

Supporting a Sustainable Development Dynamic in Lyon

Mike Muldoon

Business Development Director, UK & I

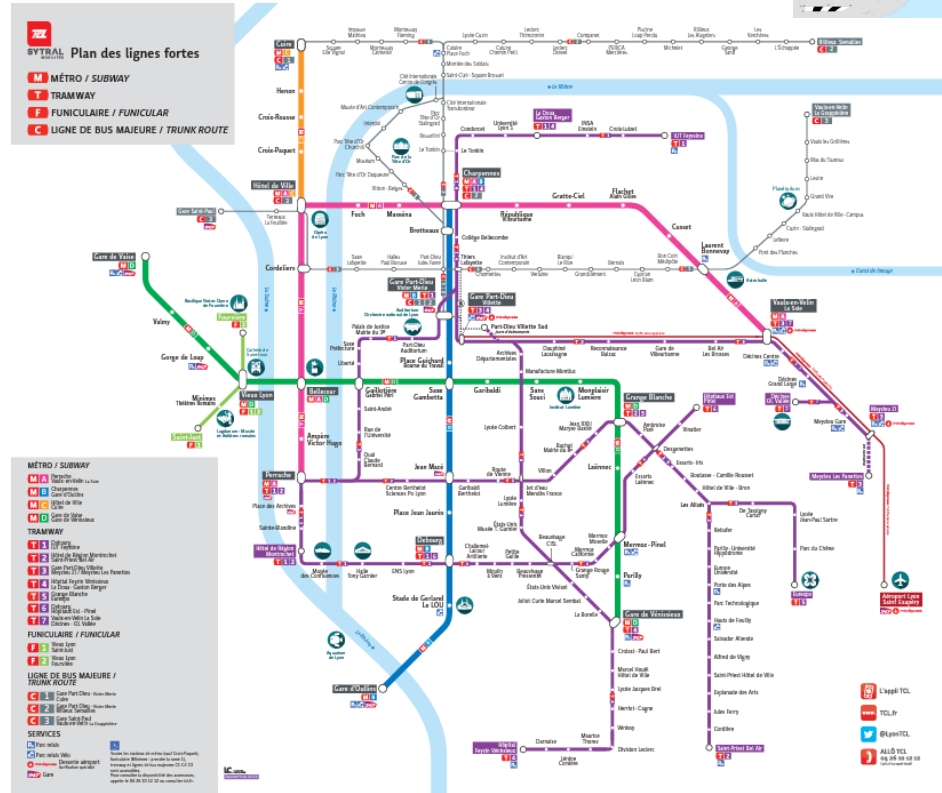
SYSTRA



Image produced by ILEX

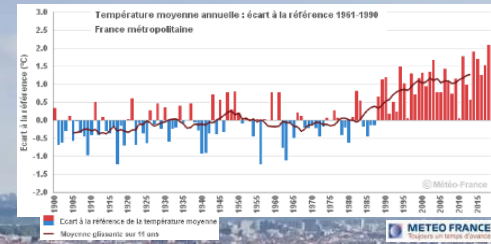
Welcome to Lyon

- Second most populace city in France
- Population of over 2.3 million in the greater Lyon area
- Linked to Paris via TGV
- It has an extensive public transport network – metro, tram and bus routes
- Centre for banking, chemical, pharmaceutical and biotech industries
- Second-largest student city in France, with nearly 200,000 students



Welcome to Lyon

- Lyon was named in a survey as one of the three French cities most likely to be impacted by significant temperature increase due to climate change
- Lyon has also described itself as a city **transforming itself to remain habitable in the summer months in the next 30 years...**





Mobility and transport infrastructure

**At the heart of
environmental issues**

Carbon emissions

- We all know how much lower operational emissions are for public transport vs cars (and most other individual modes of transport)
- But we still generate emissions and we can improve
- Around 80% of tram lifecycle emissions are due to construction and maintenance of the infrastructure
- This is the challenge we are now addressing with Ecodesign

