The Northern Powerhouse Independent Economic Review

Workstream 4 Scenarios for Future Growth in the North – Final Report

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Key Findings

- A 'transformational' economic future for the North, in which there are substantial improvements in the skills base, in innovation performance, and in transport connectivity, is projected to raise the growth rate of the North's productivity, gross value added (GVA) and employment markedly above past trends, helping to close the productivity and prosperity gap compared with the rest of England. By 2050, GVA is projected to be some 15% (£97bn, in 2015 prices) higher than a 'business as usual' projection, and productivity some 4% higher; some 850,000 additional jobs are projected compared with 'business as usual' in 2050, and 1.56m more than in 2015.
- The improved economic performance is led by a marked improvement in the North's distinctive offer of 'Prime' capabilities (Advanced Manufacturing, Energy, Health Innovation and Digital), supported by the contribution of key 'Enabling' capabilities (Financial and Professional Services, Logistics and Higher Education). Many of the additional jobs come in city and town-based services, including those that benefit from the population's higher spending power.
- Enhanced pan-Northern city-centre to city-centre rail links, east-west and north-south are needed to improve markedly pan-northern connectivity and facilitate the bigger labour markets that support the success of knowledge-based firms. To be effective, they must be integrated with city-region local public transport networks operating through a series of nodes that also link with other public transport networks. Most of these rail nodes (interchanges) are in city centres. Manchester Airport is another.
- The increase in town and city centre employment in the knowledge-based 'Prime' and 'Enabling' capabilities cannot be accommodated through private (car) travel alone. It will require enhanced public transport connectivity within city regions: coherent, user-friendly joined-up networks, involving frequent rail services (including cross-city operations), light rail and bus, all supported by smart, multi-modal ticketing with simplified fares.
- Global connectivity, for people and for goods, is critical if the North's Smart Specialisation opportunities are to be realised fully. Surface access to airports is a key constraint. For ports, constraints on rail capacity and the limitations on the network's capability to cater for the latest generation of inter-modal containers on standard wagons need to be addressed.
- Targeted investment in new road infrastructure is required, for example to facilitate new housing or employment development, to tackle particular bottlenecks, or to address remaining network gaps.
- Improvements in other drivers of productivity that operate in the wider 'business ecosystem' are an essential part of the transformation, notably in the areas of Education and Skills, Graduate Retention, Innovation, and Inward Investment.

1. Introduction

Context

1.1 In late October 2015, SQW Ltd and Cambridge Econometrics Ltd (CE), supported by Steer Davies Gleave Ltd (SDG), John Jarvis Consulting, and (as peer reviewers) Professors Philip McCann (Groningen), Ron Martin (Cambridge) and Roger Vickerman (Kent) were appointed by Transport for the North (TfN) on behalf of wider partners, to undertake **an Independent Economic Review (IER) of the Northern Powerhouse (NPh).**

1.2 Partners' intentions in commissioning the IER were threefold, namely to provide:

- **data, evidence, and intelligence to underpin TfN's Northern Transport Strategy in Spring 2016**, as an input to the Spring 2016 Budget, and subsequent proposals for transport investment.
- the evidence and arguments around **which the 'narrative' for the NPh** could be forged and developed.
- the **analytic bedrock on which subsequent NPh development**, – including, but not limited to, strategy and action planning – could be built and progressed for the future.

1.3 The work was undertaken between late-October 2015 and March 2016. It comprised five workstreams as follows:

- Workstream 1 – analysis of the **prosperity and productivity gaps in the North**, and the potential contribution role of different drivers, including (proxies for) transport connectivity, in closing these.
- Workstream 2 – a focused analysis of the **economies of the 11 Local Enterprise Partnership (LEP) areas, which together form the North**, including an assessment of local productivity performance and causes, sectoral specialisms, capabilities, and assets, and major investments planned/underway to address the causes of the performance gaps and realise sector opportunities.
- Workstream 3 – analysis of **distinctive competitive advantage and sectoral strengths, capabilities, and industrial potentials** of pan-Northern significance.
- Workstream 4 – **modelling future growth scenarios for the North, including growth consistent with NPh's aspirations**, and the role of agglomeration and transport in influencing the growth across the North.
- Workstream 5 – developing **suggested proposals for an Independent Panel** to act as the guardians of the IER's evidence base going forward.

What the Review was . . . and what it was not

1.4 The Review was seeking to characterise the North's economic position and the causes underpinning its performance, and to identify opportunities where 'pan-Northern' effort can sensibly support existing 'local' activities. Whilst key elements of the work involved drilling

down into transport specifics, the Review as a whole was intended to reflect on the wider 'ecosystem' in the North of England, of which transport is a part.

1.5 Importantly, the Review was not intended as a fully-dimensioned 'economic baseline' for the North, although in undertaking its work it ranging widely across a range of domains. Equally importantly, the IER was not about developing the NPh strategy or action plan, nor was it concerned with any NPh governance arrangements. Rather, it relied heavily on a review and synthesis of existing literature and evidence, with additional modelling work by Cambridge Econometrics, building on analysis of the North's 'prosperity' and 'productivity' gaps, and sectoral performance, as its key evidential foundations.

Workstream 4: Report Structure

1.6 This document summarises the final findings for Workstream 4 on future growth scenarios for the North. It has been written to report fully on the content, findings, and draft conclusions of the Workstream. As such, it is designed as a self-standing output, but it should also be read in the context of the companion reports which have been produced for the other Workstreams, especially Workstream 3 'Competitive Advantage and Sector Strengths'.

1.7 The remainder of this Report is as follows:

- Section 2: sets out the context for the work, and the approach adopted for in progressing the Workstream.
- Section 3: outlines the assumptions underpinning the 'transformational' scenario
- Section 4: explains how the potential impact of agglomeration effects have been incorporated into the analysis
- Section 5: presents the results from the scenario testing
- Section 6: discusses the implications for transport.

1.8 The bibliography is presented in Annex A. Additional data are provided in Annex B. Comments from the Review's Academic Panel are at Annex C.

2. The context for, and approach taken to, developing the scenarios

Key Messages

- The logic behind various alternative economic futures for the North are developed in this section, notably (1) a continuation of past underperformance relative to the rest of England, and (2) a 'transformational' scenario which begins to close the existing prosperity gap and fulfil the vision for the Northern Powerhouse.
- The improved economic performance in the transformational scenario is led by a marked improvement in the North's distinctive offer of 'Prime' capabilities (Advanced Manufacturing, Energy, Health Innovation and Digital), supported by the contribution of key 'Enabling' capabilities (Financial and Professional Services, Logistics and Higher Education). Many of the additional jobs come in city and town-based services, including those that benefit from the population's higher spending power.

Context

2.1 The report *The Northern Powerhouse: One Agenda, One Economy, One North*[1] sets out a broad vision for a transformed economic future for the North. It refers to HM Treasury analysis cited by the Chancellor of the Exchequer that quantifies what such a future could be worth in terms of gross value added (GVA). That estimate calculates the GVA that would arise in the North over 2013-30 if the region grew at the same rate as the projected UK average rate and compares this with GVA that would arise if the region grew at the (slower) rate that it experienced over 1994-2012. The difference, £37bn[2] in real terms, was described by the Chancellor as the 'prize that awaits the north of England'. Commitments were given in the Autumn Statements of 2014 and 2015 and the March and summer Budgets of 2015 to improve transport and broadband infrastructure, invest in certain science and innovation centres and cultural centres, expand school academy chains with the aim of raising educational standards, devolve certain powers, extend existing and create new additional Enterprise Zones, and support trade missions. The March 2016 Budget gave the go-ahead for the HS3 rail link between Leeds and Manchester, and also included funding for key road improvements and a Northern Powerhouse Schools Strategy.

2.2 The report produced under Workstream 1[3] reviewed the extent and persistent nature of the economic performance gap between the North and the rest of England, highlighting the role played by a range of drivers including skills, innovation, and connectivity[4]. The scenarios developed here assume improvements across the range of these drivers which bring about a closing of the productivity gap and stronger growth in economic activity.

[1] Transport for the North and Department for Transport (2015) *The Northern Powerhouse: One Agenda, One Economy, One North*. A report on the Northern Transport Strategy, HMSO, London, available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427339/the-northern-powerhouse-tagged.pdf.
[2] See https://www.gov.uk/government/speeches/chancellors-speech-at-the-cbis-2015-annual-dinner.
[3] SQW and Cambridge Econometrics (2016) *Northern Powerhouse Independent Economic Review, Workstream 1: Analysis of the pan-Northern Performance Gap - Final Report*.
[4] The role of these drivers was also emphasised in the 'Joint Statement Between the North's Core Cities and Government, Northern Powerhouse Phase 2' published alongside the March 2016 budget. See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/508108/NPH_Budget_Statement_Final_2_.pdf

2.3 Transport services and infrastructure planning requires a quantified view of the future from which the likely demands upon transport capacity can be derived. It cannot simply be based upon *aspirations* for future economic development because of the risk that investment in capacity will prove to have been excessive if those aspirations are not met: while transport is a critical factor in improving economic growth, it needs to be accompanied by a range of other improvements to the drivers of growth and productivity to bring about the trend change in economic outcomes that the aspiration envisions. Nor can infrastructure planning be based simply on an *extrapolation of past trends* in economic outcomes because of the risk that the projection becomes a self-fulfilling prophecy: the desired change in economic outcomes will not come about without improved transport connectivity.

2.4 Previous studies have sought to use empirical analysis to quantify the contribution of various drivers to economic development in particular places or time periods, which in principle might help to inform a forward-looking scenario analysis. But there are important caveats to be aware of when seeking to draw lessons for the future of the North:

- There is no straightforward data measure of transport connectivity that can be incorporated in econometric analysis, particularly when the geographical unit of analysis covers a large area, and so the findings of previous studies may not be readily applicable for assessing the impact of improved transport connectivity
- The drivers identified in this kind of analysis are themselves part of the process, making it difficult to attribute causality. For example, the direction of causation in the past may have run from stronger economic development to decisions to invest (for example, in transport connectivity or in skills) rather than the other way round.

Approach

2.5 The approach constructs forward-looking scenarios that compare the growth that might be expected in the North, if:

- The future is like the past ('*business as usual*')
- The aspirations embodied in the LEPs' Strategic Economic Plans are fulfilled ('*SEPs' expectation*')
- The North's future performance is transformed, relative to the past ('*transformational*')
- The 'transformational' scenario is adjusted to reflect a higher UK GDP growth context (consistent with the Office for Budgetary Responsibility's long-term view) ('*transformational plus*').

