Codema
Dublin's Energy Agency

Comhairle Cathrach
Bhaile Átha Cliath
Dublin City Council

DUBLIN CITY COUNCIL ENERGY REVIEW 2017

01. INTRODUCTION

Codema has developed this Energy Review on behalf of Dublin City Council (DCC), which is the largest local authority in Ireland. The aim of this Energy Review is to highlight the total amount of energy DCC consumed in 2017, along with the total cost and carbon emissions associated with this energy use.

This Energy Review also aims to clearly demonstrate where energy is used in the council, what drives its consumption, and where the greatest energy-saving potential is; this will help DCC to identify where it currently is in relation to public sector energy targets, and what areas it needs to prioritise in order to meet these targets between now and 2020.

As part of this process, Codema has analysed DCC's total energy use and broken this down into six Significant Energy Users (SEUs), which are explained in detail within this Energy Review. Codema gives an overview of the current energy use associated with each SEU, and provides recommendations on the action DCC must take to reduce energy consumption in each SEU area and meet 2020 targets.

PUBLIC LIGHTING

OFFICES & DEPOTS

HOUSING

TRANSPORT

SPORTS FACILITIES

FIRE STATIONS

Current Status & Obligations

In 2017, DCC consumed a total of 186 GWh of primary energy[1]; this is the equivalent of 39,590 tonnes of CO_2, and Codema estimates the associated cost of this energy use to be approximately €13 million.

This information comes from Codema's database, which incorporates the data from the Monitoring and Reporting (M&R) system developed by the Sustainable Energy Authority of Ireland (SEAI) and the Department of Communications, Climate Action and Environment (DCCAE). It is important to note that these figures may vary, as changes to data within the M&R system for previous years are accounted for, such as the addition of missing accounts or the removal of accounts that are no longer linked to DCC. These changes are made throughout the system, from the baseline year to date, and don't affect the baseline or reduction target.

Codema has been entering this yearly data into the M&R system on behalf of DCC since 2011, in order to comply with the reporting requirements of the European Energy Efficiency Directive 2012/27/EU. The directive has been transposed into Irish Law as Statutory Instrument S.I. 426 of 2014, which sets out several obligations on public bodies with respect to their "exemplary role" for energy efficiency by achieving savings of 33% by 2020. This is an average reduction target of 3% per year.

To date, as reported by the M&R system, DCC has improved its energy performance by 29.8%, compared to the baseline year, which is an average of between 2006-2008. This amounts to a cumulative absolute saving of 39.9 GWh of primary energy or 9,470 tonnes of CO_2. This means that DCC must improve its energy performance by 3.2% in its buildings and operations between now and 2020, in order to meet the 33% public sector target.

Based on the findings from last year's Energy Review and the appointment of its Energy Performance Officer (EPO), Dublin City Council established an Inter-Departmental Energy Oversight Committee in 2017. Codema helped facilitate these committee meetings in order to identify and cost potential projects in areas such

1. Primary energy (TPER) is an energy form that has not been subjected to any conversion or transformation process. It is energy received as input to a system. Primary energy can be non-renewable or renewable.

DCC Energy Overview 2017

CONSUMED 186 GWH OF PRIMARY ENERGY

39,590 TONNES OF CO_2 EMITTED

€13 MILLION ASSOCIATED ENERGY COST

Public Sector Obligations

ACHIEVE SAVINGS OF 33% BY 2020

REDUCTION TARGET OF 3% PER YEAR

DCC Progress: Baseline - 2017

IMPROVED ENERGY PERFORMANCE BY 29.8%

9,470 TONNES OF CO_2 SAVED

3.2% IMPROVEMENT REQUIRED TO MEET THE 33% PUBLIC SECTOR TARGET

01. INTRODUCTION
(CONTINUED)

as Public Lighting, Offices and Depots, Housing, Fire Stations, Sports Facilities, Libraries and Transport, which will help the council stay on track of 2020 energy targets. The first project proposals were finalised in December 2017, and are earmarked for completion in 2018. Codema will continue to work with the Energy Oversight Committee in 2018 to identify further potential energy saving projects, based on the findings of this Energy Review, and will aim to develop an Energy Management System throughout the whole of DCC, as part of this process.

Methodology

In order to calculate potential energy savings in DCC, it is necessary to analyse changes in other factors that are directly related to the council's energy use. With this in mind, Codema uses Energy Performance Indicators (EnPIs) to measure DCC's energy performance more accurately. This method determines how efficiently DCC is using energy, as it is normalised to account for changes in the activity level related to the energy use, or the "activity metric", of the local authority. This is a measure of the key activity that has the greatest influence on energy consumption. An EnPI is calculated by dividing the organisation's Total Primary Energy Requirement (TPER) by an activity metric.

When there are multiple variables that drive energy consumption, a composite performance indicator is used. Determining a single performance indicator for complex situations where multiple variables drive consumption can be difficult, because different aspects of the facility consume different amounts of energy and are driven by different variables. In such cases, a composite performance indicator based on more than one variable is used. The scale of each variable's contribution is defined by a weighting scale.

In the case of DCC, the overall performance indicator is based on population served. Therefore, DCC's EnPI is the TPER divided by the population served for that year. Therefore, the performance of DCC is determined not only by its annual energy use, but also by a rise or fall in population in the Dublin City area in the same year. Savings are based on cumulative absolute primary energy and carbon savings from the baseline year to 2017.

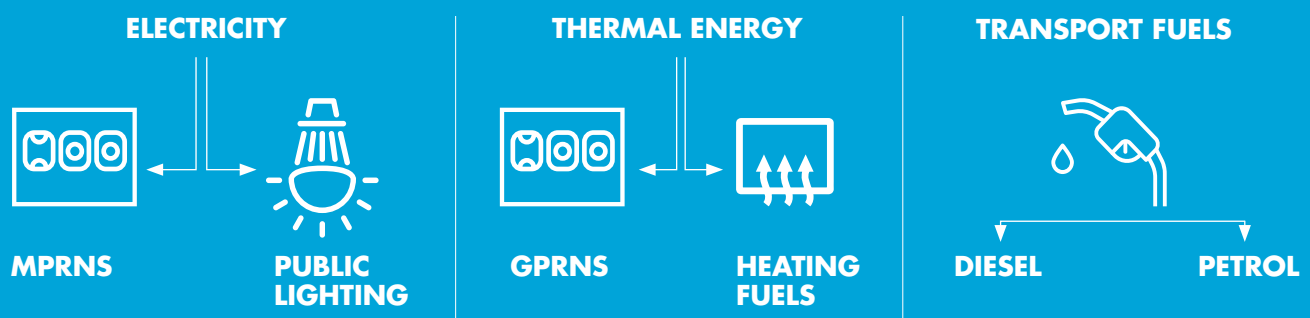
In 2010, the Dublin Local Authorities outsourced waste collection within the region. Also, in 2013, water services within the local authorities were transferred to Irish Water. The M&R system and Codema's database have provisions to account for these changes, and therefore accurately track the actual energy performance of the local authority from the baseline year to 2017, which takes proper account of services that have been outsourced.

Formula for Calculating EnPIs for SEUs

$$\text{ACTIVITY}_0 = \sum_{i=1}^{x} \left(\frac{\text{Subactivity}_i}{\text{Subactivity}_{i,\text{baseline}}} \times \text{Weighting}_i \times 1{,}000 \right)$$

02. DCC ENERGY CONSUMPTION 2017

The energy database shows that DCC consumed 186 GWh of primary energy and produced 39,590 tonnes of CO_2 in 2017. Codema estimates the costs associated with this energy use to be approximately €13 million for the year. This is broken down into three principal energy categories; electricity, gas/heating and transport fuels. Electricity consumption comprises of metered electrical accounts (MPRNs) from DCC's buildings and unmetered public lights. Thermal energy consumption consists of metered gas accounts (GPRNs) and heating fuels data from buildings, and transport accounts for all the transport fuels within DCC, i.e. diesel and petrol.



02. DCC ENERGY CONSUMPTION 2017
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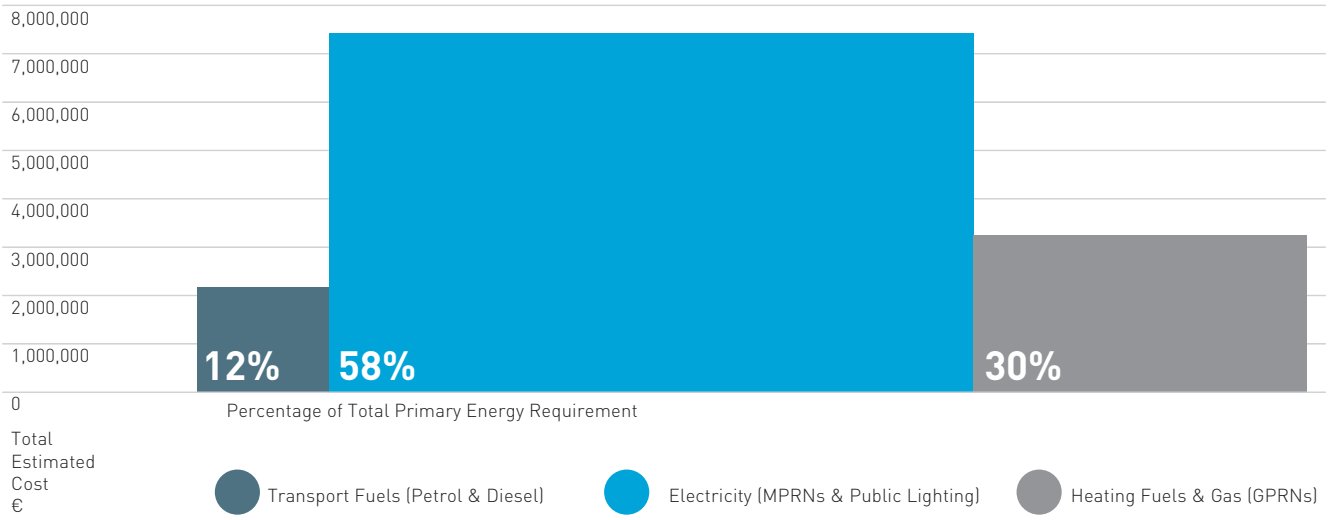

Figure 1: DCC Energy Categories - 2017

Figure 1 above shows the breakdown of the consumption categories. The height represents the total estimated cost of that energy type, and each coloured area highlights what percentage of the overall energy use this energy type accounts for.

