

Transportation System in London:

Analyzing a “Hard System” in a Smart City

Yixuan Liu, Yining Xu, Qiwei Qu, Jiayu Zhang



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About Us



Jiayu (Joy) Zhang



Yixuan (Hannah) Liu



Yining (Evelyn) Xu



Qiwei (Cookie) Qu



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Background and Overview

London is one of the smartest cities in the world and serves as a great example of how various systems in a smart city function and influence one another.

A: Why is London Smart?

B: What Makes the Transportation System Special?



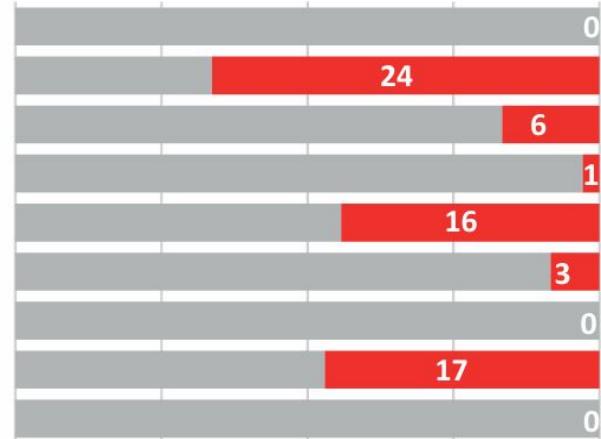
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London as the Smartest City in the World

IESE Cities in Motion Index 2022



Positions that London would have to gain
to be a leader in each dimension



SMART LONDON PLAN



Using the creative power of new technologies to serve London and improve Londoners' lives

- 2013: Launched Smart London Board
- 2013: “Smart London Plan” - Updated **2016**
- 2018: “Smarter London Together” Roadmap



Open Data



Technology



Collaboration

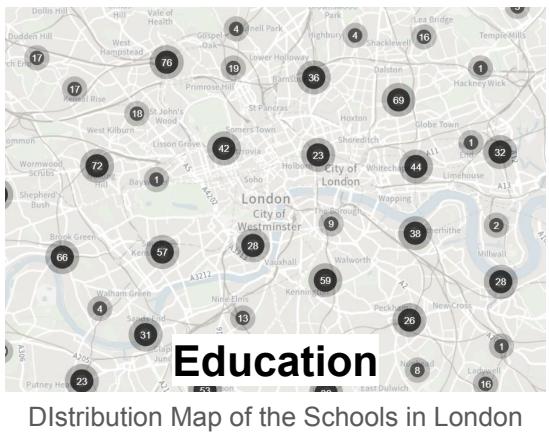


Management

Core Hard Systems



Core Soft Systems



Urban System can become
a System of System in Smart Cities

Why Transportation System?

- **Massive Scale:** One of the largest transport systems *globally*
- **Smart Technology:** Real-time apps, smart APIs, and wearable integration streamline, etc.
- **Openness & Transparency:** TfL's open data platform is among the largest and most timely of its kind.
- **System Integration:** Connected with sustainability (*ULEZ*), public health (*walking/cycling*), social wellness (*accessibility for underrepresented groups*), etc.

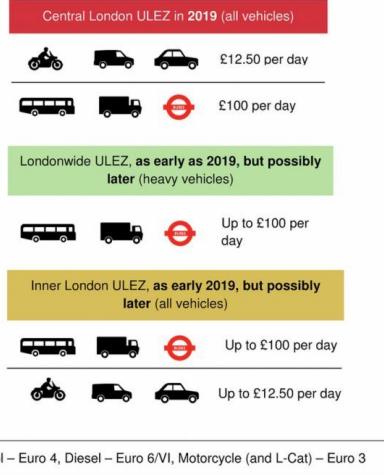
Transportation + ...?

Tube map showing below ground 4G and 5G coverage



Transportation + Infrastructure:
4G & 5G Coverage Below Ground

A well-connected system where public engaged and systems intersect

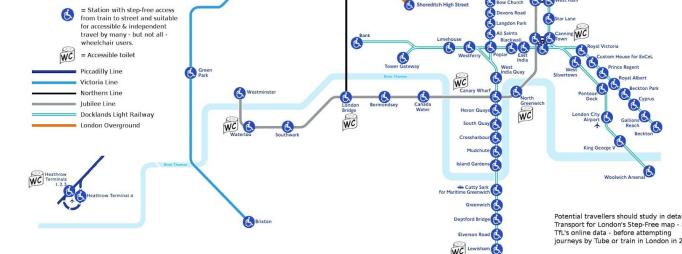


Transportation + Energy:
Ultra Low Emission Zone

Wheelchair user?
Welcome to
independent travel
in London-2012!

Wheelchair user?

Welcome to
independent travel
in London-2012!



Many London Transport maps show a wheelchair symbol, indicating that access from the street to the platform is step free. However, the vertical step and horizontal gap from the platform to the train can be up to 323mm (12.7 inches) for the step and up to a 253mm (10 inch) gap, denying wheelchair users the dignity of independent travel.

This is NOT an official Transport for London map in anyway whatsoever!

Transportation + Social Wellness:
Wheelchair Accessibility in London

Transportation System:

Networks

London's transportation network is a vast, multi-modal system that interconnects various modes of transport, including buses, the Underground, trams, overground rail, cycling infrastructure, and emerging smart mobility solutions.

