GLAECONOMICS

The Greater London Authority's Economy-Environment Model: Summary of Findings

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Transport for London

LONDON DEVELOPMENT AGENCY

MAYOR OF LONDON

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The Mayor of London established GLA Economics in May 2002 to provide a firm statistical, factual and forecasting basis for policy decision-making by the GLA group. GLA Economics is funded by Transport for London (TfL), the London Development Agency (LDA) and the Greater London Authority (GLA).

Foreword

One of the Mayor of London's key objectives is to promote London as a sustainable city. The Mayor has already produced a series of strategies covering a number of environmental matters: air quality, waste, energy, biodiversity and noise. These will all help improve the quality of life and the environment in London.

To move forward, we also need to gain a clearer understanding of how the economy and the environment interact. This report documents some first steps in this direction. It is by no means a complete answer. This is a complex topic in which there are many feedbacks between economic activity, the environment, health and quality of life. We do not pretend to have captured here more than some of the more obvious and unidirectional effects.

However, we believe that this is a journey that will have many stages and it is better to publish partial material as a basis for discussion than a complete black box which no-one understands.

We look forward to constructive discussions of the results and to establishing the next steps in modelling both the benefits and the costs of further strategies.

Bridget Rosewell
Consultant Chief Economist

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Introduction

In April 2003 GLA Economics commissioned Enviros Consulting Ltd to develop a model to assess and quantify the impact of London's economic growth on the environment. The model projects the impact of population, tourism and economic growth on a range of environmental indicators. The results cover performance from 1990 and projections until 2016. It is based on the contribution and targets of seven Mayoral strategies and assesses the impact of over 250 policy variables, related to three key sectors (transport, commercial and domestic) on the environment.

This report briefly describes the main findings of the model for two scenarios:

1. Business as usual: In this scenario, the variables change only due to national regulations. Otherwise they are assumed to be constant with historical values and trends.
2. Mayor's strategies: In this scenario, policies in the mayoral strategies, which can be quantified and are expected to have an environmental impact, are included.

This model is a first step towards identifying and understanding the links between the economy and the environment in London. The exercise has been useful in gathering relevant data and understanding the sensitivity of environmental and health impacts to changes in London's economy. Furthermore, it has modelled polices and proposals in the Mayor's crosscutting strategies to reduce London's environmental impact from economic and population growth. The model is intended to be a tool to further debate on the impact of economic and population growth on the environment. It allows comparison across a range of environmental indicators, emission factors, waste disposal routes and health impacts of economic and population growth. The aim of this work is to provide an initial step towards a framework within which these economic–environmental issues can be analysed.

This report contains calculations on emissions for waste and energy use per person. An initial assessment of the environmental impact of the reduction in vehicle kms due to the congestion charge is also provided. The report covers only some key results from the model and is not the final or exhaustive output of the model.

1. Key findings

(Using the Mayor's strategies scenario)

Greenhouse gases

- By 2016 the Mayor's strategies scenario is projected to reduce greenhouse gas emissions from London by 20 per cent from a 1990 baseline and by 10 per cent from 2000 levels.
- Total greenhouse gas emissions in 2016 are projected to be 11 per cent lower compared to a business as usual scenario. This equates to 4.2 million tonnes of CO_2 equivalent.
- In 2016 commercial, domestic and transport greenhouse gas emissions are projected to be 3, 2 and 29 per cent lower respectively compared to a business as usual scenario.
- Per capita carbon dioxide (CO_2) emissions are projected to be 10 per cent lower in 2016 compared to a business as usual scenario.
- Gross Value Added (GVA) per tonne of CO_2 is projected to be 70 per cent higher in 2016 compared to 2000 levels.

Air pollution

- In 2016 the Mayor's strategies scenario is projected to reduce the cost[1] associated with health impacts[2] of air pollutants by around a half.
- Oxides of nitrogen (NO_x) emissions are projected to be 3 per cent higher in 2016 compared to a business as usual scenario due to increased use of buses.
- In 2016 particulate matters (PM_{10}) and sulphur dioxide (SO_2) emissions are projected to be 8 and 12 per cent lower respectively from a business as usual scenario.

Waste

- Municipal solid waste is projected to increase by 34 per cent from 2000 levels in 2016 against 66 per cent under the business as usual scenario. The Mayor's strategies scenario is projected to reduce nearly 1.4 million tonnes of municipal solid waste, equivalent to that carried on average by 144,000 refuse collection vehicles.
- Commercial and industrial waste is projected to increase by 43 per cent in 2016 from 2000 levels compared to 56 per cent under the business as usual scenario. This is around 840,000 tonnes less of commercial and industrial waste.

Others

- Household water consumption is projected to be 25 per cent lower in 2016 compared to a business as usual scenario. This is almost 110,000 mega litres, or enough to fill 44,000 Olympic size swimming pools.
- In 2016 the area of land under private and public (managed and unmanaged) green space is projected to be 6 per cent (3,400 hectares) higher compared to the business as usual scenario. This area is equivalent to around 5,300 football pitches.

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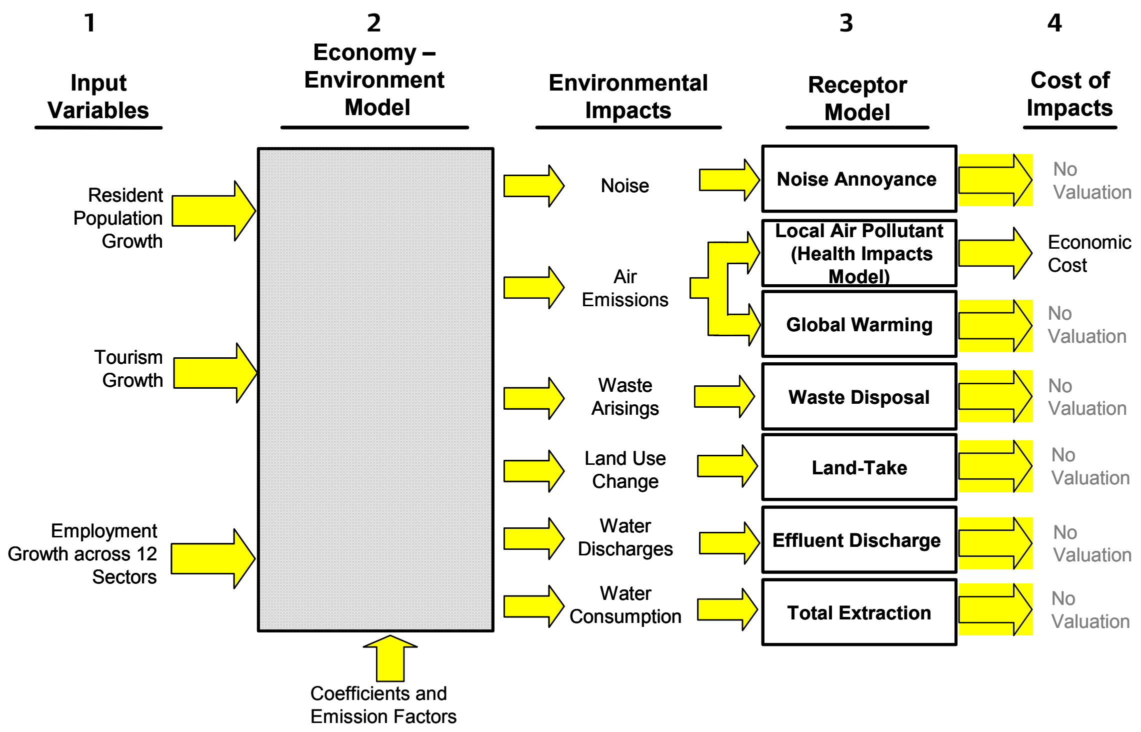
[1] These costs include the cost of treatment, the willingness to pay to avoid an illness and the loss of economic productivity associated with illness.

[2] Acute mortality caused by SO_2, respiratory hospital admissions by PM_{10} and leukaemia caused by Benzene.

2. Model structure

The GLA's economy-environment model is a linear model that translates economic activity into environmental and health outcomes using a series of links.

Figure 1. Economy-environment model structure



The input variables drive a set of intermediate economic variables: GVA by 12 industrial sectors, commuting patterns and household and dwelling numbers. These input and intermediate variables are linked by coefficient and emission factors, which give the impact on six environmental indicators over time. The receptor model accounts for how the environmental impact is assimilated or managed. This takes into consideration policies in the Mayor's strategies to manage environmental impacts such as air emission and waste. It also shows how these strategies will affect the quality of the environment. The localised impact of air pollutants on health is quantified in monetary terms.

The model also accounts for greenhouse gas emissions and air pollutants outside London, due to electricity consumption by residents and industrial sectors in London.

Variables used in the model

The data for all variables used in the model ranges from 1990 to 2016.

1. Input variables:

i. **Resident population**: population projection 1991 to 2016.

ii. **Tourism growth**: includes domestic and international tourists and those staying over night.

iii. **Employment growth across 12 (1-digit SIC codes) industrial sectors**: employment and GVA growth in the following sectors:

   a. Primary and utilities
   b. Manufacturing
   c. Construction
   d. Retail
   e. Wholesale
   f. Hotels and restaurants
   g. Transport and communication
   h. Financial services
   i. Business services
   j. Public administration
   k. Health and education
   l. Other services

2. Economy-environment model

Intermediate variables

i. **Households**: calculated from population projections using GLA occupancy ratios.

ii. **Dwellings**: calculated from population projections using GLA occupancy ratios.

iii. **GVA**: includes growth in GVA per sector and employee.

iv. **Commuters**: defined as employees travelling to work in Greater London from outside the region. Calculated from the total number of employees in London less the number of residents employed in London.

v. **Transport**: demand is determined by domestic residents, tourists and commuters. It is divided into the following modes:

   a. Road: car, freight, taxi, motorcycle, bus, emission–free travel (cycling and walking)
   b. Rail: Tube and overground rail
   c. Air travel: London City Airport and Heathrow.

Coefficient and emission factors

i. **Fuel emission factors**: for oil and natural gas consumption by dwellings and GVA by industrial sector. This covers CH_4, N_20, NO_x, VOCs, CO, SO_2 and PM_{10} per tonne of fuel combusted.

ii. **Electricity emission factors**: for electricity provision through the national grid. These factors (based on projections in the Department for Trade and Industry Energy Projections Paper, EP 68) are varied over time according to technological changes and assumptions about the grid generating mix. The model also provides factors for CO_2, SO_2, NO_x, PM_{10} and VOCs emissions.

The business sector emission factors are based on building related energy consumption of oil, gas and electricity. Process energy use and related emissions are not included.

iii. **Transport emission factors** vary with each transport type:
   a. Road includes: traffic speed, share of road traffic, engine sizes, efficiency of motorcycle engines and vehicle emission factors and standards.
   b. Rail includes: underground train energy consumption, electric train energy consumption, split of train types, diesel train emission factor and fuel consumption.
   c. Air includes: emission factors for landing and take-off cycles.

3. Receptor model variables

i. **Air emissions**: divided into two groups:
   a. Greenhouse gas emissions (CO_2, CH_4 and N_2O)
   b. Health impact of local air quality by the same pollutants inside London.

ii. **Solid waste**: divided into three waste categories:
   a. Municipal solid waste: determined by coefficients related to the number of households in London.
   b. Commercial and industrial waste: determined by the level of economic activity in each sector.
   c. Construction and demolition waste: determined by the level of economic activity in each sector and sector specific waste generation factors per unit of GVA.

The model also provides projections for nine waste management options: reuse, recycling, composting, incineration, landfill, backfill, mechanical biological treatment, anaerobic digestion, and gasification/pyrolysis. The last three relate to municipal solid waste and backfill to construction and demolition waste only.

iii. **Waste water discharges**: Three impact routes are modelled:
   a. Road run-off
   b. Effluent: Four pollutants are modelled under this route: ammonia, biological oxygen demand, phosphates and suspended solids. The quantity of pollution in the effluent is estimated by the limits contained in discharge permits modified by changes in population.
   c. Sludge arisings: Total sludge arisings are determined according to the population equivalents of employees in the business sector, tourism and the existing resident population.

iv. **Water consumption**: Domestic sector water consumption is determined by the number of residents. Business sector consumption is linked to the number of employees except for restaurants and hotels where total consumption is dependent on the number of tourists and dining patterns of the resident population (including tourists). London's total water consumption takes into account the effects of leaks from the water distribution system.

v. **Land use**: Variables included are vacant dwellings, plot ratios and surface area. In the domestic sector, total land consumed is determined by the total number of households and the expected building density (m^2 floor space per hectare plot area). In the business sector, each sub-sector's land consumption is determined by the expected floor area to plot area ratio and the level of economic activity.

vi. **Noise**: Variables included are level of annoyance, changes in noise, noise impact in London and dominant source of noise. The model assumes a linear relationship between noise caused by road and rail transport and the impacts on those affected (expressed as the number of people annoyed).

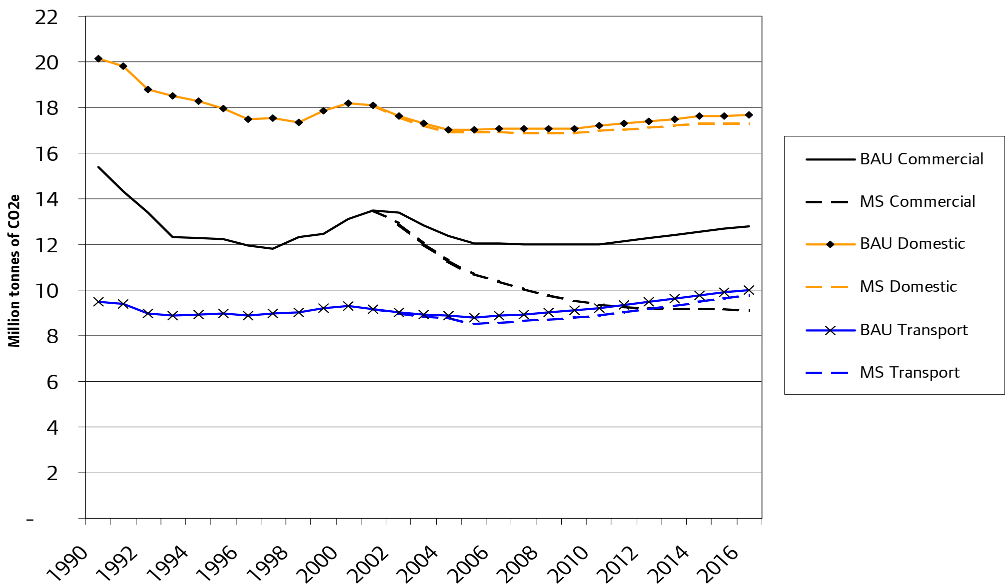
4. Cost of impacts

The health impacts of local air pollutants (eg PM_{10}, SO_2) are modelled. First the model converts emissions into ambient concentrations. These are then translated into health effects, which are then monetised using valuation coefficients. These costs include the cost of treatment, the willingness to pay to avoid an illness and the loss of economic productivity associated with illness.

