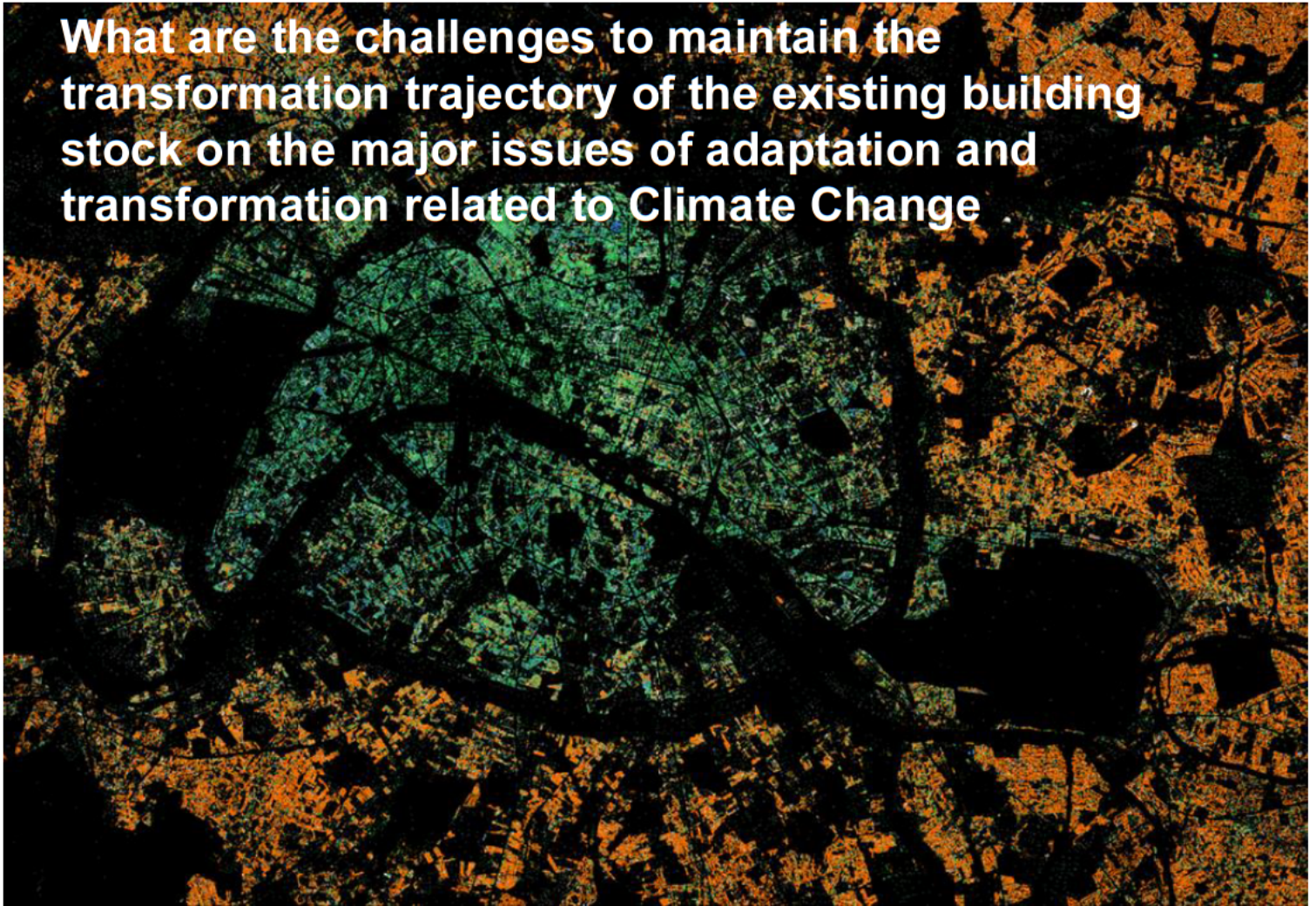


What are the challenges to maintain the transformation trajectory of the existing building stock on the major issues of adaptation and transformation related to Climate Change



CSTB
le futur en construction

VISION 2030 CSTB R&D ROAD MAP



2030
VISION

CSTB
LE FUTUR EN CONSTRUCTION

BUILDINGS AND QUARTER FOR BETTER CO-LIVING

Programming for the horizon of 2023

Approche urbaine intégrée

Qualité des environnements intérieurs (QEI): mesure et modélisation

Qualité des environnements intérieurs (QEI): data et indices

Sécurité sanitaire dans les bâtiments

Pertinence et environnements bâtis

2024

État de l'art d'un outil d'analyse urbaine intégrée
Qualification des ambiances urbaines pour concevoir les villes avec une approche systémique et centrée autour de l'humain
Partenaires: CHED - UMR Paris Lodron, CITEO - UMR Aix-Marseille, AECI, CITEO, UMR
Urbanité

Nature en ville: caractérisation de la biodiversité dans les projets d'aménagement
objectif ZAN
Partenaires: MINT, CORRAL, Supélec

Construction de modèles de pollution (air, bruit, lumière de QEI via des données continues obtenues par capteurs)
Modèles prédictifs de la qualité globale des environnements intérieurs
Partenaires: UCL, LASIE, Anika

Risques sanitaires émergents et émergents: caractérisation de l'exposition aux virus et aux pathogènes, aux particules ultrafines, aux produits d'infection...
Résilience et prévention: développement de modèles et de stratégies de conception pour l'air et l'eau
Développement d'indicateurs de contribution écologique (niveau de 10, niveau 2) pour la gestion sanitaire des bâtiments, des lieux à valeur patrimoniale
Partenaires: IMT Nord France, IMT

Comportement des agents pathogènes: étude de leur dynamique de survie
Partenaires: Institut Pasteur, CERES (CITEO, ANSES, CNRS)
Mesure continue à l'échelle d'un quartier par la surveillance via les yeux ouverts
Étude des performances des solutions de gestion des bâtiments pour prévenir leur propagation

Revue de données de QAI et de QEI en regard des caractéristiques environnementales, climatiques, des bâtiments/ quartiers/villes et des facteurs liés à la gestion de la communauté scientifique, des acteurs de la recherche, des gestionnaires de bâtiments et du grand public. Connexion à la Base de Données Nationale du Bâtiment (BDNB) du CSTB

Plan National Santé Environnement: cartographies de l'exposition aux ondes électromagnétiques à l'échelle du territoire français
Partenaires: ANSES

Nature en ville: objectif qui impacte physique en quantifiant le rôle du végétal en ville comme source de rafraîchissement et comme puits de carbone

2027

Développement d'outils prédictifs de diagnostic multicritères (physiques et socio-comportementaux) et d'aide de choix dans la conception et l'implémentation des espaces urbains pour les acteurs de la ville
Partenaires: universitaires: Paris Lodron, Paris Saclay, Grand Paris Aménagement, SAEI, École nationale d'Architecture, Epimove, IMMO, Imepop

Interopérabilité des modèles autour d'une plateforme commune, MATIS

Constitution d'une base de données d'évaluation (qualitative et quantitative pour le chauffage)
Étude de la compatibilité de certaines interactions entre les polluants et les lieux/ modes de vie
Développement de solutions techniques de réhabilitation

Technologies innovantes d'activation des bâtiments et mise en place d'un dispositif d'appui à l'adoption familiale dans une situation d'urgence sanitaire
Partenaires: INRAE, ANSES, Adobio

Couplage de ces cartographies avec la BDNB

Élaboration d'indices QEI qui agissent sur différents besoins des utilisateurs en ce qui concerne et en les rendant facilement lisibles selon le type d'environnement
Modèles de prévision court/moyen terme de données QEI à partir de données continues recueillies à l'aide de capteurs selon le type d'environnement

Constitution des modèles prédictifs en intégrant les comportements des occupants
Les modalités de diagnostic sont optimisées et partagées avec les acteurs de la construction

2030

5 Fields of Strategic Action
16 projects
For the Research of CSTB



Buildings and Quarters for better co-living

- > Inclusive urban analysis
- > Quality of interior environments: measuring and modernization
- > Quality of interior environments: data and indexes
- > Sanitary security of buildings
- > Buildings and Pandemic
- > Mitigation of the climate change
- > Adaptation to the climate change



