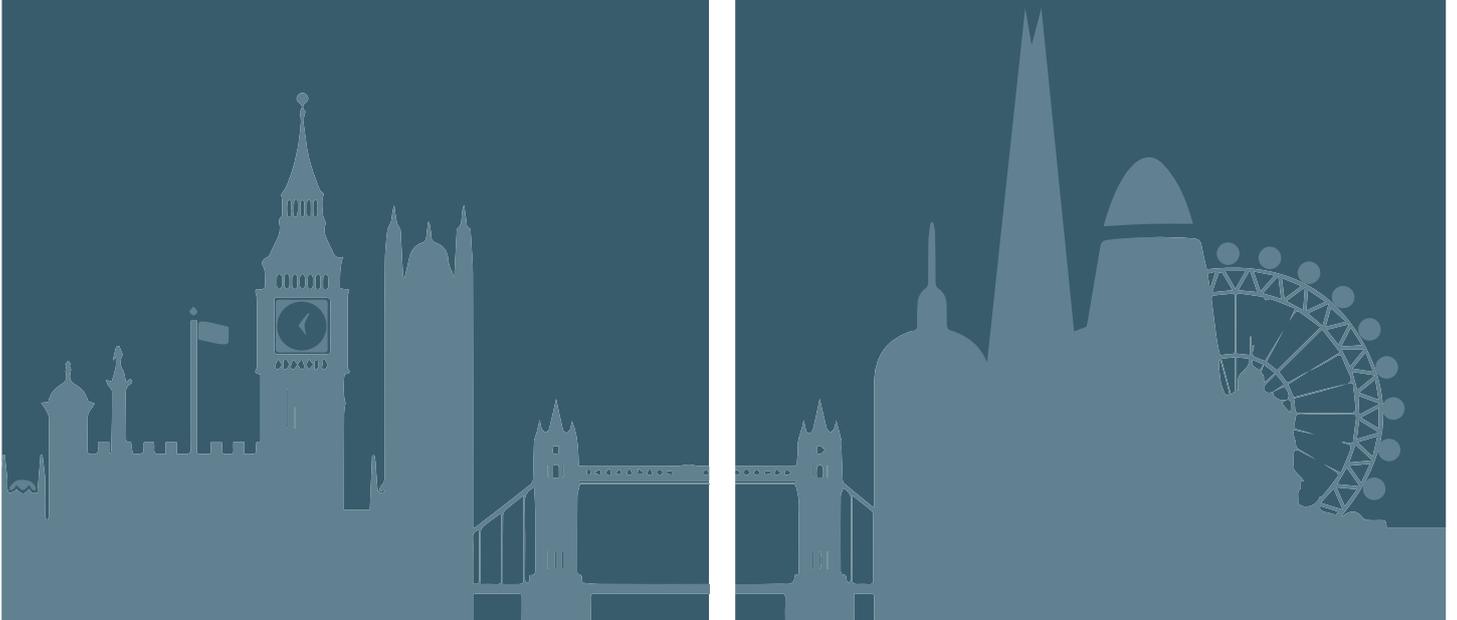


GAP

MIND THE

Funding and
financing city
investments in
the 21st century





‘Mind the Gap’ is a report about Greater London as an urban system, how it responds to public investments, and the long-term socioeconomic ‘cost of not’ making such investments.



Summary

'Mind the Gap' is a report about Greater London as an urban system, how it responds to public investments, and the long-term socioeconomic 'cost of not' making such investments.

The analyses in this report address a critical investment gap, its consequences and potential solutions for Greater London.

The gap is caused by chronic shortages of public funding and financing for city investments.

These shortages delay or prevent public investments, causing permanent losses of future housing availability, environmental quality, social balance, economic growth, and government revenues.

Three important findings emerge from these analyses and inform potential solutions.

- 1. Despite pronounced public investment shortfalls, London's population has grown and will continue growing.**
- 2. Where public investments can be made, they produce quite large and long-lasting benefits that help to address mounting problems such as the housing shortage and social imbalance.**
- 3. As these benefits are monetized in the form of tax revenues, they can support substantial new flows of private financing for public investment in Greater London.**

The report outlines innovative public / private solutions to the challenge of funding and financing public investments in London and other cities.



GAP

MIND THE

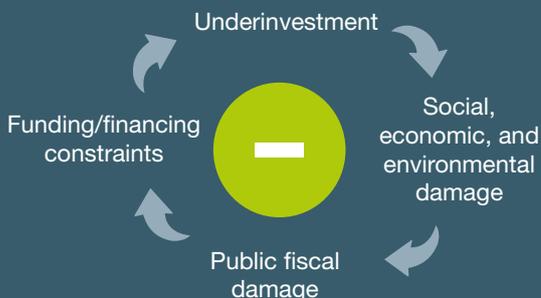
The challenge

Status quo is failing to deliver what cities and investors need

The solution

Dynamic whole-city analysis supporting new funding, financing, and city investments

From vicious cycle...



