Assessing the Value of Ordnance Survey OpenData to the Economy of Great Britain

Full Study Interim Report

Prepared for Ordnance Survey

Version 2.0

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Version History

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For further information on this report

[redacted]

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Overview

The overall purpose of the study was to evaluate the impact of the OS OpenData initiative in economic terms. It focused on the private and third sector impacts only, since the impact on the public sector is difficult to assess because of the Public Sector Mapping Agreement (PSMA). The study reports interim results that indicate OS OpenData will generate a net growth in Gross Domestic Product (GDP) of between £13.0 million and £28.5 million per annum by 2016. This net growth is predicted after applying a negative impact to account for the Government investment in OS OpenData and the negative effect on exports of the order of £3.7 million per annum through reuse of these products by companies based outside the UK.

Due to the cautious approach taken to all components of the assessment, the impact is almost certainly understated.

Introduction

The overall purpose of the study is to evaluate the success of OS OpenData in economic terms, and also provide information to inform any future considerations of changes to the range of free-at-the-point-of-use data from Ordnance Survey. This report covers the first stage of the full study, and indicates the order of magnitude of the economic value to the economy of Great Britain[1]. The study results should be regarded as an interim statement, with further work necessary to prepare the material for public discussion, as originally envisaged (stage 2B).

Details of the datasets covered by the initiative are given in Section 1 and Appendix A.

Economic Modelling

The study used Computable General Equilibrium (CGE) modelling to assess value resulting from the impacts of the OS OpenData initiative, on the economy of Great Britain (GB). It predicts a new equilibrium in the overall economy arising from changes in a range of sectors. Furthermore, it provides a framework in which to consider the "counterfactual" – testing the economic value that might otherwise have been achieved by using alternative technologies or business models other than making the OS OpenData datasets available free at the point of use.

CGE modelling overcomes problems with simply applying multipliers to individual benefits used in many other approaches. The modelling allows analysis of changes in macro-economic aggregates arising from changes in specific sectors of the economy, which may

[1] Northern Ireland is excluded from the scope of the study. Ordnance Survey Northern Ireland (OSNI) has a similar brief to Ordnance Survey Great Britain (OSGB) but does not have the same policies regarding the equivalent products to OS OpenData. For brevity, OSGB is referred to throughout this report as Ordnance Survey or abbreviated to OS.

well include negative impacts. These aggregates include changes in GDP, income[2], investment, wages and employment depending on the nature of task. The macro-economic results also enable the analyst to demonstrate potential changes to government revenues from taxation and other sources.

The impacts (shocks) which drive the CGE model have been generated using a "bottom up" approach combining individual case studies and analysis of OS OpenData download records for the period from April 2010 to January 2012.

Detailed discussion of the modelling methodology is provided in Sections 2 and Appendix C. The overall approach is covered in Section 3.

Independent Economic Review

Ordnance Survey commissioned a review of the validity of the approach by two independent economic consultants, Prabhat Vaze and Patricia Seex. Both are members of the Advisory Panel on Public Sector Information (APPSI) and have considerable experience in the information sector. The review was based upon the feasibility study report and in-depth discussions with the consultants.

The review concluded that CGE modelling is an appropriate method for valuing the contribution of OS OpenData to the economy of Great Britain and commends Ordnance Survey for commissioning the study. They anticipate that the final report will make a useful contribution to the literature and our understanding of the economics of OpenData policies in the UK (at the time of this review it was envisaged that the findings would be summarised to be accessible to a wider audience). In addition, they make several recommendations with regard to improvements that might be made in the next stage of the work i.e. that which is reported here.

Detail of the recommendations for improvement and their implementation in this report are detailed in Section 4. Their review is reproduced in full at Appendix B.

Literature Review

A summary of the extensive literature reviewed as part of the study is presented, focusing particularly on economic analysis as applied to pricing policy and public sector information reuse.

These studies which show, in varying degrees, that the economic benefits of data reuse exceed the loss of government revenue. However, where there is less agreement is the effect of a gradual degrading of public sector information if governments do not continue to fund its maintenance and upgrade to reflect users' needs. Consideration is also given of the alternative pricing strategies that might be applied in such circumstances and their relative merits.

More detail is provided in Section 5 and Appendix D.

[2] Real National Disposable Income in terms of national economic aggregates reported by the Office of National Statistics

Impacts on Ordnance Survey

To compensate Ordnance Survey for the losses of revenue consequent upon the decision to make the OS OpenData products free at the point of delivery, the Department of Communities and Local Government (CLG) established a contract with OS, worth £20 million per annum. The apportionment of the financial impacts of this public investment between public and private (commercial and consumer) sectors is central to the economic value assessment.

An estimated [redacted] of the investment impacts Ordnance Survey's public sector customers, notably Central Government departments, Local Government and the NHS. This proportion (around [redacted]) is a transfer within Government and cost-neutral from an economic modelling perspective. Whilst evidence from other projects[3] suggests the cost transfer from OS to public sector users would generate net benefits, we have deliberately not examined these effects as it is difficult to isolate OS OpenData impacts from those associated with the Public Sector Mapping Agreement (PSMA).

The remaining [redacted] (around [redacted]) of the public investment is a transfer from Government to private sector customers. However, the service charge element ([redacted] per annum) is for a new facility and therefore not a transfer of previous income. In addition, there is a substantial [redacted] per annum) component which represents an overseas transfer, modelled as a decrease in exports, of revenue previously earned by OS from companies who do not pay UK tax. This leaves a positive impact on the private sector of [redacted] per annum, which is distributed across all of the standard industry classifications (SIC)[4] in proportions based on their share of the geospatial market.

There is a balancing negative impact on Government as the [redacted] is not available for allocation to other projects.

For detailed consideration of this topic, see Section 6.

Economic Impact on Users

The CGE model is driven by a series of a case studies plus analysis of downloads of OS OpenData products.

The case studies are drawn from interviews with nearly 100 organisations, mostly by telephone. As expected, no single "killer app" is identified, but a whole series of incremental benefits across a wide range of sectors of the economy. They cover a mix of efficiencies realised by existing users and innovations. The efficiencies are more prominent than completely original innovations. However, this is to be expected since the initiative is less than 2 years old and some of the most significant innovations are only now reaching the market. Furthermore, the efficiency gains are found in existing customer organisations

[3] Assessing the value of geospatial information in local public service delivery. ConsultingWhere and ACIL Tasman for the Local Government Association, 2010.

[4] Office for National Statistics, Standard Industry Classification 2007.

where the products are already in use, so the "friction" associated with implementation is low.

Some significant cross-sector benefits are also identified, particularly route optimisation for medium-size organisations. However, the biggest single area of cross-sector benefit is the reduction in administration and "policing" of OS OpenData products and services that the Open Government licence[5] brings.

Negative impacts were also evaluated as part of the case study activities. For example, the efficiencies lost by users processing OS OpenData themselves into a format suitable for their particular type of system, rather than continuing to use the valued added services provided by some OS business partners. The picture for business partners is however mixed, with others reporting increased use of OS OpenData as part of a "freemium" business model.

For sectors known to be heavy users of OS products but where the consultants were not able to secure case studies an analysis of downloads has been used to "fill in the gaps". A very conservative approach has been taken to estimating the economic value in these cases with nominal savings allocated on the basis of unique downloads requested from companies only being considered.

Details of the methodology used to calculate economic value for both case studies and download analysis is provided in Section 7. This section also provides details of additional evidence collected from other data providers with similar products to those covered by OS OpenData such as Google and OpenStreetMap.

Social Impacts

A conservative approach has been taken to the evaluation of benefits. Broader social and environmental benefits for which there is no market price, so-called 'non-market impacts', have not been quantified. By their very nature, they are much more difficult to assess because they cannot be easily costed. However, to illustrate how they might be taken into account, key examples relevant to this study such as savings in time, avoidance of injuries or fatalities and environmental gains are discussed in Section 8.

Inputs to the CGE Modelling

In Section 9 the report explains how the impacts of the shift to CLG funding, case studies and download analysis are combined and then allocated to particular sectors according to the Office of National Statistics Standard Industrial Classification (SIC).

Results

The results of the CGE modelling are presented in Section 10. The picture they present is encouraging in the context of the overall aims of the OS OpenData initiative. The model predicts that by 2016, after taking account of the public sector investment , Great Britain's real GDP will increase by between a lower bound of £13.0 million and an upper bound of

[5] http://www.ordnancesurvey.co.uk/oswebsite/opendata/docs/os-opendata-licence.pdf

£28.5 million.

The main components of this increase are net productivity gains (£8.1 million – £18.2 million) and additional real tax revenues (£4.4 million – £8.3 million).

The increase is also net of £3.7 million per annum, applied as a negative shock to GB exports, to account for OS OpenData being integrated into products of companies paying taxes abroad. Despite the fact that GB loses this export income, overall the value of exports to the economy increases by £6.1 million – £10.3 million as other sectors of the economy expand.

While this is a small proportion of GDP, the products covered by the initiative only represent the minority of OS products in terms of turnover (albeit of some significance in terms of growth potential). It is an indication of the significant positive net economic impact of a relatively small policy change.

Another important metric is the increase in real national income (real GNP) in the range £10.2 million – £24.1 million by 2016. This is an indication of the increase in economic welfare for British society as a whole.

Conclusions

The principal conclusion is that the results demonstrate an improved level of productivity in the economy, and higher overall levels of output, directly attributable to making OS OpenData free at the point of delivery. It however assumes that Government will continue to fund OS OpenData under the contract to ensure that Ordnance Survey can meet its responsibilities as custodian.

We also use the Conclusions section to summarise the discussion of evaluating pricing models for other OS products which might potentially be considered under the Government's open data initiative. This important discussion can be found at Section 11.

Recommendations

We also make recommendations regarding actions that might facilitate realising greater benefits from the initiative, based on consistent elements of feedback from parties interviewed and observations of the consultants. These include the lack of available OpenData coverage for the whole of the UK which affects organisations operating UK-wide (Northern Ireland has a separate mapping agency and a different policy on open data under its devolved administration) and greater transparency of OpenData product maintenance commitments. Further recommendations relate to improving awareness of the products and their capabilities in emerging markets.

The recommendations are set out in detail in Section 12.

1 Introduction

1.1 OS OpenData

In April 2010, Ordnance Survey launched OS OpenData, providing free and unrestricted access to a large range of mapping and geographical information datasets covering Great Britain[6].

The OS OpenData portal allows users to download these datasets direct to their computers; view maps and boundary information for the whole country and develop web-map applications using the OS OpenSpace® API.

The OS OpenData datasets include the detailed 1:10 000 scale OS Street View®, Boundary-Line™, which provides the electoral and administrative geography of the country; and Meridian™ 2 and Strategi®, which offer customisable views of Britain's topography. OS VectorMap® District, a brand new mid-scale vector and raster dataset that has been specifically designed to display information on the web, is also available. The other datasets included are 1:50 000 Scale Gazetteer, 1:250 000 Scale Colour Raster, OS Locator™, Code-Point® Open, MiniScale® and Land-Form PANORAMA®. Appendix A provides a fuller description of the datasets included.

A key goal of the initiative is to stimulate digital innovation in the reuse of these data, to develop applications and solutions, drive new markets and unlock new potential for jobs in existing and new technologies.

1.2 Purpose

This study, commissioned by Ordnance Survey from ConsultingWhere and ACIL Tasman, aims to evaluate the success of OS OpenData in economic terms and also to inform any future considerations of changes to the range of free-at-the-point-of-use data from Ordnance Survey. If the OS OpenData initiative is achieving its objectives then, understanding its impact in more detail could help shape other OpenData programmes within UK government as well as underpin the political nature of the decision with sound economics. If it is failing to live up to expectations, then early warning may enable impediments to optimal take-up to be identified and corrected.

1.3 Status

This report covers the full study stage building on the feasibility study. It is an interim report for the use of OS and its Government partners. The project envisages a further stage during which the report is summarised for external review.

[6] Northern Ireland has a separate organisation, Ordnance Survey Northern Ireland (OSNI), which undertakes broadly similar functions to Ordnance Survey Great Britain (OSGB), within the province. For brevity we refer to OSGB as simply Ordnance Survey or OS throughout the report.

1.4 Timeframe

OS OpenData was launched in April 2010. The research for this report was carried out in over a one year period from March 2011 to March 2012. In this study the date used as a "benchmark" for forward projections is 30th June 2011.

1.5 Acknowledgements

The authors would like to acknowledge the assistance of large number of private and third sector contributors who have provided, often highly confidential, financial and other information without which it would not have been possible to complete this study. We also owe a debt of gratitude to numerous staff within Ordnance Survey who provided introductions and information.

2. Economic Modelling

2.1 Introduction

We believe that the economic modelling approach to assessing the value of initiatives involving geospatial information which has been developed by ConsultingWhere and ACIL Tasman is both innovative and thorough. It leverages best international practice, harnesses the experience in the UK geospatial industry of ConsultingWhere and exploits the expertise in economic modelling of location-based applications brought to the project by ACIL Tasman. It also builds on the success of the recent assessment of the economic value of geospatial information for local public service delivery carried out by the same team for the Local Government Association (LGA)[7].

The techniques applied are outlined in the next few paragraphs.

2.2 Computable General Equilibrium (CGE) Modelling

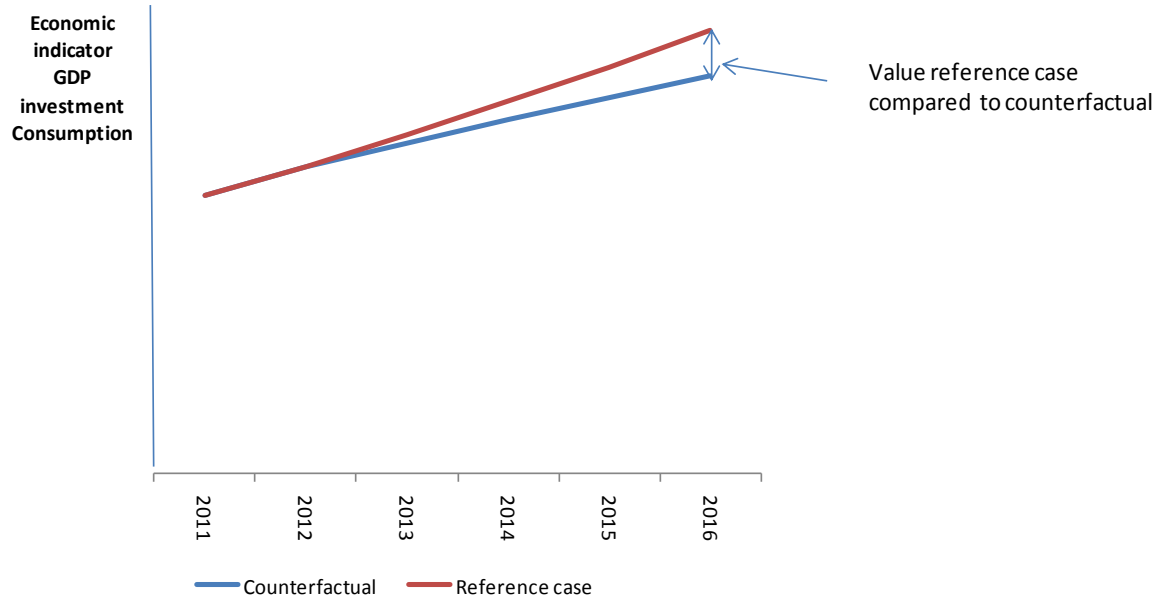
Using Computable General Equilibrium (CGE) modelling to assess value resulting from impacts on an economy, such as the OS OpenData initiative, is a well documented and internationally recognised technique. It predicts a new equilibrium in the overall economy arising from changes in specific sectors. Furthermore, it provides a framework in which to consider the "counterfactual" – testing the economic value that might otherwise have been achieved by using alternative technologies or business models other than the course adopted, in this case making the OS OpenData datasets free.

CGE modelling overcomes problems with simply applying multipliers to individual benefits used in many other approaches. The modelling allows analysis of changes in macro-economic aggregates arising from changes in specific sectors of the economy. These aggregates include changes in Gross Domestic Product (GDP), income, investment, wages and employment, depending on the nature of task. The macro-economic results also enable the analyst to demonstrate potential changes to government revenues from taxation and other sources.

Economic impacts can be demonstrated by examining different economic outcomes and reporting the differences now or in the future. In our discussion we will refer to the outcomes resulting from the OS OpenData policy intervention as the "reference case" which is compared with a "counterfactual" that represents a continuation of the previous pricing approach. The comparison of the counterfactual and reference case, for an example of improvement as a result of a policy intervention, is illustrated simply in Figure 1.

[7] ConsultingWhere and ACIL Tasman (2010) The Value of Geospatial Information to Local Public Service Delivery in England and Wales, Local Government Association. http://new.lga.gov.uk/lga/aio/12380949

Figure 1 Comparison of economic scenarios



ACIL Tasman's CGE model *Tasman Global* is, as the name suggests, a global model that provides the capability to account for trade flows with other countries as well as resource shifts within the economy of England, Scotland and Wales.

A key advantage of *Tasman Global* is the level of detail in the database underpinning the model. The database is derived from the latest Global Trade Analysis Project[8] (GTAP) database which was released in 2008. This database is a fully documented, publicly available global database which contains complete bilateral trade information, transport and protection linkages among regions for all GTAP commodities.

The GTAP model was constructed at the Centre for Global Trade Analysis at Purdue University in the United States. It is the most up-to-date and detailed database of its type in the world.

Tasman Global builds on the GTAP model's equation structure and database by adding five important features: dynamics (including detailed population and labour market dynamics), detailed technology representation within key industries, the ability to repatriate labour and capital income and a detailed emissions abatement framework. The database has been disaggregated for this study to separately identify Great Britain as distinct from the United Kingdom. The disaggregation of the GTAP database was undertaken by ACIL Tasman using the estimated 2009 gross value added by industry by region, the 2009 Input-Output Supply and Use Tables (01 December 2011 release), the regional trade statistics, the population and the labour market statistics as reported by the Office for National Statistics.

More details of the Computable General Equilibrium (CGE) Model are provided in Appendix C.

[8] See https://www.gtap.agecon.purdue.edu/models/current.asp

2.3 Bottom Up Analysis

There are many methods by which the inputs into CGE modelling can be derived. We have adopted a "bottom up" technique based on case studies and market intelligence. The results have been "triangulated" using analysis based on download statistics supplied by Ordnance Survey and publicly available statistics of market size.

Basing the analysis primarily on case studies, drawn from discussion with individual customers, has many advantages. In particular, the information gathered reflects the real world situation, albeit for a sample of organisations. The OS OpenData initiative covers a series of products that were already mostly in existence[9] at the time the decision was taken to make them free at the point of access. It is therefore amenable to this type of analysis.

The analysis focuses on three main components of economic value:

- The costs and cost savings experienced by Ordnance Survey in the provision of free and open access to information (section 6);
- The costs and benefits experienced by the users in accessing and using the products throughout the supply chain (section 7); and
- The wider economic and social (welfare) impacts of the initiative (section 8).

Our experience in this study reflects similar work undertaken in Australia analysing Public Sector Information reuse[10]. To quote directly from that study:

> *"It is always more difficult to identify benefits than costs. Benefits may accrue in a variety of ways, including cost savings, efficiency gains, and new opportunities to create value through doing things in new ways and doing new things.*
>
> *These are, successively, more difficult to quantify: not least because they often emerge over time and can only be realised in the future. An obvious approach is to begin with the most direct and directly measurable benefits, namely agency and user cost savings.*
>
> *Wider benefits are more difficult, and in some cases impossible, to measure."*

For this reason, we have adopted a considered but cautious approach to assigning benefits in all of the above components. In particular, we have not sought to apply the wider social welfare benefits in the CGE model but present them in qualitative terms.

2.4 Evaluation of Changes to the Supply Chain

The OS OpenData initiative changes the supply chain and the value derived from various parts of that chain. There is a considerable body of literature concerning the modelling of the economic effects of information policy. Particularly relevant to developing the discussion of the supply chain effects in relation to OS OpenData is a report titled

[9] Vector Map District is the only product that was newly created for OS OpenData.

[10] Houghton, John; Victoria University (2011) Costs and Benefits of Data Provision: Report to the Australian National Data Service, September 2011. http://ands.org.au/resource/houghton-cost-benefit-study.pdf

"Measuring European Public Sector Information Resources: Final Report of Study on Exploitation of public sector information – benchmarking of EU framework conditions" by Makx Dekkers et al, for the European Union[11]. It is widely known as the Measuring European Public Sector Information Resources (MEPSIR) report.

It identifies the component effects upon the value chain that can be expected from reuse policy changes. These are listed below with comments (in italics) on evidence for each effect found during the study and how they are handled within the CGE model:

1. **Direct price effect**: the costs of purchasing public sector information from the government will decrease. *In our case, this impact is modelled as a reduction in revenue to the Government sector but an increase in profitability for private sector user. This is discussed in more detail in Section 9.*
2. **Downstream price effect**: this lowering of costs is (partly) translated into lowered prices in the successive parts of the chain. *A good example of this effect is the ability of the software supplier to set a lower price point to an entry level package in the housing association case study (section 7.3.6).*
3. **Quantity effect**: re-users will buy more products, due to lowered prices and increased accessibility. *This is exemplified in the increased volumes of data downloads observed from the OS OpenData portal and the "reuse" of budget from OS OpenData products into purchase of additional "paid-for" products*.
4. **Entry effect**: through the disposal of exclusive arrangements, more companies will enter the value chain, at various points. *One example of this effect is the entry of an increasing volume of app developers into the location market (see section 7.3.13) another is the use the OS OpenData products by other data suppliers highlighted in case studies such as the Navigation Data Wholesaler (section 7.3.10).*
5. **Diversification effect**: new and diversified products will be developed and brought to the market. *Use of OS OpenData for route optimisation illustrates this effect. The case study in section 7.3.17 shows diversification in an existing application area to make the technology usable by Small and Medium size Enterprises (SMEs).*
6. **Quality effect**: new entrants will force 'older' suppliers to increase quality. *This is illustrated by the reaction of one of the established vendors to a relatively new entrant, in this case Google, by launching a Data as a Service (DaaS) offering with high quality cartography using the OS OpenData products (see section 7.3.5).*
7. **Elimination effect**: parts of the value chain may disappear since their basis for adding value may be lost. *This effect is best illustrated by reduced revenues for those OS business partners who previously traded on their ability to process or reformat OS OpenData products now obviated by the OS OpenSpace portal which supports download in multiple formats (see section 7.4.1).*

[11] Executive summary of MEPSIR report: http://ec.europa.eu/information_society/policy/psi/docs/pdfs/mepsir/executive_summary.pdf

8. **Competition effect**: the country will increase its competitive strength in relation to other countries, resulting in increased exports. *Anecdotal evidence collected as part of our feasibility study work did identify organisations, such as Infoterra (see section7.6.3), starting to use OS OpenData to demonstrate internationally the potential of their systems. However, we have not attempted to model this effect.*
9. **Income effect**: cash streams of the governmental agencies selling the information will decrease; *In respect to its application in the model, this is the same as direct revenue effect (1 above).*
10. **Revenue effect**: tax revenues will increase under increased economic activities. However, the places where the benefits and losses accrue are different. *The model calculates net taxation effect and also the differences in net gains and losses between sectors (see section 10.2).*

3 Approach

3.1 Overview

In order to address concerns over the timing of the study - it being too soon for the impacts to be observable and to accommodate external review and validate adoption rates, the study has been undertaken in two distinct stages, each with two phases:

Stage 1A: Feasibility Study
The feasibility study report was presented in June 2011. Its main objective was to establish whether there are sufficient sources of robust evidence for the full study to yield meaningful results. The results of the feasibility study suggested that it was of sufficient value to move forward into the second stage of the project and conduct a full study into the value of OS OpenData.

Stage 1B: Independent Assessment
In order to ensure the validity of the approach, Ordnance Survey also commissioned a peer review by two independent economists, Prabhat Vaze and Patricia Seex. This peer review was supportive of the approach taken, whilst making valuable suggestions for enhancement. It is referenced heavily in this report and reproduced in full as Appendix B.

Stage 2A: Full Study Interim Report
This is the interim report on the full study. It builds on the feasibility study and incorporates much of the material acquired during that stage but also includes an investigation of how OS OpenData is being used in a broader variety of sectors.

Stage 2B: Final Report
For the final report, it was envisaged that the findings would be summarised to be accessible to a wider audience and the interim conclusions updated through a process of wider consultation.

3.2 Full study Interim Report

The following activities have been undertaken:

i) **Literature review**. This included looking at economic value studies in relation to Public Sector Information (PSI) reuse from the European Union, United States, Canada, Australia and New Zealand.

ii) **Candidate case study list**. This involved compiling a long list of potential users with strong (potential or actual) business cases for innovative applications and new efficiencies in existing business processes using OS OpenData.

i) **Market sectors identified**. Using previous work undertaken by the consultants to assess the size of the UK location market and based upon segmentation by Standard Industry Classification (SIC)[12].

iii) **Interviews**. The credibility of potential case studies and the strength of the business case were established, usually by one-to-one telephone interviews. Often interviews led to other contacts and ultimately more than 100 individuals were interviewed. The offer of preservation of anonymity proved to be important, as many of the case studies are commercially sensitive.

iv) **Net benefits**. From the interviews we assessed the net benefits for individual organisations and made an initial estimate of the range of values for ultimate size (turnover) for new products and services or efficiencies achieved across the market for the application.

v) **Download Analysis**. The records of downloads of OS OpenData products were analysed for the period from launch (April 2010) to January 2012. The information was used to determine the numbers of individual downloads by market sector. This provided an indication of impacts for sectors known to be significant users of geospatial data but where no suitable case studies could be obtained. The data was also used to assess adoption rates, see (vii) below.

vi) **Adoption Rates**. These were estimated for each application over a five year period (2011-2016). This was based upon download analysis during the period from April 2010 to January 2012 augmented by reference to experience in other similar OpenData and web 2.0 initiatives.

vii) **Impact Calculation**. The resulting impacts to the sectors or sub-sectors to which the case studies related, were calculated. Where relevant and feasible, this included evaluating "knock-on" effects upon subsequent parts of the value chain.

ii) **CGE Modelling**. These impacts (shocks) formed input to the Tasman Global CGE model, which was customised to aggregate England, Wales and Scotland into a single Great Britain entity.

iii) **Economic Assessment**. Outputs from the model have been interpreted by ACIL Tasman economists and expressed as tables of productivity and other economic indicators, which together represent value to the economy.

iv) **Report**. Present and write up the full study, including recommendations regarding how to stimulate the uptake of OS OpenData.

3.3 Structure

The remainder of the report is structured as follows:

Section 4: considers the independent economic analysis into the methodology and how the recommendations of that report have been incorporated;

[12] Standard Industry Classification (SIC) – is the standard method used by the Office for National Statistics (ONS) for classifying industrial activities into a common structure.

