Appendix 4.10
Feasibility Assessment - District Heating

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Feasibility Assessment

Herbata Data Centre Campus - District Heating Network

Naas, County Kildare
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Prepared By: Robert Thorogood HDR

Edited By: Robert Thorogood HDR

Authorised By: Ulrich Groenewald HDR

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1 Executive Summary

HDR has undertaken a high-level feasibility assessment on behalf of Herbata Ltd to assess the opportunities for harnessing the waste heat associated with the proposed Herbata data centre campus facility in Jigginstown, Co. Kildare. The study looks at the potential uses for ideally between 5 and 20 MW of medium to high grade waste heat recovered from the exhaust stacks from two of the gas turbines used to power the data centres. The study includes reviewing both existing and proposed local facilities that could be used and to provide a high-level heat demand map and delivery model.

From a policy perspective, a lead has been taken from The District Heating Steering Group that was formed under the Climate Action Plan 2021, as part of the Irish Government's commitment to further the expansion of district heating in the State. The Steering Group coordinates the rollout of policies and measures to support district heating in Ireland and reports annually to the Government on steps taken to ensure district heating is developed in a structured way, including outlining actions taken to support the expansion of district heating, applying appropriate legislation basis, and interpretation of EU Directives. The Steering Group makes evidence-based recommendations to the Department of the Environment, Climate and Communications on targets for district heating. Four key areas of work have been identified:

- Regulation
- Finance
- Planning and Regulations
- Research

Further policy definition is provided cognizant of legislative changes that are likely to be required to support the rollout of District Heating in Ireland, in addition to the regulatory requirements of EU legislation (Renewable Energy Directive 2018/2001/EU and Energy Efficiency Directive 2018/2002/EU). There is important information and support from SEAI, references to their documents are included in the reference section of this report.

There is no doubt that heat networks will need to form part of Ireland's response to its net-zero 2050 target and the utilisation of waste heat will significantly help with the heating decarbonisation challenge. This study concludes that a waste heat load of 20MW (or smaller) provides a number of significant opportunities to decarbonise the heating of public buildings, businesses, new homes in the local area close to the site. A heat load output of 20 MW would be of significance to County Kildare and further opportunities should be explored to designate the surrounding areas as candidates for additional local heat networks. It is expected that the data centre will be developed with a phased approach, and therefore the heat load may be smaller than 20MW initially; the actual phasing and development is to be determined.

It is currently difficult to determine the scope and size of this potential use of the heat, so is not included in this report, but further studies could be undertaken.

In the *Table 1-1* below (as *Table 6-7*), it is shown that a single turbine's heat output could be used at an average rate of around 33%, however there would be variations between summer and winter, it is estimated that the peak could be as much as 60% dependent upon the amount of stored heat that is provided local to the heat load (thermal stores).

Table 1-1. Single turbine's heat output

Section	Description	Heat Demand (GWh/year)	Average Annual Load (kW)	Percentage of Annual Load (less 15% for losses)	
				10MW	20MW
6.2	Existing Facilities	5.62	642	7.55%	3.77%
6.3	Business Areas	14.11	1611	18.95%	9.48%
6.4	Northwest Quadrant	4.88	557	6.55%	3.28%
Totals		**24.61**	**2,810**	**33.06%**	**16.53%**

In order to provide heat to these heat loads, extensive flow and return pipework will be required to be laid throughout the west of Naas, it is estimated that the total length of pipework could be as much as 10km and would need roads and paved areas to be used for trenching. All of this will be subject to further studies and more detailed proposals.

Part of the next set of studies will be to look at the overall viability of the scheme, for this a heat network operator should be involved to provide their view on the scheme. As an example, if they were to sell all the heat noted in the table above as medium-grade heat, 24GWh per year, at a rate of say 4c/kWh (a typical value for medium-grade heat), the heat network operator would likely be able to generate over €1 million per year of revenue. As a rough order of magnitude, the cost to provide the district heating network would exceed €20 million, so a long term (30 to 40 year typically) assessment would be needed to show that the scheme offers potential benefits to a heat network operator their heat load customers.

This assessment therefore makes the following recommendations in terms of next steps:

- Promote discussions with owners of existing facilities to discuss the potential for connecting to the proposed district heating network.
- Discuss with business park owners and operators as to how they may be able to connect into a district heating network.
- Discuss with KCC the development plans for the Northwest Quadrant to develop a more detailed heat mapping.
- Reassess the heat loads for the various facilities, areas, and development to provide a more accurate assessment.
- Consider if any other facilities or buildings that could be connected into the network. This may also include agricultural facilities such as heated greenhouses and vertical farming.
- Consider the phasing of the delivery of the district heat network, review if the phasing is appropriate to the loads and available properties.

- Review the impact of installing district heating trenches, consider if any of the routes could use soft areas rather than roads or pathways.
- Consider the impact on local traffic during the installation, consider potential mitigations, review options with KCC.
- Engage district heating operators to understand potential interest in being involved in the district heating network, review feedback, amend proposals as required.
- Re-calculate the heat load capacities and provide an assessment of the amount of saved carbon and report to KCC.
- Engage specialist engineering installers for cost and schedule assessments for each phase of the district heating system. Review potential revenues & economic benefits.
- KCC are a key stakeholder in actively delivering district heating.

2 Introduction

HDR has been commissioned by Herbata Ltd to undertake a high-level feasibility assessment for the development of a district heating scheme using waste heat from the some of the gas turbines that will support and provided power to a new data centre facility proposed Herbata Data Centre Campus. This report has been developed in response to comments and requests made at a pre-planning meeting with Kildare County Council (KCC) who wish to see how the waste heat could be used in a meaningful way in the Naas and Jigginstown area with either existing or proposed facilities and buildings. Herbata are already committed to providing the waste heat to a connection point on the site, however it is the identification of potential heat uses that is equally important; this report address this issue.