Buildings and towns facing to the climate change



Renovation and reliability of construction

- > Knowledge of the park
- > Insite evaluation of performances
- > Multi-criteria rehabilitation
- > Knowledge of the field



Circular economy and resources for building

- > Circular economy: Secondary raw materials – Conception Eco
- > Durability of performances
- > Management of waters

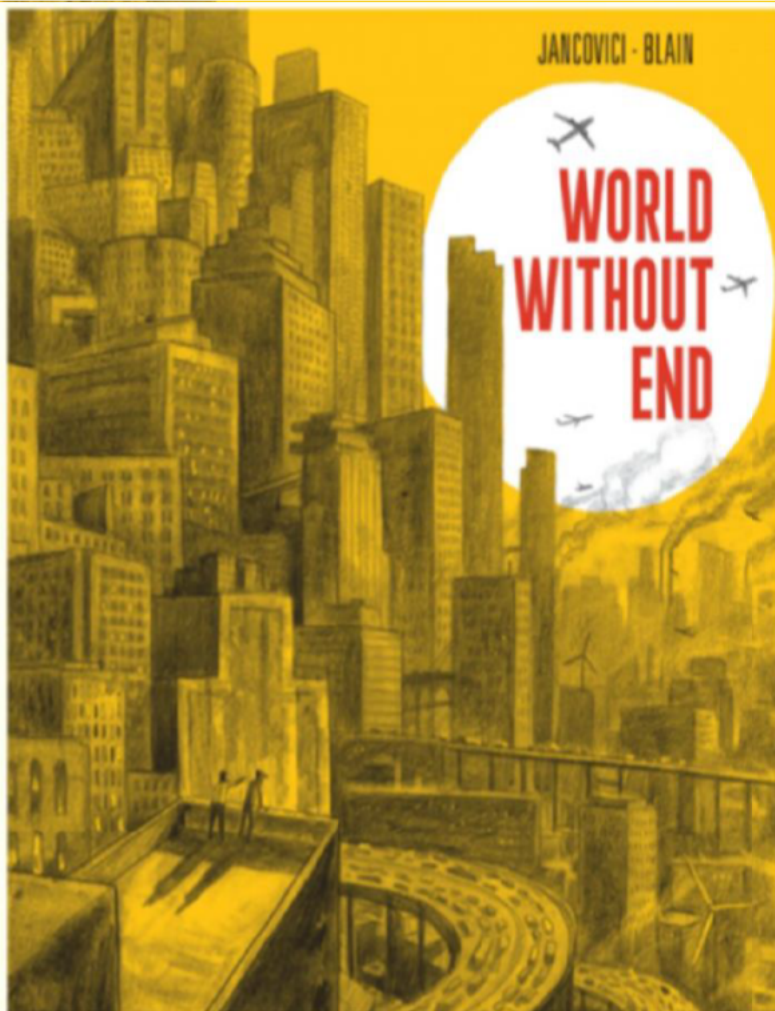


Performant construction products and systems

- > Evaluation multi-critères des produits & montée en compétence essais
- > Technology research

Digital transverse

Prospective transverse





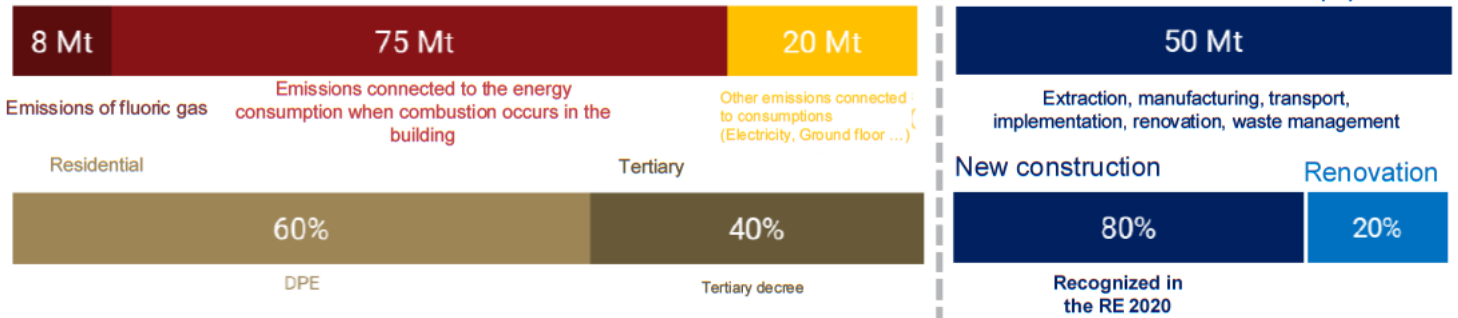
CSTB / Carbon print – Building field: 153 Mt eq CO₂/year



Exploitation of buildings – direct and indirect emissions



Products of construction and equipment



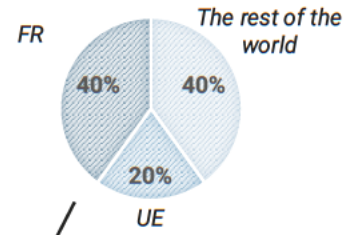
Across the French territory



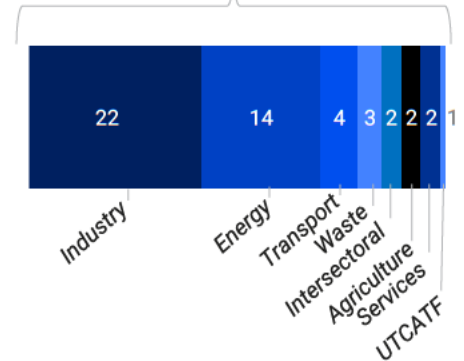
New construction



The inches we need are everywhere around us. They're in every break of the game, every minute, every second.



Emissions related to Products of construction and equipment



PELLAN M; LOUERAT M; HABERT G. A holistic perspective on the French building and construction GHG footprint, SB22
Source : calculé avec Exiobase v3.8.1, Base ADEME (facteur d'émissions), SDES (bilan énergétique)

Carbon threshold RE 2020

	Emission CO2 (Kg/m2)
RE 2020: MI: Ic_{energy} (over 50 years)	160
RE 2020: LC: Ic_{energy} (over 50 years)	560
RE 2020: MI: $Ic_{construction}$	640
RE 2020: LC: $Ic_{construction}$	740

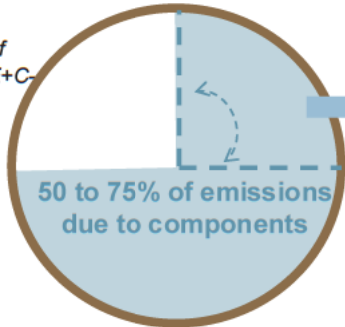


Distribution between exploitation and components?

ORDER OF MAGNITUDE FOR NEW BUILDINGS:

Over 50 years
1-1.5 tCO₂ eq./m²

Source:
Feedbacks of
experience E+C-



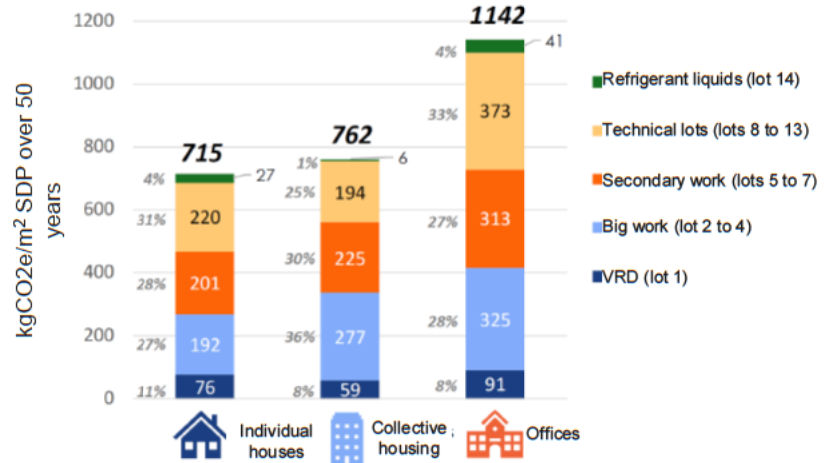
Sequestration and stockage on the plot:
~ 1 tree par 1m2 constructed and exploited

[hypothesis: absorption by 1 tree of 25kgeq.CO₂ per year]