3. Main results

This section presents the results of the model using the Mayor's strategies and business as usual scenarios, and their impact on greenhouse gas emissions, waste arisings and land take patterns.

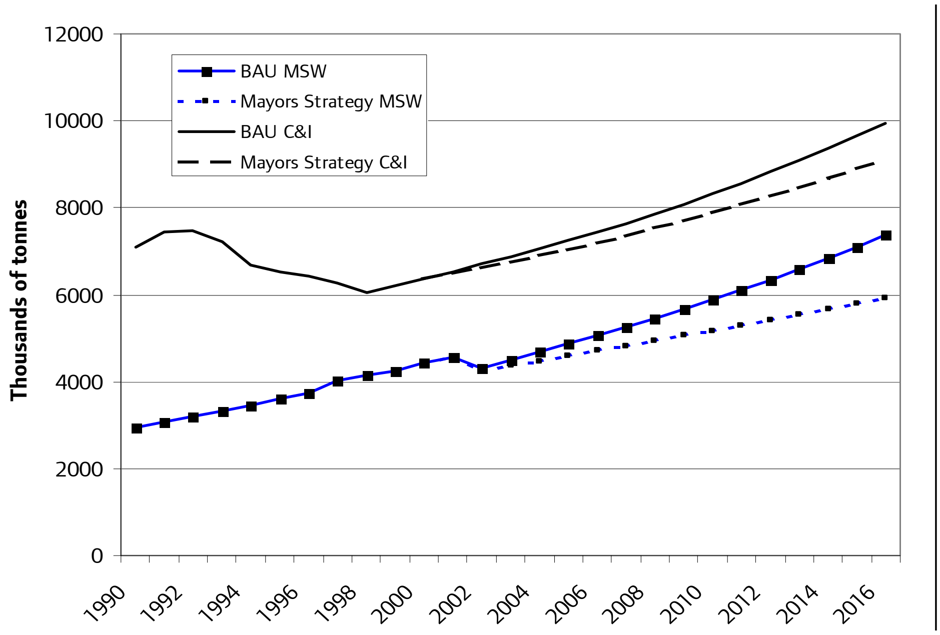
Figure 2. Projected greenhouse gas emissions



Note: BAU: Business as usual, MS: Mayor's strategies

If all the proposals and infrastructure projects in the Mayor's strategies were fully implemented, then London would meet the Mayor's target of a 20 per cent reduction in total greenhouse gas emissions from a 1990 baseline by 2016. Figure 2 shows that the majority of the gains are made by the commercial sector due to the high rate of turnover of building stock. This enables a higher rate of uptake of improved building standards and onsite renewable electricity generation.

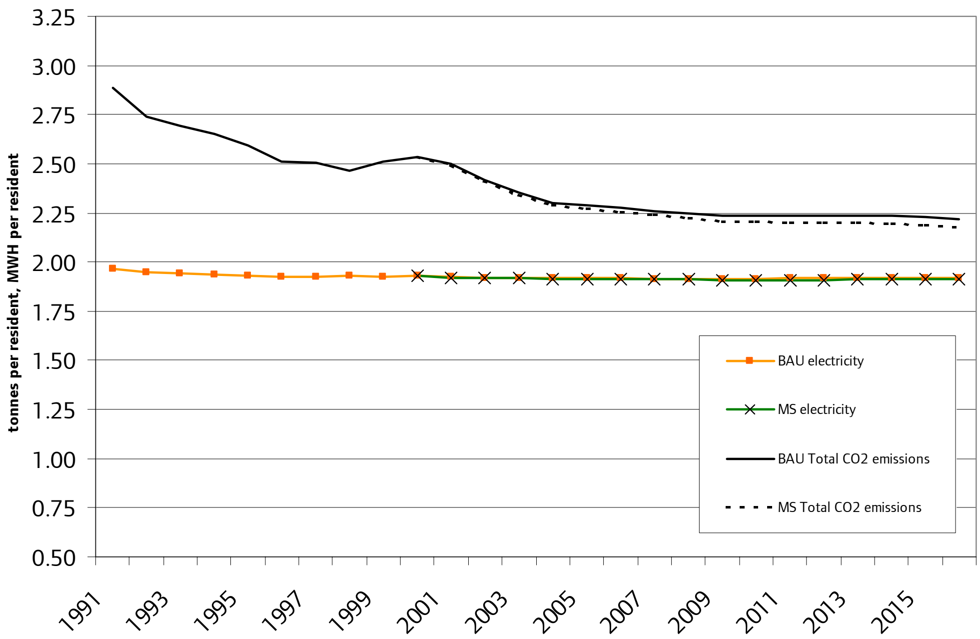
Figure 3. Total waste arisings



Note: BAU: Business as usual, MS: Mayor's strategies, MSW: Municipal solid waste, C&I: Commercial and industrial

By 2016, Mayor's Strategies would reduce municipal solid waste and commercial and industrial waste by 20 and 8 per cent respectively compared to the business as usual scenario.

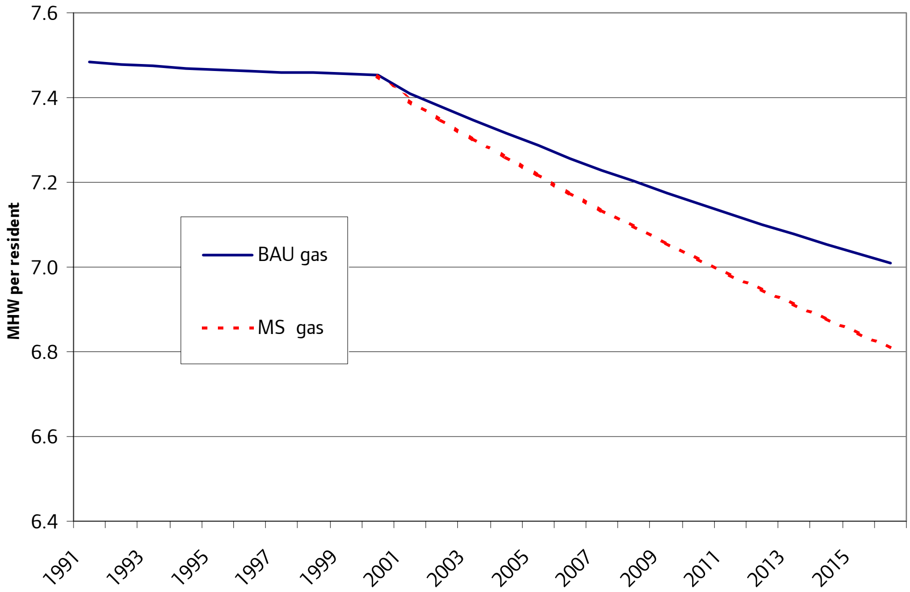
Figure 4. CO_2 emissions (tonnes) and electricity consumption (mega watt hour) per resident



Note: BAU: Business as usual, MS: Mayor's strategies

Figure 4 shows that electricity consumption per resident in 2016 is projected to be just 0.5 per cent lower compared to the business as usual scenario. Total CO_2 emissions[3] per resident, in 2016 are projected to be 2 per cent lower compared to the business as usual scenario.

Figure 5. Gas consumption (mega watt hour) per resident

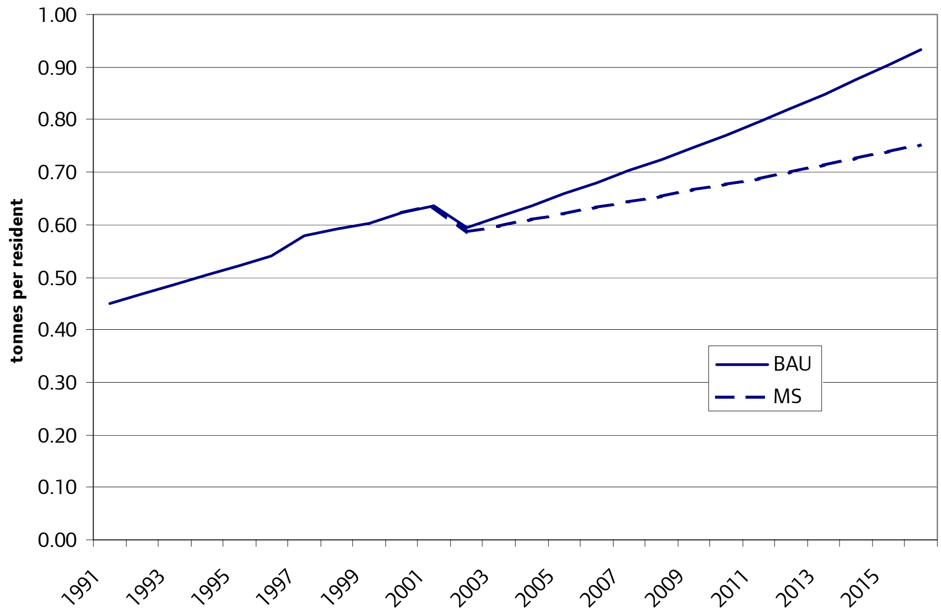


Note: BAU: Business as usual, MS: Mayor's strategies

In 2016, the Mayor's Strategies are projected to reduce gas consumption per resident by 3 per cent compared to the business as usual scenario.

[3] This includes emissions from energy consumption in London and emissions at power stations to generate this energy.

Figure 6. Municipal solid waste (tonnes) per London resident

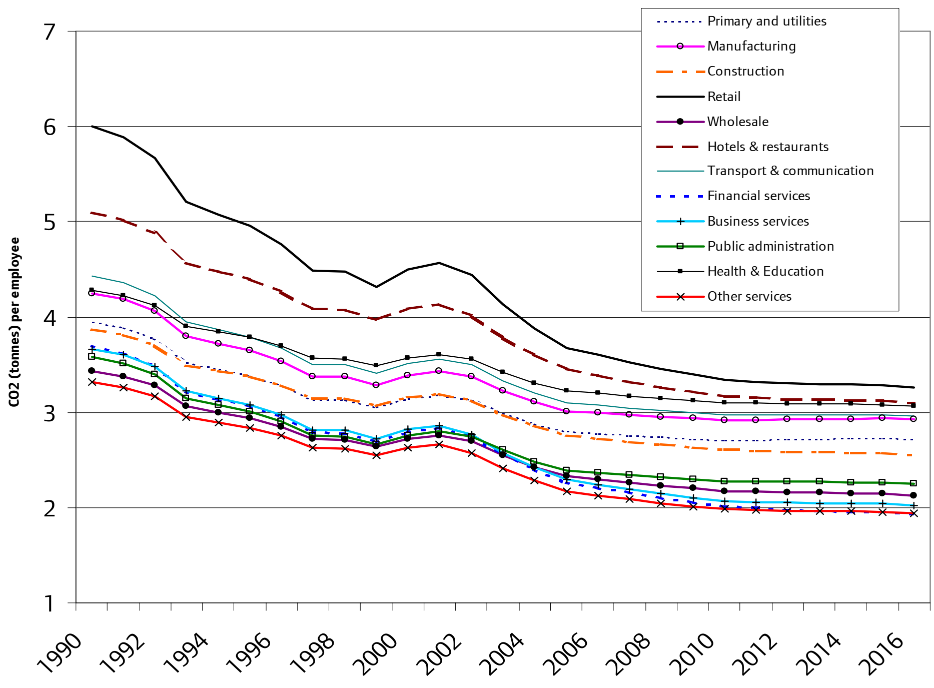


Note: BAU: Business as usual, MS: Mayor's strategies

In 2016, municipal solid waste per London resident is projected to be 20 per cent lower under the Mayor's strategies scenario compared to the business as usual scenario.

Figure 7. Total CO_2 emissions (tonnes) per employee

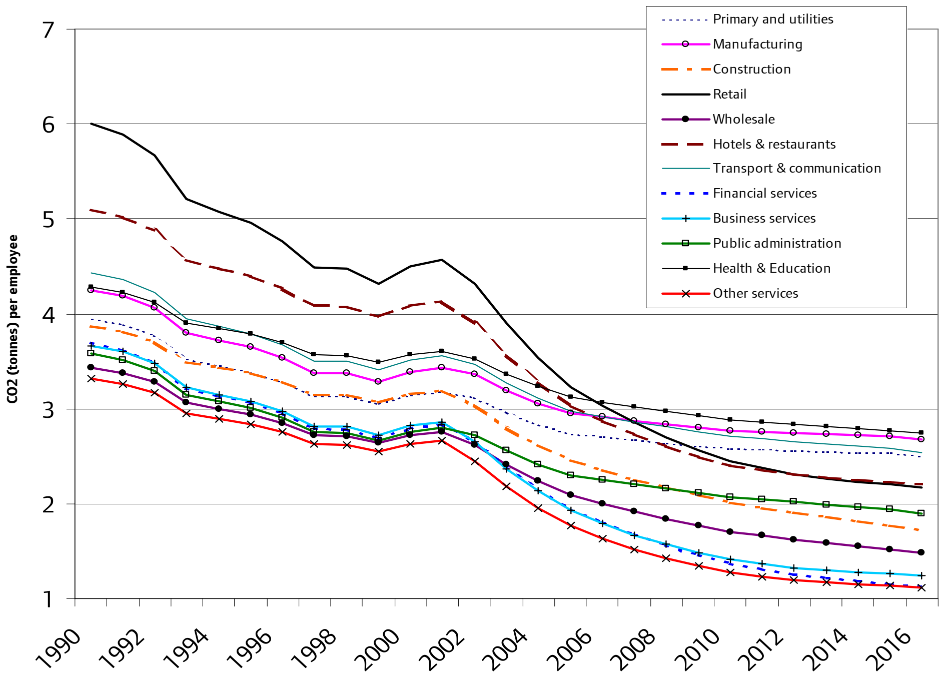
(business as usual scenario)



Note: BAU: Business as usual, MS: Mayor's strategies

Figure 8. Total CO_2 emissions (tonnes) per employee

(Mayor's strategies scenario)

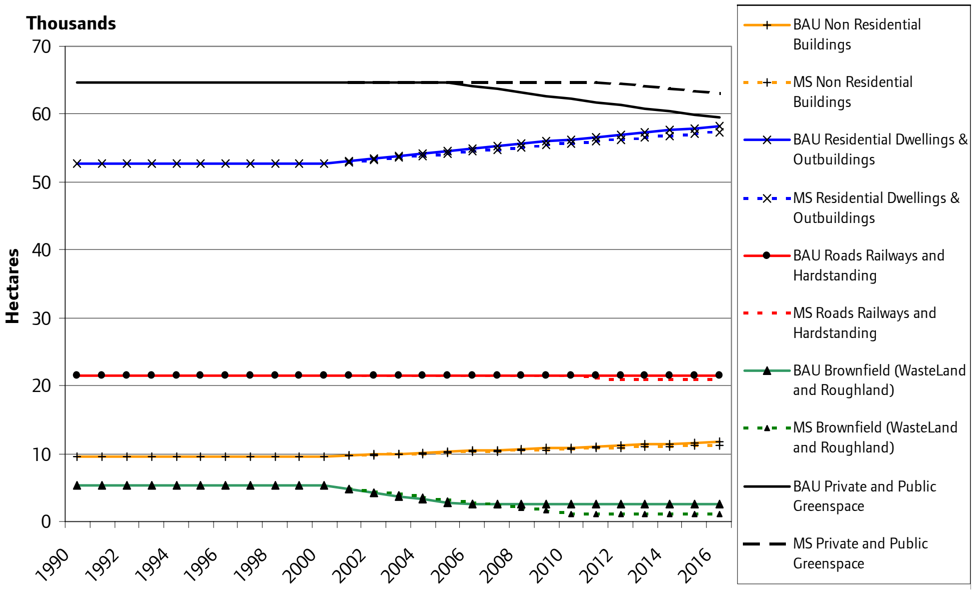


Figures 7 and 8 show that in 2016 the Mayor's strategies would lead to a significant reduction in CO_2 emissions per employee for each industrial sector compared to the business as usual scenario. The increase in CO_2 emissions seen in Figures 7 and 8 for 2000 and 2001 were due to the change in electricity grid average emission factors with more coal used than in previous and subsequent years. These projections are based on the Department for Trade and Industry's Energy Paper 68.

