THE REVISION OF THE UK PIPE INSULATION STANDARD: - ITS LIKELY EFFECT ON BUILDING ENERGY EFFICIENCY AND THE UPTAKE OF HIGHLY EFFICIENT INSULATION MATERIALS

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Abstract: The UK Government has set an ambitious target of a 20% reduction in CO_2 emissions by 2010 based on a 1990 baseline. Since buildings account for over 40% of current CO_2 emissions, the revision of building and building services insulation standards has been a high priority. The previous UK pipe insulation standard (BS 5422 - 1990) was based on an economic thickness methodology that resulted in thickness requirements for different materials of unequal energy saving value.

The 2001 revision (BS 5422 - 2001) not only addresses this imbalance by defining environmental thicknesses that deliver equivalent energy savings but also increases the potential to reduce CO_2 emissions by up to 5 million tonnes per annum. To stimulate this potential, the UK Government has introduced a tax incentive under the existing Capital Allowances scheme to promote the widespread adoption of the new standard in both new build and, more importantly, in renovation projects.

Just as importantly, the new standard highlights the true cost-effectiveness of highly efficient insulation materials such as phenolic foam. Phenolic foam had already gained more than a 15% market share in the UK pipe insulation market prior to the recent changes to the standard on the basis of its excellent thermal resistance and fire properties. However, previous economic thickness models had promoted the use of less efficient materials with a poorer level of energy saving being the result. With this loophole now closed, the phenolic foam industry believes that its product will receive the acclamation that it deserves – while helping the UK Government to meet its own CO_2 targets.

Introduction

BS 5422 entitled: ***'Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range –40 °C to + 700 °C'*** has been the standard for determining pipe insulation thicknesses in the UK since its introduction in 1990. During the development of the initial standard, the decision was taken to base the calculations on a method known as the determination of economic thickness. This reflected the fact that any decision to insulate was based at that time on a financial balance between investment cost and the value of energy savings accruing. Clearly, the unit cost of the insulation itself became, under these circumstances, a significant factor in determining the amount of insulation that could be applied to a pipe and hence, the amount of energy saveable during the lifetime of operation. This led naturally to a situation where the energy saved using the standard would vary depending on the insulation chosen. Perhaps, more importantly, the unit cost of various insulation materials was determined in a rather arbitrary fashion and, looking back on the values adopted, some would argue that various product groups might not have been consulted to the extent they should have been! Inevitably, the process led to biases that had significant influence on the uptake of individual product types.

Despite its shortcomings, BS 5422 (1990) was a significant step forward in insulation levels, since it required investments that would only be recouped after approximately five years on average – considerably longer than most investment returns in the construction sector. This pay-back period extended even further as the real price of fuels continued to drop during the 1990s. Figure 1[1] shows the trend from 1980 onwards in this respect. Accordingly, we can conclude that the original standard was significantly ahead of its time in terms of

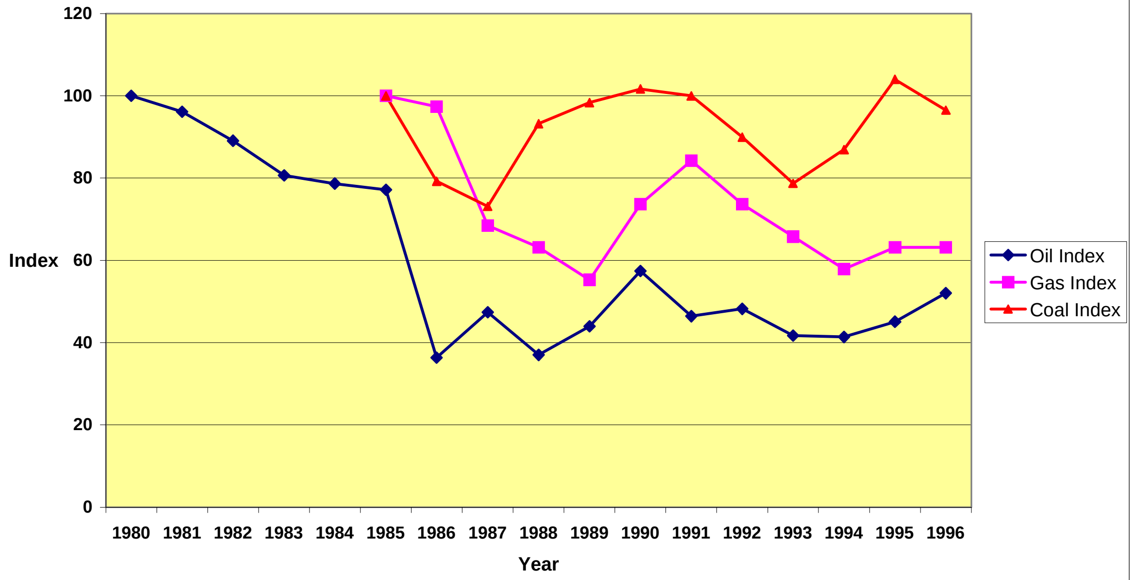


Figure 1 : Price Decline in Fuel Sources 1980 - 1996
(Source: BP Statistical Review of World Energy (1997))

the insulation levels promoted. However, with the emergence of concerns over the impact of energy consumption on carbon dioxide (CO_2) emissions from the carbon-based fuels consumed, it became increasingly evident that action would be necessary to take this aspect into consideration. This paper is the account of that action.