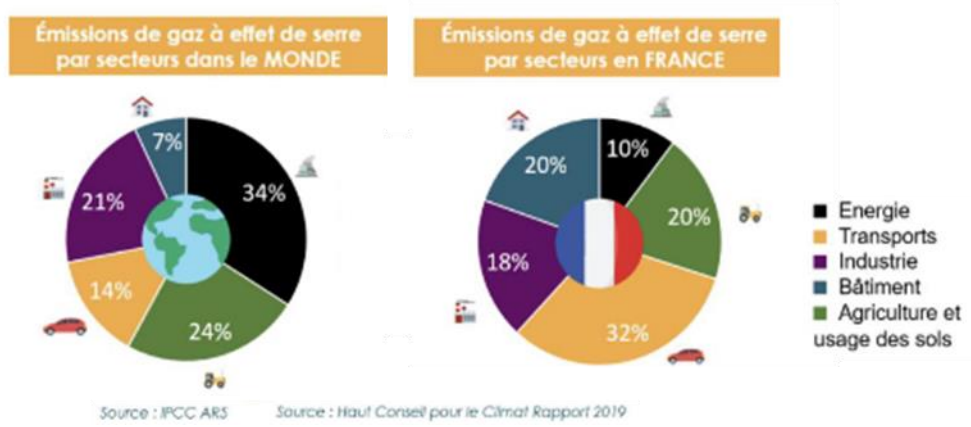




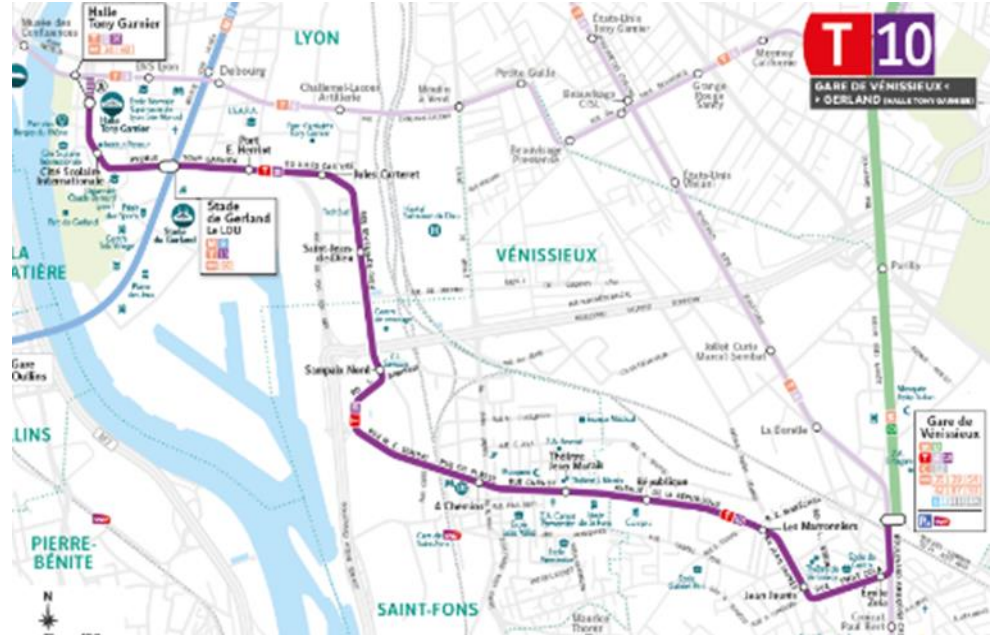
Image produced by ILEX

Lyon T10 tramway

The ecodesign process

Overview

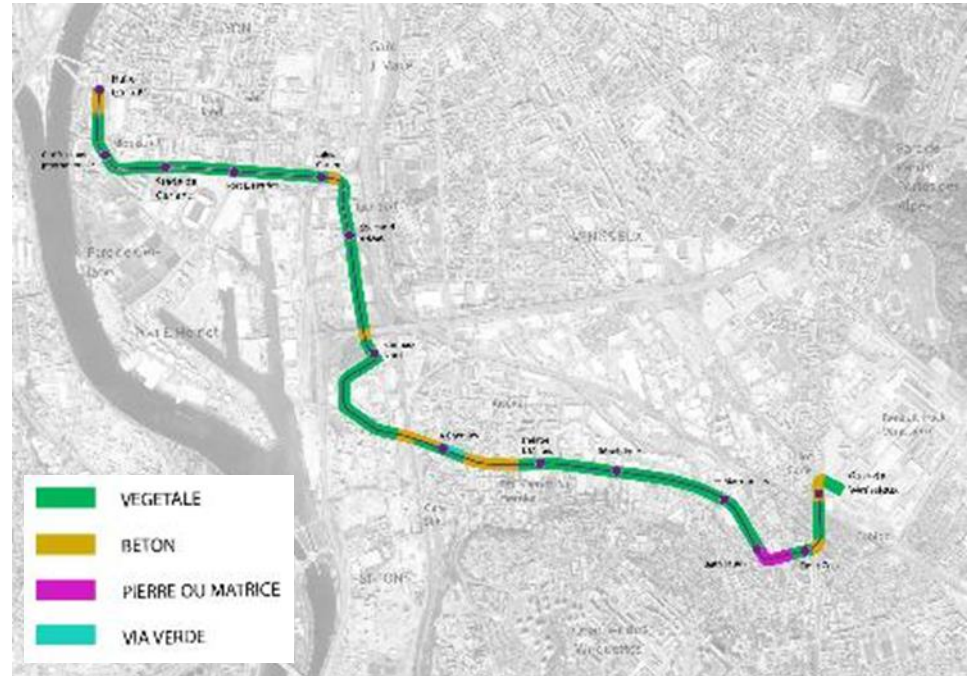
- Urban context
 - 3 municipalities
 - Second ring road line
 - Mixed urban/industrial context
- Key figures
 - 8.1 km of infrastructure
 - 4 stations
 - 4 substations
 - €225 million, including:
 - €42.5 million for utilities networks
 - €34.5 million for storage area
 - Depot for 45 x 32m trams
