Skanska aspires to be the leading green project developer and contractor, as detailed in the company’s Journey to Deep Green™ 2011-2015 Business Plan. The company has begun implementing carbon footprinting – a key aspect of its Journey to Deep Green™, and one of Skanska’s Green Strategic Indicators, to realize improved environmental and economic project performance.

The bottom line for carbon footprinting

Skanska’s projects are increasingly using carbon footprinting to realize carbon and financial savings, through resource efficiency and value engineering. In addition, Skanska occasionally submits alternative green bids, which identify opportunities to make project carbon and financial savings. One alternative green bid in Sweden in 2012 offered to reduce embodied carbon by almost 20% and related costs by around USD 7m (SEK 47m).

Furthermore, a proactive approach to resource efficiency often attracts the attention of forward-thinking clients. For example, after hearing of Skanska’s carbon footprinting work, London Underground Limited (LUL) approached Skanska UK to hold an educational workshop for their management team. Skanska has since assisted LUL to develop a carbon workshop for their entire supply chain, and LUL are now incorporating carbon footprinting into all their construction activities.

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Journey to Deep Green™
Skanska’s initiative to encourage projects with near-zero environmental impact.

Skanska Color Palette™
Skanska’s strategic framework and communication tool for Green Business, which has been developed to measure and guide project performance on the company’s Journey to Deep Green™. The Color Palette™ rates both embodied carbon and operational energy to gauge a project’s life cycle performance, in addition to aspects related to water and materials.

Why does Skanska conduct carbon footprinting?
Construction is a resource-intensive industry, which often involves the extraction, manufacture and transport of large quantities of raw materials. Carbon footprinting helps us to understand and mitigate these environmental impacts and allows us to deliver greener projects. Surprisingly often, reduction of carbon equals reduction of cost!

A building’s carbon footprint typically comprises of around 80% operational carbon and 20% embodied carbon. However, as buildings become increasingly energy efficient, embodied carbon is becoming an increasingly important part of a building’s total life cycle carbon footprint. For example, the carbon footprint of Skanska’s energy efficient Bassängkajen commercial development in Malmö, Sweden, comprises of over 40% embodied carbon. Similarly, embodied carbon may be responsible for an infrastructure project’s entire lifecycle carbon footprint. Embodied carbon is therefore the next step for any green building contractor and developer seeking to realize lifecycle carbon savings from energy efficient projects.

Project Carbon Footprint
The project carbon footprint is defined as the carbon dioxide (CO₂) emissions resulting from the production of construction materials and construction related activities. The project carbon footprint is expressed in carbon dioxide equivalent (CO₂e), which is a measure of how much global warming a given quantity of greenhouse gas may cause by using CO₂ as a reference. CO₂ is one of many greenhouse gases. The term “carbon” is commonly used when referring generically to either CO₂ or CO₂e emissions.

Preliminary Carbon Footprint
A carbon estimate conducted at the bid or early planning stage of a project. The preliminary carbon footprint can be used to identify potential carbon and financial savings if used at the design phase of a project.

Embodied and operational carbon
A carbon footprint can be divided into embodied and operational carbon. Embodied carbon is the total emissions related to construction materials and construction activities, and operational carbon denotes the emissions associated with the heating, cooling and electrical consumption of a building during its operational lifespan.

Skanska has seen the number of preliminary carbon footprints increase significantly during the first two years of its 2011-2015 Business Plan. Individual projects have achieved carbon savings of up to 27% compared to the preliminary footprint baseline, with associated financial savings for the client in excess of USD60m (SEK403m) (figures from the M25 Widening Project).
Facts and trends

In the UK, foundation piles have been reused on several projects, which has reduced the associated costs by over 50% and made significant carbon savings.

The footprint played a vital role in identifying potential carbon savings throughout the M25 widening project, reducing carbon emissions by around 27% compared with the preliminary carbon footprint.

Skanska has pioneered the use of BIM as a carbon footprinting tool, which can provide quick and cost-effective carbon analyses of construction alternatives.

Skanska helped to develop an intranet-based carbon-modeling tool for Anglian Water, which has helped realize Wastewater Treatment Plant upgrade embodied carbon savings of up to 27% or almost 2,000 tCO₂e.

Skanska conducted 36 project carbon footprints in 2011 in six of its Home Markets to benchmark project carbon emissions and to help identify low-carbon project options.

