DKPartnership

post@dkpartnership.com : E

00 353 (0) 1-813-1930 : T
00 353 (0) 64-664-1686 : T

PROPOSED MIXED USE DEVELOPMENT AT CLONGRIFFIN

CITY DISTRICT HEATING NETWORK

MIXED USE DEVELOPMENT

CLONGRIFFIN
DUBLIN 13

GERARD GANNON PROPERTIES

DKP-K00-6091-2G
2019-08-09

Document control

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Circular	Issue >	1P	2P
Clients	Gerard Gannon Properties	x	x
Architects	CCK, Wilsons, Downey Architecture	x	x
Planning consultants	Downey Planning	x	x
Structural/civil engineer	Waterman-Moylan	x	
Quantity surveyor	MMP	x	

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Status

N	No status
G	General Information
P	Planning
O	Outline/sketch design
S	Scheme design
D	Detail design
T	Tender
C	Construction
B	Build / Constructed

ING Gerard (Craig) van Deventer CEng., BE(mech)., HDip CIOB, MCIBSE

M : [00] 353 (0)87 260 8080
E : gerard@dkpartnership.com

DKPartnership
70 Main Street, Applewood , Swords, Co.Dublin, Ireland
Reen Kenmare Co. Kerry

post@dkpartnership.com
www.dkpartnership.com

T : [00] 353 (0)1813 1930
T : [00] 353 (0)64664 1686

Contents

1 Executive summary

1.1 Report purpose.

This report was issued to give information on a de-centralised heating network option in the Clongriffen area as part of the current master planning phase.
For the purpose of this report the heat network is called the Clongriffin District Heating Network (CDHN).

1.2 Description.

For the new proposed mixed use development it is proposed to apply a city district heating network (CDHN) serving all residential and commercial units within the 15 no. blocks covering approximately 1950 units and +/- 22,727m2 commercial space.
A further potential 3 blocks (7,9,10) could also be added increasing the viability of the system.

1.3 Environmental advantages of the CDHN.

City district heating networks offers not only advantages in terms of higher efficiencies and reduced consumption but also on capital cost savings and reduced operating and maintenance costs.
The Clongriffin CDHN allows for efficient use of thermal energy using mainly combined heat & power (CHP) giving the project a 23%-25% primary energy saving and a 38% carbon dioxide (CO_2) saving.
In energy terms this is a saving of +/- 6.7 million kWh per year and a 1.4 million kg CO2 (1400 Ton) per year.
This is of importance to the environment as every kWh saved is a reduction of CO_2 and a saving of our natural resources and Irelands commitment to the Kyoto protocol.
The proposed CDHN also provides the bulk of the statutory renewable energy requirement under the new Part L 2017 and proposed new Part L 2018 better known as the NZEB requirements.

1.4 Financial advantage.

Financially there are capital cost savings and an additional revenue stream.
The CDHN system based on a very basic cost model gives a capital reduction of in the region of € 6,000,000 mainly due the economy of scale and avoidance of conventional renewable energy systems like PV or Solar thermal.
This reduction in capital cost actually completely covers the cost of the CDHN estimated at +/- € 3,000,000

1.5 Additional revenue stream.

As the CDHN is metered / invoiced by the developer or operator to end-users by means of an individual credit meter or pre-pay meter additional revenue is derived from energy sales.
The fully loaded CDHN would return annual profits in excess of € 500,000.00 and is also a reliable profit returning every year.

1.6 Other savings or practicalities.

With the CDHN providing most of the renewable it also frees up roof spaces for gardens, green roofs or other for purposes.
No individual gas boilers or gas boiler locations to be found, no flue terminal and no individual gas risers to each apartment unit generally routed externally on the facades.