The reduction for each sector in 2016 under the Mayor's strategies scenario compared with the business as usual scenario is given below:

Sectors	**Reduction in CO_2 emissions per employee %**
Primary and utilities	8
Manufacturing	8
Construction	32
Retail	33
Wholesale	30
Hotels and restaurants	29
Transport and communication	14
Financial services	42
Business services	38
Public administration	15
Health and education	11
Other services	42

Figure 9. Land take patterns

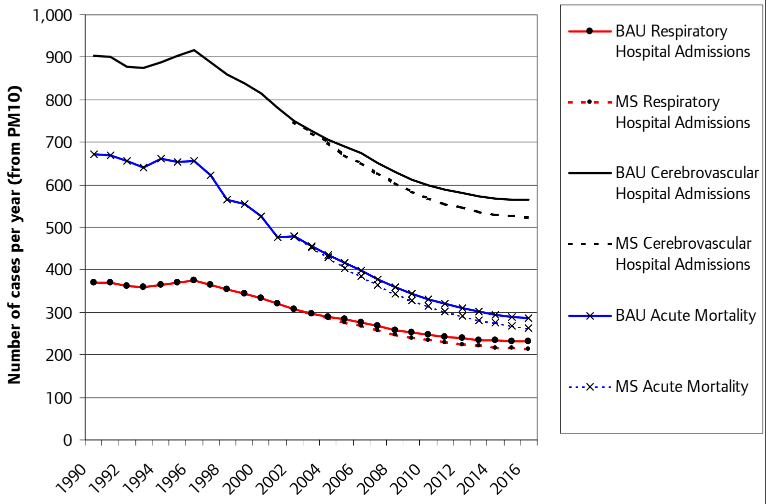


In 2016, the Mayor's strategies scenario is projected to reduce brownfield areas by 60 per cent (1,600 hectares) in 2016 compared to the business as usual scenario. Land use for residential dwellings and outbuildings is projected to be 2 per cent lower compared to the business as usual scenario. The change in land take patterns is mainly due to a strategy of higher building densities and the reduction in brownfield sites.

Health impact

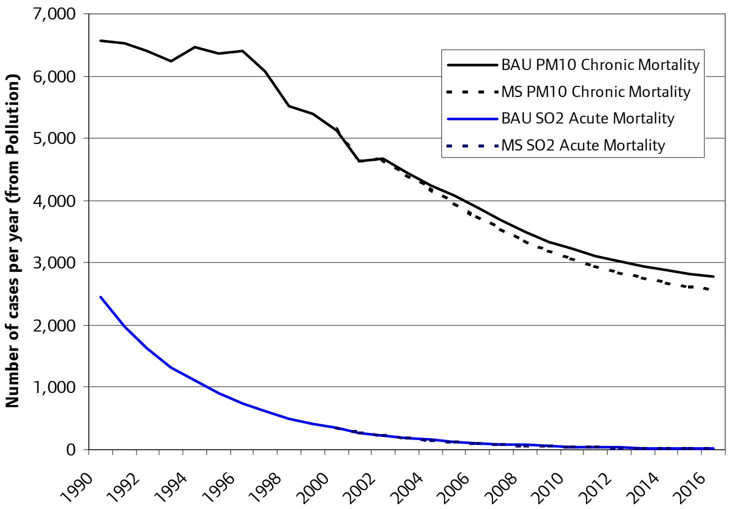
The model calculates the health impacts of air pollutants such as PM_{10}, SO_2, CO_2, Benzene and 1,3-Butadiene.

Figure 9. Health impacts associated with total PM_{10} emissions



- Particulate matters are emitted in a wide range of sizes and type of particles.
- They are associated with respiratory (eg asthma) and cardiovascular problems and mortality. Cerebrovascular refers to the blood vessels of the cerebrum or brain.

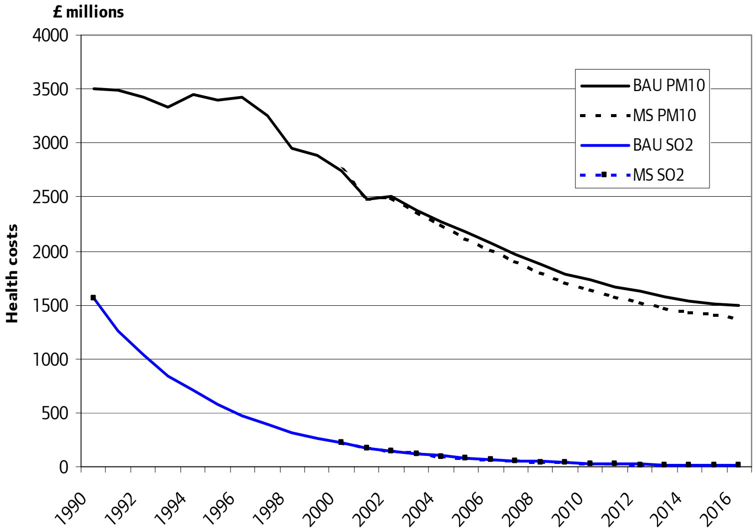
Figure 10. Health impacts associated with total emissions: SO_2 and PM_{10}



- Sulphur dioxide arises mainly from burning sulphur-containing fuels.
- Studies have shown that SO_2 can cause acute mortality[4].
- SO_2 causes constriction of the airways by stimulating nerves in the lining of the nose, throat and airways of the lungs.

[4] GLA, The Mayor's Air Quality Strategy, Cleaning London's Air, September 2002

Figure 11. Total health costs for PM_{10} and SO_2



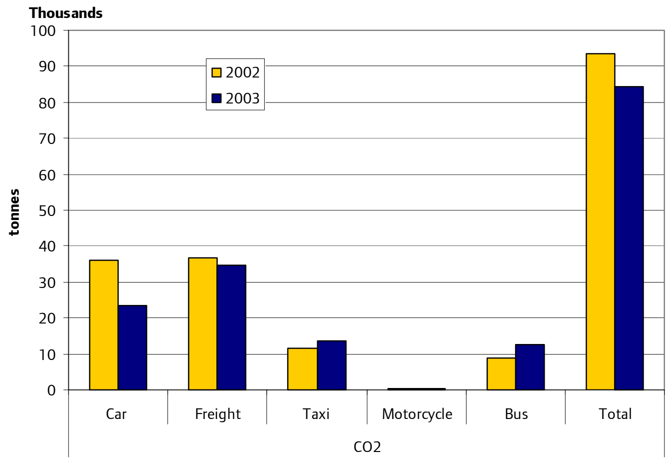
- PM_{10} costs include respiratory hospital admissions, cerebrovascular hospital admissions and acute and chronic mortality.
- SO_2 costs include acute and chronic mortality.
- The Mayor's strategies are expected to reduce the health costs associated with PM_{10} and SO_2 by 8 and 12 per cent respectively from the business as usual scenario.

4. How the model could be used: Environmental impact of the congestion charge in the congestion charging zone

This section uses the model to make some preliminary estimates of the initial environmental impacts of the congestion charge in London's congestion charging zone. It is important to note that this is an example of how the model could be used in the future, and does not show all the environmental impacts of the congestion charge.

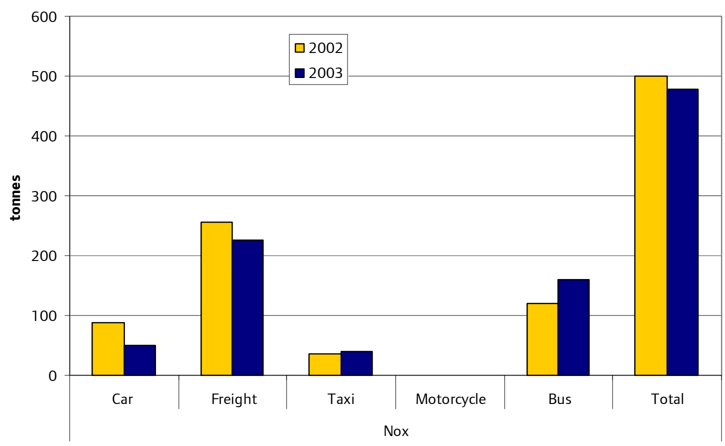
Congestion charging has changed the pattern of vehicle kms driven in London. The model was used to calculate emissions on the basis of vehicle kms driven during the charging hours on a typical weekday for the pre-charging (2002) and post-charging (2003) periods.

Figure 12. CO_2 emissions in the congestion charging zone during charging hours[5]



- CO_2 is a greenhouse gas and contributes to global warming.
- Transport is one the highest contributors of CO_2 emissions.
- Emissions by buses are lower than cars.
- Emissions by cars have fallen by 35 per cent (12,400 tonnes) whereas emissions by buses have increased by 39 per cent (3,500 tonnes).

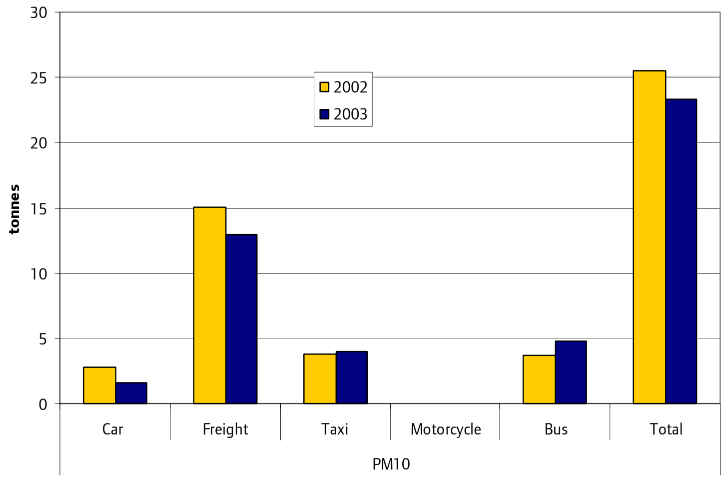
Figure 13. NO_x emissions in the congestion charging zone during charging hours



- NO_x has both short-term and long-term effects on health.
- Long-term exposure may affect lung function.
- Emissions by cars have fallen by 43 per cent (38 tonnes) and emissions by buses have increased by 34 per cent (41 tonnes).

[5] This does not cover the internal ring road.

Figure 14. PM_{10} emissions in the congestion charging zone during the charging hours



- Freight is the largest contributor, although it was down by 14 per cent in 2003.
- Bus emissions have increased by 28 per cent and car emissions have fallen by 43 per cent.

Cost associated with health impact of pollutants
(Absolute cost of each pollutant per year)

2002

Pollutant	Health outcome	Cost of health impact (per person)	Using resident population of congestion charging zone		Using resident population of congestion charging zone and resident equivalent of 1 million commuters per day	
			Cases per year	Total cost per year £	Cases per year	Total cost per year £
PM_{10}	Respiratory hospital admissions	2,748	0.39	1,075	1.03	2,840
PM_{10}	Cerebrovascular hospital admissions	10,640	0.95	10,139	2.52	26,779
Benzene	Leukaemia	700,000	0.02	13,905	0.05	36,728
1,3-Butadiene	Cancer risk estimates	500,000	0.004	1,861	0.010	4,916
			Total	26,980	**Total**	71,263

Note: Some of the figures may not sum due to rounding.

2003

Pollutant	Health outcome	Cost of health impact (per person)	Using resident population of congestion charging zone		Using resident population of congestion charging zone and resident equivalent of 1 million commuters per day	
			Cases per year	Total cost per year £	Cases per year	Total cost per year £
PM_{10}	Respiratory hospital admissions	2,748	0.37	1,012	0.97	2,673
PM_{10}	Cerebrovascular hospital admissions	10,640	0.90	9,541	2.37	25,199
Benzene	Leukaemia	700,000	0.01	7,807	0.03	20,620
1,3-Butadiene	Cancer risk estimates	500,000	0.003	1,404	0.007	3,708
			Total	19,763	**Total**	52,200

Note: Some of the figures may not sum due to rounding.

The tables above show the number of cases a year (from pollution) and the total cost associated with each health outcome. The health outcome is based on the concentration levels of each pollutant in the congestion charging zone (it does not cover the internal ring road except for PM_{10}). For each year, emission levels obtained from vehicle kms driven in the congestion charging zone during charging hours are converted to ambient concentrations using average conversion factors. Cases per year are calculated by multiplying dose response functions of each pollutant and ambient concentrations and population in the congestion charging zone. The total cost of each pollutant's health outcome is obtained by the number of cases times the cost associated with the health impact per person.

Reduction in health costs per year due to congestion charging in the congestion charging zone

Pollutant	Health outcome	Reduction in costs (£)		Reduction in costs (%)
		Using resident population of congestion charging zone	Using resident population of congestion charging zone and resident equivalent of 1million commuters per day	
PM_{10}	Respiratory hospital admissions	63	168	6
PM_{10}	Cerebrovascular hospital admissions	598	1,580	6
Benzene	Leukaemia	6,099	16,108	44
1,3-Butadiene	Cancer risk estimates	457	1,208	25
Total		7,217	19,063	

Note: Some of the figures might not sum due to rounding errors.

Using the GLA economy-environment model, initial calculations suggest that the health benefit of congestion charging in the congestion charging zone could be around £7,000 to £20,000 per year. This benefit is in terms of health costs saved due to lower emissions of key pollutants in the zone.