Within this report, there is a description of the facilities to be included on the data centre campus, in particular the plant that will be producing the heat. It should be noted that it is intended to use primarily gas-based turbines to produce the electricity for the data centre buildings rather than use electricity from the grid, which is currently highly constrained. By adding thermal boilers to a selected number of the gas turbine flues can provide high quality heat for use in a district heating system. Use of the waste heat from the data centre halls within the buildings themselves is not deemed viable as the temperature of the heat is typically only around 35 degrees C and so can't easily be used or transported directly.

Having identified where the heat may be generated, the next stage of this report is to identify potential uses. Heat maps of the local area are generated to identify the likely highest uses of heat both at peak and annually, these are also reviewed against potential development areas as identified by KCC.

In addition to the development areas already identified by KCC, there is always the option to use the heat for new uses, particularly for agriculture. There are many examples in locations such as The Netherlands, Iceland, and the Middle East where the heat has been exported to provide for warmed greenhouses for crops and flower growing and also for aquaponics and hydroponics where nutrient-rich specialist water is fed to the roots of plants; this is also known as vertical farming. Establishing a facility nearby for this form of agriculture would mean land remained for agriculture and also used the heat generated on the Herbata site. It is currently difficult to determine the scope and size of this potential use of the heat, but further studies could be undertaken.

Once all the potential uses are identified, then the highest uses are considered in slightly more detail, rules of thumb are used to assess the likely annual energy use and compared to the expected energy production from the gas turbines. Consideration is also given to heat storage, maintenance requirements and potential pipework routing.

The final part of this report provides recommendations on likely viability, next steps and approach going forward.

3 Proposed Data Centre Project

3.1 Site Location

The site is located approximately 2.5 km to the west from Naas town centre in County Kildare, 33 kilometers to the west of Dublin and 20km from Kildare Town. The travel time from Dublin's city centre takes an estimated 45min and from Dublin Airport approximately 40-45 minutes. The site address is Jigginstown, Naas, Co Kildare, Ireland (Lat. 53°13'07'' N / Long. 6°42'00'' W) and is shown in ***Error! Reference source not found.*** below.

Figure 3-1. Site Location

The site is 'green field' and has a gentle slope from North to South. The entire site measures 37.5ha (92.9 Acres). The Northern site boundary measures approximately 730m and runs along the regional R409 road which provides access to the site. This road starts in Naas and travels northwest to end at the intersection with the R403 road. There is a small farmland located at the north-east part of the site in the triangle formed between M7 motorway and R409. The boundary between the site in question and small triangle site is formed by a line of scattered trees. Western site boundary measures approximately 380m and it is formed by a line of trees and hedges.

To the East the site is facing the M7 Motorway with a line of trees and hedges located along the boundary. This site boundary measures approximately 630m. Since 1st December 2021 this site is zoned in the Naas Local Area Plan 2021-2027 for specific

use as a Data Centre P (1). The Proposed Development the subject lands are approximately 37.5ha in extent and are located on the western side of the M7 motorway, positioned between Junctions 9a and 10. The site is bound to the north by the R409 road which provides a direct link to the centre of Naas, approximately 2.5km to the east.

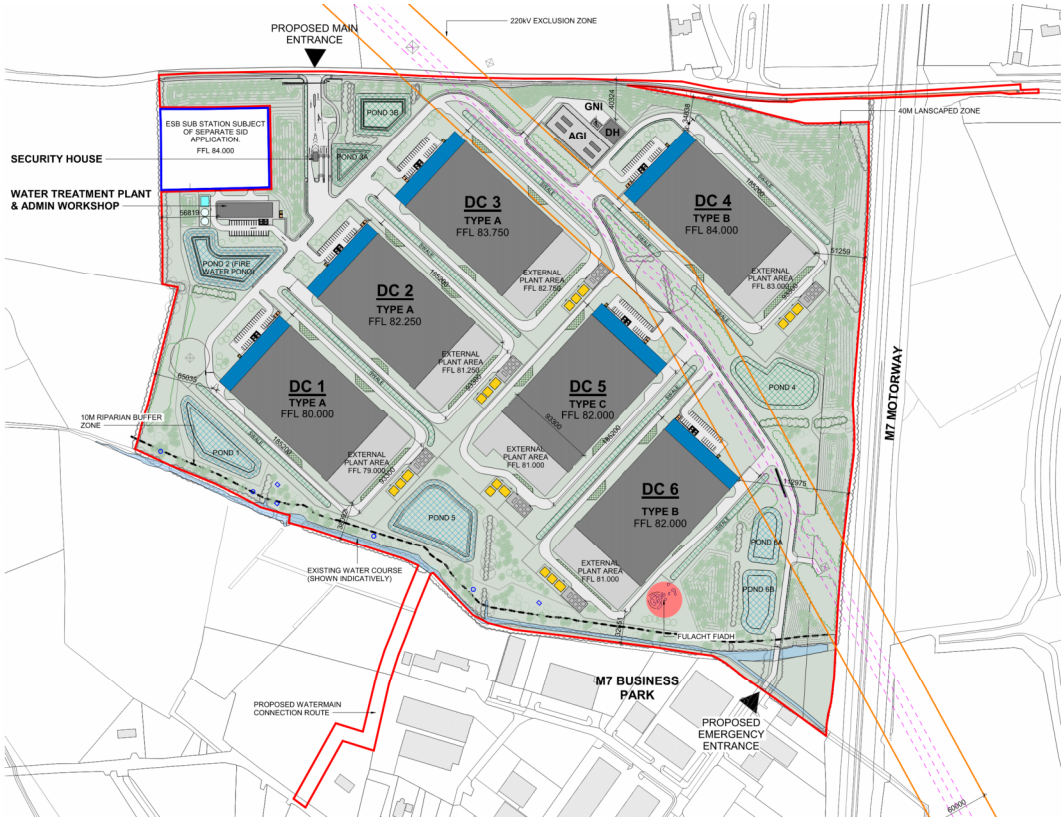
The lands are located between the existing 'M7 Business Park' and 'Osberstown Business Park'. The Osberstown Wastewater Treatment Plant is located nearby to the north. The site is bounded to the east by the M7 motorway and to the west by agricultural lands. The 'Newhall Retail Park' is located to the south of the site, on the east side of the M7 motorway. There has been significant development in the locality in recent years, particularly light industry, logistics and services.