Sources : Selmi, W. (2016). *Evaluation des services écosystémiques rendus par les arbres urbains. Etude de l'effet des arbres sur l'environnement urbain. Résultats de l'application du modèle i-Tree Eco à la ville de Strasbourg.*

[Prescripteurs Hub Bas Carbone, 2020. Messages clés. Observatoire E+C-. 19 pages.](#)

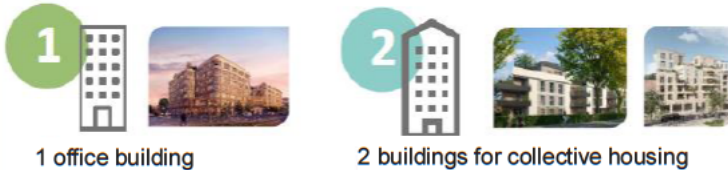
Distribution of emissions among components



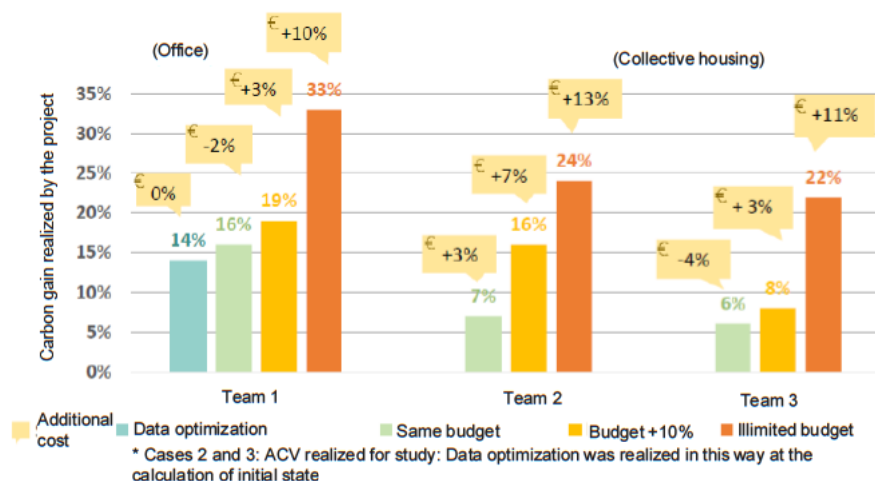
Cost/carbon focus equation

3 cases of study

Use of 3 existing designed projects and realized projects, to remain connected to the operational reality.

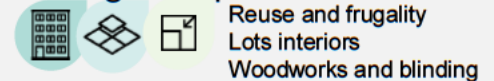


Carbon gain realized by the projects according to four scenarios

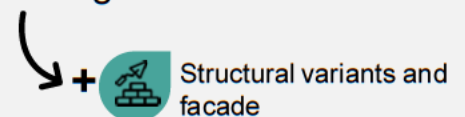


[The hub of low carbon prescribers - IFPEB](#)

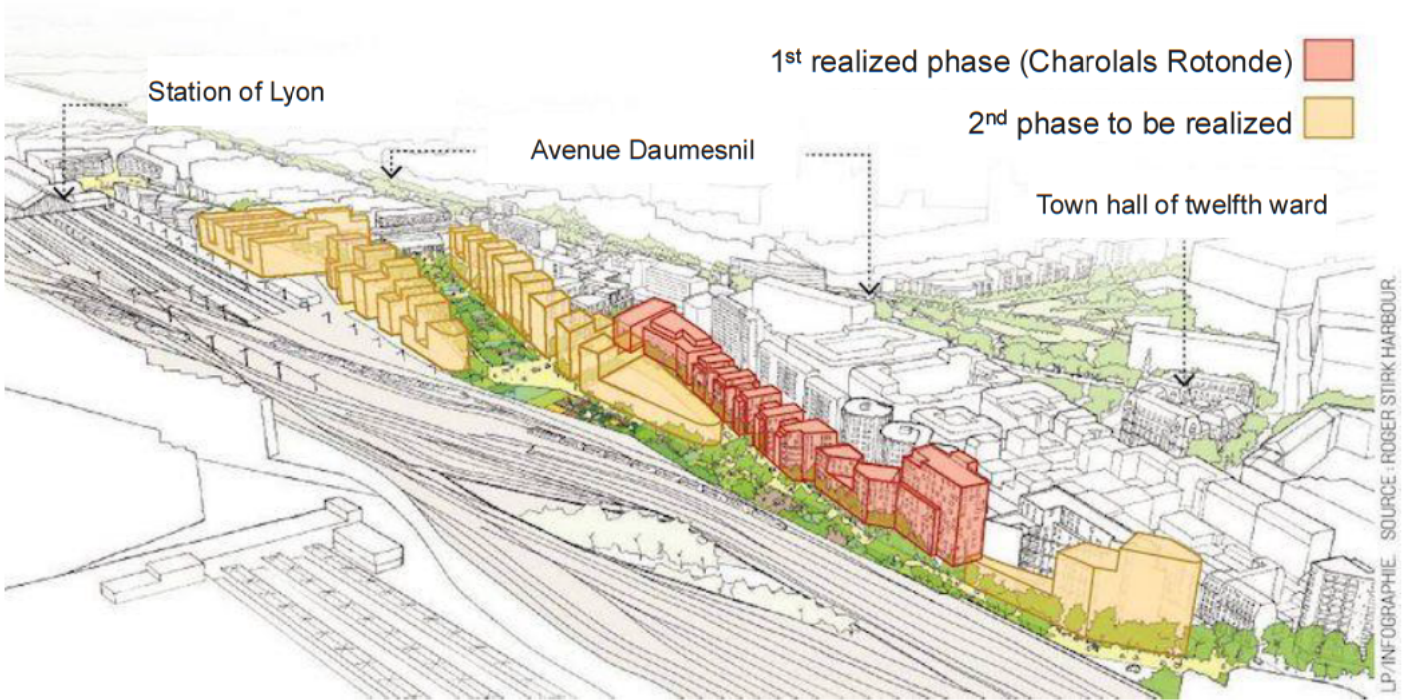
At low additional cost, the following was prioritized:



With a higher budget: the following were realized:



Low carbon variants can be more cost saving!



Label BBCA quarter (User perimeters)

How much can my project reduce the footprint of dwellers of my quarter? What are the other sectors of impact which I can affect in order to improve my quarter, even if qualitatively?

BBCA EVALUATION

Calculation of indicators BBCA Quarter



Dwellers footprint: Carbon impact of the way of living of an average dweller of the quarter, in terms of TCO₂eq/dweller/year, through statistic approach.

Average carbon footprint of a dweller of the quarter
Potential climate warming (kg eq CO₂/year)

Total carbon footprint of a dweller of the quarter

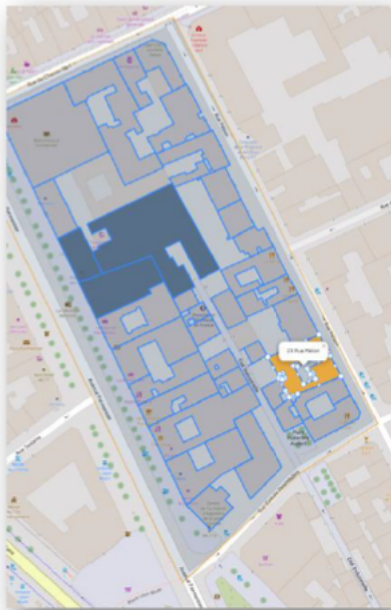


Performance of the quarter against the low carbon national trajectory (annual) 2028

Average carbon footprint of a dweller of the quarter
8,5 t.CO₂e/year

Annual average carbon footprint of referential dweller
9,1 t.CO₂e/year

Quarter Energy Carbon and Urban Footprint Method



Can be used for the phases before the conception up to the building site phases even if detailed data are not available, thanks to numerous data.



Adapted to new project, renovation or mixed.

ACV calculating principles of RE2020 and/or label E+C- are take into consideration.

Automatic feedback of geometries and characteristics of buildings existing from BDNB.



ACV powerful calculating models at the pace of the **chronical time** based on dynamic simulation engine and data base of the

IRIS scale for the evaluation of ACV environmental impacts:

- Of buildings
- Of outside spaces
- Of systems and network
- Of mobility

On the following constructors: energy, products of construction and equipment, waters, waste, building site, mobility.

