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Incentives for CHP Development in the UK:
Analysis and evaluation of their relative importance

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ABSTRACT

This paper assesses the impact of the UK government's measures to promote CHP schemes, the most important of which is exemption from the Climate Change Levy (CCL), in support of its target for 2010 of 10,000 MWe of CHP generating capacity. This paper analyses the effectiveness of this exemption in terms of its impact on key investment parameters. The annual cost savings in gas and electricity due to the CCL exemption are calculated for different energy prices and the savings are compared with the up-front cost of installing a CHP unit. It is shown that CCL exemption can reduce quite significantly the simple pay back period for a CHP project and has higher impact on the IRR compared to an accelerated depreciation policy. Exemption from business rates has little impact on the scheme's profitability. The benefits of exemption from the (fixed) CCL are proportionately least important when energy prices are high, but this is when support is least likely to be required.

Keywords

Climate Change Levy (CCL), Combined Heat and Power (CHP), financial incentives

1. INTRODUCTION

Combined heat and power (CHP) plants simultaneously produce electricity and heat. While the efficiency of the electricity production is reduced compared to the conventional power generation the overall thermal efficiency of the plant is significantly increased. The UK government has a target for 2010 of 10,000 MWe of

CHP generating capacity. To help reach this target, it has provided incentives in the form of Enhanced Capital Allowances that can be offset against Corporation Tax on profits, reductions in the Business Rates paid to support local government, and exemption from the Climate Change Levy (CCL) introduced as an environmental tax on energy use in 2001. This paper analyses the effectiveness of the CCL exemption as an incentive for CHP schemes.

The majority of the CHP schemes in the UK, about 12,000 schemes, are below 1MW electricity output. Most plants in the UK are sized to meet the minimum heat load on their site. Only a few have a device called a thermal store or heat accumulator[1] which allows for short term heat storage and is a way of dealing with the mismatch between the electricity and heat demand. The store is charged when heat production is higher than heat consumption and discharged in the opposite case. The gas engine plants usually have only one engine which is running full load 50% to 60% of the total hours in a year. The extra heat load above the minimum is met usually by one or two boilers. Typically, these plants do not produce more electricity that they need on site while sometimes they may have to buy electricity to cover the demand.

The Government announced, in 2000, a target of achieving at least 10,000 MWe of Good Quality CHP capacity by 2010 and the development of a Strategy to achieve it. A draft Strategy was published for consultation in May 2002 and in February 2003 the Energy White Paper – *Our energy future – creating a low carbon economy* – reaffirmed the Government's commitment to the target[2].

Currently the UK legislation provides three main incentives for CHP; the climate change levy (CCL) exemption, the enhanced capital allowances (ECA) and business rates reductions. This paper analyses and evaluates the impact of these incentives on a typical CHP scheme. It shows their impact on the simple-payback period and internal rate of return for the scheme, calculated for different prices for gas and electricity. It also calculates the break-even combinations of gas and electricity prices required to earn a given internal rate of return, and investigates how these vary with the level of incentives.

2. BACKGROUND

The CCL[3] is a tax which came into effect on the 1st of April 2001, and applies to energy used in the non-domestic sector, that is, industry, commerce and the public administration sector. There are several exemptions from the levy in order to support energy efficiency schemes and renewable sources of energy.

CHP schemes are exempted from the CCL on their energy use if they are assessed as being ‘good quality’[4] CHP. There are two key parameters for assessing a CHP scheme; the power efficiency and the Quality Index (QI). A scheme that qualifies as Good Quality CHP for its entire annual energy input is one where the power efficiency equals or exceeds 20%. The power efficiency (n_{power}) is defined as the ratio of the total annual electricity output of the scheme to the total annual fuel energy input, based on the gross calorific value of input fuel.[5] A scheme that qualifies as Good Quality CHP for its entire annual power output is one where the QI equals or exceeds 100. The Quality Index of the plant is an indicator of the energy efficiency and the environmental performance of the scheme. It takes account of the fact that power supplied is more valuable than heat supplied.