...To virtuous circle



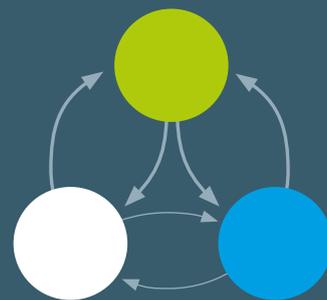
The emerging innovation

Greater London Simulator



Measuring whole-city investment impacts

New funding and financing options



Private financing for increased public investment

Five Investments: Simulated impacts on London and UK to 2050

Sutton Tram Extension – Crossrail 1 Extension – Bakerloo Line Extension + Options – Crossrail 2 – Royal Docks

365,000 additional housing units

640,000 population increase

Loss of middle-income houses reduced by 60%

379,000 additional jobs

4-year delay on CO₂ emissions target

£34bn/year added to the economy

£9.8bn/year additional HMT tax take



The Greater London Simulator is a neutral test-bed for a wide range of public investments, providing objective measures of social, economic, environmental and fiscal impacts

Developing the Greater London Simulator

In 2014 Greenwood began developing technology for simulating the dynamics of cities. Since 2015 Greenwood and the Greater London Authority (GLA) have partnered in setting up and employing the Greater London Simulator, a whole-city 'virtual twin' (computer model) of the London city system and how it responds to investments.

In 2016 Greenwood began a similar partnership with Boston (Massachusetts), simulating that city and the rest of Greater Boston. In 2017 Greenwood added simulators of Norfolk (Virginia), and Frankfurt and Coburg in Germany.

The Greater London Simulator and its counterparts in other cities are neutral test-beds for urban investments, providing objective measures of their long-term social, economic, environmental and fiscal impacts on these cities and their stakeholders. By measuring how each city-system is monetising non-financial investment outcomes, these simulators more fully value such investments.

The need for innovation

Governments and institutional investors such as pension funds generally agree that the status quo in cities and capital markets is broadly failing to deliver what cities and investors need from each other and should be able to provide.

- Cities have huge unmet needs for infrastructure and other investments. Even cities like London are able to fund and finance only a fraction of the investments needed for resilience and sustainability in the face of continued population, job, and economic growth.
- Government tax revenues, funding and borrowing have been insufficient to meet this need and this is unlikely to change in future.
- Institutional investors have huge unmet needs for safe and long-lived investments, but few public investments are currently available to them.
- The missing link is a framework in which private investors, ranging from individual citizens to pension funds, can play a much larger role in financing public urban investment.

New opportunities from whole-city analysis

City investments that are delayed or prevented by public funding and financing constraints cause substantial and long-lasting social, economic and environmental damage in cities, along with lost government cash flows that perpetuate underinvestment.

Measuring the whole-city impact of public investments reveals that many have real potential to be self-funding through the economic and fiscal growth they bring. This opens up the possibility of new financing approaches and private investment capital that can help relieve public budgets and borrowing constraints and enable cities to be more resilient and better prepared for sustainable growth.

Funding and financing solutions can convert the vicious cycle of under-investment into a virtuous circle, in which city investments increase growth and bring higher tax revenues that help reduce pressure on Her Majesty's Treasury (HMT).