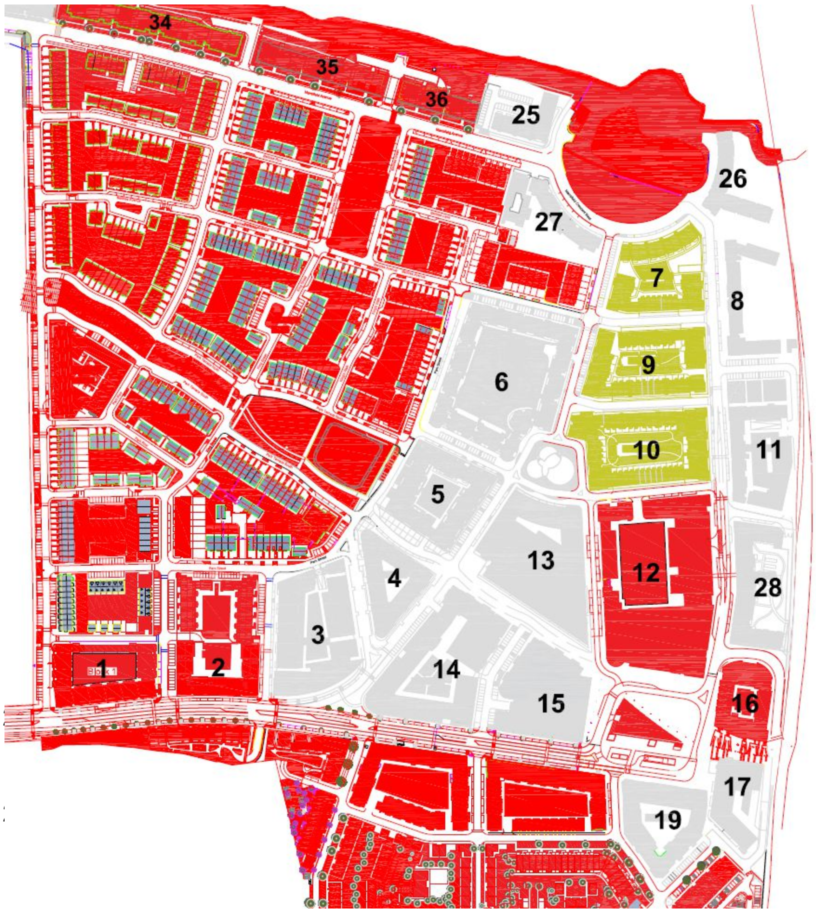
2 Introduction

2.1 Back ground.

The aim of this report is to provide information on a de-centralised energy supply option for the current master plan phase of the Clongriffin area in the form of a common heat network using a combined heat & power plant as the main heat energy source to reduce the impact on the environment with the significant lower overall energy usage and carbon dioxide emissions as part of a sustainable energy approach.
This report covers the energy efficiency, practicalities, advantages, construction cost and feasibility of a City District Heating network (CDHN) for the Clongriffin site as part of the implementation of the Nearly Zero Energy Buildings (NZEB) requirements for the buildings in the proposed development.

2.2 Clongriffin site details.

The site is in the Clongriffin area being developed by Gerard Gannon Properties and the current master planning phase comprises 15 apartment blocks (3,4,5,6,8,11,13,14,15,17,19,25,26,27,28) and a possible additional 3 no. blocks (7,9,10) covering approximately 1950 + 250 residential units and a total of +/- 22,727m2 of commercial space. Given its urban type density the development is suitable for a city district heating system.



Grey blocks :
Part of current master plan phase

Yellow blocks :
Possible future addition

Illustration 1 Clongriffin CDHN apartment blocks

2.5 Benefits of the CDHN for the environment.

a – Lower energy requirements
b – Lower carbon dioxide emissions

2.6 Benefits of the CDHN for the developer / operator.

The following is a simple list of advantages of the CDHN
a – Lower capital cost
b – Revenue from energy sales
c – Reduced maintenance / cost
d – No gas services in buildings, no fire protection requirements for gas services
e – No carbon monoxide monitoring
f – No Gas boiler / heat pump condenser location issues
g – No heat pump external condenser noise issues

The CDHN capital cost just compared to a conventional individual gas boiler type system are approximately 10% less however the avoidance of separate renewable energy provides additional significant savings covering the cost of the complete CDHN capital cost element.
The CHP system provides most of the Part L compliance required renewable energy in the form of primary energy savings whereas as with a conventional system the renewable energy would have to be provided separately by PV (photovoltaic), biomass or thermal solar. See section 2.11 and appendix C for capital costs.

Revenue from thermal energy sales and electrical energy sales are significant due to the fact that all thermal and electrical energy units can be sold to the residential and commercial units and any surplus fed back to the national grid. See section 2.11 / Appendix C for energy sales.

2.7 Benefits of the CDHN for the end user.

The following as a simple list of advantages of the CDHN
a – No fuel or fuel storage requirements
b – No combustion process, no local emissions
c – No exhausts and or carbon monoxide monitoring
d – No gas boiler location or noise issues, no heat pump external condenser noise issues
e – Heating and hot-water energy always available

2.8 Statutory Part L requirements.

For the purpose of this report as the proposed project is going to apply for planning in the next couple of weeks it is has been assumed that applying the current Part L 2011 (NZEB) is not realistic given the required completion dates of the transitional periods hence the following targets are applied ;
Residential units : Part L 2019 (NZEB)
Commercial units : Part L 2017 (NZEB)

Technically (and financially) the impacts on the residential and commercial units are different.
The impact on the residential units between Part L 2011 and Part L 2019 is not that significant with the main effects to be the renewable energy provision change from a fixed rate (10kWh/m2) to a variable rate (20% of primary energy) and the air tightness testing from a proportional quantity of units to be tested to all units to be tested.
The impact of the commercial Part L from 2008 to 2017 is significant in particular the required energy reductions and the requirement of renewable energy provision. See appendix A for a general comparison guide.

For the purpose of calculating the CDHN peak load and annual energy usage and for Part L compliance of the residential and commercial units both part L 2017 (commercial) and part L 2019 (residential) have been applied. See appendix B for general compliance parameters.

3 City district heating network

3.1 What is district heating network.

District heating is where a number of buildings or residential / commercial / industrial units are heated from a central source via a common district heating distribution network.
The district heating distribution network then delivers the heating energy to all connected buildings, blocks or units.
Typically a block would be fed directly from the district heat network via a central block heat exchanger and peak load buffer/thermal storage tank arrangement.
From here the heating energy is distributed to each unit by a secondary block building heating network or building communal heating system using a Heat Interface Unit (HIU).
A HUI typically is a compact heat exchanger for the transfer of heating and hot-water energy from the building communal heating system to the fully separate and independent unit heating/hot-water installation.
The HUI also comprises a heat meter which records and accumulates the energy usage collected electronically by the CDHN data collection server and used to raise periodic energy invoices.
If available other heat energy sources can be connected into the system to provide low cost energy, i.e. waste heat from processes, solar thermal gains, etc.

