport method, with three-fifths (61%) of all trips and over two-thirds (70%) of trips to work undertaken by car.[f81] In addition to greenhouse gas emissions, cars also produce nitrogen oxides (NO_x) pollutants which lower life expectancy, and has led to policies like London's Ultra Low Emissions Zone (ULEZ).[82] The growing number of cars is leading to congestion and slow journey times, which damages the UK's productivity. Congestion was estimated to cost the UK economy £7.9 billion in 2018, an average of £1,317 per driver.[83]

Many car journeys could be undertaken on an e-scooter, meaningfully reducing carbon emissions, pollution and congestion. A majority (58%) of car journeys in the UK are for a short distance, with 7% of car journeys below one mile, 18% between one and two miles, and 33% between two and five miles.[84] Similarly, 72% of taxi/minicab journeys are under five miles.[85] The numbers are even higher when just looking at trips in UK cities. Transport analytics firm Inrix found that two-thirds (67%) of city trips in the UK are under three miles - meaning many trips could be replaced with e-scooters.[86] They specifically analysed five cities: Manchester,

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77 Department for Transport, "Road Traffic Forecasts 2018: Moving Britain Ahead" (London, UK: HM Government, 14 September, 2018), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/740399/road-traffic-forecasts-2018.pdf.

78 Intergovernmental Panel on Climate Change, "Global Warming of 1.5 ºC" (Geneva, Switzerland: United Nations, October, 2018), http://ipcc.ch/sr15/.

79 Department for Business, Energy & Industrial Strategy, "2017 UK Greenhouse Gas Emissions" (London, UK: HM Government, March 28, 2019), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/776083/2017_Final_emissions_statistics_one_page_summary.pdf.

80 Department for Transport, "Statistical data set: Energy and environment (TSGB03)" (London, UK: HM Government, December 6, 2018), https://www.gov.uk/government/statistical-data-sets/tsgb03.

81 Office for National Statistics, "Travel to work methods and the time it takes to commute from home to work, Labour Force Survey, 2007 to 2016" (London, UK: *HM Government*, January 30, 2018); Department for Transport, "National Statistics: National Travel Survey: 2017" (London, UK: *HM Government*, July 26, 2018).

82 Mayor of London, "London Environment Strategy- Chapter 4: Air Quality" (London, UK: London City Hall, May 2018), https://www.london.gov.uk/sites/default/files/air_quality.pdf.

83 "Congestion Costs UK Economy £8bn in 2018 - an Average of £1,300 per Driver," *Sky News*, February 12, 2019, https://news.sky.com/story/congestion-costs-uk-economy-8bn-in-2018-an-average-of-1-300-per-driver-11635271.

84 Department for Transport, "National Statistics: National Travel Survey: 2017" (London, UK: HM Government, July 26, 2018), https://www.gov.uk/government/statistics/national-travel-survey-2017.

85 Department for Transport, "National Statistics: National Travel Survey: 2017" (London, UK: HM Government, July 26, 2018), https://www.gov.uk/government/statistics/national-travel-survey-2017.

86 Inrix, "Micromobility Potential in the US, UK and Germany" (Kirkland, Washington: Inrix, September 9, 2019), http://inrix.com/campaigns/micromobility-study-2019/.

Birmingham, Glasgow, London and Sheffield. A small-scale study of 38 subjects in Munich found that e-scooters are suitable for the "majority of daily trips," but limited by the likes of weather and baggage capacity.[87]

E-scooters are particularly appropriate for providing increased access to public transport, such as train stations, for people who live further than walking distance, providing for the 'last mile' that is often provided by driving. Lime claims that 1-in-5 of its users use the platform to connect to public transport.[88] They have estimated that an individual replacing a car journey with lime and public transport reduces CO_2 emissions by 200 kilograms per year, and that by April 2019 their users had saved 699,786 gallons of gas (about 1,320 vehicles).[89] Thus, e-scooters will help encourage the use of public transport and increase the benefits that use brings.

Studies have consistently found that e-scooters replace car journeys, reducing the number of car trips on roads by millions.

The Portland, Oregon e-scooter pilot study found that 34% of e-scooter trips were replacements of car trips, including both personal car (19%) and taxi and ride sharing (15%).[90] This accounts for about 230,000 fewer car journeys in just four months. Among tourists who used e-scooters, almost half (48%) of journeys were replacements for car trips. About a third of trips replaced walking (37%). Relatively few trips were instead of bicycling (5%) and three-quarters of e-scooter users never having used the city's bike sharing scheme. There were also many Portlanders who did or considered reducing their car ownership, with 6% of users saying they got rid of a car because of e-scooters and a further 16% saying they considered it. Importantly, for reducing congestion, the study found that almost three-quarters of journeys were for transportation, with the remaining journeys for recreation or exercise. More trips (19%) were taken during the weekday peak, 3.00pm to 6.00pm, than any other time.

A similar study by the city government of Denver, Colorado found that one-third (32%) of e-scooter trips replaced car trips, including taxi and car ride sharing (22%) and driving a vehicle (10%).[91] A survey by Lime found that 39% of e-scooter rides in St Louis replaced car journeys.[92] Lime's 2018 annual report claimed that 30% of

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87 Cornelius Hardt and Klaus Bogenberger, "Usage of E-Scooters in Urban Environments," *Transportation Research Procedia*, 21st EURO Working Group on Transportation Meeting, EWGT 2018, 17th – 19th September 2018, Braunschweig, Germany, 37 (January 1, 2019): 155–62.

88 Lime, "Year-End Report 2018" (San Francisco: Lime, December 18, 2018), https://www.li.me/hubfs/Lime_Year-End%20Report_2018.pdf.

89 John Wachunas, "E-Scooters And Earth Day: Measuring Micromobility's Impact On The Environment," April 22, 2019, http://v1.li.me/second-street/e-scooters-earth-day-measuring-micromobility-impact-environment.

