Evidence Review and Illustrative Policy Options for a Scottish Aggregates Levy

Final Report

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Executive Summary

Background and Context

The UK Aggregates Levy was introduced in 2002 with the dual aims of reducing the negative environmental impacts of quarrying and increasing the recycling rate of construction materials, by reducing the rate of primary material extraction. The scope of the UK levy includes all sand, gravel and rock that has either been dug from the ground, dredged from the sea in UK waters or imported into the country. The current rate of the levy is £2 per tonne of aggregates.

The Scotland Act 2016 devolved powers to the Scottish Government for the Aggregates Levy, although the devolution has been delayed by ongoing European Court procedures over the exemptions for secondary aggregates. In anticipation of a resolution of the legal proceedings, Scottish Government wanted to establish the current role of the Aggregates Levy in Scotland, with a view to designing and implementing a Scottish Aggregates Levy. This project has investigated the historical complexities and impact of the Aggregates Levy in the UK and used these findings to develop some illustrative future tax policy options for a Scottish Aggregates Levy, with modelled associated scenarios and potential impacts.

Project Objectives

Based on the above background and context, the following objectives were identified for the project for each of the two delivery phases:

Phase 1

- Review existing literature on UK Aggregates Levy, and similar environmental taxes in other European countries, including modelling studies and environmental planning policies;
- Development of the Business as Usual (BaU) illustrative model for Scottish Aggregates Levy based on aggregates market behaviour in Scotland and the rest of the UK;
- Prepare a case study examining the impact of adjustments to levy exemptions in Northern Ireland (NI) and their impacts on the aggregates industry in NI and the Republic of Ireland given the obvious parallels for Scotland and RUK potentially having two different tax regimes either side of a land border;

Phase 2

- Develop a broad set of illustrative policy options varying the levy rate and structure as well as changing other relevant policies (e.g. landfill tax for inert materials);
- Model and analyse the economic and environmental impacts of these illustrative policy options including impacts on import and export of aggregates between Scotland and the rest of the UK, as well as between Scotland and the rest of the world;

- Understand and model the interaction of the levy with Scottish Government policies such as the Scottish Landfill Tax; and
- Develop a report on the aggregates market in Scotland setting out the current demand, production, distribution and reserves of aggregates from Scottish quarries within the currently restricted level of Scottish data that is available

Review of the UK Aggregates Levy and Similar Taxes in Other Countries

As a part of this research, the UK Aggregates Levy and similar taxes in some of the other European countries have been reviewed, which suggests a complementary role for landfill tax in increasing substitution towards recycled aggregates, as observed in the UK and the Danish case. The review also suggests applying the same rate of levy on domestic production and imports will eliminate any comparative disadvantage for local producers.

Northern Ireland Case Study

Prior to and following the introduction of the UK Aggregates Levy in April 2002, concerns were repeatedly raised that the levy would promote illicit imports to Northern Ireland from the Republic of Ireland. The experience from Northern Ireland indicates that, implementing a different levy rate in Scotland compared to the levy rate in England would be likely to increase illegal cross-border movements of aggregates, and therefore a strict monitoring and enforcement regime would be required to minimise illegal cross-border trade in untaxed aggregate.

Analysis of the Scottish Aggregates Market

Analysis of the Scottish aggregates market revealed that aggregates production has followed a declining trend over the past few years, especially for sand and gravel.

It was observed that Scotland imports very little aggregates, as it produces sufficient amount of crushed rock, and sand and gravel locally. It was also observed that Scotland exports a small amount of sand and gravel, but it exports a very large amount of crushed rock (mainly from Highland & Moray). We know from secondary data sources that this level of crushed rock exports has remained high over time.

Observation of the price trends for aggregates supplied in the UK indicates that, the price of crushed rock has increased by 21%, compared to a 50% increase for sand and gravel over the last 15 years despite the Aggregates Levy remaining at £2 per tonne over this period.

Approach to Developing the Scottish Aggregates Levy Model

The Scottish Aggregates Levy model was developed over Phase 1 and Phase 2 of the project. Phase 1 involved developing the business as usual (BaU) model using historical data and econometric forecasting of aggregates production. The BaU model produced the following projections for the modelling period 2018 – 2030:

- Production of primary aggregates including aggregates imports and exports (million tonnes);
- Production of recycled aggregates (million tonnes); and
- Estimates of Aggregates Levy revenue for Scotland (£million).

Phase 2 involved selecting illustrative policy options for the Scottish Aggregates Levy, and extending the Phase 1 BaU model to develop the detailed Aggregates Levy model for analysing the impacts of the selected policy options. The detailed scenario modelling in Phase 2 also included the changes in the level of import and export of aggregates due to hypothetical levy rate differentials between Scotland and the rest of the UK that were implied by the illustrative policy scenarios.

Modelling the Business as Usual Scenario

According to the project scope two types of aggregates were modelled:

- **Primary aggregates**, which includes crushed rock and sand and gravel; and
- **Secondary aggregates**, which include recovered material from construction and demolition (C&D) waste which is sold as a secondary material for use in construction projects.

The approach to modelling the BaU scenario comprised two key stages:

- **Historic aggregates production, import and export** – all available aggregates data were reviewed and used to compile a historic dataset on production, import and export of aggregates for Scotland; and
- **Forward projections** – projections of aggregates production, import and export out to 2030 were created for the BaU scenario i.e. where the current rate of aggregates levy is assumed to stay constant in future years.

The forward projections were developed based on econometric forecasting using the historic data on aggregates production and other relevant factors. The forward projections of both crushed rock, and sand and gravel production in Scotland displayed a declining trend over the next few years.

Illustrative Impacts from Changes to the Levy

Different illustrative policy options were discussed with the project governing team at Scottish Government throughout Phase 1, and the following four options were selected for inclusion in the Phase 2 modelling:

- **Option 1 – High levy rate (tax increase scenario)**: Under this option, the Scottish levy rate is set above the UK levy rate.
- **Option 2 – Low levy rate (tax decrease scenario)**: Under this option, the Scottish levy rate is set below the UK levy rate.
- **Option 3 – Scottish Government baseline (no tax scenario)**: The levy rate is set to zero under this option. Results from this option is required for developing future tax legislation in Scotland where the Scottish Government needs to set out the impacts of a ‘do nothing’ approach.

- **Option 4 – New landfill tax band for aggregates (Landfill tax scenario)**: The levy rate is kept at the same level as the UK levy rate, while creating an additional band of landfill tax for aggregates which is higher than the rate for landfilling inert materials. This should increase the recycling of aggregates through increasing the cost of landfilling aggregates.

Option 1 (tax increase) displays an overall reduction in demand for primary aggregates due to the increase in levy rate. Similarly, Option 2 (tax decrease) displays an overall increase in primary demand due to the reduction in levy rate. Options 1 and 4 generate the highest level of recycling activity, due to an increase in Aggregates Levy or the introduction of a new banding in landfill tax rates related to aggregates (e.g. inert rate), respectively.

Both Option 1 and Option 4 would generate the highest level of recycled aggregates production. However, Option 1 would also generate significantly higher levy revenue and has lower externality costs compared to the BaU scenario and all other options. So, if the most desirable objectives are to maximise levy revenue and/or to reduce the externality costs of aggregates extraction in Scotland along with increasing the production of recycled aggregates, Option 1 seems to be the preferred option.

However, it should be noted that the amount of additional recycling generated through change in a Scottish Aggregates levy or by introducing a new landfill tax band for aggregates is very small, given that approximately 87% of C&D wastes are currently being recycled under the BaU scenario. Choosing such an option will also require additional monitoring and enforcement, which will increase the implementation costs of such a measure. Finally, various provisions for the exemption of C&D wastes from the landfill tax will need to be revised to ensure that C&D wastes are recycled to the highest quality possible for using as a substitute of primary aggregates rather than other low value uses e.g. pipe bedding or backfilling.

Introduction

Eunomia Research & Consulting Ltd was commissioned by the Scottish Government to analyse and appraise some illustrative policy options for implementing a Scottish Aggregates Levy. The work was commissioned before the UK Government review of the Aggregates Levy was announced in March 2019[1] and does not take into consideration any outcomes of the review.

Background and Context

The UK Aggregates Levy was introduced in 2002 with the dual aims of reducing the negative environmental impacts of quarrying and increasing the recycling rate of construction materials, by reducing the rate of primary material extraction.[2]

The scope of the UK levy includes all sand, gravel and rock that has either been dug from the ground, dredged from the sea in UK waters or imported into the country.

The levy was first introduced in 2002, at a flat rate of £1.60 per tonne of aggregates. In 2008, the rate was increased to £1.95 per tonne to account for inflation since the introduction of the levy, followed by a further increase to £2.00 per tonne in 2009. The levy was expected to continue to increase in line with inflation. However, a planned rate change for 2010 was cancelled due to the ongoing global economic crisis at that time and shifting political priorities of a new Government.[3] The rate has remained at the level of £2 per tonne of aggregates since 2009.

Under the heading of "Strengthening accountability and finance", the final report of the Commission on Scottish Devolution (The "Calman Commission"), published in 2009, recommended that the Stamp Duty Land Tax, the Aggregates Levy, the Landfill Tax and Air Passenger Duty be devolved to the Scottish Parliament.[4] The Stamp Duty Land Tax (subsequently the Land and Buildings Transaction Tax) and the Landfill Tax (as the Scottish Landfill Tax) were devolved through the Scotland Act 2012 and both have been in place since 1 April 2015.[5]

Following the Scottish independence referendum in September 2014[6] and the subsequent Smith Commission[7], the Scotland Act 2016 devolved powers to the Scottish Government for the Aggregates Levy and Air Passenger Duty (APD). The devolution of the Aggregates Levy has been delayed by ongoing European Court procedures over the exemptions for secondary aggregates. Although a European Commission decision in 2015 ruled that all but one of the exemptions could not be

[1] https://www.gov.uk/government/publications/review-of-the-aggregates-levy

[2] https://www.gov.uk/government/publications/review-of-the-aggregates-levy/review-of-the-aggregates-levy-discussion-paper

[3] https://researchbriefings.files.parliament.uk/documents/SN01196/SN01196.pdf

[4] https://researchbriefings.files.parliament.uk/documents/SN04744/SN04744.pdf

[5] https://www.gov.uk/guidance/scotland-act-2012

[6] https://www.gov.uk/government/topical-events/scottish-independence-referendum

[7] https://www2.gov.scot/Topics/constitution/smith-commission

construed as State Aid, there were ongoing appeals by the British Aggregates Association. The litigation against the UK Government and the European Commission has now been withdrawn. Following the conclusion of this longstanding litigation, the UK Government undertook a comprehensive review of the UK Aggregates Levy, working closely with the Scottish Government, the Welsh Government and Northern Ireland Executive throughout the review process.[8,9]

In anticipation of a resolution of the legal proceedings, Scottish Government wanted to establish the current role of the Aggregates Levy in Scotland, with a view to designing and implementing a Scottish Aggregates Levy. This project has investigated the historical complexities and impact of the Aggregates Levy in the UK and used these findings to develop some illustrative future tax policy options for a Scottish Aggregates Levy, with modelled associated scenarios and potential impacts.

As the history of the introduction of the UK Aggregates Levy shows, reducing the impact on aggregates extraction through the use of tax policy measures is a complicated matter. At the time when discussions of the UK Levy began in the late 1990s, the Campaign to Protect Rural England (CPRE) was focused on pushing forward better planning regulations, while the industry proposed voluntary agreements to tackle the growing issue.[10] Although the government ultimately decided to introduce a levy, and fixed the rate based on the estimated externalities[11] associated with aggregates extraction, as highlighted in other reviews of the policy landscape, the Levy cannot be viewed in isolation. The Scottish Aggregates Levy should therefore also not be developed without due consideration of these interacting policies. The most obvious interaction is with the Scottish Landfill Tax whose objectives in promoting recycling overlap, to an extent, with those of the Aggregates Levy.

Furthermore, Scotland aims to achieve a Zero Waste society and has a number of policies in place which focus on waste reduction and on promoting a circular economy that might influence the effectiveness of the Scottish Aggregates Levy.[12] There are also potential fiscal policy impacts of the devolution of the Aggregates Levy to Scotland as detailed in the fiscal framework agreement between the UK government and the Scottish Government.[13] This implies that the revenue-raising potential of the

[8] https://www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2019-02-08/HCWS1315/

[9] https://www.gov.uk/government/publications/review-of-the-aggregates-levy/review-of-the-aggregates-levy-discussion-paper

[10] ECOTEC et al. (2001) Study on the economic and environmental implications of the use of environmental taxes and charges in the European Union and its Member States, Report for DG Environment, European Commission. https://ec.europa.eu/environment/enveco/taxation/environmental_taxes.htm

[11] Externalities refers to situations when the effect of production or consumption of goods and services imposes costs or benefits on others which are not reflected in the prices charged for the goods and services being provided.

[12] See for example, https://www.gov.scot/policies/managing-waste/

[13] https://www.gov.uk/government/publications/the-agreement-between-the-scottish-government-and-the-united-kingdom-government-on-the-scottish-governments-fiscal-framework

Aggregates Levy and its role in the wider fiscal framework is of some importance in the future design of the tax.[14]

Modelling these policy options will require, first, an in-depth understanding of the aggregates extraction market in Scotland which forms the tax base. Only then can the Scottish Government start to build the policy options for a Scottish Aggregates Levy including changes to levy rate, structure, exemptions, reliefs and definitions relating to the point of application.

With the outputs from the illustrative policy options modelling of the Scottish Aggregates Levy, Scottish Government will be able to consider, in broad illustrative terms, the advantages and disadvantages of each option.

Project Objectives

Notwithstanding the UK Government review of the Levy, based on the above background and context, we identified the following objectives for this project for each of the two delivery phases:

Phase 1

- Review existing literature on UK Aggregates Levy, and similar environmental taxes in other European countries, including modelling studies and environmental planning policies;
- Development of the Business as Usual (BaU) illustrative model for Scottish Aggregates Levy based on aggregates market behaviour in Scotland and the rest of the UK;
- Prepare a case study examining the impact of adjustments to levy exemptions in Northern Ireland (NI) and their impacts on the aggregates industry in NI and the Republic of Ireland given the obvious parallels for Scotland and RUK between potentially having two different tax regimes either side of a land border;

Phase 2

- Develop a broad set of illustrative policy options varying the levy rate and structure as well as changing other relevant policies (e.g. landfill tax for inert materials);
- Model and analyse the economic and environmental impacts of these illustrative policy options including impacts on import and export of aggregates between Scotland and the rest of the UK, as well as between Scotland and the rest of the world;
- Understand and model the interaction of the levy with Scottish Government policies such as the Scottish Landfill Tax; and
- Develop a report on the aggregates market in Scotland setting out the current demand, production, distribution and reserves of aggregates from Scottish

[14] See for example, https://www.gov.scot/publications/fiscal-framework-factsheet/pages/overview/

quarries within the currently restricted level of Scottish data that is available to anyone with an interest in the subject.

Scope of the Scottish Aggregates Levy

Currently the scope of the UK Aggregates Levy includes two broad types of materials:[15]

- Crushed rock; and
- Sand and gravel.

It was discussed whether the scope of the Scottish levy could include differential rates based on the type and/or quality of aggregates. As well as being somewhat arbitrary, it was decided that this approach could involve potential state aid issues, and was thus excluded from the scope of this study.

[15] https://www.gov.uk/government/publications/excise-notice-agl1-aggregates-levy/excise-notice-agl1-aggregates-levy

Review of the UK Aggregates Levy and Similar Taxes in Other Countries

UK Aggregates Levy

The aggregates levy in the UK was implemented in order to reduce the negative environmental impacts of aggregates extraction and to incentivise production of recycled aggregates. It was introduced in 2002 and is currently levied at a rate of £2 per tonne of aggregates. The levy is applied at the point at which it is commercially exploited in the UK. Since its introduction in 2002, the basic structure of the levy has not been reviewed. However, following the conclusion of litigation in February 2019, the UK government announced a comprehensive review of the levy.[16]

Levy rate history

The levy was introduced at a flat rate of £1.60 per tonne of aggregates in 2002. In 2008, the rate was increased to £1.95 per tonne to account for inflation. It was increased further to £2 per tonne in 2009. Although the levy was expected to continue to increase in line with inflation, a planned rate change for 2010 was cancelled due to the response to the global economic crisis and shifting political priorities of a new Government. The rate has remained at the level of £2 per tonne of aggregates since 2009.[17]

Scope of the levy

The levy is applied to all rock, sand and gravel that has either been dug from the ground, dredged from the sea in UK waters or imported. The levy is applied at the point at which the aggregates are first commercially exploited[18] in the UK. Exemptions are in place for certain materials, e.g. clay, soil, vegetable or other organic matter. Export of aggregates and their use in certain agricultural and industrial process are also exempted from the levy. A number of exemptions have recently been the subject of State Aid investigations from the European Commission, which found part of the shale aggregates exemption unlawful in 2015. As a result, the exemption has been amended.

Collection and use of the levy revenue

The revenue since the introduction of the levy at UK level has ranged from around £247 million in 2002/03 to £367 million in 2018/19.[19] All of the revenue currently raised

[16] https://www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2019-02-08/HCWS1315/

[17] Rate of the UK Landfill Tax, on the other hand, gradually increased since its introduction in 1996 from £7 per tonne (standard rate) to £91.35 per tonne in 2019.

[18] Commercial exploitation is defined as when it is removed from the aggregate's originating site (e.g. quarry); when subject to a written agreement to supply; or when mixed with anything other than water.

[19] https://www.gov.uk/government/statistics/aggregates-levy-bulletin

forms part of the total revenues raised by the UK Government in taxation (£620 billion in 2018-19).[20]

From 2002 to 2011, approximately £35 million of the levy revenue was allocated to the Aggregates Levy Sustainability Fund in each year.[21] This fund had the stated objective of reducing or mitigating the local environmental impacts of primary aggregates extraction. The fund was devolved to England, Scotland, Northern Ireland and Wales and was implemented by local and national environmental NGOs and other organisations. However, due to budget considerations, it was abolished in England and Wales in 2011 and 2017, respectively.

Effectiveness of the levy

Since the levy was first announced in 2000, the use of primary aggregates per unit of construction output has reduced by around 40% for the period 2010-2014.[22] However, these figures cannot be solely attributed to the Aggregates Levy. UK Landfill Tax, introduced in 1997, is also thought to have had a significant impact by incentivising recycling of construction and demolition (C&D) waste.[23]

Other impacts

Given that the cost of primary aggregates tends to be only a small proportion of the overall cost of construction projects, it is unlikely that the Aggregates Levy in isolation has had any significant impact on the construction industry.[24] There might have been some minor competitiveness impacts, particularly on smaller companies in the construction sector, but these impacts are likely to be small as the levy is expected to have been passed on to consumers due to the estimated price inelasticity of demand for these products.[25] Moreover, the design of the levy may have eliminated any potential comparative disadvantage for the domestic producers, as aggregates imports from outside the UK are levied at the same rate as domestic extraction, while exports to destinations outside the UK are exempted from the levy. Although there has been some concerns about illegal cross-border movement of aggregates across the Republic of Ireland and Northern Ireland border, the issue relates more to monitoring and enforcement of the levy rather than its design. This is discussed further in the Northern Ireland case study in Appendix 5.

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[20] https://www.gov.uk/government/statistics/hmrc-tax-and-nics-receipts-for-the-uk

[21] Lockhart-Mummery, E. (2015) UK Aggregates Levy & Sustainability Fund, presentation given at UK Expert Visit to Israel.

[22] IEEP et al., 2017. Capacity building, programmatic development and communication in the field of environmental taxation and budgetary reform. Report for the DG Environment of the European Commission.

[23] Eunomia Research & Consulting et al. (2009) International review of waste management policy: Summary report, report for Department of Environment Heritage and Local Government (Ireland).

[24] ECOTEC et al. (2001) Study on the economic and environmental implications of the use of environmental taxes and charges in the European Union and its Member States, Report for DG Environment, European Commission. https://ec.europa.eu/environment/enveco/taxation/environmental_taxes.htm

[25] ibid.

European aggregates taxes

Besides the UK, a few other countries in Europe have similar taxes in place. European Commission's Environmental Fiscal Reform Information System (EFRIS) database[26] lists the following taxes:

- Austria – Levy for landscape protection and nature conservation (a regional tax applied to different types of materials in different regions);
- Belgium – Aggregates Tax (regional tax in Flanders);
- Denmark – Raw Materials Extraction Tax;
- Estonia – Mineral Resources Extraction Charge;
- France – Aggregates Tax;
- Hungary – Mining Act: Royalties charged on the extraction of minerals, gas and oil;
- Latvia – Natural Resource Tax;
- Lithuania – Taxes on Natural Resources;
- Slovakia – Resource Extraction Charge;
- Slovenia – Mineral extraction tax; and
- Sweden – Tax on Natural Gravel.

Out of the abovementioned taxes, we discuss the taxes in Denmark, Sweden and Estonia in Appendix 4. Other taxes were excluded from the discussion owing to a lack of detailed information (written in the English language) on them.

Table 1 presents the key features of the in Denmark, Sweden and Estonia, which displays substantial variations among them. It can be observed that the UK levy rate is significantly higher than the Swedish and the Danish tax rates at the exchange rates at the time of writing. The taxes also vary in terms of their scope – the Estonian tax has the widest scope which includes energy carriers and agricultural minerals along with aggregates-type of materials, while the Swedish tax only includes natural gravel in order to address the scarcity of this particular resource in the country. There are also variations in terms of the application of these taxes on cross-border movement of materials – for the UK levy and the Danish tax, imports are taxed, while exports are exempted, whereas the Swedish tax is applied to exported materials and the imports are exempted possibly reflecting the shortage of natural gravel there. Finally, both the UK levy and the Danish tax operates in conjunction with a waste

[26] https://ec.europa.eu/environment/integration/green_semester/pdf/EFRIS%20-%20Data%20from%20Report_2016.xlsx

disposal type tax in order to incentivise the production of primary aggregates substitutes (recycled aggregates).

