MAGIC Project

City-Scale and Transport Modelling in London

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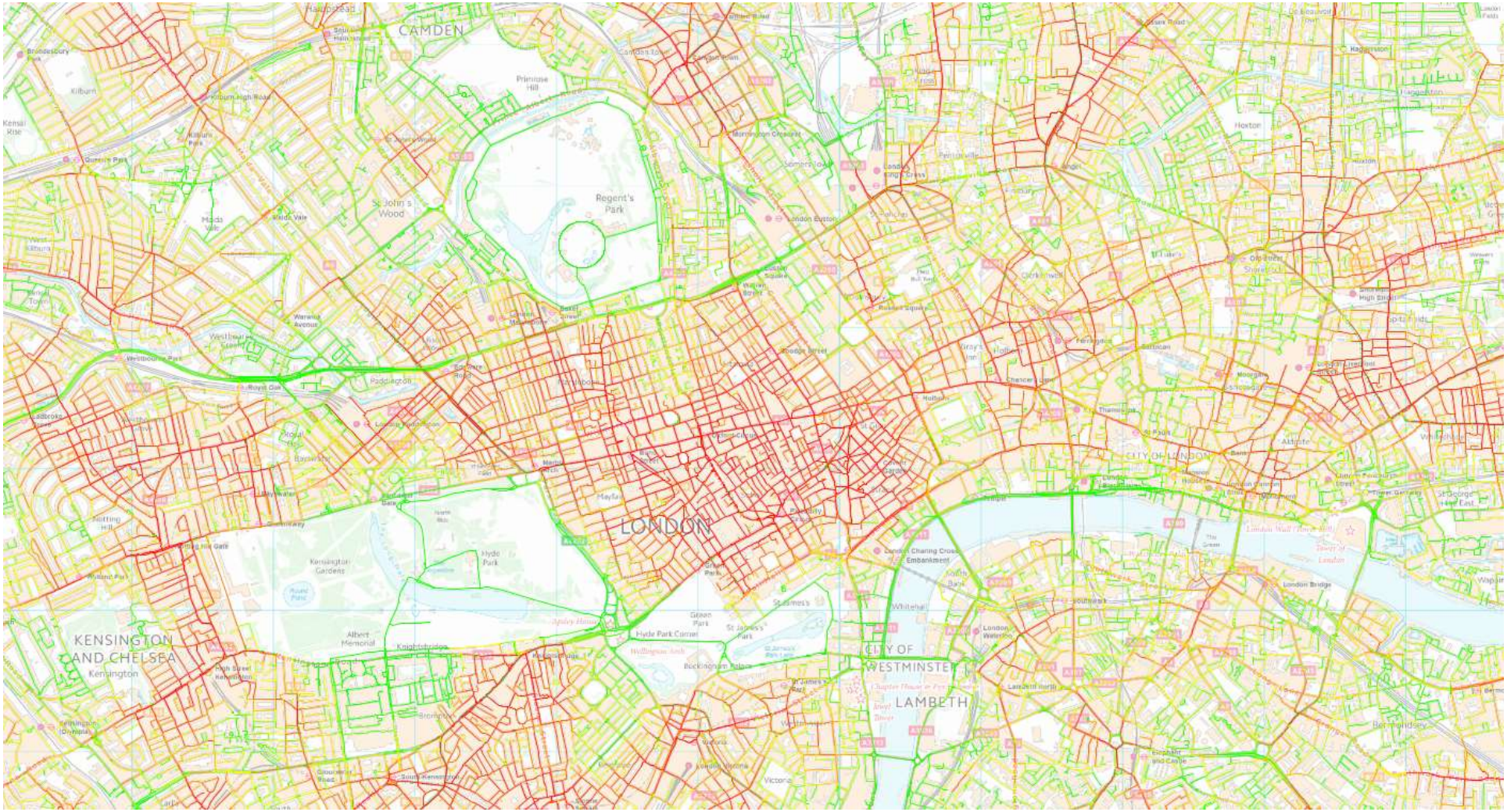
(with contributions from Vassilis Zachariadis, Tim Hillel and Steve Denman)

Layer 1: transport network and land use



Layer 2: Travel

London Travel Demand Survey

Survey data

t_r

Recorded
trip duration

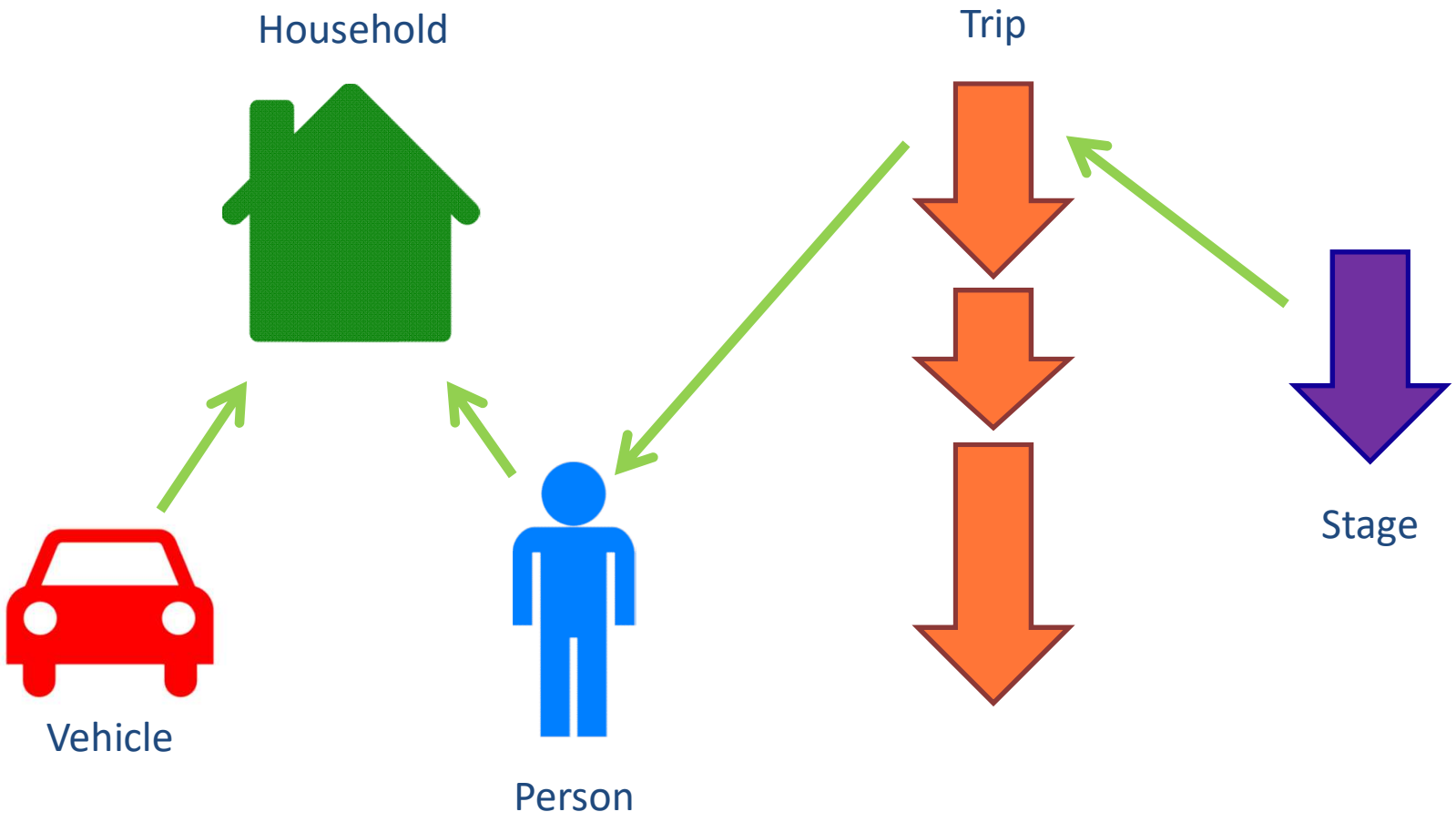
Trip details

Google Directions
API

t_c

Predicted trip
duration

London Travel Demand Survey



London Travel Demand Survey

LTDS

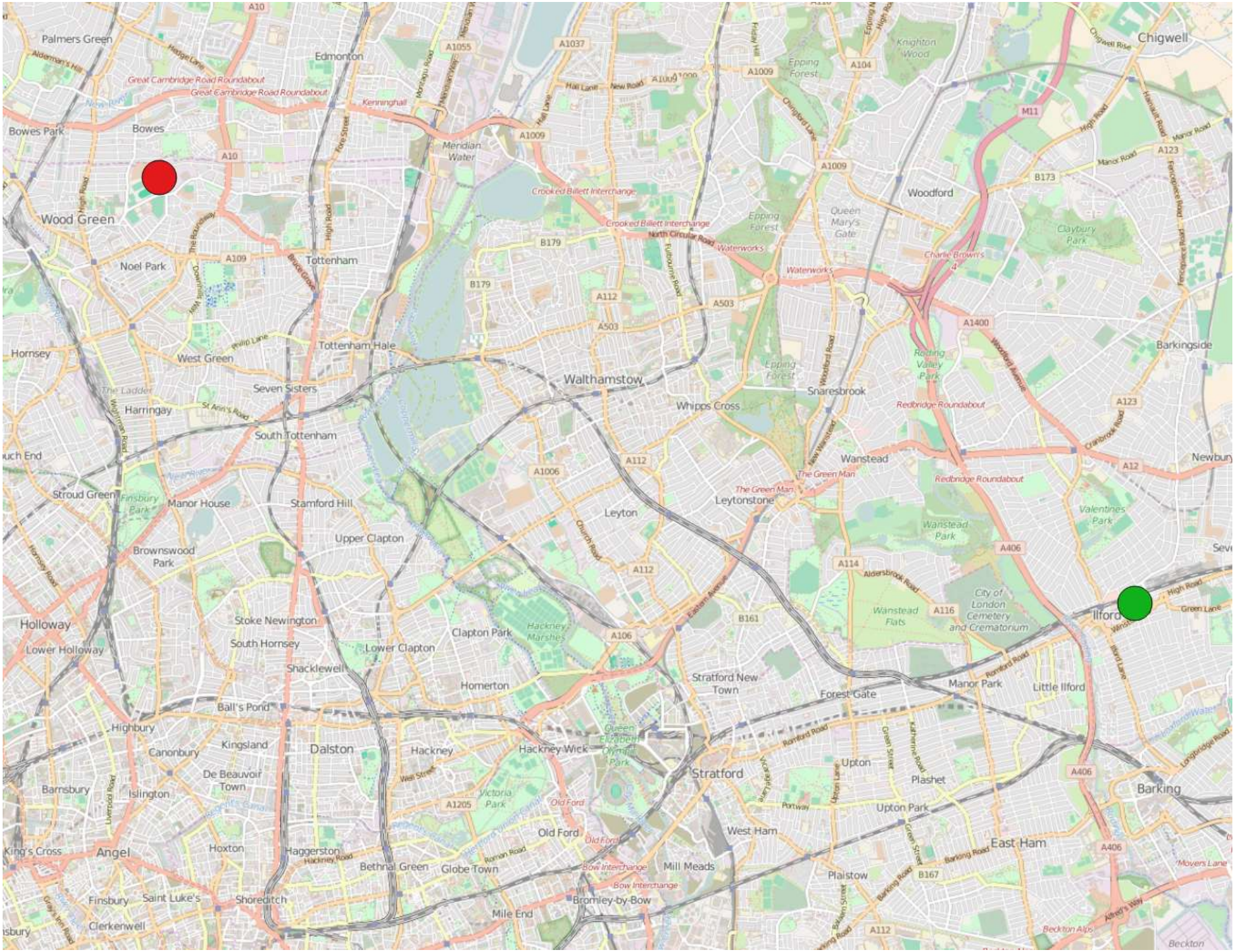
2005/06-2014/15

Each year (approx.):

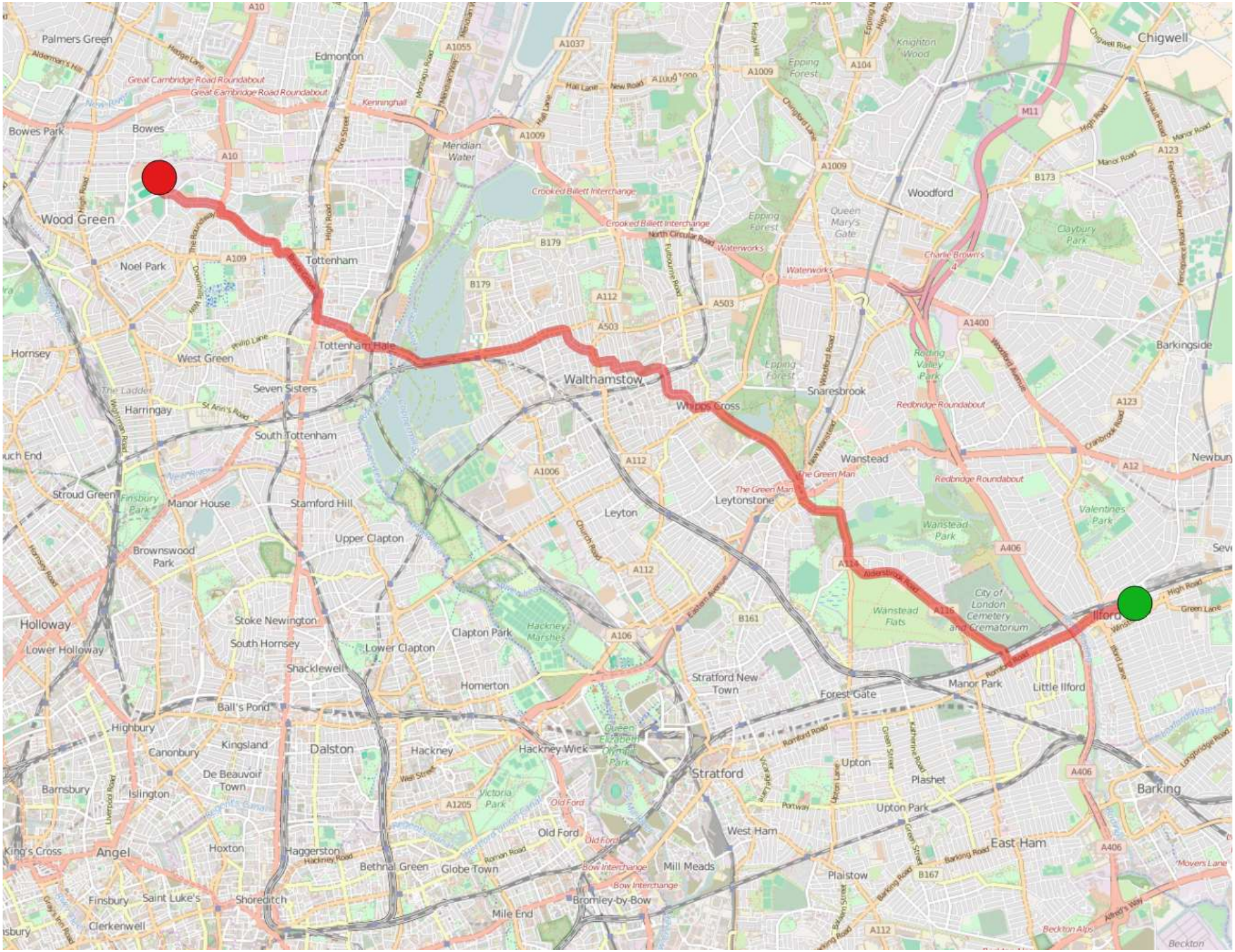
- 8000 households
- 19000 people
- 43000 trips

2012-14 (3 years):

- 130,000 trips



Palmers Green
Edmonton
Chigwell
Bowes Park
Bowes
Wood Green
Noel Park
Tottenham
Meridian Water
Woodford
Queen Mary's Gate
Epping Forest
Knighton Wood
Claybury Park
Charlie Brown's
Waterworks
Hornsey
West Green
Tottenham Hale
Walthamstow
Snaresbrook
Whipps Cross
Barkingside
Seven Sisters
Harringay
South Tottenham
Wanstead
Newbury
Stroud Green
Manor House
Stamford Hill
Leyton
Leytonstone
Valentines Park
Wanstead Park
Upper Clapton
Brownswood Park
Holloway
Lower Holloway
Stoke Newington
South Hornsey
Lower Clapton
Clapton Park
Hackney Marshes
Wanstead Flats
City of London Cemetery and Crematorium
Ilford
Shacklewell
Homerton
Stratford New Town
Forest Gate
Manor Park
Little Ilford
Ball's Pond
Highbury
Canonbury
Kingsland
Dalston
Hackney
Hackney Wick
Queen Elizabeth Olympic Park
Stratford
Upton
Plashet
Barking
Barnsbury
Islington
De Beauvoir Town
Victoria Park
Old Ford
Upton Park
West Ham
East Ham
King's Cross
Angel
Hoxton
Haggerston
Bethnal Green
Globe Town
Mill Meads
Plaistow
Finsbury
Saint Luke's
Shoreditch
Bromley-by-Bow
Mile End
Clerkenwell
Beckton
Great Cambridge Road Roundabout
Crooked Billett Interchange
Redbridge Roundabout
The Green Man
Bow Interchange



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Seven Sisters
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Snaresbrook
Barkingside
Harringay
South Tottenham
Wanstead
Newbury
Stroud Green
Manor House
Stamford Hill
Leyton
Leytonstone
Upper Clapton
Brownswood Park
Holloway
Lower Holloway
Stoke Newington
South Hornsey
Lower Clapton
Clapton Park
Shacklewell
Homerton
Stratford New Town
Forest Gate
Manor Park
Little Ilford
Ilford
Ball's Pond
Highbury
Canonbury
Kingsland
Dalston
Hackney
Hackney Wick
Stratford
Upton
Plashet
Barking
Barnsbury
Islington
De Beauvoir Town
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Haggerston
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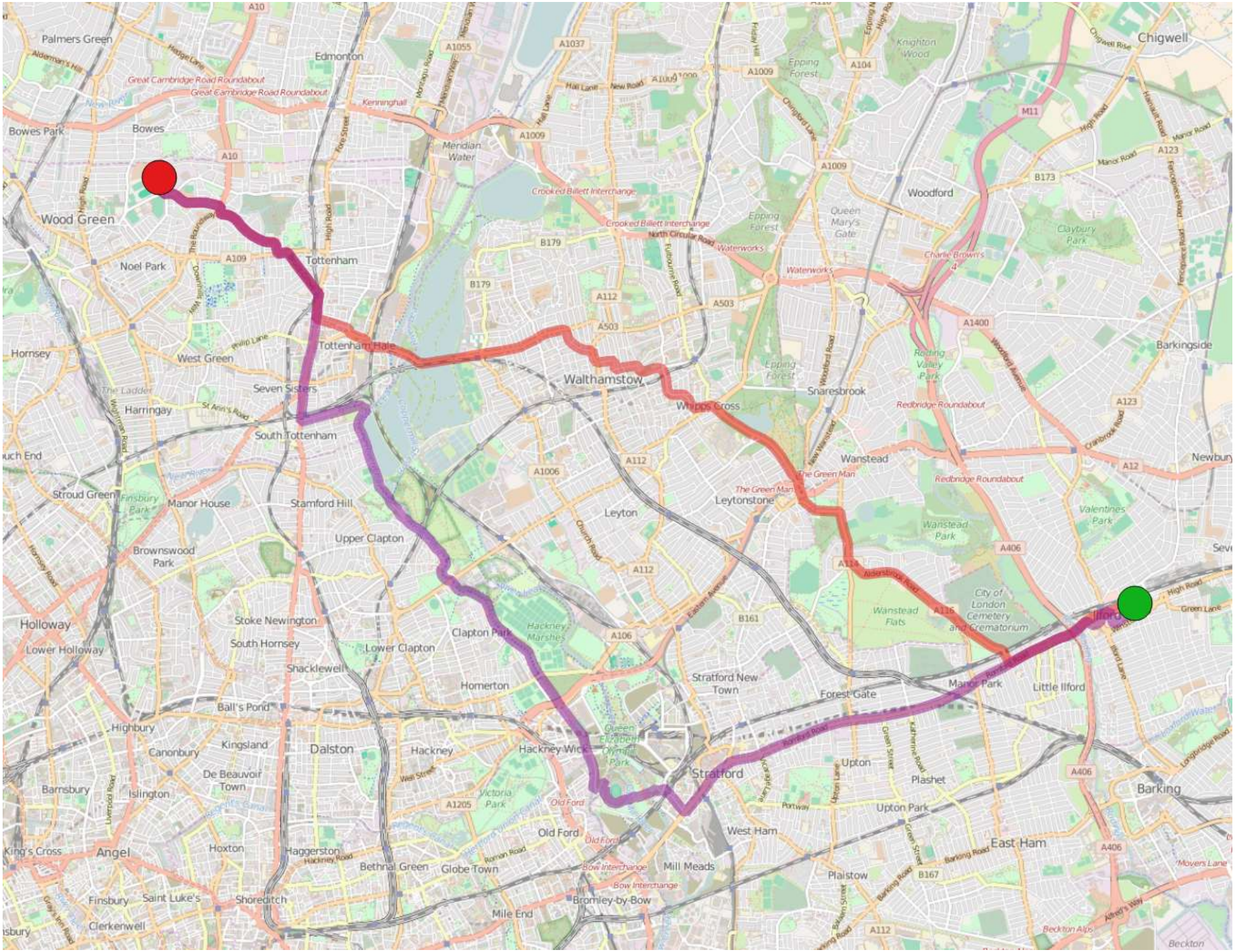
Plaistow
Finsbury
Saint Luke's
Shoreditch
Bromley-by-Bow
Mile End
Clerkenwell