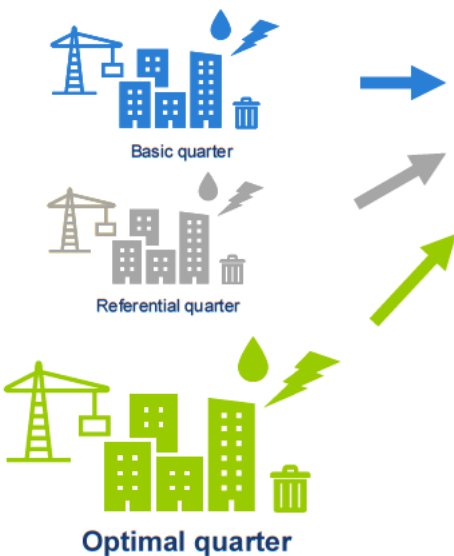


Diagram of Shapley

What are leverages (available in Urban footprint) that still I could use to improve more my project?

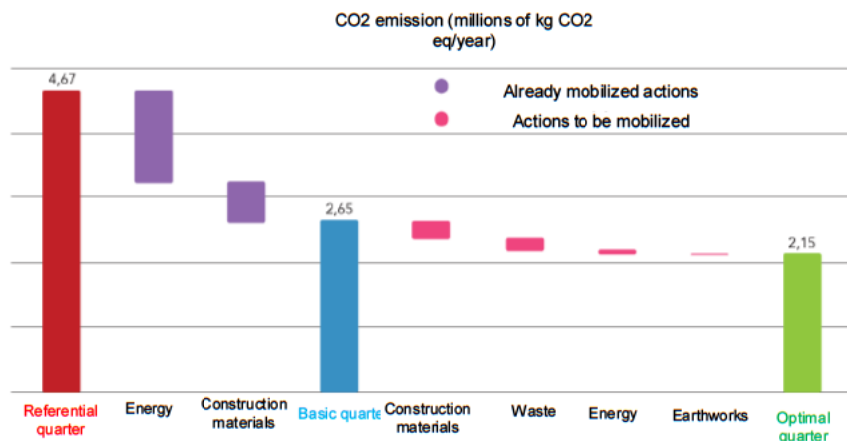
EVALUATION OF THE POTENTIAL

Identification of used/not used leverages



Aide for the decision

Sensibility analysis for evaluation of efforts realized by the basic quarter and room for possible progress. The most performant leverages are also evidenced in order to take action towards possible <<better quarter>>.

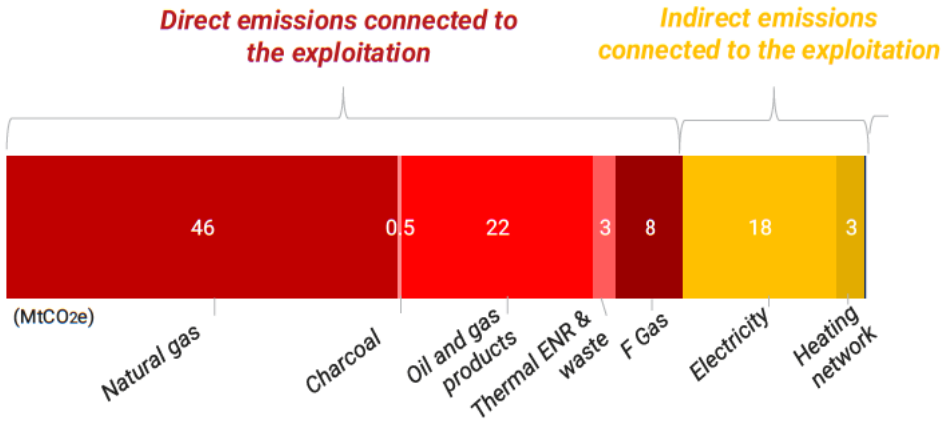


Calculated by a tool which can identify the combination of action leverages that are still available to attain the optimal in terms of carbon performance



$$\Sigma = 153 MtCO_2e$$

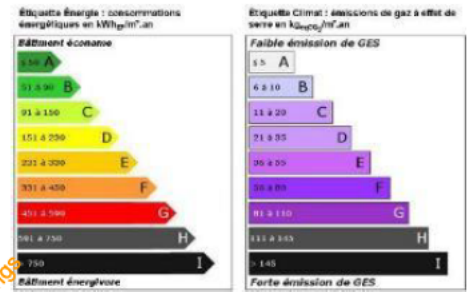
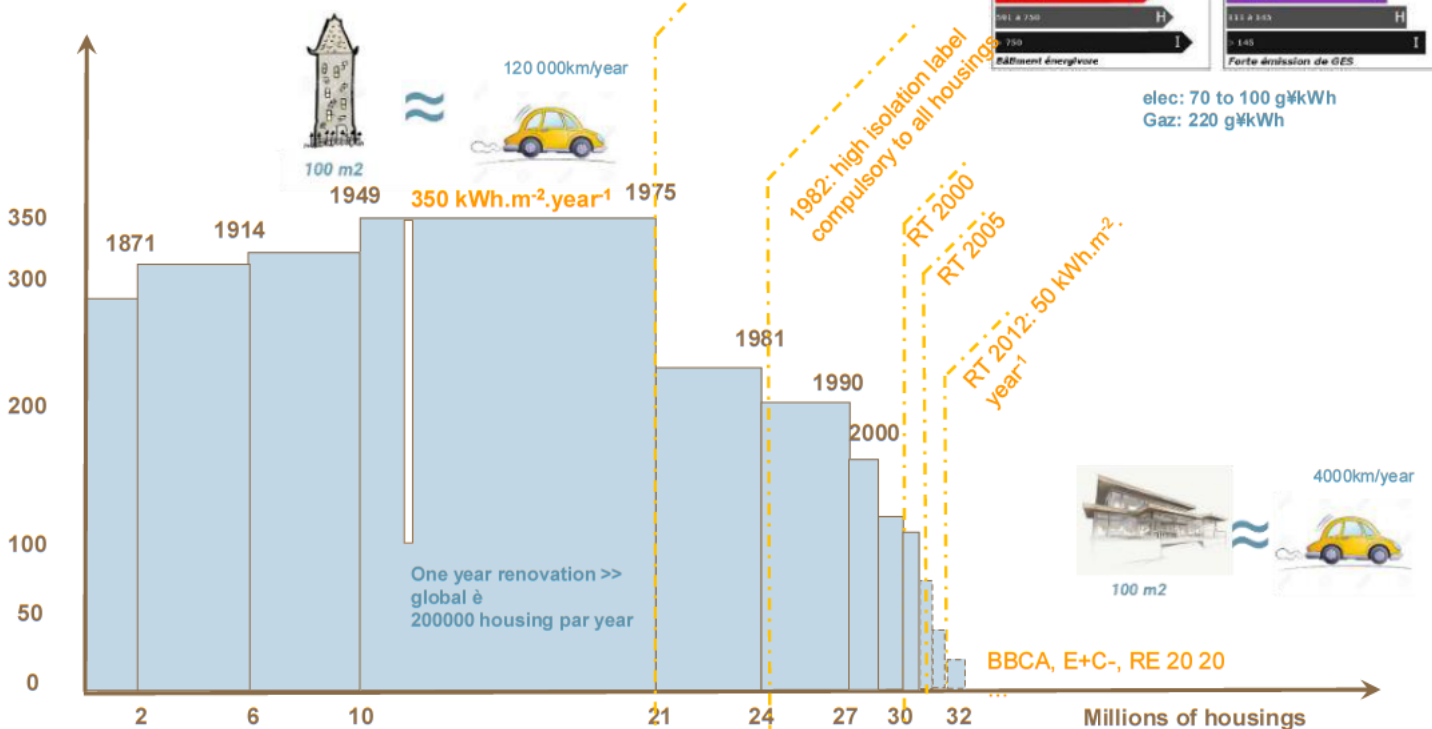
The existing park



PELLAN M; LOUERAT M; HABERT G. A holistic perspective on the French building and construction GHG footprint, SB22
Source : calculé avec Exiobase v3.8.1, Base ADEME (facteur d'émissions), SDES (bilan énergétique)