Table 1: Comparison between taxes related to aggregates in selected European countries

	UK	Denmark	Sweden	Estonia
Name of the tax	Aggregates Levy	Raw materials extraction tax	Natural gravel tax	Mineral resource extraction charge
Year of introduction	2002	1977	1996	1991
Primary objectives	Internalisation of external costs, increase recycling of C&D waste	Increase recycling of C&D waste	Substitution of natural gravel with crushed rock	Reduce mineral extraction
Scope of the tax	Crushed rock, sand and gravel	Mainly sand, gravel, stones, peat, clay and limestone	Natural gravel	Various types of aggregates as well as energy carriers and agricultural minerals
Current tax rate	£2/tonne	DKK 5/m^3 (£0.58/m^3) or DKK 8/tonne (£0.92/tonne)[27]	SEK 13/tonne (£1.07/tonne)	Rate varies according to type and quality of material. On average EUR 0.33 – 3.34 per tonne (£0.28 - £2.87 / tonne)
Application of the tax on cross-border movements	Imports are taxed while exports are exempted	Imports are taxed while exports are exempted	Imports are exempted while exports are taxed	
Complementary taxes	Landfill tax	Waste tax		

The material above on the international evidence suggests that the following design features might be useful to consider when designing the Scottish Aggregates Levy:

- Landfill tax could play an important role as a complementary tax for increasing substitution towards recycled aggregates, as observed in the UK and the Danish case; and

[27] Average weight of 1 m^3 crushed rock is approximately 1.6 tonnes.

- Applying the same rate of levy on domestic production and imports will eliminate any comparative disadvantage for local producers, considering the potential cross-border aggregates flows (in particular exports) between Scotland and the rest of the UK.

Northern Ireland Case Study

Scotland's land border with England has implications for both the enforcement of a Scottish Aggregates Levy and the impact of the Levy on quarry operators on both sides of the border. As such, it is pertinent to consider the lessons learned in Northern Ireland and the impact of a Levy there that did not apply in the Republic of Ireland. Here we present a brief background of the situation in Northern Ireland and the key implications for the Scottish Aggregates Levy, while the detailed analysis are presented in Appendix 5.

Prior to and following the introduction of the UK Aggregates Levy in April 2002, concerns were repeatedly raised that the levy would promote illicit imports to Northern Ireland from the Republic of Ireland. As a result, the Aggregates Levy Credit Scheme (ALCS) was introduced in Northern Ireland in April 2004, which enabled companies in Northern Ireland to claim an 80% relief on the levy, providing they met specified environmental conditions. However, the ALCS was suspended in December 2010 due to repeated court challenges lead by the British Aggregates Association (BAA).

As discussed in Appendix 5, there were a number of factors affecting Northern Ireland's quarry industry during this period (not least the recession, the relative strengths of the two currencies, the island's geology and the level of enforcement activity). As such, it is unlikely that Scotland would be affected to the same extent as Northern Ireland if Scotland were to have a different Levy to England, or that there would be the same risk of illegal activity.

Nevertheless, the experience from Northern Ireland indicates that any disparity between the Aggregates Levy in England and a new Levy in Scotland would create concerns that the market would be distorted. Scottish quarry operators would oppose a higher levy in Scotland on the grounds that they risk losing out to imports from England, while English operators would similarly seek to challenge a lower Levy in Scotland. This underlines the need to tax imports from the rest of the UK and beyond to Scotland at the same level as domestic quarry products and exempt exports. Similarly, it will be important for the industry to have full confidence in enforcement activity by the tax authorities in England and Scotland.

Analysis of the Scottish Aggregates Market

This section provides an overview of the current production, distribution and reserves of crushed rock and sand and gravel in Scotland. Despite best efforts to find the timeliest data, there are numerous Scottish aggregates data issues that would need to be considered before the design of the tax is implemented.

The primary, official source of data is the Scottish Aggregates Survey, however, the latest survey was conducted in 2012 and published with a considerable lag in 2015. As a result, some of the data is not as current as we would have wished for. In this study, the survey has been supplemented by discussions with the Mineral Products Association (MPA), which represents quarry operators in Scotland, and by the UK Minerals Yearbook, produced by the British Geological Society (BGS). The latest Yearbook was published in 2019 and included data from 2017.[28]

Additional, more timely information (particularly on sand and gravel) has been provided by the Monthly Bulletin of Building Materials and Components published by the UK Government's Department for Business, Energy and Industrial Strategy (BEIS),[29] the ONS Mineral Extraction in Great Britain report, published by the Department for Communities and Local Government[30] and the BGS Minerals Survey for England and Wales.[31] We are restricted in that we do not want to report data for different elements of aggregates for different years. This is why we have had to revert back to the Scottish Aggregates Survey for 2012.

Market Overview

Following an initial study by the Office of Fair Trading (OFT) in 2011,[32] the Competition Commission launched in investigation into the aggregates, cement and ready-mix concrete market. The Competition Commission reported that, across Great Britain, there were 239 aggregates suppliers in 2011. In 2012, five major suppliers accounted for 71% of aggregates sales.[33] This was down from the 73.3% share

[28] BGS (2019) United Kingdom Minerals Yearbook 2018. https://www.bgs.ac.uk/downloads/start.cfm?id=3514

[29] https://www.gov.uk/government/collections/building-materials-and-components-monthly-statistics-2012

[30] https://www.gov.uk/government/statistics/mineral-extraction-in-great-britain-2014

[31] https://www.gov.uk/government/publications/aggregate-minerals-survey-for-england-and-wales-2014

[32] Office of Fair Trading (2011) Aggregates: Report on the Market Study and Proposed Decision to Make a Market Investigation Reference. August 2011. https://assets.publishing.service.gov.uk/media/532ad455e5274a226b000303/oft1358.pdf

[33] Competition Commission (2014) *Aggregates, Cement and Ready-Mix Concrete Market Investigation. Final Report*. 14th January 2014. https://assets.publishing.service.gov.uk/media/552ce1d5ed915d15db000001/Aggregates_final_report.pdf

reported by the OFT for 2009, when one company accounted for nearly 21% of sales.[34]

The five major companies are also present in Scotland, where the Competition Commission additionally named two "mid-tier" suppliers. The precise number of small suppliers in Scotland specifically is not known, however the MPA lists 19 members in Scotland, including the five major companies identified by the Competition Commission.[35] At present, the British Aggregates Association lists 23 members in Scotland, or 19 if members of the MPA are excluded.[36]

The OFT used the concentration ratio (CR5) and the Herfindahl-Hirshman Index to compare the levels of concentration. They found that the CR5 for aggregates in Great Britain increased from around 50% in 1991 to over 70% in 2009. Scotland had a lower rating, having moved from just under 20% to over 50% during this time. This indicates that the market in Scotland may be more diverse than the wider British market, but seemed to be moving in the same direction as the British market as of 2011.

The OFT investigation was partly launched in response to concerns about the level of vertical integration in the market: the five major companies had 90% of the cement market, 75% of the aggregates market and 70% of the ready-mix concrete market. The OFT also noted the high barriers to entry, due to the need for planning permission and physical capital requirements. The OFT had received reports of "vertically integrated firms refusing to supply or discriminating against non-integrated competitors through their pricing". The Competition Commission concluded that the five major companies distributed between 33% and 49% of their aggregates sales to their own downstream businesses. This was lower than the 80-93% for internal sourcing of concrete.

Aggregates Production

Figure 1 illustrates the trends in Scottish aggregates production between 1980 and 2017, with crushed rock production peaking just before the 2008 recession and a general downwards trend in sand and gravel production which appears to have started as long ago as 1990.

The UK Minerals Yearbook 2018 reports that Scotland produced 5.9 million tonnes of sand and gravel in 2017, and 22.5 million tonnes of crushed rock.[37] This compares to 4.5 million tonnes (sand and gravel) and 14 million tonnes (crushed rock) recorded in the 2012 Scottish Aggregates Survey. Thus, depending on the data point, crushed rock is 3-4 times more significant than sand and gravel in tonnage (and levy) terms in Scotland.

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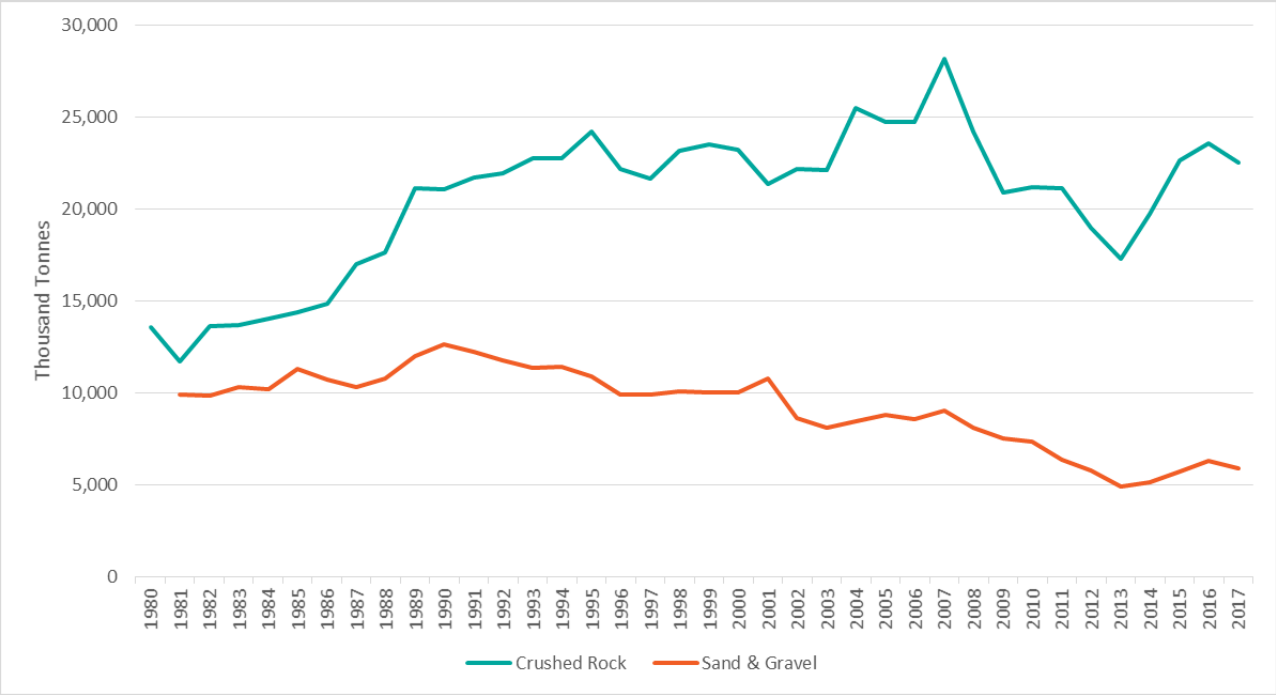
[34] Office of Fair Trading (2011) Aggregates: Report on the Market Study and Proposed Decision to Make a Market Investigation Reference. August 2011. https://assets.publishing.service.gov.uk/media/532ad455e5274a226b000303/oft1358.pdf

[35] https://www.mineralproducts.org/documents/Facts-at-a-Glance-2018.pdf

[36] https://www.british-aggregates.co.uk/list-of-baa-members/

[37] BGS (2019) United Kingdom Minerals Yearbook 2018. https://www.bgs.ac.uk/downloads/start.cfm?id=3514

Figure 1: Aggregates Production in Scotland



Source: BGS (2019) United Kingdom Minerals Yearbook 2018

According to 2012 Scottish Aggregates Survey, more than half of Scotland's sand and gravel comes from West Central Scotland and Tayside & Fife. The former also accounts for nearly a quarter of Scotland's crushed rock, while just under 40% of Scotland's crushed rock is produced in Highland and Moray, predominantly at Glensanda on the west coast of Scotland.

Aggregates Sales

Table 14 (Appendix 6) provides the Scottish regions' sales of sand and gravel in 2019. 5.4 million tonnes were recorded, with West Central Scotland and Tayside & Fife accounting for 61% of the total amount.

The ONS report[38] does not include equivalent sales statistics for crushed rock. However, Table 4 and Table 5 in that report provide a breakdown of sales in 2014 (see Table 15 in Appendix 6). The figures for sand and gravel are broadly consistent with 2019 sales.

Imports

In addition to the aggregates extracted within Scotland, some material is also imported from England and Wales which we refer to as "RUK imports" to distinguish them from "imports from overseas".

These RUK imports mean, combined with the extraction figures in Table 16 (Appendix 6), Scotland's total supply in 2014 was 19.775 million tonnes of crushed rock. In 2014,

[38] https://www.gov.uk/government/statistics/mineral-extraction-in-great-britain-2014

the ONS reports that 5.111 million tonnes of sand and gravel was sold, meaning the total supply of sand and gravel, including imports, was 5.194 million tonnes.

Thus, it is clear that RUK imports to Scotland of crushed rock represented just 0.1% of the total supply of crushed rock in Scotland in that year and were therefore relatively insignificant. This is because Scotland is essentially self-sufficient in this type of material given the locally-available supply.

In terms sand and gravel, RUK imports totalled 83,000 tonnes (almost exclusively from North West England) in 2014 representing 1.9% of total of supply in Scotland, again suggesting that RUK import penetration of sand and gravel is relatively minor. Again, this is because Scotland mostly produces sufficient sand and gravel for its needs without requiring it from RUK or further afield. It also reflects the relatively high costs of transportation for sand and gravel making long-distance transportation uneconomic.

Exports

Scotland's crushed rock exports to England and Wales (which from now on we refer to as "RUK exports") significantly exceed its imports. According to the 2012 Scottish Aggregates Survey, Scotland exported 5.573 million tonnes of crushed rock to England, compared to the 16,000 tonnes imported i.e. at that point in time Scotland exported 350 times more crushed rock than it imported. The exports originate in Highland & Moray, and represented 30 to 40% of all crushed rock recorded in Scotland that year. Highland and Moray also exported 12,000 tonnes of sand and gravel to England, while SESPlan[39] exported 1,000 tonnes to England. This means that Scotland exported 0.3% of its sand and gravel (13,000 tonnes out of 4.468 million tonnes); sand and gravel imports, shown in Table 16 (Appendix 6), exceed Scotland's sand and gravel exports. Scotland did not directly export aggregates outside Great Britain in 2012 but clearly did (and still does) export significant amounts to RUK (principally from Glensanda) which may or may not have ultimately been exported overseas. This can be seen from UK port statistics which show the tonnage leaving Glensanda (essentially an aggregates-only facility) in recent years has fluctuated around 6 million tonnes per annum.[40]

The 2014 England and Wales survey reported that 3.2 million tonnes of aggregates were imported from Scotland and Europe (notably Norway) to England and Wales, however there is no further breakdown to indicate what proportion of the imports originated in Scotland.[41] As it is known that Scotland exported 5.6 million tonnes to England in 2012, this indicates that Scotland's exports to other parts of Britain declined between 2012 and 2014.

[39] The Strategic Development Planning Authority for Edinburgh and South East Scotland.

[40] https://www.gov.uk/government/statistics/port-freight-annual-statistics-2018-final-figures

[41] BGS (2016) *Coalition of the Results of the 2014 Aggregate Minerals Survey for England and Wales*. Report for the Department for Communities and Local Government and Welsh Government. March 2016.

It is clear also that Scottish RUK exports of sand and gravel represented just 0.3% of the total supply of sand and gravel in Scotland in that year and were also relatively insignificant. This is because RUK is essentially self-sufficient in sand and gravel given the readily-available supplies there, as well as the prohibitive transportation costs of moving sand and gravel over long distances across the UK.

Regional Distribution in Scotland

As shown in Table 17 and Table 18 in Appendix 6, the majority of aggregates produced in Scotland are retained within the region in which they are extracted. Highland and Moray is the notable exception, as it only retains 6% of its crushed rock and exports 94% to England, though it is likely that the majority of this is for onward destinations outside the UK following processing at facilities in England. However, for the purposes of the survey, these exports are not counted as exports outside UK.

The destinations of aggregates sold outside the region of origin are shown in Table 19 and Table 20 in Appendix 6. This information is useful for planning purposes and also provides an indication of the degree to which Scottish aggregates are transported around Scotland in response to demand from public infrastructure projects or private commercial and housing-related demand.

Reserves

Table 21 (Appendix 6) shows that the estimated consented reserves[42] of crushed rock in Scotland stood at 533.6 million tonnes in 2012. This was down from 1,367.7 million in 2005, a 61% reduction. 1,227.8 million tonnes of crushed rock were available at active sites in 2005.[43] The 2005 and 2012 reports used slightly different reporting regions, limiting direct comparisons of the reserves in each region. Though these figures provide some context for the level of reserves, they are essentially 8 years old at the time of writing so are therefore will overestimate the current level of reserves of crushed rock.

For sand and gravel, consented reserves were estimated to be 122.8 million tonnes in 2005.

[42] Mineral reserves with a valid planning consent.

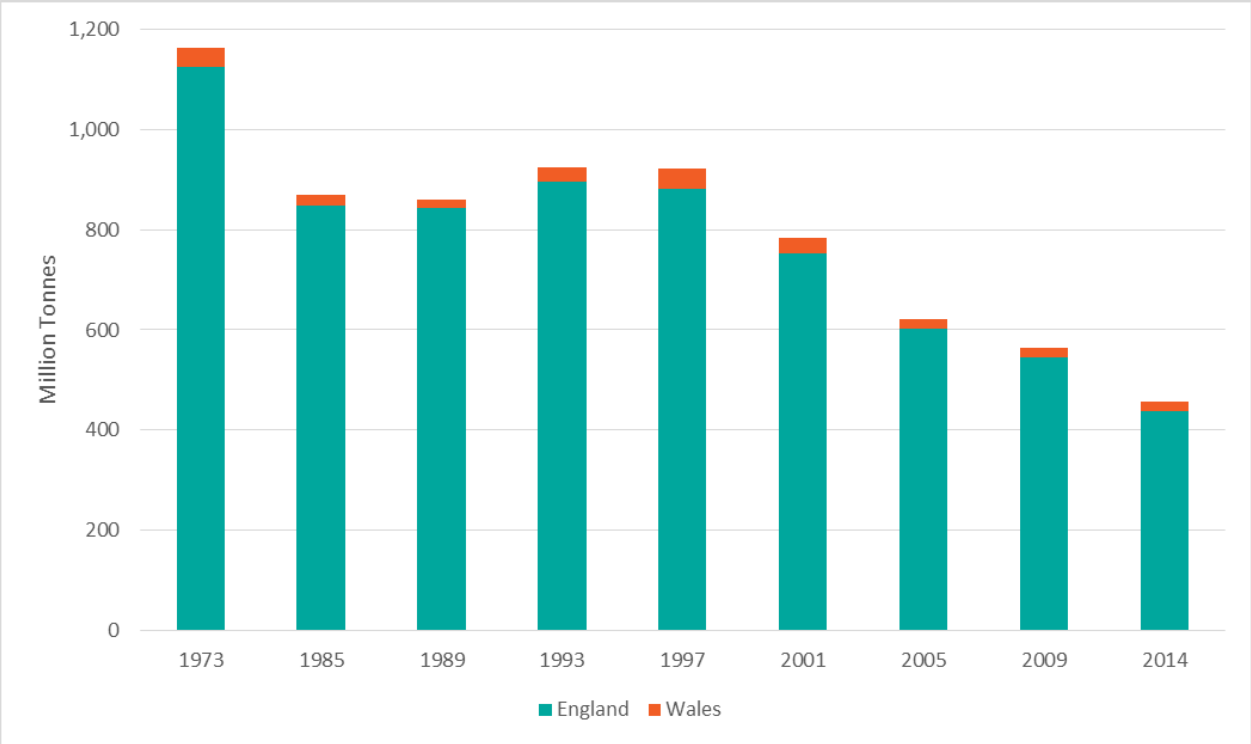
[43] The Scottish Government (2007) *Scottish Aggregates Survey 2005.* November 2007.

Table 22 (Appendix 6), therefore, indicates that 'Estimated Consented Reserves' declined by 32% between 2005 and 2012 to 84.8 million tonnes. It was also estimated that 102.3 million tonnes were available at active sites in 2005, suggesting a 41% reduction in 'Estimated Consented Reserves in Active Sites' to 60.8 million tonnes.[44]

2012 is the latest year for which official data is available. Some local development plans, however, provide an indication of the situation in certain localities. For instance, East Dunbartonshire expects sand and gravel reserves to be constrained after 2021.[45] It is reported that there are sufficient reserves of crushed rock within Glasgow and the Clyde Valley to meet demand until 2035.[46]

As a point of comparison, Figure 2 and Figure 3 show the aggregates reserves in England and Wales. Total reserves of sand and gravel declined by 61% between 1973 and 2014, including a 26% decline between 2005 and 2014. Crushed rock reserves decreased by 49% between 1973 and 2014, with a 19% fall between 2005 and 2014. England and Wales' reduction in crushed rock was less than half the rate of reduction in Scotland over roughly the same period (61%).