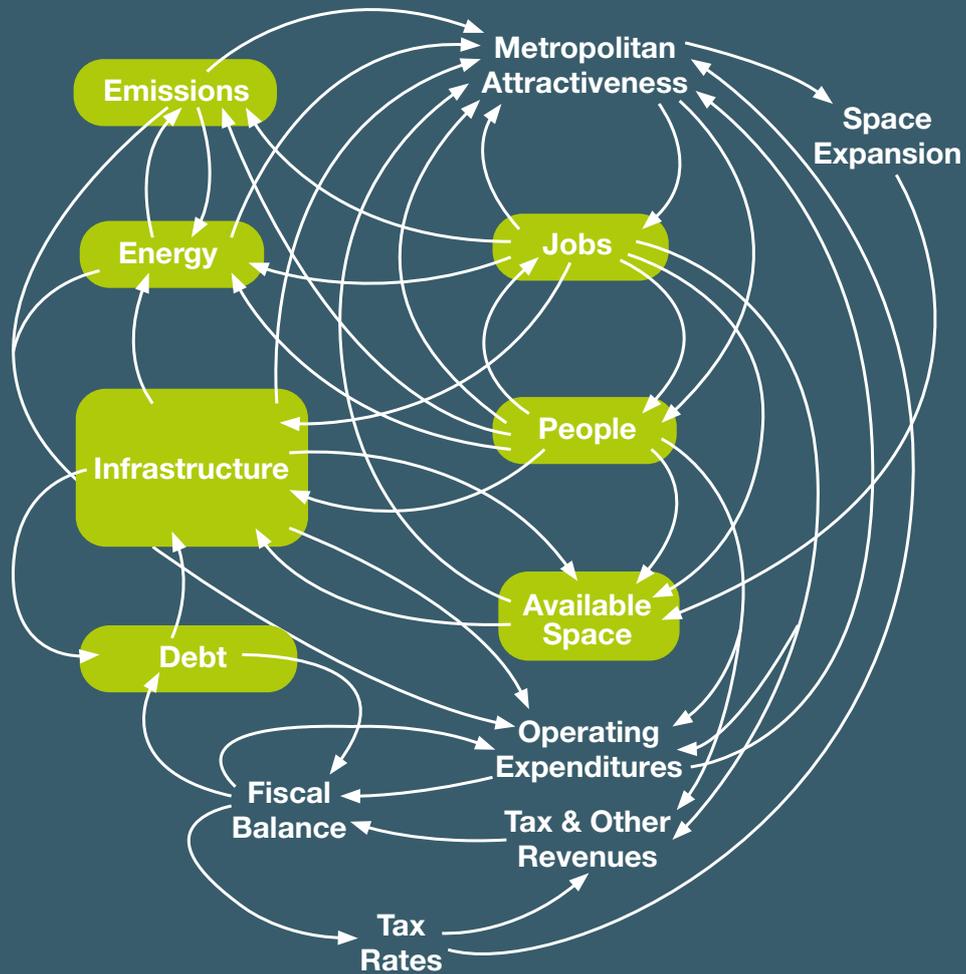


City stakeholders lose when public investments with self-funding potential are delayed or eliminated due to near-term funding constraints

Greater London Simulator



The dynamic city system





The status quo in cities and capital markets is broadly failing to deliver what cities and investors need from each other

Simulating Greater London investments

Greenwood and the GLA have used the Greater London Simulator (GLS) to simulate seven prospective public investments, measuring their social and economic impacts and how the city monetises these impacts in the form of government cash flows.

The seven investments analysed are:



Three extensions of existing public transport lines (Sutton Tram, Crossrail 1 and Bakerloo Line)

A major new high-speed commuter rail line (Crossrail 2)



A major brownfield redevelopment (Royal Docks)



High-speed fibre-based digital access to every building in Greater London



Accelerated housing development as targeted in the Mayor's London Plan

All but one of these investments repurpose land or bring new public transport, supporting residential development that will help relieve Greater London's housing crisis thereby easing the leading constraint on job creation.

Together the five transport and redevelopment investments can sustain London's housing growth close to its recent but insufficient rate of development.

The simulated investments in accelerated housing development increase the pace of housing growth first to 40,000 net new units per year and then to the London Plan's annual target of 65,000 units per year.

Impacts from five of these investments

Beginning with the four transport projects and the brownfield redevelopment project, these simulations measure Greater London investment impacts in terms of:

1. cumulative differences in absolute growth of population, housing and jobs to 2050
2. increases in the simulated sizes of London's 2050 economy and HMT's 2050 tax take from London.