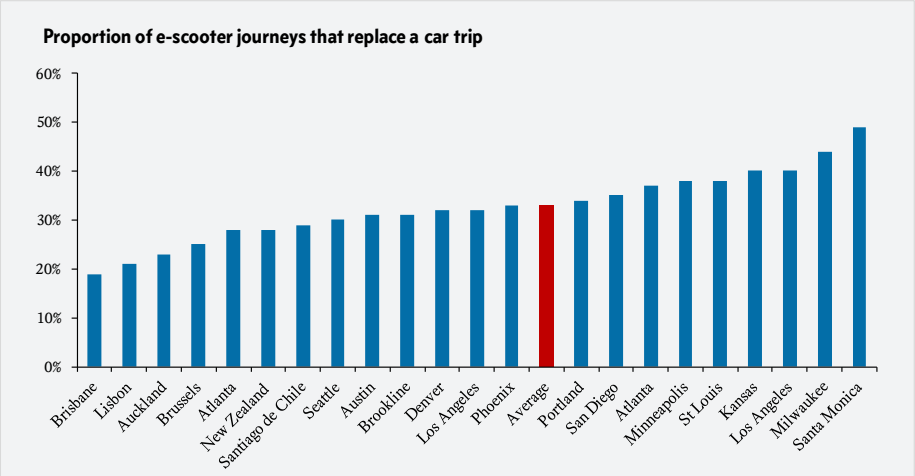
90 Portland Bureau of Transportation, "2018 E-Scooter Findings Report."

91 Denver Public Works, "Denver Dockless Mobility Program: Pilot Interim Report" (Denver, CO: City and County of Denver, February 2019), https://denvergov.org/content/dam/denvergov/Portals/705/documents/permits/Denver-dockless-mobility-pilot-update-Feb2019.pdf.

92 Vickie Wu, "Nearly 40% Of St. Louis Lime Riders Use Electric Scooters To Replace Car Rides," *2nd STREET*, April 19, 2019, https://www.li.me/second-street/nearly-40-percent-st-louis-electric-scooters-replace-car-rides.

rides replace car trips.[93] A survey by Bird found similar numbers of car replacement in other cities such as Los Angeles (32%), Phoenix (33%), Atlanta (28%) and Austin (22%).[94] A survey in Paris, France found that 71% of e-scooter users were using their cars less often because of e-scooters.[95]

Figure 2, The proportion of e-scooter journeys that replace a car trip (including private, ride sharing, and rentable cars)[96]



The evidence on the overall environmental impact of e-scooters is still developing. A robust study would have to consider the precise reduction in car trips, the environmental impact of the construction of e-scooters, the electricity required to charge e-scooters, and the van trips required to retrieve and deploy e-scooters. The trips to maintain and charge e-scooters carry an environmental footprint, though notably companies such as Bird and Lime use electric vehicles for e-scooter fleet movement and undertake carbon offsetting for energy used to charge the devices.[97] It is also important to acknowledge the incremental improvement of the technology, including durability that extends device life up to 2 years, longer lasting batteries, and the emergence of swappable batteries and decentralised charging stations which may alleviate the environmental impact of the charging process. A study would also have to account for lower emissions and energy use in needing to produce fewer cars in the first place. This task is outside of the scope of this paper.

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93 Lime, "Year-End Report 2018."

94 Bird reported these findings in here: Strickland, "A Look at E-Scooter Safety: Examining Risks, Reviewing Responsibilities, and Prioritizing Prevention."

95 "A Paris, Les Trottinettes Électriques de Bird Ont Rencontré Leur Public," *Les Echos*, December 13, 2018, https://www.lesechos.fr/industrie-services/tourisme-transport/les-trottinettes-electriques-de-bird-ont-fait-leur-nid-a-paris-238492.

96 Note on methodology: Many of the surveys of consumer behaviour have been undertaken by an e-scooter companies, with the particular findings and methodologies unverified. Nevertheless, the company reported findings vary substantially, and are broadly consistent with the findings from independent studies. Usage patterns vary by city and it would be necessary to gather UK-statistics following introduction.

97 Lime, "Lime Green," accessed August 1, 2019, https://www.li.me/lime-green; "Bird x Earth Day: Renewable Energy Credits and Carbon Offsets," *Bird* (blog), April 23, 2019, https://www.bird.co/blog/renewable-energy-credits-and-carbon-offsets/.

There have been some initial efforts to calculate the relative environmental impact of e-scooters in comparison to cars. The *Financial Times* reported on a study by Rhodium Group that concluded e-scooters are "even better than the carbon footprint of a vegan on a stroll".[98] The study, which did consider manufacture, redistribution and propulsion, estimated that an e-scooter's CO_2 emissions are just 28g per mile travelled, compared to 48g for a vegan who is burning calories by walking, or 292g for a car. "No matter what you eat for lunch, from a climate standpoint you should probably go pick it up on a scooter," Rhodium claimed. An alternative life analysis by energy analyst Matt Chester, based on a presumption of regular replacement of devices, was less optimistic, concluding that the devices produce 240-557g of CO_2 per mile.[99] Another study published in *Environmental Research Letters* found the impact heavily depends on the collection, charging, and life cycle, with scooters that are used for two years almost certainly decreasing carbon emissions.[100] Lime has claimed every mile travelled mitigates roughly 350 grams of CO_2.[101] A study commissioned by Lime into the environmental impact in Paris alone concluded that between June 2018 and September 2019, e-scooters had replaced 1.2 million motor vehicle trips and kept more than 330 tonnes of CO_2 from being emitted into the atmosphere.[102] There is clearly room for further analysis on this point.

On the question of the built environment, there have been concerns raised about e-scooter users inappropriately parking their bikes in a way that obstructs pedestrians, bikes or traffic.[103] This is particularly problematic for people with disabilities, who need access to sidewalks.[104] These concerns, however, should not be overstated. The Portland study found that 73% of e-scooters were parked correctly, a further 11% were parked inappropriately such as next to a bike rack.[105] Just 5% blocked pedestrian movement completely, and 8% partially blocked pedestrian movement. A further 3% impeded ramp access, and 1% were parked too close to a bus stop. An independent study of e-scooter parking by San Jose State University's Mineta Transportation Institute found that 90% of e-scooters were appropriately parked, 97% were parked upright and just 1% obstructed pedestrian traffic.[106] Some compa-

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98 Tim Bradshaw, "Electric Scooters Battle to Prove 'Green' Worth," *Financial Times*, March 12, 2019, https://www.ft.com/content/cd6fcae8-28a6-11e9-9222-7024d72222bc.

