Assessing the heat demand of a whole community for biomass district heating potential

This exercise shows how to estimate the heat demand of a local community or a subsection of that community. This would typically include a range of residential and commercial buildings within a local defined area such as a village or neighbourhood. The exercise is also designed to provoke discussion on the key aspects affecting the viability of a district heating system.

Allow **75 minutes** to complete this exercise

Films that accompany this exercise
The facilitator should be familiar with the various films on disc 1 relevant to the heat technologies (solar, biomass, heat pumps and energy from waste) and the individual film 'Setting up a biomass district heating project'.

Number of people or groups

For this exercise you'll be working around a large satellite map of your area. If you have a very small or compact community and fewer than 15 people at your meeting, one large map is probably sufficient. For larger communities, use blown up maps of different sections of the village or neighbourhood, and split the audience into groups of two to six to assess a section each.

It is important that quite a few of the people attending have enough local knowledge to identify types of building (house, shop, office, community buildings etc) and number of storeys from aerial-view photographs.

Materials needed

1) Large-scale satellite photos of your area
These need to be at a scale which enables you to identify individual buildings, and you can get them from Google Earth or Google Maps. You need enough print-outs to cover your whole village or neighbourhood which probably means several sheets of A3 stuck together to make one large composite image.

2) The smallest-possible red and green sticky dots.

3) Print outs (ideally A3) of Table 1 and Table 2 (see below) and the hand-out 'Non-domestic energy benchmarks'.

4) A calculator for each group.

5) Large 'flipchart' sized versions of tables 3 and 4 and a map of the whole site for the final discussion session.

Arranging the room
Stick the satellite photos up on the walls or flip chart stands around the room before the event starts.

Running the exercise

Stage 1) Grouping and explaining (5 minutes)

Begin by explaining that you are going to look at a simple way to estimate the heat demand of the group of buildings within their particular community and then make some initial assessments of the potential for district heating. You should be clear from the start that the methods are approximate only and that the heat loads will be more accurately assessed by specialists before making any firm decisions or specifying equipment.

Stage 2) Carrying out the exercise (45 minutes)

Explain to the whole audience that you are going to work in groups to do the exercise so ask them to split into X groups (the number depends on the number of satellite photos you have).

Ask each group to stand in front of one of the satellite photos. If the groups are very uneven in size, ask people to move to other groups to even this out.

Tell them that each group is going to note the number of buildings of a particular type on their map. Explain to them that they should use their sticky dots to mark up the buildings on the plans like this:

- A green dot for a house or flat
- A red dot for non-domestic buildings
- A red and green dot for a mixed-use building e.g. flats above shops

The group will then need to fill out the pre-prepared

tables: **Table 1** for domestic properties and **Table 2** for non-domestic. This should be done as follows:

Table 1: Domestic properties

The group should use their local knowledge to look at all the dwellings marked up on the map and see how many there are in each category (flats, detached houses, semi-detached, etc). You are unlikely to be able to accurately assess all the properties in this way – best guesses will do for now. The individual green dots on the map should be crossed off as each category is counted up.

The numbers in each category should then be entered on Table 1 and then heat demand calculated as shown.

Table 2: Non-domestic properties

The group should then look at the non-domestic buildings marked up on the map and categorise them by the building types listed in the **'Non-domestic Energy Benchmarks' handout** (below). The figures are kWh per m^2 per year (kWh/m^2/yr) and approximations only. For each non-domestic building identified on the map, the best-matching category should be selected from the handout and the values entered on Table 2. The group is unlikely to be able to accurately assess all the buildings in this way, so, again, best guesses will do for now.

The red dots on the map should be crossed off as the details of each building are entered on Table 2.

The approximate floor area of each building should also be entered on Table 1 to work out total energy from the benchmark. To do this, find an average semi-detached house on the map. The ground floor area of this building is 45m^2 so you can use this to estimate the ground floor area of other buildings i.e. how many of the house's footprints will fit into the footprint of the other building. The group will need to use their local knowledge to identify how many storeys the building has and multiply this by the estimated footprint to get overall floor area.

The total delivered energy and heat load for each building should then be calculated as shown on Table 2.

Stage 3: Compiling results (5 minutes)

The facilitator should then collate and add up the totals from each group and fill in Table 3, which should be visible to the whole group on a flipchart or whiteboard. A map of the whole site should also be placed alongside for reference.

*As a follow-up task, someone may like to compare this figure with actual gas consumption data, which is now available from the Sub-national Energy Consumption Statistics section of the Department of Energy and Climate Change (DECC) website. Consumption data for both domestic and non-domestic consumers is available down to 'Middle Layer Super Output Area' level, which is similar to 'Ward' level. This is unlikely to match the geographic area of your selected community, but can potentially be used as a comparator when the vast majority of heating is provided by gas.