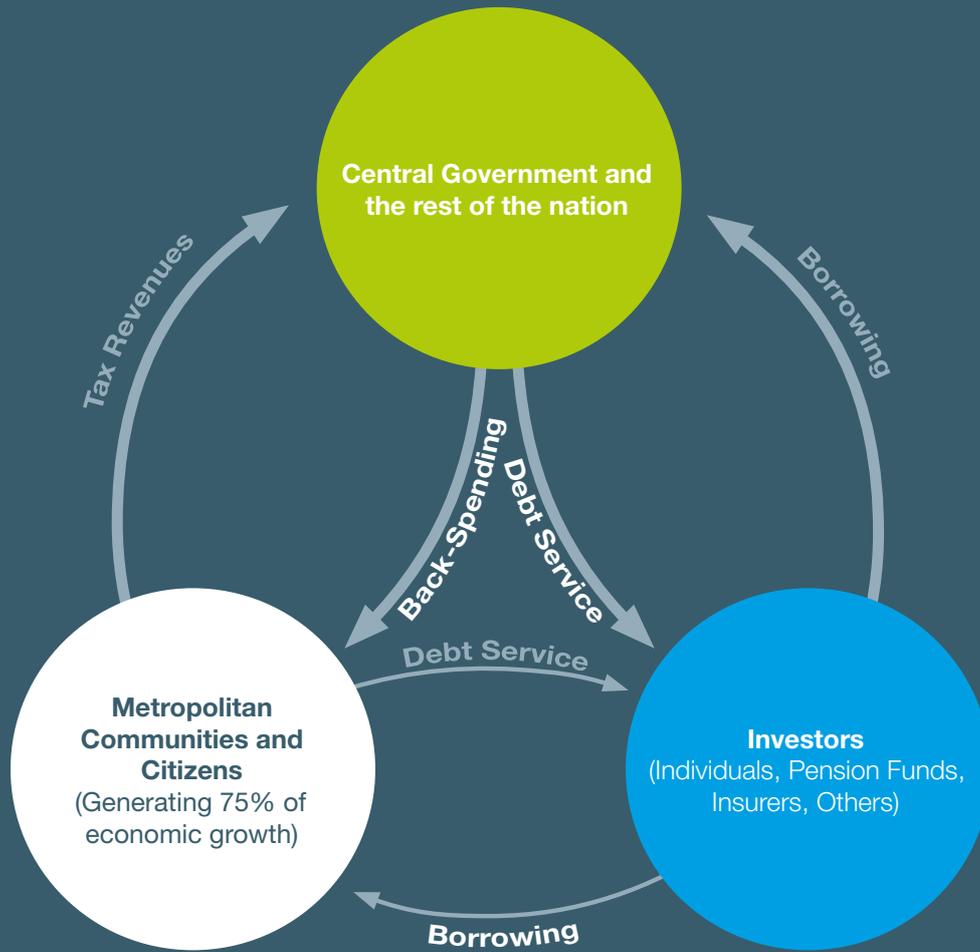
The high 'cost of not' investing

Simulating Greater London without and then with these public investments demonstrates their importance to the city's health and wellbeing. In the absence of these or equivalent investments, the inter-connected dynamics of London's jobs, population and housing operate in a significantly less balanced and effective way.

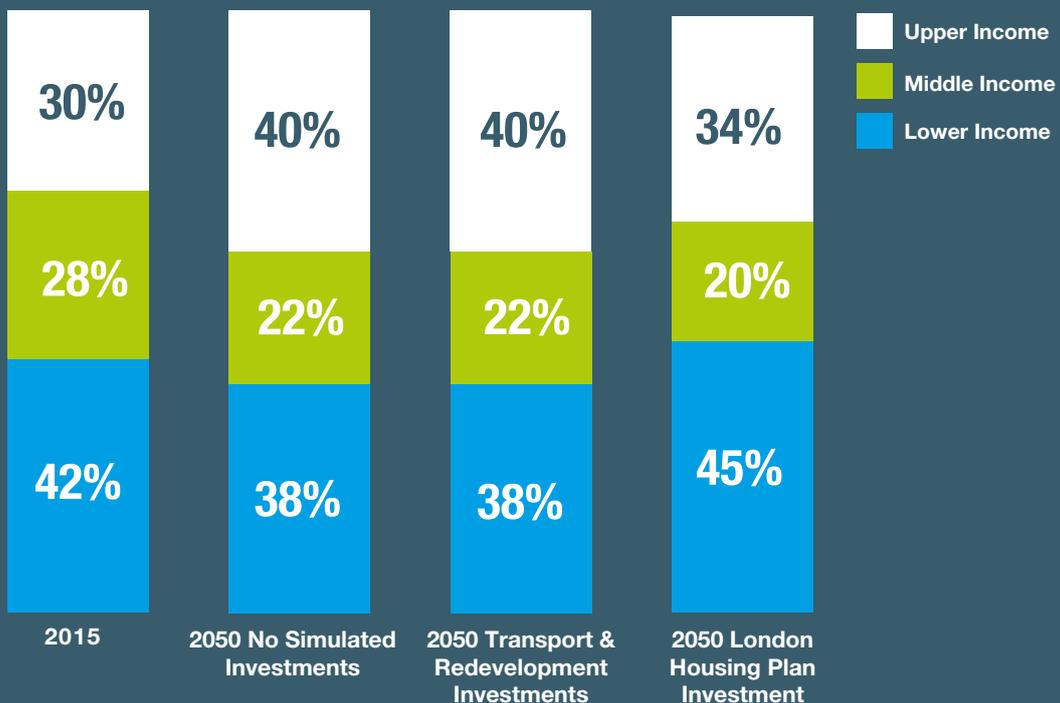
- Without these investments Greater London will have 365,000 fewer new housing units in 2050, equivalent to about 10% of London's total housing stock in 2015.
- Without these units London housing grows by only 12% to 2050, but the city's population swells by over 17% to 9.9 million people, so the housing crisis worsens steadily.
- Therefore social balance continues to deteriorate as middle-income Londoners shrink from 28% to just 22% of total population by 2050, due to diminishing middle-income housing.
- Because of the housing that isn't built, London's total job growth to 2050 is lower by 16% and economic growth is down by 10%. As a result, HMT's real annual London tax revenues are almost 12% lower in 2050 than they would be with these five investments.