99 Matt Chester, "The Electric Scooter Fallacy: Just Because They're Electric Doesn't Mean They're Green," *Chester Energy and Policy* (blog), June 11, 2018, http://chesterenergyandpolicy.com/2018/06/11/the-electric-scooter-fallacy-just-because-theyre-electric-doesnt-mean-theyre-green/.

100 Joseph Hollingsworth, Brenna Copeland, and Jeremiah X. Johnson, "Are E-Scooters Polluters? The Environmental Impacts of Shared Dockless Electric Scooters," *Environmental Research Letters* 14, no. 8 (August 2019): 084031.

101 Zoheb Davar, "The Environmental Impact of Electric Scooters," *Medium*, February 9, 2019, https://medium.com/cleantech-rising/the-environmental-impact-of-electric-scooters-8da806939a32.

102 "New Report Examines The Sustainability Impact Of E-Scooters In Paris," *Lime*, October 10, 2019, http://li.me/second-street/new-report-examines-sustainability-impact-e-scooters-paris.

103 See, for example, Peter Holley, "Scooters Are Littering Sidewalks and Injuring Pedestrians. Can This Start-up Bring Order to the Chaos?," *Washington Post*, March 12, 2019, sec. Innovations, https://www.washingtonpost.com/technology/2019/03/12/scooters-are-littering-sidewalks-injuring-pedestrians-can-this-startup-bring-order-chaos/.

104 Greg Moran, "Disability Advocates Target City of San Diego and Scooter Companies in Lawsuit," *Los Angeles Times*, January 12, 2019, https://www.latimes.com/local/lanow/la-me-ln-ada-suit-scooters-san-diego-20190112-story.html.

105 Portland Bureau of Transportation, "2018 E-Scooter Findings Report."

106 Kevin Fang et al., "Where Do Riders Park Dockless, Shared Electric Scooters? Findings from San

nies, such as Lime, have responded to ongoing issues about parking by requiring users to upload a photo of a safely parked device when they end the trip. Notably, this issue has been found to reduce over time. As time went on during the Portland study there were fewer complaints about parking.[107] Additionally, when it comes to the physical environment, e-scooters take up substantially less space than cars, which take up 212 square feet to park compared to e-scooters that take up to just three to six square feet to park.[108]

4. EQUITY AND THE ECONOMY

E-scooter companies not only make an economic contribution in the form of jobs and investment. They also provide access and opportunity for easy, cheap mobility to underserved communities.

The micromobility industry is now valued at billions of pounds and expected to rapidly grow in the coming years. A study by McKinsey estimated that the micromobility industry could grow to as much as $200 to $300 billion a year in the United States and $100 to $150 billion in Europe.[109] They also found that by January 2019, there had already been $5.7 billion invested in micromobility start-ups. Bird, which last year raised $400 million venture capital funding, is the fastest ever start-up to reach 'unicorn' status, a valuation of over a billion dollars.[110] Lime is also now worth over a billion dollars, reaching a $2.4 billion valuation in February 2019.[111] Stockholm-based VOI has raised over $80 million. Ford, General Motors, Google and Uber have invested millions in micromobility.[112] A leaked pitch from Lime to investors said that the e-scooters pay for themselves in less than two months, with an average of 9.3 daily rides and $27.70 in daily revenue.[113] UK entrepreneurs have been unable to tap into the opportunity provided by e-scooters. These companies both employ thousands of people themselves. They also provide jobs for people who are contracted to pick up, charge and redistribute e-scooters around cities.

Jose, California," *Mineta Transportation Institute Publications*, November 1, 2018, https://scholarworks.sjsu.edu/mti_publications/251.

107 Portland Bureau of Transportation, "2018 E-Scooter Findings Report."

108 NYC Board of Standards and Appeals. http://www.nyc.gov/html/bsa/downloads/pdf/forms/memostandardnotesv6.pdf

109 Kersten Heineke et al., "Sizing the Micro Mobility Market," *McKinsey & Company*, January 2019, https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/micromobilitys-15000-mile-checkup.

110 Alison Griswold, "Bird Is the Fastest Startup Ever to Reach a $1 Billion Valuation," *Quartz*, June 14, 2018, https://qz.com/1305719/electric-scooter-company-bird-is-the-fastest-startup-ever-to-become-a-unicorn/.

111 Kyle Wiggers, "Lime Raises Another $310 Million, Bringing Its Valuation to $2.4 Billion," *VentureBeat*, February 6, 2019, https://venturebeat.com/2019/02/06/lime-closes-310-million-series-d-valuing-the-company-at-2-4-billion/.

112 Aparna Narayanan, "Ford, GM Join Electric Scooter Companies And Electric Bike Companies Chasing $6 Billion Market," *Investor's Business Daily*, November 7, 2018, https://www.investors.com/news/electric-scooter-companies-electric-bike-companies/.

113 Kia Kokalitcheva, "Scoop: How Lime Is Pitching Its Scooter Biz to Investors," *Axios*, June 21, 2018, https://www.axios.com/how-lime-is-pitching-its-bike-a-1529492063-f32aac78-caf6-4455-a7f1-215cc4bf4552.html.

E-scooters are also an enabler of economic activity and help alleviate congestion in cities by reducing car usage.[114] Studies indicate that most e-scooter trips are short, with a majority less than 10 minutes, and undertaken during day time.[115] A study of *docked bike schemes* found that "respondents use bike sharing to go to cafes, restaurants, grocery stores, concerts, bars, and the like, and they spend modest amounts of money on these trips," with some evidence that the schemes induce new trips.[116] This study focused on economic activity at nearby docking stations. Extrapolating from this study for e-scooters would point to even greater benefits. E-scooters enable easy access to a range of previously inaccessible locations, broadly stimulating economic activity, particularly on high streets that are otherwise struggling. Furthermore, e-scooters save time by allowing individuals to get to their destination faster and reducing cars on the road and therefore the associated congestion. This increases the productivity of cities – in the same way that traffic congestion undermines productivity in a city. E-scooters enable people to spend less time travelling and more time with their friends and family enjoying life.

