Session 4. Gas CHP, Tim Kay, AECOM

What is CHP?

Combined heat and power – generating heat and power at the same time.

Two main technologies to do it.

1. Using simple internal combustion engine, put in fuel (gas) turn engine to make electricity and recover heat (coolant system that takes off hot water and heat can be recovered) and the second way is from exhaust gases.

2. Larger scale method, generating heat from boiler, using steam through steam turbine and recovering the electricity from that.

CHP generates electricity and heat. Viable technically and financially, as electricity is a higher cost, higher carbon fuel, if we can generate it on site, we can save money and carbon. Electrical efficiency typically in the range of 24-55%, thermal efficiency typically 35-55%. Total efficiency usually equates to approx 80-85% so a higher electrical efficiency equates to lower thermal efficiency and vice versa. Larger systems tend to have a better electrical efficiency which is advantageous in carbon and economic terms since electricity has a higher purchase cost and higher carbon burden than offset heat.

Units of 2,3,4, kW but generally 30kW to 500 kW - not domestic house scale, but commercial scale or for networks.

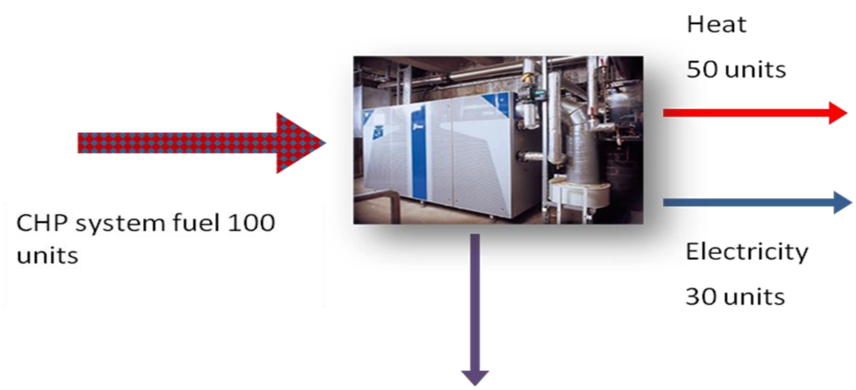
Key parameters are ratio of heat and electricity – we want as much electricity as possible – so we maximise electricity output (it's more expensive to buy than heat).

With electricity if you have excess you can dump it to grid and get paid, but heat is not easily exported unless you're in a network.

Components include: a CHP engine (like your car engine but bigger), heat recovery, inverter (that converts the electricity to AC), meter and electrical connection (we discussed grid connection and capacity last week) and a top up boiler – these systems operate as a baseload technology – it meets the baseload demand, and you have a gas boiler to top up extra requirements.

Key issue is smoothing out baseload demand to maximise demand. (see the little graph on slide 229)…we need to minimize peaks and therefore use of the expensive top up boiler. Thermal storage is key way of how we do this to smooth out demand patterns and increase financial prospects.

System size and electrical efficiency – bigger systems have better efficiency 35 – 40% – smaller ones are less efficient.



How we design system - you can design it to meet electricity demand or thermal demand. If you have too much electricity you can export it. If you have excess heat and you can't export it or use it, then it is wasted. Normally systems are designed for thermal demand.

Spark Gap – this is the gap between the electricity and gas price… the Spark Gap is fundamental to the financial viability of CHP schemes… high electricity price and low gas price – makes it viable. If costs are similar you're generating a medium cost fuel and using a medium cost fuel.

Demand profiles, important… two demand profiles (See slide 229). Could be across a 24 hour period. Top one could be house profile… heat on am, lunch, heat on at evening – lots of peaks and spikes, small baseload demand. Weak baseload.

Bottom e.g. has a smoother demand. You've reduced peaks down by half, and peaks are slotted into dips. You can operate CHP at reasonable level and place a smaller demand on the top up boiler.

Slides 230-233 illustrate how thermal storage can be used to absorb peaks and troughs within the demand profile to provide a smooth baseload and minimise peak loads.

