Agenda Item No: 4

Report To: **Overview and Scrutiny Committee**

ASHFORD BOROUGH COUNCIL

Date: 26th February 2013

Report Title: **Stour and Civic Centres: Review of either Biomass Boilers or Combined Heat and Power (CHP) for heat provision to the buildings**

Report Author: Project Office Manager

Summary: A reappraisal of the two heating methods (either two 350 kWh biomass boilers or a 400 kWh gas fuelled CHP plant) has been undertaken with the following key outcomes:

I. Over a twenty year period, based on annual inflationary cost increases of 4% and after deduction of capital costs, a net present value analysis shows that the use of biomass boilers could cost the Council an estimated additional £140,000 against the existing utilities bill. The use of gas fuelled CHP could save £1.384m.

II. A sensitivity analysis of these figures shows that if gas supply cost increases faster than electricity then the CHP 20 year saving would be significantly reduced whilst the biomass cost could change to a saving.

III. If electricity supply cost increases faster than gas then the CHP savings benefit would significantly increase and the biomass cost would remain unchanged.

IV. If gas and electricity costs rise in line with each other at a faster rate, then CHP generates greater increased savings. The Councils energy supplier has indicated that this is the most likely scenario over the next four years.

V. Estimated annual CO_2 emission savings against the existing heating and power supply regime in the buildings are 460 Te for biomass boilers and 546 Te for the CHP plant.

VI. Additional areas of Kent woodland could be protected and maintained as a result of coppicing for wood fuel supply to a biomass plant, with the associated benefit to biodiversity of the local environment. This benefit is dependent upon a local company winning the wood fuel supply contract which would need to be advertised in the European Journal possibly resulting in fuel supply from outside the UK.

	VII.	The use of biomass boilers could generate additional turnover for a local wood fuel supplier of around £75,000 per annum including two new local jobs. This benefit is dependent upon a local company winning the wood fuel supply contract.
	VIII.	A CHP plant would create no local jobs and spending on gas fuel would not be local.
	IX.	Experience has shown that wood chip fuel quality and good design of fuel storage and transfer into the biomass boilers is critical to minimise biomass operational maintenance costs and service interruption.

Financial Implications:

The Biomass heating option would generate an additional cost to the Council estimated at £140,000. The CHP option would generate an estimated saving of £1.384m that would be available to the Council to invest in the old part of the Stour centre. The opinion of the S151 officer is that CHP gives by far the best value for money for local tax payers and that this an overwhelming reason to select CHP for heating the buildings. If Biomass is chosen the Council will have to find funding from other sources to invest in the refurbishment of the old part of the Stour Centre.

Possible Recommendations:

Either;
to confirm the Cabinet decision to proceed with the Stour Centre Essential Repairs and Proposed Invest to Save Project (including the choice of a CHP plant for heating and power supply to the buildings) based principally on the significant saving of £1.384m that CHP has over a twenty year period
or;
to recommend to Cabinet that it's decision to proceed with the Stour Centre Essential Repairs and Proposed Invest to Save Project should be reviewed to include a biomass plant for heat supply to the buildings (rather than a CHP plant), based principally on the possible benefits of biomass to local job creation and management of local woodland, but at a potential cost to the council of £140,000.

Exemption Clauses: **N/A**

Background Papers: N/A

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Agenda Item No.4

Report Title: **Stour and Civic Centres: Review of either Biomass Boilers or Combined Heat and Power (CHP) for heat/power provision**

Background and review information

1. On the 10th January 2013 the Cabinet approved the recommendations for implementation of the Stour Centre Essential Repairs and Proposed Invest to Save Project (including the choice of a CHP plant for heating and power supply to the buildings)

   'subject to more sensitivity work being undertaken, and a reappraisal of the financial aspects of this scheme and subject to any recommendations following a review by the Overview and Scrutiny Committee…'

2. A comprehensive reappraisal has been carried out by officers, in consultation with some Members, to assist O & S Members in conducting their review including:

   I. A reappraisal of the financial savings and environmental benefits arising from the two options.
   II. A sensitivity analysis identifying the impact on financial savings of changes in gas and electricity prices.
   III. A refreshed comparison of the pros and cons of biomass and CHP for providing heating/power to the Stour and Civic centres

3. The review of the biomass option has been undertaken in consultation with Matthew Morris – Woodfuel Pathfinder Development Manager, Nick Sandford – Godinton Estate Manager and South East Wood Fuels a local wood chip fuel supplier.

4. The review has included a visit with Members to see three biomass boilers at leisure centres in the south east. Unfortunately only one of these was working at the time of the visit however the importance of good design, choice of boiler and quality of wood fuel to the efficiency of biomass operation was very apparent and is critical to service continuity.

5. An independent assessment of the estimated carbon savings related to the two heating options has been carried out by an experienced specialist in sustainable development (AECOM). See Appendix 1

6. The AECOM recommendations 1 to 4 in section 5.2 of the report have all been taken into account in this review. In particular the sustainability of the biomass fuel source from local woodland has been confirmed

7. A thorough check of all of the inputs to the financial models for the two heating options has been carried out including a reassessment/check on:

- maintenance, operating and capital costs,
- heating plant efficiency,
- fuel costs,
- renewable heat incentive tariff (received for biomass).

Commercial Appraisal

8. The commercial appraisal (see Appendix 2) comparing the two options has been checked, refined and updated with amendments made as follows:

   I. The size of the CHP plant has been reduced to 400 kWh to better reflect the actual daily power demand profile of the two buildings.

   II. The period of the appraisal has been increased from 15 to 20 years to take full account of the 20 year life of biomass boilers. A CHP plant has a life of 15 years so its capital cost has been increased by one third in the appraisal to make a fair comparison with biomass.

   III. The existing total electricity demand for the two buildings has been updated taking into account the effect of the PV panels installed on the Civic centre last year, which have reduced the power demand from the national grid.

   IV. Gas and electricity costs have been revised based on recently received figures from the Council's supplier for the next six month period.