Section 5: presents a review of selected recent papers which have addressed the economic benefits of the OS OpenData initiative and the wider issues of public sector information reuse;

Section 6: assesses the economic impact on Ordnance Survey, consequent effect upon existing customers and UK export income;

Section 7: describes case studies, analysis of download statistics and other evidence of use of OS OpenData collected during the study;

Section 8: consider the wider welfare benefits;

Section 9: explains how the evidence was used to create the impacts used as input to the CGE model;

Section 10: presents the results of the CGE modelling;

Section 11: draws conclusions from the study;

Section 12: makes recommendations regarding optimisation of the economic and social benefits that GB might realise from the OS OpenData initiative.

There are also a number of Appendices which provide more detail on various aspects of the study.

4 Independent Economic Review

The feasibility study was reviewed by two independent economic consultants, Prabhat Vaze and Patricia Seex. Both are members of the Advisory Panel on Public Sector Information (APPSI) and have considerable experience in the information sector. Their brief was to comment on the methodology adopted for the study in order to provide a view to Ordnance Survey as to its validity. In addition, they were encouraged to make recommendations with regard to improvements that might be made in the full study. Their report is reproduced in full in Appendix B.

In this section we reflect on the recommendations and how these have been addressed within the full study. The bold sections paraphrase relevant extracts from the report, whilst the italicised text that follows describes our response.

4.1 Survey Work

4.1.1 Case Study Approach

The "bottom up" approach of identifying case studies from organisations using OS OpenData to change their processes or drive new sales, is recognised as conservative. "The approach taken therefore seems cautious and not one that would over-state impacts."

The team's concern has constantly been not to over-estimate the value of the OS OpenData policy intervention, as this has been the root cause of many previous studies having been criticised. Based on this endorsement, many of the case studies from the feasibility study have therefore been carried forward into this report.

4.1.2 Analytical Consultancies

The report suggests further engagement with the analytical consultancies that provide services to businesses, such as Experian[13]. This was to ensure the effect on medium size firms who rely upon CACI or Experian is taken into account. Related to this was to establish any changes in spending on analytical services due to OS OpenData to establish whether firms maybe substituting or outsourcing resources.

In response, we did attempt to interview both of the major players cited above. In one case without success in terms of financial evaluation but in the other case, we were able to get an economic assessment, albeit non-attributable. This is included in the case studies.

With regard to changes in spending patterns, we found two effects. A number of large retailers were increasing the size of their analytics team with geospatial analysis being at the heart of their strategy. Medium-sized retailers interviewed who were reliant upon the products of the analytical consultancies were, in at least one case, unaware of the range of

[13] Experian are referenced in the autumn statement on OpenData measures: http://www.cabinetoffice.gov.uk/resource-library/open-data-measures-autumn-statement-2011

data available under OS OpenData and in another case were unable to evaluate OS OpenData because they could not load it into their system.

4.1.3 Price Discrimination[14]

The review suggests the full study looks for direct evidence on the price discrimination aspects of PSI in the surveys. Were businesses better able to target their purchase of premium products through their experience of the OpenData?

The case studies detailed in Section 6 *contain examples of price discrimination in services offering the embedding of OS OpenData, particularly we would draw attention to:*

> *The* [redacted] *uses the functionality of their smartphone app to apply price discrimination. The smartphone only supports view-only access to geological data. If the user wishes to download the same data in order to combine it with other sources or perform analysis, then they have to purchase the data.*
>
> *The Data as a Service (DaaS) case study shows how OS OpenData is being used as part of a freemium model. Access to all OS OpenData layers is provided free under a fair use policy without any guarantee on service availability. The premium service which is charged for on a subscription basis provides unlimited use and agreed service levels.*

4.1.4 Data Warehouse Businesses

The review considered that, "[redacted]**and other large-scale data warehouse businesses should be interviewed more carefully ..... such businesses were both innovative in how they commercialised data and were multinationals, much more able to import and export intellectual property and other assets associated with making PSI use more productive".**

In order to address this point, we have included material from our interview with [redacted]*. Although they were not willing to talk about the financial value of OS OpenData, they were quite open about their use of Code-Point Open, Boundary-Line and OS Street View to enhance their databases. Another* [redacted] *company has also provided a case study (section 7.3.10) based on their use of OS OpenData to enhance their databases.*

With respect to commercialising data, we estimate that for every smartphone app directly using OS OpenData there are about 20 using Google maps. In discussion with the developers of the applications, the reasons for choosing Google are usually related to:

> *Awareness – many were not aware of OS OpenSpace and OS OpenData when they started development;*

[14] Definition (Investopedia): A pricing strategy that charges customers different prices for the same product or service. In pure price discrimination, the seller will charge each customer the maximum price that he or she is willing to pay. In more common forms of price discrimination, the seller places customers in groups based on certain attributes and charges each group a different price.

Simplicity – the Google maps API is easy to use and provided sufficient information for the application;

Functionality - Google has significant "value-added" capabilities including spatial analysis and routing;

Global coverage – for application developers requiring coverage beyond GB, the coverage of Google, including imagery and other content, meant developing a single map interface which can be used in all countries, wherever the user was located.

4.2 Modelling Approach

4.2.1 Grossing up to provide sector level estimates

The assessment recommends that the authors are more explicit about how these estimates are arrived at and include a sensitivity analysis on these assumptions or provide ranges for the sector level and total economic impacts based on different assumptions.

The assumptions on which the grossing up of figures for each sector are based were explicitly stated within the spreadsheet calculations used to drive the CGE model. It was an oversight that they were not supplied to the reviewers. However, in this report the assumptions are explicitly stated by sector.

4.2.2 CGE modelling using the GTAP model

The assessment suggests there needs to be more evidence about the suitability of GTAP in PSI shocks. Perhaps an annex offering a summary of the recent work in this area and any issues or benefits established in the use of the modelling framework in PSI shocks.

This is addressed in the Conclusions in Section 11 and in Appendices C *and* D.

4.2.3 Comparison with Cambridge Study

The assessment states that, "To some extent, the approach improves on the Pollock work and it would be sensible to ask those researchers to comment on where this work does add to theirs".

This is addressed in Appendix D: Assessing economic impacts *and sub-sections 11.2 and 11.3 of the conclusions.*

4.3 Conclusion

The review concludes that CGE modelling is an appropriate method for valuing the contribution of OS OpenData to the economy of Great Britain and commends Ordnance Survey for commissioning the study and that the final report will make a useful contribution to the literature and our understanding of the economics of OpenData policies in the UK.

5 Literature review

5.1 Introduction

This section looks at the more important papers relevant to this study. To provide a summary of current thinking in respect of pricing and policy related to public sector data reuse.

5.2 Pricing Policies

There is extensive economic literature on pricing policies for public sector information and their implications for economic welfare and equity. The central concern of economists is the impact of different pricing policies on maximising economic welfare.

5.2.1 Cambridge Study[15]

Although there is growing literature on measuring the value of public sector information only a limited number of papers focus on the economic value of different pricing policies for the distribution of geospatial information.

An important contribution to the task of estimating the economic benefits of pricing policies for government information was undertaken in 2008 by Rufus Pollock, Meade Fellow in Economics at Emmanuel College, Cambridge University.

The study uses welfare analysis which, being based on a partial equilibrium analysis, assumes in the first instance that other sectors of the economy are unchanged by the pricing policy changes being assessed. It addresses the limitations of a partial equilibrium analysis by applying a multiplier to the results and it deals with the time delay by applying a discount factor to allow for delay in delivery of the results.

The economic principles behind this approach are robust and the paper represents an important contribution to estimating the economic value of public sector information. However there are limitations to the use of welfare analysis that must be based in each case on the demand and supply characteristics of single products. The shape of the demand curve is critical to measurement of the welfare effects. The choice of a linear demand curve, as in the Cambridge study, implies that the elasticity of demand decreases as the price is lowered as one moves down the demand curve.

To address this, the analysis develops estimates of elasticities of demand between different price policies drawn from the experience of agencies. While the study defines the elasticity of demand as that at the average cost pricing policy, the study estimates an average elasticity of demand for movements between different pricing regimes. This is necessary for the purposes of working with a linear demand model but the welfare effects could be different if the demand curve is not linear.

[15] Pollock, Rufus; Meade Fellow in Economics, Emmanuel College (2208) Models of Public Sector Information Provision via Trading Funds, Cambridge University, February 2008

Partial equilibrium analysis also assumes that resource allocation in the rest of the economy does not change. It is noted in the report that geospatial information is used in many sectors of the economy and there are potentially significant spill-overs into multiple sectors.

Pollock deals with this problem by applying a multiplier to the results. However this means that the results are based on assumptions for which there is limited data available.

The analysis focused on two product offerings – Large Scale Topographic and Transport Network Products. Consistent with the partial analysis approach, it was assumed that the pricing of other products remained unchanged. With the broader approach to making OS OpenData free, this assumption is no longer valid. The study therefore cannot, without some adjustment, account for interactions between Ordnance Survey products and the dynamic effects associated with the interactions between products and users.

The Cambridge study uses a discount factor to account for delay in delivery of the benefits. Encapsulating the dynamic effects into the static analysis by necessity required a simplification of complex processes of adoption and as well as delivery of economic benefits to other sectors of the economy. Important underlying changes in adoption may be missed in the use of a discount factor and multiplier.

These comments do not imply that the methodology is inappropriate for the purpose. Rather it demonstrates the importance of the assumptions underlying the analysis and the difficulty in isolating the underlying economic data that supports the assumptions.

5.2.2 Oxera Study[16]

Oxford Economic Associates Ltd prepared its report on the economic contribution of Ordnance Survey GB in 1999. This report was not required to address the economic impact of a change in pricing policy as was required in for the Cambridge Study and for this study. Rather its terms of reference were to estimate the economic contribution to the national economy of the organisation's products and services.

The report provides an excellent discussion of the nature of the products and services of Ordnance Survey canvassing their quasi-public good nature and the extent of monopoly characteristics. It argues that its preferred approach would have been a willingness to pay analysis. It then concludes that a full willingness to pay study, based on surveys, would be time-consuming and difficult to accomplish without bias.

The report first examines the social gains resulting from the use of Ordnance Survey products concluding that they are an integral part of national life in Great Britain.

It then undertakes a high level value added approach to estimating the economic contribution of Ordnance Survey by examining the sectors where it is known that Ordnance Survey's data and products are used. For each sector the analysis:

- determines the Gross Value Added of the sector;
- estimates the proportion of production that is dependent on OS data and services;

[16] Oxford Economic Associates Ltd: The Economic Contribution of Ordnance Survey GB, 24 September 1999.

- uses this proportion to estimate the value-added that can be assumed to be dependent on Ordnance Surveys products.

The results are then added to provide a total value added across these sectors judged dependent on Ordnance Surveys products; arriving at an estimate that Ordnance Survey products contribute 12 to 20 per cent of gross value added mainly from outputs from other parts of the economy (£79 billion to £136 billion in gross value added).

This, as the Oxera authors acknowledge, is an inferior approach to a willingness to pay analysis. It is important to note that the numbers calculated bear no relation to the economic impact of changes in pricing or other policies. While the findings are based on a value added analysis, it is a fundamentally different approach to the use of a Computable General Equilibrium Model to compare the difference between macroeconomic outcomes for two different policy scenarios that has been applied in this study.

5.2.3 ANZLIC[17]

PriceWaterhouseCoopers (PWC) undertook an analysis of the economic impacts of different pricing policies for the Australian and New Zealand Land Information Council (ANZLIC). This report used the same willingness to pay framework as the Cambridge report. However it extended the analysis to include dynamic modelling of changes in competition and innovation over time on dynamic efficiency aspects.

The analysis focused on four topographic data products to develop estimates of elasticity of demand which were incorporated into equations that enabled the analysts to model the outcomes over time.

The policy changes modelled were:

- from full cost recovery to marginal cost pricing (or free online);
- from full cost recovery to price discrimination (commercial versus non-commercial);
- from price discrimination to marginal cost pricing (or free online).

The analysis is comprehensive and notes limitations associated with estimating demand curves, linearity and estimating elasticities. It calculates average elasticities from two points on a demand curve that is assumed to be linear but also analyses the consequences if the demand curve is not linear (an isoelastic curve where the elasticity of demand is constant).

The report concludes from the analysis that:

> *"Except in cases of low elasticity of demand (which is atypical), the free fundamental data model generally delivers the greatest social welfare at a point in time. This is the case even where the lowest possible multiplier of one is applied."*

It also observes:

> *"Given these limitations, the results of welfare analysis should not be viewed as conclusive. Rather, the welfare analysis serves as an indication of the implications of different pricing and access models, with this being one of a range of relevant factors for an agency to consider."*

[17] ANZLIC (2010) Economic Assessment of Spatial Information Pricing and Access, October 2010

One aspect of the report's conclusions is perhaps a little confusing. It interprets government revenue as agency rather than revenue from overall taxes and charges. This leads to a conclusion that government revenue is not maximised when economic welfare is maximised. This is an unlikely outcome if economic welfare is measured by economic surplus.

With this one comment, the ANZLIC report further extends the analysis of the Cambridge study to explore dynamic effects. The report's authors however also note that welfare analysis based on four product lines is limited when assessing the overall implications of policy change across the total geospatial products and services of Government.

5.3 Public Sector Information (PSI) Reuse

5.3.1 The Power of Information[18]

Evidence suggests that PSI plays an increasingly important role in knowledge-based economies. This report was probably the most important, in the UK context, in setting out the arguments supporting this position. Written by Ed Mayo and Tom Steinberg for the Labour Government in 2007, the report argues that UK government should grasp the opportunities that are emerging in terms of the creation, consumption and re-use of information. Current government policy and action was not yet adequate to grasp these opportunities.

The report recommends a strategy in which government:

- welcomes and engages with users and operators of user-generated sites in pursuit of common social and economic objectives;
- supplies innovators that are re-using government-held information with the information they need, when they need it, in a way that maximises the long-term benefits for all citizens; and
- protects the public interest by preparing citizens for a world of plentiful (and sometimes unreliable) information, and helps excluded groups take advantage.

The review made practical recommendations in line with this strategy. These were designed to achieve a step change in the way that government acts in relation to public information and user-generated websites.

It was the main catalyst for the work of Tim Berners-Lee and Nigel Shadbolt referred to as *Making Public Data Public*, which led to the OS OpenData initiative.

[18] http://www.opsi.gov.uk/advice/poi/power-of-information-review.pdf

5.3.2 MEPSIR study: Measuring European Public Sector Information Resources[19]

Based on a large survey of PSI producers and users, the study sought to estimate the size of the PSI market in the member states (as in 2006) plus Norway. The findings of the study clearly indicate that there still existed at that time considerable gap between the reuse sought by the European Union PSI reuse directive and the reality on the ground. However, it predicted the directive would have its effect on the economic performance in the value chain soon. Furthermore, it suggested that increased equality of re-use conditions would result in the entrance of new market players, increased innovation and more competition, bringing benefits to companies and citizens throughout Europe. Based on these assumptions it estimated the overall market for PSI in the EU plus Norway at around €27 billion (approximately 0.25% of aggregated GDP).

The value of this study, we believe, is less to do with the absolute number stated for the value of reuse but the way in which it decomposed the value chain resulting from making PSI free, which we have already referenced in section 2.4.

5.3.3 Pricing Of Public Sector Information Study (POPSIS) [20]

This study published in 2011, assessed the different models of supply and charging for public sector information (PSI) and their effects through the analysis of 21 case studies. The study also produced a snapshot of the smartphone applications market based on PSI and a comparative analysis of several OpenData portals in Europe and beyond.

The conclusions of the case studies show a clear trend towards lowering charges or facilitating re-use or doing both. The costs resulting from lowering charges appear to increase very little, and may eventually decrease if the volumes of re-use grow significantly. Once re-use facilitation processes (such as web services) are properly organised, they become embedded in the provider's activities without incurring significant extra cost.

Mobile Apps present an interesting market opportunity because customers are more willing to pay for them than for web services. Even if the most popular apps today are generally games, PSI is used as the basis for a sizeable proportion of apps, especially weather, travel and transport applications. While most PSI-based apps are free, developers expect there to be more revenue opportunities that emerge from apps that integrate different data sources, more value added datasets and datasets which provide real-time data.

A comparative analysis of several OpenData portals concluded that they appear to offer an important step in pushing forward the OpenData agenda and delivering its policy impact. Although, their direct short term economic effects have been limited so far, the indirect effects are more significant, stimulating creativity and innovation and paving the way to unanticipated value creation.

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[19] Dekkers, Mark *et al* (2006) Measuring European Public Sector Information Resources (MEPSIR), European Commission, 2006.
http://ec.europa.eu/information_society/policy/psi/docs/pdfs/mepsir/executive_summary.pdf

[20] Vries ,Mark de *et al* (2011) Pricing of Public Sector Information Study (POPSIS), , European Commission
http://ec.europa.eu/information_society/policy/psi/docs/pdfs/report/11_2012/models.pdf

5.3.4 Vickery study: Review of recent studies on PSI re-use and related market developments[21]

This study was sponsored by the European Commission in the context of the forthcoming review of the PSI Directive and seeks to update the figure of the potential market value of PSI re-use in Europe. There is no new research included but it reviews the majority of recent work undertaken in the field. It suggests that although care needs to be taken with existing estimates as they are based on a range of sources using different methodologies, overall economic gains from opening up PSI and providing easy access for free or marginal cost of distribution could be up to € 40 billion for the member states.

5.3.5 Strasbourg Study: The reuse of public sector information: an economic optimal pricing model[22]

Unfortunately, only the executive summary is available in English. The report, however, finds that an over simplified approach is assumed by many studies which regard all public sector information as unprocessed raw data, whereas much is highly processed information. It uses a data, information and knowledge approach to classifying PSI and show that various levels of value are added by the producers.

It suggests that charging a price based on "willingness to pay" may be a more sustainable model particularly in circumstances where budgets for agencies producing the information are restricted. Provided the price is set at a level lower than the user's willingness to pay then reuse will not be restricted. Variable pricing based on generic type of activity for which the data is used is suggested as optimal for commercial users.

5.3.6 Houghton Study: Costs and benefits of Data Provision (Australia)[23]

The report was commissioned by the Australian Federal Government and written by John Houghton from the Centre for Strategic Economic Studies at the University of Victoria. It presents case studies exploring the costs and benefits that PSI producing agencies and their users experience in making information freely available. It also makes preliminary estimates of the wider economic impacts of open access to PSI. In doing so, it outlines a possible method for cost-benefit analysis at the agency level, not unlike we have adopted for this

[21] Vickery, Graham (2011) Review of recent studies on PSI re-use and related market developments, , Information Economics for European Commission. http://ec.europa.eu/information_society/policy/psi/facilitating_reuse/economic_analysis/index_en.htm

[22] Penin, Julien *et al* (2011) The reuse of public sector information: an economic optimal pricing model, Bureau of Theoretical and Applied Economics, University of Strasbourg, http://www.primet.org/file/Oslo%20Declaration%20and%20other%20Reports/PSI%20Pricing-%20Exec%20Summary%20French%20report_BETA_EN.PDF

[23] Houghton, John; Victoria University (2011) Costs and Benefits of Data Provision: Report to the Australian National Data Service. http://ands.org.au/resource/houghton-cost-benefit-study.pdf

study. It also explores the data requirements for such an analysis – recognising that few agencies will have all of the data required.

Significant is the excellent explanation of many of the key economic issues in a manner that is intelligible to the non-economist. It is also particularly relevant since one of the primary case studies it examines is the Geoscience Australia's OpenData initiative. It uses the impacts of the observed increases in use, as indicated by trends in downloads delivered through the period of change from charged to free (2001-02 to 2005-06) to calculate average social returns to annual expenditure on data collection. This suggests an increase in social returns (benefits) of some AU$15 million and benefits may be around 13 times the costs in terms of revenue foregone.

5.3.7 Summary

These studies show that in varying degrees that the economic benefits of data reuse exceed the loss of government revenue. Therefore the business case for OpenData would appear to be clear. However, what is not evaluated is the effect of a gradual degrading of public sector information if governments do not continue to fund its maintenance and upgrade to reflect users' needs. On this particular point, the Strasbourg study gives a good explanation of alternative, so called "second best" approaches.

We return to a number of these issues in the Conclusions in Section 11.

6 Economic Impact on Ordnance Survey

6.1 Introduction

The economic analysis in this study tests the impact of the change in policy with respect to the provision, as OpenData, of a component of the data services provided by OS. For the purpose of discussion we are referring to the new arrangements as 'the reference case' and the former arrangement as 'the counterfactual'. The counterfactual reflects the situation that would have occurred had there not been the policy change to make OS OpenData available free of charge.

The CGE modelling is used to assess the net economic impact in 2016 of the difference between the reference case and the counterfactual. There are two direct impacts that need to be considered in developing the impacts (shocks) to compare the economic impact of the two scenarios:

- the economic impact of the income shifts for users and for the Government;
- the productivity impacts for the users of greater use of OS OpenData.

In this section we consider the effect of the Ordnance Survey payment under contract (administered by the Department of Communities and Local Government (CLG) and referred to in the text as the CLG contract) to compensate for the net loss of revenue and other effects attributed to the OS OpenData initiative[24].

At this point, we should note that the CLG contract is taken as a matter of fact. We are not in a position to comment on the level of the funding, nor the split of revenues between public and private sectors.

[24] Compensation breakdown analysis supplied to ConsultingWhere by OS on 16th June 2011, with update on overseas seepage on 2nd April 2012

6.2 Impact of Income Shifts

The CLG contract compensation represents a shift in the source of income to OS. The main differences between the reference case and counterfactual in the first instance are therefore as follows:

- Counterfactual
  - Users pay a fee for OS OpenData products and services to OS;
  - Revenue estimated to be £ 5.3 million per annum[25].
- Reference case
  - Users pay no fee for access to OS OpenData products;
  - OS receives payment of £20 million per annum under the contract. This is compensation for direct loss of revenue above, but also to cover substitution and competition effects plus a fee for running a distribution service and royalties payable to Royal Mail for use of data embedded in OS OpenData products.

[redacted]

[redacted]

6.2.1 Public and Private Sector Apportionment

Using Table 1, the public sector total is valued at [redacted] per annum. The private sector total is calculated by adding commercial [redacted] and consumer[27] (£4.904 million) categories and equates to [redacted] per annum. The service charge and Royal Mail components are undifferentiated in terms of public and private sectors.

The apportionment of the overall contract between public and private sector in percentage terms is therefore calculated to be:

Public sector	[redacted]	[redacted]
Private sector (commercial + consumer)	[redacted]	[redacted]

This split is used in determining the impacts to be applied to the undifferentiated components i.e. the service charge and Royal Mail royalties.

6.2.2 Direct Revenue Loss

For the purpose of calculating the shocks in the CGE model, the impact of removing charges for purchasing OS OpenData is a positive shock for users as it increases their net income and a negative shock for Ordnance Survey and its resellers as they lose this revenue.

£2.731 million per annum of the direct revenue impact is loss of sales to public sector customers. This is treated as a transfer payment within one sector of the economy. The positive shock to public sector users cancels out the negative shock to Ordnance Survey as both are within the public administration and defence sector[28] in the CGE model.

It is necessary to introduce positive shocks for the private sector's use of Ordnance Survey data which, by adding direct commercial revenue of [redacted] and direct consumer revenue of [redacted], equates to [redacted] per annum. This represents revenue previously received that, following the introduction of OS OpenData, is now transferred to the private sector. There is a negative shock of the same amount to the government sector.

6.2.3 Substitution

We understand that substitution represents the loss of revenue that OS predicts it is already suffering, or will suffer in the future, due to customers electing to licence products available free-at-point-of-use rather than products for which they would be required to pay a fee. Within the public sector this is estimated by OS to be worth [redacted] per annum. Using the principle explained in section 6.2.2, this is a transfer within the public sector with a neutral impact in CGE modelling terms and so no shock is applied.

The positive shock to the private sector and balancing negative shock to the public sector is calculated by adding the commercial sector value [redacted] to the

[27] Consumer is assumed to be private sector, since the revenues under this category are derived from commercial B2C activities by organisations such as Google.

[28] As a more detailed breakdown is not available, public administration and defence sector carried all public sector impacts. The other public sectors categories in the SIC (health and education) are not shocked.

consumer sector value [redacted] giving a total of [redacted] per annum.

6.2.4 Competition

This we understand represents loss of sales of paid for products resulting from other organisations selling alternative products made possible by these third parties embedding OS OpenData products.

Again using the principle established in section [redacted] is a transfer within the public sector and [redacted] is a positive shock to the private sector and balancing negative shock to Government.

6.2.5 Service Charge

A fee of [redacted] is paid in respect of services, described as the cost of online services and hard media fulfilment to enable public access to products. We understand this comprises three components:

i) Avoidable costs of services which are an element of existing cost-base which OS would no longer incur in the long-run if services cease;

ii) Incremental supply costs - additional costs incurred by OS as a result of making products free (e.g. maintaining web portal, etc);

iii) Transition costs - one off direct and opportunity costs as a result of making products free (e.g. development of portal, legal fees, senior staff time)

As the charge is not differentiated between public and private sector, the apportionment approach between public and private sector described in section 6.2.1 is used in this instance. [redacted] is treated as public sector [redacted] and cost-neutral. [redacted] is a negative shock to Government. As this is a new cost, there is no positive impact on the private sector.

6.2.6 Royal Mail Royalties

Some OS OpenData products, most notably Code-Point Open contains embedded elements of Royal Mail data. In order that Royal Mail revenues are not prejudiced by the initiative, we understand that a payment of [redacted] was agreed.

Assuming, in the absence of other evidence, that the public to private proportions reflect the calculation in section 6.2.1, then the public sector transfer is [redacted] and private sector positive shock is [redacted] with balancing negative shock to Government.

6.2.7 Export Impact

A negative shock, referred to elsewhere in the report as overseas seepage, needs to be applied to exports to account for some revenues previously received being from companies

operating in other countries[29] for tax purposes as determined by their status as zero VAT registered. The cost to the economy is estimated by Ordnance Survey as an average of [redacted] over the period. This is composed of [redacted] in direct sales and [redacted] in substitution[30].

These fees are income earned from exports and are negative shocks to the UK government sector and positive shocks to the rest of the world in the model. Tasman Global CGE is a global model and it would be possible to provide a positive shock to the rest of the world. This might feed back as a positive growth in demand for other products exported from the UK. However this is a subtlety that is beyond the scope of the project and has not been modelled. The loss of exports is therefore only recorded as a negative shock to the UK government sector.

It is necessary to avoid "double counting" effects in the modelling. The direct sales and substitution impacts for the private sector have therefore been reduced commensurately.

6.2.8 Summary

Based on the foregoing discussion, we have applied impacts to the CGE model in respect to the CLG contract payments, as summarised Table 2 overleaf.

[29] It should noted that not all revenue will be reported abroad as work is undertaken on the OpenData in GB to make it suitable for use within their products. However, in the absence of evidence to the contrary, this approach is the best available.

