4 April 2012

Dear Simon,

Response to 'Alternative uses of biomass in decarbonising industry'.

The Brick Development Association (BDA) has asked Arup to review the report, ‘Alternative uses of biomass in decarbonising industry’ Pöyry (2011), ‘the report’, with a focus on the technical product related assumptions made with respect to the construction sector. This review has not considered the cost related assumptions or the cost benefit assessment methodology.

The report was developed to identify the scope for bio-based product substitution in industry to reduce UK industry carbon emissions.

The methodology used in the report is as follows:

- Identify potential substitutions
- Quantify potential CO₂ savings at a product level
- Quantify cost implication on substitution at a product level
- Quantify UK CO₂ emissions of displaced products
- Estimate maximum substitution potential
- Estimate likely substitution potential
- Analyse cost and CO₂ abatement potential of a variety of scenarios at an industry level

We think this is a sound approach to this topic.

The report highlights the industries related to the construction sector; iron and steel, cement and brick, as those with the most abatement potential. This has caused concern among industrial groups, regarding the way the findings of the Pöyry report might be used to inform carbon emission reduction policy. In particular, we agree that the suggestion to require a minimum level of bio-based materials in the Building Regulations would not be beneficial to the industry overall and would prevent designers from choosing the most appropriate solution to the situation.
The report recommends that sector specific studies would be beneficial. We agree with this recommendation as we feel that, as with any industry level evaluation, the inevitable impact of the simplifications required can cause potential discrepancies in the resulting findings. Our brief review has found a number of areas within the assumptions and methodology that could be strengthened in a more detailed study, namely:

- the compatibility of the substitution options with the functional performance of the displaced products;
- the proportion of industrial CO₂ emissions attributable to the displaced products;
- the maximum technical substitution levels.

Each of these issues is discussed in turn below.

**Compatibility of substitution options**

The methodology used in the Pöyry report highlights a series of bio-products that could be substituted to achieve a lower carbon solution. The review has identified two example cases where these substitution options may not be comparable to the displaced products.

*Replacement of steel and concrete beams with glue-laminated timber beams*

CO₂ reductions of 76% and 86% respectively are reported from substituting concrete and steel beams with glulam beams (extrapolated from Table 6). However, the material assumptions for the substitutions are unclear and the functional unit that these comparisons have been based on has not been defined in the report.

This could have a significant impact on the results as Arup studies have found that by looking at material characteristics, for example, compressive strength against embodied carbon, concrete, steel and glulam have a similar bending performance to embodied CO₂ ratio. This indicates that the reductions at a product level would be much smaller than suggested in the report.

*Replacement of cladding bricks with planed sawnwood*

Planed sawn timber is suggested as an alternative to brick as a façade material. While it is possible to use timber as a façade finish, it cannot be compared to brick on a like-for-like basis. A brick façade provides weather protection, robustness, longevity and load bearing capacity. In addition, the durability of the two systems will differ considerably causing there to be differences in their lifetime embodied carbon due to different maintenance or replacement requirements.

Similarly to the beam substitutions, no functional units or material quantities were provided in the report, therefore it is unclear how comparable the two options presented are. This again could potentially have lead to an over-estimation of the carbon reductions attributable to the substitution.

These uncertainties appear to stem from data in the equivalent masses required to perform the same function (Table 7). These figures refer to an earlier Pöyry report (2001), which has not been considered as part of this review.

**Industrial CO₂ emissions**

*Brick*

The industrial emissions assigned to the brick industry are not realistic. All emissions from the mineral sector not attributable to either glass or cement have been assigned to brick (p38). Our estimation is that this is more likely to be around 40%. Allocating 100% of the
emissions to brick production does not take into account the wide range of minerals uses including other masonry products such as cut stone, ceramics, aggregate and sand etc.

Data from the Office of National Statistics\(^1\) shows that less than 1% of extracted minerals in Great Britain are clays used for bricks, pipes or tiles. Combining this with some simple assumptions of embodied CO\(_2\) of the various minerals (taken from the Bath ICE database\(^2\)) provides the rough estimate above.

**Cement**

In the report, it is assumed 100% of cement is used for concrete production (p39). This is not the case. A large proportion is used in mortars, screeds, fibre cement boards and concrete products such as blocks and paving stones. Data from the Mineral Products Association (MPA) shows that on average only 50% of cement is used directly in ready mix concrete\(^3\).

**Steel**

Research conducted at Cambridge University\(^4\) found that 10% of global iron and steel production was used as structural steel in buildings; this includes beams and columns. It can be expected that similar proportions will be true for UK steel production. Therefore the 28% assumption of steel beams as a proportion of iron and steel production is in the right region but may be slightly high.

**Maximum technical penetration levels**

Discontinuities in approach are introduced in the maximum penetration levels section of the report. The technical substitutions discussed in the maximum penetration section are not consistent with those quantified earlier in the report. The differences for the construction sector are highlighted in the table below.

<table>
<thead>
<tr>
<th>Substitution considered in CO(_2) emission reduction calculations</th>
<th>Technical substitution discussed in maximum penetration section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bricks as a facing material (p17)</td>
<td>above ground brick structures and cladding (p43)</td>
</tr>
<tr>
<td>Concrete beams (p20)</td>
<td>all concrete above ground in buildings (p41)</td>
</tr>
<tr>
<td>Steel beams (p20)</td>
<td>steel in prefabricated buildings and other structures (p43)</td>
</tr>
</tbody>
</table>

As discussed above, it is important that the substitutions are achieving the same technical performance. The CO\(_2\) saving from substitution of a steel beam with a glulam beam in a residential or office building will be very different to using glulam in an industrial building or a bridge, and therefore the same CO\(_2\) reduction will not apply.

The report goes on to discuss other non-technical restrictions that may limit the actual penetration.

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\(^1\) Mineral Extraction in Great Britain, Business Monitor PA1007, Office for National Statistics. 2010
\(^3\) Data taken from ‘Table 3 Quarterly Cement Channel of Sale’, obtained from http://cement.mineralproducts.org/downloads/industry_statistics.php March 2012.
Summary

This review has focused on issues of methodology and product related assumptions; the cost related assumptions or the cost benefit assessment methodology have not been considered.

The report follows a logical approach to assessing the potential of bio-based substitutions in reducing industrial CO₂ emissions, however; due to the broad scope, a number of assumptions and simplifications needed to be used. Due to the uncertainties these introduce, the potential abatement levels that could be achieved in the construction industry may have been overestimated.

We support the view that further work is required to understand in more detail, the potential scope for carbon emission reduction arising from bio-based product substitution in UK construction industry. We hope this letter helps to contribute to this more detailed understanding.

Yours sincerely,

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Note: This letter takes into account the particular instructions and requirements of the BDA. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.