NHS Wales Carbon Footprint 2018/19

Scope 1, 2 & 3 Carbon Footprint assessment for NHS Wales

24/07/2020

The Carbon Trust's mission is to accelerate the move to a sustainable, low carbon economy. It is a world leading expert on carbon reduction and clean technology. As a not-for-dividend group, it advises governments and leading companies around the world, reinvesting profits into its low carbon mission.

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Abbreviations

NHS Organisations:

	Shorthand	Abbreviation
Abertawe Bro Morgannwg University Health Board	Abertawe Bro Morgannwg	ABMUHB
Aneurin Bevan University Health Board	Aneurin Bevan	ABUHB
Betsi Cadwaladr University Health Board	Betsi Cadwaladr	BCUHB
Cardiff and Vale University Health Board	Cardiff & Vale	CVUHB
Cwm Taf University Health Board	Cwm Taf	CTUHB
Hywel Dda University Health Board	Hywel Dda	HDUHB
NHS Wales Informatics Service	NWIS	NWIS
NHS Wales Shared Services Partnership	Shared Services Partnership	NWSSP
Powys Teaching Health Board	Powys Teaching	PTHB
Public Health Wales NHS Trust	Public Health Wales	PHW
Velindre University NHS Trust	Velindre	VEL
Welsh Ambulance Services NHS Trust	Welsh Ambulance Service	WAST
Welsh Blood Service	Welsh Blood Service	WBS

Other Abbreviations:

	Shorthand	Abbreviation
Combined Heat and Power	CHP	CHP
Environmental Economic Input Output Analysis	EEIO Analysis	EEIO
Environment (Wales) Act 2016	Environment Act	
Estates Facilities Performance Management System	EFPMS	EFPMS
Finished Admission Episode	Patient Episode	FAE
Greenhouse Gas	GHG	GHG
Purchasing power parity	PPP	PPP
Well-being of Future Generations (Wales) Act 2015	Well-being of Future Generations	WBFGA
Well-to-tank	WTT	WTT
Transmission and distribution	T&D	T&D
Renewable Energy Guarantees of Origin	REGO	REGO

Executive Summary

In 2019 Welsh Government declared a Climate Emergency for Wales to help trigger more action to address the climate change challenge. As part of this Welsh Government have reinforced the ambition for the Public Sector in Wales to be carbon neutral by 2030, and provided Prosperity for All: A Low Carbon Wales (2019) which sets out 100 policies and proposals to decarbonise Wales. The Environment (Wales) Act 2016 and Well-being of Future Generations (Wales) Act 2015 also remain as key legislative drivers for decarbonisation of the Public Sector in Wales.

This Carbon Footprint assessment has been commissioned by NHS Wales Shared Services Partnership (NWSSP) on behalf of the Welsh Government and provides a calculation of the NHS Wales Carbon Footprint (Scope 1, 2 and 3) for financial year 2018/19 in line with the Greenhouse Gas (GHG) Protocol. This builds upon the NHS Wales Carbon Footprint 2016/17 and provides appraisal of progress in the analysis categories of *Buildings*, *Transport*, and *Procurement*. This Carbon Footprint will be used as evidence to support an NHS Wales decarbonisation strategic delivery plan, which will act as the core response to the Climate Emergency in Wales.

Carbon Footprint 2018/19

The Carbon footprint for NHS wales for the financial year 2018/19 is 1,001 $ktCO_2e$. Scope 3 emissions are shown to be the most significant, contributing to 81% of the total Footprint. This is also reflective of the Procurement analysis category of which 62% of emissions are attributed.

NHS Wales Carbon Footprint 2018/19
1,001,378 tCO_2e
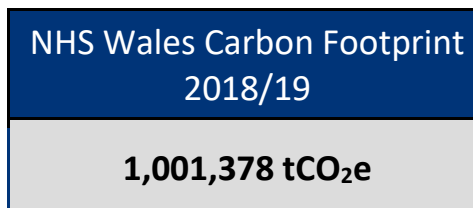
Footprint by Scope 2018/19
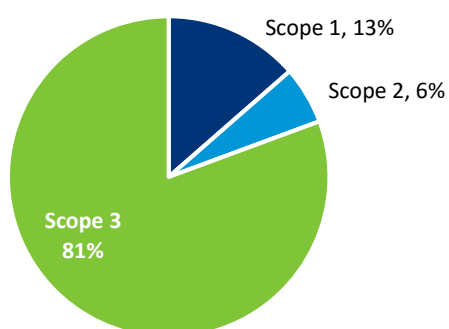
Footprint by Category 2018/19
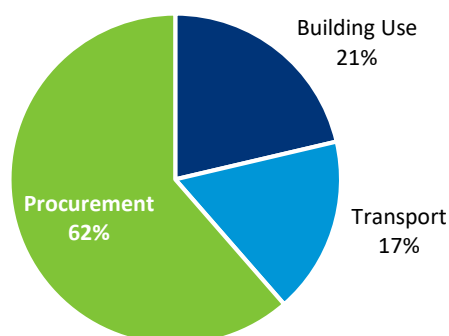
Over the last few years NHS Wales have started to take a more proactive approach in addressing their Carbon Footprint. A key action taken between 2016/17 and 2018/19 has been the shift in procurement to purchase REGO certified renewable electricity. This is positive progress, however, due to the key GHG Protocol principle to avoid double counting, REGO procured electricity cannot be considered as an offset reduction within the reportable Carbon Footprint. This is since REGO certified electricity is included within the grid electricity average carbon intensity. This is reflective of the "Carbon reporting guide for the public sector in Wales", developed by Welsh Government.

The GHG Protocol and UK Environmental Reporting Guidelines encourage dual reporting to allow reflection of positive carbon activity by demonstrating 'Net Emissions'. With respect to REGO procured electricity, the Net Emissions are shown as 6.1% lower than the reportable Carbon Footprint.

The "Carbon reporting guide for the public sector in Wales" is due to be published. The methodology undertaken with this NHS Wales Carbon Footprint aligns with this guidance, however, the boundary is slightly different with patient & visitor travel excluded. Within this Footprint, patient & visitor travel has been included as it is important that NHS Wales understand these emissions over which NHS Wales has influence; patient & visitor travel accounts for ~4% of the total Footprint. The reportable carbon emissions aligned with the new guidance are 964,961 tCO$_2$e. The defined baseline, and ongoing carbon accounting approach will be established within the NHS Wales decarbonisation strategic delivery plan.

Key Findings

A key aspect of this assessment has been to compare the 2016/17 Carbon Footprint[1] with the 2018/19 outcomes. The overall Carbon Footprint has shown a reduction of 4.8%. However, greater variation can be observed when reviewing analysis category performance.

NHS Wales Carbon Footprint 2016/17 vs. 2018/19 [2]
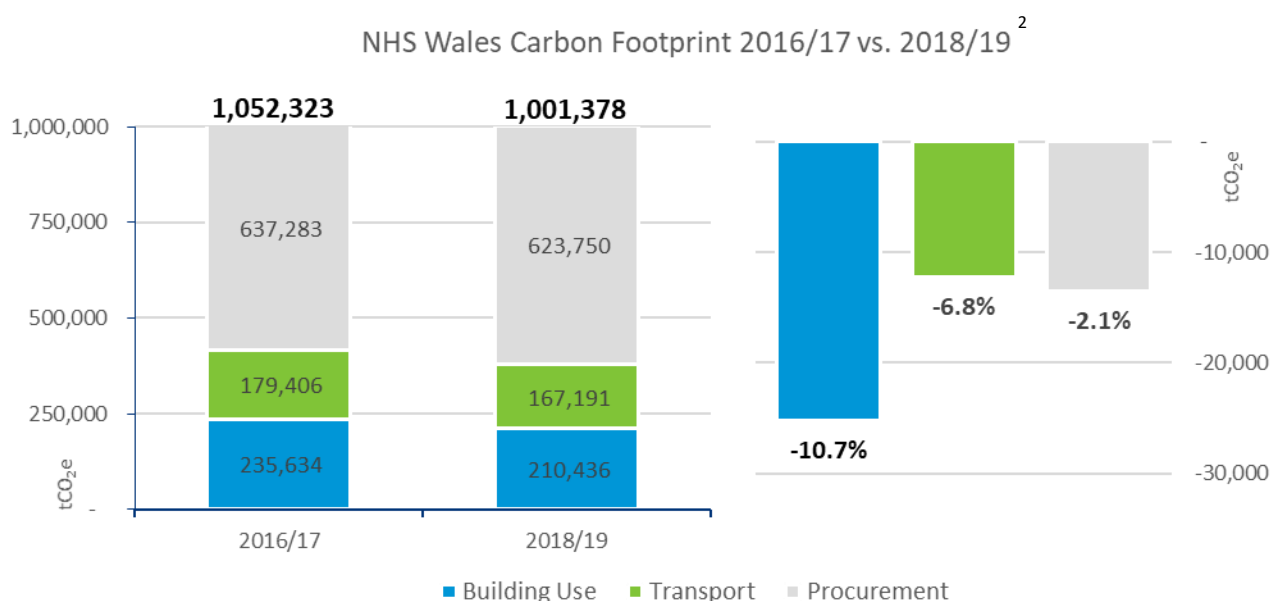
Building Use associated emissions show a 11% reduction. However, in terms of energy (kWh), electricity consumption has actually increased by 1.4% and natural gas has decreased by 1.5%. The reduction observed is largely attributed to electricity grid decarbonisation, in which the carbon intensity factor has reduced 32%.

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[1] Note that the 2016/17 NHS wales Carbon Footprint has been revised with availability of further data
[2] Note that building related emissions provide an accurate basis for comparison; however, transport and procurement emissions provide only an indication of carbon performance due to assumptions required and the methodology employed

The procurement emissions *indicate* a decrease in emissions; however, it should be noted that this variation is within the margin of error of the methodology employed. For instance, the methodology used only estimates emissions for procured goods and services based on spend data; no specific market assessment of suppliers, supply chain geography, product volumes or product specific carbon intensity has been undertaken. Therefore, it is recommended that no judgement of carbon performance should be made against the estimated procurement emission figures. An assessment by individual NHS supplier has also been undertaken as the first step towards a market-based approach, this demonstrates that 30% of procurement emissions are attributed to the top 20 suppliers.

Transport emissions calculations are considered the most challenging from a data quality perspective. Based on the same methodology for both comparison years, overall Transport emissions are shown to decrease by 7%. This is mainly attributed to an improved estimate of staff commute and patient / visitor related travel carbon emissions due to additional staff travel survey data made available for 2018/19. NHS Wales controlled fleet emissions are shown to have reduced by 3% since 2016/17.

Comparison of performance analysis has also been undertaken on a Health Board / Trust basis. Overall the Health Boards have a range in performance of between minus 7% improvement to plus 0.4% increase. The three NHS Trusts show greater change in emissions, ranging between a 6% and 13% improvement. Note that since the footprints cover financial years 2018/19 and 2016/17, the recent changes to Health Board boundaries and organisational names are not considered.

Health Board / Trust Carbon Footprint 2016/17 vs. 2018/19
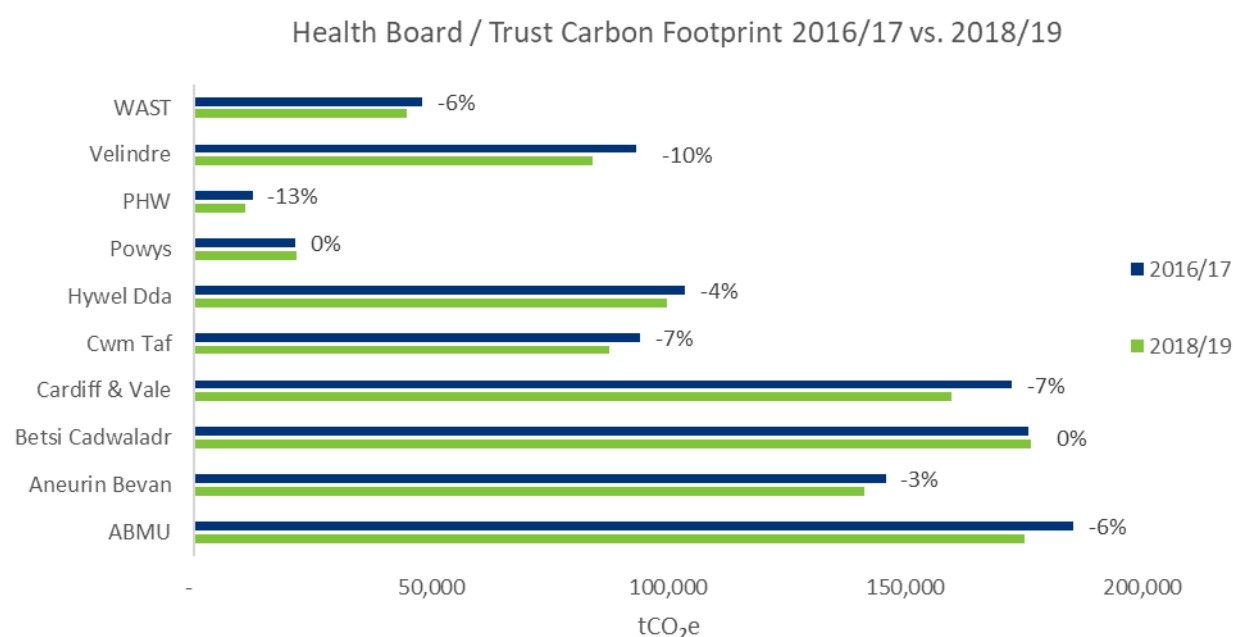
Powys and Betsi Cadwaladr are the two Health Boards shown as static between the two footprint years. In the case of Powys, an increase in Building Use related emissions of 10% is the driving variable against demonstrating a carbon improvement. For Betsi Cadwaladr, Building Use emissions are shown to have reduced by 6% (as expected with electricity grid decarbonisation), however an apparent increase in transport related emissions, in particular fleet and estimated staff commuting, have balanced the apparent improvement in building related emissions. Across the other Health Boards, building related emissions are shown to reduce in the range of 10-13%.

Recommendations

This Carbon Footprint assessment has provided a Scope 1, 2 & 3 comparative assessment for NHS Wales to a level of detail not undertaken before. The data sources, data quality, and assessment methodology has been accurately replicated to provide a sound basis for comparisons. This assessment has also been progressive in improving Footprint understanding and accuracy. In particular, enhanced procurement supplier data has provided extra insight and comparison with 2016/17 emissions and has helped to improve the accuracy and confidence in a baseline that can be included within a decarbonisation strategy. Particular recommendations for further improvement and next steps include:

- Through the NHS Wales decarbonisation strategic delivery plan development process – increased review, appraisal and feedback should be sought to understand the Footprint further, and develop a defined boundary for ongoing baseline monitoring (including alignment with Welsh carbon accounting guidance).

- Further improvements to data quality and accessibility can be made. In particular the use of existing reporting mechanisms such as the EFPMS can be reviewed, with the opportunity to build in specific requirements for useful ongoing footprinting data.

- Supplier specific emissions data should be built upon, and a progression towards a 'market-based' approach made for emissions associated with supply of goods and services. This will entail a staged approach of targeting specific suppliers and understanding specific supply chain emissions relating to specific goods and services received by NHS Wales. This will enable improved accuracy, and support performance monitoring of procurement emissions in the future.

- Limited travel survey information is available to accurately calculate staff and patient/visitor travel. Individual organisations have undertaken surveys in the past, however, it is felt an aligned approach, focused through travel managers will markedly improve emissions estimates. In addition, the accuracy of business (staff expensed) travel data is particularly variable - further clarification is needed on the best replicable approach going forward.

- It is recommended that regular updates of the NHS Wales Carbon Footprint are undertaken to provide a basis for ongoing performance assessment. This will be key in tracking progress against an NHS decarbonisation strategic delivery plan. In addition, the "Carbon reporting guide for the public sector in Wales" sets the requirements for carbon accounting in Wales will be a driver for regular assessment.

1. Carbon Footprint Approach

1.1 Greenhouse Gas Emissions

The Greenhouse Gas (GHG) Protocol provides a comprehensive, and globally used framework standard for measuring and managing emissions from private and public sector operations, value chains, products, cities, and policies. The GHG Protocol is recognised by the UK Government as an independent standard for reporting greenhouse gases, and provides the basis of numerous schemes requiring emissions calculations. The GHG Protocol divides emissions into three Scopes.

- Scope 1: Direct emissions from combustion of gas and other fuels
- Scope 2: Emissions resulting from the generation of electricity and other energy purchased
- Scope 3: Emissions made by third parties in connection with operational activities

Furthermore, emissions can also be categorised as 'upstream activities' or 'downstream activities' of the reporting organisation. This terminology is used to further categorise Scope 3 emissions; with 'upstream' considered as product supply / transport / assets associated with the supply and operation of the organisation. 'Downstream activities' relates to product outputs and assets without operational ownership. The majority of NHS scope 3 activities are 'upstream'. Figure 1 below provides a diagram of activities within each scope.

Appendix 1 provides further detail on the GHG Protocol, and detail of the calculation methodology and assumptions taken.
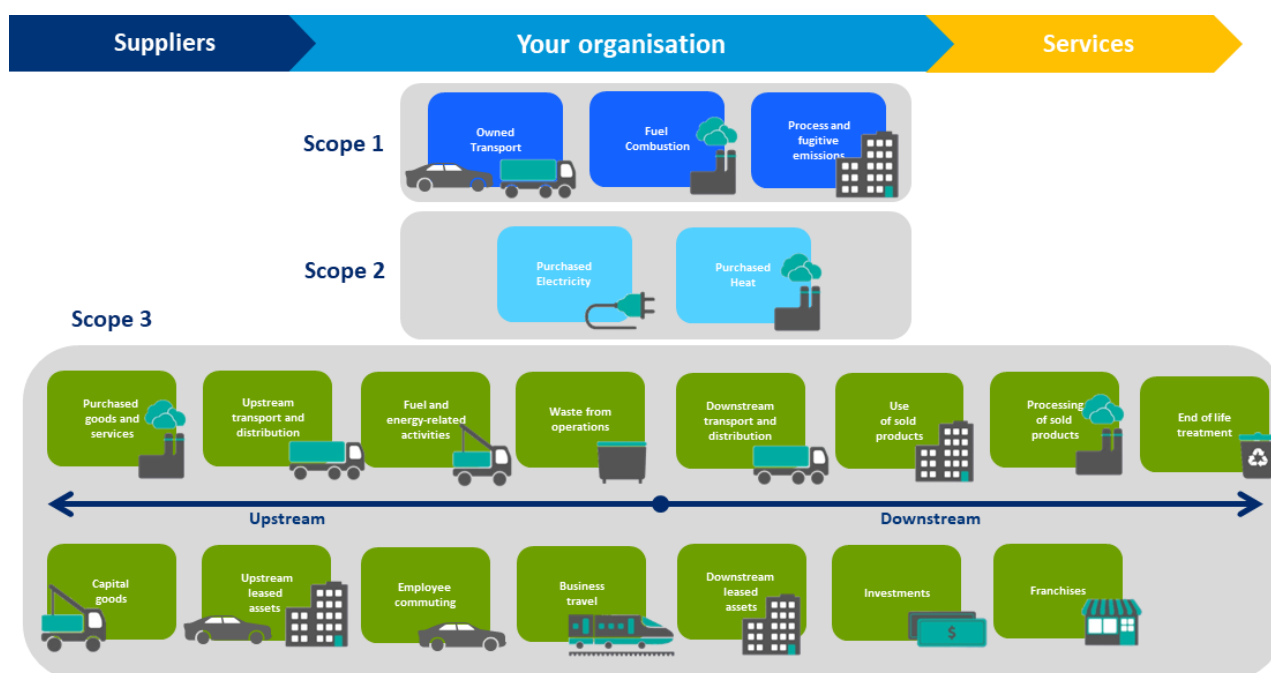
Figure 1 Greenhouse Gas Protocol Scope 1, 2 and 3 Emissions

1.2 Organisational Footprint Boundary

The NHS in Wales is structured into seven Health Boards which deliver healthcare services in their local areas. Additionally, there are three NHS Trusts in Wales which focus on specialised services. The overall organisational breakdown of NHS Wales is shown in the below organigram. Note that since

this Carbon Footprint considers financial year 2018/19, the recent changes in Health Board boundaries and organisational names are not considered.
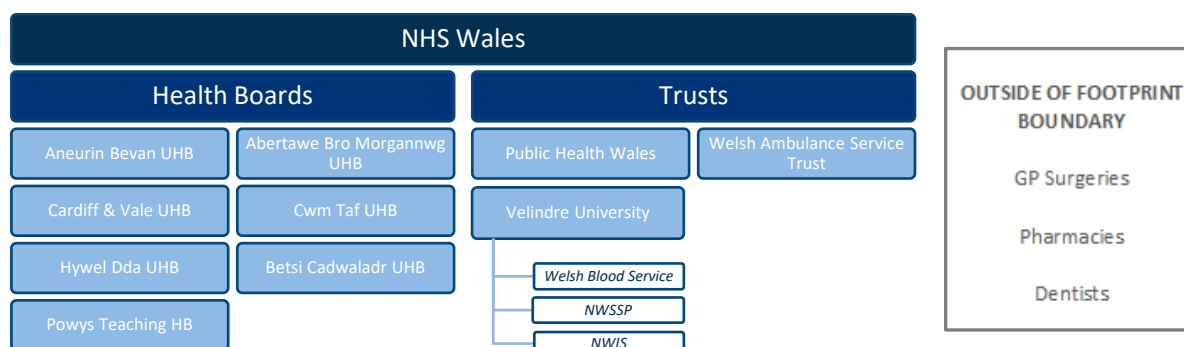
Figure 2 NHS Wales Organigram & Footprint Boundary

For the purposes of this Carbon Footprint, the 7 Health Boards and 3 Trusts form the organisational Footprint Boundary. In many cases, primary care services are delivered in Health Board operated buildings; however much primary care (such as GP surgeries, pharmacies and dentists) remains independent and is considered outside the boundary of this study.