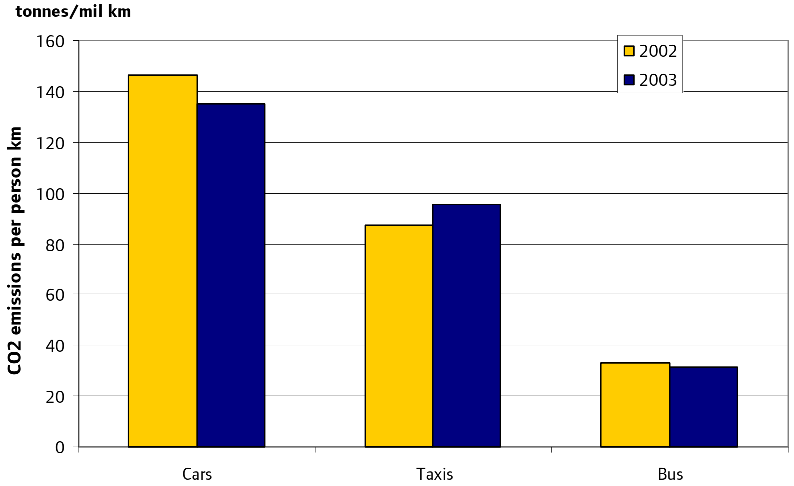
Note:
The calculations above do not consider reductions in vehicle kms and emissions outside the congestion charging zone. This could be substantial, as congestion charging could eliminate the entire length of a trip starting outside the zone. However, some trips will be displaced to other locations, including commuters who may drive to public transport outside the zone. Also, some other trips in the zone that used to take place during congestion charging hours before the charge was introduced will now be displaced to outside charging hours rather than not taking place at all. Moreover, it does not include tourists (day-trippers and overnight visitors) in calculating the total number of people in the congestion charging zone.[6] Emissions in this analysis are slightly under-estimated – they would also fall due to increases in average speeds and a reduction in stop-go traffic (ie less time spent stationary).

Diesel fuel generates much higher external costs than petrol. Even though cars have a higher share of vehicle kms, they account for less environmental damage than buses and goods vehicles per km travelled.[7] The vehicle km mix for 2003 shows that emission by cars have

[6] The intensity of the dose response function for each pollutant on tourists and commuters would not be the same as residents. They are converted to resident equivalents to adjust for this bias.
[7] A Hunt 2002, Economic Costs of Health Effects of Vehicle Emissions, Clean Air, 32(2), 58-64

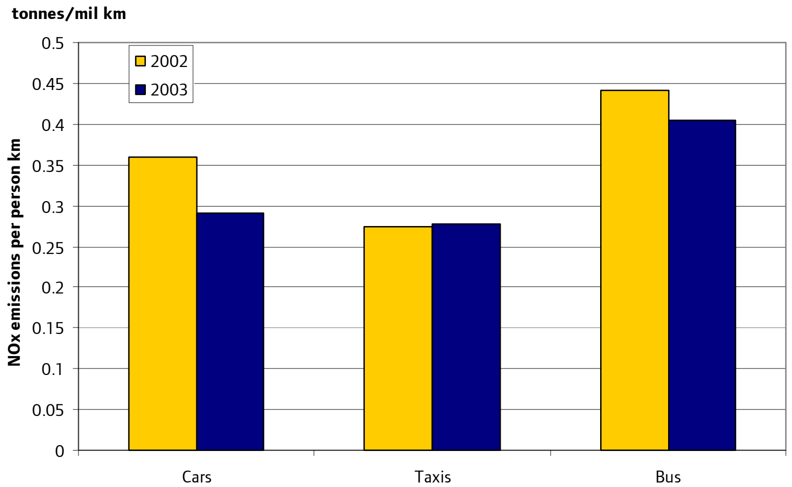
gone down whereas emissions by buses have increased (Figures 12-14). However, if CO_2 emissions per passenger km[8] are considered then buses perform much better than cars (Figure 15).

Figure 15. CO_2 emissions per person km in the congestion charging zone during charging hours[9]



- CO_2 emissions per passenger km travelled are much lower for buses compared to taxis and cars.

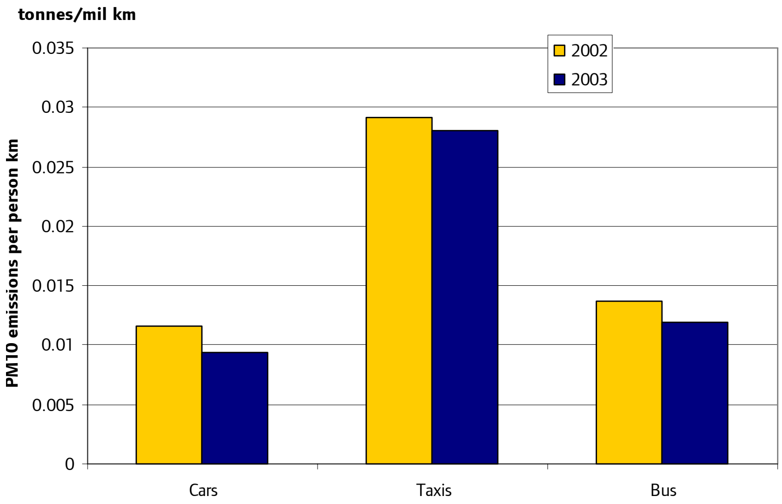
Figure 16. NO_x emissions per person km in the congestion charging zone during charging hours



- NO_x emissions per passenger km travelled are much lower for cars compared to taxis and buses.
- Buses have a high NO_x emission factor (9.3g/km) for each km travelled compared to cars (0.4g/km).[10]

[8] Person kms is obtained by multiplying occupancy factor by vehicle kms for each mode of transport for each year.
[9] This does not cover the internal ring road.
[10] The emission factors for buses and cars are for 2003 and take into consideration the mix of vehicles according to engine size and EURO I, II, II or IV emission standards.

Figure 17. PM_{10} emissions per person km in the congestion charging zone during charging hours



- PM_{10} emissions per passenger km travelled are marginally greater for buses compared to cars.
- Taxis produce slightly more PM_{10} per person km travelled than cars.

Conclusion

The main results of the model are driven by economic and population growth. These results should be treated with caution – as with any projection exercise the model suffers from significant uncertainties. Further developments such as cross-sectoral relationships, disaggregation of the economic sectors to 2-digit SIC codes and detailed spatial analysis are already planned. As a first step the model has been helpful in explaining specific economy-environment relationships, such as waste, in more detail. It has also provided a mechanism to compare previous sector specific models such as emissions and energy.

The model has also helped to flag up areas where good data is not readily available, such as the noise and health impacts of certain pollutants. It has identified areas that need further work, such as accounting for the environmental impact of commuters and tourists.

The Mayor's strategies scenario shows that polices in the strategies can reduce the environmental impact of population and economic growth compared to the business as usual scenario. Most of these reductions are projected to come from the commercial sector. Businesses and households are projected to be more waste and energy efficient compared to the business as usual scenario.

Overall, the model has demonstrated the first steps towards a viable framework that can analyse the effects of growth in London's economy on London's environment.

Appendices

The following appendices contain charts for each industrial sector.

Appendix A. Per capita CO_2 emissions and per capita natural gas consumption for each industrial sector.

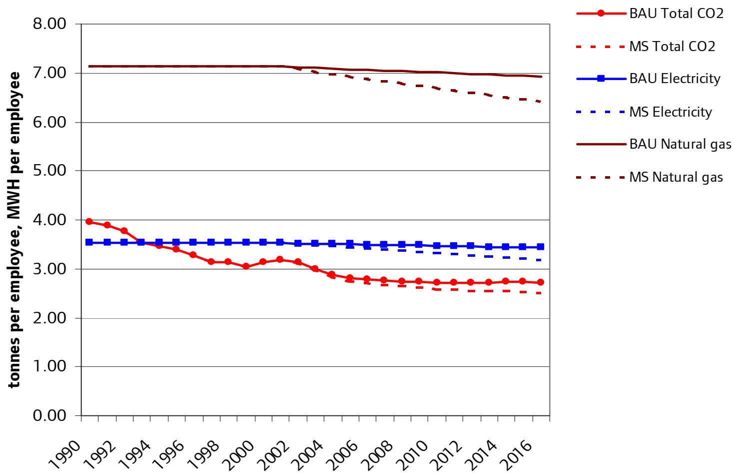
Appendix B. CO_2 emissions (tonnes) per GVA (£s) per employee (productivity). For these charts, GVA per employee is calculated for each industrial sector, which gives average productivity for that sector. The ratio of CO_2 emissions with sector productivity is then calculated. This shows the amount of CO_2 emitted per pound of output by each employee for each industrial sector.

Appendix C. Commercial and industrial waste and construction and demolition waste (tonnes) per employee. These charts show the amount of commercial and industrial waste generated per employee for each industrial sector and construction and demolition waste for the construction sector. It is measuring waste per employee for each sector.

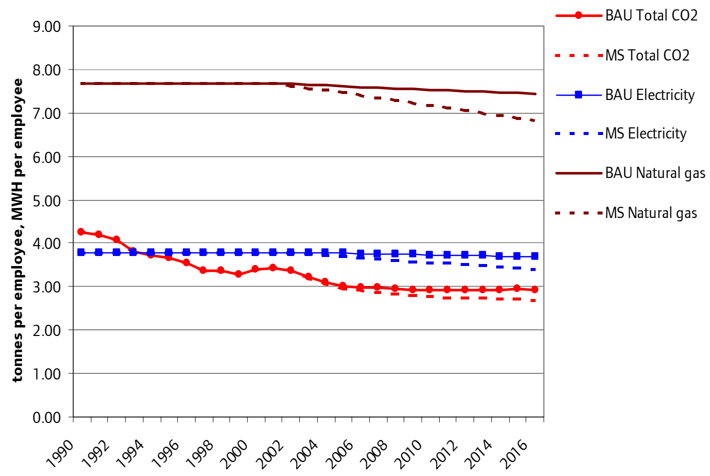
Appendix D. Commercial and industrial waste and construction and demolition waste (tonnes) per GVA (£) per employee (productivity). The approach used to create these charts is similar to that for the charts in Appendix B. They show the amount of waste generated per pound of output by each employee for each industrial sector.

Appendix A. CO_2 emissions (tonnes) and natural gas consumption (mega watt hour) per employee

