



Contributing to the transition towards a carbon-free, energy-efficient society



Propose

Act

Involve

BOUYGUES
CONSTRUCTION

Shaping a **Better Life**

Our business activities

To face the challenges of climate change and energy efficiency, Bouygues Construction is reinventing itself through the exploration of new construction methods, new business models and new ways of working.

With the goal of becoming a key player in low-carbon construction, Bouygues Construction is developing innovative solutions combining environmental and economic performance for its customers. The Group is involved in a collective dynamic with all its stakeholders, working together to reduce the carbon footprint of its activities.



BUILDING

Housing, schools and universities, hospitals, hotels, office buildings, stadiums, airports, exhibition and leisure centres...



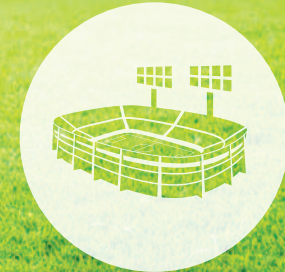
CIVIL WORKS

Tunnels, bridges, trams, metros, rail and port infrastructure...



ENERGY AND SERVICES

Energy network infrastructures, street lighting, mechanical, electrical and HVAC engineering, facility management...



CONCESSIONS

Management and operation of transport, sports, and entertainment facilities, port areas...

Contributing
to the transition
towards
a carbon-free,
energy-efficient
society

Propose solutions, products and services to reduce the carbon footprint of our customers and users



Page 05

Propose

Act on processes, behaviour and the way in which we buy and sell to reduce our carbon footprint



Page 23

Act

Get involved in the collective dynamic with all stakeholders



Page 31

Involve



The Kai-tak trade and industry tower | Hong Kong:

Delivered by Dragages Hong Kong, this eco-designed building helps combat the heat island effect through the establishment of an extensive green roof covering more than 30% of the total surface area. A building integrated photovoltaic (BIPV) system produces more than 42 MWh per year.

438M² OF PHOTOVOLTAIC PANELS



PROPOSE SOLUTIONS, PRODUCTS AND SERVICES

to reduce the carbon footprint of our customers and users

Renovate existing buildings

In the Building and Civil Works sector, there is great potential for energy savings through the renovation of existing buildings.

To meet this challenge, Bouygues Construction is developing solutions to increase buildings' energy efficiency and thermal performance, finance their operation and upgrade existing buildings.

Carbon energy



Reconcile heritage and thermal performance

A bioclimatic facade for the renovation of the Bordeaux 1 university (33 - France)

Bouygues Construction has implemented an innovative bioclimatic concept for the redevelopment of old, highly energy-intensive buildings, namely a double facade providing ventilation, heating/cooling and insulation, while respecting the buildings' architecture. The Group will manage the design, delivery, operation and maintenance of the 17 buildings for a period of 30 years. Energy consumption is monitored using Hypervision® (see page 12), which is developed by Bouygues Energies & Services. All buildings are HQE-certified and have the BBC (low energy building) Renovation label.





Achieve high environmental performance for the service sector

Challenger: renovation of an occupied site, Bouygues Construction's sustainable building showcase (78 – France)

Challenger, Bouygues Construction's head office, has become one of the first positive energy office buildings renovated. The use of geothermal energy together with 24,000m² of naturally ventilated double skin facade, 25,000m² of photovoltaic panels (terrace and solar farm) and 300m² of DualSun® hybrid (photovoltaic and thermal) solar panels enabled this remarkable level of performance to be achieved, as well as improving employees' quality of life.



Compared to a conventional concrete solution:

CO₂ savings of 19% by adding storeys made of wood at the overall project level

CO₂ savings of 96% on materials, only taking walls of the extra storey into consideration

Provide a range of innovative technical and financial services for renovation

Range of services for adding storeys made of wood - Rue de Tolbiac (Paris)

With Brézillon (Bouygues Bâtiment Ile-de-France) as general contractor, renovation on an occupied site, and addition of storeys made entirely of wood to a social housing residence of 5 and 4 floors. The addition of storeys made of wood requires no work on foundations and no additional heating power for homes.

Bouygues Construction has a wood engineering department that can add stories to any type of building, with a goal of keeping the cost lower than €2,000/m² before tax.

