change 2024
Sydney | 3-4 July

Leveraging openBIM for Low-Cabon Design

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SYSTRA

The climate emergency imposes taking action in reducing carbon emissions

THE PARIS AGREMEENT

2050: Carbon neutrality

WITHIN THE EU

2030: 50% reduction in carbon emissions

SUSTAINABLE DEVELOPMENT GOALS

5 GENDER EQUALITY

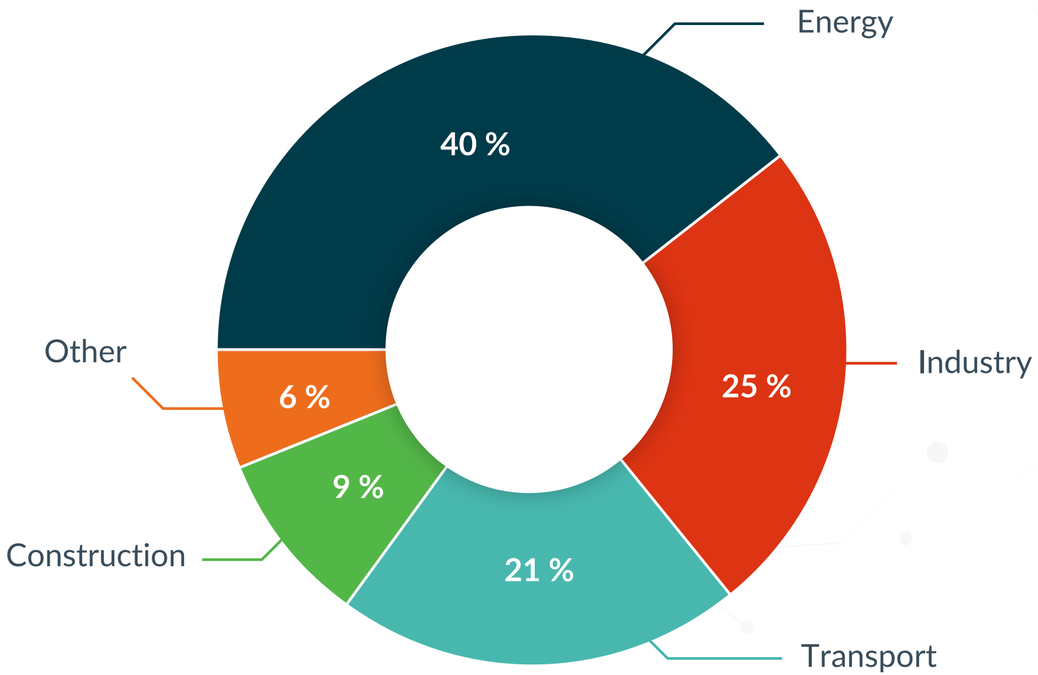
8 DECENT WORK AND ECONOMIC GROWTH

9 INNOVATION & INFRASTRUCTURE

11 SUSTAINABLE CITIES AND COMMUNITIES

13 CLIMATE ACTION

As a mobility and transport expert, SYSTRA has a key role to play



CO2 emissions by sector in 2020

Source: International Energy Agency

Infrastructures have a significant carbon footprint

A COMMERCIAL BUILDING OF 6 500m²

6 000 tCO2e

Equivalent to **1 200 x** per capita per year carbon emissions*

A 1 000m TUNNEL

20 000 tCO2e

Equivalent to **4 000 x** per capita per year carbon emissions*

A 1 000m RAILWAY VIADUCT

22 850 tCO2e

Equivalent to **4 570 x** per capita per year carbon emissions*

ASSESSING THE CARBON FOOTPRINT OF TRANSPORT INFRASTRUCTURES IS LESS COMMON AND MORE COMPLEX THAN THAT OF BUILDINGS.
TO HELP MANAGE IT EFFICIENTLY, **SYSTRA** HAS DEVELOPED **CARBONTRACKER**

Source: Construction21 and SYSTRA projects, figures applied to construction, carbon emissions in France

Why CARBONTRACKER ?

A carbon tool **developed specifically for infrastructure projects**

A database of carbon data derived from our 20 years of global expertise

We go further than a mere technological approach by addressing the carbon footprint, you **give meaning to your projects within the context of the climate emergency**

CARBONTRACKER

A web solution created with professionals from multiple areas of technical expertise *(BIM, climate and carbon, civil engineering, architecture, systems etc.)*

A decision-making tool to view and determine **the most appropriate optimisation solutions depending on your criteria**

Ability to visualise the emissions avoided via optimisations and to obtain reliable information in order to **communicate the positive effects of the project to your stakeholders**

Implementation Success Factors

Using the CarbonTracker web application, which is BIM-compatible, to

MEASURE | **MANAGE** | **CONTROL**

carbon emissions at **every stage of a transport infrastructure project**

Quantify in real time the carbon footprint and the avoided emissions

Measure carbon emissions for various assets and design scenarios

Identify carbon emissions hotspots across the lifecycle of the infrastructure

Run sensitivity tests to compare carbon emissions when varying parameters

Assess progress towards project carbon reduction targets

SUPPORT DECISION-MAKING AROUND SUSTAINABLE DESIGN SOLUTIONS

Harnessing a Multi-Platform Web App and Open Data

CONFIGURATION DATA

All configuration Data including the CO2 database can be exported in JSON files

INPUT DATA

The use of OpenBIM supports the life cycle process through open and transparent standardized digital description