2.6 The '***business as usual'* scenario** reflects both historical experience and expected UK trends, notably in the performance of sectors of the British economy and in population changes. It is not simply an extrapolation of past outcomes, but can be interpreted as reflecting past experience suitably adjusted for expected UK outcomes. So 'business as usual' implies the same scale of investment as in the past, set in the present and future context for the North. It is not, strictly speaking, a 'policy-off' scenario because it is not feasible (a) to distinguish and quantify the impact that policy has had in the past (so as to exclude those effects when extrapolating), and (b) to incorporate explicitly the economic impact that existing policy

commitments will have (particularly in the near future, so as to allow for what is already committed). This scenario takes account of changes in the structure of the North's economy that reflect past trends so that, for example, industries that in the past have shed jobs and capacity have a lower weight in the economy now than they did 10-20 years ago.

2.7 The second scenario, the '***SEPs' expectation',*** seeks to aggregate the views of the North's 11 LEP areas as expressed in their Strategic Economic Plans, submitted to government in Spring 2014. These Plans were developed in the context of a time horizon set by national government of ten years and so generally cover that same period. They were developed independently, and so they may be based on different underlying assumptions about the economic context and the strategies to be pursued to promote growth[5]. Their expectations may not be compatible with one another if, for example, there are particular investments that could take place in one area or another but not both[6]. The analysis to aggregate the plans was carried out by Transport for the North in late 2015, and includes a 20% reduction in the implied aggregate growth rate to allow for some element of duplication between the Plans. The Plans focus on actions, and their impact, in the coming decade, whereas this report has a longer-term focus.

2.8 The third scenario, ***'transformational',*** is largely developed bottom-up by constructing futures for the various sectors of the economy, allowing for the Review's identification of 'Prime' and 'Enabling' capabilities. It is discussed in more detail below.

2.9 The outcomes for the North of the 'business as usual' and 'transformational' scenarios are prepared in the context of Cambridge Econometrics' view about the long-term prospects for growth in the wider UK economy. This view has UK GDP growth growing at a somewhat slower rate (a difference in the annual growth rate of about 0.2 percentage points) than the long-term assumptions published in OBR (2015). The scenarios, therefore, also include a ***transformational plus*** outcome, in which the differential between the North's growth in the 'transformational' scenario relative to Cambridge Econometrics' view for UK growth is applied to the OBR assumptions for long-term UK GDP growth.

2.10 In the presentation of results for prospective GVA growth in the North, comparison is also made with a future that is given the label '***HMT aspiration'***, interpreted as a growth rate equal to UK GDP growth. This is constructed by applying the Office for Budgetary Responsibility's long-term UK GDP growth rate assumptions (published in OBR, 2015) to the starting level of GVA in the North in 2015.

The transformational scenario

2.11 The transformational scenario assumes, implicitly, that progress is made in tackling the wide range of factors that are responsible for the performance gap observed in the past, described in Workstream 1, through measures beginning with (and extending well beyond) the kinds of policy initiatives that the Chancellor has announced. This assumption is *implicit* because, given the existing state of knowledge about what accounts for differences in regional

[5] There will also be some issues around double counting, as some Local Authority Districts are in more than one LEP area across Yorkshire. This is not an issue across the North West and North East, where LEP boundaries do not overlap. As we note in the main text, TfN has sought to account for double counting.
[6] We also acknowledge that the SEPs expectations were based on the plans in the LEPs' respective SEPs, but not all of the interventions set out in the SEPs were awarded Growth Deal (or other) funding, and so their expectations (in terms of economic growth) may be over-stated. We understand that some LEPs are in the process of revising their growth expectations in the light of this at the time of the IER study.

economic performance, it is not feasible to construct scenarios based on separate contributions to growth to be expected from specified initiatives. The effects are assumed to be realised fully within about 25 years, recognising that, for some drivers, the improvements take a long time to come through (for example, from higher attainment of children in school through to higher skill levels of the whole labour force), and that the response of business to improvements in any the drivers (for example, new investment encouraged by improved skills and connectivity) will be spread over a number of years. With respect to the role to be played by improved transport infrastructure in bringing about a transformed economic performance, the scenario assumes improvements that are pan-Northern in scope, offering the prospect of a substantial change in the economic geography of the North.

2.12 For example, the evidence from Workstream 1 indicates that a transformed economic future for the North will involve necessarily a marked improvement in the skills of the labour force. Policy-driven, supply-side initiatives to support this might target formal education, training and work experience for the long-term unemployed, and training for those in work (including managers), but the IER does not attempt to specify what exactly those initiatives might be, or to speculate about what impact any such initiatives might have. In any case, the willingness of firms and individuals to engage in such supply-side initiatives will depend upon the prospective returns to investment in skills, which in turn depend upon the wider economic environment in the North: the success of supply-side skills initiatives depends upon the success of other initiatives to improve other drivers of growth, including foreign direct investment, innovation and connectivity. Since 'business as usual' incorporates past trends, it can be interpreted as including policy measures of a similar kind and magnitude to those that were applied in the past two decades, and so the 'transformational' scenario implies a *stronger* level of policy action than in the past.

2.13 Importantly, the 'transformational' scenario does not target a particular outcome for economic growth in the North or assume an outcome that matches growth in other parts of the country. Rather, it explores what rate of growth comes about as a result of *sector*-level assumptions for growth which are directly related to a narrative about the nature of future economic development in the North, and whose values are formed through explicit judgements. This recognised, the 'transformational' scenario plays particular attention to the 'Prime' and 'Enabling' *capabilities*[7] identified as the key differentiators of the North's economy, as identified in Workstream 3 of the IER. To remind the reader:

- The four 'Prime' capabilities are:
  - **Advanced Manufacturing**, with a particular focus on materials and processes
  - **Energy,** in particular expertise around generation, storage, and low carbon technologies and processes, especially in nuclear and offshore wind
  - **Health Innovation,** with a focus on Life Sciences, Medical Technologies and Devices, and a growing competence in new service delivery models brought about by e-health and devolution in Health and Social Care funding

[7] The term 'sector' is used to refer to the conventional standard industrial classification of firms, which underpins the data sources that support the modelling work. The term 'capability' is used to refer to areas of thematically-related activities that cut across the conventional classification, reflecting the changing nature of the modern economy. Capabilities are a more sophisticated concept than sectors, and set out in full for the North in the Review's Workstream 3 Report.

- **Digital**, focusing in particular on computation, software tools/design and content, data analytics, and simulation/modelling, and wider strengths in media.

- These are supported by three 'Enabling' capabilities which will play a critical role in supporting the growth and development of the ''Prime' capabilities. These are:
  - **Financial and Professional Services**, which provide essential services to businesses in the 'Prime' economic capabilities, and offer opportunities in terms employment growth via 're-shoring' activities.
  - **Logistics**, particularly linked to port activity and airport development, recognising the criticality of resilient Logistics capability and good transport at a competitive price to enable the 'Prime' capabilities to perform in overseas markets.
  - **Education** (primarily Higher Education), which offers research capability and technical expertise that underpins the 'Prime' capabilities above, provides access to global networks, and also provides a supply of skilled labour and export strengths in its own right.

3. Assumptions underpinning the 'transformational' scenario

Key Messages

- The 'transformational' scenario sets out a quantified view of what the economy of the North would look like in an improved economic future. It is built up by forming judgements on potential growth in GVA, productivity and jobs in the four 'Prime' Northern capabilities if the North's historical underperformance with respect to the drivers of productivity and growth were addressed.
- Similar judgements are also made about potential improvements in performance of sectors in the wider economy that largely serve markets outside of the North.
- Knock-on effects are then estimated for suppliers and for private and public services that serve a population with higher income.

3.1 The **'transformational' scenario** builds up a picture of what the North's economy would look like were six things to occur:

- There is substantial growth in the four 'Prime' Northern 'capabilities', and supporting growth in the three 'Enabling' capabilities, identified in Workstream 3 (which together currently make up about 35% of Northern GVA and 30% of Northern employment)
- There are consequent effects on suppliers based in the North
- There is improved competitiveness and hence higher growth in output (but to a considerably lesser extent than for the 'Prime' capabilities) and productivity for selected other sectors that largely serve markets outside of the North
- There are agglomeration effects arising from faster connections between cities in the North, reflected in the growth in output and productivity of city-based business services
- There are broadly-based improvements in productivity across the wider economy and a higher employment rate[8] (associated particularly with higher skills)
- There are consequent effects on private and public services that serve the population which has a higher income.

3.2 Why take this bottom-up, structural approach? It is, of course, uncertain which particular technologies will develop most rapidly and experience the fastest growth in markets. And it is similarly uncertain which of these market segments will prove to be the ones in which firms based in the North are successful. For this reason, the definition of the capabilities that Workstream 3 proposes as making up the North's distinctive offer is deliberately quite broad, based on what can already be identified as existing specialisms. To take a long-term view of the kinds of transport infrastructure that could support a more successful economic future for

[8] There is a potential tension between the objectives of (1) closing the productivity gap between the North and the rest of England, on the one hand, and (2) bringing more people who are not employed (typically with low skills) into (presumably relatively low-productivity) work.

the North, it is necessary to take a view on the kinds of places (city centre, out-of-town and close to major road networks, smaller towns; sparsely-populated rural areas) where economic activity is expected to grow most and the kinds of connectivity (commuting into cities, passenger travel between cities; freight connectivity with the rest of the world; passenger connectivity with the rest of the world) that will be needed. The *structure* of the economy is a key factor influencing these. It is also a key consideration for the kind of development that will be needed for some other drivers of future economic growth and productivity, including skills, innovation and the attraction of foreign direct investment. Thus, similar considerations have in the past been taken into account in the selection of technologies for inclusion in the UK's Catapult Centres programme and in the selection of sectors for government to prioritise in trade and investment promotion.

3.3 How quickly could a shift towards faster growth in the North come about? The Workstream 1 report demonstrates that the North's gap in performance and in key productivity drivers is long-running and persistent, which suggests that bringing about an improvement in outcomes is likely to be a long-term endeavour. A marked improvement in skills will require, among other things, an improvement in school-leaver attainment. But even if that improvement can be brought about within, say, five years and if attainment can then be sustained at the higher level, it will take decades before these better qualified leavers form a majority of the labour force.

3.4 The motivation to acquire higher skills, the retention within the North of those who acquire the skills, and their impact on productivity and wages all depend upon the availability of jobs that make use of those skills, and so investment in the skills system will, in any case, need to go hand in hand with improvements in the other drivers of business performance. Similarly, it will take time to put into place the substantial scale of investment in pan-Northern transport infrastructure required to support a transformational change in the North's economy. Once in place these may be followed by quite rapid changes in some aspects of behaviour (facilitated, for example, by decisions that anticipate the delivery of better connectivity) as new capacity is exploited, but it seems likely that the full effects on the expansion of business, the attraction of new business investment and the development of greater specialisation will take years to be realised.

3.5 The assumptions made here to characterise the 'transformational' scenario therefore consist of improvements whose effects build up over some 20-25 years. Particular initiatives in particular places will, of course, take effect over a shorter period than this: it is the accumulation of these measures in different places at different times that together will drive the overall improvement in performance.