The site is currently in agricultural use and comprises a number of fields which are bounded by hedgerows. There is a cluster of farm buildings located within the site, accessed from the R409. The site falls at a generally even grade from north to south.

3.2 Proposed Site Development

The campus will have six independent two-storey data centres each with a 30MW ICT capacity. The buildings will have their own secure boundaries encompassing the main building, (ancillary facilities, data halls, power generation, fuel storage, etc.), together with dedicated parking. This is shown in ***Error! Reference source not found.*** below, the proposed concept masterplan.

Figure 3-2. Proposed Concept Masterplan



The site will consist of a secure boundary with security for the entire site including a transportation lock and rejection facility.

Ancillary buildings on site will include those dealing with gas and electrical connections for the campus together with workshops and facilities for campus personnel.

3.3 Electrical and Heat Systems Infrastructure

The proposed data centre will have its primary source of power generation on-site. Generation of electricity is proposed on site using highly efficient gas turbines for the majority of the generation, with top up from gas engines. This is in line with recent EU and Irish Government direction on the use of gas for generation as a transition fuel. It also avoids any negative impact from the Proposed Development on the public electricity distribution system and allows for excess power to be exported to the grid to aid Eirgrid in their supply of electricity. The onsite power generation capacity will be in excess of that required for the operation of the data centre and will provide an opportunity for the export of energy to the grid if and when required.

The turbines and engines will be provided with a high-pressure gas supply from Gas Networks Ireland to provide the primary energy supply to each building. The running of the turbines and engines will be continuous with the quantity of units operating at any one time dependent on the load demand in the data halls and the resilience required.

Two of the gas turbines are proposed to have waste heat thermal boilers installed within their exhaust flues to recover the medium to high grade heat from the turbines. Each turbine as a nominal electrical output rating of 5MWe, the available maximum heat output is assumed at 10MWth per turbine, with a total capacity of 20MWth possible when both turbines are available and running. Both turbines will be prioritised in terms of running whenever possible.

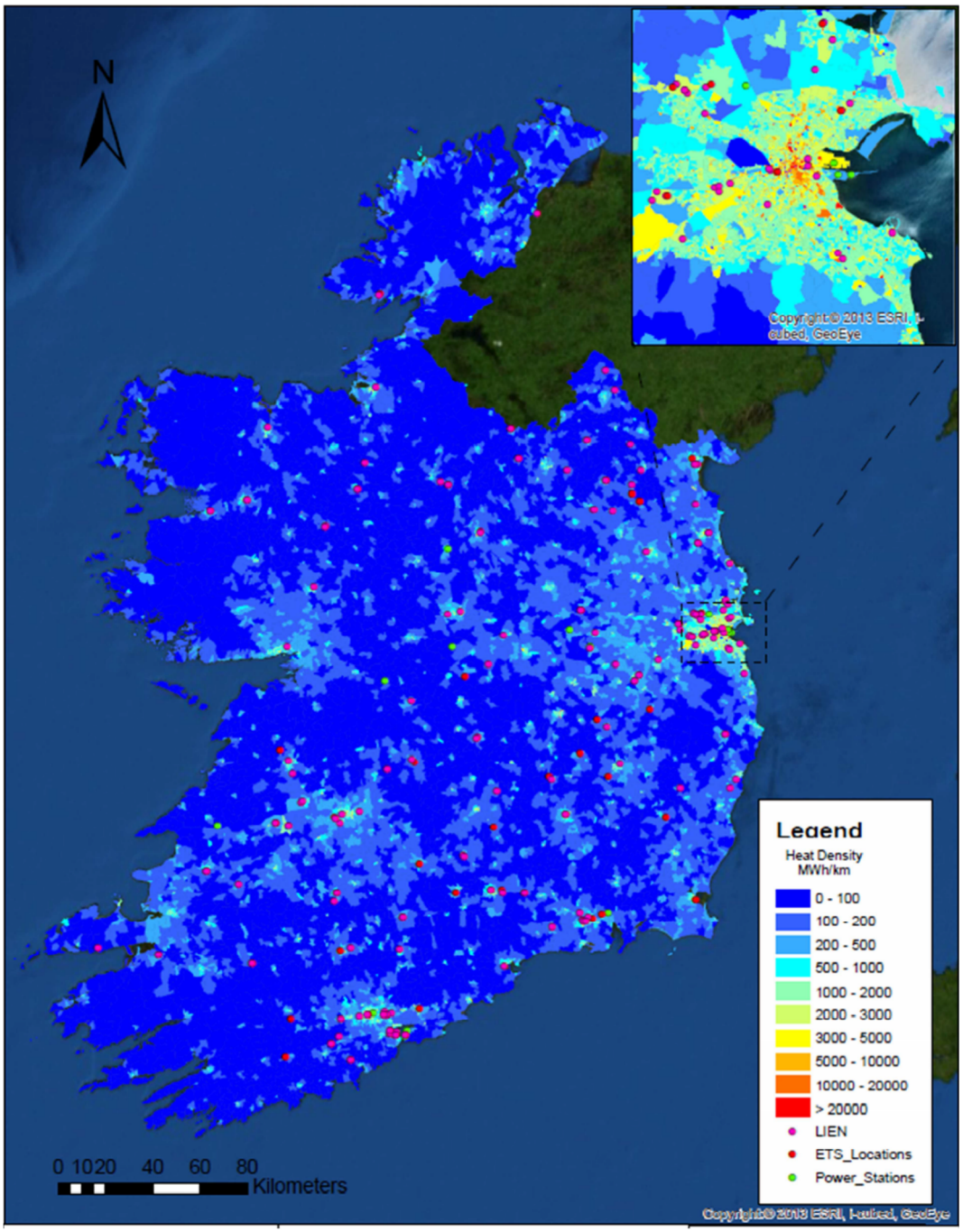
The heat from the thermal boilers will then be pumped via heat exchangers to the perimeter of the data centre campus, to enable district heating pipework to be connected to the identified uses.