   V. Wood fuel supply cost has been increased based on indicative pricing obtained from South East Wood Fuels.

   VI. Operation and maintenance costs for both options have been adjusted based on supplier's whole life maintenance cost estimates and an estimate of biomass operational costs made following the visits to three biomass boilers providing heat to leisure centres.

   VII. Renewable Heat Incentive (RHI) payments for the biomass boilers now include the governments two tier payment regime. This has reduced the benefit of RHI which was overstated in the original appraisal.

   VIII. The CHP capital cost has reduced as a result of the reduction in plant size and due to confirmation that the existing gas pipework is adequate to supply the increased volume of gas required to operate a CHP plant (a contingency sum had been allowed for this in the original appraisal).

9. The results of the revised commercial appraisal are summarised in Table 1. The model assumes a 4% annual cost increase in wood, gas, electricity and maintenance costs as a base case.

Table 1 Commercial Appraisal Summary for Biomass and CHP
Base case: 4% annual inflation on all costs (figures shown at net present value)

Heat/Power supply Option	Estimated cost saving against existing regime over 20 years (£)	Estimated Capital cost of plant (£)	Balance of 20 year saving available to the Council (£)
Existing regime: Gas boilers for heat and national grid for electricity	-	-	N/A
Biomass boilers for base heat load plus existing boilers for balance of heat and national grid for all electricity	527,560	668,000	(140,440)
CHP producing heat & electricity plus existing gas boilers and national grid for balance of heating and electricity respectively	2,083,940	700,000	1,383,940

10. The refreshed appraisal shows that the use of CHP will save the Council £1.384m, whereas the use of biomass will cost the Council £140,000 more, than its current utilities cost.

Commercial appraisal sensitivity

11. An analysis has been carried out to show the sensitivity of the 20 year commercial appraisal to relative changes in annual inflation of the cost of electricity and gas. The potential supplier of wood fuel has indicated that future price increases would be linked to the Retail Price Index (RPI). Therefore there is a lower risk of disproportionate increases in the cost of wood fuel and so the inflation of wood fuel cost has been fixed at 4% for all of the sensitivity scenarios. The results are shown in Table 2.

Table 2 Sensitivity of net present value saving to annual inflation of gas and electricity costs (wood fuel cost fixed at 4%)

Scenario	Annual inflation of gas %	Annual inflation of electricity %	Balance of 20 year saving available to the Council Biomass	Balance of 20 year saving available to the Council CHP
Base case (see table 1)	4	4	(£0.140)	£1.384m
1	6	4	£0.104m	£1.045m

Scenario	Annual inflation of gas %	Annual inflation of electricity %	Balance of 20 year saving available to the Council **Biomass**	Balance of 20 year saving available to the Council **CHP**
2	4	6	(£0.140)	£2.327m
3	6	6	£0.104m	£1.988m

The results show that if the cost of gas rises faster than electricity then the saving with a CHP plant reduces significantly. If electricity cost rises faster than gas then the saving from using a CHP plant increases.
If electricity and gas costs increase in line with each other at a higher inflationary rate of 6% then both options offer an increased saving compared to the Council's existing utility costs. The Councils energy supplier has indicated that this is the most likely scenario over the next four years.

Environmental Appraisal

12. The use of biomass boilers would generate carbon savings of 460 tonnes/annum representing a 17% improvement on the existing emissions. These savings arise from the use of locally sourced wood chip as fuel provided from the lower quality timber (branch wood) in coppiced woodland, which replaces the use of gas fossil fuel by gas boilers.

13. A CHP plant would generate higher carbon savings of 546 tonnes/annum giving a 20% reduction on existing emissions. This saving arises primarily from the generation of local electricity by the CHP plant which replaces electricity taken from the national grid. National grid electricity is generated by a mix of methods including coal and gas fired power stations and transmitted over relatively long distances to reach the Stour and Civic centres.

14. The Department of Energy and Climate Change (DECC) published a Bioenergy Strategy in April 2012. Whilst the DECC concludes that the use of biomass for fuel will be a requirement of the strategy to meet the UK's carbon reduction target, there are uncertainties that arise from the use of biomass. Therefore the DECC intends to review its position every five years. Furthermore the DECC intends to introduce sustainability criteria for biomass heat into the Renewable Heat Incentive scheme in 2013. This could impact qualification for RHI if biomass is adopted for the Stour and Civic centres however disqualification is considered to be unlikely.

15. Biomass could offer additional environmental and economic benefits. There is ample coppiced woodland in Kent to provide a long term sustainable wood fuel supply to the Stour and Civic centres. If the long term wood fuel supply contract is secured by a local Kent based company, then the Council would spend in the order of £75,000 a year on a local supply contract resulting in the generation of two jobs. This benefit is dependent upon a local company

winning the fuel supply contract which would need to be advertised in the European Journal.

16. Additional areas of Kent woodland would be protected and maintained as a result of coppicing for wood fuel supply, with the associated benefit to biodiversity of the local environment.

Summary of Biomass and CHP appraisal

17. Appendix 3 summarises the key points in the appraisal of the two heating options.

Conclusion

18. Following the Cabinet request for O & S Committee to review the choice of CHP rather than biomass for heating the Stour and Civic centres a thorough environmental and financial reappraisal of the two options has taken place. This has included visits with Members to biomass plants, consultation with sustainability and wood fuel supply specialists, downsizing of the CHP plant to model the actual heat demand profile and a thorough check on the inputs to the financial comparison of the two heating methods.

19. The findings are that the use of biomass heating could generate local environmental and employment benefits if the wood fuel supply contract is won by a local company. However the refreshed appraisal confirms that the option of CHP gives a very significant financial advantage over biomass.

20. A sensitivity analysis of the savings from CHP and biomass has been carried out and the most probable scenario of higher like for like increases in gas and electricity supply costs would increase the commercial advantage that CHP has over biomass.