Physical mobility is a building block for social mobility. Individuals with lower incomes are more likely to live further out from city centres and economic hubs, with lower quality of services like public transport.[117] Even in cities with high quality public transport, there exists mobility deserts: underserved communities who lack access or face barriers to access. This leads to higher levels of driving, since the origin or destination is not a comfortable walking distance from a transport hub such as a train station. E-scooters help tackle this challenge by providing a low-cost, last mile transport option. E-scooters themselves are also inexpensive, typically costing just $1 to start and then a low per minute/per mile cost. Lime has calculated that using an e-scooter and public transport is three-quarters cheaper than using a car ($28.18 average daily cost of car ownership in urban context v.s. $7.27 average daily cost of using an e-scooter and public transport).[118] There are also initiatives by the major e-scooter companies, including Lime and Bird, to provide substantial discounts for individuals with low incomes.[119]

There is emerging evidence that e-scooters provide for lower income and minority groups.

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114 See the previous section of this report for car replacement findings.

115 Jijo Mathew et al., "Analysis of E-Scooter Trips and Their Temporal Usage Patterns," *Ite Journal* 89 (June 1, 2019): 44–49.

116 Craig Bullock, Finbarr Brereton, and Sive Bailey, "The Economic Contribution of Public Bike-Share to the Sustainability and Efficient Functioning of Cities," *Sustainable Cities and Society* 28 (January 31, 2017): 76–87.

117 I discuss this tendency in my book, Matthew Lesh, *Democracy in a Divided Australia* (Brisbane, Australia: Connor Court Publishing, 2018).

118 Lime, "Year-End Report 2018" (San Francisco: Lime, December 18, 2018), https://www.li.me/hubfs/Lime_Year-End%20Report_2018.pdf.

119 Lime, "Lime Access | Smart Mobility in Underserved Communities," accessed August 1, 2019, https://www.li.me/community-impact; Bird, "Low-Income Program," Bird, accessed August 1, 2019, http://help.bird.co/hc/en-us/articles/360030673152-Low-Income-Program.

The Portland city study found that e-scooters can help expand opportunity and access for underserved communities.[120] In an opinion poll associated with the study, 74% of people of colour and 66% of lower income people viewed e-scooters positively. In practice, only 47 users signed up for a low-income plan that reduced the cost of e-scooters during the trial. Nevertheless, in historically underserved East Portland, deployment of e-scooters provided for 44,155 during the trial period. The trips in East Portland were on average 60% longer. One East Portlander surveyed for the study said that:

> "I LOVE having the scooters be part of the mix. They're fast, fun and convenient (when available, there needs to be a lot more). I live on 114th & E Burnside and have been pleased to see reasonable distribution of the scooters as far east as 150th. Keep and EXPAND the scooters!"

In an ongoing Chicago e-scooter pilot, Lime claimed that nearly 40% of rides started or ended in west side neighbourhoods that have limited access to mass transit and bike share stations.[121] An independent analysis of e-scooters access equity, that looked at the location of e-scooters relative to the demographics of different areas in a city, found that e-scooters are substantially more equitably distributed than fixed bike share schemes. Independent mobility data analysts Populus found that in Washington, DC, "the Black and African-American population (which represents 47% of the entire D.C. population) has adopted dockless services at a significantly higher ratio: 2.6 times more versus 1.2 times more".[122] A survey by Lime of 7,500 riders in the US found relatively high levels of adoption by gender, race and income, with over half of riders earning below the average US household income, a higher proportion of people of colour riders than the national average and a higher proportion of women riders compared to bike commuters.[123]

E-scooters have also been adopted by women in higher numbers than fixed bike share schemes, which have typically been heavily biased in favour of men leading to an "active transportation gender gap". Men are over twice as likely to have used a bike share scheme compared to women, while men are only about one-third as more likely to have used an e-scooter.[124] Furthermore, while bike share schemes have been criticised for their lack of access in more impoverished communities, in-

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120 Portland Bureau of Transportation, "2018 E-Scooter Findings Report."

121 John Wachunas, "Chicago Scooter Report Shows Increased Mobility Access, Significant Supply/Demand Gap," July 29, 2019, https://www.li.me/second-street/chicago-scooter-report-increased-mobility-access-supply-demand-gap.

122 Populus Insights, "Measuring Equitable Access to New Mobility: A case study of shared bikes and electric scooters" (Populus, November 2018), https://research.populus.ai/reports/Populus_MeasuringAccess_2018-Nov.pdf.

123 John Wachunas, "New Lime Report Highlights Diversity Of Electric Scooter Riders," *2nd STREET*, March 27, 2019, https://www.li.me/second-street/new-lime-report-highlights-diversity-electric-scooter-riders.

124 Populus Insights, "The Micro-Mobility Revolution: The Introduction and Adoption of Electric Scooters in the United States" (Populus, July 2018), https://www.populus.ai/micro-mobility-2018-july.

dividuals with lower incomes have been found to be more positive about e-scooters than individuals with higher incomes.[125]

5. FUTURE REGULATIONS FOR MICROMOBILITY

Micromobility is not a fad. New transport options, such as e-scooters and dockless bikes, are here to stay. Policymakers should be open to innovative technologies that provide clean, safe 'last mile' transport options. This does not just apply to e-scooters – the issue that is currently grabbing global headlines – but also to other new technologies, and technology that is yet to be invented. There is a need to reform outdated laws and develop a regulatory regime that ensures safety, usability and a competitive market – as well as setting consistent, liberal rules on issues such as where e-scooters can be ridden and parked, how fast they can go, and a range of other issues. Specific rules should be set locally, adaptive to changing circumstances and developed in consultation with e-scooter companies and users. They should be as permissible as possible to ensure that e-scooters can succeed in achieving their potential for safety, environmentally-friendly, convenient transport.

If the Government wants to enable technology of the future, ensure safety, help the environment, and reduce congestion, they should undertake the following steps:

1. Legalise e-scooters, and allow for future micromobility

The case for amending the outdated *Highways Act 1835* and the *Road Traffic Act 1988* to allow e-scooters is becoming overwhelming. E-scooters are popular, safe, environmentally-friendly, and support communities underserved by existing transport options. The allowance of e-scooters, however, is only part of the puzzle. While e-scooters may be in focus today, micromobility is a much broader concept than a single device, and includes the likes of shared bikes, electric bikes, segways, and as-yet-undeveloped new technologies. There is already thinking about the next stage of micromobility, with the possibility of rentable mopeds and pogo sticks.[126] As a broad principle, policymakers should follow the 'permissionless innovation' approach: allowing entrepreneurs to experiment with new business models and technologies, and only intervening when there are clear, demonstrable harms to the public.[127] In the case of e-scooters this means updating the definition of legal forms of transport within the law to legalise, and allow for the development of regulation, of both current technologies and as-yet-unknown technologies.[128]

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125 Populus Insights, "The Micro-Mobility Revolution: The Introduction and Adoption of Electric Scooters in the United States" (Populus, July 2018), https://www.populus.ai/micro-mobility-2018-july.