The general form of the QI definition is:

$$QI=(X*n_{power}) + (Y*n_{heat})$$

where X and Y are coefficients that are related to alternative power supply and alternative heat supply options in correspondence and their values vary for different sizes and types of CHP schemes

n_{power} is the power efficiency of the scheme defined as mentioned above and,

n_{heat} is the heat efficiency of the scheme defined as the ratio of the total annual heat output of the scheme to the total annual fuel energy input

The other legislative incentives are the ECAs and the Business Rates. The ECAs[6] were introduced for the first time with the Capital Allowances Act 2001, Section 45A(1) to (4). Corporation tax is charged at a rate of 30% on profits, but a business can write off the costs of capital investment against its profits over four years, effectively getting a tax rebate equal to 7.5% of the cost of the asset in each year. Accelerated depreciation allows the business to claim this rebate earlier, thus increasing the discounted value of the saving. A business can claim 100% first-year allowances (FYAs) if it incurs qualifying expenditure on designated energy-saving plant and machinery. This means that it gets a 30% rebate in the first year after the investment, rather than getting 7.5% a year for four years. Qualifying expenditure is capital expenditure incurred on new energy-saving plant or machinery for business purposes. The qualifying technologies and products are specified in the Energy Technology List. The current list was published on 14 July 2005 and came into effect on 7 September 2006. The list contains details of the energy-saving criteria that must be met for each of the technology classes. It also contains lists of products that have been certified as meeting those standards. The qualifying technologies are specified in the Energy Technology Criteria List. The list is not fixed, it is periodically reviewed and technologies can be added or removed in the future. CHP qualifies as energy-saving plant and machinery if it is certified as "Good Quality CHP" under the quality assurance scheme for CHP (CHPQA), and has been granted a "certificate of energy efficiency". The ECA is only relevant to investment and therefore represents an incentive to invest in a new CHP scheme without really affecting existing CHP schemes.

Business rates are taxes that businesses have to pay to local authorities. Every non-domestic property has a rateable value, intended to represent the annual rent that would be paid for it in an open market transaction on a fixed valuation date. The amount payable is equal to this rateable value, multiplied by the Uniform Business Rate, equal to 43.3% in 2006/7. While equipment such as a CHP plant would normally increase the rateable value of a property, Good Quality CHP schemes are exempt from business rates and so the value of the scheme is not included in the rateable value of the property. Under the scheme of prescribed assessment (used until 2005), gas-fired power plant (without steam turbines) had a rateable value of £5,000 per MW of capacity, implying that exemption from rates would be worth £2,165 per MW in 2006/7.

3. METHODOLOGY

A typical UK CHP scheme is modelled in an Excel spreadsheet. The monthly variation in heat demand is based on that of the Kings Buildings CHP scheme at the University of Edinburgh. This scheme is sized to meet the minimum monthly heat demand and the electricity produced is all used to just cover the electricity demand of the scheme. It is assumed that the engine is running 60% of the time equally distributed amongst all months apart from February and September, when we assume that the engine is not available 4 days in each of these two months, in order to account for maintenance or grid failure. The system is sized to meet the minimum heat load. In detail, it is sized to meet the total heat demand of the month with the minimum total heat load, August in this case. It is assumed that all the electricity produced is consumed on site.

As indicative values of efficiency[7,8] for the gas engine, 38% electrical efficiency and 40% heat efficiency have been assumed, when the energy input is measured in gross calorific value (GCV).

In UK boiler plants typically run standard boilers[9] and the existing systems are not designed for the low temperatures required for the condensing boilers.[10,11] For this reason, in the general case that is examined in this work, a plant with standard boilers has been considered. However, it should be mentioned that recent regulations are pushing for higher efficiency in boilers[12]. A typical efficiency of 82% in gross calorific value has been assumed here for a standard natural gas UK boiler[13,14].

The total gas consumed and the electricity bought are calculated for each month and for the whole year, separately identifying the gas consumed by the boilers and by the CHP unit (if installed). The spreadsheet also calculates the power efficiency and the quality index of the plant.

These calculations are performed for four case-scenarios of plant configuration and CCL exemption:

Case1 (No CHP): The plant runs only boilers. The plant pays CCL for the gas consumed and the electricity bought.

Case 2 (No CCL exemption): The plant runs boilers and CHP. No CCL exemption is assumed, and so the plant pays the CCL on its gas and electricity purchases. However, in this case the electricity in-house demand is covered by the production of the CHP unit.

Case 3 (Partial CCL exemption): The plant runs boilers and CHP. It is assumed that the plant has to pay the CCL for the gas used in boilers, but the gas used in CHP and the electricity bought for in-house use are exempted from the levy.

Case 4 (Full CCL exemption): The plant runs boilers and CHP. The plant assuming it is a good quality CHP is exempted from the levy on all the gas consumed and the electricity bought.

For each of the three scenarios with CHP, we calculate the annual cost saving in gas and electricity, taking account of the cost of operating and maintaining the CHP unit, compared to using heat-only boilers and buying all the site’s electricity from the grid. First, we calculate this extra cost assuming that there is no CCL exemption for the plant (A). We also calculate it (B) assuming that the CHP scheme has to pay CCL only for the gas used in boilers and (C) assuming that all the gas consumed at the site is exempted from CCL and the electricity brought is also exempted (full CCL exemption) .

