

National Infrastructure Commission call for evidence: 'London's transport infrastructure'

Evidence submitted by the iBUILD Infrastructure Research Centre,
January 2016

Introduction

The iBUILD (Infrastructure **B**usiness models, valuation and **I**nnovation for **L**ocal **D**elivery) Infrastructure Research Centre brings together a multi-disciplinary team from Newcastle, Birmingham and Leeds Universities to improve the delivery of local and urban infrastructure. iBUILD is developing and demonstrating alternative infrastructure business models that: take a whole life cycle view of infrastructure systems; exploit technical and market opportunities from modern interconnected infrastructure; leverage economic, social, environmental, aesthetic and other values from infrastructure; identify changes in governance, regulation and policy to unlock improvements; and, use innovative financing and funding mechanisms.

iBUILD promotes a service and system-wide approach to local and urban infrastructure, believing that there are significant advantages to be gained from planning, investing and managing infrastructure on an interdependent basis. As the recent floods in Cumbria, Northumberland and elsewhere in the north of England demonstrated, long-term resilience should be built into the UK's infrastructure sectors and systems. Otherwise, the potential economic and social benefits that can be derived from infrastructure investment will be marginal compared to the economic, social and environmental costs of repairing infrastructure that is damaged or destroyed by adverse (but increasingly regular) weather-related events.

The emergence of the National Infrastructure Commission (NIC) reflects the recent emphasis towards national scale infrastructure planning in the UK, and provides an important strategic context for the planning, development and operation of infrastructure. However, it is also important to consider the distinct role of local and urban infrastructure in driving local, regional and national economies. It is at the local and urban scales where infrastructure services are most dense and where the majority of people use infrastructure services in their everyday lives. Balancing growth across different geographical scales – from the local to the city/city-region – is vital to the long-term success of the national economy, as infrastructure drives local economic growth and job creation, as a consequence of construction and management activities as well as the enhancement and facilitation of other economic activities.

The response below first summarises key findings from our research programme that are relevant to all infrastructure delivery, before specifically responding to the consultation questions. Our response draws predominantly on new research identified during the iBUILD project, but also decades of research and experience in the iBUILD team. This includes engineering expertise in the Centre for

Earth Systems Engineering Research (CESER)¹ and the Institute for Resilient Infrastructure (IRI)², and the long-standing track record in local and regional development by the Centre for Urban and Regional Development Studies (CURDS).³

iBUILD focuses on all infrastructure sectors, not just transport, but our work has also drawn lessons from non-infrastructure sectors. Where our research is undergoing external peer review we cite working papers which, amongst other work, can be found at www.ibuild.ac.uk.

iBUILD Mid-Term Review and Policy Manifesto

In March 2015, iBUILD published a mid-term review and manifesto setting out thirteen evidence-based policy recommendations on how local and urban infrastructure business models could be strengthened in both design and in application. The key recommendations are elaborated in the full manifesto document which is available online.⁴

Research from across the iBUILD Centre has identified five priority action areas for government and industry. If applied to all infrastructure planning and decision-making, these action areas will help to challenge the “timid, uncoordinated, incremental, wasteful”⁵ way the UK currently builds and manages its infrastructure, and help to develop a new approach to delivering infrastructure systems and their services that will enhance the health, wealth and security of UK citizens.

Priority Action Area #1: Have a broader, integrated appreciation of infrastructure

Infrastructure is not just tracks, tubes and trunk roads. Failure to consider the resources that flow along these, the services they provide and the people and businesses that depend on them, will lead to investments that don't deliver effectively. At the same time, it is crucial to understand how all these systems are interconnected; infrastructure depends on other infrastructure to work, not just technically, but also economically and socially. The UK's infrastructure is amongst the most mature and interconnected in the world and therefore has a pressing need to adopt a broad, integrated and sophisticated approach to infrastructure planning.

Recommendation 1: Infrastructure planners, financiers, engineers and other stakeholders need to use a broad, but appropriately specified, definition of infrastructure if they are to identify the full range of opportunities from alternative business models.

Recommendation 2: Housing and ‘hidden infrastructure’, such as efficiency measures, should be considered alongside the large-scale capital investments with which they interconnect, within infrastructure and spatial planning processes

¹ www.ncl.ac.uk/ceser

² <https://www.engineering.leeds.ac.uk/resilience/>

³ www.ncl.ac.uk/curds

⁴ iBUILD (2015) *Are you being served? Alternative infrastructure business models to support economic growth and well-being*, iBUILD Manifesto and Mid-term Report, Newcastle University: Newcastle upon Tyne. The full manifesto can be downloaded from <http://research.ncl.ac.uk/ibuild/outputs/>

⁵ Infrastructure UK (2010) *National Infrastructure Plan 2010*, First NIP: October 2010, HM Treasury.

Recommendation 3: National reforms in policy and regulation are required to enable an integrated approach to local infrastructure planning that can identify, and has the capacity to exploit, synergies across infrastructure sectors.

Priority Action Area #2: Enable action at the local scale that connects with the national

Too much infrastructure planning is top-down, yet every piece of infrastructure has to go somewhere; it is inherently local. Top-down approaches to infrastructure development and management stop locally-led and innovative business models from flourishing and discourage innovation. It also risks the wrong infrastructure being put in the wrong place at the wrong time because of a lack of local knowledge, engagement and ownership. These issues prevent the UK from maximising returns from infrastructure investment. The UK must devolve an appropriate and sensible proportion of infrastructure investment and responsibility to local institutions so they can deliver infrastructure that better reflects the values and needs of the communities it serves, yet remain mindful of the national strategy.

Recommendation 4: National and local policy frameworks should be realigned to focus on delivering wider societal benefits and to enable local infrastructure business models to emerge that can provide local solutions that are complementary with mainstream systems.

Recommendation 5: Effective operation of local alternative infrastructure business models requires greater fiscal decentralisation, complemented by a stronger and statutory devolved role for cities and localities in the planning, development and delivery of infrastructure.

Recommendation 6: Provide support for a wider range of innovative local infrastructure financing mechanisms, including tax increment financing, municipal bonds, social impact bonds and crowd source funding approaches.

Priority Action Area #3: Capture long-term value of every kind

Infrastructure is not only about cash returns. Investment in infrastructure provides wider health, economic and environmental benefits for society; infrastructure converts financial value to social value. A new economic valuation system that recognises these long-term, whole-life benefits is essential to maximise the benefits. Infrastructure must also be built for minimum whole-life costs. This might mean paying a bit more upfront for something that will last – and serve – for longer without the need for frequent maintenance; a resilient and sustainable infrastructure.

Recommendation 7: Incorporate measures of social and environment benefit (and cost) into infrastructure appraisal frameworks to recognise the wider societal and environmental outcomes and ascertain the widest possible set of mechanisms to capture revenue and other values.