The 'Prime' capabilities

3.6 The paragraphs that follow set out the four 'Prime' capabilities in turn and the underpinning assumptions for each that have informed the development of the 'transformational' scenario. These capabilities were developed in Workstream 3 to represent existing and/or future potential sectoral and capability specialisms where the North is genuinely differentiated and distinctive, performs well in terms of productivity, and can compete at national and international scales. Judgements about these capabilities are then translated into the sector classification for which data are available to support modelling.

3.7 *Advanced Manufacturing* (especially processes and materials) includes the design and manufacture of specialist materials and textiles, engineering and manufacturing, research and design, and metal and non-metallic production processes. In terms of the conventional definition of sectors contained within this capability (bearing in mind that each capability encompasses the expertise of the wider knowledge base, for example in Higher Education, research institutes, and in the North's wider hard and soft asset bases), Advanced Manufacturing activities are found in Textiles, Chemicals, Plastics, Metals and Metal Products, certain Non-Metallic Mineral Products, the Engineering industries, Motor Vehicles and Engineering Services. The challenge when it comes to quantification and projections is that the conventional classification typically does not permit the activities that can be expected to see rapid, technology-driven growth from more traditional activities that are still experiencing the effects of restructuring (although the weight of the latter is less than it was).

3.8 Consequently, the growth rates that could be assumed reasonably for the entire 'Advanced Manufacturing' group of sectors included in the capability have to take account of the continued restructuring of parts of the sector. The assumptions for GVA growth have slow growth in the period 2015/25, reflecting the effects of weaker global markets for material and engineering products in the short and medium term, and then a gradual acceleration in growth as the effects of stronger innovation, foreign direct investment and improved skills strengthen the performance of the technology-driven segments and the weight of traditional sectors declines further. By the 2030s, it is assumed that the entire group is growing at an annual rate about 1 pp faster than the average over 1995-2015 (implying much faster rates for the technology-driven segments within this). This long-term annual rate is also about 1 pp faster than the projected UK rate for the equivalent definition of the group of sectors, implying growing specialisation of the North in this capability.

3.9 In the past, productivity growth has reflected the impact of restructuring away from traditional activities, a trend that will continue but whose impact on the entire group's productivity will be less because the weight of traditional activities is now less. At the same time, an accelerated shift towards more knowledge-intensive, higher value-added activities can be expected to raise productivity growth. In the projections, this is reflected in the assumption that productivity will grow at a gradually accelerating rate, reaching (in the 2030s) an annual rate about 0.5 pp faster than in the past two decades.

3.10 The *Energy* capability includes the various aspects of Energy generation, storage and distribution, the production of the associated technologies and the provision of associated consultancy and supporting services. A similar issue arises when considering quantification and projections as for Advanced Manufacturing: the entire group is a mixture of some segments that can be expected to grow rapidly (notably to support decarbonisation of Energy use over the long term) and others that are not (including some that could suffer a reduction in demand in a low-carbon future). The past two decades saw very substantial restructuring dominated by the decline of Coal, but this has little weight in the sector now. The assumptions for GVA growth have a similar profile to those for Advanced Manufacturing, with slow growth in the early part of the period and then an acceleration as the market for low carbon technologies develops and as the assumed benefits of a stronger performance in terms of innovation and skills development in the North take effect. By the 2020/30s, it is assumed that the entire group grows at an annual rate some 1.0-1.5 pp faster than the projected UK rate for the equivalent definition of the group of sectors, implying growing specialisation of the North in this capability.

3.11 Past trends in productivity growth in Energy are so affected by the decline of Coal that they are not a helpful guide to the future. The assumptions for the scenario assume gradually accelerating productivity growth over the period of the projections, but at a somewhat slower annual rate (0.3-0.5 pp) than in Advanced Manufacturing, reflecting the fact that the group of activities includes Energy generation and distribution as well as the development of Energy technologies (where productivity growth might be expected to be faster).

3.12 The *Health Innovation* capability includes sectoral activity in Life Sciences, Medical Devices, Instruments, various elements of Health Research (including clinical trials) and delivery (particularly e-/tele-health and, with Health Devolution, Personalised Medicine, etc.). While some specialist elements of the sector are operating in a global market, others depend heavily on trends in NHS spending, and this has a strong influence on the growth of the overall group both in the past and in the future projection.

3.13 While Health Innovation is a capability in which the North has, and can be expected to develop further, a particular specialism, other parts of the UK (and notably the Cambridge-London-Oxford research footprint) are also expected to grow strongly. Furthermore, the prospective growth in some segments of health delivery are related to population growth (and, in particular, growth in the very young and old age groups that are more intensive users of health services), which is likely to be at least as strong in the rest of the UK as in the North, even with an improved economic performance in the North. In the assumptions for GVA growth, therefore, a more modest (than for Advanced Manufacturing and Energy) differential compared with the projected UK growth is included, of about 0.5 pp.

3.14 Health Innovation includes health delivery in the NHS where, because market prices do not apply, there are well-known issues for economic statisticians in measuring the value of outcomes and hence productivity in the official statistics, which make the task of developing assumptions for the scenario particularly challenging. An acceleration in productivity growth is assumed, reflecting the assumption of stronger growth (and hence a larger weight) for the technology-driven segments, as in the rest of the UK (so that the positive differential compared with the UK average is small).

3.15 The *Digital* capability includes sectoral activities in data processing and hosting, big data analytics, virtual simulation and modelling, software development (including games), telecoms, TV and video production, and limited kinds of publishing. It has, of course, experienced extremely rapid growth over the past two decades, facilitated by innovation in computing power, wider electronics, and communications technologies. Similarly, high rates of growth are projected over the next decade, slowing somewhat after 2025 (though still higher than whole-economy growth) as the activities increase in size and some segments become more mature. This is also a capability in which other parts of the UK can be expected to see strong growth and the long-term GVA assumptions have a differential compared with projected UK growth of 0.5-1.0 pp.

3.16 Productivity growth was relatively (for a largely service activity) high in Digital during the period of extremely rapid growth of the past two decades. The projection assumes a rate of growth more in line with knowledge-intensive services, and broadly in line with the projected productivity growth for the sector in the UK as a whole.

The 'Enabling' capabilities

3.17 In addition to the four 'Prime' capabilities, the Workstream 3 report identified three 'Enabling' capabilities which, both in their own right and through interactions with firms and organisations in the 'Prime' economic capabilities, will exert significant influence over the North's long-term economic development.

3.18 For the three 'Enabling' capabilities, *Financial and Professional Services*, *Logistics* and (primarily Higher) *Education*, the approach initially taken to forming assumptions for GVA growth has been to examine the past growth of these activities in comparison to the wider Northern economy and then to apply the same relationship in relation to the growth projected for the North in the 'transformational' scenario. The motivation is that, as 'enablers', these activities serve a market that is to a considerable extent located in the North and so their growth depends on growth in the wider economy.

3.19 This is, of course, a simplification of what is in practice a much more complex story. Some specialised businesses in *Financial and Professional Services* serve national and international markets, and the prospective 'agglomeration' benefits of better transport connectivity can be expected to increase specialisation and hence the competitive advantage and market share of these businesses. The past experience has been that Financial and Professional Services have grown at a faster rate than the wider economy, reflecting the development of such specialisms and also the structural change towards greater use of these services throughout the economy.

3.20 To the extent that these trends continue into the future, the method of forming assumptions initially adopted here allows for a similarly faster rate of growth for this sector than the wider economy, and productivity growth slightly faster than is assumed for the UK. But on the assumption that much improved connectivity will boost agglomeration effects and specialisation, allowing a marked acceleration of activities serving markets outside of the North, somewhat faster trend growth in GVA and productivity have been assumed. The scale of increase is discussed in the section on agglomeration effects below.

3.21 For *Logistics*, the past experience has been growth at a slightly faster rate than in the wider economy. The kind of future expected here implies trends that both reduce and boost the demand for Logistics: lesser importance of heavy freight imports/exports (and for the future a greater reliance on more sustainable modes, notably rail and water-borne) and supply-chain imports associated with those sectors; greater importance of business and leisure travel, commuting travel, imports of consumer goods and high-value (including air) freight. The net effect is unclear, and for the assumptions the same relationship (slightly faster growth than the whole economy) as in the past is maintained. Productivity growth is assumed to be at a similar or slightly faster rate than in the UK as a whole.

3.22 For *Education*, the method of relating growth to the wider economy is a considerable simplification. Higher education has a strong foreign student component, demand from which is unrelated clearly to the Northern economy, although the competitiveness of Northern institutions' offers in a global context is vital in ensuring success. Higher Education institutions are also developing increasingly wider income streams from foreign operations and collaborations, for example through international campuses. But other, large parts of the Education sector are servicing demands within the region and are important for improving the underlying skills base.

3.23 This recognised, the 'transformational' scenario assumes that the North's university research base will support innovation among the 'Prime' capabilities, and this development, focused on the fast-growing technologies, is expected to be more rapid than growth in the wider economy, but it is a small part relatively of the whole sector. Investment in skills, including intermediate skills, is a clear need to support the transformation of the North's economic performance, and this is likely to involve expansion of some parts of further education. In the past, growth in education was slower than in the wider Northern economy: in the projection it is assumed that this will continue to be the case, but that the differential is less than in the past. Productivity growth is assumed to be at the same rate as in the UK as a whole.

The Wider Economy

3.24 Together, the 'Prime' and 'Enabling' capabilities, the core focus of Workstream 3 of the IER, account for about 35% of the North's economy by value, and about 30% by employment (some 2.3m jobs). Given this, how is the remainder of the North's economy treated in the scenarios which follow?

3.25 For *Agriculture and Food* and *Other Production Industries*[9], the assumption is made that growth in the 'transformational' scenario will be slower than in much of the economy, but 0.5-1 pp faster, at an annual rate, than experienced in the past, supported by stronger productivity growth (and hence continued declines in employment).

3.26 For *Other Business Services* (i.e. other than those already considered above), a similar approach is followed as for Financial and Professional Services, namely to relate its growth to the growth in the wider Northern economy and to draw on the past experience of that relationship when forming assumptions for the future, with an additional allowance for agglomeration effects (see section below). Past growth was, in fact, considerably faster than in the wider economy, and that tendency has been maintained in the assumptions for the 'transformational' scenario, but with a somewhat smaller differential.

3.27 For the *remaining services* (mostly Consumer Services, including the visitor economy, and the remaining Public Services), the approach has been to relate growth to the growth of the population in the North, applying a similar differential as in the past (they all grew considerably faster than the population, reflecting among other things the rise in per capita incomes). For Consumer Services, productivity is assumed to be boosted further by agglomeration effects (see section below).