21. If CHP is chosen over biomass then a saving of £1.384m would be generated for reinvestment into the refurbishment of the old part of the Stour centre.

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APPENDIX 1 Environmental Review of Stour & Civic Centres Heating Upgrade

Stour Centre Heating Upgrade Proposals – An Environmental Review

Prepared by: Matthew Turner
Principal Consultant

Checked by: Miles Attenborough
Technical Director

Rev No	Comments	Checked by	Approved by	Date
1	Draft Report for Client Comment	MA	MA	04/02/13
2	Final report including revisions following CHP resizing in line with the recommendations in the previous version	MA	MA	14/02/13

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Job No: n/a Reference: Ashford Biomass Study Date Created: 14th February 2013

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1 Introduction

1.1 Introduction to this technical note

AECOM have been commissioned by Ashford Borough Council to review the environmental case for the proposals to upgrade the heating system of the Stour Centre.

This work is informed by a technical study previously undertaken by Slender Winter Partnership Ltd (SWP)[1] which reviews the potential to upgrade the existing mechanical and electrical services.

The report reviews the available options for improving the insulation of the buildings and integrating low and zero carbon energy technologies. It then goes on to investigate in detail the potential to use either biomass boilers or gas-CHP to replace the existing gas boilers that serve the buildings and which are now coming to the end of their useful lives. The report concludes that gas-CHP would offer the best financial returns although the relative benefits with regard to reducing the CO_2 emissions from the site and not explicitly compared.

This study aims to provide some additional detail to inform the decision making around which system to adopt. In particular, Ashford Borough Council has asked for a more comparative assessment of the relative environmental benefits of the two options and a review of the current guidance and evidence around the sustainable use of biomass as a fuel.

1.2 Content of this technical note

This technical note contains the following information and analysis:

- A review of the current issues and guidance on the use of biomass as fuel;
- An appraisal of the carbon savings of the biomass and combined heat and power solutions proposed for the Stour centre;
- An appraisal of other conclusions and recommendations from the SWP report; and
- Conclusions and recommendations arising from our review.

[1] Report on the upgrading of the mechanical and electrical services to the old part of the building, SWP (2012)

2 The sustainability of using biomass as fuel

2.1 Introduction

Biomass is generally considered to be a low carbon fuel since, at a simplistic level, the CO_2 emissions released when burnt can be considered to be offset by those which are absorbed during growth.

In practice there are a range of further factors that need to be considered in providing a comprehensive assessment of the sustainability of using biomass as a fuel and which are affected by the source of the biomass and its end use, these include:

- The CO_2 emissions associated with processing and transportation of different biomass fuels from source to end user;
- The CO_2 emissions associated with land use changes or changes to the way the land is managed;
- The implication of the use of that land if it could otherwise have an alternative use that may have more social or environmental benefits;
- The implications of the alternative use of that biomass, specifically if it could be used as a material (in which case the carbon would be sequestered rather than released); and
- The end use of the biomass fuel and the relative environmental and financial costs and benefits compared to an alternative fossil fuel energy source.

To reflect this more complex argument and to define a position on both the appropriate sources of biomass for energy and the most appropriate use of biomass fuel, the Government and key national agencies like the Forestry Commission have recently published a number of key guidance documents and reports.

This section sets out the relevant guidance and requirements from the key reports and studies that make up the current national position on the use of biomass for heat, against which the appropriateness of using biomass for the Stour Centre should be assessed.

2.2 EU Guidance

In 2010 the EU published a report into the sustainability of biomass[2]. It confirmed that 'Member States are free to put in place their own national schemes for solid and gaseous biomass used in electricity, heating and cooling' but provided sustainability criteria and recommendations for Member States to minimize the risk of the development of varied and possibly incompatible criteria that might impact upon trade and the growth of the bio-energy sector.

The recommended criteria relate to:

(a) a general prohibition on the use of biomass from land converted from forest, other high carbon stock areas and highly biodiverse areas;

(b) a common greenhouse gas calculation methodology which could be used to ensure that minimum greenhouse gas savings from biomass are at least 35% (rising to 50% in 2017 and 60% in 2018 for new installations) compared to the EU's fossil energy mix;

[2] Report from the Commission to the Council and the European Parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling SEC(2010) 65 final SEC(2010) 66 final http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52010DC0011:EN:HTML:NOT

(c) the differentiation of national support schemes in favour of installations that achieve high energy conversion efficiencies; and

(d) monitoring of the origin of biomass.

A national scheme was subsequently put in place in the UK, although more recent research has subsequently been undertaken leading to updates in the Government's position.

2.3 DECC Bioenergy Strategy

The DECC Bioenergy Strategy[3], published in April 2012, is the key Government guidance on the use of wood and energy crops for bioenergy.

It concludes that the use of biomass for fuel will be a requirement of the strategy to meet the UK's carbon reduction target, and that wood and energy crops are a good option for delivering carbon reductions compared to alternative uses of the resource, although this is qualified by a reference to 'certain circumstances but not all'.

The report raises the issue of risks, including biodiversity, whole life-cycle carbon emissions and land for food, but also the potential of biomass to deliver significant reductions in greenhouse gas emissions.

To reflect the inherent uncertainties that surround the different issues that arise from the use of biomass, the report defines the following low-risk energy deployment pathways that are to be supported:

- Use of biomass as wood in construction;
- Use of end-of-life waste biomass materials for energy;
- Use of biomass to provide low carbon heat for buildings and industry;
- Use of some biofuels for transportation; and
- Use of sustainable biomass as a transitional fuel in electricity generation.

The high level of uncertainty means that DECC intend to review their position over time and a five yearly review process is suggested in the report. It is therefore possible that the guidance on the potential sources of biomass and the use of biomass fuel could change in the future.

It should also be noted that the report states:

"*We intend to introduce sustainability criteria for biomass heat into the Renewable Heat Incentive in 2013".*

It is likely that if such guidance was published as planned this would impact upon the Stour Centre scheme should a biomass system be proposed.

