GOOD PRACTICE ENERGY CASE STUDIES IN DUBLIN CITY

emerge

Sustainable Energy Community Dublin

seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Comhairle Cathrach Bhaile Átha Cliath
Dublin City Council

energy solutions
Independent Professional Energy Experts

codema
Dublin's Energy Agency

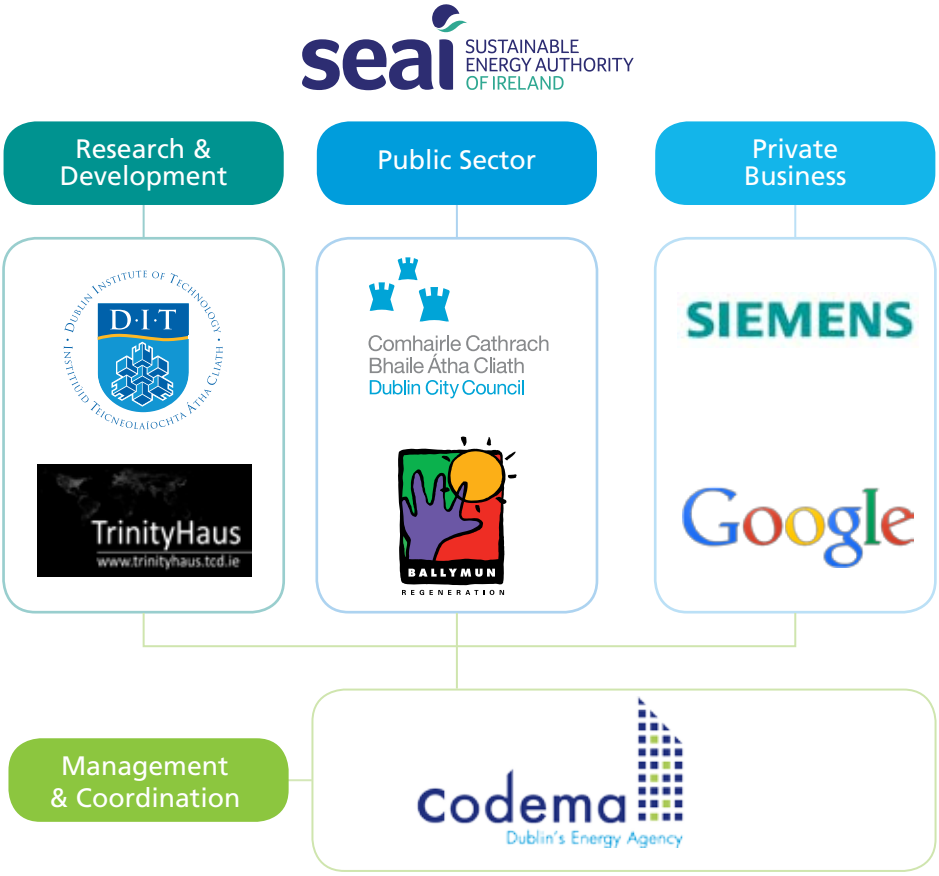
About the Emerge Project

Emerge is Dublin's Sustainable Energy Community, which was set up under a partnership between Dublin City Council and the Sustainable Energy Authority of Ireland (SEAI).

Set up in 2012, Emerge is one of three exemplar sustainable energy communities around Ireland, which aims to demonstrate best practice in sustainable energy. The initiative is managed by Codema, Dublin's energy agency, and provides a platform for communications among stakeholders from the public, private and academic sector as well as the local authority.

The Emerge Steering Committee is set up as follows:

Emerge Steering Committee



1. To provide a networking platform and open forum for discussion on energy topics

2. To share best practice examples of sustainable energy for easy replication and adaptation

3. To connect individual sustainable energy projects in Dublin City

In 2013, the Emerge Steering Committee decided to focus its activities on the Dublin Docklands, as the area is home not only to world leaders in finance and technical innovation but also schools, residential housing and small indigenous businesses. Many resident companies have strong expertise in implementing energy-efficiency schemes in the workplace and can act as leaders for promoting sustainable energy practice.

The following projects have been initiated under the Emerge project:

- Submission of energy requirements to the Docklands' Strategic Development Zone (SDZ)
- Creation of a GIS energy map of the Docklands' area by TrinityHaus with the first energy benchmark for the area
- Metering of a selection of public buildings to collect real data
- Dublin District Heating Seminar

As part of Emerge, Codema commissioned Energy Solutions to conduct a review of a range of organisations in the Dublin Docklands and surrounds in an effort to identify suitable best practice energy efficiency projects.

The objective was to gain a personal and 'on the ground' perspective of the process towards implementing such projects. Within this process, 10 organisations were selected to participate and these projects are presented as case studies.

Through these case studies Emerge wishes to document and promote best practice in sustainable energy so that similar projects may be replicated and the knowledge gained in their implementation shared.

In order to best represent the range of commercial activity based in the Docklands area and surrounds, organisations were selected from the five sectors: Residential, Public, Large Corporation, SMEs and Healthcare. These sectors represent the various drivers behind decisions to commit to energy efficiency projects and identify how different organisations tend to have varying agendas and structures in relation to energy policies.

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Sustainable Energy Community Dublin

"The energy efficient lighting trial introduced significant savings and the lighting specification has been rolled out to other Delivery Service Units in An Post network."

John Smith, Facilities Manager, An Post

Lighting Retrofit in Public Building

Technology:	Lighting Retrofit with 206 Patina LIDO 455 luminaires
Location:	Cardiff Lane in the Dublin Docklands
Results:	Energy Saving of 442,250 kWh, savings of 237 tonnes per annum
Financing:	Financed by An Post via an energy performance capital budget
Installation Date:	2010

237
tonnes of CO_2 saved per annum

Organisation
An Post is the Republic of Ireland National Mail sorting and delivery service. There are over 10,000 staff who collect, process and deliver more than 2.5 million items of mail each day including:

- Up to 2.1 million business and residential addresses
- Using a road fleet of 2,778 vehicles
- Serving 1.7 million customers every week through a unique national network

There are four main distribution centres (Mail Centres) together with 121 satellite depots (Delivery Service Units). The Docklands Delivery Service Unit (DSU) is located in Cardiff Lane and operates on a 24-hour basis.

Project Background
The Delivery Service Units which were constructed in the preceding 5-10 years were mainly equipped with constant-wattage, high-output, metal-halide luminaires. Since the construction of the DSU in Cardiff Lane there has been a lot of innovation in lighting which has improved the lighting quality in terms of veiling reflectance, lack of uniformity and discomfort glare.

Consulting engineers R. N. Murphy & Associates confirmed that it was the first time in their experience that the operators and general workforce were complimentary about the integration of the new technology. Due to the success of the project in Cardiff Lane, a program was established in which all the metal halide lights in An Post's DSUs have now been upgraded with the same technology.

Project Description
An initial analysis of the electricity usage and lighting configuration was carried out at the Cardiff Lane Depot. Following initial contact with the contractor Patnia Lighting, it was proposed to install six LIDO 455 luminaries for evaluation. The Cardiff Lane DSU was a particularly difficult environment as different lighting solutions had been proposed over the years without success.

Project Funding
The capital cost for the satellite trial project in Cardiff Lane was €15,000 with a simple payback of two years. It was funded internally by An Post under a specifically allocated capital budget for improving the energy performance in each of the mail distribution centres.

The energy efficient lighting technology has since been rolled out to other distribution mail centres at a cost of €134,000 having a simple payback of 2.5 years.

Project Development
Following the trial in Cardiff Lane, An Post was able to adopt a program of replacing the metal halide fittings with LIDO 455 luminaries across its business units which saved money and reduced CO_2 levels.

Capital Cost:	€134,000 (€15,000 in Cardiff Lane)
Annual Energy Savings:	442,250 kWh
Annual CO_2 Savings:	237 tonnes
Annual Savings:	€27,000
Payback Period:	2.5 years
Consultants:	R.N. Murphy & Associates
Lighting Supplier:	Patina Lighting
Project Contact:	John Smith, An Post Tel: +353 (0)1 7058125

50
tonnes of CO_2 saved per annum

Energy Performance Contract (EPC) in Restaurant

Technology:	Energy efficient lighting (LED), Building Management System upgrade
Location:	The Capel Building, Mary's Abbey, Dublin 7
Results:	Energy Saving of 100,000 kWh, CO_2 savings of 50 tonnes per annum
Financing:	Energy Performance Contract financed by an Energy Services Company
Installation Date:	Throughout 2013

"High energy costs were affecting the viability of the business. Engaging an energy management services provider allowed us to achieve immediate cost savings with no up-front costs."