Figure 2: Sand and gravel Reserves in England & Wales (2014)



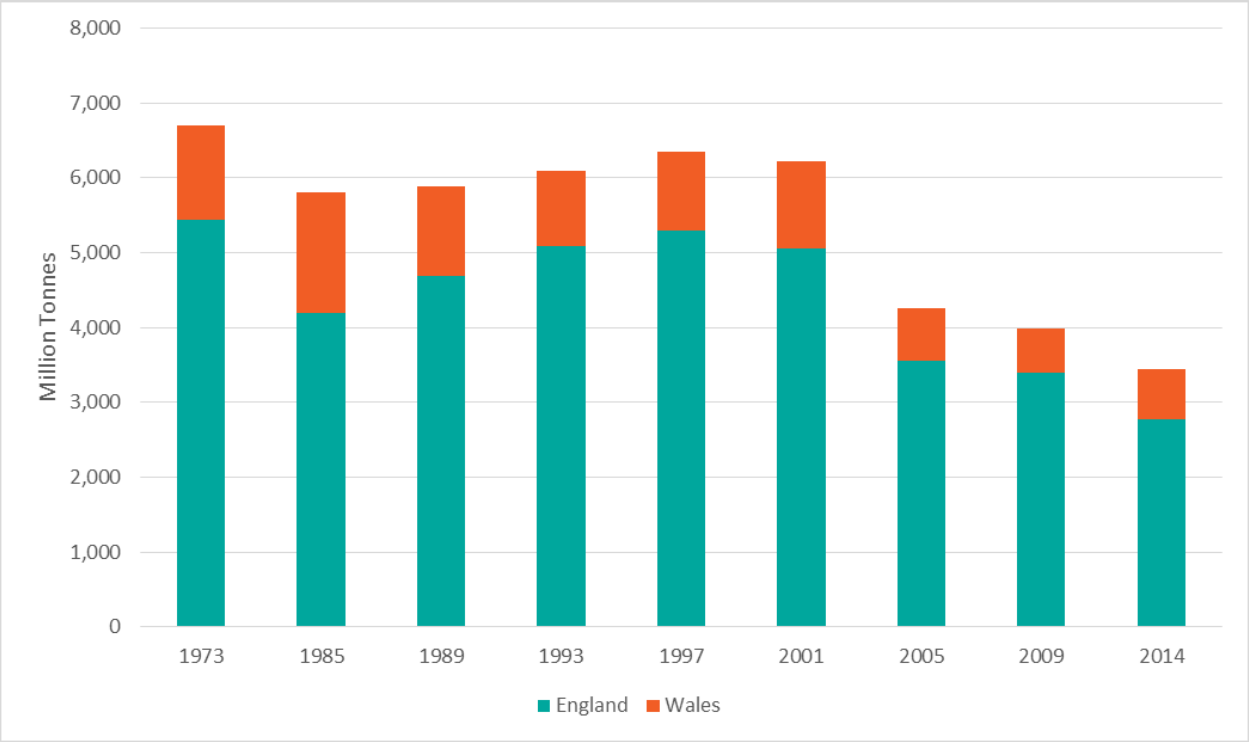
Source: BGS (2016) Collation of the Results of the 2014 Aggregate Minerals Survey for England & Wales.

[44] The Scottish Government (2007) *Scottish Aggregates Survey 2005.* November 2007.

[45] East Dunbartonshire Council (2017) *Local Development Plan*. 23rd February 2017. https://eastdunbarton.gov.uk/sites/default/files/filedepot/Local%20Development%20Plan.pdf

[46] West Dunbartonshire Council (2018) *Local Development Plan 2*. September 2018. https://www.west-dunbarton.gov.uk/media/4315752/ldp-proposed-plan-final_web2.pdf

Figure 3: Crushed Rock Reserves in England & Wales (2014)



Source: BGS (2016) Collation of the Results of the 2014 Aggregate Minerals Survey for England & Wales.

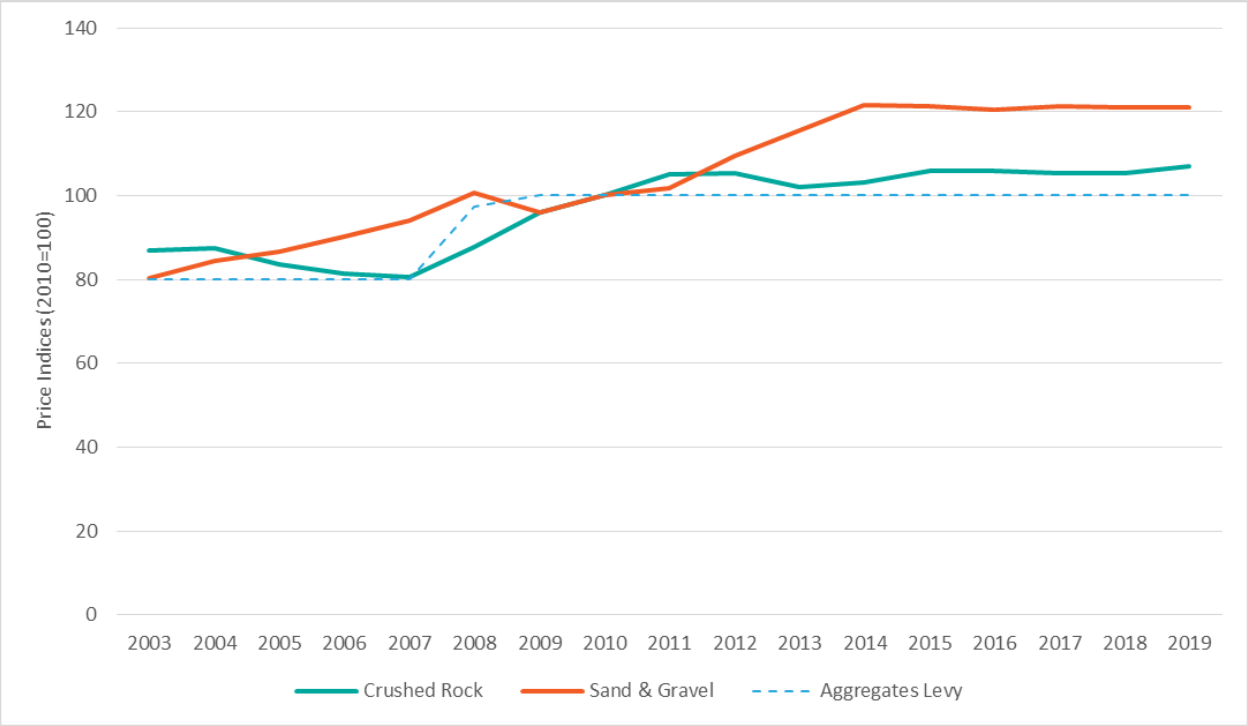
The MPA reports that, across Great Britain, the ten-year average replenishment rate for sand and gravel reduced to 53% in 2017, compared to 62% in 2016, with newly consented sand and gravel accounting for 24% of sales in 2017. They report that the replenishment rate for crushed rock has reduced "significantly" to 69%, and new permitted reserves represented 3% of sales in 2017.[47]

Price Trends

Figure 4 shows indices of the change in aggregate prices since 2003; the price of crushed rock has increased by 21%, compared to a 50% increase for sand and gravel over the 15 year period.

[47] MPA (2018) *AMPS 2018 – 7th Annual Mineral Planning Survey Report.* https://mineralproducts.org/documents/7th_AMPS_Report_2018.pdf

Figure 4 UK Aggregates Price Trends (including Levy), 2003 – 2019



Source: DBEIS: Monthly Bulletins of Building Materials and Components

Costs

Data on the costs of aggregates extraction (for example, on a per tonne basis) is not generally available for commercial reasons and is likely to vary significantly with the different circumstances, scale and geologies operating in different quarries. However, some information relating to transport costs is available. Interviews with the industry representatives regarding the Aggregates Levy Credit Scheme (ALCS) indicated that it cost 8 pence per tonne per mile to transport aggregates in Northern Ireland when the Aggregates Levy was introduced in 2002. The BGS reported in 2004 that road haulage costs add £6 per tonne to the price of crushed limestone.[48]

As cost is a limiting factor on the distance aggregates are transported, it is worth noting that the average delivery distance for aggregates by road in the UK was 49.8 km (31 miles) in 2013. That year, approximately 10% of aggregates were transported by rail.[49] The MPA reports that 80% of mineral products are used within a 30 mile radius of the quarry, and that 30 million tonnes of quarry products are transported annually outside the road network.[50] These findings support the 2004 report, which concluded that the maximum 'economic' transport distance for aggregates was 60km (37 miles) by road and 200km (124 miles) by rail.[51]

[48] BGS (2004) The Economic Importance of Minerals to the UK - https://www.bgs.ac.uk/mineralsuk/planning/economy.html

[49] Mineral Product Association Fact File - https://mineralproducts.org/iss_fact01.htm

[50] Mineral Product Association General Issues - https://mineralproducts.org/iss_key01.htm

[51] BGS (2004) The Economic Importance of Minerals to the UK - https://www.bgs.ac.uk/mineralsuk/planning/economy.html

End Use of Aggregates

Across Great Britain, the MPA estimated in 2017 that 30% of aggregates are used in the public sector and 70% in the private sector, following the breakdowns in Table 2. However, as the proportion of public construction in Scotland was higher than the UK average, the MPA concluded that the public sector share of aggregates use in Scotland could be as high as 40%.[52]

Table 2: Estimates of Primary Aggregates End-Uses by Construction Sector in the UK (2017)

Sector	Public Sector (Million Tonnes)	Private Sector (Million Tonnes)	Total (Million Tonnes)	Share of Public Sector	Share of Private Sector
New					
Housing	6.3	35.8	**42.1**	15%	85%
Roads	13.6		**13.6**	100%	0%
Other Infrastructure	6.9	27.7	**34.6**	20%	80%
Industrial	N/A	5.8	**5.8**		100%
Commercial	N/A	39	**39**		100%
Non-housing	13.5	N/A	**13.5**	100%	
Repair & Maintenance					
Housing	2.6	9.7	**12.3**	21%	79%
Infrastructure	8.5	1.1	**9.6**	89%	11%
Other	1.4	4.2	**5.6**	25%	75%
Total	**52.8**	**123.3**	**176.1**	**30%**	**70%**

Source: MPA

Limitations of the Current Market Analysis

In many cases, the market data is limited because a) the surveys involving a Scottish breakdown of aggregates were conducted several years ago and have been discontinued/not repeated, b) because the information is commercially confidential or c) the surveys did not receive a response. Not having the most up-to-date and comprehensive data on production and consumption means further data will be required to finalise estimates for the amount of total of aggregates produced in Scotland and consumed in Scotland, RUK and the rest of the world. This data could come in the form of a repeat of the Scottish Aggregates Survey last carried out in

[52] Private communication from the MPA

2012. It could also come in the form of a Scottish addition to the UK Government surveys of the industry.

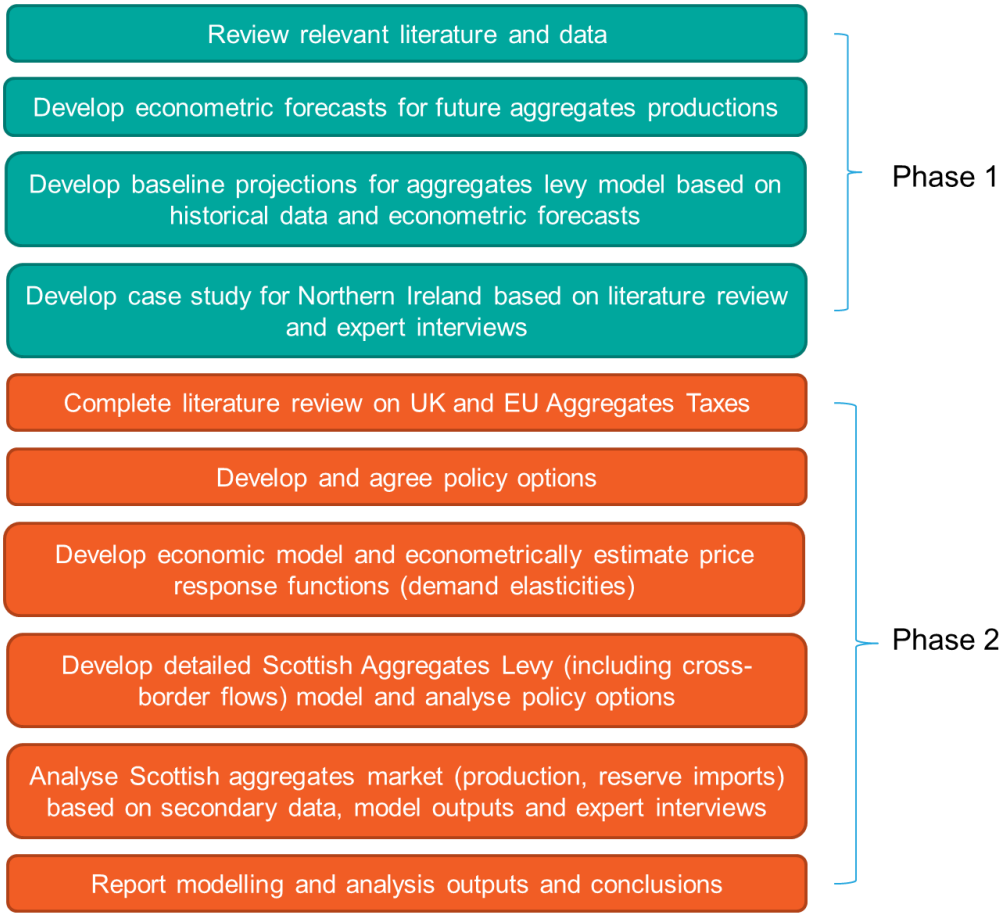
This means it is difficult to draw as firm conclusions about the current aggregates market in Scotland, or draw reliable comparisons from past trends, as we would have liked to. However, the evidence indicates that the majority of aggregates, once extracted, are retained for use within their region of extraction. West Central Scotland is a major source of both crushed rock and sand and gravel; Tayside and Fife is also a significant sand and gravel producer, while the Highlands region is the most significant area for crushed rock, though also the biggest exporter of this rock to RUK and/or beyond. More detailed geological research and Scottish-specific data and analysis is needed to provide reliable, up-to-date information on consented reserves.

Approach to Developing the Scottish Aggregates Levy Model

Overview of the Project Methodology

A main aim of this project was to develop an options appraisal model to analyse the potential impacts of various illustrative policy options related to the revision of the Scottish Aggregates Levy. The model was developed over Phase 1 and Phase 2 of the project. The key methodological steps for completing the study are presented in Figure 5.

Figure 5: Overview of Approach

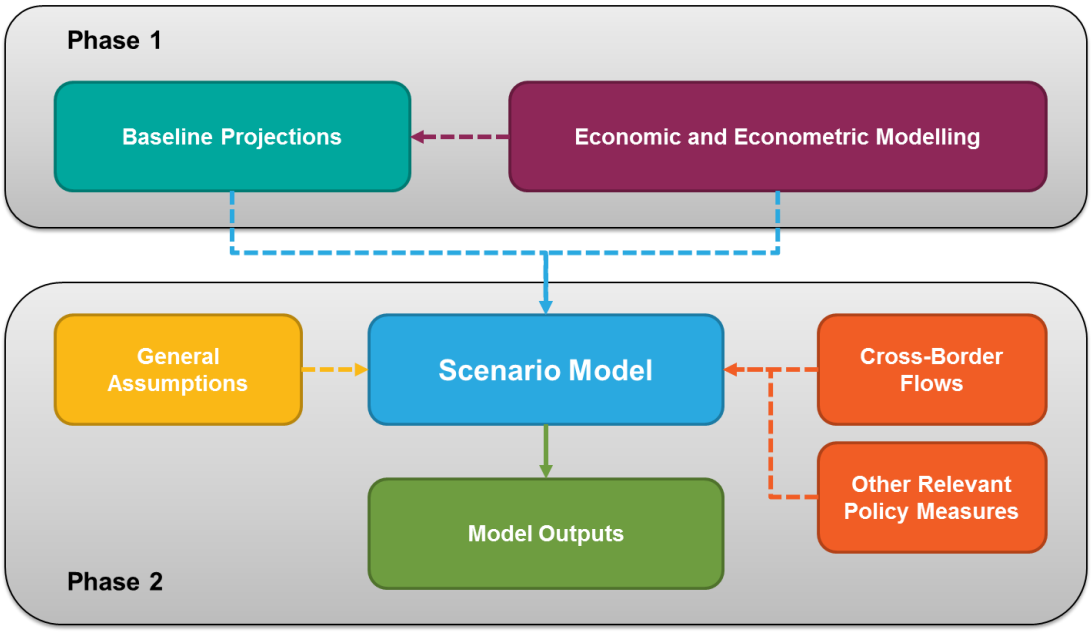


Phase 1 involved developing the business as usual (BaU) model using historical data and econometric forecasting of aggregates production. The BaU model produced the following projections for the modelling period, 2018 – 2030:

- Production of primary aggregates including aggregates imports and exports (million tonnes);
- Production of recycled aggregates (million tonnes); and
- Levy revenue (£million).

Phase 2 involved selecting illustrative policy options for the Scottish Aggregates Levy and extending the Phase 1 BaU model to develop the detailed Aggregates Levy model for analysing the impacts of the selected policy options. The detailed scenario model in Phase 2 also included the changes in import and export of aggregates due to levy rate differentials between Scotland and the rest of the UK that was implied by the scenarios. Figure 6 presents the key modelling elements in the Phase 1 and Phase 2 modelling described above.

Figure 6: Key Modelling Elements



The detailed Aggregates Levy model developed in Phase 2 was used to analyse the following impacts from the illustrative policy options:

- Primary aggregates production and supply including exports and imports;
- Production of recycled aggregates;
- Revenue from the levy; and
- Environmental impacts / externality costs.

Modelling the Business as Usual Scenario

According to the project scope, as set out above, two types of aggregates were modelled:

- Primary aggregates, which includes crushed rock and sand and gravel; and
- Secondary aggregates, which include recovered material from C&D waste which is sold as a secondary material for use in construction projects.

The approach to modelling the BaU scenario comprised two key stages:

- **Historic aggregates production, import and export** – all available aggregates data were reviewed and used to compile a historic dataset on production, import and export of aggregates for Scotland;[53] and
- **Forward projections** – projections of aggregates production, import and export out to 2030 were created for a 'business as usual' scenario i.e. where the current rate of aggregates levy is assumed to stay constant in future years.

These modelling stages along with the data sources and assumptions are described further in the Appendix 2.

Modelling Illustrative Policy Options

Different illustrative policy options were discussed with the project governing team at Scottish Government throughout Phase 1 of the project. From these, selected options were presented in the interim project meeting. The following four options were subsequently selected for inclusion in the Phase 2 modelling:[54]

- **Option 1 – High levy rate (Tax increase scenario)**: Under this option, the Scottish levy rate is set above the UK levy rate.
- **Option 2 – Low levy rate (Tax decrease scenario)**: Under this option, the Scottish levy rate is set below the UK levy rate.
- **Option 3 – Scottish Government baseline (No tax scenario)**: The levy rate is set to zero under this option. Results from this option is required for developing future tax legislation in Scotland where the Scottish Government needs to set out the impacts of a 'do nothing' approach.
- **Option 4 – New landfill tax band for aggregates (Landfill scenario)**: The levy rate is kept at the same level as the UK levy rate, while creating an additional band of landfill tax for aggregates which is higher than the rate for landfilling inert materials (this should increase the recycling of aggregates through increasing the cost of landfilling aggregates).[55]

Changes to the demand for primary aggregates and subsequent changes to the production, imports and exports of primary aggregates as well as the production of recycled aggregates were modelled based on the estimated price elasticities of demand. Table 3 presents the modelled levy rates along with direction of effects on demand and supply of primary and recycled aggregates under each policy option.

[53] Without any reliable data on imports and exports of primary aggregates between Scotland and the rest of the world (outside the UK), it was assumed that all modelled imports and exports of primary aggregates are between Scotland and the rest of the UK.

[54] It should be noted that these four policy options selected for the modelling exercise are purely illustrative and don't represent the 'actual' tax options being considered by the Scottish Government.

[55] We have also modelled this scenario with the Scottish Aggregates Levy rate set to zero. However, the results were very similar to the results under Policy Option 3 (Scottish Government Baseline), and therefore the option for separate landfill tax band for aggregates with zero aggregates levy rate has not been considered further.

Table 3: Modelled levy rates and impacts under different policy scenarios

	BaU	Option 1	Option 2	Option 3	Option 4
Aggregates levy rate	£2.00	£2.50	£1.50	£0.00	£2.00
Landfill tax for inert materials	£2.90	£2.90	£2.90	£2.90	£2.90
New landfill tax band for aggregates	-	-	-	-	£3.80
Demand for aggregates	-	Decrease	Increase	Increase	Unchanged
Production of primary aggregates	-	Decrease	Increase	Increase	Decrease
Imports (see footnote 85)	-	Decrease	Increase	Increase	Decrease
Exports (see footnote 85)	-	Increase	Decrease	Decrease	Unchanged
Production of recycled aggregates	-	Increase	Unchanged	Unchanged	Increase

Further details on the estimation of price elasticities, along with assumptions behind effects on demand and supply of aggregates are discussed in the Appendix 3.

Useful Definitions and Identities

Here we present some useful definitions and identities that are used throughout the analysis to follow.

Domestic production is defined as the total amount of primary aggregates extracted in Scotland for consumption in Scotland and export.

Demand for primary aggregates (or Primary demand), is the total demand for primary aggregates in Scotland excluding their export of while including imports. Thus:

Primary demand = Domestic production + Imports – Exports

Finally, **Total demand in Scotland** include demand for both primary and secondary aggregates. Thus:

Total demand = Primary demand + Demand for Recycled Aggregates

The following two sections discuss the results of BaU and the scenario modelling, respectively.

A Note on the Data Gaps

Given the high level of confidentiality within the aggregates market in Scotland and the rest of the UK, there were large gaps in the data that were required for undertaking a robust modelling. Particularly, the lack of data on imports and exports of primary aggregates made the modelling of cross-border flows extremely challenging. As result, the robustness of estimated cross-border flow impacts of potential changes to the levy are highly dependent on the reliability of the assumptions that were made to fill the data gaps. A more robust modelling of cross-border effects can be undertaken in future, if better quality data are available.

Modelling the Business as Usual Scenario

Results for the BaU modelling are presented in this section.

Econometric Forecasting of Future Aggregates Demand

The demand for crushed rock and sand and gravel in future years is estimated econometrically based on historical production data, and using time-series forecasting techniques. The modelled dependent variables in this case were:

- Production of crushed rock; and
- Production of sand and gravel.

Both of these dependent variables are likely to depend on external factors, such as, construction output in the economy, population, etc., as well as on internal factors, such as, the past demand for these two types of aggregates. Accordingly, both dependent variables were modelled using the ARMAX (Autoregressive Moving Average model with External factors) technique, which incorporates the dependence on past values along with the dependence on external factors.

Separate models were estimated to generate forecasts for crushed rock and sand and gravel. Both models were estimated in log-log form (log transformation has been applied to dependent and independent variables before estimation).[56]

The data on production of crushed rock and sand and gravel were sourced from the UK Minerals Yearbook 2018.[57]

Data on construction output in Scotland from ONS did not contain any data prior to 1999. So Scotland's GDP (with 1 year lag) was used as a proxy for construction output in Scotland. We have also used population in Scotland as another external factor that affects the demand for aggregates. Data on population were sourced from ONS.

Forecasting the production of aggregates for the period 2018 to 2030 also requires future projections of GDP and population in Scotland for the same period. The GDP forecasts were sourced from Scotland's Economic & Fiscal Forecasts by Scottish Fiscal Commission[58], while the population projections were sourced from ONS[59].