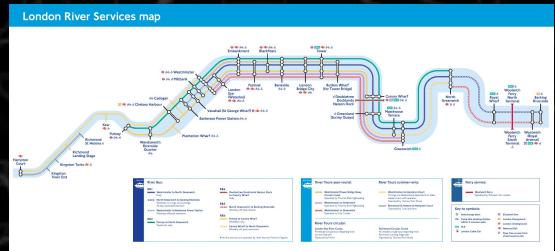
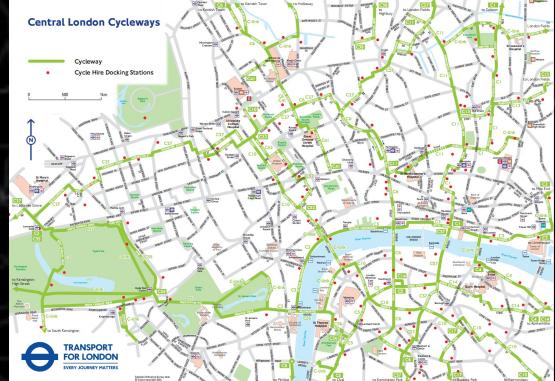
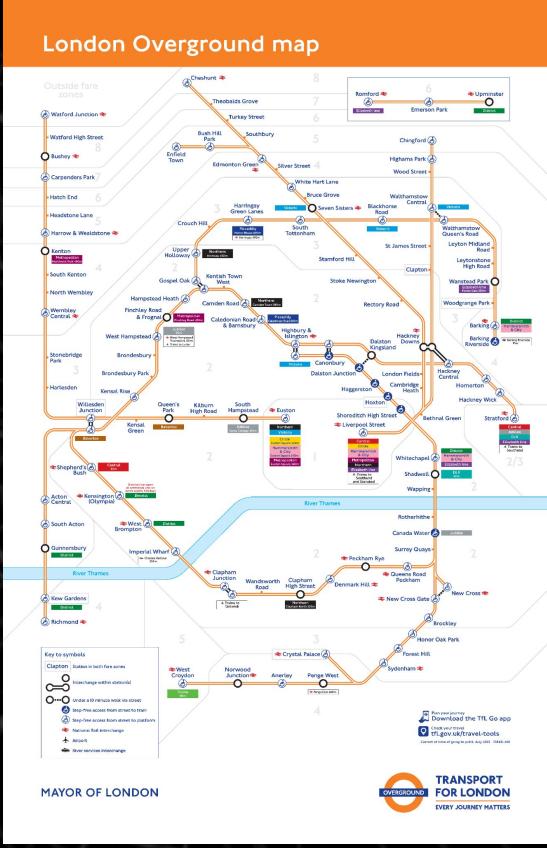
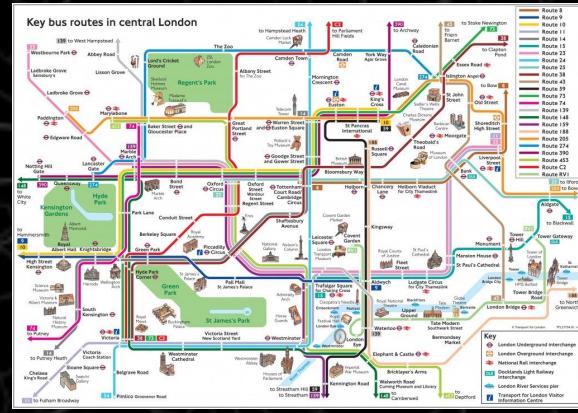
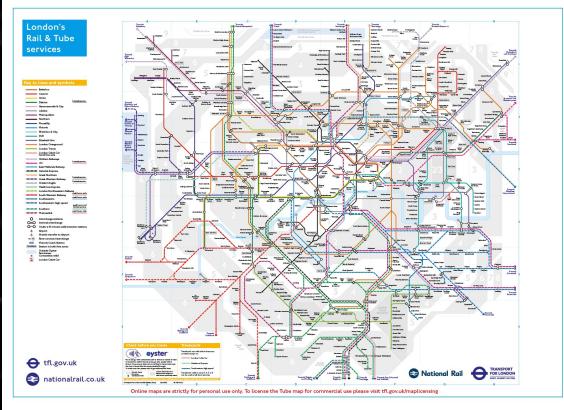
A. Physical Routes Networks