Carl Andreucetti, Manager, Brasserie 7

Organisation
Brasserie 7 opened in October 2012 and is located centrally in the heart of Dublin's Legal District on Capel Street & Mary's Abbey. Brasserie7 has a hospitable atmosphere where customers enjoy fresh ingredients and dynamic dishes. It is a large restaurant with a total floor area of 783m². It is closed every Monday, and is open from 11am until 11pm other days. Since the opening of the Brasserie 7 in October 2012, the energy bills increased every month to the point where energy costs were threatening the viability of the business.

Project Background
To address their concerns on energy expenditure, Brasserie 7 contacted prospective consultants and service providers to investigate usage and to reduce energy use and cost. Rather than choosing to solely commission an energy audit, Brasserie7 decided to engage a service provider to provide energy management services on a Pay-As-You-Save basis. The main benefits of this service were no upfront cost and a sustained commitment to energy management.

The selected service provider carried out an energy audit and installed metering with remote telemetry to identify uses and usage trends.

Project Description
The monitored data showed that the AHUs and chiller were using large amounts of energy. The total rated power of the AHU fans is 32kW. Although the fans are equipped with a Variable Speed Drive (VSD) they were running at 100% power at all times. The BMS was upgraded to reduce the fan speed and to control it by temperature. Furthermore, the fan operating hours were optimised to match the opening times.
The chiller supplying cooling to the AHUs was observed to run

continuously, even when the kitchen was closed (at night and on Mondays) and during winter-time. The weekly average load was about 8kW. The BMS was adjusted to control the chiller so that it would not operate unless there is a demand for cooling in the kitchen or restaurant.

In addition to energy savings achieved through improved HVAC control and BMS upgrades, further savings were achieved through a lighting retrofit. In the main dining area, offices, bathroom and bar, energy-hungry halogen spots were replaced by high efficiency LED lamps, reducing energy usage for lighting by over 80%.

The catering equipment's load was about 12kW and was almost constant during the normal operating hours which were between 10am and 11pm. Energy management and staff awareness have helped to reduce usage through managing the use of equipment and switching equipment off when possible.

A review of the bills showed that Brasserie7 was incurring significant excess Maximum Import Capacity (MIC) charges. An increase in the MIC in conjunction with load management resulted in significant cost savings.

Project Funding
The project was self-financing through the energy cost savings achieved. Energy Solutions provided outsourced energy management and energy bureau services on a shared savings basis and invested in particular projects on an energy performance contracting basis.

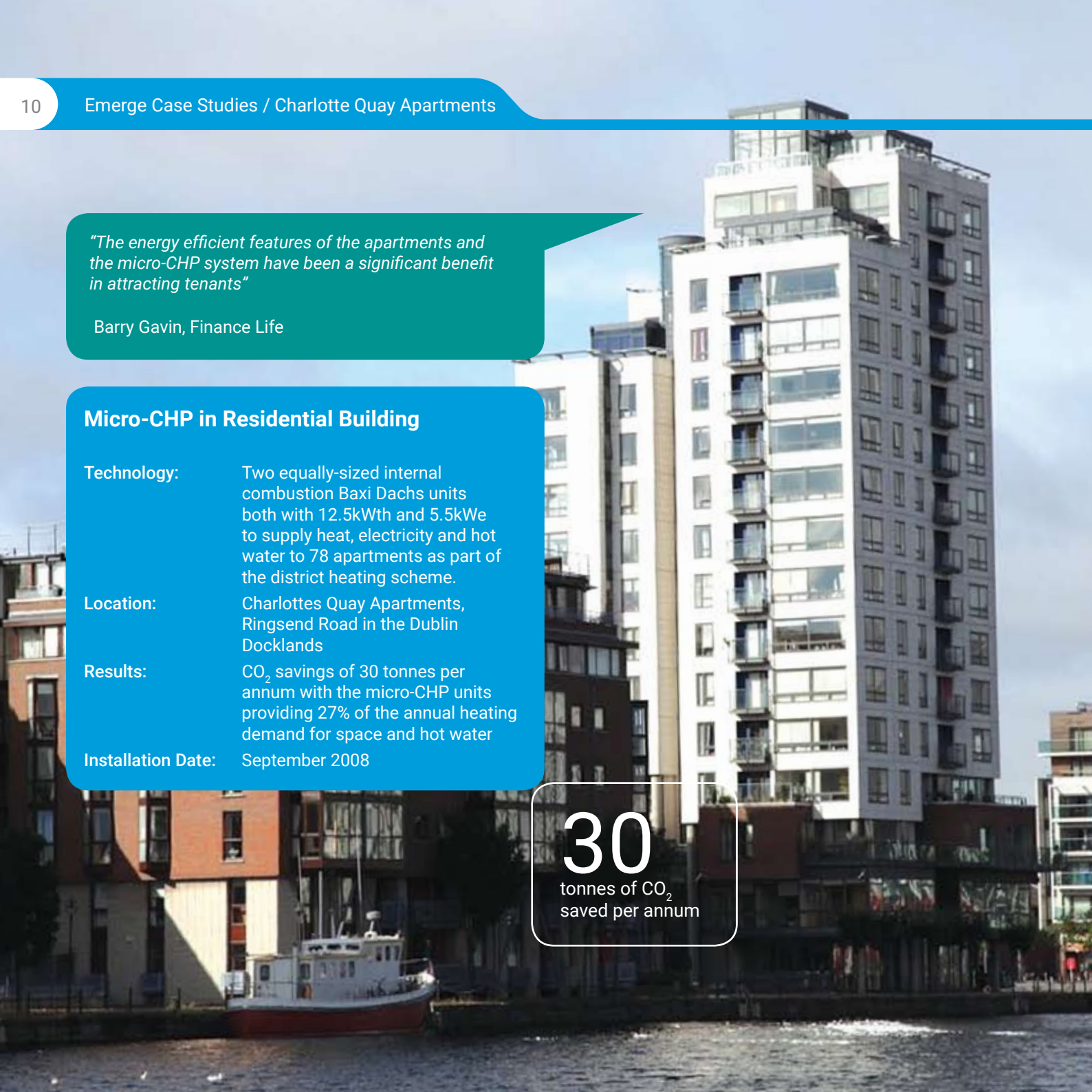
Brasserie7 therefore achieved significant and increasing energy cost savings with no up-front cost or risk.

Project Development
Electricity was the predominant energy use at the restaurant with natural gas being used for cooking. Seven electricity meters were installed on circuits and connected to a data logger with remote telemetry to monitor the electricity use. The energy audit and metered data identified HVAC as the predominant user, accounting for over a third of the total electricity consumption. The first focus was therefore on HVAC through improved controls on air handling unit (AHU) fans and on the chiller. Lighting was also identified as a significant user of energy with scope for savings.

Given that the projected savings were substantial, the energy services company proposed an Energy Performance Contract to the client. This EPC allowed the client to save energy without upfront cost. Indeed, Brasserie7 did not pay upfront for the energy audit or the metering equipment installation; instead, the savings were shared between the client and the energy services company.

The agreement was based on a 50% share of general savings to a specified limit and 90% of savings attributable to specific investments apportioned to whoever made the investment. Most of the savings were obtained by management and by upgrading the BMS, so the contract period could be as short as one year.

Capital Cost:	€7,500
Annual Energy Savings:	100,000 kWh
Annual CO_2 Savings:	50 tonnes
Annual Savings:	€15,000
Payback Period:	approx. 6 months
EPC Contractor:	Energy Solutions
Project Contact:	Carl Andreucetti Tel: +353 (0)1 4707770



"The energy efficient features of the apartments and the micro-CHP system have been a significant benefit in attracting tenants"

Barry Gavin, Finance Life

Micro-CHP in Residential Building

Technology:	Two equally-sized internal combustion Baxi Dachs units both with 12.5kWth and 5.5kWe to supply heat, electricity and hot water to 78 apartments as part of the district heating scheme.
Location:	Charlottes Quay Apartments, Ringsend Road in the Dublin Docklands
Results:	CO_2 savings of 30 tonnes per annum with the micro-CHP units providing 27% of the annual heating demand for space and hot water
Installation Date:	September 2008

30
tonnes of CO_2 saved per annum

Organisation
Finance Life built 78 apartments as part of a complex at Charlotte Quay on the Ringsend Road. The development also includes office blocks and a retail complex. The apartments were part funded by the Sustainable Energy Authority of Ireland (SEAI) under the House of Tomorrow programme due to their energy efficient features and were the first dwellings to be supplied with energy from micro-CHP. The apartments and the micro-CHP system are currently managed by Just Property.