Electricity accounts for the largest share of energy consumed at approximately 58%. The reasons for this are the large number of public lights in the Dublin City area and the high conversion factor of electricity from Total Final Consumption (TFC) to Total Primary Energy Requirement (TPER). The reason for the high conversion factor is to account for the high losses on the transmission system in Ireland, and the carbon-intensive method in which Ireland generates electricity.

With regards to the energy cost, the analysis is much more complex, as fuel tariffs vary and the various energy accounts have different suppliers. Also, the local authority's targets are measured in energy efficiency, not cost savings. In order to estimate the total cost of energy attributable to the different energy categories, Codema has used average national prices for electricity, heating gas and the different fuel types sourced from SEAI's commercial fuel cost comparison charts.

The energy database shows that DCC improved its energy performance by 29.8% between the baseline year and 2017. This represents a cumulative absolute saving of 39.9 GWh of primary energy or 9,470 tonnes of CO_2 from the baseline year to 2017. This highlights a gap-to-target of 3.2%, meaning that DCC must improve its energy performance by a further 3.2% between now and 2020, in order to meet its 33% target. This is estimated to be a cumulative absolute saving of 9 GWh[2] in primary energy.

Figure 2 on the next page illustrates DCC's absolute energy consumption compared to the baseline. Figure 3 illustrates DCC's normalised annual energy performance compared to the 33% glidepath. This takes into account the rise and fall of the activity metrics, and tracks them compared to DCC's TPER of all fuel sources.

As highlighted in last year's Energy Review, there was a significant decrease in energy consumption between 2010 to 2014; this is attributable to all SEUs within DCC, with the largest reductions coming from Offices and Depots, Housing, Sports Facilities and Transport.

Figures 2 and 3 also show a steady decrease in energy consumption across DCC since 2015. This decrease is attributable to all SEUs but Housing and Sports Facilities have made the most notable improvements. Housing has achieved significant savings from the Heating, Ventilation and Air Conditioning (HVAC) Division's Managed Energy Services Agreement (MESA) project and the Better Energy Communities (BEC) project in 2016, both of which resulted in a number of upgrades being carried out in this area. The reduction in Sports Facilities in 2017 is largely due to the Energy Performance Contract (EPC) that upgraded three of DCC's largest leisure centres the previous year. All measures that are linked to this energy reduction in the different SEU areas are outlined further on in this Energy Review.

2. Codema calculated this figure using SEAI's gap-to-target tool, which takes into account the potential changes in the conversion factors and percentage increases of the activity metrics up until 2020.

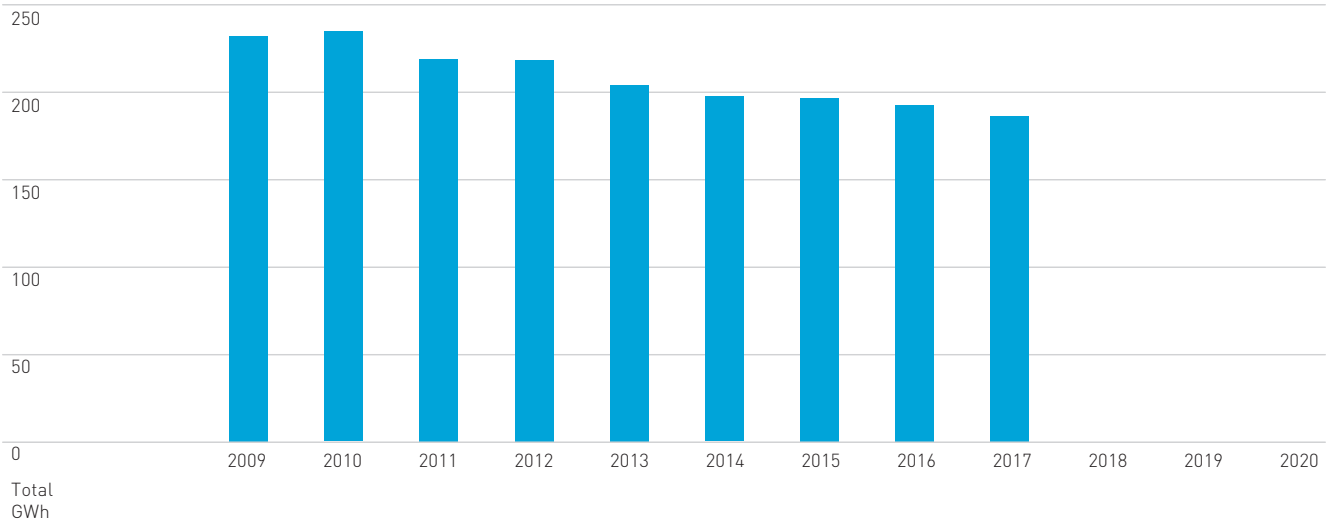

Figure 2: DCC Absolute Annual Energy Consumption

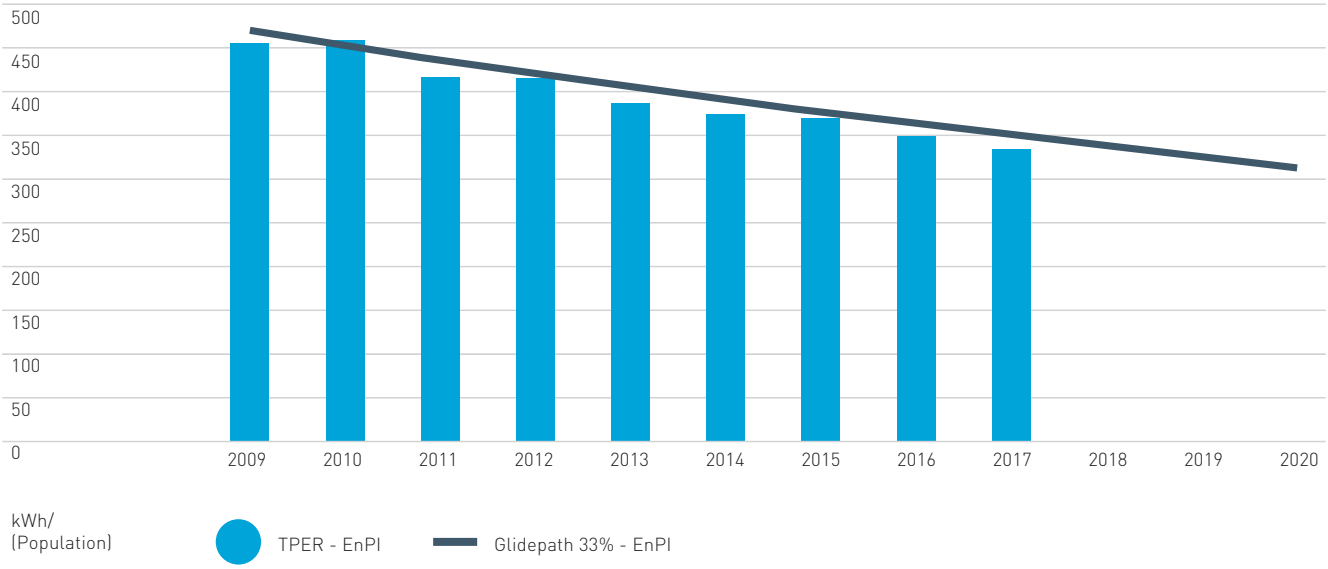

Figure 3: DCC Annual Energy Performance Compared to 33% Glidepath

03. SIGNIFICANT ENERGY USERS

To help better understand DCC's energy use, Codema has broken up the council's total energy consumption into Significant Energy Users (SEUs). These SEUs help identify the measures that will contribute most effectively to energy savings and will have the most positive impact on energy efficiency targets.

This approach ensures the most efficient use of resources for maintaining and improving energy efficiency in critical areas within DCC. Codema developed these SEUs by creating an energy database, which includes all the data reported in the M&R system, data compiled by Codema through energy audits, and direct contact with DCC staff.

Codema compiled all of the council's electricity and gas accounts and developed a full list of buildings by marrying electrical and gas accounts for each of these buildings. DCC's Transport Department provided all of the fuels data, and all data on public lighting was compiled through contact with the Public Lighting Department and the Unmetered Registrar (UMR).

The database gives a breakdown of each of DCC's SEUs into Total Primary Energy Requirement (TPER), CO_2, and cost year-on-year, and compares this back to the baseline. Codema also compares this data to an energy performance indicator to track the energy performance of each SEU.

By analysing this data, Codema has identified six key areas, or SEUs, within the council. These account for 85% of DCC's total primary energy requirement and can be broken down as follows:

PUBLIC LIGHTING 25%

OFFICES & DEPOTS 16%

HOUSING 15%

TRANSPORT 12%

SPORTS FACILITIES 11%

FIRE STATIONS 6%

Figure 4 shows the breakdown of DCC's SEUs. Public Lighting is the largest SEU, accounting for 25% of the total load. This is followed by Offices and Depots at 16%, which comprise of all the area offices and depots around the city, and also the Civic Offices on Wood Quay. Housing is accountable for 15%, while Transport accounts for 12% of the total load. Sports Facilities account for 11%, while Fire Stations make up 6% of the total load. The remainder of the consumption is made up of smaller accounts within DCC, such as libraries, heating fuels and smaller electrical accounts.