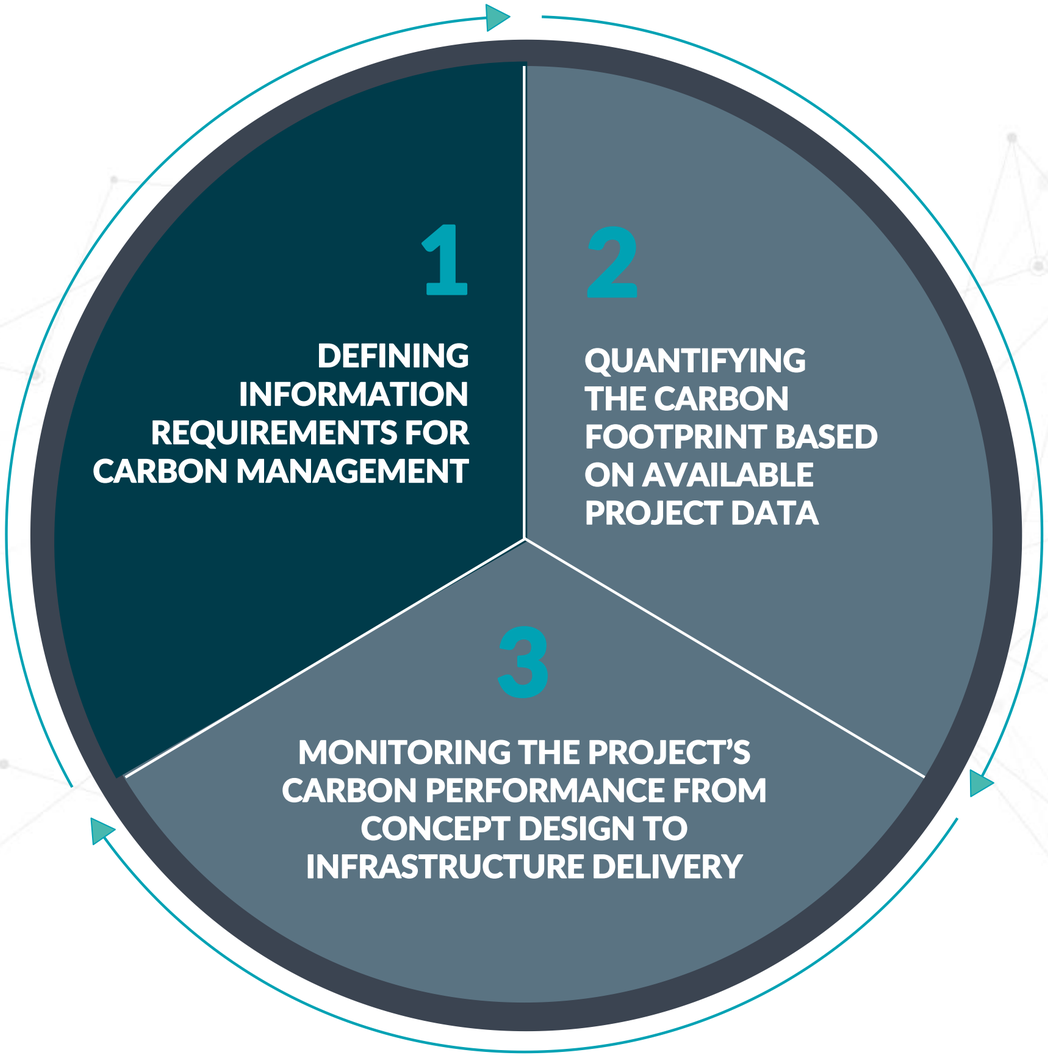
OUTPUT DATA

All Results DATA can be exported in JSON files.

CARBONTRACKER is a web application with data stored in an open-source database.

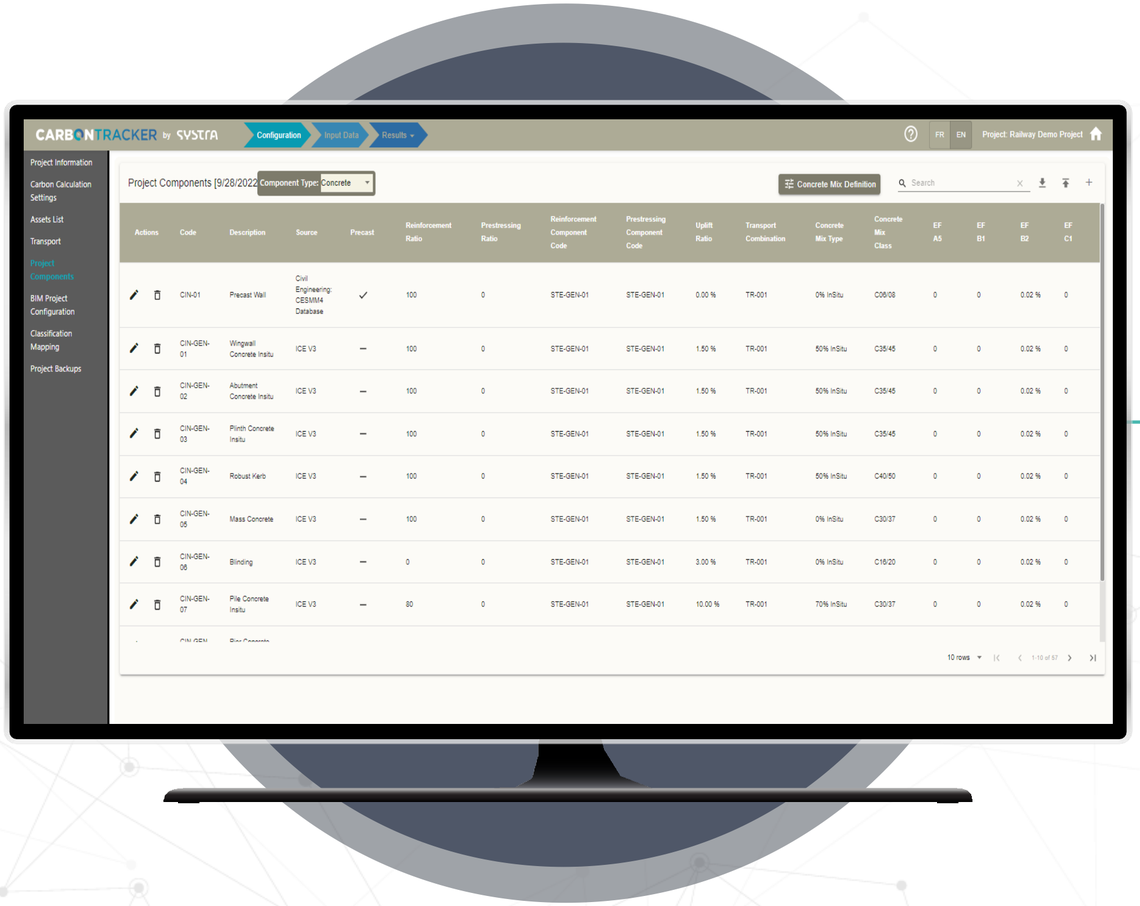
All historicized Configuration and Output Data can be exported in JSON files including links with Design files used for the calculations.