For the purpose of this study, it is assumed that the average electrical load of the site associated with ICT (information and communications technology) and cooling, when fully operational, is likely to max out at 220MW, however typically data centres don’t achieve 100% utilisation of the power, more normally they max out at 70-80% so in this case with all phases completed an annual power demand from the onsite generation of around 140MW. It is acknowledged that this load is unlikely to be present on the first operational day, with a phased approach being employed by the data centre developer, this will have to be considered in any detailed district heating assessment.

4 Heat Mapping

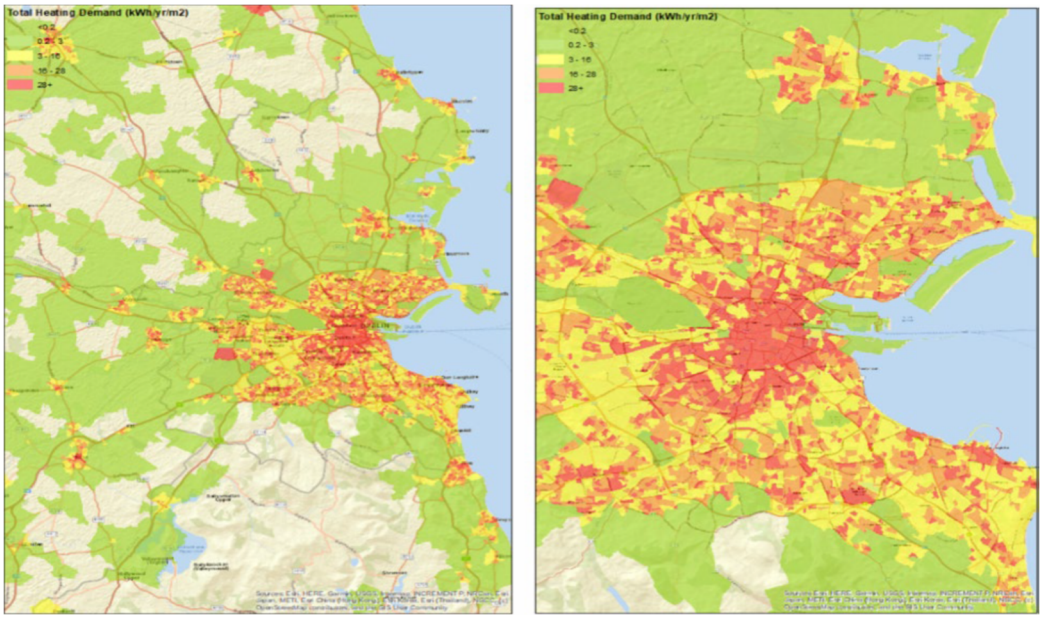
There have been several exercises at heat mapping parts and the whole of Ireland. Examples are given in the references cited at the end of this report. Examples are given in *Figure 4-1* and *Figure 4-2* below.

Figure 4-1. Total 2025 Forecast Linear Heat Density



(Source: SEAI report 2015)

Figure 4-2. Total Heat Demand Sample

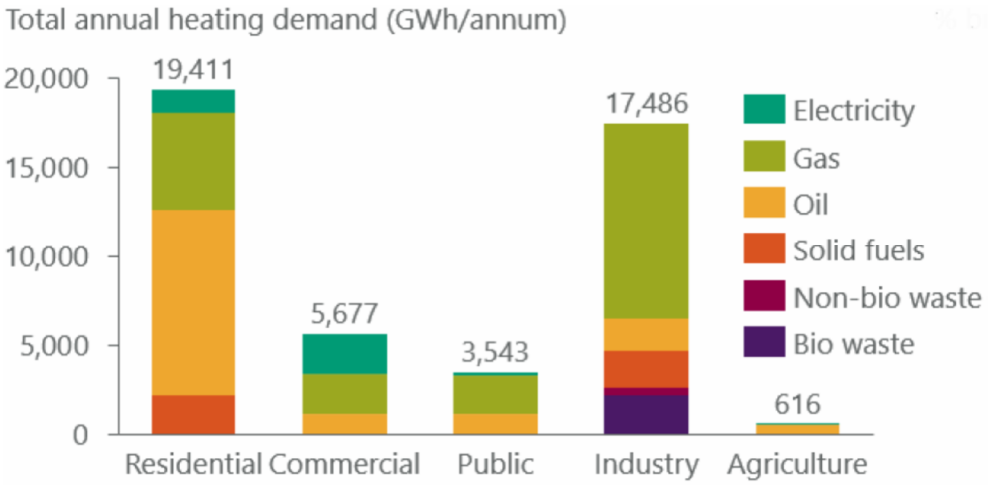


(Source: SEAI National Heat Study 2021)

These studies provide excellent information for the introduction to heat mapping but require more detailed local studies to enable proposals and recommendations to be made in particular areas and regions. Whilst this is understood, it is important to carry out the local study, in this case around Naas and the KCC region.

One other aspect to consider is the types of facility or building and their energy use. SEAI provide this information as guidance in their National Heat Study. It should be noted that by far the highest heat demand in Ireland is residential, see *Figure 4-3* below, but there are very large numbers of residential units to connect to make this worthwhile. Instead, it is worth considering much higher densities of heating demand, these are illustrated in *Figure **4-4*** below.