The management of energy in these six SEUs is critical for DCC to achieve its 33% energy reduction target. For this reason, the DCC Energy Oversight Committee has targeted these areas and has identified potential energy saving projects to be implemented from 2018. These projects are highlighted further on in the individual SEU chapters in this report.

Figure 5 shows how the SEUs performed in 2017, compared to 2016. With the exception of Transport, all of the SEU areas recorded an improvement in energy performance in 2017, compared to the previous year. The reason for this rise in energy consumption within Transport (+231 MWh) was due to an increase in diesel consumption.

Public Lighting decreased its energy consumption by 730 MWh, due to the ongoing upgrading of public lights to LEDs. Offices and Depots improved its energy performance by 0.5 GWh, mainly due to the ongoing works and energy management system in the Civic Offices, while Housing saw a reduction of just over 470 MWh, due to the BEC project that was carried out in 2016. Fire Stations recorded energy savings of 682 MWh, due to the replacement of the boiler at Tara Street Station and repairs to the roof at Stanley Street Garage.

However, Sports Facilities achieved the greatest savings year-on-year, with energy consumption reducing by just over 4 GWh in this area. A large part of this (2.8 GWh) was due to the implementation of DCC's first EPC project, which resulted in a number of upgrades to Ballymun, Finglas and Markievicz Sports and Fitness Centres. The remaining savings came from lighting upgrades at Irishtown Stadium and the reconfiguration of the Building Management System (BMS) and improved energy management practices at St Catherine's Community Centre.

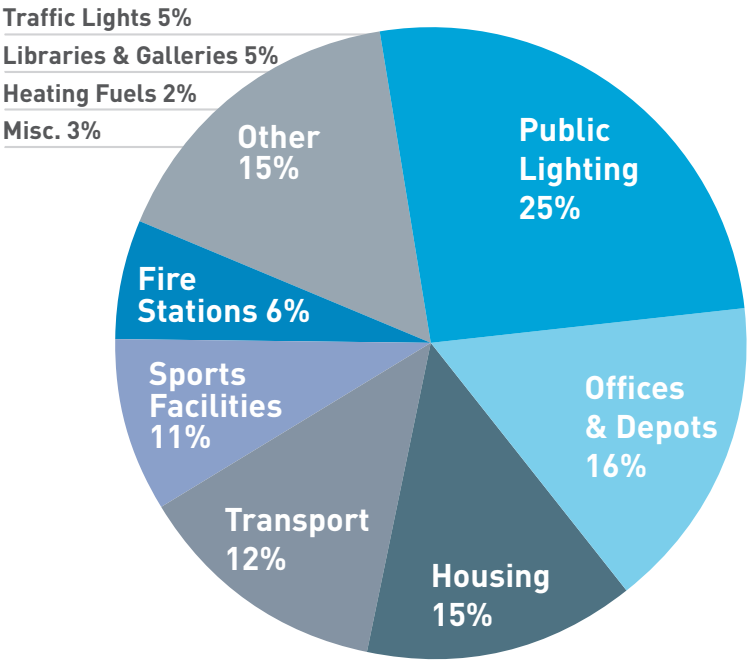

Figure 4: SEU Analysis

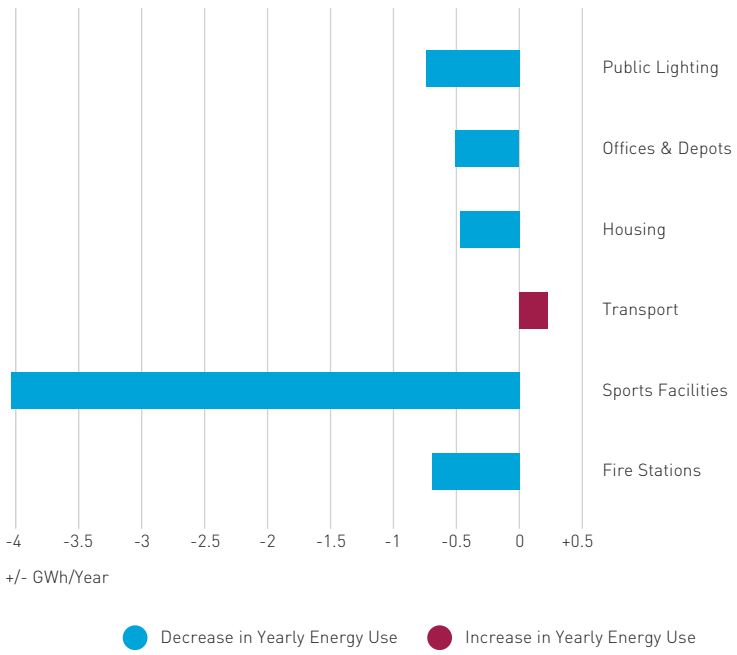

Figure 5: SEU Performance Change Between 2016 & 2017

03. SIGNIFICANT ENERGY USERS
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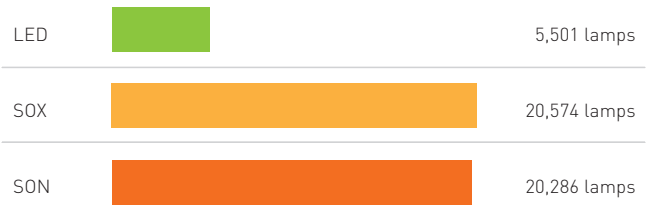
PUBLIC LIGHTING

Public Lighting is the largest SEU within DCC. In 2017, Public Lighting accounted for 25% of DCC's primary energy consumption, which amounted to 46.1 GWh of primary energy, 10,503 tonnes of CO_2 and almost €2.8 million in energy costs. Public Lighting consists of over 46,000 street lamps. The street lamps are broken up into three main different light sources. Listed below is a summary of these main light sources and their associated quantity; they are also listed in order of their efficiency:

- Light Emitting Diode (LED) – 5,501 lamps
- Low Pressure Sodium (SOX) – 20,574 lamps
- High Pressure Sodium (SON) – 20,286 lamps



DCC Public Lighting 2017

CONSUMED 46.1 GWH OF PRIMARY ENERGY

10,503 TONNES OF CO_2 EMITTED

€2.8M ASSOCIATED ENERGY COST

IMPROVED ENERGY PERFORMANCE BY 8.5% SINCE BASELINE

Identification of Relevant Variables for Public Lighting

In relation to Public Lighting, the relevant variables for the development of EnPIs to track the energy performance are very constant. Public Lighting only consumes electricity and has a predictable load. Public Lighting is also charged on a predefined number of burn hours per year, and is largely unmetered. Burn hours are reflected seasonally, and don't change from year to year.

One variable that is not a constant, and drives energy consumption in Public Lighting, is the quantity of lights. As the region grows to support a rise in population, the quantity of lights increases. This is reflected in the data received from the Unmetered Registrar (UMR). Therefore, to accurately track

the energy performance, Public Lighting is compared to the number of unmetered public lights for that given year:

Public Lighting EnPI =
kWh TPER /number of public lights

Energy Performance of Public Lighting

To date, DCC's Public Lighting Department has already retrofitted 5,501 lights with LEDs. The energy database shows that Public Lighting has improved its energy performance by 8.5% since the baseline, based on its EnPI. This is an absolute reduction of 3.4 GWh of primary energy, and 1,281 tonnes of CO_2. This is illustrated in Figure 6.

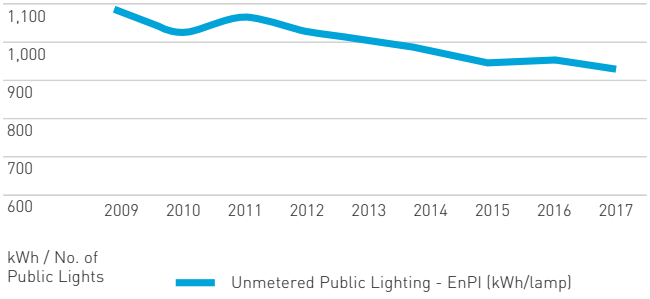
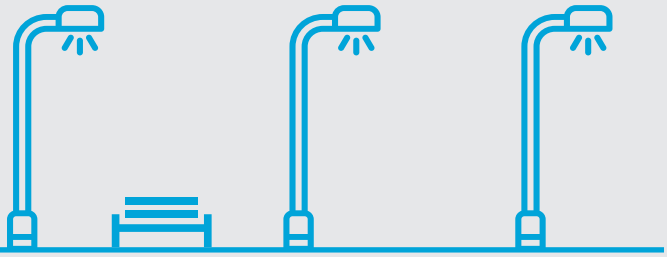


Figure 6: Public Lighting Annual Energy Performance

PUBLIC LIGHTING PLAN TO 2020



As Public Lighting is key to DCC achieving its energy efficiency target, it is strongly recommended that the council commits to further energy reductions in this area between now and 2020, and beyond. Energy reduction in electricity has more impact on the council's targets than any other energy type, due to the poor primary energy conversion factor.

SOX lamps have traditionally been replaced with SONs (a high-pressure equivalent) when upgrade work was being carried out. SON lamps are brighter, have better colour rendering, and are easier to replace. This upgrade work resulted in an improvement in light quality, but this is sacrificed by an increase in energy consumption and maintenance costs, due to a shorter lamp life.