Recommendation 8: Implement a quantitative framework within the infrastructure appraisal process to assess the value of flexibility and resilience across the whole system over the long-term.

Recommendation 9: Local authorities and infrastructure owners should apply resource assessments as a matter of course to identify the potential of land and infrastructure assets to generate long-term, stable revenue streams and not just one-off, short-term windfalls from selling-off assets.

Recommendation 10: Employ a new approach to infrastructure economics that recognises the long-term and system-wide value of infrastructure provision.

Priority Action Area #4: Deliver more efficient planning, procurement and delivery

Approaches to project financing, funding and delivery should not be chosen for political reasons. Mechanisms must be adopted that can best deliver the desired economic, social and environmental values, regardless of their political flavour. Many of methods and tools to enable this already exist: the Project Initiation Routemap, Building Information Modelling (BIM) systems, life-cycle assessment, so they must be used. These approaches support more efficient planning and procurement, minimise costs and human effort, preserve the environment, and maximise the potential to reuse and recycle materials and components in the future.

Recommendation 11: Implementation of the Project Initiation Routemap has been shown to have many cost reduction benefits and should be made standard practise for all public funded projects.

Recommendation 12: Planning and design of infrastructure should consider the material and resource demands of infrastructure pipelines to identify opportunities for reducing waste in the construction and operation phases, whilst designing for end of life material recovery or repurposing of infrastructure.

Priority Action Area #5: Accelerate the uptake of innovations through practical action and demonstration

Action often speaks louder than words. Alternative approaches to infrastructure business models are emerging. However, to quickly identify the most successful approaches and encourage their wide uptake locally, nationally and internationally, a number of ambitious demonstrator sites should be established for integrated infrastructure planning and testing of innovative infrastructure business models.

Recommendation 13: Establish full-scale urban demonstrator sites for integrated infrastructure planning and testing of innovative infrastructure business models.

1. What are the major economic and social challenges facing London and its commuter hinterland land over the next two to three decades?

Key messages:

- *As with all UK cities, London faces significant economic, social and environmental challenges over the coming years. Population growth, in absolute and relative terms, poses a particularly significant challenge in London and the wider city region.*
- *Governing and planning for growth and meeting future challenges, in London and the wider city region, requires effective institutional and administrative co-ordination between the Mayor of London, Greater London Authority and local authorities in the south east of England.*
- *No strategy will tackle all the challenges, and trade-offs between planning and infrastructure choices are inevitable. However, redressing the London-rest of UK balance by stimulating growth elsewhere will help alleviate many of these pressures in London.*

iBUILD researchers have been examining the governance of infrastructure funding and financing in the London mega city-region. Interviews undertaken as part of the study have sought to identify the major economic, social and environmental challenges facing London in relation to infrastructure.⁶ The overwhelming majority of interviewees have stated that the fundamental challenge facing London is how to ensure that there is adequate housing, transport, water, energy, communications and other infrastructure to accommodate and absorb the significant population growth that has taken place, and is projected to occur, within the administrative boundaries of London and the broader city region. In one interview, a stakeholder suggested that:

“Population growth requires the opening up of new locations for housing growth. There could also be the opening up of existing residential areas. All the accompanying infrastructure that is required to enable housing growth to be sustained is the number one challenge.”

Dealing with the implications of population growth poses profound questions about the planning, governance, funding, financing and operation of infrastructure across and within the London functional economic geography. There is limited, if any, formal strategic planning activity across the functional city-region, and there are noticeable differences in the institutional capacity, statutory responsibilities and funding of the Greater London Authority (GLA), London Boroughs and individual local authorities and Local Enterprise Partnerships (LEPs) in the south east of England outside London. The limited strategic planning capability at the interface of these organisations makes the case for long-term planning and securing public and private (particularly international) investment in infrastructure problematic. The Mayor of London, GLA and South East local authorities and LEPs are

⁶ Stakeholder organisations that have taken part in the iBUILD research, include: the Greater London Authority; Transport for London; London First; and the Department for Transport.

attempting to overcome these spatial challenges by working through a new voluntary ‘wider south east summit’ framework. These arrangements could offer some scope for project or programme-based ‘deal-making’ between different local authorities in the city region in an attempt to plan urban development collaboratively and to use geographical scale as a means of generating new investment and attracting private sector contributions in infrastructure in London and the wider South East. Continued institutional ‘reform’, in an attempt to overcome local administrative fragmentation, and improve urban economic performance⁷ is a noticeable feature of how many global cities are governed.⁸ The recent establishment of *Métropole du Grand Paris*, as well as current plans to manage the delivery of spatial and economic strategies within and across the Sydney ‘city-region’, illustrate how local and national actors continually attempt to co-ordinate and ‘improve’ the governance of large metropolitan areas.⁹

The other major economic and social challenges facing London and the wider city-region, include:

- Improving transport mobility and accessibility for people in London and the wider city region, for work and leisure purposes.
- For many employers, the issue of housing is of heightened significance because of the affordability crisis and some of the difficulties that companies face in recruiting and retaining staff in London. Ensuring that ‘doing business’ in London remains a viable proposition for international and national firms, which means preventing the cost of business (in terms of commercial rents) from becoming prohibitive.
- Providing sufficient brownfield sites in London and the wider city region for commercial and residential use, and that GLA, London Borough and local authority statutory plans are aligned and there is agreement upon what development is built where.
- Tackling poverty and low wages in London, and ensuring that transport infrastructure supports affordable access to job and training opportunities and addresses and does not exacerbate the problem of rising inequality in different parts of the city and city region.
- Managing the growing demand for health and social care services, as well as ensuring there is ‘quality’ early years and post-16 education for children and young adults.
- Creating and maintaining sufficient green spaces to underpin and support greater social equality and improved individual and collective environmental health and well-being.
- Addressing poor air quality and environmental degradation.
- Improving water quality and maintaining the effectiveness of flood defences.

⁷ Ahrend, R., Farchy, E., Kaplanis, I. and Lembcke, A. C. (2014) ‘What Makes Cities More Productive? Evidence on the Role of Urban Governance from Five OECD Countries’, *OECD Regional Development Working Papers*, 2014/05, Organisation for Economic Cooperation and Development: Paris.

⁸ Storper, M. (2014) ‘Governing the Large Metropolis’, *Territory, Politics, Governance*, 2(2): 115-134. Katz, B. and Bradley, J. (2013) *The Metropolitan Revolution: How Cities and Metros are Fixing our Broken Politics and Fragile Economy*, Brookings Institution Press: Washington D.C.