126 Eric Boehm, "Scoot Over: Get Ready for Rental Mopeds," *Reason*, May 2019, https://reason.com/2019/05/01/scoot-over-get-ready-for-renta/; Jason Plautz, "Will pogo sticks be the next scooters?," SmartcitiesDive, June 4, 2019, http://smartcitiesdive.com/news/will-pogo-sticks-be-the-next-scooters/556096/.

127 Lesh, Dumitriu, and Salter, "Safeguarding Progress"; Adam Thierer, *Permissionless Innovation: The Continuing Case for Comprehensive Technological Freedom* (Arlington, Virginia: Mercatus Center at George Mason University, 2014).

128 Jennifer Huddleston, "Testimony: Embracing Innovation in Micromobility Transportation" (Washington, DC: Mercatus Center at George Mason University, February 28, 2019), https://www.

2. Begin pilot studies for shared micromobility, with data collection and independent studies

While the first step is the legalisation of e-scooters for personal use - which should be undertaken immediately - there is a further process necessary in relation to managing the rollout of dockless micromobility schemes. International experience has shown that e-scooters can integrate into urban mobility systems in a wide array of contexts. There are, however, divergent regulatory models, with specific rules varying by city and country. It is challenging to prescribe appropriate regulations in advance of an e-scooter sharing scheme coming to the UK or even specific cities and towns. The appropriate rules for San Francisco may not work for London, and what works for London may not work in Birmingham or Leeds. To overcome this uncertainty, the Department for Transport should work with interested companies, cities and councils to undertake pilots. This incremental approach has proven successful in a wide array of other contexts for shared micromobility – from Portland and Kansas City in the United States to Brisbane, Australia – to test e-scooters in local contexts, build data, address issues, and develop popular support. One study of American municipalities found over half had instigated scooter pilot schemes.[129]

It has been noted that in the United States, "planners and policymakers who are struggling to both understand and manage their potential impacts" of e-scooters.[130] The National League of Cities has recommended that cities are proactive in their approach, undertake pilot programmes, consider safety, have a plan for gathering data, revaluate bike infrastructure, focus on equity, and learn from other cities.[131] Jennifer Huddleston and Trace Mitchell of the Mercatus Center at George Mason University have called for the development of "innovation-enabling pilot program[s]," which are open to all interested companies, have flexible requirements, provide an opportunity to identify problems, and with the end-goal of developing a permanent scheme.[132] These should take a similar approach to a 'regulatory sandbox' designed with minimal rules to encourage innovation and experimentation.[133] This has also been called a 'soft law' approach, in which policymakers provide some kind of governance with limited restrictions.[134] For example, regulators

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mercatus.org/system/files/huddleston_-_testimony_-_maryland_micromobility_testimony_-_v1.pdf.

129 William Riggs and Matthew Kawashima, "Exploring Best Practice for Municipal E-Scooter Policy in the United States," SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, January 12, 2020).

130 Kirstin Anderson-Hall et al., "Governing Micro-Mobility: A Nationwide Assessment of Electric Scooter Regulations," 2019, https://trid.trb.org/view/1572811.

131 Nicole DuPuis, Jason Griess, and Connor Klein, "Micromobility in Cities: A history and policy overview" (Washington, DC: National League of Cities), https://www.nlc.org/sites/default/files/2019-04/CSAR_MicromobilityReport_FINAL.pdf.

132 Jennifer Huddleston and Trade Mitchell, "With Pilot Programs, Cities Can Give Micromobility a Test Drive," *Mercatus Center*, August 20, 2019, https://www.mercatus.org/bridge/commentary/pilot-programs-cities-can-give-micromobility-test-drive.

133 The Financial Conduct Authority's 'Regulatory sandbox' is a good model of this approach, see Financial Conduct Authority, "Regulatory sandbox" (London, UK: HM Government, April 29, 2019), https://fca.org.uk/firms/regulatory-sandbox.

134 Jennifer Huddleston, "Is 'soft law' the solution for tech policy problems?" (Washington, DC: The Hill, March 18, 2019), https://thehill.com/opinion/technology/434497-is-soft-law-the-solution-for-tech-policy-problems.

can expect e-scooters to have certain features, such as brakes, a light and a bell, however it is unnecessary for policymakers to dictate the design specifics.

As Ryan Bourne of the Cato Institute in Washington, DC has argued, regulations for e-scooters should be developed in an evolutionary manner:

> "Whenever new forms of transport arise, they bring legitimate worries about externalities. Given city or town-specific conditions (not least prevalence of viable cycle pathways), continual innovation, uncertainty about the consideration of users to pedestrians, or even the long-term likelihood of this vehicle type's success, the best regulatory approach is surely evolutionary and devised once we observe how operations fare in practice.
>
> Only then can you consider whether there should be restrictions on fleet management, tighter speed restrictions, or reconfiguration of public spaces and transport infrastructure, according to a rational cost-benefit analysis."[135]

Pilots provide an opportunity for analysis of e-scooter usage, safety, and environmental and equity impact. The permission for a company to operate during a pilot in a city could be combined with an appropriate data sharing agreement. This would allow cities to understand where, when, and by whom e-scooters are being ridden, as well as detailed information on reported crashes and injuries. This data, which should also be publically available for independent research, is already being provided under the General Bikeshare Feed Specification and the Mobility Data Specification in cities such as Los Angeles, Santa Monica and Austin.[136] Data gathering, nevertheless, must be balanced with privacy and commercial sensitives, including precise requirements for anonymising and de-identifying data.[137] This knowledge can be used for the development of evidence-based e-scooter regulations as well as planning for infrastructure upgrades based on usage.