B. Networks of Digital Infrastructure that coordinates



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Physical Routes Networks



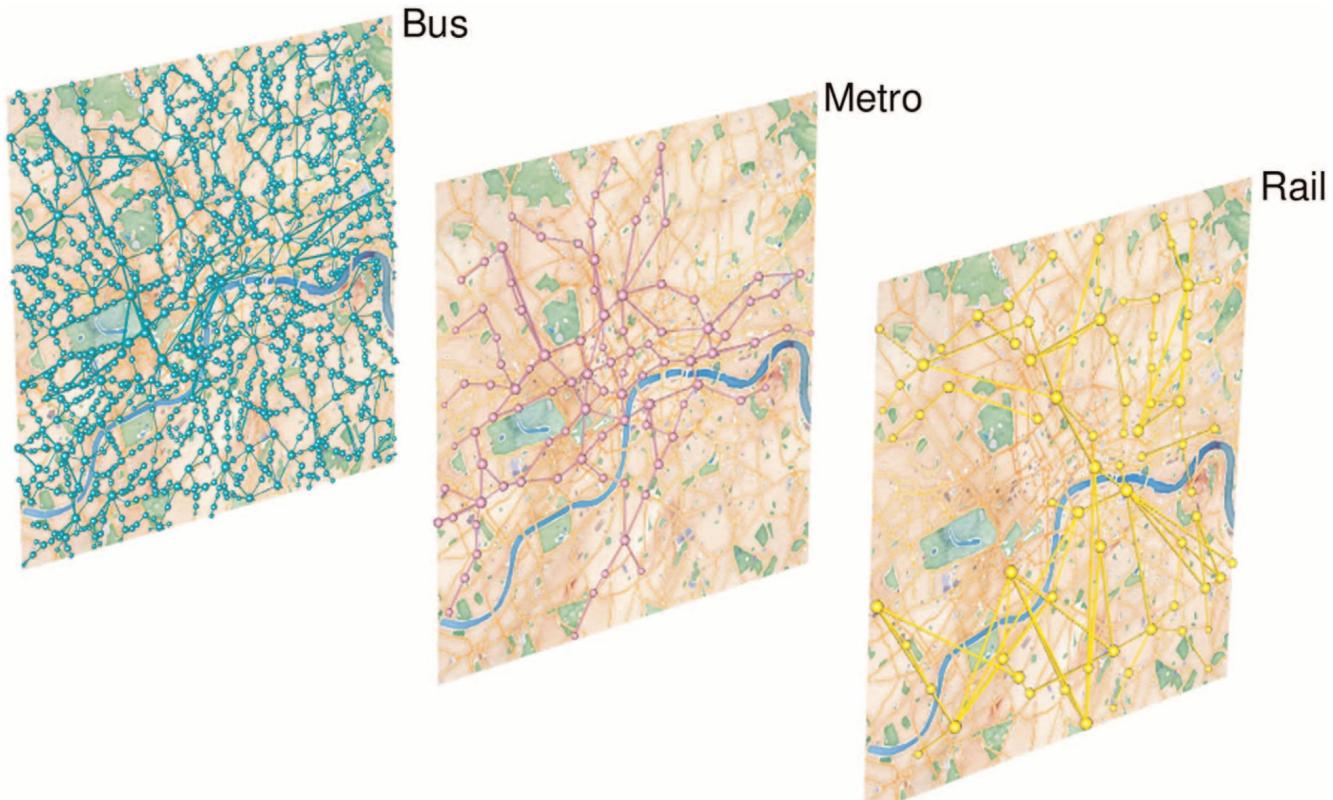
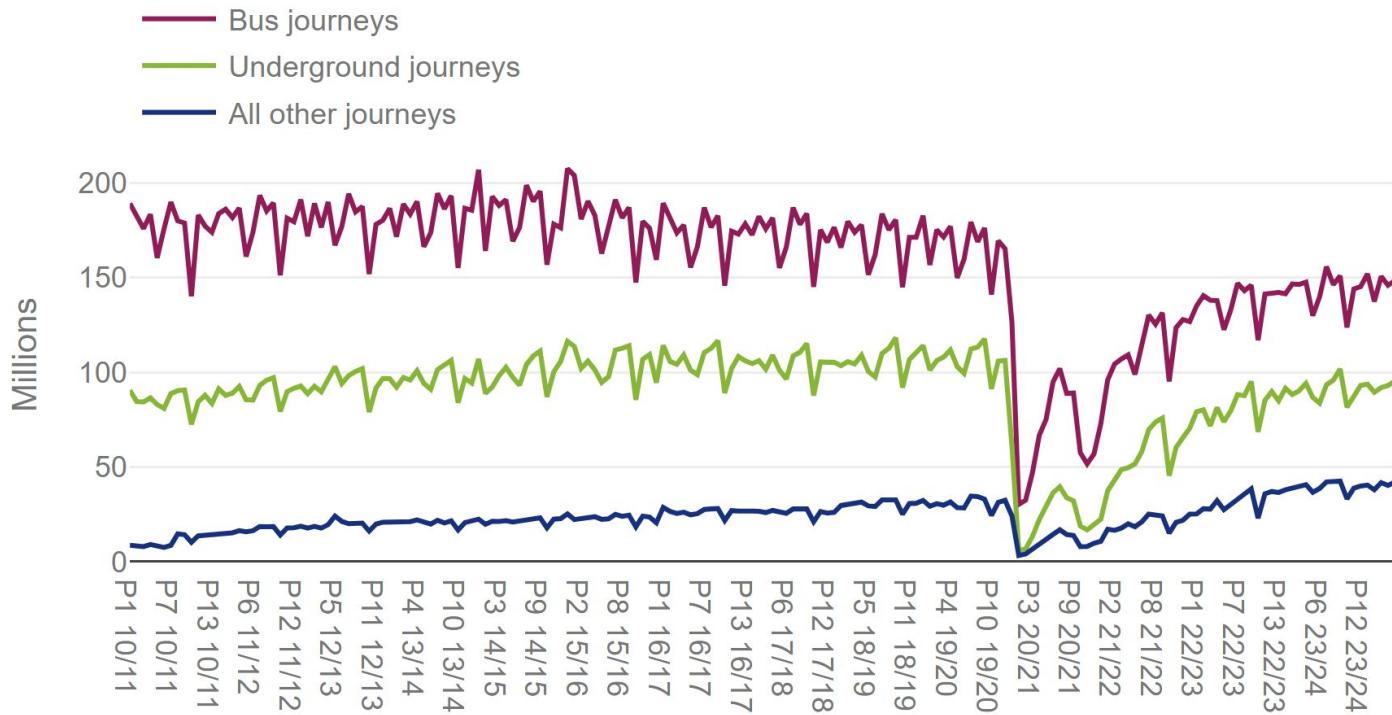
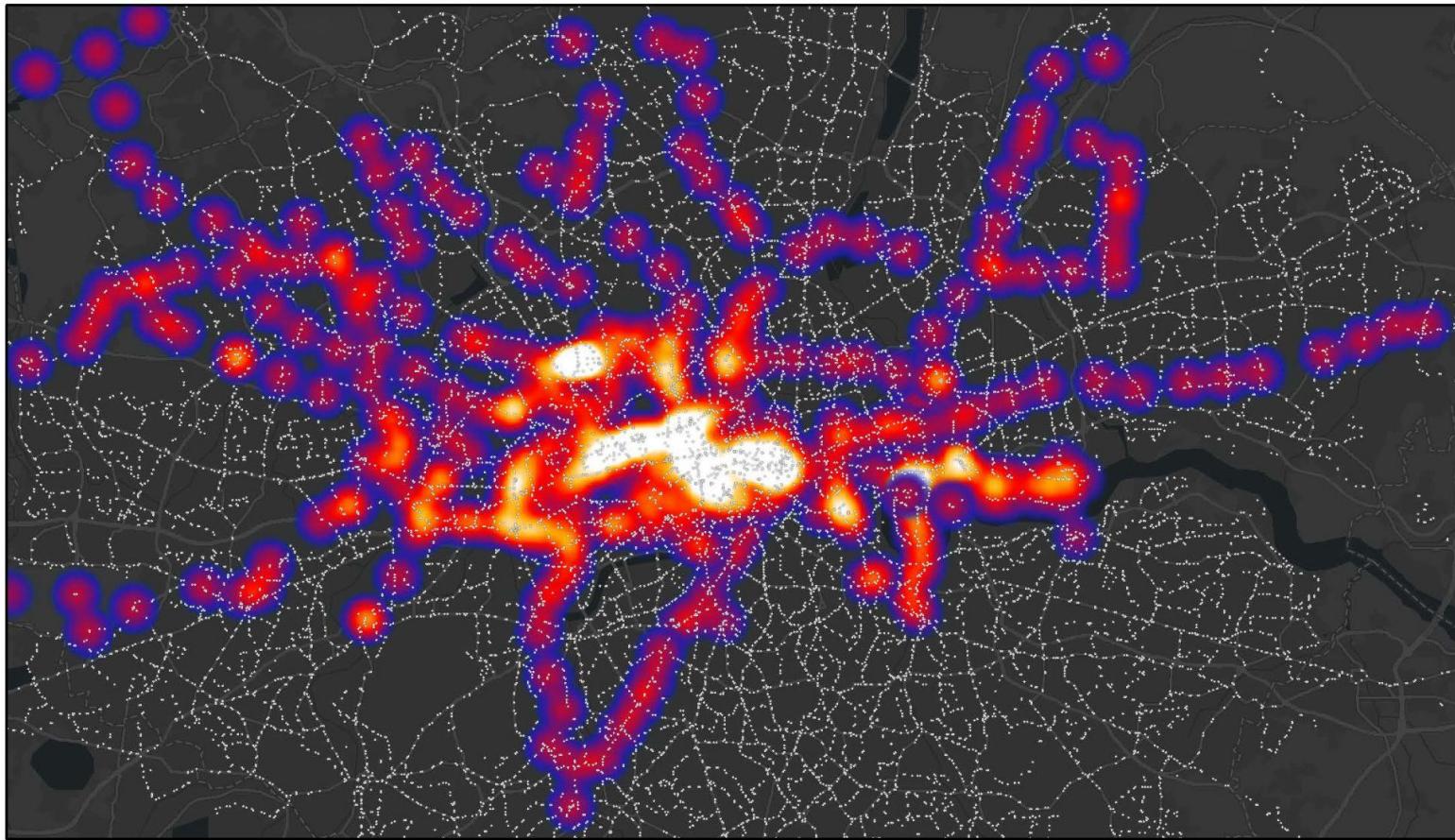