Build differently

Limiting the impact of the building process implies taking carbon energy issues into account from the design phase onwards, in particular those concerning material-related emissions. Bouygues Construction is striving to develop new eco-design tools (life cycle analysis) and promote new construction methods and low-carbon materials.

Carbon energy



50% increase (2012 TR) on the bioclimatic front

Compared to a conventional concrete solution: 320 tons reduction in CO₂ over 30 years.

Architects: SNC Lavalin - LCR Architects - Stebat ;
Albedo Energie - Gamba Acoustique
Credit: Pierre Le Chatelier

Promote new construction methods

“Le Djinn” wooden module student residence – CNOUS project – Le Bourget-du-Lac (73 - France)

Design and delivery by Bouygues Bâtiment Sud-Est (developed by Cirmad Grand Sud) of a student residence (120 bedrooms) consisting of 18m² 3D wooden modules, factory-produced by Ossabois, assembled on site, and fully equipped (toilets, appliances and furniture). Domestic hot water is produced by a renewable source combining solar power and a thermodynamic system*. More than 600 rooms have been built on this principle in Nantes, Saint-Nazaire and Arras (France).

*Solar Pump® system combining a glycolated water/water heat pump with unglazed air solar collectors.



Use low-carbon materials

Mixed wood/concrete construction: Le Grand Carcouët - Nantes (44 - France)

As part of a consortium and with Bouygues Bâtiment Grand Ouest as general contractor, delivery of 2 positive energy (BEPOS) buildings (5 floors) comprising 30 apartments. High level of performance, with simple technical systems: mixed wood/concrete construction, loggias (solar collector), electric heating, Heliopac system for hot water, grey water energy recovery (power pipe), photovoltaic panels.

Two years of support to project field coordination with regard to the uses and performance of the building.

Low-carbon concrete: Barbes Thorez Student Residence - Ivry-sur-Seine (94 - France)

With Bouygues Bâtiment Ile-de-France Habitat Résidentiel as general contractor, delivery of a student residence comprising 112 rooms and a staff apartment. This building used low carbon CEMV* type concrete for almost 60% of the concrete surface.

*CEMV: concrete including cement which is made of recycled materials from the steel industry.

Recycled aggregates for the Nimes-Montpellier railway bypass cycle way (CNM) (30 - France)

On the CNM project delivered by Oc'Via, Bouygues Travaux Publics built a part of the cycle way using concrete containing 20% RCAs (Recycled Concrete Aggregates), in accordance with the standard in force. After the success of this experiment, a second development is being considered, this time with a 40% proportion of RCAs. The opportunity to use recycled material depends on the distance of natural material extraction.

Operate and use buildings to make them more efficient

The carbon footprint left by the operation and use of buildings remains a major issue in the life cycle of a construction project. By relying on breakthrough technologies, promoting renewable energies, providing services to private and public customers and supporting users, Bouygues Construction offers a complete range of solutions to optimise energy efficiency and reduce the energy consumption of customers and users alike.

Carbon energy



Strive for autonomy of use

ABC (Autonomous Building for Citizens) demonstrator

In 2017, an ABC concept demonstrator building will be built in Grenoble. The ABC concept is among the R&D programmes led by Bouygues Construction in partnership with the Valode & Pistre architectural firm. The building aims for water autonomy by using rainwater and wastewater, energy autonomy through the production and storage of renewable energy and the optimisation of waste management. Not only is the environmental impact during the operation phase close to zero, but the structure also has a low-carbon design. Residents will be informed and supported in order to reduce consumption with this new lifestyle, where renewable resources are necessarily limited and dependent on weather conditions.



An innovative heat pump: Nanterre Green Home (92 - France)

In Nanterre, Bouygues Bâtiment Ile-de-France Habitat Résidentiel is building a project of 147 positive energy, passive apartments on a tertiary base. Thanks to extremely passive casing which prevents any heat loss and ventilation equipped with a double flow exchanger that recovers 96% of the apartment's heat, the project needs neither conventional heating systems nor distribution networks in the building. A unique process: domestic hot water is produced by the innovative PAC F7® heat pump designed by ERIEE, a start-up backed by Bouygues Construction.