CHP is not the only technology that operates on baseload, biomass and others do also – these low carbon technologies are generally more experience than conventional gas-fired boilers and therefore are not designed to meet full demand, but the baseload demand. People often refer to the percentage of total annual energy demand that is met by a CHP unit, e.g. 80% of the total annual heat demand may be met by the gas CHP, with the remaining 20% met by conventional gas-fired boilers. Through smoothing the demand profile as much as possible, we can maximise the % of demand met by the CHP to maximise carbon savings and maximise the financial viability of the system.

E.g. demand profile over a 24 hr period, demand am and pm (100kW peak) you need a boiler that gives 100kW or you'll be short. CHP in this not effective. Heat demand met by top up.

With thermal storage – demand average across the day is 40kW. How do we slot peaks into void areas? Use thermal storage… a big tank of water… Where we have supply exceeding demand, e.g. demand is 10kW (and a $40kW_{th}$ CHP unit) we have 30kW surplus so we don't dump the heat, we store up hot water for later use. Once we have demand, we call on that heat and use it into the system to meet the bigger demands so we balance it out during the day. So we end up with an average of 40 kW. Smooth effective demand.

Q: How does it retain the heat?
A: Generally very efficient with some losses, big buffer vessel 5-8m^3. Big mass and well insulated/lagged, therefore storage losses are relatively small.

It works for hot water demand, for space heating demand more complex? Storing heat does not mean you put it directly into radiators, you can use it for pre-heating into the boiler. Similar to solar thermal system, it's giving pre-heated water so the boiler has less work to do, reduces fossil fuel demand of the system.

Potential applications – needs smooth base load demand, typically buildings with large constant heat demand, e.g. sports centres, large public buildings that are normally inefficient. NHS sites, or networks to smooth out profile – linking domestic and commercial properties that have opposite type demands during the day.

Known as heat networks or shared energy networks.

Typical rules of thumb:

Capital costs £500 - £1,500 per kW(th)
Electric efficiency: 24% - 45%
Thermal efficiency: 35% - 55%
Typical system size: $5kW_{elec}$ - $500kW_{elec}$ +

Numbers for efficiency vary – go by electrical efficiency and thermal efficiency – small system is less electrically efficient. Total efficiency is around 80% - higher electrical bias is much more useful in terms of carbon and financial efficiency.

$kW_{\mathbf{th}}$ refers to thermal output
$kW_{\mathbf{elec}}$ refers to electrical output

CHP gas is not generally eligible for financial incentive schemes (e.g. FiT or RHI). However very small systems (less than $2kW_{elec}$) are eligible under the FiT pilot scheme…

Payback 5 – 50 years – largely variable as depends on a number of different factors. Compare this to PV which gives a much more predictable payback of 10-18 years as PV isn't dependent upon the demand profiles.

Planning considerations – not that different to a gas fired boiler – flue, some noise due to rotating equipment.

Planning and electrical connection – this is potentially one of the biggest issues – there are issues in some areas with electrical capacity, there are also delays on getting the connection. Bring electrical operator into discussions at an early stage.

Carbon emissions of electricity is very important as it determines the carbon and heat output from the system.

Each different fuel type has an emissions factor associated with it – gas has approx 0.198 kgCO2 per kWh and generated electricity has approx 0.529 kgCO2 per kWh (electricity is 2 or 3 x more carbon intensive than gas).

How you work out carbon burden of CHP and compare to a normal boiler?

CHP we have fuel input 100% - useful heat 50% (recovered from exhaust/water jacket) we can use it (hot water at 80/90 degrees C) Electricity 32% efficient. Losses (friction etc) 18%

Example: What is the carbon burden of 1 unit of heat from the system?

Work backwards from 1 unit of output to see what amount of fuel needs to go in to get it.

1 unit of heat – you need 2 units (because you've got 50% efficiency) you get 0.64 units of electricity out (as you have 32% electrical efficiency).
Now add carbon burden:

Fuel is gas, so 0.198 x 2 Units in = (0.396) then you displace the offset electricity that's generated (0.64 x 0.529 = 0.339)… you come up with total burden of 0.057 kgCO2.

Carbon burden of heat is carbon burden of fuel in minus the offset electricity carbon saved.