Project Background
As is the case for all apartment complexes, there is a large demand for heating, hot water and electricity. The use of centralised block heating facilitates the use of energy efficient and alternative technologies, such as micro-CHP. As part of SEAI's House of Tomorrow programme, the apartments are 40% more efficient than typical standards at the time of construction.

Project Description
Two identical Baxi Dachs units were selected as the most appropriate given the base electrical loads. Combined, they have an electrical capacity of 11kWe and an average thermal capacity of 25kWth. The micro-CHP meets approximately 30% of the annual space and hot water demand and runs continuously apart from scheduled servicing. The thermal performance of the units are optimised in apartments with heat metering, heat recovery ventilation, high levels of insulation and building fabric air tightness.

Micro-CHP is defined as a combined heat and power plant (CHP) with an electrical capacity of less than 50kW. Whereas CHP has traditionally been installed in larger sites, this scale of CHP is suitable for smaller businesses.

The benefits of CHP (when compared to importing electricity and using boilers) to generate heat include:

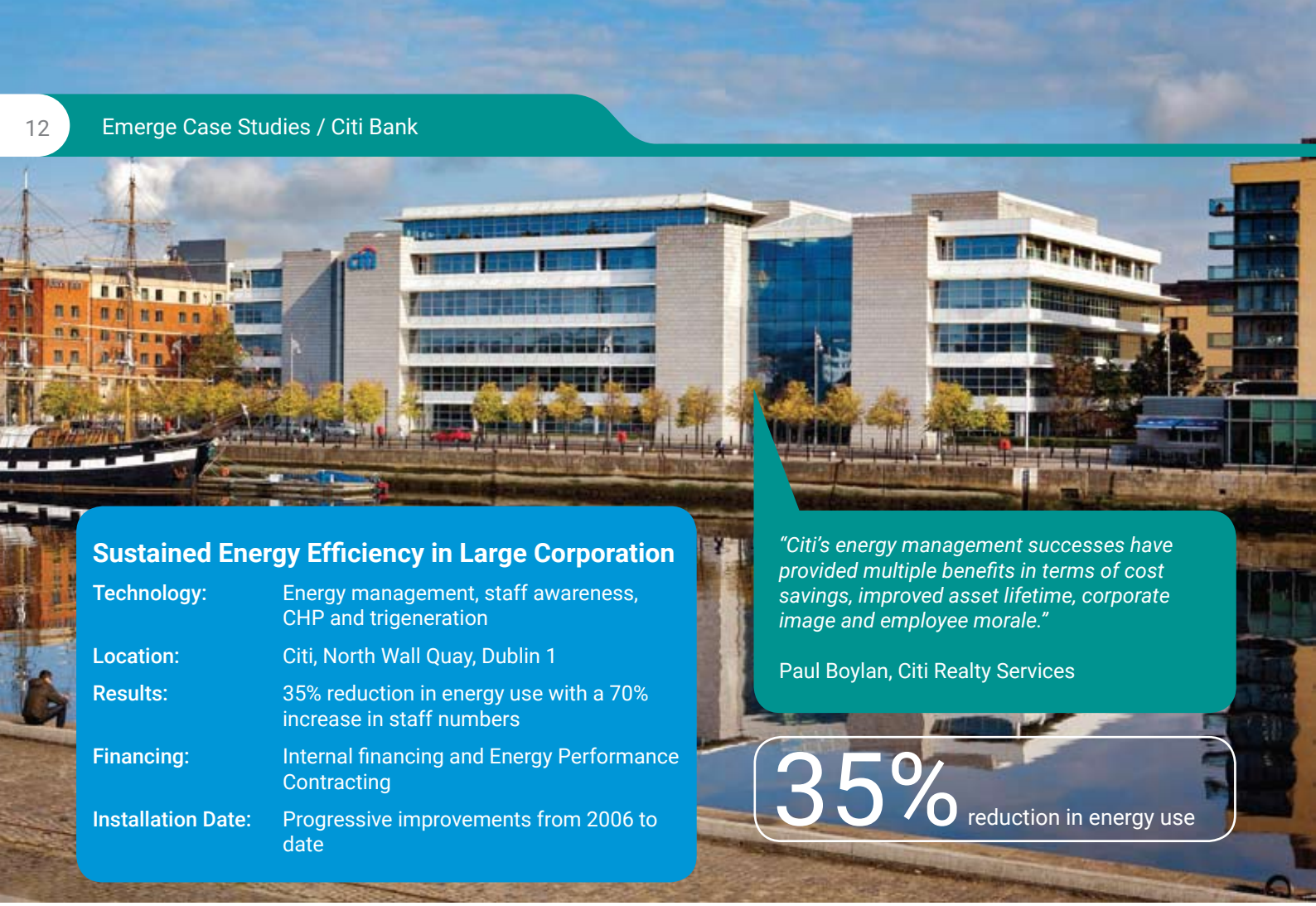
- improved efficiency of overall primary energy use,
- energy and CO_2 emissions savings,
- independence and security of power supply

CHP, often referred to as co-generation, is the combined production of heat and power in a single process.

Project Funding
The capital cost for the CHP was €51,000. It was part-funded by the SEAI under its House of Tomorrow programme. The annual savings are approximately €8,100 per year leading to a three year payback.

Project Development
Micro-CHP was the most feasible and practical choice for this site given the continuous base load of electrical requirements (e.g. car park lighting, pump loads etc.) and the large amount of heat required by the 78 units. The base electrical load was calculated for the complex and designed with this in mind; given that there is no payment for export to the grid at present. The heat requirement could then be addressed with the use of a 7,500 litre buffer tank which allows for the continuous running of the CHP units whilst continuing to displace electrical imports from the grid. The micro-CHP units are used in conjunction with two large boilers for back-up and extra heat demand.

Capital Cost:	€51,000
Annual Energy Savings:	120,000 kWh
Annual CO_2 Savings:	30 tonnes
Annual Savings:	€8,100
Payback Period: approx.	5 years with no support or grant. 3 years with an SEAI grant.
Consultants:	Envirobuild & Associates Ltd.
CHP System Supplier:	Kinviro Ltd.
Boiler Suppliers:	Precision Heating
Substation Supplier:	Danfoss Ireland Ltd. Micheal Galvin Tel: +353 (0)1 8433856



Sustained Energy Efficiency in Large Corporation

Technology:	Energy management, staff awareness, CHP and trigeneration
Location:	Citi, North Wall Quay, Dublin 1
Results:	35% reduction in energy use with a 70% increase in staff numbers
Financing:	Internal financing and Energy Performance Contracting
Installation Date:	Progressive improvements from 2006 to date

"Citi's energy management successes have provided multiple benefits in terms of cost savings, improved asset lifetime, corporate image and employee morale."

Paul Boylan, Citi Realty Services

35% reduction in energy use

Organisation

Citi employs over 2,400 people in Ireland with the majority located at the head office on North Wall Quay in Dublin 1. The facilities extend over eight levels with a gross floor area of 38,000m². Citi has a strong sustainability agenda covering carbon, energy, water and waste. Globally, Citi achieved a 10% reduction in CO_2 in 2011 compared to 2005. The 2015 target is a 25% reduction.

Citi is part of a group of eight companies in the Green IFSC, an initiative which aims to make the IFSC one of the most resource-efficient financial centres in the world.

Project Background

Citi's Irish Headquarters began its journey towards sustainable energy and environmental management in 2006 with an initial focus on reducing energy waste and reducing costs when the current head of realty services, Paul Boylan, was appointed. Citi won the SEAI award for Outstanding Energy Manager of the Year in 2009. This has developed into a sustainable green agenda aimed at reducing Citi's environmental impact while improving competitiveness and enhancing its corporate image.