Promote renewable energy solutions

Wood for the "True zero carbon*" campus – University of Hertfordshire - Hatfield (United Kingdom)

Bouygues UK has set up a CHP (Combined Heat and Power) gas biomass cogeneration system for the production of fuel gas on the site, using wood pellets burned at a high temperature. Unlike a conventional solution, the fuel gas produces electricity first and then heat. Excess electricity on the site is fed back into the network, thus enabling "carbon negative" operation. In addition, the excess heat produced is stored and used to meet all the site's domestic hot water needs on demand.

*True zero carbon: the difference between the CO₂ emitted by residents and the CO₂ reductions obtained (photovoltaic production, less energy-consuming behaviour...).



More than 20,000 tons of CO₂ emissions avoided per year.



Drive energy efficiency

Hypervision®: reducing buildings' energy consumption and CO₂ emissions in real time

Solar trackers for 3 photovoltaic power plants in France – (40 - France)

Bouygues Energies & Services is leading a consortium for the design, construction and maintenance over 10 years of three ground-mounted power plants generating a total of 25 MW, for the energy producer Noen. These are the first solar farm projects in France to be equipped with solar trackers, whose development is encouraged by the French Energy Regulatory Commission.

The single-axis Tracker technology used in the three power plants in the Landes region optimises energy production through a mechanism which enables panels to follow the sun's path.



Hypervision® is a Bouygues Energies & Services service for optimising energy consumption in buildings and reducing their carbon footprint. It is based on a solution of remote collection and analysis of a building's energy consumption and fluids, as well as user comfort and the correct functioning of facilities.

With over 3 million square metres covered for various customers (Property companies, Tenants, Ministries, Local Authorities, Universities, Hospitals, ...), Hypervision® provides an overview of accessible energy performances within buildings.



Energy consumption for lighting divided by 3
 —
 Project financed exclusively through energy savings made

Meeting the needs of industry – The “Service de Lux”

On its Batilly site (54), Renault is experimenting with a new approach to improving energy performance. Through a 5-year service contract, which frees Renault from making any investments, and financed by the savings made through electricity cost optimisation, Bouygues Energies & Services is modernising the lighting system, guaranteeing a correct level of lighting in production areas. This “Service de Lux” includes an improvement plan, with a continuous improvement process across the entire site.



User support

Optimise energy consumption with connected housing

Bouygues Construction offers connected services allowing users to monitor their consumption in real time (heating, water, electricity and gas).

The developed systems combine proven technology with usage, to meet its customers' expectations:

- better control of common and rental expenses
- execution of a performance contract
- reduced overall cost of data and consumption bills
- better energy performance of the building, by providing the residents with practical methods to help them do something about their energy consumption

In their change of behaviour: Reli2 project

How can a family live comfortably in accommodation that is disconnected from the regular electricity network? This is the aim of Reli2 project, managed by Bouygues Construction as part of the programme initiated by the Technology Research Institute, Nanoelec. In order to tackle this challenge, an entire family will take part in a 12-month living-lab experiment. The aim is to co-design the devices adapted to the context of innovative housing with the inhabitants themselves. A monthly sociological follow-up will be carried out to understand the family's perceptions and daily practices, with design workshops to develop the device all year round.



Commitment to results

The City of Paris' Energy Performance Contract (EPC)

In the framework of the EVESA group, Bouygues Energies & Services is supporting the project management, and the use and maintenance of 180,000 light sources used for public lighting and 140,000 tri-colour light-signalling devices in the City of Paris, until 2021. In particular, the challenge is to reduce energy consumption by 30% over the 10 years of the contract as part of the Climate Plan, without affecting the quality of service.