Assessing the significance of pipe insulation

In order to establish the relative impact of increasing the thickness requirements determined in BS 5422 (1990) still further, it became necessary to establish two things:

(i) The amount of energy (and hence CO_2) already being saved by BS 5422 (1990)

and

(ii) The incremental benefit to be gained from any proposed revision of the standard

In an act of some foresight, the Thermal Insulation Manufacturers and Suppliers Association (TIMSA) decided to commission Caleb Management Services in 1998 to determine precisely these two factors. TIMSA is a trade association representing all product types in the building services and process sector. As such, it was uniquely placed to carry out this work without inflaming some of the inter-product animosities that had emerged as a result of the BS 5422 (1990) process.

In the work that followed, Caleb developed a series of spreadsheets to model the energy savings of installed insulation. This was no easy task since data on the market by product type, application and pipe diameter was scarce. What was available was an assessment of the UK market by product type[2]. However, the analysis dated back to 1992. The information is shown in Table 1.

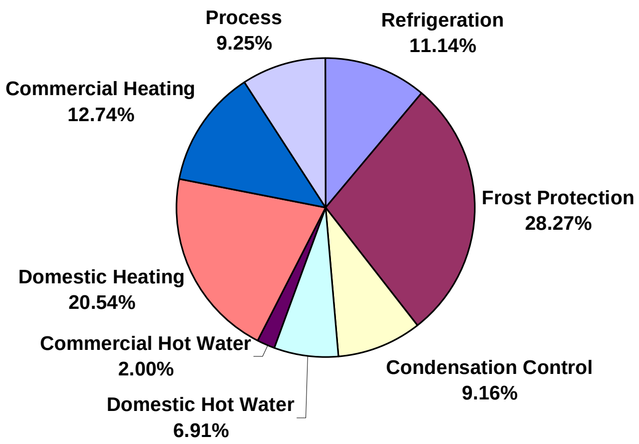
Insulation Type	*UK Market*	
	Volume (%)	*Value (%)*
Expanded Nitrile Rubber	21.8	23.0
Polyethylene Foam	48.4	19.0
Glass Mineral Wool	9.1	11.7
Rock Mineral Wool	9.7	21.1
Phenolic Foam	4.4	9.5
Others	6.7	15.8

Table 1 – UK Market for Pipe Insulation by Product Type

The complication for the project was that there was no linkage between the product type and the application area. The authors therefore decided to call together an ‘expert group’ of the most knowledgeable individuals in the industry to construct an assessment of each application sector covered by BS 5422 (1990). This group reviewed each application area by pipe diameter and made an assessment of the split between each of the products used at that level. The work was significant and pain-staking. However, using the assumption that all pipe insulation installed in these sectors in 1992 was to BS 5422 (1990) standards, it was possible to derive a split of the various application areas in terms of running metres of pipe insulation consumed. This is shown in Figure 2.

It is interesting, although perhaps not totally surprising, to note that the more significant markets in terms of linear metres of pipe covered were found in the residential sector – mostly in connection with frost protection and condensation control. Insulation sold for process pipe work was comparatively low although, as we shall see, this is no reflection on its energy saving qualities.

Figure 2: Split of pipe insulation sales in 1992 by application
(83.4 million running metres)



In order to convert the data provided in Figure 2 into something more meaningful in terms of energy consumption and, ultimately, energy savings, it was necessary to adopt a series of assumptions relating to the various applications identified. These assumptions would necessarily need to cover such issues as utilisation rates, efficiency of fuel use and the percentage of pipe work remaining uninsulated. This latter dataset was particularly difficult to determine because the market data for metallic pipe sales makes no direct reference to application sector served. The project therefore needed to be reliant on its expert group for an anecdotal assessment of the quantities of pipe work left uninsulated in each application area.

Finally, in order to develop a picture of the CO_2 implications of the energy consumption of each application, it was necessary to make assumptions about the fuel mix involved. Again, the expert group assisted in this respect. Table 2, below, summarises the overall assumptions made:

Table 2 - Assumptions made by Application Sector

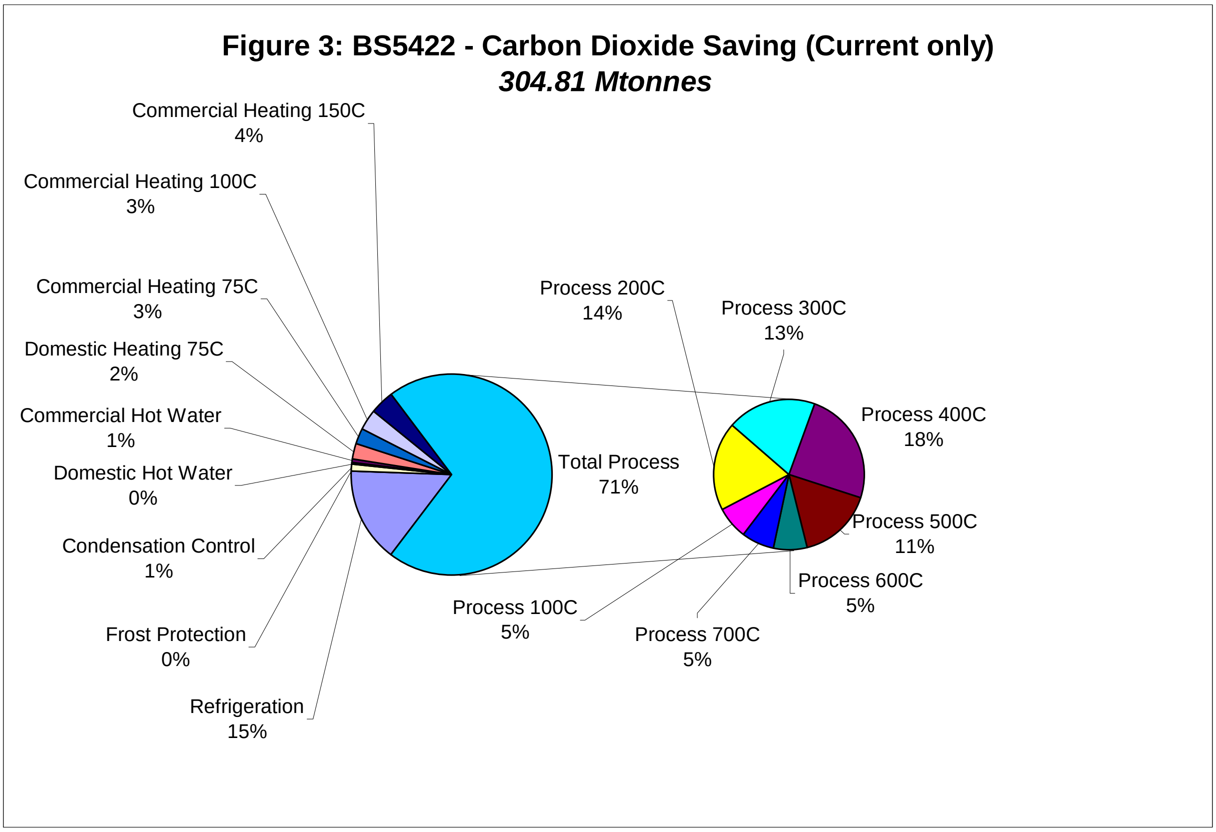
Application Sector	Utilisation (hrs/year)	Efficiency of Fuel Use (%)	Fuel Split (%)				Percentage Personnel Protection	Percentage Uninsulated
			Gas	Oil	Coal	Elec.		
Refrigeration	8760	50*	0	0	0	100	0	0
Frost Protection	8760	75	25	25	25	25	0	50
Condensation Control	8760	50	0	0	0	100	0	15
Domestic Hot Water	500	75	40	20	15	25	0	65
Commercial Hot Water	4380	75	50	30	20	0	0	25
Domestic Heating	3500	75	40	20	15	25	0	50
Commercial Heating – 75^0C	3500	75	50	30	20	0	0	20
Commercial Heating – 100^0C	3500	75	50	30	20	0	20	5
Commercial Heating – 150^0C	3500	75	50	30	20	0	30	0
Process – 100^0C	8760	75	50	30	20	0	50	0
Process – 200^0C	8760	75	50	30	20	0	50	0
Process – 300^0C	8760	75	50	30	20	0	50	0
Process – 400^0C	8760	75	50	30	20	0	50	0
Process – 500^0C	8760	75	50	30	20	0	50	0
Process – 600^0C	8760	75	50	30	20	0	50	0
Process – 700^0C	8760	75	50	30	20	0	50	0

* Offset by Coefficient of Performance assumption of ‘2’

Using these assumptions, it was possible to put together an overall assessment of energy saved, and hence CO_2 saved, by the insulation installed during 1992. However, it is self-evident that this does not reflect the energy savings of all of the installed insulation at any given time.

The expert group estimated that the replacement of insulation on an installation takes place, on average, every fifteen years (shorter period for process applications and longer for building services). This implies that the installed stock of insulated pipe work would be fifteen times that of the 1992 figure. However, this takes no account of market growth factors.

