

The environmental benefits of offsite manufacture compared to traditional construction

This paper has been prepared as a reference document, bringing together other publicly available research around the benefits of offsite manufacturing (OSM).

The [built environment](#)¹ accounts for:

- 45% of total [UK carbon emissions](#) (27% from [domestic buildings](#) and 18% from non-[domestic](#)).
- 72% of [domestic emissions](#) arise from [space heating](#) and the provision of [hot water](#).
- 32% of landfill [waste](#) comes from the [construction](#) and [demolition](#) of [buildings](#).
- 13% of [products](#) delivered to [construction sites](#) are sent directly to landfill without being used.

The [UK Green Building Council](#) says that around 10% of the [UK's carbon dioxide emissions](#) are directly associated with [construction](#). The [construction sector](#) uses more than 400 million tons of [material](#) each year, much of which has a negative environmental impact. In particular, the [products](#) that are used during the [construction process](#) can be damaging due to intensive extraction of raw [materials](#), transporting to manufacturing [plant](#) and [site](#), [energy consumption](#) in [manufacture](#) and [in use](#), [waste](#) generation and so on.²

For many people with local responsibilities for housebuilding therefore, a key question is how can we do this in a greener way?

Waste reduction and waste management

32% of all UK landfill waste comes from the construction industry.³ The efficiency of offsite construction methods ensures that materials are used in a way that minimizes waste - "factory-produced elements result in less waste, as offcuts from processes can often be reused or recycled at the factory. Fewer trades means fewer vehicle trips to site. Timber products used in systems such as CLT act as a carbon sink, further reducing greenhouse gas emissions".⁴

Conventional building can include a 10% material wastage, studies have shown this can be halved in offsite construction.⁵ "In fact, according to the scheme of environmental evaluation by the European Program EuroHouse (Long 1999), are considered, among the consequential benefits from the employment of prefabricated systems:

- from 30 to 60% in the reduction of times on site through a more efficient coordination of the different construction packages;
- the reduction of 50% of water quantity in comparison to a traditional construction;
- 50 reduction% of the quantity of material utilized and produced by excavations;
- wider use of recycled materials (like timber, steel, aluminum, etc.);
- up to 80% in the reduction of waste materials during on site works;
- up to 60% in the reduction of CO2 emissions and of annual energy consumes during building life cycle;

¹ https://www.designingbuildings.co.uk/wiki/Sustainability_in_building_design_and_construction

² https://www.designingbuildings.co.uk/wiki/Environmental_impact

³ https://www.rmfi-services.co.uk/recycled_raised_flooring/construction_waste_facts.aspx

⁴ <https://www.architectsjournal.co.uk/buildings/essay-offsite-construction-is-the-future-ignore-it-at-your-peril/10023964.article>

⁵ https://www.buildoffsite.com/content/uploads/2015/03/BoS_offsiteconstruction_1307091.pdf

- possible reutilization and reuse of prefabricated elements”.⁶

Pollution

Noise is a major form of pollution recognized by WHO; it negatively impacts the health of humans and animals. Vehicles are also huge pollutants which are used far less in the offsite construction process. Noise and vehicle pollution are dramatically reduced in offsite construction which can be completed up to 30% faster.⁷

Energy efficiency in use

The energy consumed in the manufacturing process itself is vastly [reduced](#), due to the controlled environment of a factory compared to the traditional building site.⁸ Net savings of around 30% are identified in terms of energy usage - which directly translates to a cost saving.

Offsite construction leads to better energy efficiency as there is higher and more consistent build quality, for example being better sealed and therefore insulated. Some studies have shown this to be up to 25%.⁹ L&G have just announced a scheme to build 154 modular homes in Selby at EPC A ratings¹⁰, and Project Etopia boast that their homes produce more energy than they use, and are in fact carbon negative.¹¹ Air tightness is crucial in energy efficiency, and a fabric first approach is favoured by the social housing sector who maintain the asset in the longer-term.

Net zero carbon

Offsite construction helps buildings have more potential for being repurposed especially when they are volumetric as they can be deconstructed into component parts and moved more easily. This helps to reduce the need for new raw materials each time when building, which is a significant improvement on the current state of play.¹²

In terms of embedded carbon, around half of the CO₂ is from cement production. There is a fantastic paper by WRAP¹³ entitled ‘Cutting Embodied Carbon in Construction Projects’, which identifies that by using offsite methods, it is possible to save around 10% through using less materials and significant further savings through designing for reuse, and a further 20% by using different materials with lower carbon intensities, such as cement substitutes. There is an ongoing debate around timber-frame vs light-gauge steel and the possible safety compromises of using the former (please be aware there are significant testing processes currently in progress around cross-laminated timber to attempt to demonstrate it is as safe as LGS from a fire-safety perspective therefore it is not to be assumed that it is not safe).

⁶ <https://www.irbnet.de/daten/iconda/CIB11824.pdf>

⁷ [DCLG. \(2017\). Fixing our broken housing market. HMSO, London](#)

⁸ <https://www.offsitehub.co.uk/industry-news/news/the-green-impact-of-modular-construction/>

⁹ https://www.buildoffsite.com/content/uploads/2015/03/BoS_offsiteconstruction_1307091.pdf

¹⁰ <https://www.edie.net/news/6/Legal---General-given-go-ahead-for-energy-efficiency-modular-homes-drive/>

¹¹ <https://www.projectetopia.com/>

¹² <https://www.offsitehub.co.uk/industry-news/news/the-green-impact-of-modular-construction/>

¹³ <http://www.wrap.org.uk/sites/files/wrap/FINAL%20PRO095-009%20Embodied%20Carbon%20Annex.pdf>