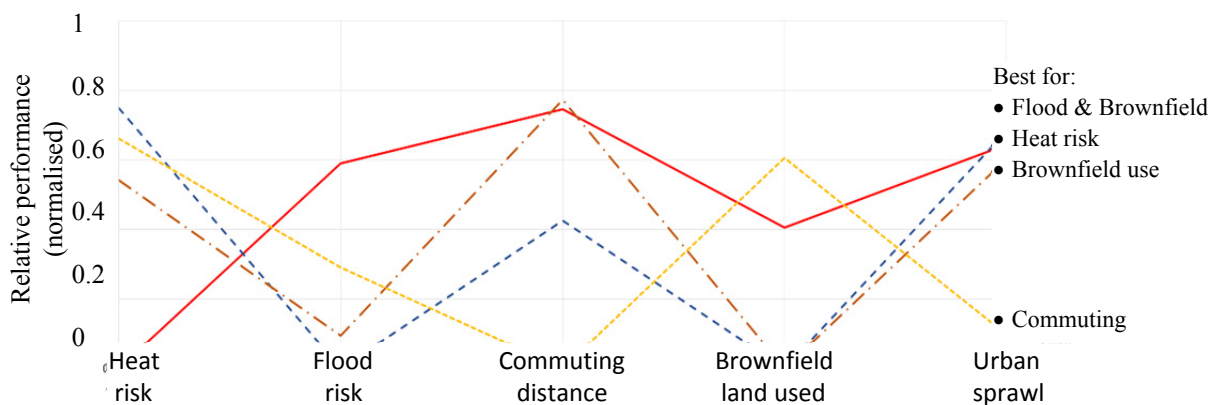
⁹ ‘Grand Paris’ will encompass an assembly of 209 councillors, drawn from local municipalities, and its area of jurisdiction will cover the densest part of the Paris region (covering approx. 7mn people). The new institution will incrementally take on new responsibilities, including urban planning and fiscal powers. By 2018, it will be headed by a new president. The Greater Sydney Commission is a new independent body, created by the New South Wales Government, which will be responsible for metropolitan planning in the Sydney metropolitan area, in partnership with State and local government – see:

<http://www.planning.nsw.gov.au/Plans-for-Your-Area/Sydney/A-Plan-for-Growing-Sydney/Greater-Sydney-Commission>

- Ensuring that London and the wider city region have the capacity and capability to fund and finance urban infrastructure now and in the future. Link to value capture in uplift from public investments and improving on the historically weaker efforts e.g. with Crossrail

It is rarely possible to satisfy all objectives, as is shown in Figure 1, where, for example, strategies that are good for managing flood risk can increase transport use and travel distance for commuters.

Figure 1: Tradeoffs between planning and infrastructure investment choices in London



Source: Caparros-Midwood *et al.* (2015).¹⁰

¹⁰ Caparros-Midwood D, Barr S, Dawson RJ (2015) Spatial Optimization of Future Urban Development with regards to Climate Risk and Sustainability Objectives, Risk Analysis. (also presented in 2nd UGEC conference, Taiwan: <http://ugec2014.squarespace.com/daniel-caparros-midwood>)

2. What are the strategic options for future investment in large-scale transport infrastructure improvements in London – on road, rail and underground – including, but not limited to Crossrail 2?

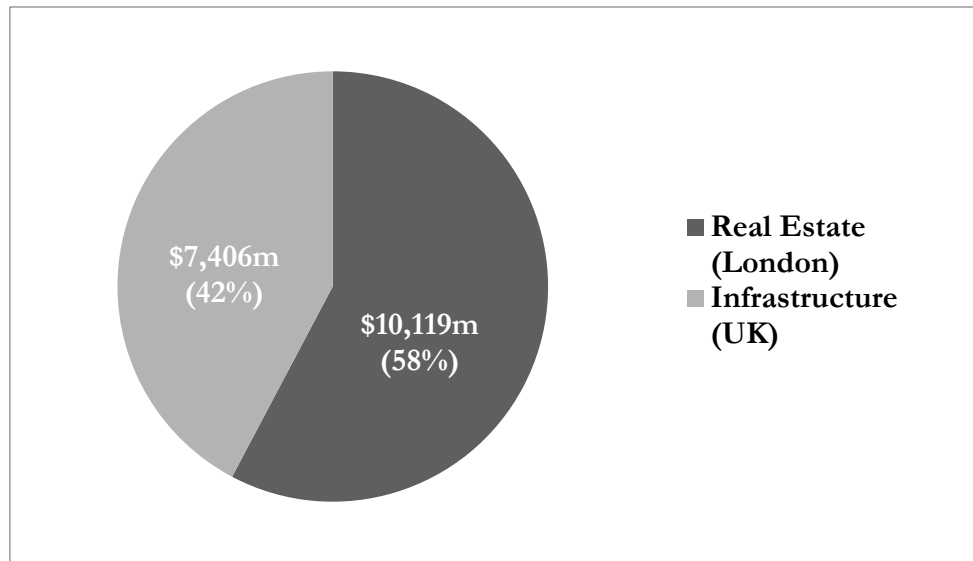
Key messages:

- *Transport infrastructure improvements led by Transport for London and other similar sponsors will increasingly be required to demonstrate their contributions to growth, jobs and housing development, beyond alleviating transport congestion.*
- *Private sector investors are more likely to invest in the early stages of transport schemes if they are part of a broader urban regeneration or development programme*
- *Central government will continue to play an important role in providing regulatory and/or financial backing for large-scale transport projects in London.*
- *Government financial support is also likely to form part of broader, multi-faceted funding packages.*
- *Small-scale interventions can play an important role in improving London's transport infrastructure.*

Under the leadership of Sir Peter Hendy, Transport for London (TfL) began to situate transport investment in a wider context and as an instrument that is measured for its broader impact above and beyond achieving journey time savings. TfL's corporate strategy and business plan have been written so that they identify and explain how individual investment transport infrastructure projects will contribute towards the economic growth and overall prosperity and performance of London. TfL has concluded that planning and investing in transport for London has to demonstrate the wider economic costs and benefits of investment.

Against this background, TfL and other transport infrastructure sponsors have framed Crossrail 2 as a specific intervention that could open up new housing sites and development opportunities as well as improving transport connectivity. This approach reflects the belief that there is a virtuous relationship between transport – housing – spatial planning and local/urban development. International sovereign wealth funds looking to invest in London's transport infrastructure will do so if there is a definitive revenue-raising urban regeneration or housing development scheme attached to a transport project, such as the Nine Elms development, which includes the Northern Line extension. The returns available in London real estate and property make investments in these assets more attractive to foreign investors than transport infrastructure alone (see Figure 2). Furthermore, major transport schemes will always require government-funding as they are often considered too risky for the private sector. Thus, national and local/city-regional governments will continue to play a major role in transport infrastructure planning and investment, especially in large metropolitan areas like London, despite the fact that investment markets are more buoyant in these places than in many other cities.