Tracking the carbon footprint in 3 steps



A robust Database and a Methodology compliant with International Standards

1



CARBONTRACKER is backed-up by a central database most relevant to infrastructures and relies on robust quantification methods. It includes emission factors for hundreds of components and for electricity depending on the local energy mix of each country.

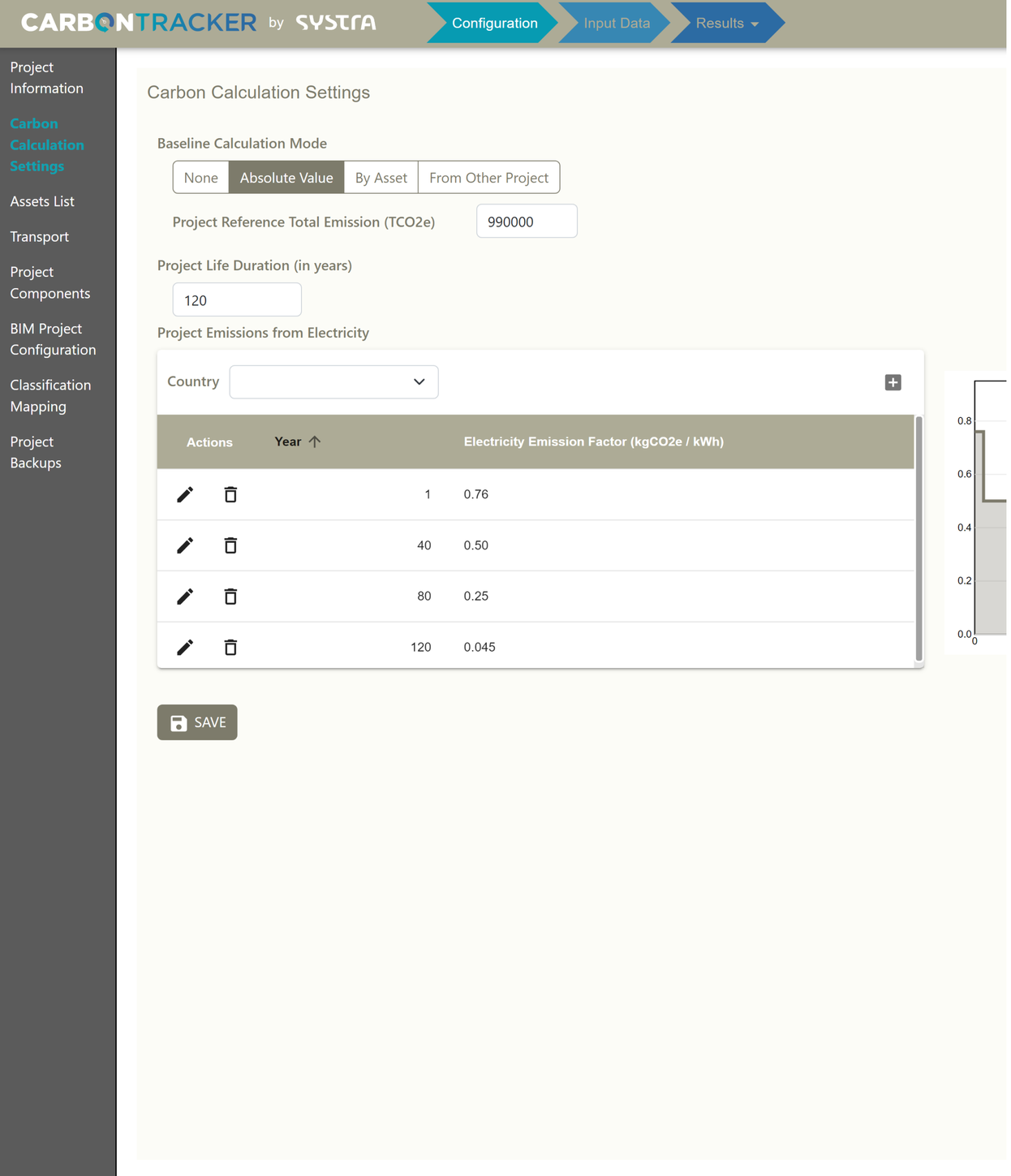
- A database developed based on SYSTRA's technical expertise and using multiple recognized national and international data sources
- Carbon calculation methodology in compliance with lifecycle assessment standards, ISO 14040, ISO 14044 and EN 15978 and a powerful tool that can support the PAS 2080 certification
- Emissions assessed for the whole project lifecycle and per lifecycle stage; from material extraction (A1) to operation (B6) and deconstruction at the end of life (C1).
- Emission factors for different transport modes and for current and future electricity mix depending on the decarbonisation strategy of each country

Defining Information Requirements for CARBON Management

1

Configuring the tool to suit project characteristics and local context

- Baseline and Carbon calculation
- Granularity of Carbon Assessments (Asset Breakdown)
- Project Transport Combinations
- Design input data requirements
- Frequency of Assessments