It was at this point that the authors realised the fortuitousness of having data for 1992. At that time (1999), the 1992 data represented the mid-point of the last fifteen years of installation. Assuming a linear growth rate for the period from 1984 to 1999, the approximation of 15 times the 1992 market sales for installed stock was viewed as reasonable. Figure 3 shows the consequences of methodology:



It is self-evident from this graphic that the savings made in the process sector are a dominant feature. To summarise the significance, less than 10% of the linear metres sold in the pipe insulation sector account for over 70% of the savings. This should come as little surprise to us when we consider the substantial temperature differentials that exist in the high temperature process sector. Nonetheless, there are significant savings occurring in other areas such as commercial hot water and domestic and commercial heating. Interestingly, domestic hot water doesn't contribute significantly – mostly because of the low utilisation rates pertaining.

Of most significance of all is the fact that over 300M tonnes of CO_2 emissions are being saved annually. To understand the significance of this figure, it needs to be compared with the overall reported emissions for the UK in 1990, which were 616 M tonnes[3]. This means that if all the pipe insulation installed in the UK were to be stripped off, it would increase the annual emissions of the country by nearly 50%!!

Having established that the pipe insulation sector is of significance, the authors went on to consider the prospects for improving the performance in the pipe insulation sector.

What more could be done?

Earlier in this analysis, we noted that assessments of uninsulated pipe were difficult because of the lack of data on pipe sales by application. In Table 2 it was assumed that there were no stretches of process pipe work left were uninsulated. There was good reason for this assumption. In the UK, there is a legal requirement to insulate hot pipe work to protect personnel against the risk of burns. The outside temperature requirement for the insulation is usually a maximum in the 50-55C range depending on the outside cladding material used.

It should be noted, however, that the performance requirement for personnel protection is typically considerably lower than that decreed for reducing heat loss under BS 5422. Accordingly, there is an opportunity for upgrading the insulation installed for personnel protection purposes to gain the additional benefit arising from energy saving. Again, with the help of the expert group, the project was able to conclude that just 6 M tonnes of CO_2 could be saved from this sector.

Adding this to the potential for insulating uninsulated pipe in other sectors (see Table 2), Caleb was able to deduce the additional potential outlined in Figure 4 without having to consider an upgrade in BS 5422 (1990). Figure 5 illustrates the breakdown on uninsulated pipe work savings arising from Table 2.

Figure 4: BS5422 - Annual CO_2 Saving and Potential Increases
(existing BS5422 only) (M tons CO2)

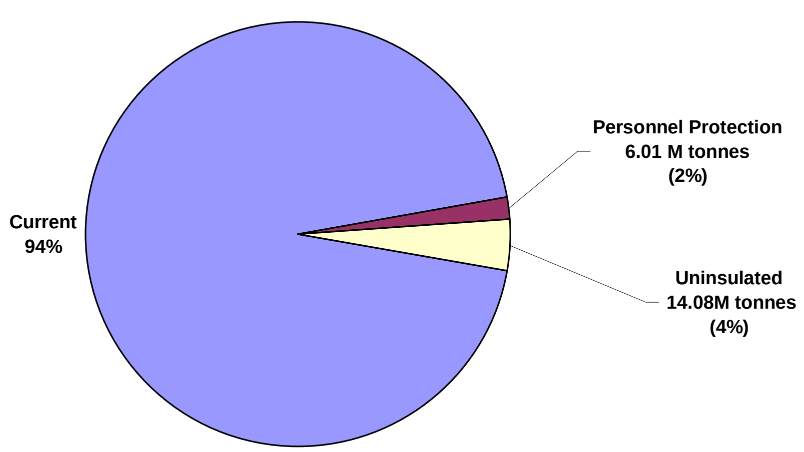
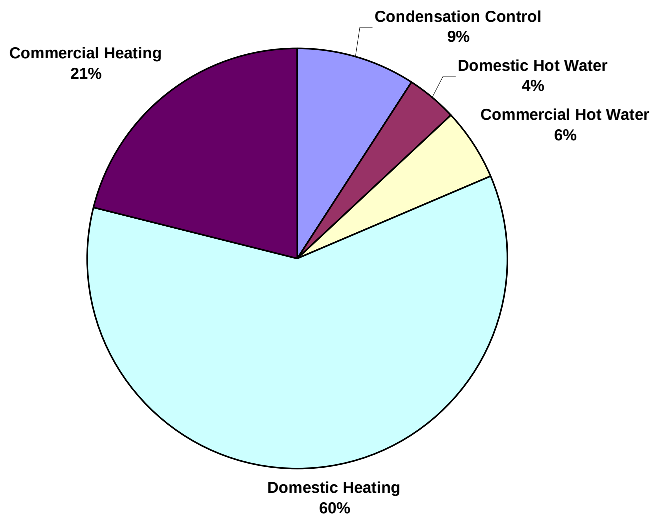


Figure 5: Minimum Cumulative Opportunity from Uninsulated Pipes
(14.08 M tonnes)



Although we have assumed that no process pipe work is uninsulated, it should be noted that the sensitivity to this factor is high. For instance, if 10% of the process pipe work stock were uninsulated (out of reach and not requiring personnel protection levels), the potential from uninsulated pipe would climb from 14.08 M tonnes to 41.09 M tonnes. One of the recommendations of the work was therefore to research this area more carefully to ensure that any such opportunities could be identified and targeted.