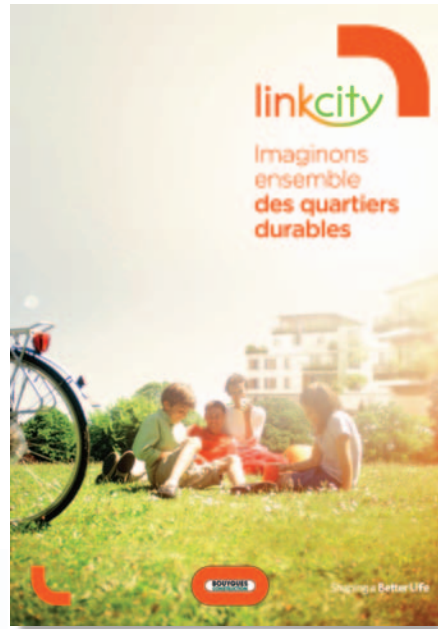
Energy Saving Certificates (ESC)

The ESC* measures are based on an obligation to make energy savings, imposed by the public authorities upon energy retailers. Numerous companies from the Bouygues Construction group have developed partnerships with certain stakeholders from the ESC industry, such as Certinergy and Enercert. These partnerships provide a solution to the financial needs of renovation projects, thanks to an allocated grant. They also ensure an optimisation of energy consumption in terms of construction works.

Become a stakeholder in the transition of territories

70% of the world's population will be urbanised by 2050. Planning decisions are at the core of debates on ecological transition and the adaptation to climate change. Attentive to local expectations, Bouygues Construction supports local stakeholders by implementing genuine expertise in the construction of urban infrastructures and by offering soft mobility solutions and eco-neighbourhood projects, which bring together a sustainable living environment with the digital revolution.

Carbon energy

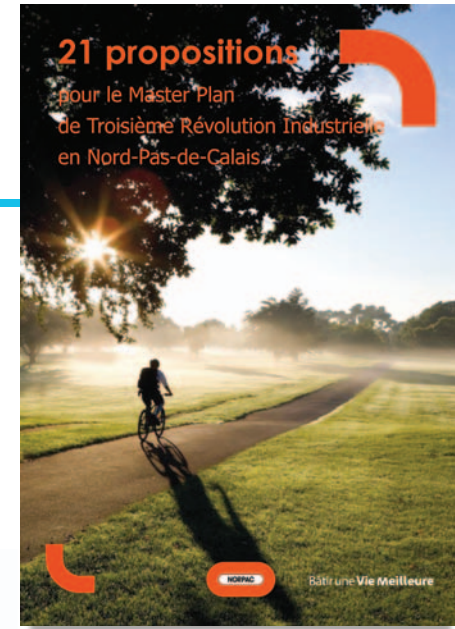


Offer new planning solutions

Meet local expectations with the LinkCity offer

A sustainable neighbourhood is made up of synergies between its buildings and its energy flows and the services that supply it. Bouygues Construction relies on a global and integrated vision of co-construction in terms of sustainable neighbourhoods with all stakeholders and a network of partners (schools, businesses, universities, associations). Objectives:

- to optimise environmental performance, with the aim of self-sufficiency of resources, in particular energy resources,
- to place the usages of future residents in the foreground through local services, optimised mobility, and an adapted digital offer.



21 proposals from Bouygues Bâtiment Nord-Est (previously known as Norpac)

In preparation for the strategic project of the Third industrial revolution in Nord-Pas de Calais by 2050, initiated by the Chambers of Commerce and Industry in the Nord de France Region and the Regional Council of Nord-Pas de Calais, Bouygues Bâtiment Nord-Est has developed 21 concrete proposals on 4 attractive themes towards a low-carbon planet, namely:

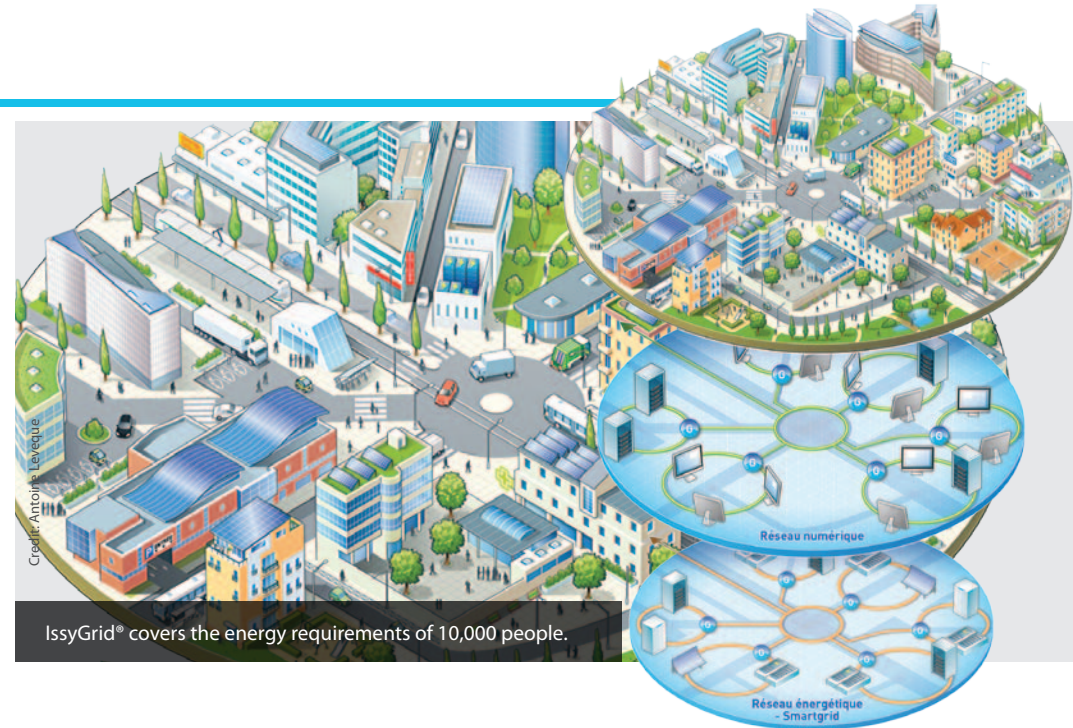
- to communicate current expertise in terms of BEPOS, restoration, biodiversity, renewable energy, co-design etc., and make them widespread,
- to implement innovative demonstrators: autonomous buildings (ABC), 2000-Watt society, mobility, performance in the industry sector, the right to experiment etc.,
- to solve the crisis of social and energy precariousness,
- to change our behavioural and economic models in a more responsible and collaborative way.



Architects: Jean-Baptiste Ferreri et associés, SHoP Architects
 CC HE Architecture SA, Grip Architecture, Archigram
 Credit: Architecstsch

Support ground breaking approaches: Eikenott Eco-neighbourhood - Gland (Switzerland)

Created by Losinger Marazzi, Eikenott, the biggest eco-neighbourhood in the French-speaking part of Switzerland (485 homes and 1200 residents) is heated at a distance by a central heating system, running on 83% wood (from the village), 15% gas and 2% solar energy from solar panels installed on the car park roof. All 21 housing buildings are certified by Minergie-ECO. As a neighbourhood without cars, Eikenott has 800 parking spots for bikes. So that residents are aware of their energy consumption, 250 homes are equipped with a touch-screen control.



Develop "Smart Grid" expertise: IssyGrid® - Issy-les-Moulineaux (92 - France)

Bouygues Energies & Services is responsible for storing electricity and public lighting for IssyGrid® (first smart grid project within a neighbourhood). New in France and on a neighbourhood-size scale, storage batteries (known as "second life" batteries) for electric vehicles have been installed in the ERDF electricity distribution station to absorb the overproduction of solar energy and counterbalance peaks in consumption.



Average savings of 40% on the electricity bill of a local community.

Credit: all rights reserved

Intelligent public lighting: Citybox®

Designed by Bouygues Energies & Services, Citybox® is an intelligent public lighting network that transforms the public lighting network into a high-speed digital network. Citybox® is a unique and patented solution, which meets 3 expectations: the improvement of the lighting network's energy performance, through a steady increase of lights depending on usage; the responsive use of the network thanks to a real-time and remote control check to make sure that the deployed services are running correctly; and finally, the extension of digital services directly onto this new infrastructure (Wi-Fi, video surveillance, sound and lighting systems etc.).