3.28 These business, consumer and public services typically have slower productivity growth than the rest of the economy, and this assumption has been maintained in the projection. But, a modest acceleration for the private services (giving productivity growth slightly faster than the UK average) is incorporated, reflecting the assumption that skill levels will be improved. Given that these sectors account for more than half of all the jobs in the North, this is an important assumption for closing the productivity gap.

[9] This group comprises all the sectors in the Northern economy outside of services that are not already included in the prime and enabling capabilities and in Agriculture and Food.

4. Incorporating the potential impact of agglomeration effects

Key Messages

- Agglomeration effects capture the impacts on economic performance (notably in the form of higher productivity and pay) that arise from specialisation and knowledge-spillovers that can be realised in larger cities. They tend to arise particularly in city-based services.
- Academic literature has provided a range of estimates for the relationship between city size and productivity by comparing cities of different sizes.
- Improved pan-Northern transport connectivity is expected to include faster and more frequent connections within and between the cities of the North, allowing greater agglomeration impacts to be realised.

4.1 The literature that seeks to quantify agglomeration effects has focused on the relationship between city size (measured by population or employment) and productivity (measured as GVA per worker or, in some cases, by 'total factor productivity'[10]), seeking to generalise from data sets that cover a range of cities of different sizes and densities. It should be noted that, to get the variations needed for statistical analysis, these typically compare cities across space rather than the experience of a given city over time. Hence, if lessons are drawn about what difference it would make if a given city were larger, or better connected, the implied assumption is that it would become more like the other larger cities with which it is being compared. Some studies have drawn a distinction between the effects of agglomeration on the productivity of a worker of a given gender, skill and occupation, and the effects that allow also for differences in the composition of the workforce between cities. If lessons are to be drawn about what difference it would make if a given city were larger, or better connected, this distinction raises the question of the extent to which such changes in composition are incorporated or not.

4.2 There is also the critical question of the direction of causation: do cities become prosperous because they are large, or do cities become large because they are prosperous? Finally, there is the question as to whether the development of cities can be treated as independent of one another, or whether a system approach needs to be taken. As is typically the case when seeking to draw on studies of the past, or of other places, judgement must be applied to when forming views about the future.

4.3 Graham (2007)[11] presents a summary of estimates made in a number of studies, mostly examining cities in the US, but including also some that examine Japan and Europe. The estimated scale of the relationship varies, but there is a cluster of estimates implying that a doubling of city size is associated with an increase in productivity in the range of 4-7%.

[10] 'Total factor productivity' is intended to measure the difference in GVA in one place over time or between places at the same time that are not explained by differences in the inputs of capital services and labour.
[11] Graham D.J., (2007), 'Agglomeration, productivity and transport investment', *Journal of Transport Economics and Policy*, 41, 317-343.

Rosenthal and Strange (2004)[12], cited by Venables, Laird, and Overman (2014)[13], provide a similar range (3-8%). Overman, Gibbons, and Tucci (2009) cite results[14] for the UK that imply a doubling of city size is associated with an increase in productivity of 3.5%. Frontier Economics (2016) presents a similar summary of results of similar magnitude[15].

4.4 Graham (2005)[16] provides empirical estimates to identify which sectors (i.e. narrower than the concept of 'capabilities' which the IER has come forward with) have the largest productivity benefits associated with agglomeration. While positive effects are reported for some manufacturing industries, they are found more consistently for service sectors, notably Finance and Insurance, Business and Management Consultancy, Hotels and Restaurants, Media Services and Public Services. The overall scale of impact in this study is higher than the range found in the studies noted above: a doubling of a city's agglomeration (here measured in terms of 'access to economic mass') is associated with a 12.5% increase in productivity, and the estimates for the service sectors with the largest effects are in the order of 20-30%. Frontier Economics (2016) presents[17] a summary of results from four studies in which the agglomeration effects for producer services are around double the average impact for all sectors.

4.5 Within Transport for the North, there are significant proposals for improved transport infrastructure for the North ('Northern Powerhouse Rail') which would reduce rail passenger journey times between the main cities, while others would improve commuting journeys into cities. The first of these types of investment can be thought of as increasing the effective density of cities or, in the language of the literature, their 'access to economic mass'. Even if businesses do not relocate, improvements to transport infrastructure make it easier for firms and their employees to interact and hence enjoy the productivity benefits associated with proximity to other firms.

4.6 In their work for the Northern Way, SERC (2009) estimated that a 20-minute reduction in train journey times between Leeds and Manchester would increase the rail contribution of 'access to economic mass' by 10% in the two cities[18], leading to an increase in wages of 2.5%[19] in both places. Expressed in monetary terms, this would be worth £6.7bn in GDP terms (in 2006 prices) across the whole of the North, of which £2.7bn would accrue to the two city regions. The 2.5% figure is the estimate made without controlling for differences in skill levels, occupational composition, age and gender between places. When these are controlled for, the impact of reduced journey times is much lower: less than 0.5%. This IER scenarios report is seeking to envisage what the Northern economy could look like in the future given improvements across the whole set of drivers of productivity, including connectivity.

[12] Rosenthal, S. S. and Strange, W. C. (2004) 'Evidence on the Nature and Sources of Agglomeration Economies', *Handbook of Urban and Regional Economics*, Vol. 4, ed. Henderson, J. V. and Thisse, J. F. New York: North-Holland.
[13] Venables, A.J., Laird, J. and Overman, H. (2014), 'Transport investment and economic performance: Implications for project appraisal', paper commissioned by the Department for Transport and available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/386126/TIEP_Report.pdf.
[14] Rice, P, A. J. Venables and E. Patacchini (2006) 'Spatial Determinants of Productivity: Analysis for the Regions of Great Britain'. *Regional Science and Urban Economics* 36 (6), 727-752.
[15] See Table 3 on p51 of Frontier Economics (2016), which presents results for 'first order' effects (i.e. controlling for differences in the characteristics of workers apart from the accessibility of the cities in which they work).
[16] Graham, D.J. (2005) 'Investigating the link between productivity and agglomeration for UK industries', report for the Department for Transport, available at http://webarchive.nationalarchives.gov.uk/20100203095137/http://www.dft.gov.uk/pgr/economics/rdg/webia/webtheory/stigatingthelinkbetweenp1077.pdf
[17] See Table 5 on p56 of Frontier Economics (2016).
[18] See Table 11 on p53 of SERC (2009).
[19] See Table 12 on p55 of SERC (2009).

Consequently, estimates of agglomeration effects that assume no change in the composition of workers will underestimate the increase in productivity in the cities that could occur in a future in which improved connectivity is reinforced by other changes[20]. Some of the change in composition that can be envisaged would come about through displacement effects: skilled workers commute (or relocate) to the cities whose accessibility has been improved. But in a long-term scenario that embodies structural change in the economy towards more knowledge-based sectors, improvements in skills, higher retention of graduates and a larger working-age population, some of the change in composition would be additional for the North.

4.7 Frontier Economics (2016) provides[21] a summary of estimates of 'total impact of accessibility improvement' on wages from five studies (including SERC (2009), which imply a range of 1.1%-2.6% for the total impact (that is, allowing for changes in the composition of the workforce) on wages of a 10% improvement in accessibility.

4.8 However, the estimates in Frontier Economics (2016) of the proportionate impact on city accessibility of shorter rail journey times between cities in the North are much lower than reported in SERC (2009). The Frontier Economics report considers reductions in rail journey times between four pairs of cities in the North, one of which is the same 20-minute reduction in the journey time between Manchester and Leeds. In contract to the 10% improvement in accessibility reported by SERC (2009), the Frontier Economics report gives estimates of a 2.8% improvement for Leeds and a 1.3% improvement for Manchester. There are a number of methodological differences between the two studies which could account for the different result. One is that the Frontier Economics report gives results for the whole city travel-to-work area (TTWA), whereas the 10% figure in SERC (2009) refers to the Manchester and Leeds local authorities alone. On the assumption that the impacts are larger in city centres, the selection of a wider area of analysis can be expected to produce lower proportionate effects.

4.9 The second type of investment, that is improving commuting journeys into cities, allows more workers to work in city-centre locations where higher-paid jobs are available and better matching between skills and jobs. Venables, Laird, and Overman (2014) illustrate this by citing the example of Department for Transport analysis of the potential impact of Crossrail in which the key effects arise because of an expected increase in employment in the City of London, Westminster, and the Isle of Dogs made possible by improved commuting opportunities. However, the increases in economic activity and employment implied by these effects are not necessarily additional to the wider economy: the connected city centres may benefit at the expense of smaller urban locations.

4.10 The full set of prospective transport improvements for the North that could be envisaged would have an impact on Manchester and Leeds larger than the 20-minute reduction in rail journey time between the two cities. Frontier Economics (2016) presents estimates of the impacts of 'achieving all Northern Powerhouse rail aims', which results in a 3.2% improvement to the accessibility of the Manchester TTWA (more than double the effect of the reduction in the Manchester-Leeds journey time alone) and a 5.2% improvement for Leeds (up from 2.8%).

[20] As SERC (2009) notes: 'This finding suggests that the effects on Manchester and Leeds will be bigger if policy interventions, such as improved transport links, induce structural change, particularly by changing the composition and skills of the workforce' (ibid, p70).
[21] See Table 4 on p53 of Frontier Economics (2016).

4.11 For the other large cities of the North, the improvements in accessibility resulting from faster rail journeys estimated in Frontier Economics (2016) are of a similar magnitude, all lying within the range 3.2% - 5.2%. Improved commuting opportunities into cities could shift workers into higher productivity jobs in most cities, and there might be an associated increase in labour force participation or migration into the region, giving a positive net impact on total employment. In a long-term projection, these effects have to be incorporated together with other continuing influences on productivity (more capital, better technology and improved skills).

4.12 The impacts on productivity in producer service sectors would be larger than the average effect for all sectors, perhaps double the average impact for the whole city if the sector differences reported above are used as a guide.

4.13 Using a reasonably narrow definition of cities to focus on city-centre activities, the metropolitan districts of Leeds, Liverpool, Manchester, Newcastle upon Tyne and Sheffield together account for some 20-25% of the North's GVA and employment of these services. Hence, if the productivity of these services were boosted by say 5-7.5% (assuming an accessibility improvement from all journey improvements of 10-15% for city-centre locations and a productivity elasticity of 0.5, including structural change effects, for producer services) as a result of improved connectivity and structural changes, and there were no offsetting impacts in other locations, this would boost the productivity of the North as a whole in these services by some 1-2%. This estimate excludes the potential benefits to productivity in other parts of the city region, but also excludes displacement effects.

4.14 In the 'transformational' scenario, for the North as a whole the increase in productivity by 2050 over the 'business as usual' case is of the order of 7% for the various business services that are expected to benefit most from agglomeration effects. This is about 1 percentage point higher than the increase in productivity for other service sectors to allow for the particular impact of agglomeration effects, adding to the impact of other improvements to the drivers of productivity, notably in skills and innovation.