1.3   Emissions Footprint Boundary

Figure 3 provides a visualization of Emissions Footprint Boundary for this study. Emissions are categorized by Scope, and are named in line with the GHG Protocol emission types. Notably, the majority of emission types considered outside of the Footprint Boundary (shown in grey) are 'Scope 3 Downstream' emissions. This is largely due to the lack of products downstream from NHS Wales, the nature of the organization is such that there are no 'sold products'.
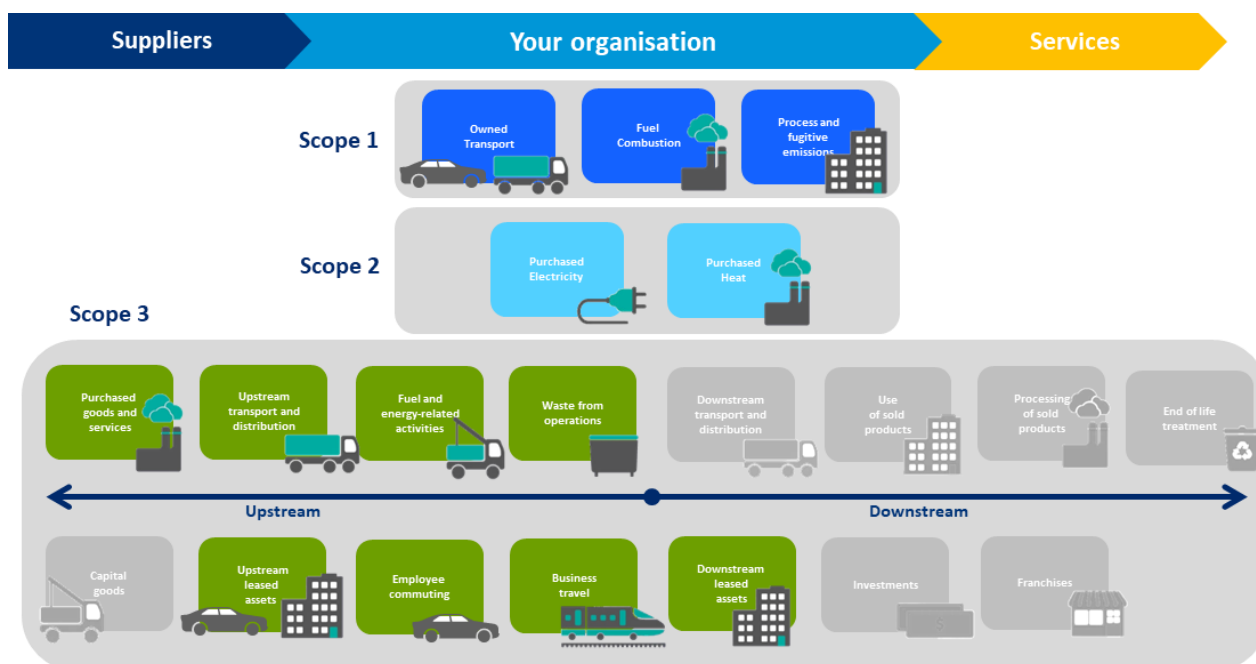
Figure 3 NHS Wales Carbon Footprint 2018/19 Emissions Boundary

2.   Carbon Footprint 2018/19 Results

2.1   Carbon Footprint

NHS Wales Carbon Footprint 2018/19   **1,001,378 tCO$_2$e**

The NHS Wales 2018/19 Carbon Footprint has been calculated as ~1 million tCO$_2$e. This has an associated estimated cost of **£1,965m** of direct NHS Wales spend. The overall footprint has been broken down using the GHG emission Scopes:

- Scope 1: Direct emissions from combustion of gas and other fuels
- Scope 2: Emissions resulting from the generation of electricity and other energy purchased
- Scope 3: Emissions made by third parties in connection with operational activities

Figure 4 provides a breakdown of NHS Wales 2018/19 Carbon Footprint by Scope. This demonstrates the significance of Scope 3 emissions, constituting 81% of the total.

NHS Wales Carbon Footprint by Scope 2018/19
(1,001,378 tCO$_2$e)
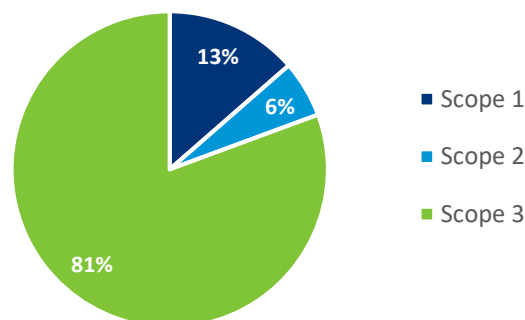
Figure 4 NHS Wales Carbon Footprint by Scope 2018/19

The Carbon Footprint has also been broken down by body (Health Board or Trust); this is shown in Figure 5. The **Health Boards are shown to cover 87%** of emissions, with 13% attributed to the Trusts.

NHS Wales Carbon Footprint by Body 2018/19 (1,001,378 tCO$_2$e)
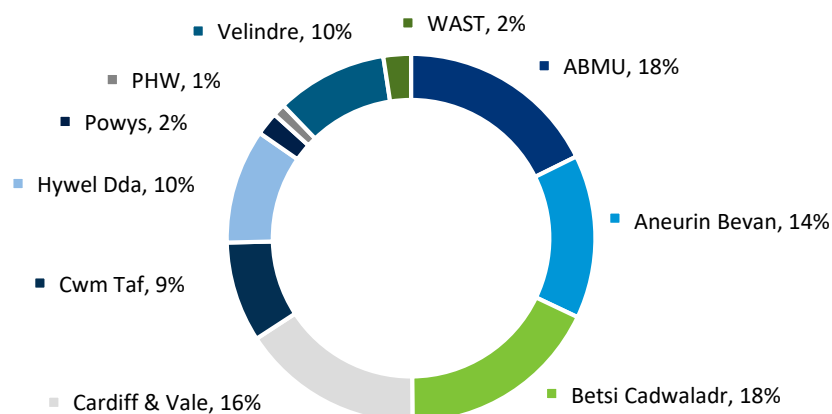
Figure 5 NHS Wales Carbon Footprint by Body 2018/19

Since this Carbon Footprint considers financial year 2018/19, the recent adjustment of Health Board boundaries for Abertawe Bro Morgannwg and Cwm Taf are not considered. Also note that the organisational names are as they were in 2018/19, Abertawe Bro Morgannwg University Health Board is now called Swansea Bay University Health Board and Cwm Taf University Health Board is now called Cwm Taf Morgannwg University Health Board. Velindre's total emissions are shown to be high in comparison to the relative size of the other Trusts, this is a result of high procurement emissions (Scope 3) due to it hosting Welsh Blood, Health Courier Service and Shared Services.

Figure 6 and Figure 7 provide further breakdown of the NHS Wales Carbon Footprint by body for Scope 1 & 2 emissions, and Scope 3 emissions respectively.

Scope 1 & 2 Carbon Footprint by Body 2018/19 (192,089 tCO$_2$e)
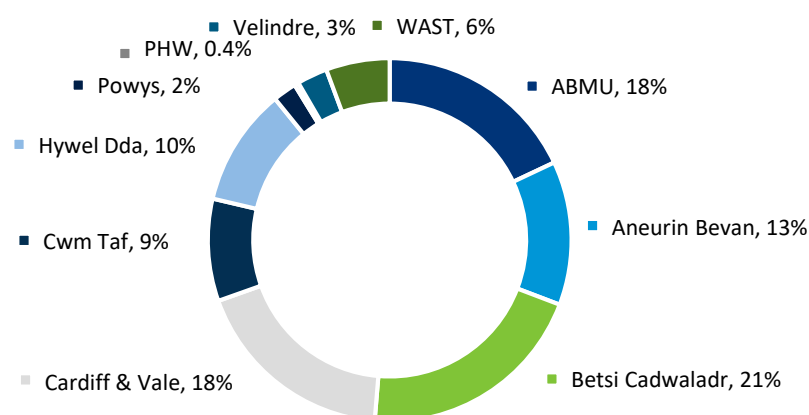
Figure 6 Scope 1 & 2 Carbon Footprint by Body 2018/19

Scope 3 Carbon Footprint by Body 2018/19 (809,289 tCO$_2$e)
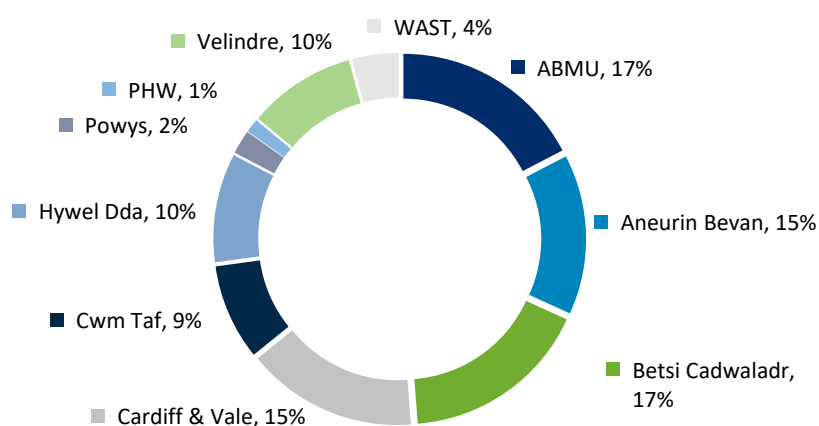
Figure 7 Scope 3 Carbon Footprint by Body 2018/19

Overall results are shown to be similar to 2016/17, with Betsi Cadwaladr and Abertawe Bro Morgannwg shown as the highest organisational footprints.

Emissions have also been broken down into three analysis categories; *building use*, *transport,* and *procurement*. Figure 8 provides a breakdown of the Carbon Footprint by analysis category. Procurement is shown to be the greatest contributor to emissions, constituting to 62% of emissions. The additional Scope 3 emissions are mostly attributed to business, staff and patient/visitor travel which make up the Scope 3 total of 81%.

NHS Wales Carbon Footprint by Category 2018/19
(1,001,378 tCO$_2$e)
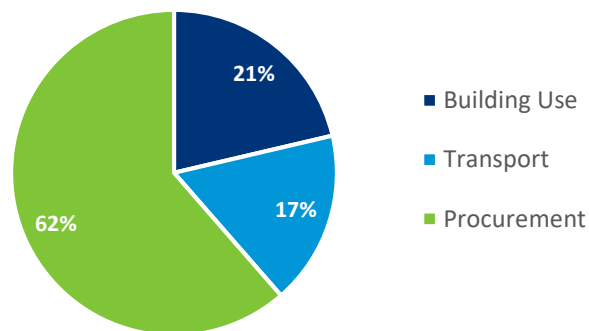
Figure 8 NHS Wales Carbon Footprint by Category 2018/19

NHS Wales Carbon Footprint by Emission 2018/19
(1,001,378 tCO2e)
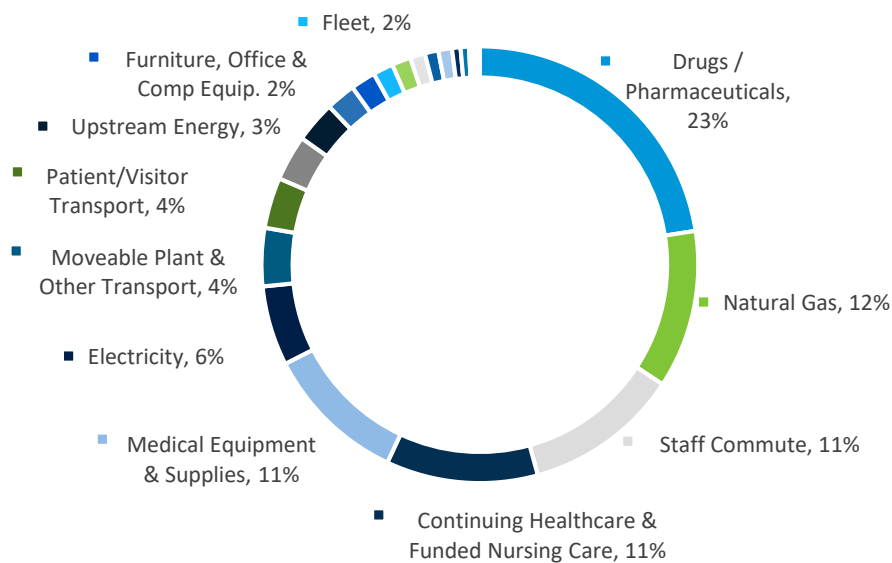
Figure 9 NHS Wales Carbon Footprint by Emission 2018/19

Figure 9 illustrates the contribution of each individual emission sources to the overall Carbon Footprint. Estimated emissions associated with the procurement of drugs / pharmaceutical products are shown to be the single greatest contributor; it should be noted that additional drugs / pharmaceutical spend data has been included in this Footprint (and applied to an amended 2016/17 Footprint). Natural gas and electricity use in buildings total 18% of overall emissions. Another procurement category of note is 'continuing healthcare & funded nursing care' which contributes 11% of all emissions and relates to services funded by NHS Wales as a continuation of care provided outside the secondary care setting, including adult mental healthcare and learning disabilities care.

2.2   Net Emissions

The GHG Protocol and UK Environmental Reporting Guidelines[2] encourage dual reporting to allow for reflection of positive carbon activity which cannot be captured within the Carbon Footprint. As part of this assessment, NHS Wales are utilising dual reporting in order to reflect 'Net Emissions'. It is noted that the overall Carbon Footprint remains the primary and reportable footprint which overall carbon performance will be assessed.

NHS Wales Net Emissions 2018/19   939,967 tCO$_2$e

A key action taken between 2016/17 and 2018/19 has been the shift in energy procurement policy to purchase REGO certified renewable electricity. This is positive progress, however, due to the key GHG Protocol principle to avoid double counting, REGO procured electricity cannot be considered as an offset reduction within the reportable Carbon Footprint. This is since REGO certified electricity is included within the grid electricity carbon intensity average (and applied by the UK Government Reporting Conversion Factors). Therefore, NHS Wales will be receiving the benefit of all REGO generated power reflected in the reducing electricity grid emissions factors.

For the purpose of Net Emissions, REGO procured electricity is considered as zero carbon for generation (Scope 2) and associated well-to-tank (Scope 3). Carbon emissions are still applied as required for the associated transmission and distribution of the power (Scope 3).

The summary impact of Net Emissions are as follows:

- Net Emissions are shown as 6.1% lower than the reportable Carbon Footprint.

- Scope 2 emissions drop by 92.4%, reflective of 92.4% of overall electricity certified REGO

- Building Use emissions reduce 29.2%

- Building Use emissions make-up 16% of total Net Emissions (versus 21% of Carbon Footprint)

- For the overall Carbon Footprint, natural gas CHP electricity generation offsets ~13,400 tCO$_2$e (electricity generation Scope 2 & 3)[3].
  - However, for Net Emissions this grid electricity carbon reduction is negated as the REGO electricity is otherwise zero-carbon
  - The impact of this is that CHP operation is increasing Net Emissions by ~12,750 tCO$_2$e (10% of natural gas emissions, or 1.3% of Net Emissions) [4]

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[2] Environmental Reporting Guidelines, https://www.gov.uk/government/publications/environmental-reporting-guidelines-including-mandatory-greenhouse-gas-emissions-reporting-guidance
[3] Estimate based on 38% CHP electrical efficiency
[4] Estimate based on 40% CHP heat use efficiency (no heat dumping) and a counterfactual gas boiler efficiency of 85%

3.   Building Use Emissions

3.1 Overall Building Use Carbon Footprint

Building Use Carbon Footprint 2018/19

210,436 tCO$_2$e

In 2018/19, 99% of NHS Wales's total building use emissions were energy related, consisting of 86% energy and 13% upstream energy (i.e. well-to-tank energy associated with fuels, transmission and distribution emissions associated with grid electricity). Water and waste account for a small percentage of building use emissions. Due to the dominance of the energy sub-category, this has been further broken down into its constituent emissions for analysis.

Building Use Footprint by Type 2018/19 (210,436 tCO$_2$e)
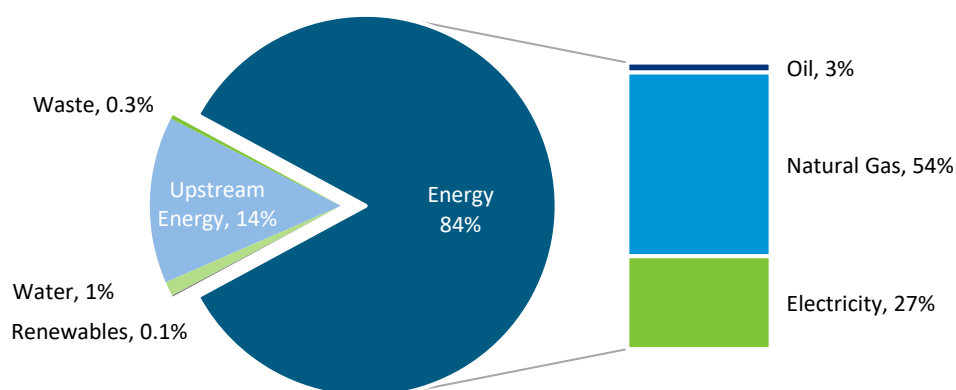
Figure 10 Building Use Footprint by Type 2018/19

Figure 11 illustrates that building use emissions are shown to largely be attributed to the largest Health Boards. The three highest emitters, Cardiff & Vale, Betsi Cadwaladr and Abertawe Bro Morgannwg, account for 60% of the total.

Building Use Footprint 2018/19 (210,436 tCO$_2$e)
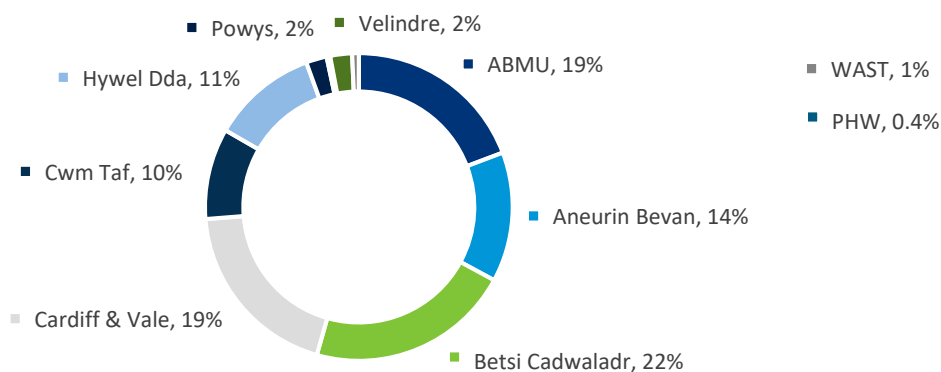
Figure 11 Building Use Footprint by Body 2018/19

3.2   Electricity Carbon Footprint

Abertawe Bro Morgannwg and Betsi Cadwaladr are the two largest electricity emitters, with Aneurin Bevan and Cardiff & Vale the next largest. These four Health Boards combined are 76% of the total electrical emissions. It is important to note the impact of on-site Combined Heat and Power (CHP) which reduces the demand for grid electricity by burning natural gas on-site to co-generate electricity and heat, in particular this will impact Cardiff and Vale with the large CHP at University Hospital of Wales (UHW).

Electricity Footprint 2018/19 (57,418 tCO_2e)

- Powys, 2%
- Velindre, 4%
- Hywel Dda, 9%
- ABMU, 24%
- WAST, 1%
- PHW, 0.6%
- Cwm Taf, 8%
- Cardiff & Vale, 15%
- Aneurin Bevan, 14%
- Betsi Cadwaladr, 23%
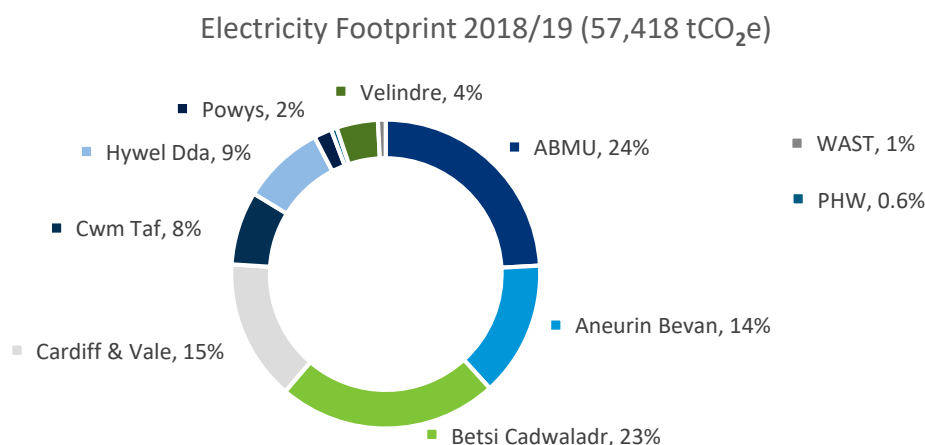
Figure 12 Electricity Footprint 2018/19

The breakdown illustrated in Figure 13 below demonstrates the top 20 specific sites of high electricity emissions. The largest emitter is Morriston Hospital, one of Wales's largest hospitals and part of Abertawe Bro Morgannwg. Despite being the largest hospital in Wales, UHW is the fourth largest in terms of electrical emissions; this is due to operation of large-scale CHP which offsets grid electricity.

Top 20 NHS Wales Sites by Electricity Emissions 2018/19 (42,543 tCO_2e)
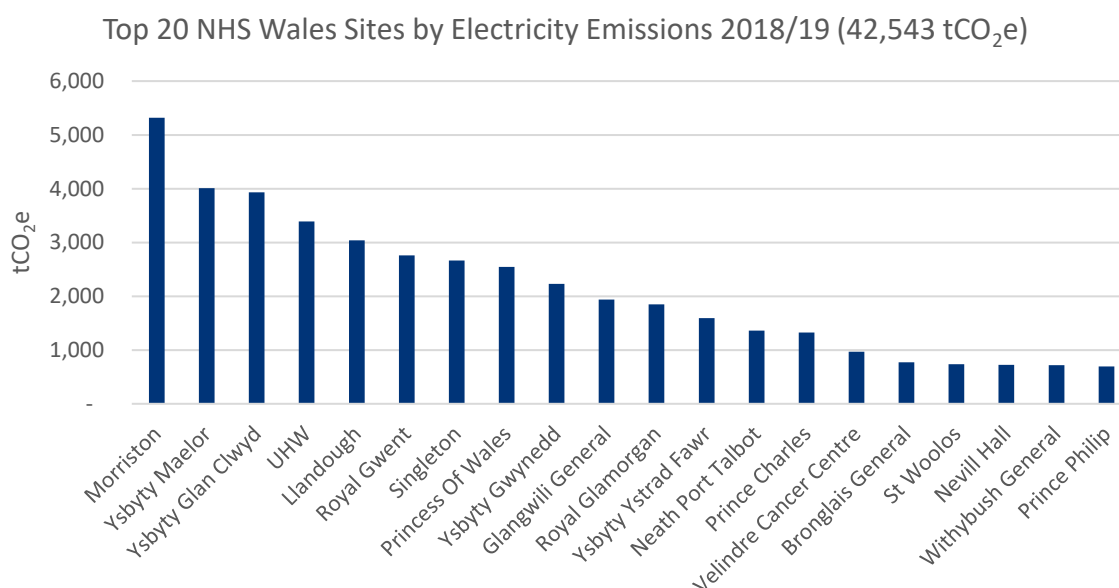
Figure 13 Top 20 NHS Wales Sites by Electricity Emissions 2018/19

Neath Port Talbot, Withybush and Prince Philip are the only sites which shown an increase in electricity consumption since 2016/17. However, for the case of Withybush and Prince Philip, the CHP electricity outputs have reduced 38% and 26% respectively between 2016/17 and 2018/19.

When considering electricity emissions, the decarbonisation of grid electric should be highlighted. Between 2016 and 2018, the UK grid emission factor has dropped by 32% representing the move away from coal-fired power stations, and an increased proportion of renewables in UK power generation. The impact of grid decarbonisation will have an impact on comparisons with past Footprints, and ongoing future Carbon Footprint assessments. This aspect is covered further in Section 6 of this report.

It is noted that 2018/19 reporting of EFPMS data shows very few installations and generation of renewable electricity (i.e. solar PV). Renewable electricity generation has been reported against only 11 individual large sites; with three Health Boards and two Trusts showing no renewable electricity generation at all. Reported renewable electric generation totals only 0.2% of total grid electricity. This demonstrates the scale of opportunities available for NHS Wales. Between 2016/17 and 2018/19 there has only been a small increase in onsite renewable energy generation. There is significant room for improvement in this area.

3.3 Thermal Carbon Footprint

As with electricity emissions, thermal emissions (Natural Gas, Biomass and Oil) are largely attributed to the largest Health Boards. Cardiff & Vale is the largest (22%), and combined with Betsi Cadwaladr, Abertawe Bro Morgannwg and Aneurin Bevan; these comprise 73% of total thermal emissions.