Additional benefits from BS 5442 revision

In this context, the industry was keen to assess what additional benefit could be extracted from a revision of BS 5422. It was recognised that the standard would only carry credibility in CO_2 terms if the energy loss for a given application and pipe diameter were equivalent for all insulation types – thus making it a genuine performance standard.

One of the problems that this created was the need to decide on a basis for determining the target heat loss for each application and pipe diameter. Although a number of approaches could have been taken, it was decided to use the thermal conductivity column* relating to mineral wool (typically 0.04Wm/K at ambient temperatures) to set the baseline and to apply an arbitrary but realistic increase to the thickness required. An example of a typical BS 5422 (1990) table is shown in Figure 6 to give orientation to this discussion.

The purpose of the approach was to allow the revising Committee of British Standards Institute (BSI) to assess several options in parallel and reach conclusions accordingly. However, one of the problems with using the existing tables was that the economic thickness calculations adopted in BS 5422 (1990) generated insulation thicknesses with increasing pipe diameter that created unacceptable 'steps' in the heat loss progression. These were dealt with by making adjustments to 'smooth' the curve. A typical curve for the revised BS 5422 (2001) is shown in Figure 7.

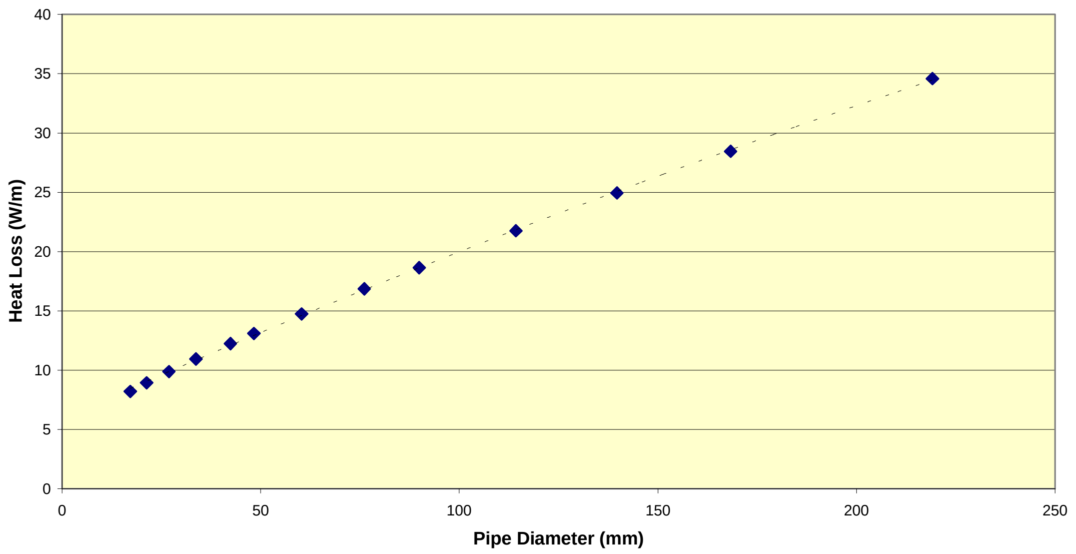
Figure 6 : A typical table from BS5422 (1990)

Table 11. Economic thickness of insulation for non-domestic heating installations served by solid-fuel fired boiler plant

Outside diameter of steel pipe on which insulation thickness has been based (in mm) [1]	**Hot face temperature** (in ^{0}C) **(with ambient still air at +20^{0}C)**											
	+ 75				**+ 100**				**+ 150**			
	Thermal conductivity at mean temperature (in W/(m.K))											
	.025	**0.04**	**.055**	**0.07**	**.025**	**0.04**	**.055**	**0.07**	**.025**	**0.04**	**.055**	**0.07**
	Thickness of insulation (in mm)											
17.2	**14**	**17**	**20**	**23**	**17**	**21**	**24**	**26**	**22**	**25**	**28**	**32**
21.3	**15**	**18**	**22**	**24**	**17**	**22**	**25**	**27**	**23**	**26**	**30**	**34**
26.9	**17**	**20**	**23**	**25**	**20**	**24**	**26**	**28**	**24**	**28**	**32**	**35**
33.7	**17**	**21**	**24**	**26**	**20**	**25**	**27**	**31**	**25**	**29**	**34**	**37**
42.4	**18**	**22**	**25**	**27**	**21**	**25**	**28**	**32**	**25**	**31**	**35**	**39**
48.3	**18**	**23**	**25**	**28**	**22**	**26**	**29**	**33**	**26**	**32**	**36**	**41**
60.3	**19**	**24**	**26**	**29**	**23**	**27**	**31**	**35**	**27**	**33**	**38**	**43**
76.1	**20**	**24**	**27**	**31**	**23**	**28**	**33**	**36**	**28**	**35**	**40**	**45**
88.9	**20**	**24**	**28**	**32**	**24**	**28**	**33**	**37**	**29**	**36**	**42**	**46**
114.3	**21**	**25**	**29**	**33**	**25**	**30**	**35**	**39**	**31**	**37**	**44**	**48**
139.7	**22**	**26**	**30**	**34**	**25**	**31**	**36**	**41**	**31**	**38**	**45**	**50**
168.3	**22**	**26**	**31**	**35**	**25**	**32**	**37**	**42**	**32**	**40**	**46**	**52**
219.1	**22**	**27**	**32**	**36**	**26**	**33**	**38**	**43**	**33**	**42**	**48**	**54**
273	**23**	**27**	**33**	**36**	**26**	**34**	**39**	**44**	**34**	**43**	**49**	**55**
Above 323.9 and including flat surfaces	**23**	**28**	**34**	**38**	**27**	**35**	**42**	**47**	**35**	**45**	**53**	**60**