4.15 The scale of agglomeration effects matters not just for what might be expected for the overall rate of GVA, employment and productivity growth in the North, but also for the spatial distribution of that growth: a greater role for agglomeration-sensitive sectors would concentrate more of the increased activity and productivity in and around the larger cities (because, by definition, agglomeration effects are larger in larger cities). This has implications for the pattern of transport improvements that are required to support a stronger economic performance in the North, giving greater emphasis to improvements to inter-city, within-city and commuting infrastructure and services. Some of the 'Prime' and 'Enabling' capabilities identified in the Review are city-based and are expected to benefit from agglomeration economies; others are located on the edge of or outside of cities and their future success depends more on other factors, including other kinds of transport connectivity improvement.

5. Results

Key Messages

- A 'transformational' economic future for the North, in which there are substantial improvements in the skills base, in innovation performance, and in transport connectivity, is projected to raise the growth rate of the North's productivity, gross value added (GVA) and employment markedly above past trends, helping to close the productivity and prosperity gap compared with the rest of England. By 2050, GVA is projected to be some 15% (or £97bn, in 2015 prices) higher than a 'business as usual' projection, and productivity some 4% higher; some 850,000 additional jobs are projected compared with 'business as usual' in 2050, and 1.56m more than in 2015.
- This future would represent a sustained better long-term performance for the North than has been seen in any period in the last four decades. It depends on long-term improvements in the various drivers of productivity and output growth, including transport connectivity, and so the impact upon economic performance is a gradual one, building up over the long term.
- The Review's projections imply a substantial restructuring of the North's economy. Some city-based service activities are assumed to become more specialised and to increase the geographical reach of the markets that they serve. As skills, productivity, and average earnings increase across the North as a whole, firms engaged in lower value added activities that are also tradeable (notably in Manufacturing) will come under increasing pressure to change their product range and processes to be able to compete in a higher labour cost environment.

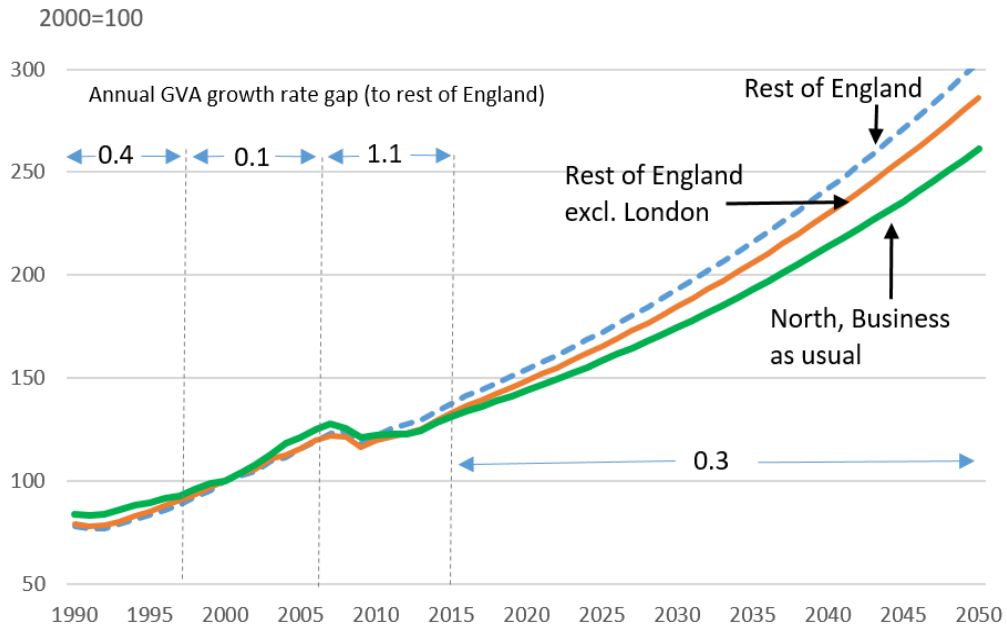
5.1 What, then, in the light of the preceding discussion are the shapes of the four scenarios proposed under this Workstream? These are set out below sequentially, starting with the baseline 'business as usual' projection.

'Business as usual' projection

5.2 Figure 5-1 shows trends in real (inflation-adjusted) Gross Value Added (GVA) in the North, compared with the trends in the rest of England, with and without London. The graph is indexed to 100 in the year 2000. The scale over the very long term is such that the worst recession in living memory appears as a 'small' drop in GVA.

5.3 The North's slower growth in the historical period is evident, and the figure also depicts the difference between the annual average growth rate in the rest of England and that in the North over various periods. In the 'business as usual' projection, the annual rate of GVA growth in the North lags behind Cambridge Econometrics' forecast for the rest of England by 0.3 percentage points, which falls in the range of the gaps experienced in the period leading up to the recession. Small differences in annual growth accumulate and result in large differences in relative performance over the long term.

Figure 5-1: Real GVA in the North, actual and 'business as usual' projections, compared with the rest of England

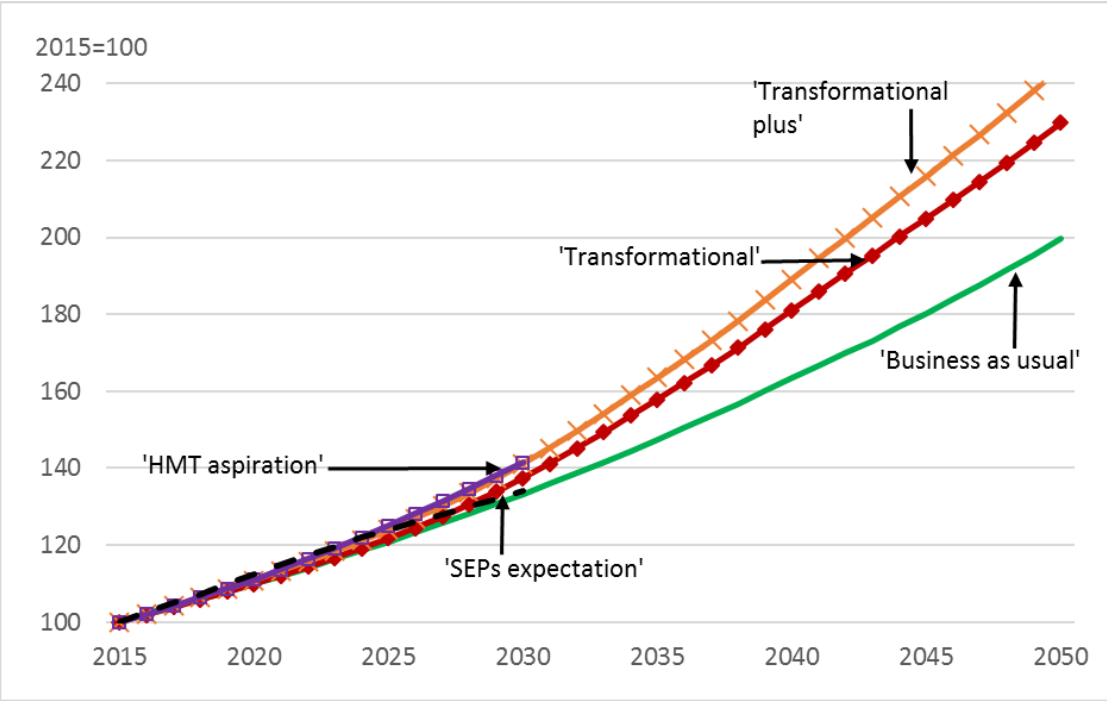


Source: CE

Scenarios

5.4 Figure 5-2 compares the projections for various scenarios for the North's real GVA, indexed to 2015=100. The 'SEPs' expectation' scenario has only been estimated to 2030, reflecting the typical time horizon of the Strategic Economic Plans. It has a relatively strong rate of growth initially, but a slower rate in the longer term, reflecting the short to medium-term focus of the strategies. **The annual average GVA growth rate of the 'transformational' scenario is about 0.5 pp higher than the business as usual rate** over the whole period 2015/50; it is about 0.2 pp higher in the period 2020/25, rising to 0.7-0.8 pp higher in the 2030s. The growth rate of the transformational plus scenario is very similar to that of 'HMT aspiration' to 2030 (i.e. the same rate of growth for the North as the OBR's assumption for the UK as a whole), but not by design. What appear to be modest changes in annual growth rates accumulate to make a large difference in the long run. In 2050 GVA is some £97bn higher (in 2015 prices) in the 'transformational' scenario than in the business as usual case. Behind the numbers lie the potential for substantial differences in living standards, the quality of jobs and life opportunities.

Figure 5-2: Real GVA in the scenarios



Source: CE

Table 5-1: Comparison of growth rates across the scenarios

	Average annual growth rate, 2015/50 (% pa)[1]			
	GVA	Jobs	Productivity[2]	Population
'Business as usual'	2.0	0.3	1.7	0.4
'Transformational'	2.4	0.5	1.9	0.6
'Transformational plus'	2.6	0.5	2.1	0.6
'SEPs expectation'	2.0[3]	n/a	n/a	n/a
'HMT aspiration'	2.3[3]	n/a	n/a	n/a
UK[4]	2.2	0.5	1.8	0.6

Source: CE
Notes: 1 all rows except 'UK' show growth rates for the Northern Powerhouse area.
2 Productivity is defined as GVA per job.
3 'SEPs' expectation' and 'HMT aspiration' GVA growth rates are calculated over 2015/30.
4 UK growth projections are from CE.

5.5 The improvement in GVA growth in the 'transformational' scenario is associated with an improvement in jobs growth compared with 'business as usual', but the difference in the annual average jobs growth rate is smaller: 0.2 pp compared with 0.4 pp for GVA. The reason is that the improved performance over 'business as usual' of the 'transformational' scenario is predicated on the assumption of an improvement in the various drivers of productivity, and this is reflected in a stronger rate of productivity growth compared with 'business as usual'. Even so, the number of jobs in the 'transformational scenario' is some 1.56m higher in 2050 than in 2015, and some 850,000 higher than the number in the 'business as usual' scenario in 2050.

5.6 The improved outcome with respect to jobs is assumed to attract and retain a larger working-age population, with an associated impact on the overall population. The rate of growth of the whole population is higher than that of jobs in all scenarios, reflecting the fact that the share of people of working-age is declining as the population ages. The rate of growth of jobs is

faster than that of the working-age population, reflecting both the tendency for some people to have more than one job and, in the 'transformational' and 'transformational plus' scenarios, an increase in the proportion of the working-age population that are in work (as a result of improved skills and accessibility).

5.7 The strongest effects on productivity (compared with business as usual) are in the 'Prime' capabilities, in Financial and Professional Services and in agriculture and those manufacturing sectors not already included in the 'Primes'. The largest increases in jobs are in the 'Enabling' capabilities and in Digital and other business and consumer services.