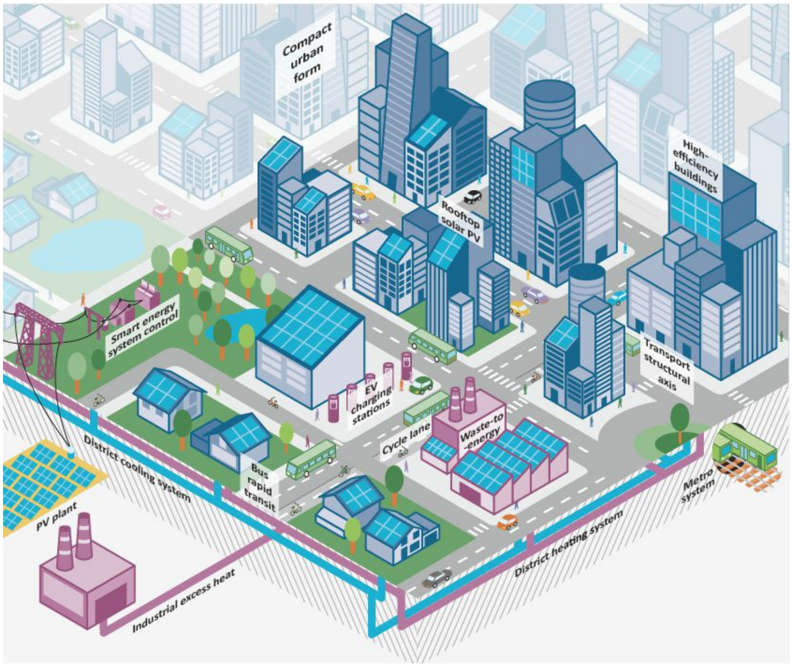


Illustration 2 : Basic (artist) view of a district heating system

3.2 What is combined heat and power (CHP).

In essence the CHP is an electricity generator which unlike a standard generator, utilises its waste heat from combustion to provide thermal energy for space heating, hot water and also cooling.
Well designed CHP units can deliver in excess of 40% of thermal energy and 45% of electrical energy.
A combined heat and power plant comprises of five basic elements, namely an engine, an electricity generator, a heat recovery system, a control system and an exhaust system.
Typically, between 80% and 90% of the fuel input can be usefully converted to electrical power and heat. This compares well with boiler plant efficiencies, but whereas a boiler only produces heat, a CHP unit also produces electricity and it is this that provides the financial savings.
In order to fully utilise CHP, it is essential to recover as much heat as possible from the machine and to use the heat to feed into a heating system or absorption chillers.
CHP plant provides heat energy when generating electricity and in order to provide viability for the CHP, the plant should be run for as long as possible at between 75% and 100% of its capacity.

The application of CHP thereby requires a constant demand for heat energy which is achieved by utilising thermal storage both as a central store and locally in the blocks.
i.e. residential / commercial mix developments unfortunately have 2 peak demands in the day which are accommodated by the thermal stores in order to have the CHP plant operating effectively.
The provided heat energy can be used for generating space heating, hot-water heating and space cooling. The latter is achieved by means of absorbent chillers.
Absorbent chillers only become financially viable with cooling connection demands of 250kW or more.