Therefore:

A=cost if case 1-cost if case 2; No CCL exemption extra cost (1)

B=cost of case 1-cost of case 3; Partial CCL exemption extra cost (2)

C=cost if case 1-cost if case 4; Full CCL exemption extra cost (3)

The costs A, B and C have been calculated using three different sets of gas and electricity prices[15] - Low, Medium and High. Firstly, gas and electricity prices of 2003 were used (the Low case). Secondly, the higher prices of the second Quarter of 2005 have been used in the calculations (Medium case). Finally, the increase in the prices between the above two years has been calculated and the third set of prices is selected to have the same increase over the Q2 2005 prices (High case). The results are shown in table 1, table 2 and table 3.

These annual cost savings must be compared with the up-front cost of installing the CHP unit. We use a figure of £500,000, which is typical for a 1MWe CHP plant, as our central value for this. The comparison is performed in two ways that might figure in a company's investment appraisal. First, we calculate the simple pay-back period for investing in a CHP plant, rather than simply using boilers and buying power from the grid. The pay-back period is equal to the additional capital cost of the CHP unit, divided by the annual saving in fuel costs (taking account of CHP operating costs). This is a very simple measure, but one widely used within industry when making investment decisions. The results are presented in Table 4.

Second, we calculate the Internal Rate of Return for the investment. This is the cost of capital at which the project would just break even if it had to borrow the money when the CHP unit was installed, and pay it back, with interest, from the savings in fuel costs. Using the IRR allows us to consider the timing of expenditure and cost savings. In particular, it allows us to include the value of the Enhanced Capital Allowances received for investment in CHP plant, which allow the company to reduce its Corporation Tax bill in the year that an investment is made, rather than having to wait four years until the full benefit is received. We calculate the IRR for two project lengths – three years and five years – in line with the short timescales often used to assess investments in energy efficiency. We calculate it with and without the benefit of the ECAs, to show the impact of this second incentive for investment in CHP plant. For sensitivity analysis, we have considered the three sets of fuel prices described above, and capital costs that are 20% above and 20% below our central figure. These results are presented in Table 5 and Table 6

4. RESULTS-DISCUSSION

The electrical efficiency of the scheme was found to be 21% and therefore just meets the requirement for CCL exemption. Furthermore, the quality index of the scheme is 122, which is again exactly within the limit required for the plant to be categorized as a 'good quality CHP plant'. Therefore, it is found that a typical UK CHP plant, being sized to meet the minimum heat load, just meets the two minimum requirements of the British legislation for being exempted from the CCL. The production of the gas engine seems to only serve this purpose. The absence of a thermal store does not allow for a bigger engine or more intensive CHP production than just meeting the minimum heat demand. A thermal store would allow the CHP plant to store heat when it is not needed, and it would allow the CHP plant to go offline when electricity import prices are low because heat load can still be met from the store. Clearly, the absence of heat storage influences the size and the operating hours of the engine; if the engine was larger then by running the CHP all the time the plant would have either to dump heat, which is undesirable, or to stop the engine. What happens in practice in cases of excess heat production is that the plant stops the engine in case more heat is produced than the heat demand.

The changes in annual costs are shown in Table 1, Table 2 and Table 3 for the cases of Low, Medium and High fuel prices. The left-hand column shows the amount spent on buying gas and electricity for the site. Moving from heat-only boilers to a CHP scheme reduces the amount of energy required by 27%, weighting gas and electricity at their respective market prices. The additional benefits of CCL exemption reduce the cost by another £37,000 (bottom line), or £21,000 with only the partial exemption (third line). This exemption is proportionately less valuable when fuel prices are high, in Table 3, than when they are low (Table 1).

We also need to consider the costs of operating and maintaining the CHP plant. These are assumed invariant to fuel prices, and therefore have a bigger proportional impact on the plant's overall saving when fuel prices are low. With low (2003) fuel prices, the overall saving on the annual costs of the boiler-only plant is 18% with no CCL exemption, or 27% with the full exemption (Table 1). With high fuel prices (Table 3), the saving ranges from 22% (no exemption) to 27% (full exemption).