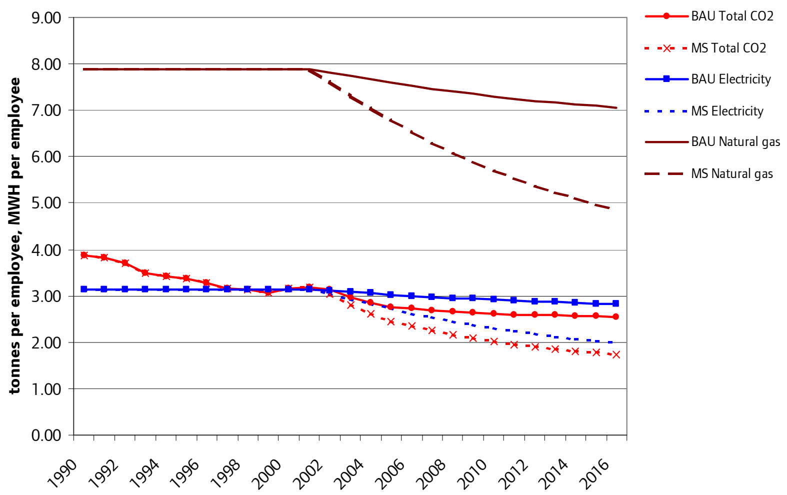
Primary and Utilities



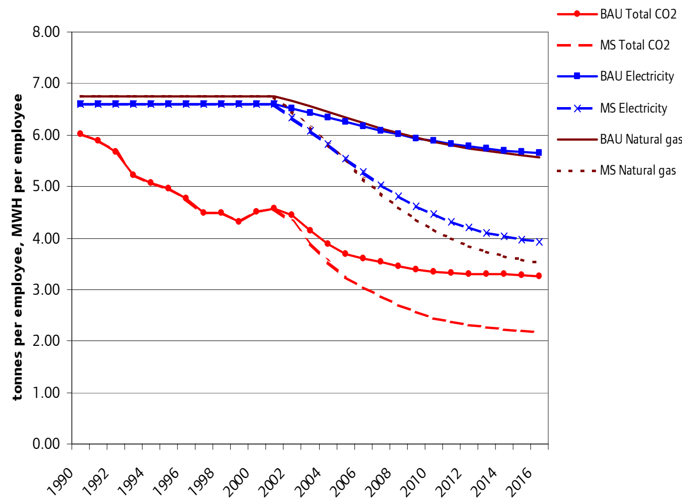
Manufacturing



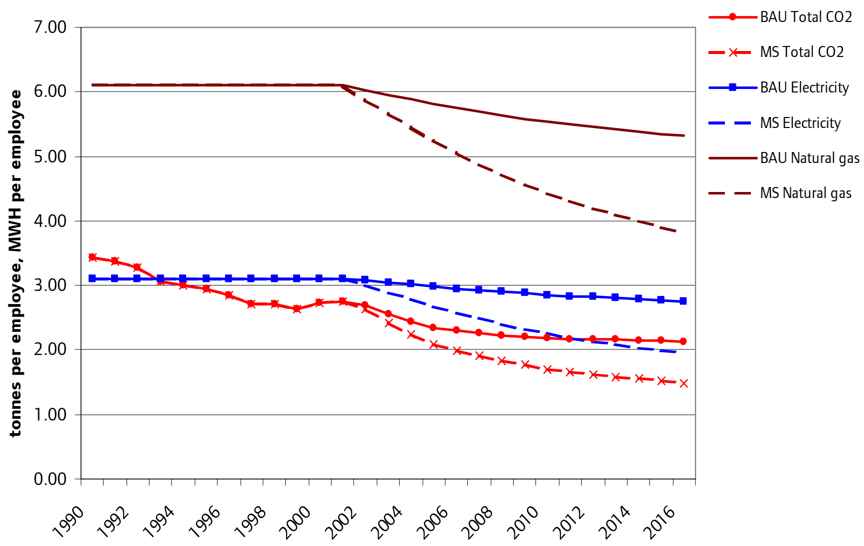
Construction



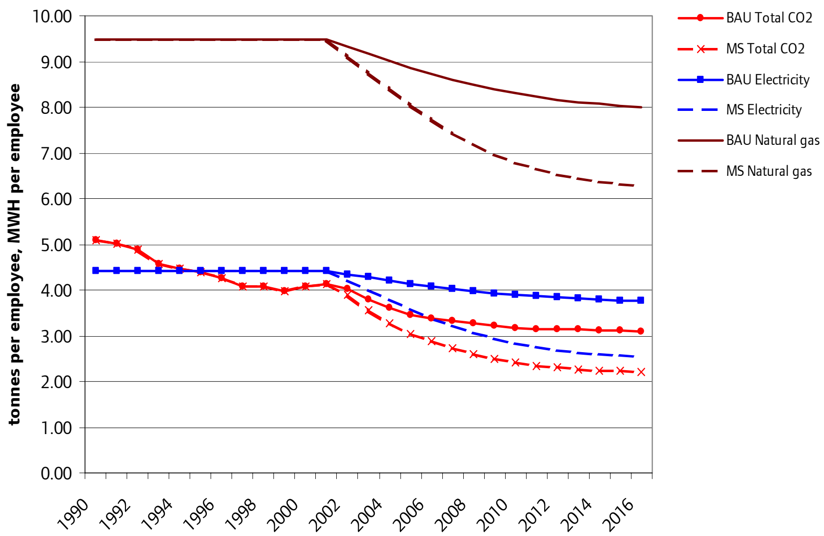
Retail



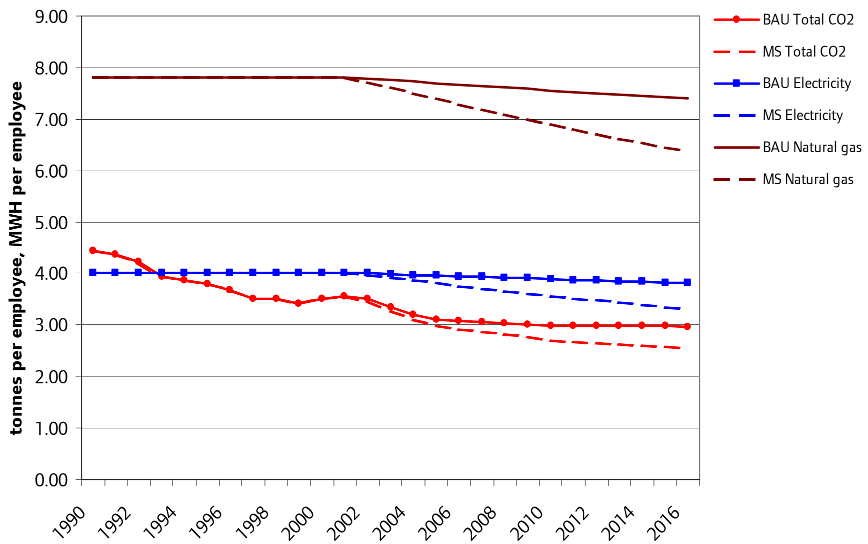
Wholesale



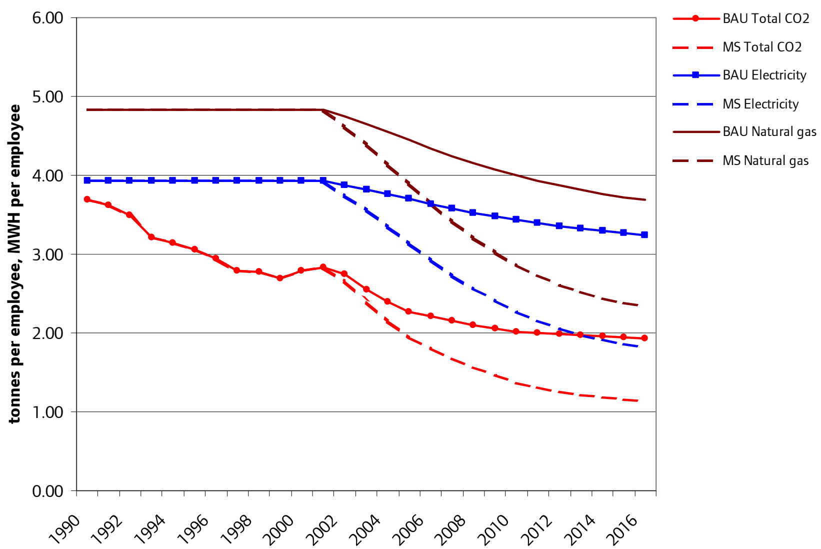
Hotels and restaurants



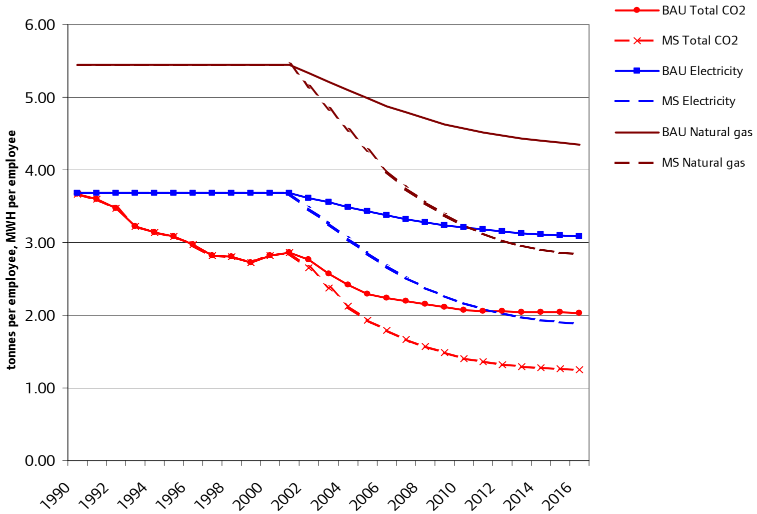
Transport and communication



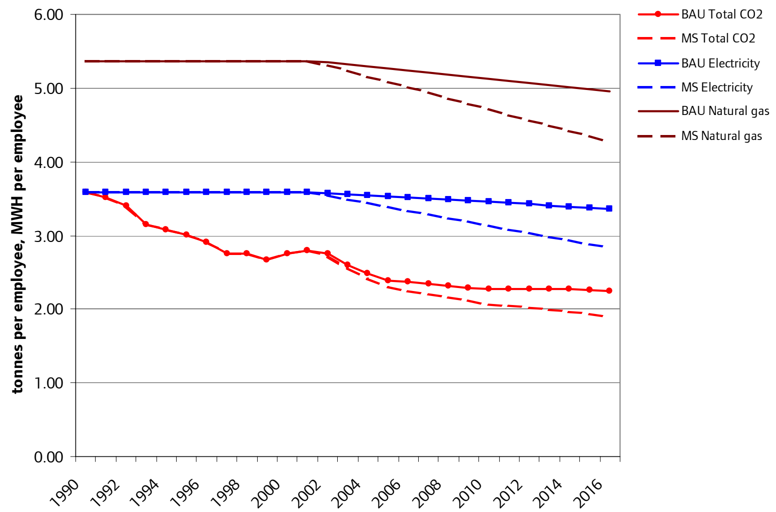
Financial services



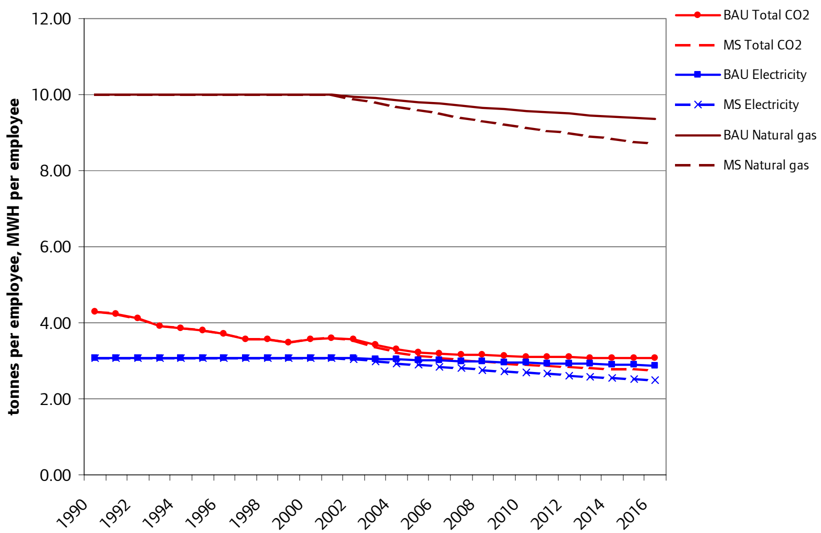
Business services



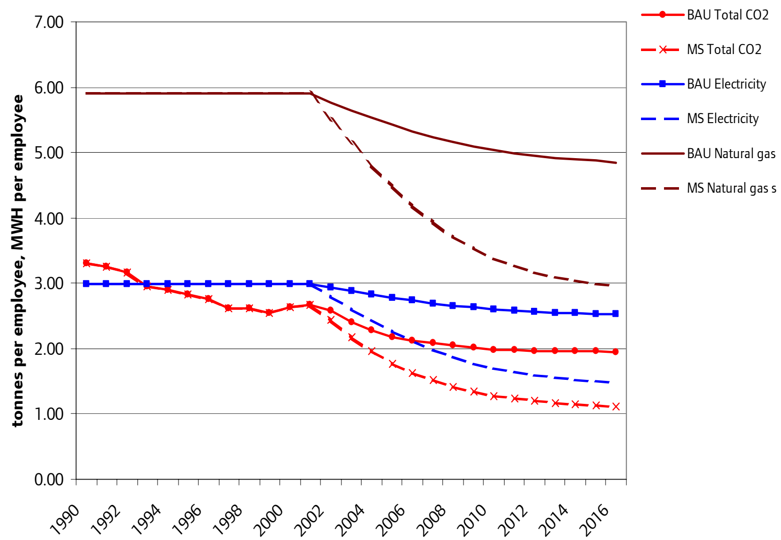
Public administration



Health and education

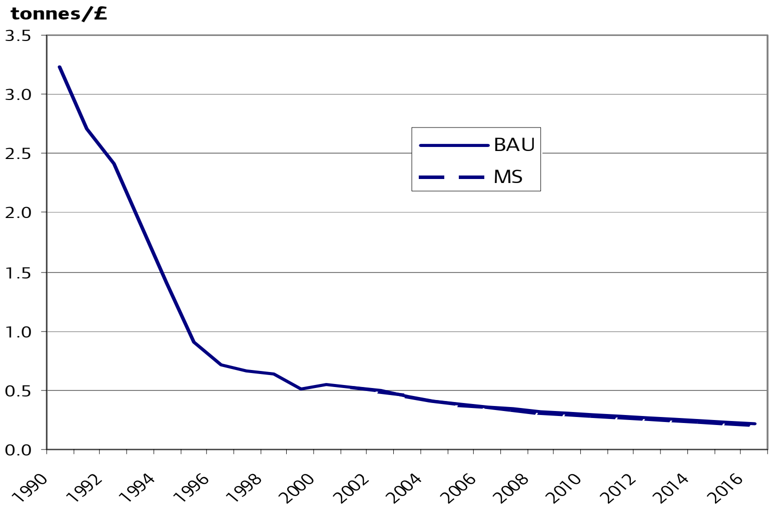


Other services

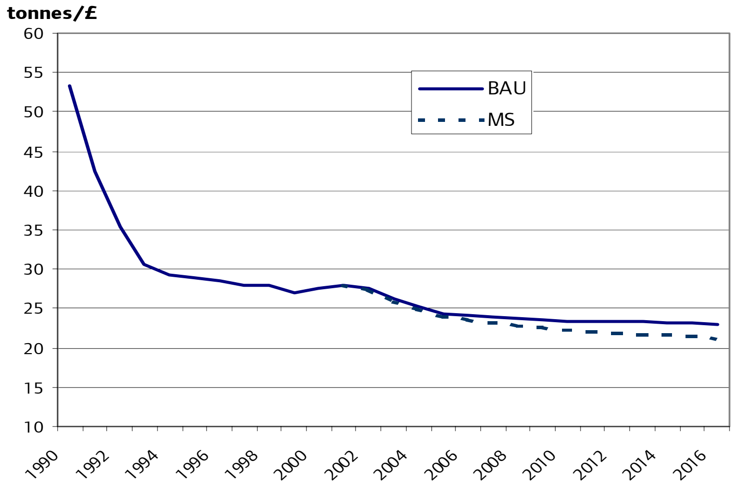


Appendix B. CO_2 emissions (tonnes) per GVA (£s) per employee (productivity)