Figure1. Urban public transport network in London.(Gallotti, Porter, & Barthelemy, 2015)

Number of Journeys on the Network



Convergence of different mode



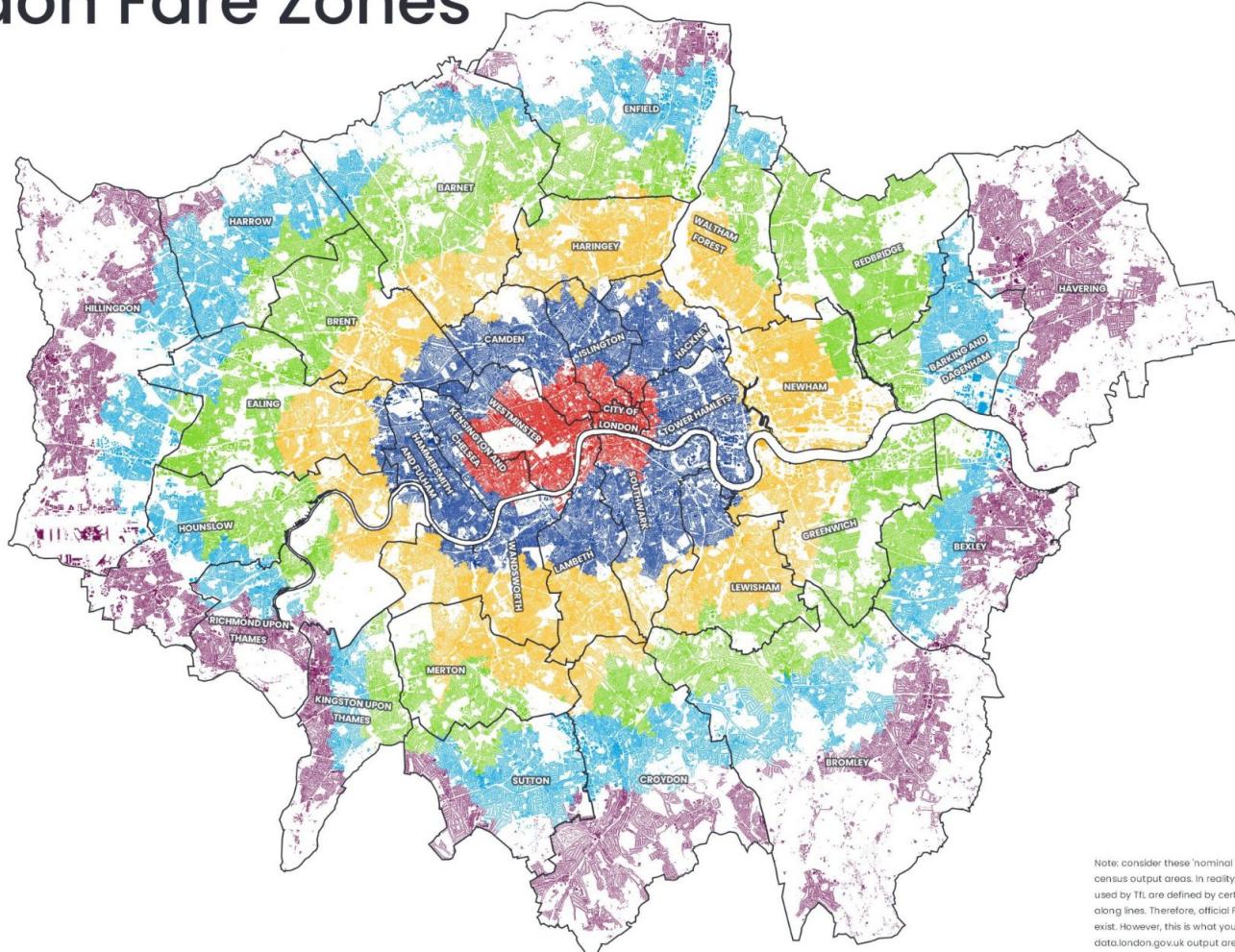
2024/9/29

1:304,604

0 1.5 3 6 mi
0 2.5 5 10 km

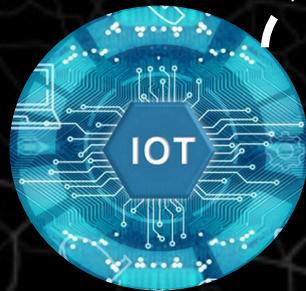
Esri UK, Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS

London Fare Zones



Note: consider these 'nominal fare zones', based on census output areas. In reality, the Fare Zones as used by TfL are defined by certain stations or points along lines. Therefore, official Fare Zone areas do not exist. However, this is what you get when you use the data.london.gov.uk output area to fare zones file.

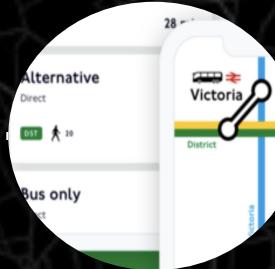
Digital Infrastructure Networks



Internet of things (IoT)
sensors



Audio Guide



TfL Go app



The Oyster card system



WebCAT
Accessibility Map

Agents

-Transport for London (TfL)-

-Public Transport Operators-

- *Buses/London Underground and Overground* •

-Private Transport Providers-

- *Bike-Sharing Services: Santander Cycles* •

-Passengers and Commuters-



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Nodes

In the London Transportation system, nodes include a wide range of facilities, including underground stations, bus stops, overground stations, tram stops, and bike-sharing stations. Each of these nodes acts as a focal point where different modes of transportation converge, allowing seamless transitions between services. Together, these nodes form a comprehensive and dynamic network, enabling the smooth flow of commuters across the city and providing convenient connections between London's various transport systems.