Natural gas is 0.198kgCO2/kWh.

Question: How do you take account of this for whole year? And of the top up boiler? A: this is coming up in an example…

This is carbon burden for 1 kWh of heat – so if your building used 100 kWh of heat, the carbon associated with this would be 0.057kgCO2/kWh x 100kWh = 5.7kgCO2.

Note:
kW is power
kWh is energy

Take a house: your total heat/energy consumed is 5,000 kWh over year. If you could meet it with gas CHP (but you can't because of demand profile) your carbon burden for supplying this energy would be 5,000 kWh x 0.057kgCO2/kWh = 285kgCO2.

If you could not smooth out it would be that plus the top up.

Smoothing means more from CHP and less from the top up.

Back to smooth and non-smooth profile.

Referring to slide 229: Bottom profile we do 80/90% of demand with CHP… therefore of our required heat demand, 80% is met by CHP and only 20% met by top up boiler.

With top graph maybe only 20% of demand is met by the CHP because the profile is much spikier and therefore doesn't lend itself well to the baseload being supplied by CHP.

Q: If you have a lower amount of top up does that then mean your gas boiler is running less efficiently than if it was running more of the time?

A: If the CHP will always be operational your gas boiler needs to be smaller – if you have a big peak/trough your baseload technology (e.g. CHP unit or biomass boiler) will be much bigger therefore more expensive.

Q: When people design buildings you've got to be intelligent about size of building – you need to consider use of building and not say '3 bed semi' therefore boiler this size…

A: Yes. District energy smoothes out the demand profile and maximises what we're heating with low carbon technology.

Q: How much detail?

A: If it says CHP is not viable for sports centre, you can ask about swimming pool being heated… so you can't necessarily say it's not viable. Be aware of what is suitable and can have a CHP boiler. New office buildings tend to have a relatively low demand for heat and so may not be suitable for CHP whereas a residential nursing home may have a relatively constant significant demand for heat and therefore maybe ideal for a CHP unit.

Comment: an office will say they'll use storage in the construction and use of heavy construction. Seasonal variation is the challenge.

If we can look at using some heat in the summer, absorption for cooling, we can fill the void in the summer time, when there's little demand for heat, we can fill the gap and meet the baseload demand with a low carbon technology - could be a pool, could be a facility with a lot of showering, catering, nursing home… always a sizable demand for hot water.

CHP may conflict with others technologies such as solar thermal and is often best when not used in combination with conflicting technologies. E.g. solar thermal and CHP would both be competing for the summer baseload demand and would therefore affect the financial viability of each technology.

Solar thermal could be better – it's a **zero** carbon technology, where CHP is a **low** carbon technology, however hot water demand may not always be when the sun is shining…

We are saying there's no single answer, it's a mix of solutions and dependent upon the demand patterns and usage of the building.

Comment: Exporting electricity to the grid for 3p – can't you sell it to an electricity trader for more money e.g. 6 or 7p. Predictability could be an issue.

Ideally you should use the electricity on site yourself. Feed it into your own system. Once we have electric cars you could feed it into the batteries and store it there.

Carbon burden will change as carbon loading on mains grid decreases… these numbers shown, projections are grid electricity will decrease in carbon intensity over time, as we have more nuclear power and renewables … and we turn off dirtier power stations.

That means any tech like CHP operating on offset electricity as high carbon fuel will become less attractive in future and heat pumps that use electricity will become more attractive.

At the moment with a heat pump for house, you need coefficient of performance of 3 to break even… if value is the same you'll be better off.

Reality is that this will be a very gradual change over 20 – 50 years.

What's the lifetime of a CHP plant? If you're putting it in now and thinking about carbon balance over lifetime.

A: 15 - 25 years – it has moving parts. Some systems going on for 30 – 40 years.

If your spark gap wasn't that good you'd turn it off.

I have not mentioned a turn down ratio – the lowest rate it can output. Systems can struggle to turn down to below 30 – 40% of output… once you go below it it's met by the top up boiler.

You can pull it out and replace it with something else in the future if necessary.

Spark gap – here when fossil fuel prices go up, electricity prices go up too.