Project Description
Following the success of energy awareness and management initiatives, Citi then started focusing on technical solutions to further increase efficiency and reduce waste. These projects started with lower capital cost investments such as efficient lighting retrofits, the introduction of variable speed drives on motors and fans and Building Management System (BMS) enhancements. Office equipment was identified as a significant user and the location and usage of printers and photocopiers was rationalised and multifunction devices were used to reduce energy usage. Larger capital spend projects included a data centre critical cooling retrofit with Computer Room Air Conditioning (CRAC) units which use 75% free cooling. In conjunction with a greater use of cloud services and virtualisation, this has significantly reduced the energy use in the data centre.

The installation of a wireless energy monitoring system in 2012 was an important initiative in further understanding usage patterns and identifying potential efficiency improvements.

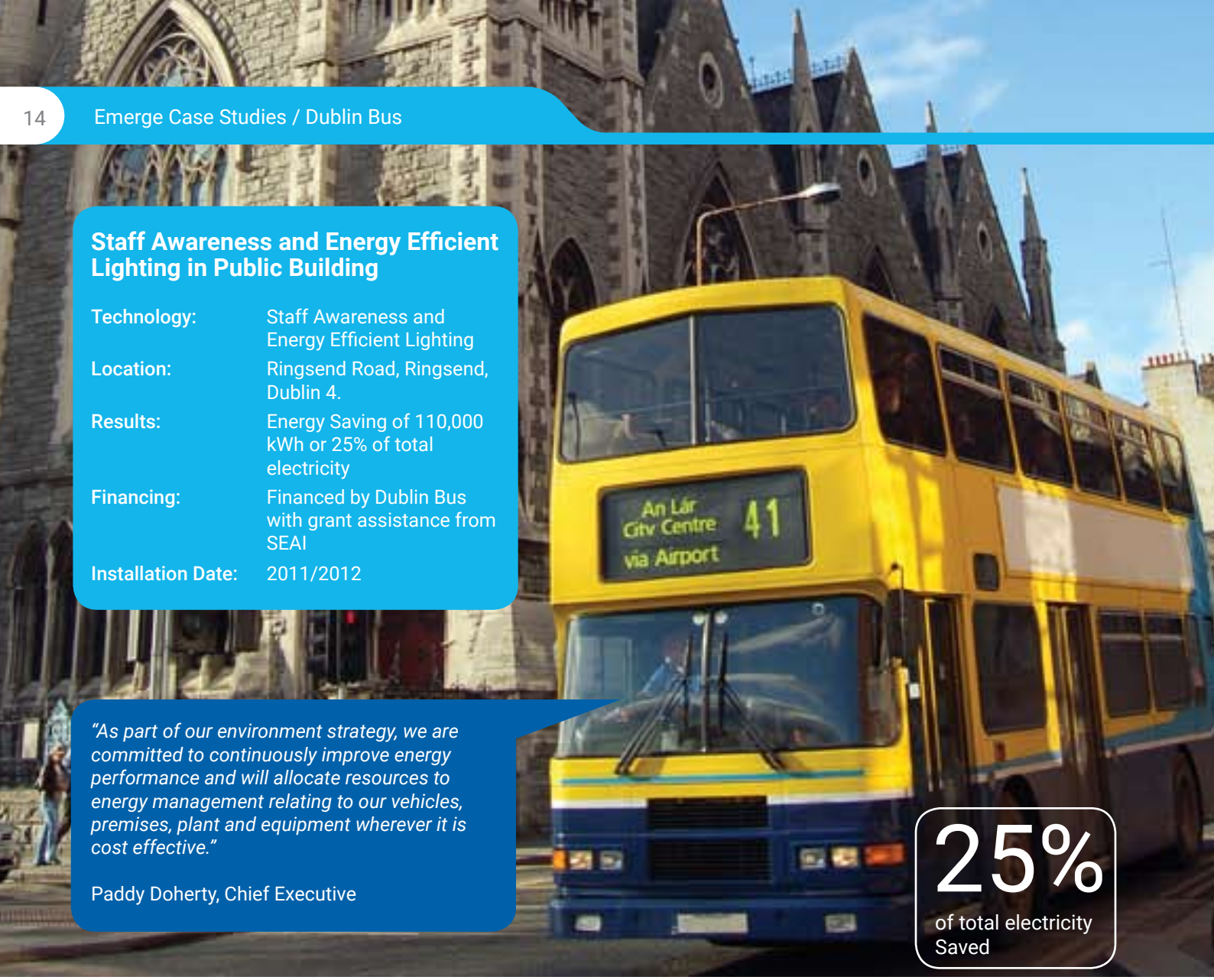
The Citi New Energy Initiative is a complex project which will allow efficient and year-round operation of CHP units on the site. The two existing 1MW units have only operated during winter months which has limited the operability of the CHP. The plan is to re-commission existing absorption chillers to provide a year-round heat demand and to export additional heat to a district heating scheme in an adjacent apartment building.

Project Funding
The project was initially focused on reduction in energy waste and housekeeping and was self-funded. Early successes in reducing energy costs and recognition with SEAI's Energy Awards assisted the business case for investment in energy technologies. Investment was generally self-funded with grant assistance from SEAI and other state agencies. The CHP plant has been operated under contract by an Energy Service Company (ESCo) since 2008.

Project Development
From 2006 to 2012, Citi HQ reduced energy usage by 35% while staff numbers increased by almost 70%, representing a 60% reduction in energy use per staff member. Achieving these results required a sustained approach to consistently improving energy efficiency. Engagement and buy-in from staff at all levels of the organisation were central in successfully reducing energy use.

Citi initially focused on energy consumption patterns and how consumption could be minimised across the working day. For example an 'Out of Hours' initiative was rolled out in 2008. This involved restricting the provision of 'heating, ventilating and air conditioning' (HVAC) and normal lighting services to between 7am and 6pm Monday to Friday. A process whereby those requesting energy services outside the normal working day were required to log a request and accept the associated energy costs on a 'pass through' basis was put in place. This clearly affected working practices and required buy-in at all levels of the organisation but was enormously successful in delivering energy savings and in engaging staff in energy efficiency.
These early successes, in conjunction with initiatives such as the establishment of a green team and annual environmental expos, were capitalised on to inspire and motivate staff to continuously improve energy efficiency.

Annual Energy Savings:	35% of benchmarked energy consumption
Contact:	Paul Boylan, Citi Realty Services (CRS) Tel: +353 (0)87 234 5399 Email: pcboylan@gmail.com



Staff Awareness and Energy Efficient Lighting in Public Building

Technology:	Staff Awareness and Energy Efficient Lighting
Location:	Ringsend Road, Ringsend, Dublin 4.
Results:	Energy Saving of 110,000 kWh or 25% of total electricity
Financing:	Financed by Dublin Bus with grant assistance from SEAI
Installation Date:	2011/2012

"As part of our environment strategy, we are committed to continuously improve energy performance and will allocate resources to energy management relating to our vehicles, premises, plant and equipment wherever it is cost effective."

Paddy Doherty, Chief Executive

25%
of total electricity Saved

Organisation

Dublin Bus is a provider of public transport in Dublin City and the greater Dublin area. It is a commercial semi-state company. Dublin Bus employs 3,200 people and almost 75% of the workforce are bus drivers (2,400).

The Dublin Bus energy policy has a firm commitment from the Chief Executive in providing the necessary time and resources required to achieve annual targets. The energy policy for Dublin Bus includes setting annual objectives and reduction targets and reviewing energy consumption on an on-going basis.

Project Background
In July 2012, Dublin Bus became a member of the Public Sector Energy Partnership Programme when they signed a partnership agreement with SEAI. Dublin Bus as a high energy user is part of the public sector programme working towards reducing its energy consumption by 33% by 2020 under the National Energy Efficiency Action Plan (NEEAP). This provides a challenge for the public sector bodies to lead the way in reducing their energy consumption and Dublin Bus is committed to achieving these targets.

Project Description
The primary energy consumption is fuel usage associated with running the bus fleet. The quantity of diesel fuel used in 2012 was over 28 million litres travelling over 57 million kilometres. The other main energy sources include seven maintenance depots and their associated gas and electricity usage. In addition, Dublin Bus also has a number of office buildings including head office, procurement and canteen. The breakdown of energy usage consists of fuel usage by fleet (95.3% of consumption), electricity (2% of consumption) and gas consumption (2.7% of consumption).

Employee Engagement
Energy teams meet in each depot to promote awareness and to carry out energy saving projects. There is a current initiative to measure and monitor the fuel savings being made through eco driver training techniques through the Certificate in Professional Competence (CPC) and Vigil Vanguard training. Trainers have received specific training in eco-driving and have participated in a workshop to develop methodologies for incorporating eco-driving into all driver training and instruction.