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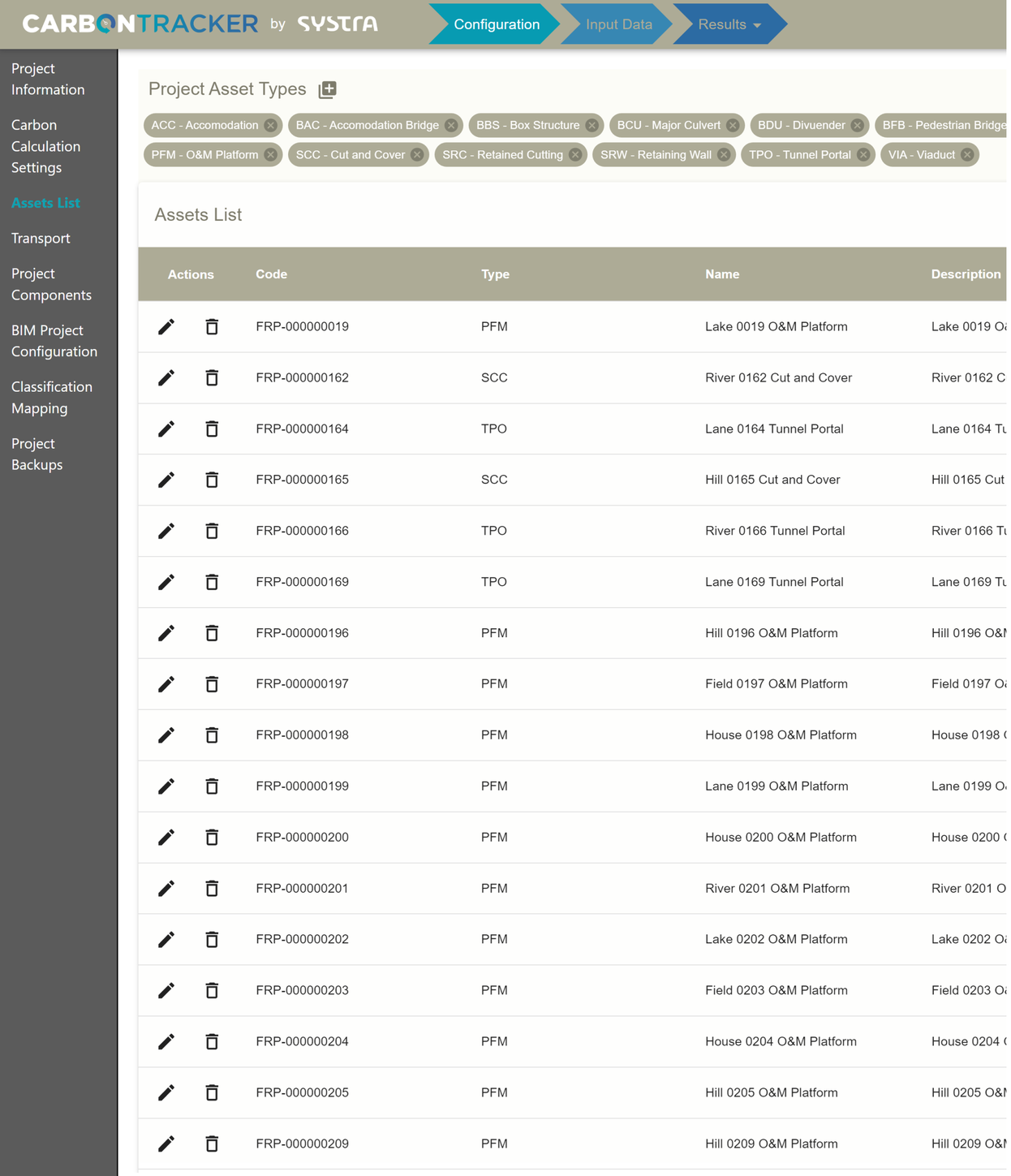
Baseline and Carbon Calculation Settings

- Baseline Calculation Mode
- Project Life Duration
- Project Emissions from Electricity



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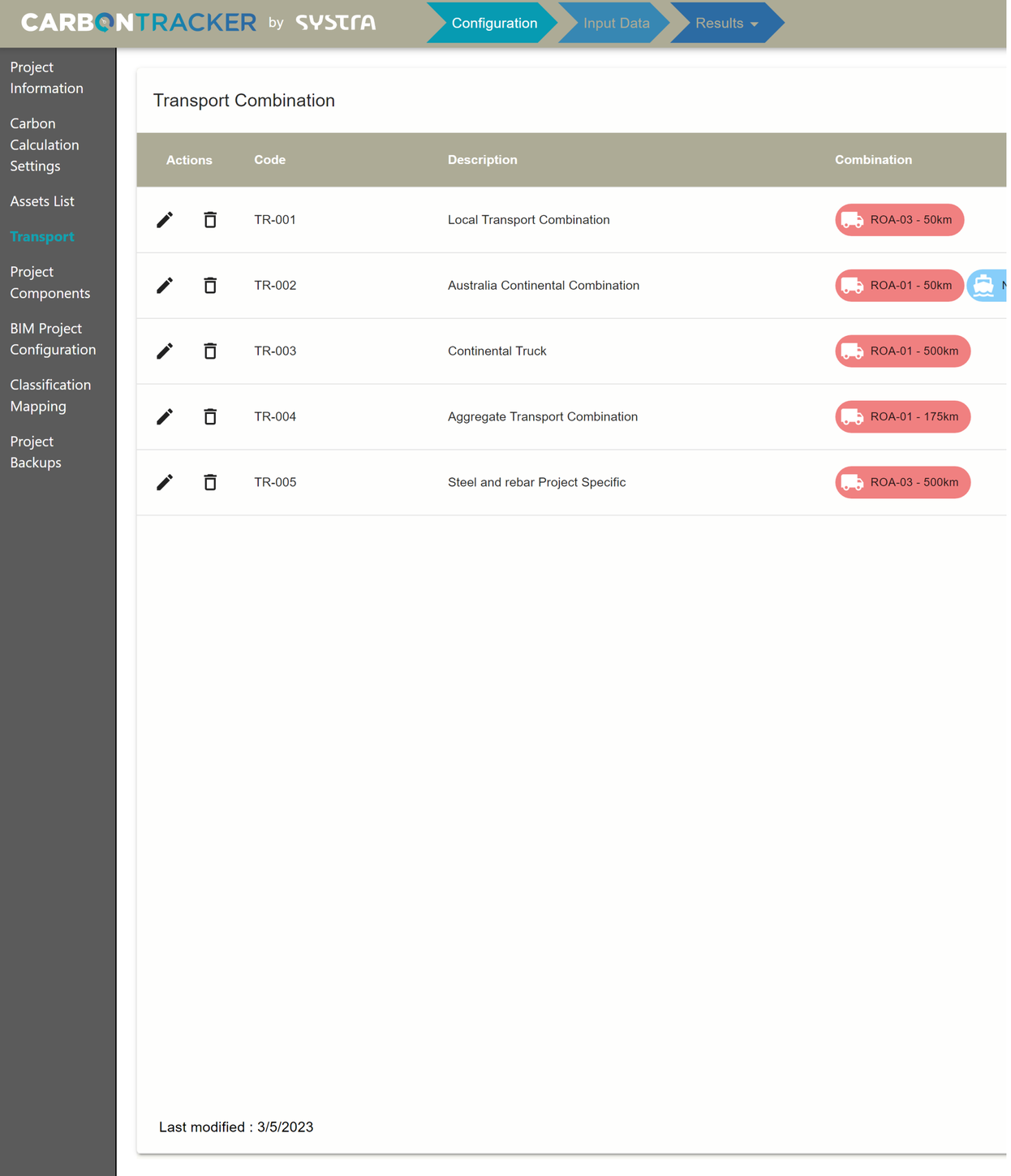
Granularity of Carbon Assessments