Thermal Footprint 2018/19 (119,980 tCO$_2$e)

- Powys, 2%
- Hywel Dda, 12%
- ABMU, 17%
- WAST, 1%
- Velindre, 1%
- PHW, 0.2%
- Cwm Taf, 11%
- Aneurin Bevan, 13%
- Cardiff & Vale, 22%
- Betsi Cadwaladr, 21%
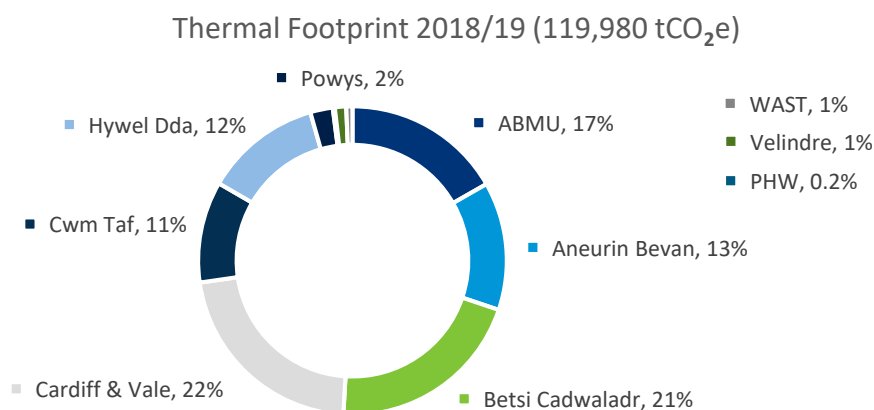
Figure 14 Thermal Footprint 2018/19

The breakdown illustrated in Figure 15 demonstrates the top 20 specific sites of highest thermal emissions. Thermal emissions are dominated by UHW, which emits ~17,500 tCO$_2$e per annum, almost three times as much as the next largest site, Morriston Hospital. The impact of large-scale CHP is evident, both on electrical and thermal emissions at UHW. The suitability of operating CHP, and developing new CHP projects, should be considered in the context of grid electric decarbonisation, and the carbon impact of CHP over its operational life.

Top 20 NHS Wales Sites by Thermal Emissions 2018/19 (89,812 tCO$_2$e)
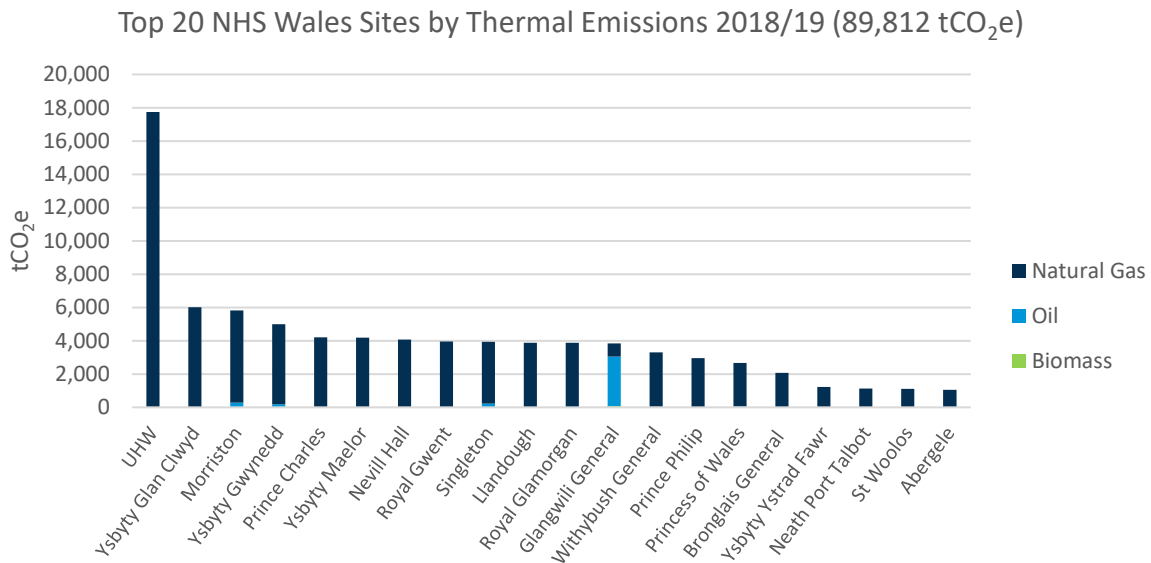
Figure 15 Top 20 NHS Wales Sites by Thermal Emissions 2018/19

Note that the following sites have natural gas CHP units which will increase the gas emissions and reduces the electricity emissions:

- UHW (4.37MW)
- Nevill Hall (800kW)
- Ysbyty Glan Clwyd (670kW)
- Prince Charles (650kW)
- Withybush (600kW)
- Prince Philip (600kW)
- Royal Glamorgan (420kW)
- Ysbyty Gwynedd (330kW)
- Bronglais (210kW)
- Glangwili General (165kW)

Overall, the natural gas CHP input reflects 19% of overall NHS Wales natural gas consumption. Without CHP operation, it is estimated that natural gas emissions would be ~10% lower[5] and electricity emissions greater.

Glangwili General Hospital has significant oil-based emissions, totalling ~2,600 tCO$_2$e per annum. Glangwili General's oil fuel usage has an inherently larger GWP and emission factor. It is also recognized that Glangwili has a biomass heating plant. Across NHS Wales the scale of biomass use is minimal and focused on a few smaller community hospitals.

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[5] Estimate based on 40% CHP heat use efficiency (no heat dumping) and a counterfactual gas boiler efficiency of 85%

3.4   Water Carbon Footprint

Water (supply and treatment) emissions are distributed between NHS Wales bodies in a similar way as that of the thermal emissions. Betsi Cadwaladr is the largest (24%), followed by Cardiff & Vale,

Water Footprint 2018/19 (2,550 tCO$_2$e)
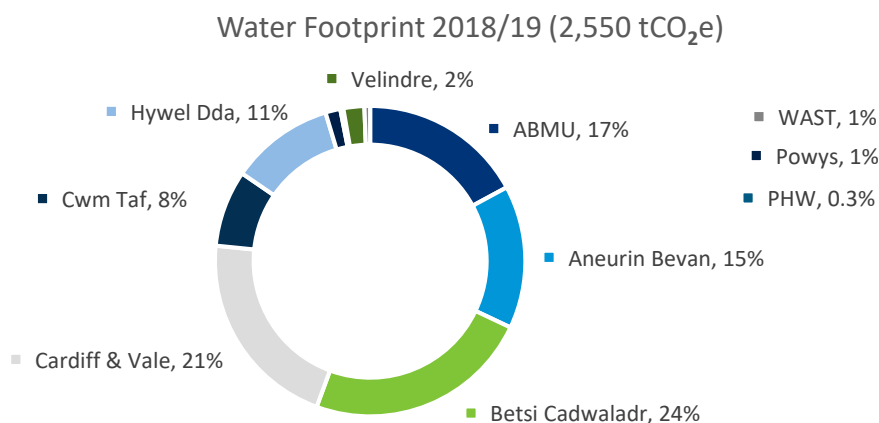
Figure 16 Water Footprint by NHS Wales Body 2018/19

Abertawe Bro Morgannwg and Aneurin Bevan. The combined total of the four largest emitters is 77% of water emissions total.

The graph below assesses the breakdown of water supply and treatment across NHS Wales' operations, totaling 2,550 tCO$_2$e for 2018/19. Higher emissions are more commonly associated with water treatment due to the processes for treatment required.

Water supply and treatment emissions are dominated by UHW. The emissions associated with this site are ~124 tCO$_2$e for water supply and ~209 tCO$_2$e through water treatment. The second largest emission site is Ysbyty Maelor. Across all twenty hospital sites, the proportionate split of carbon emissions between supply and treatment is similar, with around 40% water supply and 60% water treatment contributions on average. This is due to the carbon intensive requirement for water treatment reflected in BEIS carbon factors; this outweighs the reduced volume for water treatment.

Water Footprint Breakdown 2018/19 (2,550 tCO$_2$e)
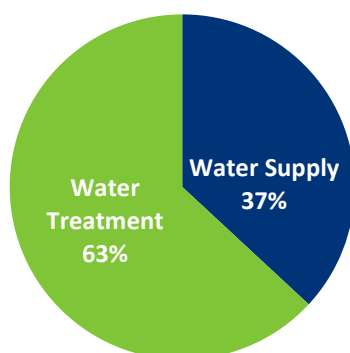
Figure 17 Water Footprint Breakdown 2018/19

Top 20 NHS Wales Sites by Water Supply and Treatment Emissions
2018/19 (2,096 tCO$_2$e)
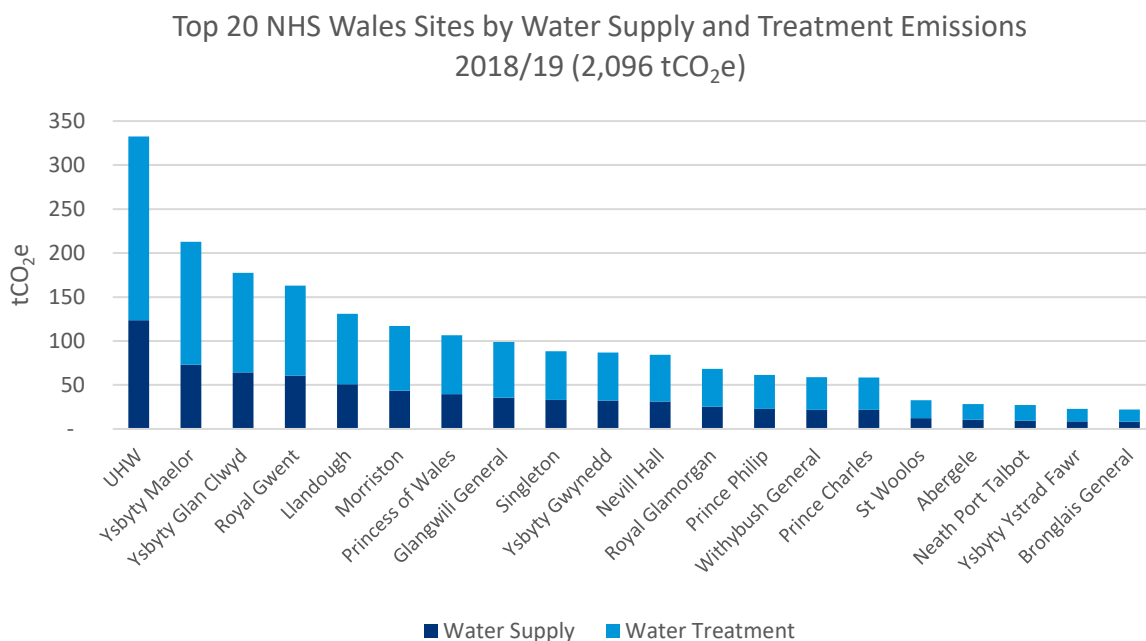
Figure 18 Top 20 NHS Wales Sites by Water Emissions 2018/19

The most significant increase observed since 2016/17 is with Wrexham Maelor, this shows an increase of ~25% and has increased from the fifth largest to the second. It was confirmed that this increase was likely a result of a significant water leak at the site in 2018 that lost a volume of water in the region of 125,000m^3. This issue has since been resolved.

3.5   Waste Carbon Footprint

Figure 19 provides a breakdown of waste emissions by NHS Wales body. Hywel Dda, Abertawe Bro Morgannwg and Betsi Cadwaladr are shown to together account for nearly half of all waste emissions. The waste volumes have an associated cost to NHS Wales of £5.6m.

Waste Footprint 2018/19 (695 tCO$_2$e)
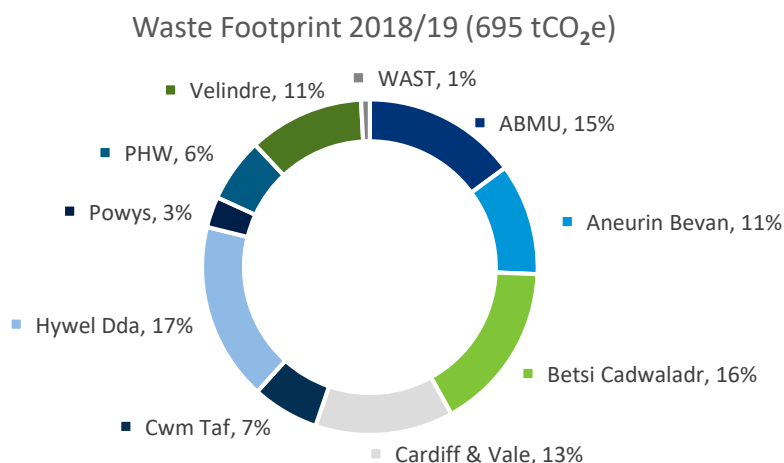
Figure 19 Waste Footprint by Body 2018/19

Since the last time the footprint was calculated, there have been changes in the way that non-clinical wastes are treated and disposed. There has been a significant shift away from landfill and toward energy from waste recovery for non-recyclable wastes.

It can be seen in Figure 20 that there is large contribution from Hywel Dda sites. This is attributed to the comparatively high volumes of landfill disposal waste, which has a significantly higher carbon intensity than recycling / recovery.
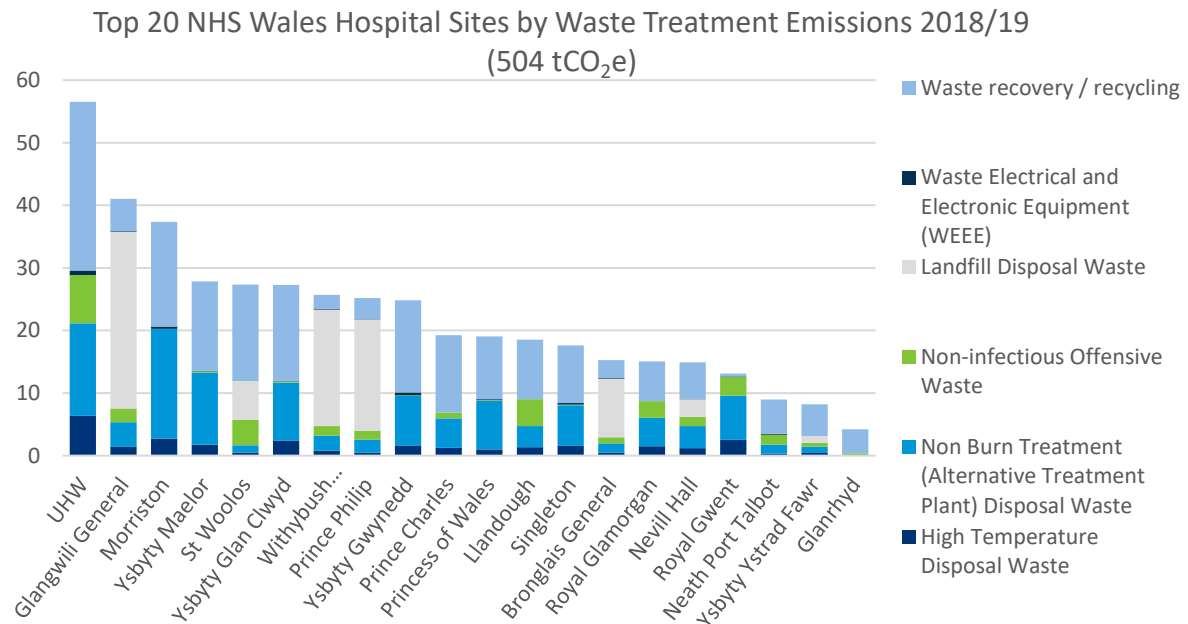
Figure 20 Top 20 NHS Wales Sites by Waste Treatment Emission 2018/19

4. Transportation Emissions

4.1   Overall Transport Carbon Footprint

Transport Carbon Footprint 2018/19   **164,755 tCO₂e**

Transport emissions are often recognised as being associated with an organisation's own vehicle fleet. However NHS Wales transport related emissions are much wider reaching than this. Beyond NHS Wales-owned and leased fleet, business travel associated with staff expensed travel in personal vehicles must also be considered. Additionally, commuting of staff from home to base and also patient and visitor travel to place of care, contribute to emissions significantly. Finally the air ambulance in Wales, also contributes to WAST associated emissions.

Figure 21 summarises NHS Wales transport emissions. This shows that staff commute and patient/vistor travel cover 89% of the total.
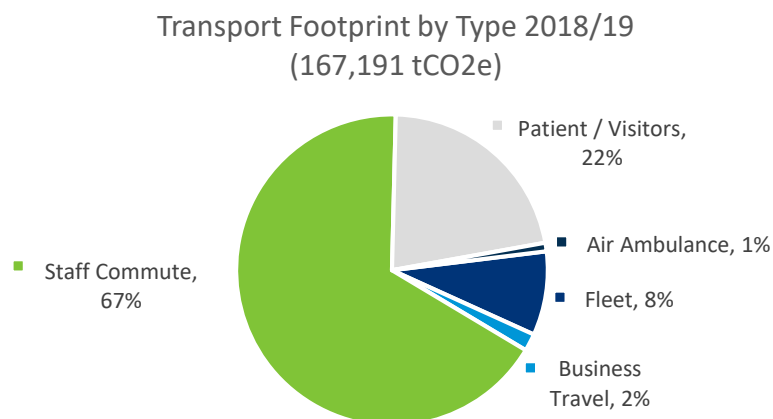
Figure 21 Transport Footprint by Type 2018/19

The breakdown of transport emissions by NHS Wales organisation is shown in Figure 22. The scale of WAST transport emissions are 10% of the total putting the Trust on a par with Cardiff & Vale, and demonstrates a higher contribution by the Trust when compared with building use analysis. Staff commute is shown to be the most significant aspect, and therefore staff numbers will have a large impact on proportions of emissions between Health Boards.
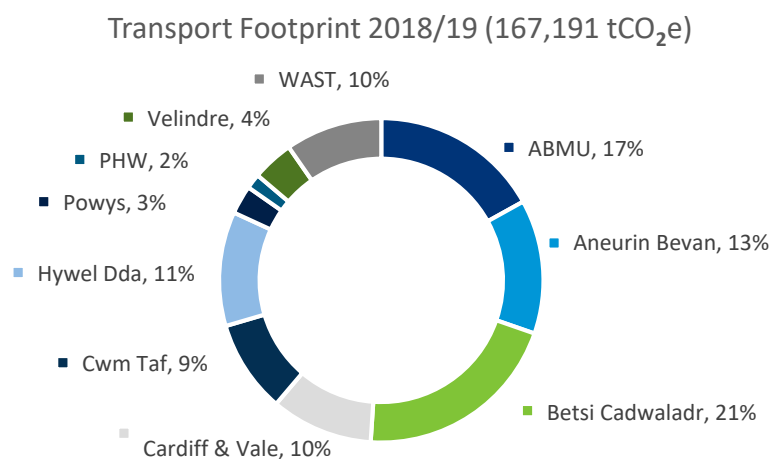
Figure 22 Transport Footprint by Body 2018/19

4.2   Fleet Carbon Footprint

WAST is the most significant contributor to the fleet emissions of NHS Wales, contributing two-thirds of the total emissions; with Velindre and Betsi Cadwaladr the second largest both at 9%. Fleet emissions calculations are based on fuel card data. It is unsurprising that the ambulance service is the main contributor, given that it operates a large fleet of emergency vehicles across Wales. This demonstrates that WAST should be primarily targeted for carbon reduction measures of NHS Wales owned vehicles. Note that Velindre is abnormally high in comparison to the relative size of the other Health Boards and Trusts due to it hosting Welsh Blood, Health Courier Service and Shared Services.

Fleet Footprint 2018/19 (14,576 tCO$_2$e)

- ABMU, 4%
- Betsi Cadwaladr, 9%
- Cardiff & Vale, 3%
- Aneurin Bevan, 2%
- Hywel Dda, 3%
- Cwm Taf, 2%
- PHW, 1%
- Velindre, 9%
- Powys, 1%
- WAST, 66%
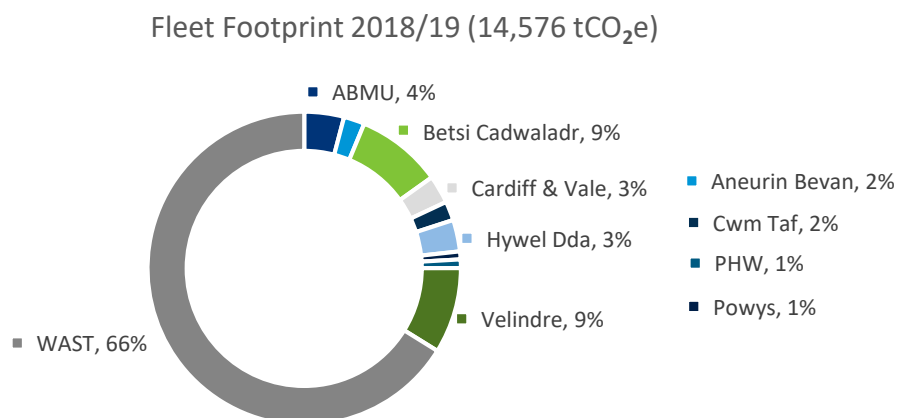
Figure 23 Fleet Footprint 2018/19

4.3   Business Travel Carbon Footprint

Business travel for NHS Wales has been based on staff business mileage via expense claims from NWSSP Payroll. In total, business travel emissions are ~3,000 tCO$_2$e, with Betsi Cadwaladr as the largest emitting organisation. Of particular note is Cardiff & Vale, which accounts for only 4% of the total. Business travel split by Health Board reflects the geographical size of the health boards.

Business Travel Footprint 2016/17 (3,019 tCO$_2$e)

- WAST, 10%
- ABMU, 12%
- Velindre, 12%
- Aneurin Bevan, 8%
- PHW, 5%
- Betsi Cadwaladr, 19%
- Powys, 5%
- Cardiff & Vale, 4%
- Hywel Dda, 17%
- Cwm Taf, 8%
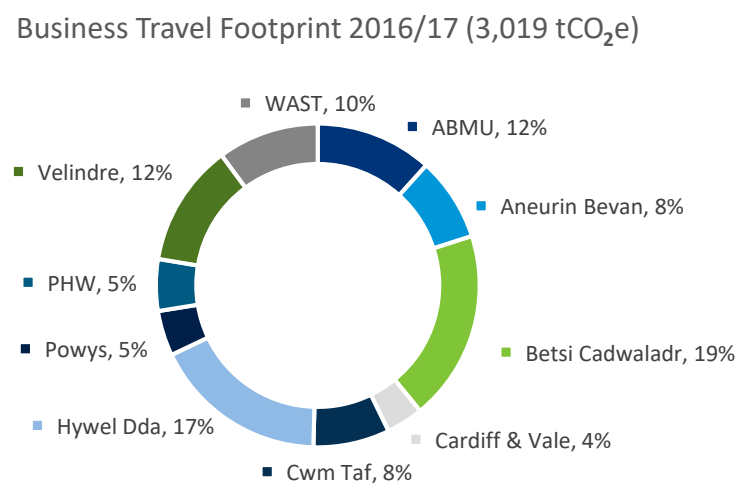
Figure 24 Business Travel Footprint 2018/19

4.4   Staff Commuting Carbon Footprint

Staff commuting data is shown to be the largest proportion of transport emissions for NHS Wales, totalling 67% of all transport emissions. Staff commuting emissions are reflective of geographical location and staff numbers. Of particular note is Hywel Dda and Cardiff & Vale, the greater estimated commute distance for staff in Hywel Dda outweighs the significantly greater number of staff in Cardiff & Vale.