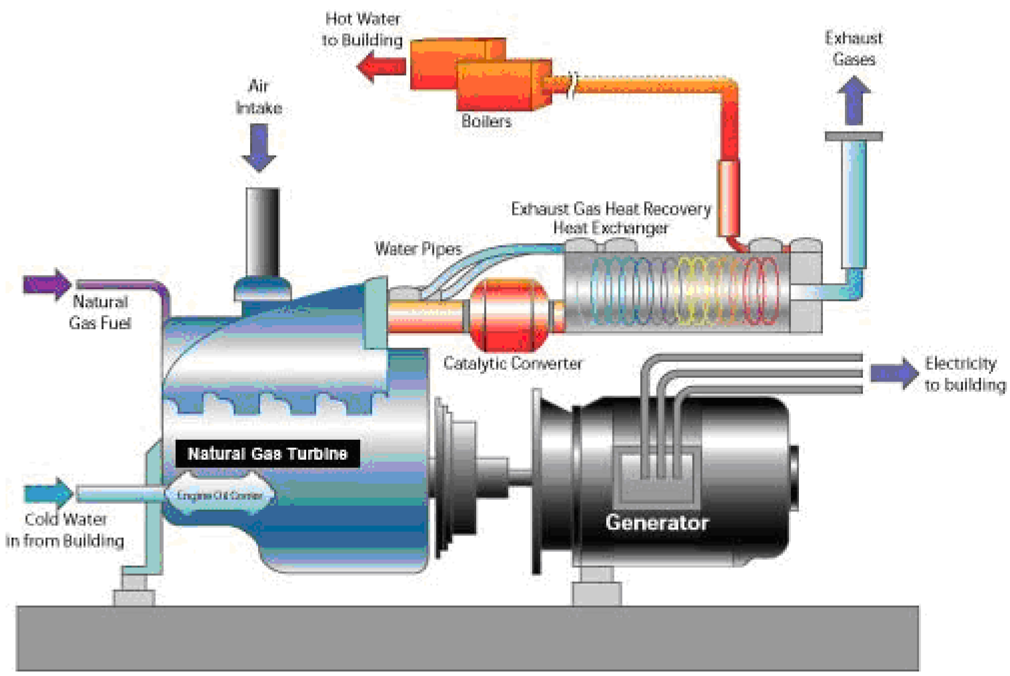


Illustration 3 : Proposed CDHN CHP units have **41%** electrical efficiency and **44%** thermal efficiency : Total efficiency 85%.

3.3 Main benefits of the district heating network.

District heating provides economies of scale and diversification of loads.
District heating systems are approximately 10%-15% more economical to construct then conventional individual unit boiler / flue / gas service pipe work systems.
The plant sizing of central equipment due to diversification is significantly lower than conventional systems which lowers the overall construction / capital cost.
The district heating network together with combined heat and power (CHP) also gives environmental benefits in the form of greatly reduced carbon dioxide (CO2) emissions and primary energy savings.

District heating / CHP provision of renewable energy.
As the primary energy savings from CHP/DH are accepted under Part L as a renewable energy provision and the fact that in most cases the CHP primary energy savings cover the Part L renewable energy contribution for both the residential and commercial elements, it avoids the need (read financial need) for biomass, photovoltaic or thermal solar systems. This alone represents a significant construction cost saving.
The fact that PV or solar thermal is not required the roofs of the buildings means that they can be used for other purposes like roof gardens, suds, etc.

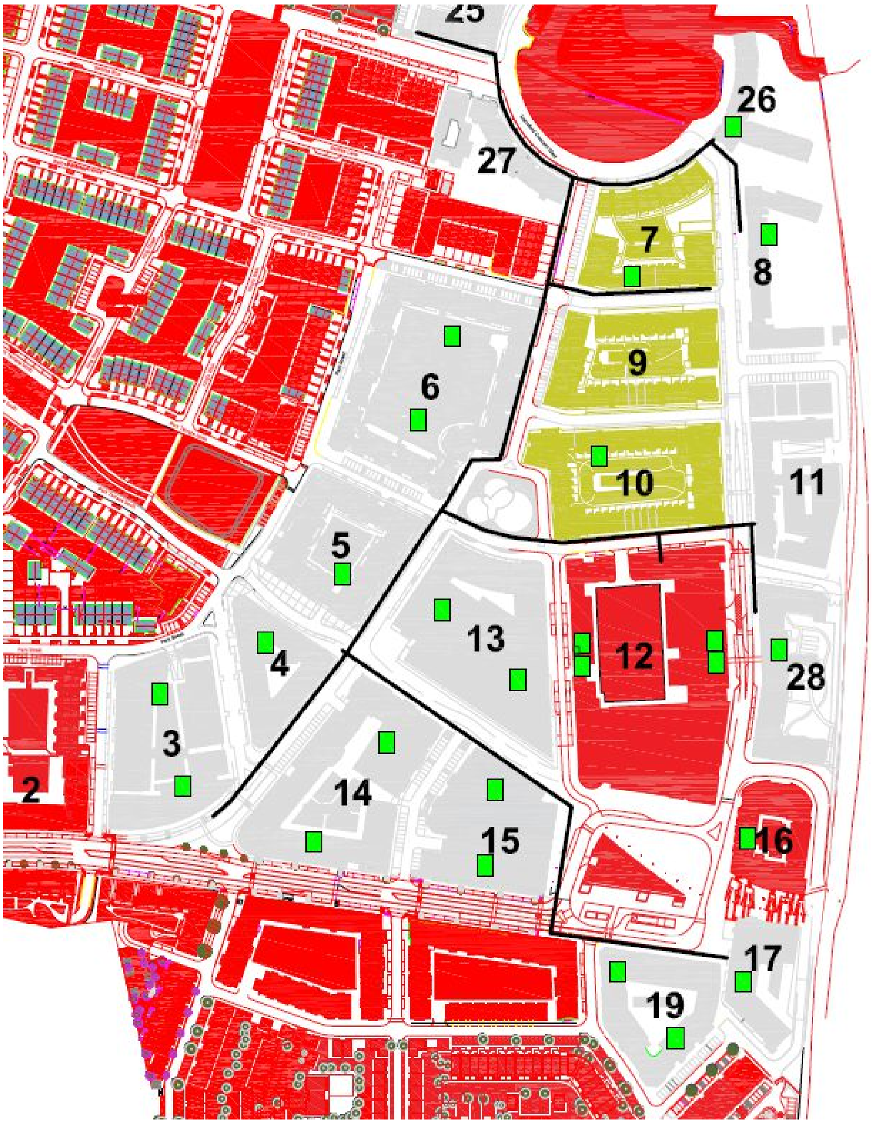
Additional revenue (for the developer)
Not as well known and utilised by developers is the fact that selling the supplied energy via a standard utility supply contracts similar as that of Irish water / ESB Networks means that the heat energy metered and collected centrally can be directly invoiced to unit occupiers giving a welcome additional revenue stream.