[1] **Outside diameters are as in BS 3600. The same thickness of insulation would be used for copper pipe work of approximately similar outside dimensions**

Figure 7: Increase in Heat Loss with Pipe Diameter for Commercial Heating pipe at 75C insulated to Revised BS 5422 requirements



* Themal insulation products are not defined specifically in BS 5422 but are denoted by their thermal conductivity

This approach allowed the development of a series of assessments based on adjustments to the existing tables. In each case, the thicknesses under each of the other thermal conductivity columns were adjusted to ensure equivalent heat loss for a given application / pipe diameter combination. There was inevitably much discussion about what constituted a realistic thickness increase. For the reasons explained in the introduction to this paper, it was clear that poorer insulants would see higher thickness increases than more efficient ones. Indeed, in some cases, a compromise had to be reached involving the reduction of required thicknesses for highly efficient materials at 0.02 W/mK or better. The impact of the possible adjustments to the tables in BS 5422 are summarised in Figure 8.

substantiated by drawing heat loss curves against changes in insulation thickness. In the case of domestic applications, for example, it was already clear that the flatter part of the curve had been reached. This is quite common where the temperatures are generally moderate and the utilisation levels are lower than in commercial and process applications.

After much further discussion, the decision of the Committee was to finalise the revision of BS 5422 to capture an additional 5.78 M tonnes annually following full stock upgrade (15 years). In the context of the 1990 UK emissions of 616 M tonnes of CO_2 this represented a further gain of nearly 1%.

FIGURE 8: - INCREMENTAL SAVINGS FROM BS 5422 REVISIONS

Annual (k tonnes) 30/08/1999

Table No.		*6%*	*8%*	*10%*	*20%*	*40%*	*50%*	*55%*	*60%*	*Low*	*Medium*	*High*	*Original*
Domestic													
18	(heated)	79.46	83.06	86.52						79.46	83.06	86.52	
19	(unheated)	21.77	22.56	23.36						21.77	22.56	23.36	
21	(heated)	6.87	7.00	7.13						6.87	7.00	7.13	
22	(unheated)	5.24	5.35	5.44						5.24	5.35	5.44	
Sub Total		**113.34**	**117.97**	**122.45**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**113.34**	**117.97**	**122.45**	**1187.32**
Commercial													
15							-2.72	-2.22	-1.76	-2.72	-2.22	-1.76	**208.47**
11/12/2013	75C						20.17	21.69	23.13	20.17	21.69	23.13	**711.11**
11/12/2013	100C						17.02	18.14	19.20	17.02	18.14	19.20	**672.43**
11/12/2013	150C						1.30	2.90	4.46	1.30	2.90	4.46	**949.07**
Sub Total		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**35.77**	**40.51**	**45.03**	**35.77**	**40.51**	**45.03**	**2541.08**
Process													
24	100C				15.50	26.10			34.41	15.50	26.10	34.41	**1635.34**
	200C				35.07	60.79			81.04	35.07	60.79	81.04	**4327.47**
	300C				93.45	114.51			131.09	93.45	114.51	131.09	**3941.91**
	400C				39.41	69.26			92.87	39.41	69.26	92.87	**5425.33**
	500C				27.37	48.17			64.67	27.37	48.17	64.67	**2761.71**
	600C				12.83	23.32			31.67	12.83	23.32	31.67	**960.72**
	700C				12.84	23.44			31.91	12.84	23.44	31.91	**759.30**
Sub Total		**0.00**	**0.00**	**0.00**	**236.47**	**365.59**	**0.00**	**0.00**	**467.66**	**236.47**	**365.59**	**467.66**	**19811.78**
					GRAND TOTAL					**385.58**	**524.07**	**635.14**	**23540.18**
					% IMPROVEMENT					**1.64%**	**2.23%**	**2.70%**	
					TOTAL ANNUAL SAVING (Mtons CO2)					**5.78**	**7.86**	**9.53**	

(orange) = Most likely Committee selection

(green) = Possible Committee selection

Although the detail of Figure 8 is not specifically relevant to this discussion, it can be seen that a 6% rise in domestic insulation thicknesses, coupled with a 50% increase in commercial thicknesses and a 20% increase in process insulation thicknesses would deliver a combined additional saving of 5.78 M tonnes of CO_2. A more radical approach, adopting percentages of 8, 55 and 40 respectively would deliver 7.86 M tonnes of additional CO_2 and in the most radical proposal considered (10, 60 & 60) savings of nearly 10 M tonnes of CO_2 could be accounted for annually.