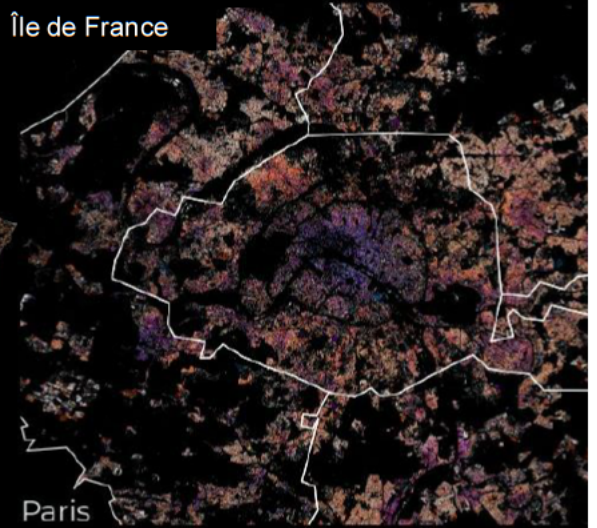
Reminder of French park

Consumption kWh.m⁻².year⁻¹

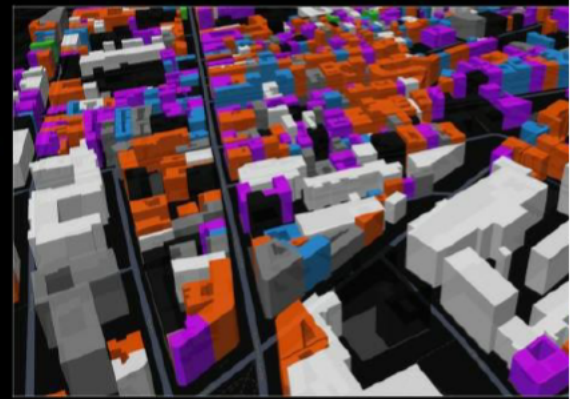


Materials of walls

Île de France



Paris



- Concrete and agglo.
- Brick
- Stone
- Milestone
- Wood

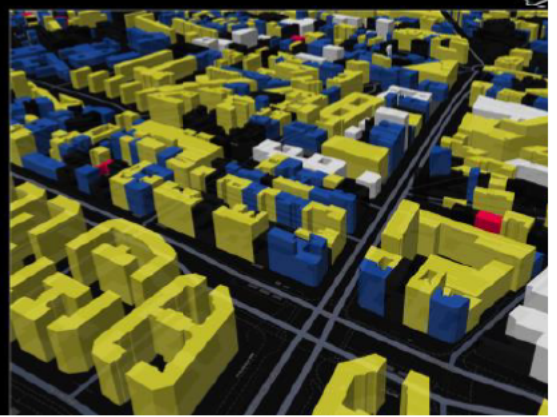
Sources : BDNB 2022-10.b, Fichier Foncier 2022, BD Topo 2022, ADEME DPE 2022