 - Bridges: 2 new + 1 modified



Line T10 route

Overview

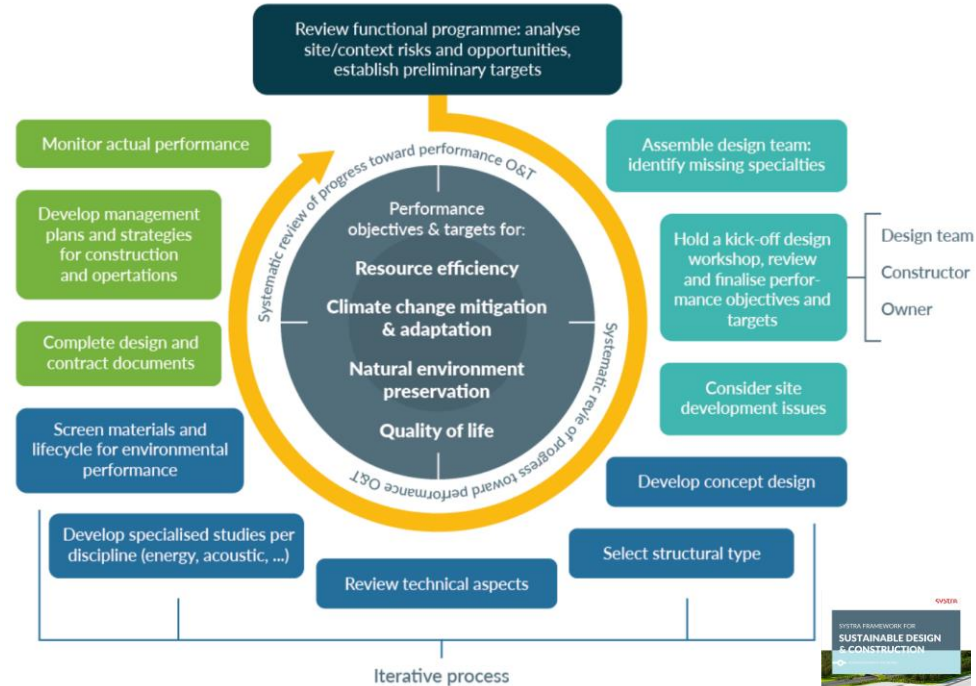
- Operation:
 - Commercial speed: ~18km/h
 - PPHPD: 22,000 (by 2030)
 - Headway: 10 minutes
 - Fleet: 8 trams of 32 m (Citadis 302 Alstom)
- Build programme:
 - Summer 2021: Concept design
 - May 2022: Outline design
 - December 2022: Detail design
 - Mid 2023 – Mid 2024: Utilities
 - End of 2023 – End of 2025: Main works
 - Q1 2026: Testing & commissioning
- Tight programme - concept paramount