These figures may seem rather strange at first sight, but the percentage increases proposed reflect the stringency of the existing 0.04 W/mK data point used to generate the rest of the table. In some applications (mostly in the domestic sector), this value was considered to be already quite aggressive and that little further CO_2 would be saved by radical changes in thickness. In contrast, the commercial and process figures were viewed as relatively 'soft' initially. These judgements are not, of course, totally arbitrary and the observations can be

Economic ramifications

It is self-evident that if the previous standard BS 5422 (1990) was based on economic pay-back considerations, the changes proposed in BS 5422 (2001) would make the investment less attractive. However, there has been a need for some time to recognise the importance of lifetime costing considerations in the context of the wider challenge of climate change and the UK Government has been doing just this[4]. In essence, if the pay-back period for pipe insulation is pushed back from 5 years to 8-10 years by these changes, the overall package still constitutes a saving over the lifetime of the insulation (15 years). This is in contrast with many other CO_2 mitigation options which carry substantial investment penalties. Figure 9 provides a basic schematic of the range of economic options potentially facing a Government. It can be seen that, in an ideal world, Governments would move from left to right on the graph, thereby achieving their CO_2 targets at minimum cost. However, often the most cost-effective measures (e.g. lighting) do not have the critical mass to deliver the full solution or even any significant part of it. The attraction of insulation in general, and pipe insulation in particular, is that it is both cost-effective and has significant critical mass. Changes in standards that can deliver over 5 M tonnes of CO_2 saving in the UK alone are few and far between!

Figure 9 shows that an increase in the 'reach' of thermal insulation, even if it is at additional cost, can be a better option than other less cost effective measures.

Such observations may be relevant at Government level but still do not attract investors at project level. Therefore, Governments need to look towards measures that will stimulate the uptake of new standards such as BS 5422 (2001).

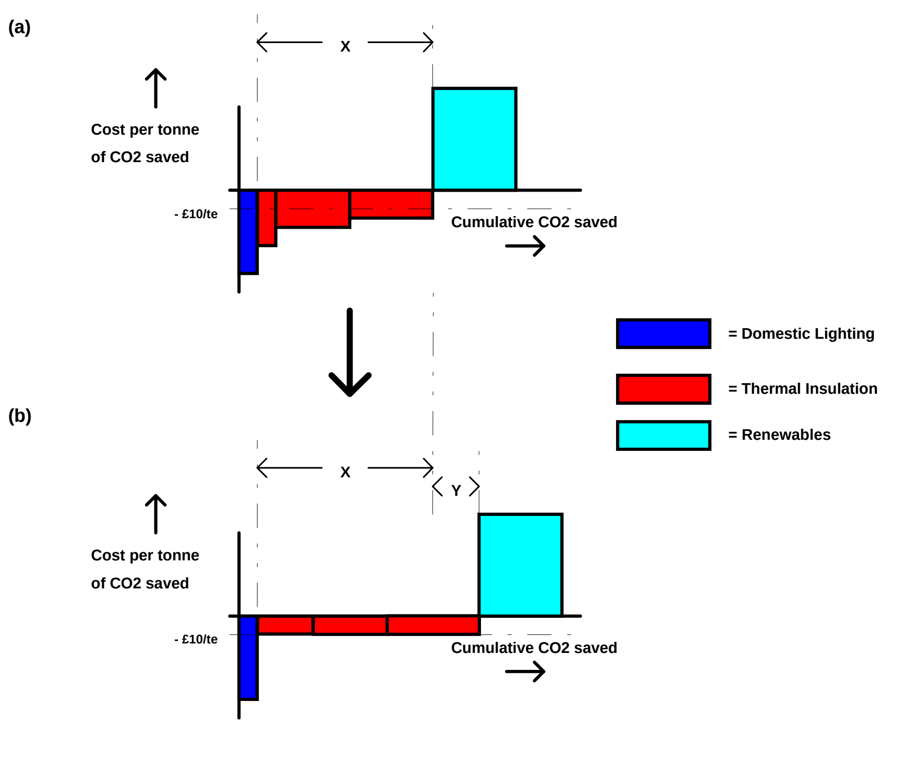
Stimulating acceptance

The UK Government has taken the revisions to BS 5422 and has embodied them into its policy framework in several ways. The first is by incorporating BS 5422 (2001) into the latest revision of the Building Regulations (2002). This makes it mandatory to use BS 5422 (or equivalent measures[+]) for all new commercial building. BS 5422 has also been highlighted as a preferable option for the domestic sector, although other, less stringent options are still permitted.