Table 5-2: Projected growth in the North by 'capability' in the transformational scenario

	GVA (£2011m)					Jobs ('000)				
	2015	2030	2050	2015/30 % pa	2030/50 % pa	2015	2030	2050	2015/30 % pa	2030/50 % pa
Primes										
Advanced Manufacturing	33.4	39.3	58.0	1.1	2.0	580	416	325	-2.2	-1.2
Energy	8.9	10.5	15.3	1.1	1.9	116	99	90	-1.1	-0.5
Health Innovation	17.5	25.3	43.0	2.5	2.7	570	584	642	0.2	0.5
Digital	9.2	20.1	41.1	5.3	3.6	130	187	216	2.5	0.7
Enablers										
Financial and Professional Services	19.8	31.3	66.7	3.1	3.9	373	457	681	1.4	2.0
Logistics	13.8	18.6	29.7	2.0	2.4	404	460	578	0.9	1.1
Higher (and Further) Education	3.8	4.8	7.0	1.6	2.0	112	121	146	0.5	1.0
Other										
Agriculture and Food	7.3	8.5	10.2	1.0	0.9	212	176	133	-1.2	-1.4
Other Production Industries	26.4	29.4	34.5	0.7	0.8	652	540	426	-1.2	-1.2
Other Business Services	34.5	52.1	88.0	2.8	2.7	1,045	1,226	1,451	1.1	0.8
Other Public Services	43.8	56.7	90.9	1.7	2.4	1,412	1,499	1,793	0.4	0.9
Consumer Services	57.5	77.5	128.2	2.0	2.6	2024	2,205	2,709	0.6	1.0
Total[1]	**302.3**	**415.4**	**694.6**	**2.1**	**2.6**	**7,630**	**7,971**	**9,191**	**0.3**	**0.7**

Source: CE
Notes: 1 Total GVA includes imputed rent for owner occupiers, which is not allocated to any of the capabilities.

5.8 Results by five-year period are presented in Annex B.

5.9 How transformational is this? The projections presented in the 'transformational' and 'transformational plus' scenarios represent a sustained better long-term performance for the North than has been seen in any period in the last four decades. They include a period in which the North's growth is projected to exceed that of the UK as a whole, as the benefits of the improvements in the various drivers of productivity and output growth, including transport connectivity, allow some degree of closing of the productivity gap.

5.10 The projections imply a substantial restructuring of the North's economy, both between and within the 'capabilities' identified in Table 5-2. As skills, productivity and average earnings increase across the North as a whole, firms engaged in lower value added activities that are

also tradeable (notably in manufacturing) will come under increasing pressure to change their product range and processes to be able to compete in a higher labour cost environment, and those that do not adapt will fail.

5.11 There is particular uncertainty over the scale of agglomeration benefits that could be realised by fast journey times between the cities of the North, and the extent to which these are additional to the North rather than a redistribution of activity within the North. It is conceivable that the response to a reduction in journey times, particularly when it is implemented across the transport network of the North, could bring about a substantial integration of the activities of the cities, yielding larger improvements in productivity through specialisation than envisaged here. But this lies well outside of the experience on which scenarios of the type developed here are based.

6. Transport Implications

Key Messages

- The Transformational and Transformational Plus scenarios should be expected to lead to increases in the number of workers employed in urban areas in general and city centres in particular. This will place new and increased demand on road and public transport links within and between the North's towns and cities for passengers and for freight.
- Enhanced pan-Northern city-centre to city-centre rail links, east-west and north-south are needed to facilitate the bigger labour markets that support the success of knowledge-based firms. To be effective, they must be integrated with city-region local public transport networks. Currently poor connections, low frequencies and complex fares, as well as slow journey times constrain rail's market appeal. The North's rail network can overcome this deficiency if it is designed to operate through a series of nodes that also link with other public transport networks. Most of these rail nodes (interchanges) are in city centres. Manchester Airport is another.
- The increase in town and city centre employment in the knowledge-based 'Prime' and 'Enabling' capabilities cannot be accommodated through private (car) travel alone. It will require enhanced public transport connectivity within city regions: coherent, user-friendly joined-up networks, involving frequent rail services (including cross-city operations), light rail and bus, all supported by smart, multi-modal ticketing with simplified fares.
- Global connectivity is critical if the North's Smart Specialisation opportunities are to be realised fully. This applies to people – to meet customers, suppliers and collaborators – and for the import and export of goods. A growing Northern economy will support strengthened air links from the northern airports, but at present surface access is one of the principal constraints to their collective growth. For ports, constraints on rail capacity and the limitations on the network's capability to cater for the latest generation of inter-modal containers on standard wagons need to be addressed.
- Targeted investment in new road infrastructure is required, for example to facilitate new housing or employment development, to tackle particular bottlenecks, or to address remaining network gaps - those routes where journey times, journey reliability and network resilience fall short of the standards achieved by the rest of the network. Completion and potential further application of the smart motorway programme will provide medium term relief on the motorway network, but in the long term road congestion will need to be addressed by demand management or a disruptive technological solution.
- For the Transformational and Transformational Plus scenarios to influence the shaping of plans for transport investment, as well as their business cases, a next step must be to develop a spatially disaggregated view of what the two scenarios mean in terms of the future location of population and employment.

The transport needs of the IER 'Prime' and 'Enabling' capabilities

6.1 The Independent Economic Review, of which this report forms a part, has shown that the persistent gap between the economic performance of the North and more prosperous parts of England is associated with gaps for most of the key drivers of growth and productivity. A transformed economic future in the North will require improvements across the range of these drivers and facilitators. The impact of public policy on some improvements (investment in skills, private sector innovation, and foreign direct investment) is mediated by the decisions made by individuals and firms. Nonetheless, policy can play a part in influencing those decisions. Others, including improvements to transport connectivity where a substantial scale of investment in pan-Northern transport infrastructure is required to support transformational change in the North's economy, can be achieved more directly through public policy.

6.2 Over the long term, private decisions to invest reflect the conditions of the wider economic environment:

- Firms and individuals are more likely to invest in skills if demand-led employment growth in well-paid jobs is strong;
- Foreign investors are more likely to be attracted to locations that are well connected to global markets, have a well-qualified workforce and a strong innovation base.
- Firms and individuals in city-based activities are more likely to develop, to specialise and innovate, and to remain in larger cities with deep and extensive labour markets

6.3 Better transport connectivity within and between cities can strengthen these three effects.

6.4 A transformed economic future in the North will reflect the place that the North can play in the wider global economy. While the restructuring of traditional industries has weighed upon the North's economic and employment growth in the past, and continues to have an ongoing legacy in particular areas, that history has also been associated with the development of key assets or 'capabilities' (firms, skills, a research base, and the inter-connections between these) that provide the foundation for activities in which technological innovation is key to global competitiveness.

6.5 These capabilities represent activities in which the North has areas of distinctive, 'smart' specialisation and which export to wider UK and global markets. These activities cut across the traditional system of economic classification: they include firms in both manufacturing and services. These activities have the potential to grow and contribute to economic growth in the North. In the Workstream 3 Report, these are described as 'Prime' capabilities. While no one can know with confidence which particular activities will see the strongest growth over the long term, it seems likely that a more economically successful North will have a core of knowledge/technology-based firms with a supporting eco-system, whatever the particular processes and applications they specialise in. And these 'Prime' capabilities, given their knowledge and technology underpinnings, should have strong potential in international markets.

6.6 The knowledge/technology-based firms that make up the 'Prime' capabilities have many common transport requirements, as do the people who work in them. These common requirements are linked to the places where such firms have a propensity to locate, how they interact with each other and with firms in other sectors, how they access international markets, and the types of people they tend to employ.

6.7 The knowledge/technology-based firms that are currently classified as high value-added services flourish in city locations, which support specialisation, knowledge-spillovers, and the wider benefits of agglomeration, including meeting their needs for specialised skills and the benefits they gain from being located in close proximity to other firms in their sector, their suppliers and their customers. Growth in knowledge/technology-based firms clearly suggests further growth in employment in the North's city centres.

6.8 Employees in these city-based knowledge/technology-based firms can broadly be grouped into higher-skilled managerial, professional and technical staff, and support staff. The former are typically well-paid. They are willing and able to commute over longer distances. They have a greater propensity to travel by rail. Support staff are typically lower skilled and lower

paid. They typically commute shorter distances and have a greater propensity to commute by local bus (as well as tram and local rail, where available).

6.9 Other businesses among the 'Prime' capabilities (that are currently classified as manufacturing) require larger premises for which city centre locations are too expensive and, typically, not sufficiently accessible for freight movements. These locations need to have high-quality connectivity for freight, particularly via road to their supply chain (in the North and beyond) and to global markets by sea and air.

6.10 Firms in the Advanced Manufacturing capability also need good links for business travel to connect with suppliers, clients and their research base. If located in urban areas, they are typically located on the periphery of towns and cities and close to the primary road network. Some are located at sites some distance from the nearest town or city. Because of this, along with their low labour intensity, such industries have a requirement for appropriate road-based connectivity. In the case of lower-paid, lower-skilled workers, adequate public transport links can be important.

6.11 In order to flourish, collectively these 'Prime' capabilities depend upon high quality support from what the Workstream 3 report describes as key 'Enabling' capabilities: Financial and Professional Services, Logistics and research institutions[22]. Financial and professional services offer essential inputs to other firms based in the North. Some are sufficiently specialised or of sufficient scale to serve markets outside of the North. The opportunity to specialise is related to the scale of access to markets and to highly-specialised workers and so there is a propensity for such firms to locate in city centres. As with technology/knowledge-based firms, they place a particular premium on commuting within and between cities, as well as accessing suppliers and markets across the North and elsewhere in the country. High-quality public transport into and within cities, and to other major cities in the North and to the rest of the UK offers the opportunity to extend markets and labour-force catchment in a way which can be economically efficient and sustainable.

6.12 The 'Enabling' capabilities include research institutions, and among these ICT is used extensively for communications, but opportunities for collaboration are fostered by good passenger transport links between the cities and towns of the North as well as to the wider UK and rest of the world.

6.13 The dependence of the other key 'Enabling' capability, Logistics, on transport connectivity is self-evident. As well as requiring good access to road and/or rail networks, Logistics activities tend to be land intensive and so located away from town and city centres where land costs are lower. The Reviewers note that Transport for the North's parallel study on 'Freight and Logistics' is examining the scope for a network of multi-modal distribution parks across the North, focussed on rail and water-borne modes with the goal of minimising unit freight costs.

[22] Agglomeration effects may operate within particular sectors or across a wide range of sectors. The former effect is likely to be experienced by 'prime capabilities' clustering within and around city centres and are referred to as localisation (or Marshallian) economies. The latter effect arises through diversification and access to a range of high-quality business services such as the range of 'enabling' capabilities described here. These effects are referred to as urbanisation (or Jacobs) economies.