Carbon footprints undertaken in Skanska Home Markets
Sweden 15   UK 13
Norway 4   Finland 2
Czech Republic 1   USA 1
36
2011

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Implementation of **carbon footprinting** driving change

Skanska conducted 36 project carbon footprints in 2011 to benchmark project carbon emissions and to help identify low-carbon project options. Skanska’s project carbon footprints can be typically broken down into construction materials or components, as on the City Green Court project, or by materials, material transport and site activities as with the Entré Lindhagen ground and concrete works footprint. A footprint may also take a lifecycle perspective that includes operational carbon as with the Telemark Rehabilitation Center project.

Preliminary carbon footprints can be used to identify opportunities for project embodied carbon and financial savings by focusing on emissions related to construction materials, site activities and logistics.

**Skanska’s Carbon Footprinting Tools**

In addition to various Business Unit (BU) and client tools, Skanska has developed a Group-wide project carbon footprinting tool, as part of its Green Toolbox, to support project teams and BUs that do not have an established footprinting tool available to them.

**Building Information Modeling (BIM) carbon tools**

Skanska has pioneered the use of BIM as a carbon footprinting tool, which can provide quick and cost-effective carbon analyzes of construction alternatives.

### City Green Court, Czech Republic: Embodied carbon emissions breakdown by construction material and component

- **Concrete & concrete products**: 5,657 tCO₂e
- **Metal**: 4,310 tCO₂e
- **Wood**: 2,633 tCO₂e
- **Foundation**: 2,564 tCO₂e
- **Columns & beams**: 832 tCO₂e
- **Façade**: 736 tCO₂e
- **Other components**: 508 tCO₂e

### Telemark, Norway Rehabilitation Center, Lifecycle Carbon Footprint

- **Construction materials**: 7 Operational energy: 33
- **Operational transport**: 5

### Embéré Lindhagen, Skanska’s new Corporate HQ in Stockholm, Sweden: Carbon Footprint

- **Materials (production and transport to supplier)**: 4,981 tCO₂e
- **Transport (from supplier to project)**: 139 tCO₂e
- **Energy (during construction)**: 2,090 tCO₂e
Material-related carbon
Significant embodied carbon savings can be realized in a project’s design phase by replacing carbon-intensive construction materials, identified by a preliminary carbon footprint, with low-carbon materials and design solutions. For example, low-carbon materials might include recycled steel or concrete based fly ash cement, whereas low-carbon design solutions may include structures that require less concrete or steel, or materials that are easier to recycle.

Skanska has developed and pioneered several material-related solutions that help to realize carbon and financial savings. For example, Skanska UK has reused foundation piles on several projects, which has reduced the associated costs by over 50% and made significant carbon savings. Skanska UK also constructs low-carbon new foundations by targeting reductions in concrete and steel by incorporating 100% recycled steel and fly ash concrete, which can reduce embodied carbon by over 25%. In addition, Skanska UK is developing a concrete mix made from recycled aggregate, which reduces the need for carbon-intensive extraction and processing activities associated with virgin aggregate.

Skanska Sweden manufactures a type of asphalt with rapeseed oil biofuel instead of fossil fuels, which reduces its overall embodied carbon by 25% compared with conventional asphalt. Skanska also incorporates existing asphalt into the production of new asphalt. In 2011, over 8% of Skanska Sweden’s asphalt was made from recycled asphalt, which saved over 4,800 tCO₂e in total.

Skanska’s procurement units are increasingly assessing suppliers against a set of lifecycle factors, including carbon and cost, which helps to identify opportunities for savings. In addition, carbon footprints typically involve close cooperation with the project supply chain, and several BU’s are working to improve carbon knowledge and awareness among suppliers. The Nordic Procurement Unit (NPU) helps project teams to obtain and compare supplier material carbon data for carbon-intensive materials. The NPU also supports the development of low-carbon solutions together with project teams and suppliers. For example, prefabricated concrete hollow core floor panels, which contain cement with 30% fly ash and around 30% less embodied carbon in total than conventional hollow core panels, were used for the first time in Norway on Skanska’s Telemark project.

Skanska UK has initiated a Supply Chain Green Solution Award, which encourages supply chain partners to submit specific solutions that could potentially be incorporated into projects to realize environmental benefits, including carbon reduction. The BU has also collaborated with a cross sector group of companies and UK universities to develop a process to help organizations understand the embodied impacts of a product and its associated supply chains.