	Energy input cost (£)	Benefit of CHP before other costs (£)	Benefit of CHP before other costs (%)	Engine O&M costs (£)	Energy input plus O&M costs (£)	Net benefit of CHP (before capital cost) (£)	Net benefit of CHP (before capital cost) (%)
1.Cost when just boiler	403,003				403,003		
2.Cost of CHP with no CCL exemption	294,484	108,519	26.93%	35,279	329,763	73,240	18.17%
3.Cost of CHP with partial CCL exemption	273,349	129,653	32.17%	35,279	308,628	94,374	23.42%
4.Cost of CHP with full CCL exemption	257,465	145,537	36.11%	35,279	292,744	110,258	27.36%

Table 1 CCL benefit on CHP, 2003 gas and electricity prices (Low Case)

	Energy input cost (£)	Benefit of CHP before other costs (£)	Benefit of CHP before other costs (%)	Engine O&M costs (£)	Energy input plus O&M costs (£)	Net benefit of CHP (before capital cost) (£)	Net benefit of CHP (before capital cost) (%)
1.Cost when just boiler	517,645				517,645		
2.Cost of CHP with no CCL exemption	378,234	139,411	26.93%	35,279	413,513	104,132	20.12%
3.Cost of CHP with partial CCL exemption	357,100	160,545	31.01%	35,279	392,379	125,266	24.20%
4.Cost of CHP with full CCL exemption	341,216	176,429	34.08%	35,279	376,495	141,150	27.27%

Table 2 CCL benefit on CHP, 2005 gas and electricity prices; 0.33 increase in the gas cost and 0.32 increase in the electricity cost over 2003 prices (Medium Case)

	Energy input cost (£)	Benefit of CHP before other costs (£)	Benefit of CHP before other costs (%)	Engine O&M costs (£)	Energy input plus O&M costs (£)	Net benefit of CHP (before capital cost) (£)	Net benefit of CHP (before capital cost) (%)
1.Cost when just boiler	669,408				669,408		
2.Cost of CHP with no CCL exemption	489,228	180,179	26.92%	35,279	524,507	144,901	21.65%
3.Cost of CHP with partial CCL exemption	468,094	201,314	30.07%	35,279	503,373	166,035	24.80%
4.Cost of CHP with full CCL exemption	452,210	217,198	32.45%	35,279	487,489	181,919	27.18%

Table 3 CCL benefit on CHP, High gas and electricity prices; 0.33 increase in the gas cost and 0.32 increase in the electricity cost over 2005 prices (High case)

These annual savings must be compared with the initial cost of the CHP equipment. We do this in Table 4, which shows the simple pay-back periods for different CCL exemption policies, fuel prices, and engine costs. For many companies, energy efficiency projects will only be adopted if they have a pay-back period of two years or less.[16] Even with high fuel prices, the full CCL exemption and a low equipment cost, the CHP project fails to meet this demanding target. However, the table clearly shows that the CCL exemption can reduce the payback period quite significantly, and the reduction is greatest in the cases with long payback periods.

Taking a higher threshold of five years, we see that the exemption makes a difference if CHP is expensive for medium energy prices (2005) but does not help if CHP is expensive for the low (2003) prices while for high prices it worth any way to do the project. Secondly, we assume that this threshold is 4 years. In this case, it makes a difference if CHP is expensive for high energy prices and if CHP has its actual cost for medium energy prices, while for low prices (2003) it makes a difference only if CHP is cheap and full CCL exemption applies.

		actual engine cost	20% decrease	20% increase
Engine cost(£):		500000	400000	600000
Pay back period in years=cost of the engine (£)/net benefit(£)				
for 2003 prices:	CHP with no CCL exemption	6.8	5.5	8.2
	CHP with partial CCL exemption	5.3	4.2	6.4
	CHP with full CCL exemption	4.5	3.6	5.4
for 2005 prices:	CHP with no CCL exemption	4.8	3.8	5.8
	CHP with partial CCL exemption	4.0	3.2	4.8
	CHP with full CCL exemption	3.5	2.8	4.3
for high prices:	CHP with no CCL exemption	3.5	2.8	4.1
	CHP with partial CCL exemption	3.0	2.4	3.6
	CHP with full CCL exemption	2.7	2.2	3.3

Table 4 Pay back period for different engine prices and gas and electricity prices- effect of the CCL exemption

Our final set of results are presented in Table 5 and Table 6. These tables show the sensitivity of the internal rate of return for a CHP project to energy prices, the capital costs of CHP, whether there is a CCL exemption, and whether Enhanced Capital Allowances are given.

Table 5 presents the upper limit of the internal rate of return (or cost of capital) of a five year project to break even. That is, if the firm's cost of capital is less than the percentages presented in Table 5, then the project will save more than enough money to pay back the money invested in it, with interest, within five years. Over the last ten years, UK companies have had an average return on capital of between 11% and 14%.[17] The 2005 Energy Review[18] used a figure of 10% when calculating the cost of various technologies for electricity generation. In practice, however, firms typically seek rather higher internal rates of return before a project is considered to be viable.