Project Funding
The project was 35% funded through SEAI's Better Energy Workplaces Programme 2012.

Project Development
Key projects developed include:

- Rationalisation of the fleet through Network Direct review resulted in a reduction in distance travelled of 3 million kilometres over the last 2 years
- Installation of energy efficient lighting for maintenance of facility workshops and parking yards
- Replacement of fuel pumps with high efficiency motors
- Installation of gas pulse meters and link to the BMS system as part of ongoing monitoring of gas consumption in the maintenance facilities
- Promotion of energy awareness among employees
- Continuation of the energy monitoring at each premises
- Idle speed modification on existing fleet to reduce fuel consumption
- Eco-driving module incorporated into all training for bus drivers
- Energy Map training

Annual Energy Savings:	110,000 kWh, 25% total benchmarked consumption
Project Contacts:	Aidan McGinty, John Saunders Dublin Bus Tel: +353 (0)1 703 3146 Email: Aidan.mcginty@dublinbus.ie John.saunders@dublinbus.ie

"A most successful sustainable project reducing environmental impacts by lowering the building carbon footprint and simultaneously reducing NOx, SOx and PM10/2.5 emissions. Financially, it achieved the first year projected savings within 10 months of operation."

Dublin Port Company

Boiler House Refurbishment & Ventilation Controls Retrofit in Public Building

Technology:	Boiler House Refurbishment & Ventilation Controls Retrofit
Location:	Dublin Port Centre, Docklands, Dublin 1
Results:	Electricity saving of 13%, gas saving of 27%
Financing:	Financed by Dublin Port Company (with 35% funding from SEAI under BEW 2012 scheme)
Installation Date:	2012

13% reduction in gas use

27% reduction in electricity use

Organisation

Dublin Port Company is a self-financing, private limited company wholly-owned by the State, whose business is to manage Dublin Port, Ireland's premier port. Established as a corporate entity in 1997, Dublin Port Company is responsible for the management, control, operation and development of the port. Dublin Port Company provides world-class facilities, services, accommodation and lands in the harbour for ships, goods and passengers. The company currently employs 144 staff. Dublin Port also handles over 1.76 million passengers through the ferry companies operating at the port and through the cruise vessels calling to the port and over 200,000 tourists. Located in the heart of Dublin City and at the hub of the national road and rail network, Dublin Port is a key strategic access point for Ireland and in particular the Greater Dublin area.

Project Background

When Dublin Port's Maintenance and Services Manager, Ciarán Callan, identified that the existing heating system was operating at less than 60% efficiency and that efficiencies in excess of 85% could be achieved with a modern condensing boiler and precisely engineered controls, a convincing case was made that the energy savings would pay for new upgrade works within a reasonable period of time.

Dublin Port Company was anxious to secure a guarantee that the energy savings would be achieved. A meaningful guarantee would incentivise the consultant and the contractors to remain involved with the project until savings were realised, thereby reducing the risk to Dublin Port Company.

Project Description
The boiler house refurbishment involved the removal of two oil-fired combiboilers, low temperature hot water (LTHW) pumps and pipework, a Motor Control Centre (MCC) and controls panel and associated pneumatics.

The upgrade included the installation of 2 x 286kW modulating and condensing gas-fired boilers, 4.5 kWe, 12.5 kWth microCHP with condenser module and 1,500 litre buffer vessel, LTHW pumps, pipework, valves and commissioning sets with lagging; domestic hot water (DHW) calorifier, new MCC and controls panel, extensive electricity, gas and heat metering and ancillary equipment. Advanced control strategies were developed to maximise boiler efficiency using direct modulation and weather compensation. Using advanced control also allowed for the CHP to be used as a lead heat generator, then charging the buffer vessels when there is no heat load, then discharging the buffer vessel when the heating is first started in the morning, while avoiding charging of the buffer vessel during the day.

The CHP (and boilers if required) is used to maintain domestic hot water at temperature when there is no space heating load, while avoiding wasteful cycling or heat loss into the space heating circuits.

Project Funding
The consultant and the main contractor each guaranteed separately to Dublin Port Company that the project would achieve a 15% energy-efficiency improvement in fossil-fuel use. If this guarantee was not achieved, each would lose 7.5% of their respective contract values.

Ventilation Controls Retrofit Contractual arrangements for Energy Performance Related Payments (EPRP)
A Pain/Gain Share Arrangement – performance measured by evaluating electrical savings - was agreed with the contractors. If 100% of the target electrical kWh savings were achieved, the parties received 100% of their respective fees. For each 1% of additional savings, the contractor would receive a bonus of 0.5% of their fee, up to a maximum of 5%. For each 1% of savings that fell short of target, the contractor will incur a penalty of 0.5% of their fee, up to a maximum of 5%.

Project Development
The ventilation controls retrofit included the removal of pneumatic controls for the Variable Air Volume (VAV) boxes in offices and installation of BMS control units and electro actuators on the VAV boxes and room temperature sensors. Whereas before office temperature control was erratic, each office is now monitored and controlled via the BMS and the temperature control of the main Air Handling Units (AHUs) can be harmonised with the requirements of the offices.

Capital Cost:	€300,000 with 35% SEAI Grant
Annual Energy Savings:	13% electrical kWh, 27% gas kWh
Annual CO_2 Savings:	134 tonnes/Year
Annual Savings:	€39,000
Payback Period:	7.5 years
Consultants:	Energy Consultancy, Design & Project Management - Powertherm Solutions Cian O'Riordan Tel: +353 (0)1 278 4388
Mechanical Contractor:	T. Bourke & Co.
Controls Contractor:	Standard Control Systems
Boiler Plant:	Supplied by Eurogas
Project Contact:	Ciaran Callan Dublin Port Company Tel: +353 (0)1 887 6000

"Despite being in a new building, we achieved substantial energy savings. This shows the potential for optimising energy performance in recently constructed buildings."

Ray Long, PwC

Substantial Savings in a New Building

Technology:	Lighting retrofit and controls, Variable Speed Drives (VSDs), BMS optimisation, condensing boiler
Location:	One Spencer Dock, Dublin 1
Results:	45% reduction in gas use, 25% reduction in electricity use
Financing:	Internal financing
Installation Date:	2011

45% reduction in gas use

25% reduction in electricity use

Organisation

PricewaterhouseCoopers (PwC) is the largest professional services firm in Ireland and provides integrated audit, tax and advisory services across all industries in Ireland and internationally.

In Ireland, PwC employs over 1,800 people in seven locations - Dublin, Cork, Galway, Kilkenny, Limerick, Waterford and Wexford. PwC's Corporate Responsibility Policy is grouped into four main areas – Community, Environment, People, and Marketplace. PwC seeks to embed corporate responsibility into corporate values and across all day-to-day business processes.

Project Background

PwC moved into the Spencer Dock building in April 2007. A key objective throughout the building planning, design and fit-out stages was to ensure One Spencer Dock was an efficient building.

A review of energy usage was carried out in 2011 which confirmed the building energy usage is within the best practice benchmarks set by the Chartered Institution of Building Services Engineers (CIBSE). However, the review also identified a significant potential for improved efficiency and performance and, while it seemed counter intuitive in a new building, PwC made energy efficiency a key focus area for 2011.

A comprehensive energy efficiency project was designed targeting a reduction in energy use of over 30%. The projects targeted improved operational control and the retrofitting of best-in-class technologies that had emerged since the original construction and fit out.

Project Description
The HVAC system was a major focus of the energy efficiency project. The HVAC controls were revamped and intelligent 'Comfort Controls' were introduced. These controls are based on the principle that comfortable temperatures can be achieved over a broader range once humidity conditions are supportive.

It was noted that there were times when both heating and cooling circuits were active despite an absence of load. The new controls were able to rationalise operation and modulate hot and chilled water circuits based on external environmental conditions which reduced pumping energy consumption (electricity), standing heat losses (gas boiler savings) and cooling loads (electric package chiller savings).

In addition, the main AHU temperature set-point was adjusted to benefit from "free cooling" by drawing in cool air on demand and therefore reducing chiller cooling loads.

VSDs were installed on all AHUs to modulate the speed of the fans to suit the occupancy of the building. This allowed the fans to be operated at 25 – 50% of rated power. The savings due to the VSDs were monitored separately and an aggregated reduction in energy use of 46% was achieved.