Carbon calculation

Carbon burden of heat from CHP is most affected by electrical efficiency – once you are generating more electricity the carbon burden of the heat falls (technically you can get to carbon negative in number terms)… generally the carbon burden of heat is typically in the region of 0.05-0.1kgCO2/kWh.

Gas CHP – finances example

If run for 5,400 hours per year (approx ¾ of the year), can generate £2,910 worth of elec and £3,960 worth of useful heat, i.e. total useful output value of £6,870.

The produce this useful energy , we need to consume £4,309 worth of gas the fuel the system.

If we also include an additional maintenance sum of £445, we have a total outgoing cost of £4,754.

When compared with the value of useful output energy produced, we save £2,116 each year. This system costs approx £15k and therefore gives a payback of around 7 years.

Note that this example is based on operating the unit flat out for ¾ of the year. The system would need to be carefully sized and demand profiles smoothed as much as possible to allow this amount of operation in practice. Note also that the sums assume all electricity produced can be consumed onsite and is therefore offset against the purchase cost, rather than at a cheaper export cost.

Q: 7 year payback – cost saved is it over the cost of a traditional gas boiler?
A: No, it's just input of energy costs and outputs… not comparing it to another system, however the value of heat is based on what this heat would've cost if generated by a gas-fired boiler.

Assumes offset electricity of 10p that you're using it (you won't get 10p if you are exporting electricity to the grid).

Q: Gas and structure – gas pressures – depending on size of CHP connection to medium or high gas pressure?
A: I don't know definitive answer to that. If it's 50% thermally efficient – if you connect it to a gas boiler 90% - not a huge amount more gas going in.

Exercise

First question

What is the carbon burden associated with one unit of heat?

First step – what are our electicity and thermal efficiencies?

Electricity 54kW output for gas input of 200 kW – therefore electrical efficiency is 27%.
Thermal output is 108kW for 200kW gas input – therefore thermal efficiency is 54% .

To get 1 unit of heat output, need 1.85 units of gas input (i.e. 1/0.54).
The carbon associated with 1.75 units of gas input is 0.367kgCO2 (i.e. 1.85 x 0.198).
1.85 units of gas input gives 0.5 units of electricity output (i.e. 1.85 % 0.27).
The carbon offset from this generated electricity is 0.265kgCO2 (i.e. 0.5 x 0.529).

The total carbon burden of one unit of heat generated is therefore the carbon burden of the gas input minus the carbon offset of the electricity generated, i.e. 0.367 – 0.265 = 0.102kgCO2/kWh of heat output.

How much carbon is associated with this system delivering 540,000 kWh over a year?

0.102kgCO2/kWh x 540,000kWh = 55,080kgCO2

How much carbon would this system save compared to a 90% efficient gas fired boiler in delivering this heat?

A 90% efficient gas-fired boiler would require 600,000kWh gas input to produce 540,000 heat output (since the boiler is assumed to be 90% efficient).
The carbon associated with this 600,000kWh of gas input is simply 600,000 x 0.198 (since 0.198 is the carbon burden of gas), which equals 118,800kgCO2.

We have previously calculated that the carbon associated with the CHP delivering this 540,000kWh of heat would be 55,080kgCO2.
Therefore the carbon saving from the CHP is 118,800 – 55,080 = 63,720kgCO2.

Note that in reality the CHP would probably be sized to meet say 80% of this heat demand, not the full 540,000kWh. Therefore the carbon savings would be slightly smaller as 20% of the heat demand would be met by a gas-fired top-up boiler.

Q: Is there an iphone app for this?
A: No – but if you follow the steps set out above you could easily produce your own spreadsheet tool to do this – this may even be a good exercise to do to understand how the carbon burden changes as electrical and thermal efficiency is varied.

Session 6. District Heating, Tim Kay, AECOM

Not just district heating to be an energy network.

Terminology – District energy, centralised, decentralised energy… sits between individual gas boiler and our electrical grid v centralised power stations… we are in the middle here … (see the slide).

Could be a whole town or a small number of buildings.

What is a heat network?