Credit: Patrick Leung

Develop mobility solutions

More sustainable infrastructures: tunnels and underground networks in urban areas

Bouygues Travaux Publics, experts in large-scale civil engineering works, is developing a specific instrumentation to make use of the heat emitted in tunnels and underground infrastructures in urban areas. Vertical-axis wind turbines transform the air produced by the passage speed of underground and overground trains. The harvesting of seepage water is used to water the green areas of the city. Tunnel boring machines with a flat base can reduce the marine excavated material to be extracted and to be stored. By relocating data centres for underground networks into tunnels, the floor space of stations, their underground volumes and pollutants, which are harmful to the city and its citizens, are reduced. Construction is mechanised and costs are reduced. Demolition is scarce, and the ecological impact of projects has been improved. Finally, the implementation of green walls and terraces in underground stations allow for a better absorption of CO₂ in urban areas.



A turnkey offer for electric vehicle charging stations: Alizé

Through its Alizé service offer, Bouygues Energies & Services is offering its skills to support its customers in terms of acquiring charging stations for electric vehicles. The offer includes: engineering, installation, supervision and maintenance of the infrastructure. As well as services such as geo-tracking via a web or mobile application, user support, etc. This is provided in a standardised way, for a national, consistent and scalable offer. This offer ensures the control of overconsumption and regulation, by incorporating daytime/night-time tariffs.



Promote solutions in order to adapt to climate change”

Support nature’s return to the city with the BiodiverCity® certification

In town, climate is subject to the “heat island” effect (a localised increase in temperature) due to urban density and hardscape. Encouraging the development of biodiversity in urban centres would reduce the effects of climate change and locally help with climate control within and around the building (vegetated surfaces to cool down the air and absorb CO₂). This is why Bouygues Construction supports the BiodiverCity® label, which highlights the consideration of biodiversity in building projects for the well being of its users.





In partnership with Manu Lorraine, DTP has developed the ECO'energy system, thereby improving the performance of excavator arms and reducing their energy consumption. The hydraulic energy released is recovered when the excavator's arm is lowered and is re-supplied when it goes back up.

20% MORE OUTPUT AND 15% LESS ENERGY CONSUMPTION



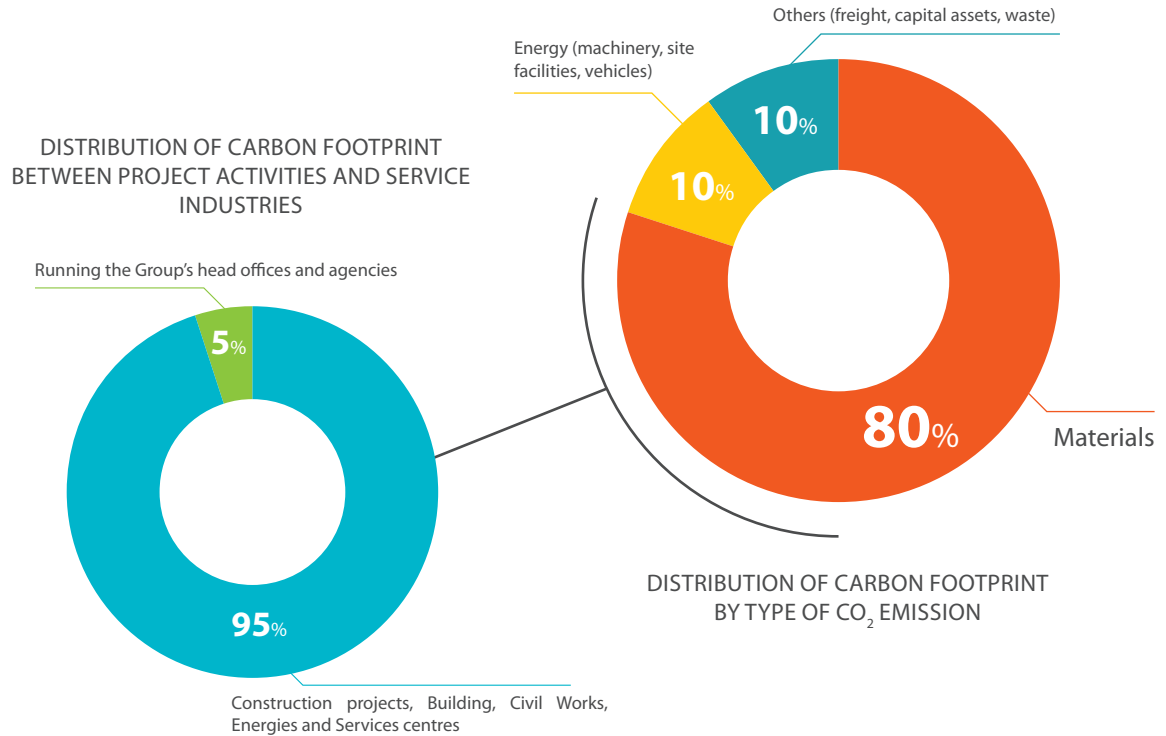
ACT

on processes, behaviour and the way in which we buy and sell to reduce our carbon footprint

Calculating to understand the challenges

To take action and reduce your carbon emissions, you need to be able to calculate them.