These measures reduced the heat load and made it possible to heat the entire building for 90% of the time with just one boiler. A condensing unit was fitted to the lead boiler, increasing boiler efficiency by 7% and providing further savings.

Further savings were achieved through improving the efficiency of the data centre. With the gradual move towards virtualisation, the amount of IT equipment in the data centre had reduced over time, reducing the cooling load.

Project Funding
The project was funded by PwC with grant support through SEAI's Better Energy Workplaces scheme. The payback period was just over two years which allowed the business case to be justified despite the fact that PwC lease rather than own the building.

Project Development
PwC carried out an internal review of energy use in 2011 and decided to appoint consultants to further analyse and assess usage and potential savings. Ascough Consulting Engineers carried out a detailed energy audit of the building and presented a range of measures that could be implemented to achieve energy efficiency gains.

The PwC Infrastructure Manager, Ray Long, then had to develop the business case for the proposed projects and to get buy-in and approval from senior management on site. The fact that PwC places a strong focus on communities and corporate social responsibility (CSR) assisted in overcoming the conceptual barrier in retrofitting a five year old building.

The project was managed and implemented over a short timescale in 2011 which was made possible by the commitment of PwC's Building Services team and external consultants and contractors. Following project delivery and installation of equipment, the commissioning and fine tuning of the controls was essential to achieving the projected energy savings.

Annual Energy Savings:	45% reduction in benchmarked gas use. 25% reduction in benchmarked electricity use
Contact:	Ray Doyle, PwC Tel: +353 (0)1 792 6826 Mobile: +353 (0)87 249 5220 Email: ray.p.long@ie.pwc.com

"This project resulted in guaranteed electrical and fuel savings for the hospital combined with improved comfort for both staff and patients. All operational and maintenance risks are the responsibility of the contractor"

RVE&EH

EPC in Public Building

Technology:	Combined Heat & Power Plant, Building Energy Management System, Energy Efficient Lighting, Insulation and a Remote Energy Monitoring System
Location:	Adelaide Road, Dublin 2.
Results:	Annual energy cost savings of €60,000
Installation Date:	November 2012

€60,000
annual energy cost saving

Organisation
The Royal Victoria Eye and Ear Hospital (RVE&EH) was established in 1897. The hospital moved to a newly built Victorian building in its present site in Adelaide Road in 1904 and is located over 4 storeys.

The hospital is primarily an ambulatory and elective surgery centre and the only stand-alone of two specialty hospitals in Ireland. It is the largest centre for retinal and strabismus cases and the only centre for ocular oncology cases in the country. In addition to patient care, education and research are the major functions in the hospital.

Project Background
In 2011, the hospital commissioned an energy audit to assess the potential to reduce electricity and gas costs together with an improved level of comfort. Following the audit recommendations, a contract with an ESCo was awarded which will run for seven years. The combined project included a 70kWe combined heat and power plant (CHP), building energy management system, energy efficient lighting upgrade, building fabric insulation and a remote lighting system. Installation work was completed in 2012.

Project Description
Micro-CHP typically saves around 25% of the energy that would have been required to produce electricity in a conventional power station and heat in separate heat-only boilers. Micro-CHP is defined as CHP with an electrical capacity of less than 50kW. Whereas CHP has traditionally been installed in larger sites, this scale of Micro-CHP is suitable for smaller businesses.

The benefits of CHP when compared to importing electricity and using boilers to generate heat include:

- improved efficiency of overall primary energy use,
- energy and CO_2 emissions savings,
- independence and security of power supply.

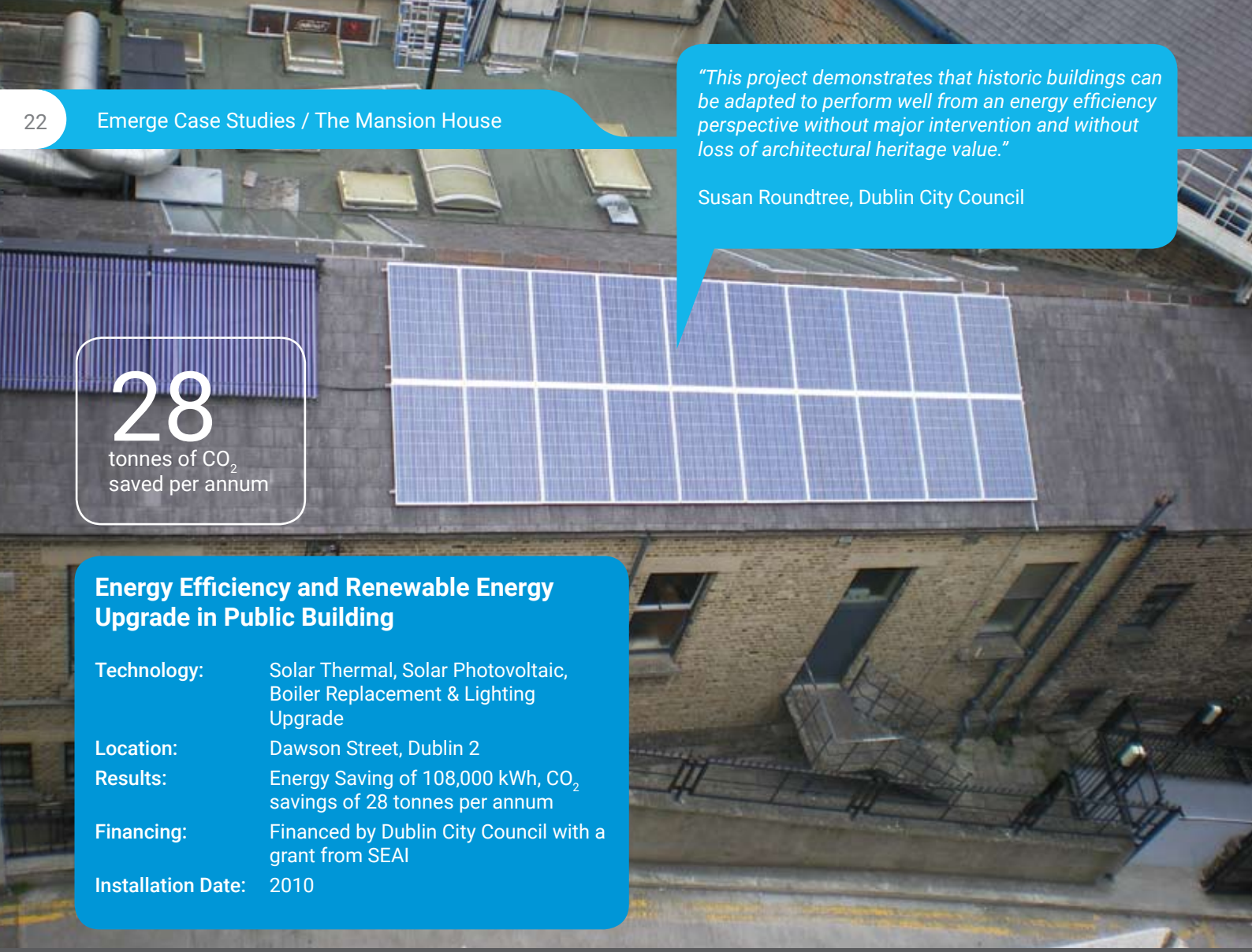
Project Funding
Approximately €300,000 capital costs were funded by the ESCo and RVE&EH. The ESCo provided 15% of capital costs from its internal financing. The RVE&EH provided 85% of the capital cost to the ESCo and was successfully awarded a 70% grant from SEAI under its 2012 Better Energy Workplaces scheme.

The ESCo contract involved a shared savings investment which will run for 7 years. The hospital will benefit from 100% of energy savings thereafter. The hospital receives a quarterly report and invoice detailing the savings. The ESCo model ensures that the RVE&EH and the ESCo work together to achieve additional energy savings.

A fully structured energy management service is provided as part of the contract, including staff awareness campaigns and routine audits outlining further opportunities for savings. There is also remote monitoring of plant performance, energy use and optimisation of plant control.

Project Development
Micro-CHP was the most feasible and practical choice for the hospital given the continuous base load of electrical requirements (e.g. car park lighting, pump loads, etc.) and the large amount of heat required.

