

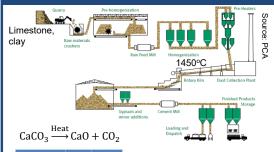


## Realistic Ways to Drastically Reduce the **CO<sub>2</sub> Emission of Cement and Concrete**

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Cement CO<sub>2</sub> emissions = 2.3 GT/yr (~6% of total anthropogenic CO<sub>2</sub> emissions)



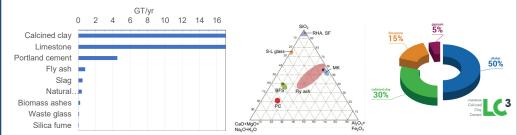
| Material               | MJ/kg | kgCO <sub>2</sub> /kg |
|------------------------|-------|-----------------------|
| Cement                 | 4.6   | 0.83                  |
| Concrete               | 0.95  | 0.13                  |
| Masonry                | 3.0   | 0.22                  |
| Wood                   | 8.5   | 0.46                  |
| Wood: multilayer       | 15    | 0.81                  |
| Steel: Virgin          | 35    | 2.8                   |
| Steel: Recycled        | 9.5   | 0.43                  |
| Aluminium: virgin      | 218   | 11.46                 |
| Aluminium recycled     | 28.8  | 1.69                  |
| Glass fibre composites | 100   | 8.1                   |
| Glass                  | 15.7  | 0.85                  |

 Quarrying & transport Grinding & preparation of raw materials Cooling, grinding, mixing

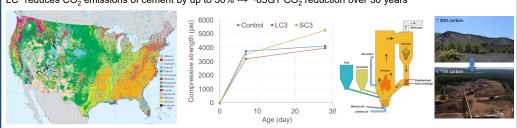
 Cement chemistry uses most abundant elements on earth

 New cement plants operate near thermodynamic efficiency Only scalable, impactful, and rapidly implementable solution to curb CO<sub>2</sub> emissions: Use less Portland cement

1. Replace cement with supplementary cementitious materials (SCM)



LC<sup>3</sup> reduces CO<sub>2</sub> emissions of cement by up to 30%  $\rightarrow$  ~85GT CO<sub>2</sub> reduction over 30 years



2. Improve (double) the service life of concrete structures (100+ years)



## Conclusions and Acknowledgements

Only realistic way of drastically reducing the CO2 emission of concrete is to reduce the use of Portland cement:

- Replace 50% of cement with SCMs
- Double the service life of concrete structures