Type of trackbed to be used along the route

Sustainable design and construction guide

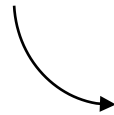
- SYSTRA's Sustainable Design and Construction Guide sets out a process to evaluate and develop project parameters from an ecodesign perspective
- Lyon T10 was the first full deployment of this approach
- A specific methodology is applied to each particular design case
- All aspects are evaluated from a range of perspectives, for example resource efficiency or natural environment preservation



Source: SYSTRA Sustainable Design & Construction Guide

The process applied

1. Infrastructure breakdown
2. Attribution of ecodesign issues by subsystem
3. Identification of critical elements
4. Definition of qualitative and quantitative criteria
5. Solution Analysis



Evaluation of the "environmental gain" achieved

Tram infrastructure

Decomposition of infrastructure into systems and subsystems

- Basic support for ecodesign analysis
- Solution at different system/subsystem/component scales
- Visualization of subsystems and people involved in ecodesign management



Selection of critical systems

			Enjeu écoconception	Efficacité des ressources				Préservation de l'environnement			Qualité de vie			Adaptation changement climatique	
				Matériaux	Energie	Eau	Solutions numériques	Ressources en eau	Biodiversité et écologie	Utilisation des terres	Intégration paysage	Réduction bruits et vibrations	Impacts qualité de l'air	Environnement confortable	Résilience
Centre de remisage	Enveloppe bâtiment	Gros-œuvre	Oui	•											•
		Equipements intérieurs	Oui										•		
		Façades	Oui	•										•	
		Charpente métallique et bois	Oui	•											
	Technique bâtiment	Toiture - terrasses	Oui	•										•	
		Equipements Basse Tension	Oui		•										
		Thermique	Oui		•										
	Hydraulique	Oui		•	•										
	Ventilation	Oui		•									•	•	
	Energie (production et consommation)	Oui		•									•	•	
Infra-structure linéaire	Plateforme	Démolition	Oui												•
		Purge	Oui												•
		Terrassement	Oui												•
		Multitubulaire	Non												
		Fondations	Oui	•											
		Pose de voie	Oui	•		•									
		Revêtement site propre	Oui	•											
Aménagements espaces publics	Voirie	Chaussée	Oui												•
		Petit génie civil	Oui	•											•
		Désimperméabilisation et gestion des EP	Oui	•											•
	Aménagement paysager	Voies Lyonnaises	Oui	•											•
		Eclairage public	Oui		•										•
		Equipement VRD	Pas évident	•											•
	Plantations	Oui		•										•	
	Mobilier urbain	Oui	•											•	



