

Gate Burton Energy Park

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Embodied Carbon Comparison for Trina and Jolywood PV Modules based on EPD Data
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Prepared for:

Gate Burton Energy Park Limited

Prepared by:

AECOM Limited

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1. Embodied Carbon Impacts for Different PV Modules based on EPD Data

- 1.1.1 It can be challenging to estimate the embodied carbon from the raw materials and manufacturing process for specialist components such as PV modules, due to a lack of reliable information published by manufacturers.
- 1.1.2 A standardised system of Environmental Product Declarations (EPD), prepared in compliance with ISO 14025 and BS EN 15804:2012, is dramatically improving this process, although the system remains voluntary in many sectors including photovoltaics.
- 1.1.3 At the time that the Gate Burton Greenhouse Gas (GHG) assessment was carried out, the team preparing the assessment was not aware of any EPDs published by Trina, the intended manufacturer of PV modules to be installed at the Gate Burton Energy Park.
- 1.1.4 Instead, the embodied carbon emissions from the manufacture of PV modules for Gate Burton Energy Park were estimated using an EPD for a PV panel manufactured by Jolywood, the JW-HD144N-166, with a rated capacity of 470W.
- 1.1.5 Although the EPD was for a different make and model of PV module, the likely similarities in raw materials and manufacturing process meant that the overall GHG impact is likely to be broadly representative of other PV modules.
- 1.1.6 The Jolywood EPD presents data for the overall global warming potential per unit of generated output, in kg CO₂e per kWh. These data are presented for three lifecycle stages: upstream, core stream and downstream.
- 1.1.7 The boundaries of each stage for the Jolywood EPD are shown in Figure 1.

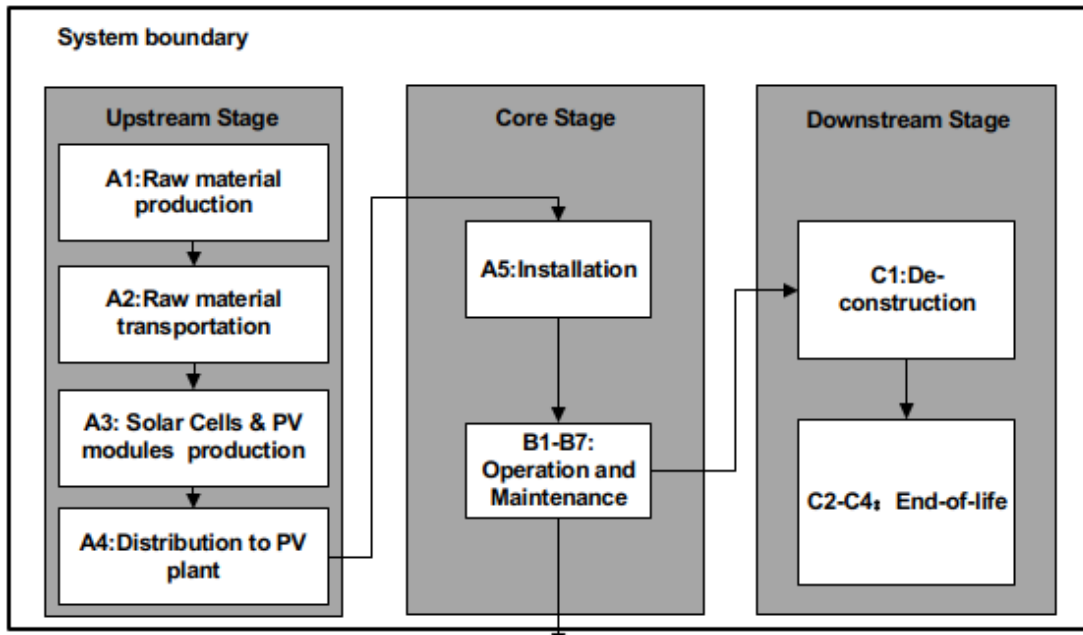


Figure 1 Lifecycle stage boundaries for Jolywood EPD

- 1.1.8 Since data for the transportation of modules to the site in Lincolnshire, the installation process, and ongoing operations and maintenance over the design life was available for the Scheme, only the figure for the Upstream Stage was used to estimate the embodied carbon in the PV modules.
- 1.1.9 The Global Warming Potential (GWP) figure for the upstream stage for the representative module was presented as shown in Figure 2.