- Asset Breakdown Structure
- Asset Life Duration
- Codification and Naming



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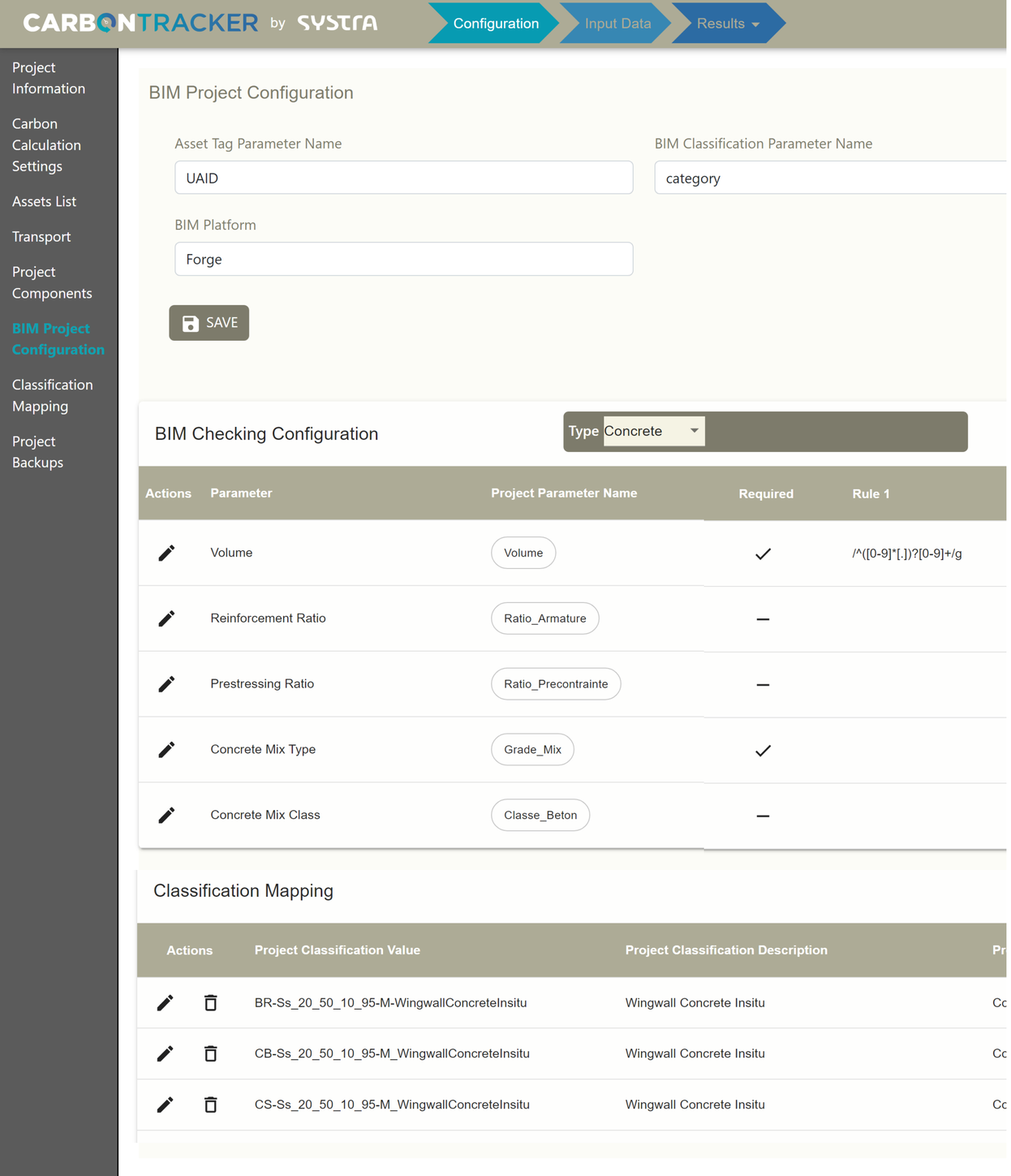
Project Transport Combinations

- Different Transport Scenarios (Naval, Road, Rail, Air)
- Transport scenarios can be combined and individually assigned to elements in the database