[redacted]

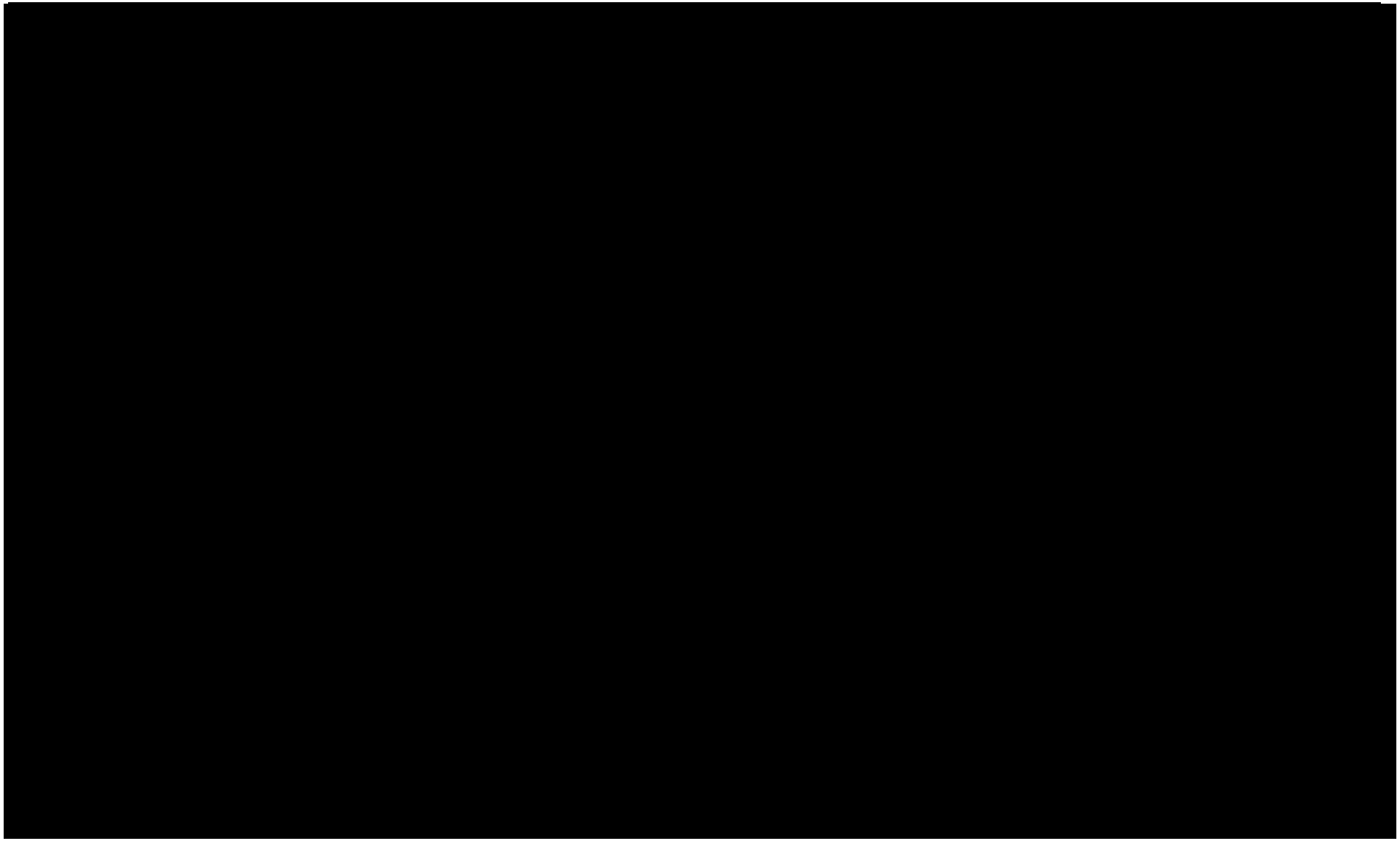


Table 2: Calculation of Impacts of the CLG Contract

7 Economic Impact on Users

7.1 Introduction

In this section we consider the economic impact upon the sectors of the economy that are the most significant consumers (or potential consumers) of the products covered by the OS OpenData initiative. The study has focused on the commercial and third sectors. This has been a deliberate decision to avoid confusing the effects of OS OpenData with those related to the Public Sector Mapping Agreement (PSMA). In the few cases where research is derived from public sector organisations it relates specifically to OS OpenData products only.

The following sections discuss in turn:

Case study overview – an outline of the techniques used and some introductory remarks regarding the outcomes;

Sector-specific case studies – examples of organisations making use of OS OpenData to either improve the efficiency of existing processes, improve sales or create new products or services;

Cross-sector case studies – these cover efficiencies and negative effects that are not limited to a single or small group of sectors of the economy but have a wider effect;

Download analysis – an extensive analysis has been undertaken of download records for the period between the OS OpenData launch in April 2010 and January 2012. These have been used to fill gaps in important sectors where no suitable case studies could be found;

Other evidence – during the course of the interview activities, a number of significant qualitative observations were recorded that provide additional insight.

7.2 Case study overview

The case studies are the result of interviews, mostly conducted by telephone, with nearly 100 individuals between March 2011 and February 2012. Case studies were written up and sent to the interviewees to check the veracity of the assumptions. It should be noted that it has not proved possible in all cases to get responses to these requests.

As expected, no single "killer app" is identified, but a whole series of incremental benefits across a wide range of sectors of the economy. They cover a mix of efficiencies realised by existing users and innovations. The efficiencies are more prominent than completely original innovations. However, this is to be expected since the initiative is less than two years old and some of the most significant innovations are only now being released. Furthermore, the efficiency gains are found in existing customer organisations where the products are already in use, so the "friction" associated with implementation is low.

Some significant cross-sector benefits are also identified, particularly significant being route optimisation for medium-size organisations. However, the biggest single area of cross-sector benefit is the reduction in administration and "policing" of OS OpenData products and services that the Open Government licence[31] brings. Negative impacts, from the experience of some value added resellers of OS data, are also included.

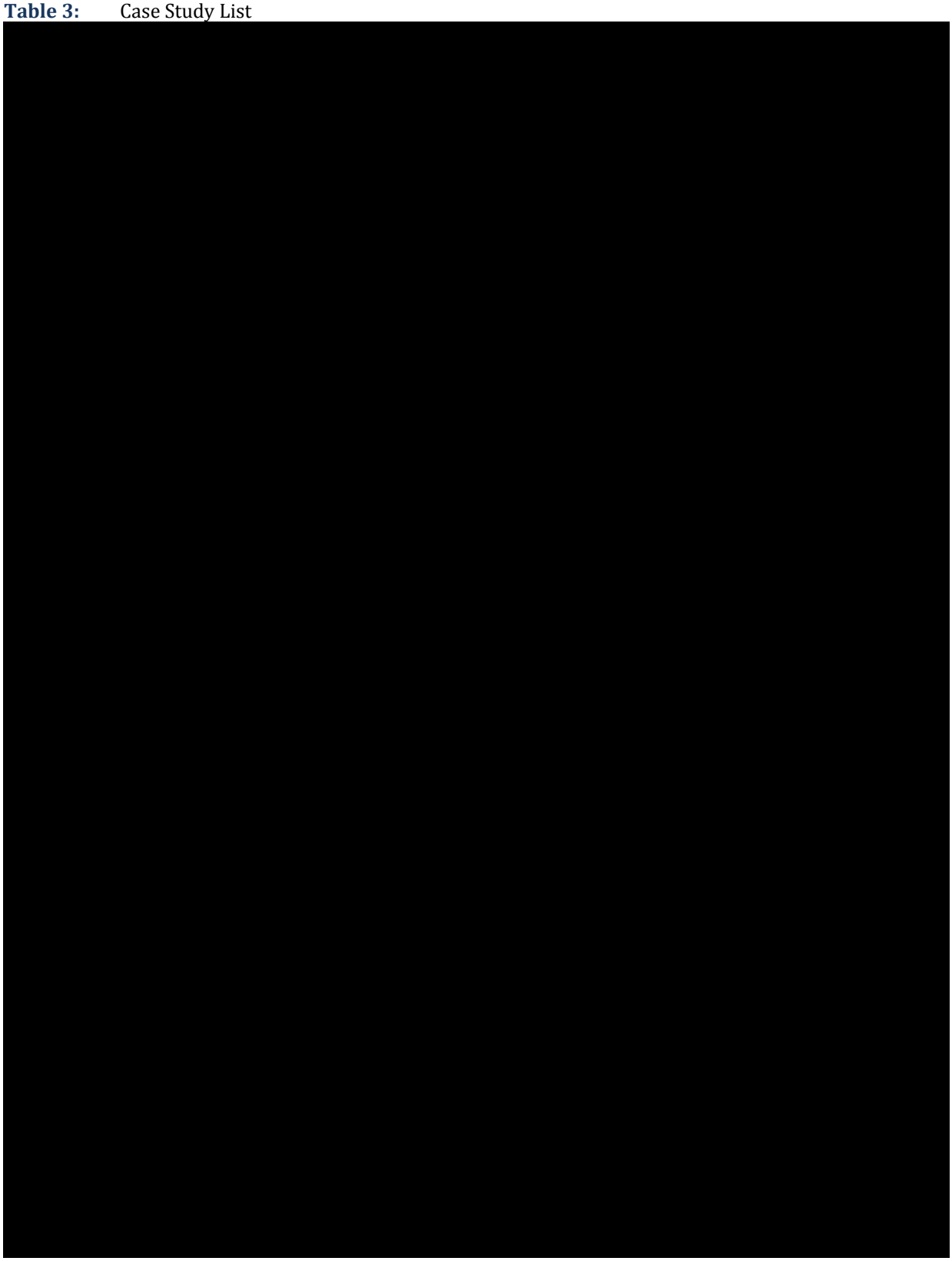
Only a proportion of the case studies identified are covered in detail in the report. Some of those not included provided validation of an included case study but in many cases there was insufficient financial evidence to backup qualitative statements pointing to often significant benefits.

The case study material included in the report is, in many cases, highly commercially sensitive. ConsultingWhere Limited and ACIL Tasman have given assurances to these organisations regarding confidentiality. For this reason the names of the organisations are often omitted. However, it may still be possible for readers to identify the organisations by inference. It is particularly important therefore that none of this information is shared outside the OS and its Government partners without the express permission of ConsultingWhere Limited and the organisations who have supplied such information.

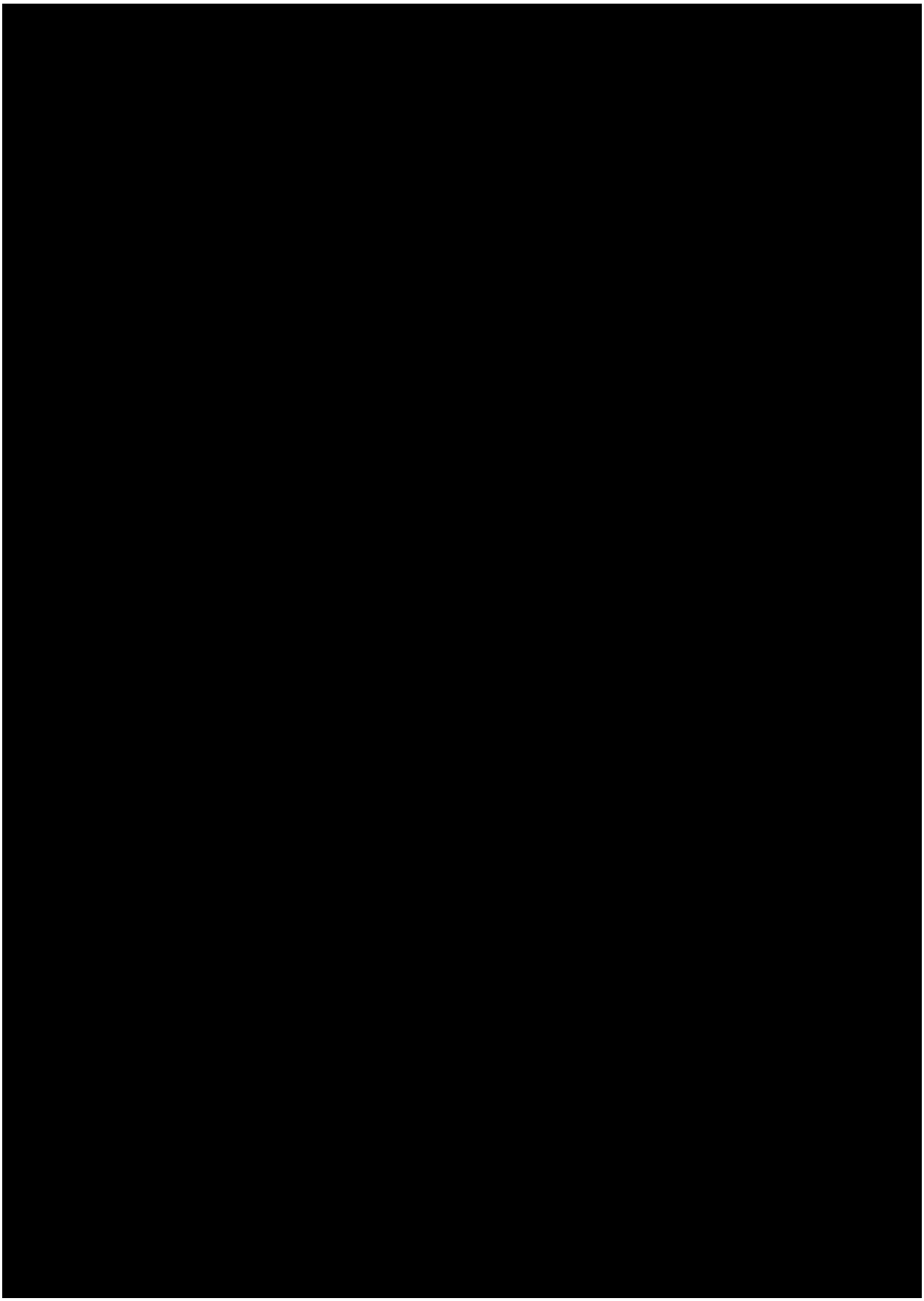
A brief name and description of those case studies included in the economic analysis are given below in Table 3.

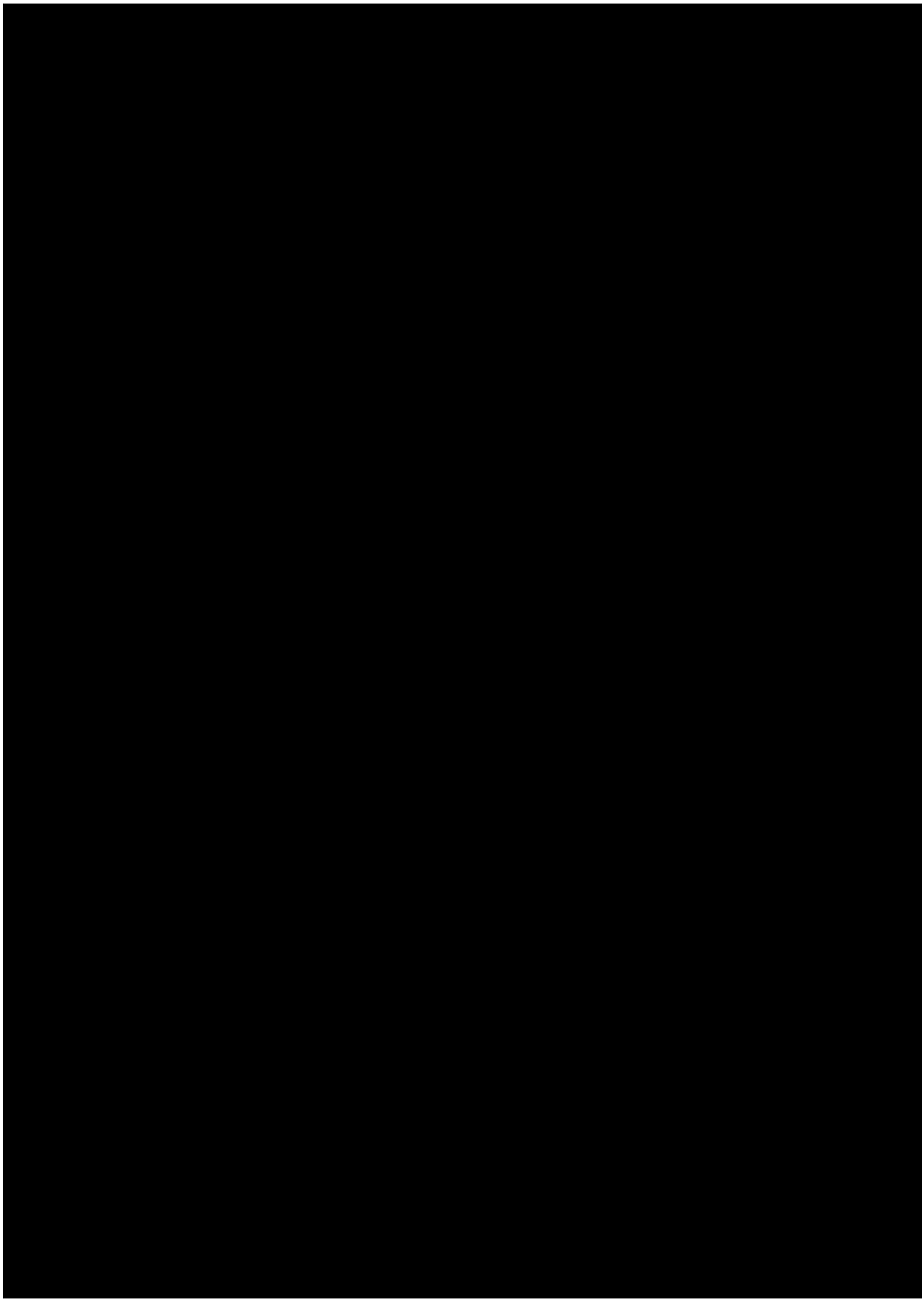
[31] http://www.ordnancesurvey.co.uk/oswebsite/opendata/docs/os-opendata-licence.pdf