Table 17 Environmental impacts of JW-HD144N-166-with frame

Parameter	Unit	Upstream	Core	Downstream	Total
Global warming potential – Fossil (GWP-fossil)	kg CO ₂ eq.	8,80E-03	5,53E-03	2,11E-04	1,45E-02
Global warming potential – Biogenic (GWP-biogenic)	kg CO ₂ eq.	-1,33E-03	-2,10E-05	-1,30E-06	-1,36E-03
Global warming potential - Land use and Land transformation (GWP-luluc)	kg CO ₂ eq.	1,55E-05	4,88E-06	1,91E-08	2,04E-05
Global warming potential (GWP) - Total	kg CO ₂ eq.	7,48E-03	5,51E-03	2,10E-04	1,32E-02

Figure 2 GHG impacts from different lifecycle stages of the Jolywood PV module

- 1.1.10 The upstream stage has GHG impacts of 7.48 x 10⁻³ kgCO₂e/kWh, or 0.00748 kgCO₂e/kWh. This figure, slightly adjusted to take account of different anticipated solar yields in China and Lincolnshire, was applied to the generation figures for Gate Burton Energy Park.
- 1.1.11 Since the GHG assessment was carried out during 2022, an EPD for a PV module manufactured by Trina has become available. This EPD is not for the exact model of PV module which may be installed at the Gate Burton Energy Park site, but it is published by the same manufacturer, and is therefore more directly relevant to the Scheme.
- 1.1.12 The data presented within the Trina EPD is also broken down between three different lifecycle stages, but it is important to note that the lifecycle stage

boundaries are set quite differently compared to the Jolywood EPD. The Trina boundaries are shown in Figure 3 below.

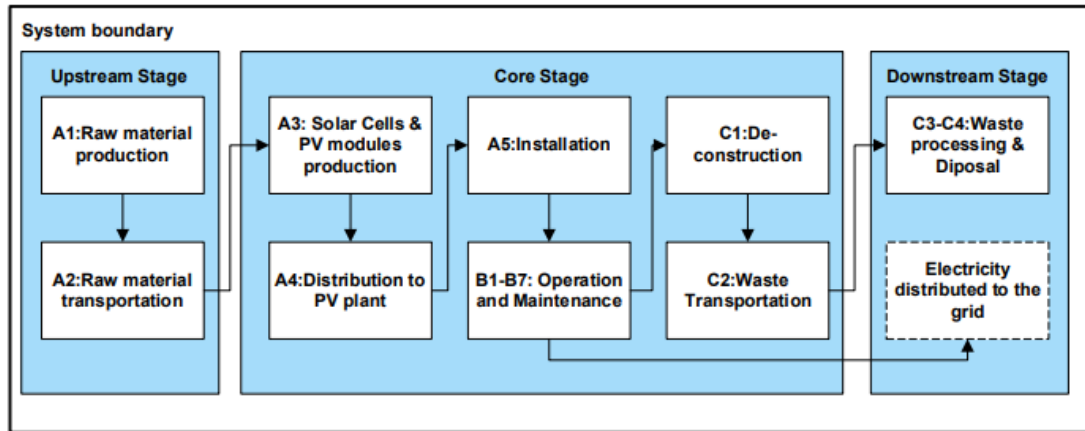


Figure 3 Lifecycle stage boundaries for Trina EPD

- 1.1.13 It is clear that many of the key operations that fall within the upstream stage of the Jolywood EPD are within the core stage of the Trina EPD. For this reason, it is not straightforward to make a direct comparison between the two.
- 1.1.14 The GHG impacts for each lifecycle stage of the Trina EPD are shown in Figure 4 below.