Within DCC's stock of public lighting, there is currently over 20,500 SOX lamps. The manufacture of these SOX lamps is in the process of being phased out, so these will have to be replaced, and LED lights, with their very high energy efficiency, are the obvious replacement. If DCC commits to replacing 4,000 of these SOX lamps by 2020, it could produce savings of 1.7 GWh of TPER and 388 tonnes of CO_2. This would have a significant impact on the council's 2020 targets. In addition, an ongoing programme to replace the remaining street lighting with LEDs beyond 2020 is strongly recommended.

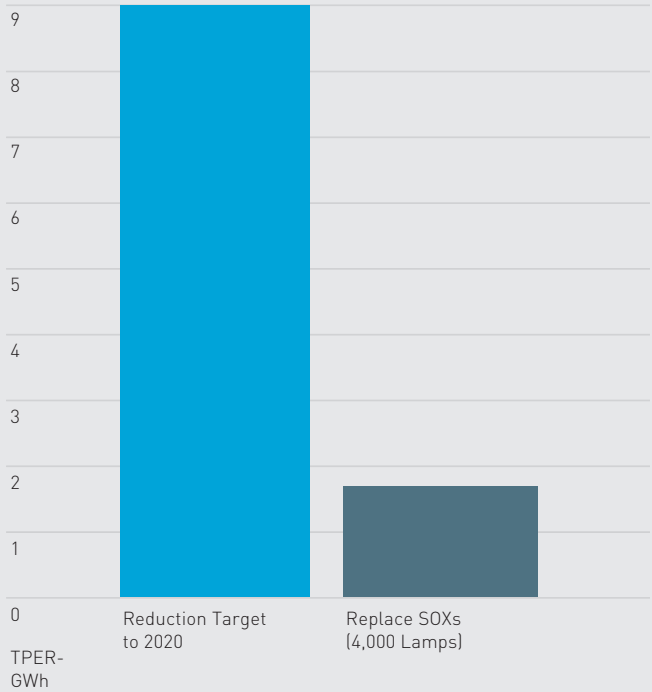


Figure 7: Public Lighting Plan to 2020

03. SIGNIFICANT ENERGY USERS
(CONTINUED)

OFFICES & DEPOTS

DCC has 108 offices and depots around the city. Of these 108 facilities, there are 38 offices, which comprise of local area offices, and the Civic Offices on Wood Quay. There are 70 depots around the city, which comprise of workshops, waste management depots and road depots.

In 2017, these facilities accounted for 16% of DCC's primary energy consumption. This is a consumption of 28.6 GWh of primary energy, 6,100 tonnes of CO_2 and an estimated €1.7 million in energy spend.

Identification of Relevant Variables for the Offices & Depots

In relation to the office and depot facilities, there are two main energy types, electricity and gas. When there are multiple variables that drive energy consumption, a composite performance indicator is used, as mentioned in the methodology section.

In terms of the electrical consumption, it is difficult to find a single significant driving factor for the energy consumption, as there are many variables that determine this, such as the number of employees, opening hours, floor area, etc. Gas consumption is mainly dependent on the external temperature. Therefore, the composite performance indicator used to measure the Offices and Depots' energy performance is the energy consumed (kWh TPER), divided by a weighting scale of Heating Degree Days (HDD) and the number of full time employees (FTE). This is derived from the formula given in the methodology, as shown below:

Offices & Depots EnPI = kWh TPER/(HDD)(FTE)

DCC Offices & Depots 2017

CONSUMED 28.6 GWH OF PRIMARY ENERGY

6,100 TONNES OF CO_2 EMITTED

€1.7M ASSOCIATED ENERGY COST

IMPROVED ENERGY PERFORMANCE BY 23.2% SINCE BASELINE

Energy Performance of the Offices and Depots

The database shows that the Offices and Depots have improved their energy performance by 23.2% since the baseline year. This is an absolute reduction of 12.3 GWh of primary energy and 2,680 tonnes of CO_2.

The Civic Offices on Wood Quay accounts for 34% of the total energy consumed by the Offices and Depots. Civic Offices has improved its energy performance by 42.7% since the baseline year. This is an absolute reduction of 9.4 GWh of primary energy and 1,470 tonnes of CO_2. There has been a considerable amount of work carried out in the Civic Offices since the baseline year, including continuous retrofitting of lighting to LEDs, the replacement of old, inefficient boilers to a new condensing energy efficient system, and the upgrading of pumps and the heating control system. The Civic Offices was also the first facility within the organisation to implement an energy management system and become ISO 50001 compliant, with huge effort from the facilities management team.

The team continues to use this system to identify future energy saving measures and the savings achieved to date are clearly illustrated in Figure 8.

As previously stated in DCC's Energy Review for 2016, Figure 8 also highlights a decrease in energy consumption in the waste management depots between 2013 and 2014. This was due to the closure of the gas accounts in the Marrowbone Lane and Bannow Road depots in 2013.

Figure 8 also shows that there was a slight rise in energy consumption between 2015 to 2016 in the Area Office and Civic Centre Division, which then levelled out in 2017. In analysing the energy consumption within this division, there was an increase across a number of facilities, which could be attributable to an increase in footfall or activity levels that the energy performance indicator cannot account for at present. This increase will be raised with the relevant facilities managers and explored further, in order to generate more robust energy performance indicators and to prevent further increases in consumption in the future.

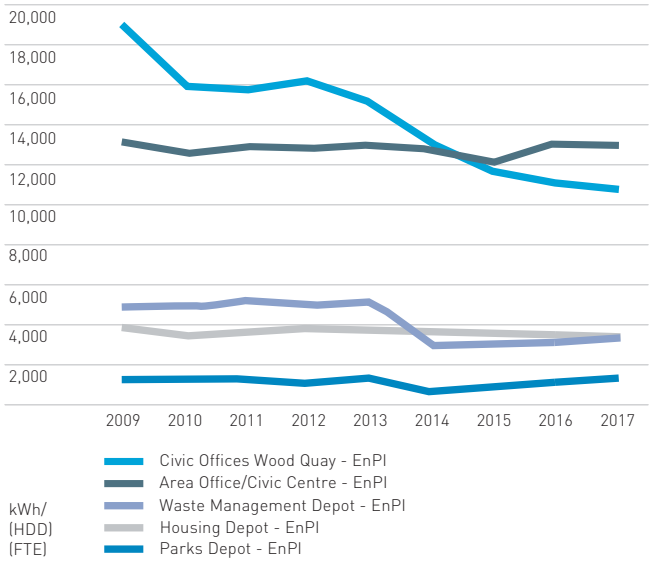


Figure 8: Offices & Depots' Annual Energy Performance

OFFICES & DEPOTS' PLAN TO 2020

Within the Offices and Depots SEU, a number of projects have been identified to provide significant energy savings. DCC is investigating the potential to install a combined heat and power (CHP) unit in its Civic Offices to provide electricity to the building and backup power in the case of a blackout. This project aims to save 80 MWh of primary energy and 30 tonnes of CO_2.

Dublin City Council is also committed to investing €2.5 million over the next three years to upgrade the HVAC systems within the Civic Offices. The planned works involve the upgrading of the Air Handling Units (AHUs), and will also include the upgrading of valves, cylinders and pumps within the building. The chiller system will also be upgraded, along with the Building Management System (BMS). These works are expected to be finished before 2020.

After the 2016 Energy Review, Codema began identifying large energy consumers within each SEU, to establish possible energy saving solutions for these specific areas. Within the Offices and Depots, Eblana House, the Joinery Workshop, the Motor Tax Office in Smithfield and the Ballymun Civic Offices accounted for almost 70% of the total energy consumption within this area. While investigating this further, Codema found that DCC only leases out a portion of the buildings containing the Motor Tax Office and the Ballymun Civic Offices, so there there is limited opportunity for energy savings within these facilities.

Codema is currently developing a proposal for Eblana House that will be complete in the summer of 2018. This proposal recommends the installation of a solar photovoltaic (PV) system to reduce the electrical load of the facility, along with a review of the control strategy of the HVAC and lighting control systems within the building.

Codema has also completed a proposal of the Joinery Workshop, recommending the replacement of the existing boiler system to a new, energy-efficient condensing system with upgraded heating controls, a complete LED lighting retrofit and a possible PV array on the roof of the facility. This project would result in savings of 0.5 GWh of primary energy

and 84 tonnes of CO_2, and would reduce costs by €38,000.

The HVAC Department has also submitted a Better Energy Communities (BEC) project application to SEAI for the retrofitting of a number of facilities' HVAC systems throughout the city; this will include the upgrade of the boiler system and controls within the Cabra Area Office.

The Transformation Unit in Dublin City Council is working with all of the operational areas in developing a consolidated depot model, which will culminate in the construction of two large-scale depot facilities, one on the northside of the city, and the other on the southside.

The northside depot was granted planning permission in February 2017 and will be located along St Margaret's Road in Ballymun. Fourteen depots from across a variety of divisions such as waste management, road maintenance, housing maintenance and electrical services will be based in this proposed new facility, which will include an office and welfare building, workshop facilities and a central store.

This large-scale depot will be designed and constructed to nearly Zero Energy Building (nZEB) standard and the move could result in savings of 2.1 GWh of primary energy, 672 tonnes of CO_2 and a reduction in costs of €211,000.

If all of the above projects are completed within the Offices and Depots by the end of 2018, they could collectively save DCC 2.7 GWh of TPER in total and 786 tonnes of CO_2.