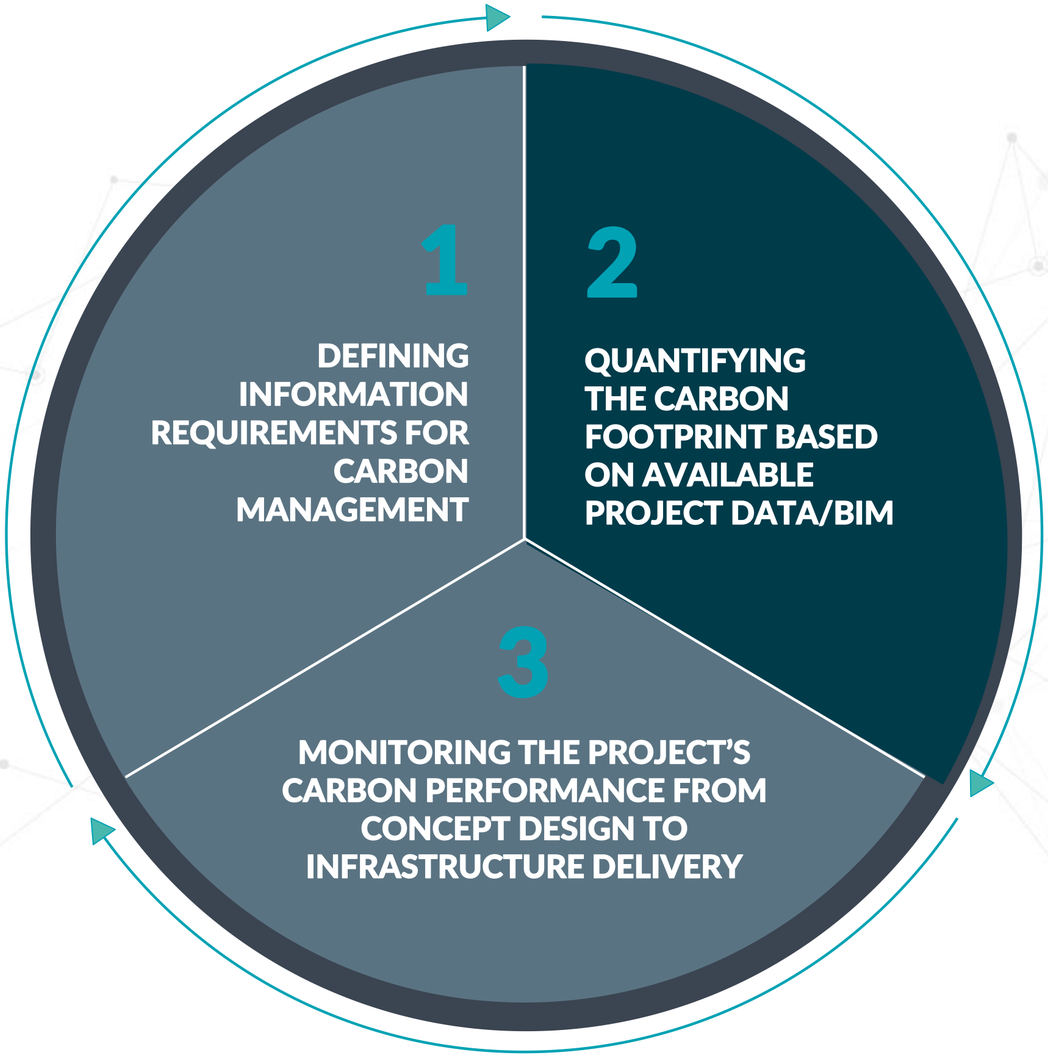


1

Design Input Data Requirements

- BIM Project Configuration
  - Asset Tag Parameter
  - Classification Parameter
- BIM Checking Configuration
- Classification Mapping