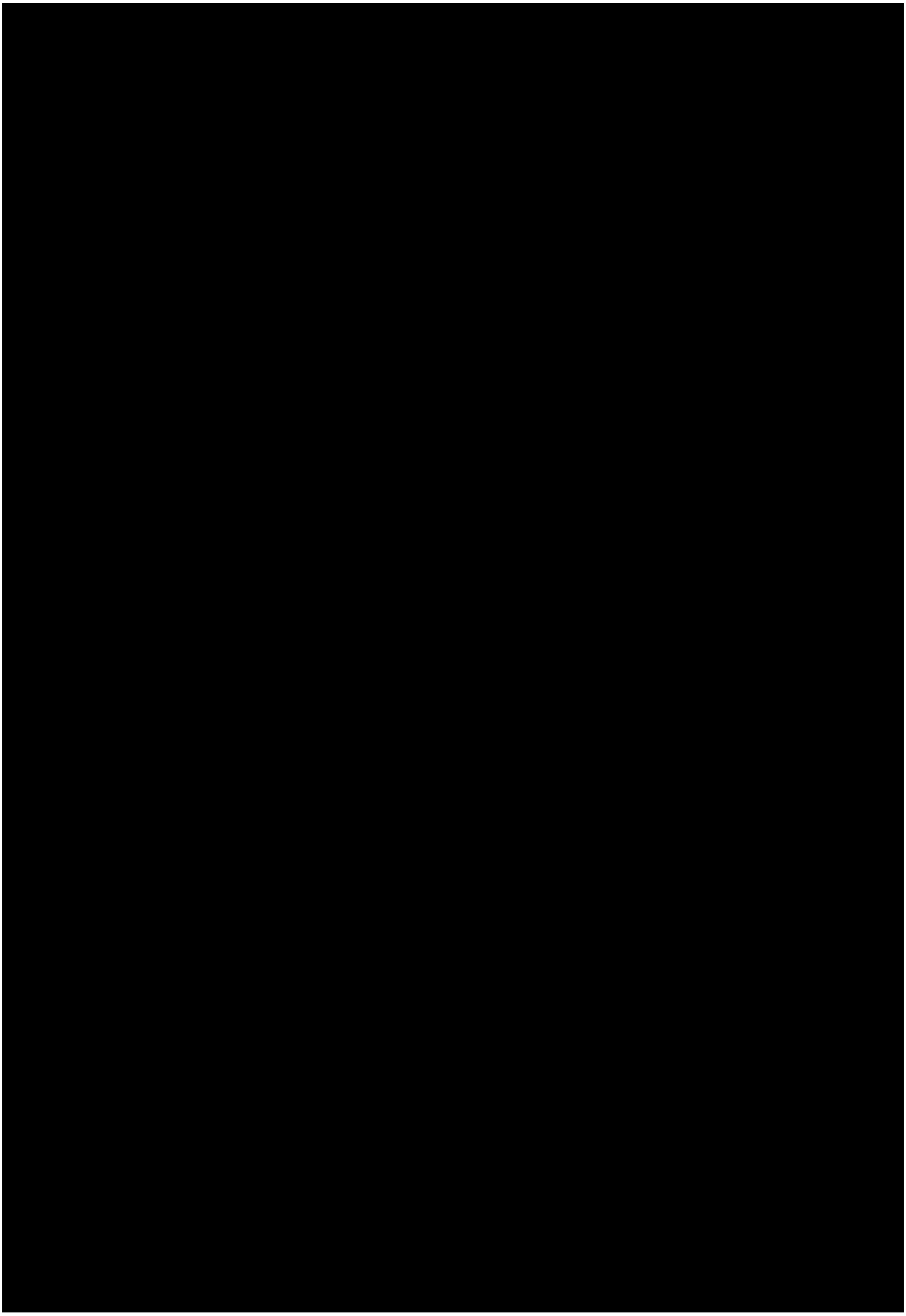
Table 3: Case Study List

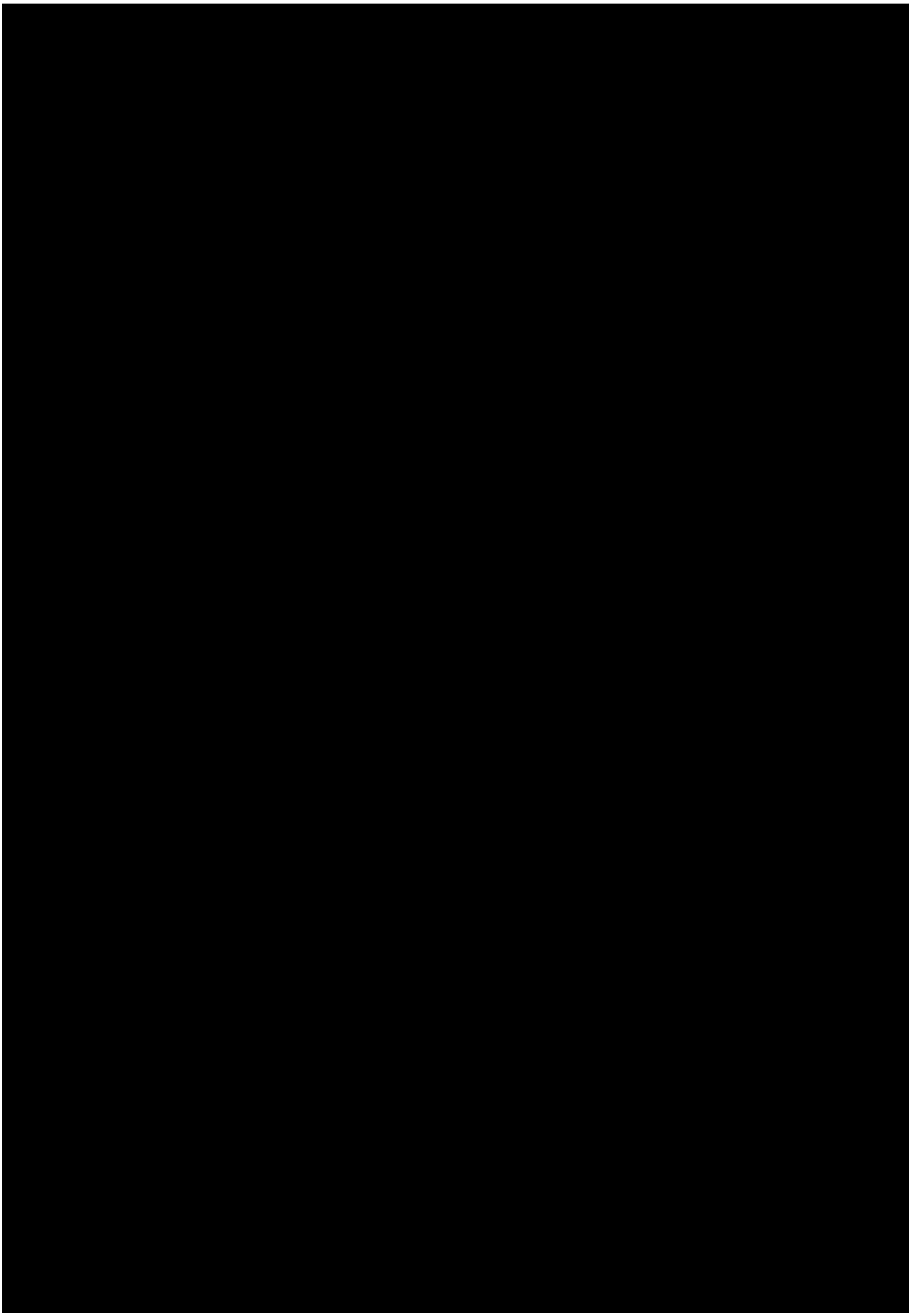


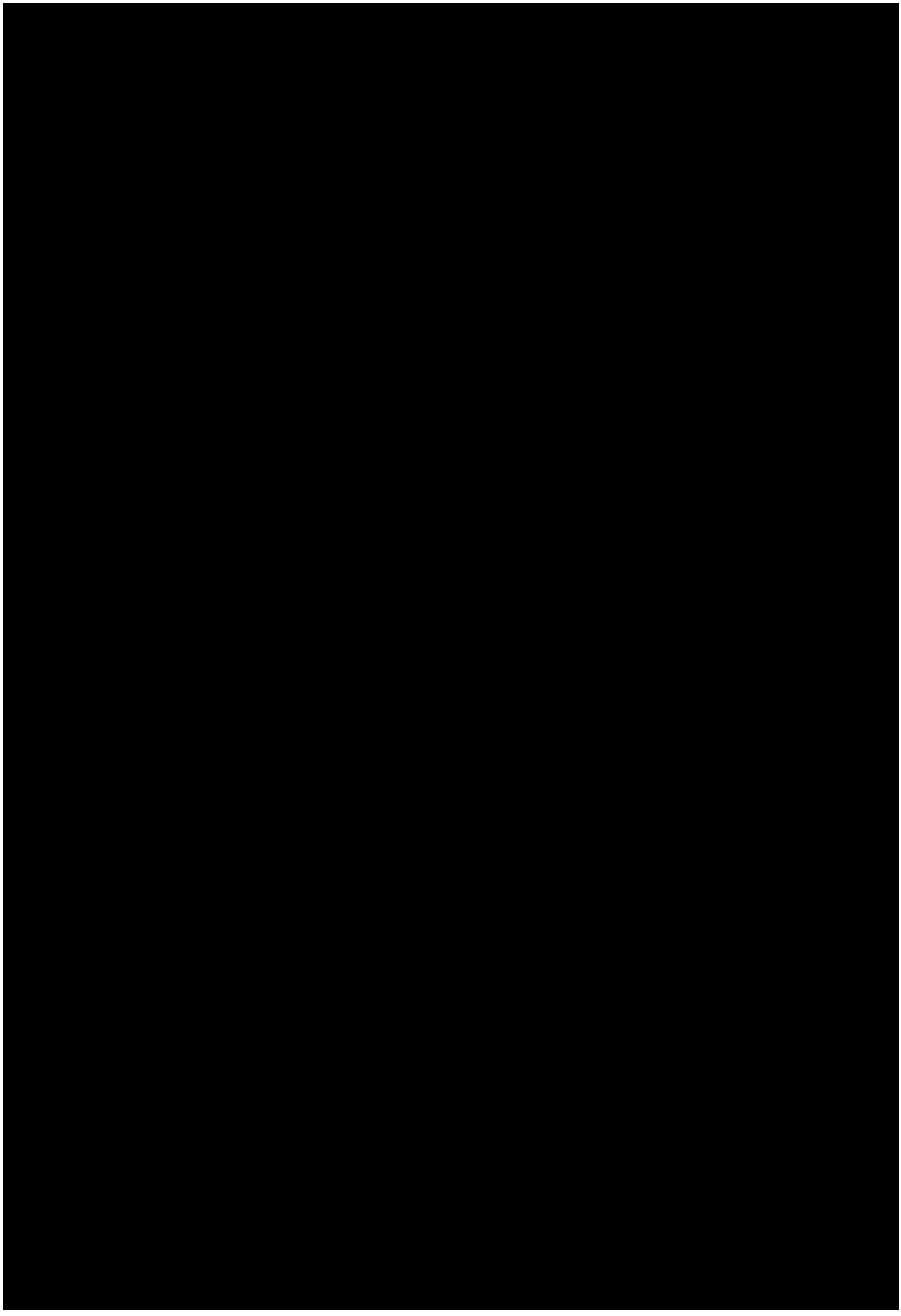
7.3 Sector-specific Case Studies

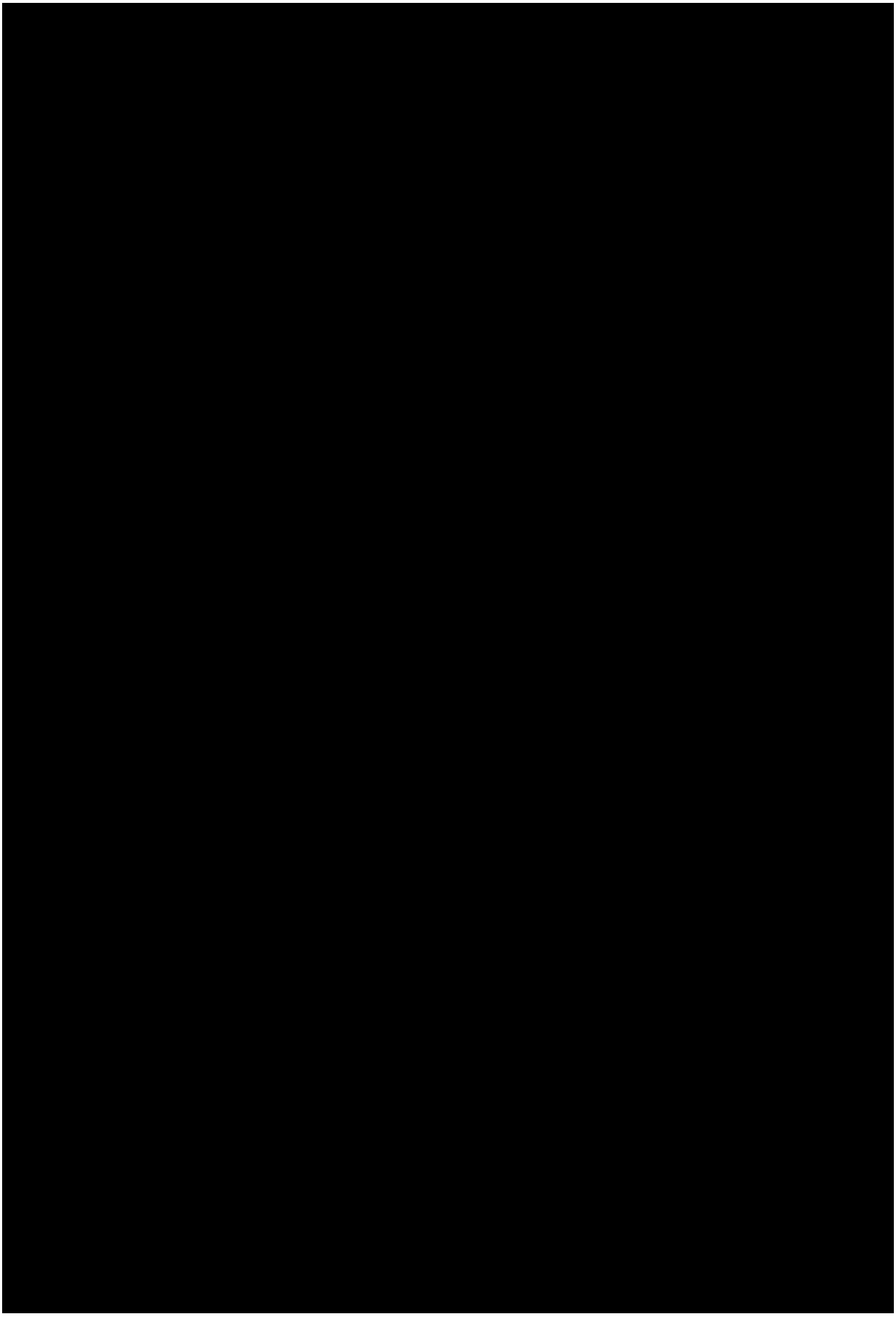


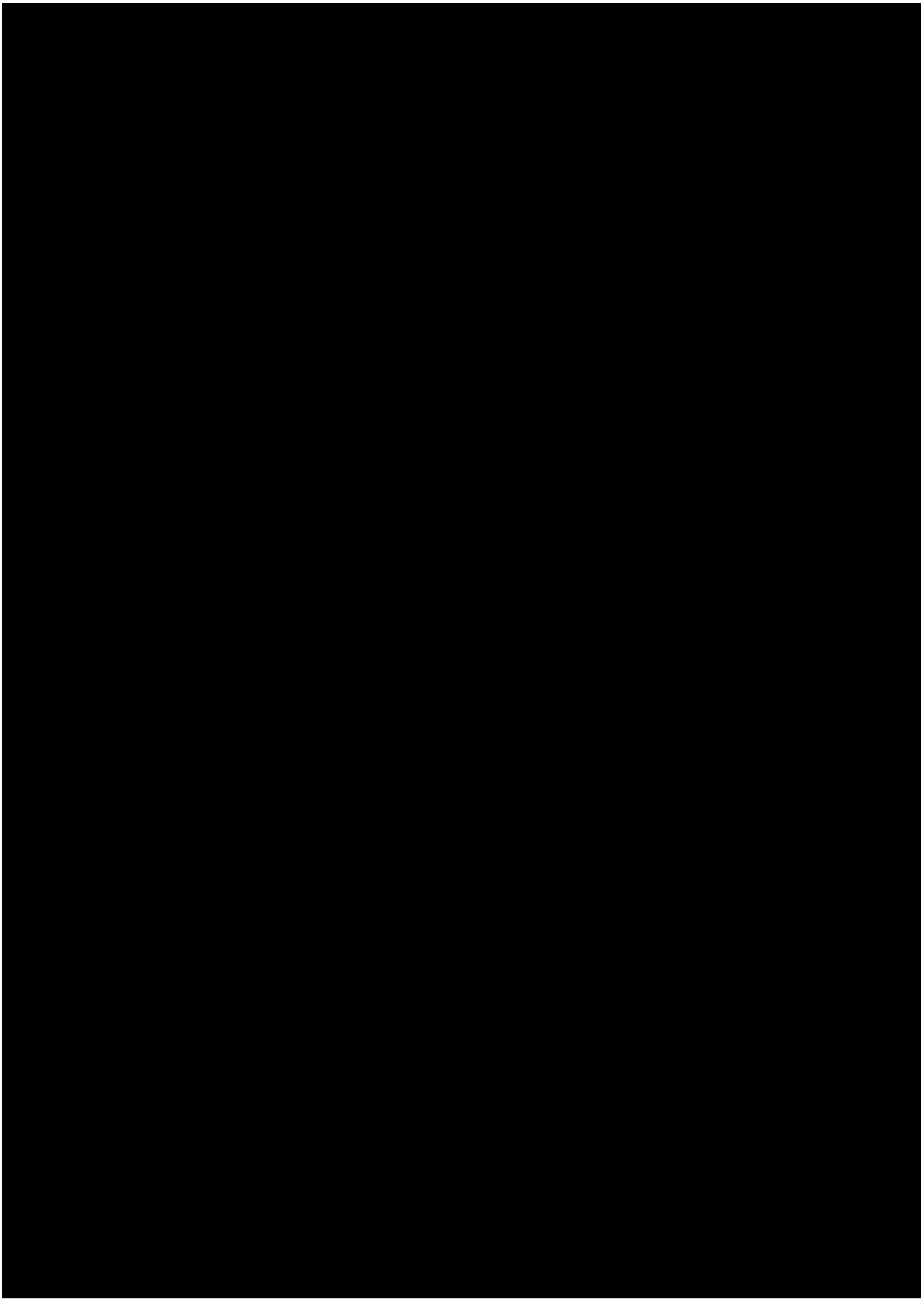


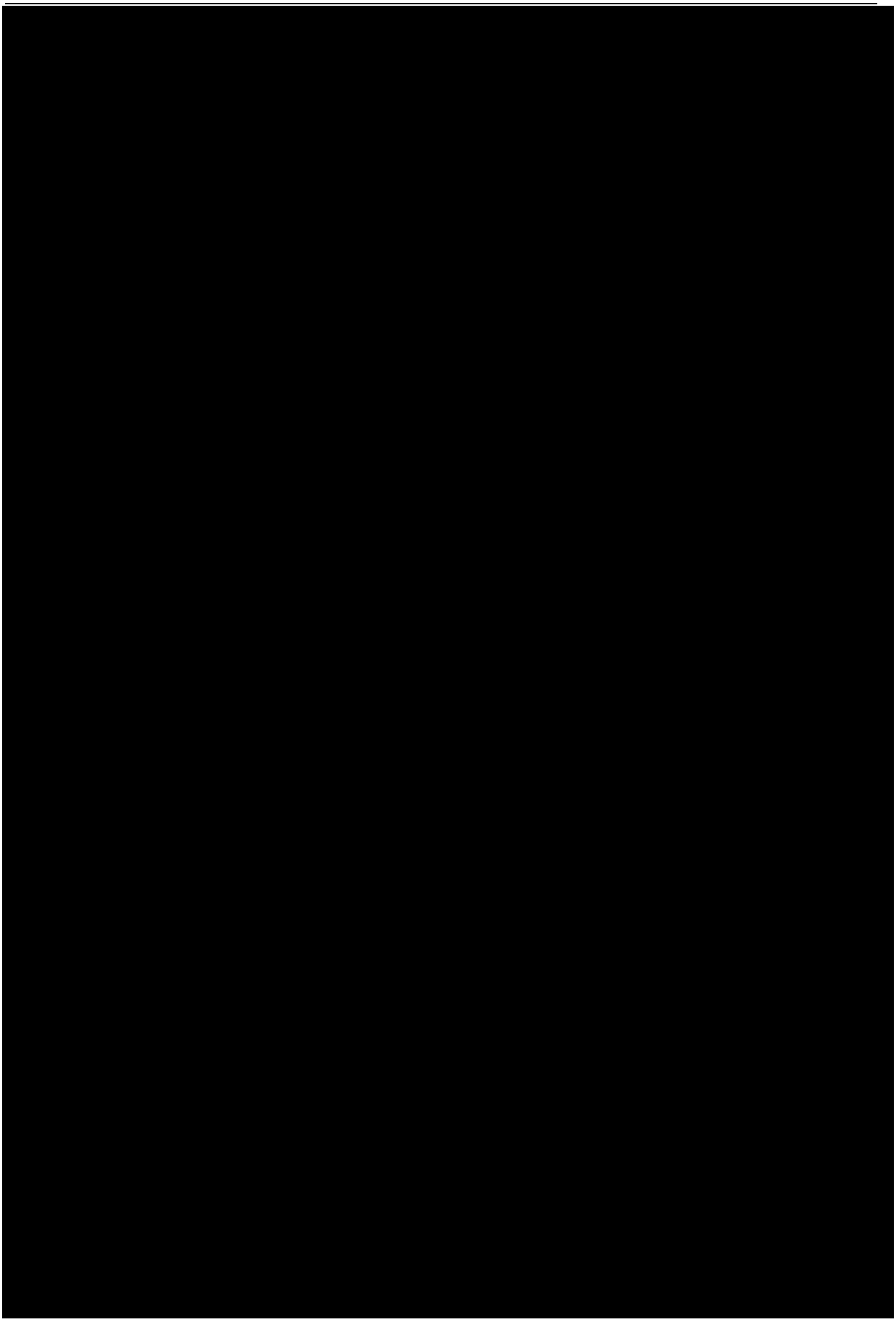


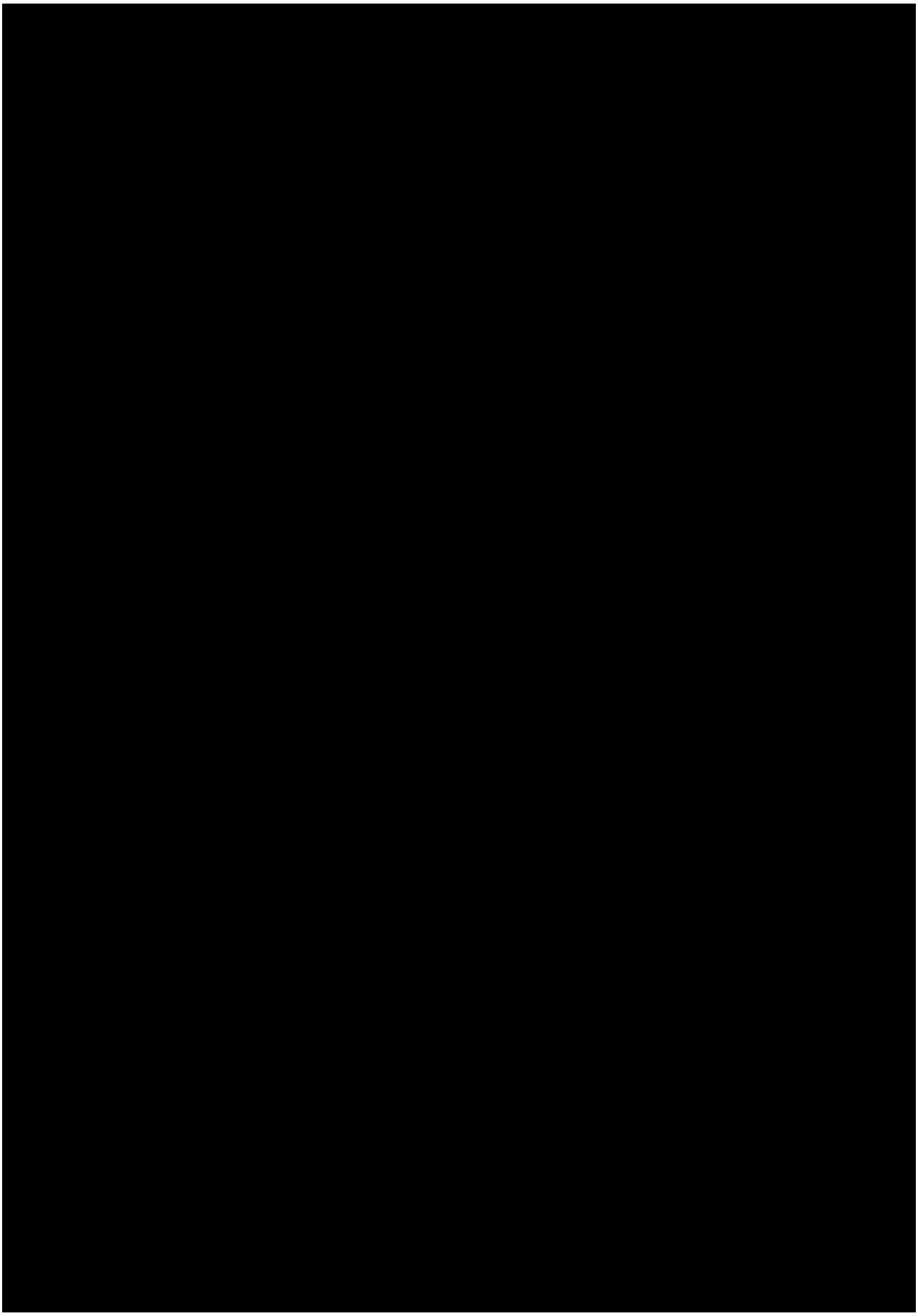












7.5 OS OpenData Downloads

7.5.1 Introduction

As part of the study the consultants analysed download records from launch (April 2010) to January (2012), the first 21 months of operation. As far as we are aware, it is a complete set and includes a total of 41,500 individual records. Downloads may be of complete datasets or where the dataset is geographically divided, such as OS VectorMap District, may consist of one or many tiles. The information supplied covers:

- Date of download – the statistics cover requests for supply by DVD as well as direct downloads but do not cover OS OpenSpace access where data is consumed through a web service.
- Breakdown by sector (according to OS categorisation[37]), with a text option where the "other" category was selected;
- Email address of the requesting organisation. Requests from what appear to be personal addresses (gmail, hotmail, btinternet and other identifiable ISP domains) have been removed from the analysis, except when evaluating leisure and community use.

The analysis has been used for two purposes:

- To validate the sensitivity of the sector analysis and adoption levels used to "gross up"[38] the impacts from that observed from the case studies;
- To provide an indication of the level of impact already evident in those sectors where no suitable case studies were found.

These two uses are now elaborated.

7.5.2 Sector Impacts from Case Studies

The independent economics review identified that the assumptions used in "grossing up" the sub-sector impacts based on the case studies were critical to establishing the credibility of the study. Our derivation of evidence of the size of the sector or sub-sector is illustrated in Appendix 11.3.7E where we look at how the sensitivity has been assessed and the forward adoption rates established.

Sensitivity: for each case study, we have analysed the statistics to evaluate whether other businesses known to be active in the same sub-sector of the market, for instance environmental impact assessment, have also downloaded the same products. A high download count of the major businesses (by turnover), particularly where the business has made repeated accesses, has been taken as an indication that "grossing up" is likely to be valid and that the case study is not unique.

[37] OS market sector categorisation is similar to the ONS Standard Industry Classification

[38] The turnover of the case study organisation as a proportion of the overall market size has been used as a multiplier to "gross up" the impact.

A figure of 20% sensitivity i.e. pessimistic forecast (lower bound) of -10% and an optimistic forecast (upper bound) of +10% was applied where the download count was high. A wider sensitivity of 40% was applied where the records showed less widespread download by major businesses. In some cases sensitivity was not applied because they are not relevant as where case studies apply to a unique application, such as in the electricity generation example.

Adoption: the principle established for sensitivity can also be applied to adoption. The proportion of most active users making repeat downloads has been used to estimate the current adoption rate. The lower bound adoption rate by 2016 is taken as the current rate and the upper rate then based on extrapolating forward that rate based on the standard Rogers approach for web technology adoption[39].

7.5.3 Sectors with no Case Studies

The number of potential uses of OS OpenData is obviously very great. We are cognisant of the depth and width of use from our recent assessment of the size of the UK location market, referenced elsewhere. In some sectors we were unable to elicit responses from some who were aware are making significant use of OS OpenData products but were unable or unwilling to make time available to assist. In other cases, such as the leisure sector, the range of uses is so diverse that the logic for "grossing up" is flawed.

We identified four sectors that we recognised as significant potential consumers of OS OpenData without case studies:

- Banking
- Media (including advertising agencies)
- Architecture and design
- Leisure and Community

Our underlying principle in estimating impacts has been to adopt a cautious approach, particularly where evidence is indirect. The download analysis shows two main types of usage pattern:

viii) Single downloads – one or many products have been downloaded but only once. This is assumed to indicate some type of evaluation process. In this case, the decision to download and evaluate represents an opportunity cost – the resources used to undertake the evaluation could have been deployed on some other activity. The lowest value that can be assigned based on this assumption is the value of the time taken to perform the evaluation. From our experience in performing such work, we have assigned an estimate of 2 hours to this task.

ix) Repeat usage – this is taken as circumstantial evidence of embedding of the data into business processes. Again using an opportunity cost approach, we estimate a minimum period for the simplest of such implementations at 5 working days (37.5 hours).

[39] For a description of Roger's work on the diffusion of innovations and the Roger's bell curve see: http://en.wikipedia.org/wiki/Technology_adoption_lifecycle

The impact is then calculated by summing the unique annualised company downloads in the sector for single and repeated use scenarios and multiplying by the overheaded rate per hour for labour is based upon Treasury Green Book advice on the value of time in business case development.

7.5.4 Limitations of this Approach

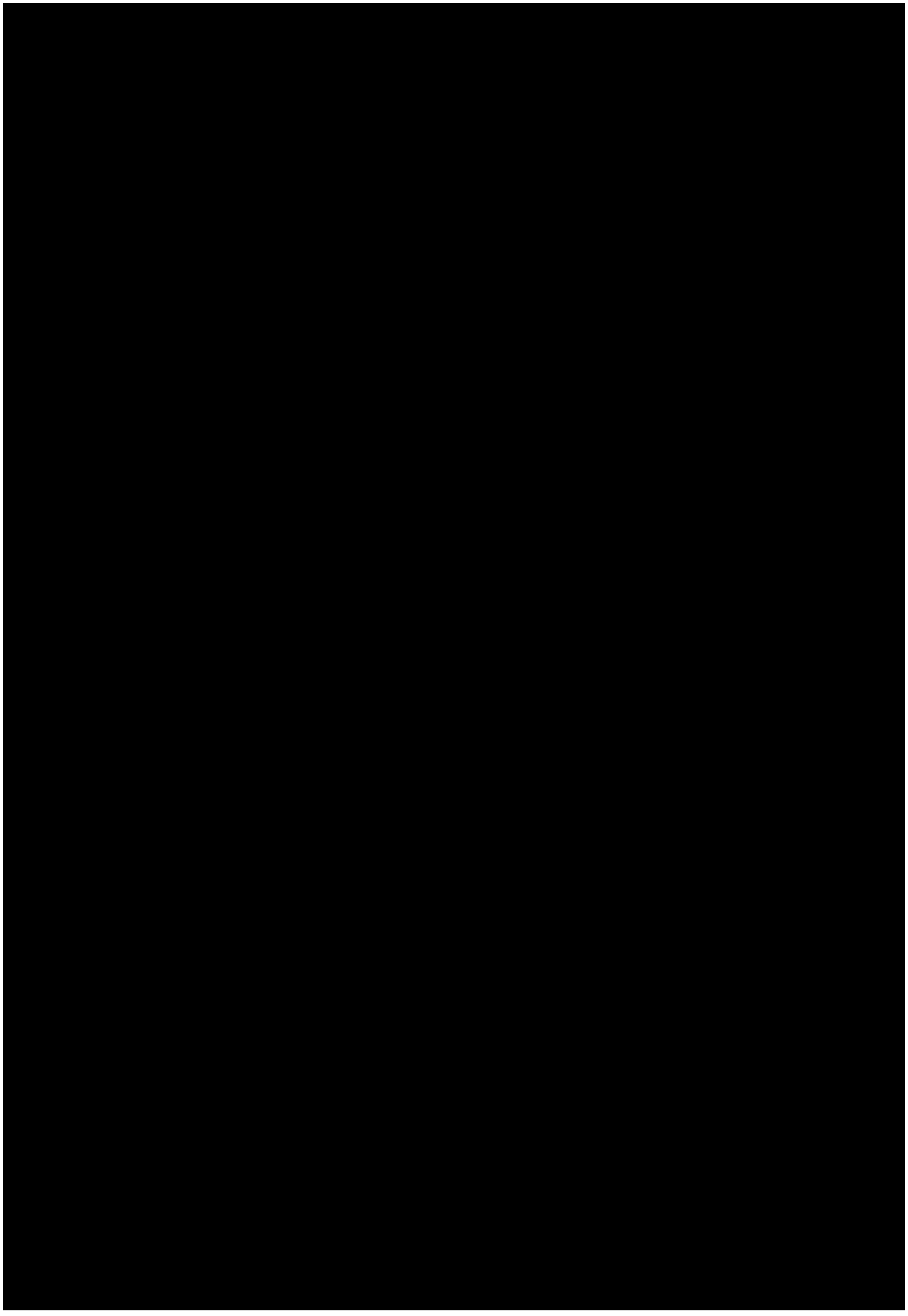
This approach is obviously not an exact science but is we believe based on a set of sound principles and real data in the form of the actual download statistics. The alternative approach would have been to undertake a market survey, which was beyond the scope of the project. Furthermore, we believe it is doubtful that as statistically significant sample would have been obtained from such an exercise – we received strong advice from within OS that "survey fatigue" would mitigate such an approach.

Whether the level of savings from an individual case study is representative of a sector as a whole is dependent on many factors, not least how efficient each organisation implements the necessary changes to processes. Within the scope of the study it is not possible to evaluate this variable, although we clearly recognise it as a factor.

7.6 Other Evidence

7.6.1 Introduction

In the course of the study a large body of additional information was gathered. In this section we summarise that which is most relevant to establishing the economic value of OS OpenData.



[41] Wikipedia definition

[42] http://itoworld.blogspot.com/2011/01/openstreetmap-gb-progress-report.html

8 Social Impacts of the OS OpenData Initiative

8.1 Introduction

A conservative approach has been taken to the evaluation of benefits. Broader social and environmental benefits for which there is no market price, so-called 'non-market impacts', have not been considered up to this point. By their very nature, they are much more difficult to assess because they cannot be easily costed.

The key examples of such non-market impacts relevant to this study are savings in time, avoidance of injuries or fatalities and environmental gains.

The UK Treasury green book, which provides the mandatory guidance on business case development in the public sector, gives details of a number of approaches that are possible where market values cannot be arrived at directly[43]. The usual approach is 'Willingness to Pay' - in other words, what a consumer is prepared to pay for some benefit e.g. a shorter journey time to work or improved amenity. Willingness to Pay is usually arrived at either from a 'Revealed Preference' or a 'Stated Preference'.

Revealed Preference is determined from observing consumer behaviour. It involves inferring a price indirectly by studying behaviour in a similar or related market. The example that is commonly used to illustrate this is house price which can be used to infer an amenity value. How much is someone prepared to pay for peace and quiet can be inferred from the difference in prices of houses of similar type in different locations.