Table 7. Life Cycle Impact Assessment Results- TSM-DE15M(II)

IMPACT CATEGORY	UNIT	UPSTREAM	CORE STREAM	DOWNSTREAM	TOTAL
Climate change -total	kg CO2 eq	5.66E-03	5.95E-03	1.10E-03	1.27E-02
Climate change - fossil	kg CO2 eq	6.36E-03	6.00E-03	1.11E-03	1.35E-02
Climate change - biogenic	kg CO2 eq	-7.03E-04	-5.46E-05	-8.08E-06	-7.66E-04
Climate change - land use and change in land use	kg CO2 eq	3.80E-06	9.21E-06	3.78E-07	1.34E-05

Figure 4 GHG impacts from different lifecycle stages of the Trina PV module

- 1.1.15 The impact from the upstream stage is lower than for the Jolywood module, but does not include as many processes. For a more comprehensive assessment to be carried out that includes the fabrication of the modules, it is necessary to include both the upstream and core lifecycle stages, for a total of 1.16×10^{-2} kg CO₂e/kWh, or 0.0116 kgCO₂e/kWh.
- 1.1.16 But this figure clearly includes many elements that are already addressed elsewhere in the GHG assessment, including installation, operation and maintenance, and some end of life activities.
- 1.1.17 In order to make an overall comparison of the GHG impacts of the two different PV modules, one supplied by Jolywood and one by Trina, it is necessary to combine all lifecycle stages in the EPDs; this should give a whole life figure for each in emissions per kWh.
- 1.1.18 Aggregating the total GHG impacts from the two modules across all lifecycle stage, including upstream, core and downstream, it can be seen that the Trina module has a lower overall GHG impact per unit of generation than the Jolywood module. This information is shown in Figure 5 below.

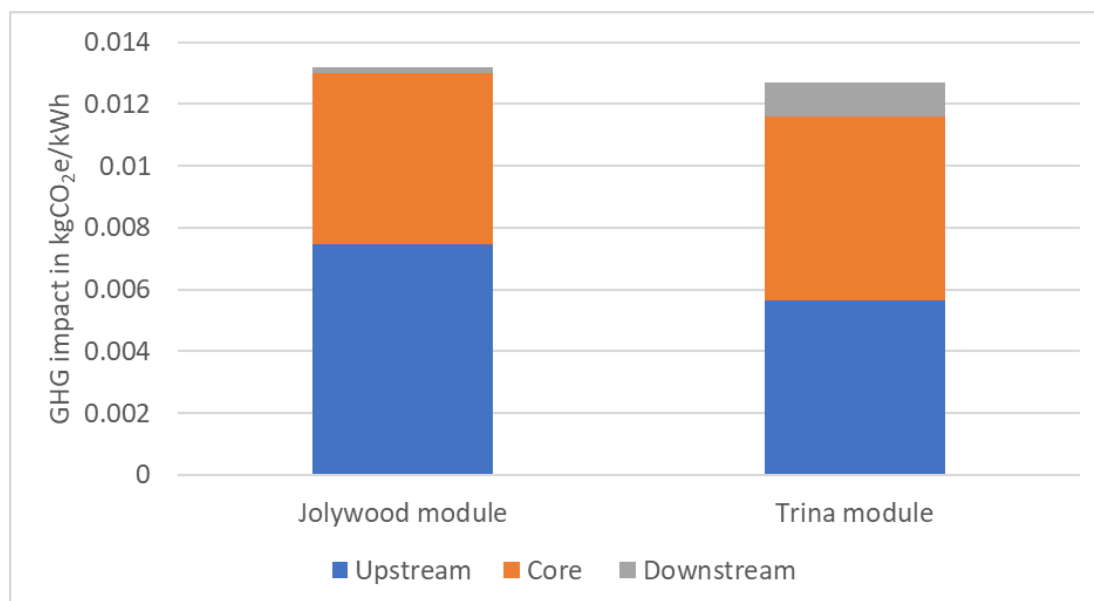


Figure 5 Comparison between overall GHG impacts for each PV module

- 1.1.19 Notwithstanding the different boundaries that each EPD places between different lifecycle stages, it can clearly be seen that taking the whole life impact into account, the data presented in the Trina EPD is lower (by around 4%) relative to the same data from the Jolywood EPD.
- 1.1.20 This comparison provides additional assurance that the embodied carbon data presented in the ES for the Gate Burton Energy Park Scheme, based on the Jolywood EPD, is very similar (indeed slightly higher) than the corresponding data would have been had it been based on a Trina EPD.