➔ Track bed



➔ Energy management



➔ Water management



➔ Road materials

Environmental footprint infrastructure

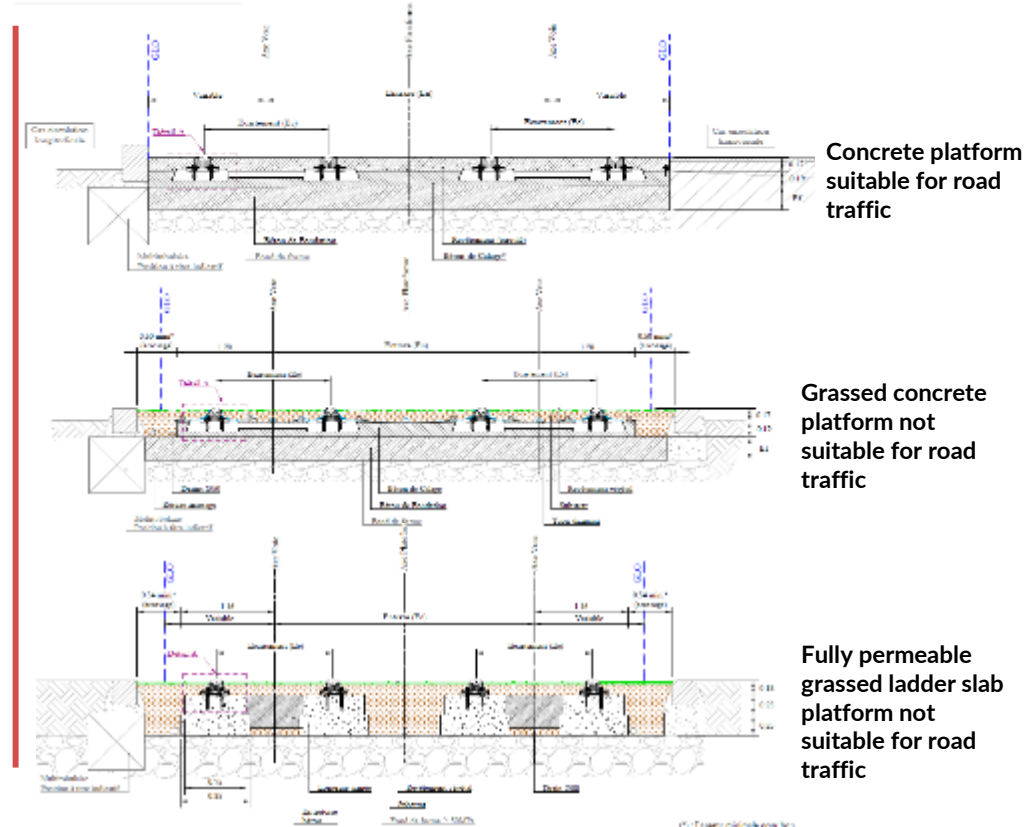
1. Track bed

- Carbon footprint
- Use of software developed by SYSTRA

CARBONTRACKER

- Carbon emission factors materials
- Results:

- Plateforme **béton minérale** : 900 $\text{kg}_{\text{eq}}\text{CO}_2/\text{ml}$
- Plateforme **béton végétalisée** : 646 $\text{kg}_{\text{eq}}\text{CO}_2/\text{ml}$
- Plateforme sur **longrines végétalisée** : 467 $\text{kg}_{\text{eq}}\text{CO}_2/\text{ml}$



Environmental footprint infrastructure

1. Track bed

- Carbon footprint

Strategy	Type of track bed	%age	Volume of excavated material (m ³)	Volume of concrete (m ³)	Track bed carbon impact (t _{eq} CO ₂)
Fit for traffic concrete track bed	Concrete	100%	30 700	30 700	8 370
	Grass over concrete slab	0%			
	Grass on ladder slab	0%			
Above plus green track bed (not ladder slab)	Concrete	34%	18 000	25 000	6 815
	Grass over concrete slab	66%			
	Grass on ladder slab	0%			
Outline design T10	Concrete	34%	24 000	23 500	6 455
	Grass over concrete slab	45%			
	Grass on ladder slab	21%			



-22,8 % of "carbon bill" of the track bed
 -3,5 % of total "carbon bill" of T10

Environmental Footprint - Infrastructure

2. Energy management of the Saint-Fons maintenance centre

Estimated energy requirement ~ 1 000 MWh/yr :

- **610 MWh/yr** energy requirement for the depot
- **300 MWh/yr** required for **heating**

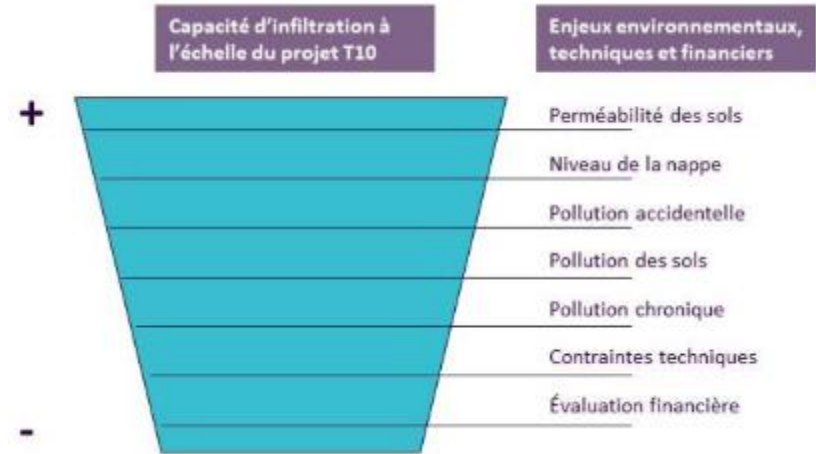
- Domestic hot water: Solar thermal installation
- Electricity production: photovoltaic solar panels
- Building heating: Surville (district heating) boiler room connection