City investments that are delayed or prevented by public funding constraints cause long-lasting social, economic, and environmental damage

Framework for funding and financing city investments



Investment impacts on London's social balance





Without these simulated investments London's social balance continues to deteriorate

Social and economic impacts from the transport and brownfield investments

Social impacts from these five investments begin with the 365,000 net new residential units they make possible by repurposing or bringing new public transport to land in Greater London.

- The new housing meets pent-up demand, enabling additional population growth of 640,000 to 2050.
- The investments also enable 913,000 m² of new London business space to 2050.
- Together, increased population and business space enable additional job growth of 379,000 to 2050.
- This increases the size of Greater London's 2050 economy (GVA) by £34B per year and enlarges HMT's 2050 London tax revenues by £9.8B per year.

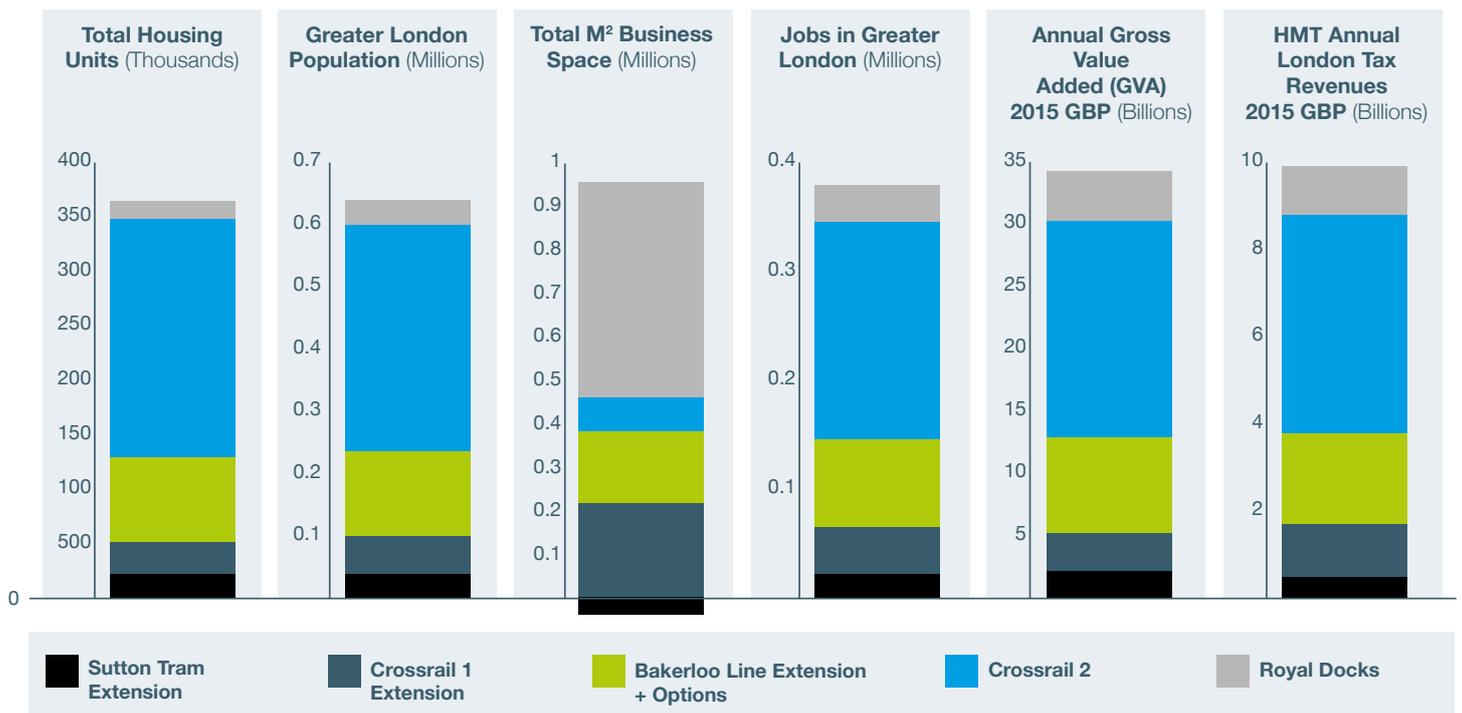
The social dynamics of housing, population and jobs are key drivers of the simulated investment impacts, and these elements are highly inter-connected. Their dependence on each other can be seen in two facts:

- The five simulated investments directly add 226,000 new housing units;
- Yet in response to these investments London housing grows by 335,000 units in total (109,000 more).