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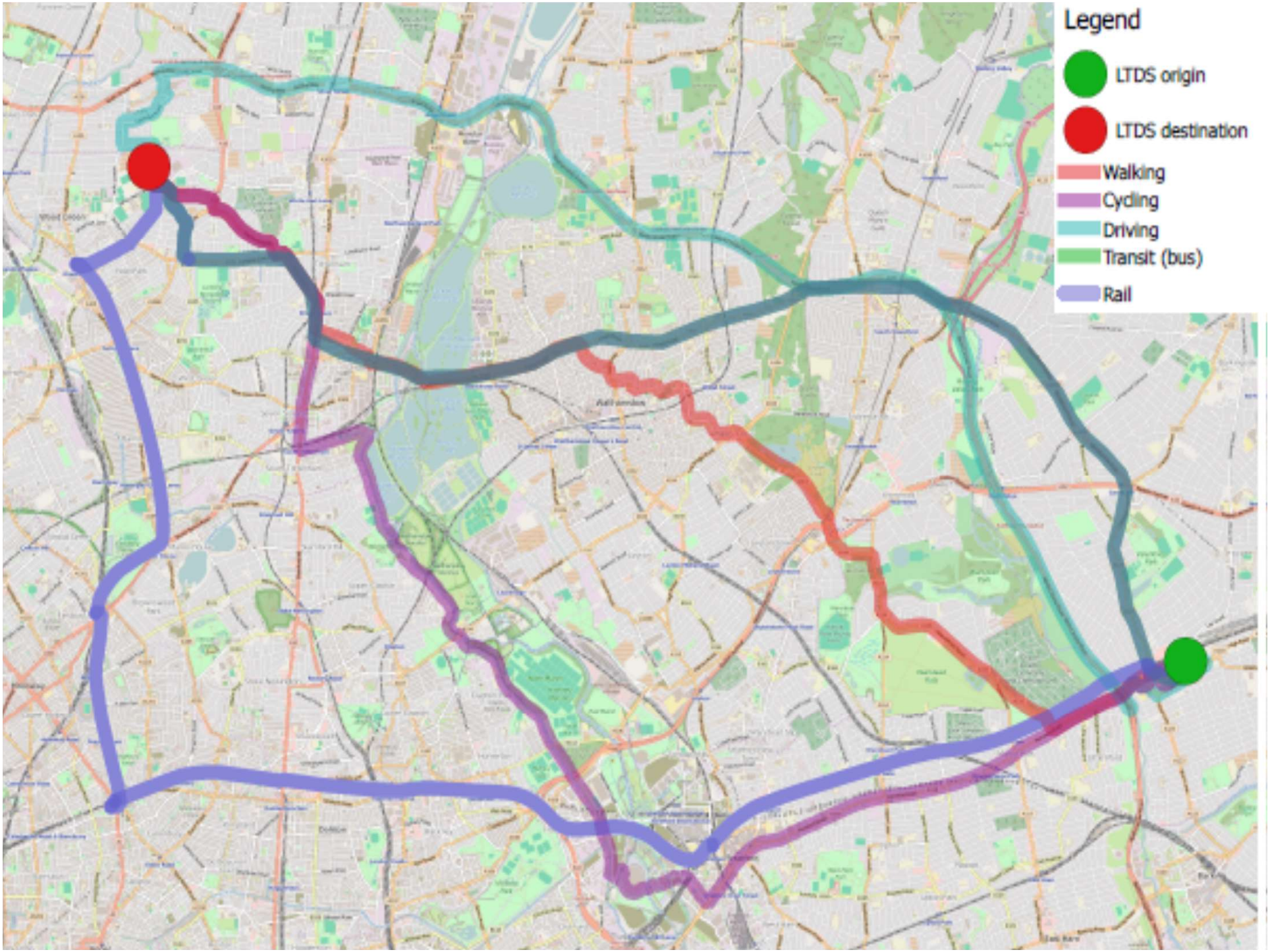
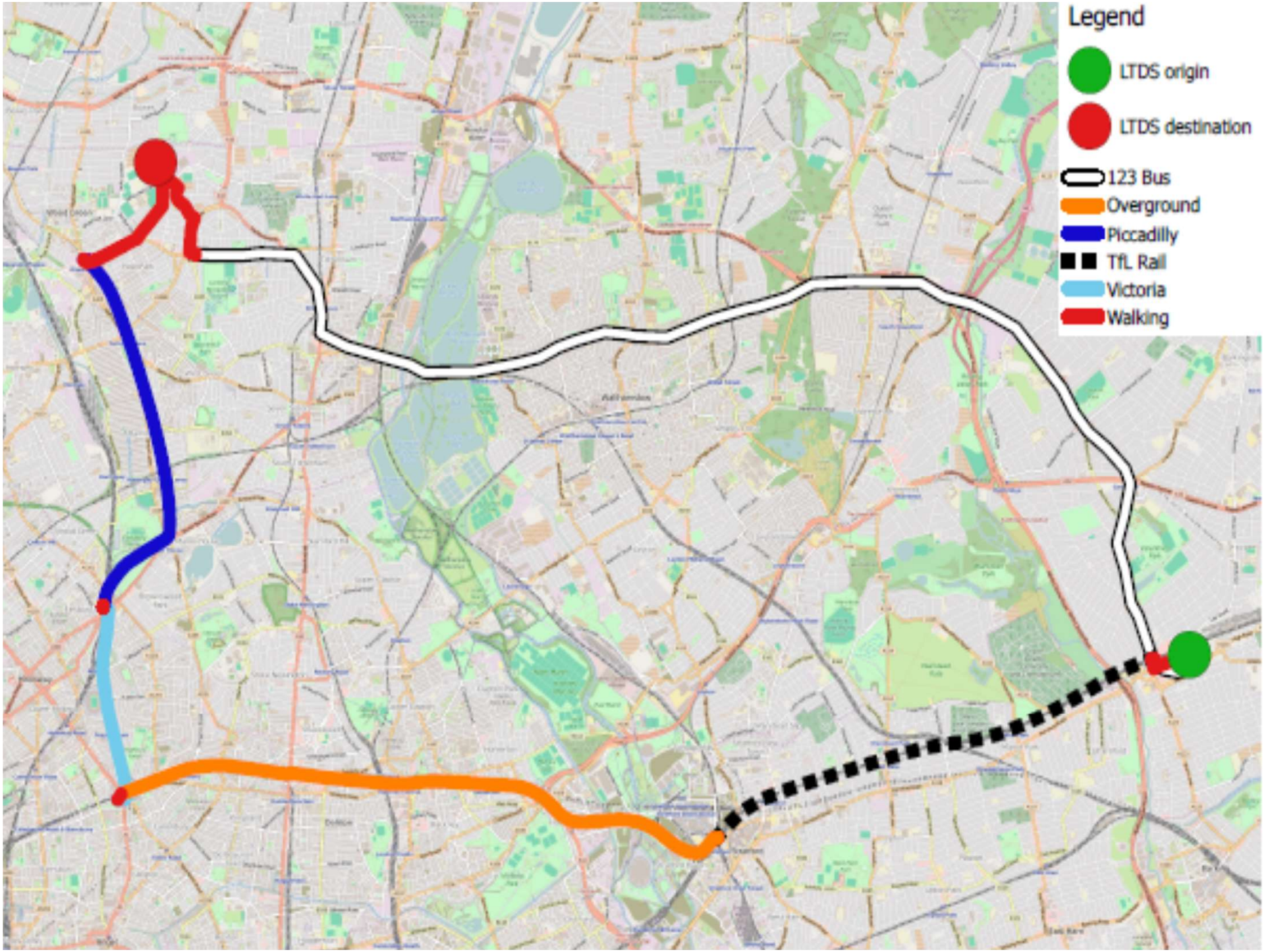
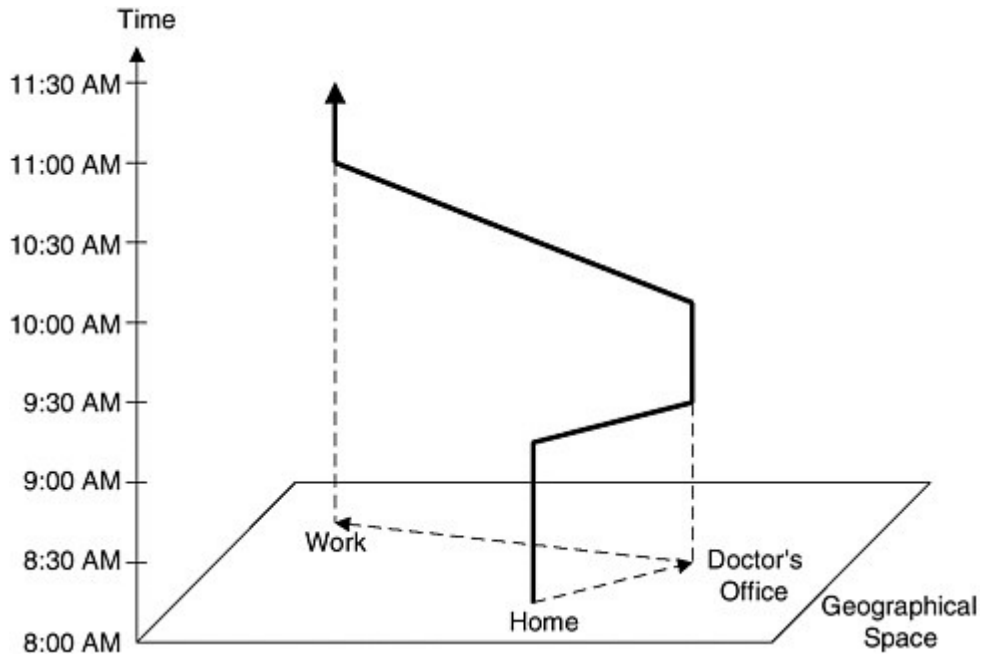
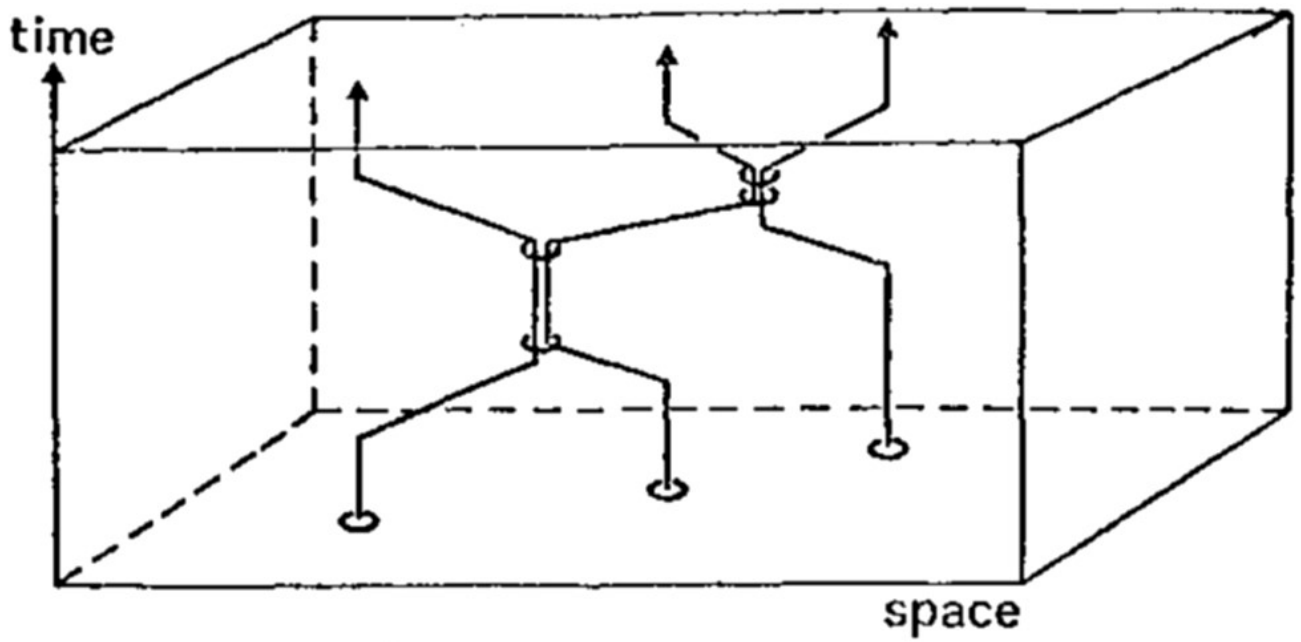
Saint Luke's
Shoreditch
Bromley-by-Bow
Mile End
Clerkenwell


Legend
LTDS origin
LTDS destination
Walking
Cycling
Driving
Transit (bus)
Rail


Legend
LTDS origin
LTDS destination
123 Bus
Overground
Piccadilly
TfL Rail
Victoria
Walking

Layer 3: Time-geography


Time
11:30 AM
11:00 AM
10:30 AM
10:00 AM
9:30 AM
9:00 AM
8:30 AM
8:00 AM
Work
Home
Doctor's
Office
Geographical
Space


time
space

CSIC Cambridge Centre for Smart Infrastructure and Construction
4:00
CSIC Cambridge Centre for Smart Infrastructure and Construction
EPSRC Engineering and Physical Sciences Research Council
Technology Strategy Board Driving Innovation
UNIVERSITY OF CAMBRIDGE

CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
5:00
CSIC
Cambridge Centre for
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and Construction
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CSIC
Cambridge Centre for
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6:00
CSIC
Cambridge Centre for
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and Construction
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Engineering and Physical Sciences
Research Council
Technology Strategy Board
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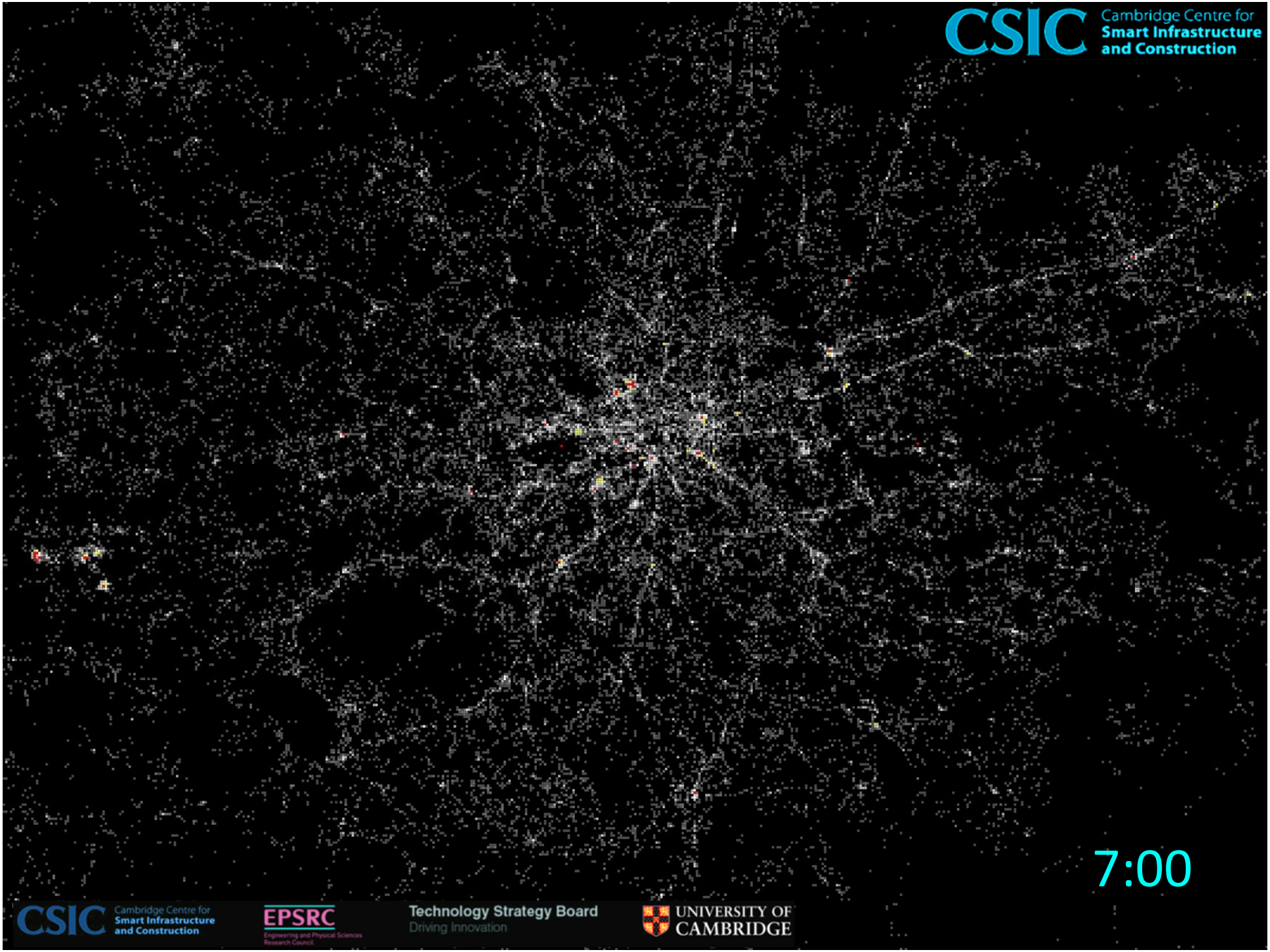
CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
7:00
CSIC
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Smart Infrastructure
and Construction
EPSRC
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
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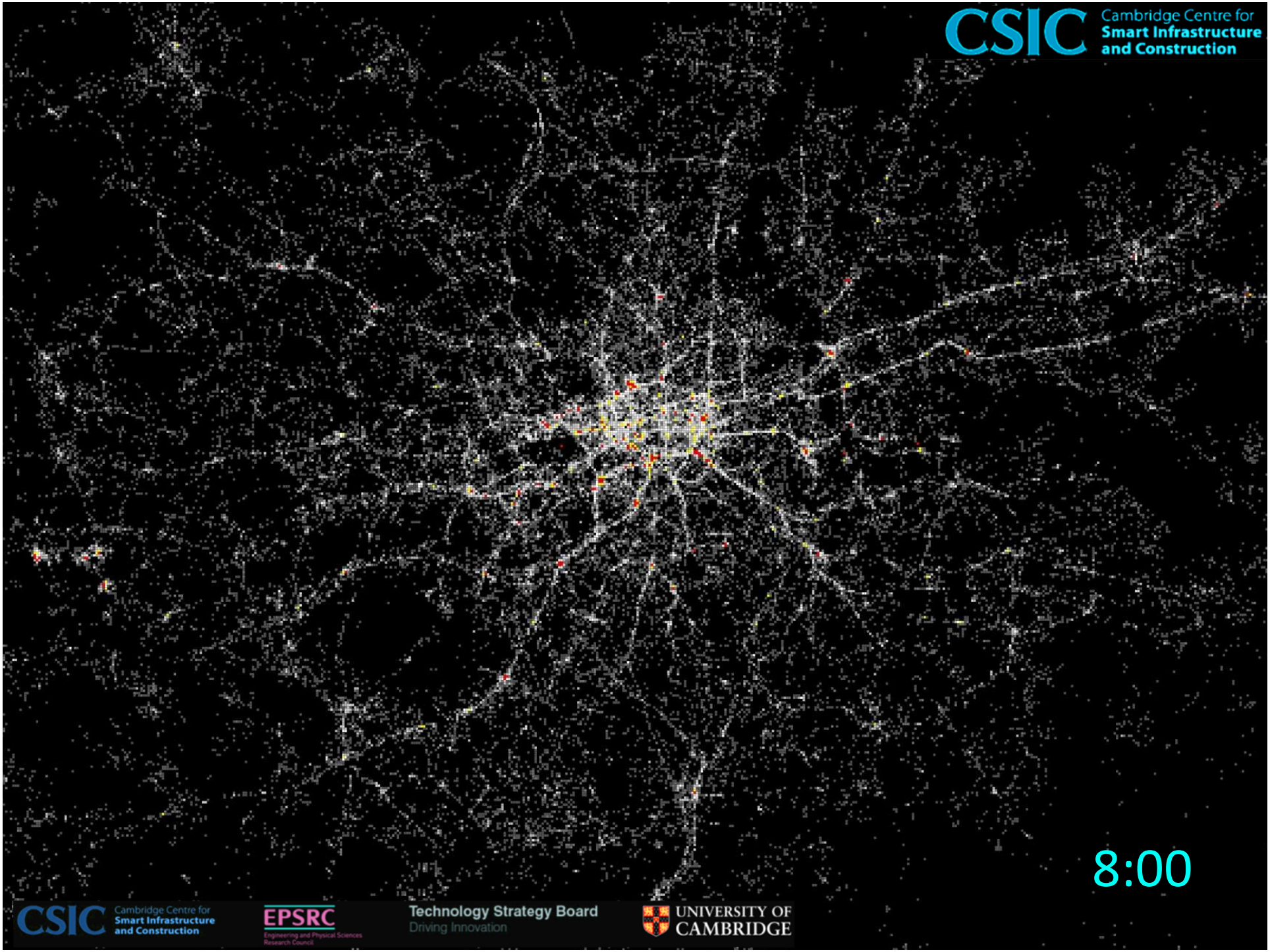
CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
8:00
CSIC
Cambridge Centre for
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and Construction
EPSRC
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
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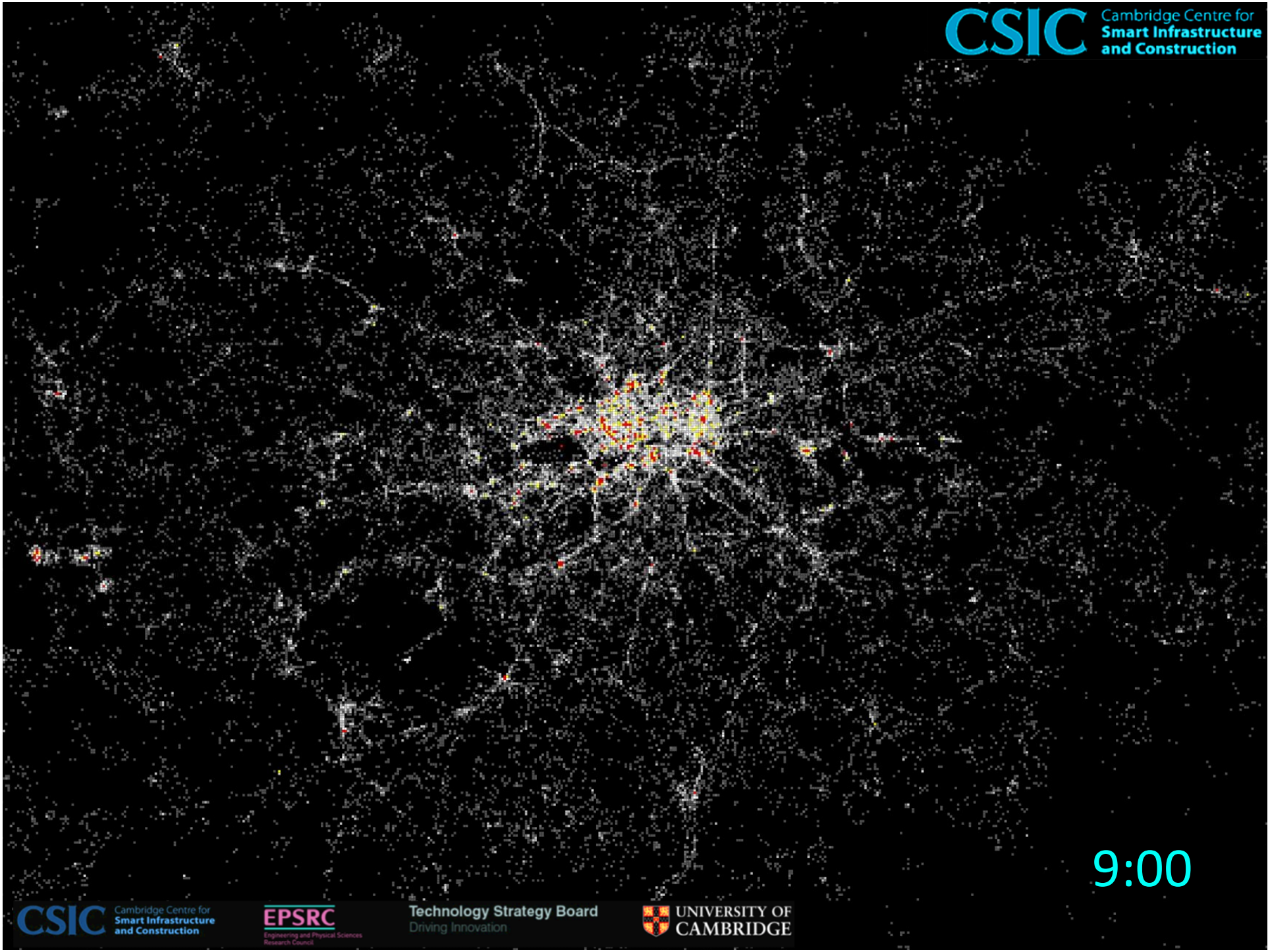
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Cambridge Centre for
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and Construction
9:00
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Technology Strategy Board
Driving Innovation
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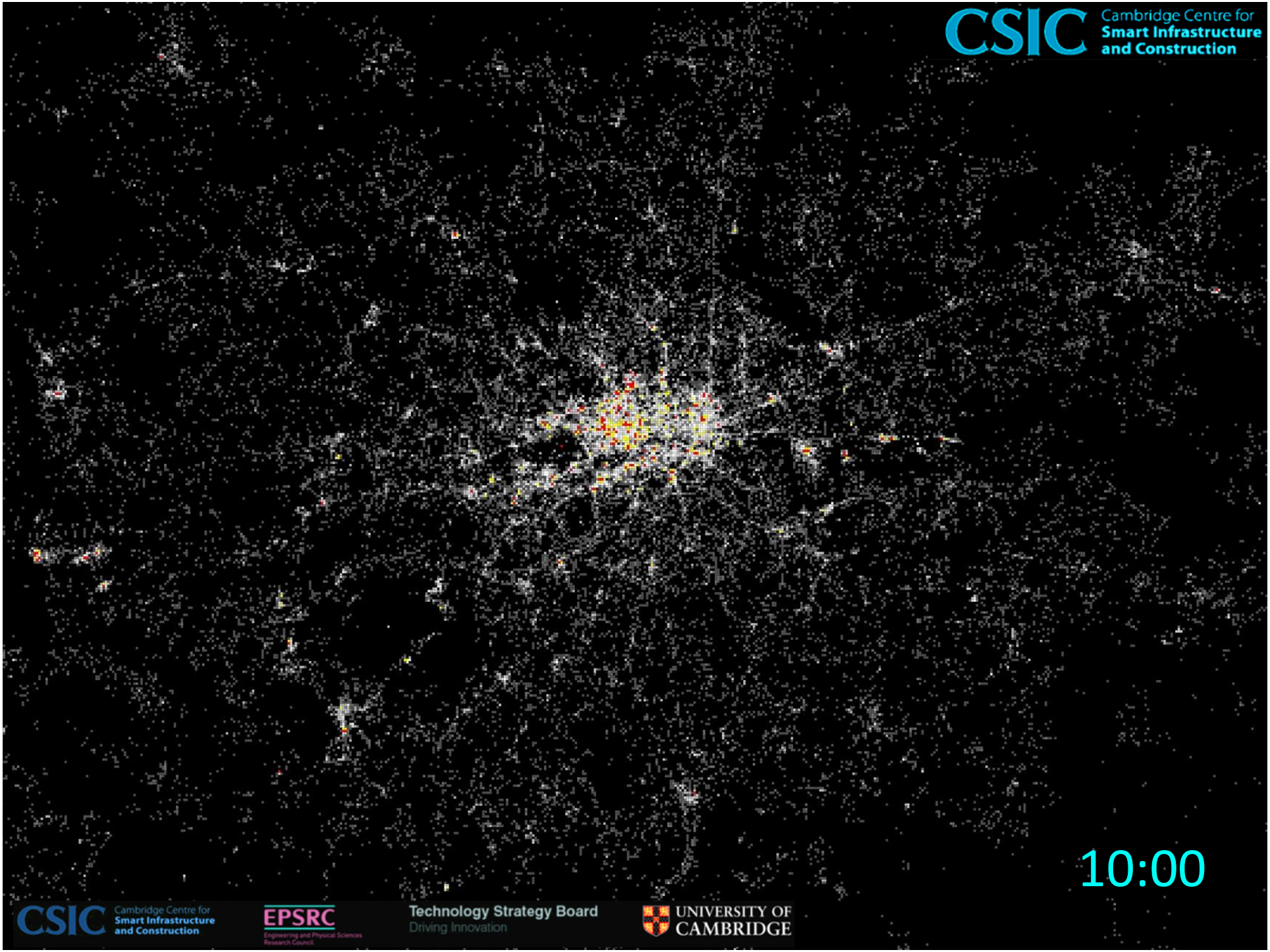
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Cambridge Centre for
Smart Infrastructure
and Construction
10:00
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Research Council
Technology Strategy Board
Driving Innovation
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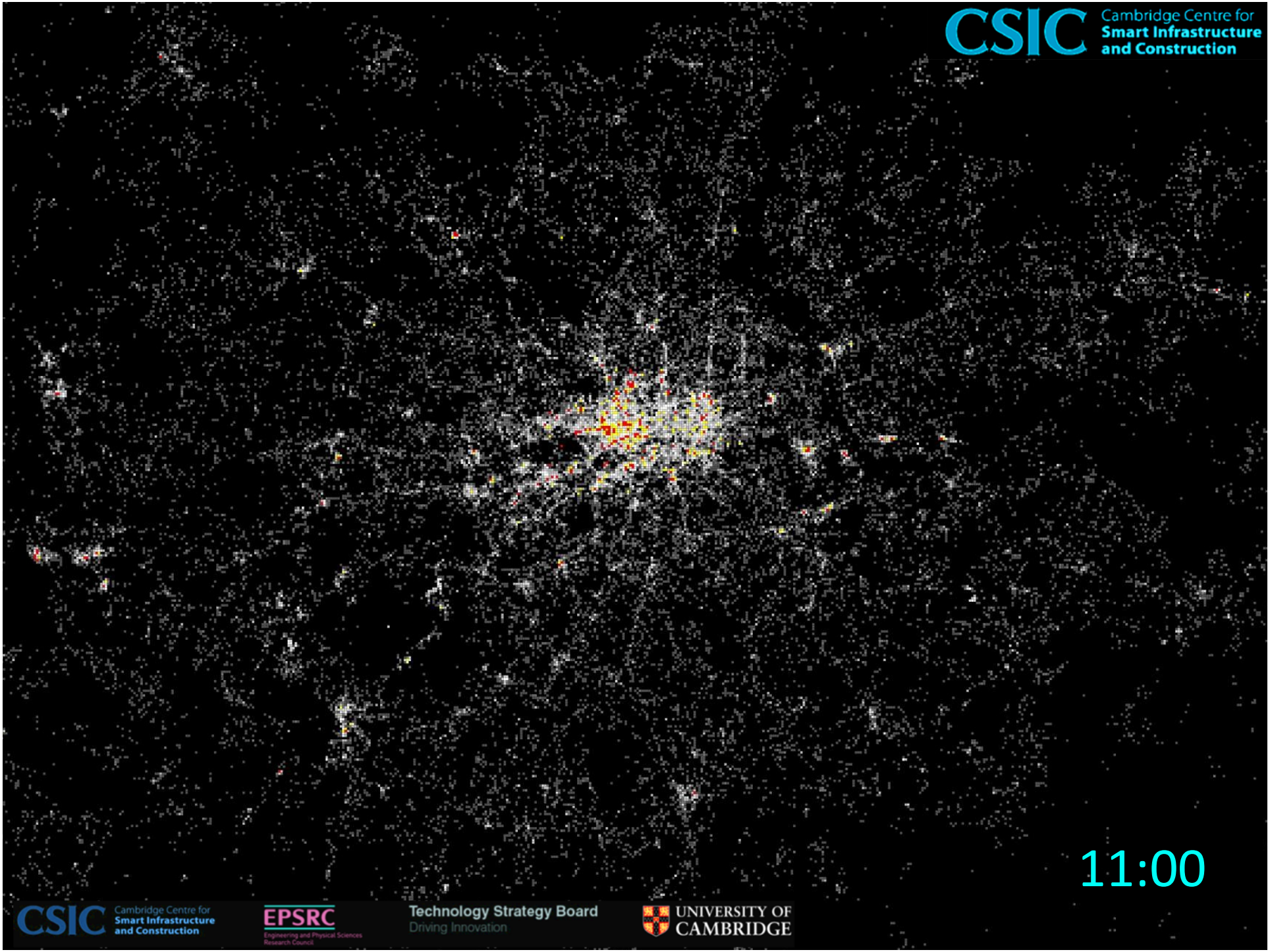
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Cambridge Centre for
Smart Infrastructure
and Construction
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Research Council
Technology Strategy Board
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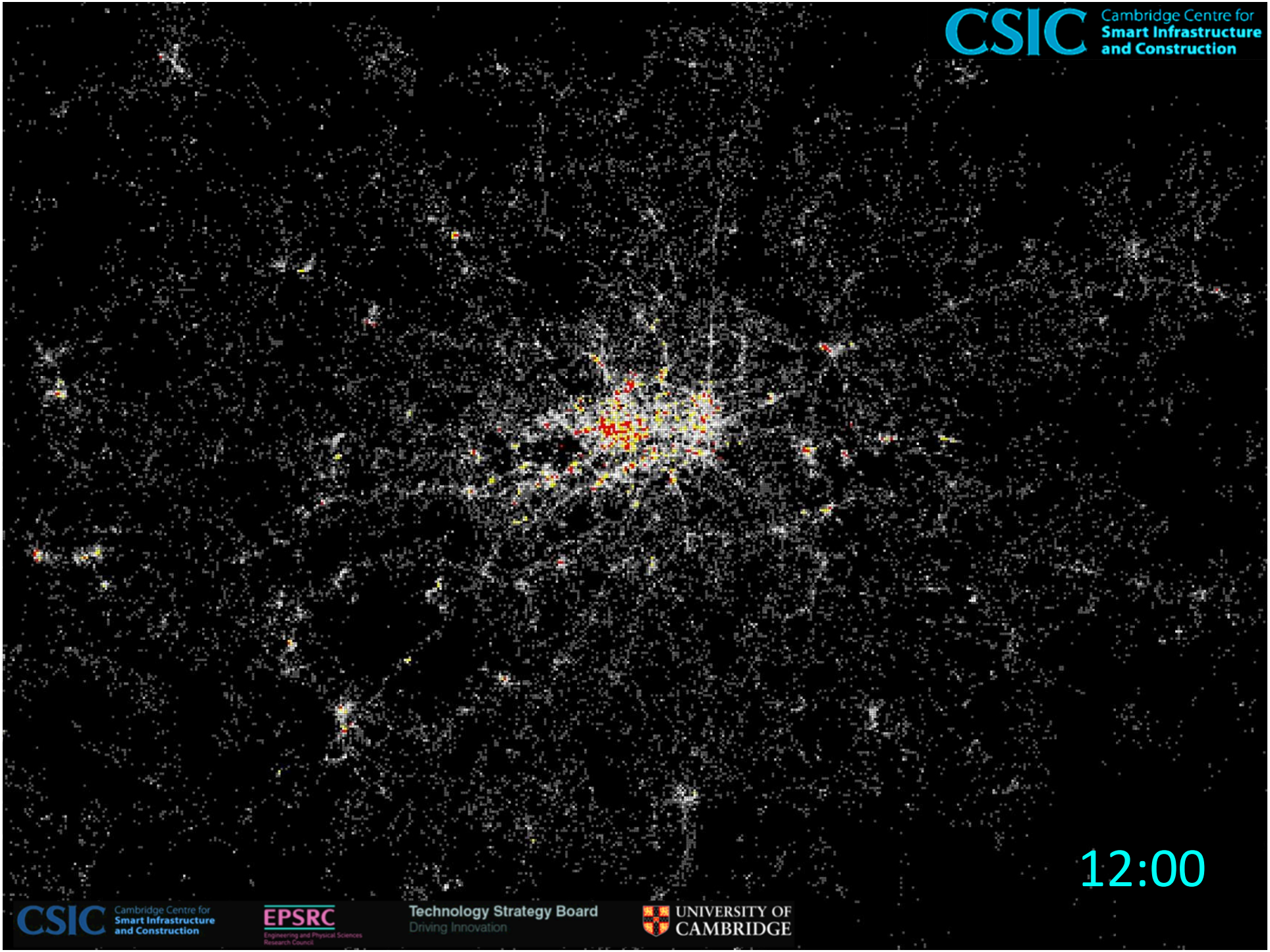
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Cambridge Centre for
Smart Infrastructure
and Construction
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Research Council
Technology Strategy Board
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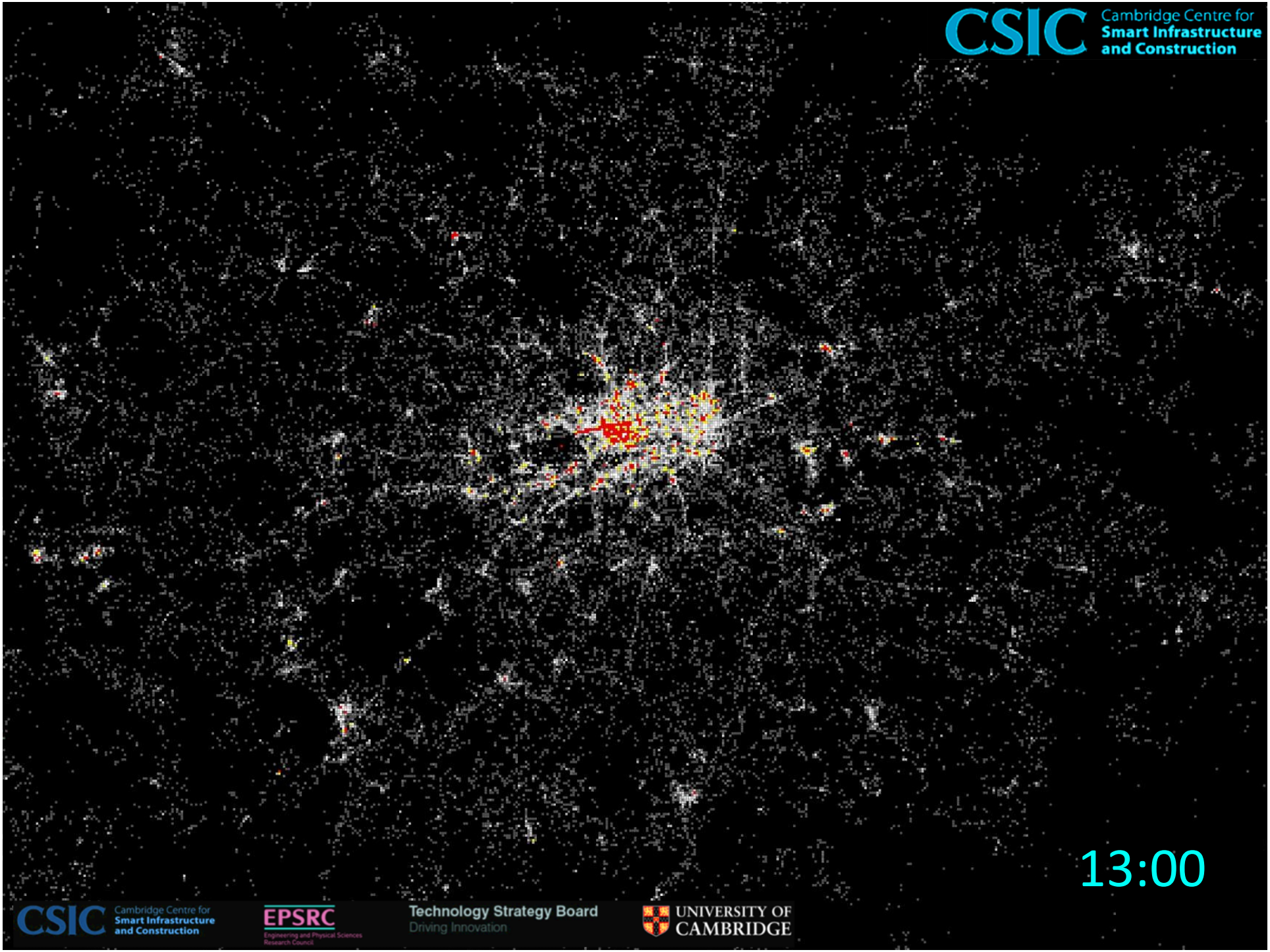
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and Construction
13:00
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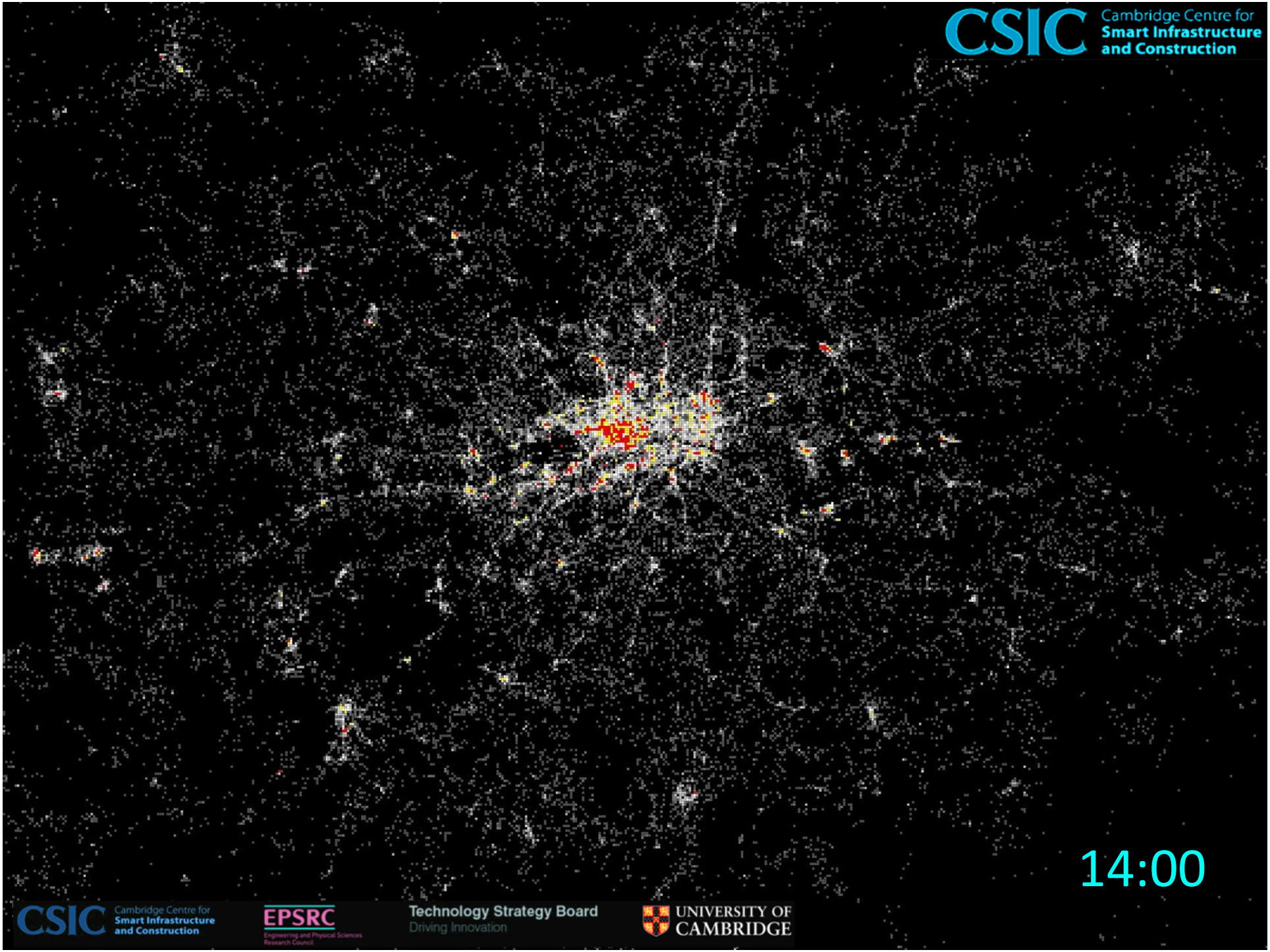
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Cambridge Centre for
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and Construction
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Research Council
Technology Strategy Board
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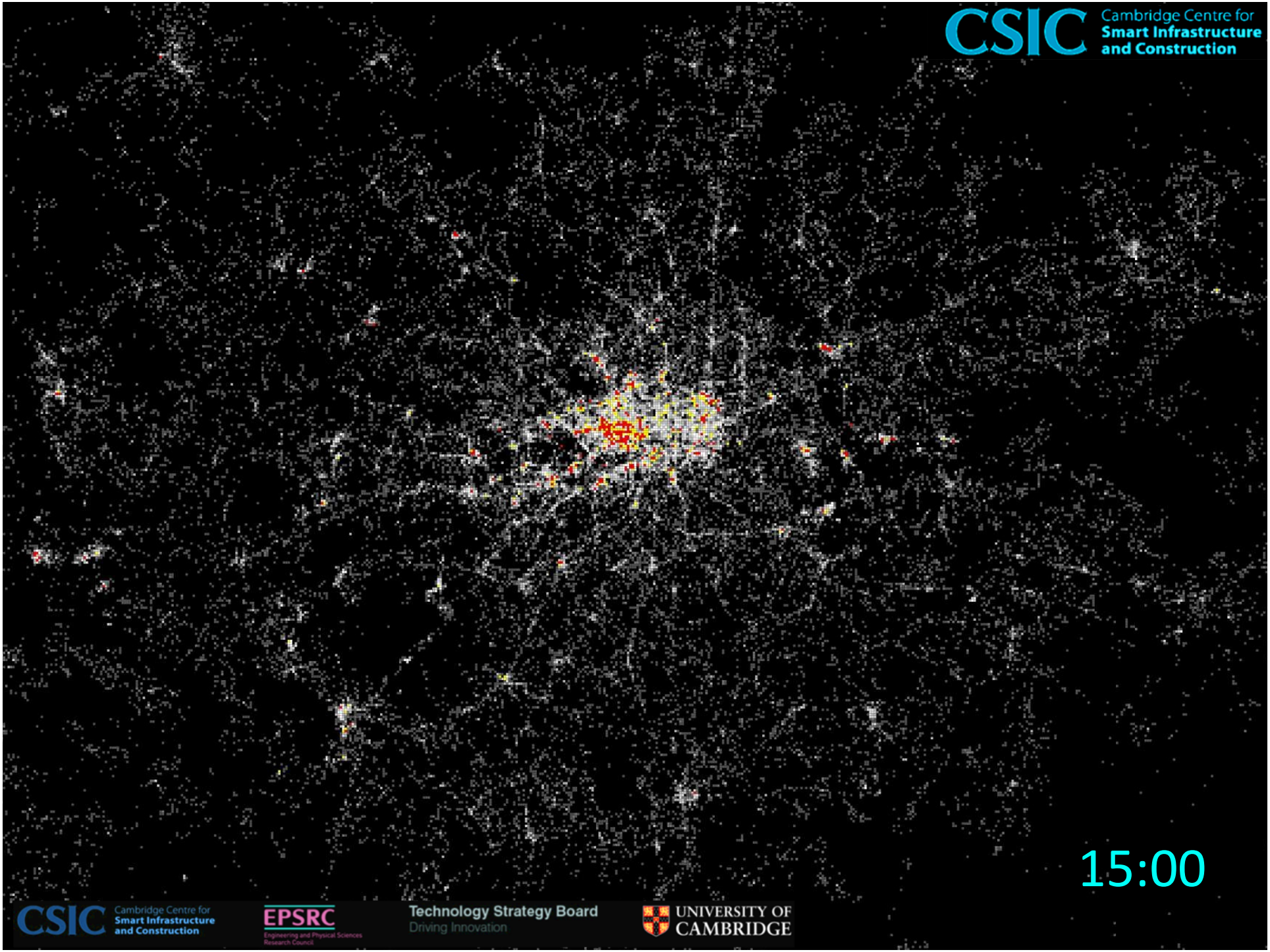
CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
15:00
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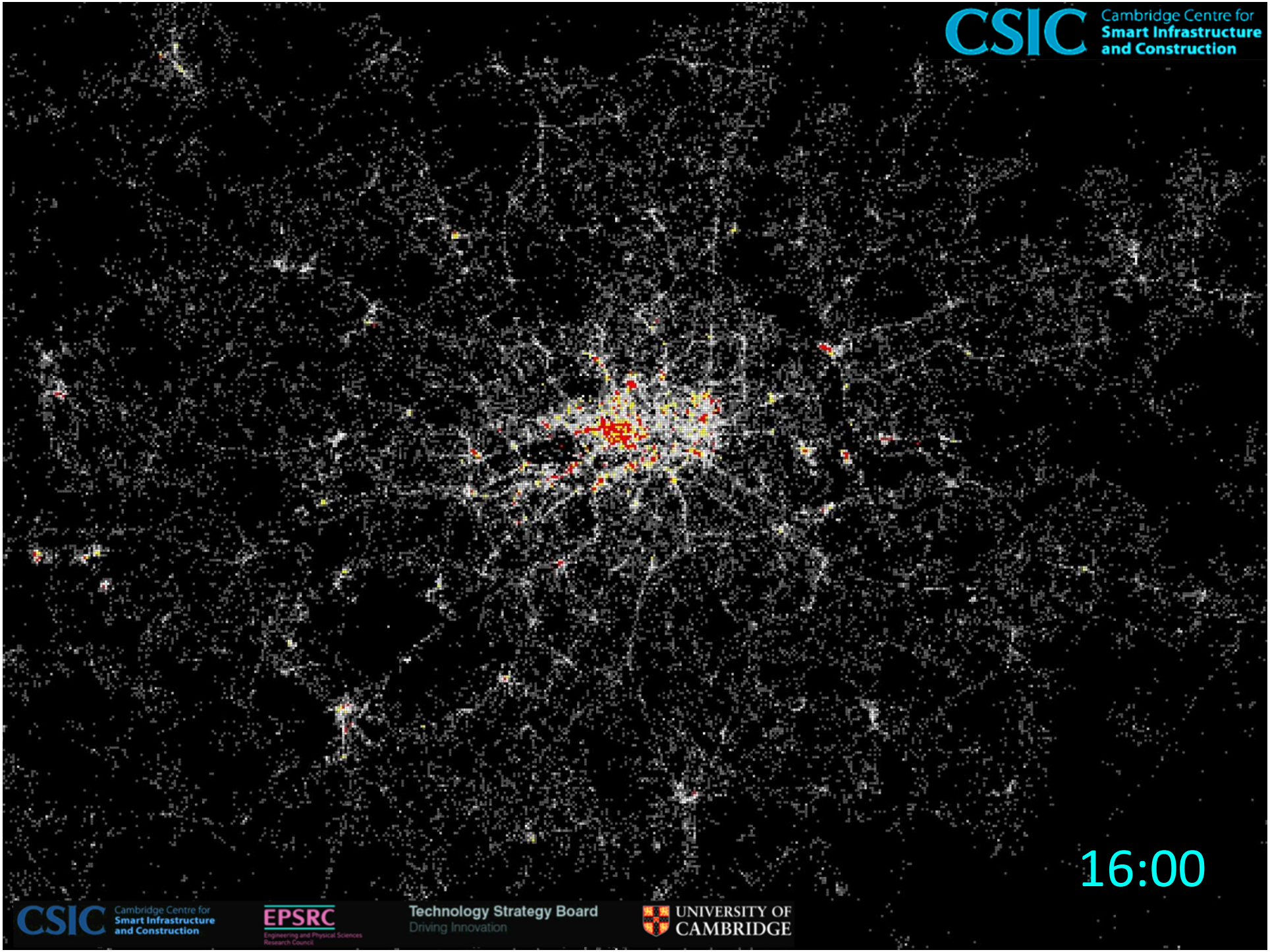
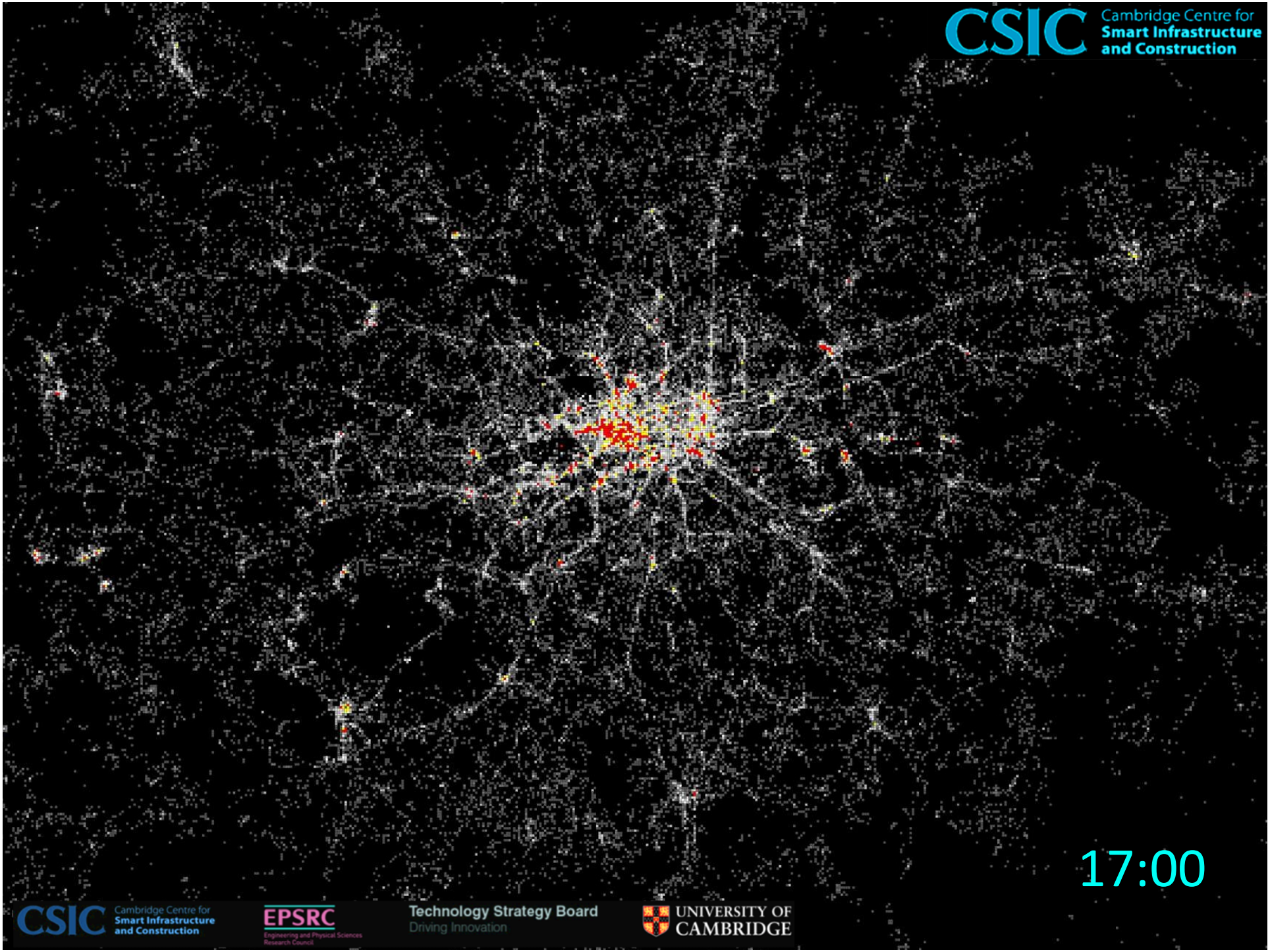
Smart Infrastructure
and Construction
EPSRC
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
UNIVERSITY OF
CAMBRIDGE


CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
16:00
CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
EPSRC
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
UNIVERSITY OF
CAMBRIDGE


CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
17:00
CSIC
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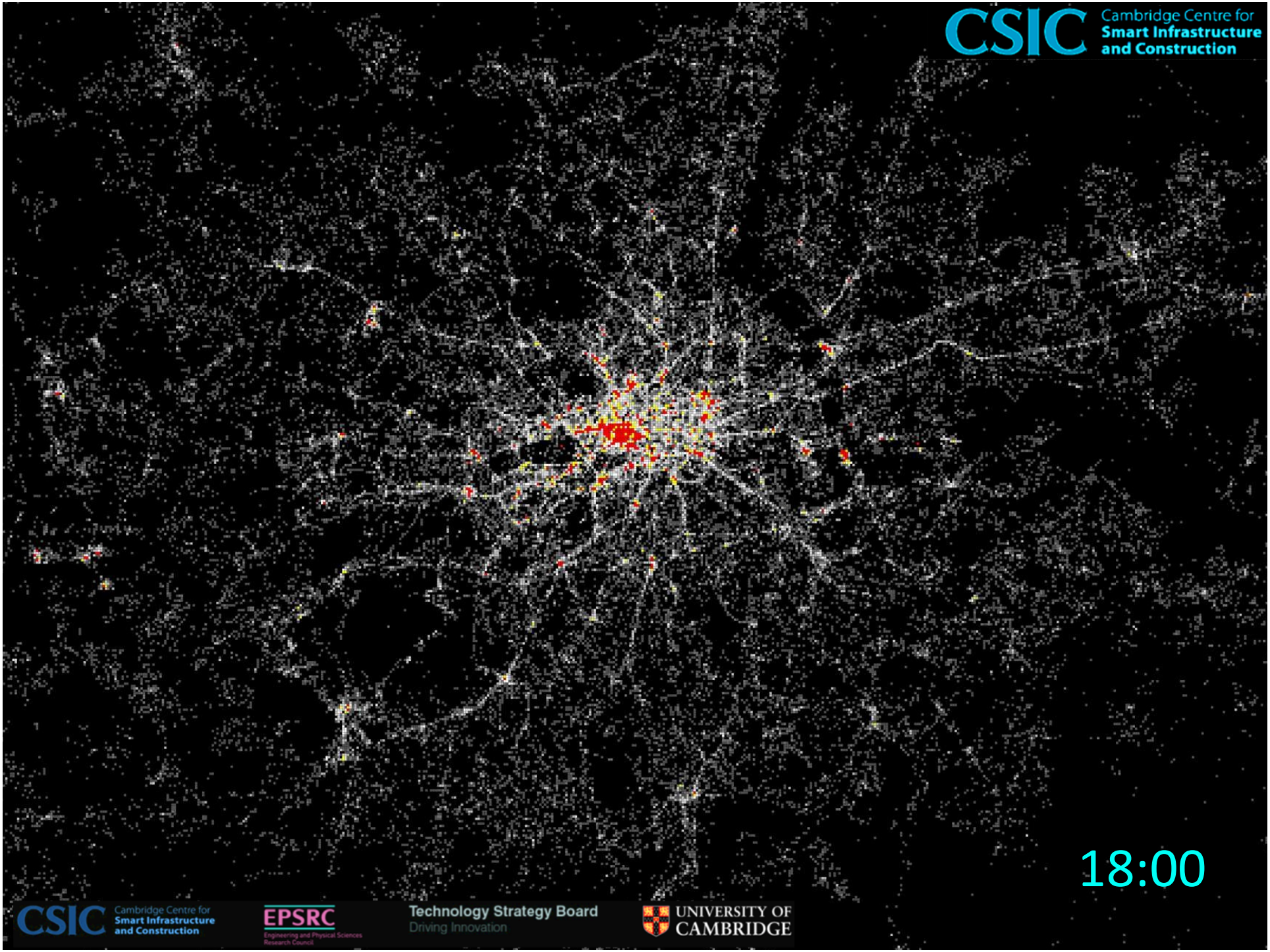
Smart Infrastructure
and Construction
EPSRC
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
UNIVERSITY OF
CAMBRIDGE


CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
18:00
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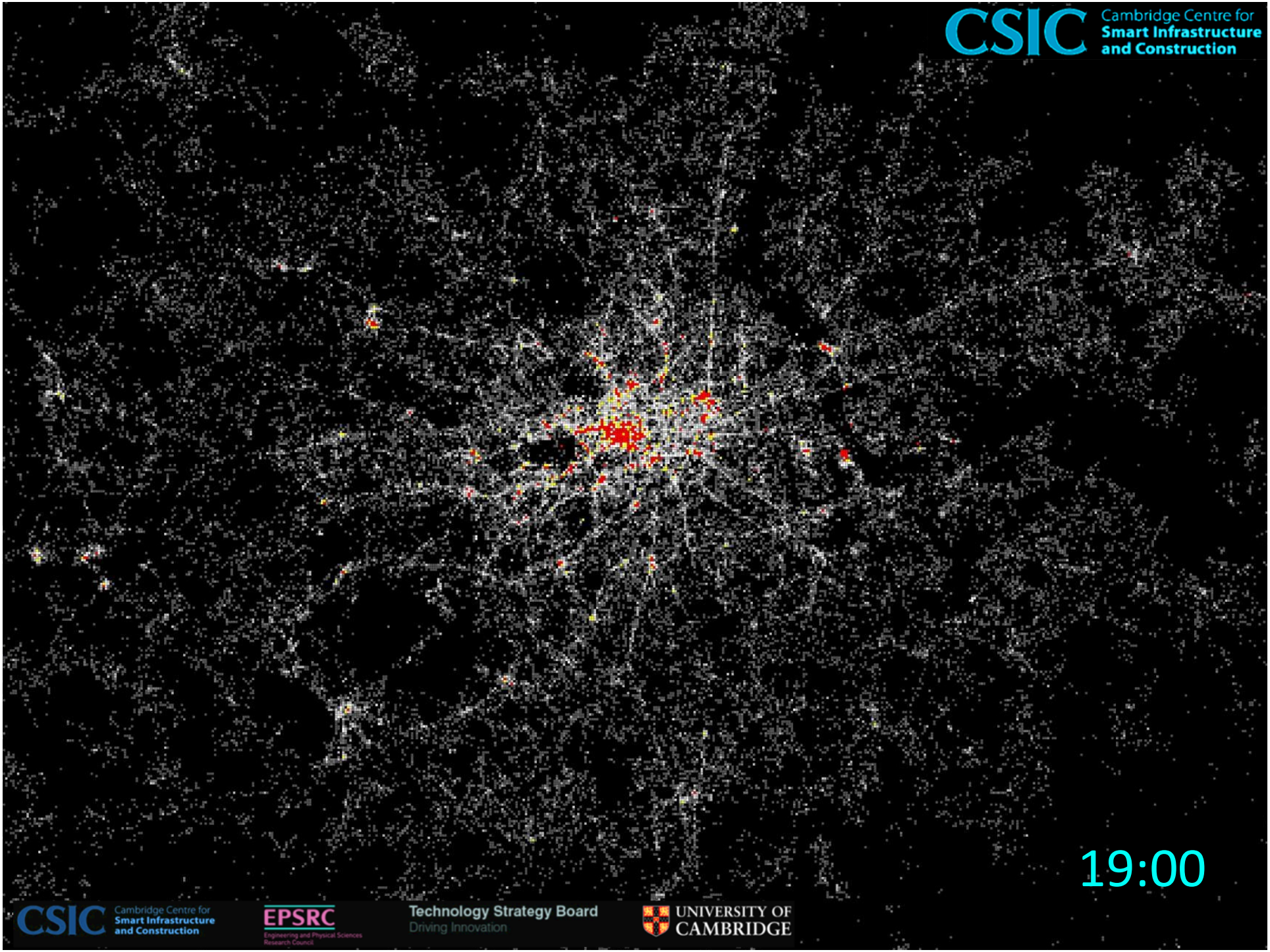
Smart Infrastructure
and Construction
EPSRC
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
UNIVERSITY OF
CAMBRIDGE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Cambridge Centre for
Smart Infrastructure
and Construction
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and Construction
EPSRC
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
UNIVERSITY OF
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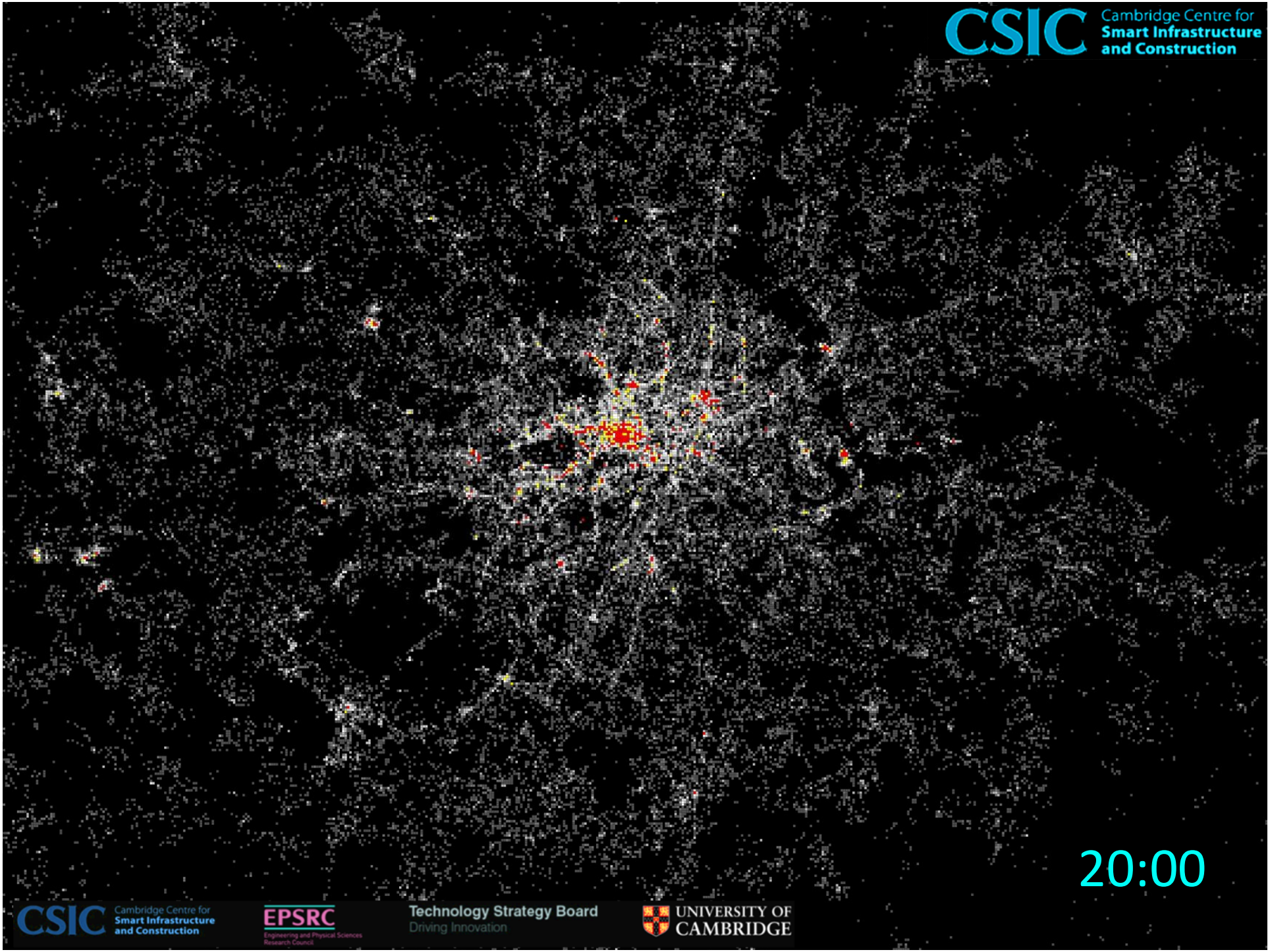
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Cambridge Centre for
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UNIVERSITY OF
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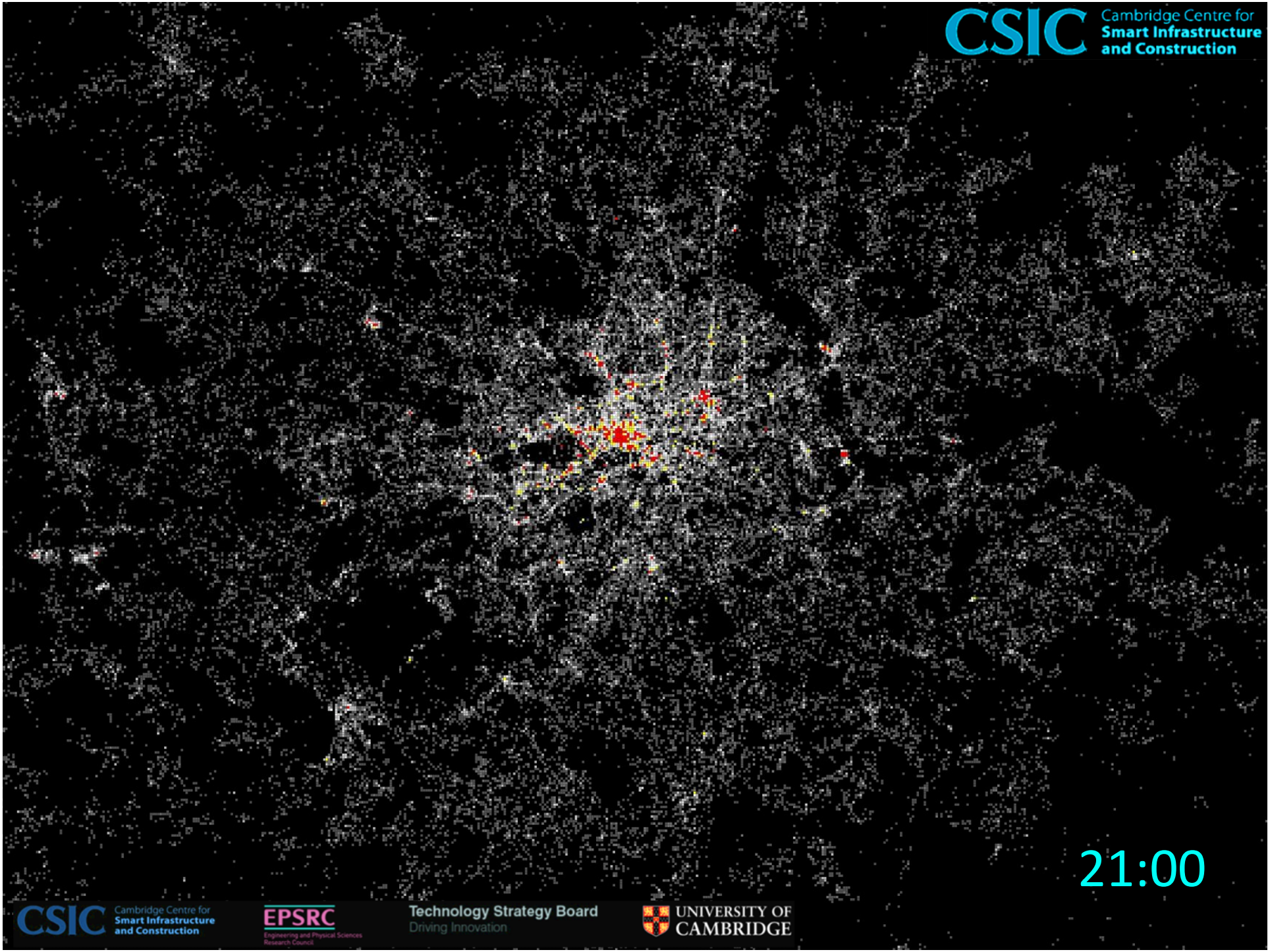
CSIC
Cambridge Centre for
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and Construction
21:00
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Technology Strategy Board
Driving Innovation
UNIVERSITY OF
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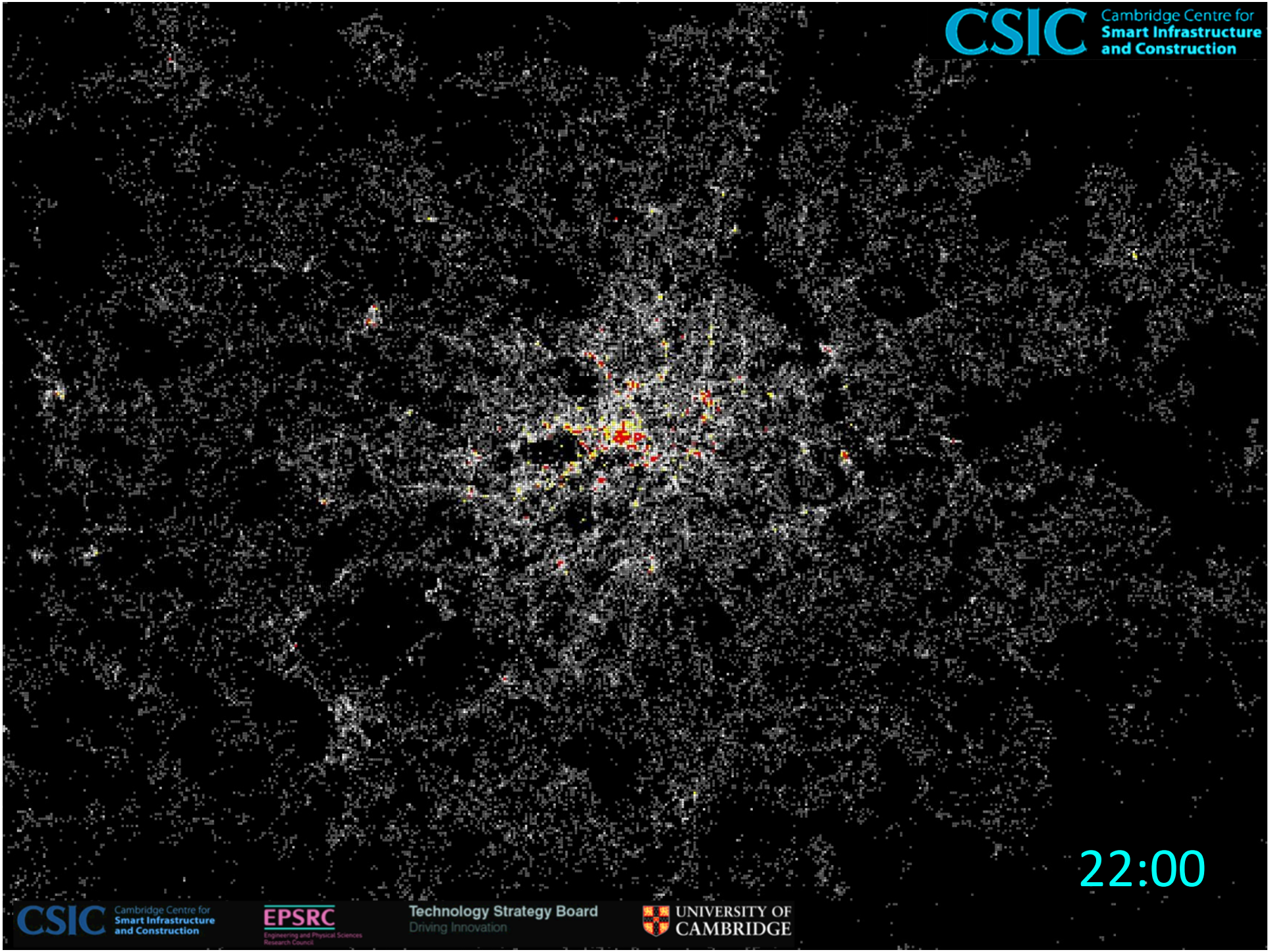
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Cambridge Centre for
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Research Council
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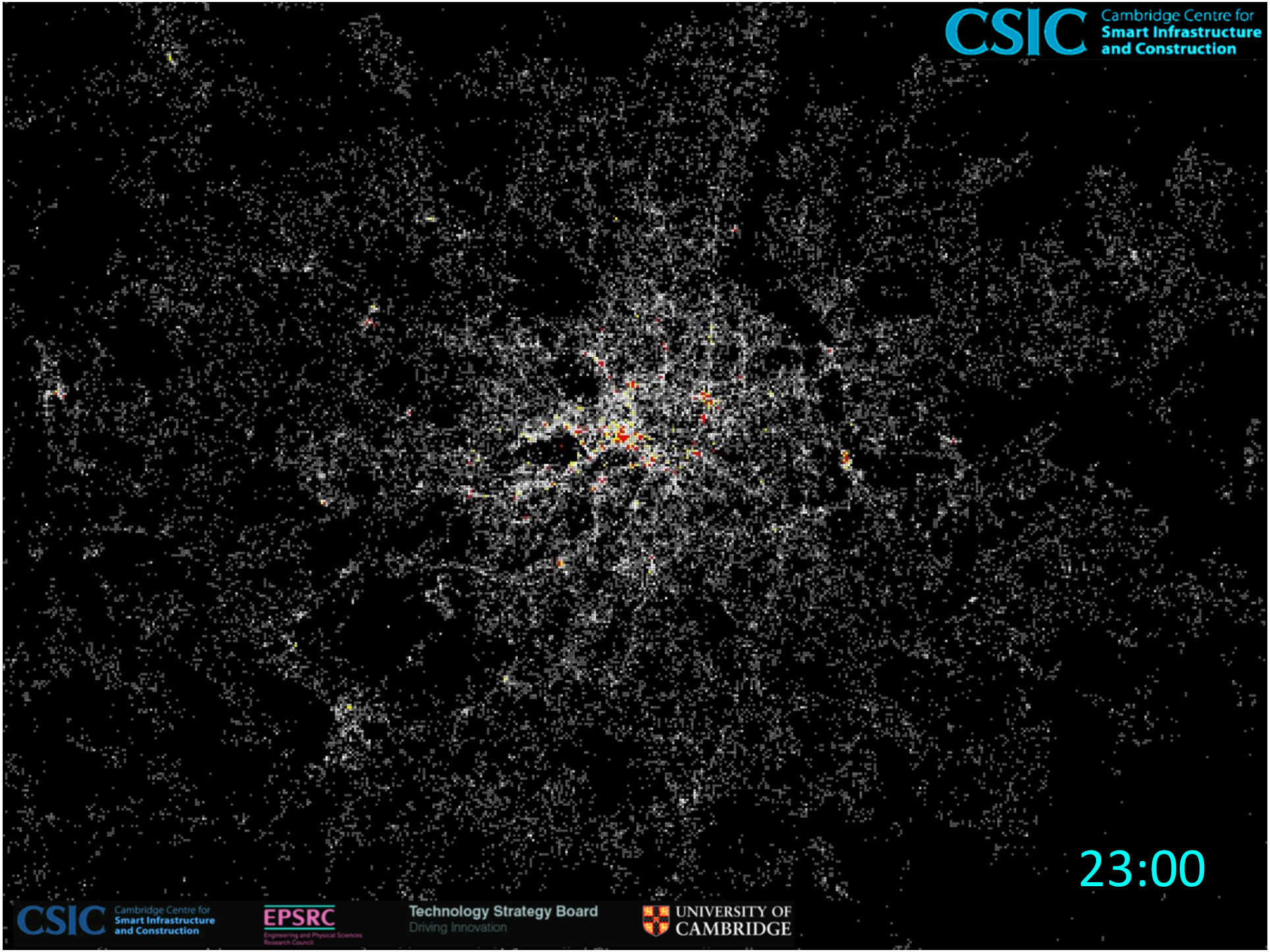
Driving Innovation
UNIVERSITY OF
CAMBRIDGE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Cambridge Centre for
Smart Infrastructure
and Construction
23:00
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Smart Infrastructure
and Construction
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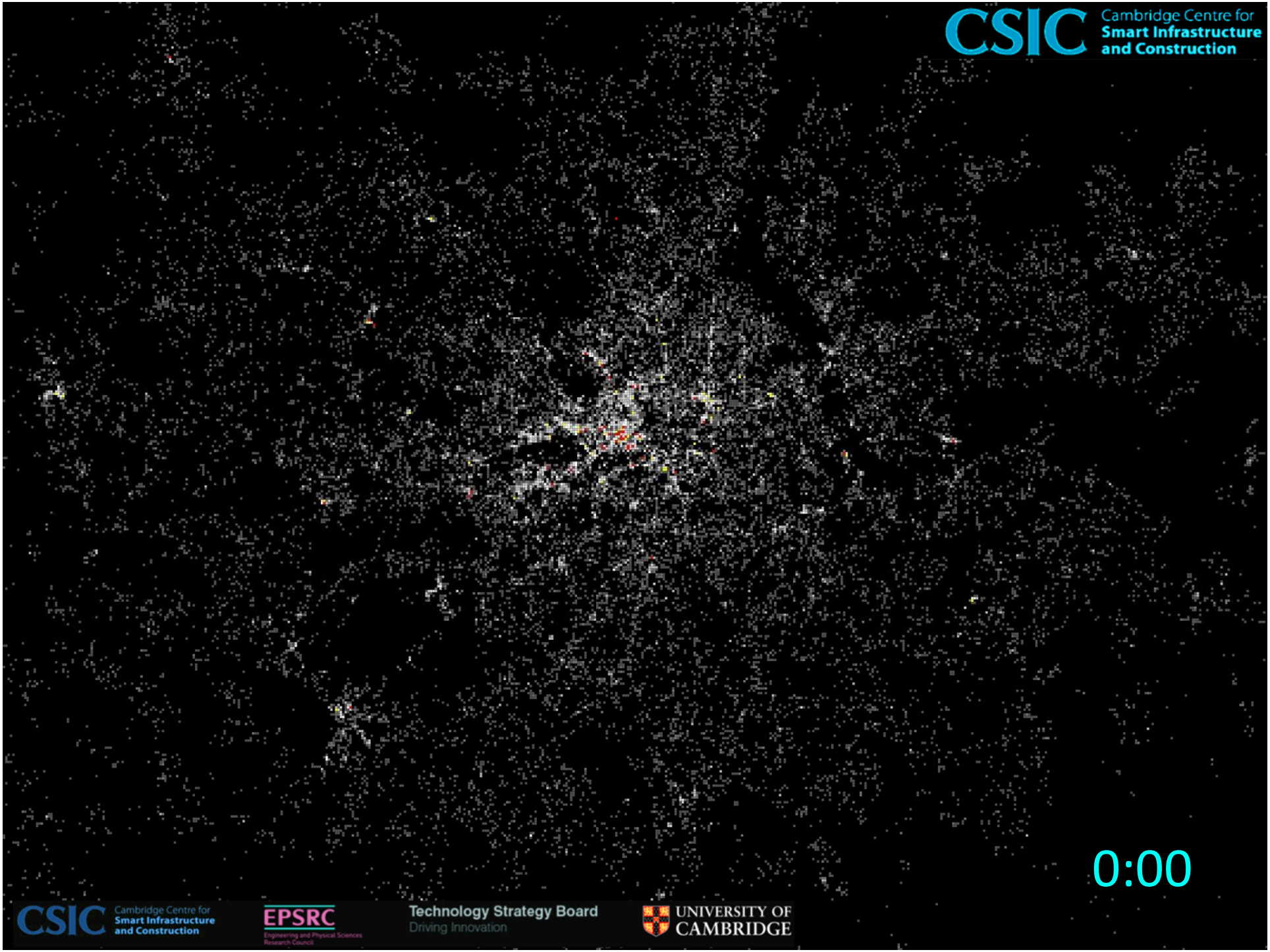
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
UNIVERSITY OF
CAMBRIDGE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Cambridge Centre for
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and Construction
0:00
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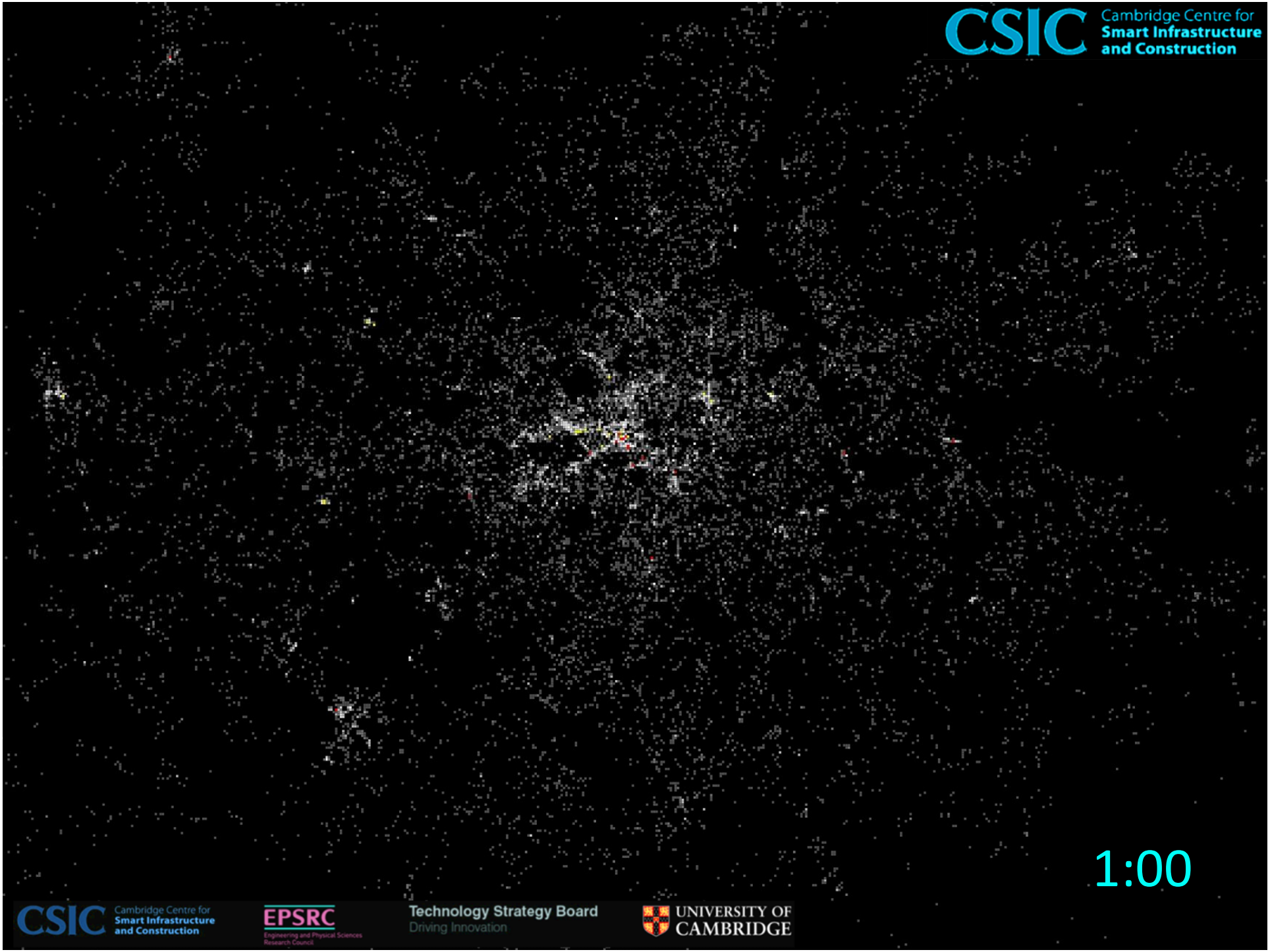
EPSRC
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
UNIVERSITY OF
CAMBRIDGE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Cambridge Centre for
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and Construction
1:00
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Smart Infrastructure
and Construction
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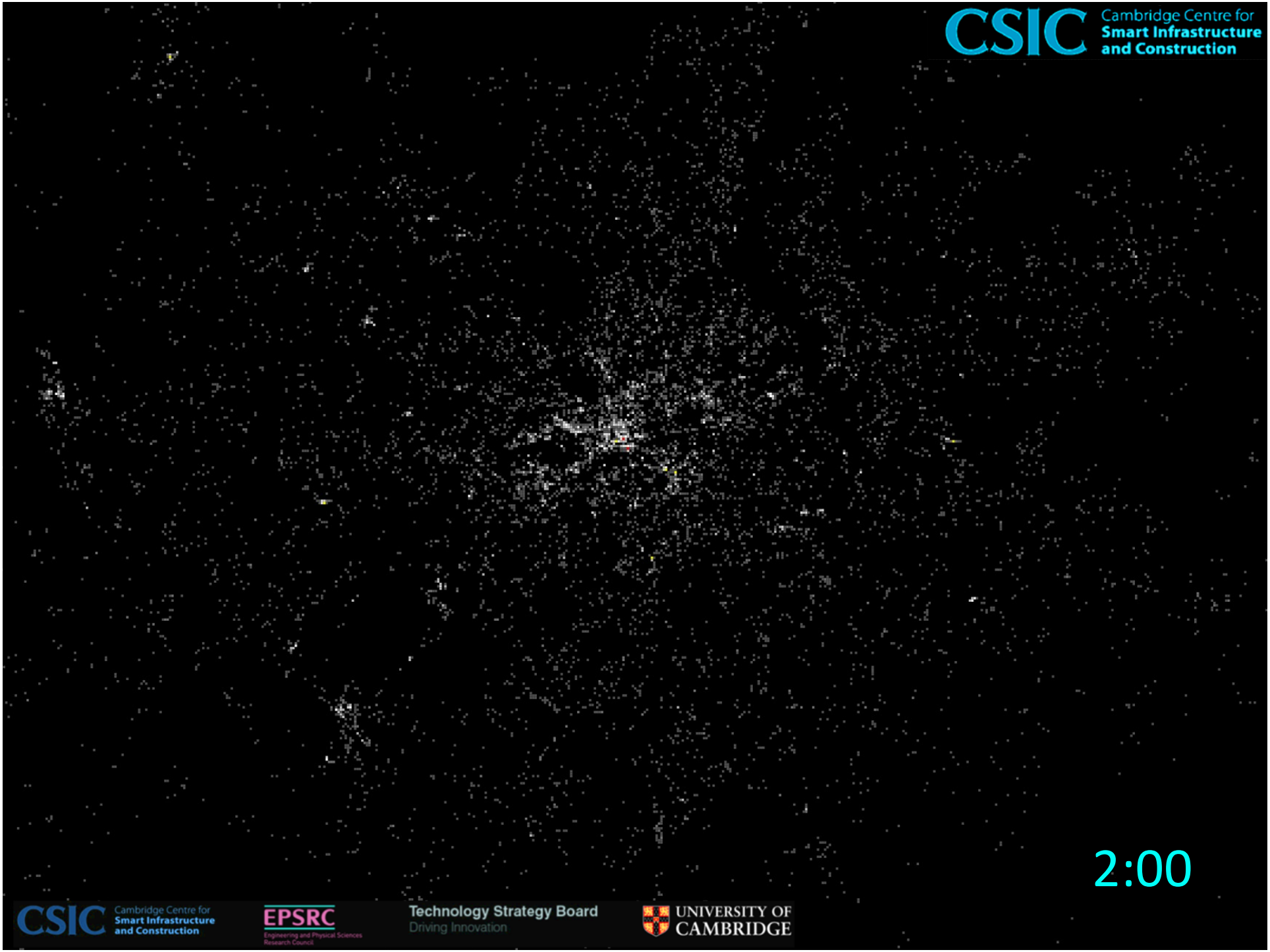
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
UNIVERSITY OF
CAMBRIDGE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Cambridge Centre for
Smart Infrastructure
and Construction
2:00
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Cambridge Centre for
Smart Infrastructure
and Construction
EPSRC
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
UNIVERSITY OF
CAMBRIDGE