Scale version of an energy generation technology – gas or biomass boiler or CHP or waste heat – puts heat in system, distributed through pipes (hot water/sometimes steam) and is distributed to end users. Sometimes connected into homes, or done through heat exchangers rather than the water going into the house.

Less than 1% of our homes are supplied like this in the UK, but in Denmark/Scandinavia it's over 60%.

Heat generation – cheaper end, gas boilers (cheap capital costs), low carbon options, gas CHP, EfW, recovery of heat from existing industrial processes etc (see slide 404).

Advantages – allow waste heat to be recovered not wasted. E.g. factory making stuff, generating steam, if they're dumping heat and if you build a house next to it, you probably can't meet demands of individual houses but if you supply a central system you can harness it and use it usefully. You can cluster opportunities.

Potential carbon savings, if we use waste heat, it's essentially free financially and carbon wise. Larger plants can operate more efficiently then you get economies of scale. Greater fuel purchasing power – especially for larger organisations buying in bulk, so 300 – 500 homes get more purchasing power.

Increases usable space in building, saves up space of boilers, CHP etc in the building.

Single piece of equipment determines CO2 for multiple end users, so not a massive social housing boiler replacement for example.

Less reliant on volatile energy prices, some fossil fuel requirement from gas top up boilers.

Effective tool against fuel poverty (e.g. Oldham's district heating network, 1,400 homes on heating system, social housing).

Disadvantages, it is not all plain sailing. Investment required, often if developers say they can't afford it. There is going to be capital investment required. How can we optimise systems so we can get most out of the heat generation plant so we can operate it viably? That said, if we can design a scheme that's viable, there are plenty of companies (ESCO) and they'll snap it up and build and operate it on a 25 year contract. Not necessarily a direct financial investment.

There has to be a minimum heat demand. Density issue: have we got the density of heat demand to justify putting the infrastructure in… not worth it for 25 x 5 bed homes. If you have block of 200 high rise apartments there's a good case for shared heat infrastructure.

Fear of the unknown, from our work with LAs, it's a cultural shift… people like having own boiler.

Q: Have problems with metering been solved? A lot of problems about how much people did/didn't use, especially if you'll have an ESCO.
A: Yes, things have moved on, meters have moved on and are essentially like a gas meter in how they work. People tampering with the meters, there will be some people who get away without paying (like tax or something…) perception that people like to own things, house car boiler. In Europe people more open to idea of paying for a service. Different to mobile phones…

Q: Can you opt out of the system if desired?
A: If you're part of a district heating system, who provides it? The provider, you might not have a gas connection, but you might for your gas oven. so you probably could opt out.

Q: Is there policy centrally to look at encouraging behavioural change to encourage district heating supply.
A: No policy, idea is district heating and energy networks are supported nationally and then locally, that that will fall perception barriers.

Q: Thinking about the electricity grid and future projections – arguments is that electricity network will be zero carbon, why bother with the infrastructure… we can do it by zero carbon.
A: To combat that, zero carbon electricity is 30 – 50 years off, no guarantee that we'll get zero carbon electricity.

Renewables target – heat helps, allows higher contribution from renewable energy. Helps us balance the load demands. And it brings down the cost of carbon savings.

Grid decarbonisation – no one knows when this will happen. What do we do in the next 30 to 50 years… we have emissions targets we can't just do nothing…

Energy Centres don't have to be ugly… insulated pipework would go into the ground (this pic integrated flow and return…) it's like in your house – flow out of boiler (80 degrees) nd return is 70 degrees – the 10 deg loss is transferred to the room. You can get two sets of pipes, or concentric pipes…

Typically the pipe is between 100mm and 500 mm in diameter, so the pipes can be quite chunky.

Looking at introducing energy infrastructure in Manchester… you can draw parallels with the industrial revolution. Manchester in 1817 had one of the first gas networks in the country… all the mill owners wanted to encourage this infrastructure network. Manchester was first city to have electric street lighting. Picture of Dickinson Power Plant in 1893 to provide street lighting demand. Picture of cables being laid. Bloom Street, steam supply to Palace Theatre and UMIST; as infrastructure developed and reliance on electricity and gas increased more generating stations were developed, with larger stations being developed on the outskirts of the city.