Heating energy

Île de France



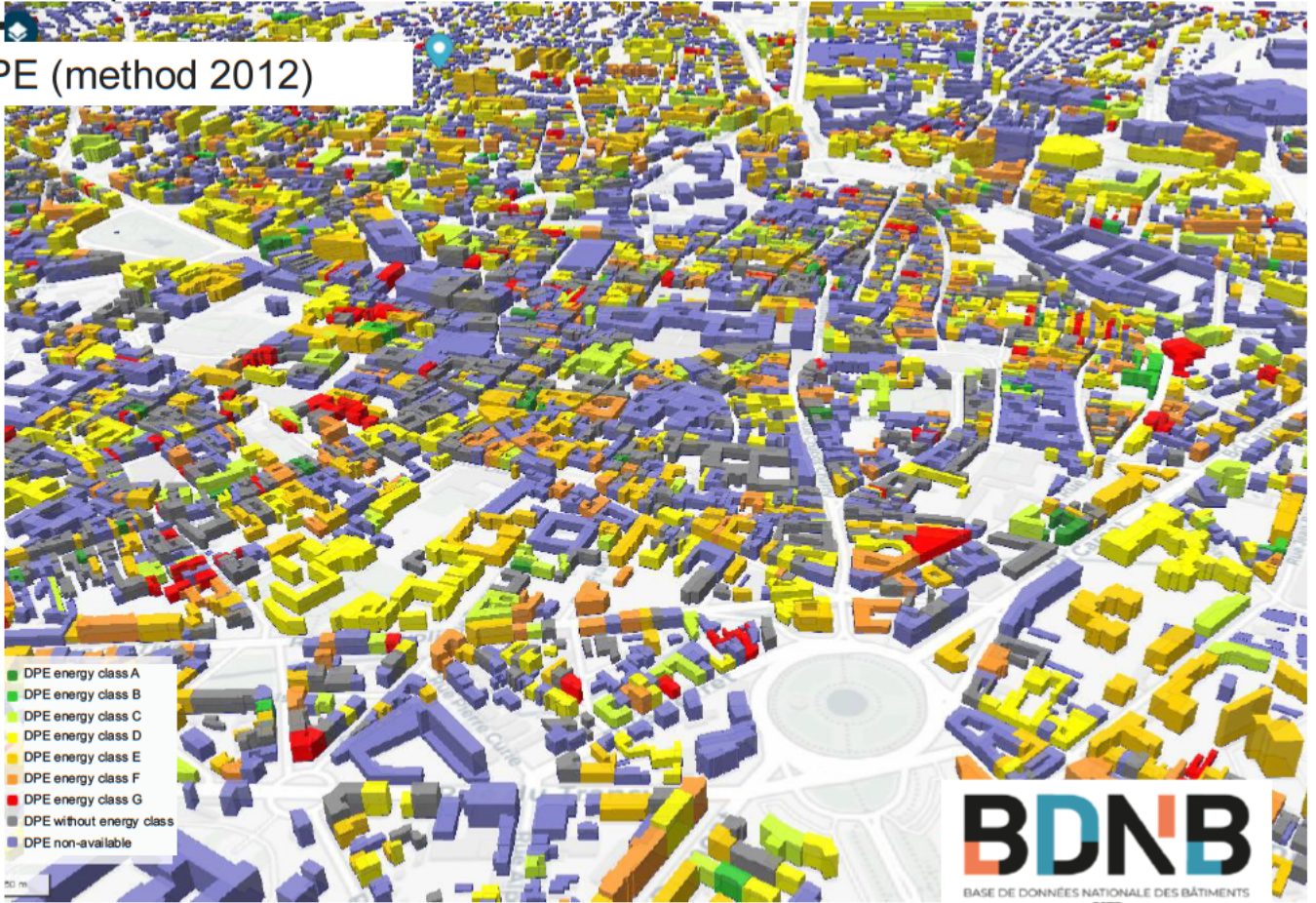
Paris, porte d'Orléans



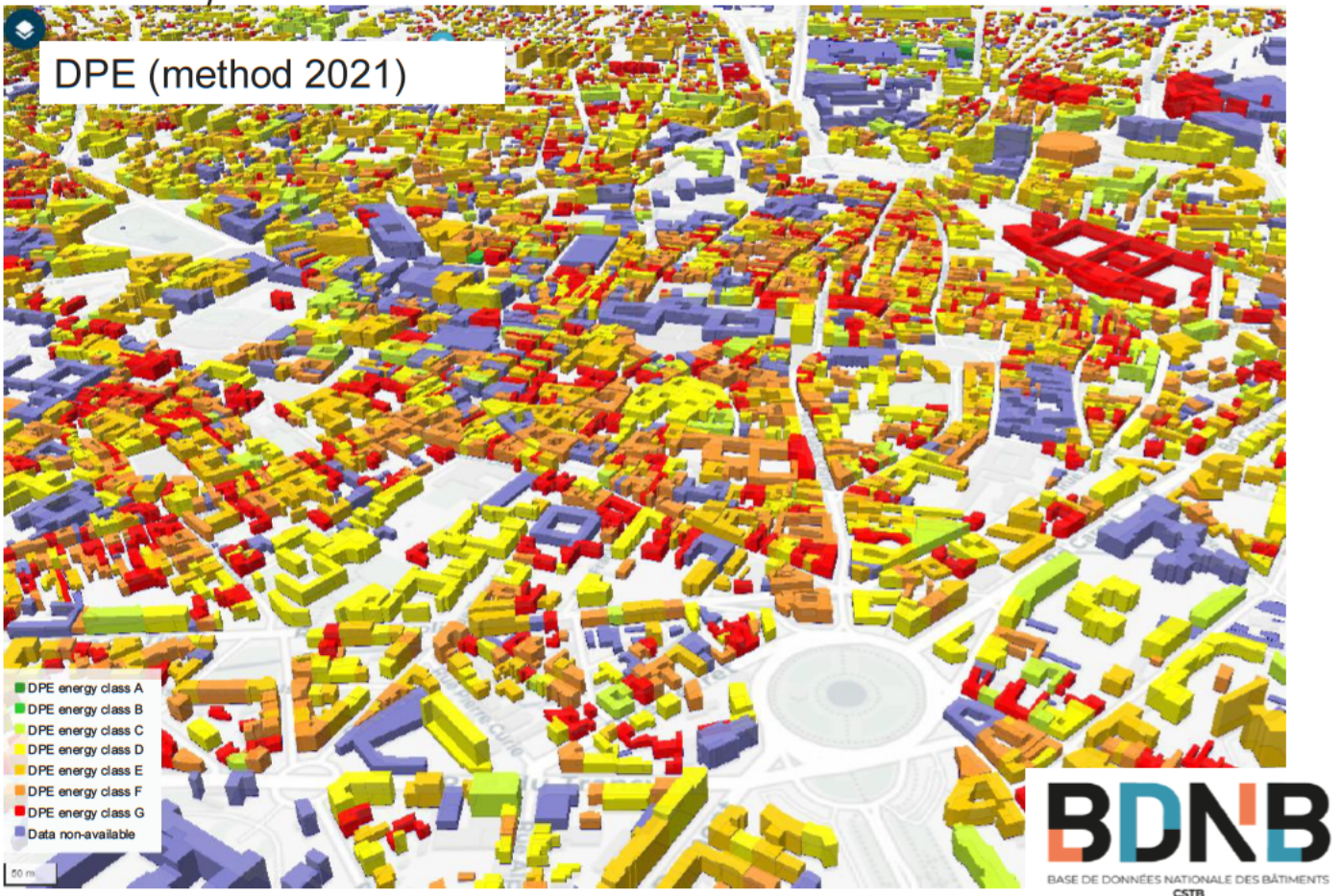
- Wood
- Fuel oil
- Heating network
- Electricity
- Gas

Sources : BDNB 2022-10.b, Fichier Foncier 2022, BD Topo 2022, ADEME DPE 2022

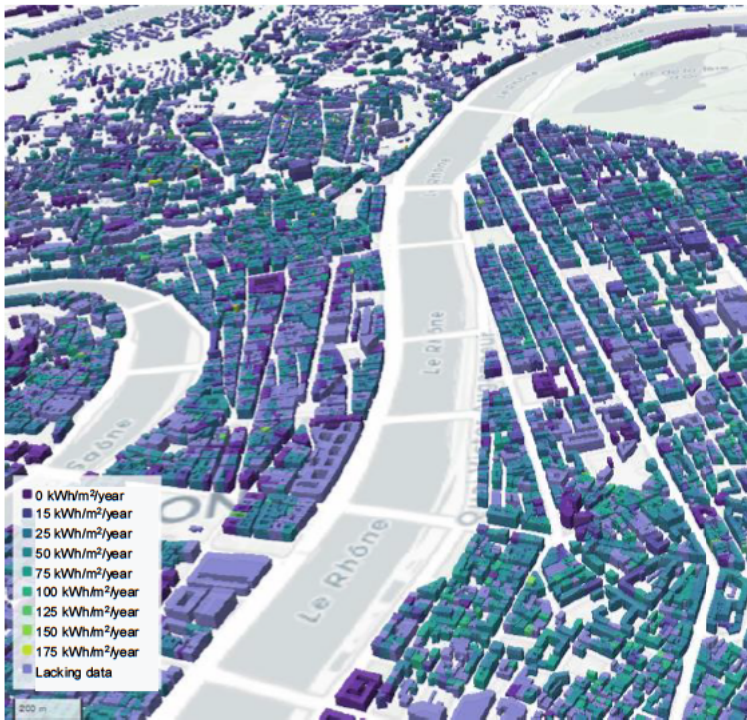
DPE (method 2012)



DPE (method 2021)



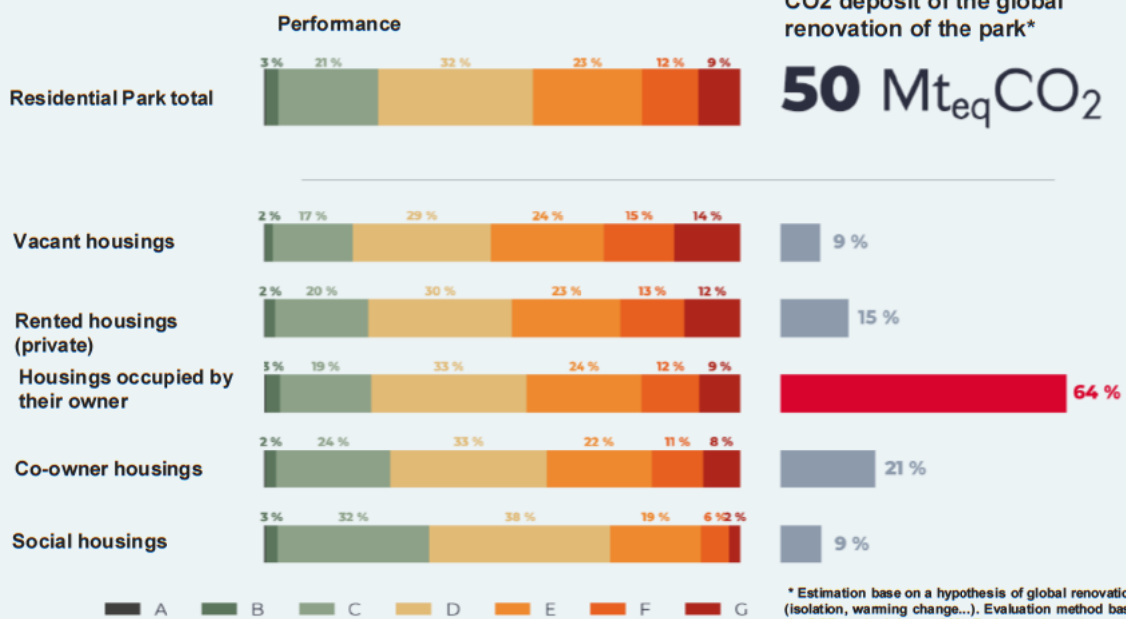
Electricity consumption par habitable m²



Sales price



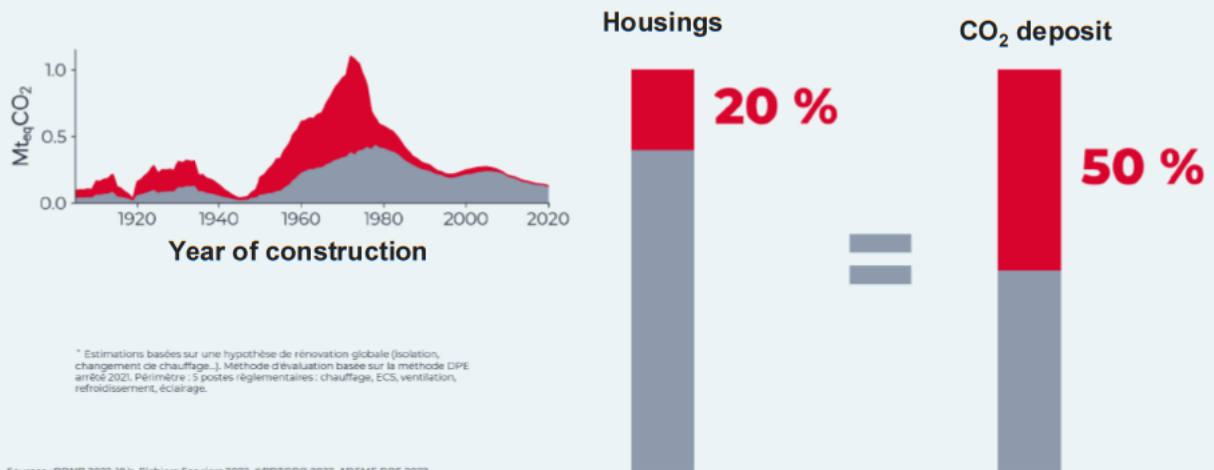
BDNB
BASE DE DONNÉES NATIONALE DES BÂTIMENTS
CSTB