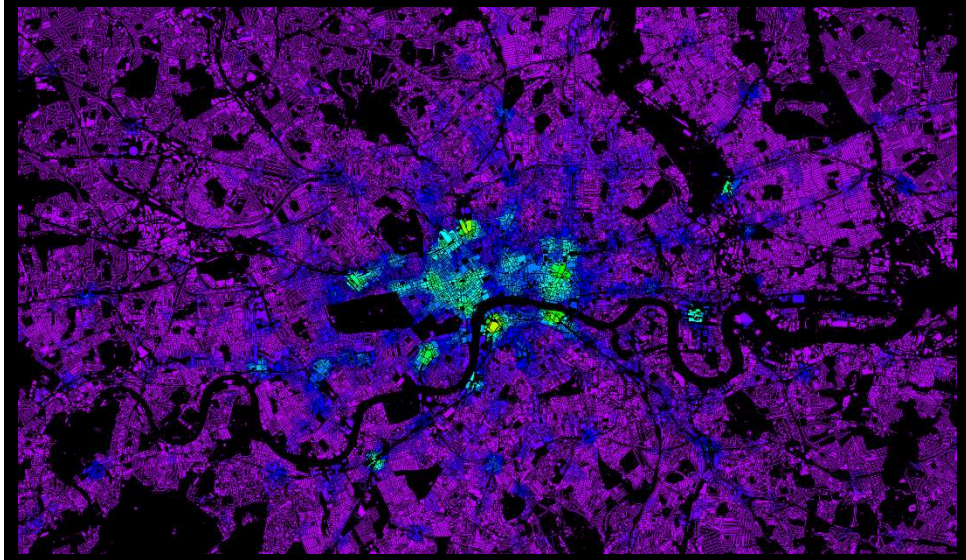
CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
3:00
CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
EPSRC
Engineering and Physical Sciences
Research Council
Technology Strategy Board
Driving Innovation
UNIVERSITY OF
CAMBRIDGE

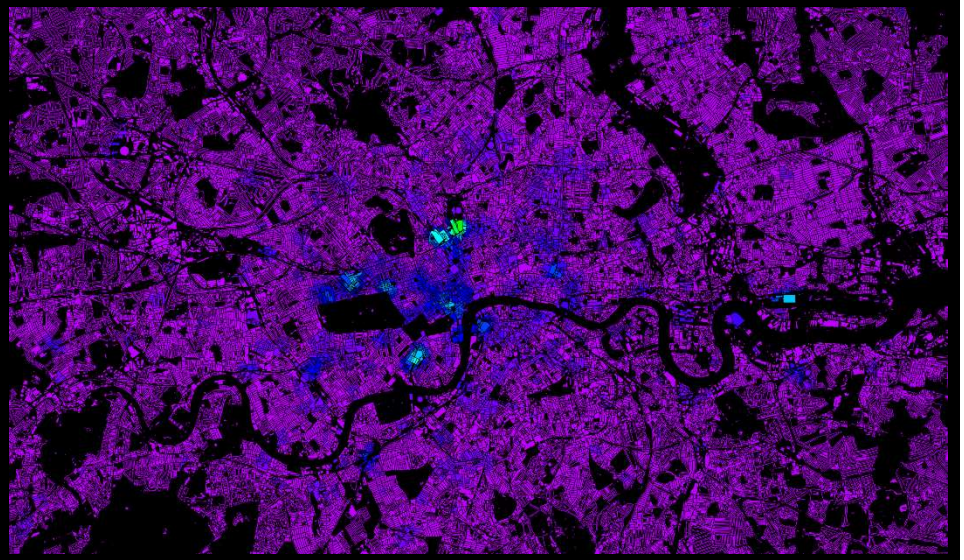
CSIC Cambridge Centre for Smart Infrastructure and Construction
4:00
CSIC Cambridge Centre for Smart Infrastructure and Construction
EPSRC Engineering and Physical Sciences Research Council
Technology Strategy Board Driving Innovation
UNIVERSITY OF CAMBRIDGE

CSIC Cambridge Centre for Smart Infrastructure and Construction

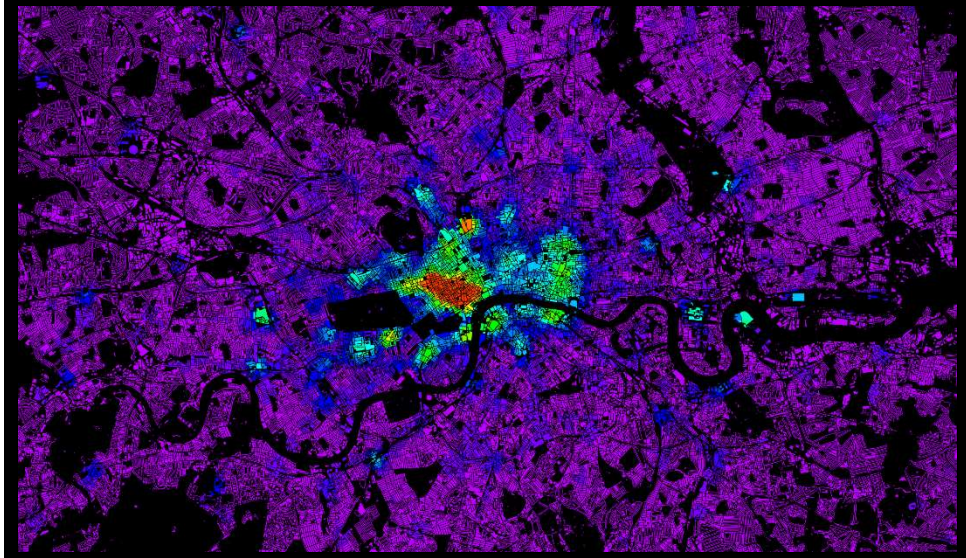
weekday

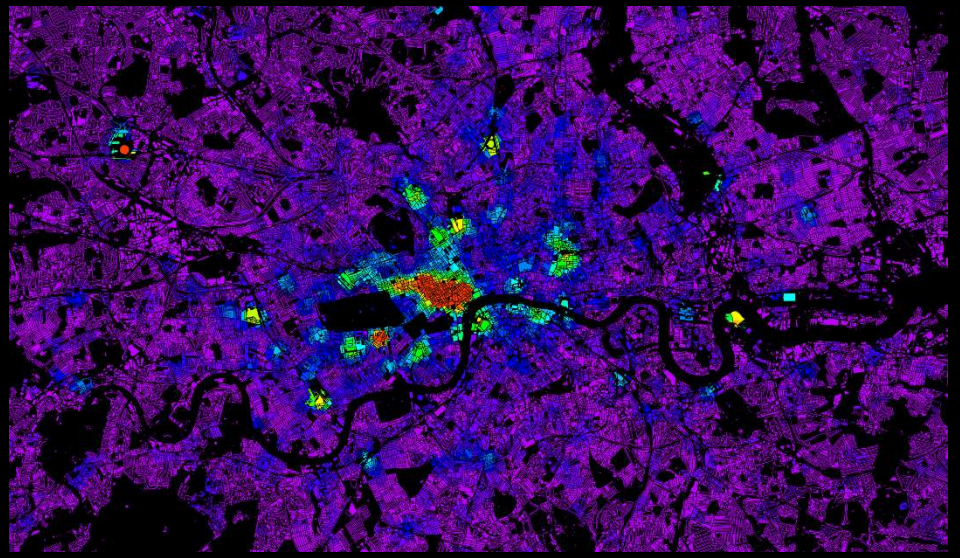
weekend





08:00





16:00

Unique Twitter users within 300m

CSIC Cambridge Centre for Smart Infrastructure and Construction

CSIC Cambridge Centre for Smart Infrastructure and Construction

EPSRC Engineering and Physical Sciences Research Council

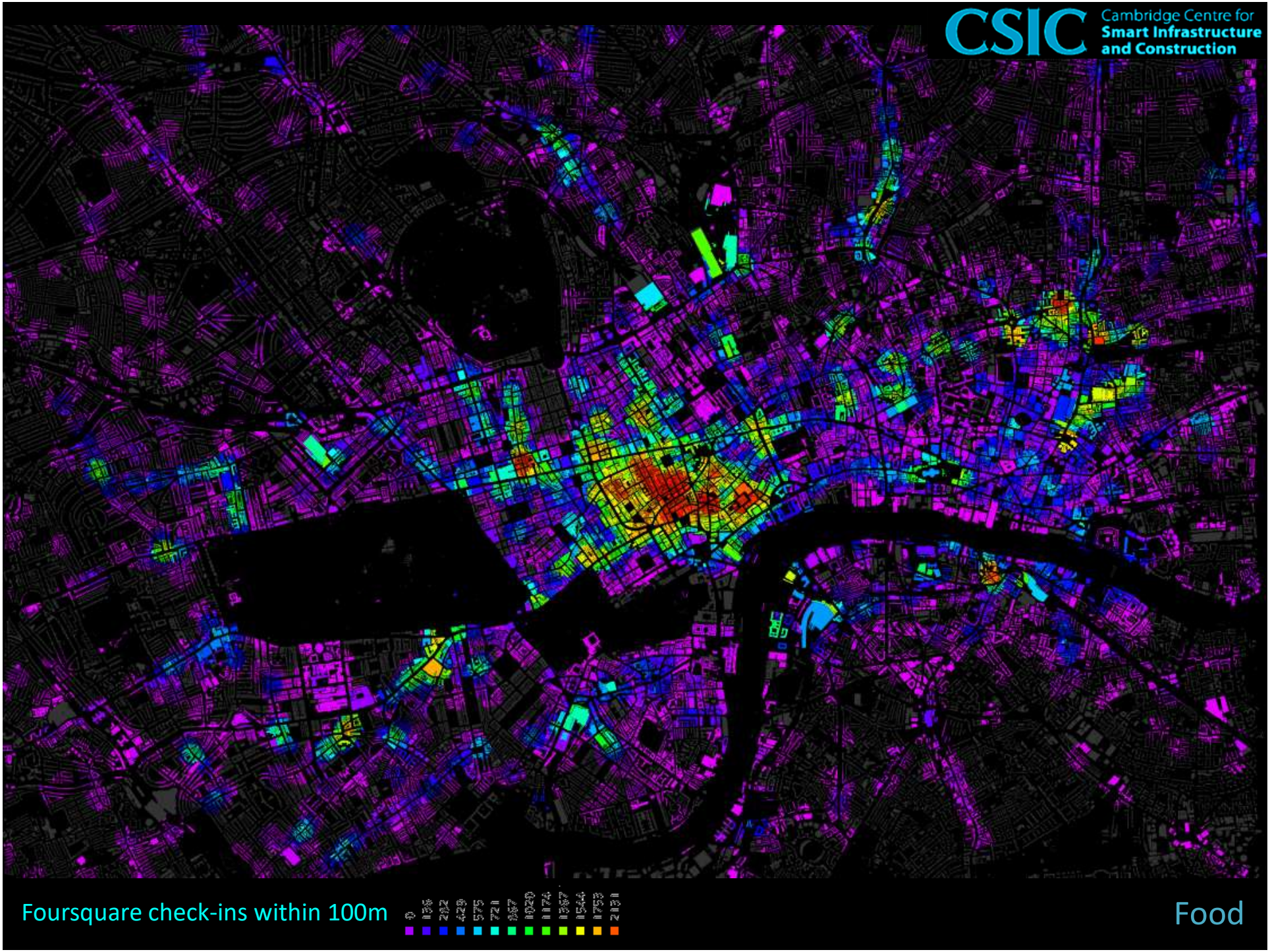
Technology Strategy Board Driving Innovation