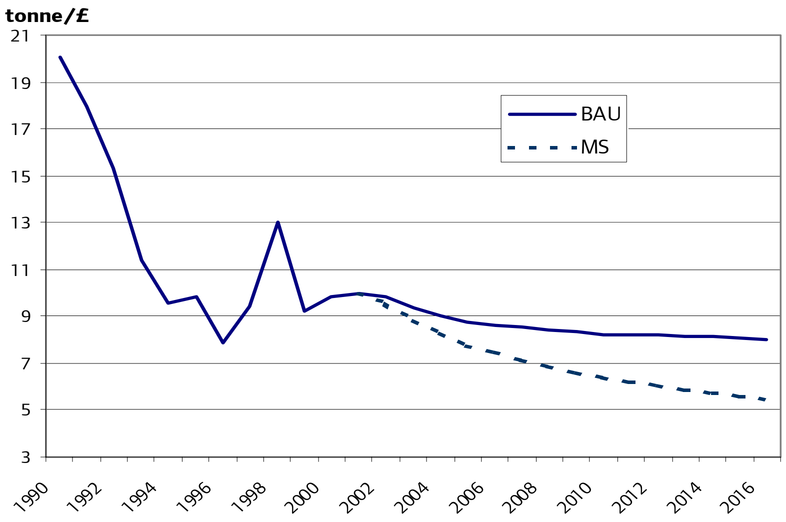
Primary and Utilities



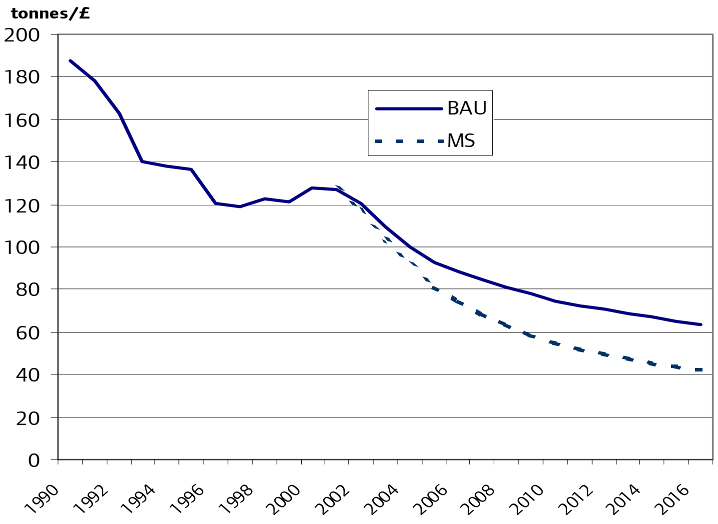
Manufacturing



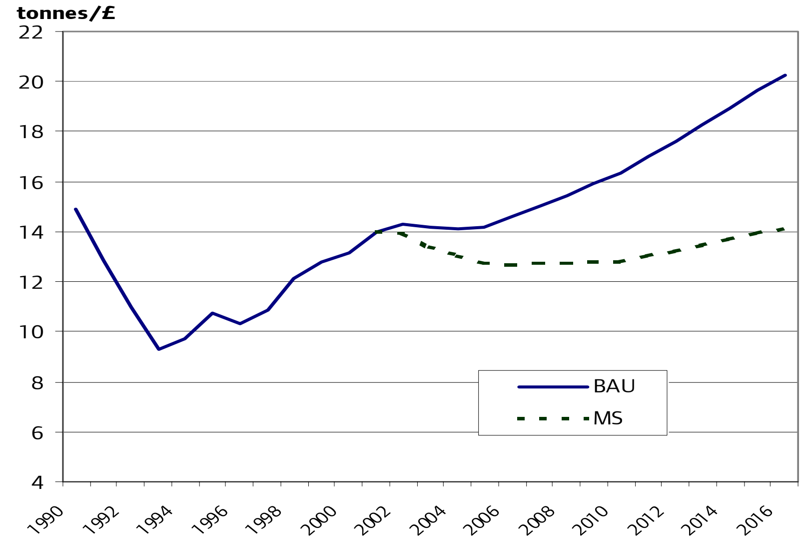
Construction



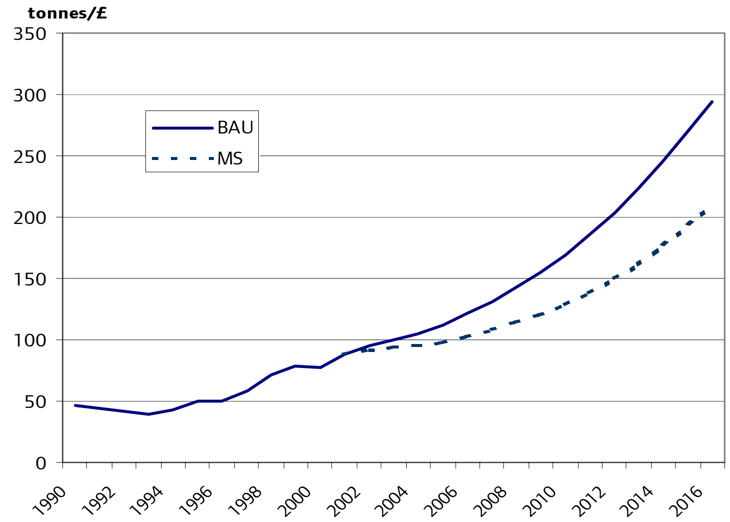
Retail



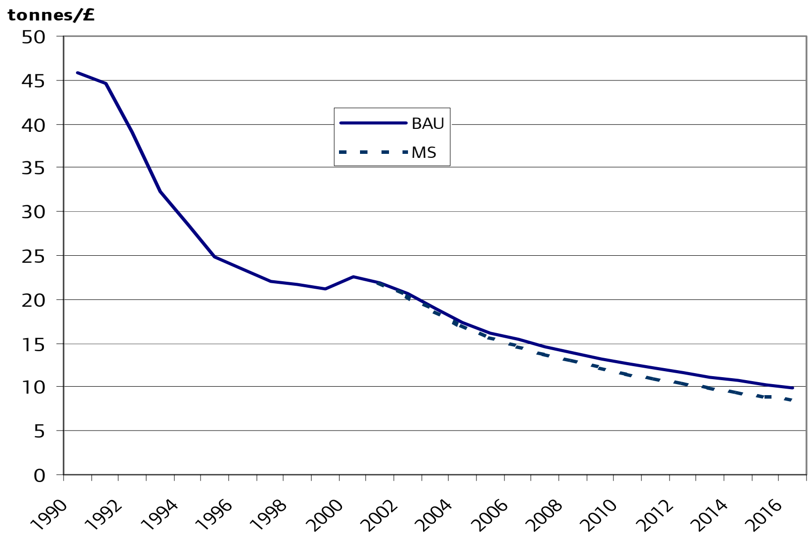
Wholesale



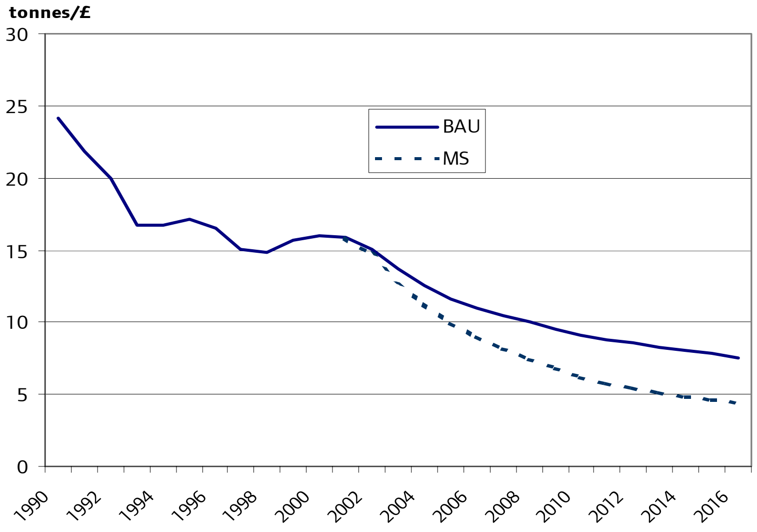
Hotels and restaurants



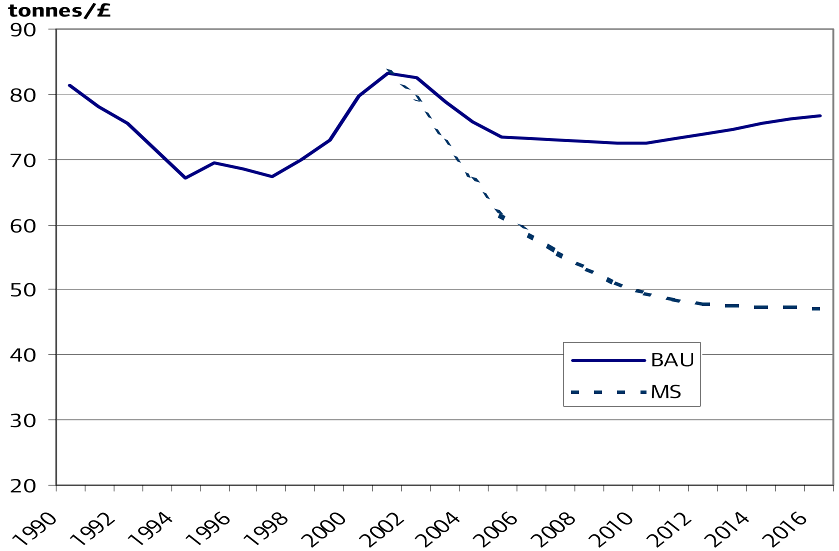
Transport and communication



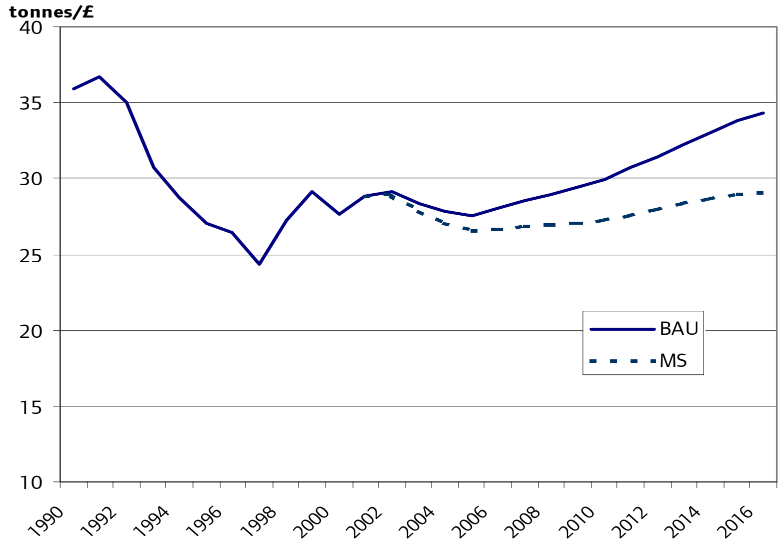
Financial services



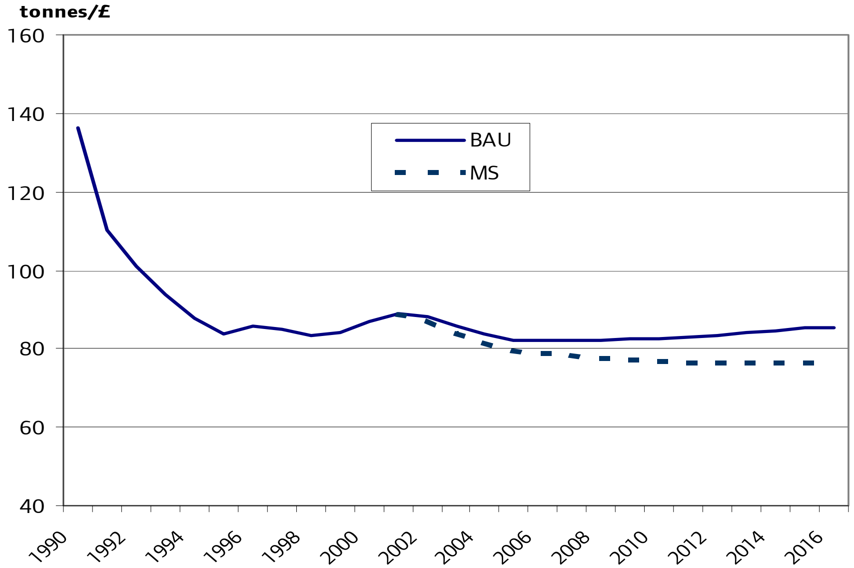
Business services



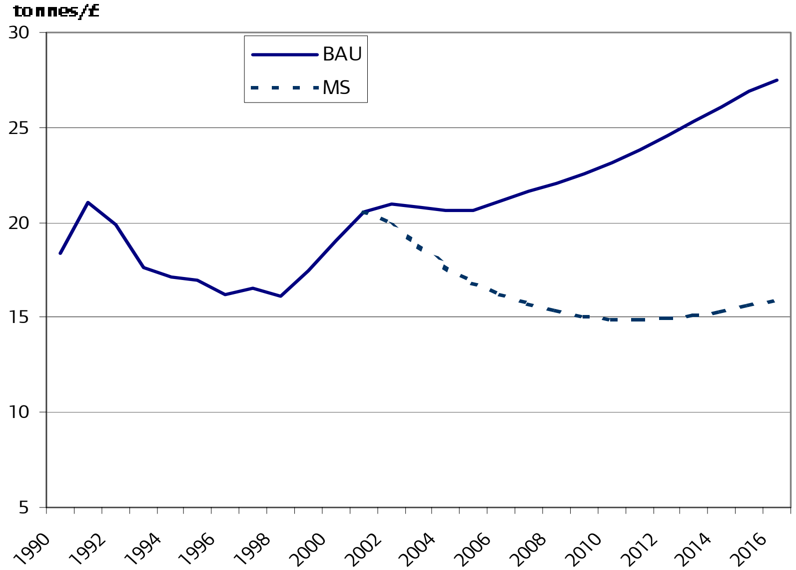
Public administration



Health and education

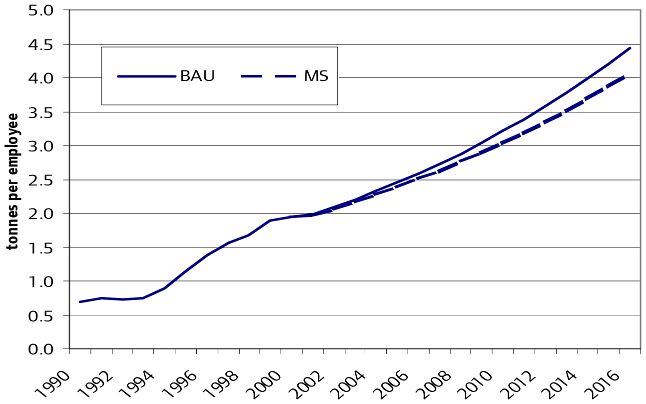


Other services

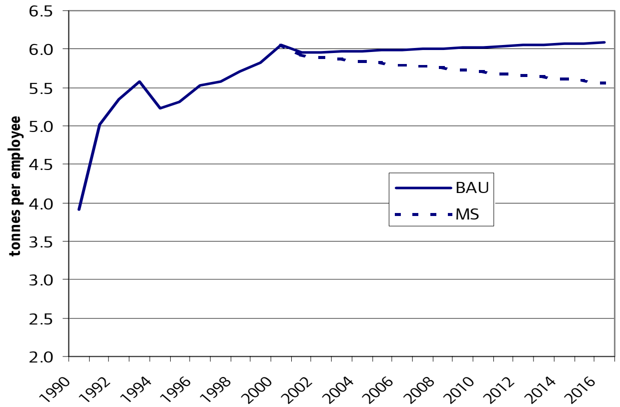


Appendix C. Commercial and industrial waste and construction and demolition waste (tonnes) per employee