For Energy Consumption Statistics see:
http://tinyurl.com/yauj9w2

For maps of MLSOAs see:
http://tinyurl.com/4g2n6k9

Stage 4: Discussion (20 minutes)

Place a large version of Table 4 alongside Table 3 so that everyone can see it. Facilitate a brief discussion with the whole group around the three issues described below. Fill in the gaps in the table with any comments from the group and decide on the next course of action following today's exercise.

1) A district heating system works best where the heat demand is fairly consistent over time. A mix of buildings with different heat requirements over time is therefore desirable, e.g. households, shops, sports centres and industrial buildings. What does the mix of buildings look like for the site in question? How might the total heat demand vary over a) 24 hours and b) a week?

2) 'Anchor loads' (existing buildings with a significant heat requirement like a leisure centre or residential nursing home) can be useful in district heating schemes because they represent a guaranteed end-user of a large amount of heat. Does your site have a potential anchor load?

3) A suitable location for a district heating plant depends on factors such as size, accessibility, proximity to residents, etc. It also makes financial sense if the buildings on the network are not too far apart, because a large proportion of the cost is the buried pipework. Is there somewhere in your neighbourhood that fits the bill? Can pipe-runs be minimised by excluding the more 'outlying' buildings with relatively low heat demand?

Table 1
Domestic heat demand

Type of dwelling	Typical space and water heat demand per dwelling* (kWh/year)	Number of dwellings	Total heat demand (kWh/year)
Flat	9,725		
Terraced house	10,830		
Semi-detached	16,774		
Detached	24,991		
		Totals	

* Figures derived from Annex 2 of 'Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme'. Assumes 2-bed properties for flats and 3-bed for the other dwelling types. Assumes that half of the dwellings have insulated cavity walls and half have solid walls. All properties assumed to have adequate loft insulation.

Table 2 Non-domestic heat demand

Type of building	No. of buildings (if more than one of similar type/size)	Fossil fuels benchmark (kWh/m2/year) [note 1]	Number of storeys	Approx. total floor area (m2)	Total fossil fuel use (or 'delivered' energy) (kWh/year)	Total heat load (kWh/year) [note 2]
				Totals		

Note 1: Look up these figures from the 'Non-domestic energy benchmark' handout provided. You'll need to select the category which best matches the building you are considering. The figures are given in kWh per square meter per year (kWh/m2/yr).

Note 2: To get 'heat load' from 'delivered energy' assume a boiler efficiency of 75% i.e. multiply 'delivered energy' by 0.75

Table 3
Summary of estimated total heat demands

	Total number of buildings	**Total annual heat demand***
All dwellings		
All non-domestic buildings		
Totals		kWh

Table 4
Discussion points

Likely periods of heat demand over 24 hrs and one week:		
Any suitable anchor loads?		
Indicative heat output rating of plant (kW)	= Total annual heat demand in kWh divided by 1,800	Assumes that for a typical mix of homes and non-residential buildings, the plant may operate the equivalent of 1,800 hours per year at max output.
Indicative footprint of biomass heat-only plant and fuel store (m2)	_____ m^2	Taking biomass heat-only plant as an example, some typical boiler and fuel store footprints are as follows: 250kW – 33m2 500kW – 64m2 750kW – 65m2 1,000kW – 75m2 (Note – biomass CHP plant would require more space)
Potential location of district heating plant:		For biomass plant, you will also need to consider access for fuel delivery vehicles
Any opportunities to minimise pipe runs?		

Handout Non-domestic energy benchmarks

Floorspace heat demand benchmarks in kWh/m2/year (source: CIBSE Guide F "Typical" values)

Classification	Annual space and water heating: kWh per m² floor area
Arts and Entertainment	142.0
Banking	98.0
Bars	257.0
Care Homes	426.5
Churches	150.0
Community Hall	173.3
Courts	181.3
Factory	325.0
Government Office	205.0
Halls of Residence	290.0
High Street Agency	230.0
Hospital	482.8
Hotel	406.7
Laundry	202.0
Library	185.0
Light Manufacturing	325.0
Museums and Art Galleries	142.0
Office	174.1
Police Station	339.8
Post Office	210.0
Primary Education	203.8
Primary Health	270.0
Residential	240.0
Restaurants	538.3
Retail_Commercial	192.0
Retail_Department Store	248.0
Retail_High Street	92.3
Science Laboratory	132.0
Secondary Education	132.0
Social Club	329.0
Sport and Leisure	364.6
Supermarket	261.0
Theatre	625.0
University	148.8
Warehouse	136.0
Workshop	136.0