If we use a figure of 15% and a five-year project life, then high energy prices would make the project viable, regardless of government policy or the initial cost of the plant. In the case of medium energy prices, either of the two policies (accelerated depreciation or CCL exemption) is sufficient to make the project viable for the actual CHP investment cost, while the CCL exemption, but not accelerated depreciation, would make the project viable if CHP is expensive to install. In the case of low energy prices, the project is never viable if CHP is expensive, while for cheap CHP and for the actual CHP cost, the project is viable if the CCL exemption, only, applies; the accelerated depreciation is inadequate on its own to make the project viable in this case. Clearly the impact of CCL exemption on the internal rate of return is higher than that of the accelerated depreciation. For 2005 energy prices and actual engine cost, the accelerated depreciation increases the internal rate of return from 14% to 18%, while the CCL exemption rises from 14% to 25%. This difference in the increase resulting from the two policies is more pronounced for low electricity prices and low engine costs.

Decrease/increase in engine cost		actual cost	20% decrease	20% increase
Engine cost(£)		500000	400000	600000
Internal rate of return of a 5-year project				
for 2003 prices:	CHP with no CCL exemption and no accelerated depreciation	5%	14%	-2%
	CHP with no CCL exemption but accel depreciation	6%	13%	1%
	CHP with full exemption and no accel depreciation	16%	27%	8%
	CHP with full exemption and accelerated depreciation	20%	29%	13%
Decrease/increase in engine cost		actual cost	20% decrease	20% increase
Engine cost(£)		500000	400000	600000
Internal rate of return of a 5-year project				
for 2005prices:	CHP with no CCL exemption and no accelerated depreciation	14%	25%	7%
	CHP with no CCL exemption but accel depreciation	18%	26%	11%
	CHP with full exemption and no accel depreciation	25%	37%	16%
	CHP with full exemption and accelerated depreciation	30%	40%	22%
Decrease/increase in engine cost		actual cost	20% decrease	20% increase
Engine cost(£)		500000	400000	600000
Internal rate of return of a 5-year project				
for high prices:	CHP with no CCL exemption and no accelerated depreciation	26%	38%	17%
	CHP with no CCL exemption but accel depreciation	31%	42%	23%
	CHP with full exemption and no accel depreciation	35%	49%	26%
	CHP with full exemption and accelerated depreciation	42%	54%	33%

Table 5 Internal rate of return for a 5 year project

Decrease/increase in engine cost		actual cost	20% decrease	20% increase
Engine cost(£)		500000	400000	600000
Internal rate of return of a 3-year project				
for 2003 prices:	CHP with no CCL exemption and no accelerated dep	-14%	-4%	-21%
	CHP with no CCL exemption but accel dep	-11%	-3%	-16%
	CHP with full exemption and no accel dep	-2%	10%	0%
	CHP with full exemption and accelerated depreciation	4%	13%	-3%
for 2005prices:	CHP with no CCL exemption and no accelerated dep	-4%	8%	-12%
	CHP with no CCL exemption but accel dep	2%	11%	-5%
	CHP with full exemption and no accel dep	7%	21%	-2%
	CHP with full exemption and accelerated depreciation	15%	26%	6%
for high prices:	CHP with no CCL exemption and no accelerated dep	8%	22%	-1%
	CHP with no CCL exemption but accel dep	16%	27%	8%
	CHP with full exemption and no accel dep	19%	34%	8%
	CHP with full exemption and accelerated depreciation	27%	41%	18%

Table 6 Internal rate of return for a 3 year project

For shorter project lives the internal rate of return to break even decreases significantly. Table 6 presents the upper limit of the cost of capital for a three year project to break even. With the low 2003 electricity prices, the project is unable to reach the 15% threshold IRR for any policy combination or initial cost we study. For medium energy prices (2005) CHP is viable with a low initial cost only if it gains an exemption from the CCL, whereas the actual engine cost implies that both CCL exemption and accelerated depreciation are required to make the project (just) viable. For high energy prices and initial cost, CHP is viable only if both policies apply, while for the actual initial cost CHP will be viable if either policy is applied. With the cheap initial cost and high energy prices, CHP would be viable without either policy. Just as with a five year project period, it is clear that the CCL exemption has more impact on the IRR than accelerated depreciation.

5. BREAK-EVEN ENERGY PRICES

The attractiveness of a CHP plant is heavily dependent on the relative prices of gas and electricity. The higher the price of electricity, relative to that of gas, the more likely it is that a given CHP scheme will be profitable. We have therefore calculated the break-even combinations of gas and electricity prices for our CHP plant, with six policy cases. The plant will be profitable, given a policy choice, if the combination of gas and electricity prices considered is above the line for that policy, and unprofitable if the prices are below the break-even line.