A. Station distribution—underground station

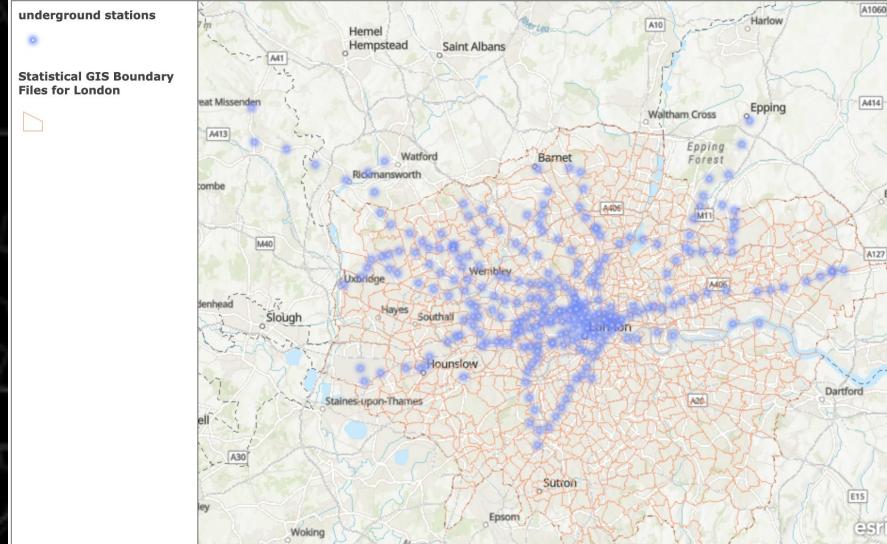
B. Access level map



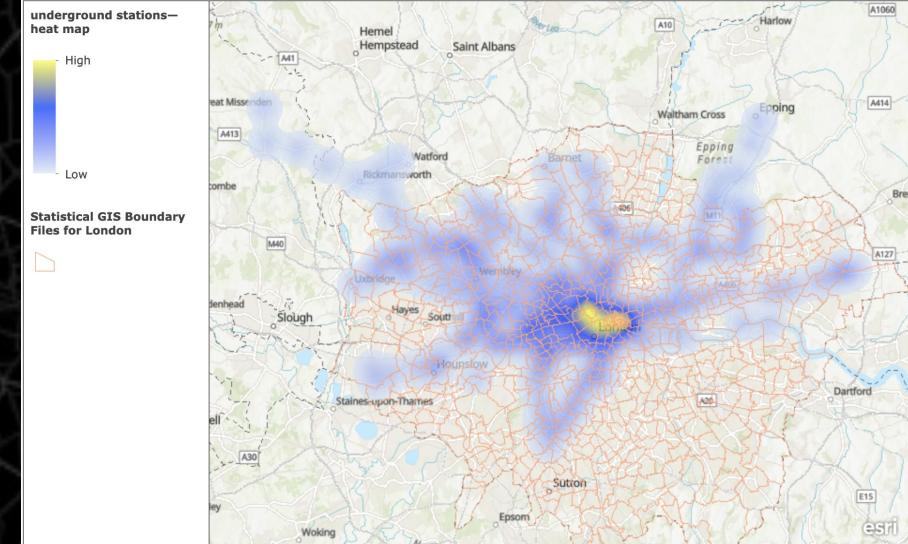
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Underground Station Distribution

London station



London station



Bus Stop Distribution

London Bus Stops

BusStops

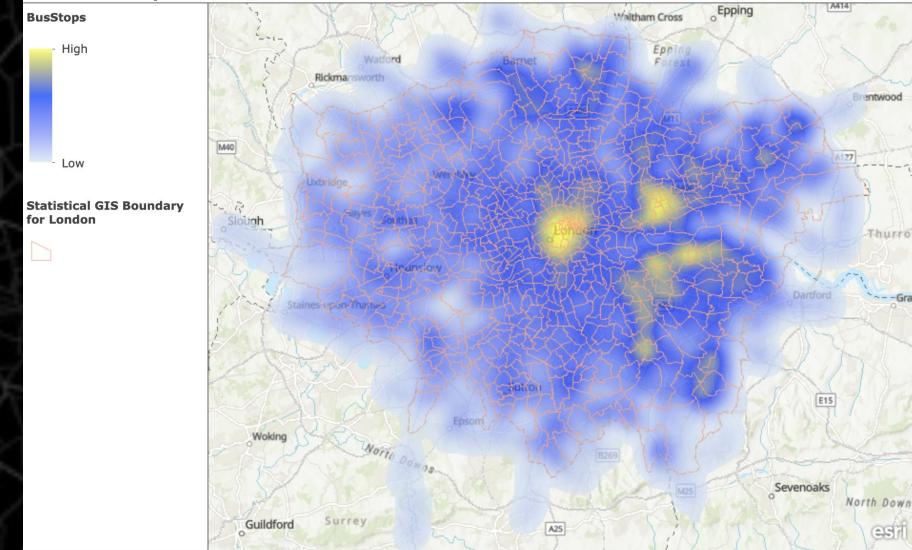
Statistical GIS Boundary
for London



London Bus Stops

BusStops

Statistical GIS Boundary
for London



Access level map—PTAL

Address or co-ordinates

The British Museum, Great Russell

Go

Access level (PTAL)

Time mapping (TIM)

PTAL: a measure which rates locations by distance from frequent public transport services.