Figure 7 and Figure 8 present the actual and estimated values for crushed rock and sand and gravel, respectively, based on the annual production data between 1980 and 2017. The figures also present the forecast values, along with 80% and 95%

[56] Log-log functional form reflects constant elasticity of demand (responsive of demand to price changes), which is more consistent with the observed data.

[57] BGS (2019) United Kingdom Minerals Yearbook 2018. https://www.bgs.ac.uk/downloads/start.cfm?id=3514

[58] https://www.fiscalcommission.scot/forecast/scotlands-economic-and-fiscal-forecasts-may-2019/

[59] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections

confidence intervals (extremities of the light blue and grey shaded regions, respectively), for these two types of aggregates for 2018 to 2030. It can be observed that the production of crushed rock is predicted to show a slight downward trend while the production of sand and gravel is predicted to decline more rapidly.

Figure 7: Econometric Forecast for Crushed Rock Production (000 tonnes)

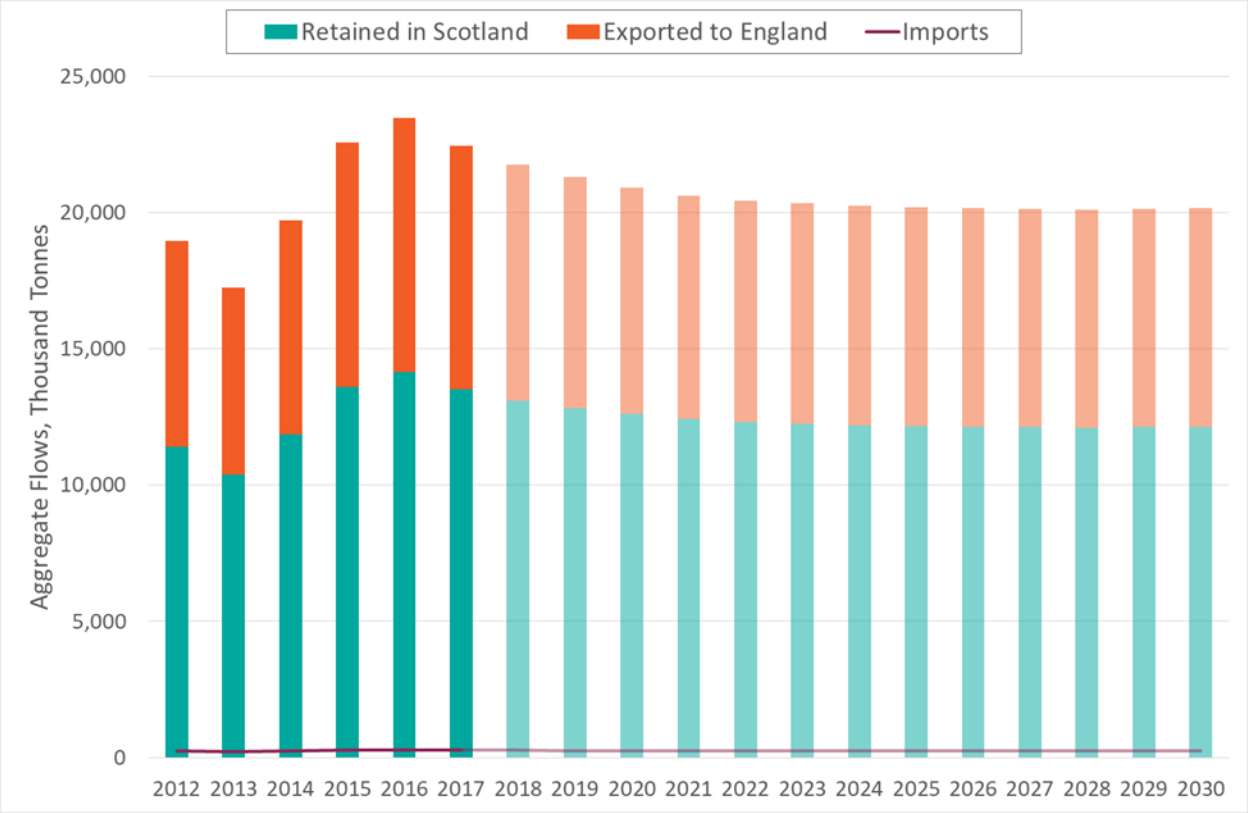
Figure 8: Econometric Forecast for Sand and gravel Production (000 tonnes)

Aggregates Production, Import and Export

Figure 9 depicts the historic data and the modelled projection for production, imports and exports of crushed rock for Scotland between 2012 and 2030 (lighter shades denotes modelled production, import and export based on econometric forecasting). During the initial period, production of crushed rock grew from 19 million tonnes to 23.6 million tonnes till 2016, and then it is projected to decline to 20.2 million tonnes in 2030. It can be observed that about 30 to 40% of the crushed rock produced in Scotland is initially ‘exported’ to England but a small proportion of this crushed rock is

commercially exploited in England. The ultimate destination of the vast bulk of unprocessed, crushed rock is a number of European countries seeking large quantities of rock to protect undersea cabling (for example). The amount of crushed rock imported to Scotland is very small as the supply of crushed rock within Scotland is essentially adequate for its needs.

Figure 9: Scottish Crushed Rock Production, Import and Export Estimates and Projections (2012 – 2030)



Sand and gravel production, import and export for Scotland for the same period are presented in Figure 10 (lighter shades denotes modelled production, import and export based on econometric forecasting). It can be observed that the production of sand and gravel has increased from approximately 5.8 million tonnes in 2012 to around 6.3 million tonnes in 2016, but predicted to fall to 3.8 million tonnes by 2030, following a declining trend after 2016, as observed in the econometric forecasting above. It can also be observed that, only a small amount of sand and gravel is exported to England and imported from England. This reflects the fact that sand and gravel produced across the UK is highly substitutable, and thus it is not cost effective to transport sand and gravel in and out of Scotland.

Figure 10: Scottish Sand and gravel Production, Import and Export Estimates and Projections (2012 – 2030)

Regional Distribution of Aggregates Production, Import and Export

Figure 11 and Figure 12 present the Scottish regional distribution of crushed rock and sand and gravel production, import and export for Scotland based on 2012 data from the Scottish Aggregates Survey 2012.[60] The largest amount of crushed rock was produced in Highland & Moray region (around 6.9 million tonnes). On the other hand, the 'West Central Scotland A' region produced the largest amount of sand and gravel (approximately 1.8 million tonnes)

It can be observed that crushed rock produced in most of the regions are retained within that region to meet local aggregates demand. However, SESPlan (the planning authority for Edinburgh and South East Scotland) and 'West Central Scotland A' regions export crushed rock to other regions, while Highland & Moray exports over 90% of the crushed rocks produced in the region to the rest of Scotland and England (we gather, anecdotally, for processing small amounts) but ultimately the bulk of Scottish exports go overseas.

It can also be observed that most of the regions export some of their production to other regions in Scotland. However, as discussed in the previous section, only a small

[60] This is based on groups of combined planning authorities of Scotland rather than particular local authority areas.

fraction of the total sand and gravel produced in Scotland is exported to the rest of the UK.

Figure 11: Geographical Distributions for Crushed Rock Production, Import and Export (2018)

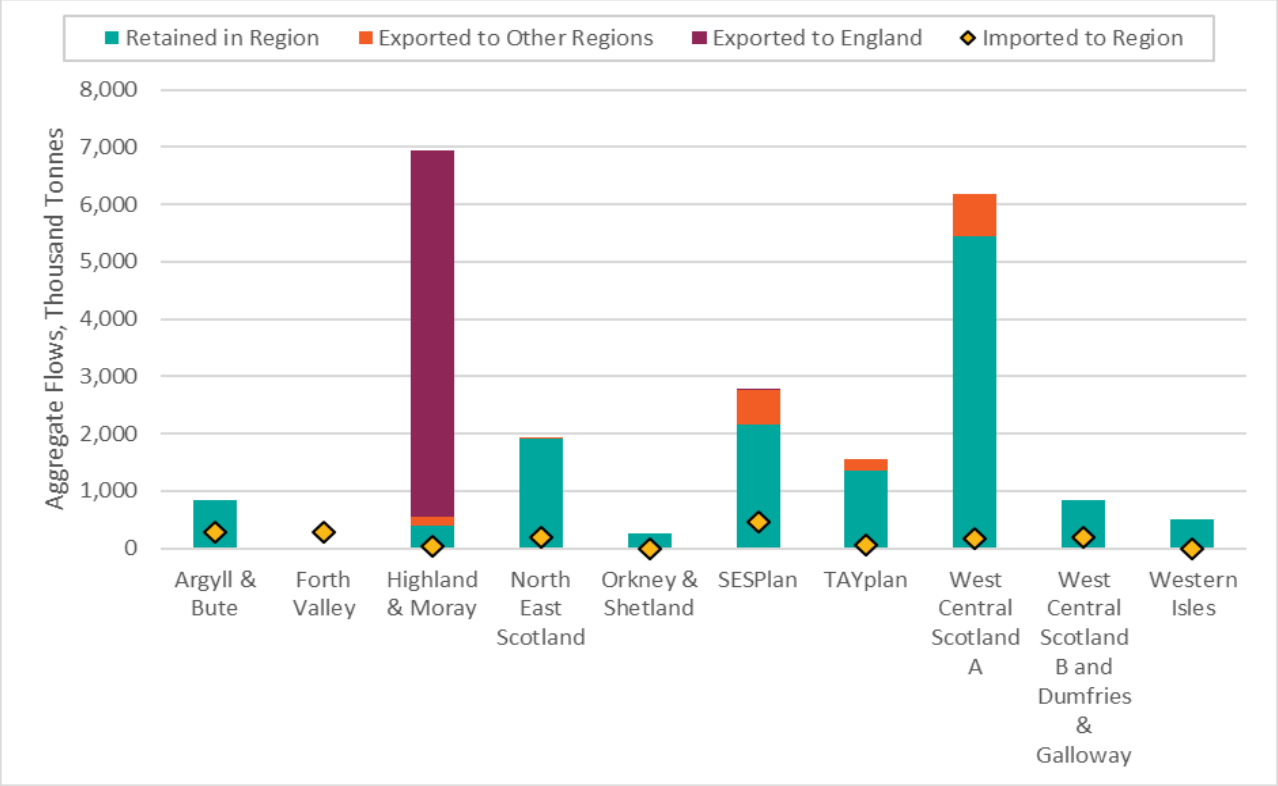
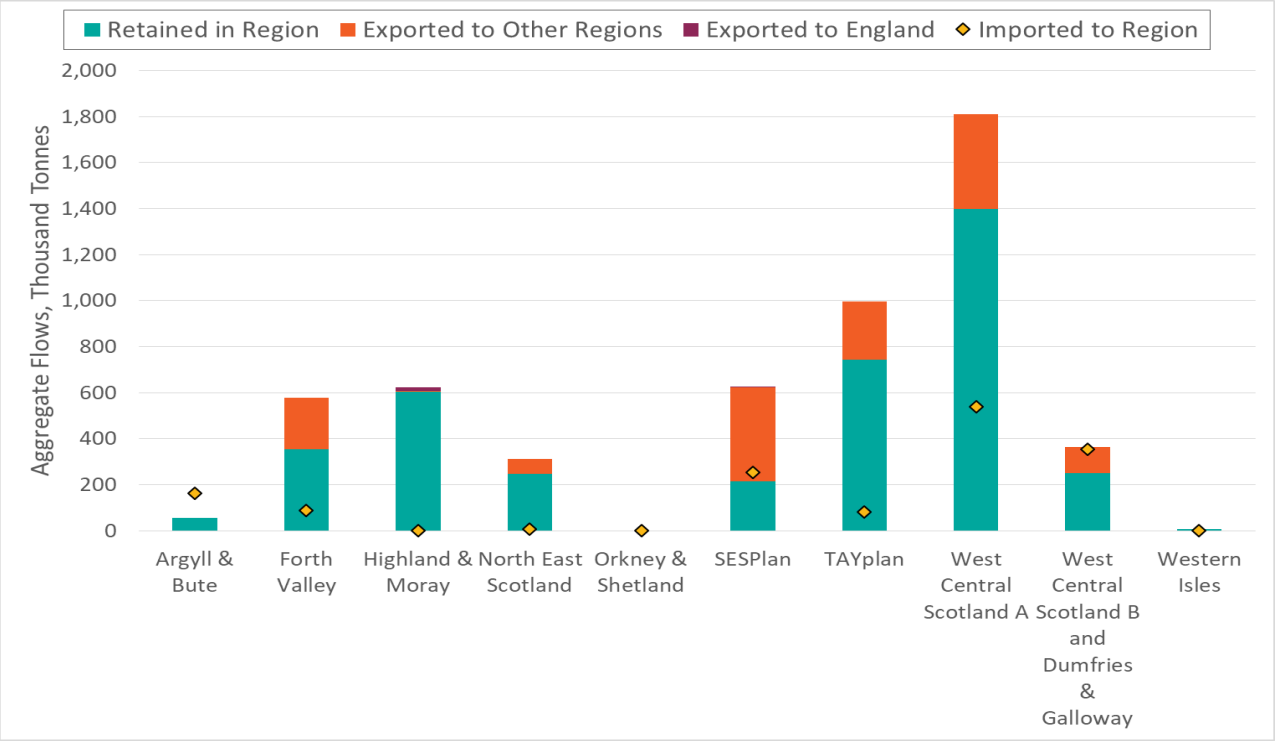


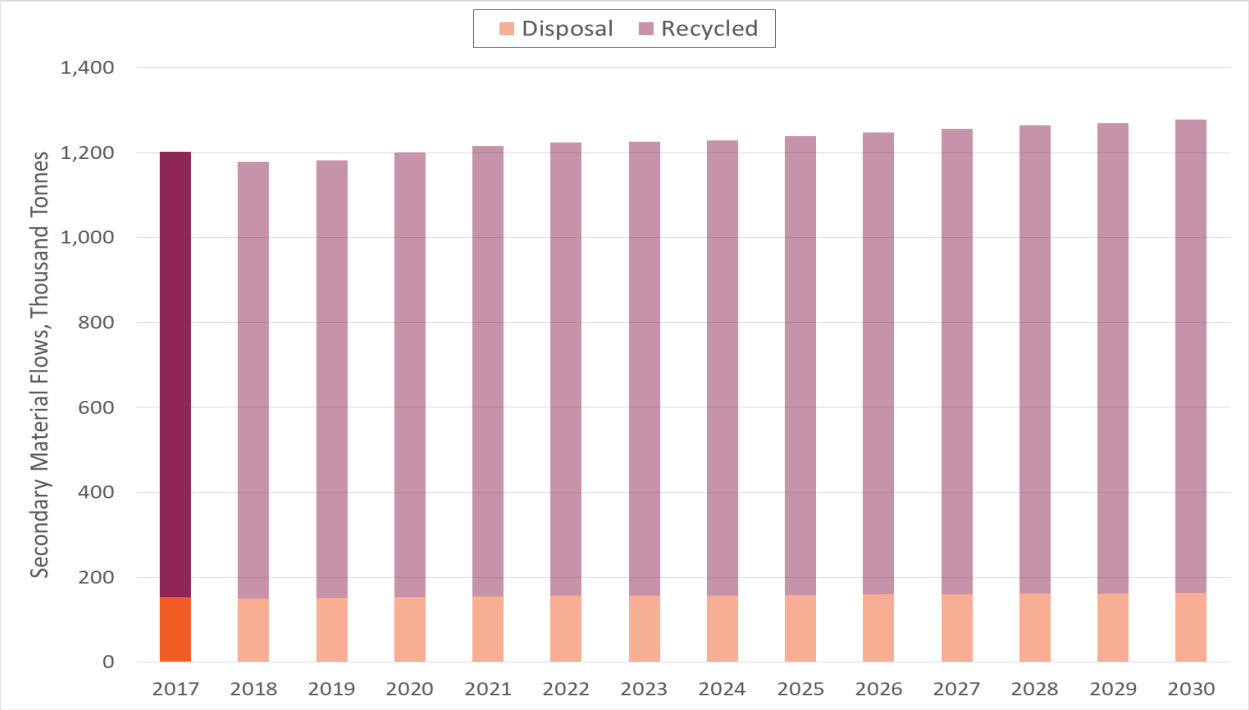
Figure 12: Geographical Distributions for Sand and gravel Production, Import and Export (2018)



Production of Secondary Aggregates

The forward projections of secondary aggregates production in Scotland up to 2030 is presented in Figure 13 (lighter shades denote modelled production based on predicted growth of C&D waste). It shows that C&D related aggregates waste generation is forecast to grow from 1.2 million tonnes in 2017 to 1.28 million tonnes in 2030. Based on the current recycling rate of C&D waste aggregates, the supply of recycled aggregates, on the other hand, may grow from 1.05 million tonnes in 2017 to 1.12 million tonnes in 2030.

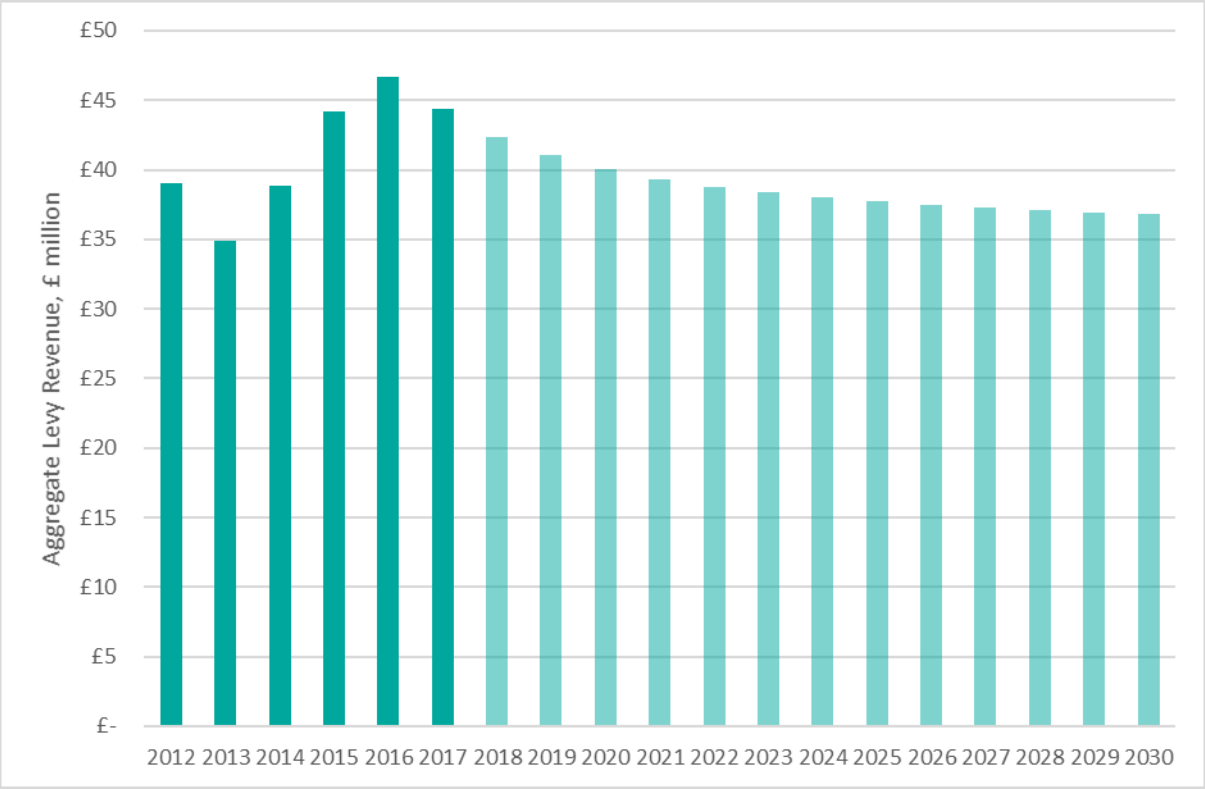
Figure 13: C&D Waste Flow and Secondary Aggregates Production Projections (2017 – 2030)



Aggregates Levy Revenue

Forward projections of revenue from Scottish Aggregates Levy for the BaU scenario are presented in Figure 14 (lighter shades denote modelled revenues based on future projections of aggregates production and import). The estimated revenue from the Aggregates Levy in Scotland in 2012 was just over £39 million, which increased to approximately £46.7 million in 2016, and slowly estimated to reduce afterwards to approximately £36.6 million by 2030. The slow decrease in levy revenue between 2016 and 2030 could be explained partly by the reduction in crushed rock and sand and gravel production, along with the increase in recycling and reuse of C&D waste observed in the modelled BaU scenario.