Bouygues Construction has been calculating its carbon footprint since 2010 and consolidates its emissions using the CarbonEco tool (scope 1, 2 and 3), a tool developed with the help of Carbone 4.



Distribution of carbon footprint

- Bouygues Construction's carbon footprint amounts to a little more than 3 million tons of CO₂ equivalents per year.
- 95% of greenhouse gas emissions are due to operational activities carried out by Construction, Civil Works and Energies and Services centres.
- The materials used, mostly concrete and steel, account for 80% of projects' greenhouse gas emissions.

Reduce the carbon footprint of our construction sites

The carbon footprint of construction sites is mainly linked to the use of construction materials (80% of emissions).

Offer eco-friendly alternatives to our customers to promote low-carbon products, and work on the impact of materials in the eco-design phase (life cycle analysis) are two of the options being explored by Bouygues Construction to reduce the carbon weight of materials. In addition, the Group supports research to reduce the consumption of civil works machinery and site facilities.

Carbon energy

Reduce the impact linked to materials

The reduced quantity of materials used and the decision to use building methods with less impact on the environment represent major issues for a general contractor like Bouygues Construction.

Using eco-design tools: Polygreen and Elodie



Bouygues Construction uses the Elodie® life cycle analysis tool, developed by the CSTB (Scientific and Technical Centre for Building), in order to measure the environmental impact of building works, notably based on environmental and health declaration sheets (FDES) for construction products. FDES are products commonly used by Bouygues Construction, and are listed in the Polygreen database, which is developed internally. Over 5,500 product data sheets facilitate the responsible selection of materials, beyond the limited economic criterion, with a “product to product” comparison.

Innovation in landscaping with hydraulic binders with low CO₂ emissions

Soil improvement during landscaping projects is traditionally done by lime conditioning and/or by hydraulic binder, which, through their manufacturing process, generate large amounts of greenhouse gas emissions. In partnership with the company Carmeuse, DTP is carrying out research studies to adapt or create new hydraulic binders with low CO₂ emissions (reduced treatment costs, reduced energy consumption and greenhouse gas emissions linked to its manufacturing process), whilst respecting the “zero footprint/zero waste” objective.



Reduce the energy consumption of construction sites

Reduce the impact of site facilities

In partnership with e-Lab Bouygues, Bouygues Télécom and Bouygues Construction Matériel, Bouygues Bâtiment Ile-de-France Habitat Social has developed a prototype. This R&D project remotely or locally controls the heating and air conditioning needs of site portacabins in a central manner, by adapting it to the comfort required, depending on its uses. Finally, the implementation of this system combines comfort and the mindful consumption of electricity.



Controlled by the Energy Management System (EMS)

A pioneer in the sector, Bouygues Travaux Publics is committed to improving its energy performance by implementing EMSs, with ISO 50001 certification, for its major projects in France.

This involves concretely identifying the Significant Energy Uses (SEU) and the possible ways forward, focussing on actions to be carried out (design and purchasing of equipment etc.), calculating the improvements in energy performance and monitoring this performance (consumption readings, etc.).



Reduce emissions linked to freight

Bouygues Construction Matériel's Smartour tool

With the introduction of the Smartour tool, Bouygues Construction Matériel manages material transport requests for the Bouygues Construction Group. The tool includes geo-tracking of delivery or return locations, access constraints, travel and loading times, and the transported volume. The rounds are carried out by optimising the distances travelled and the number of lorries, by pooling regional and national resources.