Figure 4-3. Total Annual Heating Demand by Type



(Source: SEAI National Heat Study 2021)

Figure 4-4. Total Annual Heating Demand by Facility Type (Non-Domestic)

(Source: SEAI National Heat Study 2021)

5 Methodology

The methodology for identifying realistic uses of the available heat is outlined below:

1. Identify the available heat from the data centre campus (see above)
2. Review existing facilities and buildings that are likely to require good quantities of heat, these would include the following:
    a. Hotels
    b. Leisure facilities
    c. Swimming pools
    d. Industrial and warehousing
    e. Other public facilities
3. Review plans and development policies for future development areas and their facility / building types.
4. Assess the facilities/building in 2, 3 and 4 above and consider the following:
    a. Size of facility or area for development
    b. Nature of usage
    c. Rules of thumb for heat usage for each (using CIBSE published data)
5. Identify the locations of each of the potential facilities/buildings.
6. Once all the potential facilities/buildings have been identified and assessed, produce a table of the highest annual usage of heat requirement and compare to the available heat.
7. Identify the largest users of heat and how a district heating pipework route may be achieved.

Using the above methodology, it should be possible to match the available heat with the heat usages.

6 Heat Map Opportunities

6.1 Heat Mapping

An area around and towards the centre of Naas has been chosen as the most likely to have opportunities to have heat demands either existing or in future developments. This area is shown in *Figure **6-1*** below.

Figure 6-1. Local Site Area Towards Naas

(Source: Google Maps)

As identified in the previous section, methodology, the intention is to identify potential heat usage for existing facilities, recent schemes with planning permission and future development plans. Those of a significant size and interest are plotted onto the maps in Figures 6-2, and 6-3 below and then combined into Figure 6-4 as the overall opportunities for connecting to heat usages.

6.2 Potential Heat for Existing Facilities

A review of nearby existing facilities has been considered each of a reasonable size and ideally with a constant load. As previously noted, residential schemes have been ignored as they are difficult to retrofit and usually have a very low heat load for 4 – 6 months of the year.

Three key facilities have been identified as follows and as shown in *Figure **6-2*** below:

1. K Leisure Complex
2. Osprey Hotel Complex
3. Kildare Country Council offices

Figure 6-2. Existing Heat Usage Facilities

(Source: Google Maps)

These three facilities have been selected based on their annual usage, size, and proximity to the proposed Herbata Data Centre campus. An assessment of each site is shown in *Table 6-1*.

Table 6-1. Heat Map Assessment

Facility	Heat Demand (GWh/year)	Average Annual Load (kW)	Percentage of Annual Load	
			10MW	20MW
1	2.72	311	3.11%	1.55%
2	1.32	151	1.51%	0.76%
3	1.58	180	1.80%	0.90%
Totals	**5.62**	**642**	**6.42%**	**3.21%**

In reviewing the information in *Table 6-1* above, several assumptions are made:

a) percentage of annual average load assumes a constant load which is unlikely during summer and winter months, this is only provided for comparison purposes.
b) The existing facilities are assumed to be heated currently using gas or electricity and have internal water-based heat distribution to radiators and air handling units or similar.
c) Each facility would need to have a local heat exchanger added to couple into the existing heating system.
d) No allowance has been made for losses, typically 15% would be lost in the distribution of heat (see later assessment)

As can be seen from *Table 6-1*, the heat demand by these existing facilities would be small in comparison to the total available capacity from the turbine heat sources.

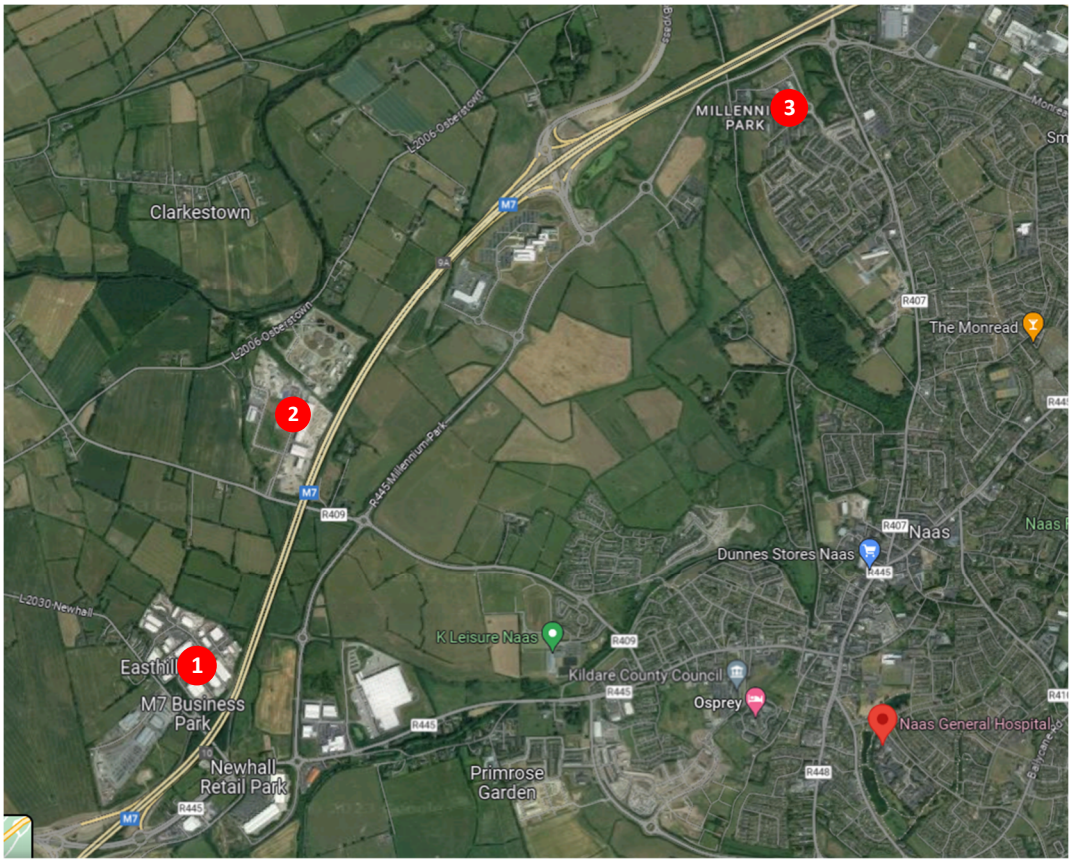
6.3 Sites for Future Development

Naas has several sites in the area for light industrial and commercial development. These are centre in specific clusters often with some development already established. This provides the opportunity to provide heat to existing and new facilities in each of these clusters.