Figure 14: Scottish Aggregates Levy Revenue Projections (2012 – 2030)



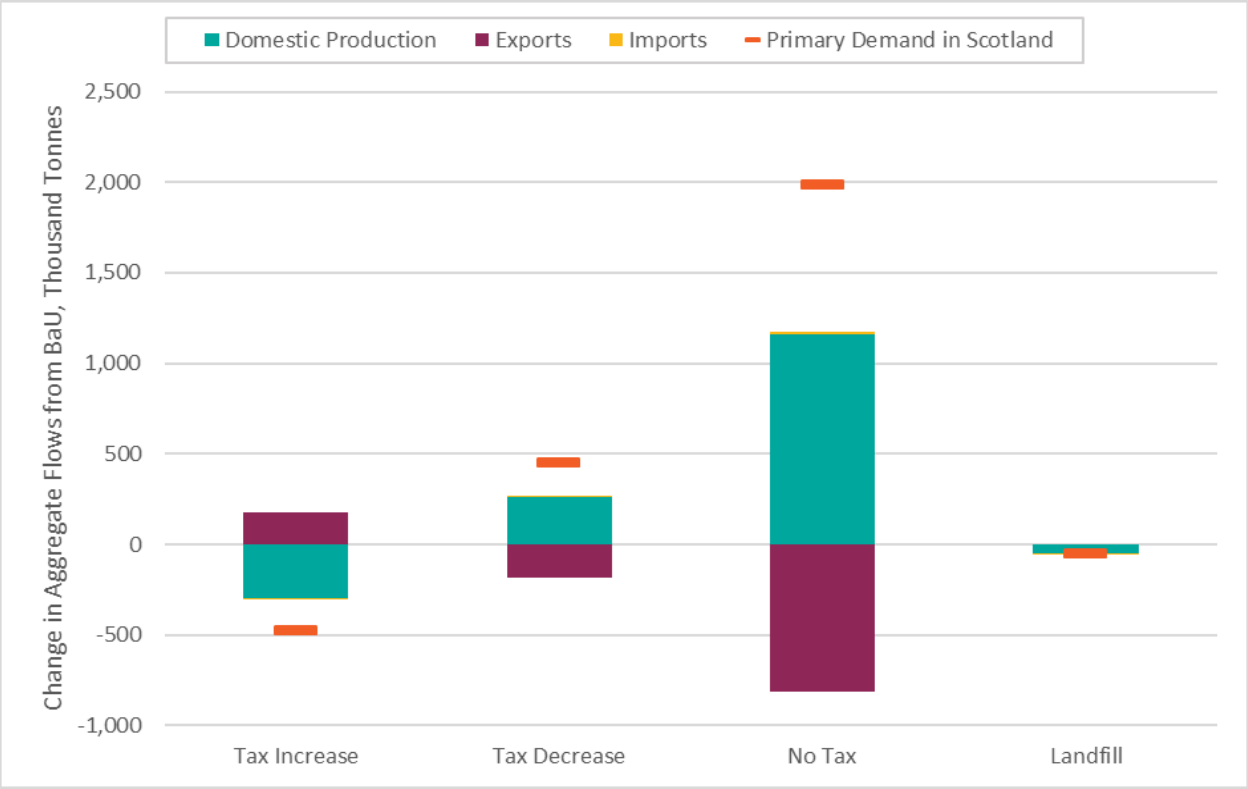
Illustrative Impacts from Changes to the Levy

This section presents the results of some scenario modelling for the selected illustrative policy options. The illustrative policy options are included purely to show the various financial and environmental outcomes of a broad range of policies. They should not be seen as indications of policy intent regarding the setting of the Scottish Aggregates Levy. The data generated is also illustrative in the sense that the independent Scottish Fiscal Commission (SFC) would ultimately be forecasting revenue and policy costings for the Scottish Aggregates Levy and they will model the devolution of the tax based on the information they have available to them at the time of their first revenue forecast. Comparison between policy options are presented in terms of changes from the BaU outputs for the final modelling year, 2030. This particular year was chosen simply to observe long-term projections and the effects of tax policy. This work therefore goes beyond the 5-year forecasts normally presented by SFC.

Aggregates Production, Import and Export

Figure 15 presents the change in domestic production, import, export and primary demand for crushed rock. Under Option 4 the change in significantly smaller than the change under other options, because the levy rate is kept constant under this option. On the other hand, the highest level of change is observed under Option 3, where the levy rate is set to zero. Option 1 displays an overall reduction in total demand for crushed rock due to an increase in the levy rate, while Option 2 displays an overall increase in total demand for crushed rock due to a reduction in the levy rate. It can also be observed that, there are very little changes in imports as a response to change in levy rates, which is consistent with import figures for presented in Table 16 (Appendix 6).

Figure 15: Production, Import, and Export of Crushed Rock in 2030 (000 tonnes)



Similarly, changes in domestic production, exports, imports and primary demand for sand and gravel can be observed in Figure 16, although there are very small changes in cross border flows of sand and gravel under all four options.

Figure 16: Production, Import and Export of Sand and gravel in 2030 (000 tonnes)

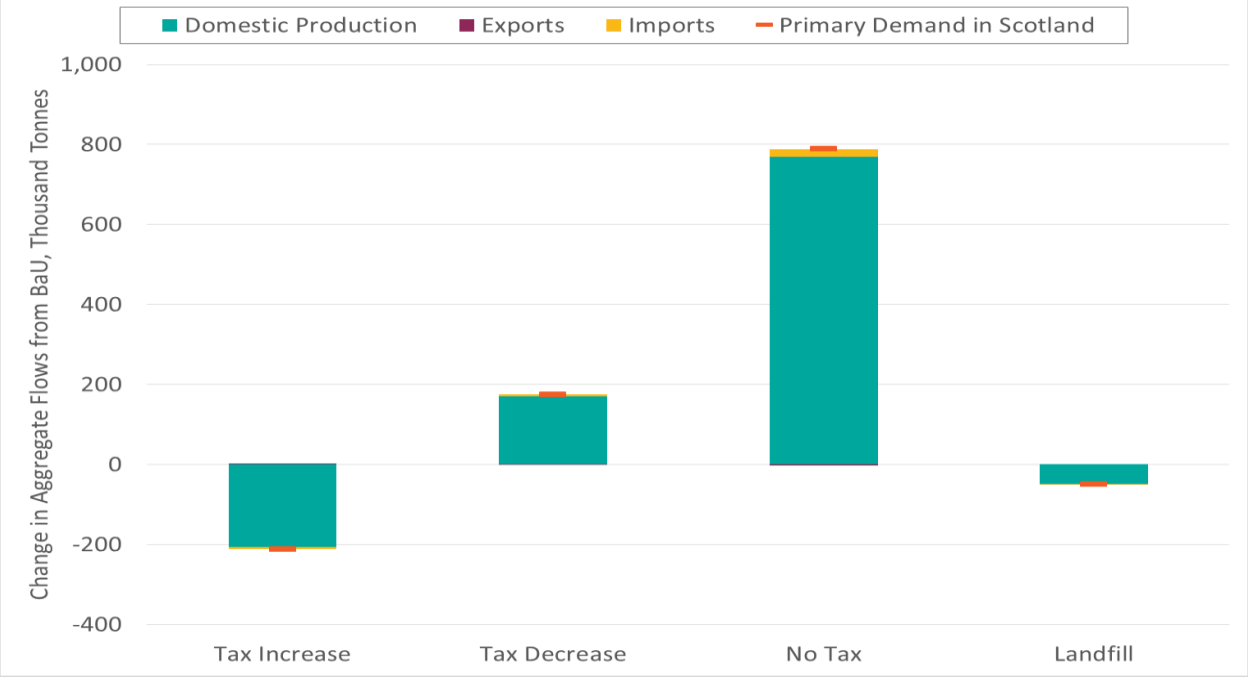
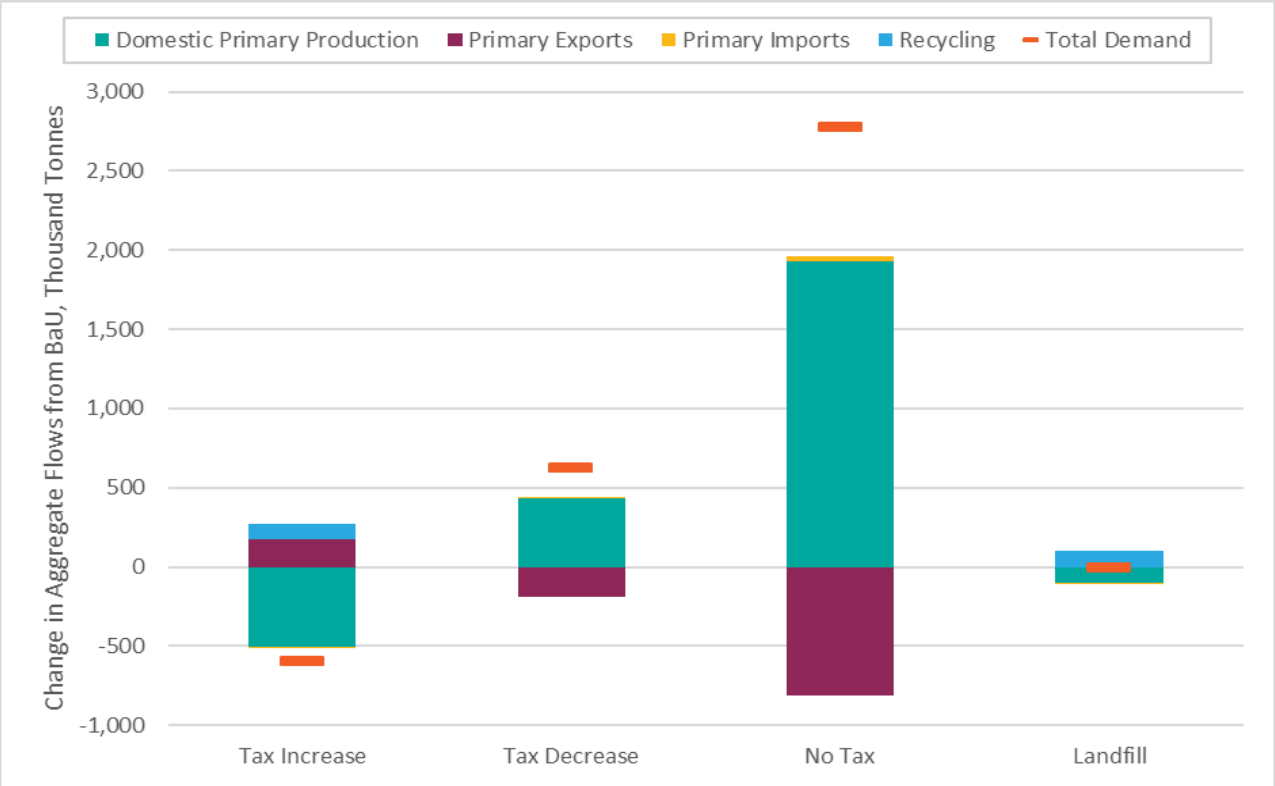


Figure 17 presents the change in total primary aggregates - crushed rock and sand and gravel - production, import, export, recycling and total demand under different

options. As before, Option 3 displays the highest level of change, whereas Option 1 displays an overall reduction in demand for primary aggregates due to the increase in levy rate. Similarly, Option 2 displays an overall increase in primary demand due to the reduction in levy rate.

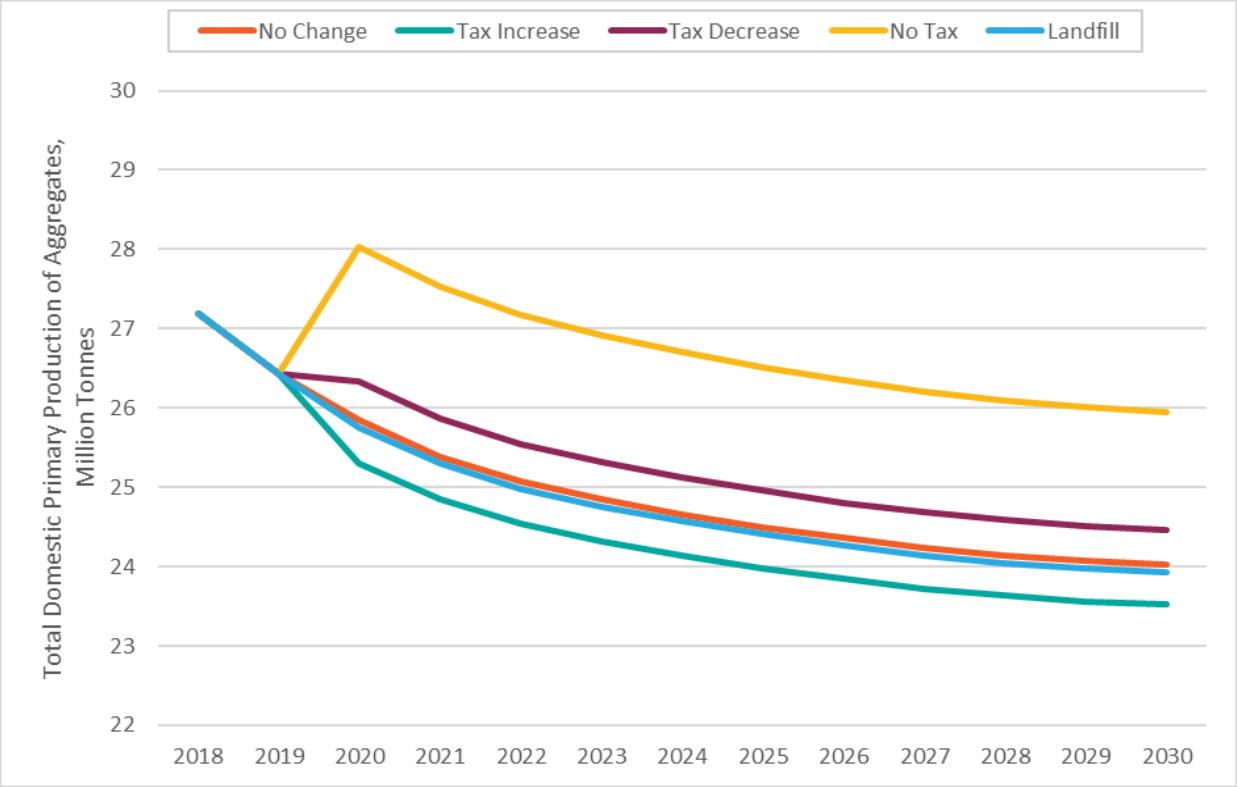
Moreover, Option 1 and Option 4 generates the highest level of recycling, due to an increase in aggregates levy or introduction of a new banding in landfill tax rates related to aggregates (e.g. inert rate), respectively.

Figure 17: Production, Import and Export of Primary Aggregates in 2030 (000 tonnes)



Finally, Figure 18 presents the change in domestic production of primary aggregates in Scotland. An overall decreasing trend is observed under all four options as well as the BaU scenario, although domestic production increases significantly in the beginning under Option 3, due to a large increase in demand in the absence of the levy.

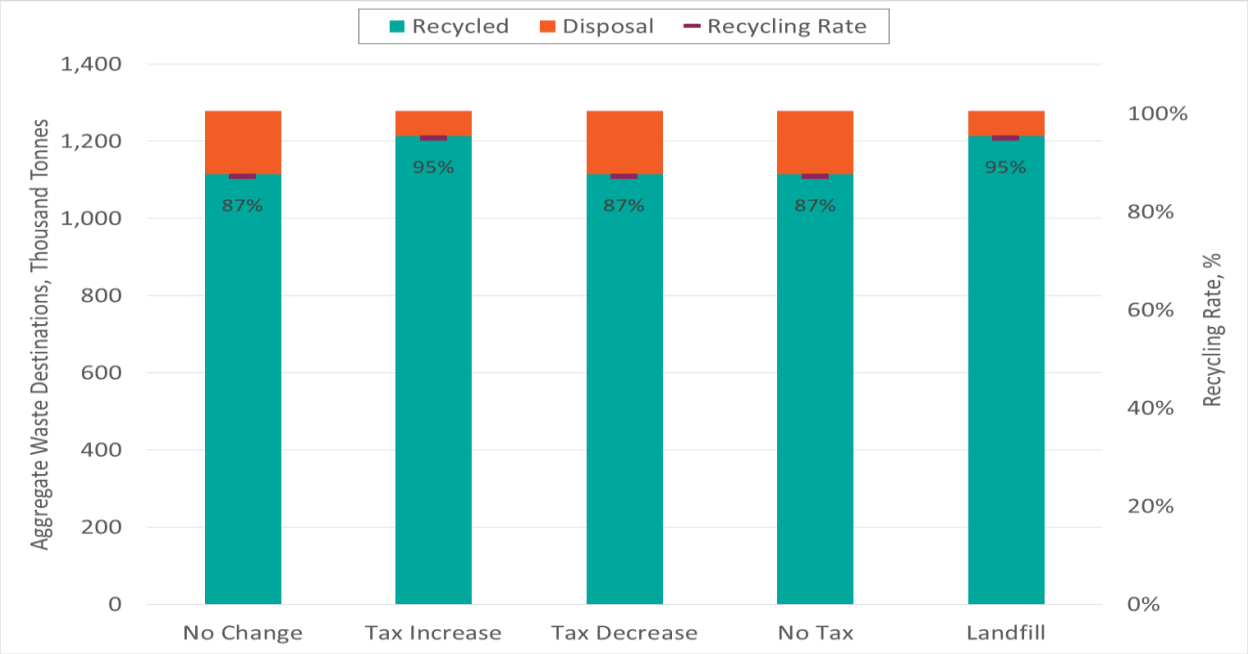
Figure 18: Domestic Production of Primary Aggregates over time (2018 – 2030)



Production of Secondary Aggregates

Production of secondary aggregates and C&D waste recycling rates are presented in Figure 19. It can be observed that the highest amounts of recycled aggregates are produced under Option 1 and Option 4, with the C&D waste recycling rate of 95%. On the other hand, for Options 2 and 3, there is no change in the production of recycled aggregates from BaU, due to lack of incentives to recycle C&D waste further.

Figure 19: Production of recycled aggregates and C&D waste recycling rates (2030)



Aggregates Levy Revenue

Levy revenues generated under different options are presented in Figure 20. It can be observed that only Option 1 generates higher levy revenue compared to the levy revenue generated under the BaU scenario. It can also be observed that Option 4 generates slightly lower levy revenue compared to BaU. This is because, under this option increase in production of recycled aggregates is offset by the reduction in primary production and import to keep demand constant, resulting in a slight reduction in levy revenue compared to the BaU scenario.

Figure 20: Scottish Aggregates Levy Revenue under some illustrative tax policy options (2030)

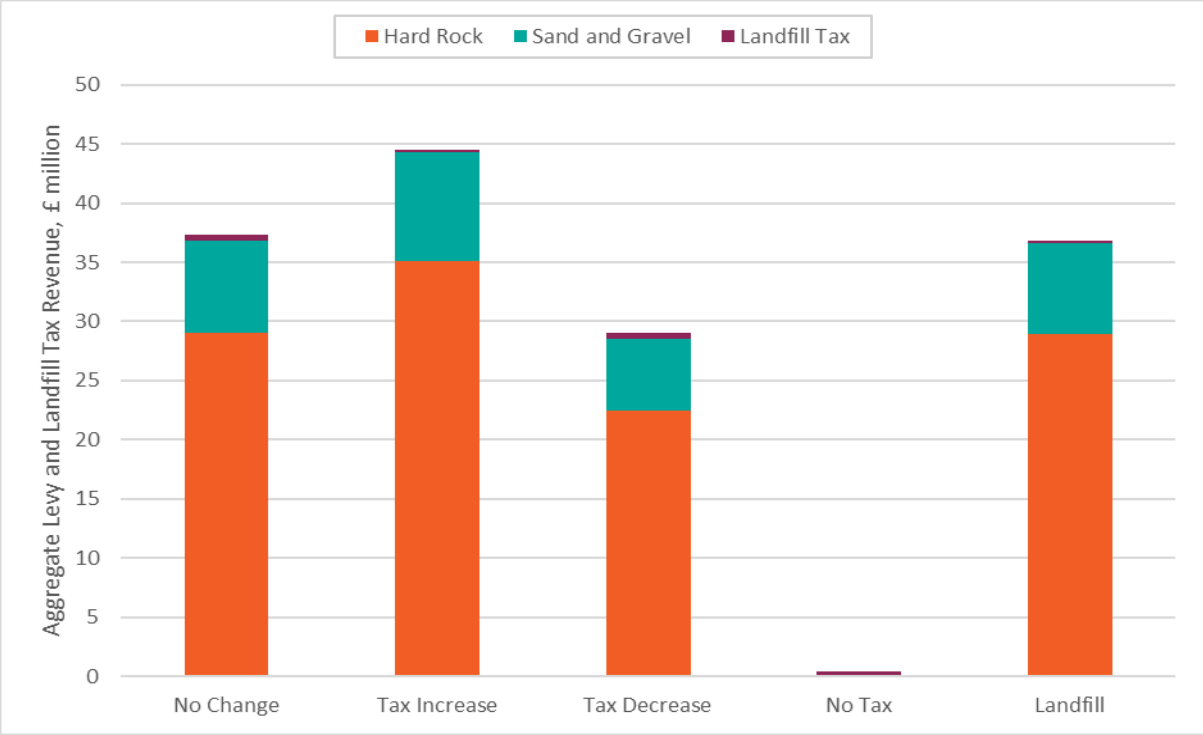
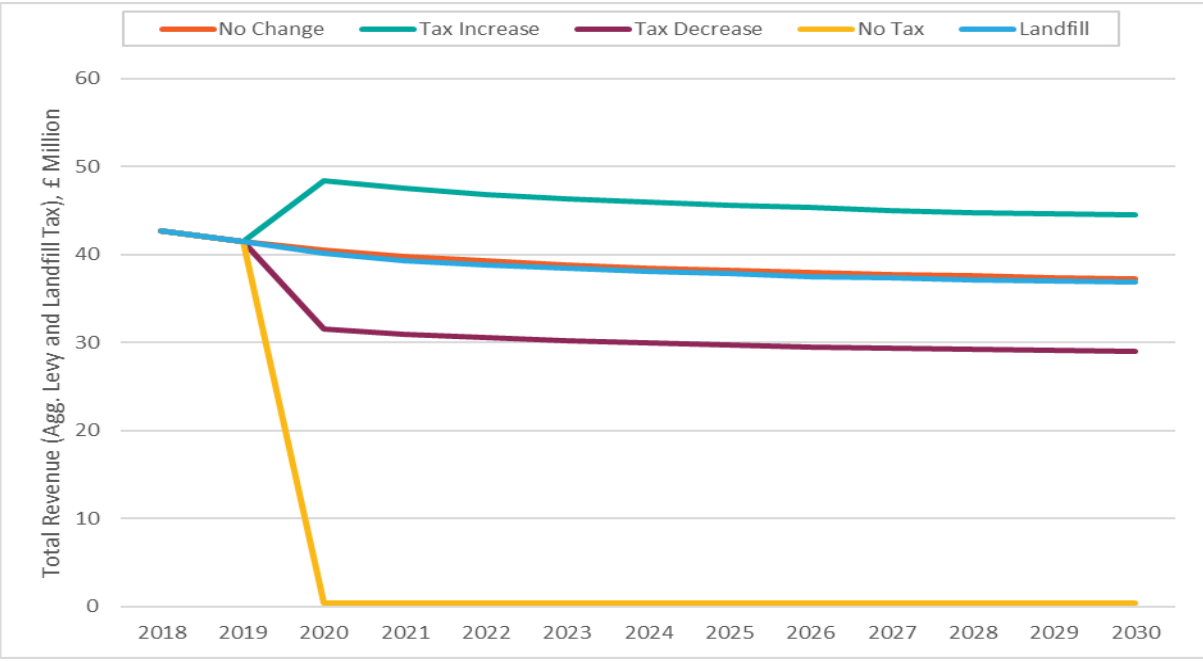


Figure 21 presents the change in levy revenue over time under all 4 options as well as the BaU scenario. Due to the reduction in demand for primary aggregates over time, levy revenue depicts a downward trend under all 4 options as well as the BaU scenario.