Figure 2: China foreign direct investment in the UK (2005-2014)



Source: Pinsent Masons and CEBR (2014).¹¹

In terms of future transport linkages, TfL, the Greater London Authority (GLA) and local authorities should recognise the importance of both radial and orbital transport connections in the London city region, as there are important economic units within and outside London's formal administrative boundaries. This requires economic and spatial plans to be aligned and to consider how London and the wider city region is set to develop in terms of population, housing and business growth. For example, in an illustration that the economic centre of London has been moving 'eastwards', TfL announced in January 2016 that it was re-zoning eight London Underground stations near Stratford and the 2012 Olympics site to the boundary of Zone 2 of the Underground.¹² Much of London's future growth is expected to be focused on the capital's Opportunity Areas, which will feature dense, mixed-use developments with high public transport connectivity – particularly in the east of London (Travel in London Report 8, 2015). TfL and the GLA are using the Opportunity Areas to shape and steer the London Plan and give it a clear linkage to economic strategies. Going forward, there will be a visible link in how transport is expected to transform the Opportunity Areas.

Atkins suggests that the focus on public transport improvements (such as rail and road capacity) could be strengthened in the London Infrastructure Investment Plan 2050 if priority was given to bus and cycle networks (to better connect outer London and are important assets for lower-income households)¹³ – helping to build and support a more inclusive and sustainable city region. While the remit of the NIC is on major transport schemes it is important to recognise that there are direct and indirect economic, social and environmental impacts from investment decisions that are based on small-scale interventions. There is also a need to focus on improving the existing transport network in

¹¹ Pinsent Masons and CEBR (2014) [China Invests West: Can Chinese Investment be a Game-changer for UK infrastructure?](#) Pinsent Masons and CEBR: London.

¹² Topham, G. (2014) 'East London tube, DLR and rail stations change zones', [The Guardian](#), Monday 4 January.

¹³ Atkins (2015) [Future Proofing London](#), Atkins and Oxford Economics: London.

London, building upon TfL's interest in whole-life asset management and benchmarking in support of improving performance and resource efficiency. We would, therefore, expect TfL and local highways bodies to look at how best to improve the maintenance and operation of the existing road network, which has seen increased congestion recently, particularly in parts of outer London. SMART technology can also help to manage performance, and TfL has made significant strides in gathering, analysing and deploying 'big data', but as recent events have demonstrated, even these assets have to be made more resilient to 'shocks'.¹⁴

We would anticipate that the strategic options for future transport investment in London would encompass, or at least benefit from, further rail devolution to London and the South East. TfL is looking to apply its existing operational experiences to suburban rail services, where, in some cases, there has been significant improvements. For example, the London Overground network, largely established since 2008, has seen a 321 per cent increase in journey stages between 2008 and 2014, on a like-for-like basis – reflecting the rapid development and enhancement of the network.¹⁵

¹⁴ 'Oyster card glitch leads to free travel in London', BBC News, Saturday 2 January 2016: <http://www.bbc.co.uk/news/uk-england-london-35213346>

¹⁵ Mayor of London/TfL (2015) *Travel in London Report 8*, Mayor of London/Transport for London: London.

3. What opportunities are there to increase the benefits and reduce the costs of the proposed Crossrail 2 scheme?

Key messages:

- *Crossrail 2 must better capture the value it delivers to the private sector, in particular through capturing the uplift of land and property value, and improving connections to major transport hubs.*
- *Crossrail 2 offers significant development opportunities and connectivity benefits, but at a projected cost of up to £32bn the case has to be made that this investment could not deliver better returns through a series of smaller scale projects in other UK regions.*
- *The Department for Transport, Transport for London and other major transport sponsors should heed the lessons of Crossrail, and consider the recommendations of the National Audit Office to ensure that Crossrail 2 and other large-scale projects deliver value for money for UK tax-payers where government grants have been included in funding packages.*

TfL estimates that Crossrail 2 will cost somewhere between £27bn and £32bn (with a 66 per cent optimum bias included), in 2014 prices and includes the cost of new trains and Network Rail works. In evidence to the London Assembly, PwC suggested that the estimated cost of Crossrail 2 could, if the optimism bias was reduced to a 'more realistic' 44 per cent, be around £20bn.¹⁶ The project intends to relieve demand on London's transport network, and to provide capacity for an extra 270,000 people to access central London at peak times by increasing the number of trains from major destinations across south west London and Surrey (including Wimbledon, New Malden, Kingston and Epsom) and across north east London and Hertfordshire (including Tottenham Hale, Waltham Cross, Cheshunt and Broxbourne). A London Chamber of Commerce poll found that 44 per cent of London businesses saw Crossrail 2 as their top transport priority.¹⁷

The cost of Crossrail 2 is significant, roughly twice the annual capital investment budget spent in London (£15bn), and represents approximately £376m for every mile of the 85 miles of proposed line. The Chancellor of the Exchequer, George Osborne, has indicated that at least 50 per cent of the funding for meeting the cost of Crossrail 2 should come from private sources, which some business organisations have suggested is feasible.¹⁸ While some costs could be saved on the rolling stock for Crossrail 2, further costs are expected to be found during the detailed design stage of the route. A premium will be placed on TfL identifying further savings given that businesses believe that the high cost of transport projects in London is a significant barrier to the delivery of infrastructure improvements.¹⁹

¹⁶ Minutes of evidence available at: <https://www.london.gov.uk/moderngov/documents/s47535/Minutes%20-%20Appendix%201%20-%20Transcript%20Crossrail%202.pdf>

¹⁷ Further details on the London Chamber of Commerce poll available at: http://www.londonchamber.co.uk/lcc_public/article.asp?aid=7197

¹⁸ London First (2014) *Funding Crossrail 2: A report from London First's Crossrail 2 Task Force*, London First: London.

¹⁹ According to business surveyed in the London Chamber of Commerce poll.

In putting together the funding and financing package for Crossrail 2, the lessons of Crossrail [1] should perhaps be heeded. In particular, Crossrail 2 will be scrutinised for how it captures private land and property value uplift that is expected to be generated given the experiences of Crossrail [1]. Researchers have forecast total house price growth of 13 per cent, between 2013 and 2018, for residential properties located near Crossrail stations, with up to 20 per cent growth in Central London, in addition to underlying capital growth.²⁰ With criticism that the taxpayer could have benefited more from Crossrail in the form of greater tax receipts on developments near proposed stations, it has been suggested that more targeted developer contributions should form part of the funding package for Crossrail 2.²¹ Furthermore, Crossrail does not connect with other recent transport investments such as the Eurostar station at St Pancras or Terminal 5 at Heathrow, and it does not necessarily serve the areas of greatest potential expansion in and around London. Consequently, the final agreed route of Crossrail 2 will need to connect or integrate effectively with other existing or proposed transport infrastructure assets, such as the HS2 terminus in Euston, without producing negative impacts for local residents and businesses in places such as Camden, which brings into focus once again the governance and spatial planning implications of co-ordinating major transport infrastructure investment in London and the wider city-region.