Staff Commute Footprint 2018/19 (111,702 tCO$_2$e)

- WAST, 4%
- Powys, 3%
- ABMU, 18%
- PHW, 2%
- Velindre, 4%
- Hywel Dda, 12%
- Aneurin Bevan, 14%
- Cwm Taf, 10%
- Cardiff & Vale, 11%
- Betsi Cadwaladr, 22%
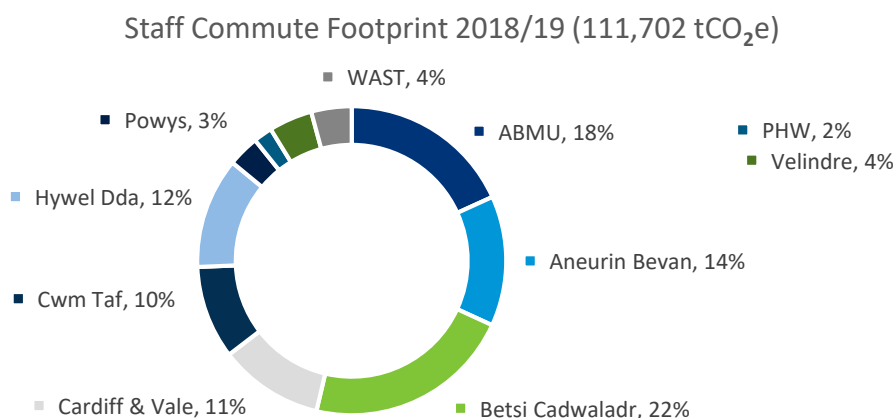
Figure 25 Staff Commute Footprint 2018/19

In 2018/19 there were around 80,000 NHS staff members across the Health Boards and Trusts. Staff commute distances have been derived from payroll expenses data in which employee average distance from office to home is recorded. These distances were also compared against staff travel survey data provided for Aneurin Bevan, Cwm Taf, Cardiff & Vale, Powys Teaching and Public Health Wales. Average percentages of each transport type used within each body was also taken from these recent travel surveys and staff numbers.

Table 1 Staff numbers and commute distances based 'home to office' data

	Average Commute Miles (round-trip)	Total No. of Staff
ABMU	20.78	14,108
Aneurin Bevan	19.32	11,343
Betsi Cadwaladr	22.40	15,416
Cardiff and Vale	15.56	12,876
Cwm Taf	21.23	7,268
Hywel Dda	22.98	8,396
Powys Teaching	29.39	1,771
Public Health Wales	25.71	1,617
Velindre	19.97	3,887
WAST	22.30	3,218

4.5   Patient / Visitor Transport Carbon Footprint

Patient / visitor transport mileage has been extrapolated for each body based on patient/visitor mileage data from the recent Cardiff & Vale patient travel survey in conjunction with patient episodes, bed days, and staff commuting data. Much like staff commuting, the geographical location of the Health Board impacts the split of emissions, with Hywel Dda shown to have greater emissions than Cardiff & Vale.

Mode of patient/visitor transport is based on information provided by the Cardiff & Vale patient / visitor travel survey and a previous Hywel Dda travel survey. Cars are the dominant mode of transport for patients and visitor across NHS Wales, averaging 85% of journeys. Further patient / visitor travel survey data would be beneficial to improve accuracy of the footprint.

Patient / Visitor Footprint 2018/19 (36,417 tCO$_2$e)

- Powys, 2%
- Hywel Dda, 14%
- Cwm Taf, 11%
- Cardiff & Vale, 12%
- ABMU, 19%
- Aneurin Bevan, 18%
- Betsi Cadwaladr, 23%
- Velindre, 1%
- PHW, 0%
- WAST, 0%
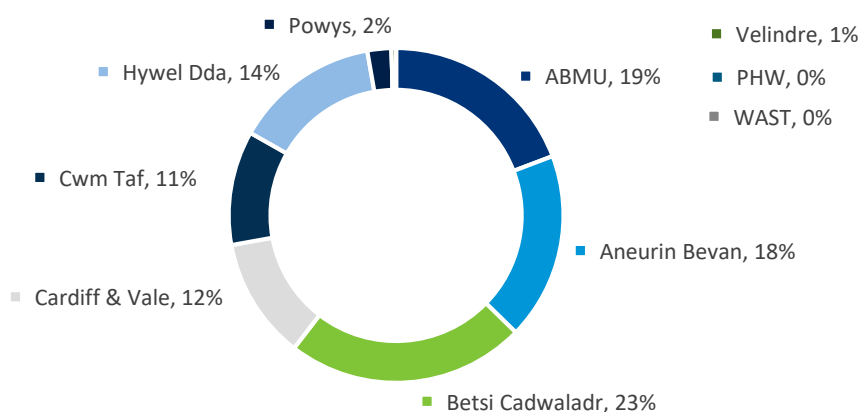
Figure 26 Patient / Visitor Transport Footprint 2018/19

Table 2: Health Board Patient Episodes, Bed Days and Estimated Mileage

	Patient Admission Episodes	Bed Days	Estimated Average Patient/Visitor Travel Distance (round-trip)
ABMU	193,891	689,165	23.46
Aneurin Bevan	241,555	606,197	22.97
Betsi Cadwaladr	191,726	697,967	27.97
Cardiff & Vale	140,525	621,343	17.56
Cwm Taf	105,935	365,393	25.24
Hywel Dda	119,639	406,480	28.69
Powys Teaching	4,796	63,401	36.69
Velindre	10,281	8,682	24.93

5. Procurement Emissions

5.1   Procurement Carbon Footprint

Procurement Carbon Footprint 2018/19   **623,750 tCO$_2$e**

The Scope 3 emissions from NHS Wales' 2018/19 procured goods and services has been calculated using economic input-output analysis, and is based on 'non-pay' cost data provided by the NWSSP Procurement services. The total cost data provided covers a procurement spend of £1,863m, and is broken down by procurement type.

The procurement spend covers a mixture of goods and services which are paid through the Oracle financial management system as well as additional drug spend paid through the Medusa financial management system. This covers the whole non-pay spend for the NHS, and care has been taken to remove emissions that would be duplicated, for instance energy procurement spend. Figure 27 shows the distribution for the whole procurement Carbon Footprint by NHS Wales body.

Procurement Footprint 2018/19 (623,750 tCO$_2$e)

- WAST, 4%
- Velindre, 12%
- PHW, 1%
- Powys, 2%
- Hywel Dda, 9%
- Cwm Taf, 8%
- Cardiff & Vale, 16%
- ABMU, 17%
- Aneurin Bevan, 15%
- Betsi Cadwaladr, 16%
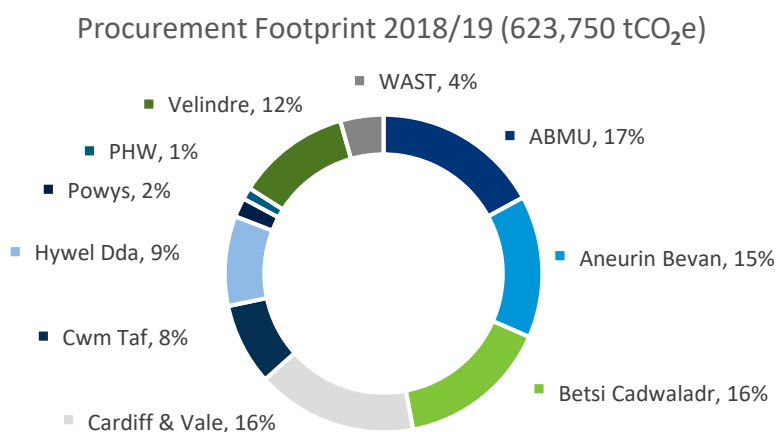
Figure 27 Procurement Footprint by NHS Wales Body 2018/19

Velindre is abnormally high in comparison to the relative size of Health Boards and Trusts. This is due to large amounts of Health Board level expenditure that is included within the Velindre accounts due to the hosting of NWSSP Procurement Services, NHS Wales Supply Chain and Health Courier Services. Some of the major areas of Velindre's expenditure relate to the Workforce Development Unit and training provisions covering the entire employee population across Wales. On top of this there is major expenditure in IT infrastructure due to the hosting of NWIS.

Figure 28 demonstrates the estimated carbon emissions per body, divided by the total spend used to calculate the emissions. The overall average is shown as 334 tCO$_2$e / £ million. ABMU is shown as the Health Board with the largest carbon emissions for the spend – this indicates that the split of ABMU spend is weighted to more carbon intensive EEIO types such as 'drug / pharmaceuticals', 'primary care services' and 'clinical appliances'. WAST NHS Trust is shown to have the greatest carbon intensity for spend, this is due to procurement associated with transport services (separate to WAST fleet).

NHS Wales 2018/19 Carbon Emissions per Procurement Spend by Body
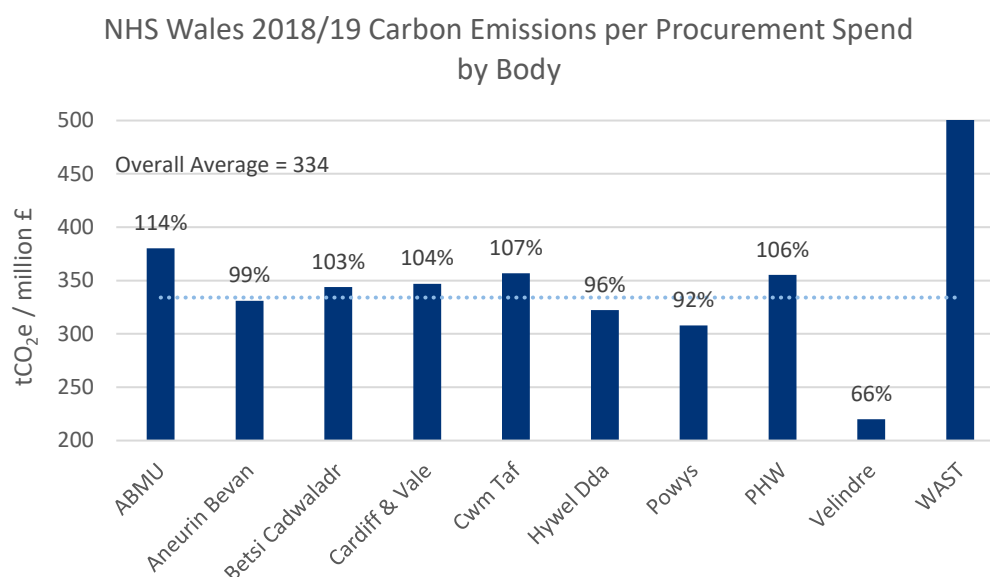
Figure 28 NHS Wales Carbon Emissions per Procurement Spend by Body

Overall procurement emissions by type is shown in Figure 29. The top three categories equate to 69% of procurement emissions. Procurement spend attributed to 'Drugs / Pharmaceuticals' alone contributes 35% of procurment emissions.

Procurement Footprint by Type 2018/19 (623,750 tCO$_2$e)
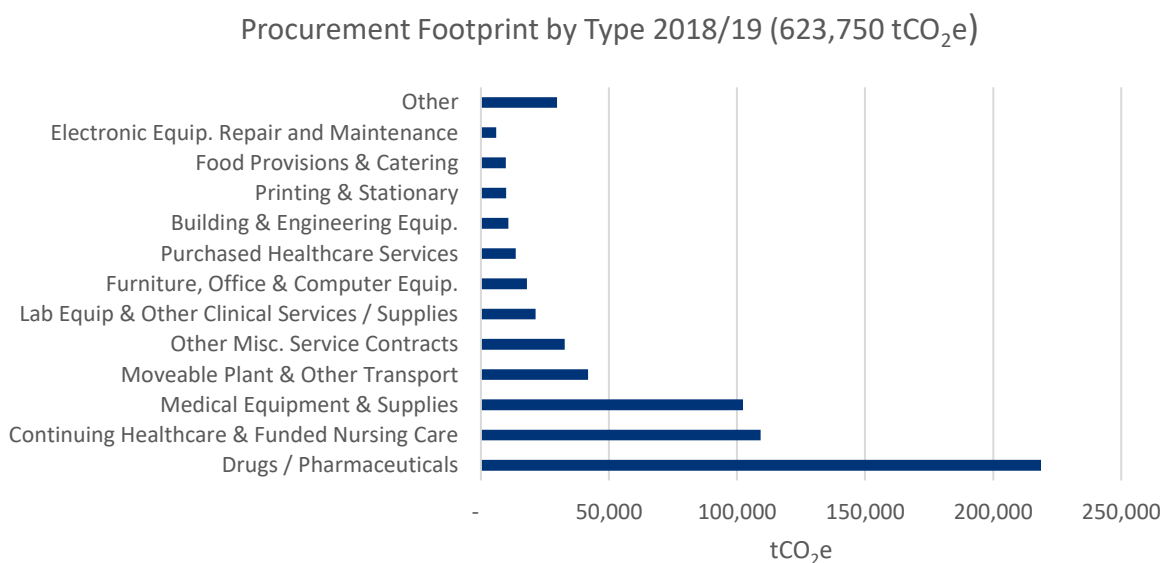
Figure 29 Top Procurement Emissions by Type 2018/19

There are ~400 unique spend descriptions within the procurement data. Procurement emission types shown are in alignment with the spend categorisation recorded with NHS Wales systems in which a category management approach to procurement is taken. It should be noted that a Health Board level comparison may not provide relevant insight due to the high utilisation of "All Wales" contracts which are often used for high level expenditures.

A full mapping of spend description across to EEIO category, and a renaming for report understanding can be found in Appendix 6.

5.2 Top 3 Procured Goods & Services

Since the top three procurement emission types contribute 70% of the procurement emissions, these three types have been further analysed. The distribution of drugs / pharmaceuticals spend is broadly reflective of Health Board size, with ABMU and Aneurin Beavan slightly higher than expected. One aspect that may impact split of emissions will be potential variation in how individual Health Boards categorise spend within Oracle.

Drug / Pharmaceutical Products Procurement Emissions 2018/19 (218,735 tCO$_2$e)
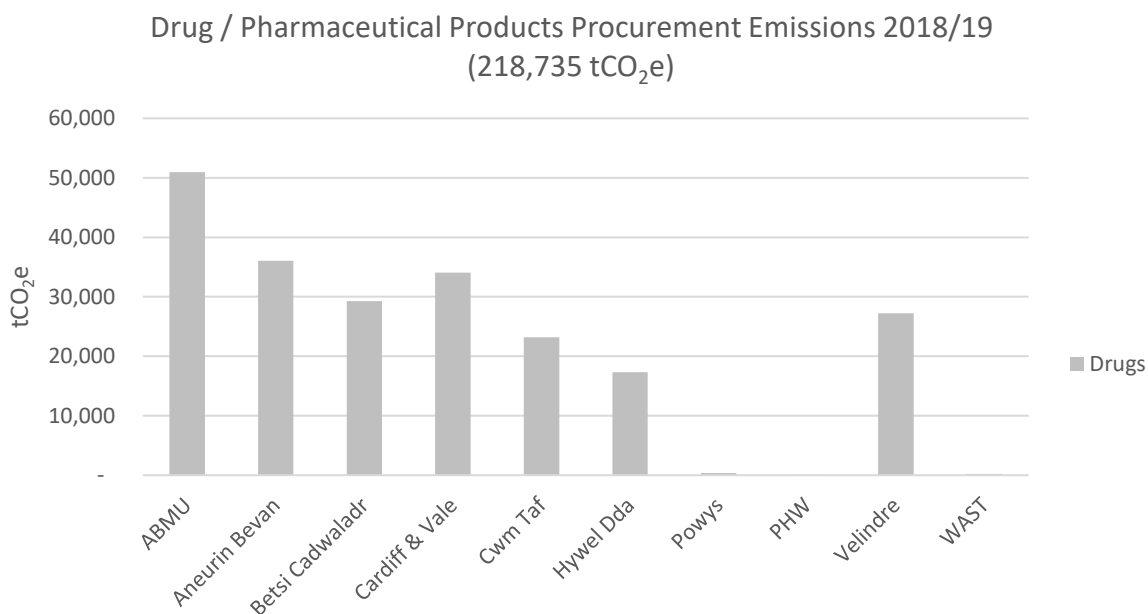
Figure 30 Drugs / pharmaceutical products Emissions 2018/19

The second and third highest procurement emissions types are shown in Figure 31 with the greatest contributing body highlighted.

Second and Third Highest Procurement Emissions 2018/19 (211,562 tCO$_2$e)
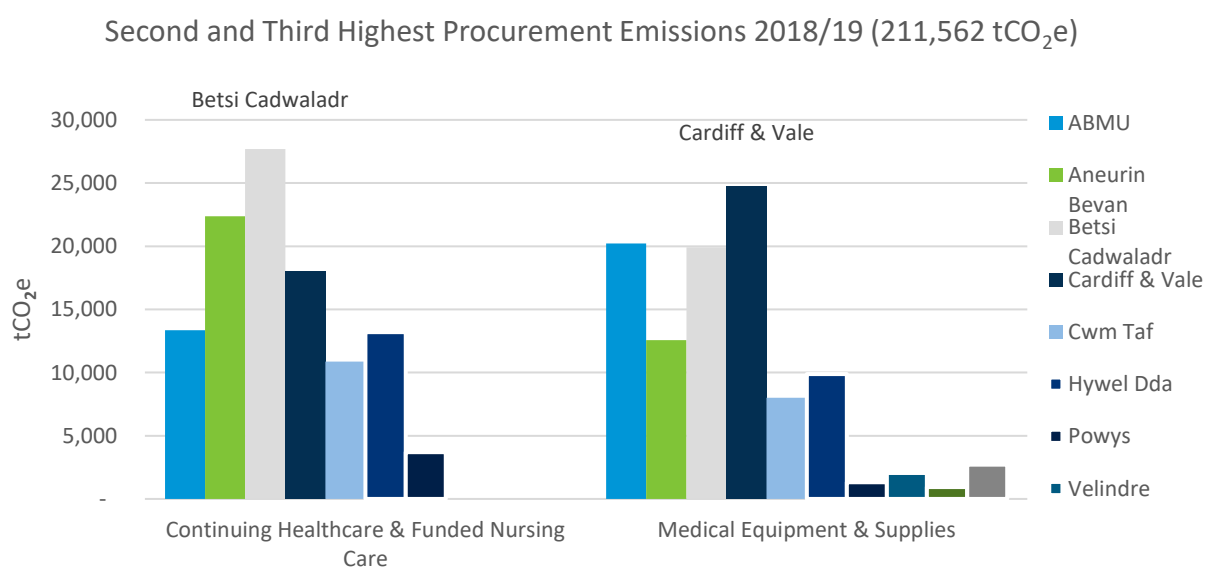
Figure 31 Greatest Procurement Type Emissions 2018/19

5.3   Emissions by Supplier

Additional data has been provided for this assessment which has allowed a distribution analysis of carbon emissions by specific supplier. This provides additional insight to inform the shift towards a more accurate 'market-based' approach to engage and assess emissions of key suppliers, and also to inform target areas for mitigation action.

There are over 13,500 individual suppliers to NHS Wales. Figure 32 demonstrates emissions for the top 20 identified suppliers, excluding pharmaceutical suppliers dealing directly with pharmacies. For a significant amount of the spend data attributed to pharmaceuticals, the specific supplier information has not been analysed due to the complexity of collating supplier level detail from the myriad of systems involved in delivering pharmacy services across the country. Often pharmaceutical items can be purchased through a number of channels, and consequently pharmacies make the optimum decision to purchase either directly from manufacturers, or from major distributors or wholesalers, which makes the carbon impact associated with a single supplier of a pharmaceutical product more complicated to calculate. The unidentified pharmaceuticals supplier data totals 136,907 tCO_2e – equivalent to 30% of the total. Note that some of the unidentified pharmaceutical supplier emissions will likely be attributed to some of the pharmaceutical suppliers listed in the top 20.

The top 20 suppliers (which have been anonymised) contribute 21% of total procurement emissions (or 30% where the supplier is known) – this demonstrates the significant scope for impact by just targeting a small number of the total 13,500 suppliers listed. Suppliers A & B contribute 8% of the total emissions where the supplier in known.

Top 20 NHS Wales Suppliers by Total Emissions 2018/19
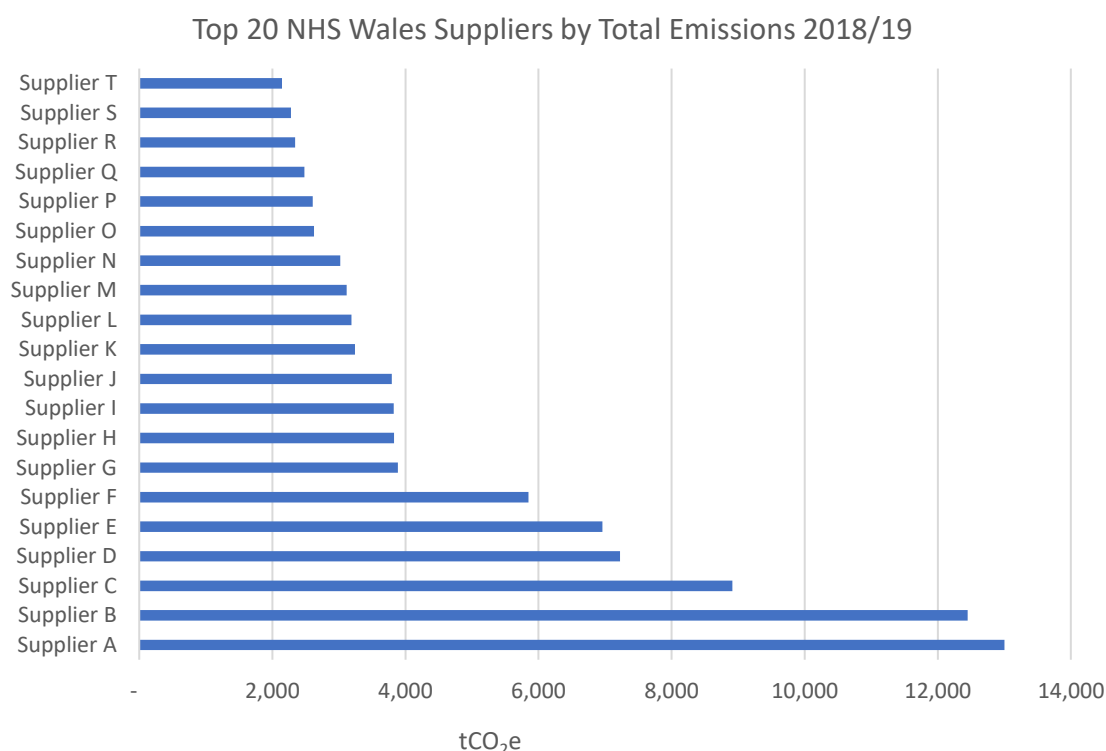
Figure 32 Top 20 Suppliers (anonymised) by Total Emissions 2018/19

A market-based approach will include a detailed assessment of the selected supplier to understand their emissions, and how this directly relates to NHS Wales. This approach requires directly engaging with targeted suppliers, understanding existing Carbon Footprint and emission reporting information, and ultimately assessing the emissions associated per quantity of product provided to NHS Wales (Scope 1, 2 and 3). The outcome is a more accurate calculation of upstream Scope 3 emissions for NHS Wales, as well as information to help inform procurement emissions, and engage suppliers to reduce their Carbon Footprint. Often independent consultancy support is required to undertake upstream market-based assessments.

6.   Footprint Comparisons

6.1 Comparison with NHS Wales 2016/17 Footprint

A comparison with the previous 2016/17 Carbon Footprint is a key aspect to understand decarbonisation progression. The following presents a comparison of the 2018/19 Carbon Footprint with an adjusted 2016/17 Carbon Footprint[6].