If it is not possible to arrive at a Revealed Preference, then a Stated Preference has to be estimated by asking consumers what they would be willing to pay for a particular benefit. This usually requires a questionnaire and interviews where people are asked either directly what they would be willing to pay or indirectly by presenting a number of choices.

Willingness to Pay is beyond the scope of this study, however, in the following paragraphs we explore evidence found during the study of various types of non-market benefits.

8.2 Valuing Citizen Time Savings

The Department for Transport (DfT) have done a lot of work on valuing time for the appraisal of road schemes and other transport projects. Their approach differentiates between working and non-working time. For working time, the value is the opportunity cost to the employer which is equated, at the margin, to the cost of labour to the employer e.g. gross wage rate, national insurance, pensions and any other costs that vary with the time worked. For non-working time including journeys to work, various empirical values have

[43] The Green Book published by HM Treasury, in particular Annex 2 Valuing non-market impacts. See http://www.hm-treasury.gov.uk/data_greenbook_index.htm

been arrived at. Because of the variations in individual circumstances, averaging has to be used in practice to derive estimates.

For working time, DfT calculated a figure of £22.11 per hour average for all persons in 2002. Using annual changes to the Retail Price Index (RPI), this would equate to £29.65 per hour in 2011. A value of £5.68 per hour was calculated for non-working time in 2008 which would equate to £6.39 per hour in 2011 using the RPI.

One particularly relevant example of public time saving found during the study comes from Transport for London (TfL). The mayor's scheme to help tackle congestion of central London streets with a large scale bike hire initiative had a number of attractions - time saving for people hiring bikes being one of the most compelling arguments.

Since the introduction of the scheme several smartphone apps have been developed to assist hirers find available docking stations. These apps use street-level maps, from Google, to calculate their estimated time of arrival.

TfL estimate that there are 50,000 bike hires on average per day and 1-2 minutes per hire is saved by knowing where docking stations are available. Making a reasoned assumption that 50% of hires are during working time and 50% in non-working time, using the DfT values above, the economic value of the time saved equates to £22,500 per day or £5.85 million per annum (working days only). As OS OpenData is embedded in Google Maps, some of this value is derived from the initiative.

8.3 Avoidance of Injury

For the prevention of injuries and fatalities various approaches to estimating have been developed. Of course there is no way that an absolute value can be put on a human life but Willingness to Pay can give some indication of what people are prepared to pay to prevent injury or loss of life. For example, in a 2005 study[44] DfT valued the reduction of the risk of death for road transport. This estimated the average value of prevention per fatal casualty as £1,428,180[45].

The treasury green book also provides guidance on the value that can be assigned to non-fatal injuries, baselined to the year 2000:

- Major injury £128,650
- Minor Injury £ 9,920

The relevance of this type of welfare benefit applies particularly to case studies related to route optimisation and home delivery services. Since distance travelled by drivers (and passengers) is directly related to risk of injury, it would be possible to infer benefits from reduced risk of injury through reduced road mileage .

[44] Source: Department for Transport (2007) - Highways Economic Note No.1. 2005 Valuation of the Benefits of Prevention of Road Accidents and Causalities

[45] This would equate to £1.782m at today's prices

8.4 Greenhouse Gas Emissions

The Green book advice in this case is that once the emissions impact of a proposal has been quantified, current research informs the calculation of illustrative values for the social damage cost of carbon[46]. This can then be used to estimate the monetary value of the impacts.

The CGE model provides an indication of the estimated size of the impact on carbon emissions of the shocks applied. This indicates (section 10.2.4) that total greenhouse gas emissions will increase by between a lower bound of 3.1 kilotonnes of carbon dioxide equivalent and an upper bound of 6.9 kilotonnes of carbon dioxide equivalent, 25% lower than would otherwise be expected. However, as practice has not been established in this area, we only observe the possibility of is type of valuation.

8.5 Conclusion

A number of examples of social benefits have been found during the study. As they are difficult to calculate accurately they have not been included in the impacts applied in the CGE model. However, they are real and do add to the economic value realised from the OS OpenData initiative.

[46] A Government Economic Service working paper 'Estimating the Social Cost of Carbon Emissions' suggests illustrative values for the social damage cost of carbon. A working paper is available on the Treasury's website: http://www.hm-treasury.gov.uk. Defra can provide an associated guidance note on how to use these values in policy appraisal.

9 Modelling the Impacts

9.1 Impact of Case Studies

The impact of the productivity improvements from the case studies outlined in Section 7 are calculated according to a common set of metrics as shown in Table 4 overleaf. The table is structured as follows:

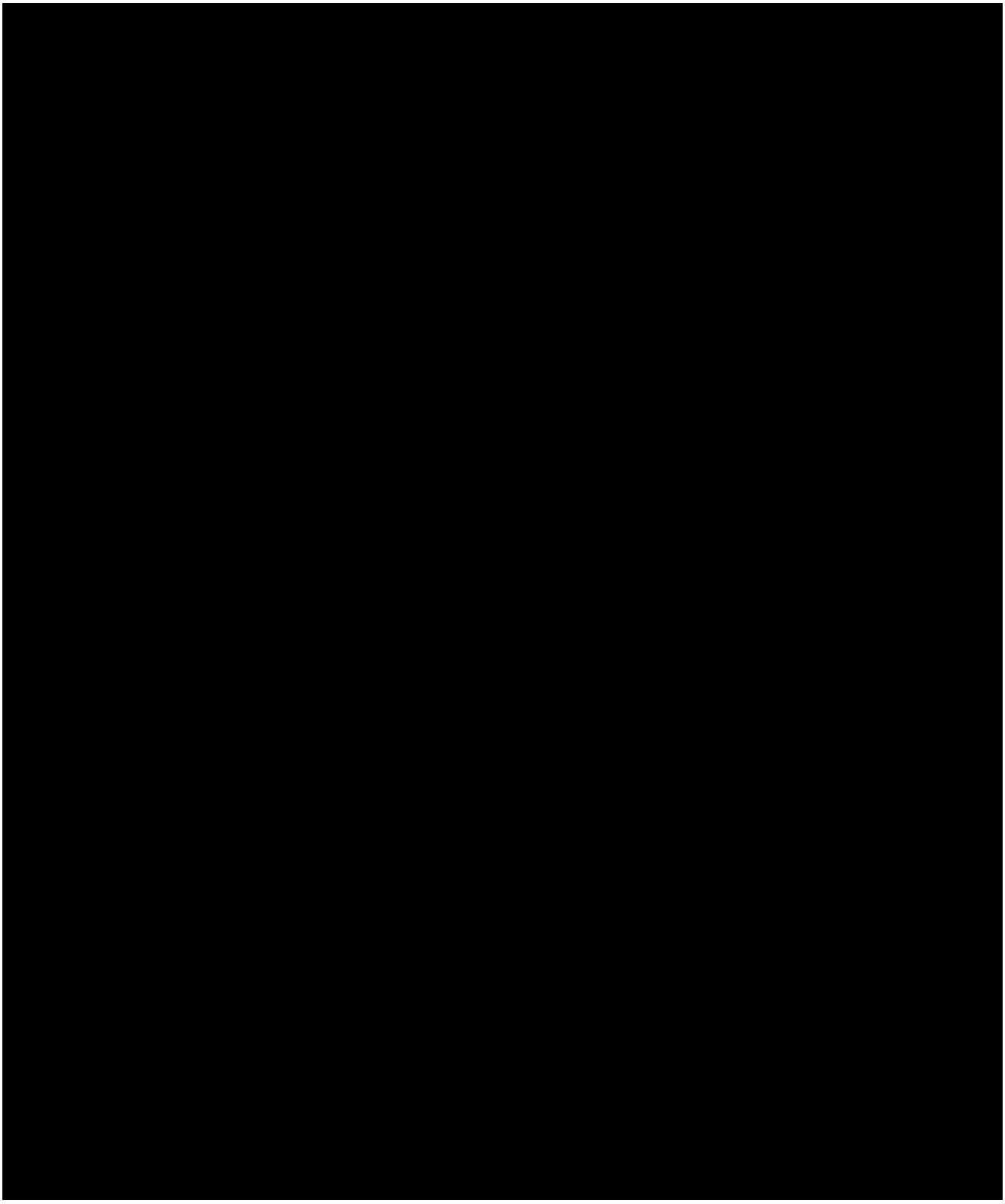
Case Study Name – where necessary, the organisation name is replaced by its business activity for reasons of commercial confidentiality.
Description – a single sentence describing of the nature of the new application or efficiency gain to existing processes.
Standard Industry Classification (SIC) - each case study is assigned to a sector, or where multiple sectors will be impacted, each is identified. The sector classification used is the Standard Industry Classification[47] used by the Office of National Statistics.
Sub-sector - the SIC sub-sector reference is also identified where possible; the significance of the sub-sector is that few case studies cover all sector activities where OS OpenData could potentially be used.
Annualised Net Benefits - estimated from interviews, annualised on the basis of the predicted growth from implementation to March 2016.
Sector Size Multiple – derived from calculating the organisation's turnover from activities that relate directly to their use of OS OpenData identified in the case study as a proportion of our estimate of the overall size of the sector to which the OpenData use could be applied.
Sensitivity – a percentage range representing the confidence in the net benefits and size of sector multiplier. For the lower bound calculation, half the sensitivity is applied as a reducing factor to the net market benefit and for upper bound it is applied as an increasing factor.
Adoption Level – is a percentage of implementation that might be achieved for the application cited in the case study over the period through to 2016. Lower and upper bound estimates are provided.
Net Market Benefits in 2016 (p.a.) – calculated from the formulae:

Net market benefit (lower bound) = Annualised net benefit x Sector size multiplier x ((100 – 1/2 Sensitivity[48])/100) x Lower Bound Adoption Level

Net market benefit (upper bound) = Annualised net benefit x Sector size multiplier x ((100 + 1/2 Sensitivity)/100) x Upper Bound Adoption Level

[47] See http://www.statistics.gov.uk/statbase/product.asp?vlnk=14012

[48] Numerical value of the sensitivity percentage e.g. 10% = 10 giving a sensitivity multiplier of:
(100 - (1/2 X 10))/100 = 0.95



9.2 Impacts from Download Analysis

The impact of the productivity improvements from the download analysis outlined in section 7.5 are calculated according to a common set of metrics as shown in Table 5 overleaf. The table is structured as follows:

Sub-sector Name – based on categorisation within download records.
Description – describing the scope of the sub-sector.
Standard Industry Classification (SIC) - each case study is assigned to a sector, or where multiple sectors will be impacted, each is identified. The sector classification used is the Standard Industry Classification used by the Office for National Statistics.
Sub-sector - the SIC sub-sector reference is also identified where possible; the significance of the sub-sector is that most cover only a proportion of the sector activities where OS OpenData could potentially be used.
Annualised Downloads – the download records cover a period of 21 months, so the figures are simply divided by 12/21 to provide an annual estimate.
Single Use – number of instances where only a single download has been made in the period, this is assumed to imply evaluation only.
Routine Use – number of instances where repeated downloads of the same product have been made. This is assumed to imply embedding in organisational workflows.
Sector Average Hourly Rate – this is an indicative average labour rate for professional staff in the sector.
Evaluation Time – conservative estimate of one-off time taken to prepare, download and perform basic evaluation of OS OpenData products. In all cases this has been assumed as two (2) hours.
Implementation Time – multiple use is assumed to imply embedding in organisational workflows. From our experience, we have made a very cautious estimate of the minimum time this might take based on the likely complexity of the applications identified from the download records and other intelligence gained during the study.
Current Value – is calculated as:

((Single Use x Evaluation Time) + (Routine Use x Embedding Time)) x Hourly Rate

Estimated Current Adoption – is based on assessing the proportion of the sector (by turnover) represented by those companies who are assumed to have embedded products in workflows.
Adoption Lower Bound (2016) – represents the level, based on the current adoption that can reasonably be expected as a minimum level of adoption by 2016.
Adoption Upper Bound (2016) – represents the level, based on the current adoption that can reasonably be expected as a maximum level of adoption by 2016.
Net Market Benefit* (by 2016) – is then calculated as:

Current value x Adoption

* Upper and lower bound figures are calculated

Table 5 Impacts from Download Analysis

Sub-sector Name	Description	SIC	SIC sub-sector	Annualised Downloads	Single Use	Repeated Use	Sector Average Hourly Rate	Evaluation Time (hours)	Implementation Time (hours)	Current Value (£k)	Estimated Current Adoption	Adoption Lower Bound (by 2016)	Adoption Upper Bound (by 2016)	Net Market Benefit 2016 (lower bound) (£k)	Net Market Benefit 2016 (upper bound) (£k)	Comments
Leisure	Undifferentiated use for leisure purposes	R		3473	3450	23	£5	2	10	£36	5%	10%	20%	£71.3	£142.6	Diverse range of uses from hobbyists to community groups
Banking	banks and building societies	K	64.1	107	97	10	£50	2	37.5	£28	50%	75%	100%	£42.7	£56.9	Customer profiling and fraud detection
Land and Property	estate agents and house builders	L	68.1	386	350	36	£30	2	37.5	£62	20%	60%	80%	£184.5	£246.0	
Telecom	Mobile operators and service suppliers	J	61	40	28	12	£40	5	50	£30	40%	60%	80%	£44.4	£59.2	A significant application is for radio wave propogation maps
Media	news, advertisers and service companies	J	58.1	49	42	7	£30	2	37.5	£10	10%	25%	50%	£26.0	£52.0	Producing maps for newspaper features through to location analysis for advertisers
Architecture and Design	Built environment	M	71	53	41	12	£30	2	37.5	£16	20%	60%	80%	£47.9	£63.8	Predominant users are consultancies and house builders
Total														£416.7	£620.5	
													Check:	£416.7	£620.5	

Data Source: ConsultingWhere Analysis

9.3 Private Sector Revenue Impacts from the CLG Contract

The impact of the transfer of funding from users to government as a result of the decision to make OS OpenData free at the point of delivery is discussed in detail in section 6.2. The next table, Table 6, shows how these are translated to input shocks in the CGE Model:

SIC Sector – this is the reference letter used in the top-level classification of industry sectors used by the Office for National Statistics.
Sector Description – is the description of the sectors in SIC.
Proportion of the Commercial Market Size – the apportionment of revenues transferred from the public sector to the private sector is based upon the relative size (in turnover) of these sectors. This is derived from the Assessment of the UK Location Market undertaken by ConsultingWhere in 2011 and published in 2012[49].
Commercial + Consumer Product Revenue Impact – this is the direct revenue from OS OpenData products transferred to the private sector (adding commercial and consumer product revenues). The total which is proportioned between sectors equates to Table 2 ref 3.
Commercial + Consumer Substitution Revenue Impact – this is the substitution effect of revenue transferred to the private sector (adding commercial and consumer categories). The total which is proportioned between sectors equates to Table 2 ref 4.
Commercial + Consumer Competition Revenue Impact – this is the effect of revenue transferred to the private sector (adding commercial and consumer categories) through OS loss to competitive products. The total which is proportioned between sectors equates to Table 2 ref 5.
Royal Mail (Royalties) Impact - this is the effect of revenue transferred to the private sector (adding commercial and consumer categories) through OS payments in lieu of lost royalties to Royal Mail. The total which is proportioned between sectors equates to Table 2 ref 2.
Total Impact of Revenue Effects – is then calculated as:

Product Revenue + Substitution Revenue + Competition Revenue + RM Royalties

[49] ConsultingWhere (2012) The UK Location Market Survey 2012: An Assessment of the Current Size and Future Direction of the UK Market for Location Information Products and Services
http://www.consultingwhere.com/reports.html

Table 6 Transfer of revenue from Government to the private sector

SIC Sector	Sector Description	Proportion of Commercial Market Size	Commercial + Consumer Product Revenue Impact (£m)	Commercial + Consumer Substitution Revenue Impact (£m)	Commercial + Consumer Competition Impact (£m)	Royal Mail (Royalty) Impact (£m)	Total Impact of Revenue Effects (£m)
A	AGRICULTURE, FORESTRY AND FISHING	2%	£0.03	£0.08	£0.00	£0.03	£0.14
B	MINING AND QUARRYING	1%	£0.03	£0.06	£0.00	£0.02	£0.12
C	MANUFACTURING	0%	£0.00	£0.00	£0.00	£0.00	£0.00
D	ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	14%	£0.29	£0.69	£0.02	£0.23	£1.23
E	WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	15%	£0.32	£0.76	£0.03	£0.26	£1.36
F	CONSTRUCTION	7%	£0.15	£0.36	£0.01	£0.12	£0.64
G	WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES	14%	£0.28	£0.67	£0.02	£0.23	£1.20
H	TRANSPORTATION AND STORAGE	14%	£0.29	£0.68	£0.02	£0.23	£1.22
I	ACCOMMODATION AND FOOD SERVICE ACTIVITIES	0%	£0.00	£0.00	£0.00	£0.00	£0.00
J	INFORMATION AND COMMUNICATION	3%	£0.06	£0.14	£0.00	£0.05	£0.26
K	FINANCIAL AND INSURANCE ACTIVITIES	8%	£0.17	£0.41	£0.01	£0.14	£0.73
L	REAL ESTATE ACTIVITIES	13%	£0.28	£0.66	£0.02	£0.22	£1.18
M	PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES	6%	£0.11	£0.27	£0.01	£0.09	£0.49
N	ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	0%	£0.00	£0.00	£0.00	£0.00	£0.00
O	PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY	0%	£0.00	£0.00	£0.00	£0.00	£0.00
P	EDUCATION	0%	£0.00	£0.00	£0.00	£0.00	£0.00
Q	HUMAN HEALTH AND SOCIAL WORK ACTIVITIES	0%	£0.00	£0.00	£0.00	£0.00	£0.00
R	ARTS, ENTERTAINMENT AND RECREATION	2%	£0.04	£0.10	£0.00	£0.03	£0.18
S	OTHER SERVICE ACTIVITIES	1%	£0.01	£0.03	£0.00	£0.01	£0.05
T	ACTIVITIES OF HOUSEHOLDS AS EMPLOYERS; UNDIFFERENTIATED GOODS- AND SERVICES-PRODUCING ACTIVITIES OF HOUSEHOLDS FOR OWN USE	0%	£0.00	£0.00	£0.00	£0.00	£0.00
U	ACTIVITIES OF EXTRATERRITORIAL ORGANISATIONS AND BODIES	0%	£0.00	£0.00	£0.00	£0.00	£0.00
	Total	100%	£2.06	£4.91	£0.16	£1.67	£8.80
						Check:	£8.80

9.4 Summing Up the Impacts

Table 7 overleaf shows how the impacts, described as shocks in CGE modelling, are now assembled to provide the overall inputs to the CGE model. Impacts from Tables 4, 5 above are assigned to economic sectors based on the ONS SIC classification. For instance, the market shock derived from the wind energy (Atmos Consulting) case study is allocated to SIC category D, the electricity, gas steam and air conditioning supply sector. Similarly, the National Power case studies are also allocated to SIC category D, so the total case study impacts are a sum of these two. Lower and upper bounds are shown in both cases

The revenue impacts of OS OpenData as described in Table 6 which are a positive effect on the commercial sector of the economy are assigned according to our estimate of the relative size of these sectors in respect to use of geospatial information. These estimates are drawn from the recent assessment of the size and growth prospects of the UK location market undertaken by ConsultingWhere[50]. The negative impact of the CLG contract on the Government sector is also shown in this column.

The total shock columns are calculated as follows:

> **2016 Low Bound Shock** = Case Study benefit (lower bound) + Download Analysis (lower bound) + Private Sector Revenue Impacts
> **2016 Upper Bound Shock** = Case Study benefit (upper bound) + Download Analysis (upper bound) + Private Sector Revenue Impacts

[50] ConsultingWhere (2012) The UK Location Market Survey 2012: An Assessment of the Current Size and Future Direction of the UK Market for Location Information Products and Services

http://www.consultingwhere.com/reports.html

Table 7 Summary of total shocks

							2016	
SIC Section	Description	Case Study Benefit (lower bound) (£m)	Case Study Benefit (upper bound) (£m)	Download Analysis (lower bound) (£m)	Download Analysis (upper bound) (£m)	Private Sector Revenue Impacts (£m)	Lower Bound Shock (£m pa)	Upper Bound Shock (£m pa)
A	AGRICULTURE, FORESTRY AND FISHING	£0.09	£0.28	£0.00	£0.00	£0.14	£0.24	£0.43
B	MINING AND QUARRYING	£0.00	£0.00	£0.00	£0.00	£0.12	£0.12	£0.12
C	MANUFACTURING	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
D	ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	£0.79	£1.15	£0.00	£0.00	£1.23	£2.03	£2.38
E	WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	£0.18	£0.39	£0.00	£0.00	£1.36	£1.54	£1.76
F	CONSTRUCTION	£0.38	£1.14	£0.00	£0.00	£0.64	£1.02	£1.78
G	WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES	£0.46	£1.14	£0.00	£0.00	£1.20	£1.66	£2.33
H	TRANSPORTATION AND STORAGE	£1.49	£4.66	£0.00	£0.00	£1.22	£2.71	£5.88
I	ACCOMMODATION AND FOOD SERVICE ACTIVITIES	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
J	INFORMATION AND COMMUNICATION	£4.21	£7.68	£0.07	£0.11	£0.26	£4.54	£8.05
K	FINANCIAL AND INSURANCE ACTIVITIES	£0.47	£1.42	£0.04	£0.06	£0.73	£1.25	£2.21
L	REAL ESTATE ACTIVITIES	£0.04	£0.16	£0.18	£0.25	£1.18	£1.41	£1.59
M	PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES	£1.77	£2.57	£0.05	£0.06	£0.49	£2.31	£3.12
N	ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
O	PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY	-£9.64	-£9.64	£0.00	£0.00	£0.00	-£9.64	-£9.64
P	EDUCATION	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
Q	HUMAN HEALTH AND SOCIAL WORK ACTIVITIES	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
R	ARTS, ENTERTAINMENT AND RECREATION	£0.00	£0.00	£0.07	£0.14	£0.18	£0.25	£0.32
S	OTHER SERVICE ACTIVITIES	£0.08	£0.31	£0.00	£0.00	£0.05	£0.13	£0.36
T	ACTIVITIES OF HOUSEHOLDS AS EMPLOYERS; UNDIFFERENTIATED GOODS- AND SERVICES-PRODUCING ACTIVITIES OF HOUSEHOLDS FOR OWN USE	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
U	ACTIVITIES OF EXTRATERRITORIAL ORGANISATIONS AND BODIES	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
	Sub-Total	£0.34	£11.26	£0.42	£0.62	£8.80	£9.56	£20.68
	GENERAL PRODUCTIVITY SHOCK						£1.24	£1.48
	PROFIT EXPORT SHOCK						-£3.72	-£3.72
	Grand Total						£7.08	£18.44

Data source: ConsultingWhere based on analysis and OS data

10 Results of the Economic Modelling

10.1 Measures of macroeconomic impacts

One of the most commonly quoted macroeconomic variables at a national level is Gross Domestic Product (or GDP) which is a measure of the aggregate output generated by an economy over a period of time (typically a year). From the expenditure side, GDP is calculated by summing total private and government consumption, investment and net trade. From the income side, GDP is equal to the returns to factors of production plus all tax revenues.

Although changes in real GDP are useful measures for estimating how much the output of an economy may change, changes in the real income are more important as this provides an indication of the change in economic welfare of the citizens. Indeed, it is possible that real GDP can increase with no, or possibly negative, changes in real income. In the Tasman Global model, changes in real income at the national level is synonymous with real national disposable income (RNDI) reported by the Office for National Statistics (ONS).

Real income is equivalent to real GDP plus net foreign income transfers, while the change in real income is equivalent to the change in real economic output, plus the change in net foreign income transfers, plus the change in terms of trade (which measures changes in the purchasing power of a region's exports relative to its imports). As the residents of many countries have experienced in recent years, changes in terms of trade can have a substantial impact on people's welfare independently of changes in real GDP.

10.2 Model Outputs

Table 8 summarises the projected impacts for lower and upper bound scenarios on the economy of Great Britain. It also presents a detailed breakdown of the estimated changes in real GDP and real income. To simplify interpretation, all results have been presented as changes due to the effect of the OS OpenData policy initiative – that is the difference in economic indicators between the reference case and the counterfactual.

Table 8 Macroeconomic impacts of OS OpenData policy initiative

Ref		Sensitivity - Lower bound	Sensitivity - Upper bound	Derivation
		2016	**2016**	
		2011 £m	2011 £m	
		Lower bound	**Upper bound**	
1	Change in real consumption	8.14	20.25	
2	Change in real investment	2.32	5.05	
3	Change in real exports	6.06	10.28	
4	Contribution of change in real imports	-3.56	-7.09	
5	**Change in real net foreign trade**	**2.50**	**3.19**	3+4
6	**Total change in real GDP (expenditure side)**	**12.95**	**28.49**	1+2+5
7	Change in value added	0.42	2.07	
8	Change in tariff revenue	-0.08	0.06	
9	Other tax revenue changes	4.51	8.20	
10	Productivity effects	8.10	18.16	
11	**Total change in real GDP (income side)**	**12.95**	**28.49**	7+8+9+10
12	Change in terms of trade	-2.76	-4.30	
13	Change in net foreign income transfers	-0.02	-0.08	
14	**Total change in real GNP**	**10.17**	**24.10**	11+12+13

***** Note that an increase in real imports has a negative contribution to the change in real GDP.

Changes in tax revenues are changes in the tax revenue at the existing specific tax rates. They are sometimes called changes in the 'real tax revenue' and, with some small caveats, they are first order estimates of the changes in the allocative efficiency of the economic system. As discussed in Pant (2007)[51], the decomposition of the change in real GDP from the income side are approximations only as there are allocative effects induced by changes in domestic relative prices that have not been isolated correctly. Nevertheless, the decomposition is still useful to shed light on the first order contribution of the different sources of change.

Results expressed in £m in 2011 terms.

Data source: Tasman Global modelling estimates

10.2.1 Real GDP

Drawing from the discussion presented earlier in this report, the OS OpenData policy initiative is projected to result in a range of productivity improvements throughout the economy of Great Britain (albeit also resulting in reduced direct exports by OS and some transfer payments). Realisation of the estimated productivity improvements will result in more effective use of Great Britain's labour and capital and will allow the economy to increase overall output compared to what will otherwise be possible.

Based on our conservative estimate of the productivity improvements, the *Tasman Global* model result predict that, by 2016, Great Britain's real GDP will increase by between a lower bound of £13.0 million and an upper bound of £28.5 million. This is as a direct result of the OS OpenData Policy Initiative. While this is a small proportion of GDP, the products covered by the initiative only represented a small proportion of OS products in terms of turnover. It is however an indication of the significant positive net economic impact of a relatively small policy change.

The net increase in real taxation revenue lies between a lower bound of £4.4 million and an upper bound of £8.3 million.

[51] Pant, H.M. 2007, GTEM: Global Trade and Environment Model, ABARE Technical Report, Canberra, June.