Environmental Footprint - Infrastructure

3. Rain water management

- Ambitious objectives for T10
 - Infiltrate to the maximum to avoid feeding into the drainage network
 - Particular attention paid to environmental constraints (pollution)
- Further considerations
 - Regulation for climate change resilience
 - Carbon footprint of the "discharge to the drainage" solution?

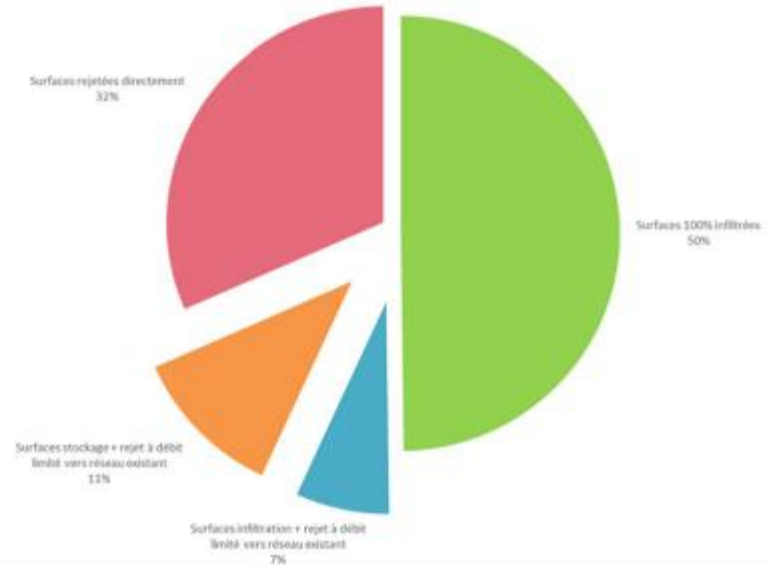


Environmental Footprint - Infrastructure

3. Stormwater management and soil sealing

- Assessment at the detail design stage
- Green zones: 100% infiltration
 - Blue zones: infiltration + limited flow discharge
 - Orange zones: storage + limited flow discharge
 - Red zones: discharge to the network (accidental pollution constraints in crossroads areas, underground congestion, etc.)

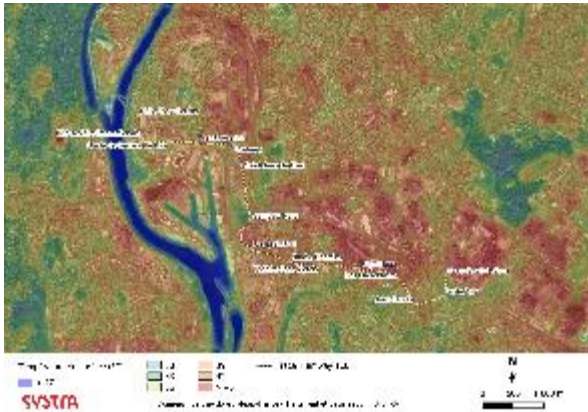
Bilan de la gestion des eaux pluviales sur la ligne T10



Environmental Footprint - Infrastructure

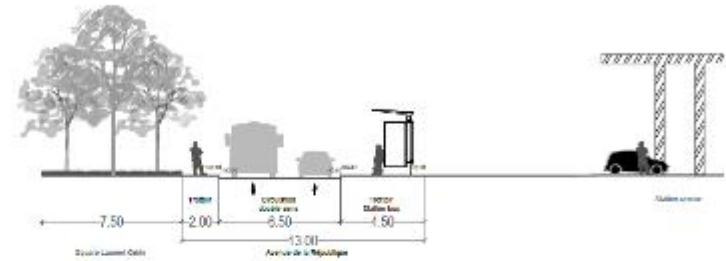
4. Road surfaces

- Rehabilitation of public space from façade to façade
- Modification of roads and restoration of pavement structures along the entire T10 route