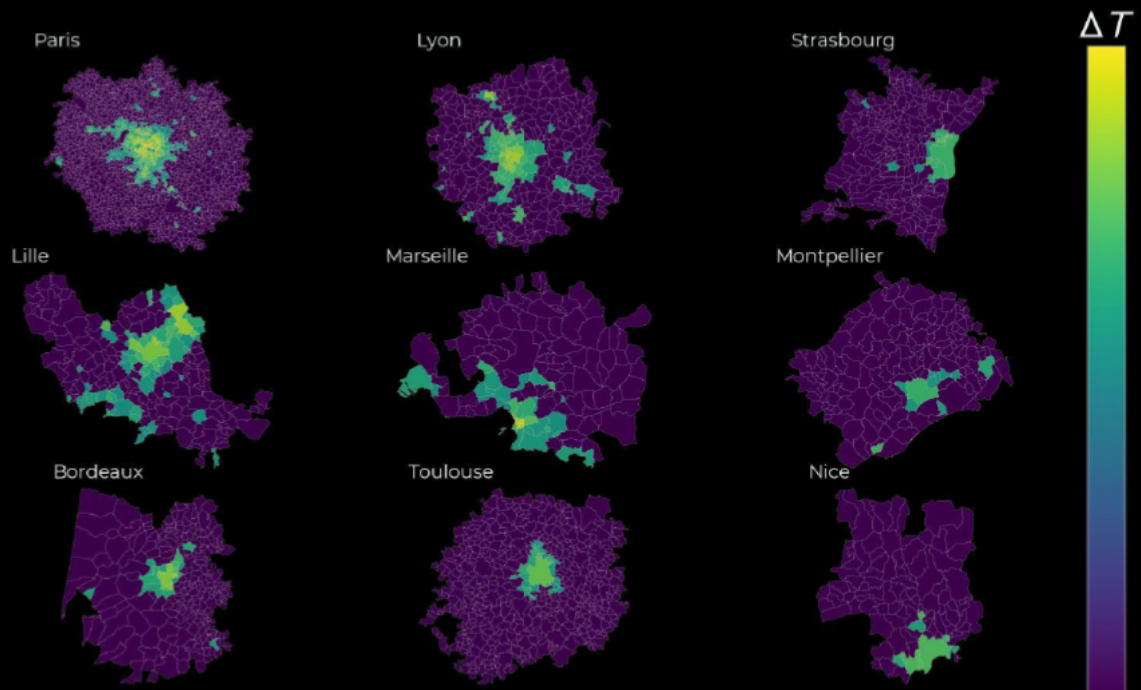
Sources : BDNB 2022-10.b, Fichiers Fonciers 2022, @BDTOPO 2022, ADEME DPE 2022

BDNB
BASE DE DONNÉES NATIONALE DES BÂTIMENTS
CSTB

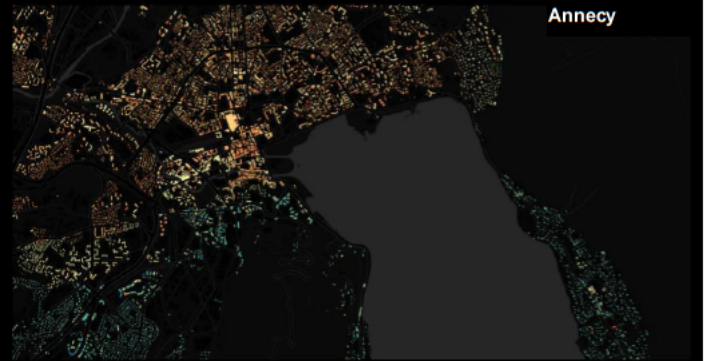
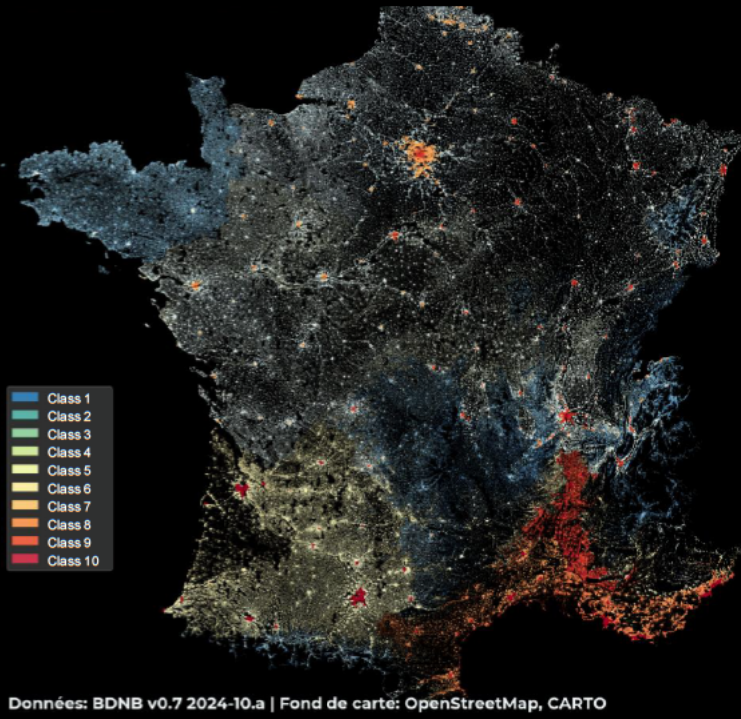
CO₂ deposit of the global renovation of the park*



Urban heat islands



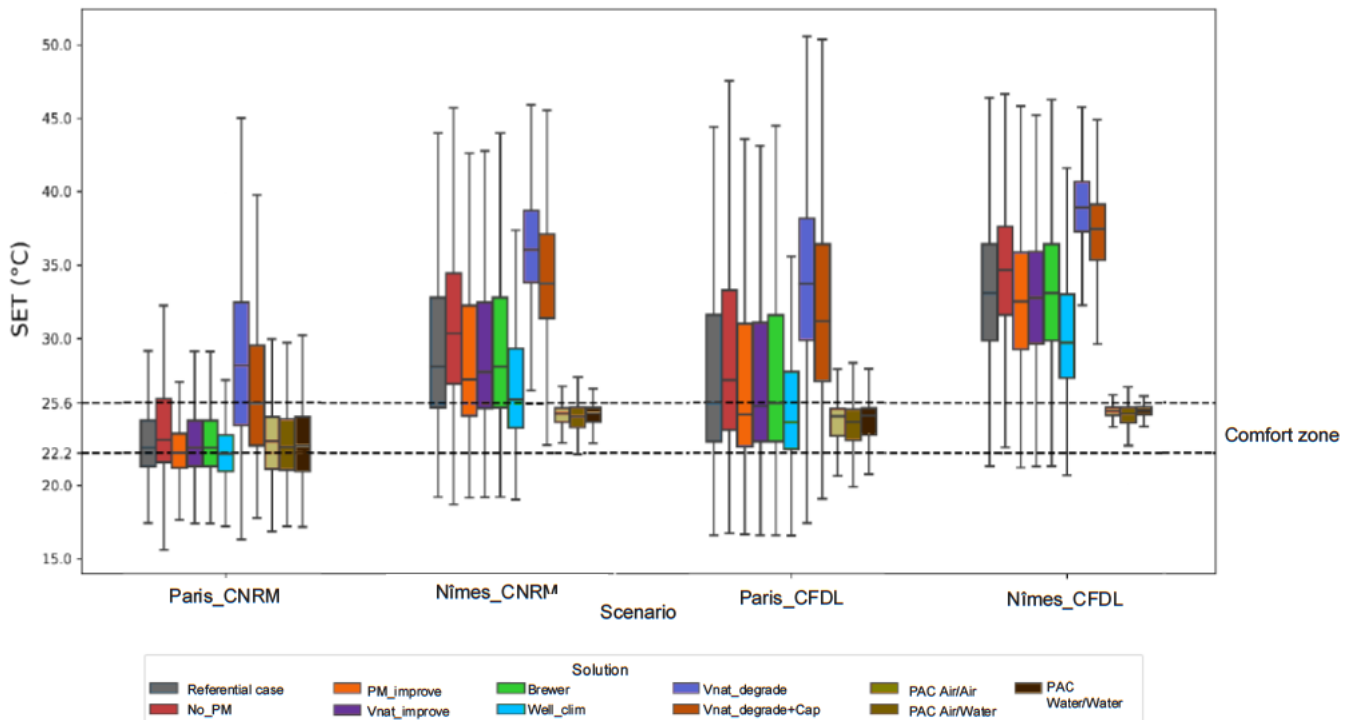
Overheat indicator of building – ISB DH



Données: BDNB v0.7 2024-10.a | Fond de carte: OpenStreetMap, CARTO

Assure the conform in scenarios that could be critical

Box plot by Solution and by Types of Scenarios (Period: June – August)