Figure 21: Trend in Scottish Aggregates Levy Revenue (2018 – 2030)



Externality Costs of Aggregates Production

Externality costs of aggregates extraction and transportation[61] under different options along with the BaU scenario are presented in Figure 22. Due to increases in domestic production of aggregates, the greatest increase in externality costs occur under Option 3 (No Tax). Option 1 (Tax Increase) generates the lowest amount of externality costs, followed by Option 4 (Landfill), both of which generating externality costs below the BaU scenario. Finally, Option 2 (Tax Decrease has slightly higher externality costs compared to BaU, given the net increase in primary production under Option 2 as compared to the BaU scenario.

Figure 22: Externality Costs of Scottish Aggregates Production (2030)

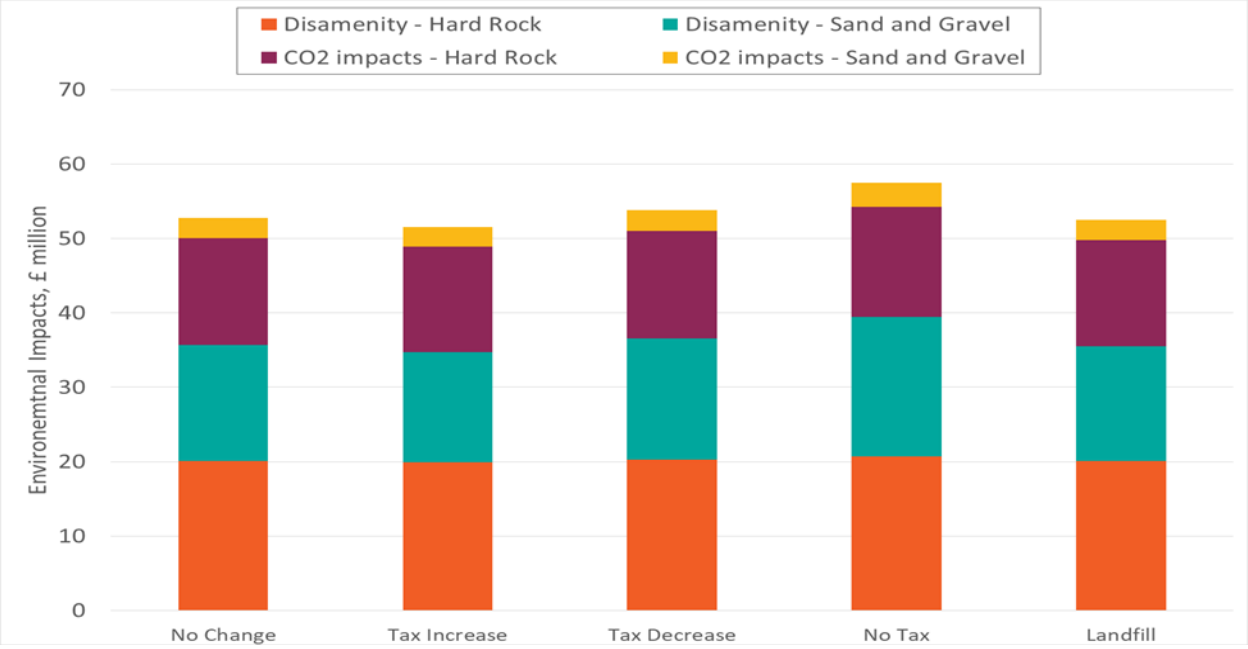


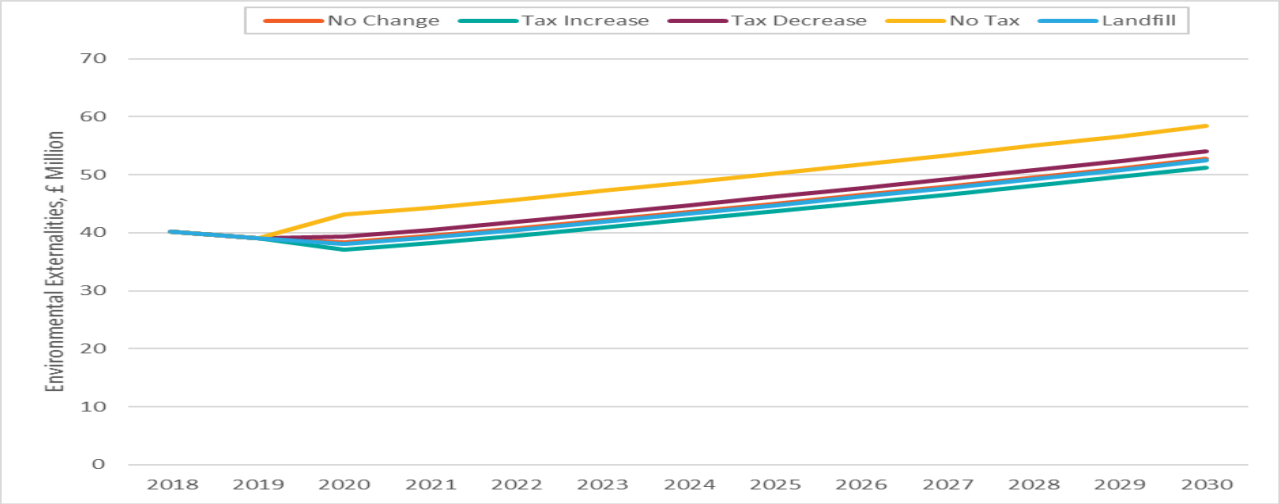
Figure 23 presents the change in externality costs over time for the period 2018 to 2030. It can be observed that, for all options as well as the BaU scenario, the overall externality costs increase over time, even though the production of primary aggregates decreases over time. As shown in Appendix 3, externality cost per tonne of aggregates production and transportation increase over time due to:

- Increase in willingness to pay with increase in income over time; and
- Increase in shadow price of carbon over time.

Therefore, when the unit externality cost increases at a faster rate than the rate of decrease of primary aggregates production, the total externality cost associated with primary aggregates production and transportation also increases over time.

[61] Two types of externality costs were modelled – disamenity costs associated with aggregates extraction, and CO_2 emissions from production and transportations of aggregates. Please see Appendix 3 for a detailed discussion of these externality costs and how these were calculated.

Figure 23: Change in externality costs over time (2018 – 2030)



Discussion of the results

Summary of the results for all 4 options in terms of difference from the BaU scenario for 2030 are presented in Table 4.

Table 4: Results summary – difference from BaU scenario (2030)

	Option 1 Relative tax increase scenario	Option 2 Relative tax decrease scenario	Option 3 No tax scenario	Option 4 New landfill tax band for aggregates
Aggregates Flows (000 tonnes)				
Domestic production	-505	435	1928	-97
Exports (see footnote 85)	175	-186	-814	0
Imports (see footnote 85)	-9	7	32	-2
Total demand	-590	627	2775	0
Recycled aggregates	99	0	0	99
C&D waste recycling rate (%)	8%	0%	0%	8%
Revenue (£ million)				
Aggregates levy revenue	7.5	-8.3	-36.8	-0.2
Landfill tax revenue	-0.3	0	0	-0.2
Externality Costs (£ million)				
Disamenity costs	-1.1	1	4.3	-0.2
Climate Change Impacts (CO2 Emissions)	-0.3	0.3	1.4	0.0
Total externality costs	-1.4	1.3	5.7	-0.2

The above illustrative analysis suggest that both Option 1 and Option 4 would generate the highest level of recycled aggregates production. However, Option 1 would also generate significantly higher levy revenue and has lower externality costs compared to the BaU scenario and all other options. So if the objective is to maximise levy revenue and/or to reduce the external costs of aggregates extraction in Scotland along with increasing the production of recycled aggregates, Option 1 seems to be the preferred option.

However, it should be noted that the amount of additional recycling generated through change in the Scottish Aggregates levy or by introducing a new landfill tax band for aggregates may be very small, given that approximately 87% of the C&D wastes are currently being recycled under the BaU scenario.

Moreover, increasing recycling of C&D waste through introduction of a new landfill tax band for aggregates, will require additional monitoring and enforcement, which will increase the implementation costs of such a measure. In addition, various provisions for the exemption of C&D wastes from the landfill tax will need to be revised to ensure that C&D wastes are recycled to the highest quality possible for using as a substitute of primary aggregates rather than other low value uses, such as, pipe bedding or backfilling.

Conclusions

A main aim of this research project was to analyse various policy options for implementing a Scottish Aggregates Levy. In doing so, we have undertaken a brief review of the UK Aggregates Levy and similar taxes in other European countries. We have also developed a case study on Northern Ireland and the issues related to cross-border aggregates movements noted there would be highly relevant to Scotland. To understand the current aggregates market in Scotland along with the potential reserves of primary aggregates, we have conducted a market analysis based on latest available data and expert interviews though acquiring the latest data has been particularly challenging given the discontinuation of various aggregates-related surveys. Finally we have developed a detailed options appraisal model to analyse the potential economic and environmental impacts of selected illustrative policy options for implementing the Scottish Aggregates Levy.

Below we present the preliminary conclusions of this research, which were finalised after the presentation of the final results and discussion with the project governing team at Scottish Government.

- Analysis of the UK Aggregates Levy and similar taxes in other countries suggests that the Scottish Aggregates Levy is likely to be more effective in terms of reducing the demand for primary aggregates and increasing recycling of C&D wastes, when it is used in conjunction with landfill or waste disposal taxes;
- If the objective is to protect the domestic aggregates producers against international suppliers, imports of aggregates to Scotland will need to be levied at a similar rate as domestic extraction while exports will need to be exempted. On the other hand, to disincentivise domestic extraction in favour of imports, aggregates imports could be exempted from the levy, while applying the levy on domestic extraction and export of aggregates.
- As observed in the Northern Ireland (and Republic of Ireland) case study, implementing a different levy rate in Scotland compared to the levy rate in England will be likely to increase illegal cross-border movements of aggregates, and therefore a stricter monitoring and enforcement regime will be required to minimise the illegal cross-border trade.
- The market analysis revealed that aggregates production seems to be following a declining trend over the past few years, especially for sand and gravel. Moreover, the econometric forecasting of the aggregates production suggests that the declining trend will likely continue over the next few years as well, although econometric forecasts are always subject to a degree of uncertainty in the wider economy as well as the construction industry.
- Modelling of illustrative policy options for the Scottish Aggregates Levy suggests that the most effective policy option for maximising the levy revenue and the production of recycled aggregates, while minimising the externality impacts of primary aggregates production, is to increase the rate of the (current UK) levy in Scotland.

- Finally, it was estimated that the recycling rate for C&D waste in Scotland is already very high (about 87%). However, it should be noted that some of the recycled aggregates are currently being utilised in low value uses of aggregates (e.g. pipe bedding or backfilling) due to various restrictions on use of recycled aggregates in concrete production and/or presence of various exemption for the landfill tax for inert waste. In order to increase the substitution of primary aggregates with recycled aggregates, further incentives will be needed through revising some of the exemptions of the landfill tax for inert materials, while introducing minimum quality restrictions on recovery of C&D wastes.

Appendix 1: Introduction

These technical appendices set out the data and methodology used in the Scottish Aggregates Levy model developed for this work, as well as the detailed Northern Ireland case study.

Two types of aggregates were modelled, these are: primary aggregates (crushed rock and sand and gravel), and secondary aggregates i.e. recovered material from construction and demolition (C&D) waste which is sold as a secondary material for use in construction projects.

The modelling approach for Phase 1 of this work was comprised of two key stages, as detailed in Appendix 2, these are:

- **Historic baseline** – all available aggregates data was reviewed and used to compile a historic dataset of aggregates flows in Scotland; and
- **Forward projections** – based on likely growth rates, projections of aggregates flows out to 2030 were created for a 'no change' (or Business as Usual) scenario i.e. where the current rate of Aggregates Levy is assumed to stay constant in future years.

Phase 2 of this work involved further development of the Scottish Aggregates Levy Model to model some illustrative impacts of varying the Levy rate. Though data is restrictive, demand elasticities were developed and applied to estimate the impacts on production, import and export of primary aggregates, recycling of secondary aggregates, and the economic impacts in terms of levy revenue. Environmental externalities are also calculated. This is described further in Appendix 3.

These modelling stages are described further for each type of aggregates in Appendix 2 and Appendix 3, respectively, while the Northern Ireland case study is presented in Appendix 5.

Appendix 2: Phase 1 Modelling

Primary Aggregates

Our modelling approach for primary and secondary aggregates are described separately here due to the distinct datasets and methodologies required.

Domestic Production Data

The main data source used for understanding historic aggregates flows is the 2012 Scottish Aggregates Survey (SAS) though, for various reasons, this was not published until 2015.[62] This survey gathers together information on the production, distribution and reserves of material produced and available from Scottish quarries in 2012, and is the most recent source of this data. The survey was sent to all known operators of quarries in Scotland. The survey outputs provide a breakdown by region of the total production quantity of aggregates. Data is also provided on the destination of the material, that is, whether it is retained in the region, exported to another Scottish region, or exported outside Scotland to either the rest of the UK or overseas.

The quantities reported in the survey and based on survey responses only. Accordingly, aggregates production by businesses who chose not to respond is not reported and therefore the survey results are an underestimate of the true totals. This is stated in the report:

> *The total amount of production in 2012 recorded by SAS was 14 million tonnes (mt) of crushed rock and 4.5mt of sand and gravel. The equivalent figures in ONS's 2012 Business Monitor PA1007 was 20mt for crushed rock and 5.7mt for sand and gravel. This represents a return rate, based on output, of 70% and 77% for the Scottish Survey. The discrepancies between the two Surveys and the level of non-responses in particular areas will be a significant limiting factor in drawing useful conclusions from the data.*

For our study, we assumed that the overall distribution of aggregates flows (i.e. the relative amounts produced by each authority and the destination of the material) for all businesses was equal to the distribution in data reported by survey respondents. We therefore factored up all reported data by the amount required for the total production figures to match those reported in the Office for National Statistics (ONS) business monitor data.[63] The only exception was that production of crushed rock in the Highlands and Moray was excluded from the factoring up process. Due to the unique nature of crushed rock production in the region, other data (port statistics for Glensanda) was used to validate the 2012 SAS figures for Highlands and Moray. In reality, as quoted above from the report, there are more non-responses in certain areas and therefore the survey sample distribution will differ from the true data

[62] The Scottish Government (2015) *Scottish Aggregates Survey 2012*, June 2015, http://www.gov.scot/Resource/0047/00479064.pdf

[63] Office for National Statistics (2014) Mineral Extraction in Great Britain 2012 – Business Monitor PA1007, February 2014

distribution. However, without further data, a more sophisticated approach to modifying survey data is not possible.

It should also be noted that the SAS conceals a number of data points in reporting to preserve confidentiality. This affects two (out of a total of ten) planning authorities for hard rock data and three planning authorities for sand and gravel. To compile a full dataset for modelling it was necessary to estimate the missing data. For hard rock, any missing material was distributed in equal proportions between authorities with missing data. A similar approach as taken for sand and gravel, with some additional corrections made to achieve the correct mass balance of exports to other Scottish authorities.

Imports of Primary Aggregates

In addition to modelling rock produced in Scotland, as described above, we also estimated the quantity of material imported to Scotland. Based on the data presented in Table 16, Scotland imported 16,000 tonnes (0.8% of total production) of crushed rock and 83,000 tonnes (1.6% of total production) of sand and gravel from England and Wales in 2014. Without having any other reliable data sources for import of aggregates, we have used the above percentage shares of import for crushed rock, and sand and gravel in 2014 to estimate the import of primary aggregates for other years.

Moreover, without any data on import of primary aggregates in Scotland from Northern Ireland and other also countries outside the UK, we have assumed these imports to be zero though in practice there is likely to be some smaller scale importing of the more specialist aggregates.

Forward Projections

The comprehensive 2012 dataset was projected forward to 2030 various datasets and estimates which are described here. We have assumed that the distribution of data, i.e. the relative quantities produced by each authority and the destination of the material will stay the same in future years. This is a reasonable assumption give that, if the rate of tax is a key driver of market behaviour, this is assumed to stay constant across Scottish planning regions.

For the period from 2012 to 2014, growth rates were based on production quantities reported in the ONS business monitor survey. This survey was discontinued following the publication of 2014 results and since then there is no consistent official set of aggregates data in Scotland. For the period from 2015 to 2017, growth rate estimates were instead based on data from the Mineral Production Association (MPA). MPA carries out a quarterly survey of members' sales volumes in GB, based on a sample of MPA members. The MPA data collection does not include all members of MPA Scotland and the survey excludes aggregates sold for use outside of GB. The MPA survey has been operating for many years with a broadly consistent sample of companies contributing. As such it provides a good indicator of changes in annual industry sales volumes of primary aggregates. The survey results for 2015 to 2017 were calculated by applying market movements recorded by MPA to the earlier ONS data. As such it is not a consistent data series but the use of the MPA survey results

enables the production of a time series which reasonably reflects more recent market movements.

For 2018 onwards, growth rates are calculated using econometric forecasts based on the log of hard rock / sand and gravel demand since 1980.[64]

Secondary Aggregates

For secondary aggregates we used waste data to understand the quantity of mineral waste in the C&D waste stream and the extent of recycling. C&D waste data is reported annually in Scotland by SEPA in their Waste Data from All Sources report for 2017.[65] This study reports total generation of 1.6 million tonnes of mineral waste.[66] However, after excluding waste collected as mineral waste but which at the treatment stage is reclassified as a different waste type (e.g. metallic wastes), the recalculated generation quantity is 1.2 million tonnes. The reported quantity of recycling is 1.05 million tonnes, and so the overall recycling rate is estimated at 87.2%.

For future years have assumed that growth rates are calculated using a moving average calculation i.e. the growth rate for any given year is assumed to be equal to the average growth rate over the five preceding years.

[64] Log of demand has been used in the forecasting model as it reflects constant elasticity of demand (responsive of demand to price changes), which is more consistent with the observed data.

[65] https://www.sepa.org.uk/environment/waste/waste-data/waste-data-reporting/waste-data-for-scotland/

[66] The following two categories from this dataset were used in our analysis: ‘Mineral waste from construction and demolition’ and ‘Other mineral wastes’

Appendix 3: Phase 2 Modelling

Scenario Specification

We have modelled 4 scenarios, which include different rates of the Aggregates Levy as well as a scenario which models the impacts of a new 'Aggregates' landfill tax category with a higher rate than the current inert waste rate. The tax rate under the BaU scenario and the illustrative policy options are set out in Table 5.

Table 5: Modelled Aggregates Levy and Landfill Tax Rates

	Tax rate, £ per tonne (2020 real terms)	
	Aggregates Levy	**Landfill Tax**
No-change (BaU)	£2.00	£2.90
Tax increase (Option 1)	£2.50	£2.90
Tax decrease (Option 2)	£1.50	£2.90
No tax (Option 3)	-	£2.90
New landfill tax band (Option 4)	£2.00	£3.80*

**New 'aggregates' tax category created – the rate for non-aggregates inert material remains at £2.90*

It is assumed that all changes to tax rates were implemented in 2020.

Approach to Scenario Modelling

The approach to estimating the effect of changing levy rates is conducted in three steps. First, the change in demand for aggregates in Scotland and exports is calculated based on elasticities of demand for aggregates, and the Aggregates Levy rates chosen for each of our scenarios (described below). Then, a simplified approach is taken to calculating any change in secondary aggregates put on the market i.e. recycling (described below). Assumptions regarding the change in primary production and imports are then applied (described below). In principle, it would be useful to have a set of own- and cross-price elasticities to cover both of these steps. In practice, such a matrix is difficult to obtain, whilst empirical evidence from other countries suggests that the effects prompted by landfill levies are apt to change in the context of non-marginal price changes.

Applying Price Elasticities

As set out in the Scotland Act 2016, which devolved further powers to Scotland, the Aggregates Levy is charged:

"*On aggregate when it is subjected to commercial exploitation in Scotland*"[67]

An equal rate of tax is therefore levied on both material produced and commercially exploited within Scotland, and imports that are commercially exploited within Scotland. Tax relief is available on aggregates sent to export.[68]

It is assumed in some of the modelling that, as the Levy rate changes, this will impact on the overall demand for aggregates in Scotland and on the quantity exported (as well as secondary material recycling rates which are discussed below). For example, as the levy rate increases, the cost of aggregate production will also increase, driving a decrease in demand. Exports are exempt from the aggregates tax, and so if the levy increases this will incentivise increased exports. This is due to reduced demand from consumers (if some or all of the levy increase is incorporated into the sale price) and/or increased incentive to Scottish producers of aggregates to look for external markets for their material, as the differential in potential profits between these and domestic markets is now greater. Conversely, if the aggregates tax were decreased or abolished this would be expected to increase domestic demand for aggregates and decrease exports.

In modelling the change in demand and exports due to changes in the levy, we have based this on the price elasticity of demand for hard rock and sand and gravel. Price elasticities of demand (commonly known as simply 'price elasticities') measure the relative change in demand (in this case, the demand for aggregates) due to a price change, in this case the price of aggregates which includes the levy, the base price for the material and transport costs. The higher the elasticity, the greater is the response to price when the cost of aggregates increases (so the change in demand falls more sharply). The formula for the Price Elasticity of Demand (PED) is:

PED = (% Change in Quantity Demanded) / (% Change in Price)

After selecting the demand elasticity, the % change in the quantity (of aggregates) demanded at the chosen levy rate can be calculated. The change in exports is calculated by applying the inverse PED (i.e. compared to changes in demand, an equal but opposite % change in exports is expected).