Historically, the argument of 'useful heat' contribution has long been used to diffuse the need for pipe insulation in internal commercial applications. However, in reality this often has meant that a cooling system has been working in the summer against the output of an uninsulated hot water pipe. To overcome this, the new Building Regulations make explicit reference to the need for pipe insulation unless a specific case can be put forward that heat from be pipe in question is *'always useful'.*

In the industrial process sector, the Government has introduced a climate change levy on fuel use with the intent of stimulating greater energy efficiency. Since any form of carbon taxation is a relatively 'blunt' instrument, it has been found that the provision of a rebate for high-energy users is both politically necessary and highly effective. The basic approach has been to grant rebates by way of legally binding Negotiated Agreements in which the rebates are granted in exchange for 'voluntary' energy efficiency commitments. Within this framework, the economics of pipe insulation shine through as a low entry-barrier means of contributing towards these commitments.

FIGURE 9 - OPTIMISING THE ENERGY SAVING POTENTIAL OF INSULATION



Thirdly, the Government has introduced a selection of tax offsets for energy efficiency measures under the Enhanced Capital Allowances (ECA) Scheme. Although this is only a means of accelerating the refunding of tax allowances that would otherwise be payable over 6-8 years, the inclusion of pipe insulation on the list of measures supported has served to highlight the opportunity in the sector. This has been particularly the case because other thermal insulation measures have yet to make the list for reasons too complex to explore here. The condition of acceptance of an ECA application for pipe insulation is that the installation complies with BS 5422 (2001). Caleb continues to act in an advisory capacity to the UK Government on compliance issues.

Market changes

From the outset of this paper, we have highlighted that the upgrade of BS 5422 would inevitably create shifts in market share for different products. In essence, the low temperature insulants (e.g. nitrile rubber) were expected to do well out of changes to refrigerated and chilled pipe requirements; the changes in mid-range (domestic & commercial hot water and heating) were expected to favour high performance cellular insulants and the thickness increases in the process sector were expected to stimulate the mineral fibre sector, among other high temperature insulation materials.

Anecdotally, these trends have all been observed, with the mineral fibre suppliers reporting an increase in average thicknesses being applied (possibly not due only to BS 5422 revision). In the high performance sector, phenolic foam has been the dominant product over the past 10 years, moving from a share well below 10% in 1992 to a level of greater than 15% (>30% in its

[+] UK Building Regulations never specify precisely how energy solutions should be delivered. The target is set by a performance standard and guidance documents (in this case Approved Document L) then describe ways in which the target can be deemed to be met.

operating temperature range) in recent years even prior to the BS 5422 revision.

Interestingly, the average thickness of pipe section supplied to the market following the introduction of BS 5422 (2001) has not increased significantly. This may be because new specifications are still working through the system. However, the more likely explanation is that other insulation materials have been 'dragged up' to the level of phenolic foam performance prescribed under the 1990 standard and that thickness increases have therefore not been necessary. The net effect of such a hypothesis is that phenolic foam will have become more competitive as a result. This hypothesis is supported by anecdotal reports of a change in product mix and the wider use of phenolic foam for the smaller pipe diameters. Either way, it is clear that phenolic foam is making additional inroads as a result of the belated recognition of its superior performance/cost ratio.

Conclusions

It is hoped that this paper has set out the learning experiences gained from the initiative taken by the pipe insulation industry, initially via the auspices of TIMSA[5], to develop the case for pipe insulation and place it into the context of the wider climate change debate. It can be seen that where this case is put clearly and persuasively, Governments will be willing to offer support by inclusion in their wider policy portfolios.

From the specific Caleb study carried out in 1998, it is clear that:

(1) Uninsulated pipe work represents the most cost effective method of CO_2 emission abatement

(2) Opportunities exist for the upgrade of the existing stock without the necessity to re-write the prevailing standard.

(3) Systematic standard revision is the ultimate method of extracting full value from the sector and also providing a level playing field for insulation products

(4) The cost effectiveness of pipe insulation as a means of combating climate change will keep the measure at the forefront of policy considerations for the foreseeable future.

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About the author

Paul Ashford has worked in the supply chain to the insulation industry for over twenty years, initially with BP Chemicals, where he was involved in process development, technology licensing and, more latterly, in business development and business management roles. Involvement in CFC phase-out issues and, later, in climate change policy took Paul into independent consultancy in 1994 when he formed his own company, Caleb Management Services. Paul is currently the co-chair of the UNEP[Δ] Technical Options Committee on Foams under the Montreal Protocol and is also a contributing author to the IPCC[♣] third assessment report. Paul was an influential member of the BSI committee tasked with revising BS 5422 and is currently a UK Government advisor, having written the case for the inclusion of pipe insulation within the Capital Allowance scheme.

He is a chemist by training and a registered Environmental Auditor.

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[Δ] United Nations Environment Programme
[♣] Inter-Governmental Panel on Climate Change