Carbon Footprint 2016/17	Carbon Footprint 2018/19	Variation
1,052,323 tCO$_2$e	**1,001,378 tCO$_2$e**	**-4.8%**

Figure 33 2016/17 vs. 2018/19 Carbon Footprint comparison

Overall the footprint shows a decrease in emissions, reducing by 4.8%. However, this needs to be considered in the context of fixed variations such as grid electricity decarbonisation, and also in the context of any changes in service provision.
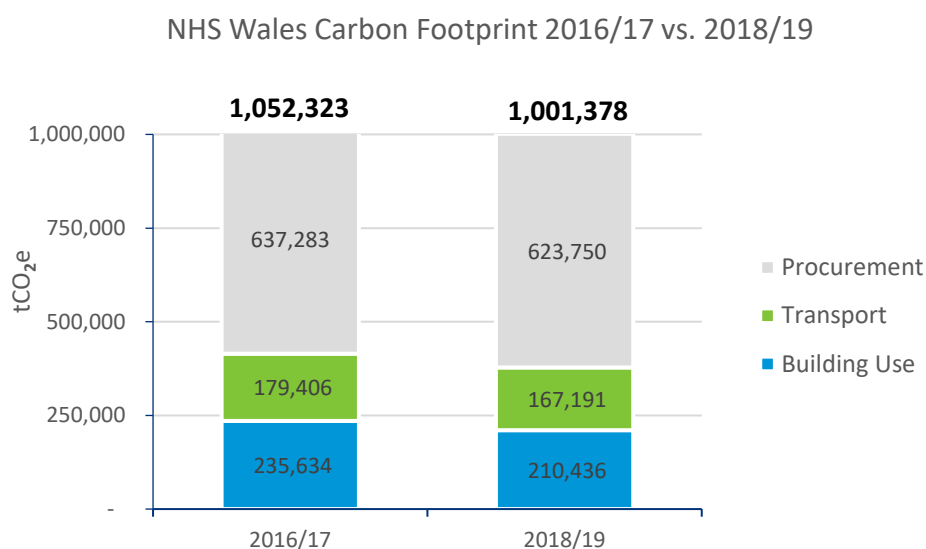
Figure 34 Carbon Footprint and Category Comparison – 2016/17 vs. 2018/19

The split between Building use, Transport and Procurement categories is shown to be relatively consistent. The adjusted footprint for 16/17 demonstrates 22% of emissions are attributed to building use; in 2018/19 building use emissions contributed 21%.

Figure 35 provides a view on variation for the specific categories making up the Carbon Footprint.

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[6] Adjustments to the previous footprint have been made as further, more accurate data has become available. The updated 2016/17 footprint increased from a total of 733,185 tCO$_2$e to 1,052,323 tCO$_2$e.

Emissions Variation by Category 2016/17 to 2018/19
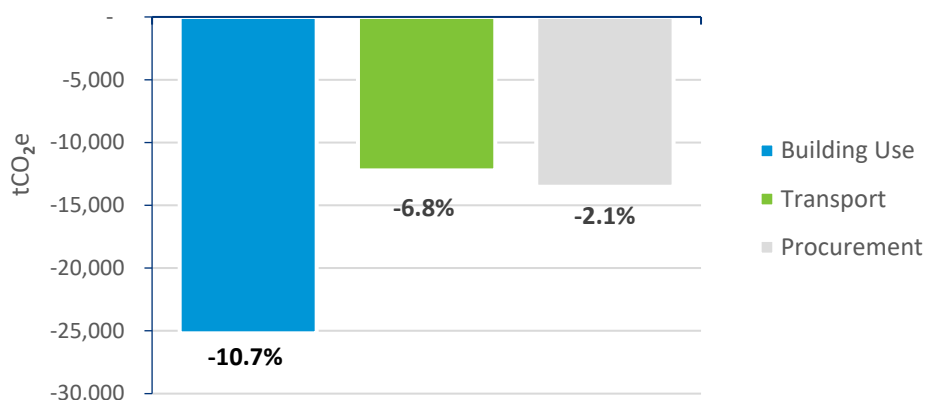
Figure 35 Emissions category variation 2016/17 vs. 2018/19

Building use emissions are shown to decrease by 11%, however, in terms of energy (kWh) electricity consumption has actually increased by 1.4%, and natural gas (including CHP gas input) has decreased by 1.5% (this does not consider the impact of weather / temperature). The overall decrease in emissions to the scale of 11% are primarily a result of the decarbonisation of the UK electricity grid.

Transport emissions are shown to have a significant increase. It should be noted that transport emissions calculations are considered to be the least accurate from a data quality perspective; however, the same approach has been taken for both footprint calculations

Procurement emissions have decreased marginally since 2016/17. Procurement spend (excluding energy, water and waste services) has increased from £1,669m in 2016/17 to £1,863m in 2018/19. Inflation and estimates for decarbonisation for supply chain (e.g. electric grid decarbonisation) are built into the factors applied, and counteract the increase in spend. Note that the make-up of the various procured goods and services impacts overall emissions, and therefore simply dividing total procurement emissions by total cost is not accurate metric of performance.

Procurement emissions variation should be treated only as an indication of carbon performance; this is since the methodology taken only estimates emissions for procured goods and services based on spend data, no specific market assessment of specific suppliers, supply chain geography, or product volumes has been undertaken. A shift towards a   market-based approach is required to more accurately understand procurement related emissions, and appropriately assess procurement related decarbonisation performance.

6.2   Comparison of Health Boards / Trusts

The overall comparison on a Health Board / Trust basis is shown in Figure 36. Comparing the two years, the Health Boards demonstrate total emissions variability of minus 7% improvement (decrease) to plus 0.4% increase. The only Health Boards which show increase in emissions are Betsi Cadwaladr and Powys, however this may be considered only a minor increase at <0.5%.

Health Board / Trust Carbon Footprint 2016/17 vs. 2018/19
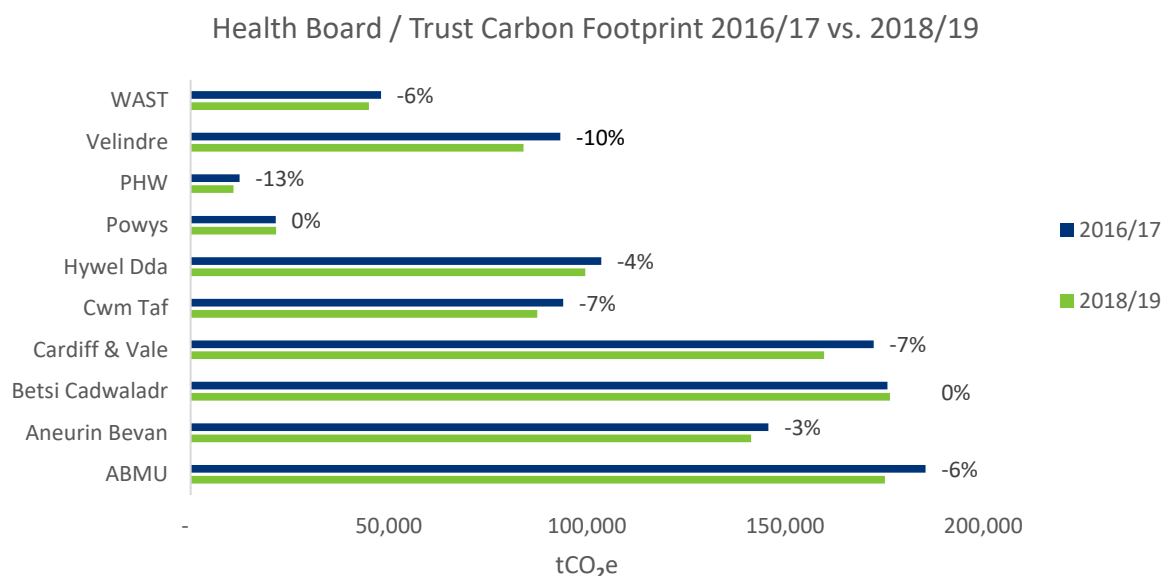
Figure 36 Health Board / Trust performance 2016/17 vs 2018/19

Further assessment of Health Board / Trust variation in carbon emissions has also been made by category.

Building Use Emissions Variation 2016/17 vs. 2018/19
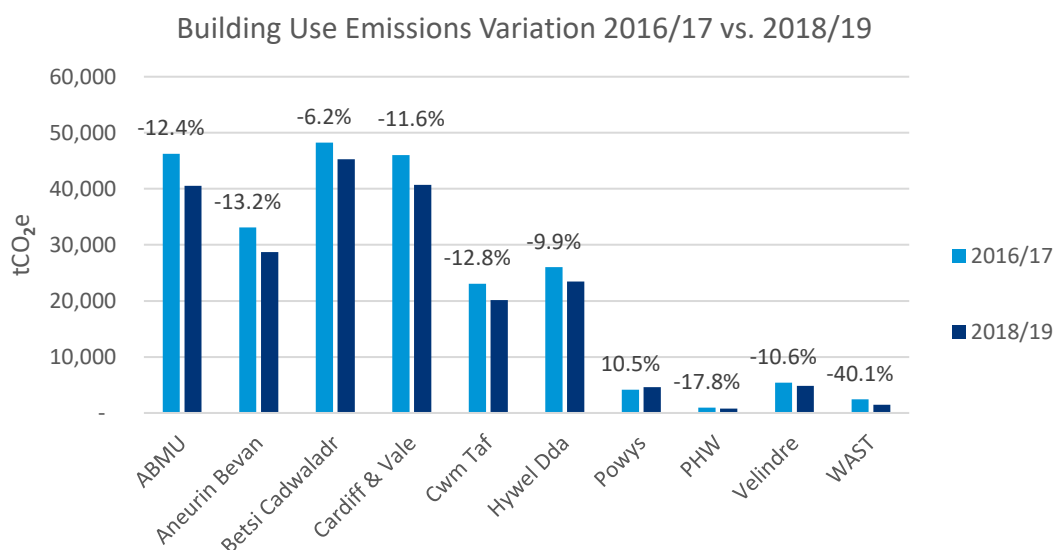
Figure 37 Health Board / Trust Building Use Variation 2016/17 vs. 2018/19

Powys is the only body to show an increase in building use emissions (+10.5%). This is attributed to a 39% increase relating to natural gas and oil. The Health Boards (and Velindre) show a similar decrease in building related emissions of 10 - 13%; this is with the exception of Betsi Cadwaladr which shows a 6% reduction. Figure 41 illustrates that the apparent improvement is primarily due to the decreased emissions from electricity consumption associated with the decarbonisation of the electricity grid (as explained in section 6.6). WAST's significantly greater reduction is also due to a reported electricity consumption decrease of 1,510 MWh (44%) since the 2016/17 reported figures.

Figure 38 shows the variation in transport emissions. There is a variation in performance across the organisations, with staff commute estimated emission the most influencing factor.

Transport Emissions Variation 2016/17 vs. 2018/19
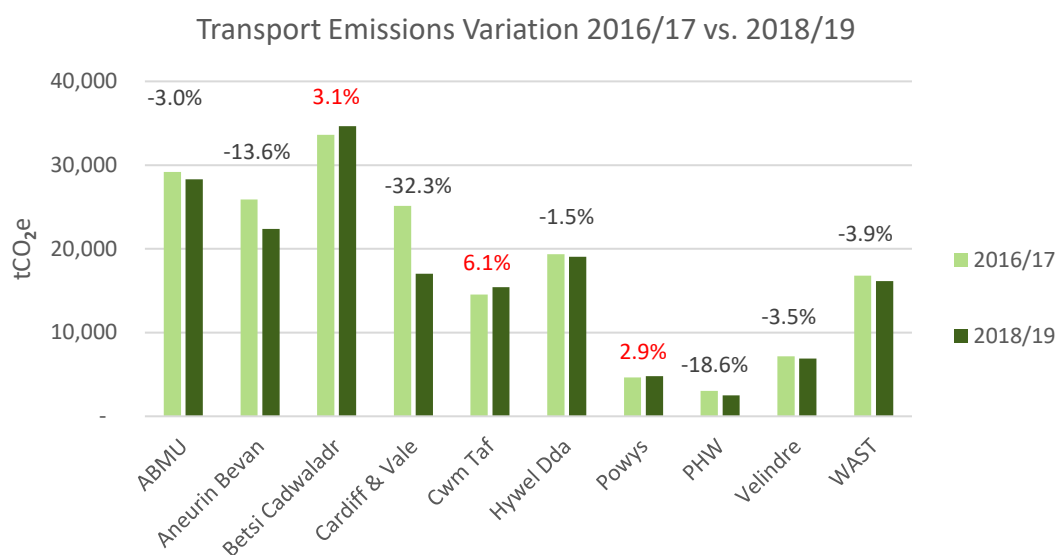
Figure 38 Health Board / Trust Transport Variation 2016/17 vs. 2018/19

Cardiff & Vale's decrease in transport emissions are a result of reduced commuting distance due to the availability of greater accuracy data for home-to-work commute distance. It should be noted that transport emissions in general suffer from data quality issues. Uncertainty in the accuracy of business travel payroll expense data and lack of available data for staff commuting and patient/visitor travel have resulted in a number of calculation assumptions; these are both recommended areas for data improvement.

Procurement Emissions Variation 2016/17 vs. 2018/19
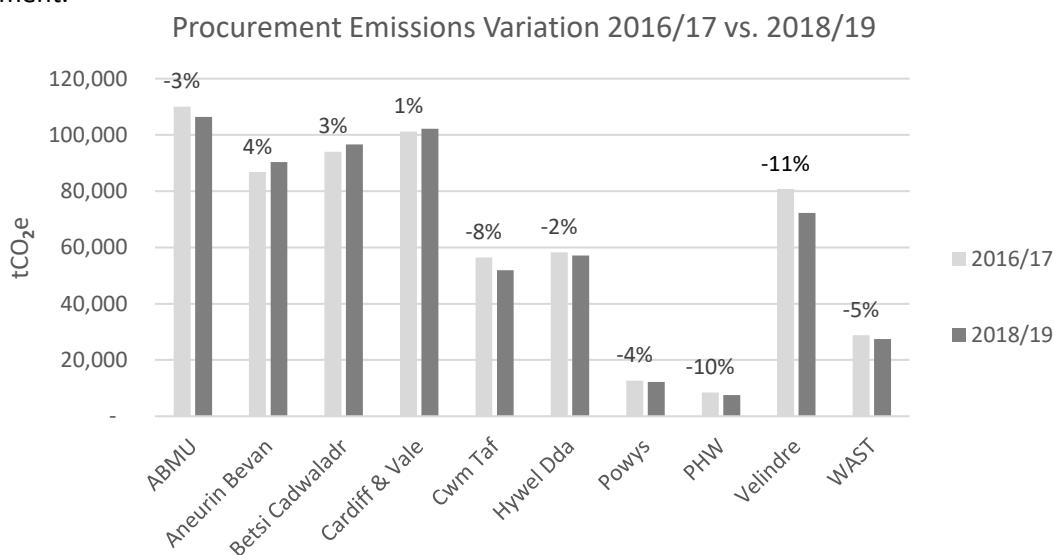
Figure 39 Health Board / Trust Procurement Variation 2016/17 vs. 2018/19

Procurement emissions variation by body in the main are shown to be fairly similar when compared to the 2016/17 Footprint. All Health Boards except Cwm Taf varying from -3% to +4%. Velindre and Cwm Taf show the most impactful reduction in emissions. It should be again noted that procurement emissions are estimated and the approach taken only provides an indication of carbon performance.

6.3   Building Use Comparison Analysis

Emissions associated with use of building are assessed by reviewing the specific top 20 sites for the emissions of electricity, thermal (natural gas and fuel oil), water, and waste. Figure 40 shows the top emitting sites in 2018/19 for thermal emissions. This shows that emissions are similar between years across NHS Wales for reported natural gas, CHP input gas, and oil consumption quantities.
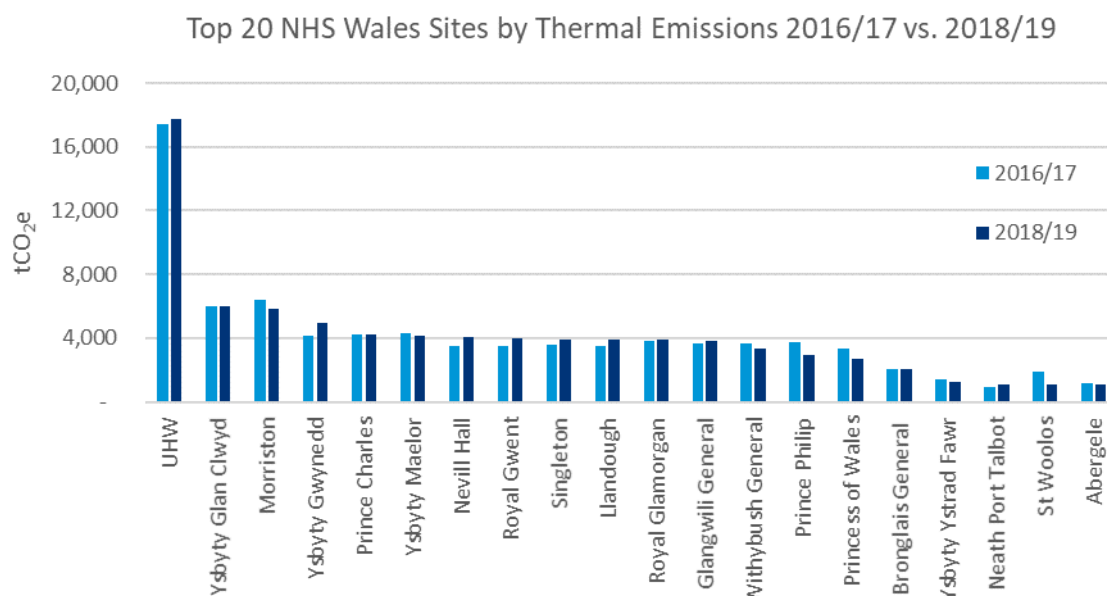
Figure 40 Top 20 Thermal Sites Comparison 2016/17 vs 2018/19

The emissions reduction from electricity shown at the sites in Figure 41 are primarily a result of electricity grid decarbonisation as discussed in section 6.6. The slight increase in emissions from Withybush General Hospital and Prince Philip Hospital have been found to be from decreases in the electricity output from the CHP units over the past two years. There is an unexplained large increase in electricity consumption at the ABMU Neath Port Talbot Hospital site.
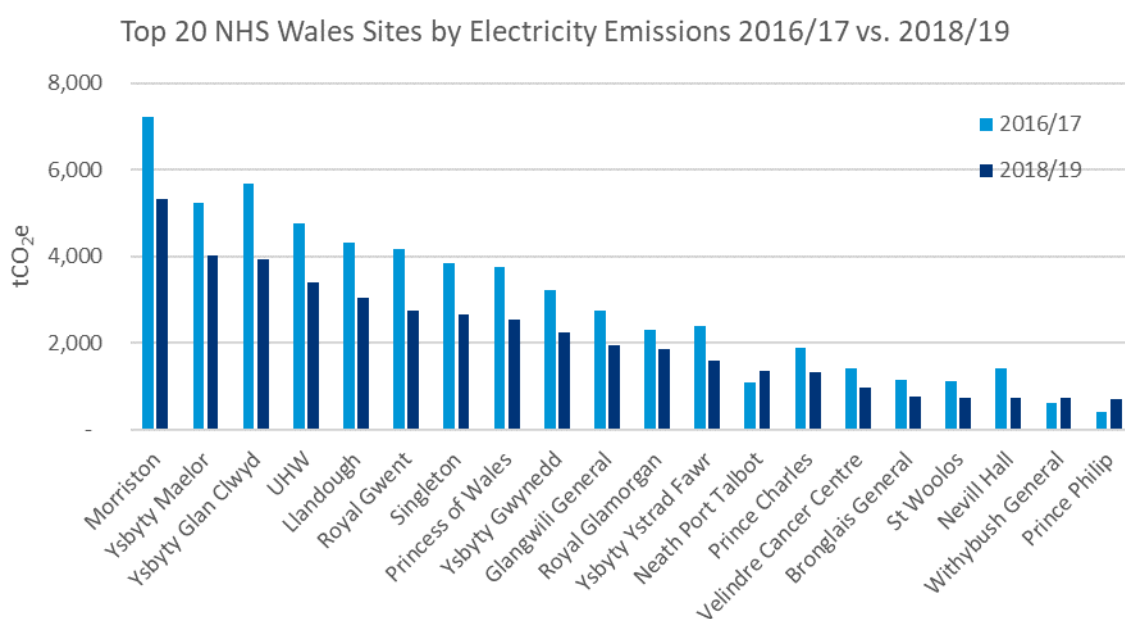
Figure 41 Top 20 Electricity Sites Comparison 2016/17 vs 2018/19

Figure 42 shows the top 20 water related emissions. The majority of sites show similar total emissions. Llandough is understood to have had a significant water leak around the time of 2016/17 – this was not spotted in the previous analysis; however, it is apparent with a comparison year. The second highest water associated carbon emitting site in 2018/19 was Ysbyty Maelor, this site has had an increase in water related emissions since the previous footprint of 25%. This has been attributed to a reported water leak at the site in 2018.
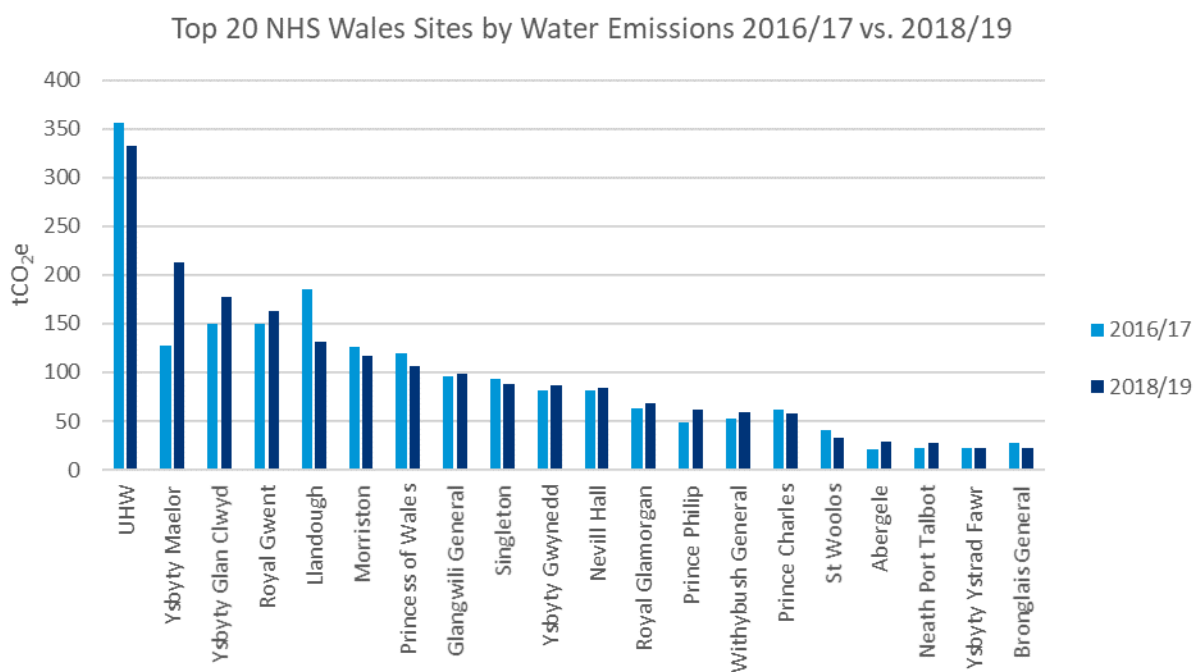
Figure 42 Top 20 Water Sites Comparison 2016/17 vs. 2018/19