UNIVERSITY OF CAMBRIDGE

Retail Land and Floorspace

CSIC Cambridge Centre for Smart Infrastructure and Construction

Retail Floorspace | Rent Rates (red £500/sq.m. yellow £1500/sq.m)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Cambridge Centre for
Smart Infrastructure
and Construction
Foursquare check-ins within 100m
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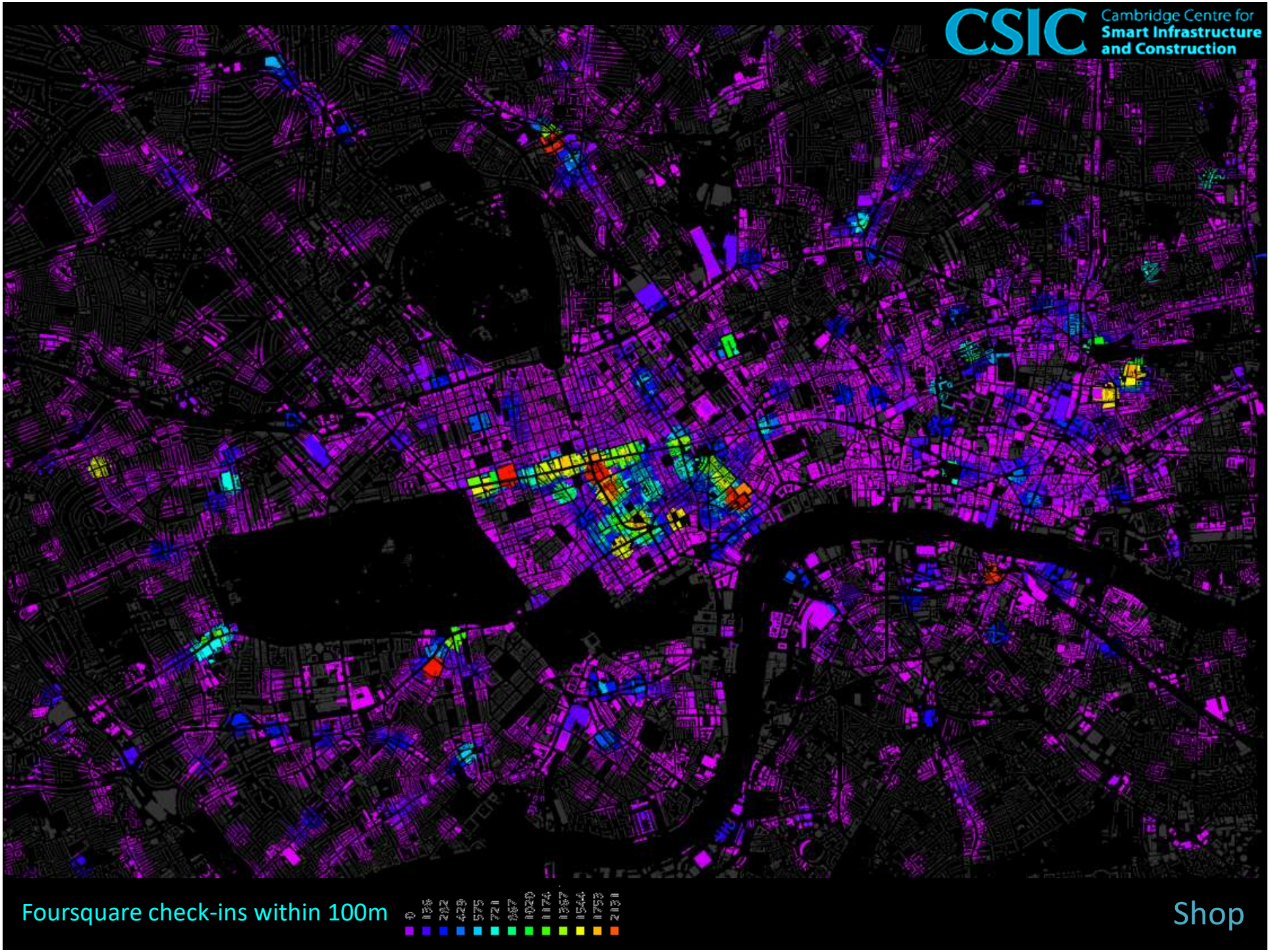
Food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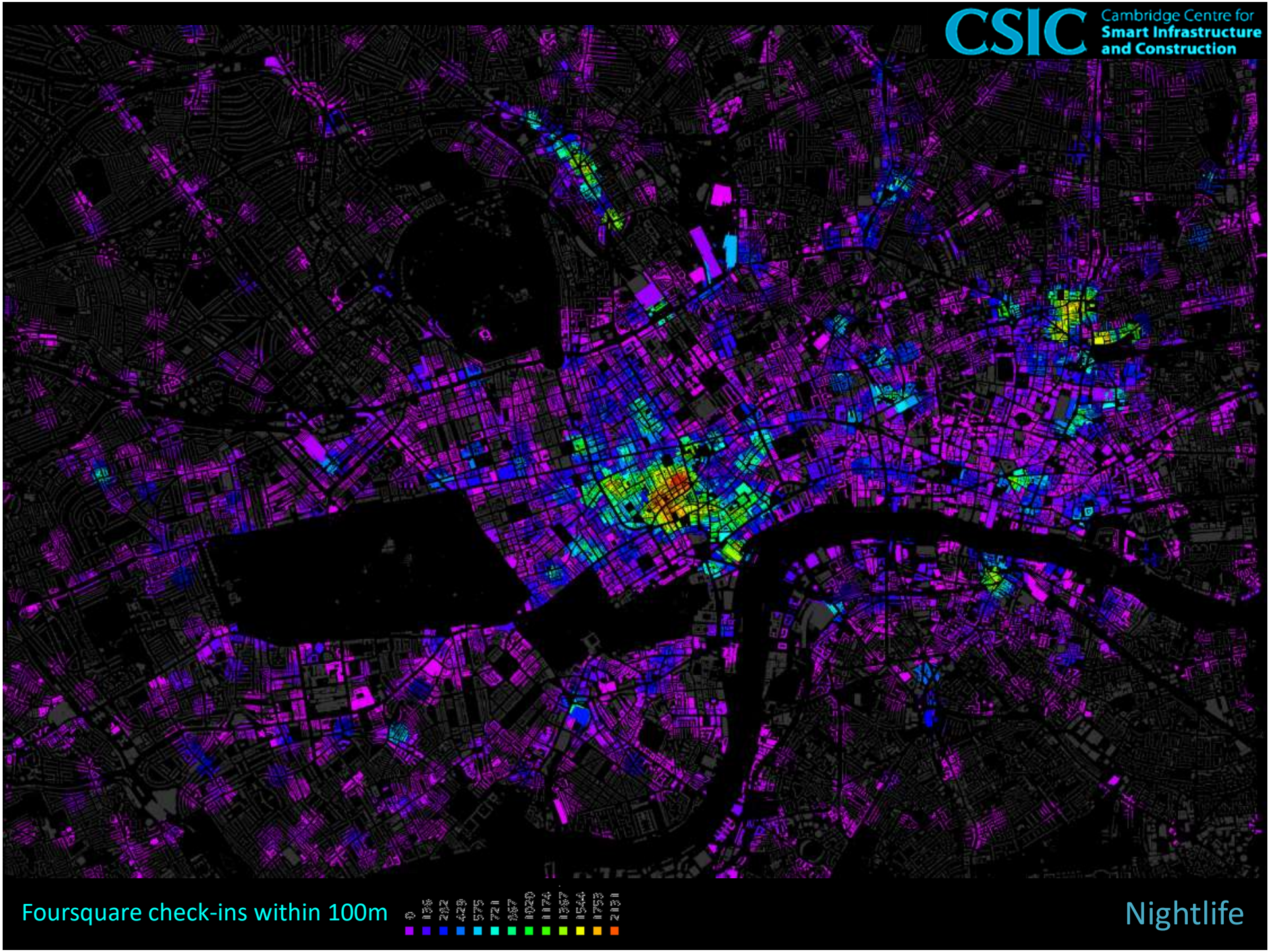
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Cambridge Centre for
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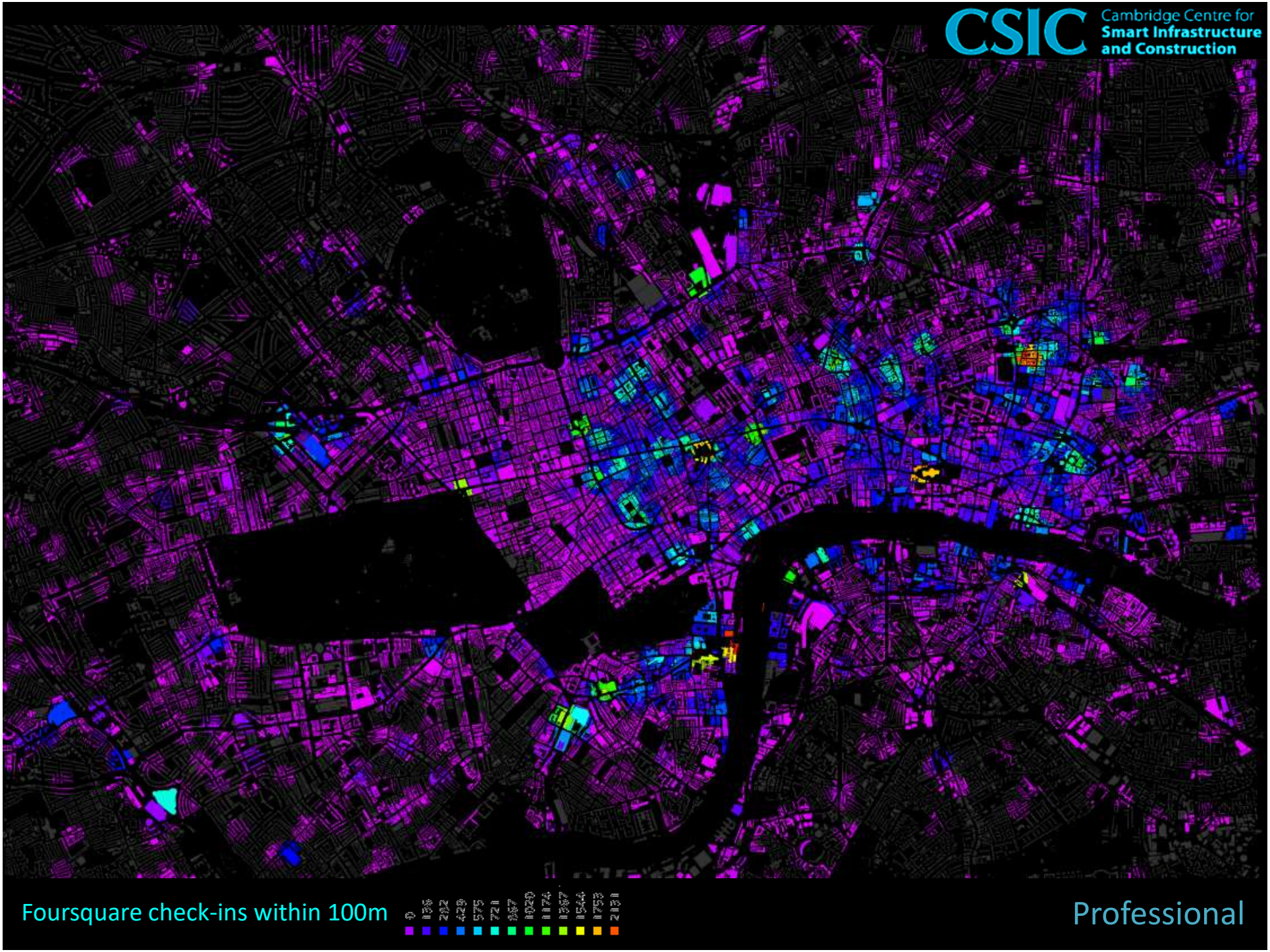
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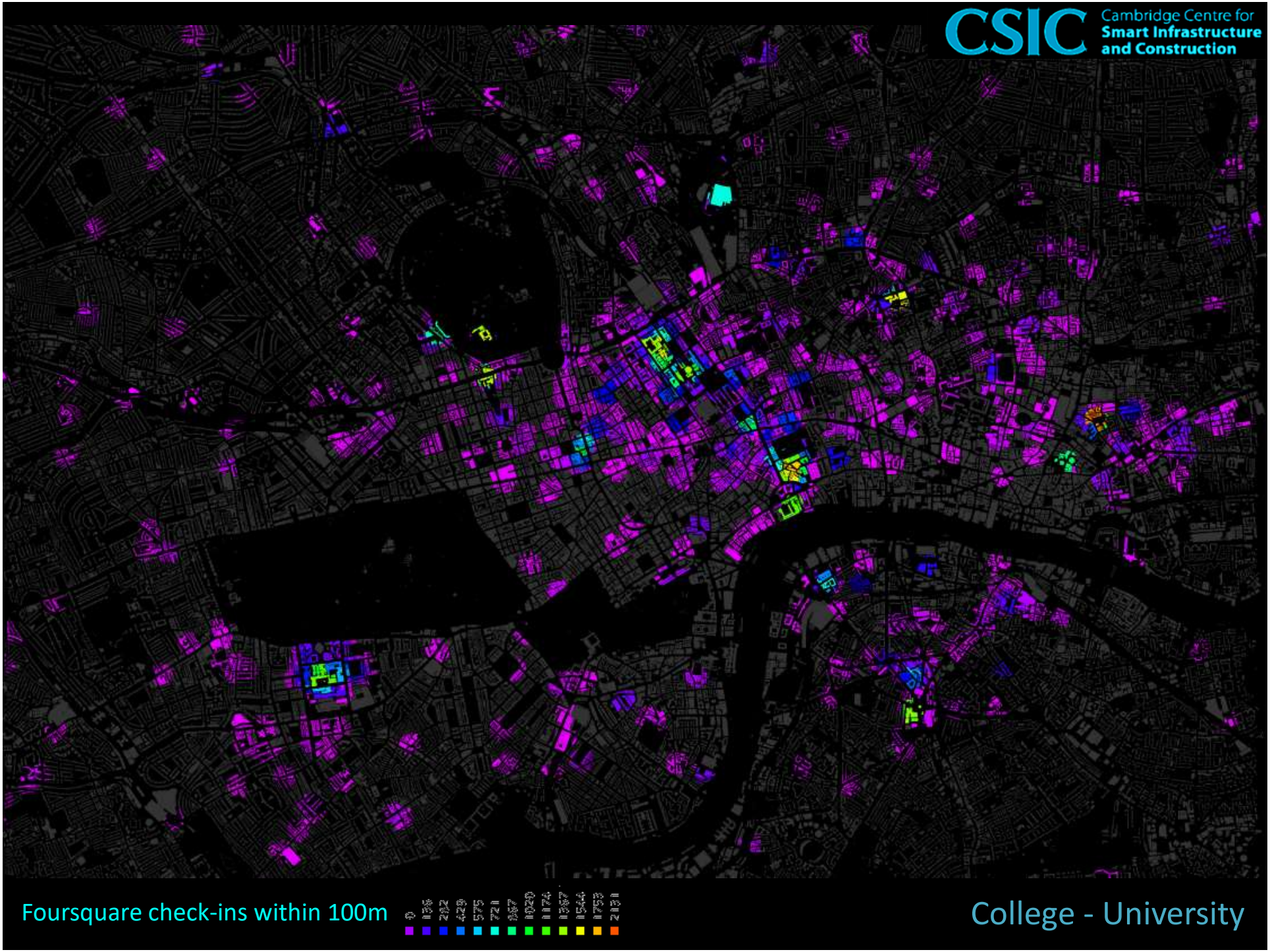
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Cambridge Centre for
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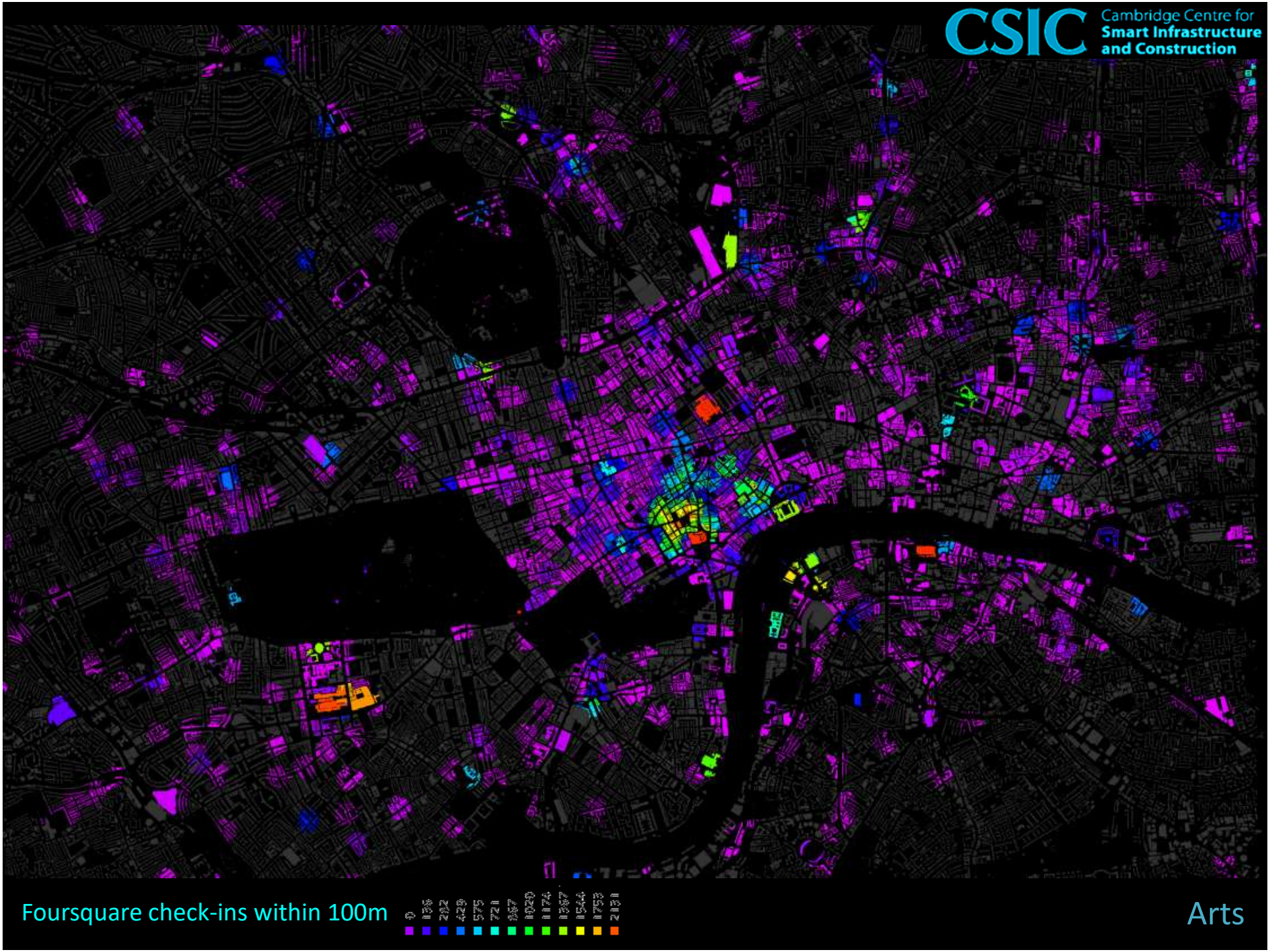
College - University


CSIC
Cambridge Centre for
Smart Infrastructure
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1753
2131
Arts

CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
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1174
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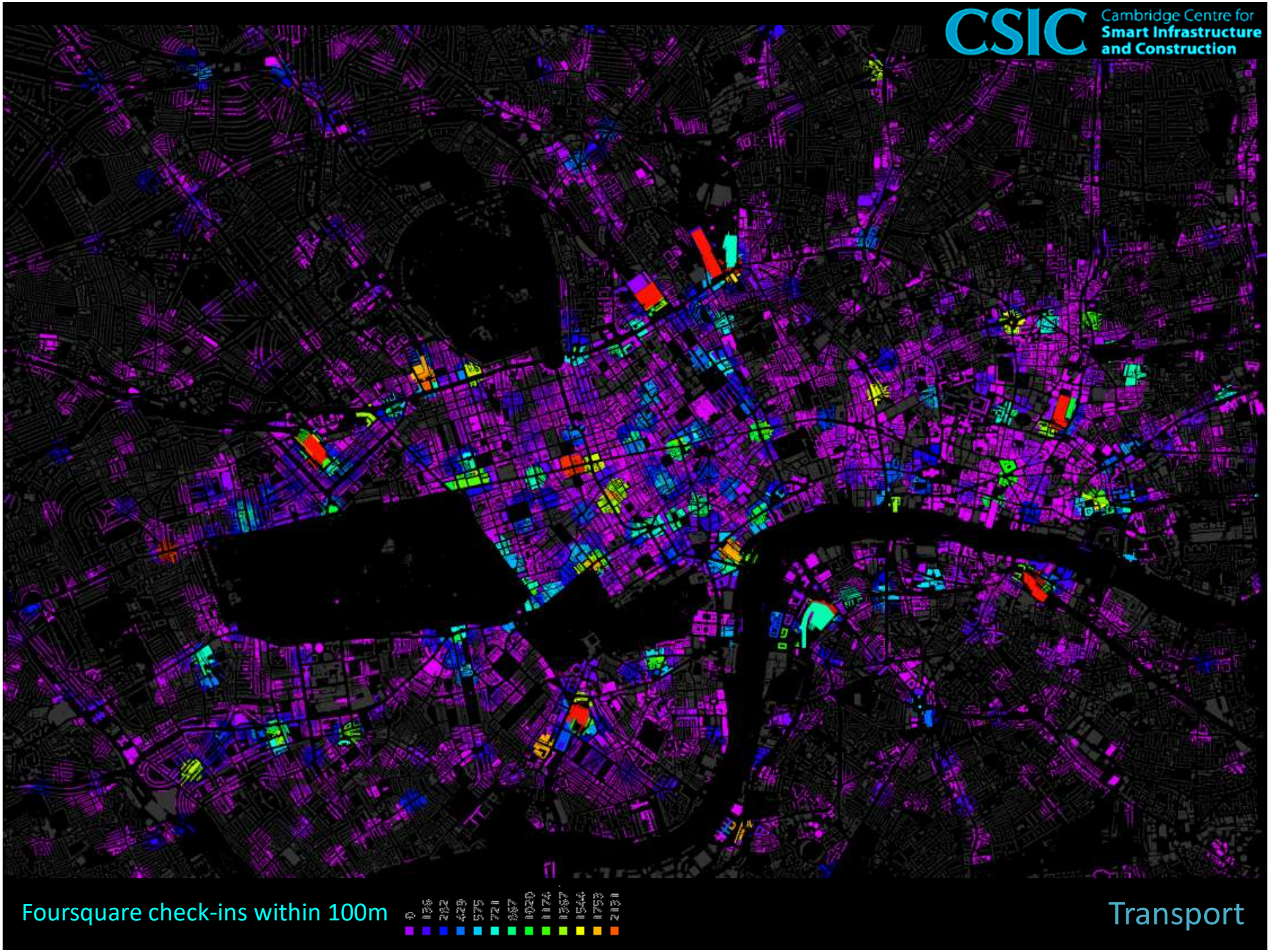
1544
1753
2131
Residence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Cambridge Centre for
Smart Infrastructure
and Construction
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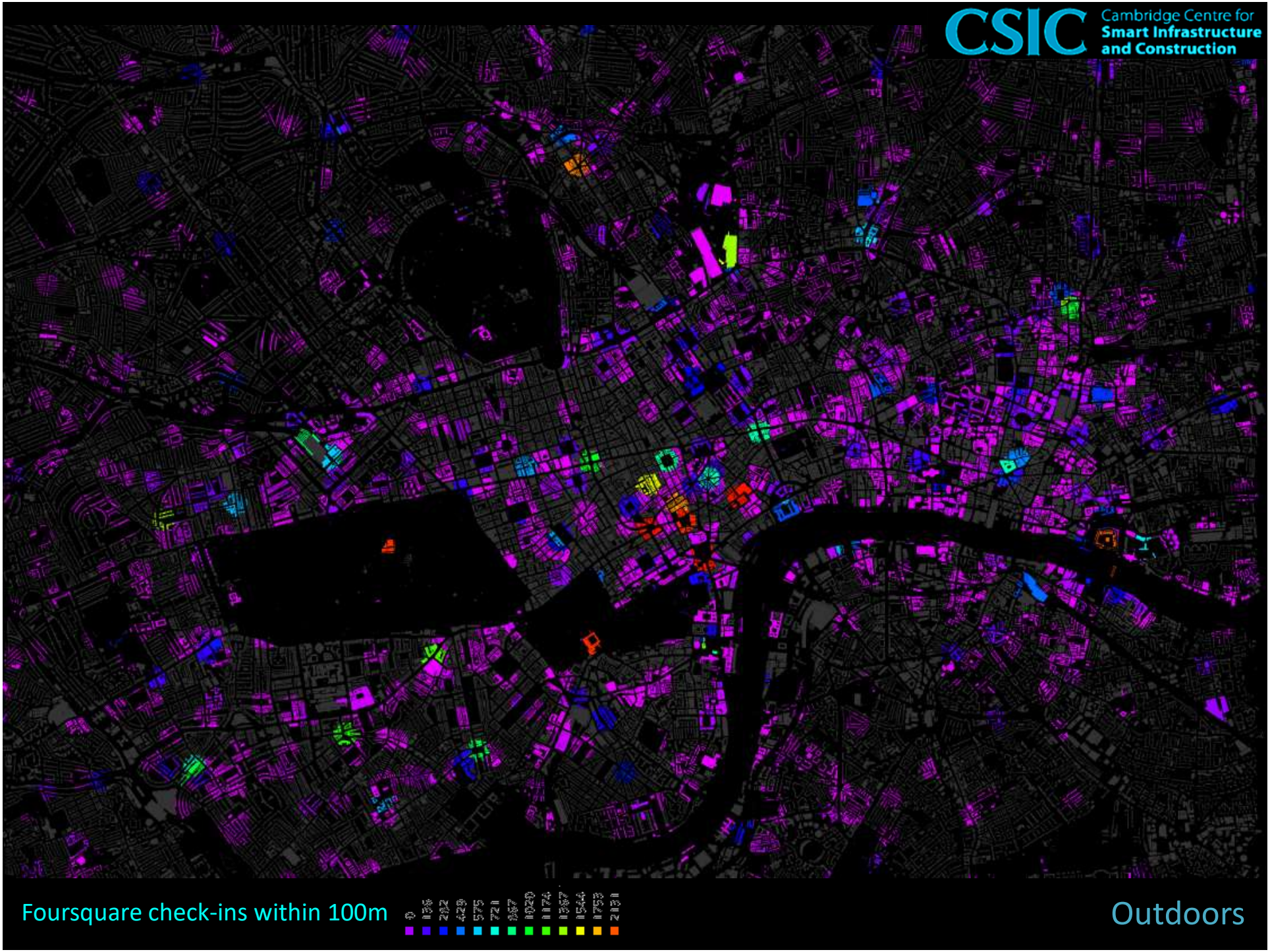
Transport


CSIC
Cambridge Centre for
Smart Infrastructure
and Construction
Foursquare check-ins within 100m
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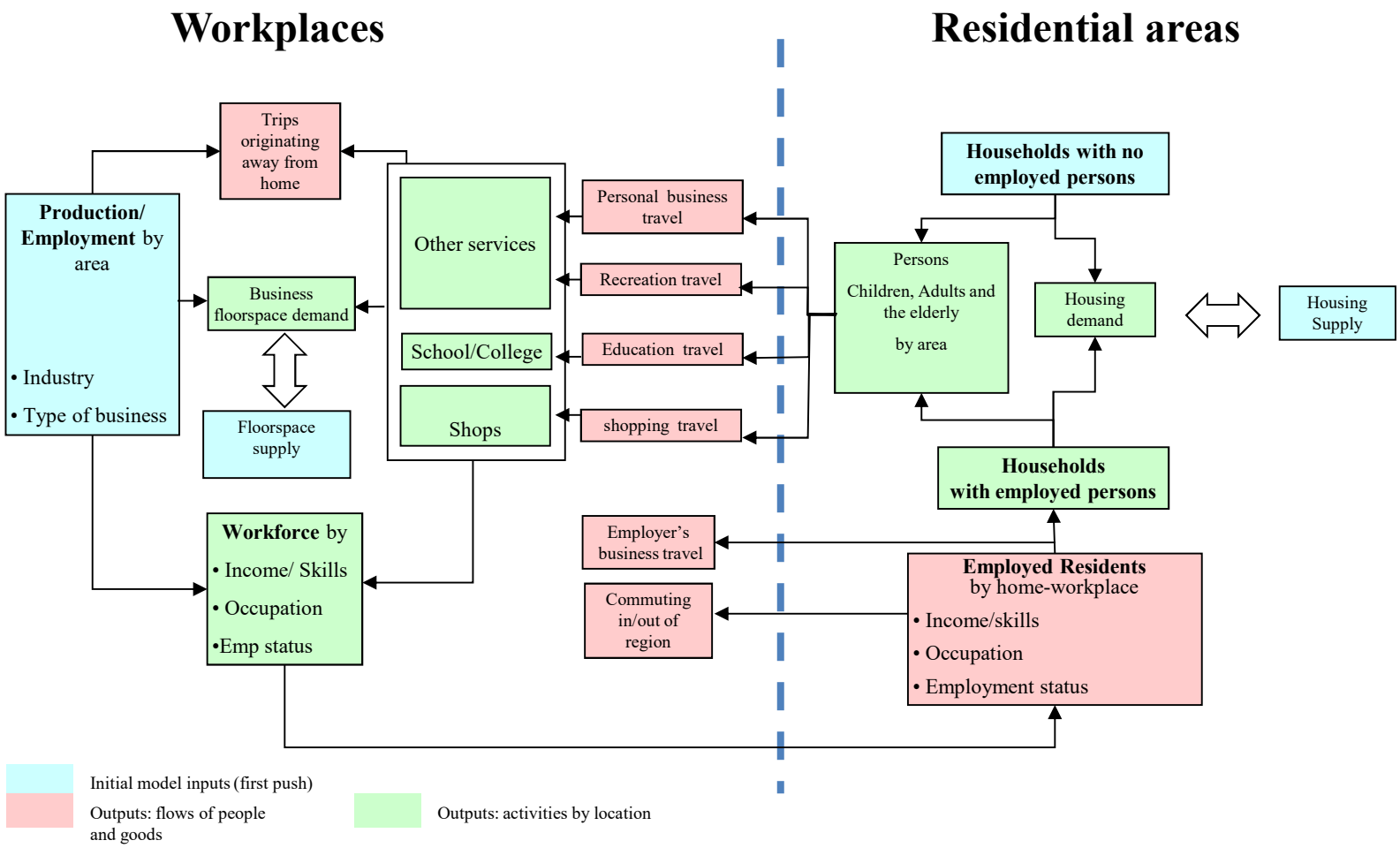
Outdoors