Further guidance on the Government's approach to the use of biomass can also be found in the Analytical Appendix to the Bioenergy Strategy[4].

2.4 Committee on Climate Change Bioenergy Report

The Committee on Climate Change produced a report on the use of Bioenergy in December 2011. The main conclusions arising from this report were as follows:

[3] https://www.gov.uk/government/publications/uk-bioenergy-strategy

[4] https://www.gov.uk/government/publications/uk-bioenergy-strategy

- Bioenergy has an important role in helping the UK to meet its climate change targets although it should be limited to meeting 10% of primary energy requirements (unless carbon capture and storage (CCS) cannot be delivered to the levels anticipated for abating fossil fuel use).
- Lifecycle emissions associated with the use of bioenergy should be accounted for, including land-use changes.
- Bioenergy should be directed to the most appropriate uses with a hierarchy that places use for construction materials and industrial heat as the most desirable followed by power and heat production (if CCS is available) and/or aviation fuels if CCS is not available and lastly as liquid biofuels or power generation without CCS).
- The availability of biomass needs to be considered and as such CCS should be developed as a matter of priority and alternatives for the use of biomass in lower priority areas should be promoted.

2.5 Forest Research and North Energy Study

Forest Research, a research arm of the Forestry Commission, and North Energy undertook a study[5] in 2012 to review the carbon impacts of biomass in bioenergy and other sectors.

The study looks at the potential greenhouse gas emissions that arise from different uses of biomass to determine the relative carbon savings that can be delivered relative to the counterfactual case of no change to the forestry management and alternative materials being used in construction or for products or for fuels.

The study found that using biomass for construction materials and products had a greater impact on the carbon saving potential than its use as fuel alone, although the most efficient uses comprised a combination of uses for different components of harvested biomass, for example sawlogs for timber, roundwood for timber products such as pellets, fences, MDF and particleboard and branchwood as fuel.

The key conclusions arising from the report are as follows:

- Management of UK forests for wood production can contribute to UK carbon objectives.
- Using wood as a construction material, as a product and as fuel can reduce carbon emissions.
- Greenhouse gas emissions are influenced by the end-of-life destination of wood products.
- Greenhouse gas emissions savings will only be achieved if the harvesting of wood does not involve the permanent and long-term depletion of carbon stocks in forests, or if reductions in carbon stocks are managed carefully over time.
- If areas of neglected forest are restored to management, this could lead to reductions of carbon stocks in some forest areas.

[5] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48346/5133-carbon-impacts-of-using-biomanss-and-other-sectors.pdf

2.6 UK Forestry Standard

The UK Forestry Standard[6], produced by the Forestry Commission in 2011, sets out various requirements for forestry management in the UK, which includes the following in relation to climate change:

“Forest management should contribute to climate change mitigation over the long term through the net capture and storage of carbon in the forest ecosystem and in wood products”.

In regards to the practical guidance for compliance with this requirement the report includes the following:

“Consider the potential for woodfuel and energy crops within the sustainable limits of the site”

The implication of this is that the management of forests to provide biomass fuel is encouraged as long as this is done in a way that did not compromise the other requirements set out in the document.

2.7 Conclusion

Based on the current recommendations and guidance from the Government and key national agencies, it would seem reasonable to assume that the use of biomass boilers to provide heat for the Stour Centre would be considered an appropriate use of biomass fuel.

Also, assuming that the proposed biomass fuel source is to be from coppicing of branchwood from existing managed forests then this too could be deemed sustainable under the current guidance set out in the documents referred to above.

If biomass boilers are selected as the plant to provide heat to the Stour Centre then a more detailed review of the fuel source(s) could be prepared to provide the evidence to confirm the sustainability of the supply with regard to the key sustainability criteria highlighted in the documents presented in this chapter.

[6] http://www.forestry.gov.uk/ukfs

3 Review of the carbon savings of the proposed options

3.1 Methodology and assumptions

Based on the outputs from the SWP study we have undertaken a comparative estimation of the relative CO_2 savings from the proposed biomass and CHP plant options.

The following assumptions have been used in our analysis

General:

- The following emissions factors, as used in the approved calculation methodologies for the current version of the Building Regulations, have been used:

	$KgCO_2$/kwh
Gas	0.198
Electricity	0.517
Biomass (wood chips)	0.009

- The efficiency of the gas boilers has been assumed to be 90%

Biomass boiler:

- The annual heat delivered by the biomass boiler is based on the figures from the SWP report, which estimates a total of 2,200,800kWh/annum
- The efficiency of the biomass boiler has been assumed as 85%

CHP:

- The annual heat delivered by the CHP is based on the figures from the SWP report, which estimates a total of 2,938,464kWh/annum
- The electricity delivered by the CHP is based on the figures from the SWP report, which estimates 2,291,200kWh/annum
- The overall efficiency of the CHP has been assumed as 80%, the relative outputs of heat and electricity are based on the outputs from the SWP report.

3.2 CO_2 savings from Biomass

As set out in the previous section, biomass is generally considered to be a carbon neutral fuel although there are some emissions associated with the processing and transportation of the fuel.

In regards to calculating the CO_2 savings from the use of biomass in place of gas, the standard approach is to use the emissions factors from the calculation methodology used for standard assessments for compliance with Building Regulations and to take account of the relative system efficiencies.

Based on the estimated energy output from the system proposed in the SWP report and the methodology and assumptions set out above, the annual CO_2 savings has been estimated to be 461 tonnes/annum, which represents a 17% saving compared to the baseline emissions.

3.3 CO_2 savings from CHP

The CO_2 savings associated with the use of gas CHP are derived primarily from the generation of local electricity.

Based on the estimated energy output from the CHP system proposed in the SWP report and the assumptions noted above, the estimated annual CO_2 savings would be 546 tonnes/annum, which represents a saving compared to the baseline emissions of around 20%.