The broader industry contribution of Crossrail is, however, also significant, particularly in the area of skills, where the Tunnelling and Underground Construction Academy, funded primarily by Crossrail, is training the next generation of future engineers. Such inputs should ensure that there are legacies of improved efficiency and productivity in future large-scale [underground] transport infrastructure projects similar in nature to Crossrail.

With the current public consultation for Crossrail 2 closing on 8 January 2016, TfL will have, at its disposal, a large volume of evidence and opinion, submitted as part of the consultation exercise. In addition, the Crossrail 2 Growth Commission's call for evidence, which closed on 23 December 2015, is also expected to be an important source of information, data and evidence that TfL and partners will have as they seek to reflect upon how best to strengthen the benefits and reduce the costs of Crossrail 2. In the current austere times, and with demands for more transport investment in the regions and nations outside of London, the economic, social and environmental case for Crossrail 2 will come under ever-closer scrutiny, and the project will need to demonstrate that it can be delivered in an effective and cost-efficient manner. TfL and the other sponsors of Crossrail 2 will no doubt be guided by the findings of the National Audit Office in its 2014 report on Crossrail, to see what lessons that can be applied in the project development and implementation of Crossrail 2. In considering the costs and benefits of Crossrail 2, it is useful to reflect upon the following recommendations in the NAO's review, which were directed specifically at the Department for Transport (DfT), and outlined a series of steps to strengthen tax-payer 'value for money' from future major transport projects:²²

- Do more to secure private sector funding contributions. The Department should ensure that when it negotiates contributions to projects from businesses and other organisations, these are based on

²⁰ CBRE (2013) *Crossrail: The Impact on London's Property Market*, CBRE: London.

²¹ Pickford, J. and Allen, K. (2014) 'Crossrail a shot in the arm for London property developers', *Financial Times*, 6 March 2014.

²² NAO (2014) *Crossrail, Report by the Comptroller and Auditor General*, National Audit Office: London, p11.

robust and realistic calculations of the benefits to business. The Department should also work to understand private sector funders' interests in its projects and how these may affect the certainty of funding.

- Consider how to achieve greater continuity in departmental officials' oversight of major programmes. The Department should identify how it will manage staff assignments to its various programmes, ideally to appoint officials for longer periods, and to manage the 'handover' process, where necessary, to achieve a smooth transition.
- Monitor all costs on major programmes including development, start-up and sponsorship costs so that it can develop an understanding of the true costs of major programmes, to help it keep these costs under control. We would expect all government departments to do this on their major programmes.
- Ensure that programmes have sufficient cash available to provide security and flexibility to the delivery body, while minimising opportunity costs.

4. What are the options for the funding, financing and delivery of large-scale transport infrastructure improvements in London, including Crossrail 2?

Key messages:

- *iBUILD research has identified a range of funding and finance schemes (Table 1) suitable for large projects, each with different advantages and disadvantages.*
- *TfL's strategic oversight in London, compared to other transport governance structures in the UK, provides them with far greater opportunity to capture and utilise value.*
- *TfL and other transport infrastructure sponsors in London will be encouraged to identify and adopt more 'innovative' funding and financing packages to support transport infrastructure investment. However, such packages are likely to be based on greater speculative forms of urban development and therefore may increase the financial risks for TfL and other institutions.*

Against the background of a reduction in central government grant funding to cover its operational budget, TfL has been encouraged to be more 'innovative' in how it funds and finances transport infrastructure in London. According to one DfT official:

"We've strongly encouraged TfL to get more savvy in the way it generates income from its estate, for example, so it's got a very ambitious commercial development programme now, which covers everything from, the sponsorship deals for Santander cycles to advertising at tube stations, to flogging off the old headquarters at 55 Broadway, which is all going to be turned into luxury homes and so on..." (iBUILD research interview with DfT official, September 2015).

There is a strong push for TfL to widen and deepen its engagement in land and property development in order to generate new revenues to fund transport infrastructure and/or services. Consequently, there are few, if any, projects in TfL's capital investment plan that are not linked to economic development, employment or housing. TfL believes that this will enable the organisation to leverage additional private and public funding. While grant funding is still the preferred mechanism, in the current fiscal climate this is increasingly testing, although for major transformational projects central government is still expected to commit resources as part of overall funding packages. While TfL is looking to become 'self-sufficient', the organisation believes that 'transformational' infrastructure schemes will require alternative funding mechanisms, which draw upon finance from a range of different sources.

As infrastructure becomes funded and financed in increasingly financialised ways, different practices, tools, instruments and governance arrangements are being modified or constructed in order to fund and finance local infrastructure. A variety of different infrastructure funding and financing practices have emerged in recent years, many of which blur and/or straddle traditional notions of public-private boundaries (Table 1). We would expect TfL and its partners to adopt some of these practices to suit specific projects and geographical contexts, subject to appropriate fiscal powers and capability being

evident. Some transformative transport schemes will require national government financial backing, in the form of direct grant, infrastructure guarantee or through borrowing. However, the likelihood is that international and national private infrastructure financiers will be reluctant to invest in the early phases of the infrastructure life-cycle of major transport projects:

“Some commentators cite that a “wall of money” from Sovereign Wealth Funds, Infrastructure Funds, Pension funds and other similar investors is available to invest in infrastructure, and that this provides evidence that projects such as Crossrail 2 could be privately financed. While there is no doubt that these investors are keen to invest in infrastructure, Crossrail 2 is unlikely to meet many of their investment requirements. The size of the project, the construction risk, the demand risk and the likely reliance on non-patronage revenues to pay the bulk of the project means that, without direct government guarantees, such investors are unlikely to invest in Crossrail 2”.²³

We would recommend that the NIC examines the 2014 report produced by PwC, which considered the range of different mechanisms and practices that could be used to fund and finance Crossrail 2.

Land (or property) value capture mechanisms offer a potential funding source for Crossrail 2. However, in the iBUILD case study of the governance of infrastructure funding and financing in London, officials that were interviewed were mindful of the ‘political difficulties’ of increasing residential taxation, despite recognising that value capture was the only ‘fair means’ of ensuring that those who benefitted most from Crossrail 2 made the biggest financial contribution. Increasing fares to generate extra revenues is also problematic given commitments by the current Mayor of London to ‘freeze fares in real terms’, and other statements by mayoral candidates. Consequently, additional financial options are being explored, including the feasibility of extending the hypothecated business rate supplement tax that has been funding Crossrail [1].