The key parameter of the achieved profit margin is the energy supply buy rate.
As the proposed development has an estimated annual energy requirement of +/- 25MWh the heating network operator can avail of an extremely low gas tariff at 2.61 cents per kWh against a residential resale rate of +/- 6.5 cent per kWh. As a bonus the generated electricity can be sold to large commercial users or directly fed into the grid. The latter should be avoided as the grid feed-in tariffs are not generous.
See economical assessment appendix C.

3.4 The Clongriffin District Heating network. (CDHN)

The CDHN at Clongriffin covers the supply of heat energy to all residential units in blocks 3, 4, 5, 6, 8, 11, 12, 13, 14, 15, 17, 25, 26, 27, 28 and 29, and electrical energy to the commercial units in the relevant blocks. The existing Block 12 is also accommodated by the CDHN as the system recently installed in Block 12 provides for district heating connection to both heat networks and electrical systems. Future blocks 7, 9 and 10 have also been considered in the CDHN system capacity but have not been assessed as part of the overall viability of the system albeit an improvement on viability will be made when added. The CDHN system extends approximately 600m length wise from Block 17 to Block 25 and 300 metre width wise from Block 3 to Block 17 with an estimated length of district heating pipe work of 1325 metres which in international terms is a small CDHN system. Illustration 2 shows the basic outline route of the district heating system with its central production plant and control / and metering centre in Block 12.

Illustration 2 shows the basic outline route of the district heating system with its proposed central production plant and control / and metering centre in block 12.



Basis route outline district heating network

Illustration 4 : Proposed CDHN network route

3.6 CDHN Pipe work

The district heating network pipe work is a pre insulated polyethylene pipe in pipe system providing excellent thermal insulation to reduce the distribution heat losses.
The system is typically operated on low temperature with a flow temperature of 85℃ and a return temperature of 45℃ or 50℃ to further reduce heat losses and electrical energy for hot water circulation.

Illustration 5 CDHN under ground pre-insulated pipe work

3.7 Main plant room CDHN equipment.

The central energy generation plant comprises of 2 no. mains gas combined heat & power plants, a peak load mains gas condensing boiler plant and a thermal store.
The latter is used to compensate the system winter peak load pattern generated by the residential units.
The plant is located in the basement of block 12 although this to be confirmed by all parties involved .
Block 12 is in a geographical central location but also has the advantage that it has existing utility connections.
The CHP units are 2 no. MWM 508 kWe units with an electrical efficiency of 41% and an thermal efficiency of 44% resulting in an overall nett efficiency of 85%.
These units are particularly efficient and only require overhaul after 80,000 hours.
The Boiler plant used is a cascade array from Remeha and the thermal store is a simple insulated concrete (underground) or steel tank (basement).
The low/medium pressure system will be operating at 3bar in the initial stage and rising to 10 bar when fully loaded.
The CHP and boiler units are to some degree modular and can be installed to suit the load on the system in a number of basic steps/phases to suit the capital cost. Primary system operating temperature is 85℃ - 50℃.