The trial should be used as an opportunity to develop a future regulatory approach. There should not be a gap between the completion of trials and the future system leading to e-scooters becoming unavailable. If there are delays in determining the ongoing arrangements, trial periods should be extended. Ideally, however, a well-

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135 Ryan Bourne, "Boris Johnson Must Stop the Hamster Wheel of Doom - Starting with Electric Scooters," *The Telegraph*, July 11, 2019, https://www.telegraph.co.uk/business/2019/07/11/boris-johnson-must-stop-hamster-wheel-doom-starting-electric/.

136 The General Bikeshare Feed Specification was developed by the North American Bikeshare Association in 2015, see North American Bikeshare Association, "General Bikeshare Feed Specification (GBFS)," accessed August 30, 2019, https://github.com/NABSA/gbfs/blob/master/gbfs.md. The Mobility Data Specification was introduced in September 2018 by the Los Angeles Department of Transportation designed for shared bikes and scooters, see City of Los Angles, "Mobility Data Specification," accessed August 30, 2019, https://github.com/CityOfLosAngeles/mobility-data-specification.

137 Jennifer Huddleston, "Should Shared Mobility Services Share Your Data?," Mercatus Center, *The Bridge*, June 26, 2019, mercatus.org/bridge/commentary/should-shared-mobility-services-share-your-data.

developed trial programme would have a set end date and a specific goal of developing permanent policies prior to its conclusion.

3. Allow councils to develop locally appropriate regulations

A complicating factor in developing appropriate e-scooter regulations is specific local conditions. As a broad principle of public policy, decisions should be made as close as possible to those impacted.[138] There is a role for some central direction and advice from the Department for Transport. The use of e-scooters themselves should be legalised nationally, and not overridden by local authorities. However, the central government should avoid setting excessively specific rules that may not be appropriate for every part of the country. The regulatory responsibility for managing e-scooter rental schemes, and local issues such as no-go zones, should be devolved to councils and cities – particularly in the case of regional governance such as the Greater London Authority and combined authorities such as Greater Manchester Combined Authority, Liverpool City Region, and others. It is unlikely that a centrally-directed model would be appropriate for the entire UK, and it is further unlikely that it would get every element correct. The devolving of this responsibility would allow for the development of appropriate local rules, as well as experimentation and cross-city learning. This could allow for the development of local, crowd-sourced micromobility data that identifies problematic areas.[139] This includes setting rules on issues such as geo-fencing – not allowing the use of e-scooters around landmarks – use on pavements outside of central areas, appropriate speed limits, and storage spaces. This model has been adopted in the United States and Canada, where individual municipalities have been responsible for designing pilots and setting rules and parking.

4. Adopt a liberal approach to regulation

While the specifics of regulation should be locally determined, it would be prudent for policymakers to take a liberal approach to ensure the success of the new technology. Excessively onerous regulations have pushed companies to leave cities in the past.[140] The overarching policy goal should be to encourage deployment. In early 2019, Lime announced that they would exit Raleigh, North Carolina following excessive limits on e-scooter numbers and the imposition of a $300 fee per scooter.[141] The presumption should be in favour of allowing people to use e-scooters as they choose until specific harm is demonstrated. Further, following J S Mill's harm

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138 Charles M. Tiebout, "A Pure Theory of Local Expenditures," *Journal of Political Economy* 64, no. 5 (1956): 416–24; Axel Dreher, "Power to the People? The Impact of Decentralization on Governance," SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, January 1, 2006), https://papers.ssrn.com/abstract=881542.

139 Anindya Maiti et al., "Impact of Urban Micromobility Technology on Pedestrian and Rider Safety: A Field Study Using Pedestrian Crowd-Sensing," *ArXiv:1908.05846 [Cs]*, January 5, 2020.

140 Christian Britschgi, "Cities Keep Imposing Self-Defeating Restrictions on Electric Scooters," *Reason*, November 16, 2018, https://reason.com/2018/11/16/cities-keep-imposing-self-defeating-rest/.

141 Billy Binion, "Bird and Lime Scooters To Leave Raleigh Due to City Regulations," *Reason.Com*, April 10, 2019, https://reason.com/2019/04/10/bird-and-lime-scooters-to-leave-raleigh/ .

principle, it is necessary to establish harm to other people, not just the user of an e-scooter who uses the devices in the knowledge of potential risks.[142]

Specifically, a regulatory model could include some of the following elements:

4.1. Clear, necessary safety rules

There are several rules that would fit within a reasonable e-scooter model, that are consistent with other road rules, such as:

- Only ride on bicycle paths and on the left-hand side of the road;

The safest, and least disruptive to other road users, places to ride e-scooters are on bicycle paths and on the left-hand side of roads. This is the approach taken in most cities.

- Riders must be 16 or over;

Individuals of a younger age might be less capable of assessing the risk.

- One rider at a time;

If the device is designed for one user it is not unreasonable to expect that it is only used by one person. Whoever is the driver should be the one responsible for risks. This should not prevent the possibility of future devices that can be used by multiple users.

- Do not ride on the sidewalks unless specified;

Sidewalks are often uneven and risk confrontation and inconvenience for pedestrians. In most places e-scooters are not allowed on sidewalks – however, there may be localised exceptions in certain areas. In the case of Brisbane, Australia, for example, e-scooters were only allowed on footpaths, bicycle-only paths and shared paths and banned from roads.[143] In Washington, DC riding on footpaths is allowed, but only outside of the central business districts. These rules should be developed on a case-by-case basis.

- A speed limit of 15-20mph; and

Policymakers must avoid unnecessarily restrictive limits on speed. Cities should use actual data and risk to decide speed limits. A speed limit of below 15mph could see other road users, such as cyclists, wizz past operating at higher speeds, potentially increasing crash risks.

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142 John Stuart Mill, *On Liberty* (Project Gutenberg, 2011), http://www.gutenberg.org/ebooks/34901.

143 Brisbane City Council, "Personal Mobility Devices," Text, accessed August 7, 2019, https://www.brisbane.qld.gov.au/laws-and-permits/laws-and-permits-for-residents/personal-mobility-devices.

- Do not ride while intoxicated or affected by drugs;

There is substantially increased road danger when individuals are under the influence of alcohol and drugs, and consistent with other road users e-scooter riders under the influence can be restricted.