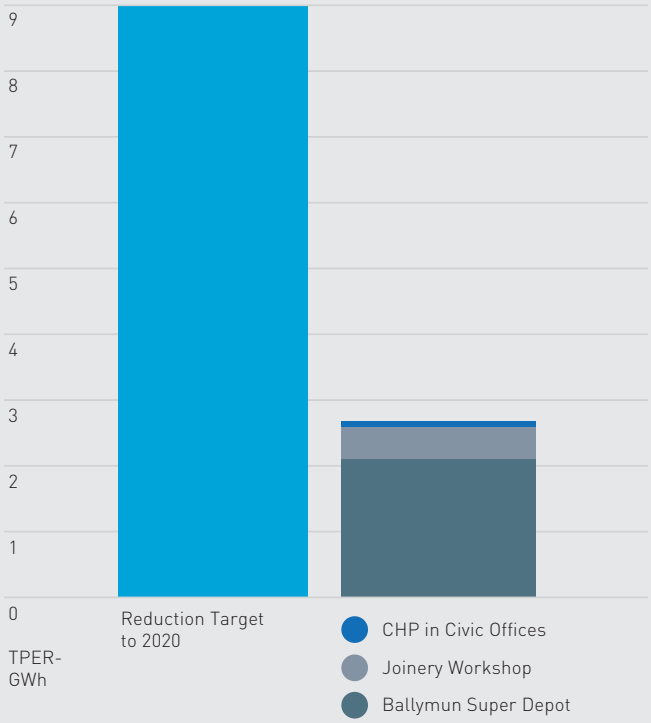


Figure 9: Offices & Depots' Plan to 2020

03. SIGNIFICANT ENERGY USERS
(CONTINUED)

HOUSING

Housing is the third largest SEU within DCC. In 2017, Housing accounted for 15% of DCC's primary energy consumption, which amounted to 26.8 GWh of primary energy consumption, 5,400 tonnes of CO_2 and almost €1.6 million in energy costs. Housing is responsible for 25,244 properties within Dublin City, which are broken up into apartments, houses, senior citizen units, etc. Housing is not responsible for the majority of the energy bills for these properties, but is responsible for areas such as landlord lighting and heating, landlord supplies, water pumping, community centres and the electrical and mechanical systems connected with these properties.

Identification of Relevant Variables for Housing

In relation to Housing, there are two main energy types, electricity and gas. Once again, when there are various factors that influence energy consumption, a combined performance indicator is used.

As is the case with many of the other SEU areas, Housing has many different factors that drive its overall energy consumption. Gas consumption is mainly dependent on the external temperature. Therefore, the composite performance indicator used to measure Housing's energy performance is the energy consumed (kWh TPER), divided by a weighting scale of Heating Degree Days (HDD) and the number of the housing stock. This formula can be seen below:

Housing EnPI = kWh TPER/ (HDD)(STOCK)

DCC Housing 2017

CONSUMED 26.8 GWH OF PRIMARY ENERGY

5,400 TONNES OF CO_2 EMITTED

€1.6M ASSOCIATED ENERGY COST

IMPROVED ENERGY PERFORMANCE BY 35.3% SINCE BASELINE

Energy Performance of Housing

The database shows that Housing has improved its energy performance by 35.3% since the baseline. This is an absolute reduction of 10.9 GWh of primary energy and 2,390 tonnes of CO_2.

Within the Housing Department, there has been a steady improvement in energy performance between the baseline year and 2015. There was then a significant improvement in energy performance in 2016, which can be seen in Figure 10. This was due to DCC implementing a Managed Energy Services Agreement (MESA) at Cromcastle Court in Coolock, which resulted in the old gas boilers being replaced with high-efficiency heat pumps, amongst other measures.

There was also an energy reduction in the Homeless Services Division during 2016, which was largely due to a number of upgrades to Maple House, one of the council's homeless facilities. The work at Maple House was carried out as part of the HVAC division's BEC project and resulted in the replacement of the two boiler systems with energy-efficient gas condensing boilers, with upgraded controls.

From analysing the data, gas consumption has reduced by 100 MWh, or almost €8,400, as a result of this work. However, this figure is based on absolute energy savings and a more detailed analysis of the weather patterns throughout the year will be needed to calculate a more precise figure for the quantity of savings attributable to the works.

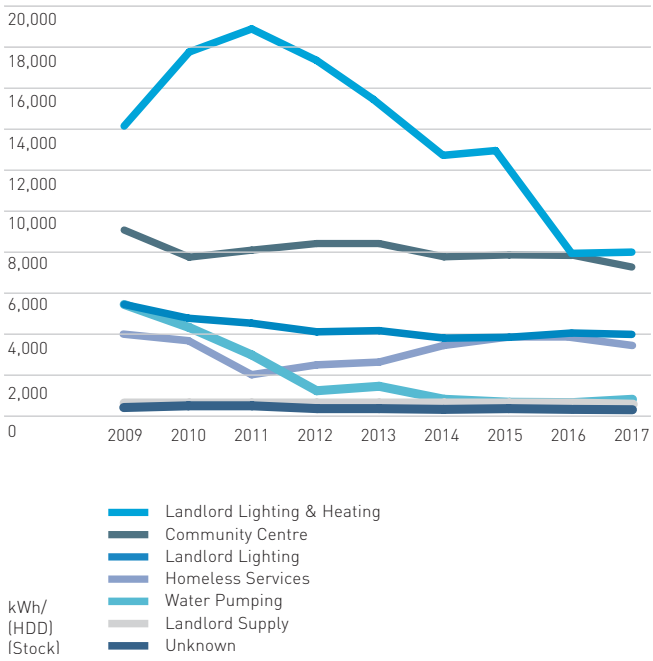


Figure 10: Housing Annual Energy Performance

HOUSING PLAN TO 2020

Housing is another area that is key to DCC achieving its targets. Figure 10 on the previous page shows that the areas within Housing with the most potential for energy savings are Community Centres, Landlord Lighting and the Homeless Services.

As mentioned previously, the HVAC Department has applied for a BEC project that aims to retrofit a number of DCC buildings across the city. Many of these buildings come under the Housing Department and will include Cherry Orchard Community Centre and various senior citizen and social housing complexes throughout the city.

The project will include gas boiler replacements, heating control upgrades and PV installations, amongst other measures. The application, if approved, will see a reduction of 2.4 GWh of TPER and 664 tonnes of CO_2. These savings are accounted for in the Housing SEU, where the majority of the work will take place.

Codema has also developed a proposal to upgrade the public access lighting to LEDs in 15 DCC social housing complexes across the city, which could potentially save 386 MWh of TPER and 93 tonnes of CO_2. This follows on from a successful Better Energy Communities project in 2016, where all of the public access lighting in Block E of Pearse House was upgraded to energy-efficient LEDs, providing better light quality and security for the tenants living there.

Homeless Services make up a large proportion of the Housing Department's energy consumption. Of this energy consumption, half is attributable to two facilities, Maple House and Parkgate Hall, and these also have the greatest energy-saving potential within the Homeless Services.

As mentioned previously, Maple House had both of its boiler systems replaced, as part of the HVAC Department's BEC project in 2016. To further the savings achieved from this project, Codema developed proposals for both Maple House

and Parkgate Hall that recommend measures such as the complete retrofit of the lighting to LEDs, the installation of PV systems to reduce the electrical load, the replacement of all windows to high-efficiency, triple-glazed units (Maple House) and the installation of energy-efficient boilers and control upgrades (Parkgate Hall). These proposals have identified total potential savings of 370 MWh of TPER and 80 tonnes of CO_2 in these facilities.

Housing is also responsible for 50 community centres across the city. These range from small community rooms to large community centres. There is potential for energy savings within these facilities with the retrofit of LED lighting and controls, heating system and control upgrades, and the installation of photovoltaic systems, amongst others.

Codema recommends that Housing develops a framework of contractors for the implementation of any energy saving measures. This framework will incorporate the maintenance and upgrade of energy related systems, with a focus on performance guarantees where suitable. Codema can support DCC with the development of such a framework.

If the Housing Department aims to complete all of the planned projects mentioned above by the end of 2018, this could result in a total saving of 3.2 GWh of TPER and 837 tonnes of CO_2.

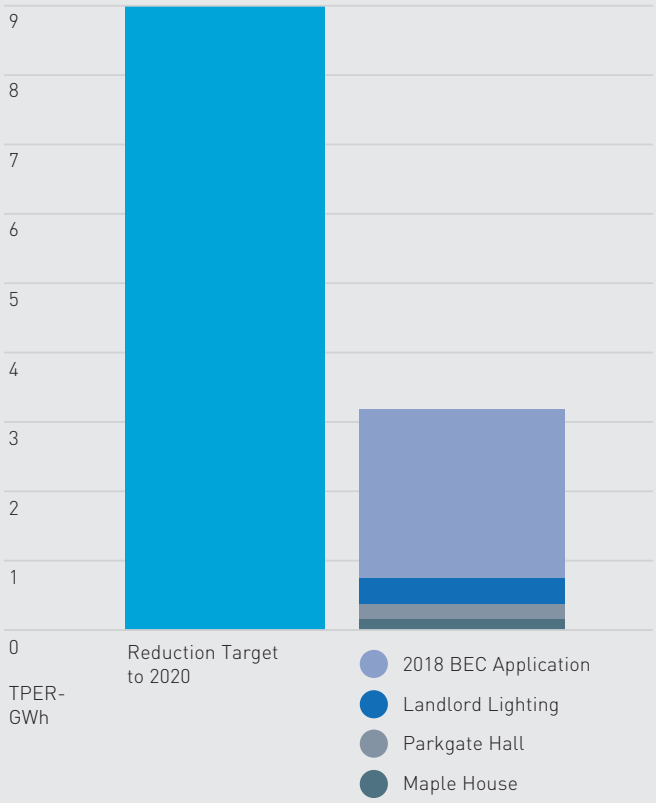


Figure 11: Housing Plan to 2020

03. SIGNIFICANT ENERGY USERS
(CONTINUED)

TRANSPORT

Transport is the fourth largest SEU within DCC, and comprises of fuels used for council vehicles (including light and heavy vehicles), and fuels used by the park services. In 2017, Transport accounted for 12% of DCC's primary energy consumption. This amounts to 22.7 GWh of primary energy, 5,360 tonnes of CO_2, or an estimated €2.2 million in energy costs. There was an increase of 200 MWh in 2017, due to an extra 25,000 litres of diesel consumed in the previous year. Without the the use of a robust energy performance indicator to help track the diesel consumed within the Transport Department, it is hard to identify why extra diesel was consumed, and warrants further investigation.