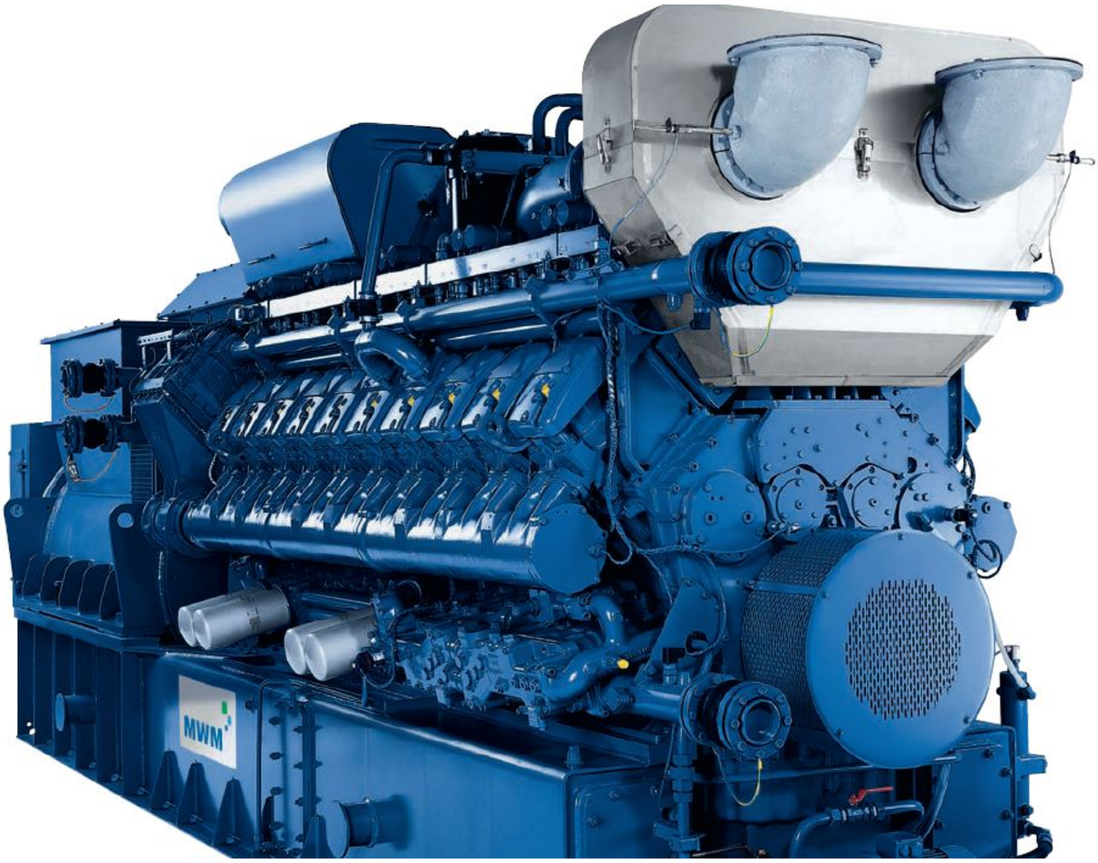


Illustration 6 MWM 500kWe CHP unit

3.8 Typical apartment and apartment block equipment.

In the blocks the CDHN is received in the plant room by a district heating heat exchange (interface) unit sized to suit the block thermal energy demand. The block peak load is lowered by a local thermal store in the form of 1,2,3 or 4 no. 5000L insulated steel buffers again to ensure an even demand for the CDHN.
Thermal energy is then distributed in the block via the block communal heating system.

Each residential and commercial unit will have a single plate heat interface unit providing energy for the space heating system and a buffered hot water system (calorifier/cylinder).
A typical residential SP HUI is approximately 450mm wide, 400mm deep and 850mm high. It has no flue and does not require ventilation.
The buffered hot water system is applied for the much lower (60% lower) peak load conditions compared with a direct on-tap hot water system reducing plant size, pipe size and operational cost.
Commercial units with sufficient cooling energy requirement can also avail of chilled water cooling using an absorbent chiller connection.
The block communal system operating temperature is 75℃ - 45℃ and the local unit system design temperature is 70℃ - 40℃.
Metering, meter data collection and invoicing is executed by the system operator/developer.

Illustration 7 Apartment heat interface unit (HIU)

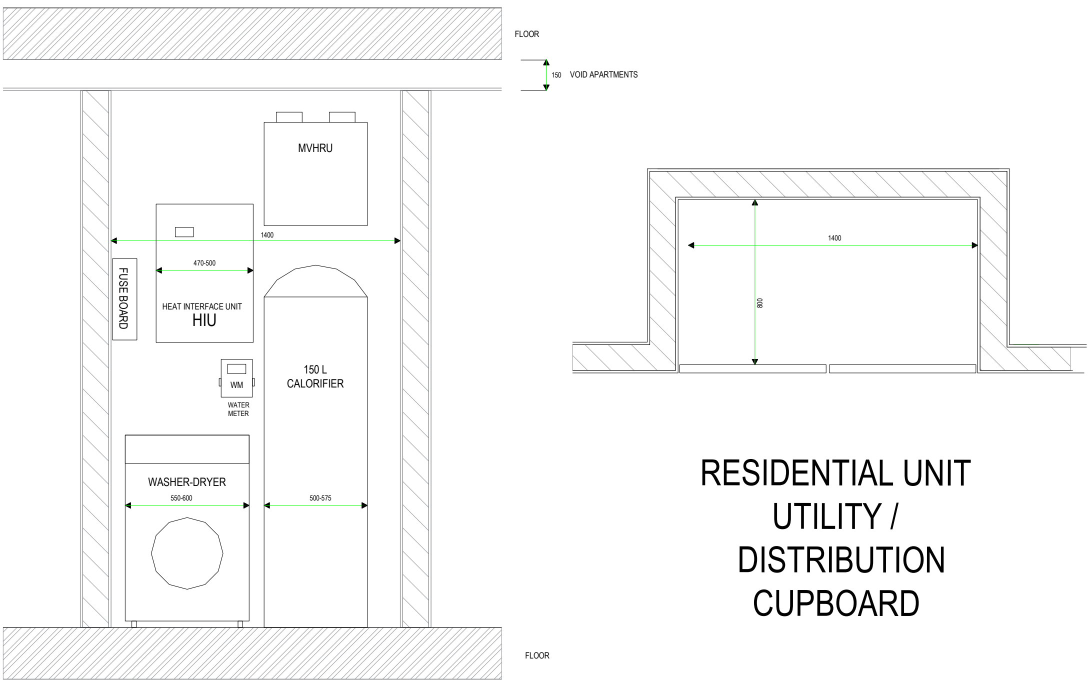


Illustration 8 Apartment heat interface unit (HIU) cupboard Front view and plan

3.9 Project overall energy data.

The overall energy and carbon dioxide data was calculated using the Deap and Neap energy calculation methodology and applying the Part L 2018 and 2017 for both the residential and commercial elements, Clongriffin district heating network energy calculations covered the following units and areas ;

