The GREENFLOOR ventilated concrete slab: **a new-generation HVAC system**

The Greenfloor solution deployed by Vinci Energies' subsidiary I.C. Entreprise reduces the amount of energy used to regulate the temperature of buildings.

Starting date of the project	January 2017
Project Localisation Places of implementation of the project at this stage and targeted geography if replicable.	Two projects in northern and eastern France were fitted with the system. Another project is underway in the Greater Paris area.
Project objectives Type of climate innovation of the project with a description of the problem/issue addressed	To improve the energy efficiency of buildings.
Detailed project description	Developed by Vinci Energies business unit I.C. Entreprise, the Greenfloor system consists of a slab equipped with ducts that are embedded in the concrete; it is activated by ventilation air which serves as the sole heat-transfer medium, harnessing the building's inertia. This system has several advantages: • Greater thermal comfort due to stable room temperature • Low noise level: no equipment in the dropped ceilings • Improved indoor air quality: fresh air supply exceeds regulation (40 cu. metres per hour per occupant vs 25 cu. metres per hour) • Free cooling during mid-season The Greenfloor solution optimises ceiling height, since the ventilated active slab is no thicker than conventional slabs, while at the same time incorporating ductwork. Air is used as a heat-transfer fluid to deliver heating or cooling to the slab, which acts as a radiant ceiling. A further benefit of this HVAC (heating-ventilation-air conditioning) technology is the energy savings it allows compared to a conventional system. Concrete has a high heat capacity ; fresh air sent into the slab at night cools it down, and cool air is redistributes during the day. Thanks to this free cooling principle, a building requires less air conditioning; AC expenditures can be reduced by 30 to 40 % compared with fan coil units or chilled beams. In winter, Greenfloor acts as an all-air system, with a minimum air change rate. Over the entire year, it is possible to achieve total savings of 10 to 15%.
Main project's drivers for reducing the greenhouse gas emissions	

Reduction levers	Details on the aspects of the project
☐ Energy and resource efficiency (including behaviour)	
☐ Energy Decarbonisation	
☒ Energy efficiency improvements	Less energy required to control building temperature
☒ Improving efficiency in non-energy resources	Amount of equipment is reduced
☐ Emissions absorption: creation of carbon sinks, negative emissions (BECCS, CCU/S, ...)	
☐ Financing low-carbon producers or disinvestment from carbon assets	
☐ Reduction of other greenhouse gases emission	

Emission scope(s) on which the project has a significant impact and quantification of GHG emission reductions per emission scope	Aspects of the project contributing to the reduction of emissions by emission category	Quantification of associated GHG emissions by emission category

		Please follow the quantification methodology used in the Afep guidelines.
Reduction of the company's carbon dependency		
Scope 1 *Direct emissions generated by the company's activity.*		
Scope 2 *Indirect emissions associated with the company's electricity and heat consumption.*		
Scope 3 *Emissions induced (upstream or downstream) by the company's activities, products and/or services in its value chain.*	Reduction of grey emissions (upstream). Less energy required to control building temperature (downstream).	150 $kgCO_2eq$/sq. metre
Increase of carbon sinks		
Emissions Absorption *Carbon sinks creation, (BECCS, CCU/S, …)*		
GHG emissions avoided by the company at third parties		
Avoided Emissions *Emissions avoided by the activities, products and/or services in charge of the project, or by the financing of emission reduction projects.*	Less energy required to control building temperature.	90 gCO_2eq/sq. metre

Clarification on the calculation or other remarks:

Grey emissions (i.e. not related to use) associated with conventional fan coil solutions can be assessed at approximately 60 gCO_2eq/sq. metre, taking into account the materials used on average.

Additionally, less energy is required to control temperature in buildings equipped with the Greenfloor system. Considering the average French energy mix used for heating buildings and the associated emission factor (0.2 $kgCO_2eq$/kWh), the Greenfloor solution can be deemed to reduce CO_2 emissions by approximately 90 gCO_2eq/sq. metre.

Vinci plans to equip a surface equivalent to 70,000 sq. metre/year.

Ultimately, avoided carbon emissions are expected to total 10,000 tonnes CO_2/year for Vinci (scopes 1 and 3) and 6,000 tonnes CO_2/year for customers (all other things being equal).

Modality of verification of the quantification.	**Calculation standard used (ADEME base, GHG Protocol, etc.):** Life-cycle analysis method – French standard NF EN 15978 (building life span: 50 years) **Verification of the calculation (internal or external): internal**
Other environmental and social benefits of the project	Embedding ducts into the slabs is a fairly simple and reproducible operation. On the future VINCI headquarters project, this task was entrusted to workers in an employment-integration programme. In this sense, the project contributes to MDG 8 – Decent work and economic growth and MDG 10 – Reduced inequalities.

Project maturity level	☐ Prototype laboratory test (TRL 7)
	☐ Real life testing (TRL 7-8)
	☐ Pre-commercial prototype (TRL 9)
	☒ Small-scale implementation
	☐ Medium to large scale implementation
	
	Remarks:
	• Full-scale prototype for measuring and modelling.
	• On the market since 2017:
	  ○ Completed: MERELEC (northern France) 400 sq. metres, Actemium (Mulhouse, eastern France) 2,000 m².
	  ○ In progress: Archipel (Nanterre) 8,000 sq. metres.

Capacity and conditions of the project reproducibility, with associated climate impact mitigation potential	Gains announced (in terms of climate impact) are inherent to our solution's design and are highly reproducible. Greater potential can be achieved through appropriate control of the system, harnessing the inertia of slabs and allowing slight temperature drifts. The GREENFLOOR System should be considered in the very early stages of projects: • Slabs need to be cast in place. The active face of the slab must not be covered by a dropped ceiling. • The incorporation of ducts into the reinforced slab may require additional design work.
Amount of investment made (in €)	€2 million were invested in the Greenfloor technology.
Economic profitability of the project (ROI)	☐ ST (0-3 years) ☐ MT (4-10 years)

	☒ LT (>10 years) **Remarks:** The Greenfloor system has several economic benefits: • **For real-estate developers:** Greenfloor is a space-saving system (no air conditioning units in the plenum space of the dropped ceilings). At constant building height, this results in a gain of one storey every 5 floors. • **For users:** energy savings lead to lower building operating costs. Maintenance costs are 80% lower compared to a fan coil solution.
Engaged partnerships	As part of this project, VINCI worked with the CERIB (French Centre for Concrete Research and Studies) to validate the fire resistance of the concrete slab with embedded ducts; the results were then approved by the CSTB (French Scientific and Technical Centre for the Construction Industry).
Open comments from the project owner	The solution has already delivered its benefits, which go beyond the climate impact, in a number of completed projects: • Greater comfort that comes from a radiant system (reduced air velocity, homogeneous temperature, increased renewal rate) • Only one fluid: air (no damage to hydraulic systems) • Diversity of external conditions and uses: the system can withstand extreme conditions and does not require adjustments to fit a different use use, such as converting a space into a meeting room.
For more information on the project	
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Project URL links	/
Illustrations of the project