Finally, TfL and other infrastructure sponsors should consider whether there are alternative quick and cost-effective wins from smaller schemes that could support London’s transport infrastructure and make the overall network more efficient. TfL could perhaps look at whether it is possible to make improvements, such as bringing back sections of unused rail line, to generate additional benefits, as has happened with the London Overground. The engineering consultancy firm, Atkins, makes a similar argument, suggesting that:

“The 2050 [London Infrastructure Investment] Plan rightly makes some ambitious plans for infrastructure provision. However, consideration should be given to whether investment in a greater number of smaller scale interventions could achieve wider benefits”.²⁴

²³ PwC (2014) *Crossrail 2: Funding and Financing Study*, PwC: London, p7.

²⁴ Atkins (2015) *Future Proofing London*, Atkins and Oxford Economics: London, p 88.

5. How have metropolitan areas in other countries responded to similar challenges and priorities? Are there any lessons to be learned and applied in London?

Key messages:

- *Preparation of the London Infrastructure Investment Plan 2050 was an important step in defining strategic priorities, and echoed similar arrangements in other leading UK and international cities. Integrating this with other planning processes provides further opportunities.*
- *A review of over one hundred infrastructure business models by the iBUILD research team highlights the potential diversity of approaches that should be explored to capture more value from local and urban infrastructure.*
- *The ability of London to address its economic, social and environmental challenges, by implementing a wider range of transport infrastructure funding and financing mechanisms and practices, similar to those employed in other international cities, will depend upon the UK government granting London greater fiscal autonomy to raise and retain local tax revenue and increase borrowing for capital investment purposes.*
- *There is a case for a systematic study to be commissioned of how these issues are being tackled in other global cities. Sydney is making new moves to tackle these infrastructure and spatial planning challenges, as is New York and Paris, and there may be common lessons to be learned, which could benefit London.*

We welcome the fact that London has published its first infrastructure investment plan, along similar lines to strategies that have been produced and implemented by other global cities, such as New York, Tokyo and Seoul as well as other UK cities (e.g. the Newcastle-Gateshead Infrastructure Delivery Plan). Lessons from international practice suggest it is important that the London Infrastructure Investment Plan and statutory London [Spatial] Plan are closely aligned, and that the infrastructure plan also fits with local development and planning frameworks in and around the London city region. This requires close engagement, even co-production, between a wide-range of different institutions and actors. iBUILD research has highlighted the benefits of taking a whole systems view to infrastructure by considering integrating with spatial planning policies. For example, reducing demand for services through ‘hidden infrastructure’ such as investment in efficiency measures and demand management strategies reduces consumer bills, frees up capacity to support growth and regeneration, and defers the need for expensive capital investment in new infrastructure (e.g. for new power stations and water treatment works). The National Infrastructure Plan, for example, sets out a pipeline of £65bn investment in energy generation and £45bn investment in energy networks over the coming years. Yet, investing a third of this in energy efficiency measures over the next four decades could free up 12 per cent headroom in generation capacity.²⁵

²⁵ Gouldson A, Kerr N, Millward-Hopkins J, Freeman MC, Topi C & Sullivan R (in review) Innovative Financing Models for Low Carbon Transitions: Exploring the case for revolving funds for domestic energy efficiency programmes. Based on

In terms of funding and finance, London currently spends around 5 per cent of its annual Gross Value Added (GVA) on capital investment while its international competitor cities spend between 10-12 per cent.²⁶ One of the other challenges facing London is that it is still required to secure central government financial or regulatory agreement for major transport infrastructure on a project-by-project basis. And unlike other global city leaders, the Mayor of London and London Boroughs have limited powers to raise their own local revenue (Table 2).

Table 2: Municipal operating expenditures and taxes per capita

	Municipal Operating Expenditures per capita (£)	Municipal Taxes (local and shared taxes) per capita (£)
London – GLA plus boroughs (2011)	3,199	476
Berlin (2010)	4,910	2,570
Frankfurt (2010)	3,577	2,140
New York (2011)	4,561	3,078
Madrid (2009)	1,267	490
Paris (2011)	2,699	1,896
Tokyo (2010)	3,301	2,312

Source: Slack (2013: p5)

On the subject of fiscal decentralisation and global cities, we would direct the NIC towards two useful studies that have undertaken detailed analysis of how London compares to other global cities and city regions when it comes to planning, funding and financing urban infrastructure. The first reference is a working paper written by Enid Slack (University of Toronto) which was commissioned by the London Finance Commission.²⁷ The paper offers an international comparison of the current methods of raising revenues in seven global cities -- London, Paris, Berlin, Frankfurt, Madrid, Tokyo, and New York -- and evaluates the costs and benefits associated with greater devolution of revenue tools to the Greater London Authority (GLA), with Slack suggesting that:

“London would benefit from greater fiscal autonomy – access to a mix of taxes and the ability to set the tax rates. A mix of taxes would give it the flexibility it needs to respond to changing economic circumstances. Local fiscal autonomy and, in particular the ability to set tax rates, is also important for accountability: governments that raise their own revenues and set their own

an earlier working paper: Gouldson A, Kerr N et al. (2014) *Revolving funds for infrastructure business models*, iBUILD Working Paper, iBUILD, Newcastle University: Newcastle upon Tyne.

²⁶ Based on statistics set out by Professor Tony Travers, London School of Economics, in a presentation given to the ‘Developing a Long Term Infrastructure Plan for London’ seminar, Monday 16 December 2013, City Hall, London.

²⁷ Slack, E. (2013) *International Comparison of Global City Financing: A Report to the London Finance Commission*, University of Toronto: Toronto.

taxes to meet local expenditure needs tend to be more responsible and more accountable to taxpayers.²⁸

The second report was published by PwC in 2014, and considers the various funding and financing mechanisms and practices that could be deployed to deliver investment in Crossrail 2, and includes a comparative analysis of how transport infrastructure projects are funded and financed in the following cities: Paris; San Francisco; Atlanta; Copenhagen; New York; Greater Toronto; Chicago; Melbourne and Sydney.²⁹ In the report, PwC concludes that London would find it problematic to replicate some of the funding arrangements employed in other international cities without greater fiscal autonomy:

“Our review of funding approaches used internationally shows that many other cities use a range of property and other taxes to fund transport infrastructure. On the face of it, similar levies implemented in London would be capable of funding a substantial part of the funding requirement for Crossrail 2. However, when we have looked at how such levies have been implemented, many appear to rely on enforcement systems that have evolved over time and in part rely on there being a general level of fiscal devolution across all local or regional authorities. This is several steps away from where London is now in terms of progress towards the first steps of fiscal devolution”.³⁰

Alternative and integrated infrastructure business models

Business models take into consideration different governance, but must also consider the wider infrastructure system that comprises (Figure 3):

- *physical artefacts* – includes the physical links, nodes and components of infrastructure systems such as roads, bridges, pipes and cables;
- *processes* – includes actors, institutions, management, regulation, protocols and procedures that govern the infrastructure over its lifecycle;
- *resources* – includes people, vehicles, water, electricity and data that are conveyed by the physical artefacts and the materials used in the construction of the artefacts; and
- *services* – such as warmth, mobility, sanitation, transportation, welfare services and communication that benefit a wide range of users.