4.2. Parking rules that minimise disruption

A consistent concern about e-scooters is careless parking. While, as discussed above, this issue should not be exaggerated, it is essential that cities have clear rules about where e-scooters can be parked. This could include rules such as:

- Do not block sidewalks, allow at least two metres of free passage.
- Park only near the curb or adjacent to a building.
- Do not block bus stops, entrances to houses and buildings, on public gardens or parks, in the middle of bicycle paths, or on car parking areas.
- Do not block access for people with disabilities.

To ensure these rules are followed, many e-scooter companies require users to upload a photo of where they have parked the devices and finished the trip. Cities can also provide for specific e-scooter parking spots, particularly in busy areas that attract a high number of users.

Users should remember that lousy parking will undermine community support for the availability of e-scooters. Further, they risk the possibility that cities will choose to fine users for mis-parking or other misuse. Paris has recently introduced a €35 fine for parking in doorways or causing obstructions and a €135 fine for riding on pavements.[144] If riders park and ride inappropriately it may be necessary to introduce similar fines to ensure the development of proper norms of behaviour.

4.3. Avoid punitive, unnecessary rider rules

There are rules that would be excessively restrictive and inconsistent with other road rules. They could potentially undermine the viability of e-scooter usage, and therefore undermine the benefits of e-scooters such as reduced car usage. This includes helmet and drivers' licence requirements and time-based bans.

There is a good case for encouraging but not requiring the use of helmets, consistent with rules about bikes. A recent review of helmet safety studies found that helmets are associated with safer bicycle riding behaviour.[145] Helmets are also associated with fewer head injuries.[146] Nevertheless, *compulsory bicycle helmet laws* are

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144 Reuters, "Paris to Fine Electric Scooter Users for Pavement Riding," *The Guardian*, April 3, 2019, sec. World news, https://www.theguardian.com/world/2019/apr/03/paris-to-fine-electric-scooter-users-for-pavement-riding.

145 Mahsa Esmaeilikia et al., "Bicycle Helmets and Risky Behaviour: A Systematic Review," *Transportation Research Part F: Traffic Psychology and Behaviour* 60 (January 1, 2019): 299–310.

146 Diane C. Thompson, Fred Rivara, and Robert Thompson, "Helmets for Preventing Head and Facial Injuries in Bicyclists," *Cochrane Database of Systematic Reviews*, no. 4 (1999).

associated with a third less bicycle riding, therefore undermining 'safety in numbers' and potentially increasing risks to riders. The introduction of compulsory helmet laws in Victoria, Australia was "associated with a higher risk of death or serious injury per cyclist, outweighing any benefits of increased helmet wearing".[147] The same applies to e-scooters, with compulsory helmet laws likely to prove highly inconvenient for riders considering the 'hop on and hop off' nature of the devices.[148] Drivers also tend to take more risks when they see riders with helmets.[149] In any case, the potential risk from now wearing a helmet is self-referential, that is, it is the individual who chooses not to use a helmet that directly faces the potential consequences and therefore it should be their responsibility. It is also not clear that enforcing compulsory helmet laws is an effective use of police resources.

The same principles can be applied to a drivers' licence requirement. E-scooters are not cars. They are not complex machines and do not require comparable skills to operate competently. The skills learnt from learning how to drive are not the same for e-scooters. Accordingly, as is the case for bicycles, you should not need a drivers' licence. Additionally, despite the higher risks of driving and bicycling after dark, we do not ban using the roads at night. If specific behaviour, such as drink-driving, is of concern that should be tackled directly without excessive rules against night time usage.

4.4. Do not regulate e-scooter numbers and companies, and placement

Some cities, with varying levels of severity, have chosen to limit the number of e-scooters and e-scooter companies. San Francisco initially limited the number of e-scooters to 1,250 and two companies, subsequently increased to 2,500.[150] Chicago's pilot programme limited the city to 2,500 scooters from ten companies, a relatively small number of 250 per company.[151] These limits are anti-competitive and anti-customer. A limit on the number of companies prevents a competitive market forming, encouraging cronyism among companies vying to provide the service and leading to the charging of higher prices to users. A limit on the number of devices prevents the accessibility of the service to as many customers, and the associated benefits that come from e-scooters.

The higher the number of scooters, the more accessibility and environmental benefits. In cities with device limits, such as Chicago, there have been shortages, as shown by a high number of app opens compared to rides, due to the arbitrary caps

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147 Dorothy L. Robinson, "Safety in Numbers in Australia: More Walkers and Bicyclists, Safer Walking and Bicycling," *Health Promotion Journal of Australia: Official Journal of Australian Association of Health Promotion Professionals* 16, no. 1 (April 2005): 47–51.

148 The Portland study found that over 90% of users do not use helmets.

149 Ian Walker, "Drivers Overtaking Bicyclists: Objective Data on the Effects of Riding Position, Helmet Use, Vehicle Type and Apparent Gender," *Accident Analysis & Prevention* 39, no. 2 (March 1, 2007): 417–25.

150 Dara Keer, "Electric scooter fleets to double in San Francisco," *CNet*, April 15, 2019, http://cnet.com/news/electric-scooters-to-double-in-san-francisco/.

151 John Greenfield, "Ready or Not, 10 Different Scooter Companies Hit the Streets Starting Saturday – Streetsblog Chicago," *StreetsBlog Chicago*, Jun 11, 2019, https://chi.streetsblog.org/2019/06/11/ready-or-not-10-different-scooter-companies-hit-the-streets-starting-saturday/.

on the number of devices.[152] A survey by Lime of users in Minneapolis found that 77% of residents had not used the devices because of a lack of scooter availability.[153] David Estrada, Bird's head of government relations, has explained that "a capped number of scooters incentivizes e-scooter providers to put their vehicles only in popular, high-density areas—not in historically underserved areas."[154] In other words, if e-scooters are excessively limited they are less likely to serve areas without other transport options. Cities should allow the deployment of as many scooters as companies would like, in response to the level of consumer demand. If numbers are limited, the allowance per company should be generous and regularly analysed to ensure that e-scooter companies can keep up with demand.[155] This could follow a similar model to Miami's pilot programme, which allows companies to "increase fleet size by 25% monthly if usage rates indicate enough demand (exceeds 3 rides per scooter per day), or decrease if usage rates decline (less than 2 rides per scooter per day)".[156]

5. Invest in appropriate infrastructure, including parking spaces and separated bike lanes, and education

There is also a need for some specific, targeted government involvement in enabling the e-scooter market. E-scooter safety requires a reconsideration of transport infrastructure investment in the context of new user patterns. It is important to consider how riders interact with everything from bike lanes and roads to cars and pedestrians. There are ongoing challenges such as potholes and road smoothness which impact safety. It has been established that e-scooters are safest in cities with separated bike lanes – which upgrading has the cross-benefit of providing benefits for bicycle and e-scooter riders.