The clusters that have been identified that are close to the proposed Herbata Data Centre campus are listed below and in and as shown in *Figure **6-3*** below:

1. The M7 Business Park
2. Osberstown Business Park, and
3. Millennium Park (part of Northwest Quadrant)
4. Northwest Quadrant of Naas (excluding Millennium Park) – this is dealt with separately in Section 6.4

Figure 6-3. Sites For Future Development



(Source: Google Maps)

Table 6-2. Business Areas Development

Area	Business Area	Approx Area (Acres)	Percent built area (%)	Built Area (m^2)	Heat Load per area (kWh/m^2)	Total Annual Heat Demand (GWh)
1A	The M7 Business Park North (existing)	Not defined	Not defined	22,737	110	2.50
1B	The M7 Business Park South (existing)	20	8	5,120	110	0.56
1C	The M7 Business Park South (new)	7.8	20	4,992	110	0.55
2	Osberstown Business Park	15	20	9,600	110	1.06
3	Millennium Park	227	10	72,640	130	9.44
	Totals	**270**		**92,352**		**11.61**

Using the output above of *Table 6-2*, this can then be taken into the Heat Map Assessment for the Business Areas as shown in *Figure **6-3*** below.

Table 6-3. Business Areas Heat Map Assessment

Area	Heat Demand (GWh/year)	Average Annual Load (kW)	Percentage of Annual Load	
			10MW	20MW
1A	2.50	286	2.86%	1.43%
1B	0.56	64	0.64%	0.32%
1C	0.55	63	0.63%	0.31%
2	1.06	121	1.21%	0.60%
3	9.44	1078	10.78%	5.39%
Totals	**14.11**	**1326**	**16.11%**	**8.06%**

In reviewing the information in *Table 6-3* above, several assumptions are made:

a) percentage of annual average load assumes a constant load which is unlikely during summer and winter months, this is only provided for comparison purposes.
b) Both existing facilities and new facilities are assumed to be heated currently using gas or electricity (direct or with heat pumps) and have internal water-based heat distribution to radiators and air handling units or similar.
c) Each facility would need to have a local heat exchanger added to couple into the existing heating system.
d) No allowance has been made for losses, typically 15% would be lost in the distribution of heat (see later assessment).

6.4 Northwest Quadrant

As noted in Section 6.3 above, Kildare County Council (KCC) have identified the Northwest quadrant as a key area for development adjacent to the centre of Naas. Reference has been made to Naas Town Council's 2007 Masterplan for information on the likely development areas, types of development and opportunities for buildings that will require heat. This is all in the context of the objective of this development is to be as sustainable as possible, to use low carbon technology such as heat pumps and to use Combined Heat and Power (CHP) where possible. Although district heating is not specifically discussed, the use of the heat from the gas turbines would be analogous to CHP albeit with the heat being produced remotely.

Within the above noted Masterplan, the following development areas and types are listed in *Figure **6-4*** below. As can be seen, the majority of the developments are residential (C-1 to C-14 and D-5), as previously noted this form of development is ignored due to low heat demand and high distribution costs. The remaining areas are considered further.

Table 6-4. Individual Zoning Area (Extract Table 5.2)

Objective No.	Specific Zoning Objective	Approx Area (Ha)	Approx. Area (Acres)
C-1	High density residential development including a minimum 10 metre wide tree planted buffer along the eastern side of the site.	1.38	3.4
C-2	To provide for and facilitate medium/higher density residential development.	4	10
C-3	High density residential development.	3.84	9.5
C-4	Medium density residential development to include a mix of house types and sizes.	1.47	3.6
C-7	Medium density residential development.	2.5	6.1
C-8	Medium density residential development.	1.9	4.6
C-9	Medium/High density residential development that must show a detailed relationship to the proposed Canal Harbour LAP in terms of linkages and sustainable forms of transport. Include provision for a nursing home that relates to the Green Belt of the canal.	6.9	17
C-14	Medium density residential development.	2.5 (1.9 Ha developable)	6 (4.6 acres developable)
D-5	Low density residential development to include provision for social and affordable housing.	2.2	5
E1 & E3	Educational Campus & Playing Pitches.	9.2	22
E	Community and Educational	9.97	24.6
E-2	Possible Ecclesiastical/Community Centre site.	9.47	23
H - 2	H2* The Council will encourage the location of Small-Medium Enterprise (SME) related industry in this zone.	1.7	4.2

Taking the information for areas that are non-residential from *Table **6-4*** above, the following assessment of the likely requirements for heat loads are assessed in *Table 6-5* below.

Table 6-5. Heat Map Assessment

Section	Specific Zoning Objective	Approx Area (Acres)	Percent built area (%)	Built Area (m^2)	Heat Load per area (kWh/m^2)	Total Annual Heat Demand (GWh)
6.2	Educational Campus/Playing Pitches	22	8	5,632	150	0.84
6.3	Community & Educational	24.6	20	15,744	110	1.73
E-2	Ecclesiastical / Community Centre	23	20	14,720	120	1.77
H-2	SME industry	4.2	40	5,376	100	0.54
	TOTALS	**74**		**41,472**		**4.88**

Using the output above of *Table 6-5*, this can then be taken into the Heat Map Assessment for the Northwest Quadrant as shown in *Table 6-6* below.