We would note that a more detailed calculation based on detailed CHP modelling and taking account of other factors such as distribution losses, would be required to obtain a more accurate estimation of CO_2 savings.

3.4 CO_2 savings over time

It should be noted that the CO_2 savings of the two options will change over time depending on the relative emissions factors associated with electricity, gas and biomass.

The emissions factors associated with gas and biomass are unlikely to change significantly over time, although the emissions factors for gas will increase slightly due to an increase in the use of liquefied natural gas and the emissions factors for biomass could increase if land use change and other indirect factors are taken into account. However, it is the emissions associated with electricity will see the most significant impacts in the near future. These are set to decrease as a result of the Government's decarbonisation agenda. The effect of this is that the carbon savings associated with the use of CHP, which are currently high due to the much lower carbon emission factor for the use of gas relative to electricity from the national grid, will decrease over time.

There are a number of different projections for the likely decarbonisation of the national grid, which reflect the level of uncertainty surrounding changes to the future power generation mix.

As a guide the carbon savings over time for the scheme have been presented below based on the DECC Baseline Scenario.

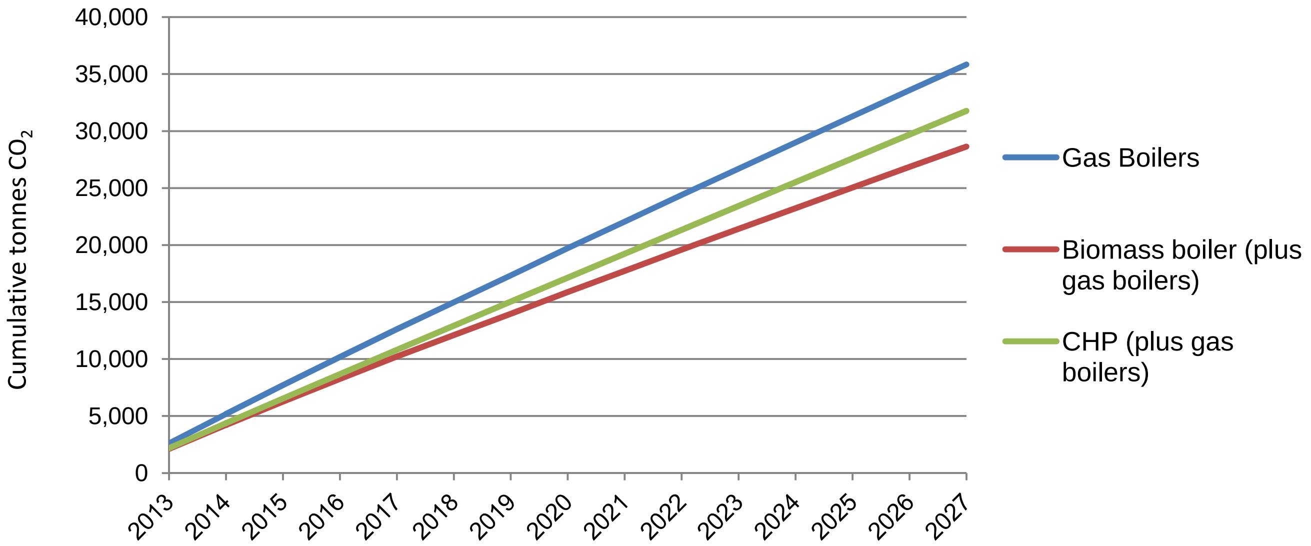

Figure 1: Indicative cumulative carbon emissions associated with the three different plant options proposed for the Stour Centre, based on the outputs from the SWP report, assumptions taken by AECOM and the CO_2 emissions factors for electricity from the national grid based on the DECC Central Scenario.

4 Review of the report recommendations

4.1 Plant sizing and outputs

We note that the biomass plant proposed in the SWP report has been sized to deliver 42% of the overall annual heat demand of the buildings. We understand that in part this has been done to maximise the returns under the Renewable Heat Incentive (RHI).

This proportion of heat demand delivered by biomass is potentially lower than could be achieved if CO_2 savings were the main priority. In many cases biomass can provide up to 80% of the load of a building, although this does depend on the nature of the building heat demand profile amongst other things. As a guide, if it were possible to deliver 80% of the heat load of the Stour Centre from biomass the CO_2 savings would increase from 461 tonnes/annum to 924 tonnes/annum.

We note that the CHP has been sized to provide 56% of the heat demand and 66% of the electricity demand. This would seem reasonable based on our experience, although more detailed modelling, ideally using half-hourly data, would ideally be required to understand this more accurately, including the appropriate provision of thermal storage. Changes to the outputs from the system, particularly the generation of electricity, could have a significant impact on the environmental and financial benefits associated with this option.

4.2 Financial assessment

The financial assessment in the SWP report, based on the plant sizes and operation that has been proposed and the assumptions taken, indicates that gas-CHP offers the best financial returns.

Based on similar exercises that we have undertaken this conclusion seems reasonable. However it should be recognised that this conclusion is realised for two key reasons and therefore the assumptions that have been taken for these should be reviewed to consider their appropriateness.

Firstly, one of the most significant factors affecting the financial viability of the biomass boiler is the cost of the biomass fuel. The assumption that has been taken in the analysis (3.3p/kWh) is a reasonable assumption for the purposes of the assessment but the conclusions realised would be significantly affected if this was to change.

Secondly, one of the most significant factors affecting the financial viability of the gas-CHP engine is the price that is placed on the electricity generated. The analysis in the Commercial Comparison is based on an assumption that all the electricity generated is used on site, at a saving of 8.8p/kW (which we assume to be the price that the Council purchases its electricity at). However, as the total electricity generation from the CHP is equivalent to 66% of the electricity requirements from the buildings connected it is not clear whether this assumption is supported by the profiles of electricity generation and demand.

It is likely that there could be times when the supply is greater than the demand, particularly outside the core operating hours of the building but while the CHP is operational, and electricity generated at these times may need to be exported. The implications of this will not affect the CO_2 savings since these can be counted for all generation but it would affect the financial assessment.