The 'extra' 109,000 housing units are produced by the social dynamics of this housing-constrained city, which tend to be self-reinforcing over the long term. Public investments that increase housing boost both population and job growth; additional jobs attract still more people, further increasing housing demand and development; the added residents filling these additional housing units enable even more job growth, which attracts yet more people, and so on.

Because these social dynamics are naturally self-reinforcing, energising them by public investments can deliver disproportionately large socioeconomic benefits relative to investment costs. Simulating these social dynamics in an integrated way is therefore essential to reliably measure the full social, economic, and fiscal impacts of public investments in London and other cities.

Social, economic, and fiscal impacts from these investments: Resulting growth to 2050



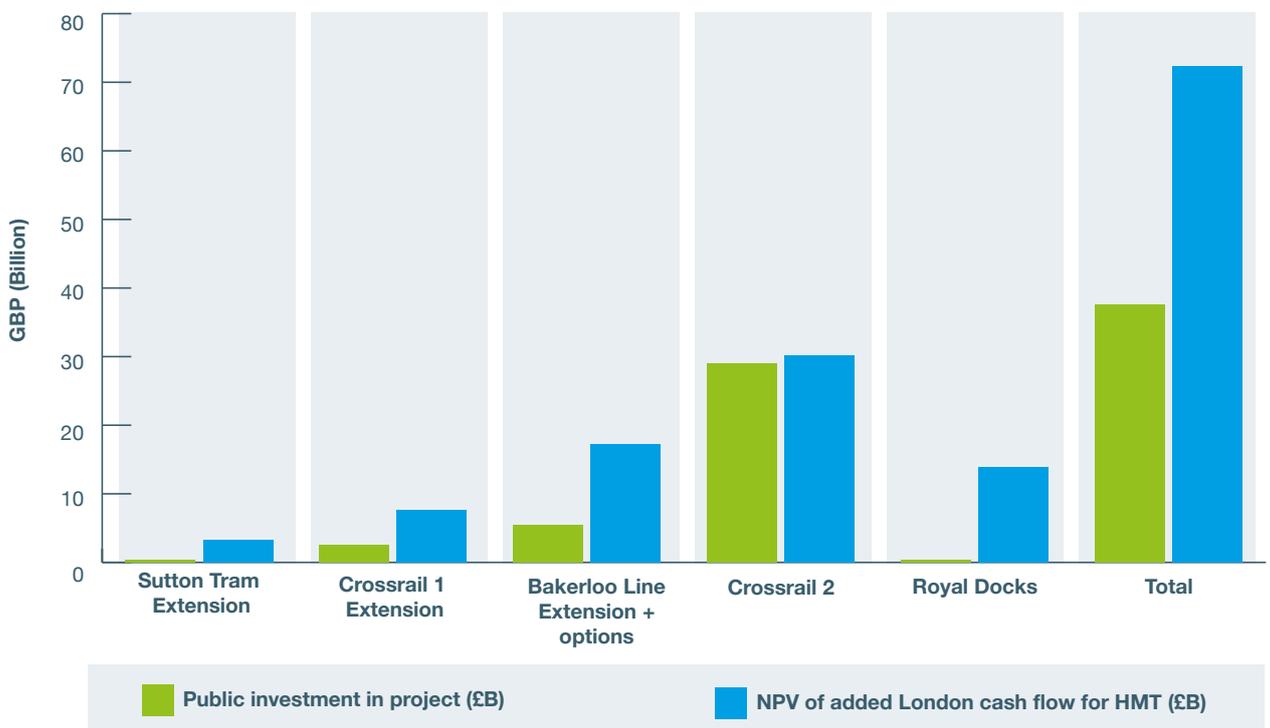
Social and economic impacts monetised as fiscal impacts

Greater London monetises the social and economic impacts of these public investments as:

- additional HMT tax revenues from London
- increased Central Government spending back into a larger London (such back-spending averages about 70% of HMT's London's tax revenues).

The Greater London Simulator measures Central Government's fiscal impact from these five investments as HMT's resulting long-term increase in net cash flow from Greater London. It also computes the net present value (NPV) of that cash flow increase so the UK's fiscal gains from these investments can be directly compared to their public investment costs.