Annual energy requirement	11,153,782	kWh/yr
24hr energy requirement (peak)	28,506	kWh/day
Primary energy equivalent	12,269,160	kWh/tr
24 hour peak demand winter	2790	kW
24 hour peak demand summer	1450	kW
24 hour peak demand average	1750	kW

Table 1

The project peak loads are accommodated by the thermal stores and peak load boiler array.
The CHP units are operated 24/7 at 100% capacity except for 1 week routine maintenance per year.
The overall project annual energy requirements (11,153,782 kWh) are met as follows :

Local peak block boilers	730,000	kWh/yr
CHP	9,551,391	kWh/yr
Central peak boiler array	899,360	kWh/yr
Total supplied	11,180,751	kWh/yr
Surplus	27,000	kWh/yr

Table 2

3.10 CHP energy and carbon dioxide savings.

The energy and carbon saving are measured against a conventional gas boiler system.
The energy savings achieved by the CHP plant are of particular use as they are also accepted as renewable energy under Part L.

Energy savings :

Equivalent energy for CHP thermal energy boiler @ 0.91		10,496,034	kWh/yr
Equivalent energy for CHP electrical energy CCGT @ 0.50		17,800,320	kWh/yr
Total equivalent energy for CHP		28,296,454	kWh/yr
Energy input for CHP		21,707,707	kWh/yr
Total energy saving	(23.3%)	**6,688,647**	kWh/yr

Carbon savings :

Carbon emissions from CHP		4,406,665	kg/yr
Carbon emissions from local boilers		200,626	kg/yr
Carbon emissions from central boilers		162,846	kg/yr
Total system carbon emissions		4,770,137	kg/yr
Carbon emission avoided from electric generation		3,889,370	kg/yr
Nett carbon emissions from CDHN		880,767	kg/yr
Equivalent (gas boiler) carbon emissions		2,264,218	kg/yr
Total Carbon reduction	(38.9%)	**-1,383,450**	kg/yr

3.11 Renewable energy requirement.

Applying both the Deap and Neap with part L 2017 (commercial) and Part L 2018 (residential) energy the following are the renewable energy requirements and the provided renewable energy.

Renewable energy requirement residential	1,887,900	kWh/yr
Renewable energy requirement commercial	634,500	kWh/yr
Total Deap/Neap renewable energy requirement	2,522,400	kWh/yr
Renewable energy provided by CHP directive 2004/8/EC	6,688,647	kWh/yr
Renewable energy provided by CHP (Part L 2011 method)	10,979,675	kWh/yr

4 Economic assessment

4.1 Economic assessment.

The economic assessment of the CDHN is based on a life cycle analysis using a 20 year period and is expressed in annual life cycle costs covering the operating, capital and funding cost.
The life cycle assessment has been used to illustrate the actual 20 year cost of the CDHN and to illustrate the additional revenue to be achieved from energy sales.
The CDHN, also reduces the overall project capital cost due to its direct renewable energy element, its single point utility supply requirement and economy of scale.

4.2 Life cycle cost assessment.

The life cycle cost is the total annual operating cost, capital cost and funding cost of the complete CDHN system over a 20 year period expressed in annual cost.

a – Annual operating cost.

CHP fuel	21,707,707	kWh	0.02610	€/kWh		566,571.16
CDHN Boilers fuel	988,308	kWh	0.02610	€/kWh		25,794.83
Local block boilers fuel	802,198	kWh	0.02610	€/kWh		20,937.36
CDHN Network operation incl write off	23,498,213	kWh	0.00144	€/kWh		33,837.43
Energy sales operating cost	11,153,782	kWh	0.00139	€/kWh		15,503.76
Total operating cost					[1]	662,644.54

b – Annual capital & funding cost.

District heating pipe work	1325	m	750.00	993,750.00
CHP units 2x500kWe n=85%	2	item	455,000.00	910,000.00
Boiler plant	1	item	50,000.00	50,000.00
Primary distribution & pumping	1	item	75,000.00	75,000.00
Acoustic treatment	1	item	32,500.00	32,500.00
Secondary distribution	1	item	62,000.00	62,000.00
Civil pipe work	1325	item	150.00	198,750.00
Civil plant	1	item	85,000.00	85,000.00
Electrical & data distribution	1	item	135,000.00	135,000.00
Thermal store	1	item	45,000.00	45,000.00
Controls	1	item	65,000.00	65,000.00
Engineering	1	item	135,000.00	135,000.00
CDHN capital cost			[2]	2,787,000.00

Capital cost to be funded	(see appendix 3 for details)	[2]		2,787,000.00
Funding cost :	2.5%	20 year		731,587.50
Total capital & funding cost				3,518,587.50
Annual capital & funding cost			[3]	175,929.38

c – Total annual life cycle cost.

Total annual operating cost [1]					662,644.54
Total annual capital & funding cost [3]					175,929.38
Total annual cost	delivered energy rate	0.075	€/kWh	[4]	838,573.91

d – Annual energy sales.

Heating energy sales	3,511,666	kWh	0.06220	€/kWh			218,425.61
Hot-water energy sales	6,912,642	kWh	0.06220	€/kWh			429,966.36
Cooling energy sales	729,474	kWh	0.05040	€/kWh			36,765.47
Electrical sales grid	5,400,160	kWh	0.05560	€/kWh			300,248.90
Electrical sales direct	3,500,000	kWh	0.09550	€/kWh			334,250.00
Total sales income	delivered energy rate		0.118	€/kWh		[5]	1,319,656.34

e – Annual profit/loss.