The elasticity values were estimated econometrically using the aggregates price indices provided in the monthly bulletin of building materials and components produced by the ONS.[69] As crushed rock and sand and gravel are somewhat complementary goods (both are needed for construction, production of concrete, etc.), it is expected that the individual demand for each of these products will depend on prices of both products. Given the interdependency of the demand functions, econometrically estimating each demand function independently will result in biased

[67] The National Archives (2016) *Scotland Act 2016*, March 2016, http://www.legislation.gov.uk/ukpga/2016/11/contents/enacted

[68] Mygov.scot (2017) *Environmental Taxes, Reliefs and Schemes for Businesses*, 8th December 2017, https://www.mygov.scot/green-taxes-reliefs/aggregates-levy/

[69] https://www.gov.uk/government/collections/building-materials-and-components-monthly-statistics-2012

estimates of elasticity. Thus, the elasticities were estimated using the Seemingly Unrelated Regression Equations (SURE) modelling technique. The estimated elasticities are presented in Table 6. Here, own price elasticity refers to the percentage change in quantity of a product demanded for a one percent change in own price, while the cross price elasticity refers to the percentage change in quantity demanded of a product for one percent change in the price of a related product.

Table 6: Aggregates Price Elasticity of Demand Estimates

	Own Price Elasticity	Cross Price Elasticity
Crushed Rock	-0.974760	-0.165369
Sand and gravel	-0.677728	-0.782544

Impacts on Aggregates Recycling

As detailed in Appendix 2, the overall recycling rate based on the most recent data (2017) is estimated at 87.2%. In modelling changes in recycling, an elasticity-based approach (as used for primary aggregates) was considered. However, given that recycling rates are high already (and thus the scope for further increase is relatively small), and furthermore taking into consideration the significant uncertainties in any elasticities that could be applied, a simplified approach was used instead.

Any increase in Aggregates Levy rate will increase demand for secondary aggregates – no tax is applied to these materials. It is assumed that this increased demand will drive increased recycling of secondary aggregates to a maximum recycling rate. This maximum is set (arbitrarily) at 95% as it is not clear whether rates higher than this are feasibly possible given current recycling collection and sorting methods. We assume this impact will not occur when a decrease in the levy rate is modelled, i.e. recycling activity will not drop as a result of lower cost primary material becoming available.

In the landfill tax scenario it is also assumed that aggregates recycling will increase up to this maximum rate. As the alternative disposal option i.e. landfill increase in cost, this is likely to drive a shift towards increased recycling.

It is assumed that any increase in the availability of recycled aggregates will reduce the total demand for primary aggregates. This effect is incorporated into our modelling. This calculation requires an understanding of the composition of secondary aggregates, i.e. are they classified as hard rock or sand and gravel. As there is little published data to help with this estimate we have assumed a 50/50 split of these two aggregates types in secondary material.

Redistribution of Material to Production and Imports

The formula below demonstrates how total demand for aggregates is calculated.

$$\text{Total demand} = \text{Primary Production} + \text{Imports} - \text{Exports}$$

As outlined above, the application of price elasticities allows the change in total demand and exports to be estimated. To balance this equation, it is necessary that

the change in quantity of primary aggregates produced in Scotland (primary production) and imports to Scotland are calculated. The total change is equivalent to the sum of total demand and exports. This change is distributed across primary production and imports based on the assumption that the current quantity of production relative to imports will stay constant (i.e. the ratio between these two variables is fixed). The assumptions used are based on tonnages reported in the 2012 Scottish Aggregates Survey (SAS) and are shown in Table 7

Table 7: Assumptions used for Distributing the Impact of Changes in Total Demand and Exports to Production and Imports

	Production	Imports
Hard Rock	98.8%	1.2%
Sand and gravel	97.7%	2.3%

Cost Assumptions

There are no official data on aggregates prices or production costs due to confidentiality concerns. According to the BGS 2008 report on the need for aggregates production in England, a typical 'ex-quarry' price of crushed rock and sand and gravel in the East Midlands region in 2005 were approximately £10-12 and £6-8 per tonne, respectively.[70] It was assumed that the average prices of crushed rock and sand and gravel in Scotland in 2005 were the same as these - £11 per tonne for crushed rock, and £7 per tonne of sand and gravel. These prices were converted to 2018 prices using aggregates price indices provided in the monthly bulletin of building materials and components produced by the ONS,[71] which amount to £13.87 per tonne for crushed rock and £8.38 per tonne for sand and gravel.

The majority of the recycled aggregates are used for own consumption, and not directly sold in the market. Therefore it is difficult to establish an average market price for recycled aggregates. Moreover, it can be argued that the cost of recovery for C&D waste will be lower than the cost of disposal in a landfill as inert waste for recovery of recycled aggregates to be economically viable. Thus, it was assumed that the implicit price of recycled aggregates is £2.50 per tonne, lower than the landfill tax of £2.90 per tonne (2019 prices) of lower rate waste.

Average transport costs for type of HGVs that are typically used for transporting aggregates by road is assumed to be 8 pence per tonne per kilometre according to a Truck Expert report.[72] According to the MPA, average transport distance by road for aggregates is around 50km.[73] Combining these estimates, the average transport cost

[70] BGS, 2008. The need for aggregates production in England.

[71] https://www.gov.uk/government/collections/building-materials-and-components-monthly-statistics-2012

[72] https://thetruckexpert.co.uk/truck-operating-costs-report-for-2018/

[73] https://mineralproducts.org/sustainability/transport.html

for aggregates was assumed to be £4 per tonne (2018 prices) for the average journey by road of 50km.

Environmental Impacts

Environmental impacts are calculated in the model based on the total primary production of aggregates in all geographical areas, this includes both domestic production and imports from England (i.e. primary production of aggregates in England). Two types of externalities are included in our calculations, these are:

- **Disamenity** - this is an attempt to quantify, in monetary terms, the 'welfare loss' - i.e. the extent to which citizens are negatively impacted – from the existence of aggregates extraction in their local neighbourhood. Studies which seek to place a monetary value on this amenity impact through determining the amount that respondents would be willing to pay for a marginal improvement from the current situation, in terms of a proportional reduction in the quantity of aggregates extraction.
- **Climate Change Impacts (CO_2 Emissions)** - Greenhouse gas valuation is based on estimates of the unit carbon emissions from the production and transport of aggregates. This is combined with assumptions for the cost of carbon per tonne to calculate the overall value of climate impacts.

The sources and assumptions used to calculate the unit externalities used in these calculations are described below.

Table 8 presents various estimates of disamenity costs of aggregates production in the UK using willingness to accept (WTA) and willingness to pay (WTP) approaches in different studies.

Table 8: Disamenity costs of production of different types of aggregates (£ per tonne, 1998 and 1999 prices)

	Average environmental cost WTA 1998[74]	Estate agents' estimate WTA 1998[63]	Average environmental cost WTP 1999[75]	Average environmental cost WTA 1999[76]
Sand and gravel	9.00	1.06	**1.93**	
Marine aggregates	4.67	0.22		
Hard rock	2.62	0.55	**0.47**	0.41-1.05

[74] Department of the Environment, Transport and the Regions (DETR), 1998. The Environmental Costs and Benefits of the Supply of Aggregates. Report by London Economics. DETR, London.

[75] London Economics, 1999. The Environmental Costs and Benefits of the Supply of Aggregates. Report to the Department of Environment, Transport and the Regions. DETR, London.

[76] Willis, K.G. and G.D. Garrod, 1999. Externalities from extraction of aggregates Regulation by tax or land-use controls, Resources Policy 25 (1999) 77–86

	Average environmental cost WTA 1998[74]	Estate agents' estimate WTA 1998[63]	Average environmental cost WTP 1999[75]	Average environmental cost WTA 1999[76]
Recycling of aggregates	0.61			
Coastal super-quarry	0.18	0.00		
Average: all aggregates	4.63			

For this research, we have used the WTP estimates from the London Economics study – £1.93 per tonne of sand and gravel production, and £0.47 per tonne of crushed rock (1999 prices). These estimates were converted to 2018 prices using consumer price index from ONS. We have also uplifted the WTP values for each year by 50% of GDP growth, as people's willingness to pay increases with income. The resulting WTP estimates for disamenity costs of aggregates production are presented in **Table 9**.

Table 9: Disamenity costs of aggregates production (£/tonne, 2018 prices)

	Sand and gravel	Crushed Rock
2018	3.66	0.89
2019	3.70	0.90
2020	3.74	0.91
2021	3.77	0.92
2022	3.80	0.93
2023	3.84	0.93
2024	3.87	0.94
2025	3.91	0.95
2026	3.94	0.96
2027	3.98	0.97
2028	4.01	0.98
2029	4.05	0.99
2030	4.09	1.00

Brown et al. (2011) estimated the total climate change impacts in terms of CO_2 emissions from production and transportation of aggregates in the UK for 2005.[77] Using the aggregates production data for 2005 in the UK, we have estimated the average CO_2 emissions for land based aggregates production and transportation as 8.7 kilograms per tonne. The estimated CO_2 emissions per tonne of aggregates production and transportation was monetised using the estimated shadow price of CO_2 emissions from BEIS, which are presented in Table 10.

Table 10: Costs of CO_2 emissions (2018 prices)

	Shadow price of CO_2 emissions (£/tCO_2e)	CO_2 emissions costs for aggregates production and transportation (£/tonne)
2018	4.29	0.04
2019	4.47	0.04
2020	4.67	0.04
2021	12.33	0.11
2022	19.98	0.17
2023	27.62	0.24
2024	35.25	0.31
2025	42.87	0.37
2026	50.48	0.44
2027	58.09	0.51
2028	65.69	0.57
2029	73.28	0.64
2030	81.27	0.71

[77] Brown et al., 2011. Aggregates in England - Economic contribution and environmental cost of indigenous supply. Resources Policy 36 (2011) 295–303

Appendix 4: Review of Similar Taxes in Other Countries

Danish Raw Materials Extraction Tax

The Danish raw materials extraction tax was first introduced in 1977 at the rate of DKK 0.35/m^3 (£0.04/m^3). It was increased to DKK 0.5/m^3 (£0.06/m^3) in 1983. In 1990, a new tax was introduced on raw materials at the rate of DKK 5/m^3 (£0.58/m^3) for selected extracted raw materials.[78]

Like the UK Aggregates Levy, the Danish raw materials extraction tax is levied on raw materials that are commercially extracted and consumed in Denmark or imported, whilst it excludes raw materials that are exported. The tax is applied to sand, gravel, stones, peat, clay and limestone, among other minerals.

The raw materials tax was introduced in close junction with the waste tax, which was introduced in 1987 at the rate of DKK 40/tonne (£4.60/tonne) of waste landfilled or incinerated. In 1993 the tax was differentiated for landfill and incineration. For landfill it increased substantially to DKK 335 (£38.56/tonne) in 1993, and subsequently increased to DKK 375 (£43.16/tonne) in 1998. The main intention of the two taxes in combination is to reduce the use of the above resources and encourage substitution to recycled materials. The two taxes have resulted in a marked increase in recycling of C&D waste, although the majority of impacts could be attributed to the landfill tax, given the large difference in the tax rates.[79]

Swedish Tax on Natural Gravel

The natural gravel tax in Sweden was introduced in 1996 with an aim to substitute some of the gravel demand by its closest substitute, crushed rock. Thus the tax rate was set at a level high enough to close the price gap between gravel and crushed rock. The tax level was initially set at SEK 5 (£0.41) per tonne to match the price difference before introduction of the tax (SEK 7–8 per tonne).[80] The Swedish Environment Protection Agency estimated that the majority of the tax burden was borne by the consumers (around SEK 4.5) due to the relatively low own price elasticity of demand. This also implies that the tax is likely to have had limited economic effects

[78] Söderholm, P., 2011. Taxing virgin natural resources: Lessons from aggregates taxation in Europe. Resources, Conservation and Recycling 55 (2011) 911– 922. https://www.sciencedirect.com/science/article/pii/S0921344911000942

[79] ECOTEC et al. (2001) Study on the economic and environmental implications of the use of environmental taxes and charges in the European Union and its Member States, Report for DG Environment, European Commission. https://ec.europa.eu/environment/enveco/taxation/environmental_taxes.htm

[80] Söderholm, P., 2011. Taxing virgin natural resources: Lessons from aggregates taxation in Europe. Resources, Conservation and Recycling 55 (2011) 911– 922. https://www.sciencedirect.com/science/article/pii/S0921344911000942

on production, while it should have provided an incentive to substitute form natural gravel to crushed rock.

In 2003, the tax was raised to SEK 10 (£0.83) per tonne, mainly to increase the incentive to substitute, and in 2006 it was increased further to SEK 13 (£1.07) per tonne. Also the natural gravel tax in Swedish is levied on extraction consumed in Sweden, on extraction for export but not on imports. In this way the tax is not designed to address competitive issues. In theory this means that imports become relatively cheaper and can thus outperform Swedish production. However, this is unlikely in practice given the high transportation costs associated with import.

The tax has been very successful in substituting natural gravel with crushed rock. However, the tax might not have been very efficient, as the uniform tax rate across Sweden did not address regional differences in availability of natural gravel in different parts of Sweden. For example, given that the availability of natural gravel is much higher in Northern Sweden, the tax in Northern Sweden could be set at lower rate compared to the rest of Sweden to ensure a more efficient regional distribution of natural gravel extraction.[81]

Mineral Resource Extraction Charges in Estonia

Mineral resource extraction charges were introduced in Estonia in 1991, which are imposed on various state owned minerals such as construction rocks, energy minerals and minerals used in agriculture. Rates of the charge were based on the quantity of resources extracted. Extraction of construction minerals like gravel and sand located on private land is not taxed; the price is negotiated between the extracting company and the landowner. However, extracting companies are required to obtain permits for the extraction of state owned or privately owned mineral resources.

Mineral resource extraction charges have increased several times over the years. Subsequently, this has led to an increase in environmental tax revenues. However, these charges could not successfully reduce quantity of mineral resources extracted, nor could these increase resource productivity, which could be due to a lack of complementary policies, such as landfill tax covering disposal of relevant minerals.[82]

[81] Söderholm, P., 2011. Taxing virgin natural resources: Lessons from aggregates taxation in Europe. Resources, Conservation and Recycling 55 (2011) 911– 922. https://www.sciencedirect.com/science/article/pii/S0921344911000942

[82] IEEP et al. 2016 Capacity building, programmatic development and communication in the field of environmental taxation and budgetary reform – Case study on the Mineral Resource Extraction Charge in Estonia. https://ieep.eu/uploads/articles/attachments/f42e1732-8ecf-4db3-9175-4a5eb78acb98/EE%20Mineral%20Extraction%20Charge%20final.pdf?v=63680923242

Appendix 5: Northern Ireland Case Study

The case study on Northern Ireland was developed based on literature review and expert interviews. The literature review included media articles, industry reports and Government documents. We then interviewed a few industry experts in both Northern Ireland and Great Britain. The interviewees were:

- Gordon Best, the Regional Director of the Quarry Products Association Northern Ireland (QPANI) – the trade association representing quarry operators in Northern Ireland;
- Richard Bird, Executive Officer of the British Aggregates Association (BAA), which represents independent quarry operators in Britain;
- A former policy lead for aggregates at HM Revenue & Customs (HMRC); and
- An official who previously managed the Aggregates Levy Credit Scheme (ALCS) team at the then Department of the Environment Northern Ireland (DoENI).

These four were chosen as they represent those responsible for the implementation and operation of the Aggregates Levy, and the businesses affected by it. HMRC introduced the Levy, DoENI administered the ALCS, the QPANI was instrumental in the development of the ALCS, and the BAA led the court challenges to the Levy and the ALCS.

The following sections outline the impact of the Aggregates Levy in Northern Ireland; the reasons for introducing the ALCS; the ALCS's impact on the aggregates industry and quarry standards; and the circumstances surrounding the suspension of the ALCS.

Background

Following the introduction of the UK Aggregates Levy in April 2002, the Aggregates Levy Credit Scheme (ALCS) was introduced in Northern Ireland in April 2004. This was due to Northern Ireland's unique position within the UK (sharing a land border with a separate country) and a recognition that the Levy's dual aims (reducing the negative environmental impact of quarrying and increasing the recycling rate of construction materials) were "unlikely" to be met in Northern Ireland, as discussed in the following sections.[83]

The ALCS enabled companies in Northern Ireland to claim an 80% relief on the levy, providing they met specified environmental conditions and registered with the Northern Ireland Department of the Environment. The UK Government sought approval from the European Commission prior to introducing the ALCS, and the Scheme was due to run until 2011.

[83] The ENDS Report (2003) *Treasury Hits Rocks Over Aggregates Levy*, 1 November 2003.

The Aggregates Levy, including its associated exemptions and reliefs, has been subject to repeated court challenges, led by the BAA. As a result, the ALCS was suspended in December 2010.

Special Circumstances in Northern Ireland

Prior to and following its introduction, concerns were repeatedly raised about the impact of the Aggregates Levy on Northern Ireland. These primarily related to:

- The 300 mile land border and ease of trade with the Republic of Ireland;
- The easy availability of aggregates due to the island of Ireland's geology;
- The lower average market price for aggregates in Northern Ireland, relative to Great Britain; and
- The importance of the industry for the Northern Irish economy and the relative reliance on Northern Ireland for the supply of aggregates in the UK.

Stakeholders have also emphasised the preponderance of small, independent quarry operators in Northern Ireland that did not have large profit margins.

In December 2000, the Northern Ireland Assembly agreed to lobby the UK Government for an exemption due to the potential economic consequences. The Northern Irish Finance Minister, Mark Durkan, cited the average price of £2.50 per tonne for aggregates in Northern Ireland, meaning that the levy of (at the time) £1.60 per tonne represented a 60% tax rate. The higher price for aggregates in the mainland UK meant that the levy was just 23% of the average price. [84]

Members of the Northern Ireland Assembly were amongst those raising concerns that the levy would promote illicit imports from the Republic of Ireland. Imported processed aggregates were exempt from the levy; while it was intended that the levy would apply to imported aggregates, there were doubts about whether this would be enforced for aggregates imported from the Republic of Ireland.

According to the QPANI, 75% of Northern Ireland's territory is within 25 miles of the border, and a levy of £2 per tonne would easily equate to the cost of transporting aggregates this distance. As such, they claim that delivery is "free" for companies within 25 miles of the Republic of Ireland that import their aggregates without the levy.[85] It has also been suggested that the level of the Levy was determined by the impact of quarrying in urban areas, so was not necessarily set at an appropriate level for more rural areas in Northern Ireland.

The QPANI additionally claimed that the Levy would have a disproportionate impact on Northern Ireland, as the province accounts for 3% of the UK population, but produces 12% of UK aggregate.[86]

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[84] The ENDS Report (2000) *Northern Ireland Seeks Exemption from Aggregates Levy*, 1 December 2000.

[85] QPANI letter to the European Commission Directorate-General for Competition, 18 December 2013

[86] Aggregates Business Europe (2009) *Ireland has Twin Aggregate Markets*, March 2009.

With the public sector procuring 60% of construction materials in Northern Ireland, and the Aggregates Levy being paid to the UK Treasury, it was also suggested that the Northern Ireland Executive could incur disproportionate costs.[87]

Finally, QPANI has suggested that self-build projects are very common in the Northern Irish countryside. As these are not commercial projects, the aggregates would not be subject to the levy if imported from outside the UK.[88]

When drawing lessons for a Scotland specific levy, it is important to note additional factors in Ireland that will not necessarily be relevant when considering the Scotland-England border. For instance, while Scotland and England use the same currency, a weaker Euro exchange rate against sterling would make imports from the Republic of Ireland cheaper for users of aggregate in Northern Ireland.[89] The tendency for diesel prices to be lower in the Republic of Ireland would also reduce the cost of transporting the aggregates to the North.

Impact of the Aggregates Levy

Due to the concerns about the particular impact of the levy in Northern Ireland, HM Customs and Excise (HMC&E) commissioned the Symonds Group in May 2003 to provide data on the production and use of primary, secondary and recycled aggregates in Northern Ireland.[90] They reported that:

> "*The overall demand for 'non-black market' aggregates has indeed been reduced by the Aggregates Levy. In the absence of data on the extent of the 'black-market' for aggregate, we are unable to estimate how great the overall reduction has been.*"[91]

Their report led the UK Treasury to conclude that:

> "*the specific circumstances in Northern Ireland mean that we are unlikely to meet the environmental aims of the Levy—to increase the use of recycled or alternative materials to primary aggregates and also to reduce the environmental impact of quarrying*".[92]

QPANI (2015) *Briefing Paper for NI Members of Parliament regarding on-going discussions with Treasury about re-introduction of a reduced Aggregates Levy in Northern Ireland*, July 2015.

[87] QPANI (2015) *Briefing Paper for NI Members of Parliament regarding on-going discussions with Treasury about re-introduction of a reduced Aggregates Levy in Northern Ireland*, July 2015.

[88] Ibid.

[89] However, it should be noted that import decisions should not be affected by the presence of a levy as long as imports are levied at the same rate as the domestic rate and strict enforcement is exercised to control illegal imports.

[90] Symonds Group Ltd (2003) *Report to HM Customs & Excise: Assessment of the State of the Construction Aggregates Sector in Northern Ireland*. Final Report. 31 October 2003.

[91] Ibid.

[92] House of Commons Northern Ireland Affairs Committee (2004) *Introduction of the Aggregates Levy in Northern Ireland: One Year On.* Third Report of Session 2003-04, 10 March 2004. https://publications.parliament.uk/pa/cm200304/cmselect/cmniaf/395/395.pdf

As summarised below, this was due to a combination of factors, including:

- The prevalence of illegal quarries within Northern Ireland;
- Un-registered imports from the Republic of Ireland; and
- Limited recycling opportunities.

Imports

A survey by the University of Ulster in September 2002, commissioned by the QPANI, indicated that an average of 89 lorries a day were importing aggregates to Northern Ireland at eight border crossing points. The Symonds Group cautioned against drawing conclusions from this, in the absence of data pre-dating the introduction of the levy, but highlighted that the official recorded imports of 4,847 tonnes that year would equate to less than one truck per working day from the Republic of Ireland to the North.[93] While it is not necessarily a result of the Aggregates Levy, this would suggest that there were imports on which the Levy, and VAT, were not paid.

Anecdotally, industry representatives claimed that the price differentials – as a result of the Levy and the weakness of the Euro relative to sterling – "led to substantial import of aggregates".[94]

While HMRC investigated and pursued reports it received from the QPANI and others of illegal operations, it did not necessarily have the resources to actively enforce the Levy as much as some in the industry would have liked. Investment in enforcement activity is often dependent on the potential revenue losses and the Aggregates Levy represents a relatively small percentage of HMRC's revenue compared to most other taxes.