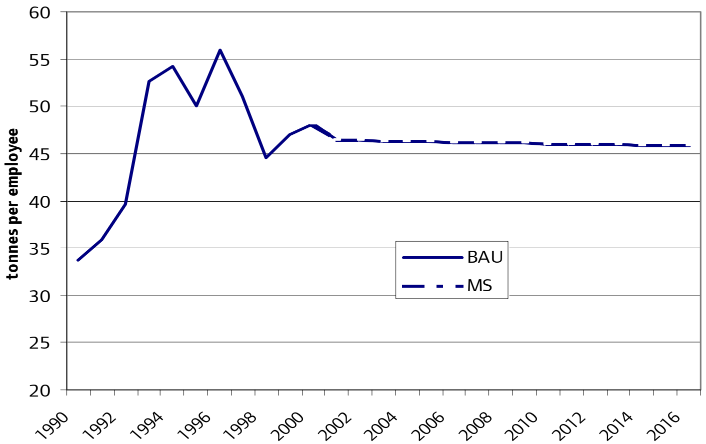
Primary and Utilities



Manufacturing



Construction



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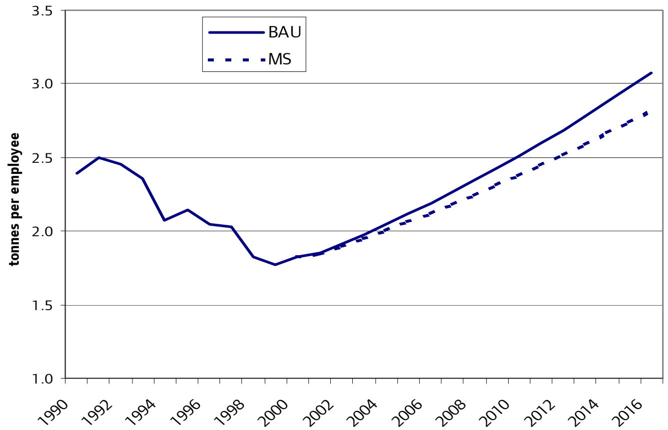
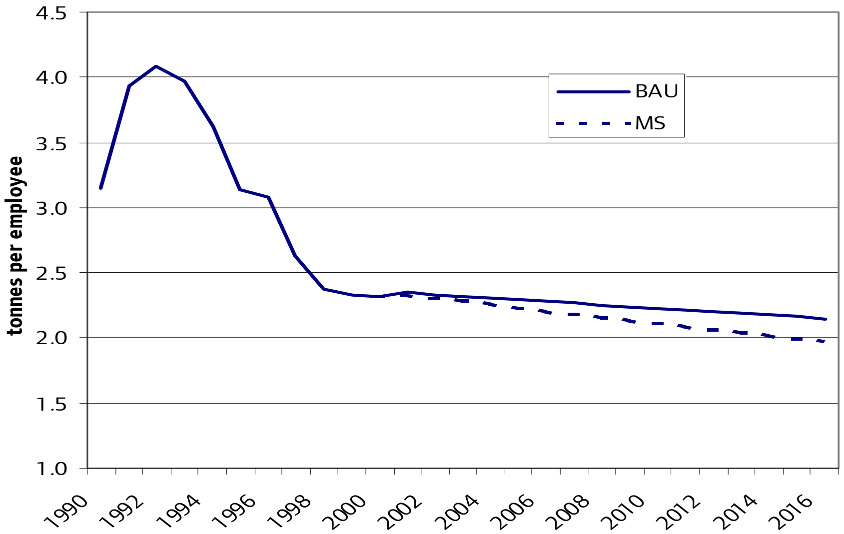
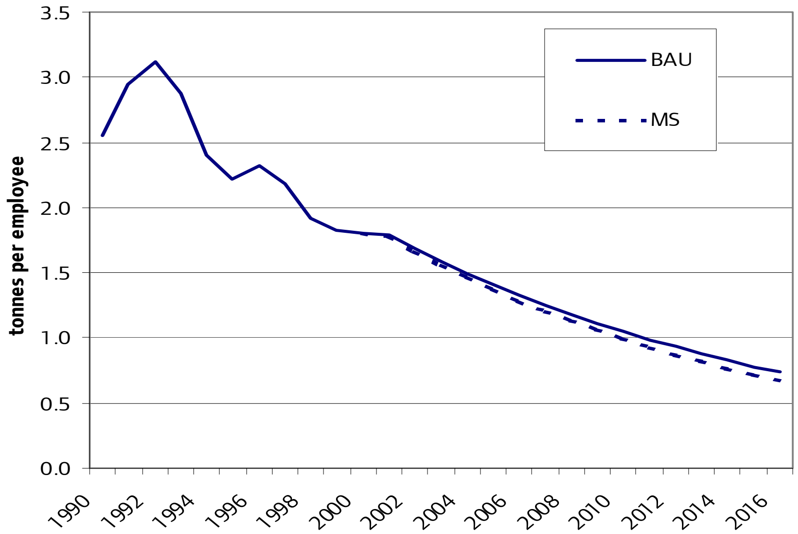


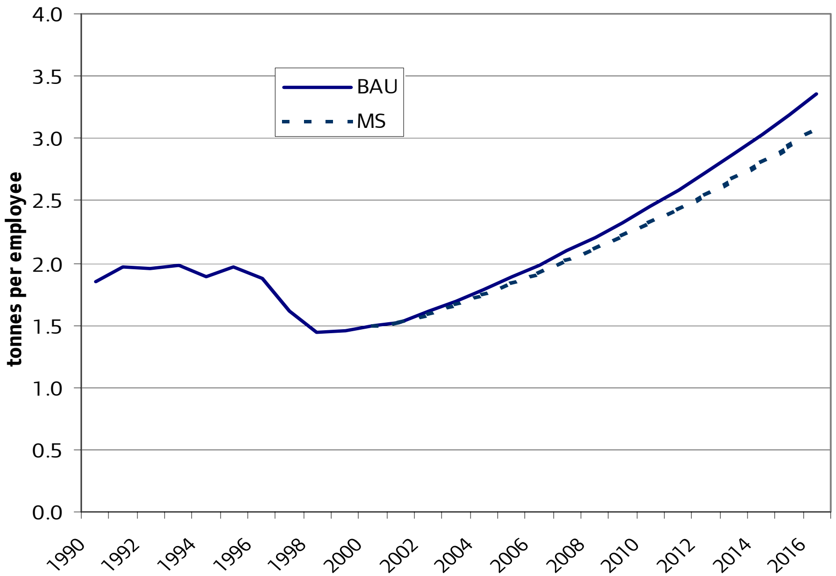
Wholesale



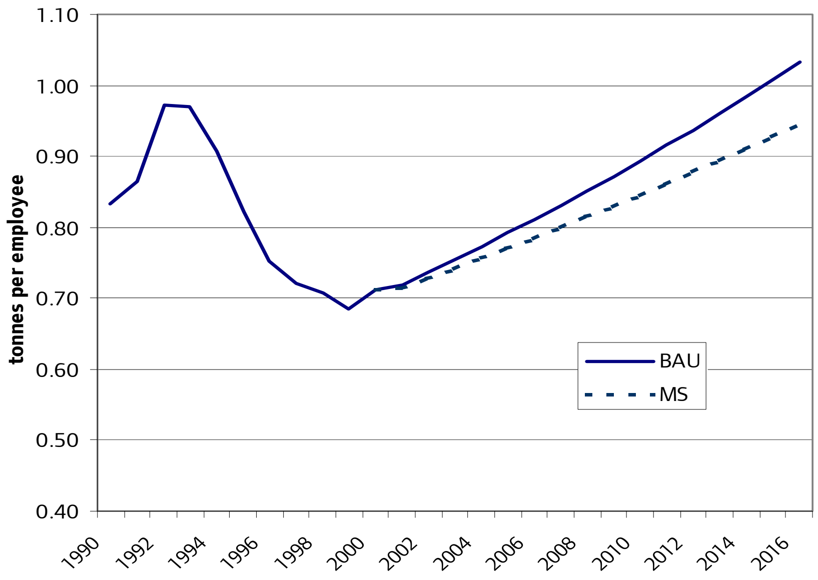
Hotels and restaurants



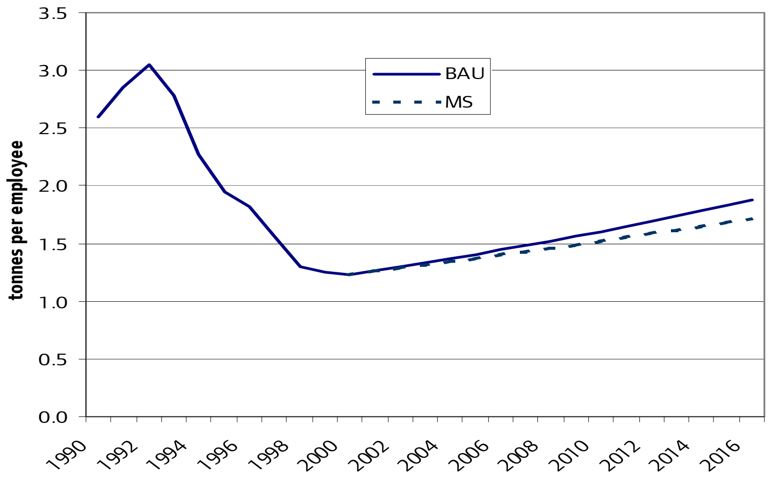
Transport and communication



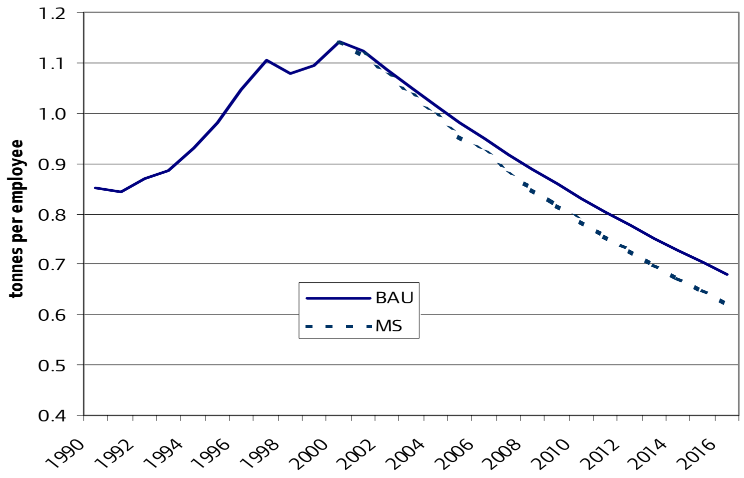
Financial services



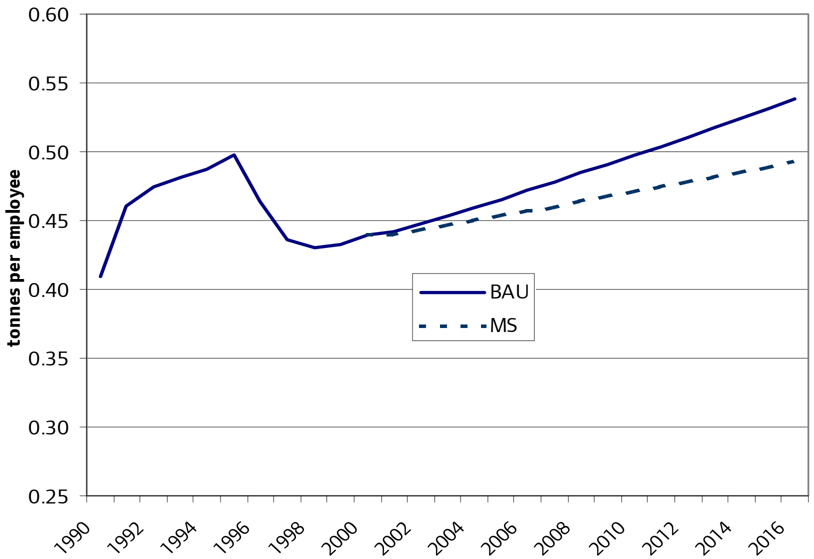
Business services



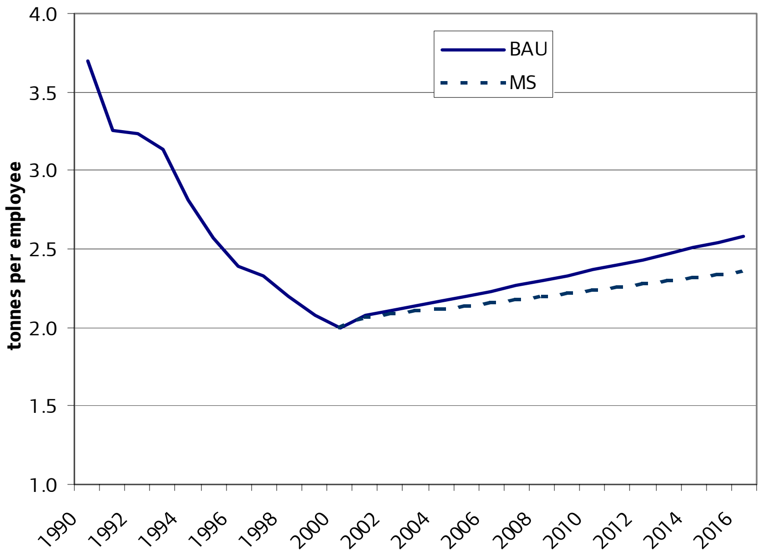
Public administration



Health and education

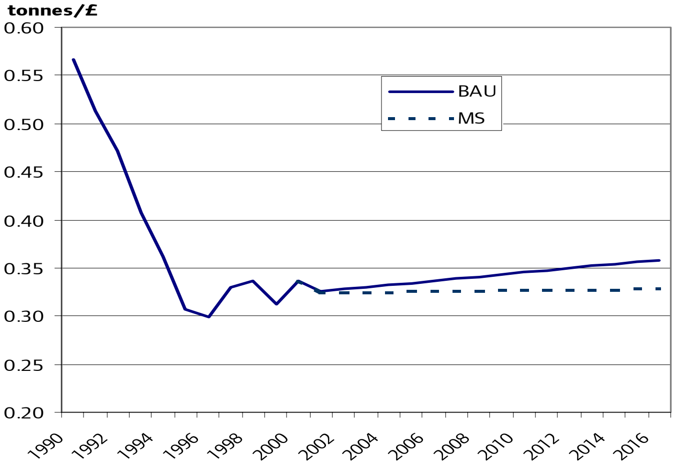


Other services

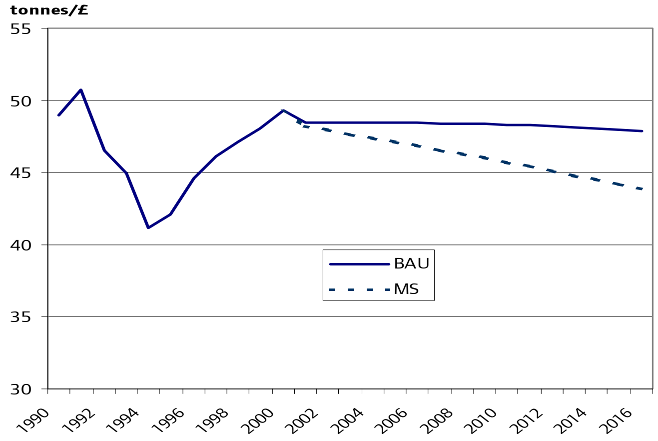


Appendix D. Commercial and industrial waste and construction and demolition waste (tonnes) per GVA (£) per employee (productivity)

