The Carbon Trust

RoboFold Ltd
Validation of Carbon Case

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TTP

1 INTRODUCTION

RoboFold have developed a technology for using robots to form sheet metal rather than stamping presses and this is expected to yield significant carbon savings as well as economic benefits. The application to the Carbon Trust Incubator scheme was discussed by the Panel on the 3rd March 2009 where it was accepted for Concept Validation. There were two Concept Validation tasks identified:

1) to carry out a carbon lifecycle analysis for a typical product to provide a high level estimate of the potential carbon savings

2) to provide a view on the IP position with respect as to how defensible is the current broad patent and are there likely to be changes that can usefully be made to strengthen that position.

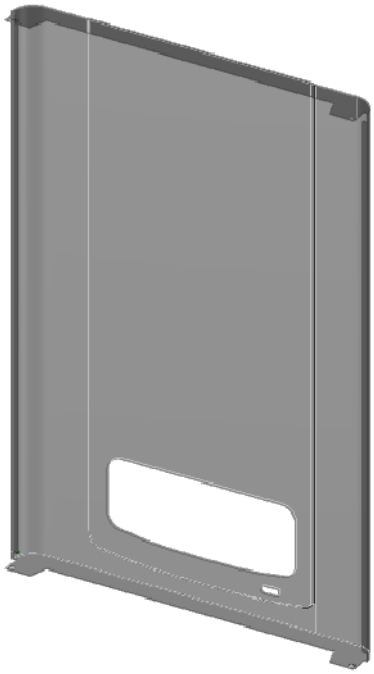
This report addresses the validation of the carbon case. The view on the IP position is in a separate report by Alan Boyle.

2 WORKED EXAMPLE – BOILER PANEL

The RoboFold process will ultimately be applicable across a broad range of industries that form sheet metal. These include domestic appliances, electrical enclosures and chassis, agriculture, medical, automotive, aerospace construction, architectural cladding and furniture. As part of their business development activity RoboFold has had positive discussions with companies from these diverse industry sectors but for the purposes of the Concept Validation project detailed discussions have been held with [redacted] who are one of Europe's leading manufacturers of heating, air conditioning and ventilation systems.

[redacted] manufacture a range of high energy efficiency boilers at their site at [redacted] and these boilers have outer casings manufactured from panels of pressed steel sheet. Initial discussions had indicated that the RoboFold process could provide an attractive alternative to the conventional use of a hydraulic press and a six stage pressing operation and [redacted] have kindly provided information on their current process to act as the base case.

The panel in question is illustrated below:



It is 720mm high and 440mm wide and the edges of the sheet have been folded through 90 degrees to provide stiffness and to provide location features during assembly with other panels to form a box. It is typical of a panel used to form the outer case of a broad range of white goods and other domestic appliances.

The panel is produced in volumes of around 200,000 per year. It is produced on a 400 tonne hydraulic press with six stages – form, crop, form, form, pierce, form – with manual transfer from stage to stage. Each of the stages requires a tool to be designed, produced, prototyped, refined and shipped from China. Appendix 1 shows the information that [redacted] have provided for a typical tooling production cycle and it can be seen that it is up to a year. TTP's own experience of having press tooling manufactured confirms that the leadtime for having tooling manufactured in China is around 26 weeks and that the total time from initial design to production could be up to a year for a difficult part. One of the major commercial benefits that RoboFold provides is a much shorter leadtime from design through to manufacture.

Appendix 1 also gives the comparison in carbon emissions for the conventional and RoboFold part. The carbon savings are obtained from two areas:

- production of the press tools (not required for RoboFold)
- part production

For the press tool the CO_2 savings are obtained from three areas:

- production of the steel (which for a set of press tools could be 6 tonnes)
- machining of the steel
- shipping the tools from China

For the panel under consideration this represents 14.6 tonnes of CO_2. If it is assumed that the tool is used for 5 years then this represents just under 3 tonnes per annum.

There are additional significant carbon savings to be made by eliminating the flights to China during the design and trial phase but as these would be very specific to each development project they have not been included in this analysis.

There area also CO_2 savings for each part produced. The main source of CO_2 is from the electrical energy to power the 400 tonne hydraulic press, which has a power rating of 123 kVA (Vaillant actually have two presses; one carrying out two pressing operations simultaneously and one carrying out four operations). As Appendix 1 shows, this means that each panel contains 251gCO_2 from the electrical power to the press. There is also a small contribution from the labour required to man the presses.

For the RoboFold process, a punch press and a 5 robot cell is used and the electrical power contributes 70 gCO_2 to each panel. Again there is small contribution from the labour required and the saving per panel is 182gCO_2.

This means that for the 200,000 units produced per year, the RoboFold process would deliver a saving of 36.4 tonnes of CO_2. Including the saving from the tooling would increase this to 39.3 tonnes of CO_2 per annum.

This is only one panel on the boiler casework. Other pressed steel sheets are used for the side, top and bottom and although they are smaller it is reasonable to assume that, combined, they would represent a similar carbon saving as the front panel. Therefore, the RoboFold process could produce CO_2 savings of >80 tonnes per annum for the boiler caseworks.

3 POTENTIAL CARBON SAVINGS

As previously mentioned, the RoboFold technology could be applied to a large range of products and markets but to provide an estimate of the potential carbon savings for this Concept Validation report we have focussed on two key applications: white goods and automotive.

White Goods

The white goods category includes fridges, freezers, washing machines, tumble dryers, cookers and microwaves. As with the boiler used for the worked example, they have outer caseworks comprising pressed steel panels of a relatively simple form which should make them suitable for manufacture via the RoboFold process. Most of the panels will be larger than the boiler example with a 'standard' appliance typically 800mm x 600mm x 600mm so for the purpose of this analysis it is reasonable to assume a similar carbon saving of 0.5kg/unit

The UK retail market for white goods was valued at £3.33bn in 2007 (Source:Researchandmarkets.com). This represents around 18 million units equivalent to a potential saving of 9000 tonnes of CO_2.

The global market for white goods is estimated to be around 380 million units, equivalent to a potential saving of 190,000 tonnes of CO_2.

Automotive

A car contains a large number of pressed steel panels (typically more than 50 individual pressings) that are welded together to form the bodyshell of the vehicle. Many of these pressings are unlikely to be suitable for manufacture using the RoboFold process because they utilise substantial plastic deformation of sections the panel to increase its strength. However, there are a number of panels, including the outer skin of the bodyshell, that are not subject to such heavy deformation (eg bonnet, boot, roof, door-skins). Each of these panels is larger in area than the example boiler panel and will be formed on very large high power presses with very large tools so it is reasonable to assume that the carbon saving could be around 3kg per vehicle.

The UK is still a significant manufacturer of vehicles and in 2008 produced 1.6 million cars (*Source:SMMT*). In terms of vehicle registrations, 2.4 million cars were registered in 2007 which represents a potential saving of 7200 tonnes of CO_2.

Worldwide vehicle production in 2007 was 69 million vehicles representing a potential saving of 207,000 tonnes of CO_2.

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