Map boundary of greater Manchester, showed different infrastructure and put it on the map. Demands grew and grew demand for power – massive power stations needed round the country. We are almost trying to take a step back – do we need these very inefficient power stations and provide different types of infrastructure – heating, cooling , gas etc…

Decentralised energy vision… not relying on dirty great power station that's 25% efficient, we have a mix, micro generation, small wind, PV on roofs, solar thermal, hydro, district energy… let's re-evaluate our infrastructure… frontrunners will get the most successful cities.

Design issues similar to CHP – what is the heat demand and how can we meet them most efficiently and effectively? Can we make the engineering influence the financial side to stack up?

Energy and heat mapping – what it tells us? (Slide No 421). Examples from Stockport, Stoke, Blackpool and MMU illustrate a range of different heat mapping approaches. From MLSOA level data to building level data.

Q: Stockport is gas consumption per household. Bigger houses are telling you that little houses are in fuel poverty and all the posh areas are using the heating much more. Classic example of how the heat map doesn't always tell you all you need to know.

Other one shows inefficient houses in Blackpool.

Q: Can you translate that data into actual energy consumption for an area? And show density?

Issue producing heat map – you can only work with what you've got. Ideally you'd have information on energy use in each house – data does not exist. DECC website shows middle layer super output area showing gas and electricity for industrial and commercial and housing – show domestic total gas consumption.

Comment, presumably you want to know what the minimum is per household in the summer?

You can't do it, knocking on each door but for commercial buildings there is usually more data available, however there is always the challenge of insufficient data.

Does Transco have amalgamated data on those areas in terms of what they're supplying in terms of gas?

Comment: If you take darker areas of Stockport could be only one house that is staggering the results.

Transco won't release picture of gas grid and where it's connected to.

You need to look at a lot of factors, speak to housing people, look at who's connected, where you look at roughly what the demand might be? What the peak might be and summer baseload. Until you're at building level you can't work it up.

Mike Eastham, Chorley – looking at green infrastructure and energy we have to put in 2,000 new houses, we would like to impose or plan in district heating systems, how to we get developers to work with us on this as well as contribute towards new dentists, schools etc.

(Slide 425) This shows a cost comparison, looking at different domestic property types to look at what level of CO2 savings you can achieve, shows if you want highest level of carbon savings you have to go down the district heating networks, shows it's most cost effective. Working with national grid and NW reactors, will not be there till 15 years time, options of pylons and wind turbines and hydro schemes.

Rules of thumb

Gas boilers are the cheapest way to install a boiler.

(Slide 422) Low carbon costs are higher, so you want your money's worth or you're wasting cash and can be difference between it being cheapest option or not for a developer.

Typical costs of networks £5,000 pounds per m pipe. Depends on what you're digging – grass verge is cheap, concrete is not! Access issues, grass verge might belong to someone, highway is simpler for access and permission.

Heat exchanger to put in house or property £2k per dwelling… similar to a boiler.

Typical network 200 town houses, would be 1 – 3 MW_{th} peak demand
Hospital has a 10 – 50 MW demand.

(Slide no. 424) Carbon savings, capital cost per tonne CO2 saved for range of technologies. Larger district energy options are cheapest, require lots of cooperation and role for council in developing these schemes…

(Slide no. 423) Other graph is costs, (green) bar chart things show co2 savings per different technologies, higher carbon savings are district heating /energy options…

Q: Do those costs include on going running costs? A: Doesn't tell whole cost.

Developer often does not care about the running cost. A RSL might care a bit, who is end user, developer etc. One main issue is separation of developer vs operation cost. Developer wants the cheapest option.

Wind is at the top end (not small onsite but refers to large wind offsite) off site large scale wind farms are very effective way of making significant carbon savings… we get zero carbon standard. Not every house can offset its carbon emissions by an off site wind farm.

Q: That means you're not taking into account embodied carbon.

A: That will come to light in 5 or so years time.