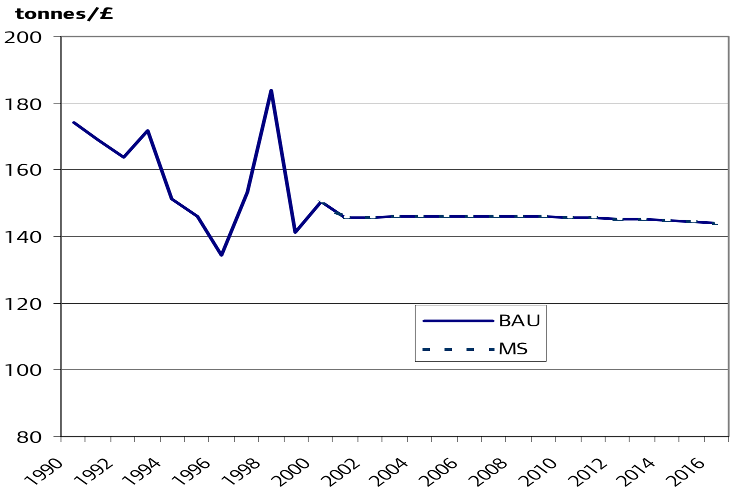
Primary and Utilities



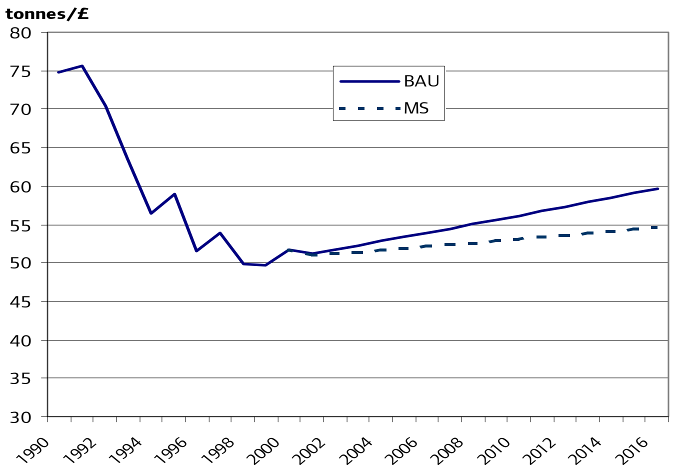
Manufacturing



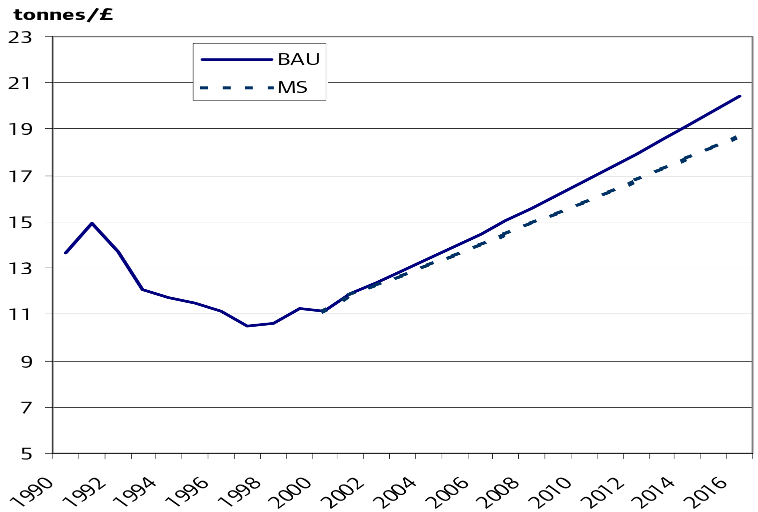
Construction



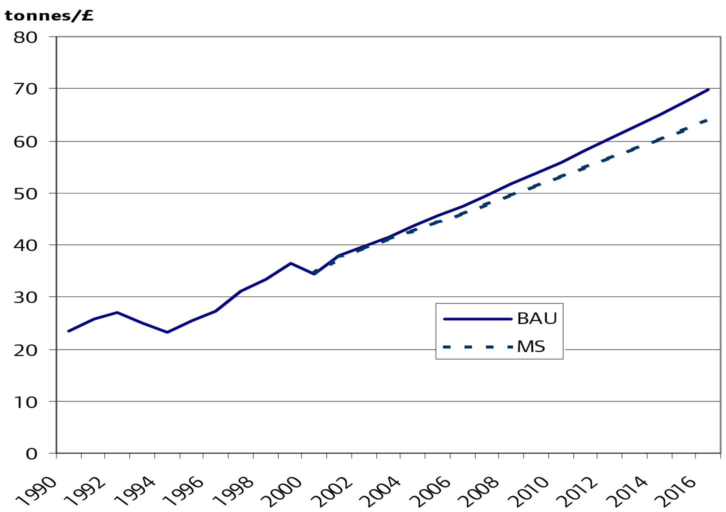
Retail



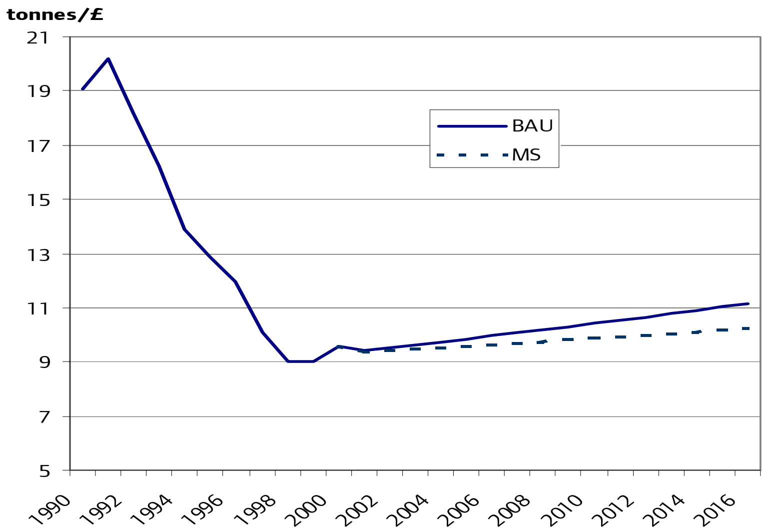
Wholesale



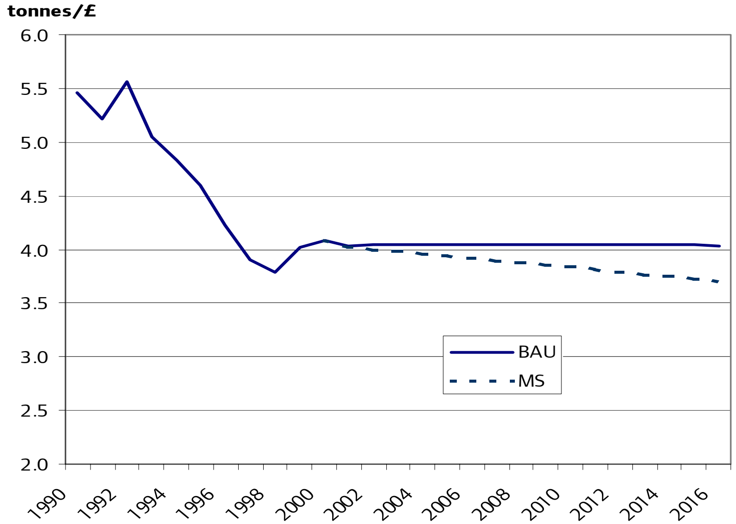
Hotels and restaurants



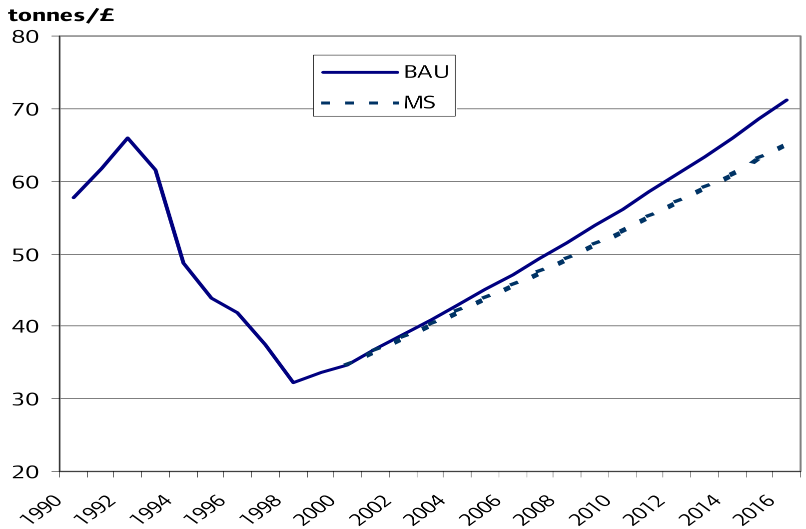
Transport and communication



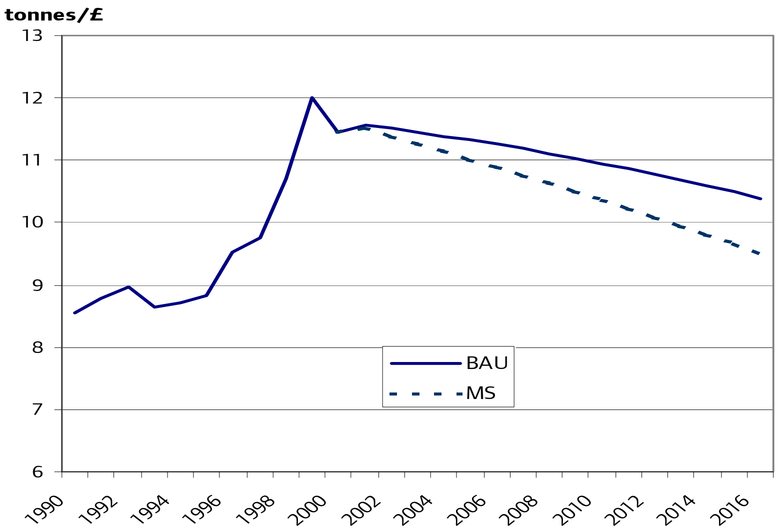
Financial services



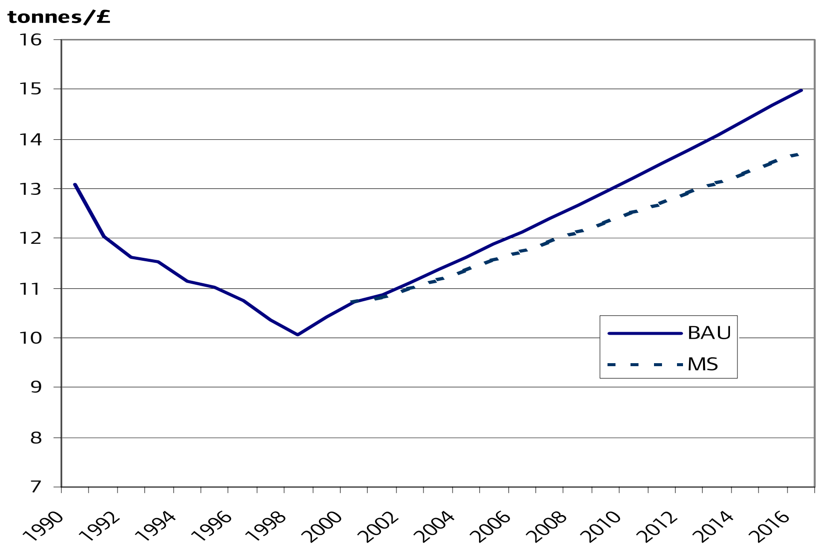
Business services



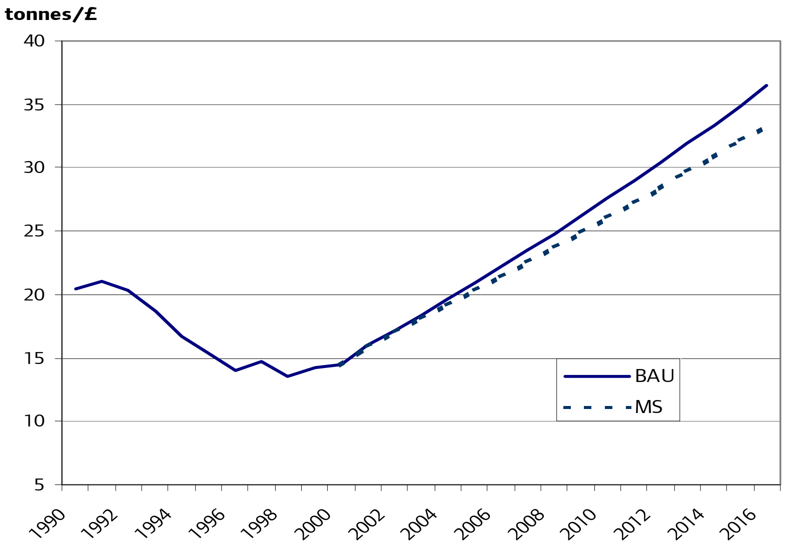
Public administration



Health and education



Other services



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Chinese

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Hindi

यदि आप इस दस्तावेज़ की प्रति अपनी भाषा में चाहते हैं,
तो कृपया निम्नलिखित नम्बर पर फोन करें अथवा दिये
गये पता पर सम्पर्क करें।

Vietnamese

Tiếng Việt
Nếu bạn muốn bản sao của tài liệu này bằng ngôn ngữ của bạn, hãy gọi điện theo số hoặc liên lạc với địa chỉ dưới đây.

Bengali

আপনি যদি আপনার ভাষায় এই দলিলের প্রতিলিপি
(কপি) চান, তা হলে নীচের ফোন্ নম্বরে
বা ঠিকানায় অনুগ্রহ করে যোগাযোগ করুন।

Greek

Αν θα θέλατε ένα αντίγραφο του παρόντος εγγράφου στη γλώσσα σας, παρακαλώ να τηλεφωνήσετε στον αριθμό ή να επικοινωνήσετε στην παρακάτω διεύθυνση.

Urdu

اگر آپ اِس دستاویز کی نقل اپنی زبان میں چاہتے
ہیں، تو براہِ کرم نیچے دیئے گئے نمبر پر فون کریں
یا دیئے گئے پتے پر رابطہ قائم کریں.

Turkish

Bize telefon ederek ya da yukarıdaki adrese başvurarak bu belgenin Türkçe'sini isteyebilirsiniz.

Arabic

إذا أردت نسخة من هذه الوثيقة بلغتك، الرجاء
الاتصال برقم الهاتف او الكتابة الى العنوان

Punjabi

ਜੇ ਤੁਹਾਨੂੰ ਇਸ ਦਸਤਾਵੇਜ਼ ਦੀ ਕਾਪੀ ਤੁਹਾਡੀ ਆਪਣੀ ਭਾਸ਼ਾ
ਵਿਚ ਚਾਹੀਦੀ ਹੈ, ਤਾਂ ਹੇਠ ਲਿਖੇ ਨੰਬਰ 'ਤੇ ਫ਼ੋਨ ਕਰੋ ਜਾਂ ਹੇਠ
ਲਿਖੇ ਪਤੇ 'ਤੇ ਰਾਬਤਾ ਕਰੋ:

Gujarati

જો તમને આ દસ્તાવેજની નકલ તમારી ભાષામાં
જોઇતી હોય તો, કૃપા કરી આપેલ નંબર ઉપર
ફોન કરો અથવા નીચેના સરનામે સંપર્ક સાધો.

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