Table 6-6. Northwest Quadrant Heat Map Assessment

Objective No.	Heat Demand (GWh/year)	Average Annual Load (kW)	Percentage of Annual Load	
			10MW	20MW
E1 & E3	0.84	96	0.96%	0.48%
E	1.73	198	1.98%	0.99%
E-2	1.77	202	2.02%	1.01%
H-2	0.54	61	0.61%	0.31%
Totals	**4.88**	**557**	**5.57%**	**2.79%**

In reviewing the information in*Table 6-6* above, several assumptions are made:

a) percentage of annual average load assumes a constant load which is unlikely during summer and winter months, this is only provided for comparison purposes.
b) All new facilities are assumed currently to be based on using air source or ground source heat pumps for heating and have internal water-based heat distribution to radiators and air handling units or similar.
c) Each facility would need to have a local heat exchanger added to couple into the existing heating system.
d) No allowance has been made for losses, typically 15% would be lost in the distribution of heat (see later assessment)

6.5 Overall Heat Map Assessment

In sections 6.2 to 6.4 various opportunities have been assessed in the west of Naas area adjacent to the proposed Herbata data centre campus. Bringing these all together, *Figure **6-4*** identifies the locations by relative heat load sizes (annual basis), *Table 6-7* shows the overall heat demand to give an aggregate loading.

Figure 6-4. Relative Heat Load Sizes

(Source: Google Maps)

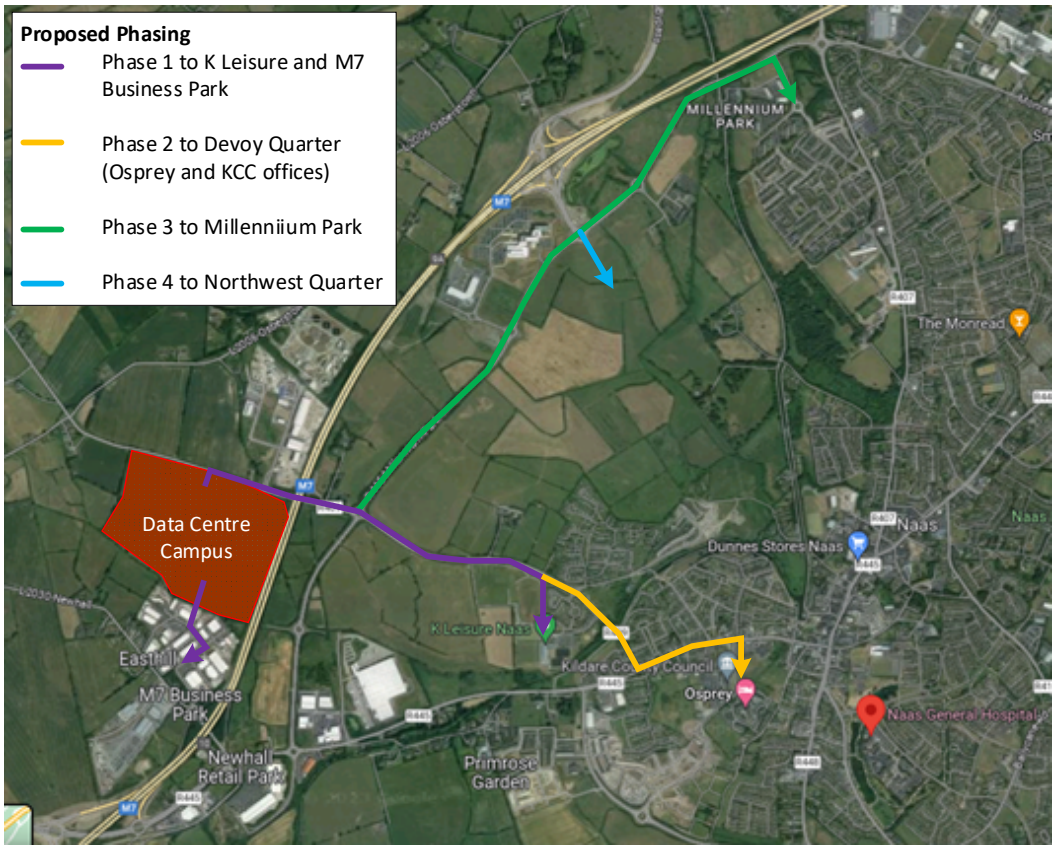
Table 6-7. Overall Heat Map Assessment

Section	Description	Heat Demand (GWh/year)	Average Annual Load (kW)	Percentage of Annual Load (less 15% for losses)	
				10MW	20MW
6.2	Existing Facilities	5.62	642	7.55%	3.77%
6.3	Business Areas	14.11	1611	18.95%	9.48%
6.4	Northwest Quadrant	4.88	557	6.55%	3.28%
Totals		**24.61**	**2,810**	**33.06%**	**16.53%**

Having now analysed the available heat load options and the likelihood of connecting into them, a district heating network can be devised that can be implemented in phases. It is clear that the M7 Business Park and the K Leisure facility offers the most immediate heat loading for the gas turbines and this is proposed as Phase 1, see *Figure **6-5*** below.

They can then be extended further to the Devoy Barracks area where both the Osprey Hotel and KCC offices could be connected. The major load has been identified as the Millennium Park area; this is shown as Phase 3 with a relatively easy extension to the Northwest Quarter as developments come onstream. It is estimated that the total length of the proposed district heating network would be in the order of 10km with flow and return pipework.