Reduce the carbon footprint in our head offices and agencies

The carbon emission at head offices and agencies only represents 5% of the Group's carbon footprint. Bouygues Construction would nevertheless like to achieve perfect harmony with its service offers (exploitation, facility management) and involve its employees in the Group's effort to reduce the carbon footprint of its construction sites. The construction and renovation of Bouygues Construction sites are the subject of an experiment and are gradually becoming a reflection of the Group's head office, a showcase of expertise in terms of energy performance.

Carbon energy

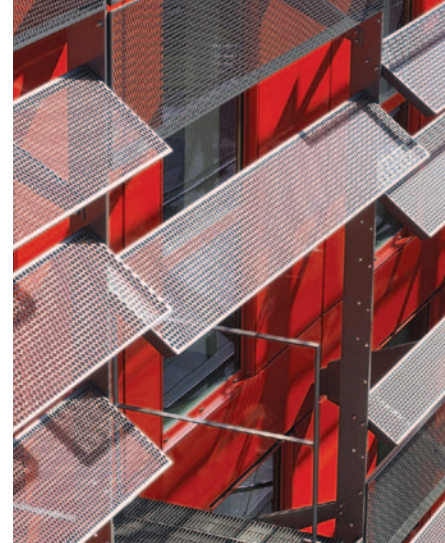


Reduce the impact linked to travel

Over 60% of greenhouse gas emissions caused by tertiary activities carried out at the head offices and agencies are linked to employee travel. The Company commuter plan, the reduced carbon weight of the vehicle pool and the tools to support car sharing each belong to the range of initiatives supported by Bouygues Construction.

Electric vehicles available for car sharing

Bouygues Construction has purchased electric vehicles for its vehicle fleet. The Group's employees can now resort to using electric vehicles as part of a car-sharing service for local, professional journeys (less than 150km).



Architect: Hubert Godet - Crédit : Laurent Zylberman

Reduce energy consumption

Through the construction and renovation of head offices and agencies: Australia - Montigny le Bretonneux (78 - France)

Australia, Bouygues Energies & Services' head office, is certified HEQ (High Environmental Quality) and has been awarded the "BBC Effnergie" certification thanks to several innovations:

- Insulation from the outside
- Solar protection thanks to perforated sheet metal panels,
- Adjustments to lighting depending on the activity and natural lighting, and the use of low-energy consumption tube lighting,
- Photovoltaic and thermal panels on the roof,
- A wood-fired boiler system,
- Distribution of hot and cold through chilled induction beams,
- Measurement and forecast tool for the technical and energy performances of a building.



By involving employees: Bouygues Construction Eco-habits Campaign

Bouygues Construction is not only worried about reducing its impact on the environment, but also about being consistent with the range of services offered. The company is therefore promoting a series of Eco-habits amongst all of its employees. Through these simple, daily habits, Bouygues Construction's employees can contribute, through their habits, to the Group's effort to reduce its energy consumption and the carbon footprint of its construction sites.



To tackle climate change and meet society's expectations, the Bouygues group encourages and promotes low-carbon innovations in all spheres of the group's business activities.

The Energy & Carbon Awards, open to all Bouygues group members of staff and run in partnership with the consulting firm Carbone 4, is based on a call for innovative projects - either completed or under way - that help bring down levels of energy consumption and CO₂ emissions.

Bouygues Construction members of staff have presented 120 solutions as part of these awards.



GET INVOLVED

in the collective dynamic with all stakeholders

Bouygues Construction is getting involved:

Bouygues Construction promotes the Bilan Carbone® approach and supports Association Bilan Carbone's work, such as the SM-GES® Greenhouse Gas Management System experiment.



Member of the Carbon club
CDC Climat's Forest-Timber



With WWF France: partnership as part of the "Re-creating cities" initiative, which aims to develop demonstrators of sustainable neighbourhoods and to promote the vision of sustainable cities.



They support us in our work:





Architects : SBA Architectures
Crédit : Alexandre Peraud
Design : O'Rkodes - 2015

Challenger, Bouygues Construction's positive-energy head office, the first tertiary building to be renovated.



Bouygues Construction
Innovation and Sustainable Development Direction

www.bouygues-construction.com
blog.bouygues-construction.com



In the same collection:



The paper used (PEFC certified Condat silk) comes from sustainably managed forests.