Although a small percentage of the overall carbon emissions of each NHS Wales body, emissions due to waste have seen significant changes since 2016/17 due to a significant shift away from landfill disposal to waste recovery/recycling, the impact of which is an 89% in carbon intensity factor applied.
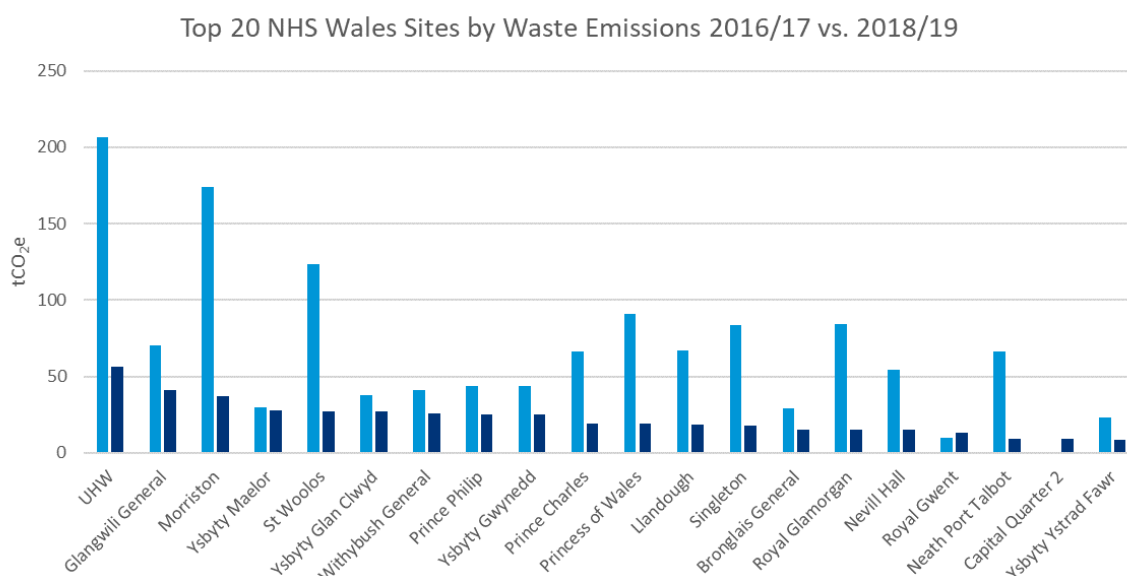
Figure 43 Top 20 Waste Sites Comparison 2016/17 vs. 2018/19

6.4   Transport Comparison Analysis

In this section, variation in transport emissions between the two footprint years are analysed. The below Figure 44 highlights that changes in transport emissions have decreased for each of the four categories. For staff commute related carbon emissions – improved staff travel survey data has been made available for 2018/19.
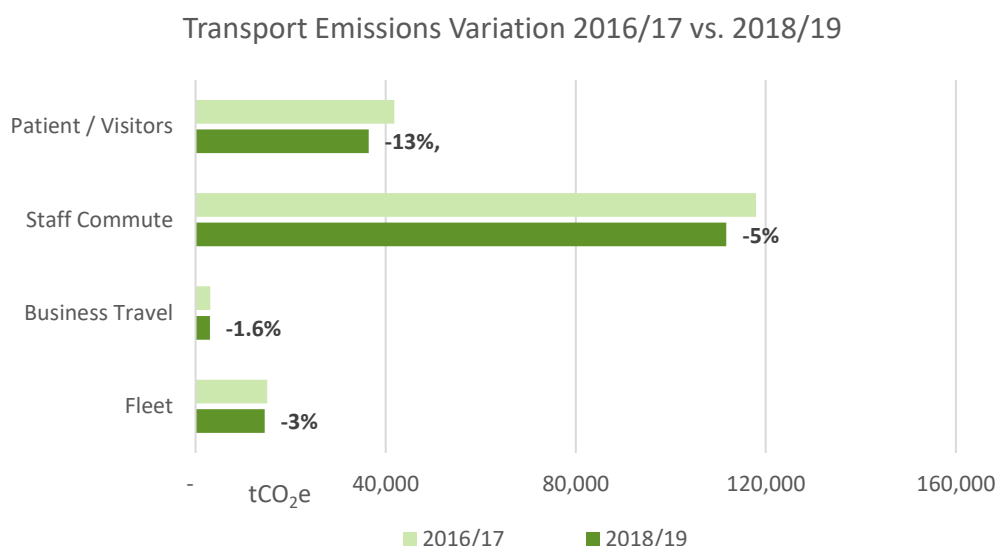
Figure 44 NHS Wales Transport Emissions Variations 2016/17 vs. 2018/19

Emissions due to fleet are largely similar to 2016/17 due to similar fuel spends. The decreased Powys emissions are due to the 2016/17 fuel spend being estimated due to lack of data. The other significant variation is shown with Hywel Dda with a 29% increase in fleet.
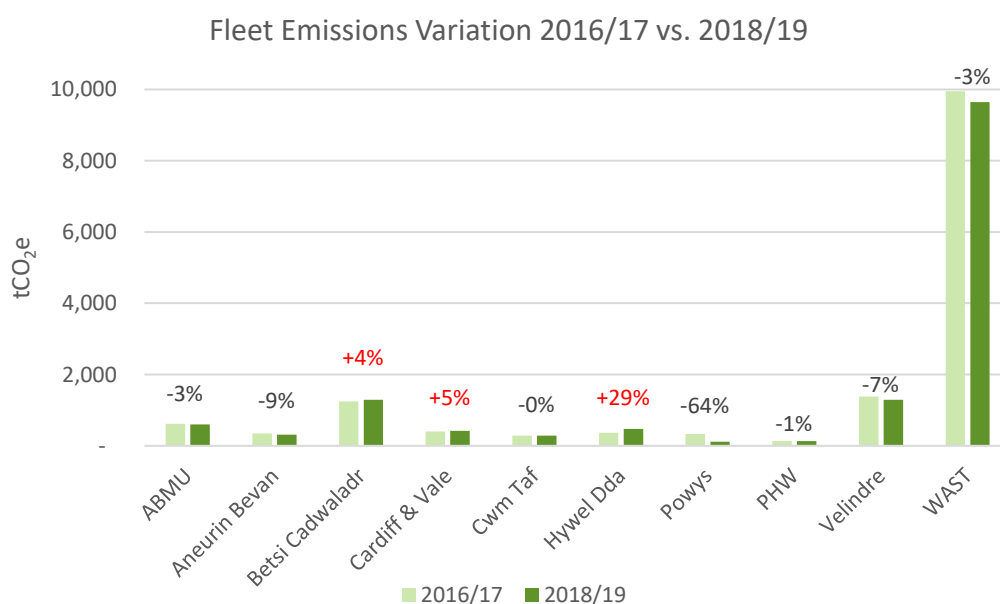
Figure 45 Health Board/Trust Fleet Variation 2016/17 vs. 2018/19

Figure 46 and Figure 47 show the estimated emissions for staff and patient / visitor transport. In both cases, Cardiff & Vale shows a the most significant reduction against 2016/17 emissions, this impact has allowed the Health Board to show a reduction rather than increase. This improvement should be considered in the context of improved data rather than mitigation action successes.
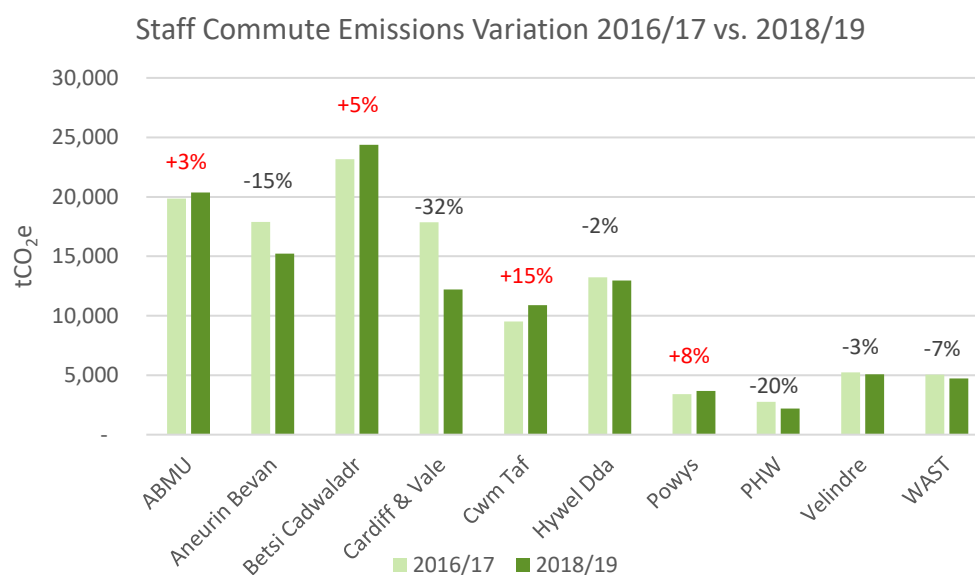
Figure 46 Health Board/Trust Staff Commute Variation 2016/17 vs. 2018/19
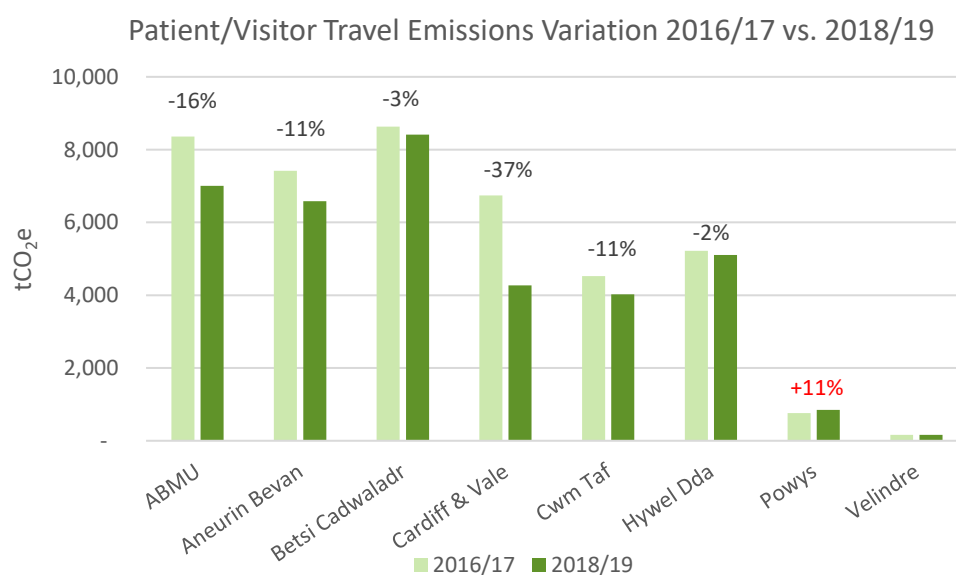
Figure 47 Patient/Visitor Travel Variation 2016/17 vs. 2018/19

6.5   Procurement Comparison Analysis

With reference to Figure 39, procurement emission variation by body has been shown to have only small variations (-3% to +4%) for the majority of Health Boards. The total estimated procurement emissions indicate a 2.1% reduction overall.

Figure 48 shows a breakdown of variation by procurement category. The top three categories show minor variation. A significant increase in emissions is recognised for 'Lab Equipment and other clinical services / supplies', with a similar scale decrease in emissions attributed to 'Office & Computer Equipment'. With the top three categories shown to be consistent between the footprint years, it is recommended that these categories are targeted first with respect to carbon reduction activity.

Top 12 Procurement Emissions Variation 2016/17 vs. 2018/19
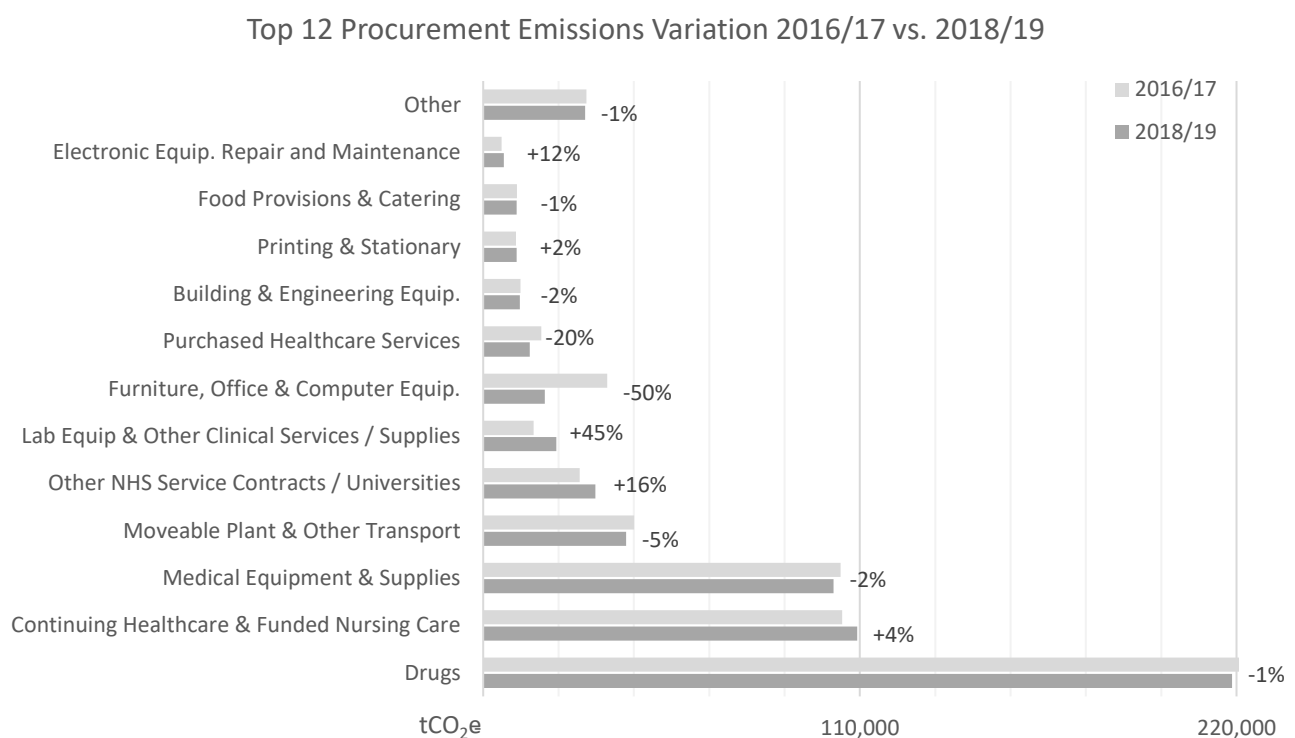
Figure 48 NHS Wales Top 12 Procurement Variations 2016/17 vs. 2018/19

6.6   Appraisal of Variations

Both BEIS emission factors[7] and the EEIO calculation factors (as explained in Appendix 1) are updated on a yearly basis. With a two-year gap between the Footprints, 'fixed variations' in calculation factors can have a significant impact on comparison analysis, and therefore should be considered. Key variations to consider are:

- - 31.6% reduction in grid electricity generation emissions factor
- - 3.4% reduction in average car (unknown fuel) emissions factor
- - 9.2% reduction for all EEIO procurement factors (based on inflation, and supply chain decarbonisation)

Figure 49 below illustrates the decrease in grid electricity carbon intensity over the last decade and highlights that the carbon intensity of grid electricity has decreased by ~32%. This graph also shows that carbon intensity of natural gas remains constant over time.
Variations due to changes in treatment of data also need consideration. In particular:
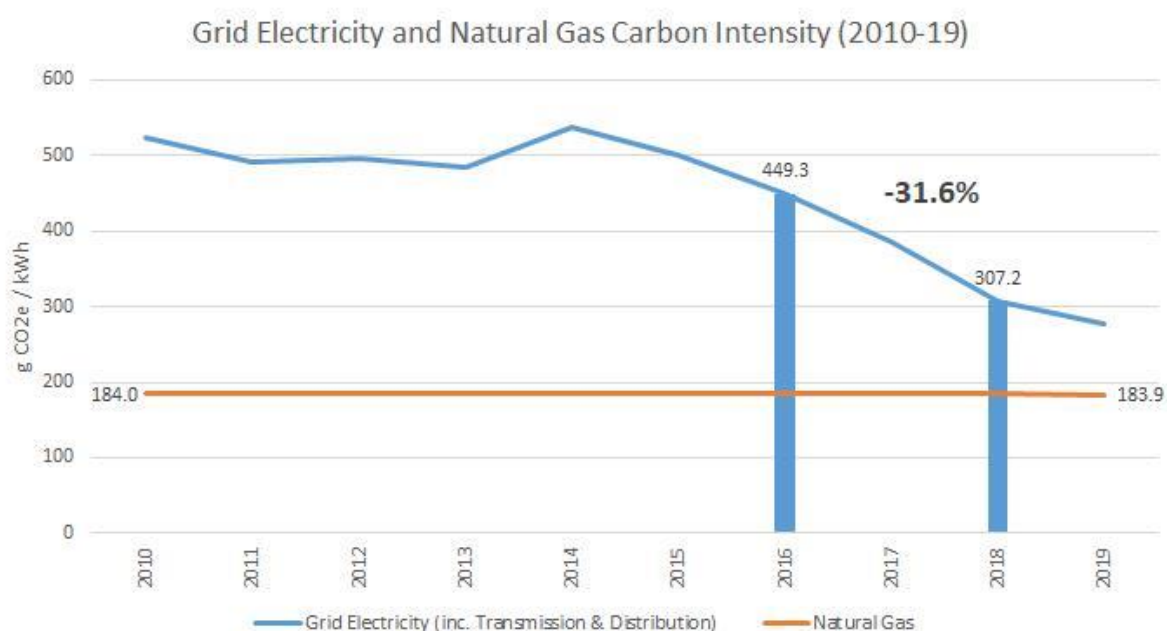
Figure 49 UK Grid Electricity and Natural Gas Carbon Intensity 2010-2019

- A large volume of waste to landfill in 2016/17 is now reported as 'Waste Recovery/Recycling' – this has a -89% impact on emissions factor (see Appendix 7).
- Business miles data source has changed, with a different data set used
- Amendments to the 2016/17 Carbon Footprint have been made to support comparison analysis and accuracy – in particular, a significant addition of procurement spend attributed to 'Drugs / pharmaceutical products' has been added, and spend addition of 'Services to other NHS bodies / Universities' to aid accurate comparison between years

A summary appraisal of data variations can be found in Appendix 7.

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[7] https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

6.7   Conclusions and Next Steps

The findings of this Carbon Footprint and the 2016/17 Carbon Footprint have helped to highlight target areas for decarbonisation and improve the accuracy and confidence in a baseline that will be used to measure against going forward. This Footprint will also provide evidence to support and inform an NHS Wales decarbonisation strategic delivery plan, which will act as the core response to the Climate Emergency in Wales.

Particular recommendations for further improvement and next steps include:

- Through the NHS Wales decarbonisation strategic delivery plan development process – increased review, appraisal and feedback should be sought to understand the Footprint further, and develop a defined boundary for ongoing baseline monitoring (including reflection to the Welsh carbon accounting guidelines).
- Further improvements to data quality and accessibility can be made. In particular the use of existing reporting mechanisms such as the EFPMS can be reviewed, with the opportunity to build in specific requirements for useful ongoing footprinting data.
- Supplier specific emissions data should be built upon, and a progression towards a 'market-based' approach made for emissions associated with supply of goods and services. This will entail a staged approach of targeting specific suppliers) and understanding specific supply chain emissions relating to specific goods and services received by NHS Wales.
- Limited travel survey information is available to accurately calculate staff and patient/visitor travel. Individual organisations have undertaken surveys in the past, however, it is felt an aligned approach, focused through travel managers will markedly improve emissions estimates.
- The accuracy of business (staff expensed) travel data provided is particularly variable - further clarification is needed on the best replicable approach going forward.
- It is recommended that regular updates of the NHS Wales Carbon Footprint are undertaken to provide a basis for ongoing performance assessment. This will be key in tracking progress against the NHS decarbonisation strategic delivery plan. In addition, the "Carbon reporting guide for the public sector in Wales" sets the requirements for carbon accounting in Wales will be a driver for regular assessment.

Appendices

Appendix 1 Calculation Methodology

Carbon Trust have structured this Carbon Footprint in alignment with the GHG Protocol, grouping emissions under each scope. The Carbon Footprint has been built up from numerous data sources, of varying detail and quality, with a specific calculation methodology applied to each. In addition, Scope 1, 2 and 3, further categorization has been undertaken to aid understanding and analysis of the Carbon Footprint. Figure 50 provides the GHG Protocol diagram of activities within each scope.
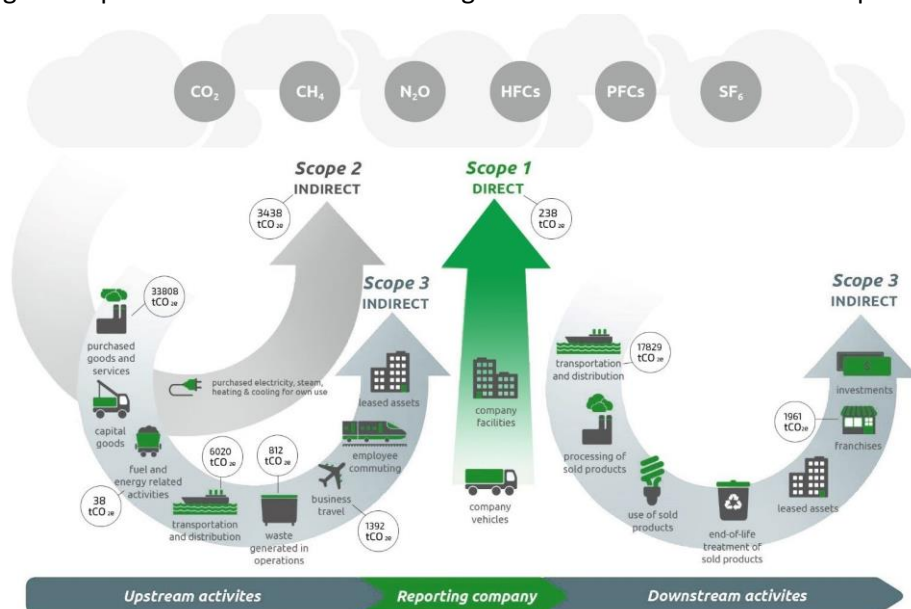
Figure 50 Greenhouse Gas Protocol Scope 1, 3, and 3 Emissions[8]

There are six greenhouse gases recognised by the Kyoto Protocol as being of global importance. Carbon dioxide is known as the greenhouse gas having the most significant effect on climate change, this is due to the volume of carbon dioxide emissions being greater than the other greenhouse gases. However, carbon dioxide is a less potent greenhouse gas than the others in terms of its 'global warming potential' (GWP). GWP is used a measure where the impact of a greenhouse gas is compared in equivalence to the impact of carbon dioxide; the units for GWP are *ktCO$_2$e* (thousands of tonnes of CO$_2$ emissions equivalent). The table below sets out GWP for the 6 main greenhouse gases (note that HFCs and PFCs are groups of compounds) as set out by the IPCC Fifth Assessment Report, 2014 (AR5).

Table 3 Global Warming Potential (GWP) by Greenhouse Gas[8]

Greenhouse Gas	Chemical Symbol / Name	GWP as set out in AR5
Carbon dioxide	CO$_2$	1
Methane	CH$_4$	28
Nitrous Oxide	N$_2$O	265
Hydrofluorocarbons	HFCs	4 – 12,400
Perfluorocarbons	PFCs	6,630 – 11,100
Sulphur hexafluoride	SF$_6$	23,500

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[8] Source: ghgprotocol.org

Building Use Data Methodology

The methodology taken to calculate the carbon emission per emission type and scope are highly dependent on the data sources, data quality, and coverage provided. Largely, building use data across the Health Boards, Velindre Cancer Centre and WAST is collected centrally on Estates and Facilities Performance and Management System (EFPMS) data returns. This data source provides raw figures of consumption such as 'kWh' of energy, 'tonnes' of waste, and 'm^3' of water. In several cases the EFPMS data source was found to not provide the coverage required, this is since particular organizations are not included within EFPMS; for instance, the wider Velindre estate, and Public Health Wales. In these cases, data was sourced directly from these organizations, where data was provided in a similar format.