Figure 6-5. Proposed District Heating Network Phasing

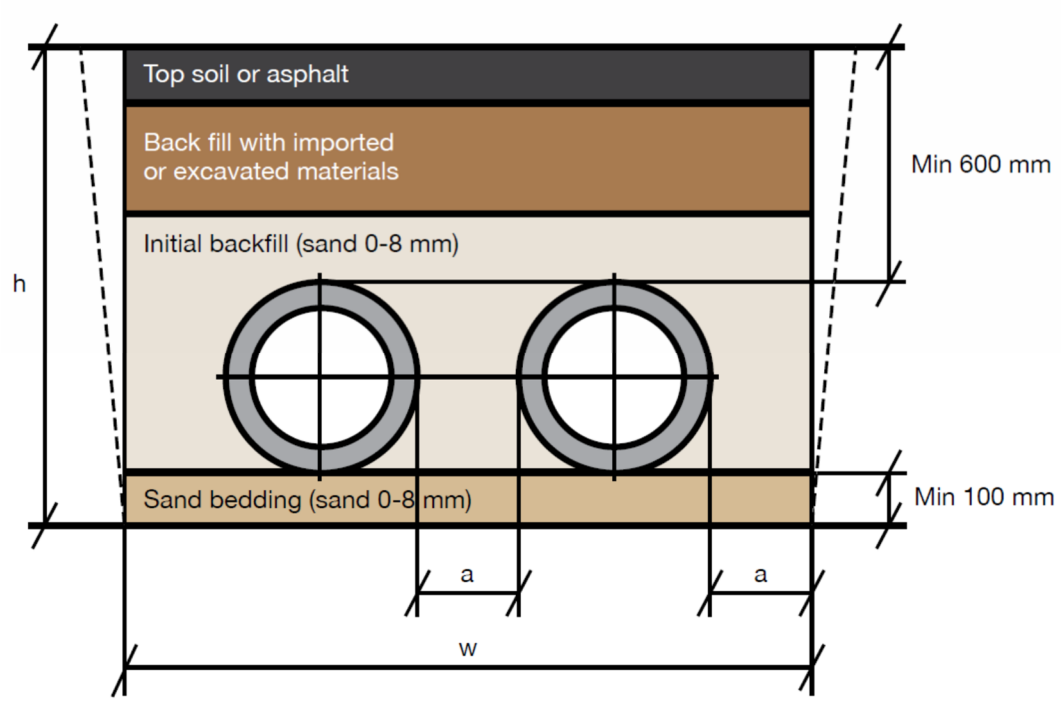


(Source: Google Maps)

It is assumed that with all of the phases for the proposed district heating, that pipework of up to 300mm in diameter plus insulation will need to be installed into trenches of varying widths. An example trench arrangement is shown in *Figure **6-6***, for 300mm flow and return pipework, the trench size would need to be 1.5m wide x 1.2m deep, as the network expands out smaller pipe sizes could be used; for example, a pair of 100mm diameter pipes would only need a trench size of 0.85m wide x 0.9m deep. The impact to roads and pavements would have to be assessed in the implementation phase of the district heating network, this will of course require KCC to take a lead role in the implementation and delivery of the district heating as the project would be a major element of infrastructure works that impacts the public amenities as well as giving energy to a number of facilities, both existing and new.

Typical district heating distribution temperatures are 120° Celsius flow and 90° Celsius return but will vary by operator.

Figure 6-6. Proposed District Heating Network Phasing



(Source: DH Manual for London)

7 Recommendations and Next Steps

This feasibility assessment is the first step towards considering whether heat that can be made available from two of the gas turbines proposed for the Herbata Data Centre campus. This assessment identifies potential locations close to the campus on the west side of Naas together with their potential heat load. It shows that on average that the turbine heat output could be used at around 33% of a single turbine, remembering that the peak level will be much higher than this level depending upon what degree of local heat storage is used (recommended). Providing access to a second turbine gives good resilience for the district heat network.

The following recommendations and next steps are proposed:

- Promote discussions with owners of existing facilities to discuss the potential for connecting to the proposed district heating network.
- Discuss with business park owners and operators as to how they may be able to connect into a district heating network.
- Discuss with KCC the development plans for the Northwest Quadrant to develop a more detailed heat mapping.
- Reassess the heat loads for the various facilities, areas, and development to provide a more accurate assessment.
- Consider if any other facilities or buildings that could be connected into the network. This may also include agricultural facilities such as heated greenhouses and vertical farming.
- Consider the phasing of the delivery of the district heat network, review if the phasing is appropriate to the loads and available properties.
- Review the impact of installing district heating trenches, consider if any of the routes could use soft areas rather than roads or pathways.
- Consider the impact on local traffic during the installation, consider potential mitigations, review options with KCC.
- Engage district heating operators to understand potential interest in being involved in the district heating network, review feedback, amend proposals as required.
- Re-calculate the heat load capacities and provide an assessment of the amount of saved carbon and report to KCC.
- Engage specialist engineering installers for cost and schedule assessments for each phase of the district heating system. Review potential revenues & economic benefits.
- KCC are a key stakeholder in actively delivering district heating.

Appendix A. References

The list below is of references used in this feasibility assessment.

- https://www.gov.ie/en/publication/6223e-climate-action-plan-2021/
- https://www.gov.ie/en/publication/3f132-district-heating-steering-group/
- https://www.legislation.gov.uk/eudr/2018/2001
- https://www.iea.org/policies/13353-eu-directive-20182002-on-energy-efficiency
- https://www.cibse.org/knowledge-research/knowledge-resources/knowledge-toolbox/benchmarking-registration
- https://www.codema.ie/images/uploads/docs/district_heating_brochure.pdf
- https://www.codema.ie/projects/local-projects/dublin-district-heating-system-1
- https://www.codema.ie/images/uploads/docs/Dublin_City_Spatial_Energy_Demand_Analysis_-_June_2015.pdf
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- https://www.nweurope.eu/media/12186/ireland-heatnet-nwe_lt-wp11_updated2020.pdf
- http://millenniumpark.ie/