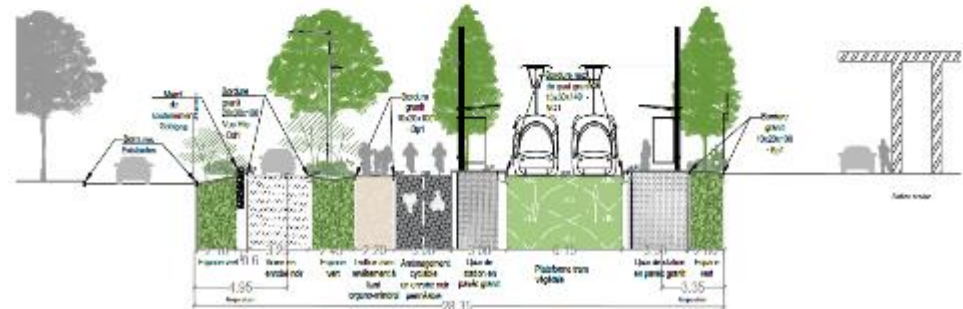


Source : Climateplus, solution developed by SYSTRA

Coupe existante - Avenue de la République Sud



Coupe projet - Avenue de la République Sud



Coupe d'aménagement - PRO - Avenue de la République

Environmental Footprint - Infrastructure

Some other themes dealt with on the project

- Fertile Soil Project (locally sourced)
 - Revegetation
 - Alignment trees (+128%)
 - Overall: 3 trees for 1 felled
 - Native and Mediterranean plant species: 70%
 - Diversification of fauna (tree/shrub/herbaceous)
 - Creation of “islands of freshness”
 - Revegetation of the platform (via verde) and trees in stations
 - Watering systems not used
- Lighting
 - Movement sensors
 - Timer control, low level lighting
 - Depot
 - Insulation
 - Green roof
 - Shed – natural lighting
 - Rainwater recovery and recycling – tram wash
 - Power sub-stations
 - Wood cement panels with integrated insulation

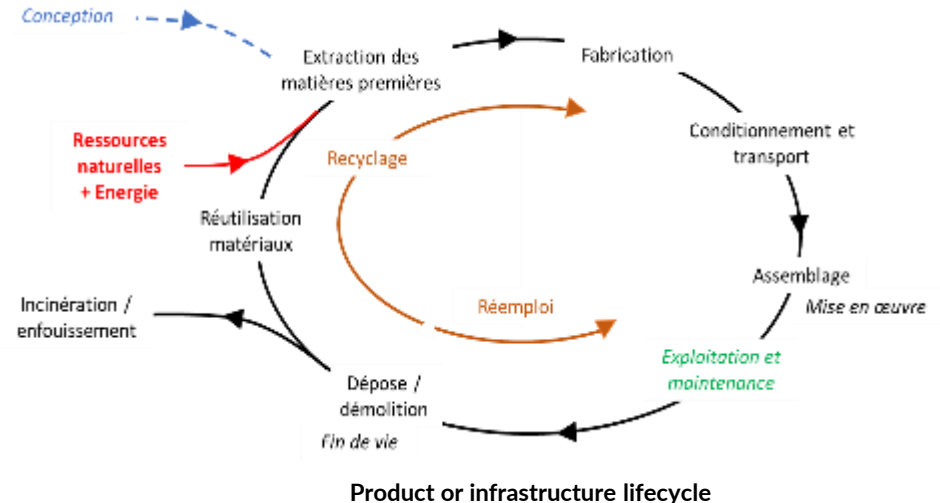


The start of the ecodesign approach

Development
prospects

A process of continuous improvement

- Continuation of life cycle analyses of the solutions implemented
 - Methodology for carrying out comprehensive carbon assessments of projects
 - Carrying out energy balances
 - Alignment of complementary LCAs: use of fresh water, soil pollution, etc.
- Ability to complete these analyses according to the expectations and demand of our customers



SYSTRA



CONFIDENCE MOVES THE WORLD