The transport needs of the rest of the North's economy

6.14 In the Transformational and Transformational Plus scenarios, the 'Prime', and the 'Enabling' capabilities while driving the North's economic growth are likely to account for less than half of the North's economy in terms of activity (gross value added) and still less in terms of jobs (although the jobs that they do create will be relatively highly skilled). A further significant part of the economy will be made up of other business services, consumer services and public services. These activities are mostly based in cities and towns, either because they tend to locate close to the firms and population that they serve or because they depend on the advantages that city locations offer to promote specialisation, including access to highly-specialised workers. A notable exception is the rural visitor economy offer, which serves people who live in the North and those who come from elsewhere in the country and from overseas. Certain consumer services, notably retailing, require road freight connectivity, either into town and city locations from which they serve customers or to the homes and business locations to which products are delivered.

6.15 One element of closing the North's prosperity gap involves increasing labour market participation, typically for people currently with relatively low skills. Among the factors that help to promote participation is ease of affordable access to jobs and learning institutions in urban locations. For many, public transport would be the main means of access.

The Implications for Transport Demand

6.16 Taken together, we see a picture in which growth in the knowledge-based 'Prime' and 'Enabling' capabilities should be expected to lead to increases in the number of high-skilled workers employed in urban areas in general and city centres in particular. Such workers are typified by longer than average commutes and greater than average business travel, both in terms of the number of trips and their average length. They also typically travel more for leisure purposes. However, not all the 'Prime' and 'Enabling' capabilities have a predominantly urban location. Advanced manufacturing production facilities and Logistics facilities are typically located in out-of-town locations with good access to road and/or rail networks. Growth in the 'Prime' and 'Enabling' capabilities will support growth in other sectors of the economy and jobs in these sectors and the people who work in them are predominantly located in the North's towns and cities. In addition, a strengthened and more prosperous northern economy will stimulate more housing demand, and the location of this will also have a major impact on future travel patterns and transport demand.

6.17 To plan and then implement the transport infrastructure that will support and facilitate transformational growth will require a new perspective on the distribution of population and employment growth across the North. Alongside this must be a recognition that both land use policies and transport enhancement proposals may need to be adapted to get the most out of existing networks and secure the best possible Value for Money from investment in transport supply, including managing down the overall impact of congestion on the strategic highway network.

6.18 While ICT facilitates greater within-business and business-to-business interaction and drives new business models (e.g. remote working, videoconferencing, etc.), by increasing the ease with which wider networks can be maintained ICT may be a complement, not a substitute, for

travel. To date, there is no evidence that ICT is leading to a reduced demand for business travel.

The Implications for Transport Supply

6.19 Throughout much of the 1980s and 1990s, the North's transport networks had spare capacity and this accommodated much of the increased demand for travel over that period. Of course, there were exceptions to this with roads that experienced congestion and over-crowded public transport services. There were also some notable network gaps in the North, where connectivity was either absent or sub-standard, although many of these, particularly on the road network, have now been addressed such as the upgrading of the A1 linking the North East directly into the motorway network. Nonetheless, the substantive point remains: in aggregate the North's transport networks had capacity that could accommodate growth.

6.20 However, it is no longer the case that the North has spare transport capacity to accommodate growth. Over the last two decades and like the rest of the country, the North's passenger rail network has experienced rapid growth in demand. This growth has supported increases in employment in knowledge-based sectors in the centres of the North's cities. While there has recently been some significant rail investment, for example electrification in the North West, much of this growth has been accommodated within pre-existing capacity. Now the North has some of the most crowded rail services in the country and the ability to accommodate further growth in peak periods is limited.

6.21 It has also been shown that compared with elsewhere in the country, the slow journey times offered by rail services in the North are correlated with low levels of longer-distance commuting. Moreover, it has been seen that when new direct rail services are introduced that offer a material reduction in rail journey times, there can be a substantial growth in demand which is much greater than conventional demand modelling would suggest – a good example of this is the direct links between Manchester and north Lancashire, Cumbria and Scotland introduced by Trans Pennine Express. It is not just for commuting that poor rail connectivity across the North suppresses demand.

6.22 The North's road network is also becoming increasingly congested. This is particularly notable for the motorway network around and through the North's conurbations which caters for a mixture of local and longer distance traffic, both private cars and goods vehicles. Investment in Smart Motorways is providing additional capacity and more reliable journeys, but in the face of forecast traffic growth they are, at best, only a medium-term solution and further measures will be needed.

6.23 Should transport supply lag behind economic development, it will create a constraint on the ability of the North to respond to changes in the global market. Having some spare capacity in the system, as there was in the past, means that the economy can grow regardless of the particular firms within the 'Prime' and 'Enabling' capabilities and the rest of the North's economy that are most successful. Of course, these cannot be known in advance; rather the challenge is to understand the types of transport connectivity that are needed to create the conditions that will support the greatest possible rate of growth.

The North's Future Transport Network

6.24 Taken the above discussion in the round, this suggests that:

- The increase in town and city centre employment that is expected to result from growth in the knowledge-based 'Prime' and 'Enabling' capabilities, and the growth in other sectors that this will induce, cannot be accommodated through private (car) travel alone. This is because road networks into many city centres already operate at or close to their capacity in peak periods. The availability of car parking is a further constraint. Even if affordable, measures to increase substantially road capacity into city centres would have unacceptable impacts on the built environment and (until low-emission vehicles become widespread) on air quality. For employment in city centres to grow to the maximum extent and the full scale of agglomeration benefits realised, it will need to be accommodated by enhanced public transport connectivity within city regions. This will entail coherent, user-friendly joined-up networks, involving frequent rail services (including cross-city operations), light rail and bus, all supported by smart, multi-modal ticketing with simplified fares.

- Growth in the knowledge-based 'Prime' and 'Enabling' capabilities is also expected to lead to increased demand for business-to-business travel, notably between firms in the 'Prime' and the 'Enabling' sectors. This will happen between firms in the North and between firms in the North and those elsewhere in the country and especially in London. Rail is well suited to cater for this demand, but adequate capacity will be required. In addition, faster journeys lead to direct economic benefits to firms, as well as extending the number of potential suppliers and customers available to them.

- Enhanced city-centre to city-centre rail links, east-west and north-south, also have the potential to facilitate the bigger labour markets that support the success of knowledge-based firms, but only if they are integrated with city-region local public transport networks. Currently poor connections, low frequencies and complex fares as well as slow journey times constrain rail's geographic market appeal. The North's rail network can overcome this deficiency (as in other parts of Britain and in other countries) if it is designed to operate through a series of nodes that also link with other public transport networks. Most of these rail nodes (interchanges) are in city centres. Manchester Airport is another.

- Global connectivity is also critical if the North's Smart Specialisation opportunities are to be realised fully. This applies to people – to meet customers, suppliers and collaborators – and for the import and export of goods. A growing Northern economy will support strengthened air links from the northern airports, but at present surface access is one of the principal constraints to their collective growth. This applies to both public transport and to road access. Looking at ports, constraints on rail capacity and the limitations on the network's capability to cater for the latest generation of inter-modal containers on standard wagons have been identified as a constraint to their maximising market share of this growing market.

6.25 It should not be forgotten, however, that the majority of trip-making and travel in the North is made by road. A number of the 'Prime' and 'Enabling' capabilities are highly dependent on road travel, notably Advanced Manufacturing and Logistics. An increased participation rate due to the spill-over effects from the 'Prime' and 'Enabling' capabilities, along with a growing

population, are likely to lead to increased demand for road travel across the North. This would be the case even if there were substantial and transformative investment in public transport provision. Targeted investment in new road infrastructure will be warranted, for example to facilitate new housing or employment development, to tackle particular bottlenecks, or to address remaining network gaps. Completion and potential further application of the smart motorway programme will provide medium term relief on the motorway network. However, road congestion will remain a pervasive problem across the North for the foreseeable future unless there is a sea-change in the approach to managing demand, or a disruptive technological change that significantly increases the capacity of the existing network.

6.26 Among these measures, improved connectivity between cities within the North is likely to rank highly, because of the relatively poor state of these connections at the moment and because of the importance of better inter-city connectivity for the opportunities for greater specialisation in high value-added, city-based activities and wider labour markets. What this review of transport implications highlights is that, over the long term, other kinds of connectivity, including global connectivity, are also important for the North's Smart Specialisation opportunities to be realised.

6.27 The Review's analysis of the North's 'Prime' and 'Enabling' capabilities and the requirements for the North's future transport network therefore deepens and strengthens the continuum of evidence that runs through the work of the Northern Way and the Eddington Transport Study through to the initial work of Transport for the North in *One North: A Proposition for an Integrated North (July 2014)* and *The Northern Powerhouse: One Agenda, One Economy, One North (March 2015)* setting out the North's transport strategy. Transformational improvements to connectivity within and between the North's cities, with London and internationally are required.

The Role of Transport for the North

6.28 In summary, the overall Northern Powerhouse goal is to facilitate an acceleration of the North's rate of economic growth. The findings of this IER are that the North has four 'Prime' and three 'Enabling' capabilities that have the potential to be the foundation of this growth. The clear implication is that the focus of Transport for the North's work should be on the collective connectivity needs of these seven capabilities. By addressing these connectivity needs, growth in those parts of the economy that are and have the potential to be the most productive will be facilitated and maximised, which in turn will support the growth of the wider northern economy.

6.29 In adopting this focus, TfN will need to consider its role in supporting enhanced:

- Labour market catchments
- Business to business links – this relates to the movement of people and the movement of goods
- Access to international markets – this, too, relates to the movement of people and goods.

6.30 The role of TfN is to complement and add to the work of local transport authorities and LEPs across the North and to work with Network Rail and Highways England to help direct their

respective enhancement programmes to secure the overall goal of rebalancing the economy. It also has a role working with Government to secure the funding to deliver the enhancements that are identified as needed to facilitate this.

6.31 A comprehensive Northern Transport Strategy will set the framework for Transport for the North's future activity. Within the context of this strategy, objective-led prioritisation will help direct the efforts of TfN and its northern and national partners to the maximum effect. As already noted, the evidence from this IER is that the four 'Prime' and three 'Enabling' capabilities that will be the foundation of future northern economic prosperity. These capabilities have a set of connectivity needs, some overlapping and some particular to a capability. Meeting these needs would seem a natural focus of any future prioritisation. They also overlap and support the connectivity needs of the rest of the North's economy.