Infrastructure is therefore the artefacts and processes of the inter-related systems that enable the movement of resources in order to provide the services that mediate (and ideally enhance) security, health, economic growth and quality of life at a range of scales.³¹ Moving beyond a narrow or solely economic view and distinct from the world of more conventional goods and services, an infrastructure

²⁸ Ibid, p26.

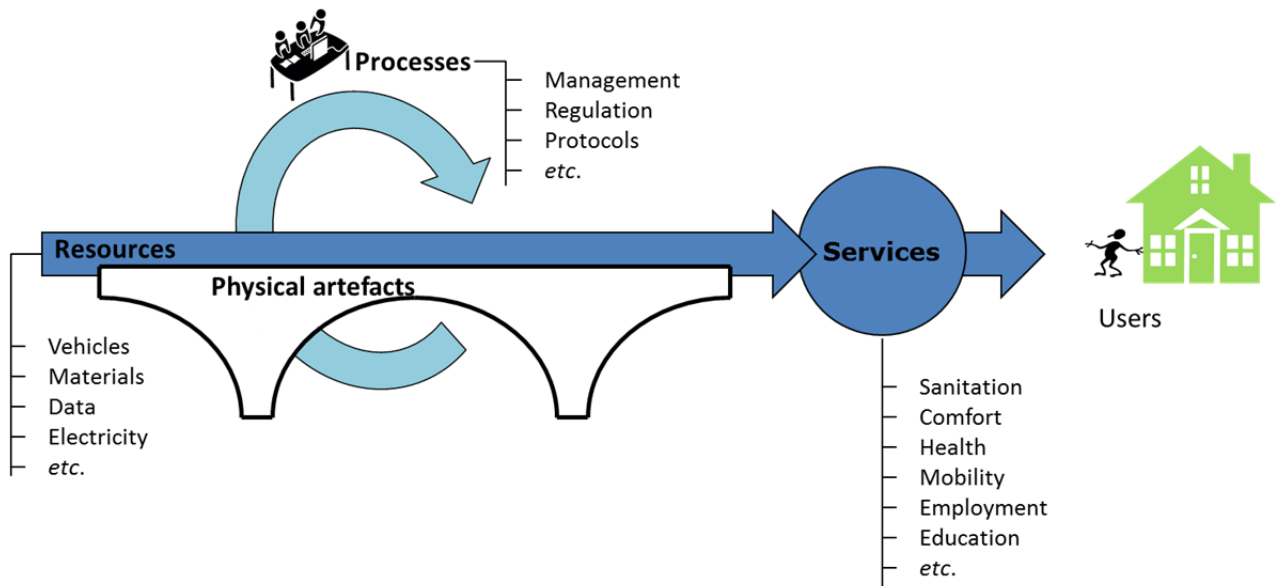
²⁹ PwC (2014) *Crossrail 2: Funding and Financing Study*, PwC: London

³⁰ Ibid, p57.

³¹ Dawson RJ (2013) *Bridges n'that: An infrastructure definition for iBUILD*, iBUILD Briefing Note 1.

business model therefore describes how infrastructure systems create, deliver and capture economic, social and environmental values over the whole infrastructure life cycle.³²

Figure 3: A systems view of infrastructure



Source: iBUILD (2015: p5).

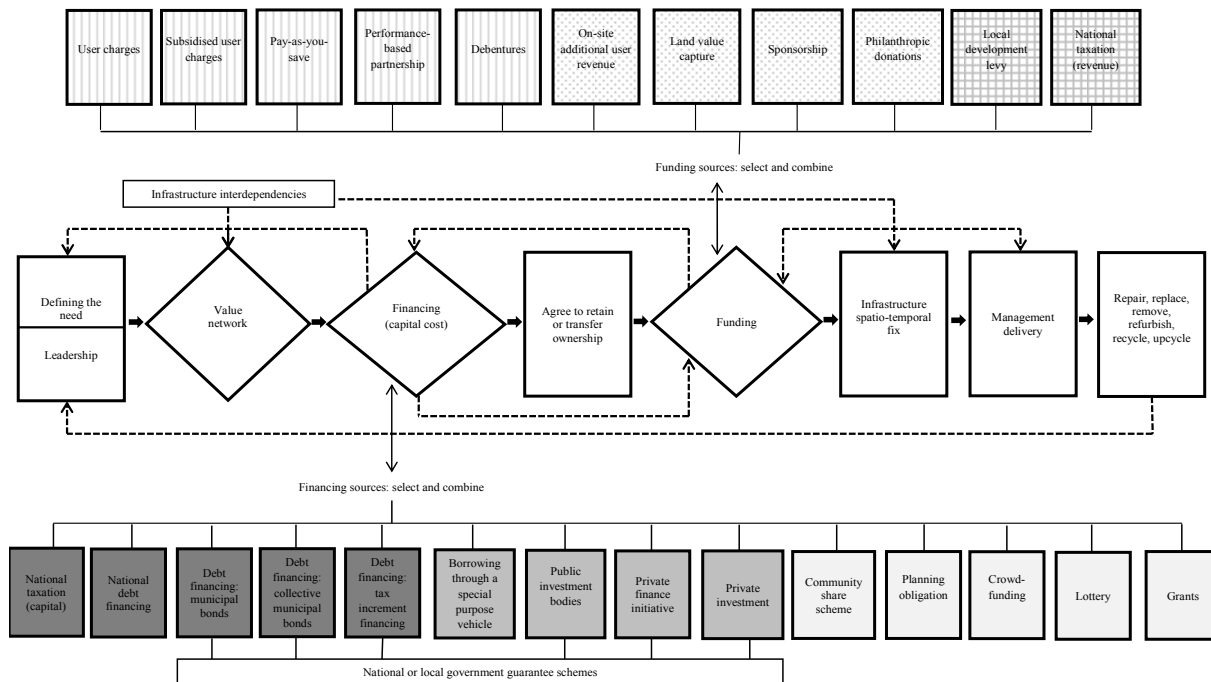
iBUILD has undertaken a review of over hundred UK and international local infrastructure business models, both traditional and non-traditional, across all infrastructure asset classes.³³ The business models are diverse. Value creation includes social, economic and urban regeneration outcomes as well as direct outputs in terms of service supply. International comparison has illustrated how the development of business models from niche to established mainstream models reflects the regulatory, political and socio-economic context (Bryson *et al.*, in review).³⁴ For example, the success of municipal decentralised energy supply in Denmark and subsidy-supported business models for local energy supply in the UK.

³² Bryson JR, Pike A, Walsh CL, Foxon T, Bouch C & Dawson RJ (2014) *Infrastructure Business Models*, iBUILD Briefing Note 2.