Map key - PTAL

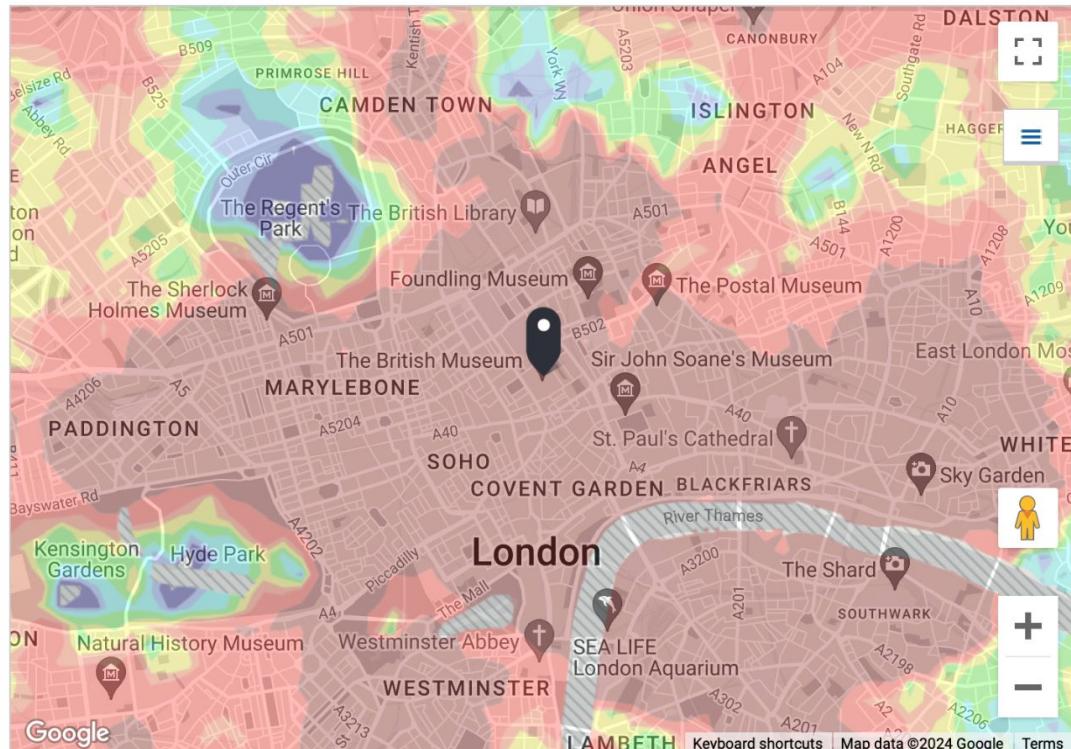


Map layers

PTAL (cell size:
100m)

WebCAT, TFL,

<https://tfi.gov.uk/info-for/urban-planning-and-construction/planning-with-webcat/webcat?Type=PTAL&lat=51.53139&lon=-0.15724&scenarioBase%20Year&zoomLevel=12&places=Stations%20stops%20and%20piers%7CTravel%20times>



Access level map—TIM

Address or co-ordinates

The British Museum



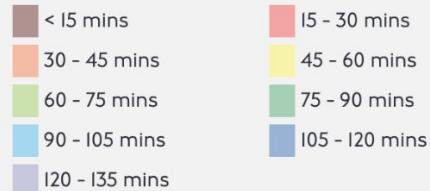
Go

Access level (PTAL)

Time mapping (TIM)

TIM: a new measure, looking at how far you can travel in a given journey time.

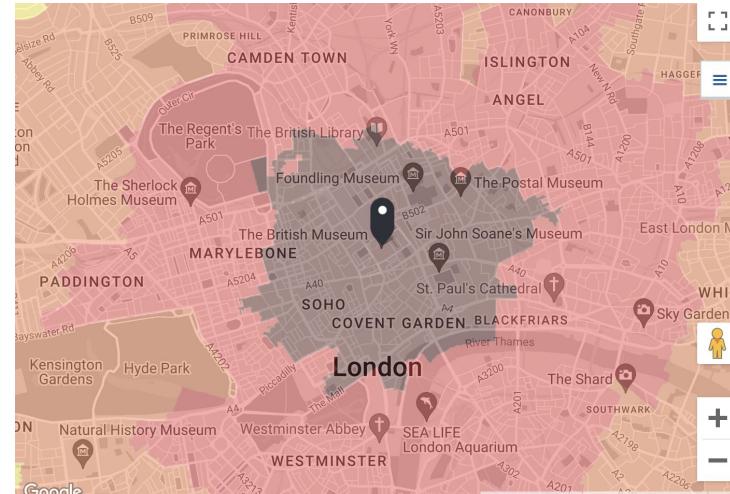
Map key - Travel Time



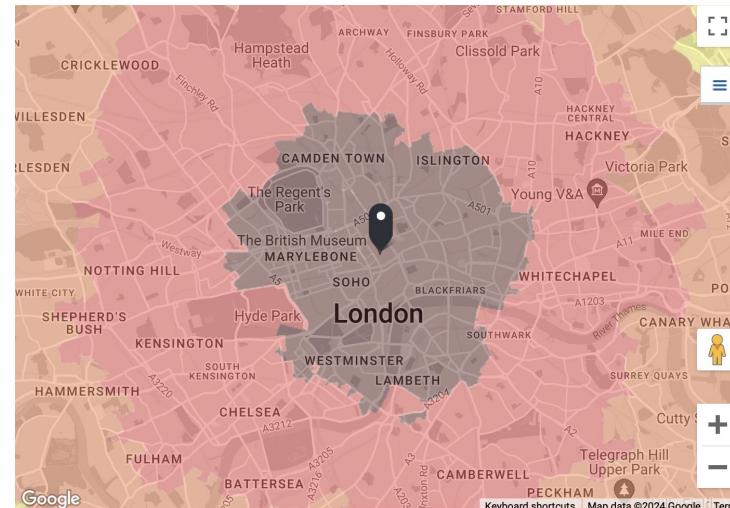
Change travel time bands



Map layers



Bus



Bike

Flows

London's transportation flow is a seamless integration of buses, the Underground, cycling, and smart mobility, supported by real-time data and contactless systems for smooth, efficient movement.