10.2.2 Real income and terms of trade

Although changes in real GDP is a useful measure for estimating how much the output of the Great Britain economy has changed, changes in the welfare of residents is of more importance to estimates of overall economic welfare. In *Tasman Global,* changes in real welfare is measured by real income[52] and, at a national level, is synonymous with real national disposable income (RNDI) reported by the ONS.

The changes in real income are equivalent to the changes in real GDP, plus changes in net foreign income, plus changes in terms of trade (which measures changes in the purchasing power of a region's exports).

The productivity improvements associated with the OpenData policy initiative will reduce production costs and boost total production. However some of these cost reductions are also passed on to foreign consumers leading to a decline in Great Britain's terms of trade compared to the counterfactual. The decline in terms of trade means that the exchange rate depreciates as British exporters become more internationally competitive. While this means more real goods and services will need to be exported to pay for imports it also means that export sectors such as manufacturing expand with the growth in demand for British goods and services[53].

Although the decline in terms of trade offsets the growth in real GDP, total welfare of Great Britain residents is still projected to be greater as a result of the OS OpenData policy initiative. In particular, real income in 2016 (real GNP) is estimated to increase by between a lower bound of £10.2 million and an upper bound of £24.1 million as a direct result of the OS OpenData policy initiative.

10.2.3 Other macroeconomic variables

Real consumption (£8.1 million – £20.3 million) and investment (£2.3 million – £5.1 million) are also projected to increase as a result of the OS OpenData policy initiative.

A notable result is that the productivity improvements associated with the OS OpenData policy initiative is a net increase in total real exports of between £6.1 million and £10.3million despite the direct loss of an estimated £3.7 million from reduced revenue from companies based overseas. The increased exports will enable British residents to purchase more foreign goods and services with real imports projected to increase by between £3.6 million and £7.1 million.

The modelling assumption that labour supply and unemployment remains constant between the scenarios means that the modelling results show no employment change. If this constraint were relaxed, employment would grow provided there was spare capacity in

[52] More specifically, in *Tasman Global*, changes in real income are equivalent to changes in equivalent variation (using the Slutsky measure of income effects). See Pant (2007) for more details.

[53] Note, however, that total production has also increased, but part of the increased production needs to be used to support demand for foreign products.

the labour market. This would be offset by lower increases in wages and salaries than shown in this model result.

10.2.4 Greenhouse gas emissions

The increased economic activity leads to small increase in greenhouse gas emissions generated by the British economy. In particular, it is estimated that total greenhouse gas emissions will increase by between a lower bound of 3.1 kilotonnes of carbon dioxide equivalent and an upper bound of 6.9 kilotonnes of carbon dioxide equivalent. The marginal increase in emissions per additional unit of real GDP is approximately 25 per cent less than the average forecast emissions intensity of the British economy in 2016 due to the increase in service orientated parts of the economy and the reduction in factor prices relative to energy prices.

10.3 Summary

Overall these effects are likely to increase the projected increase in real GDP and real income, with the size of the increase compared to the projections presented in this analysis dependent on the amount of spare capacity in the labour market.

11 Conclusions

11.1 Economic Assessment

First we must be clear about the treatment of transfers within the Government sector. An estimated [redacted] of the CLG contract investment (£20 million per annum) impacts Ordnance Survey's public sector customers, notably central Government departments, local Government and the NHS. This proportion[redacted] is a transfer within Government and cost-neutral from an economic modelling perspective. Whilst evidence from other projects[54] suggests the cost transfer from OS to public sector users would generate net benefits, we have deliberately not examined these effects as it is difficult to isolate OpenData impacts from those associated with the Public Sector Mapping Agreement (PSMA).

The CGE modelling indicates that after applying the remaining [redacted] per annum as a negative shock to the Government sector, the OS OpenData initiative will deliver a net £13.0 million - £28.5 million increase in GDP in 2016. The main components of this increase are net productivity gains (£8.1 million – £18.2 million) and additional real tax revenues (£4.4 million – £8.2 million).

The increase is also net of £3.7m per annum, applied as a negative shock to GB exports, to account for OS OpenData being integrated in to products of companies paying taxes abroad. Despite the fact that GB loses this export income, overall the value of exports to the economy increases by £6.1m – £10.3m as other sectors of the economy expand.

Another important metric is the increase in real national income (real GNP) in the range £10.2m – £24.1m by 2016. This is an indication of the increase in economic welfare for British society as a whole.

11.2 General equilibrium verses partial equilibrium analysis

In previous sections we have discussed the differences between a partial and a general equilibrium approach to estimating the net economic impact of changes in pricing policies for geospatial information in general. This discussion noted that the approach used in the Pollock, ANZLIC and Houghton studies, detailed in Section 5, relied on partial equilibrium approaches to assessing changes in economic surplus arising from different pricing policies.

There are two issues that the Pollock paper was not able to address fully in the application of a partial equilibrium approach to pricing policies for large scale topographic and transport network products. The first arises from the fact that some of the products produced by Ordnance Survey are effectively exported. They are products that are incorporated into value added products abroad - reducing the price of these products results in a loss of

[54] ConsultingWhere and ACIL Tasman: Assessing the Value of Geospatial Information in Local Public Service Delivery, Local Government Association, 2010.

export income. This has exchange rate implications as well as net loss of income to the British economy.

The second issue is the fact that the products are used in multiple sectors of the economy and that the use of the products leads to efficiency improvements. Evidence suggests that usage across sectors of the economy is growing rapidly. This leads to shifts in changes in economic surplus in other sectors of the economy that cannot be captured by a partial analysis without resorting to multiplier assumptions. Although technically possible (albeit complicated), multipliers are a poor instrument for estimating the benefits of productivity improvements and, by their nature, do not provide any information on how resources will shift around the economy in response to productivity improvements. The case studies in this report show that the change in pricing policies will result in an overall increase in economic surplus, some sectors can still contract (for example legal services). It is very difficult to account for such resource shifts in the economy with multiplier techniques.

Partial equilibrium analysis has an important place in assessing economic impact of policy change. However, where policy change affects more than one sector, partial analysis cannot reliably incorporate the wider effects on the economy. For these reasons, analysts have turned to approaches that address the change in value added[55] across the economy.

A full discussion of the different approaches to estimating the economic impacts of policy change has been provided by the Australian Competition and Consumer Commission[56]. The Commission's paper notes that partial equilibrium analysis is generally sufficient where policy change only affects a narrow sector of the economy or where spillovers to other sectors of the economy are not considered significant enough to produce material changes in consumer or producer surplus elsewhere in the economy.

However a partial analysis will not accurately produce the net change in economic surplus where policy change results in resource shifts between other sectors of the economy and delivers significant changes in economic surplus in other sectors. Such changes can be positive or negative. For example in one case study undertaken for this project it was shown that the legal profession is experiencing a decrease in producer surplus, as a result of simpler licensing terms, while increases in consumer surplus were being produced elsewhere. General equilibrium analysis can take these changes into account.

The case study approach overcomes the problems associated with estimating elasticities of demand over a wide range of price and quantity assumptions. It also incorporates levels of adoption as well as productivity and other shocks in different sectors. This avoids the need to factor in discount rates of time delay as the impacts can be measured at current and future times depending on the policy questions being addressed. The adoption rates are

[55] Value added is the difference between the value of goods and services sold and the cost of inputs. It is the major component of measures of Gross Domestic Product (the other components being taxes and subsidies).

[56] Australian Competition and Consumer Commission: Evaluating infrastructure reforms and regulation: a review of methods. (August 2010)

derived from case studies of specific applications where assumptions are verified in interviews and download analysis for the data in question.

It is not necessary to make assumptions about indirect impacts as these are incorporated in the CGE model. When one sector is subject to a shock, the direct impacts feed through into adjustments across all sectors in the model. Positive and negative effects are calculated for the sectors of the economy as the model determines a new equilibrium for the economy as a whole. Resource shifts between sectors are incorporated into this calculation.

In this way, benefits to resellers and their customers are automatically incorporated in to the modelling using the established relationships between sectors in the economy, their inputs and outputs and their resulting valued added contribution to GDP.

It should also be noted that the demand functions in the Tasman Global model do not assume a linear demand curve. Elasticities are derived from the demand functions and adjusted at different levels of demand.

Changes in trade with the rest of the world can also be analysed. As discussed earlier, a reduction in the price of geospatial data supplied by Ordnance Survey has resulted in some loss of revenue from users located abroad. This results in a fall in export income that can be incorporated into the basket of shocks.

General equilibrium modelling thus overcomes many of the material constraints associated with partial equilibrium modelling of pricing policies for services supplied by Ordnance Survey.

We conclude that recent literature has acknowledged that both partial and general equilibrium modelling have a place in assessing economic impacts of public sector data. However, partial equilibrium modelling is more suited to assessing the impacts of a specific product or service where policy change is not likely to result in resource shifts in elsewhere in the economy. Where the policy change applies to a number of services as is the case with OS OpenData, and where there are material implications for value added in many other sectors of the economy, general equilibrium modelling is a more robust approach.

11.3 Pricing Policy

Pricing objectives include considerations of economic efficiency, equity, revenue sufficiency and simplicity.

A central issue to assessing the economic impacts of different pricing policies for OS OpenData is the concept of economic welfare. It is the impact of different pricing policies on the aggregate economic welfare that provides the guide to estimating their economic impact. However maximising economic welfare does not necessarily achieve equity objectives and may not provide sufficient revenue for the supply of public goods by agencies despite the fact that overall economic surplus is greater for the economy as a whole.

Different pricing approaches involve different trade-offs of these objectives, as discussed below.

11.3.1 Welfare economics

Welfare economics provided the theoretical framework for identification and estimation of the economic benefits that might result from policy reform. Welfare economics is built around concepts of economic efficiency which includes concepts of allocative, cost and dynamic efficiency. At the core of economic efficiency however is the concept of economic surplus that is created as a consequence of the outcomes of supply and demand in the many markets that constitute a nation's economy.

These concepts depend on some important value judgements[57]. These value judgements or postulates are as follows:

- Social welfare is based solely on the welfare of individuals that make up society.
- Individuals are the best judges of their own welfare.
- Pareto Criterion
  - Society is deemed better off as a consequence of policy change if that change results in at least one individual being made better off and no individual being made worse off
  - Generally referred to as the Pareto criterion and any change satisfying it is referred to as a Pareto improvement or the no-loser outcome[58].
- Kaldor-Hicks criterion[59]
  - In the 1930s and 40s a number of economists observed that few economic policy changes actually achieved the no-loser outcome. For example the repeal of the Corn Laws in the 1840s resulted in consumers of bread benefiting from lower prices while landowners lost out by receiving lower prices for their wheat.
  - In 1939 two economists Kaldor and Hicks argued for that economic policy change was desirable if the gainers from that change would still be better off if they were to compensate the losers for their losses
  - This is sometimes referred to as the Kaldor Hicks criterion or the Potential Pareto criterion.
- Later Harberger[60] specified three basic postulates for applied welfare economics that provided guidelines for applying the Kaldor-Hicks criterion. These were:
  - The competitive demand price that a consumer is willing to pay for a unit of a good or service reflects the value of that unit to the consumer
  - The competitive supply price for a given unit of a good or service measures the value of that unit to the supplier
  - When evaluating the net benefits or costs of a given policy change, the costs and benefits accruing to each member of the nation should normally be added without regard to the individuals to whom they accrue.

[57] Australian Competition and Consumer Commission: *Evaluating infrastructure reforms and regulation: a review of methods.* (August 2010)

[58] Pareto, V. (1906). *Manual of political economy.* London: MacMillan Press Ltd.

[59] (Kaldor, 1939) (Hicks, 1939)

[60] Harberger A (1964) Taxation Resource Allocation and Welfare NGER 25-27

These concepts or postulates have been broadly adopted by economics as forming the basis of work in applied welfare economics and the estimating of social net benefits arising from policy change – sometimes referred to as social cost benefit analysis.

11.3.2 Maximising economic welfare

Maximising economic welfare in its simplest form requires that the economic surplus created in an economy is maximised. Economic surplus is measured by consumer and producer surplus (see Figure 2 at Appendix D.4).

This is in essence a static approach applying to a specific point in time. This does not necessarily capture the changes that can take place over time both in terms of productivity and in terms of innovation. For this reason some analysts refer to three forms of efficiency:

- Allocative efficiency
  - Allocative efficiency relates to the allocation of finite resources to their most valuable uses across the economy. In basic terms this means that the value of the marginal unit produced to consumers matches the additional cost to the economy of producing that unit.
- Productive efficiency
  - Productive efficiency refers to the condition where a given level of output of a good or a service is produced at the minimum cost.
- Dynamic efficiency
  - Dynamic efficiency refers to the impact on efficiency of innovation over time through new or improved production processes, organisation structures and / or services.

Most of the partial equilibrium analysis and general equilibrium analysis starts with allocative efficiency. This is the first point of estimate for the Pollock, ANZLIC and Houghton papers discussed in this report. In partial equilibrium analysis, productive efficiency and dynamic efficiencies are generally dealt with through extra assumptions including the use of multipliers and assumptions of staged delivery of benefits over time.

General equilibrium analysis addresses productive efficiency through changes in productivity shocks which draw on observations of rates of adoption as well as rates of technological change. Neither approach addresses dynamic efficiency arising from fundamental changes in the structure of economies without major changes in the structure of the models.

11.3.3 Marginal cost pricing

One of the best-known results of economic analysis is that allocative efficiency is achieved by pricing goods and services at their marginal cost of production. Short run marginal cost (SRMC) is the relevant definition of marginal cost, as it represents the true resource costs that are incurred in supplying an additional unit of service, using the existing infrastructure.

An argument for marginal cost pricing of digital geographic information is that it is an essential input to many products and services in other important sectors of the economy. This implies that is important to minimise pricing distortions which might lead to a misallocation of resources. Further, GIS data are often an essential input into new technologies, which have the potential to open up new markets and foster economic growth[61].

However where there are high fixed costs, SRMC implies that revenue will under-recover costs by some margin. In the absence of sufficient revenue to cover costs, marginal cost pricing implies the need for government subsidy. However, funding such subsidies from taxation imposes efficiency costs because taxation is acknowledged to absorb resources and distort decisions. For this reason, the marginal social cost of public funds needs to be taken into account: estimated to be as high as 30% of the value of the additional tax receipts involved.

Another perspective on this is the "Theory of the Second Best" by articulated Lipsey and Lancaster (Lipsey, 1956-57). The Theory of the Second best suggests that while economic welfare would be maximised through economic efficient pricing policies, the existence of market, policy or regulatory failure in other sectors of the economy may actually make things worse.

In this case, the application of marginal cost pricing might result in the data not being adequately maintained because governments elected not to appropriate sufficient funds for this purpose. In this case blind pursuit of marginal cost pricing could lower not raise national economic welfare.

11.3.4 Average cost pricing

Fully allocated (or average cost) pricing results when a business covers its costs while setting a price that is uniform across all customers. Average cost prices are typically defined as the direct or incremental cost of providing the service plus a mark-up to cover the common costs incurred across the whole service.

Economists criticise fully allocated cost principles on the grounds that the mark-up over incremental cost is essentially arbitrary, and is not based on any principle of efficient resource allocation[62]. The advantage of a fully allocated cost approach is that it is relatively simple and transparent, and less complex to implement than other pricing approaches[63].

[61] See Office of Fair Trading, Dec 2006, The commercial use of public information (CUPI) and HM Treasury, 2000, Cross Cutting Review of the Knowledge Economy.

[62] Armstrong, M. and Doyle, C (1995) The Economics of Access Pricing, Report for the Competition and Consumer Policy Division, OECD, p18

[63] KPMG (Sept 1997) Report on the Pricing Principles in the NSW Rail Access Regime, Report submitted to the NCC, p31

11.3.5 Two part tariffs

In some circumstances, a two part tariff can be an efficient way of addressing the supplier's budget constraint. For example, a service charge to all users of network infrastructure can be used to cover the fixed costs, so that the usage charge can reflect SRMC. Service fees are commonly used in network utility services such as telecoms, water and electricity.

11.3.6 Ramsey pricing

Ramsey pricing has been suggested when subsidies or two-part tariffs are not feasible. The so-called "Ramsey rule" determines prices by maximising a total welfare function subject to a budget constraint. The objective of Ramsey pricing is to minimise the distortions to allocative efficiency caused by raising price above marginal cost (to allow the firm to cover its fixed and common costs).

Mark-ups are applied which are inversely related to the elasticity of demand[64]. Where demand is relatively inelastic (that is, relatively insensitive to price), a mark-up above marginal cost will have less effect on the quantity demanded than where demand is elastic and accordingly the allocative distortions are minimised.

However pure price discrimination is unlikely to be acceptable for a government owned agency. For example, charging higher prices to customers for whom the data is essential, or to customers who have invested in configuring their own systems to use PSMA data more efficiently, is likely to be seen as inequitable. Indeed, this is one of the criticisms frequently levelled at Ramsey pricing. A further criticism is that it is demanding in terms of the information required to estimate price and cross price elasticities.

That said, it would be possible to combine the price discrimination implicit in Ramsey pricing with product differentiation. Thus most of the fixed costs could be allocated to high value added products. This would leave fewer costs allocated to the unrefined data, which could be priced closer to marginal cost.

11.3.7 Summary

The change in policy to provide OS OpenData free at the point of delivery implemented a policy of marginal cost pricing. This is a first best option that avoids the need for segmented or structured pricing frameworks.

The results of the CGE modelling demonstrate an improved level of productivity in the economy, and higher overall levels of output, directly attributable to making OS OpenData free at the point of delivery.

However, it important to recognise that the analysis assumes that Government will continue to fund the organisation to ensure that it can meet its responsibilities as custodian of this data.

[64] Brown and Sibley (1986).

The theory of the second best implies that if Government does not continue to fund the organisation at a level to meet these responsibilities a less optimal outcome is likely for economic welfare as a whole as well as for the ability of Ordnance Survey to continue to provide the services necessary to realise the economic benefits potentially available.

A fuller discussion of the concepts discussed in this section is provided in Appendix D.

12 Recommendations

12.1 Standardisation of Economic Evaluation

Much of the discussion in this report has centred on establishing the validity of different economic approaches and acceptance of the metrics which underpin the assessment of value. It is evident that the transport industry, led by the DfT, has invested much effort in standardisation of approaches and creation of tools to facilitate economic appraisal of proposed policy interventions. Their experience could usefully applied within the geospatial industry.

We recommend that OS, in conjunction with the geospatial industry, sponsor an initiative to establish common methodologies for evaluating economic value from proposed policy initiatives ideally before, rather than after, the political decisions have been made.

12.2 UK-wide Approach

Many of the organisations interviewed are operating across the whole of the United Kingdom. The lack of an equivalent initiative in Northern Ireland means that the benefits of OS OpenData are less than would otherwise be the case. In some sectors this has caused them not to use OS OpenData in many of their products. One interviewee estimated that 85% of their customers operated UK-wide and they had decided not to change their embedded licensing terms for OS data to avoid confusion.

It is recommended that the results of this study are shared with the Northern Ireland government in order to attempt to persuade them to adopt a similar policy.

12.3 Product Maintenance

Many organisations are concerned that OS OpenData will not be maintained to the same degree of currency as paid-for products and hence its value will decline over time. They need to be reassured that this is not the case. This would be facilitated by OS clearly publishing and publicising details of the maintenance regime for OS OpenData.

We recommend that OS publicise commitments to maintenance and currency of the OS OpenData products.

12.4 Awareness

There is a lack of awareness in certain sectors of the benefits of OS OpenData. The B2C application developer community is currently over-represented by “social applications” designed to support political or social campaigns. It is our belief that the smaller app development companies are not sufficiently aware of the potential of OS OpenData. Other sectors identified as lacking the awareness of the free authoritative content now available is the agricultural sector.

We recommend renewed publicity for the OS OpenData initiative, focusing particularly on parts of the private sector where this study has identified significant gaps in awareness.

12.5 Database Supply

A number of interviewees expressed frustration with the need to download and stitch together multiple tiles. This has been a discouragement to use of OS OpenData and in one case had meant that the potential user had abandoned investigation of the products.

We recommend that OS OpenSpace is enhanced to enable a complete download option for the tiled datasets.

A Appendix A – OS OpenData scope

OS OpenData covers the following datasets, released under data.gov.uk collective commons licensing:

- **OS Locator** is a fully searchable national gazetteer of road names.
- **OS VectorMap District** is a mid-scale digital vector mapping product giving a district-level view. It clearly shows the landscape features relevant to its level of detail, including generalised buildings, roads, railways, landscape features, boundaries and rivers. It is also available in a raster form.
- **Strategi** is a generalised vector dataset that has been derived from 1:250 000 scale topographic mapping. It contains a comprehensive range of feature types, including railways, airports, ferries, water features, ceremonial boundaries, cities, towns and other settlements, woods and land use, and geographic names. It is designed for use at a regional scale.
- **Boundary-Line** is a polygon dataset of areas defined by electoral and administrative boundaries. The product is supplied as a set of separate layers, representing local authority administrative areas (county, unitary and district councils), ward, civil parish, parliamentary, assembly and European constituency boundaries.
- **Meridian 2** is a mid-scale digital representation of Great Britain that allows considerable customisation of its Communication theme and Topographic theme. The intended primary use of this data is as a customisable base mapping solution.
- **OS Street View** is 1:10 000 scale street-level colour digital raster mapping that has been specifically designed to cartographically emphasise road carriageways, road names and their DfT numbers, generalised buildings and areas of vegetation.
- **Code-Point Open** is a postal geography dataset that features a set of geographically referenced points that represent each of the 1.7 million postcode units in Great Britain.
- **MiniScale** is the smallest scale product designed primarily for use within desktop graphic applications where simple backdrop topographic mapping is required.
- **1:250 000 Scale Colour Raster** is a small-scale topographic digital mapping product that features cities, towns, many villages, motorways, A and B class roads, railways, rivers and some woodland.

- **1:50 000 Scale Gazetteer** provides an excellent reference tool or location finder. The Gazetteer contains entries for airports, farms, hills, woodlands, commons and other places, including over 42 000 towns and settlements with coordinates to 1 km resolution.

- **Land-Form PANORAMA** is a mid-scale product representing the physical three-dimensional shape of the surface of the ground. It is provided as two distinct datasets: (a) Contours: as a set of contours, spot heights, breaklines, coastlines, lakes, ridges and formlines in vector form; (b) DTM: as a gridded digital terrain model with a 50 metre post spacing.

B Appendix B: Independent Economist Assessment

This is a full reproduction of the report prepared following review of the feasibility study.

Assessing the Value of Ordnance Survey OpenData to the Economy of Great Britain: Review of Feasibility Study Report

Patricia Seex and Prabhat Vaze

Background

The feasibility study covered two areas that the study will focus on over the coming months. Firstly, there is a survey of businesses in all sectors where significant use is made of the OS products. The survey seeks to establish the incremental efficiencies that have been delivered through the provision of OpenData, focusing on savings in administration of datasets and any other resource costs excluding the OS charges. The study then scales up the survey results to estimates of the productivity improvements at industry level. In the second part of the study, the GTAP general equilibrium model is used to model the multiplier effect of these industry level shocks.

Survey work

The survey appears 'bottom-up', asking firms for measurable benefits or costs. Businesses were asked to estimate savings attributable to OpenData (such as analysts' time savings, legal admin costs etc.). In addition, some estimation was made of new products where firms would expect to see demand shifts as OpenData price benefits are passed on to the market. Businesses in this area were asked to estimate sales changes. The approach does not ask for businesses to estimate productivity improvements, per se. The approach taken therefore seems cautious and not one that would over-state impacts. Businesses covered for the feasibility study include transport planners, retailers and other high end users of OS products.

Some notes on the approach would be:

- Some further work on the analytical consultancies that provide services to businesses would be needed, such as Experian. It was apparent that the larger firms had in-house capabilities. Further, those businesses that were very focused on spatial planning also would be direct users of OS products. However, numerous medium size firms would use CACI or Experian and the benefits seen by such firms needed some specific analysis.
- Related to this, as businesses are interviewed, it would be worth establishing any changes in expenditures on geo products, including analytical services, due to OpenData. Firms with or without in-house analysts may be substituting across in-house providers and out-sourcing.
- We may also be able to get some direct evidence on the price discrimination aspects of PSI in the surveys. It was noted that the provision of OpenData to firms in engineering areas meant other OS data was purchased, suggesting a 'freemium'

model. Were businesses better able to target their purchase of premium products through their experience of the OpenData.

- It was felt that Google and other large-scale data warehouse businesses should be interviewed more carefully. Recognising that there will be sensitivities about this area, such businesses were both innovative in how they commercialised data and were multinationals, much more able to import and export intellectual property and other assets associated with making PSI use more productive.

Modelling approach

There are in effect two stages to the modelling:

1) grossing up from the case study interviews to sector level estimates; and
2) CGE modelling using the GTAP model to estimate the impact on GDP and other economic indicators.

In grossing up to the sector level the authors apply a market size multiplier and an estimate of the adoption or take up rate of the innovation within the sector. These are fundamental assumptions in generating the sector level inputs into the CGE model. We recommend that the authors are more explicit about how these estimates are arrived at and include a sensitivity analysis on these assumptions or provide ranges for the sector level and total economic impacts based on different assumptions.

Efficiency benefits resulting from process improvements may have 100% adoption, whereas revenue benefits resulting from new products or services will be limited to the market potential of the new product/service.

GTAP is a recognised suite of modelling for determining policy impacts which ripple through the economy, taking account of indirect effects as well as direct 'shocks' to particular sector. It is used to establish the total net effects as product markets reach a new equilibrium following the policy shock.

CGE modelling is a specialist field, and whilst we do not have concerns about the GTAP model or the modelling results, Ordnance Survey may consider asking an academic expert or other practitioner to peer review the final report.

We would however suggest the following:

- There needs to be more evidence about the suitability of GTAP in PSI shocks. Perhaps an annex offering a summary of the recent work in this area and any issues or benefits established in the use of the modelling framework in PSI shocks.
- To some extent, the approach improves on the Pollock work and it would be sensible to ask those researchers to comment on where this work does add to theirs. Given a lot of the same people are involved from the Government side, presumably a formal interaction can be set up, perhaps a seminar, for this.

Overall conclusion

CGE modelling is an appropriate method for valuing the contribution of OS OpenData to the economy of Great Britain and we commend Ordnance Survey for commissioning the study.

We recognise the significant difficulties the consultants faced in accessing the data required for this approach. We have suggested further refinement of the modelling and improvement of the reporting. We believe the final report will make a useful contribution to the literature and our understanding of the economics of OpenData policies in the UK.

C Appendix C: Tasman Global CGE Model

ACIL Tasman's computable general equilibrium model Tasman Global is a powerful tool for undertaking economic impact analysis at the regional, state, national and global level.

There are various types of economic models and modelling techniques. Many of these are based on partial equilibrium analysis that usually considers a single market. However, in economic analysis, linkages between markets and how these linkages develop and change over time can be critical. Tasman Global has been developed to meet this need.