Layer 4: integrated activity modelling

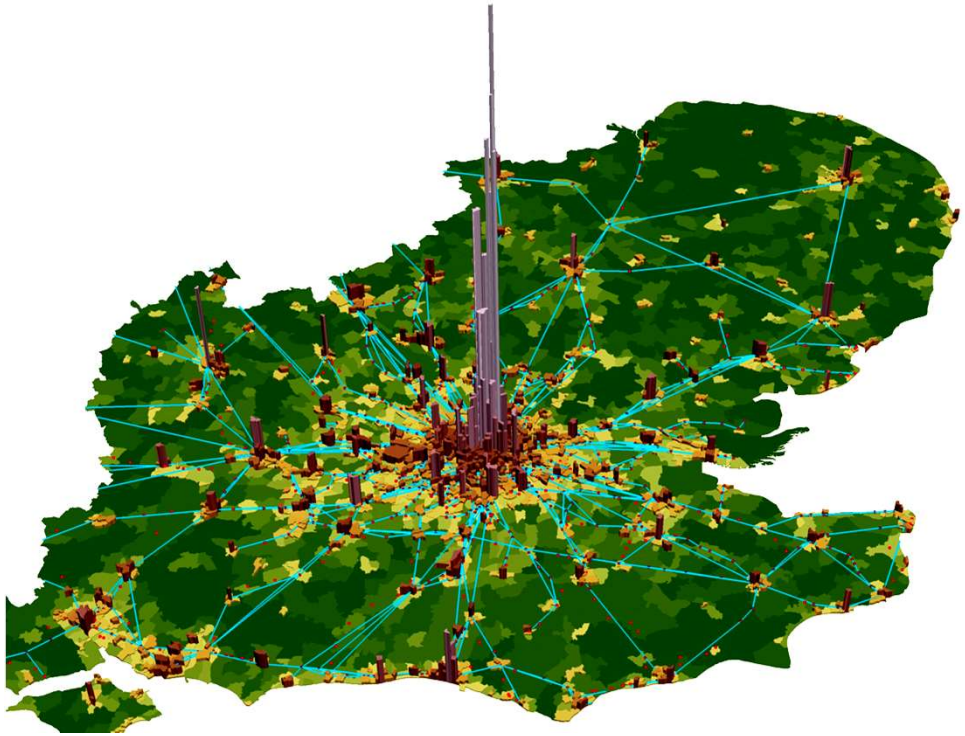
The MEPLAN-based applications – as used in London+Regions and Cambridge Futures



MODEL FOR LONDON

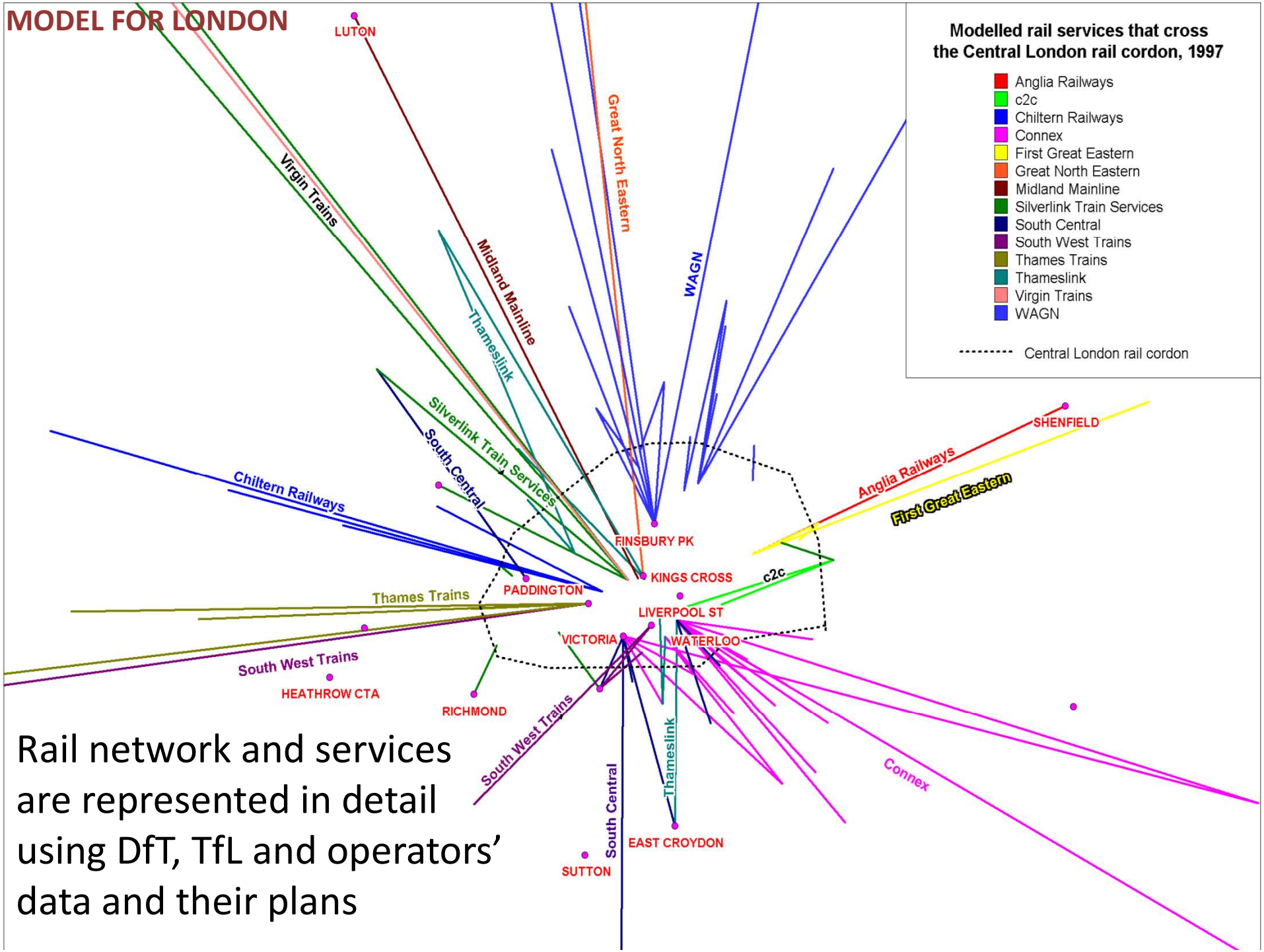
Transport and land use scenarios in London and surrounding regions (2000-2014)

- The Wider South East Regional Study (WSER) for central government 2002-2007 and then incorporated in further academic research programs 2006-2014 (WSP, 2005a; 2005b; Echenique et al, 2011; 2012)
- Scenarios included all major road, rail, underground investment/pricing options at the time and tested with strategic housing sites and airport expansion options
- The model was calibrated to a high fidelity of choice patterns and demand elasticities
- Main inputs: projections of jobs and total population, land use plans, road, rail & airport investments, pricing options
- Main outputs: distribution of population, housing demand and rents, AM peak traffic and congestion/overcrowding
- Base year: 1997/98
- Forecast horizon: 2016



Employment density 2001; Census data; graphics by A Hagen-Zanker

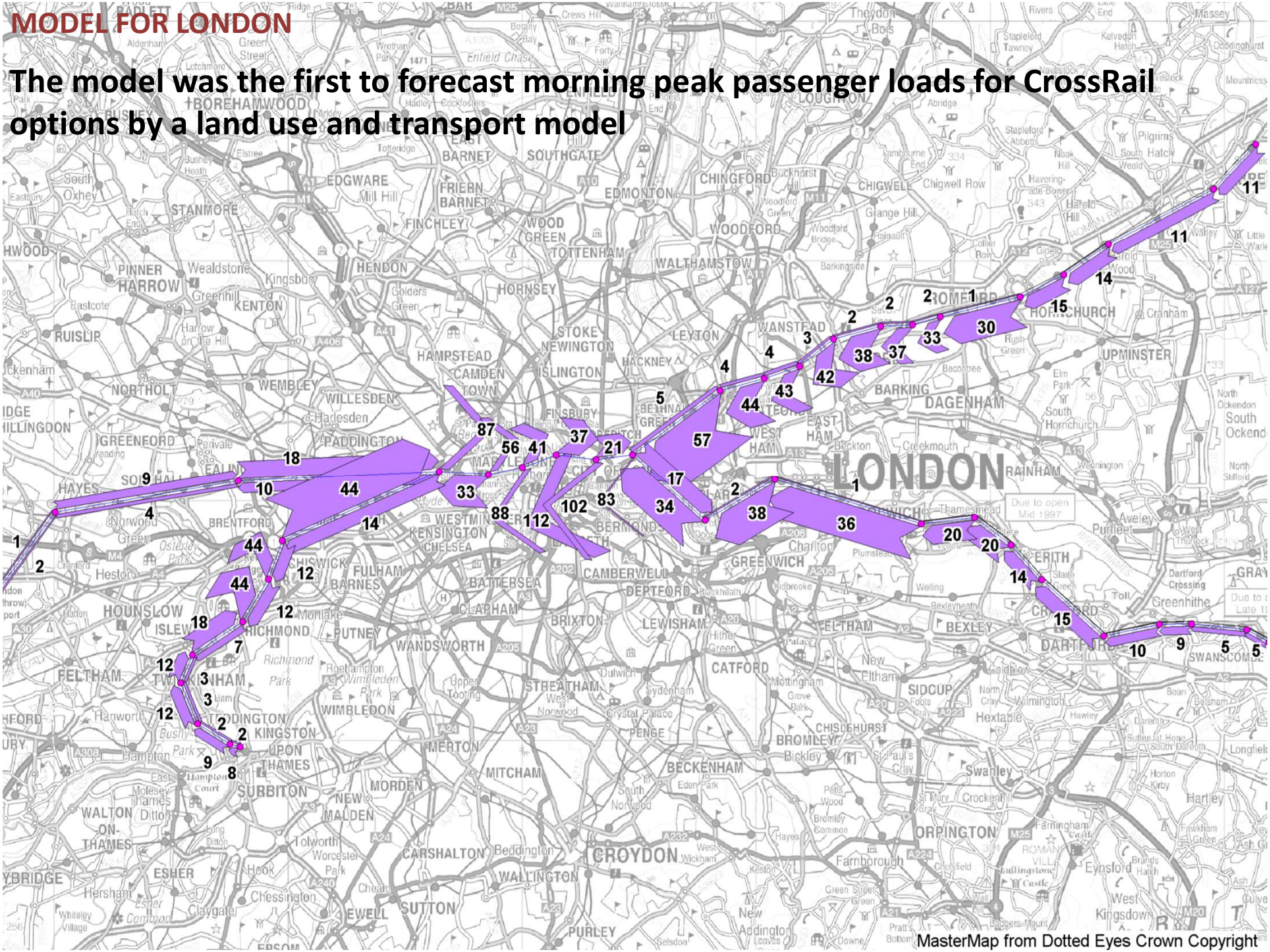
MODEL FOR LONDON



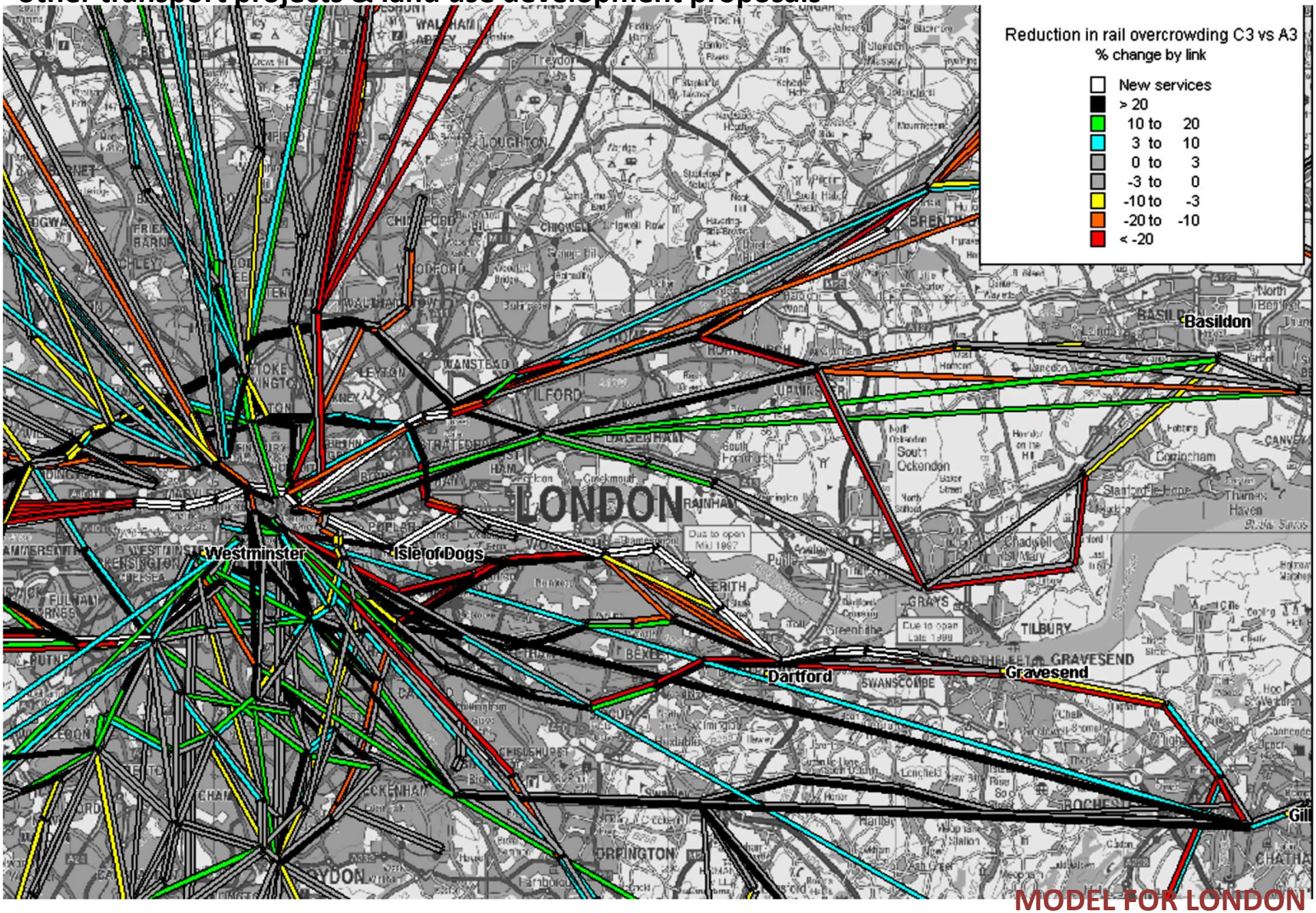
Rail network and services are represented in detail using DfT, TfL and operators' data and their plans

MODEL FOR LONDON

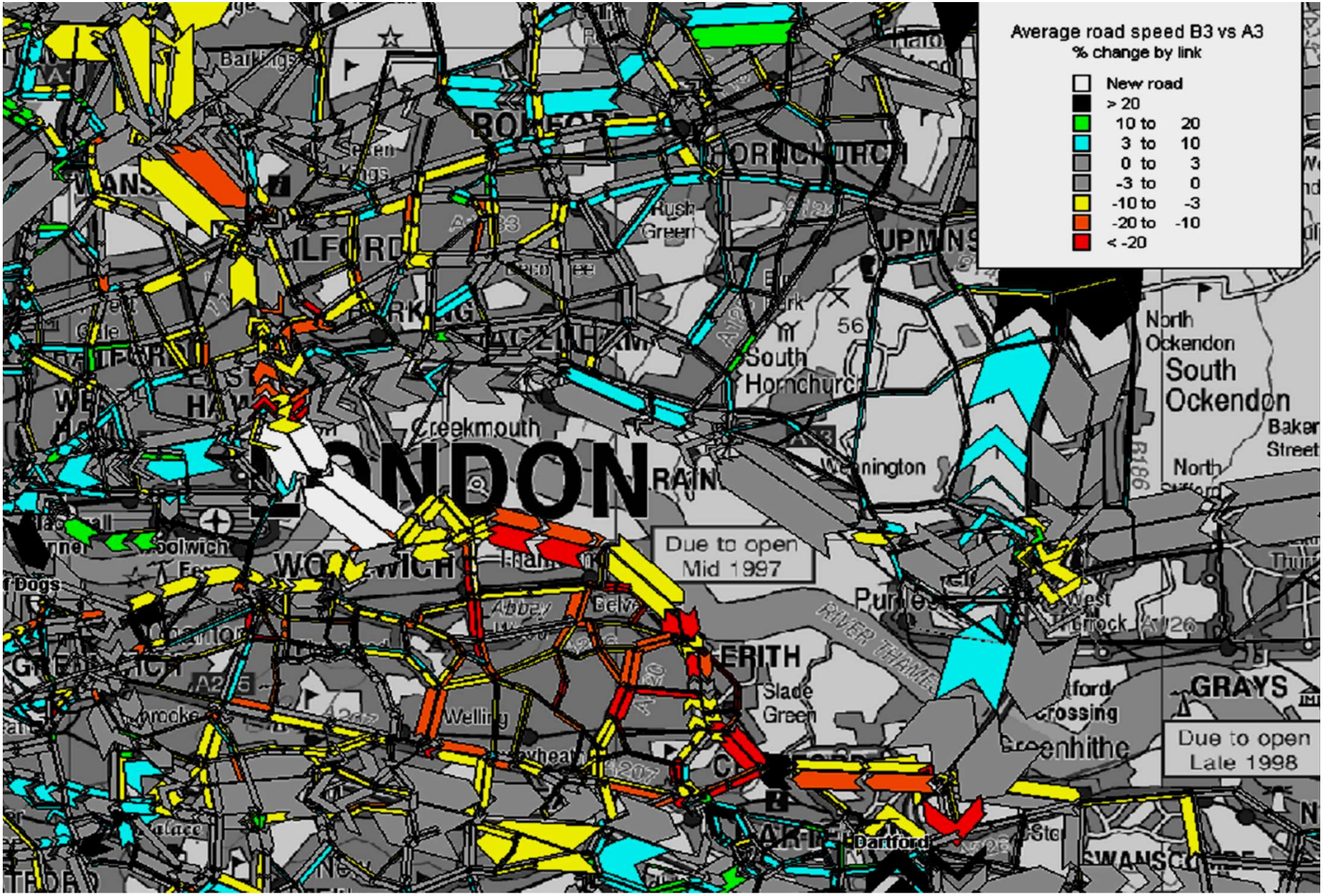
The model was the first to forecast morning peak passenger loads for CrossRail options by a land use and transport model



The model results showed where CrossRail could relieve/worsen rail crowding, given other transport projects & land use development proposals

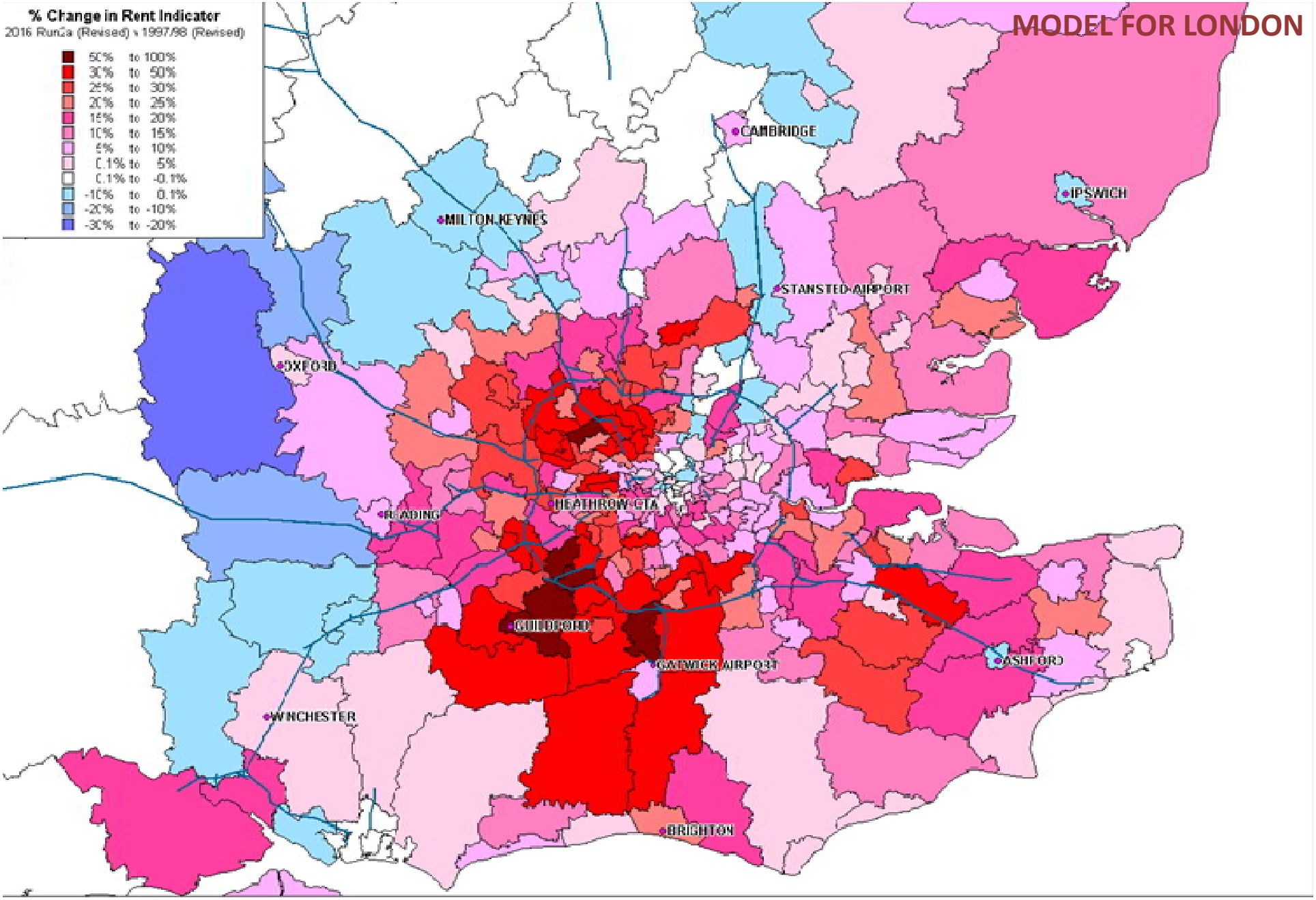


MODEL FOR LONDON



Similarly, the model quantifies road congestion effects- in this example, the effects of a proposed new Thames crossing

MODEL FOR LONDON



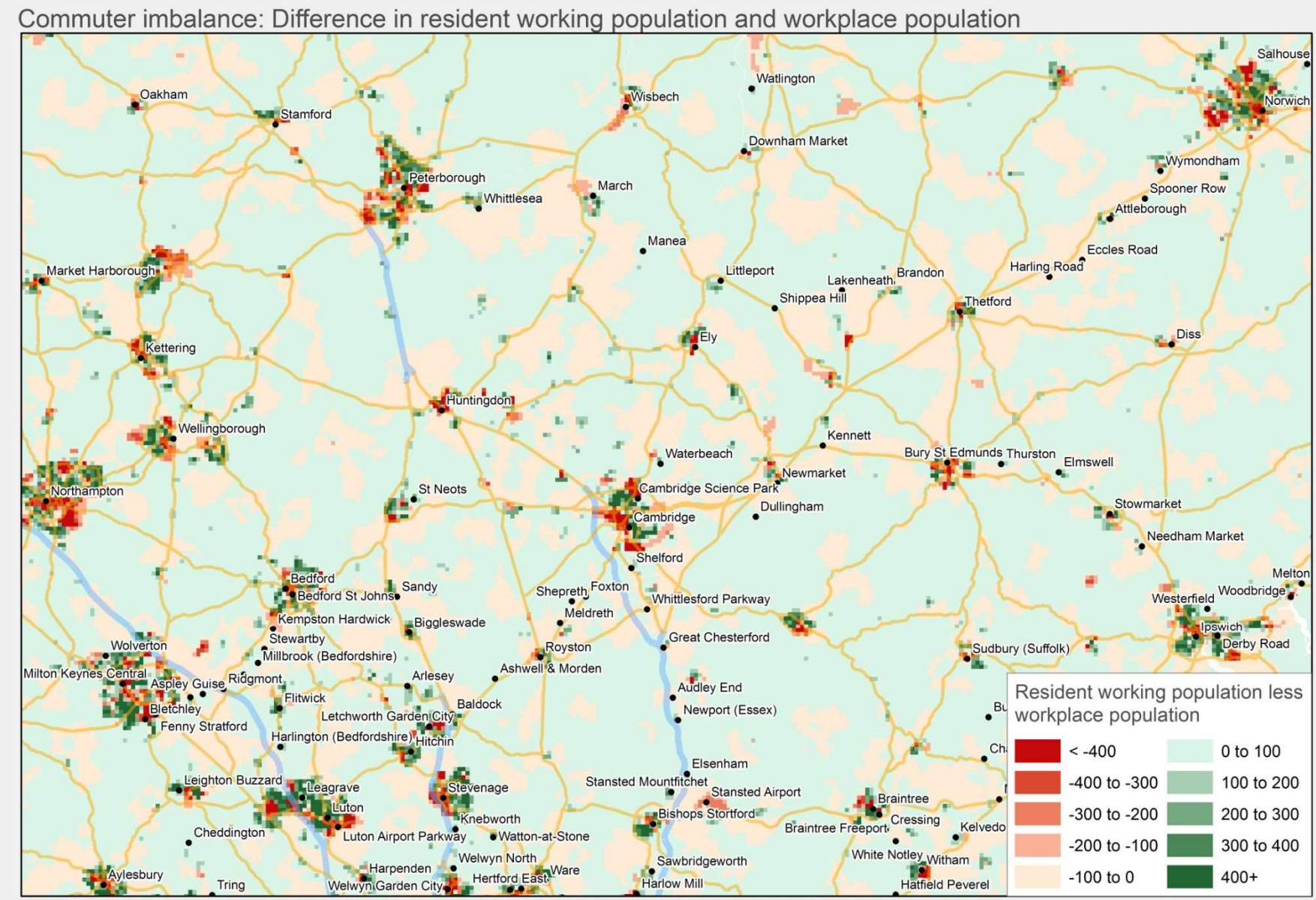
The model forecasts changes in housing rents (shown above), costs of living and wages subject to transport/land use inputs and travel to work/services