Energy emissions were calculated based on raw energy use data from NHS Wales, derived from the Estates and Facilities Performance and Management System (EFPMS) data returns multiplied by the appropriate emissions factors published by BEIS (UK Government GHG Conversion Factors used for Company Reporting[9]). Each published factor has been used in a direct calculation with no estimation.

All the electricity consumed by NHS Wales was assumed to be representative of the grid average emissions intensity (i.e. tCO$_2$e per kWh) in each given year. Electricity is fed to the national grid from a mix of energy sources (e.g. nuclear, gas, oil, and renewables). Because this mix has changed over time, the average grid intensity has also changed. Records of the national grid electricity mix in each year, along with BEIS's emissions intensity values for each energy source, have been used to calculate the emissions factors for electricity. Scope 2 data has been calculated on a location-based approach due to lack of data available for a market-based approach. A location-based approach estimates carbon emissions using published emission factors based on procurement spend for a specific procured goods or service category. An improvement for future Carbon Footprint assessments would be to undertake a market-based approach for key supplies; this would entail assessing specific supplier emissions factors (i.e. generation mix), so that carbon credentials of procured suppliers are reflected in NHS Wales' overall Footprint.

Upstream energy (Scope 3) emissions have been calculated based on the same data as provided for Scope 1 and 2 emissions calculations. Factors for upstream and 'well-to-tank' (WTT) have been used as published.

Water emissions have been calculated for both upstream and downstream emissions. This was also calculated with emission factors supplied by BEIS for both water supply and water treatment. Water supply and water treatment (sewerage) data has been made available and assessed, ground water is not included within the scope.

Waste emissions were calculated on total waste tonnage by treatment type emission factor. Waste data streams have been mapped across to BEIS emissions categories for calculation. This analysis

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[9] https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting#conversion-factors-2018

involved no estimation of waste volumes, and the EFPMS and individual sub-organizations (e.g. Public Health Wales) data has been wholly accounted for.

Key assumptions taken during analysis of building use data are as follows:

- Energy consumption data with EFPMS has been reported as 'kWh'. It is assumed that metering, and conversion factors to calculate 'kWh' consumption are correct, and that data is representative of the year period reported in EFPMS.
- Within EFPMS, other fuels such as heavy fuel oil, light fuel oil, kerosene, diesel (used for back-up generators) have all been reported under the heading 'oil'. For the purpose of this Carbon Footprint, the factors used for oil are taken for 'fuel oil' within carbon conversion factors.
- Biomass reporting with EFPMS is not defined between woodchip, wood-pellets, or wood-logs. For the purposes of this Carbon Footprint, the emissions factor for woodchip has been used (this is equivalent to the factor for wood-pellets)
- Within the Public Health Wales provided data, no defined consumption for sewerage was provided, for the purposes of this Carbon Footprint a 5% water non-return assumption was taken.
- It has been assumed that all CHP data reported within the EFPMS are located within each sites Scope 1 boundary, and that gas input consumption totals are accounted for with the whole site natural gas. No export of heat or electric from CHP has been assumed.
- It has been assumed that all renewable electric generation reported within EFPMS (wholly solar PV) are not exporting to grid, and that all systems are receiving Feed in Tariffs.
- EFPMS waste categories of 'high temperature', 'non-burn', and non-infectious offensive' have all been mapped across to the emissions factors for 'commercial and industrial waste – combustion'.

Transport Data Methodology

NHS Wales' direct fleet and fuel purchases have been attained from the procurement team at NWSSP. This data consisted of fuel spent on each Health Board and Trust feel via fuel cards. Fuel spend was then used to calculate litres of fuel which could then produce an output of total emissions by each Health Board. For Betsi Cadwaladr, a proportion split of litres of fuel was attained. This was then extrapolated to other NHS Wales bodies to apply an average percentage of diesel and petrol.

NHS Wales's business travel mileage was sourced from NWSSP Payroll Services. The data source for 2018/19 is the 'home to office' mileage data sheet provided which include overall business travel distance – this is a change in source from 2016/17 in which summarised data was provided. Data for business travel was categorized in to car, motorcycle, and public transport (assumed rail) mileage data. This was multiplied by the relevant emissions factors for each transport mode published by BEIS for 2016/17.

Staff travel emission data was calculated based on obtained NHS Payroll e-expenses data in which individual mileage claims have a deduction of 'home to office' mileage. This data was analysed to remove duplicates and inappropriate data (zeros / negatives) to produce an average mileage of 'home

to office' for each Health Board. For some Health Boards, proportion split of travel mode was obtained, this was extrapolated across all Health Boards.

Patient travel data was calculated based on publicly available NHS Wales admission episode numbers, staff commuting data and obtained patient travel survey results (2015) obtained from Hywel Dda. Results from four hospitals under Hywel Dda Health Board were used to calculate a proportion split of travel mode type and this was applied to admission data for all Health Boards.

Key assumptions taken during analysis of fleet transport data are as follows:
- Fuel card cost data is taken to be representative of each organization's fleet vehicle spend on fuel consumption
- 'BEIS – Weekly Fuel Prices 2018'[10] has been used to establish the average cost per litre of fuel

Key assumptions taken during analysis of business travel data are as follows:
- An assessment of payroll home to office expenses reports was undertaken and used to provide full business miles travelled (minus excess mileage)

Key assumptions taken during analysis of staff commute data are as follows:
- An assessment of payroll home to office expenses reports was undertaken.
- The subset of staff with expense mileage data is shown to be statistically representative sample for the commute distance of all staff.
- Home to office mileages showing negative or zero mileage have been filtered out of the data set. It has also been assumed that home to office mileages in expense claims are one-way journeys (based on a review of destination and office base postcodes; not home address postcodes)
- Cardiff & Vale, Hywel Dda, Public Health Wales, Velindre have provided staff travel surveys. This has been used to establish the mode of transport.
- During extrapolation, an assumption regarding number of journeys was required. Based on Hywel Dda travel surveys, it is found that 62% of staff work normal office hours and 38% work shift hours. It has been assumed that normal office hour staff make 5 commutes a week, and shift staff make 4 commutes a week. It has been assumed that there are 6 non-working weeks a year.

Key assumptions taken during analysis of patient/visitor transport data are as follows:
- Patient transport data has been based on the number of Finished Admission Episodes[11] (Patient Episodes), and number of visitors has been based on number of bed days. A key assumption is that there will be 1 return visitor journey per bed day.
- Cardiff & Vale and Hywel Dda patient / visitor travel surveys have been used to estimate the mode of transport, this has been assumed for all bodies.
- Cardiff & Vale and Hywel Dda patient / visitor surveys have been used as the basis for travel distance. In order to extrapolate this across the other regions, the Hywel Dda patient / visitor data has been proportioned to the staff commute distance (123% of staff commute distance),

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[10] https://www.gov.uk/government/statistical-data-sets/oil-and-petroleum-products-weekly-statistics
[11] https://gov.wales/statistics-and-research/hospital-admissions-data-online/?lang=en

and then this factor has been extrapolated using the staff commute distances as a basis for extrapolation.

Procurement Data Methodology

NHS Wales provided Carbon Trust with 'non-pay' procurement cost data for procured goods and services. This 'non-pay' data has been exported from the NHS Wales 'Oracle' system. In addition, supplementary cost data regarding 'drugs / pharmaceutical products' spend for Betsi Cadwaladr, Cardiff & Vale, and Hywel Dda has been provided to accounts for apparent missing 'non-pay' data from the Oracle system.

Carbon Trust uses an augmented version of 'OPEN IO', which is an open source of *'Environmental Economic Input Output'* (EEIO) data. EEIO data is available from the GHG Protocol (http://www.ghgprotocol.org/Third-Party-Databases/OPEN-IO), and provides an assessment of 430 economic sectors. EEIO was originally published by the University of Arkansas and the Sustainability Consortium. The EEIO factors cover cradle to gate emissions. The EEIO factors are sub-divided into Tier 1: Scope 1 & 2 emissions, Tier 1: supply chain emissions (i.e. Tier 1: supplier's own Scope 3 emissions), and upstream transport emissions of goods and services.

The methodological basis of EEIO emission factors is the use of economic input-output models to understand the gross domestic product (GDP) value of different sectors of the economy, and to associate that with the GHG emissions incurred by those sectors. At its simplest, the total GHG emissions of the sector is divided by the total GDP value generated by the sector to produce an EEIO emission factor of 'x' kg CO_2e/$ value. This represents the average CO_2e emissions per $ spent for each sector of the economy. Note that EEIO raw data values are published in US dollars.

Carbon Trust carry out an annual review of the OPEN IO database to ensure that it is aligned with changes in emissions efficiency, inflation and non-USD currencies.

To account for the changes in emissions efficiency (for example, grid decarbonisation) and inflation since the OPEN IO database was created, the EEIO emission factors are updated accordingly, using changes in efficiency and inflation. This value, published by the World Bank, is the kg CO_2e improvement per purchasing power parity (PPP) of GDP.

In order to convert the amount spent into USD (if using a non-USD currency), a PPP conversion factor is used (purchasing power parity). This is a currency conversion factor different to market exchange rates, which not only converts non-USD currency into USD, but also takes inflation over time into account. For example, it is possible to examine what the British pound was worth in USD according to year (2010 to present in this model). PPP also compares different countries' currencies through a market approach, so two currencies are in equilibrium when a market set of goods are priced the same in both countries. The actual purchasing power of any currency is the quantity of that currency required to buy a specified unit of a good.

The calculation methodology of emissions using EEIO factors is as follows, and described in the below formula.

1. Procurement categories are matched to the EEIO categories.
2. For each category, the spend (GBP) is converted to USD with the application of the PPP rate.
3. The spend is multiplied by the relevant EEIO factor to give the emissions for that category
4. The emissions for all categories are summed to give the total emissions for purchased goods and services.

$$Cat1_{EEIO} = \frac{Spend\ [GBP]}{PPPrate[GBP/USD]} \times EEIOfactor[kgCO_2e/USD]$$

A key stage in this process has been the mapping of NHS Wales's procurement spend descriptions. There are 82 unique spend descriptions in the NHS Wales procurement data. These were manually mapped to the most relevant EEIO goods/services descriptions based on wording and further descriptive explanations from NWSSP. Appendix 6 provides a full list of NHS Wales named procurement spend descriptions, and how these are mapped to 28 individual EEIO categories.

Key assumptions taken during analysis of procurement data are as follows:
- Procurement spend descriptions have been mapped to EEIO categories as per Appendix 6.
- EEIO published factors have been recalculated for grid carbon intensity since original publication date.
- PPP factors are determined for 2016/17, and applied in calculation as set out previously.
- Data has been provided with an un-named column including some costs. This data has been attributed to Velindre.
- Procurement data spend relating to 'Utilities & Rates' has been manually removed from procurement data to avoid replication of building use emissions.
- Procurement data spend relating to 'Travel, subsistence & removal expenses' has been manually removed from procurement data to avoid replication of transport emissions.
- EEIO categories have been re-named for the purpose of presentation in this Carbon Footprint, full details of EEIO renaming to procurement type are in Appendix 6.

Appendix 2 Emissions Footprint Boundary

At initiation of this and the previous Carbon Footprint assessment, an important step was taken to define the Footprint Boundary. This involved a mapping of all emissions, followed by an assessment as to whether each emission type should sit within the Footprint Boundary. The approach taken to determine if an emission type should be included has been a subjective assessment of the following:

- Does the emission type have any significance on overall Carbon Footprint, a particular scope, or a particular analysis category?
- Is actual data for this emission type practically available?
- Is the emission type directly manageable or directly influenced by NHS Wales (i.e. for mitigation action)?

If the answer to all three above questions is 'no', then particular emissions types were considered outside of the Footprint Boundary. In order to understand potential significance of an emission type, a review of the 2010 Carbon Footprint findings was undertaken.

The diagram below provides a visualization of emissions Footprint Boundary for this study. Emissions are categorized by scope, and are named in line with the GHG Protocol emission types. Notably, the majority of emission types considered outside of the Footprint Boundary are 'Scope 3 Downstream' emissions. This is largely due to the lack of products downstream from NHS Wales, the nature of the organization is such that there are no 'sold products'.
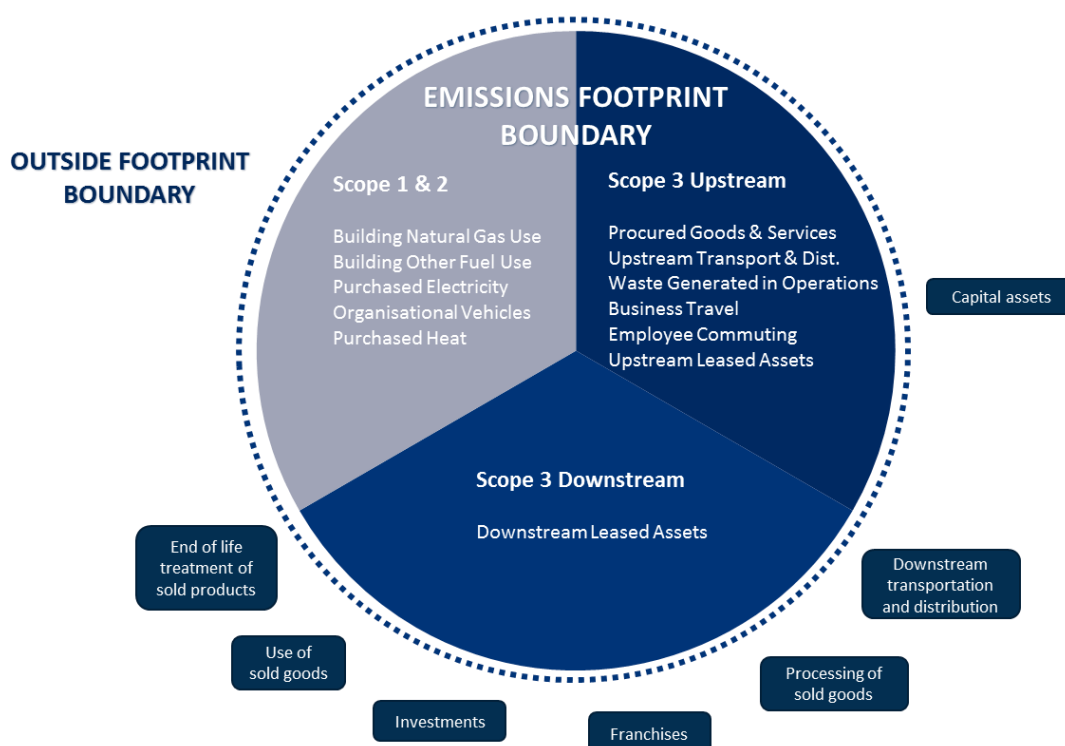
Figure 51 NHS Wales Carbon Footprint Emissions Boundary

The following table provides the rationale for emission types to be excluded from this study.

Table 4 Rationale for Emission Exclusion from Carbon Footprint Boundary

Scope	Emission Type	Exclusion Rationale
Scope 3 Upstream	Capital Assets	Data collection not viable
Scope 3 Downstream	Downstream Transportation & Distribution	No specific products / sold goods definable, or with available data
Scope 3 Downstream	Processing of Sold Goods	No specific products / sold goods definable, or with available data
Scope 3 Downstream	Use of Sold Goods	No specific products / sold goods definable, or with available data
Scope 3 Downstream	End of Life Treatment of Sold Products	No specific products / sold goods definable, or with available data
Scope 3 Downstream	Franchises	No franchises existing
Scope 3 Downstream	Investments	No investments defined

Appendix 3 Emissions Categorisation

Categorization beyond emission scope has been undertaken to support understanding and analysis of data. The categorization used is in line with the 2016/17 Carbon Footprint study to aid ease of comparison. Emission are split into three analysis categories; **Building Use, Transport,** and **Procurement.** These analysis categories are further split to greater demonstrate the type of emission. Analysis categories and types of emissions are as follow:

Table 5 Emissions by analysis category and type

Scope	Analysis Category	Type	Emission
Scope 1	Building Use	Energy	Natural Gas
Scope 1	Building Use	Energy	Oil
Scope 1	Building Use	Renewables	Biomass
Scope 1	Transport	Fleet	Diesel
Scope 1	Transport	Fleet	Petrol
Scope 2	Building Use	Energy	Electricity
Scope 2	Building Use	Renewables	Renewable Electricity
Scope 3	Building Use	Water	Water Supply
Scope 3	Building Use	Water	Water Treatment
Scope 3	Building Use	Upstream Energy	Upstream Electricity
Scope 3	Building Use	Upstream Energy	Natural Gas Well-to-Tank
Scope 3	Building Use	Upstream Energy	Oil Well-to-Tank
Scope 3	Building Use	Waste	Waste
Scope 3	Transport	Grey Fleet	Business Travel Fuel
Scope 3	Transport	Staff Commute	Staff Commute Fuel
Scope 3	Transport	Patient / Visitors	Patient / Visitor Fuel
Scope 3	Transport	Air Ambulance	Aviation Turbine Fuel
Scope 3	Transport	Air Ambulance	Aviation Turbine Fuel Well-to-Tank
Scope 3	Procurement		Purchased Good and Services

Building upon the table above, a full list of all data sources, and their emissions coverage, can be found in Appendix 3.

Appendix 4 NHS Wales Data Sources

Data has been provided from a variety of sources in NHS Wales. One of the major challenges during the process of this Carbon Footprint assessment has been to establish the coverage of each data source, and to identify replication with other data sources. Table 6 below provides details of a key selection of data sources used. This is not an all-encompassing list, and many other data sources were used to plug gaps in data coverage.

Table 6 Summary Data Sources

Selected Data Sources	Source
EFPMS: Estates and Facilities Performance Management System	NHSSSP - Specialist Estates Services
Fuel Card Cost Data	NWSSP - Procurement
Business Expense Mileages	NWSSP – Payroll
Business Expenses – Home to Work Base Mileages	NWSSP – Payroll
NHS Wales Categorised Procurement Spend	NWSSP - Procurement

Data Source	Source	Description
EFPMS: Estates and Facilities Performance Management System	NHSSSP - Specialist Estates Services	Health Board submission to a digital database providing consumption information and other metrics per Health Board / Trust at individual site level. Data streams within EFPMS include energy, waste, water, renewables, and CHP which are used as the base data for emissions calculations. Additionally, metrics such as staff numbers and patient bed days are available and are used as proxy data for extrapolation as required. Omissions from the EFPMS are Public Health Wales, Velindre NHS Trust (except for Velindre Cancer Centre which is included), and serval Health Board laundries.
Fuel Card Cost Data	NWSSP - Procurement	There are several providers covering Health Boards / Trusts, but the majority are centrally procured by NWSSP procurement. Fuel cards are used for NHS Wales fleet vehicles, including ambulances, and Health courier service. Raw transaction cost data has been provided; no fuel information or associated vehicle information has been provided. Data have been extrapolated using key assumptions in order to calculate the associated emissions. The only omission regarding fuel card data is Powys, which undertakes its own procurement of fuel cards, this data has been extrapolated.

Data Source	Source	Description
Business Expense Mileages	NWSSP – Payroll	All expense claims are made by NWSSP payroll. Summary information of this data has been shared to provide overall expense claim miles by Health Board / Trust. Mileage is further categorised by expense journey type. *This specific summary data has not been applied in 2018/19 – with preference to use the Home to Work Base Mileages data.*
Business Expenses – Home to Work Base Mileages	NWSSP – Payroll	Individuals' expense mileage claims include a subtraction of home to work base mileages. NWSSP payroll have provided a report from the expense system to show all business expenses including commute distances for individuals claiming travel expenses. Further assumptions regarding extrapolation for all employees, transport type, and number of journeys have been made.
BEIS Weekly Fuel Prices 2017	UK Government – BEIS website publication	Fuel cost data used as basis for transport petrol / diesel fuel rate assumptions.
NHS Wales – Health Board admission numbers		Hospital admissions numbers by Health Board / Trust have been sourced as publicly available information. This information has been used as a basis for estimation of patient visitor transport emissions. Base data for patient / visitor miles has been based on the staff commute distances, this has been undertaken to represent the demographic variation between Health Board.
NHS Wales Categorised Procurement Spend	NWSSP - Procurement	All purchased goods and services for NHS Wales are undertaken and reported via a central procurement portal - 'Oracle'. Cost data by Heath Board / Trust has been provided by NWSSP Procurement to show yearly procured cost by category and description. Description text has been used to map cost across for analysis. *In addition, supplier specific identified data has been utilised for 2018/19.* Additional 'Drugs / pharmaceutical products' spend via the Medusa procurement system has been supplied separately.
Wales Air Ambulance Fuel 2017/18	Babcock International	Flight hours and fuel consumption efficiencies for four air ambulance service areas / helicopter types.
Hywel Dda Patient and Staff Travel Survey	Hywel Dda Estates	There is limited staff and patient/visitor travel survey data available across the Health Boards. Historical Hywel Dda surveys have been made available and are used to form a basis of proportioning of travel mode, and as a

Data Source	Source	Description
		basis for patient / visitor distance travelled. *Used for basis of assumptions in 2016/17 and 2018/19.*
Cardiff & Vale Patient and Staff Travel Survey	Cardiff & Vale Travel Manager	Travel survey data utilised to compare centrally sourced distanced (commutes) and infer mode of travel.

Appendix 5 Data Sources, Coverage and Data Quality

An important step to calculate a verifiable footprint is the access to data of good quality, preferably - data that derives from primary sources. In order to determine the quality of data used, an assessment of data accuracy has been undertaken. Accuracy has been estimated across four levels, with an associated scoring value, and 'traffic light' system.

Table 7 Data Accuracy Scoring Description

Rating	Accuracy Description
	Accuracy deemed poor, low confidence in accuracy of data. Either no primary data made available with a high level of estimation used from other data (e.g. national averages), or minimal primary data available and a large amount of extrapolation used with assumptions deemed open to significant variability.
	Accuracy deemed reasonable, and there is some confidence in accuracy of data to give an estimated value. Some primary data made available, but a high amount of extrapolation is required to determine totals. Extrapolation is based on other primary data made available.
	Accuracy and confidence in data is deemed high. The majority of the data used is primary data, with some extrapolation used to cover missing data. Or data may be provided with whole coverage, but some assumptions are required to establish appropriate metrics for analysis.
	Whole coverage of data is provided, and close to exact output is considered with very high confidence. Comprehensive level of primary data, with either no assumptions, or minimal assumptions required which would adhere a low amount of variability.

In addition to scoring of data accuracy, an assessment of significance has been undertaken to support a review of importance of missing or low accuracy data, and to support an overall indication of how accurate the total overall outcome values are. Scoring of significance has been determined across four levels. Establishing level of significance is considered a subjective undertaking rather than determining data accuracy, comparison with 2016/17 findings has been used as a basis for significance rating.

Table 8 Data Significance Scoring Description

Rating	Significance Description
NONE	Data considered with significance a 'NONE' is deemed to have no material impact on the overall Carbon Footprint, and also no material impact on a particular scope, or analysis category of this Carbon Footprint.
LOW	Data with 'LOW' significance is recognised to have an impact on the Carbon Footprint, but is deemed to only have a marginal impact on the overall findings. To define further, data streams considered to have <20% impact on a particular scope, or analysis category will be considered as 'LOW' significance.
HIGH	Data with 'HIGH' significance is recognised to have a material impact on the overall Carbon Footprint findings, and also have a significant impact on a particular scope, or analysis category. To define further, data streams considered to have >20% impact on a particular scope / analysis category will be considered as 'HIGH' significance.
CRITICAL	Data considered with 'CRITICAL' significance is recognised to have major impact on the overall Carbon Footprint findings. This can be further defined as data streams considered to have >50% impact on a particular scope. In addition, this may be a data stream deemed important for decarbonisation activity.