CRNM=Least hot model, GFDL=Hottest model

Components of works

1. Accelerate realization and access to the **environmental data** for a clear choice at the various steps of the project
2. Create conditions to **secure** and, therefore, **accelerate** the appeal to the low carbon components
3. Decarbonization of industrial processes – Generalize actions of industrials in favor of decarbonization
4. Accelerate the use of low carbon weight components having a performance meeting with the demand
5. Rely on local resources and solutions
6. Optimize durability, reuse and recycling of construction components
7. Develop functionality economy

Renovation

1. Reinforce the efficiency requirement of the renovation
2. **Massif the global renovation**
3. Raise objectives of the renovation
4. Measure the performance

Use of buildings

1. Develop a **culture** of building exploitation and use which is sober and **low carbon**
2. Develop technical condition which is operational for exploitation of sober and low carbon buildings
3. Consume energy otherwise (better and at the good timing) in the exploitation phase
4. Facilitate the parceled densification and the multi-usage in an existing building

25 leverages, 120 measures for decarbonization of building sector

New construction

1. **Optimize m²**
2. **Enlarge the field of application of RE2020**
3. Green the building and the plot
4. Encourage the elevation
5. Develop **frugal architecture** to win on resources and consumption
6. Rethink of construction system to optimize the material quality

Transverse levers

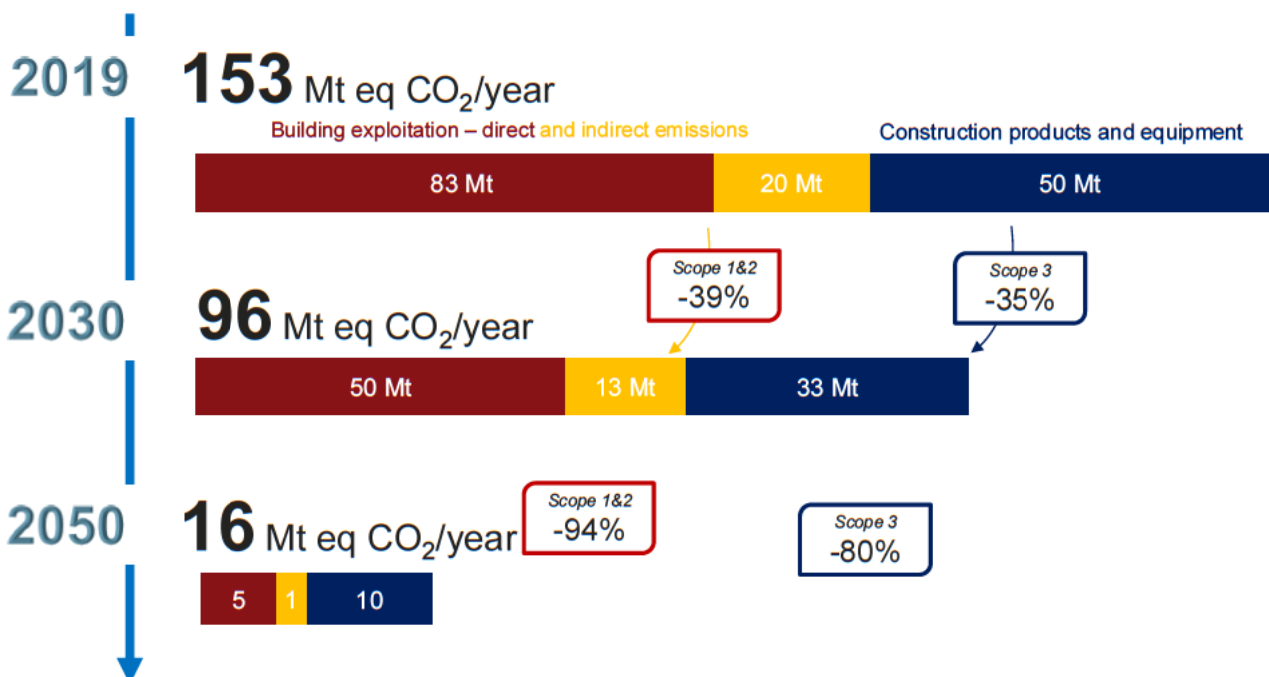
1. Secure an optimum between deconstruction and renovation
2. Improve and complete the means proposed by financial actors to massif the building decarbonization in every and all scales
3. Favorize installation and utilization of very effective systems of renewable energy and recuperation in the building
4. Manufacturing in a workshop of construction bricks at a low level of carbon emission



<https://www.planbatimentdurable.developpement-durable.gouv.fr/la-feuille-de-route-decarbonation-du-cycle-de-vie-a1673.html>

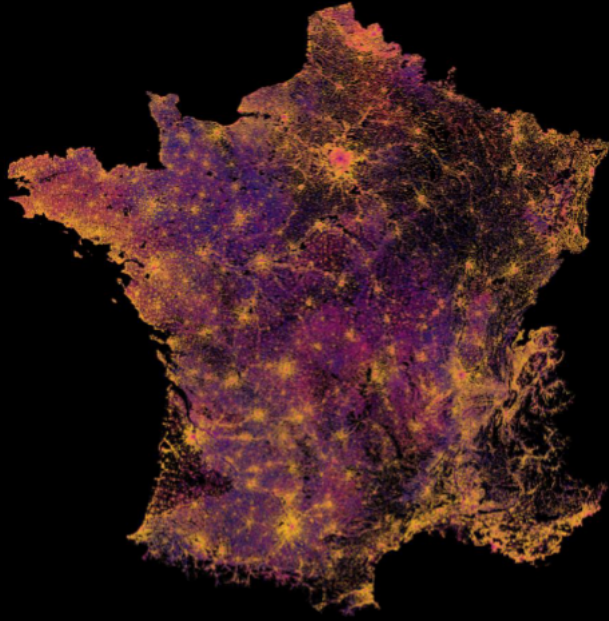


Carbon footprint of the sector Objective 2030 and 2050



Thank you for your attention!!

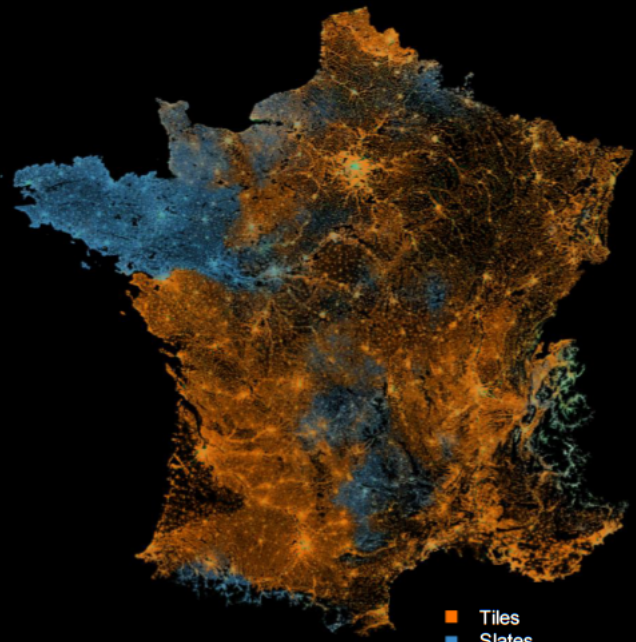
Year of construction



1800 1825 1850 1875 1900 1925 1950 1975 2000

Year of construction

Roof material



- Tiles
- Slates
- Zinc Aluminum
- Concrete