A : Physical Flow

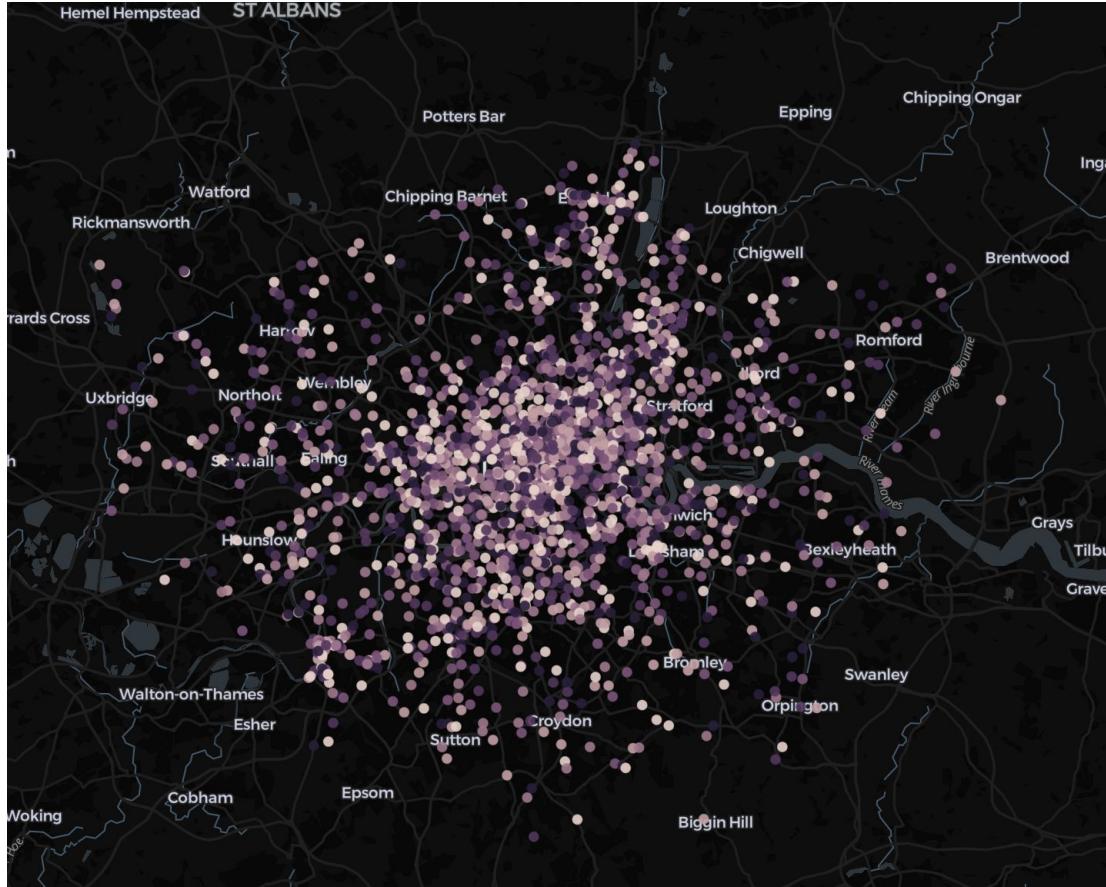
B : Digital Flow



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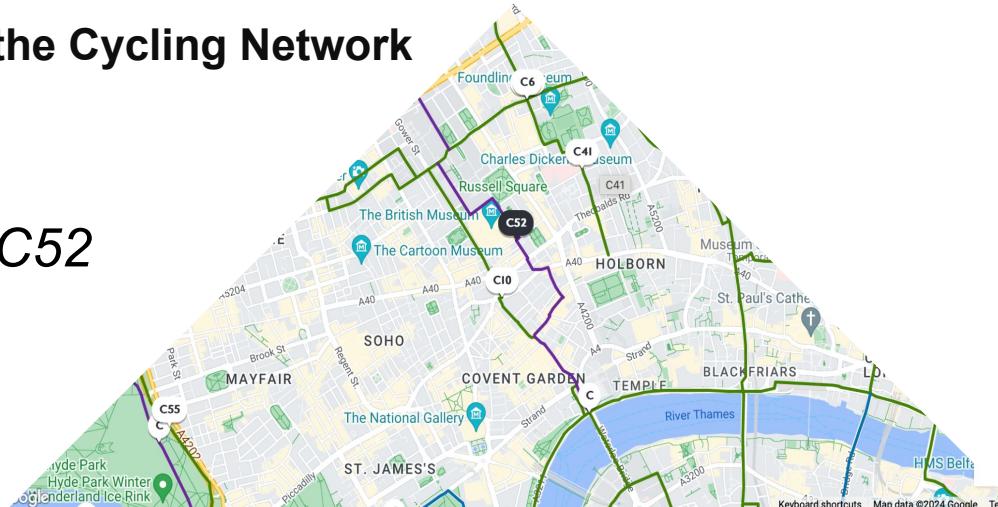
Map of Santander Cycle docking stations