Nevertheless, industry representatives report that, as a result of the Levy, communication improved between the various regulatory authorities.

Illegal operations

According to the QPANI, "legal and illegal operations sprang up" as a result of the "imbalance" created by the Aggregates Levy and the strength of sterling.[95]

The Symonds Group similarly noted reports that "unauthorised and unregulated quarries" had "grown in prominence" "beyond the ability of current enforcement regimes to address them adequately".[96] They could not corroborate the QPANI's claims that there were at least 3 million tonnes of illegal aggregates in Northern Ireland and 38 illegal quarrying operations, but the Symonds report for the UK Government did confirm that "unlicensed sites exist, [and] that they appear to operate

[93] Symonds Group Ltd (2003) *Report to HM Customs & Excise: Assessment of the State of the Construction Aggregates Sector in Northern Ireland*. Final Report. 31 October 2003.

[94] Aggregates Business Europe (2009) *Ireland has Twin Aggregate Markets*, March 2009.

[95] Ibid.

[96] Symonds Group Ltd (2003) *Report to HM Customs & Excise: Assessment of the State of the Construction Aggregates Sector in Northern Ireland*. Final Report. 31 October 2003.

quite openly".[97] These would not, however, be solely attributable to the Aggregates Levy, especially given the VAT requirements and the health and safety regulation associated with licensed sites.

Anecdotally, there are suggestions that aggregates suppliers could have listed aggregates as a different product on invoices to avoid charging the Levy. Such avoidance practices, if they were used, would not necessarily be exclusive to Northern Ireland.

Sales

Industry groups note that there was a 10% fall in official recorded stone production in 2002, despite construction spending increasing by almost a third.[98]

The Symonds Group report concluded that "sales of quarried products in the year ending 31 March 2003 were lower than two years before (i.e. they have declined since the introduction of the Aggregates Levy)", with quarries reporting that they were no longer able to see all their 'scalpings' and low-grade materials.[99]

It is, however, worth noting that several quarry operators reported that their exports to the Republic of Ireland had increased to help meet demand in counties neighbouring the border, where the local quarries had increased their exports to Northern Ireland. The trade figures reported to the then HMC&E in the years preceding the introduction of the Aggregates Levy and the year following are included in Table 11**.**

Table 11: Northern Ireland's aggregates trade with the Republic of Ireland (tonnes)

Year	Exports to the Republic of Ireland	Imports from the Republic of Ireland
1998	295,888	1,470
1999	325,194	3,569
2000	709,700	4,333
2001	621,751	4,748
2002	1,891,748	4,847

Source: Symonds Group (2003)

Recycling

Prior to the introduction of the Aggregates Levy, members of the Northern Ireland Assembly warned that Northern Ireland did not have the same opportunities to use

[97] Ibid.

[98] The ENDS Report (2003) *Treasury Hits Rocks Over Aggregates Levy*, 1 November 2003.

[99] Symonds Group Ltd (2003) *Report to HM Customs & Excise: Assessment of the State of the Construction Aggregates Sector in Northern Ireland*. Final Report. 31 October 2003.

recycled aggregates, because the Province "did not have the same level of urban regeneration" as Great Britain.[100]

There were, therefore, concerns about the level of supply of recycled materials, while the Symonds Group found that opportunities to increase the use of recycled aggregates were limited by insufficient incentives and regulation to deter landfilling or fly-tipping. Nor were there many facilities for crushing and sorting C&D waste, and they reported that there was "a long way to go" before recycled materials were accepted in Northern Ireland as an alternative to primate aggregate. Accordingly, their four conditions needed to have a reasonable prospect of developing the aggregates recycling industry were not met in Northern Ireland.

ALCS

The ALCS offered an 80% rebate to aggregates producers in Northern Ireland up to 2011. To qualify for this, and to satisfy the European Commission's State Aid rules, they were required to register with the Northern Ireland Department of the Environment, with an agreement to improve environmental standards.

On a commercial level, the QPANI has claimed that the ALCS "levels the playing field", citing the fact that companies must be registered with the scheme if they are tendering for Government contracts.[101]

The industry body also claims that "the ALCS significantly raised standards within the Northern Ireland quarry industry".[102]

The agreement with DoENI committed quarry operators to site audits, site-specific targets and compliance with a Code of Practice, with continuing eligibility for the relief depending on regular monitoring and reviews.[103] Quarry operators that registered for the ALCS commissioned their own audits, which were reviewed by a Government-appointed auditor.

The Department of the Environment Northern Ireland operated the ALCS on behalf of the UK Government, and was reimbursed for their costs. There are indications that this assisted the regulatory activities of the planning authorities, Natural Heritage and water management. The Code of Practice and Audit Protocol covered 16 areas which were:

1. Air Quality;

2. Archaeology & Geodiversity;

[100] The ENDS Report (2000) *Northern Ireland Seeks Exemption from Aggregates Levy*, 1 December 2000.

[101] Aggregates Business Europe (2009) *Ireland has Twin Aggregate Markets*, March 2009.

[102] QPANI Aggregates Levy Booklet, June 2010.

[103] Hansard (2004) House of Commons Written Ministerial Statement, 11 May 2004, c8WS https://www.theyworkforyou.com/wms/?id=2004-05-11.8WS.4

3. Biodiversity;

4. Blasting;

5. Community;

6. Dust;

7. Energy Efficiency;

8. Groundwater;

9. Landscape & Visual;

10. Noise & Vibration;

11. Oil & Chemical Storage;

12. Restoration;

13. Surface Water;

14. Transport;

15. Waste Management;

16. Secondary Aggregates Usage / Recycling.

Using environmental audit data from the DoENI, the QPANI reported, in 2010, that since 2004, non-compliance scores had reduced by over 80%. The performance audit rates each of the 16 criteria on a scale of 1 to 5, with 1 indicating "Issue of potential high impact significances has not been recognised or improvement action taken. All mandatory issues are deemed to be of high significance". A scoring of 5 means "Works undertaken to a standard that indicate that no further practical action can/need be taken to reduce impacts." Between the first and second audits, the total number of 1 scores reduced from 856 to 58, while the 5-ratings increased from 2,124 to 3,484.[104]

The ALCS was supported by both the industry and the Northern Ireland Executive. According to Connor Murphy, the then Northern Ireland Minister for Regional Development, abolishing the relief

> "*would mean an average price increase to Roads Service for resurfacing reconstruction activities of some 2.5%. Consequently, if Roads Service budget was not increased to cover this rise in aggregates levy, then the amount of resurfacing / reconstruction undertaken by Roads Service would be reduced to 97% of its output*

[104] QPANI Aggregates Levy Booklet, June 2010.

… an increase in aggregates levy would, therefore, only lead to an increased maintenance backlog."

The then Northern Irish Minister for Finance and Personnel, Sammy Wilson, commented that

"*The 80% derogation on the Aggregates Levy has benefited both the industry and the local economy significantly since it was introduced. It has ensured that quarry product manufacturers are able to compete fairly with imports from the Republic of Ireland…. The derogation has also resulted in significant investment in environmental improvements and the industry is to be commended for its achievements. It is vitally important that the derogation is extended for a further ten years*".[105]

Amongst those interviewed, there was general agreement that the ALCS had had a positive environmental impact, although this did not necessarily mean that standards in Northern Ireland consequently exceeded those in Great Britain. The QPANI estimated that implementation of the standards cost approximately 30 pence per tonne.

Some stakeholders suggested that the environmental gains could have been achieved through procurement policies. Interviewees also commented that the ALCS might not have been needed if the Levy had been set at a "realistic" level.

State Aid

The environmental conditions were a necessary part of the ALCS, as they were used to demonstrate to the European Commission that Northern Ireland's aggregates producers were not benefitting from preferential treatment.[106]

The Government received state aid clearance from the Commission on 7th May 2004.[107] The Commission's reasoning, documented below, was based on the evidence of the impact on the Northern Ireland industry's ability to compete, the illegal activity linked to the introduction of the Levy, and the fact that producers in Northern Ireland were still required to pay a proportion of the tax (20%):

"According to the UK authorities, the 2002 AGL has put firms in the Northern Ireland aggregates industry in a more difficult competitive position than initially anticipated. After the gradual introduction of the levy in Northern Ireland, there has been an increase in illegal quarrying, and an increase in undeclared imports of aggregates into Northern Ireland from the Republic of Ireland, without the Aggregates Levy being paid in either case. Consequently, the legitimate quarries paying the Levy are being undercut by illegal sources operating outside the levy and therefore losing sales to these illegal sources. The findings in a report commissioned by the UK authorities from specialist consultants in the quarrying/construction sectors and other evidence

[105] Ibid.

[106] The ENDS Report (2003) *Treasury Hits Rocks Over Aggregates Levy*, 1 November 2003.

[107] Hansard (2004) House of Commons Written Ministerial Statement, 11 May 2004, c8WS

available to the UK Customs and Excise authorities - responsible for enforcing the Levy - confirm this development.

According to the EU environmental aid guidelines, firms eligible for a reduction from environmental taxes that are imposed in the absence of harmonisation at the Community level must still even after the temporary reduction, pay a significant proportion of the national tax. In the present case, the UK proposed to maintain the tax at the level of 20 per cent of the full rate, which the Commission considers significant.

In light of the above, the modification of the Aggregates Levy in order to take account of the difficult competitive situation of quarries in Northern Ireland fulfils the conditions set out in the environmental guidelines. Therefore the tax exemption scheme can be approved." [108]

As a result of appeals and further legal challenges brought by the British Aggregates Association, the European Commission's decision was annulled by the General Court in 2010, after finding that the Commission failed to examine "the question of possible tax discrimination between the domestic products in question and imported products originating in Ireland". The ALCS was consequently suspended, pending further European Commission investigations, from 1 December 2010. The Commission reported on 7 November 2014 that the scheme generally complied with state aid rules, but raised concerns that the ALCS did not apply to aggregates commercially exploited in Northern Ireland but imported from other EU Member States. The UK Government was consequently required to address the disadvantage and subsequently introduced the Special Tax Credit Scheme.[109]

Suspension of the ALCS

Since the 2015 European Commission decision on the ALCS, Northern Ireland operators have paid the full rate of £2 per tonne. According to the QPANI, this represent nearly 40% of the selling price for stone in Northern Ireland. They claim the increased levy "has and continues to cause significant loss of business to imports from the Irish Republic and to the growing black market across Northern Ireland. The Aggregates Levy is also a major drain on the construction budgets of the NI Executive."[110]

Table 12 shows the fall in Levy revenues from Northern Ireland after the ALCS was introduced in April 2004, and the increased levels following its suspension in 2010.

Table 12: Aggregates Levy Revenues from Northern Ireland

[108] European Commission (2004) *Commission Approves Modified Aggregates Levy for Northern Ireland*, 7 May 2004. http://europa.eu/rapid/press-release_IP-04-614_en.htm?locale=en

[109] https://www.gov.uk/government/news/governments-aggregates-levy-credit-scheme-in-line-with-state-aid-rules

[110] QPANI (2015) *QPANI Call for Urgent Action to Stop Aggregates Levy Uncertainty*

Year	Aggregates Levy per tonne, after ALCS (£)	Levy Revenues (£million)	% of UK receipts
2002-03	1.60	16	6.4
2003-04	1.60	26	7.7
2004-05	0.32	9	2.6
2005-06	0.32	9	2.8
2006-07	0.32	9	2.9
2007-08	0.32	11	3.3
2008-09	0.39	9	2.7
2009-10	0.40	9	3.2
2010-11	0.40; 2.00	8	2.7
2011-12	2.00	35	12.1
2012-13	2.00	32	12.2
2013-14	2.00	34	11.8
2014-15	2.00	34	9.8
2015-16	2.00	35	9.8
2016-17	2.00	40	9.8

Source: HMRC - https://www.gov.uk/government/statistics/disaggregation-of-hmrc-tax-receipts

Special Tax Credit Scheme

In response to the Commission's November 2014 decision, the UK Government introduced the Special Tax Credit Scheme in 2015. This enabled importers to retrospectively claim the relief the Commission ruled they should have been eligible for on aggregates imported from another EU member state between 2004 and 2010. Importers had to demonstrate that the aggregates was sourced from a quarry that met the environmental standards comparable to the ALCS requirements.[111] Aggregates imported to Northern Ireland from other UK countries are not eligible for the scheme.[112]

Several interviewees indicated that the take-up rate for the Scheme had been very low. This may in part have been because imports to Northern Ireland were not that high (and it is not possible to determine whether, or to what extent, the ALCS affected

[111] http://www.legislation.gov.uk/uksi/2015/946/pdfs/uksiem_20150946_en.pdf

[112] https://www.gov.uk/government/publications/revenue-and-customs-brief-5-2015-aggregates-levy-tax-credits-in-northern-ireland/revenue-and-customs-brief-5-2015-aggregates-levy-tax-credits-in-northern-ireland

demand for imported aggregate), and it may also indicate that some people had already found loopholes to avoid the Levy.

When applications were made, there were difficulties in retrospectively corroborating the environmental standards of the supplying quarry, particularly as the quarry operator had little incentive to co-operate, as it was their customers (not them) who paid the levy.

The Northern Ireland Aggregates Industry

Table 13 provides indicative data on the size of the quarrying industry in Northern Ireland throughout the period covering the introduction of the Levy, the introduction of the ALCS and the suspension of the Levy. It is difficult to draw firm conclusions from these data, given that they will include figures from companies unrelated to the Levy and it does not take account of effect of the recession on the construction industry.

Table 13: Key data for the Combined Mining/Quarrying Industries in Northern Ireland

Year	Turnover (£ million)	GVA (£ million)	Employment
2000	158	54	1,928
2001	221	75	1,800
2002	224	70	2,009
2003	269	77	2,021
2004	249	78	1,995
2005	284	95	2,023
2006	266	92	1,938
2007	317	84	2,271
2008	337	100	2,309
2009	301	106	1,939
2010	377	88	2,352
2011	355	118	1,984
2012	380	109	2,150
2013	363	110	1,883
2014	395	113	2,294
2015	407	142	2,491
2016	387	151	2,286
2017[113]	372	122	-

[113] Employment figures have not been provided in the 2017 data.

Source: NI Annual Business Inquiry (2005 – 2017)[114]

Appendix 6: Additional Tables on the Analysis of the Scottish Aggregates Market

Table 14: 2019 Quarterly Sales of Sand and gravel (Thousand Tonnes)

	Q1	Q2	Q3	Q4	Total
South of Scotland	109	119	118	79	425
North East Scotland	104	129	150	110	493
Highlands	172	177	176	97	622
Island Areas	*	*	*	*	*
East Central Scotland	*	*	*	*	*
West Central Scotland	416	511	495	457	1,879
Tayside and Fife	329	387	388	327	1,431
All Scotland	1,254	1,484	1,462	1,196	5,396

** denotes confidential. It should be noted that the total for all of Scotland also includes the sales in regions that were suppressed in the table for confidentially reasons.*

Source: Monthly Bulletin of Building Materials and Components – February 2019 (https://data.gov.uk/dataset/75ee36ed-21f7-4d7b-9e7c-f5bf4546145d/monthly-statistics-of-building-materials-and-components)

[114] https://www.nisra.gov.uk/statistics/business-statistics/annual-business-inquiry#toc-4

Table 15: 2014 Crushed Rock Sales by Region & End-use (Thousand Tonnes)

	Roadstone				Concrete aggregates	Other screened & graded	Rail ballast	Other construction uses	Armourstone & gabon	Total	% of Total
	For asphalt on site	For asphalt off site	Uncoated Roadstone	Surface dressing chippings							
South of Scotland	*	*	*	*	*	*	-	*	*	1,879	10%
West Central Scotland	211	506	1,317	*	739	418	*	895	*	4,455	23%
East Central Scotland	*	*	688	*	*	143	-	238	*	1,707	9%
Tayside & Fife	*	*	402	-	*	*	*	*	20	1,155	6%
North East Scotland	312	*	*	*	*	*	-	*	42	2,300	12%
Highlands	*	*	*	*	*	*	*	*	*	7,720	39%
Western Isles	*	-	*	*	*	*	-	8	*	*	
Orkney	*	-	*	*	*	*	-	*	*	*	
Shetland	*	-	*	*	*	*	-	*	2	263	1%
Total	936	1,472	4,972	*	2,537	3,716	*	4,670	*	19,759	

*Source: ONS (2016) Mineral Extraction in Great Britain 2014. Business Monitor PA1007. March 2016. *Withheld to avoid disclosure. - Nil or less than 500 tonnes*

Table 16: Scotland's Imports from England and Wales (RUK imports) in 2014 (Tonnes)

	Crushed Rock	Sand and gravel
East Midlands	1,000	-
North West	5,000	80,000
Yorkshire and the Humber	7,000	-
North East	2,000	3,000
South Wales	1,000	-
Total	16,000	83,000

Source: BGS (2016) Coalition of the Results of the 2014 Aggregate Minerals Survey for England and Wales. Report for the Department for Communities and Local Government and Welsh Government. March 2016.

Table 17: 2012 Regional Distribution of Crushed Rock (Thousand Tonnes)

	Production	Retained in Region	% Retained in Region	Imports to Region	Exported to England	Exported Outside UK
Argyll & Bute	*	*	-	150	0	0
Forth Valley	0	0	-	154	0	0
Highland & Moray	6,040	341	6%	28	5,573	0
North East Scotland	1,042	1,034	99%	106	0	0
Orkney & Shetland	142	142	*	0	0	0
SESPlan	1,489	1,165	78%	250	5	0
TAYplan	848	731	86%	35	0	0
West Central Scotland A	3,327	2,938	88%	90	0	0
West Central Scotland B and Dumfries & Galloway	*	*	-	106	0	0
Western Isles	267	267	100%	0	0	0
Total	14,063	7,526	54%	919	5,578	0

Source: The Scottish Government (2012) Scottish Aggregates Survey 2012. June 2015. (Denotes confidential)*

Table 18: 2012 Regional Distribution of Sand and gravel (Thousand Tonnes)

	Production	Retained in Region	% Retained in Region	Imports to Region	Exported to England	Exported Outside the UK
Argyll & Bute	*	*	*	134	0	0
Forth Valley	*	*	*	72	0	0
Highland & Moray	521	502	96%	0	12	0
North East Scotland	259	204	79%	5	0	0
Orkney & Shetland	0	0	N/A	0	0	0
SESPlan	520	179	34%	212	1	0
TAYplan	827	618	75%	68	0	0
West Central Scotland A	1,505	1,162	77%	448	0	0
West Central Scotland B and Dumfries & Galloway	*	*	*	293	0	0
Western Isles	6	6	100%	0	0	0
Total	4,468	3,220	72%	1,232	13	0

Source: The Scottish Government (2012) Scottish Aggregates Survey 2012. June 2015.

Table 19: 2012 Regional Distribution of Crushed Rock (Thousand Tonnes)

	To										
From	**Argyll & Bute**	**Forth Valley**	**Highland & Moray**	**NE Scotland**	**Orkney & Shetland**	**SESPlan**	**TAYPlan**	**West Central A**	**West Central B**	**Western Isles**	**England**
Argyll & Bute	*										
Forth Valley		0									
Highland & Moray			341	86							5,573
North East Scotland			8	1,034							
Orkney & Shetland					142						
SESPlan	150	15				1,165	35	90	30		5
TAYplan		27	20	20		50	731				
West Central Scotland A		113				200		2,938	76		
West Central Scotland B and Dumfries & Galloway									*		
Western Isles										267	
Total	*	154	369	1,140	142	1,415	766	3,028	*	267	5,578

Source: Scottish Aggregates Survey 2012

Table 20: 2012 Regional Distribution of Sand and gravel (Thousand Tonnes)

	To										
From	**Argyll & Bute**	**Forth Valley**	**Highland & Moray**	**NE Scotland**	**Orkney & Shetland**	**SESPlan**	**TAYPlan**	**West Central A**	**West Central B**	**Western Isles**	**England**
Argyll & Bute	*										
Forth Valley	*	*						*	*		
Highland & Moray			502			2		2			12
North East Scotland				204			55				
Orkney & Shetland											
SESPlan		*				179	13	196	93		1
TAYplan	96	*		5		10	618	64			
West Central Scotland A						200		1,162	143		
West Central Scotland B and Dumfries & Galloway								*	*		
Western Isles										6	
Total	181	365	502	209	0	391	686	1,609	503	6	13

Source: Scottish Aggregates Survey 2012

Table 21: Reserves of Crushed Rock in Scotland (2012)

	Production	Estimated Consented Reserves	Maximum Supply at 2012 Production Levels (Years)	Estimated Consented Reserves in Active Sites in 2012	Maximum Supply from Active Sites at 2012 Production Levels (Years)
Argyll & Bute	*	*	*	*	*
Forth Valley	0	*	-	0	-
Highland & Moray	6,040	*	*	23,205	4
North East Scotland	1,042	*	*	240,792	231
Orkney & Shetland	*	1,759	*	*	*
SESPlan	1,489	47,275	32	21,809	15
TAYplan	848	21,483	25	17,193	20
West Central Scotland A	3,327	94,841	29	81,627	25
West Central Scotland B and Dumfries & Galloway	720	*	*	18,131	25
Western Isles	267	*	*	2,770	10
Total	14,063	533,562	38	410,427	29

Source: Scottish Aggregates Survey 2012

Table 22: Reserves of Sand and gravel in Scotland (2012)

	Production	Estimated Consented Reserves	Maximum Supply at 2012 Production Levels (Years)	Estimated Consented Reserves in Active Sites in 2012	Maximum Supply from Active Sites at 2012 Production Levels (Years)
Argyll & Bute	*	*	*	*	*
Forth Valley	*	*	*	*	*
Highland & Moray	521	5,469	11	5,430	10
North East Scotland	259	4,151	16	4,151	16
Orkney & Shetland	0	0	-	0	-
SESPlan	520	17,768	34	16,768	32
TAYplan	827	20,360	25	10,460	13
West Central Scotland A	1,505	26,740	18	18,791	12
West Central Scotland B and Dumfries & Galloway	*	*	*	*	*
Western Isles	6	123	20	123	20
Total	4,468	83,795	19	60,842	14

Source: Scottish Aggregates Survey 2012

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