Capital Cost:	€300,000
Annual Energy Savings:	120,000 kWh
Annual CO_2 Savings:	N/A
Annual Savings:	€60,000
Payback Period:	approx. 5 years
Project Contact:	Nora Reddington **ESCo:** Aramark
Consultants:	Michael Ferguson Aramark Environmental Services Tel: +44 (0) 28 9023 0127 Email: ferguson-michael@aramark.ie



"This project demonstrates that historic buildings can be adapted to perform well from an energy efficiency perspective without major intervention and without loss of architectural heritage value."

Susan Roundtree, Dublin City Council

28
tonnes of CO_2 saved per annum

Energy Efficiency and Renewable Energy Upgrade in Public Building

Technology:	Solar Thermal, Solar Photovoltaic, Boiler Replacement & Lighting Upgrade
Location:	Dawson Street, Dublin 2
Results:	Energy Saving of 108,000 kWh, CO_2 savings of 28 tonnes per annum
Financing:	Financed by Dublin City Council with a grant from SEAI
Installation Date:	2010

Organisation

The Mansion House is the residence of the Lord Mayor of Dublin and, as such, it is one of the premier buildings in Ireland. The Mansion House was purchased by Dublin Corporation in 1715 as a Mayoralty House and has retained this use. The building is of historical as well as architectural significance and is visited by many visitors each year, both for formal and informal events.

The building has been upgraded a number of times in its history. Some of the upgrades were extensive and others more piecemeal. The building services installations in particular were added on an 'as needed' basis and therefore not well integrated and lacked intelligent control. Prior to energy efficiency works, the building used over 400,000kWh of energy per annum.

Project Background
Dublin City Council undertook a full review of the Mansion House and produced a Conservation Plan in July 2009 setting out the importance of the building and proposing upgrades and alterations to help preserve and enhance the building. The building services installations were reviewed within the study and given that many of the systems were reaching the end of their useful life, recommendations were made for energy efficient upgrades. The boiler plant was old and inefficient with inadequate building heating zoning considering the multiple building uses as offices, residences, public facilities and storage space and heating circuits were reworked to provide zoning.

Project Description
Hot water was previously provided using electricity as the primary fuel and this was converted to gas-fired hot water heating with solar thermal panels.

The older lighting specification contained tungsten lamps in chandeliers and other older T12 luminaires. These were replaced with LED and energy efficient T5 fluorescent lamps. Given the large electrical baseload, 30m² of solar photovoltaic panels were installed. These panels produce 25,000kWh of electricity per annum.

Energy savings have been based on achieving a 30% saving on gas and a 15% improvement with the boiler plant and a further 15% saving via zoning, controls and thermostatic radiator valves (TRVs). Electrical energy saved is 15% based on relamping of fittings, the installation of 30m² of solar photovoltaic panels (PV) and the changeover of hot water from electrical heating to gas-fired and solar heating.

Project Funding
The capital cost for the Mansion House project was €180,000. The project was undertaken by Dublin City Council with a substantial grant of 60% of the cost coming from SEAI under its Energy Efficiency Retrofit Fund (EERF). A new boiler and controls were sourced for €60,000. The solar thermal panels cost €10,000, the solar photovoltaic panels and electrical system cost €25,000 and €10,000 was spent on a lighting system upgrade.

Project Development
The existing heating system was separated into sub-circuits to provide heating zones for separate uses – residence, offices, public areas, storage and hot water with associated pumps and controls. The old heating system had just one time clock for all areas and no modulation of the boiler. TRVs were fitted to replace standard valves and the old gas-fired boiler was replaced with a new modulating gas-fired condensing boiler.

The electric hot water cylinder serviced the Mayor's apartment and point of use heaters for the public WCs. This hot water requirement is now serviced by a dual coil cylinder fed from the gas boiler and 10m² of solar thermal panels. Installation of solar thermal panel array linked to the new hot water service calorifiers. Existing Tungsten lamps and old fluorescent lamps were replaced with a combination of T5 fluorescent lamps and LED lamps.

Capital Cost:	€180,000
Annual Energy Savings:	108,000 kWh
Annual CO_2 Savings:	28 tonnes
Annual Savings:	€6,000
Payback Period:	30 years
Consultants:	Edith Blennerhassett, Engineering Environments
Email: edith.blennerhassett@engenvironments.com	
Solar Photovoltaic Supplier:	Coolair jloughlin@coolair.ie Tel: +353 (0)86 853 1993
Project Contact:	Susan Roundtree[1] Dublin City Council Tel: +353 (0)1 222 2222 [1] Since retired

"Energy Solutions delivered immediate and significant energy cost savings and clarity on what's using the most energy which will allow us target further savings."

Colm O'Cleirigh, Westcourt Management Services

Energy Efficiency in Serviced Offices

Technology:	Energy efficient lighting, lighting controls and heating controls
Location:	Serviced offices on Clarendon St, Dublin 2 and Dominick St, Dublin 1
Results:	Energy Saving of 40,000kWh, CO_2 savings of 20 tonnes per annum
Financing:	Energy Performance Contract financed by an Energy Services Company with grant assistance from SEAI
Installation Date:	November 2012

Organisation
Westcourt Management Services (WMS) specialises in property management and maintenance in Dublin city and have been in business since 1987. They manage over 200 residential units across Dublin city and over 5,000 square metres of commercial space.

As a property management company, one of WMS's top priorities is to control the spend of their clients. WMS actively assist their clients to work to reduce energy costs as part of their service and are keen to continue these efforts as new energy efficiency technologies become available to the market.

Project Background
After a sharp rise in energy bills at one of the serviced offices managed by WMS, they contacted an energy consultancy and services company, Energy Solutions, to investigate usage. Energy Solutions installed sub-metering to identify end uses and found that servers and IT equipment use a significant proportion of electricity at the site. Significant potential savings through a lighting retrofit were also identified.

Energy Solutions proposed to install energy efficient lights, lighting controls and heating controls and to recover the installation costs through a share of the energy cost savings via an Energy Performance Contract (EPC).

Project Description
Clarendon House is a mid-20th century office building in the city centre with an area of 1,400m² over three floors. Dominick Court is a Georgian period building in Dublin 1 with a floor area of 900m² over five floors. Both buildings had older T8 light fittings with magnetic ballasts throughout. The lighting levels were generally good in the buildings but a detailed survey identified some areas with higher levels of lighting than others.

A full lighting design was carried out to ensure

appropriate lighting levels in all areas. This enabled the number of fittings to be reduced in certain areas increasing the energy savings.

High output T5 fittings with high Light Output Ratio luminaires were fitted throughout. On average, over the two buildings, a 55% reduction in rated capacity for lighting the buildings was achieved while maintaining or improving lighting levels.

The buildings are serviced offices and tenants are not billed for energy usage. There is therefore no incentive for tenants to manage usage. For this reason, occupancy controls on lighting were essential. In some cases, rewiring was necessary to allow occupancy sensors to control lighting in appropriate areas. Monitoring before and after indicated a 30% reduction in burn hours due to the use of occupancy sensors resulting in a reduction of almost 70% for energy use in lighting.

Space heating in the Dominick Street site is provided by electrical storage heaters. This is the only option for heating given that it is a period, listed building. However the heaters rely on occupants to change the controls depending on the weather and the offices were frequently overheated.

Project Funding
The capital cost for the lighting retrofit project at two buildings and heating controls at one building was €37,000. The cost was funded by Energy Solutions via an EPC with project financing from Bank of Ireland. A 35% grant through SEAI's Better Energy Workplaces scheme was secured.

Project Development
The prospect of implementing energy efficiency projects through an EPC with project funding by Energy Solutions was first raised in March 2012. As Energy Performance Contracting was a new concept to WMS; it took some time to work through various EPC models and to agree the best method for project delivery.

Energy Solutions offered to finance the projects, manage their implementation and to guarantee energy cost savings to WMS. The availability of grant funding through SEAI's Better Energy Workplaces scheme was a significant driver for the project both through providing comfort with the model and the concept of Energy Performance Contracting. The grant also enabled a shorter term contract.

The period of the contract was especially important at Clarendon House as the building is not owned by WMS and the contract period had to be shorter than the lease period. The term of the contract was three years for Clarendon House. Dominick Court is a period building and the cost of retrofitting lighting was higher than in non-period buildings, requiring a four year contract.