Plan for the MAGIC Layer – air quality exposure at the city scale

- Build on the city layers we already have for London – network, land use, travel by time period, future activity patterns
- Connect to building and neighbourhood level MAGIC findings
- Identify patterns and typologies of air quality exposure at the city scale
- Predict effects of policy interventions through scenarios

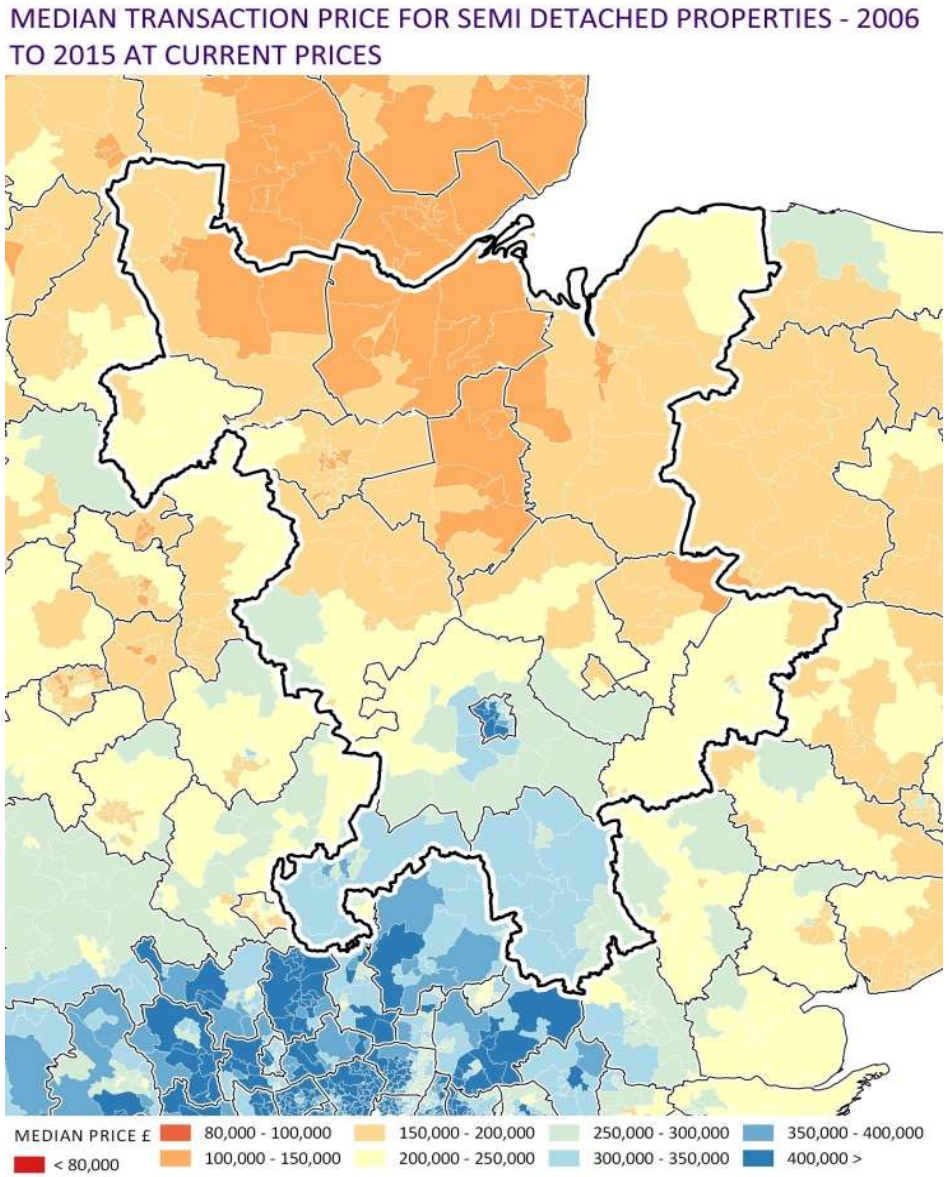
Greater Cambridge

Identification of distinct land use patterns



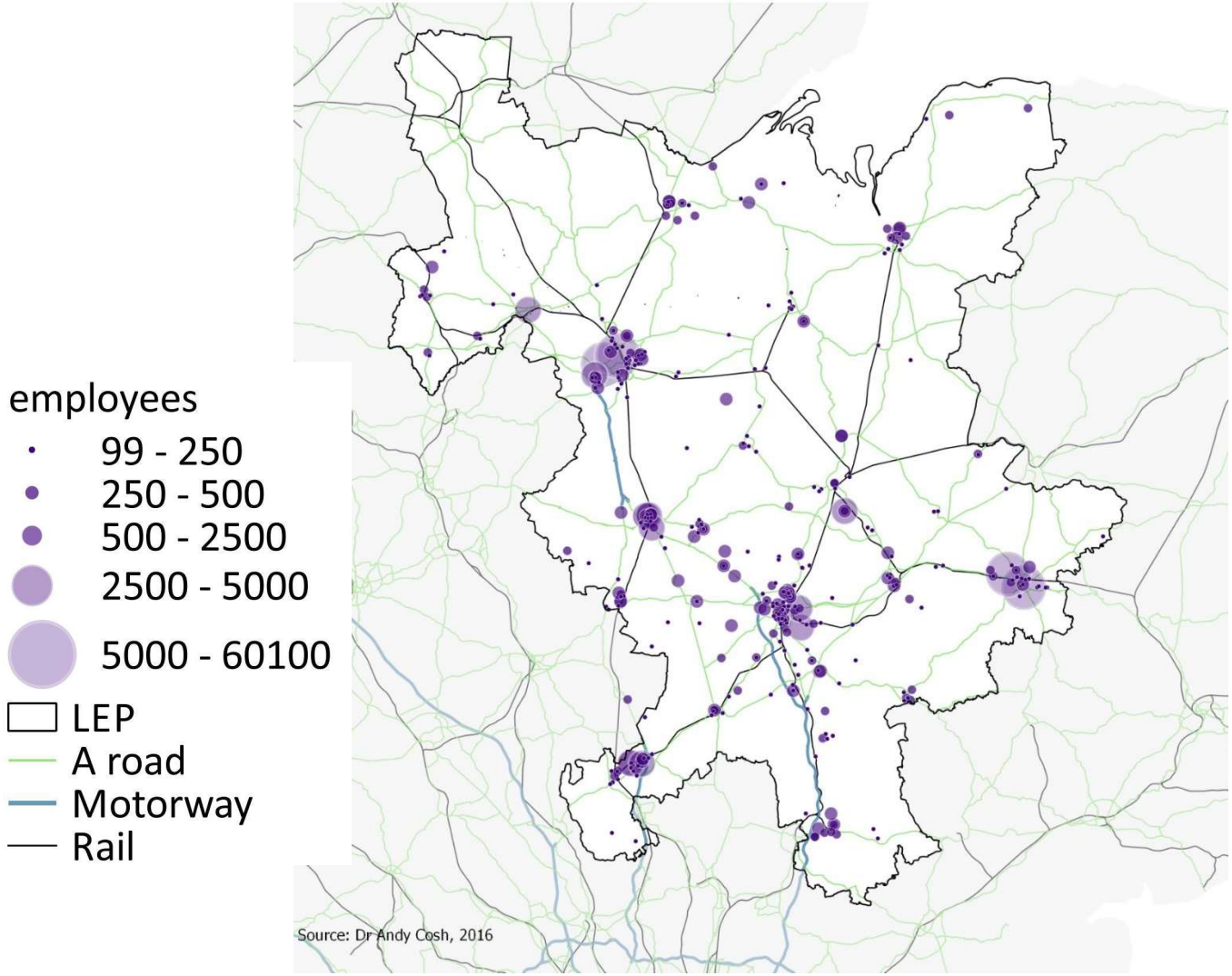
Source: 2011 census tables KS601EW to KS603EW - Economic activity by sex at Output Area level. Output Areas have been split into 0.5km grids and data aggregated based on intersecting area to provide uniform geography.

The proposed study: make full use of the house price & rents data

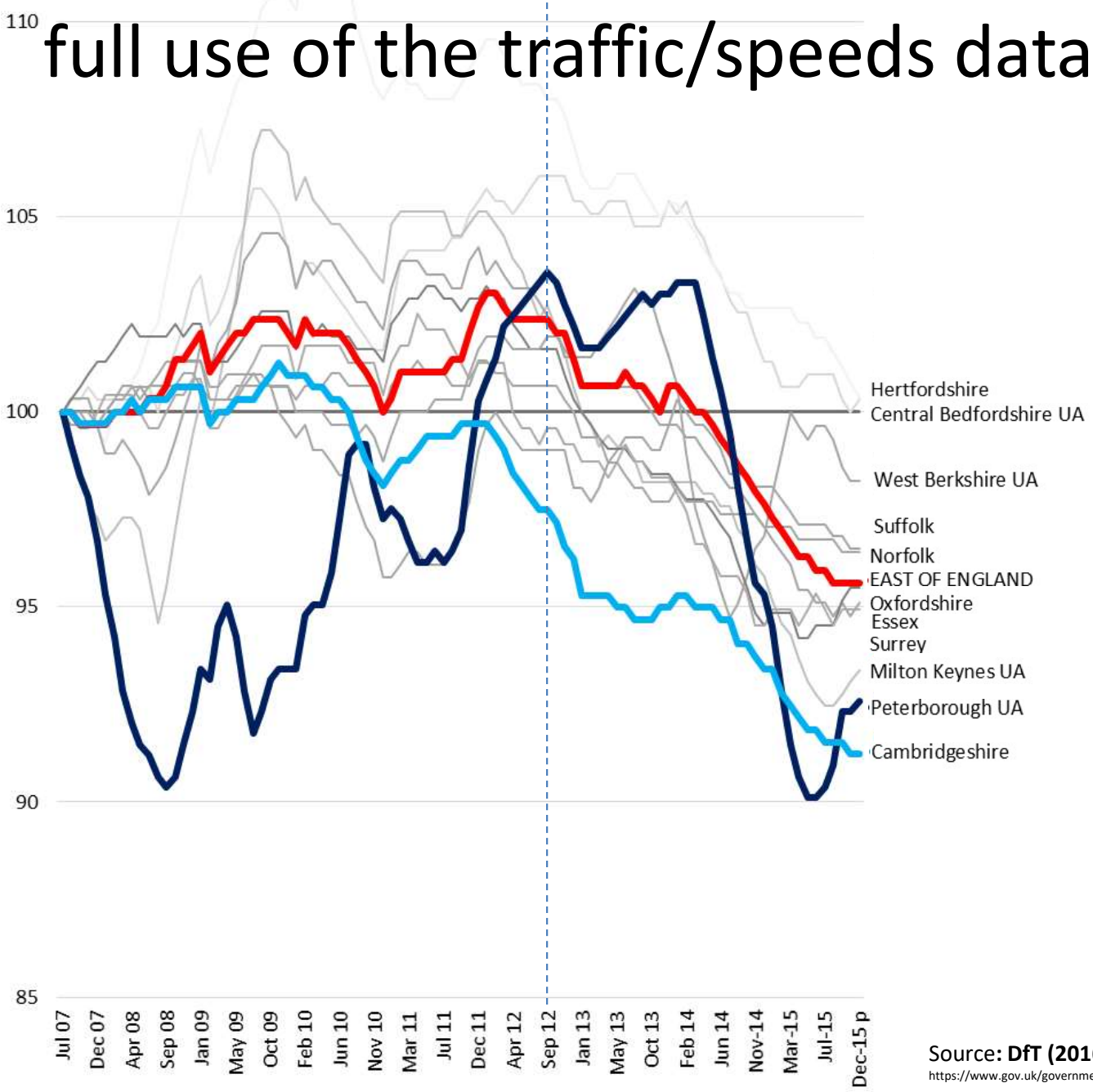


The proposed study: make full use of the business clusters data

Location of all businesses of 100 employees or more
All sectors



The proposed study: make full use of the traffic/speeds data



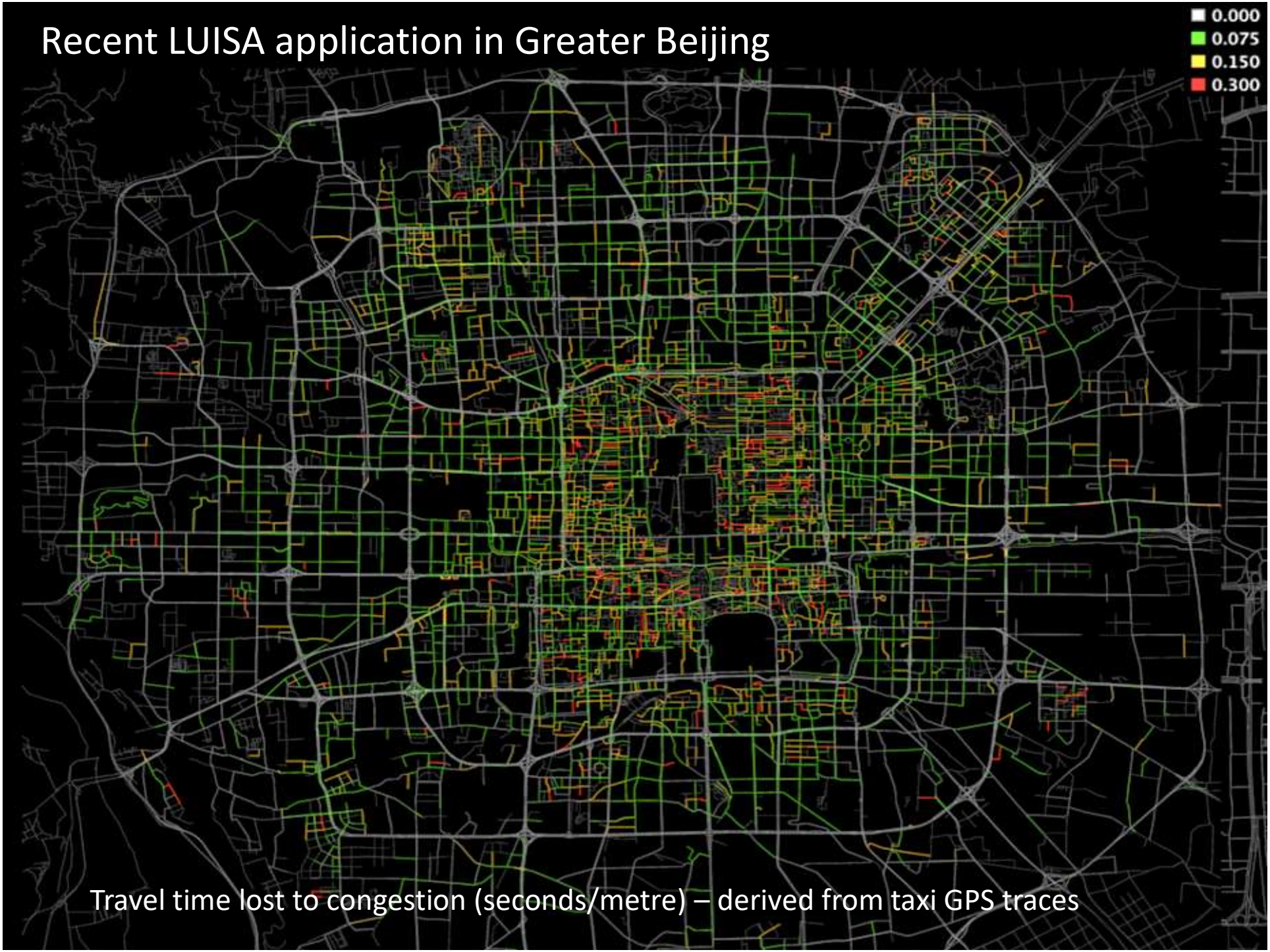
Changes in morning peak vehicle speeds on monitored locally managed A-Roads 2007-2015
Speed in 2007=100

Cambs	A10
	A1096
	A1101
	A1123
	A1134
	A1198
	A1301
	A1303
	A1304
	A1307
	A1309
	A141
	A142
	A1421
	A15
	A505
	A603
	A605
Peterborough	A1129
	A1139
	A1175
	A1179
	A1260
	A15
	A16
	A47
	A605

Source: **DfT (2016) Flow weighted vehicle speeds (CGN02)**
https://www.gov.uk/government/statistical-data-sets/cgn02-flow-weighted-vehicle-speeds#table-cgn0209

Greater Beijing

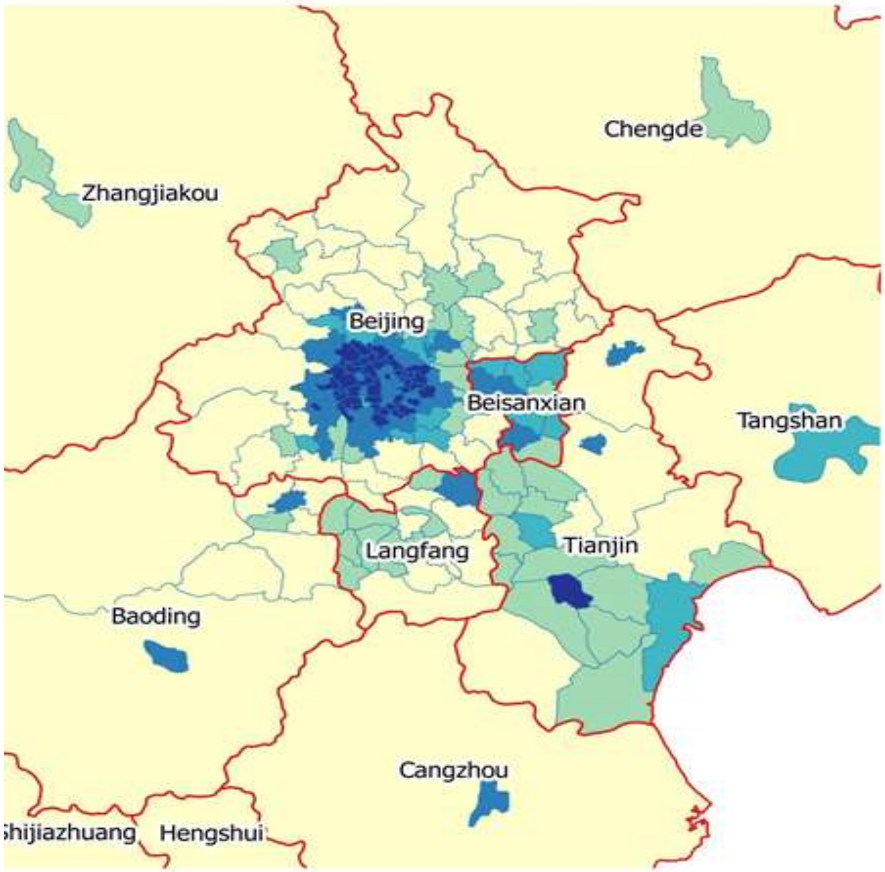
Recent LUISA application in Greater Beijing



Travel time lost to congestion (seconds/metre) – derived from taxi GPS traces

Forecasts of locations of residents and jobs

Density of Total Residents 2050

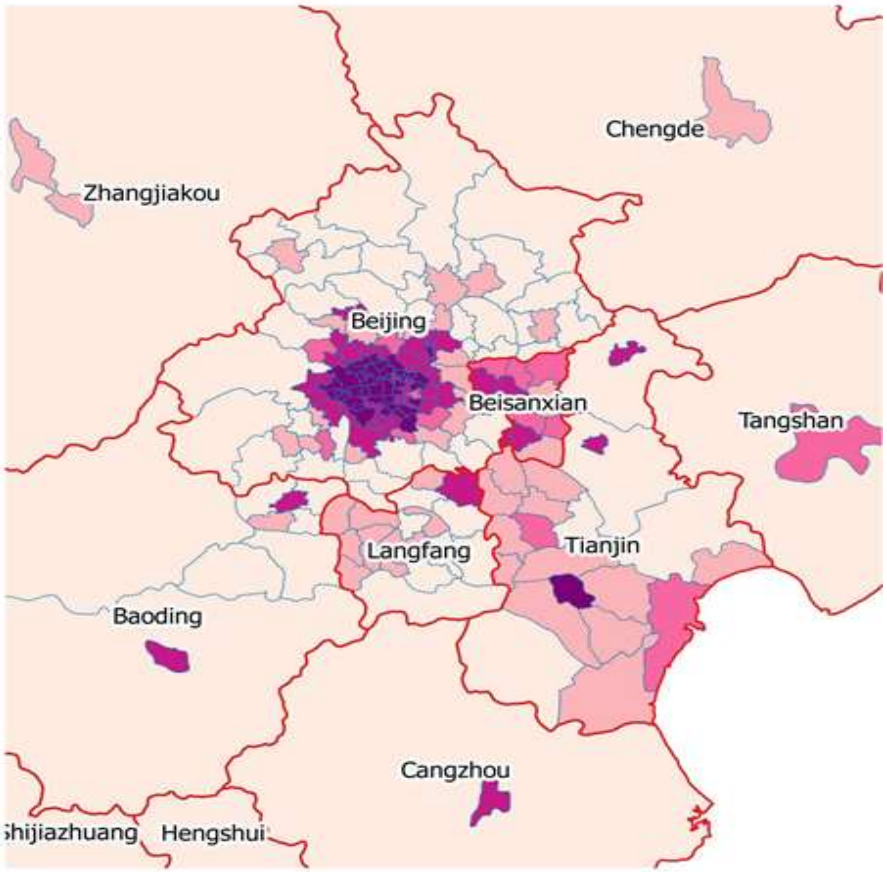


Legend

Total_Resident_Density

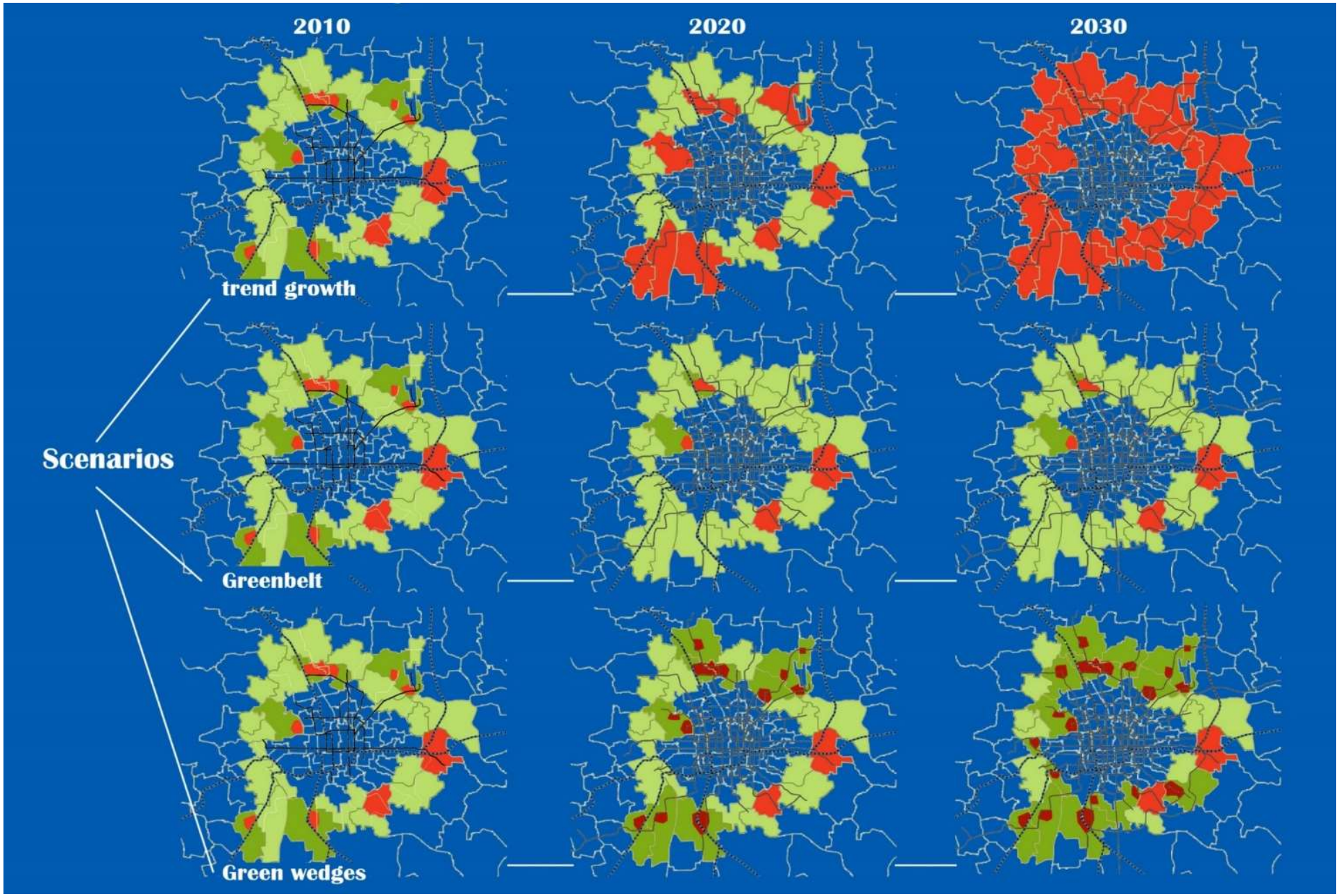
- 0 - 1000 (person/km2)
- 1000 - 2000 (person/km2)
- 2000 - 3000 (person/km2)
- 3000 - 10000 (person/km2)
- Above 10000 (person/km2)

Density of Total Employment 2050



Legend

Total_Employment_Density

- 0 - 1000 (person/km2)
- 1000 - 2000 (person/km2)
- 2000 - 3000 (person/km2)
- 3000 - 10000 (person/km2)
- Above 10000 (person/km2)

Testing alternative land use and transport scenarios
From top: sprawl (trend), strict control (greenbelt) and green wedges