6.32 There is one further implication for Transport for the North. Realisation of the Northern Powerhouse goal requires a transformational change of the northern economy. This will be driven by growth of the North's 'Prime' and 'Enabling' capabilities. Investing in transport connectivity is necessary to facilitate the maximum growth of these capabilities in the locations that they can be most productive. This means that future patterns of land use – where jobs are located and where the people live who fill those jobs – is contingent on the future scale and shape of the North's transport networks, and especially the North's future public transport networks. Conventional approaches to assessing the Value for Money of transport enhancements assume that there is no such effect, other than at the margin. If the Value for Money of transformational transport enhancements is to be properly assessed – and this must happen if the necessary funding to support transformational growth is to be secured – then the approach to transport appraisal as well as the approach to spatial economic planning in the North must be able to capture and deliver the benefits of this transformational change in a way that all parties can have confidence.

7. Conclusions for Further Work

7.1 As has been emphasised throughout this report, a transformed economic performance in the North will depend on marked improvements also in the other (apart from transport connectivity) drivers of productivity, which make up the wider ecosystem that supports successful economic development. This Review does not attempt to develop in more detail what those improvements need to be, but the Reviewers believe that they include:

- Improved education outcomes
- Improved graduate retention, helped by better prospects for skilled, mobile workers to make their careers in the North through good access to opportunities in more than one city region, and by a good supply of high-quality housing
- Improved work-based and vocational training
- Better commercialisation of university research
- Better management skills, including the uptake of innovation
- Attraction of inward investment by world-leading, international businesses that can bring transformed business practices and access to leading technologies.

7.2 These areas of additional necessary exploration are ones which a new *'Guardians of the Evidence'* Panel, argued for in Workstream 5 might progress. Not all of these thematic areas require policy development and implementation to be undertaken at a pan-Northern level (as has been the case for strategic transport infrastructure). Vocational skills and housing policy clearly need to be aware of particular local needs and circumstances. For others, such as inward investment and innovation, there is a case for coordinating action over a larger geographical scale. But even if policy implementation happens at a local level there is a case for having a single body (such as the proposed Independent Panel) to monitor progress and to provide or commission research and analysis to support policy.

Annex A: Bibliography

A.1 The references listed here include those explicitly cited in the report together with those that were reviewed during the course of the study.

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Annex B: Data Tables

Table B-1: Scenario results by five-year period

		2015	2020	2025	2030	2035	2040	2045	2050
GVA (£2011bn)	**Business as usual**	302.3	332.4	365.3	402.9	445.5	493.9	544.9	603.4
	Transformational	302.3	332.3	368.0	415.4	477.2	547.4	619.5	694.6
	Transformational plus	302.3	335.2	374.6	426.5	494.3	571.8	652.6	737.9
Jobs ('000)	**Business as usual**	7,630	7,725	7,809	7,904	8,011	8,133	8,229	8,336
	Transformational	7,630	7,700	7,776	7,971	8,315	8,642	8,928	9,191
	Transformational plus	7,630	7,700	7,776	7,970	8,313	8,639	8,924	9,187
Population ('000)	**Business as usual**	15,639	15,960	16,258	16,586	16,954	17,330	17,715	18,108
	Transformational	15,639	15,976	16,377	16,894	17,515	18,205	18,887	19,572
	Transformational plus	15,639	15,976	16,377	16,894	17,515	18,205	18,887	19,572

Annual average growth rates

		2015/ 20	2020/ 25	2025/ 30	2030/ 35	2035/ 40	2040/ 45	2045/ 50
GVA	**Business as usual**	1.9	1.9	2.0	2.0	2.1	2.0	2.1
	Transformational	1.9	2.1	2.4	2.8	2.8	2.5	2.3
	Transformational plus	2.1	2.2	2.6	3.0	3.0	2.7	2.5
Jobs	**Business as usual**	0.2	0.2	0.2	0.3	0.3	0.2	0.3
	Transformational	0.2	0.2	0.5	0.8	0.8	0.7	0.6
	Transformational plus	0.2	0.2	0.5	0.8	0.8	0.7	0.6
Population	**Business as usual**	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	Transformational	0.4	0.5	0.6	0.7	0.8	0.7	0.7
	Transformational plus	0.4	0.5	0.6	0.7	0.8	0.7	0.7

Annex C: Comments from Academic Panel

Prof. Philip McCann, University of Groningen

C.1 The improving connectivity arguments, whereby attempts are made to scale-up and better link the different parts of the North to each other by investments in inter-urban road and rail transportation facilities, is fundamentally about increasing the internal market potential of the region. We know that greater market potential is broadly associated with higher wages, higher productivity and higher levels of firm formation, and significantly improving these connections is aimed at significantly increasing the internal market potential of the North. This is based broadly on a New Economic Geography type of argument. At the same time, improvements in commuter transportation facilities are aimed at broadening and improving the matching and interaction of high-skilled individuals in key city-centre locations. This is based on a more standard urban economic way of thinking linking scale to density and to productivity.

C.2 In addition to the above effects, one of the potential drivers of the 'transformational' or the 'transformational plus' scenarios concerns the extent to which private investors genuinely perceive and believe that the greater long-term financial commitments and actions in the North made by central government alongside the greater local autonomy to design and deliver these actions are meaningful. In other words it depends on the degree to which the private sector is convinced by the scale and longevity of the public sector decisions and commitments to rebalance the economy. Improvements in the overall regional market potential alongside improvements in local centre-city activities may induce upward shifts in the expectations of both investors and also skilled labour, thereby fostering additional inflows of both into the region.

C.3 All of these processes are long-term in nature, and rapid pay-offs should not be expected. Long-term commitments are required for long-run returns.

Prof. Roger Vickerman, University of Kent

C.4 I think the general thrust of the report is in the right direction.

C.5 The Graham-type analysis (para 4.2 and 4.3) or that from Overman et al (para 4.5) are based essentially on single (large) city studies. It is not clear that the agglomeration type effects work in the same way in a system of cities, as Para 4.1 notes, and so it is not clear that one can generalise from single city studies to the wider network of cities in the North. Using the same type of analysis so far suggests the effects may be smaller, although it can be argued (cf KPMG for HS2, or PWC for the Airports Commission) that this approach underestimates the impact of improved connectivity.

C.6 There are potential issues in using the headline times between Manchester and Leeds, and the other core cities without knowing the impact on frequencies and capacities at intermediate smaller towns. This may simply shift activity around the North. If agglomeration effects work in the bigger cities, their growth could compensate falls in the smaller cities, but is that an acceptable solution?

C.7 This same issue reappears in Section 6. I think it is important to distinguish the 'address on the network' type of effect that might impact on inward investment – measured by international airports and their range of destinations and access to other regions via e.g. HSR and motorways – and the density and quality of the regional transport system that impacts on commuting and the thickening of labour markets. This is the fundamental question whether it is really poor transport that holds back the North – as opposed to poor skills or other input constraints. Whilst delaying transport improvements may constrain growth, investing too much in transport up-front can crowd out other worthwhile investments if, directly or indirectly, it comes at the expense of alternative publicly-funded investment. There is evidence from ex-post studies on projects funded by the Structural and Cohesion Funds of the EU, where too much investment in cases where transport is not the key constraint, has been ineffective in raising regional growth and productivity. Thus, the timing of new investment may be as critical as measuring its potential steady state effect, as the former may affect the latter.

Prof. Ron Martin, University of Cambridge

C.8 I think that overall the report contains much valuable analysis and provides useful insights into the structure and capabilities of the 'Northern Powerhouse' region, and of the possible contribution that new investments in the region's transport infrastructure could make to the area's economic performance.

C.9 My comments relate particularly to Section 4 on agglomeration impacts, since these seem to figure prominently in much recent academic work on the economic performance of cities and city-regions, and to be implicit in Government policy statements on 'powering up' northern cities.

C.10 The measurement of agglomeration, and thence of agglomeration externalities, is very far from an exact science. Some analyses use population or employment size to proxy the degree of agglomeration. But others use population or employment density. There is an obvious issue here of defining the geographical extent or limit of the city or regional units used to measure 'agglomeration' and its effects. Ideally they should be functional units, such as travel to work areas. But even these are not unproblematic.

C.11 Much of the work on measuring the impact of agglomeration externalities is indirect in the sense that identifying and measuring specific externality variables is rarely attempted. Rather the operation and impact of such agglomeration effects (which typically are assumed to exist) is instead inferred by the relationship between degree of agglomeration (as measured for example by city size or density of activity), and different indicators of economic performance, such as productivity, wages, per capita incomes, etc.

C.12 The estimates of the effect of agglomeration on productivity that are summarised in the report, are modest. Doubling the size of a city to achieve a 3 percent increase in productivity is modest indeed. And many such estimates are for a one-off increase: they do apply to growth rates. A doubling of a city's or (urban agglomeration's) size does not necessarily result in a permanent increase in the rate of productivity growth. It should also be pointed out the the literature in this area is dominated by studies of US cities (see point 7 below).

C.13 Moreover, many of the studies that come up with these estimates do not take account of the congestion and other negative externalities possibly associated with such a doubling. Doubling the size of a city can involve step changes infrastructural requirements/costs. We know too little about how the costs of servicing, managing and sustaining a growing agglomeration (like London, for example) rise with increasing size. Increasing the size of an agglomeration seems likely to require ever rising investment in infrastructure to maintain a given productivity growth rate.

C.14 It should be noted, as Baldwin et al argue (in Economic Geography and Public Policy, a major policy-orientated book on Krugman-style New Economic Geography models), there may be potentially multiple equilibria between city size (and agglomeration benefits), and city productivity performance: much depends on how congestion and other such effects increase with city size, and on the impact of inter-firm competition on profitability.

C.15 A high estimate of a positive agglomeration on productivity in financial services is, of course a unique case. It is strongly influenced by how productivity is measured in this sector (and 'head office' effects are undoubtedly also a factor). And not every city/city region can have the high order financial functions enjoyed by London.

C.16 Interestingly, work by Mike Batty (UCL) that compares the correlation between city size and various indicators, such as productivity, wages, etc, in the USA and the UK, finds that while there is a positive (power function) relationship in the former, there is little evidence of such an effect in the latter. This seem to hold for various geographical definitions of city agglomerations, as measured by density and internal connectivity. This raises a question about there being differences between US and UK cities in terms of how they function, their economic and financial autonomy, and their governance arrangements.

C.17 Another issue that is in fact the subject of long and ongoing debate is the role of specialisation in city growth (and the relationship of specialisation to city size). Literature is emerging to suggest that what matters is not sectoral specialisation, but functional specialisation. Still other work (e.g. from Harvard) shows that countries, regions and metro areas that have a diverse but related product base tend to enjoy higher growth over the long run. Indeed, the more interrelated is an economy's product portfolio, the more innovative in terms of developing new products, is seems to be. (See the work of Hidalgo, Hausman and others).

C.18 What is of importance for the Northern Powerhouse is intra-regional connectivity - improvements to the connections between the various cities and towns that make up this region - not least to improve its functioning as a regionally integrated labour market, but also to encourage and foster regionally focussed supply networks. I suspect there would be more 'bang for the buck' from investment in transport within and across the Powerhouse region, than from connecting Manchester to London via HS2.