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Comprehensive life cycle approach (LCA) tool applied to road construction

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Researchers have used a new comprehensive life cycle approach to estimate greenhouse gas (GHG) emissions from road construction. When applied to four projects in Spain, the results suggest improvements could be made in the use and efficiency of off-road machinery, the choice of materials and restoration of ecosystems.

Road construction has a range of environmental impacts, including GHG emissions, resource use, energy consumption, waste generation and land use change. It is important to assess the sources of road construction's environmental impacts to inform decision-making and mitigation policy. Life cycle analysis (LCA) provides a valuable method to carry out this assessment but previous research in this area has tended to omit or underestimate certain aspects, such as the carbon balance associated with land use change and the absorption of CO_2 by road surfaces and concrete structures.

The study presents the first integral approach to estimating the GHG emissions of road construction by applying the CO_2NSTRUCT tool to four road construction projects in Spain: three highways and one conventional road. CO_2NSTRUCT has a large database containing information on a range of materials, construction machines, energy sources, environmental systems, waste types and transport vehicles. Unlike previous research, the study considered GHG impacts from the maintenance stage of construction, such as those from street lights and road cleaning, and the emissions caused by land use change. However, it did not include road dismantling and the use of vehicles on the road once it was built.

GHG emissions varied among the four projects from 8,860 to 50,300 tonnes of CO_2 equivalent per kilometre. Overall, the majority of emissions took place during the construction stage (rather than the maintenance stage).

A more in-depth analysis of the emissions of the different areas, elements and sectors of the construction stage indicated that earthworks accounted for 60-85% of the emissions, depending on the project. This includes the extraction, supply and transport of earth. In comparison, the actual structures, pavements and tunnels involved in the construction produced relatively low levels of emissions.

In terms of the different elements of construction, off-road machinery contributed the most to GHG emissions (62-85%) and materials were the second largest contributor (10-33%). Accounting for just 4-7% of emissions, the disruption of environmental systems and land use change were not major sources of GHGs, but they did produce more emissions than transport of materials.

The study also broke down the GHG emissions in terms of the sectors responsible for emissions. Unsurprisingly, the construction sector was the most notable emitter of GHGs, accounting for about 50-70% of the emissions. Industry was a secondary, but important, sector responsible for releasing emissions during the production of materials.

For the projects considered, the results indicate that efforts to reduce GHG emissions from road construction should focus on earthworks and improvements in off-road machinery in the construction sector. The choice of construction materials and restoration of ecosystems also have a role to play.

However, the main objective of the study was to demonstrate a comprehensive LCA approach for road construction. This was achieved, but researchers called for application to more case studies to inform the development of the tool. They also called for better availability of quality data, which will require participation from industry and construction companies.

Source: Barandica, J.M. - , G., Berzosa, A., Delgado, J.A. & Acosta, F.J. (2013) Applying life cycle thinking to reduce greenhouse gas emissions from road projects. *Journal of Cleaner Production*. Doi: 10.1016/j.jclepro.2013.05.036
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