Tasman Global is a large-scale computable general equilibrium model which is designed to account for all sectors within an economy and all economies across the world. ACIL Tasman uses this modelling platform to undertake industry, project, scenario and policy analyses. The model is able to analyse issues at the industry, global, national, state and regional levels and to determine the impacts of various economic changes on production, consumption and trade at the macroeconomic and industry levels.

A Dynamic model

Tasman Global is a model that estimates relationships between variables at different points in time. This is in contrast to comparative static models, which compare two equilibriums (one before a policy change and one following). A dynamic model such as Tasman Global is beneficial when analysing issues where both the timing of and the adjustment path that economies follow are relevant in the analysis.

In applications of the Tasman Global model, a reference case simulation forms a 'business-as-usual' basis with which to compare the results of various simulations. The reference case provides projections of growth in the absence of the changes to be examined. The impact of the change to be examined is then simulated and the results interpreted as deviations from the reference case.

The database

A key advantage of Tasman Global is the level of detail in the database underpinning the model. The database is derived from the latest Global Trade Analysis Project (GTAP) database. This database is a fully documented, publicly available global data base which contains complete bilateral trade information, transport and protection linkages among regions for all GTAP commodities.

The GTAP model was constructed at the Centre for Global Trade Analysis at Purdue University in the United States. It is the most up-to-date, detailed database of its type in the world.

Tasman Global builds on the GTAP model's equation structure and database by adding six important features:

- dynamics (including detailed population and labour market dynamics)

- detailed technology representation within key industries (such as electricity generation and iron and steel production)
- the ability to repatriate labour and capital income
- a detailed emissions accounting abatement framework

Nominally the Tasman Global database divides the world economy into 120 regions although in reality the regions are frequently disaggregated further.

The Tasman Global database also contains a wealth of sectoral detail currently identifying up to 70 industries. The foundation of this information is the input-output tables that underpin the database. The input-output tables account for the distribution of industry production to satisfy industry and final demands. Industry demands, so-called intermediate usage, are the demands from each industry for inputs.

For example, electricity is an input into the production of communications. In other words, the communications industry uses electricity as an intermediate input. Final demands are those made by households, governments, investors and foreigners (export demand). These final demands, as the name suggests, represent the demand for finished goods and services. To continue the example, electricity is used by households – their consumption of electricity is a final demand.

Each sector in the economy is typically assumed to produce one commodity, although in Tasman Global, the electricity, diesel, transport and iron and steel sectors are modelled using a 'technology bundle' approach. With this approach, different known production methods are used to generate a homogeneous output for the 'technology bundle' industry. For example, electricity can be generated using coal, petroleum, gas, nuclear, hydro or other renewable based technologies – each of which have their own cost structure.

The other key feature of the database is that the cost structure of each industry is also represented in detail. Each industry purchases intermediate inputs (from domestic and imported sources) primary factors (labour, capital, land and natural resources) as well as paying taxes or receiving subsidies.

Factors of production

Capital, land, labour and natural resources are the four primary factors of production. The capital stock in each region (country or group of countries) accumulates through investment (less depreciation) in each period. Land is used only in agriculture industries and is fixed in each region. Tasman Global explicitly models natural resource inputs as a sector specific factor of production in resource based sectors.

D Appendix D: Assessing economic impacts

D.1 Introduction

This appendix discusses the approach taken to an evaluation of the economic impact of removing the charges for OS OpenData. It first discusses the evaluation process, then outlines the approach taken to defining the different scenarios and the importance of the counterfactual. Finally it briefly reviews different approaches to estimation of the economic impact of policy change.

The level of detail included here is designed to meet the recommendation of the independent review (section 4.2) that the final report include an explanation of the "state of the art" in respect to approaches to modelling economic impacts. Some of what appears in this Appendix has already been included in the Conclusions Section 11, it is repeated here to provide a complete and standalone account of the economic assessment.

D.2 Evaluation process

There are several ways outlined in the literature in which the impact of policy changes can be assessed. Impacts can be measured after policy changes have been implemented (*ex-post*) or at a future date (*ex-ante*). Impacts may be also assessed at various levels from the project level to the economy wide level. The different approaches that might be used to assess the impact of introducing the new pricing policy for OpenData might be summarised in the following way:

- An economy wide assessment
  - this would involve an assessment of the economy wide impact of introducing the OS OpenData pricing policy.
- A sector level assessment
  - this would address the net benefits for a specific sector of introducing the policy such as those associated with an increase in use of OS OpenData by one set of organisations working in (say) the environment sector.
- A project level assessment. This could include either
  - a focused assessment of the increase in demand for certain categories of OS OpenData requiring an estimate of the demand curve for the specific data group
  - or the benefits associated with a specific project or application.

The essence of the policy change for this project is a transfer of funding of OS OpenData from users to central government. Some of the users will be industry and some of the users will be other government agencies. In the case of the latter, the change in funding arrangements is an internal transfer internal to the government sector. The main economic impact arises as a result of the expected change in use of OS OpenData by either the private or the public sector, including the impact on productivity. A further impact arises as a result of transferring funding from users to central government.

A general principle underpinning this policy change is the public good properties associated with what is now referred to as OS OpenData. The cost of additional resources required to implement this change - relating to setting up web access and changes to facilitate the free internet access arrangements, is small by comparison with the total cost of collecting and maintaining the data. The benefits that are expected to accrue as a result of this change are an increased use by users across many sectors of the British economy and greater levels of innovation.

With the benefits being so spread across many sectors of the economy, it is not appropriate to limit the estimate of net benefits to those accruing to a single project, a single sector or a limited number of sectors. This would result in a vast underestimate of the benefits. Furthermore, the nature of the policy change is likely to result in some sectors of the economy expanding while other sectors contract. Focussing only on those sectors that expand would overestimate the net benefits that might accrue to the economy as a whole. For example the case study showed that there would be a decrease in legal services as contractual complexity of licensing is reduced.

For these reasons the report assesses the net benefits of the policy change across the economy as a whole.

The pricing policy has only recently been implemented and benefits are expected to take some time to emerge as new and existing users develop additional value added products and services based on an increased use of OS OpenData. An *ex-ante* estimate of future benefits is therefore required with the time frame being long enough to allow for increased use of OS OpenData but short enough to make reasonably reliable estimate of the likely impact. We estimate from comparison with other information innovation adoption that a period of five years is a reasonable “default” period over which to expect the adoption cycle to have run its course.

While an *ex- ante* assessment depends on reliable estimates of the changes that are likely to arise as a result of the policy change, a conservative approach to estimating the benefits, counterbalanced by sensitivity testing of variables to provide a range of possible outcomes helps place the uncertainties associated with making the estimates into context.

In addition, provided the comparison of the two scenarios is well formulated, the results will serve as a baseline against which outcomes can be measured over time and compared with the various sensitivity outcomes. This can help when monitoring the outcomes of the policy change over time and undertaking *ex-post* impact assessments once sufficient time has elapsed. An *ex-post* assessment at the end of the period can be a useful tool to assessing the effectiveness of different arms of policy implementation and guide future policy adjustments.

D.3 Approach to the cost benefit analysis

D.3.1 Welfare economics

Welfare economics provides the theoretical framework for the identification and estimation of the economic benefits that should result from policy reform. Welfare economics is built around the concept of economic efficiency in terms of allocative, cost and dynamic efficiency.

These concepts depend on some important value judgements that were summarised in a report issued by the Australian Competition and Consumer Commission in 2010. These value judgements or postulates are as follows:

- Social welfare is based solely on the welfares of individuals that make up society.
- Individuals are the best judges of their own welfare.
- Pareto Criterion
  - Society is deemed better off as a consequence of policy change if that change results in at least one individual being made better off and no individual being made worse off
  - generally referred to as the Pareto criterion and any change satisfying it is referred to as a Pareto improvement or the no-loser outcome (Pareto, 1906).
- Kaldor-Hicks criterion[65]
  - In the 1930s and 40s a number of economists observed that few economic policy changes actually achieved the no-loser outcome. For example with the repeal of the Corn Laws in the 1840s resulted in consumers of bread benefiting from lower prices while landowners lost out receiving lower prices for their wheat.
  - In 1939 two economists Kaldor and Hicks argued for that economic policy change was desirable if the gainers from that change would still be better off if they were to compensate the losers for their losses
  - This is sometimes referred to as the Kaldor Hicks criterion or the Potential Pareto criterion.
- In 1971 Harberger[66] specified three basic postulates for applied welfare economics that provided guidelines for applying the Kaldor-Hicks criterion. These were:
  - The competitive demand price that a consumer is willing to pay for a unit of a good or service reflects the value of that unit to the consumer
  - The competitive supply price for a given unit of a good or service measures the value of that unit to the supplier
  - When evaluating the net benefits or costs of a given policy change, the costs and benefits accruing to each member of the nation should normally be added without regard to the individuals to whom they accrue.

[65] (Kaldor, 1939) (Hicks, 1939)

[66] Harberger A (1964) Taxation Resource Allocation and Welfare NGER 25-27

These concepts or postulates have been broadly adopted by economics as forming the basis of work in applied welfare economics and the estimating of social net benefits arising from policy change – sometimes referred to as social cost benefit analysis.

D.3.2 Concepts of economic efficiency

Allocative efficiency

Allocative efficiency relates to the allocation of finite resources to their most valuable uses across the economy. In basic terms this means that the value of the marginal unit produced to consumers matches the additional cost to the economy of producing that unit.

A more sophisticated interpretation of allocative efficiency can be gained by satisfying three basic conditions:

- Efficiency in production
  - This occurs where available productive resources are allocated in a way that the output of any one good can only be increased by reducing the output of another good and/or services
- Efficiency in consumption
  - This occurs where the bundle of goods and/or services produced is allocated so that no one individual can be made better off without somebody being made worse off
- Overall efficiency
  - This is realised when the economy trades off between goods and/or services in production as individuals trade them off in consumption

Productive efficiency

Productive efficiency refers to the condition where a given level of output of a good or a service is produced at the minimum cost. Productive efficiency includes the concepts of cost efficiency, technical efficiency and "X factor" efficiency.

Cost efficiency refers to least cost production and involves consideration of the price of inputs while technical efficiency refers to the efficiency of turning inputs into outputs. Technical efficiency is a key determinant of productivity which can be referred to as labour productivity or in recent years Total Factor Productivity which studies the growth rates in output and inputs.

X factor efficiency was introduced by Leibenstein in 1987 which is the efficiency achieved in a fully competitive environment[67]. X factor productivity may be important in the use of OpenData as value added resellers and end users combine in new ways to deliver services and data that significantly change productivity in other sectors of the economy.

[67] Leibenstein, H. (1987). X- Efficiency Theory. *The New Palgrave Dictionary of Economics*, 934-935.

Dynamic efficiency

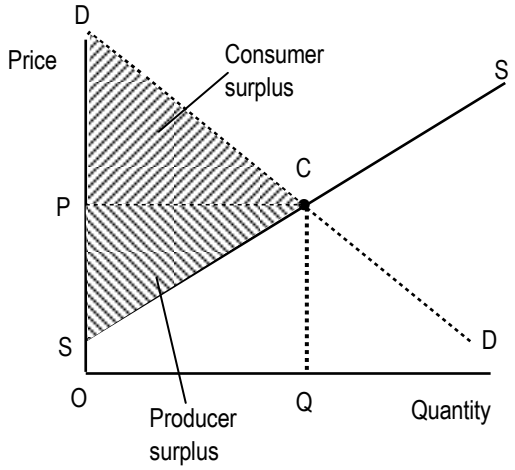
Dynamic efficiency refers to the impact on efficiency of innovation over time through new or improved production processes, organisation structures or services or both. This is extremely difficult to estimate. Experience has shown that it is hard to estimate what value added resellers or end users will do with the data. This sector of the economy has been characterised by fast innovation and rapid growth in new services as the data and data delivery services become available.

D.4 Maximising economic welfare

In applied economic impact assessment, allocative efficiency is often interpreted in terms of the change in net economic surplus from a policy change.

Economic surplus is measured by consumer and producer surplus. The conceptual base for providing an understanding of consumer and producer surplus is the supply and demand, or market, model shown in **Figure 2**.

Figure 2 Standard concepts of producer and consumer surplus



Note DD represents the demand curve, SS represents the supply curve. P and Q are the efficient price and quantity outcomes in this market model

ACIL Tasman chart

This market model provides the basis for identifying and estimating the net economic values to consumers and the net economic values to producers, referred to as consumer surplus and producer surplus, respectively.

Consumer surplus is the difference between what an individual would be willing to pay (demand) for a good or service (the total benefit to the consumer) and what they have to pay (the cost to the consumer i.e. consumer expenditure (price times quantity). In **Figure 2** it is the area between the demand curve and the price line.

Producer surplus is the difference between the revenue (consumer expenditure) received for a good or service (total benefit to producer) and the costs (supply) of the inputs used in

the provision of the good or service (economic cost to producer). In practical terms, it is the net revenue (before tax) that is earned by producer of goods and services. In **Figure 2** it is the area between the price line and the supply curve.

The interaction of demand and supply determines the market price for a good and the quantity that is produced in any given time period. The market is said to be in equilibrium at a level of production Q where the supply curve and the demand curve intersect. At this point the marginal cost of an additional unit of supply is equal to the marginal value of that unit of additional supply to consumers (in terms of the Pareto concept discussed above). This is the point where total economic welfare is maximised. In a perfectly operating market allocative and productive efficiency are achieved at this point.

D.5 Market failure

The assumption that economic welfare is maximised when the marginal cost is equal to the marginal value (or in monetary terms - marginal revenue) only applies in a perfectly operating market. In the real world markets are not always perfect. These imperfections are referred to as market failures in economic theory. More specifically, a market failure is said to occur when there is an inefficient allocation of resources[68]. There has been a long ranging debate regarding the sources of market failure and, indeed, whether the phenomenon of market failure even exists. Based on the current mainstream view, market failures are said to potentially occur under many circumstances including:

- market power or monopoly behaviour
  - including the 'waste' of economic resources by firms attempting to rent seek (for example, by lobbying governments for control of, or exclusive access to certain markets)
- unpriced spill-over costs and benefits sometimes referred to as externalities
  - environmental damages on un-owned property (such as the atmosphere or international waters) are one commonly referred to example of an externality.
- provision of public goods
  - goods that are non-rival or non-excludable such as national security and some government collected information
- information asymmetries
- regulatory or policy failure
  - inefficient intervention by government in the operation of markets.

In many cases, Government policy changes are designed to correct for such market failure. For example regulation of monopolies as provided under the Competition Act 1998[69] or regulation of the energy and water sectors are examples of policy interventions designed to

[68] That is, it is possible to reallocate goods in such a way where a market participant may be made better-off without making someone else worse-off.

[69] http://www.oft.gov.uk/about-the-oft/legal-powers/legal/competition-act-1998/

correct for market failure. They are predicated on the principle that such intervention will result in a net increase in economic welfare (i.e. the net change in consumer and producer surplus is positive).

Many if not all of the data included in the OS OpenData framework demonstrate aspects of public good characteristics. The data is non-rival because by and large consumption of the data by one consumer does not preclude the consumption of the same data by another consumer. The data may demonstrate some aspects of excludability in some situations but in general it is possible to limit access on the internet by password protection.

The way in which access is provided can also be a source of market segmentation. For example data provided by the British Geological Survey for surveyors on iPhones or iPads can only be accessed for viewing. Access to the underlying data must be provided by other media. This in effect segments the market for the same data.

However to the extent that the data in OS OpenData has the characteristics of a public good it might be argued that the price of that data should be set at the marginal cost of distributing the data. This is more likely to apply where basic data that government would collect anyway is involved. It is not our position here to enter this argument. The important point to mention in this discussion of partial equilibrium analysis is that the policy change involved moving the price of this data to the marginal cost of supply.

The net benefits of doing so would be reflected in the change in consumer and producer surplus that would arise as a result of this change. Such an approach reflects (to some small degree) the analysis that was undertaken in 1999 by Oxera[70]. This report had many characteristics of a partial equilibrium analysis although through estimates of multipliers and efforts to estimate the opportunity costs of inputs some effort was made to take into account wider economic impacts beyond a partial analysis.

D.6 Partial equilibrium interpretation

In a partial equilibrium interpretation, allocative efficiency is interpreted in terms of change in net economic surplus in a micro-economic context. This means that price and allocative changes at the micro-level do not result in changes in prices or resource allocation elsewhere in the economy.

This is generally a sufficient assumption where the policy change being considered only effects a narrow sector of the economy or where the spillovers to other sectors of the economy are not considered significant enough to result in material changes in consumer or producer surplus elsewhere in the economy.

However a partial analysis may misrepresent the net change in economic surplus for the economy where the policy change delivers significant changes in economic surplus in a number of other sectors across the economy.

[70] http://www.ordnancesurvey.co.uk/oswebsite/aboutus/reports/oxera/index.html

To draw on the assessment of the impact of the Corn Laws for example, a partial equilibrium analysis might look only at the change in economic welfare in the bread making industry. The net economic impact in this case might only consider the change in consumer surplus for consumers of bread and the change in producer surplus for bakers. This would ignore the loss of producer surplus for British landowners for whom the policy change lowered the price they received for wheat produced on their land.

A partial equilibrium analysis therefore can overlook the impact of resource allocation transfers across the whole economy as a result of a policy change in one sector.

D.7 General equilibrium interpretation

General equilibrium analysis was developed around 1938 by Hotelling[71] and refined by Harbergar[72] in 1964. It was developed to account for the presence of substitutes and complements for goods and services and to include the broader impact on economic surplus of specific policy changes.

Thus for example, while the policy change to price the OpenData series at marginal cost (free on the internet) might deliver productivity benefits to the planning and development sector in lower costs of development approvals it might also reduce incomes for the legal fraternity in lower conveyancing charges and litigation.

The general equilibrium approach also deals with situations where the Pareto efficiency condition cannot be fully met simultaneously in more than one area or sector of the economy. This might arise for example because of market or regulatory failure elsewhere in the economy.

This problem was addressed in the 1950s with the concept of the "Theory of the Second Best" by Lipsey and Lancaster[73]. The Theory of the Second best has two dimensions:

- Where one Pareto efficiency condition is not satisfied, it does not necessarily improve welfare to satisfy another of the conditions
  - For example if price exceeds the long run marginal cost in both industries A and B it may not necessarily improve efficiency to set price equal to long run marginal cost in industry A alone.
- Where one or more conditions for Pareto efficiency are not met then there can be a second-best efficient divergence of price from long run marginal cost in the area that can be controlled. In other words it is sometimes better to make the best of a bad lot.

The theory of the second best has implications for evaluation techniques. This may apply to some degree in the case of the OS OpenData policy. For example because of the grey areas

[71] Hotelling, H. (1938) The General Welfare in Relation to Problems of Railway and Utility Rates. *Econometrica*, 242-269

[72] Harberger, A. (1964) Taxation Resource Allocation and Welfare. *NGER*, 25-70.

[73] Lipsey, R. (1956-57) The general theory of the second best. *Review of Economic Studies*, 11-32

associated with public good characteristics, the policy change may not exactly achieve a Pareto optimum – indeed it would probably be impossible to achieve such an optimum. If on the other hand central government had not been willing to provide funding for the collection and maintenance of OS OpenData in concert with moving to free data (marginal cost) the economic welfare gains of marginal cost pricing would have been lost because the data would not have been maintained anyway. The theory of the second best suggests that providing government funds the acquisition and preparation of data, a general free data policy is likely to result in an improvement in economic welfare despite the fact that it is difficult to say if a Pareto condition has been achieved.

The main implications of this theory is that partial analysis may not always capture the full extent of the net change in economic welfare because it can ignore resource transfers and price effects across the economy that are not captured in the partial analysis or it may not take into account the implications of not achieving a general equilibrium in the Pareto optimisation sense.

A general equilibrium approach on the other hand attempts to estimate the economy wide changes in economic surplus of a specific policy change. Depending on the methods used it can also estimate the change in economic welfare from a policy change based on a second best outcome.

D.8 Assessing economic value

There are several methodologies that can be applied to assess the economic impact of goods and services. Those discussed below are practical approaches to the task consistent with the above theoretical underpinning.

D.8.1 Willingness to pay

Willingness to pay is a common approach to estimating the economic value of a good or service. This in effect attempts to infer a demand curve from which an estimate of the benefits can be made.

In many cases the geospatial information services exhibit strong public good characteristics where price is difficult to determine or strong externalities where additional value is created but not reflected in price. Assessing willingness to pay can therefore require an estimate by proxy rather than an observation of a price determined in a market.

There a many credible techniques for estimating the willingness to pay. ACIL Tasman used survey techniques in a study of the economic benefits of the Western Australian Land Information System in 2004 [74].

[74] ACIL Tasman. (October 2010) A new approach to calculating the benefits associated with calculating infrastructure investment. Perth: ACIL Tasman.

This approach requires the conduct of user surveys and is more suitable for assessment of a focussed service. In the case of this project however the number of sectors to be reviewed is likely to lead to unacceptable costs and time requirements.

Making estimates of willingness to pay is therefore not recommended unless the data is already available from recent credible studies.

D.8.2 Estimating value added

An alternate approach to estimating the value of the economic contribution of a sector is to make high level estimates of the value added. Value added is the value of output from the good or service produced less the value of the goods used to produce it. Value added is the main building block of Gross Domestic Product.

Estimates of value added can be direct – that is for the specific good or service - and indirect – that is for other industries that use the good or service. Direct value added can be assessed from studies of the net benefits delivered by a sector compared with the counterfactual. These are then used to estimate changes in outputs between the two scenarios which is then used to change assumptions in a General Equilibrium (GE) model of the economy. GE models provide the capability to model the economy wide impacts of changes in outputs on a national or regional level.

General equilibrium models are an accepted means of estimating the direct and indirect impacts of changes in output of goods and services such as geographical information.

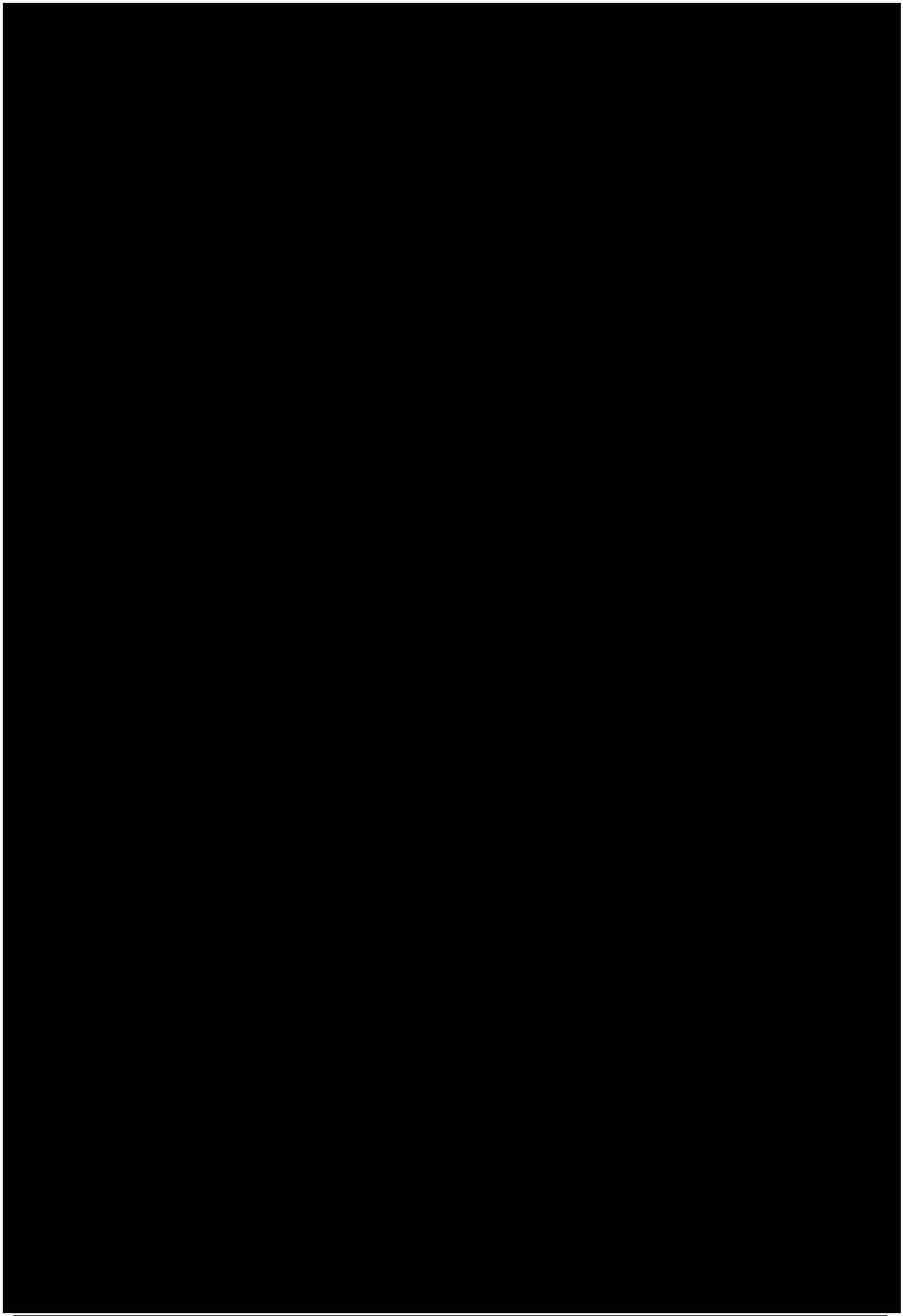
It is proposed that the value added approach using a GE model of the economy is the primary mechanism for measuring economic impacts for this study.