Following the development of the rules, it is necessary that riders are educated. An American survey found that almost one-third of e-scooter riders are uncertain about what traffic laws to follow.[157] Like with any change of regulations, it is necessary to invest in a public education campaign, including an easy-to-use and clearly worded website that describes the rules for riding and parking. It is essential that people understand that e-scooters will be legal to ride on the road, and not on footpaths, and that they must be parked in such a way as to not become an obstruction. Notably this is in addition to the information provided by users in-app when first signing up for an e-scooter sharing service. Users could also be encouraged to wear helmets for their safety.

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152 Wachunas, "Chicago Scooter Report Shows Increased Mobility Access, Significant Supply/Demand Gap."

153 "Minneapolis Is Using E-Scooters To Replace Cars, But There's A Catch," *Lime*, August 23, 2019, https://www.li.me/second-street/minneapolis-using-scooters-replace-cars-theres-catch.

154 Britschgi, "Cities Keep Imposing Self-Defeating Restrictions on Electric Scooters."

155 "A Conversation with Deputy Mayor of Tel Aviv-Yafo, Meital Lehavi."

156 City of Miami, "Miami Scooter Pilot Program," accessed August 28, 2019, https://miamigov.com/Services/Transportation/Miami-Scooter-Pilot-Program.

157 Ryan Felton, "8 Deaths Now Tied to E-Scooters," accessed June 3, 2019, https://www.consumerreports.org/product-safety/deaths-tied-to-e-scooters/

Education, infrastructure and ongoing administrative costs can be funded, at least in part, by levies on e-scooter companies on a per scooter basis. While these fees should not be so high as to discourage the deployment of e-scooters, it is necessary for some cost recovery on a user pays principle.

CONCLUSION

The history of transport epitomises 20th century economist Joseph Schumpeter's concept of 'creative destructive,' the:

> "process of industrial mutation—if I may use that biological term—that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one."[158]

Over the past two centuries there has been a constant process of change and dislocation in transport technologies. New technologies have liberated individuals and tackled the tyranny of distance that kept most individuals incapable of exiting their general surroundings. What began with humans limited to walking, followed by camels, mules and horses gave way to the horse and buggy, only to be subsumed by the likes of trains, combustion engine-powered vehicles, planes, and in the not-too-distant future, self-driving cars, supersonic and space flight, and Hyperloop ground transport. New technologies open new economic opportunities. The combustion engine not only allows for transport of goods over distances – leading to economies of scale previously unimaginable – but allows for people to commute to an otherwise inaccessible job and leisure activities.

The same applies to micromobility. The question of 'last mile' transport is a crucial challenge across cities. When people can more easily get from A to B, it enables them to contribute to and stimulate the economy, and spend more time enjoying their lives. E-scooters are a popular transport option in much of the world but restricted by outdated laws in the UK. The alternative to allowing the development of new technologies is not safety and security today, it is inevitably stagnation and decline. It is important to embrace change, and develop regulatory regimes that allow the new technologies to prosper.

The international evidence is that e-scooters are safe, environmentally friendly, and tackle transport inequities. Studies indicate that e-scooters are a comparable risk to bicycle riding. Legalising e-scooters – which are already a not uncommon sight on UK streets – will not only free up police time to tackle more serious crimes, but also allow for greater safety in numbers. They help the environment by reducing car usage, with about one-third of trips replacing car journeys. E-scooters also help address economic immobility by providing for physical mobility to areas that are underserved by traditional transport options.

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158 Joseph A Schumpeter, *Capitalism, Socialism, and Democracy* (London: Harper & Brothers, 1942).

The key question is no longer whether e-scooters should be legalised, but when and how? A permissive, localised approach to regulation will allow for e-scooters to prosper in the UK. It would also be sensible to begin legalisation with trials across a wide array of cities, and use a data-driven approach to develop appropriate regulations and invest in the necessary infrastructure.

E-scooters are a vital piece in the puzzle of the future of transport; it is time to legalise the new technology.

APPENDIX 1: DATA TABLES

Table 1. Bike share and e-scooter usage, USA

Year	Bike share (Docked)	Bike share (Undocked)	E-scooter
2010	321,000	0	0
2011	2,400,000	0	0
2012	4,500,000	0	0
2013	13,000,000	0	0
2014	18,000,000	0	0
2015	22,000,000	0	0
2016	28,000,000	0	0
2017	32,000,000	3,000,000	0
2018	36,500,000	9,000,000	38,500,000

Source: Shared Micromobility in the U.S.: 2018, National Association of City Transportation Officials

Table 2, The proportion of e-scooter journeys that replace a car trip (including private, ride sharing, and rentable cars)[159]

City	Car replacement rate
Atlanta[a]	37%
Atlanta[b]	28%
Auckland[agi]	23%

159 Note on methodology: Many of the surveys of consumer behaviour have been undertaken by an e-scooter companies, with the particular findings and methodologies unverified. Nevertheless, the company reported findings vary substantially, and are broadly consistent with the findings from independent studies. Usage patterns vary by city and it would be necessary to gather UK-statistics following introduction.

Austin[ab]	31%
Brisbane[a]	19%
Brookline[a]	31%
Brussels[a]	25%
Denver[c]	32%
Kansas[a]	40%
Lisbon[a]	21%
Los Angeles[b]	32%
Los Angeles[a]	40%
Minneapolis[a]	38%
Milwaukee[f]	44%
New Zealand (Auckland, Hutt Valley, Christchurch, Dunedin)[h]	28%
Phoenix[b]	33%
Portland[d]	34%
San Diego[a]	35%
Santa Monica[e]	49%
Santiago de Chile[a]	29%
Seattle[a]	30%
St Louis[a]	38%
Average	**33%**

Source: [a]Lime [b]Bird, [c]City of Denver, [d]City of Portland, [e]City of Santa Monica, [f]City of Milwaukee, [g]City of Auckland [h]University of Canterbury [i]Fitt & Curl 2019