Within Transport, diesel accounts for almost 98% of the total primary energy consumption. Petrol accounts for just 2%, as it is only used to fuel small equipment. This is shown in Figure 12. Transport consists of 980 vehicles, which are broken up into 24 different vehicle types. Below is a summary of the main vehicle types and their associated quantity:

- Medium sized vans – 279
- Small vans – 257
- Fire engines – 81
- Lorries > 7.5 kgs – 58
- Road sweepers – 45
- Large vans – 37
- Ambulances - 35

Identification of Relevant Variables for Transport

It was very easy to identify the many variables that drive energy consumption within Transport, such as miles travelled, efficiency of the fleet, number of vehicles, etc. However, some of these variables are not reported consistently, and so there is currently very little data available to develop a robust performance indicator for Transport. However, in 2017 the Transport Department provided information on the quantity of vehicles they are responsible for. With this new information, and with further updates to it each year, a more robust energy performance indicator can be developed.

DCC Transport 2017

CONSUMED 22.7 GWH OF PRIMARY ENERGY

5,360 TONNES OF CO_2 EMITTED

€2.2M ASSOCIATED ENERGY COST

IMPROVED ENERGY PERFORMANCE BY 14% SINCE BASELINE

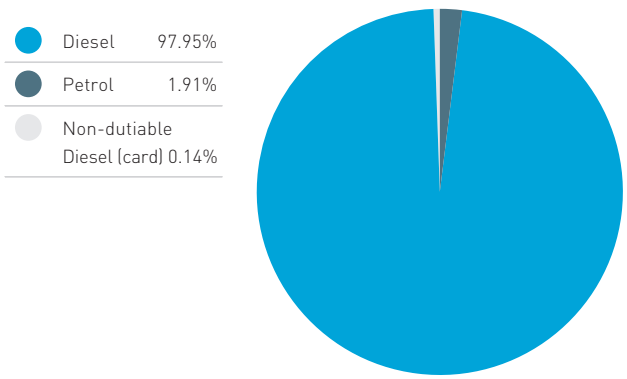


Figure 12: DCC Fuels TPER - 2017

With this in mind, Codema used the number of vehicles to develop a new performance indicator for Transport. This gives a more true depiction of the energy consumed by the Transport Department than the previous performance indicator of population served. Therefore, the EnPI for Transport is the kWh consumption of primary energy divided by the total number of vehicles. This formula is:

Transport EnPI = kWh TPER / total number of vehicles

Energy Performance of Transport

Based on the new performance indicator, the database shows that the energy performance of Transport has improved by 14% since the baseline. This is an absolute reduction of 3.2 GWh[3] of primary energy and 760 tonnes of CO_2. As previously stated in DCC's Energy Review for 2016, Figure 13 shows that between the years 2010 and 2013, there was a significant decrease in energy consumption. This is due to the reduction in the litres of diesel consumed by the council's fleet. From consulting with fleet management, Codema believes this to be due to the reduction in the fleet's workload as a result of the recession. Another factor is the introduction of newer, more fuel-efficient vehicles to replace older vehicles, which naturally improves energy performance as a result. In 2014, there was an increase in diesel consumption, which corresponded in a slight rise in energy consumption overall within Transport. Even though smaller, this rise was seen again in 2017. Without the use of a robust energy performance indicator to track this diesel consumption, it is hard to find a definitive reason for these increases.

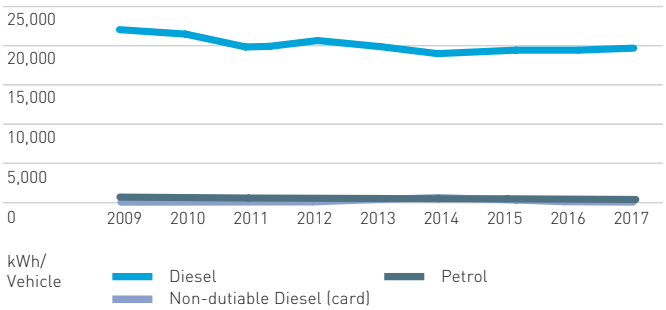


Figure 13: Transport Annual Energy Performance

TRANSPORT PLAN TO 2020

As mentioned earlier, Figure 13 shows a significant decrease in DCC's consumption of diesel between 2010-2011 and then again between 2012-2013. This is due to variations in fuel consumption within DCC's fleet vehicles and the procurement of more energy-efficient vehicles.

DCC is currently upgrading its light, commercial fleet to newer, more fuel-efficient vehicles, which should help continue the downward trend in fuel consumption. DCC is also looking to test mobility options for staff to carry out their work. Specifically, DCC wants to explore and expand its fleet-electrified vehicles to help reduce its transport emissions.

To date, DCC has three electric vehicles that can be used by staff, and booked through an online system within the council. DCC has also recently procured 13 small electric vans that are used in a number of the council depots around the city, and will continue to monitor the feasibility of introducing more electric vehicles to its fleet in the future.

Looking at Transport's energy performance since the baseline and assuming similar savings are made from the changing over of the light, commercial fleet to newer, more fuel-efficient vehicles, Transport could see savings of 1.3 GWh of TPER and 343 tonnes of CO_2.

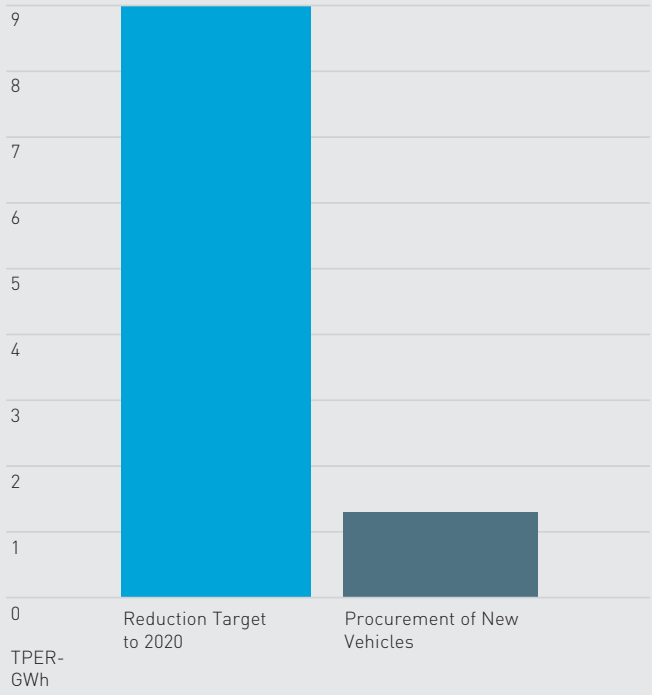


Figure 14: Transport Plan to 2020

3. The energy database has provisions incorporated to account for the outsourcing of waste collection, and also to take into account the use of Irish Water within the local authority fleet.

03. SIGNIFICANT ENERGY USERS
(CONTINUED)

SPORTS FACILITIES

Sports Facilities are the fifth largest energy consumer within DCC. DCC currently operates five large leisure centres, four smaller swimming pools and 24 dry sports centres. In 2017, these facilities accounted for 11% of the local authority's primary energy requirement. This is a consumption of 19.5 GWh of primary energy, 3,880 tonnes of CO_2, and an estimated €983,000 in energy spend.

Identification of Relevant Variables for the Sports Facilities

In relation to the Sports Facilities, electricity and gas are the two main energy types. Once again, these Sports Facilities have multiple variables that drive energy consumption, so a composite performance indicator is used to determine their overall performance.

Within the Sports Facilities, various factors such as footfall, opening hours and floor area determine the overall energy consumption. Gas consumption is once again based on the external temperature. Therefore, the composite performance indicator used to measure the Sports Facilities' energy performance is the energy consumed (kWh TPER) divided by a weighting scale of the total floor area (m^2) and Heating Degree Days (HDD). This is shown in the formula below:

Sports Facilities EnPI = kWh TPER/ (m^2)(HDD)

DCC Sports Facilities 2017

CONSUMED 19.5 GWH OF PRIMARY ENERGY

3,880 TONNES OF CO_2 EMITTED

€983,000 ASSOCIATED ENERGY COST

IMPROVED ENERGY PERFORMANCE BY 10.2% SINCE BASELINE

Energy Performance of the Sports Facilities

The energy database shows that the Sports Facilities have improved their energy performance by 10.2% since the baseline, compared to the EnPI. This is an absolute reduction of 1.1 GWh of primary energy, and 325 tonnes of CO_2. As mentioned in the 2016 Energy Review, energy consumption increased between 2009-2010, due to the opening of the Swan Leisure Centre in Rathmines. In 2010-2014, there was a steady decrease in energy consumption in the Sports Facilities, which could be due to the effect of the recession on the activity levels of these facilities.

There was a decrease in the energy consumed by the smaller swimming pools in 2013. This was due to the closure of Sean McDermott Street, Coolock and Crumlin swimming pools for necessary maintenance works. This can be seen in Figure 15.