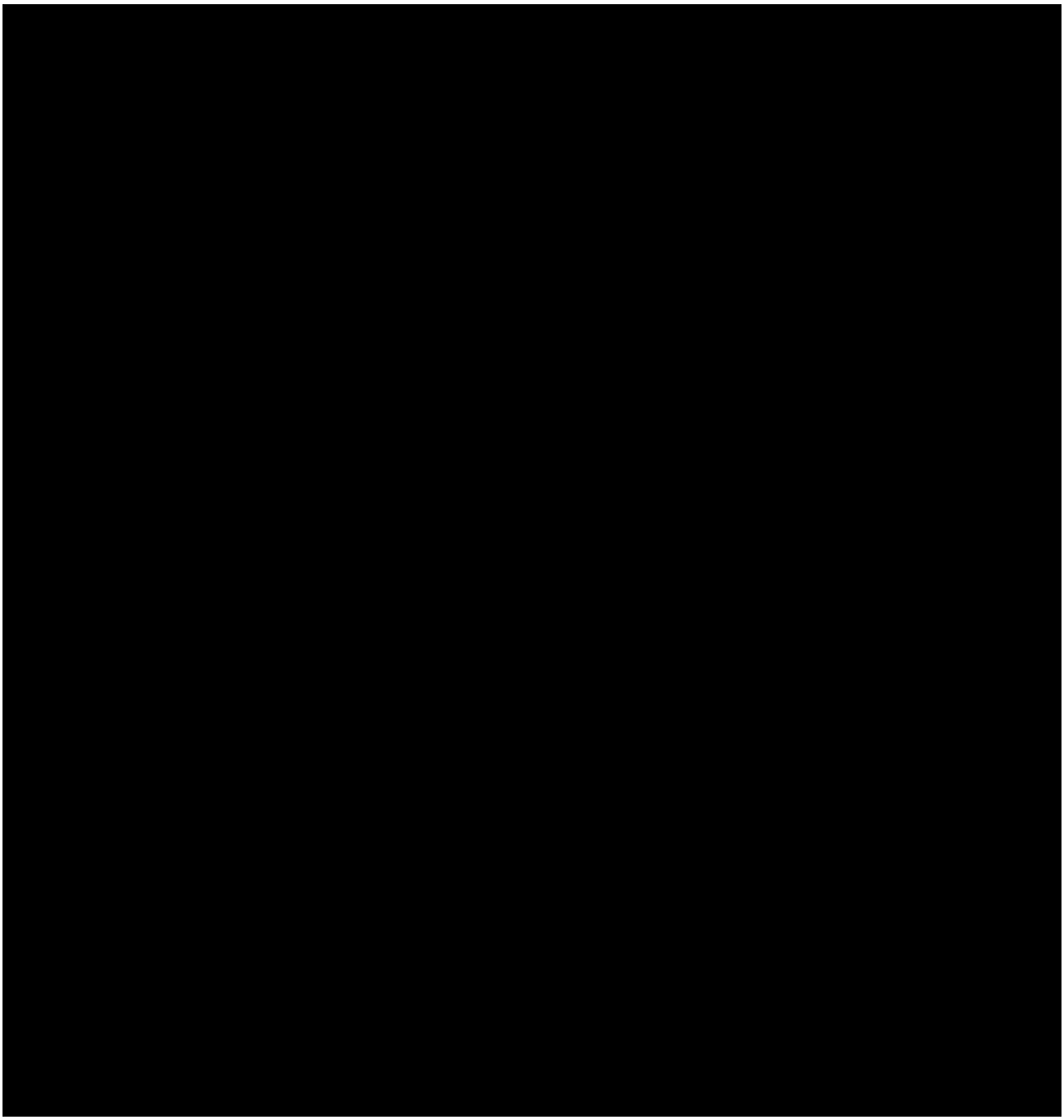
D.8.3 Valuing options

Another approach to valuing the impact of spatial information is in the options it creates for other parties in government and industry to realise higher levels of productivity, grow markets and move into higher value. ACIL Tasman has used real options approaches to estimate the value of investments subject to high levels of uncertainty. In some circumstances the use of real options can overcome some weaknesses in traditional assessments of net benefits from investments subject to high levels of uncertainty. It allows for an assessment of the opportunities for adaptive management of investments that are subject to decision points in the future.

ACIL Tasman has used real options to value things like geoscience data for the Geological Survey of NSW and research and development for the Lapsing Program Review of the Australian Commonwealth Science and Research Organisation.

Real options techniques may well apply to assessing the future economic, environmental and social benefits that are possible from spatial information systems. It is particularly useful for accounting for environmental and social benefits.





[76] See: http://www.bis.gov.uk/files/file35101.pdf

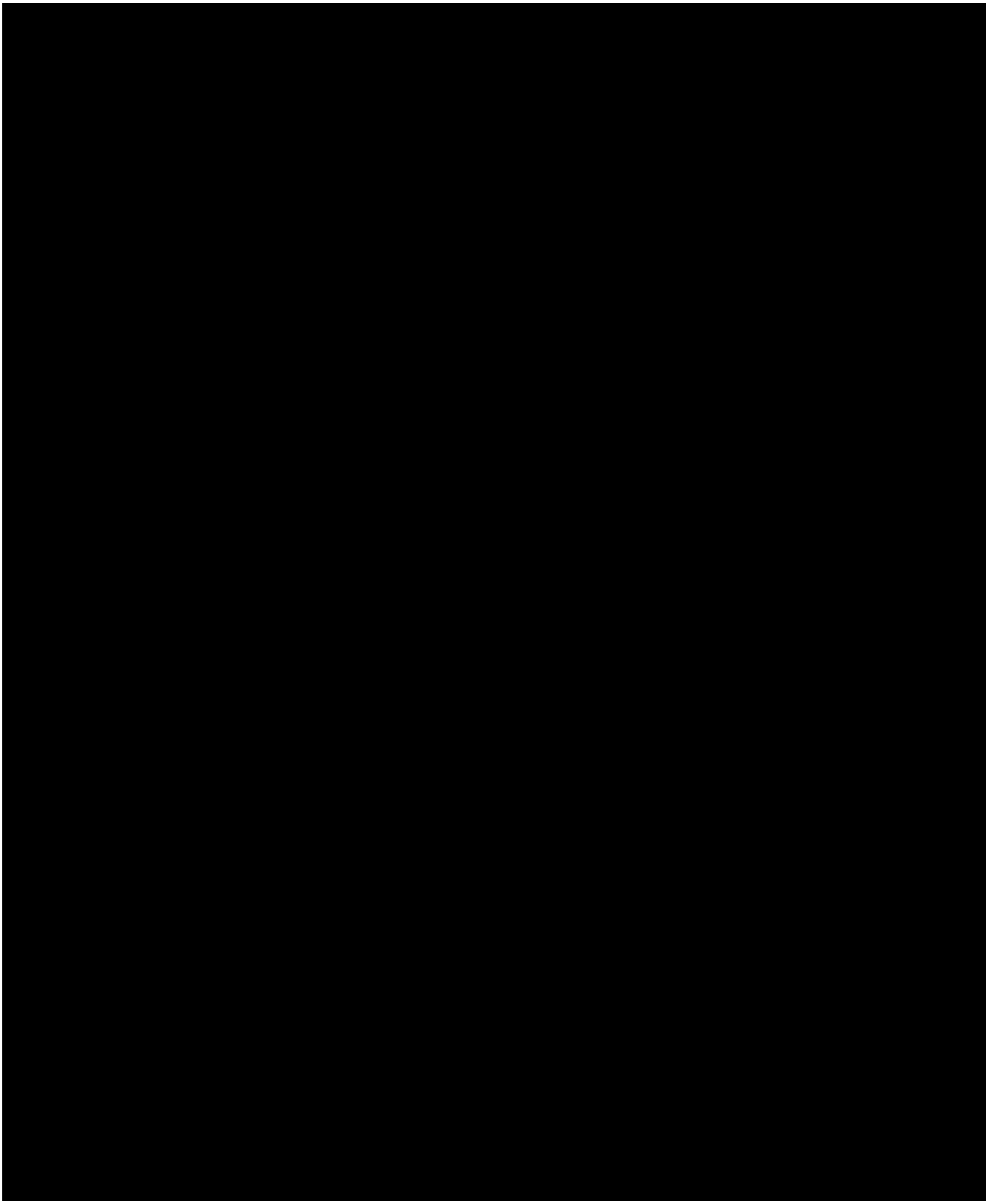
[77] See: http://www.envirok.com/Market_assessment_sample_pages-1.pdf

[78] From: Environment Analyst (2010) Market Assessment of the UK Environmental Consulting Sector 2010 Research Summary for Survey Participants

[79] Environment Analyst (2010) Market Assessment of the UK Environmental Consulting Sector 2010 Research Summary for Survey Participants

[redacted]

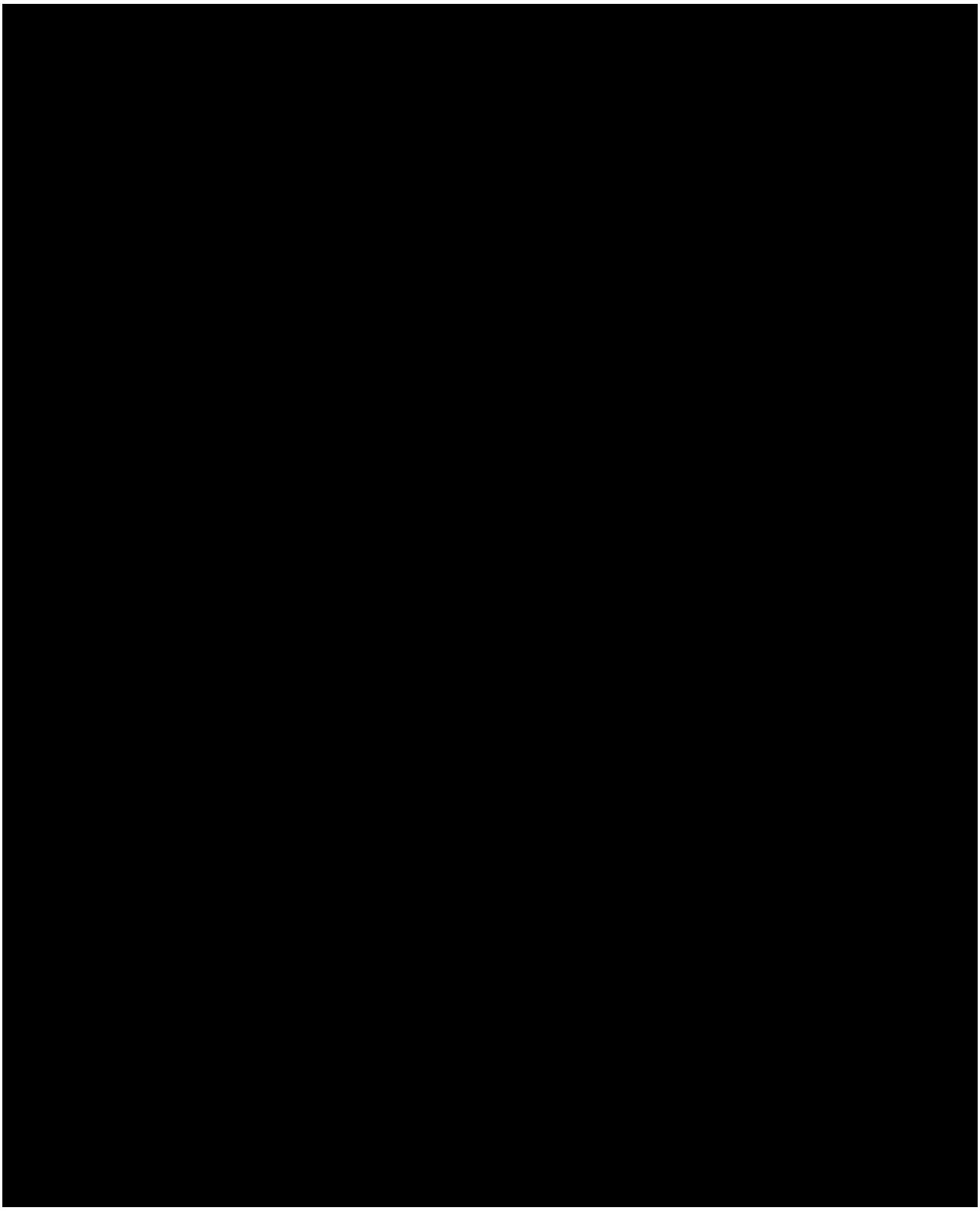
[80] Ditto



[81] See http://en.wikipedia.org/wiki/Renewable_energy for a general introduction

[82] See http://www.decc.gov.uk/assets/decc/Statistics/publications/dukes/313-dukes-2010-ch7.pdf

[83] BERR (2009) Low Carbon and Environmental Goods and Services: an industry analysis http://www.bis.gov.uk/files/file50254.pdf

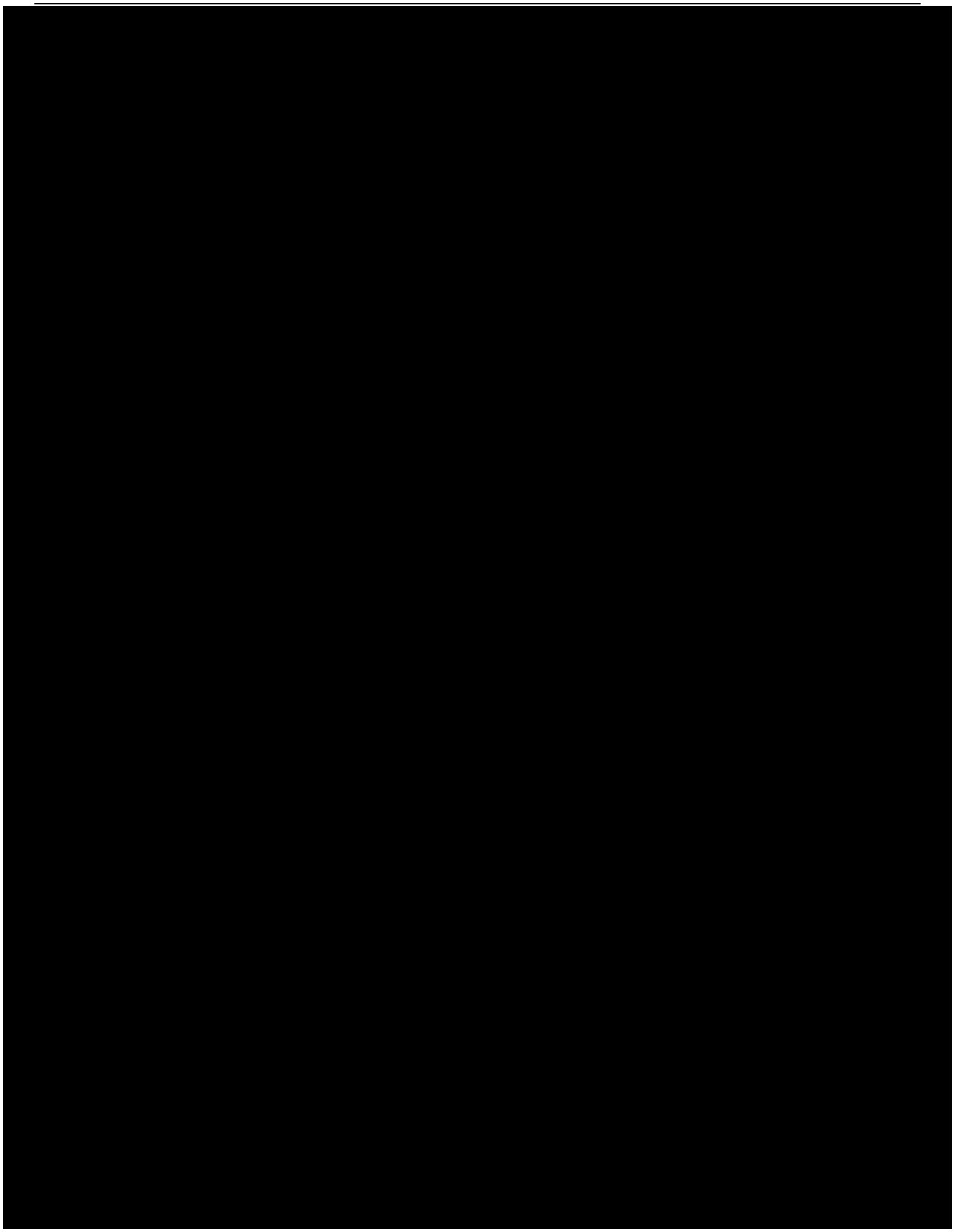


[84] Includes “extended value” and supply chain activities.

[85] NB estimate only arrived at from taking the overall LCEGS figure for NI (*c* £3.25 billion), deriving a percentage for UK and apply this to the UK sales figures for each of the renewables sub-sectors.

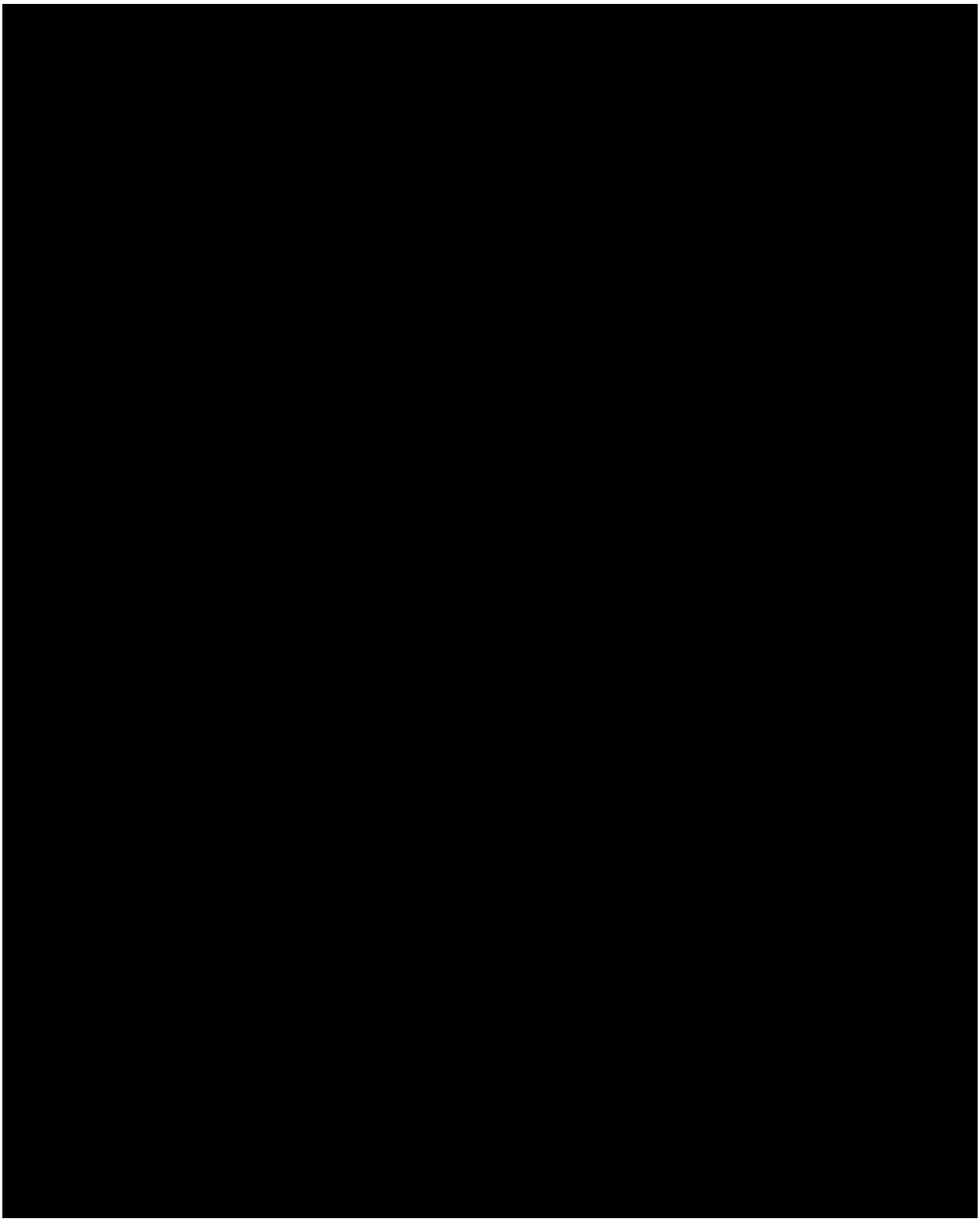
[86] Excluding consultancy

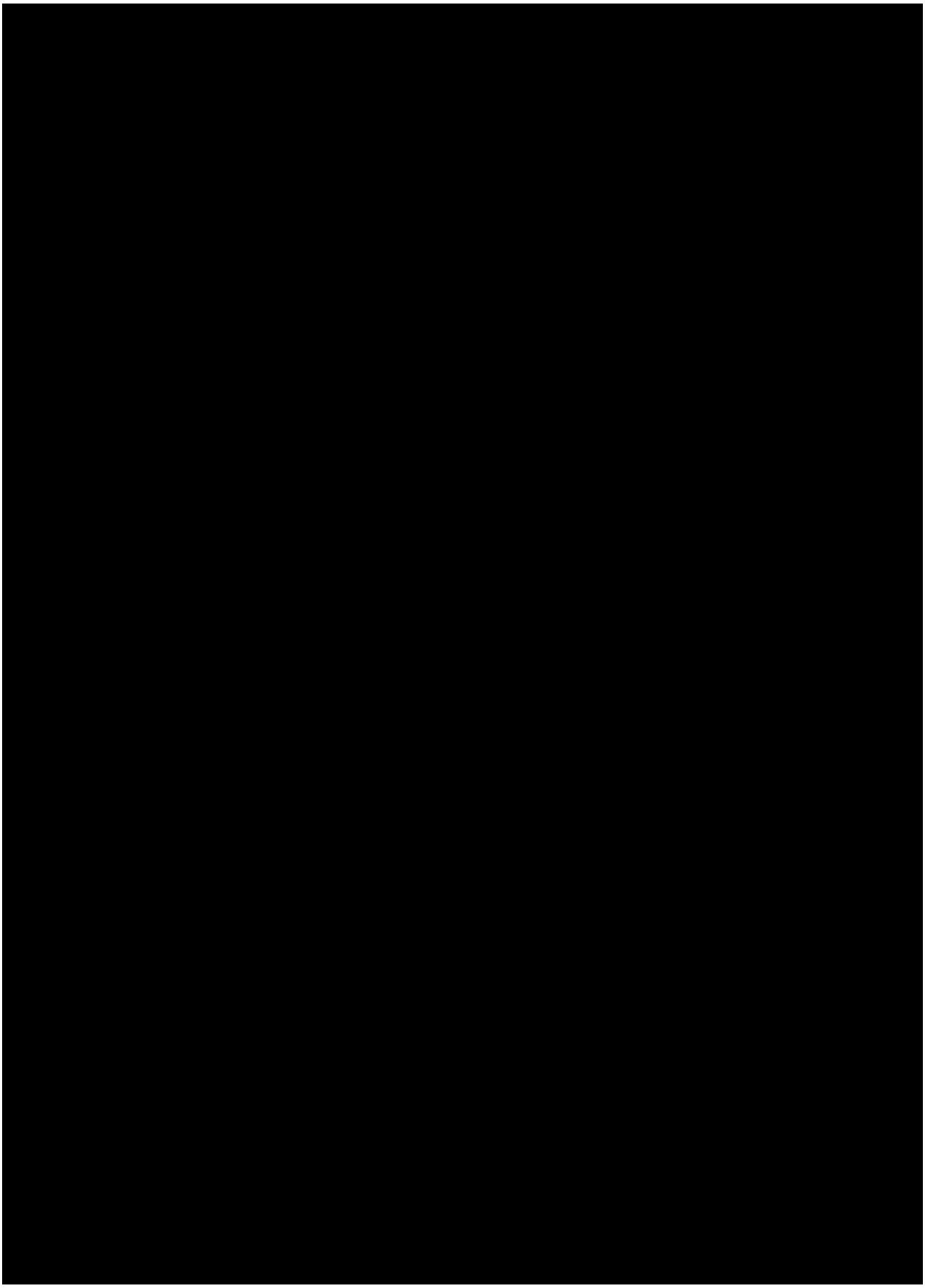
[87] This figure seems extremely high and I doubt its veracity – there are only a handful of geothermal schemes in the UK and in terms of outputs of renewables, it is insignificant (see notes below).

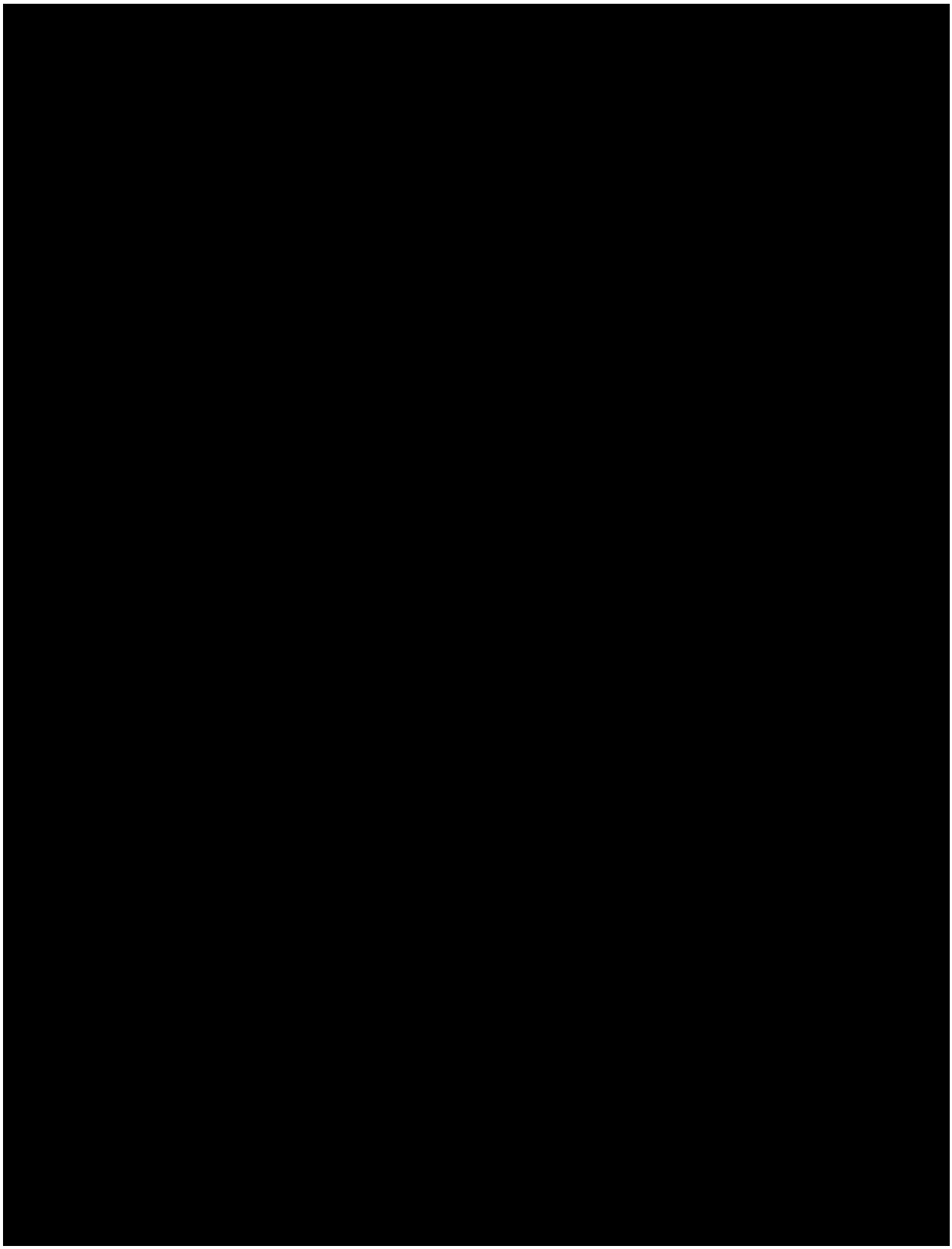


[88] As estimated in December 2008. Includes exports

[89] See Department of Energy and Climate Change, Energy Trends, March 2011 http://www.decc.gov.uk/en/content/cms/statistics/publications/trends/trends.aspx







[90] The Value of Geospatial Information to Local Public Service Delivery in England and Wales. http://www.consultingwhere.com/reports.html