Capital Cost:	€37,000
Annual Energy Savings:	40,000 kWh
Annual CO_2 Savings:	20 tonnes
Annual Savings:	€8,000
Payback Period: approx.	5 years with no support or grant. 3 years with SEAI grant.
EPC Contractor:	Energy Solutions
Project Contact:	Fergal Purcell Tel: +353 (0)1 617 4853
Contact for WMS:	Colm O'Cleirigh Email: info@wmsltd.ie Tel: +353 (0)1 677 9706

Technologies

The projects included a broad range of energy efficient technologies and techniques including the following:

- Energy awareness and 'switch off' programmes
- Metering, monitoring and reporting usage
- HVAC controls and BMS upgrades
- Efficient lighting and controls
- Variable Speed Drives
- Efficient data centre cooling
- Condensing boilers
- CHP
- Trigeneration
- District heating
- Insulation
- Solar thermal
- Solar PV

Decision-making process

The decision to commit to an energy project in the private sector was generally driven by energy cost savings with corporate social responsibility being a key motivator, generally in large organisations. In the public sector, the 33% target for energy efficiency gains and SEAI's public sector programme, in conjunction with cost savings, drove the project.

For example, in Citi and PwC the sustainable energy initiatives were very much in line with global corporate policy which assisted in getting the projects off the ground. In both cases, strong individual initiative and a convincing business case were required for project approval.
In all cases, the projects needed an internal energy champion to identify the opportunities, develop the business case, get approval and implement projects. This was often done with the input and assistance of an expert consultant. In public sector organisations, SEAI's public sector programme provided valuable resources and expertise to organisations looking at energy efficiency.

In smaller SME's, there was generally neither the resources (time) or expertise to identify and implement energy efficiency projects and the input of an independent consultant was considered to capitalise on a concern over high usage and costs and to deliver energy savings. Assistance from energy management services companies, or possibly energy suppliers, would aid in the delivery of potential energy savings.

Funding

The projects were funded through a mixture of internal funding by companies and Energy Performance Contracting, often with grant assistance from SEAI. The fact that grant assistance was available does not infer that the project would not have proceeded without grant aid, but the availability of grants undoubtedly assisted the business case. With the phasing out of grants, government policy is to stimulate energy efficiency through market based mechanisms such as Energy Performance Contracting, Pay–As-You-Save and supplier obligations.

The projects funded through Energy Performance Contracting were done through a variety of models from full third party funding to an energy and heat supply agreement to energy performance related payments.

Organisation	Funding Method
An Post, Delivery Service Unit Cardiff Lane	Internal budget for energy efficiency projects
Brasserie7	Energy Performance Contract financed by an Energy Services Company
Citi Bank	Internal financing and Energy Performance Contracting
Dublin Bus	Internal Funding and SEAI Grant Assistance
The Mansion House	Internal Funding and 60% SEAI Grant Assistance
Dublin Port Company	Internal Funding, ESCo guaranteed savings and 35% SEAI Grant Assistance
Royal Victoria Eye and Ear Hospital	Internal Funding, ESCo guaranteed savings and 70% SEAI Grant Assistance
Charlotte Quay Apartments	Developer funded with 40% grant assistance from SEAI.
PwC	Internal financing
Westcourt Management Services	Energy Performance Contract financed by an Energy Services Company with 35% grant assistance from SEAI

Barriers	Possible Solutions
Inexperience with Energy Performance Contracting	Grant funding through SEAI's Better Energy Workplaces Scheme which provided comfort with the concept of Energy Performance Contracts and through enabling a shorter term contract
Low budget for investments in energy efficiency	Outsourced energy management service contract based on shared saving provided ideal opportunity to reduce energy costs without any risk or investment
Technology trials delay the commitment to a full scale energy retrofit project	Verification of energy savings to ensure a successful implementation of the new technology
Difficulties to unlock internal financial resources	A meaningful guarantee that energy savings will be achieved would incentivise the consultant and the contractors to remain involved with the project until savings were realised

Energy and CO_2 saved

The table below summarises the energy savings and associated CO_2 reduction for each of the sites and projects. CO_2 savings were either reported in tonnes per year or percentage savings. Across all sites it is evident that significant energy savings were achieved, with savings obviously depending on the scale of use at the site.

Organisation	Projects	Energy Reduction kWh CO_2	Savings T/Yr
PwC[2]	HVAC and BEMS upgrade	35%	35%
Citi Bank[3]	Energy management, CHP and DH - EPC	4,000 MWh	35%
Charlotte Quay Apartments	CHP and district heating	120,000	30
Westcourt Management Services	BEMS & Lighting retrofit – ESCO	40,000	20
Royal Victoria Eye & Ear Hospital	CHP and energy efficient upgrade – ESCO	120,000	71
Dublin Port Company[4]	Boiler House Refurbishment & Ventilation Controls Retrofit	N/A	134
An Post, Delivery Service Unity Cardiff Lane	Lighting - High Bay	442,250	237
The Mansion House	Solar PV Thermal	108,000	28
Brasserie7	Energy efficient lighting (LED), Building Management System upgrade, Energy bureau	100,000	50
Dublin Bus	Staff Awareness and Energy Efficient Lighting	110,000	50

[2] Capital Cost and Energy Savings were not disclosed by this site. Energy savings are reported as a % of total use.
[3] Capital Cost and Energy Savings were not disclosed by this site. Energy savings are reported as a % of total use.
[4] Energy Savings were not disclosed by this site

The following table shows the average and total capital investment, excluding PwC and Citi Bank which did not report total capital spend.

Overall Project Indicators	Overall Project Results
Average Capital Investment (€)	144,214
Total Capital Investment (€)	1,009,500
Average grant awarded (% of project costs)	44%
Total Energy Savings (kWh)	1,040,250
Total Energy Savings (€)	163,100
Total CO_2 Savings (T/Yr)	621
Average Project Payback (Years)	8

PwC and Citi Bank implemented a range of measures and it is likely that the spend at these sites exceeded the spend at all other sites combined. The payback on investment at PwC was less than two years, which allowed project to be justified in a building not owned by PwC. In Citi, the energy projects were largely self-financing with paybacks of under one year. The CHP and trigeneration projects are financed by an ESCo.

The total capital spend at the other sites exceeded €1 million with an average project payback of 8 years. The paybacks ranged from 30 years to less than one year. The sites with longer payback periods generally included investment in renewable energy sources such as solar pv or solar thermal. The median payback was 5 years. These paybacks do not include any grants or other supports.

Conclusion

The Emerge Good Practice Energy Case Studies have shown that energy efficiency is achievable in all types of organisations and building types once a sound business case is presented. These can result in significant cost saving and CO_2 emissions while improving the operations of an organisation.

The measures discussed are all now mainstream mature and proven technologies, there is competition in the market to provide these leading to good value for the customer. There is a move away from grant funding for such measures towards assistance in leveraging financial mechanisms such as ESCOs, energy performance contracts and loans specifically for such works.

It is the hope of the Emerge project that these studies will inspire other organisations to take a closer look at their businesses energy and the value that implementing savings can have for a company.

AHU	Air Handling Units
BMS	Building Management System
CHP	Combined Heat and Power Plant
CIBSE	Chartered Institution of Building Services Engineers
CPC	Certificate in Professional Competence
CO_2	Carbon Dioxide
CRAC	Computer Room Air Conditioning
CSR	Corporate Social Responsibility
DHW	Domestic Hot Water
DSU	Delivery Service Units
EERF	Energy Efficiency Retrofit Fund
EPC	Energy Performance Contract
EPRP	Energy Performance Related Payment
ESCo	Energy Service Company
GIS	Geographic Information System
HQ	Headquarter
HVAC	Heating, Ventilating, and Air Conditioning
IFSC	International Financial Services Centre
kW	kilowatt
kWh	kilowatt-hours
kWe	kilowatt-electric
kWth	kilowatt-thermal
LED	Light-Emitting Diode
LTHW	Low Temperature Hot Water
MCC	Motor Control Centre
MIC	Maximum Import Capacity
MW	Megawatt
NEEAP	National Energy Efficiency Action Plan
PV	Photovoltaic Panel
PwC	PricewaterhouseCoopers
RVE&EH	Royal Victorian Eye and Ear Hospital
SDZ	Strategic Development Zone
SEAI	Sustainable Energy Authority of Ireland
SME	Small and Medium Enterprises
TRV	Thermostatic Radiator Valves
VAV	Variable Air Volume
VSD	Variable Speed Drives
WMS	Westcourt Management Services

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