Our base case is shown in figure 1 – we assume an engine cost of £500,000, a five-year project life, and a required internal rate of return of 15%. The first policy, and the one producing the highest break-even electricity price, is that CHP schemes receive no support. The second policy, supporting CHP only via the exemption from business rates, produces only a marginal reduction in the break-even price. For plausible gas prices, the annual expenditure on the CHP scheme is of the order of several hundred thousand pounds, and so a rate rebate worth £2,000 has almost no impact. Enhanced capital allowances produce a slightly greater impact on the break-even electricity price, but it is still small. Our fourth policy case gives the CHP partial exemption from the CCL – this is the case 3 of section 3. This has roughly twice as much impact as the enhanced capital allowances. The impact of full CCL exemption, our fifth policy, is roughly twice as great, in this example. Each of the lines so far considers a single support policy in isolation, but the final, lowest, line shows the impact of all three current policies together.

The figure also shows the electricity and gas prices paid by the "other" sector (dominated by commercial users) from the Digest of UK Energy Statistics, table 1.6, for three recent years. In our base case, requiring a 15% IRR over five years, our CHP plant would have been marginally profitable, even without support, given the prices ruling in 2001 and 2005, but would have been unprofitable in 2003, had it not received the CCL exemption.

We present some sensitivity analyses in figures 2-5. These show, respectively, the impact of requiring only a 10% IRR, a ten-year project life, and lower (£400,000) and higher (£600,000) engine costs. The break-even lines are shifted downwards, as expected, in all but the last of these cases. The pattern of the lines does not change, however – the CCL exemption is still by far the most effective policy of the three in promoting CHP.

We note that the lines are approximately parallel in all five figures. This is because the value of the incentives is not linked to the price of gas or electricity, since the CCL is a fixed tax. This would imply that the proportionate value of the incentives are much greater when the prices of gas and electricity are low. If the gas price rises by £1/MWh, the break-even electricity price rises by £1.34. In the electricity market, however, gas is converted in power at a thermal efficiency of around 55%, or less in the older plants. This implies that a £1/MWh rise in the price of gas would lead to an increase in the price of electricity of nearly £2/MWh. In other words, as the price of gas rises, the market price of electricity is likely to rise much faster than the break-even price of power calculated for our CHP scheme. The CHP scheme is more likely to be profitable when gas prices are high. It is therefore appropriate that the government incentives have their greatest proportional impact when gas prices are low – there is little point in providing more generous subsidies at times when CHP schemes are likely to be in profit at the market prices.

6. CONCLUSIONS

The UK government promotes CHP via three main incentives – exemption from business rates, enhanced capital allowances, and exemption from the Climate Change Levy. A typical UK CHP scheme is modelled in an Excel spreadsheet for the analysis and evaluation of these incentives. It was found that CHP plants sized to meet the minimum heat load, since there is no heat storage facility in most of them, just meet the requirements for 'good quality' CHP and therefore exemption from the CCL. The extra cost to run a plant with only boilers in case of partial and full CCL exemption was calculated for different energy prices. We showed how the CCL exemption raised the annual cost savings from running the CHP plant, and how this becomes less pronounced as energy prices increase, since the CCL remains constant. The annual cost savings were compared with the up-front cost of installing the CHP unit. Firstly, the sensitivity of the beneficial effect of the CCL exemption on the capital cost of CHP has been studied using as a criterion the pay back time and it has been shown that the CCL exemption can reduce the payback period quite significantly. However, the beneficial effect is less pronounced for high energy prices and low engine costs. Secondly, a study was conducted to compare the impact of CCL with the impact of the accelerated depreciation on a CHP project. This was done by calculation of the IRR for different energy prices, capital costs, and for five and three year project lifetimes. We showed that the CCL exemption has a much greater impact on the IRR than the accelerated depreciation. Again, high energy prices and low engine costs reduce the benefit of the CCL exemption, in exactly those circumstances when it is less likely to be required. Finally, we calculated the break-even gas and electricity prices for our scheme, and showed how these varied with the policy instruments chosen. The impact of exemption from business rates was minimal, but the exemption from the CCL will have been sufficient to make some otherwise unprofitable schemes profitable at times of low energy prices.

While we are not arguing for the other policies promoting the adoption of CHP to be dropped, this work shows that their impact is likely to be much lower than that of the CCL exemption. If each policy to promote CHP implies an administrative burden on government and, if it has to be claimed explicitly, on CHP operators, we recommend that these burdens could be minimised by channelling a chosen level of support through the minimum number of significant measures.