Tracking the carbon footprint in 3 steps

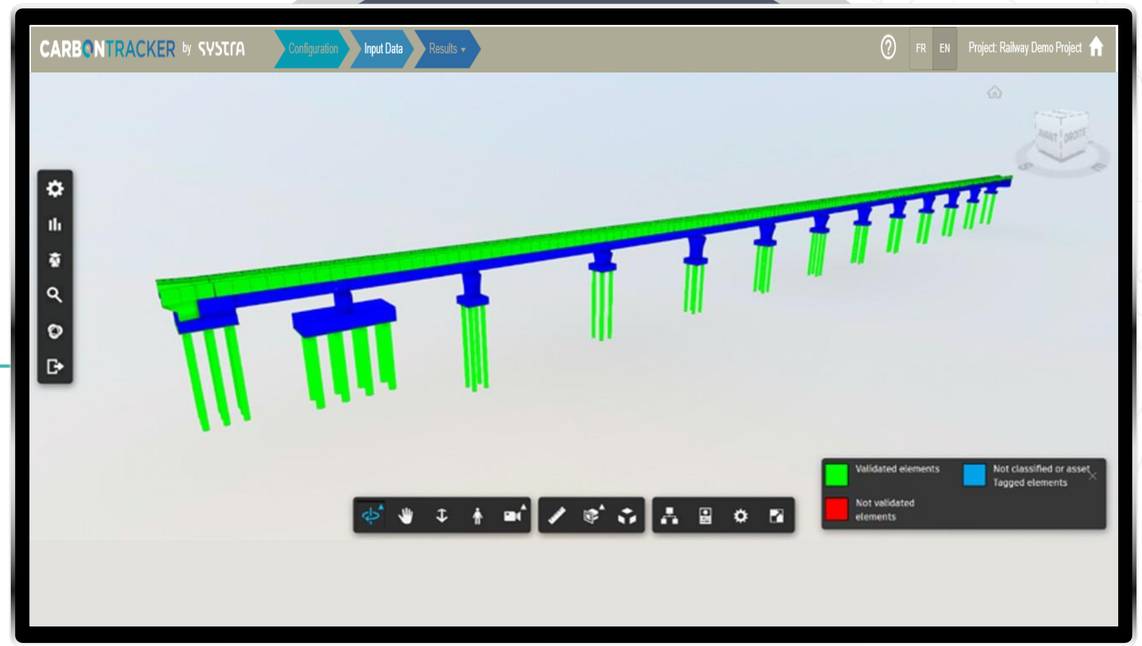


Quantifying the carbon footprint based on available project data / BIM

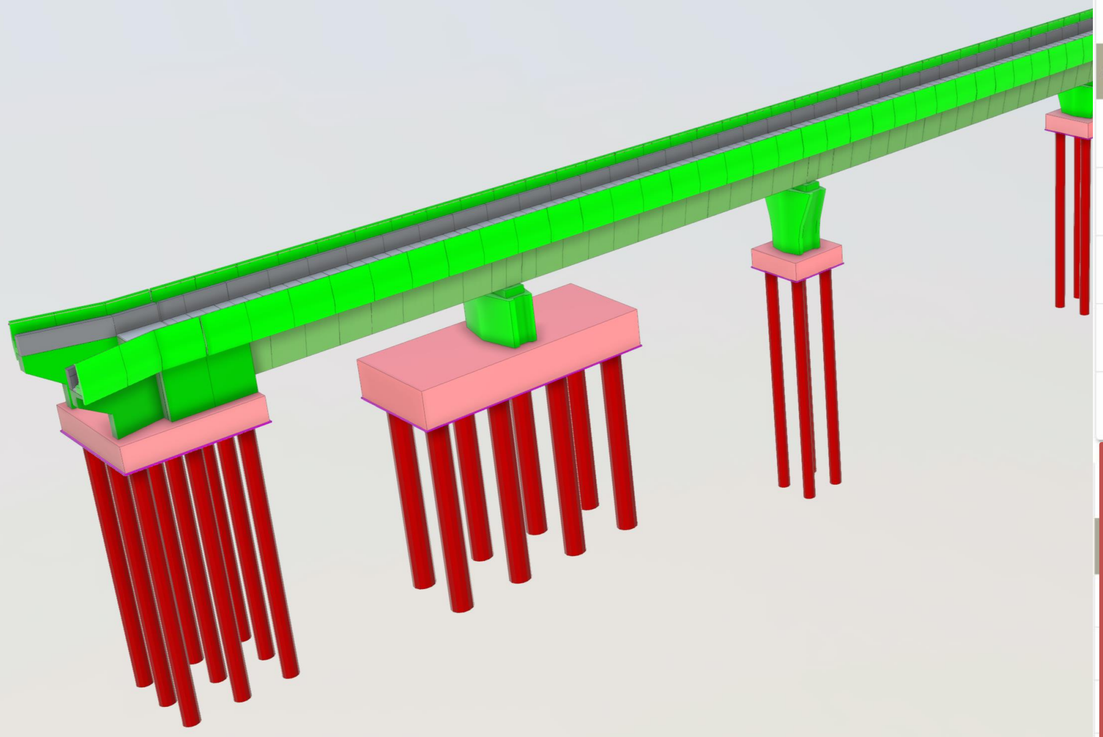
2

CARBONTRACKER is compatible with BIM technology but can also integrate non-BIM data from multiple sources (Excel, JSON, ..) allowing to adapt to a project's design maturity.

- **Captures** non-BIM and BIM data based on project models.
- **Checks BIM and non-BIM data** for missing properties and errors in configuration, providing relevant alerts
- **After initial configuration, automatically maps** project components and assets and calculate their carbon emissions



ASSESS THE CARBON FOOTPRINT FROM THE EARLY PHASES OF THE PROJECT TO SET OR COMPARE WITH A REFERENCE SCENARIO PER ASSET OR FOR THE ENTIRE PROJECT