A: We also currently don't look at embodied carbon in a gas or coal power station… either. Not what's gone into building it. If you want embodied carbon of renewable source you have to take into account power station … it's difficult to decide when to stop counting.

6 – 9 m payback carbon on large wind turbine.

(Slide 425) extracted tables from zero carbon consultation. urban regen end terrace house… advanced practice energy efficiency (insulated) with solar thermal (45% part L saving, £8.5k capital cost).
GSHP – 48% Part L saving, £13k capital cost). i.e. additional £4.5k for extra 3% Part L saving!
PV alone - 69% carbon saving, £11.5k capital cost.
District biomass CHP, 117% CO_2 savings, capital cost £10.7k. i.e. cheaper and 50% more carbon savings than PV alone.
Table does not tell you that you can't do district scheme for one house.. district energy gives you massive carbon saving potential but requires coordination between multiple buildings.

Link to domestic Zero Carbon Homes Consultation Doc:
http://www.communities.gov.uk/publications/planningandbuilding/zerocarbondefinition

Delivery options

Two extremes: public sector led or private sector led (packaged out if commercially viable).

Nottingham
Aberdeen
Woking
Birmingham
Southwalk

Ultimately council led scheme has more control of scheme, taking in fuel poverty areas, commercial led scheme may not make best social or regeneration scheme.

Q: Does that mean they are mainly partnership?

A: Yes, some kind of hybrid.

Southampton - deep geothermal borehole, generating some heat, operated by private ESCO

Media City, Salford – Operated by Elyo Suez, Tri-generation network, i.e. Combined Cooling Heat and Power (CCHP)

One of the major installers of district heating infrastructure is Vital Energi located in Blackburn.

Aberdeen Heat and Power – ESCO council led… transition to council led. Council still input to it to influence it. Special purpose vehicle.

Council led, Thameswey – Council led, maximum control…

Policy – some local authorities with polities relating to this… heat gas guidance e.g. Stockport. AGMA study identified some potential policies. More looking at how to word policies.

Stockport Council has a policy.
Policy SD-3 identifying areas for networks and setting targets for those areas, looking at flow chart for developers.. if it falls into that network they have some targets to try to get them to consider district energy.
Policy SD-4 min threshold for SD-3 to filter out smaller developments… tries to make sure they can be future proofed (not putting in electric heating but putting in a wet heating system so gas boiler can be ripped out and heat exchanger put in, thinking about position of boiler) …
Policy SD-5 community owned energy.
Link to Stockport policies: http://stockport-consult.limehouse.co.uk/portal

Q: What have they had to do to get behind the policies? E.g. an energy map, what kind of network they'd like?
A: It has to go through examination and be adopted as part of LDF core strategy and down to the evidence base – AECOM looked at character area types, costs etc from our findings the policies were valid.

No reason why they can't be put into core strategies.

Comment: All this is based on the assumption that district heating is best solution.
A: no, we are not saying that every building should be connected to district energy. See flow chart – onus on developer to show why it's not viable.

Underlying assumption that Stockport is suitable. Situation that network is set up across the area.

It's an energy opportunity study saying it could be feasible there… not every area will have a wind farm in it.

We should not encourage district heating everywhere – not saying that – but we there are opportunities we should be promoting this as part of the energy mix.

Q: Does first developer to put it in bear disproportionate costs to the rest?
A: Difficult question – we could do nothing, put PV, solar thermal, wait for building regs to ramp up and then we'll have to have these solutions to allow us to hit building regs. To be ready for April 2016 we need to get these ramped up… in theory if there was no support it would be an issue of the first developer bearing cost so it won't happen. There has to be some coordination to make sure a single developer won't have to pay all the costs.

Q: Is there a risk that people look at this as a solution and don't do the energy efficiency measures?
A: Idea is that building regs covers that with its minimum standard of energy efficiency. Energy efficiency is the first step. Once you have put in good energy efficiency, to meet renewables or carbon target of 10% it's easier as the energy demand is lower, so it's an easier target for a developer to achieve.

What about first buildings? How do you get existing dwellings into the network?

Part L for existing buildings is relatively weak, Stockport's policy addresses this and give you opportunity to improve existing buildings.