Site-related carbon
The carbon related to site activities can account for as little as 3% of a building’s total embodied carbon, such as on the Torvalla Retirement Home project in Sweden. However, Skanska works actively to minimize all emissions in our direct sphere of influence, including carbon emissions related to site activities and processes. Skanska has developed an internal Green Workplace environmental management system, which is aimed at reducing the environmental impacts associated with site activities, including energy use and carbon emissions. Green Workplace may involve adding insulation and double glazed windows to site cabins, demanding higher emission standards for site machinery compared with local legislation, the use of energy-efficient construction lighting and the continuous monitoring of site energy use. For example, US BU’s are using solar charged lighting systems on construction projects. BU’s in Sweden, Norway, Finland and the UK all implemented variations of the Green Workplace management system. These efforts on the construction site represent Skanska’s green vision and might also signify the customers’ commitment to pursue greener projects.

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Logistics-related carbon
The transportation of construction materials to site may account for around 5% of a building’s embodied carbon. Skanska works with its supply chain and logistical partners to find low-carbon and potentially less costly solutions, such as more local suppliers, consolidated deliveries, lower volumes of waste to be removed from site, and lower-carbon means of transport. Skanska transported prefabricated elements of the Clarion Sign Hotel in Sweden to the site by train from Slovakia, which saved 23,800 tCO₂e and reduced transport costs by around 10% compared to road transport. In addition, Skanska Finland has estimated that consolidated just-in-time (JIT) deliveries can help decrease carbon emissions and reduce logistics-related costs for material groups delivered via the logistics terminal by around 50%, compared with conventional delivery practices. Around 70% of Skanska’s residential projects in southern Finland used consolidated JIT deliveries in 2011.

End of life-related carbon
At present, Skanska typically omits demolition-related emissions from carbon footprinting. However, the Two Kingdom Street office project in the UK included a carbon estimate for the energy to demolish the building and four end of life scenarios for the main components of the building. End of life carbon accounted for approximately 2% of the building’s total embodied carbon.

Turning carbon into cash – project examples

M25, UK
A Skanska Joint Venture calculated the carbon footprint of the USD1.65bn (SEK11bn) M25 highway-widening scheme, near London. The footprint played a vital role in identifying carbon savings throughout the project and helping to reduce emissions by 21%.
- 24,000 tCO₂e and around 150,000 m³ of asphalt was saved by overlaying a 35 mm wearing course where possible, which avoided the need for 360,000 tons of asphalt.
- 35,000 tCO₂e and around 500,000 m³ of cement were saved by incorporating 2.4 million tons of excavation materials and demolition waste from the site and other construction sites.

South East Electricity Substation Alliance (SEESA), UK
SEESA is a National Grid led partnership with Skanska, Alstom and Mott MacDonald which is upgrading the electricity transmission network in the southeast of England. The project has involved conducting carbon footprints on a project level, which has helped to realise savings of up to 129,000 tCO₂e and USD17.5m in initial cost savings on individual projects. The team also developed a reusable packing crate for aluminum piping, which saved around 1,500,000 £ (USD2,100,000) and over 6 tCO₂e per site alone. Surplus items were shared among SEESA projects to make further financial and carbon savings.

Anglian Water, UK
The Anglian Water Asset Management Plan (AMP) involves the upgrade of existing sewage and water treatment infrastructure on a number of sites throughout the Anglian region of England. Skanska helped to develop an intranet-based carbon-modeling tool for Anglian Water, which has helped to reduce embodied carbon savings of up to 27% or almost 2,000 tCO₂e. Overall operational carbon following an upgrade can be reduced by 50%, which resulted in annual savings of approximately 600 tCO₂e and USD70,000 (SEK470,000).

Catthope Viaduct Replacement, UK
The USD27m (SEK181m) Catthope Viaduct replacement scheme involved the construction of a new bridge over the M1 highway, construction of a new approach road, a new link road and the demolition of the existing viaduct. The project used over 21,500 tons of Incinerator Bottom Aggregate Ash as bulk fill instead of normal granular fill material, which saved around 105,000 tCO₂e

Glasbrodot, L. Sweden
The project involved the construction of masts and drains in Malmo, and calculated the project’s installation carbon footprint. The project team substituted concrete drainage pipes with those made from polyethylene, which decreased lifecycle carbon emissions by around 6% or 85 tCO₂e. The use of polyethylene pipes also reduced project costs by USD38,000 (SEK250,000).