Social and economic impacts monetised as fiscal impacts



This analysis has not measured other forms of fiscal impact from these public investments, including:

1. increased cash flows for Transport for London (TfL) from the four transport investments
2. increased council tax revenues from the new housing these investments bring
3. potential new tax revenues from sharing in the uplift in land values along the four transport corridors involved.

Measuring only HMT's London cash flow impacts from these investments therefore provides a conservative quantification of their fiscal benefits.

That said, for each investment the net present value (NPV) of HMT's added London cash flow is positive and exceeds expected investment cost. In fact, the combined NPVs of the added London cash flows are nearly double the expected investment cost of these projects. This is an evidence-based demonstration that these public investments can generate their own funding and more in the form of increased London tax revenues for HMT.

There is a high 'cost of not' making investments that can produce important social benefits, fund themselves and generate a significant surplus to fund other initiatives around the UK



Residential development to the London Plan target of 65,000 units annually strongly boosts social and economic growth

Wider impacts in the UK outside London

HMT's added cash flows from these five simulated investments are worth £72B (in NPV terms), which accrues to Central Government and thus to the UK outside Greater London. This is a quite substantial benefit to the rest of the nation, but these dynamic analyses do not yet account for other positive and negative impacts from London investments in other parts of the country. Such impacts are important, for example, to assess whether fiscal benefits from Greater London investments are net additional to the UK economy.

Evidence suggests that fiscal benefits to London from the simulated investments are net additional for the UK as a whole due to:

1. London's openness to and connections with the international economy
2. Higher economic efficiencies in larger cities (due to agglomeration effects)
3. London's large resulting net tax surplus for HMT
4. London supply chains that extend throughout the rest of the UK
5. Strong correlation between growth in London and in the rest of the UK.

Furthermore, dynamic analyses strongly suggest that public investments in other growing UK cities have the same self-funding potential as in London, and can be part-funded with HMT's increased cash flows from public investments in the capital.

Further dynamic analyses are therefore required to measure the social, economic and fiscal impacts on the rest of the UK from public investments in Greater London.

Digital and London Plan housing impacts

The simulated digital investment in Greater London spurs job growth that would further reduce loss of middle-income households and modestly increase economic growth.

Simulated residential development to the London Plan target of 65,000 units annually significantly eases London's housing crisis, strongly boosts social and economic growth, reverses the decline of middle-income households, and modestly increases unemployment.

Environmental impacts

The GLA's ambitious decarbonisation programme aims to reduce London's 2050 greenhouse gas emissions by 90% from 1990 levels. Dynamic analysis indicates that London is on track to achieve that target by about 2061 with these five investments, or by about 2057 without them (due to lower economic growth). Simulating without the decarbonisation programme, a growing London sees rising energy consumption and emissions.

Innovative funding and financing

The prospect of city investments that produce their own funding makes private financing of such investments much more feasible. Financing instruments are available that can bring private capital and defer public expenditures until investments are producing their expected social, economic and fiscal impacts.

Credit Participation Certificates™ are an innovative example of such instruments. UFT Commercial Finance LLC developed and administers the global CPC™ platform, which is open to a wide range of participating lenders, borrowers and investors. CPCs™ are used in a variety of credit markets including trade finance and private equity, and in multiple jurisdictions including the UK.

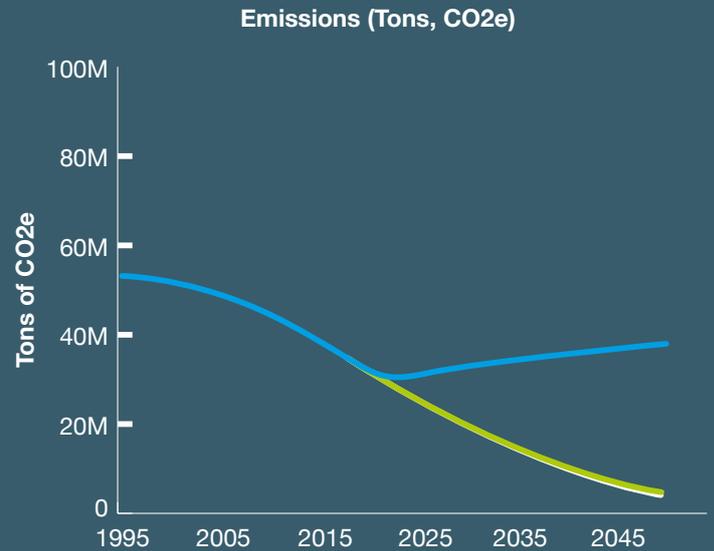
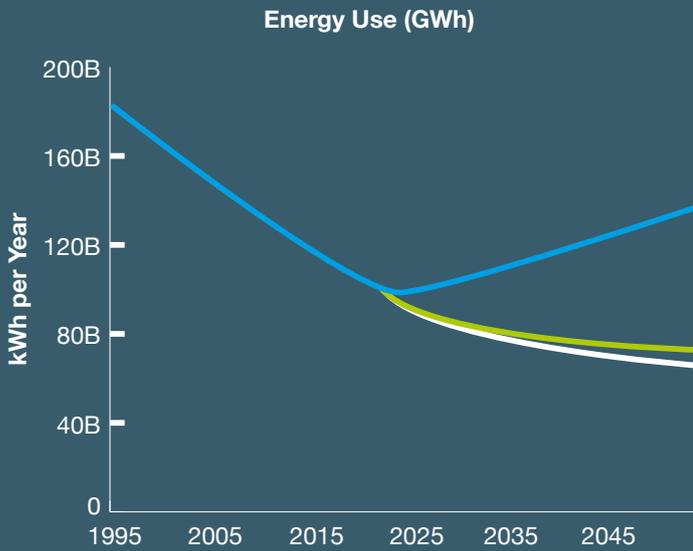
The combined capabilities of dynamic city analysis and the CPC™ platform represent a new chapter in public infrastructure finance. Together they can bring new-build city projects to a much broader base of investors (including UK pension funds) and reduce risk by making such investments tradable in liquid markets.