Scope	Analysis Category	Type	Emission	NHS Wales Body	Data Source	Accuracy	Significance
Scope 1	Building Use	Energy	Natural Gas	Health Boards	EFPMS		**CRITICAL**
Scope 1	Building Use	Energy	Natural Gas	Velindre NHS Trust – VCC	EFPMS		**HIGH**
Scope 1	Building Use	Energy	Natural Gas	Velindre NHS Trust – WBS, NWIS	Velindre NHS Trust Totals 2018 – 19 annual Report		**LOW**
Scope 1	Building Use	Energy	Natural Gas	Velindre NHS Trust - NWSSP	NWSSP: 'CO2e Carbon Footprint Survey Summary All Sites YTD'		**NONE**
Scope 1	Building Use	Energy	Natural Gas	WAST	EFPMS		**NONE**
Scope 1	Building Use	Energy	Natural Gas	Public Health Wales	Public Health Wales – Emissions Calculations for 2018/19		
Scope 1	Building Use	Energy	Oil	Health Boards	EFPMS		**NONE**
Scope 1	Building Use	Energy	Oil	Velindre NHS Trust-VCC	EFPMS		**NONE**
Scope 1	Building Use	Energy	Oil	Velindre NHS Trust – WBS	Velindre NHS Trust Totals		**NONE**
Scope 1	Building Use	Energy	Oil	WAST	EFPMS		**NONE**
Scope 1	Building Use	Renewables	Biomass	Health Boards	EFPMS		**LOW**
Scope 1	Building Use	Energy	CHP	Health Boards	EFPMS		**LOW**
Scope 1	Transport	Fleet	Diesel	Health Boards	Fuel Cards		**LOW**
Scope 1	Transport	Fleet	Diesel	Velindre NHS Trust	Fuel Cards		**LOW**
Scope 1	Transport	Fleet	Diesel	WAST	Fuel Cards		**LOW**

Scope	Analysis Category	Type	Emission	NHS Wales Body	Data Source	Accuracy	Significance
Scope 1	Transport	Fleet	Diesel	Public Health Wales	Fuel Cards		**LOW**
Scope 1	Transport	Fleet	Petrol	Health Boards	Fuel Cards		**LOW**
Scope 1	Transport	Fleet	Petrol	Health Boards - PT			**LOW**
Scope 1	Transport	Fleet	Petrol	Velindre NHS Trust	Fuel Cards		**LOW**
Scope 1	Transport	Fleet	Petrol	WAST	Fuel Cards		**LOW**
Scope 1	Transport	Fleet	Petrol	Public Health Wales	Fuel Cards		**LOW**
Scope 2	Building Use	Energy	Electricity	Health Boards	EFPMS		**CRITICAL**
Scope 2	Building Use	Energy	Electricity	Velindre NHS Trust – VCC	EFPMS		**CRITICAL**
Scope 2	Building Use	Energy	Electricity	Velindre NHS Trust – WBS, NWIS, NWSSP	Velindre NHS Trust Totals 2016 – 17 annual Report		**CRITICAL**
Scope 2	Building Use	Energy	Electricity	WAST	EFPMS		**CRITICAL**
Scope 2	Building Use	Energy	Electricity	Public Health Wales	Public Health Wales – Emissions Calculations for 2018/19		**CRITICAL**
Scope 2	Building Use	Renewables	Renewable Electricity	Health Boards	EFPMS		**LOW**
Scope 2	Building Use	Renewables	Renewable Electricity	Velindre NHS Trust - VCC	EFPMS		**LOW**
Scope 3	Building Use	Water	Water Supply	Health Boards	EFPMS		**HIGH**

Scope	Analysis Category	Type	Emission	NHS Wales Body	Data Source	Accuracy	Significance
Scope 3	Building Use	Water	Water Supply	Velindre NHS Trust - VCC	EFPMS		**HIGH**
Scope 3	Building Use	Water	Water Supply	Velindre NHS Trust – WBS, NWIS, NWSSP	Velindre NHS Trust		**HIGH**
Scope 3	Building Use	Water	Water Supply	WAST	EFPMS		**HIGH**
Scope 3	Building Use	Water	Water Supply	Public Health Wales	Public Health Wales – Emissions Calculations for 2016-17		**HIGH**
Scope 3	Building Use	Water	Water Treatment	Health Boards	EFPMS		**HIGH**
Scope 3	Building Use	Water	Water Treatment	Velindre NHS Trust - VCC	EFPMS		**HIGH**
Scope 3	Building Use	Water	Water Treatment	Velindre NHS Trust – WBS, NWIS, NWSSP	Velindre NHS Trust Totals		**HIGH**
Scope 3	Building Use	Water	Water Treatment	WAST	EFPMS		**HIGH**
Scope 3	Building Use	Water	Water Treatment	Public Health Wales	Public Health Wales – Emissions Calculations for 2018/19		**HIGH**
Scope 3	Building Use	Upstream Energy	Upstream Electricity	Health Boards			**NONE**
Scope 3	Building Use	Upstream Energy	Upstream Electricity	Velindre NHS Trust			**NONE**

Scope	Analysis Category	Type	Emission	NHS Wales Body	Data Source	Accuracy	Significance
Scope 3	Building Use	Upstream Energy	Upstream Electricity	WAST			NONE
Scope 3	Building Use	Upstream Energy	Upstream Electricity	Public Health Wales			NONE
Scope 3	Building Use	Upstream Energy	Natural Gas WTT	Health Boards			NONE
Scope 3	Building Use	Upstream Energy	Natural Gas WTT	Velindre NHS Trust			NONE
Scope 3	Building Use	Upstream Energy	Natural Gas WTT	WAST			NONE
Scope 3	Building Use	Upstream Energy	Natural Gas WTT	Public Health Wales			NONE
Scope 3	Building Use	Upstream Energy	Oil WTT	Health Boards			NONE
Scope 3	Building Use	Upstream Energy	Oil WTT	Velindre NHS Trust			NONE
Scope 3	Building Use	Upstream Energy	Oil WTT	WAST			NONE
Scope 3	Building Use	Upstream Energy	Oil WTT	Public Health Wales			NONE
Scope 3	Building Use	Waste	Waste	Health Boards	EFPMS		NONE
Scope 3	Building Use	Waste	Waste	Velindre NHS Trust – VCC	EFPMS		NONE

Scope	Analysis Category	Type	Emission	NHS Wales Body	Data Source	Accuracy	Significance
Scope 3	Building Use	Waste	Waste	Velindre NHS Trust – WBS, NWIS, NWSSP	Velindre NHS Trust Totals		NONE
Scope 3	Building Use	Waste	Waste	WAST	EFPMS		NONE
Scope 3	Building Use	Waste	Waste	Public Health Wales	Public Health Wales – Emissions Calculations for 18/19		NONE
Scope 3	Transport	Grey Fleet	Business Travel Fuel	Health Boards	NWSSP Payroll Expenses		LOW
Scope 3	Transport	Grey Fleet	Business Travel Fuel	Velindre NHS Trust	NWSSP Payroll Expenses		LOW
Scope 3	Transport	Grey Fleet	Business Travel Fuel	WAST	NWSSP Payroll Expenses		LOW
Scope 3	Transport	Grey Fleet	Business Travel Fuel	Public Health Wales	NWSSP Payroll Expenses		LOW
Scope 3	Transport	Staff Commute	Staff Commute Fuel	Health Boards	NWSSP Payroll Expenses (Home to work claim reductions)		HIGH
Scope 3	Transport	Staff Commute	Staff Commute Fuel	WAST	NWSSP Payroll Expenses (Home to work claim reductions)		HIGH
Scope 3	Transport	Staff Commute	Staff Commute Fuel	Public Health Wales	NWSSP Payroll Expenses (Home to work claim reductions)		HIGH

Scope	Analysis Category	Type	Emission	NHS Wales Body	Data Source	Accuracy	Significance
Scope 3	Transport	Patient / Visitors	Patient / Visitor Fuel	Health Boards	NHS Wales Patient Admissions Data; and C&V, Hywel Dda patient travel survey		HIGH
Scope 3	Transport	Patient / Visitors	Patient / Visitor Fuel	Velindre NHS Trust	NHS Wales Patient Admissions Data; and C&V, Hywel Dda patient travel survey		HIGH
Scope 3	Transport	Patient / Visitors	Patient / Visitor Fuel	WAST			NONE
Scope 3	Transport	Patient / Visitors	Patient / Visitor Fuel	Public Health Wales			NONE
Scope 3	Transport	Air Ambulance	Aviation Turbine Fuel	WAST	Babcock International		NONE
Scope 3	Transport	Air Ambulance	Aviation Turbine Fuel WTT	WAST	Babcock International		NONE
Scope 3	Procurement		Purchased Good and Services	Health Boards	NWSSP Procurement – non-pay data from Oracle		CRITICAL
Scope 3	Procurement		Purchased Good and Services	Velindre NHS Trust	NWSSP Procurement – non-pay data from Oracle		CRITICAL
Scope 3	Procurement		Purchased Good and Services	WAST	NWSSP Procurement – non-pay data from Oracle		CRITICAL

Scope	Analysis Category	Type	Emission	NHS Wales Body	Data Source	Accuracy	Significance
Scope 3	Procurement		Purchased Good and Services	Public Health Wales	NWSSP Procurement – non-pay data from Oracle		**CRITICAL**
Scope 3	Procurement		Purchased Good and Services – Drugs / pharmaceutical products Spend	Betsi Cadwaladr, Cardiff & Vale, Hywel Dda	NWSSP Procurement – Medusa drugs / pharmaceutical products spend		**CRITICAL**

Appendix 6 Procurement Spend Mapping

Procurement Spend Mapping to EEIO Category

Spend Description (ACCDescription)	EEIO Category
Advertising	Advertising and related services
Uniforms & Clothing	Apparel (cut and sewn)
Non Cash Limited Expenditure	Average - Capital goods
Computer Maint & External Non NHS Data/Comp Contracts	Computer related services, including facilities management
Building & Engineering Equipment	Construction machinery
Bedding & Linen	Curtains and linen
Dental Prosthesis	Dental equipment and supplies
Laboratory Equipment - Maintenance	Electronic and precision equipment repair and maintenance services
M&SE Maintenance	Electronic and precision equipment repair and maintenance services
X-Ray Equipment - Maintenance	Electronic and precision equipment repair and maintenance services
Footwear Adaption Maintenance & Repair	Electronic and precision equipment repair and maintenance services
Hearing Aids : Repairs	Electronic and precision equipment repair and maintenance services
ALAC: Environmental Controls	Environmental control equipment (automated)
Provisions & Catering	Food services and drinking places
Furniture, Office & Computer Equip	Furniture (institutional)
Contractual Clinical Services	Hospital services
Purchase Of Health Care Services	Hospital services
Other Establishment Costs	Hospital services
Contract Hotel Services	Hotels and motels, including casino hotels
Laundry Equipment & Materials	Laundry equipment for households
External Contract Staffing & Consultancy	Management, scientific, and technical consulting services
Laboratory Equipment - Purchases	Medical and diagnostic labs and outpatient and other ambulatory care services
Other Clinical Services & Supplies	Medical and diagnostic labs and outpatient and other ambulatory care services
General Medical Services	Medical and diagnostic labs and outpatient and other ambulatory care services
Drugs / pharmaceutical products	Medicinal and botanical products
FNC & CHC	Nursing and residential care services
Ophthalmic Implants	Ophthalmic goods
Pharmaceutical Services	Pharmaceutical preparations
Secondary Healthcare	Professional, scientific, and technical services (miscellaneous)
Postage	Postal services
Printing & Stationery	Printing services

Spend Description (ACCDescription)	EEIO Category
Building & Engineering Contracts	Professional, scientific, and technical services (miscellaneous)
External General Service Contracts	Professional, scientific, and technical services (miscellaneous)
Other General Supplies & Services	Professional, scientific, and technical services (miscellaneous)
Other Miscellaneous Services	Professional, scientific, and technical services (miscellaneous)
Auditors Remuneration	Professional, scientific, and technical services (miscellaneous)
Cleaning Equip. & Materials	Soap and cleaning compounds
Breast Implants	Surgical appliances and supplies
M&S Prosthesis General	Surgical appliances and supplies
M&SE PURCHASES	Surgical appliances and supplies
Maxillo Facial Implants	Surgical appliances and supplies
Orthopaedic Implants - NJR Registration Fees	Surgical appliances and supplies
Orthopaedic Implants - Other	Surgical appliances and supplies
Orthopaedic Implant - Trauma	Surgical appliances and supplies
Orthopaedic Implants - Hips	Surgical appliances and supplies
Orthopaedic Implants - Knees	Surgical appliances and supplies
Orthopaedic Implants Foot/Ankle	Surgical appliances and supplies
Orthopaedic Implants Hands	Surgical appliances and supplies
Orthopaedic Implants Shoulders	Surgical appliances and supplies
Orthopaedic Implants Spines	Surgical appliances and supplies
Pacemakers	Surgical appliances and supplies
Vascular Implants	Surgical appliances and supplies
Voice Prosthesis	Surgical appliances and supplies
X-Ray Film & Chemicals - Purchases	Surgical appliances and supplies
Orthopaedic Implant - Upper Limb	Surgical appliances and supplies
X-Ray Equipment - Purchases	Surgical appliances and supplies
ALAC: Buggies & Accessories	Surgical appliances and supplies
ALAC: Contract	Surgical appliances and supplies
ALAC: Disabled Living Aids	Surgical appliances and supplies
ALAC: Disabled Living Aids / Accessories	Surgical appliances and supplies
ALAC: Limbs	Surgical appliances and supplies
ALAC: Mods / Construction	Surgical appliances and supplies
ALAC: New Wheelchairs	Surgical appliances and supplies
ALAC: Non-Contract	Surgical appliances and supplies
ALAC: Prosthesis	Surgical appliances and supplies
ALAC: Re-Conditioned Wheelchairs	Surgical appliances and supplies
ALAC: Spares	Surgical appliances and supplies
ALAC: Special Cushions	Surgical appliances and supplies

Spend Description (ACCDescription)	EEIO Category
ALAC: Special Seating	Surgical appliances and supplies
ALAC: Storage	Surgical appliances and supplies
ALAC: War Pensioners	Surgical appliances and supplies
ALAC: Wheelchairs	Surgical appliances and supplies
Breast Care Prosthesis	Surgical appliances and supplies
Cochlear Implants	Surgical appliances and supplies
DRESSINGS	Surgical appliances and supplies
Hearing Aids : Purchases	Surgical appliances and supplies
Low Visual Appliances	Surgical appliances and supplies
Patients Appliances : Lease	Surgical appliances and supplies
Patients Appliances : Purchase	Surgical appliances and supplies
ALAC: Out Of Range Chairs	Surgical appliances and supplies
Telephones	Telephone apparatus
Other Transport & Moveable Plant	Truck transportation services

Procurement Category Renaming for Report Understanding

EEIO Category	Procurement Type Name
Advertising and Related Services	Advertising
Apparel (Cut and Sewn)	Uniforms
Average - Capital Goods	Non Cash Expenditure
Computer Related Services, Including Facilities Management	Computer related services, including facilities management
Construction Machinery	Building & Engineering Equip.
Curtains and Linen	Bedding and linen
Dental Equipment and Supplies	Dental Prosthesis
Electronic And Precision Equipment Repair and Maintenance Services	Electronic and precision equipment repair and maintenance services
Environmental Control Equipment (Automated)	Environmental control equipment
Food Services and Drinking Places	Food Provisions & Catering
Furniture (Institutional)	Furniture, Office & Computer Equip.
Hospital Services	Purchased Healthcare Services
Hotels and Motels, Including Casino Hotels	Contract Hotel Services
Laundry Equipment for Households	Laundry Equip. & Materials
Management, Scientific, and Technical Consulting Services	External Contract Staff & Consultancy
Medical and Diagnostic Labs and Outpatient and Other Ambulatory Care Services	Lab Equip & Other Clinical Services / Supplies
Medicinal and Botanical Products	Drugs / pharmaceutical products
Nursing and Residential Care Services	Continuing Healthcare & Funded Nursing Care
Ophthalmic Goods	Ophthalmic Implants
Pharmaceutical Preparations	Pharmaceutical Services
Physicians, Dentists, and Other Health Practitioners	Secondary Healthcare
Postal Services	Postal services
Printing Services	Printing & Stationary
Professional, Scientific, and Technical Services (Miscellaneous)	Services to other NHS Bodies / Universities
Soap and Cleaning Compounds	Cleaning Equip.
Surgical Appliances and Supplies	Medical Equipment & Supplies
Telephone Apparatus	Telephone apparatus
Truck Transportation Services	Moveable Plant & Other Transport

Appendix 7 Fixed Variations and Data Variations

Fixed Variations

Emission factors applied in both this Footprint and the 2016/17 Footprint are sourced from BEIS emission factors[12]. Emissions factors are updated yearly in order to reflect carbon intensity of each emission within that year period. The impact of these 'fixed variations' must be considered during Footprint comparison analysis. Some of the key BEIS factors used in this footprint and their changes between 2016/17 and 2018/19 are shown in Table 9 below.

The most significantly different emission factor is that of electricity generation. This decrease is as a result of the decarbonisation of the UK electricity grid due to the increased proportion of renewable electricity generation feeding in to the national grid and reduced coal. In addition, the emissions factors relating to transport have decreased, with the average car on the road estimated to be 3.4% less carbon intensive for GHG emissions reporting.

Table 9 Summary Emission Factors Variation 2016/17 vs. 2018/19

	2016/17 BEIS Conversion Factor (kgCO$_2$e)	2018/19 BEIS Conversion Factor (kgCO$_2$e)	Variation (%)
Electricity (/kWh)	0.4121	0.2831	- 31.3%
Oil (/kWh)	0.2763	0.2765	+ 0.1%
Natural Gas (/kWh)	0.1840	0.1840	0%
Biomass (/kWh)	0.0131	0.0151	+ 15.3%
Diesel (/litre)	2.6116	2.6270	+ 0.6%
Petrol (/litre)	2.1970	2.2031	+ 0.3%
Average Diesel Car (/mile)	0.2945	0.2857	- 3.0%
Average Petrol Car (/mile)	0.3088	0.2956	- 4.3%
Average Car Unknown Fuel (/mile)	0.3009	0.2907	- 3.4%

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[12] https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

Figure 52 below illustrates this decrease in grid electricity carbon intensity over the last decade and highlights that since the last NHS Wales carbon footprint, the carbon intensity of grid electricity has decreased by ~32%. This graph also shows that carbon intensity of natural gas remains constant over time.
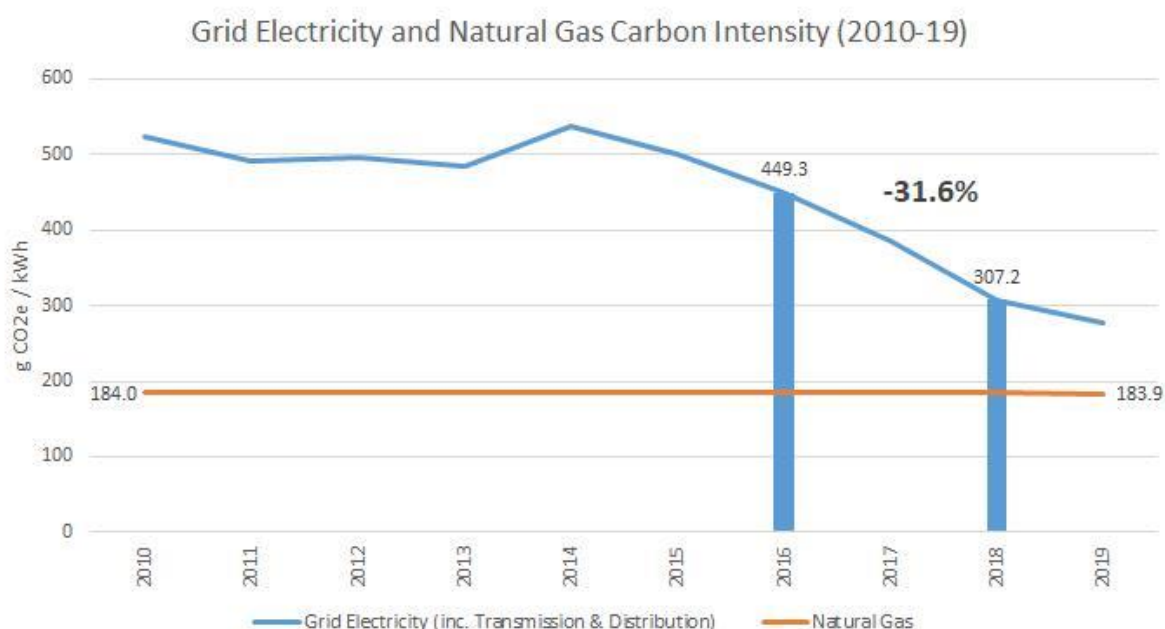

Figure 52 UK Grid Electricity and Natural Gas Carbon Intensity 2010-2019

The basis for procurement emission calculation is financial spend data which is then applied to EEIO calculation factors (this methodology is further explained in Appendix 1). A fixed variation between 16/17 and 18/19 occurs with the application of inflation on costs for goods and services, and the impact of decarbonisation of the supply chain (similar to UK grid electricity decarbonisation). Overall, the impact of this is a fixed 9.2% reduction on estimated carbon emissions for each EEIO factor.

Data Variations

Waste EFPMS landfill data for 2018/19 for all Health Boards is managed in a different way from 2016/17. In the majority, all waste previously reported as landfill is now captured under the 'Waste Recovery/Recycling' EFPMS category. The impact of this is significant, Table 10 demonstrates that this significant volume of waste is now reported against an emissions factor shown to be 89% less carbon intensive.

Table 10 Impact of EFPMS Waste Reporting

2016/17 Commercial Waste to Landfill Conversion Factor (kgCO$_2$e/tonne)	2018/19 Commercial Waste to Recovery/Recycling Conversion Factor (kgCO$_2$e/tonne)	Variation (%)
199.00	21.38	-89.3%

A variation to the data source for business has been applied for 2018/19. Numerous iterations of summary expenses data showed significant variation. For 2018/19 the expenses data provided to estimate 'home to base' has been deemed to be expense related data in the rawest format and

therefore used as a basis for business miles calculation. For the purposes of comparison analysis – the similar 2016/17 data is deemed not suitable to be applied for estimate all business travel – therefore an amendment to the 2016/17 footprint has been made to reflect 2018/19 data to ensure no apparent skew in overall results. This specific data aspect requires further clarification and standardisation for future footprinting.

It should also be noted, that adjustments have been made to the 2016/17 carbon footprint to ensure alignment for comparability. This is also undertaken as further data related to 2016/17 has been provided. Adjustments include:

- Update and accuracy improvement of drug / pharmaceutical spend data

- Removal of procurement spend categories deemed out of scope (e.g. legal spend data)

- Adjustment of patient travel assumptions to remove travel by NHS ambulance

- Adjustment of business travel mileages

- Addition of spend associated with the 'Services to other NHS bodies / Universities' matched to 18/19 for accurate comparison

References

References

- BEIS, 2018, UK Government GHG Conversion Factors used for Company Reporting, https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

- Greenhouse Gas Protocol, https://ghgprotocol.org/

- Environmental Reporting Guidelines: Including streamlined energy and carbon reporting guidance, https://www.gov.uk/government/publications/environmental-reporting-guidelines-including-mandatory-greenhouse-gas-emissions-reporting-guidance

- BEIS, Weekly Fuel Prices 2018, https://www.gov.uk/government/statistical-data-sets/oil-and-petroleum-products-weekly-statistics

- Welsh Government, Patient Episode Database for Wales, https://gov.wales/statistics-and-research/hospital-admissions-data-online/?lang=en

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