High density - High traffic flow



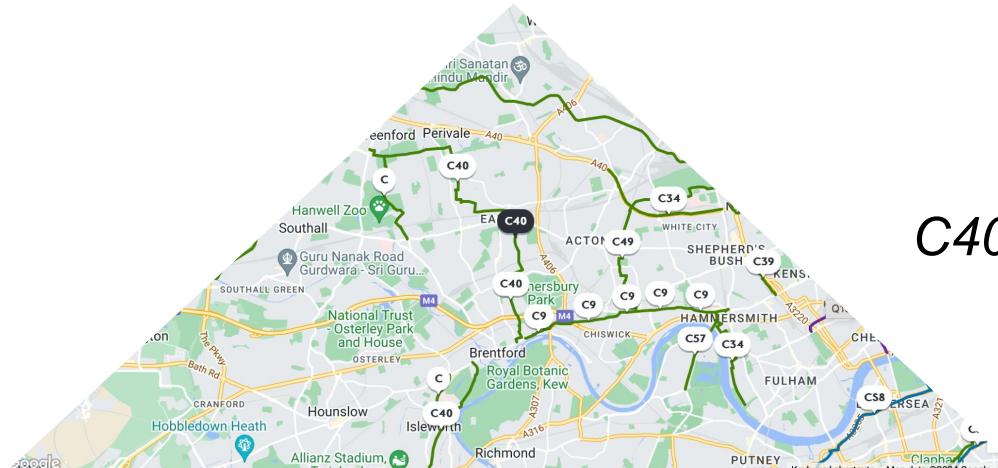
Physical Flow of the Cycling Network

C52



facilitate flow from outer suburbs into central business districts

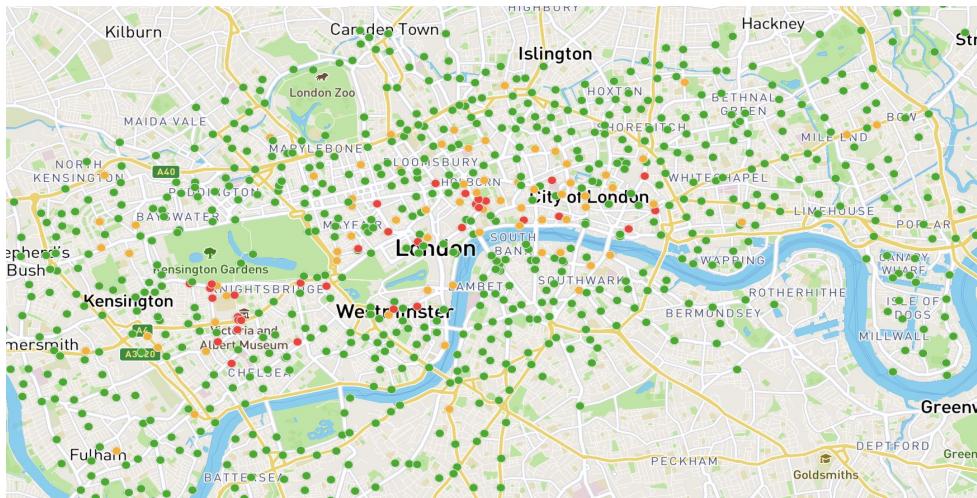
C40



connects areas like Greenford and Hayes to the city center

Digital Flow - Santander Cycles and Availability

<https://santandercycles.tfl.gov.uk/map?intcmp=48337>

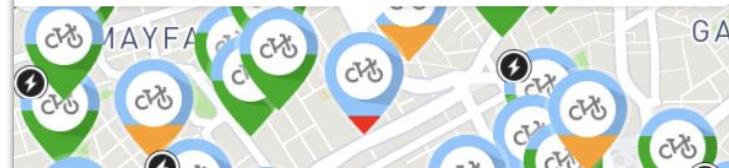


Sackville Street, Mayfair

0 17

Bikes Docks

Last Updated 10:31 PM



Hatton Garden, Holborn

4 ⚡ 1 22

Classic Ebikes Docks



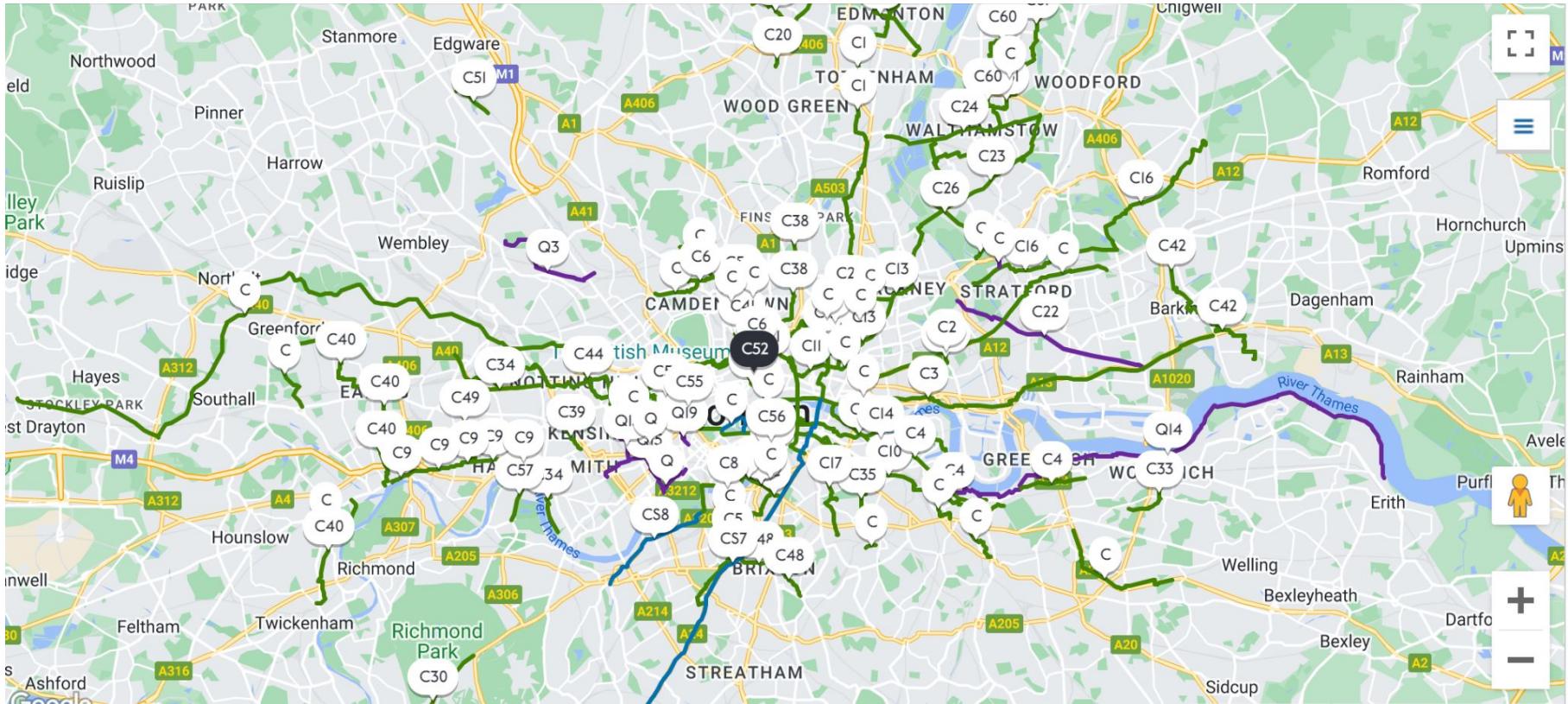
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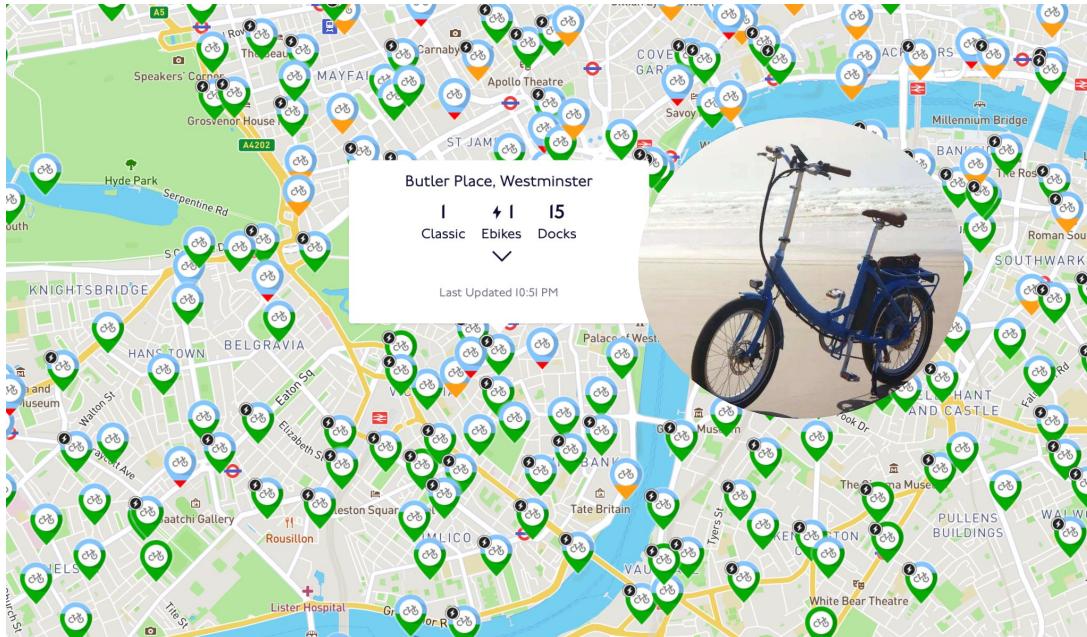
London's Hard System Flow: Cycling Infrastructure

Commuter-Friendly Design/Outer Suburban Reach

<https://tfl.gov.uk/maps/cycle>



Future Flows - Ebike Availability



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