For all electricity exported an assumed price of around 4 to 4.5p/kWh would be more appropriate to use in the financial assessment and as such the current financial assessment, which assumes 8.8p/kWh for all electricity generated could be overestimating the returns.

5 Conclusions and recommendations

5.1 Conclusions and comments

- The use of biomass fuel derived from coppicing of branchwood from existing managed local forestry sources to provide heat for the Stour Centre would be considered as sustainable under the current guidance set out by the Government and key national agencies. We have not assessed the ability to service the estimated fuel requirements from these sources but understand that the Council is currently looking into this.
- The proportion of heat provided in the biomass solution proposed in the SWP is rather low and as such the CO_2 savings are lower than could be expected if CO_2 savings were prioritised. We understand this was in part due to the desire to maximise the returns under the RHI but this could potentially be increased if a higher weight was to be placed on maximising the CO_2 savings.
- The financial returns calculated for the CHP could be overestimated if a significant proportion of electricity needs to be exported.
- It is our understanding that the analysis has been undertaken based on the heat demands from the current building and therefore does not account for the reduction in heat demand that would result from the improvements to the building fabric that have been proposed, including the reduction in the annual and peak demands that would affect the system sizing and annual performance. Accounting for this would impact on the outputs of the technical and financial assessment of the biomass and CHP systems.

5.2 Recommendations

1. We would suggest a review of the proposed biomass sizing and operational regime based on a more detailed understanding of the heat demand profile in order to assess whether a biomass boiler solution could support a greater proportion of the heat load and therefore deliver higher CO_2 savings.
2. We would suggest a comparison of the electricity generation from the CHP with the building electricity consumption profile to better understand the amount of electricity that might be exported.
3. Based on the results of Recommendations 1 and 2 the relative financial and environmental benefits of Biomass and CHP could be reviewed in more detail.
4. If a biomass solution was taken forward, the Council may wish to collect the following evidence to confirm the sustainability of the biomass sources:

- Confirmation of the existing use of the land from which the biomass would be derived
- Confirmation of the nature of the forestry practices used to harvest the biomass
- Confirmation of the management regime of the woodland used
- A calculation of the whole lifecycle carbon emissions from the biomass source(s)
- Confirmation of the ability to source the required amount of fuel from sustainable sources

Appendix 2 Commercial Comparison of Biomass and CHP Heating Options over a 20 Year Period **REVISION O & S 1**

An A2 hard copy of this appendix can be made available to Members if required. Please contact Julia Vink if you require a copy.

NPV factor 3%

General notes

Base Case - Annual inflation of all costs assumed at 4% per annum
Based on building with current insulation and no improvements
Maintenance costs of retained gas boilers not included as common to all three options
Based on costs to ABC for gas of 2.378p/kWh incl standing charge for equipment
Based on costs to ABC for electricity of 8.8p/kWh
Based on costs to ABC for woodchips of 3.3p/kWh. (Quote from SE Wood Fuels allows for 80% boiler efficiency)

Revisions to Cabinet version: Appraisal period increased to 20 years to reflect life of biomass boilers
Maintenance costs for Biomass and CHP revised.
CHP size reduced to 400 kWh to reflect daily power demand profile
Existing power demand reduced to account for new PV panels on Civic centre
RHI calculation corrected to allow for 2 tier payment arrangement
Gas cost updated to new cost for next six months.

Existing regime - use of new boilers in Stour Centre plus Civic Centre boilers to provide heating

	Inflation	YEARS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Estimated Totals
Gas consumption kWh pa		4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	4,764,000	95,280,000
Electricity consumption kWh pa		3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	3,225,987	64,519,730
Gas cost	4%	£113,288	£117,819	£122,532	£127,434	£132,531	£137,832	£143,345	£149,079	£155,042	£161,244	£167,694	£174,402	£181,378	£188,633	£196,178	£204,025	£212,186	£220,674	£229,501	£238,681	£3,373,497
Electricity cost	4%	£283,887	£295,242	£307,052	£319,334	£332,107	£345,392	£359,207	£373,576	£388,519	£404,059	£420,222	£437,031	£454,512	£472,692	£491,600	£511,264	£531,715	£552,983	£575,103	£598,107	£8,453,604
Total cost pa		**£397,175**	**£413,062**	**£429,584**	**£446,768**	**£464,638**	**£483,224**	**£502,553**	**£522,655**	**£543,561**	**£565,303**	**£587,916**	**£611,432**	**£635,890**	**£661,325**	**£687,778**	**£715,289**	**£743,901**	**£773,657**	**£804,603**	**£836,787**	**£11,827,100**
NPV pa		**£397,175**	**£401,031**	**£404,924**	**£408,856**	**£412,825**	**£416,833**	**£420,880**	**£424,966**	**£429,092**	**£433,258**	**£437,464**	**£441,712**	**£446,000**	**£450,330**	**£454,702**	**£459,117**	**£463,574**	**£468,075**	**£472,620**	**£477,208**	**£8,720,643**

Option 1 Two 350kWh Biomass boilers supplemented by boilers in Stour Centre plus Civic Centre boilers to provide top up heating (Old boilers in old part of building removed) plus power from the national grid