If you put district heating in, if a school gets refurbished it has a chance to link in. Creates opportunities.

Aberdeen system set up originally because they could not insulate those two tower blocks, that gave tenants cheaper bills… retrofit was best option.

Considerations:

Policy
Sustainability checklists
Sharing experiences
AGMA doing this and packaging up certain projects for investment
Planning issues – land ownership – pipework routing, energy centre
Coordinating seed capital, buyout solutions (allowable solutions that the government is allowing as they can't get to zero carbon).

Other support – get senior management buy in, and have got council members are keen to see these coming forward, AECOM worked with Ernst and Young on Oldham scheme… 12% return on investment is possible. Crucially individual leaders driving it forward…

Other kinds of networks

District Cooling – trends for heat demand will increase in the summer through cooling. Should we insulate homes more, or put in cooling networks (bad idea, swaps good design to cooling network – rather than natural protection against solar gains) there will always be a demand for heat even if just for hot water…

Q: How does absorption cooling work
A: Complex… takes high grade heat and turn it into cooling using a black box… http://en.wikipedia.org/wiki/Absorption_refrigerator

Q: Should we be encouraging air tight homes, modern homes and rise in respiratory diseases?
A: Yes, because part L and part F (ventilation) goes hand in hand. We make homes more air tight and we make sure we don't end up with ventilation issues – people need to be air tight and use extract systems and trickle vents.

Idea of air tightness is controlled ventilation – ideally heat recovery. Retrofit is an issue.

Other energy networks

Private wire electrical connection – it could be a hydro or wind or PV feeding directly to a building…

Shared water loop and heat system… Stockport – distribute medium temperature hot water, so with mix of heat/cool demand you can share it using a heat pump where you have a balance of heating and cooling needs.

Oldham have an existing heat network supplying 1,400 properties, social housing on smaller estates, (hatched areas – see slide 438 onwards) leisure centre, plant room with three 5.5MW gas boilers. Red lines are high pressure heat mains, go to series of satellite heat exchangers, blue are distribution lines. Existing system was put in 40 years ago.

Opportunities to expand the network – in line with adding gas boiler or CHP biomass in plant room, looked at hospital college, civic, market and new developments…

Flow 110 degrees C and return 95 degrees C.

Current peak is only 6MW – a lot of redundant energy in that plant room, some estates knocked down, 16MW capacity… reasonable summer baseload cost of swimming baths.

General thoughts/questions/issues/opportunities on district energy…

Will it become redundant? If we end up with zero carbon. Well, if we see advances in technology with fuel cells, can we plug in?

Grid infrastructure capacity – increase in electricity demand, electric cars… is increasing… despite switch to low energy light bulbs… should we use high grade electricity for heating? Electrical energy is high grade… I would suggests we save it for something more complex.

Can we make use of waste heat from old plants, surge of regeneration of hydro schemes. Can we use historic sources?

Part of energy mix.

Why did we not do it when we put our infrastructure in before? Heat is the 3rd form of infrastructure that could be put in – not sure if we should.

Decarbonisation of electrical grid won't meet our demands, almost a false target.. excuse not to do something.

Personally I think there is a place for all three forms of infrastructure, use electricity for high grade applications. Gas we need, will be a place, security issues.

District heating offers flexibility and way of moving away from centralised power stations.

FIT and RHI – we have seen a massive surge of applications. Local generation and people being self sufficient.

Problem is lack of economic driver – RHI not giving additional money for heat infrastructure.

Cumbria is looking at rural communities – found it interesting once you've done work to find the buildings to look at small scale heat networks. I can see things like developments clustering around our AD plants… using the high grade heat, social planning…

Tim, look at an area, filtering process looking at predicted energy demands, with anchor loads (e.g. council owned and you can control what goes on) could be two or three buildings that get a shared energy boiler plant… then you go on to link in future buildings. That's what Oldham's done.

Q: With two or three buildings to put in a system, seems easier if public sector – what if they are in a private sector development is there a ransom system?

A: If it was operated by a commercial ESCo they'd want you to connect in… commercial organisation. They would probably incentivize you to join.