In 2016, there was a significant decrease in electricity consumption in Irishtown Stadium, due to LED lighting upgrades, and also in St Catherine's Community Centre, due to a reconfiguration of the BMS and improved energy management practices. However, these savings were counteracted by a rise in energy consumption in some of the other dry sports centres.

In addition, Codema helped Dublin City Council to implement its first Energy Performance Contract (EPC) in 2016, for the upgrade of Ballymun, Finglas and Markievicz Sports and Fitness Centres. Works included new LED lighting, improved building control systems and a new CHP system in Ballymun. Codema is assisting DCC with the ongoing Measurement and Verification (M&V) of this project; in the first year alone, DCC has saved over €122,000 and has achieved average energy savings of 38%. These savings achieved from 2016 to 2017 can be seen in Figure 15.

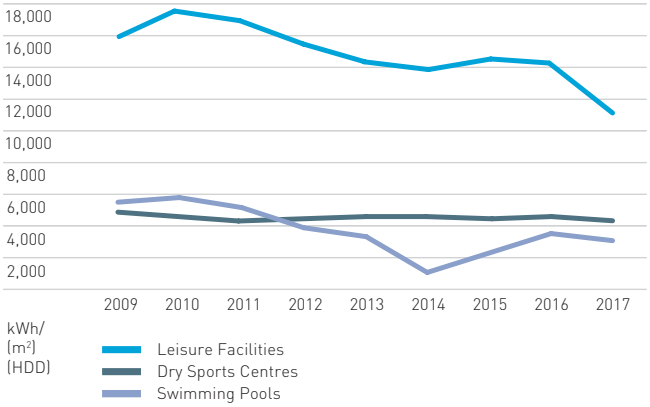


Figure 15: Sports Facilities' Annual Energy Performance

SPORTS FACILITIES' PLAN TO 2020

Due to the success of the pilot EPC project mentioned above, Codema also helped DCC to initiate a second EPC in 2017, which will involve an upgrade to the existing lighting, heating and ventilation systems across seven council buildings: Ballyfermot Sports and Fitness Centre, St Catherine's Community Centre, Ballybough Community Centre, Cabra Parkside, Irishtown Sports and Fitness Centre, Bluebell Sports Centre, and Poppintree Community Sports Centre.

Boiler upgrades may also be considered as part of this project, including a review of the existing CHP system in Ballyfermot. This project is currently out to tender and work is due to be completed in these buildings in late 2018.

From analysis of the energy consumption within these sports facilities, a further 2.1 GWh of primary energy and 321 tonnes of CO_2 could be saved by 2020 by implementing this second EPC project in these buildings.

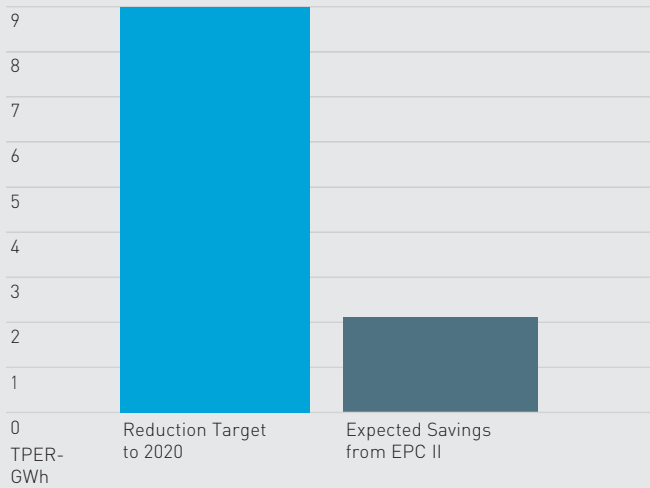


Figure 16: Sports Facilities' Plan to 2020

03. SIGNIFICANT ENERGY USERS
(CONTINUED)

FIRE STATIONS

Fire Stations are the sixth largest energy consumer within DCC. The Dublin Fire Brigade currently consists of the Fire Brigade HQ and Control Centre in Tara Street, the O'Brien Institute on the Malahide Road, Stanley Street Garage, and 14 fire stations across the entire Dublin region. In 2017, the Dublin Fire Brigade accounted for 6% of the local authority's primary energy requirement. This is a consumption of 11.3 GWh of primary energy, 2,315 tonnes of CO_2, and over €648,500 in energy spend.

Identification of Relevant Variables for the Fire Stations

In relation to the Fire Brigade, electricity and gas are the two main energy types. As mentioned in some of the previous SEU sections, it is difficult to define a single driver for the energy consumption, as there are multiple factors that determine this, such as floor area, opening hours, etc. Population served is also viable given that the energy consumption of the Fire Brigade's fleet is also driven by the area that it serves. Therefore, as the population of DCC grows, so do the areas that the Fire Brigade must respond to. Gas consumption is mainly dependent on the external temperature. Therefore, the composite performance indicator used to measure the Fire Brigade's energy performance is the energy consumed (kWh TPER) divided by a weighting scale of total floor area (m^2) and Heating Degree Days (HDD) and the population served, derived from the formula given in the methodology:

Fire Stations EnPI = kWh TPER/ (m^2)(HDD) (Population Served)

DCC Fire Stations 2017

CONSUMED 11.3 GWH OF PRIMARY ENERGY

2,315 TONNES OF CO_2 EMITTED

€648,500 ASSOCIATED ENERGY COST

IMPROVED ENERGY PERFORMANCE BY 31.9% SINCE BASELINE

Energy Performance of the Fire Stations

The energy database shows that the Fire Stations have improved their energy performance by 31.9% since the baseline, compared to the EnPI. This is an absolute reduction of 4.2 GWh of primary energy, and 943 tonnes of CO_2.

Tara Street has the largest energy consumption, but has also achieved the greatest reduction since the baseline year. During this time, it reduced its consumption by 1 GWh, which translates to an improvement in performance of 32%. The majority of this was due to the replacement of the old, inefficient boiler system with a new, energy-efficient condensing system with upgraded heating controls.

In addition, four of the smaller stations (Blanchardstown, Phibsboro, Kilbarrack, and Finglas) improved their overall energy performance by an average of 40%, and saved a total of 1 GWh of primary energy. The majority of these savings were in Blanchardstown and Finglas Fire Stations, as can be seen in Figure 18. This was due to a complete boiler replacement in Blanchardstown and a whole facility upgrade in Finglas, which included boiler replacement, fabric upgrades, LED lighting and the installation of solar panels.

Figure 17 shows an increase in gas consumption at Stanley Street Garage and the O'Brien Institute during 2014-2015. Stanley Street Garage was having problems with the roof, and this increase in consumption could be attributable to this.

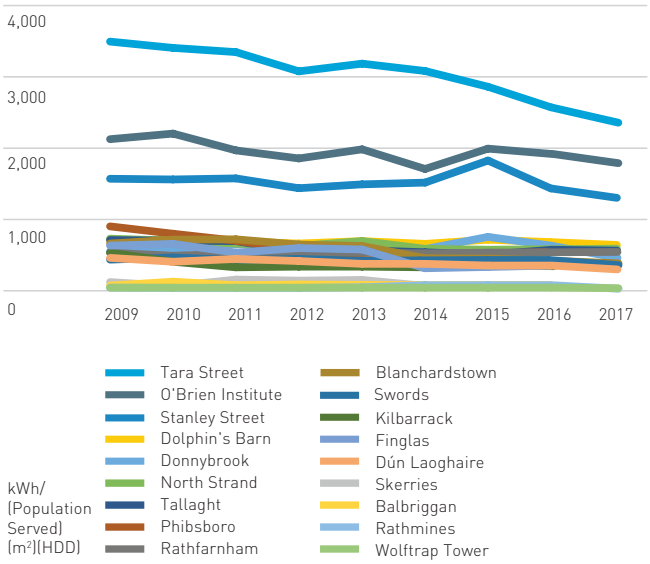


Figure 17: Annual Energy Performance of the Fire Stations

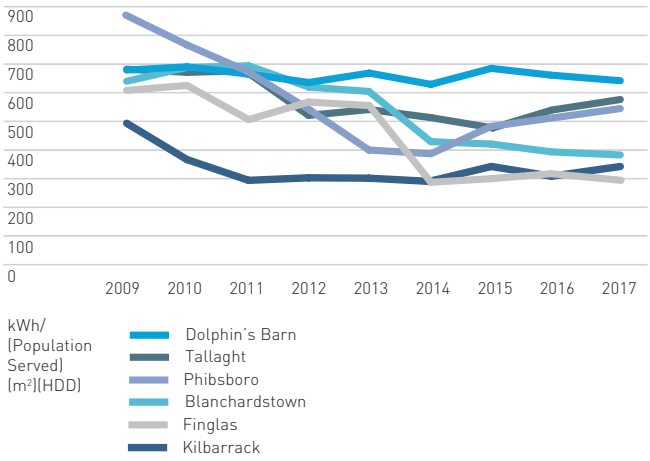


Figure 18: Annual Energy Performance of the Smaller Fire Stations

FIRE STATIONS' PLAN TO 2020

Codema was approached by the Dublin Fire Brigade property maintenance manager to identify the best options for the replacement of the boilers within the O'Brien Institute, which are coming to the end of their lifespan. Instead of upgrading the boilers to a more energy-efficient model, Codema is investigating the feasibility of installing a more carbon-neutral alternative, such as a condensing gas boiler and micro CHP hybrid system, to reduce both the electrical and gas consumption within the facility. Another option is to install a heat pump and micro CHP hybrid system.