	Inflation	YEARS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Estimated Totals
All inclusive servicing	4%	£10,000	£10,400	£10,816	£11,249	£11,699	£12,167	£12,653	£13,159	£13,686	£14,233	£14,802	£15,395	£16,010	£16,651	£17,317	£18,009	£18,730	£19,479	£20,258	£21,068	£297,781
Operational Maintenance	4%	£10,950	£11,388	£11,844	£12,317	£12,810	£13,322	£13,855	£14,409	£14,986	£15,585	£16,209	£16,857	£17,531	£18,233	£18,962	£19,720	£20,509	£21,330	£22,183	£23,070	£326,070
Electrical energy produced kWh pa		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	
Heat produced kWh pa		2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	2,200,800	
Cost of woodfuel £0.033/kW	4%	£72,626	£75,531	£78,553	£81,695	£84,963	£88,361	£91,896	£95,571	£99,394	£103,370	£107,505	£111,805	£116,277	£120,928	£125,765	£130,796	£136,028	£141,469	£147,128	£153,013	£2,162,675
Balance of Gas required for existing boilers kWh pa		2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	2,563,200	
Cost of balance of Gas required for existing boilers	4%	£60,953	£63,391	£65,927	£68,564	£71,306	£74,159	£77,125	£80,210	£83,418	£86,755	£90,225	£93,834	£97,588	£101,491	£105,551	£109,773	£114,164	£118,730	£123,479	£128,419	£1,815,060
Electricity cost	4%	£283,887	£295,242	£307,052	£319,334	£332,107	£345,392	£359,207	£373,576	£388,519	£404,059	£420,222	£437,031	£454,512	£472,692	£491,600	£511,264	£531,715	£552,983	£575,103	£598,107	£8,453,604
TOTAL COST / pa		£438,416	£455,953	£474,191	£493,158	£512,885	£533,400	£554,736	£576,926	£600,003	£624,003	£648,963	£674,921	£701,918	£729,995	£759,195	£789,563	£821,145	£853,991	£888,151	£923,677	**£13,055,189**
RHI tariff benefit	4%	£73,811	£76,763	£79,834	£83,027	£86,348	£89,802	£93,394	£97,130	£101,015	£105,056	£109,258	£113,629	£118,174	£122,901	£127,817	£132,929	£138,247	£143,776	£149,528	£155,509	£2,197,950
Capital cost interest		£19,800	£19,100	£18,400	£17,600	£16,800	£15,900	£15,000	£14,100	£13,200	£12,200	£11,300	£10,300	£9,200	£8,100	£7,100	£5,900	£4,700	£3,500	£2,300	£1,100	£225,600
NET TOTAL COST pa		**£384,405**	**£398,289**	**£412,757**	**£427,731**	**£443,336**	**£459,498**	**£476,342**	**£493,895**	**£512,187**	**£531,147**	**£551,005**	**£571,593**	**£592,945**	**£615,194**	**£638,478**	**£662,533**	**£687,599**	**£713,714**	**£740,923**	**£769,268**	**£11,082,840**
NPV pa		**£384,405**	**£386,689**	**£389,063**	**£391,435**	**£393,899**	**£396,367**	**£398,929**	**£401,582**	**£404,325**	**£407,080**	**£409,999**	**£412,931**	**£415,879**	**£418,917**	**£422,109**	**£425,255**	**£428,489**	**£431,809**	**£435,214**	**£438,703**	**£8,193,078**

Saving against existing regime	**£527,565**
Biomass Capital cost	**£668,000**
Nett saving to ABC	**-£140,435**

Option 2 New 400 kWh CHP plant supplemented by boilers in Stour Centre plus Civic Centre boilers to provide top up heating (Old boilers in old part of building removed) plus some power from the national grid

	Inflation	YEARS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Estimated Totals
Maintenance	4%	£25,318	£26,330	£27,384	£28,479	£29,618	£30,803	£32,035	£33,316	£34,649	£36,035	£37,476	£38,976	£40,535	£42,156	£43,842	£45,596	£47,420	£49,316	£51,289	£53,341	£753,914
Electrical energy produced kWh pa		2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	2,291,200	
Heat produced kWh pa		2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	2,938,464	
Cost of gas fuel pa	4%	£142,341	£148,035	£153,956	£160,115	£166,519	£173,180	£180,107	£187,312	£194,804	£202,596	£210,700	£219,128	£227,893	£237,009	£246,489	£256,349	£266,603	£277,267	£288,358	£299,892	£4,238,653
Balance of Gas required for existing boilers kWh pa		1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	1,825,536	
Cost of balance of Gas required for existing boilers	4%	£43,411	£45,148	£46,954	£48,832	£50,785	£52,816	£54,929	£57,126	£59,411	£61,788	£64,259	£66,830	£69,503	£72,283	£75,174	£78,181	£81,308	£84,561	£87,943	£91,461	£1,292,703
Balance of Electricity use kWh pa		934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	934,787	
Electricity cost	4%	£82,261	£85,552	£88,974	£92,533	£96,234	£100,083	£104,087	£108,250	£112,580	£117,083	£121,767	£126,637	£131,703	£136,971	£142,450	£148,148	£154,074	£160,237	£166,646	£173,312	£2,449,581
Cost of heat produced		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	
TOTAL COST/ANNUM		£293,332	£305,065	£317,267	£329,958	£343,156	£356,883	£371,158	£386,004	£401,445	£417,502	£434,202	£451,571	£469,633	£488,419	£507,955	£528,274	£549,405	£571,381	£594,236	£618,005	**£8,734,851**
RHI tariff benefit		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Capital cost interest		£20,800	£20,000	£19,200	£18,400	£17,600	£16,600	£15,700	£14,800	£13,800	£12,800	£11,800	£10,700	£9,700	£8,500	£7,300	£6,100	£4,900	£3,700	£2,400	£1,000	£235,800
NET TOTAL COST pa		**£314,132**	**£325,065**	**£336,467**	**£348,358**	**£360,756**	**£373,483**	**£386,858**	**£400,804**	**£415,245**	**£430,302**	**£446,002**	**£462,271**	**£479,333**	**£496,919**	**£515,255**	**£534,374**	**£554,305**	**£575,081**	**£596,636**	**£619,005**	**£8,970,651**
NPV pa		**£314,132**	**£315,597**	**£317,153**	**£318,797**	**£320,527**	**£322,169**	**£323,988**	**£325,891**	**£327,798**	**£329,791**	**£331,868**	**£333,954**	**£336,195**	**£338,377**	**£340,645**	**£342,994**	**£345,424**	**£347,933**	**£350,461**	**£353,010**	**£6,636,703**