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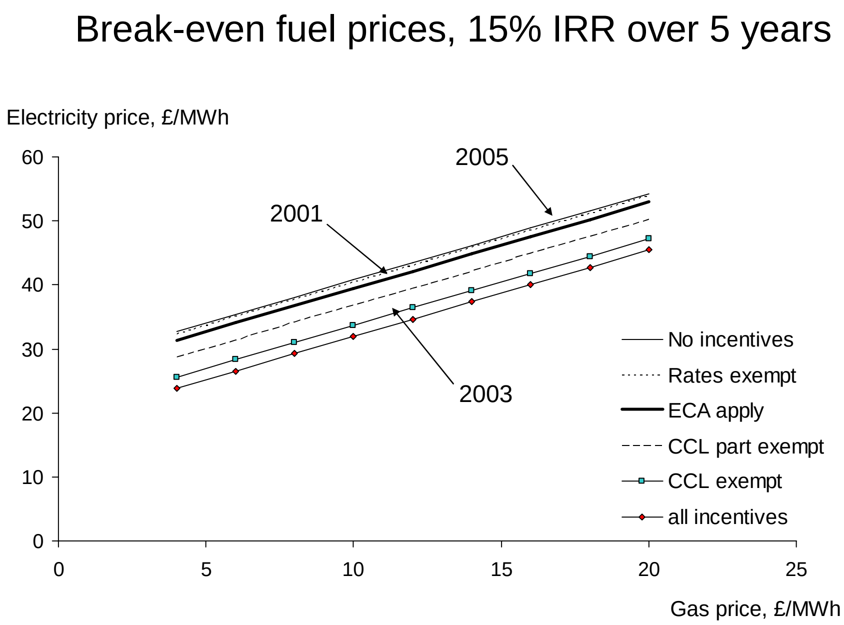