³³ Currently online here: <http://ceg-research.ncl.ac.uk/ibuildDemo/> (URL subject to change when site goes fully live)

³⁴ Bryson, J. R., Mulhall, R., Song, M. Loo, and Dawson, R. J. (in review) 'Conceptualising Local Infrastructure Business Models: The Spatio-Temporal Fix', *Research Policy*.

Figure 4: Conceptual Framework of Local Infrastructure Business Models



Source: Bryson et al. (in review).

Developing and implementing alternative approaches provides some benefits, but as noted above, our infrastructures are increasingly interconnected and some of the most promising opportunities are from thinking about delivering what people really require i.e. warmth, light, mobility etc. rather than electricity, gas, roads. This can help identify business models that deliver efficiencies across multiple ‘traditional’ sector boundaries. A rapidly emerging interdependence is between electricity and transport infrastructure – most notably uptake of electric vehicles (EVs). Coupled analysis of energy and transport systems models, has demonstrated that distribution networks could accommodate higher growth in electric vehicles than previous studies have suggested. Exploiting the geographic spread and different timings of EV charging can limit the impact on power infrastructure. Distribution network operators should collaborate with new market players, such as charging infrastructure operators, to support the roll out of an extensive charging infrastructure to make both networks more robust.³⁵

A well-established demonstration of the value of integrated infrastructure thinking applied to an industrial park – now an industrial ecosystem – is the closing of material and energy loops locally with integrated infrastructure in Kalundborg, Denmark. Since 1972, this industrial park has evolved from a single power station into a cluster of companies that exchange materials and energy for mutual benefit as by-products from one business are often inputs for others. For example, treated wastewater from a refinery is used to cool a power station which in turn provides steam for the refinery and a pharmaceutical plant. Surplus heat from the power station is also used for warming nearby homes and

³⁵ Neaimeh M, Wardle R, Jenkins A, Hill GA, Lyons P, Yi J, Huebner Y, Blythe PT & Taylor P (in press) A probabilistic approach to combining smart meter and electric vehicle charging data to investigate distribution network impacts, *Applied Energy*.

businesses. This has led to substantial annual savings of resources and costs – for example, a reduction in water consumption of 3.3mn m³/year, savings of \$15m from resource sharing and far larger savings by sharing infrastructure have been reported – highlighting how integrated infrastructure business models can produce substantial savings.³⁶³⁷

There are many potential ways of organising and regulating such interactions to create efficiencies. For example, in 1887 in Indianapolis, local civic leaders established a natural gas company as a Public Trust, with an aim to “create the greatest long-term benefit for customers and communities”. Today, the Citizens Energy Group owns and operates a large portfolio of physical infrastructure assets that deliver multiple services including energy, water and wastewater for 800,000 people and thousands of businesses in the Indianapolis area. This has provided community services that are entirely compatible with good financial management. The group was awarded a top rating (MIG 1) by Moody’s credit rating agency in 2014, a reflection, in part, of the strength of the company’s infrastructure business model.³⁸ By recognising the opportunities from the interdependencies of modern infrastructure, and explicitly designing this into our energy and other systems, this not only offers opportunity for alternative business models but also can be used to deliver flexible infrastructure systems that can enhance resilience.³⁹


³⁶ Chertow MR & Lombardi DR (2005) Quantifying Economic and Environmental Benefits of Co-Located Firms, *Environmental Science & Technology*, 39(17):6535 -6541.

³⁷ Chopra SS & Khanna V (2014) Understanding resilience in industrial symbiosis networks: Insights from network analysis, *Journal of Environmental Management*, 141:86-94.

³⁸ www.moody.com/research/Moodys-Concludes-Review-and-Confirms-MIG-1-on-Indianapolis-Indiana--PR_302963

³⁹ Khoury M, Bullock S, Fu G, and Dawson RJ (2015) Improving measures of topological robustness in networks of networks and suggestion of a novel way to counter both failure propagation and isolation, J. *Infrastructure Complexity*, 2(1):1-20.

Table 1: Infrastructure Funding and Financing Practices⁴⁰

Temporality	Type	Examples
<p>Established 'Tried and Tested'</p>  <p>Newer 'Innovative'</p>	Taxes and fees	Special assessments; User fees and tolls; Other taxes.
	Grants	Extensive range of grant programmes at multiple levels (e.g. federal national, province, state, supranational)
	Debt finance	General obligation bonds; Revenue bonds; Conduit bonds; National Loans Funds (e.g. PWLB).
	Tax incentives	New market/historic/housing tax credits; Tax credit bonds; Property tax relief; Enterprise Zones.
	Developer fees	Impact fees; Infrastructure levies.
	Platforms for institutional investors	Pension and Insurance infrastructure platforms; State infrastructure banks; Regional infrastructure companies; Real estate investment trusts; Sovereign Wealth Funds.
	Value capture mechanisms	Tax increment financing; Special assessment districts; Sales tax financing; Infrastructure financing districts; Community facilities districts; Accelerated development zones.
	Public private partnerships	Private finance initiative; Build-(own)-operate-(transfer); Build-lease-transfer; Design-build-operate-transfer.
	Asset leverage and leasing mechanisms	Asset leasing; Institutional lease model; Local asset-backed vehicles.
	Revolving infrastructure funds	Infrastructure trusts; Earnback and Gainshare

⁴⁰ Strickland, T. (2015) Infrastructure Funding and Financing, unpublished PhD thesis, Newcastle University: Newcastle upon Tyne.

Contributing authors

The iBUILD Centre involves over 50 researchers who have contributed to the research base that we draw from here. The submissions to the three NIC consultations were coordinated and prepared by: Peter O'Brien & Andy Pike, Centre for Urban and Regional Development Studies, Newcastle University

Richard Dawson, Centre for Earth Systems Engineering Research, Newcastle University

John Tomaney, Bartlett School of Planning, UCL

Phil Purnell, Institute for Resilient Infrastructure, University of Leeds

Niall Kerr & Stephen Hall, School of Earth and Environment, University of Leeds

For further information about iBUILD please contact:

Centre Director: Professor Richard Dawson

[email and telephone number redacted]

Centre Manager: Dr Claire Walsh

[email and telephone number redacted]

Additional contact details

iBUILD Newcastle - Headquarters
Professor Richard Dawson
School of Civil Engineering and
Geosciences
Cassie Building
Newcastle University
Newcastle upon Tyne
Tyne & Wear
NE1 7RU

iBUILD Birmingham
Professor Chris Rogers
School of Civil Engineering
University of Birmingham
Edgbaston
Birmingham
B15 2TT
United Kingdom
Tel: +44 (0) 121 414 5066
Fax: +44 (0) 121 414 3675

iBUILD Leeds
Professor Phil Purnell
Faculty of Engineering
Woodhouse Lane
University of Leeds
Leeds
LS2 9JT
United Kingdom
Tel: +44 (0)113 343 0370