Saving against existing regime	**£2,083,940**
CHP Capital cost	**£700,000**
Nett saving to ABC	**£1,383,940**

APPENDIX 3

Stour & Civic Centres - Comparison of Biomass and CHP installations for heating

Rev 0

HEATING OPTION	**400 kWh gas powered CHP plant** supplemented by existing gas		**2 No 350 kWH BIOMASS Boilers** powered by wood chip fuel & supplemented by existing gas boilers	
Estimated annual energy consumption *(cf current regime: Gas 4.76m kWh Electricity 3.23m kWh\)*	**Gas 7.81 million kWh Electricity 0.93 million kWh**		**Gas 2.56 million kWh Electricity 3.23 million kWh Wood Chip 2.20 million kWh**	
Estimated net present value energy cost saving against current regime over 20 years (annual energy cost inflation assumed at 4% for gas & electricity)	**Provides £1.384m saving**		**Costs additional £140,000**	
System Specific Capital Cost	**£700,000**		**£668,000**	
	PROS	**CONS**	**PROS**	**CONS**
Carbon Savings in comparison to existing regime	Uses gas, a fossil fuel. Provides annual CO2 emission saving of approximately 546 Te per year. The CO2 saving arises from local generation of electricity by the CHP plant rather than electricity supply from the national grid which is part supplied from 'dirty' fuels such as coal and which has significant transmission loses.		Uses renewable wood fuel not a fossil fuel. Biomass heating is considered to be carbon 'lean' and there will be a CO2 emission saving of approximately 460 Te per year	
Local employment & business impact		Generates no local jobs and gives no benefit to local businesses.	Use of wood chip fuel could create two new jobs in Kent as part of a local wood fuel supply contract with a value of around £70,000 per annum for a south east based supplier. This would add momentum to the wood fuel supply market in kent. These benefits are dependant upon a local company winning a competitively tendered wood fuel supply contract advertised in the European Journal.	
Other Environmental benefits			Additional areas of Kent woodland could be protected and maintained as a result of coppicing for wood fuel supply, with the associated benefit to biodiversity of the local environment.	
Whole life routine plant maintenance and equipment repairs	Full CHP servicing and equipment failure replacement can be carried out by the plant provider using remote performance monitoring and control of the plant alongside regular site maintenance visits. The cost of this has been included in the commercial appraisal	CHP whole life plant maintenance is considerably more expensive than Biomass.	Biomass boiler suppliers have been reluctant to give a whole life maintenance and repair cost for all the equipment required for this heating solution. One supplier has given an annual cost of £10,000. Therefore biomass boiler maintenance and the cost of equipment repairs is substantially cheaper than for CHP.	

	PROS	CONS	PROS	CONS
Operational maintenance	There are no operational costs associated with CHP.			Biomass boiler operational maintenance can be quite involved and expensive if fuel quality, storage and handling methods are not well controlled/designed. This could result in the need for a part time operative to order fuel, supervise unloading, clear fuel blockages and clear ash. However these problems and the associated labour cost can be minimised by good fuel quality control and plant design. The cost of operational maintenance has been reduced to £10,950 per annum on the assumption that this will be the case.
Operational flexibility	CHP has a turn down capacity of 60% making it more flexible particularly in mild mid-season periods. CHP can operate 365 days per year. The plant includes recuperation of heat from exhaust gases as well as generation of electricity. In summer excess heat could be used to provide chilling for air conditioning The ability of the CHP plant to generate electricity negates the need to maintain (and replace at end of life) the existing emergency diesel generator in the Civic centre. This would generate a future capital cost saving in the order of £40,000 and an annual maintenance cost saving of £1,000			Biomass boilers do not cope well with large and rapid changes in heat demand and so they have to operate on a static heat baseload which limits their size. The biomass boiler size could be increased (increasing the 20 year cost saving) if absorption chilling is incorporated into the overall design. The business case for this would be checked at detail design stage.
Equipment replacement		CHP plant life expectancy is 15 years, 5 years less than Biomass boilers. This has been taken into account in the commercial appraisal of the two options	Biomass boiler life is 20 years. The fuel transfer system may need replacement before the boilers. This has been taken into account in the commercial appraisal	
Fuel supply	Secure gas supply with automatic delivery		Use of wood fuel spreads fuel supply cost risk across three fuels; wood, gas and electricity. The Kent woodland provides a sustainable source of fuel for Biomass	
Fuel storage	No storage required for gas			Fuel storage must be watertight (through good design) to avoid excessive clinker in boilers
Fuel transfer	No transfer mechanism - piped supply			The fuel transfer mechanism is a complex mechanical system which can be susceptible to blockages if design is inadequate or if fuel quality is not carefully controlled.
Fuel quality	No expected quality issues with gas			Size of wood chips and moisture content are very important. High moisture content can lead to 'smoke' generation and a drop in boiler efficiency. Fuel quality can be controlled by fuel supply contract conditions and careful audit.
Fuel source and cost	ABC is less exposed to electricity price increases as CHP generates electricity from gas	There is a risk of cost escalation of gas supply (could be higher than woodchip) as gas is dependant on world supplies	Kent has sufficient coppiced woodland to provide a sustainable wood fuel source. Fuel cost increases can be linked to RPI or a similar index by entering into a long term supply contract. This would avoid risk of disproportionate cost escalation.	The chosen biomass solution does not generate electricity so ABC is exposed to cost escalation on electricity supplied from the national grid. There are biomass plants available that can generate electricity as well as providing heat but these types of plant are not recommended for a plant size of less than 2 megawatts.
Renewable Heat Incentive (RHI)		No benefit from RHI	Biomass qualifies for RHI payments from the government for a period of 20 years	The Governments RHI application process is complicated and so the first RHI payments could be delayed. This risk may be minimised by pre-application.
Gas supply availability		Relies on additional sustained gas supply being available into the building. Gas supplier has confirmed that this can be made available	An increased gas supply is not required	