It is expected that these innovations will substantially increase the volume of private financing for public investments while significantly reducing the cost of such financings.

Without the GLA's Decarbonisation programme, a growing London sees rising simulated energy consumption and emissions

The combined capabilities of dynamic city analysis and the CPC™ financing platform represent a new chapter in infrastructure finance

Greater London energy use and emissions



Where will Greater London be in 2050 without and with these five investments?

	Without	With	Impacts
	—	+	=
Population	9.9m	10.6m	640,000
Jobs	7.7m	8.0m	356,000
Housing units	3.8m	4.2m	379,000
Business space (m ²)	61.4m	62.3m	913,000
Economy (in real terms)	£691B/year	£725B/year	£34B/year
HMT tax take (in real terms)	£205B/year	£215B/year	£10B/year



Systemic analysis capability is essential for reliable valuation and prioritization of urban investments

Dynamic investment analysis in other cities

The feasibility and usefulness of dynamic analysis in other cities is demonstrated by its application in five cities ranging from 42,000 to 8.5 million residents and on diverse issues including flood protection, health infrastructure investment, brownfield redevelopment, housing and land use, public transport, and macroeconomic influences. All of these city simulators employ publicly available data for model initialization and testing, and the most recent simulators have been set up and in use in about twelve weeks.

The way forward for London

Dynamic simulation and analysis fills a strategic gap in the GLA's knowledge and understanding of how London (and cities in general) work, namely as systems of interconnected systems.

Planning is in process to enhance the capabilities of the Greater London Simulator and the range and value of dynamic analyses.

- Simulate additional geographic layers including: inner and outer London Boroughs; regions adjoining Greater London and others well beyond the city; and major London transport corridors.
- Extend the Greater London Simulator to measure property values, housing affordability relative to incomes, and potential for value uplift sharing.
- Expand environmental simulation to include air quality and pluvial flooding, their social, health and productivity effects, and mitigation investments.
- Individually simulate Central Government's primary London expenditure categories for more complete analysis of fiscal impacts from public investments.
- Further analysis regarding private financing for large-scale public infrastructure investments.
- Expand participation with Greater London stakeholders and collaborative solution development.

Conclusion

The GLA now has a tested dynamic analysis platform for integrated measurement of social, economic, environmental and fiscal impacts from public investments in Greater London, along with their monetised values for local councils, Central Government and the rest of the UK.

The indicated values of simulated investments are high and mostly insensitive to possible Brexit impacts. There is reason to believe that many such investments can fund themselves and help fund other projects through the economic growth and fiscal benefits they bring.

This development has potential to transform and resolve the UK's public investment funding challenge through innovative private financing.

Greenwood recommends that the GLA, Transport for London, Greenwood Strategic Advisors, and UFT Commercial Finance work with appropriate lenders in assessing the feasibility of a several-billion-pound CPC™ financing of new public infrastructure in Greater London. The Crossrail 1 extension project to Ebbsfleet in Kent is a good candidate for such a feasibility study.

The simulator model structure recreates cities' different histories with equal accuracy and simulates their quite different future trajectories

Greater London Simulator: complementing existing sector models



About this report

The investment analyses described in this report were conducted using the Greater London Simulator, through the support of the Mayor of London (for the London-specific scenario development and analyses described) and with part-funding (for the report) from the European Union's European Multi-Regional Assistance: Revolving Investments in Cities in Europe project.

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