Codema is also looking at an Energy Performance Related Payment (EPRP) contract, which will incentivise the contractor to remain involved with the project until savings are established, thereby reducing the risk to the council. Codema is currently carrying out a financial analysis of all options for replacing the boilers, and hopes to go to tender on this project before the end of the summer.

Within the Fire Stations' facilities, the top three consumers, Tara Street, Stanley Street and the O'Brien Institute, account for half of the total consumption. With the boiler replacement project planned for the O'Brien Institute, Codema intends to look at the Tara and Stanley Street facilities in more detail, in order to identify potential energy savings in these buildings. Another station of interest is Swords Fire Station.

These works could include measures such as the retrofit of LED lighting and controls, heating system and control upgrades, and the installation of photovoltaic systems, amongst others. Energy audits will help identify these measures, which can then be prioritised in terms of highest potential for savings.

The Dublin Fire Brigade is also interested in developing a new maintenance programme that will categorise its facilities according to size, consumption and age profile.

In addition, it will also tender for a framework of maintenance companies that will incorporate an energy performance element to the contract, in the effort to drive down energy consumption across all of the Dublin Fire Brigade's facilities.

The Dublin Fire Brigade has also committed to retrofitting its lighting stock to LEDs. This will be achieved by integrating a new policy within their maintenance contracts that states that any failed fittings should be replaced with LEDs. These LEDs will also comply with local government procurement rules and will be on the SEAI Triple E register.

If the Fire Brigade aims to replace the boilers in the O'Brien Institute by the end of 2018, it could result in a saving of 198 MWh of TPER and 41 tonnes of CO_2.

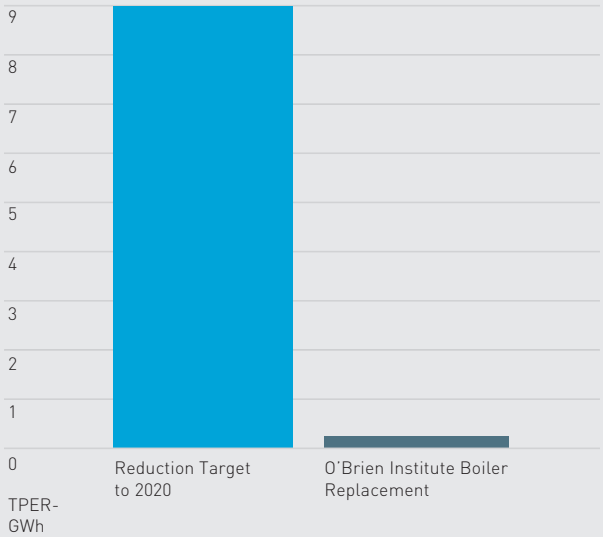


Figure 19: Fire Stations' Plan to 2020

04. CONCLUSION

DCC has achieved energy savings of 29.8% between the baseline year and 2017. While these savings are substantial, the council still needs to save a further 3.2% to achieve the 33% energy saving target by 2020. The next three years will be crucial, and will require the most innovative and challenging projects to date, in order to achieve DCC's targets by the 2020 deadline.

The savings that have been achieved since the last Energy Review can be attributable to the investment of DCC's staff and resources to the achievement of the council energy reduction targets by 2020. This has been aided through the appointment of the council's Energy Performance Officer (EPO) and the set-up of an Inter-Departmental Energy Oversight Committee in 2017.

This Energy Oversight Committee is committed to achieving an accredited energy management system in 2018 for the whole organisation, and will continue to identify and cost potential projects in areas such as Public Lighting, Offices and Depots, Housing, Fire Stations, Sports Facilities and Transport, which will help the council stay on track of 2020 energy targets and beyond.

Figure 20 below illustrates DCC's gap-to-target model for the next three years. If all the projects set out in this Energy Review are completed by 2020, they could result in a total saving of 11.2 GWh of TPER and 2,716 tonnes of CO_2. This reduction figure goes well beyond DCC's target reduction of 9 GWh, or 33%, by 2020.

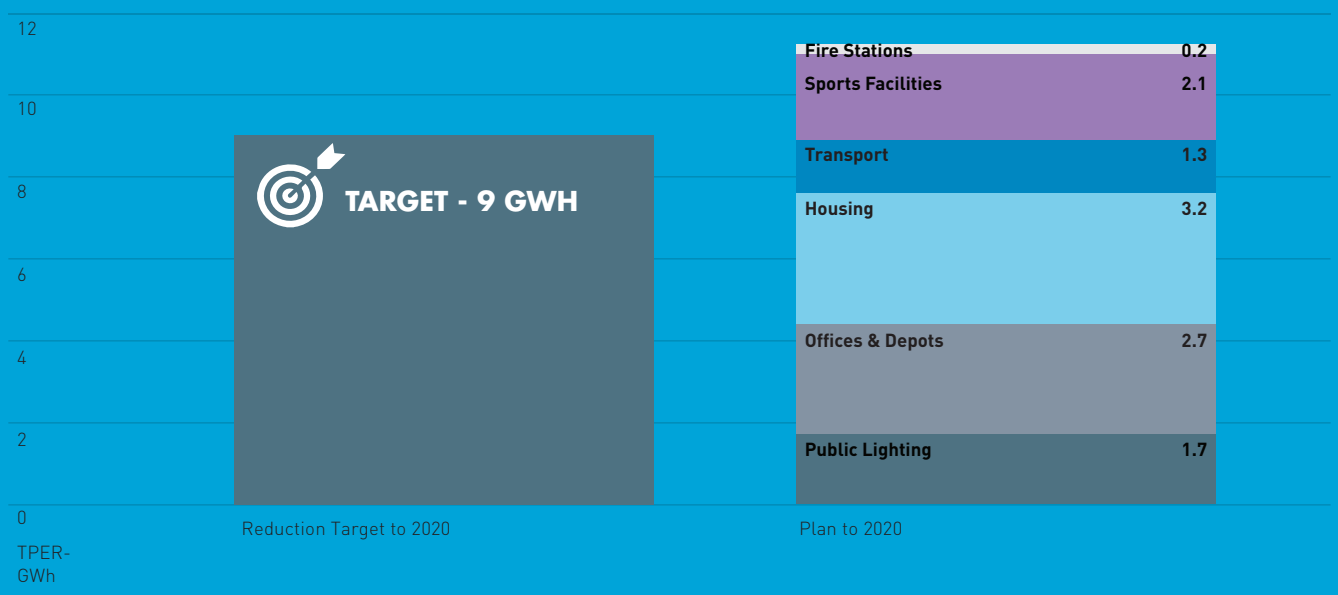


Figure 20: DCC Plan to 2020

SEU AREA	ACTION	ESTIMATED SAVINGS
PUBLIC LIGHTING	REPLACE 4,000 SOXS WITH LEDS	1.7 GWH
OFFICES & DEPOTS	UPGRADES TO CIVIC OFFICES, JOINERY WORKSHOP & DEVELOPMENT OF BALLYMUN SUPER DEPOT	2.7 GWH
HOUSING	UPGRADES TO COMMUNITY CENTRES, HOMELESS FACILITIES & SOCIAL HOUSING / SENIOR CITIZEN COMPLEXES	3.2 GWH
TRANSPORT	PROCUREMENT OF NEW ENERGY-EFFICIENT VEHICLES	1.3 GWH
SPORTS FACILITIES	EPC II - UPGRADES TO LIGHTING, HEATING & VENTILATION SYSTEMS ACROSS 7 COUNCIL SPORTS FACILITIES	2.1 GWH
FIRE STATIONS	REPLACEMENT OF BOILERS AT THE O'BRIEN INSTITUTE	0.2 GWH

05. APPENDICES

SEU Summary

Table 1 SEU Summary

SEU	TPER - GWh	Tonnes CO_2	Cost	% +/- since baseline
Public Lighting	46.1	10,503	€2,752,700	-8.5%
Offices & Depots	28.6	6,104	€1,725,854	-23.2%
Housing	26.8	5,407	€1,568,457	-35.3%
Transport	22.7	5,360	€2,191,092	-14.0%
Sports Facilities	19.5	3,886	€983,084	-10.2%
Fire Stations	11.3	2,315	€648,504	-31.9%
Total	155.0	33,575	€9,869,691	

Project Plan to 2020 Summary

Table 2 Project Plan Summary

SEU	TPER - GWh	Tonnes CO_2
Public Lighting	1.7	388
Offices & Depots	2.7	786
Housing	3.2	837
Transport	1.3	343
Sports Facilities	2.1	321
Fire Stations	0.2	41
Total	11.2	2,716

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Abbreviations

AHU	Air Handling Unit
BEC	Better Energy Communities
BMS	Building Management System
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
DCC	Dublin City Council
DCCAE	Department of Communications, Climate Action and Environment
EnPIs	Energy Performance Indicators
EPC	Energy Performance Contract
EPO	Energy Performance Officer
EPRP	Energy Performance Related Payment
FTE	Full Time Employees
GPRNs	Metered Gas Accounts
GWh	Gigawatt hour
HDD	Heating Degree Days
HVAC	Heating, Ventilation and Air Conditioning
Kg	Kilogram
kWh	Kilowatt hour
LED	Light Emitting Diode
m^2	Metres Squared
M&V	Measurement and Verification
M&R	Monitoring and Reporting
MESA	Managed Energy Services Agreement
MPRNs	Metered Electrical Accounts
MWh	Megawatt hour
nZEB	nearly Zero Energy Building
PV	Photovoltaic
SEAI	Sustainable Energy Authority of Ireland
SEUs	Significant Energy Users
SON	High Pressure Sodium
SOX	Low Pressure Sodium
TFC	Total Final Consumption
TPER	Total Primary Energy Requirement
UMR	Unmetered Registrar

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