Total annual sales	[5]		1,319,656.34
Total annual cost	[4]		838,573.91
Annual profit/loss		[6]	+ 481,082.43

NB : We note that the life cycle analysis is based on the full capital cost at € 2,787,000.00 including the related funding cost however in real terms the CHP / Boiler plant will be installed in stages relevant to the load connected.

4.3 Capital (and funding) cost savings.

The CDHN also provides capital cost saving to the overall construction cost as outlined in the table below.

a	*Traditional heating & renewable energy equipment blocks*		
	Residential boilers / flues / gas pipe work, gas connections, fire & CO measures		5,402,990.00
	Commercial boilers / flues / gas pipe work, gas connections, fire & CO measures		390,775.00
	Renewable energy : PV installation : 4/5 no / residential unit, 8/10 no / commercial unit		4,880,000.00
	Total traditional	[7]	10,673,765.00
b	*District heating system*		
	Residential and commercial heat interface units		3,068,625.00
	Block communal heating systems		1,470,000.00
	Renewable energy : provided by CDHN		-
	Total CDHN	[8]	4,538,625.00
c	Capital cost saving [7] - [8]		6,135,140.00

We can see from the table above that the construction cost savings due to the CDHN completely cover the capital cost of the CDHN installation.

But there are further indirect cost savings which have not been included at this point like for example the 2 no. CHP plants provide a secondary electricity supply in the building which will replace the need for a stand-by generators for the fire fighting (sprinkler) installation in block 12 and other possible blocks.

The design intend is to use the CHP power supply for all the landlord electricity supplies in all blocks providing a significant operational cost saving.

The CHP plant also secures a back up power supply facility for the block 12 Digital Hub or anchor tenant and indeed other sections of block 12 and other blocks with significant commercial areas.

APPENDIX A basic new (NZEB) Part L compliance building construction parameters.

RESIDENTIAL UNITS – TYPICAL PART L 2019 COMPLIANCE PARAMETERS

Conductivity (U values)
Ground floors : U = **0.10 – 0.11** W/m2K
External walls : U= **0.13 - 0.14** W/m2K Emissivity factor : <=0.5
Party walls : U= **0.0** W/m2K where appropriate.
Roof : U= **0.10 – 0.11** W/m2K
Window & frame : U<=**0.8** W/m2/K, Solar transmittance 0.61, Light transmittance : 0.72
External door & frame : U = **1.0** W/m2K
Fabric / facade
Cold bridging : U<=**0.06** W/m2K
Thermal mass : **TP250** : Medium density
Air tightness : Design assumption <= **3.0** m3/m2*h
Ventilation.
Full balanced mechanical ventilation system with heat recovery, n>=85%, ɦ<=0.7W/l/s
General
Lighting : Low energy lighting. **100% LED**
Controls.: Space heating & hot-water heating time controls, Room thermostat & TVR's, Hot water thermostat..
Circulation pump9s) : Class A Variable speed
Thermal energy source : CDHN: n>= 96%.
Hot water storage : 150L calorifier, 10kW coil, 24 storage loss of <= 2.00 kWh/24hr
Renewable energy.
20% of primary energy usage provided by CDHN : If majority (>=80%) of thermal energy is supplied by CDHN / CHP.

COMMERCIAL UNITS – TYPICAL PART L 2017 COMPLIANCE PARAMETERS

Conductivity (U values)
Ground floors : U = **0.11 – 0.12** W/m2K
External walls : U= **0.13 - 0.14** W/m2K Emissivity factor : <=0.5
Curtain walling : U= **0.7 – 0.9** W/m2K
Party walls : U= **0.0** W/m2K where appropriate.
Roof : U= **0.10 – 0.11** W/m2K
Window & frame : U<=**1.0** W/m2/K, Solar transmittance 0.55, Light transmittance : 0.75
External door & frame : U = **1.0** W/m2K
Fabric / facade
Cold bridging : U<=**0.08** W/m2K
Thermal mass : **TP250** Medium density.
Air tightness : Design assumption <= **3.5** m3/m2*h
Ventilation.
Occupied areas : Mechanical ventilation system with heat recovery, n>=80%, ɦ<=1.4W/l/s
Wet rooms : Occupancy controlled mechanical extract @ 15 l/s (10l/s per cubicle)
General
Lighting : Occupancy and illumination controlled lighting systems. Target of a Luminair lumen/ circuit watt of 60.
Time controls : Individual units / zone / area time control,
Space temperature controls : Weather compensation, individual room temperature control,
Hot water temperature control : Calorifier/cylinder thermostat.
Circulation pumps : Class A variable speed.
Thermal energy source : CDHN: n>= 96%.
Hot water storage : 5 l/pp calorifier, xxkW coil, 24 storage loss of <= 0.012 kWh/24h/l stored.
Cooling energy source : CDHN absorbent chiller n>=65%, Heat-pump : SSEER >=**270%**
Renewable energy.
CDHN : If majority (>=80%) of thermal energy is supplied by CDHN / CHP.