Figure 1

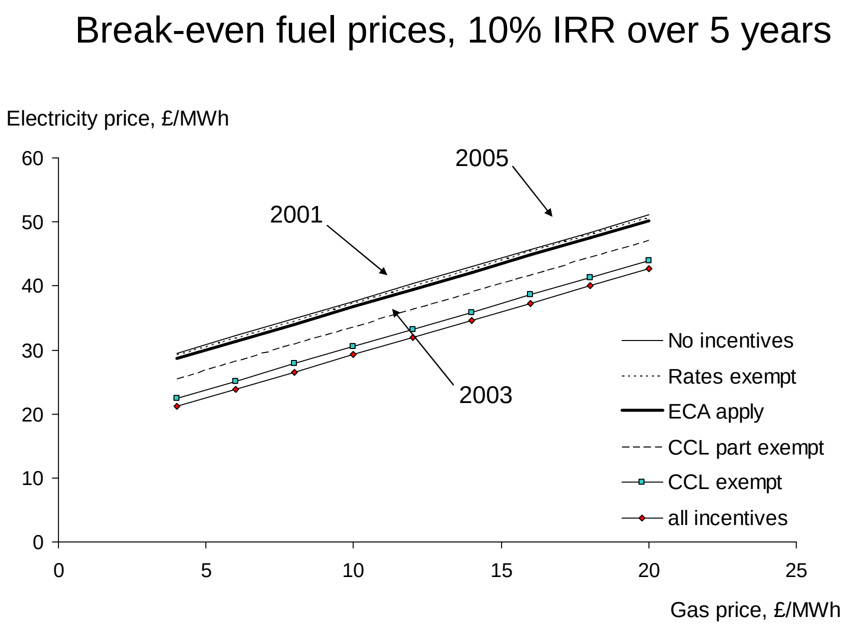

Figure 2

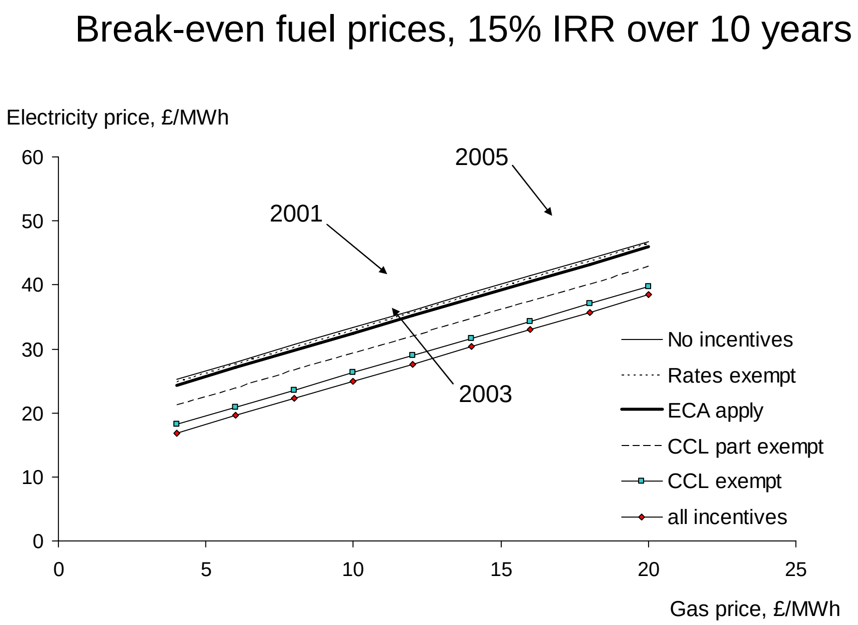

Figure 3

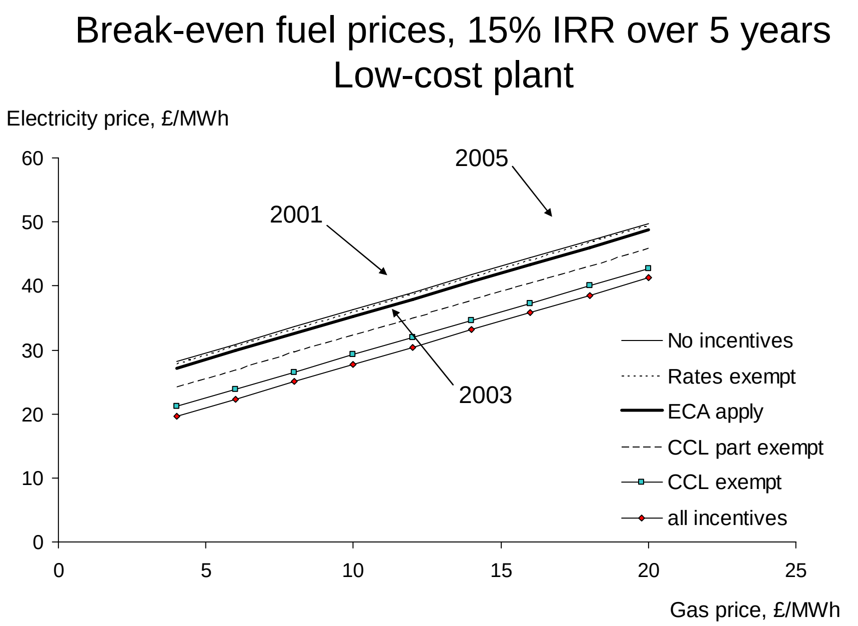

Figure 4

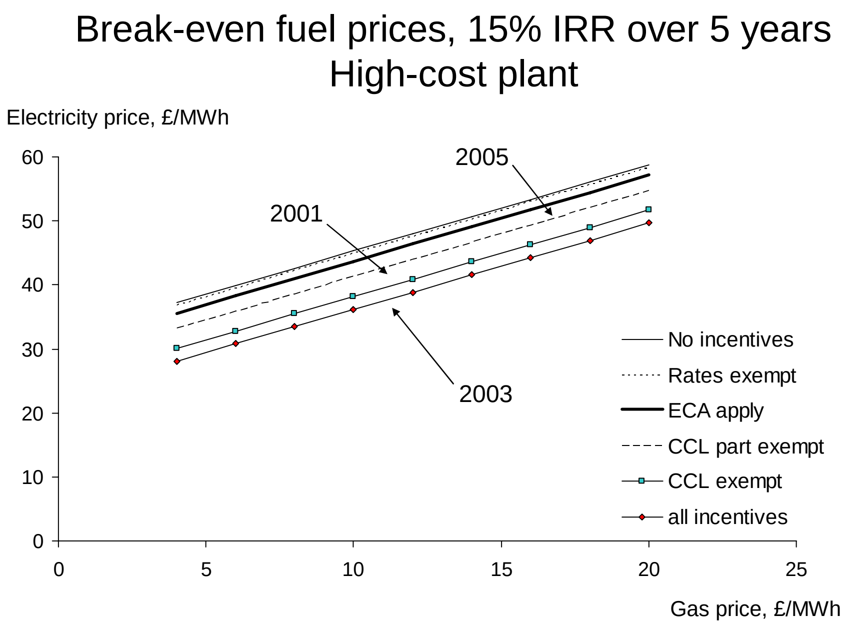

Figure 5

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