BIM Project Configuration

Asset Tag Parameter Name: UAID

BIM Classification Parameter Name: category

BIM Platform: Forge

SAVE

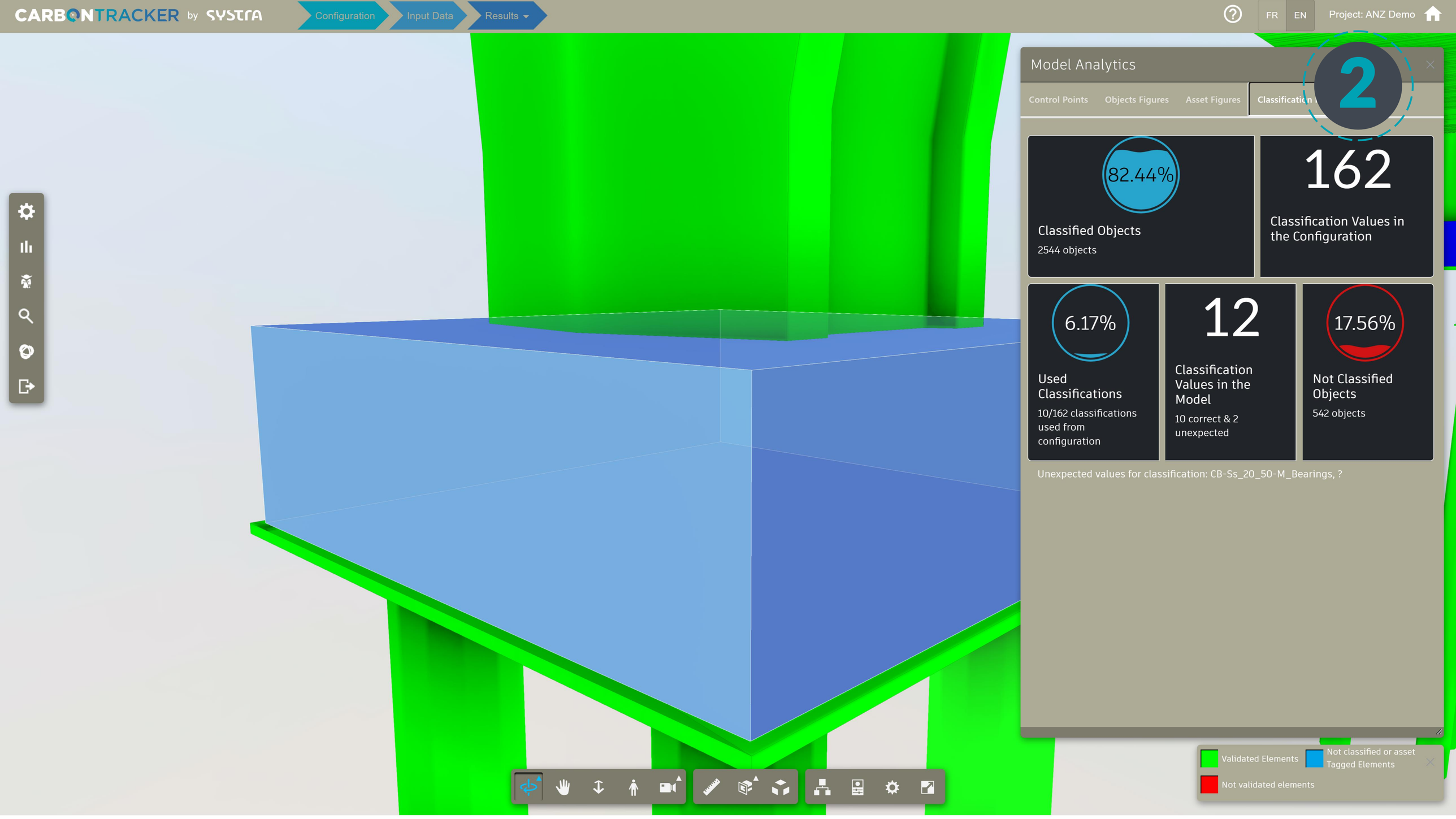
BIM Checking Configuration

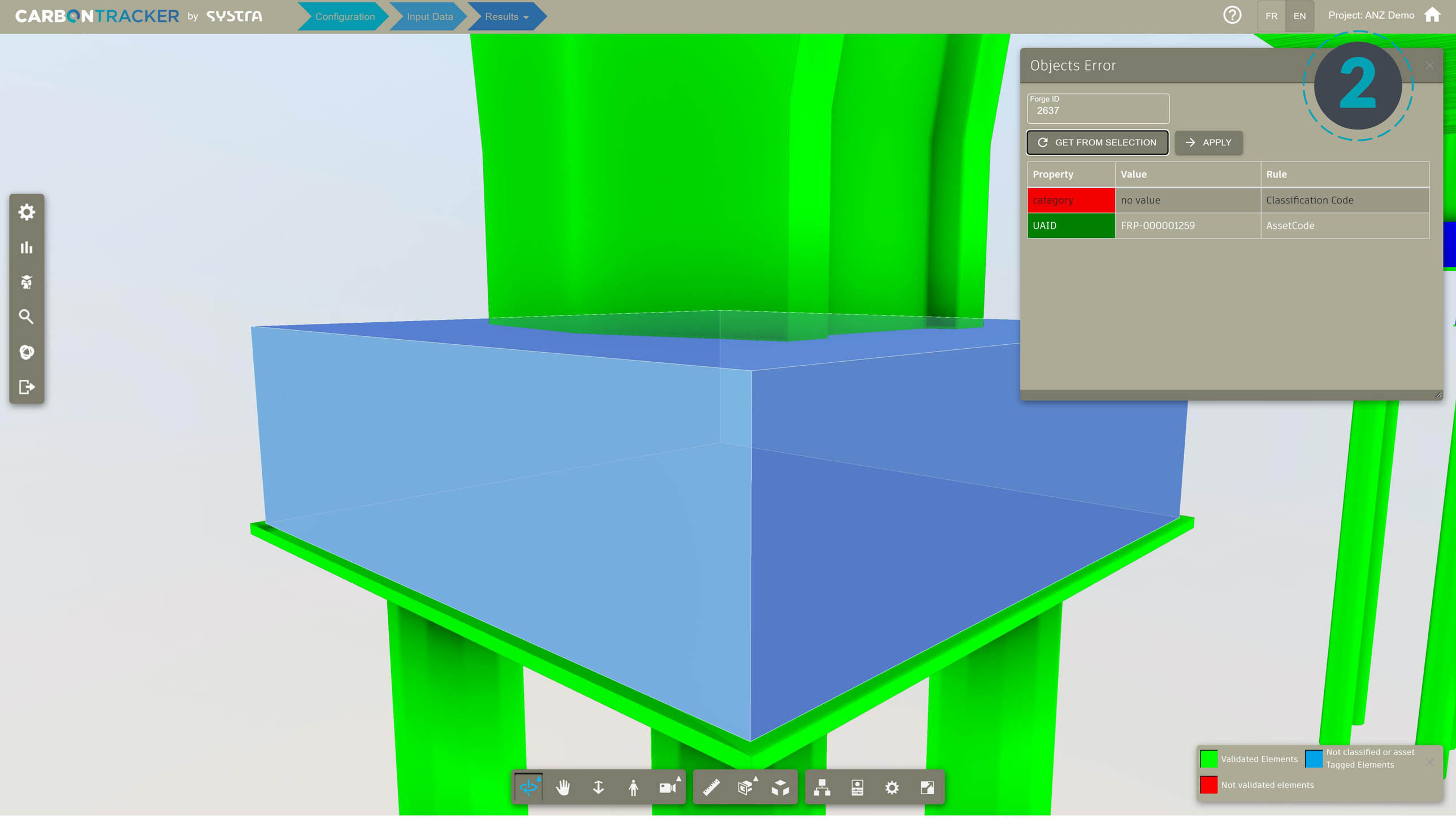
Type: Concrete

Actions	Parameter	Project Parameter Name
	Volume	Volume
	Reinforcement Ratio	Ratio_Armature
	Prestressing Ratio	Ratio_Precontrainte
	Concrete Mix Type	Grade_Mix
	Concrete Mix Class	Classe_Beton

Classification Mapping

Actions	Project Classification Value	Project Classification Description	Pr
	BR-Ss_20_50_10_95-M-WingwallConcreteInsitu	Wingwall Concrete Insitu	Cc
	CB-Ss_20_50_10_95-M_WingwallConcreteInsitu	Wingwall Concrete Insitu	Cc
	CS-Ss_20_50_10_95-M_WingwallConcreteInsitu	Wingwall Concrete Insitu	Cc


CARBONTRACKER by SYSTRA
Configuration
Input Data
Results
FR
EN
Project: ANZ Demo
Model Analytics
2
Control Points
Objects Figures
Asset Figures
Classification
82.44%
Classified Objects
2544 objects
162
Classification Values in the Configuration
6.17%
Used Classifications
10/162 classifications used from configuration
12
Classification Values in the Model
10 correct & 2 unexpected
17.56%
Not Classified Objects
542 objects
Unexpected values for classification: CB-Ss_20_50-M_Bearings, ?
Validated Elements
Not classified or asset Tagged Elements
Not validated elements

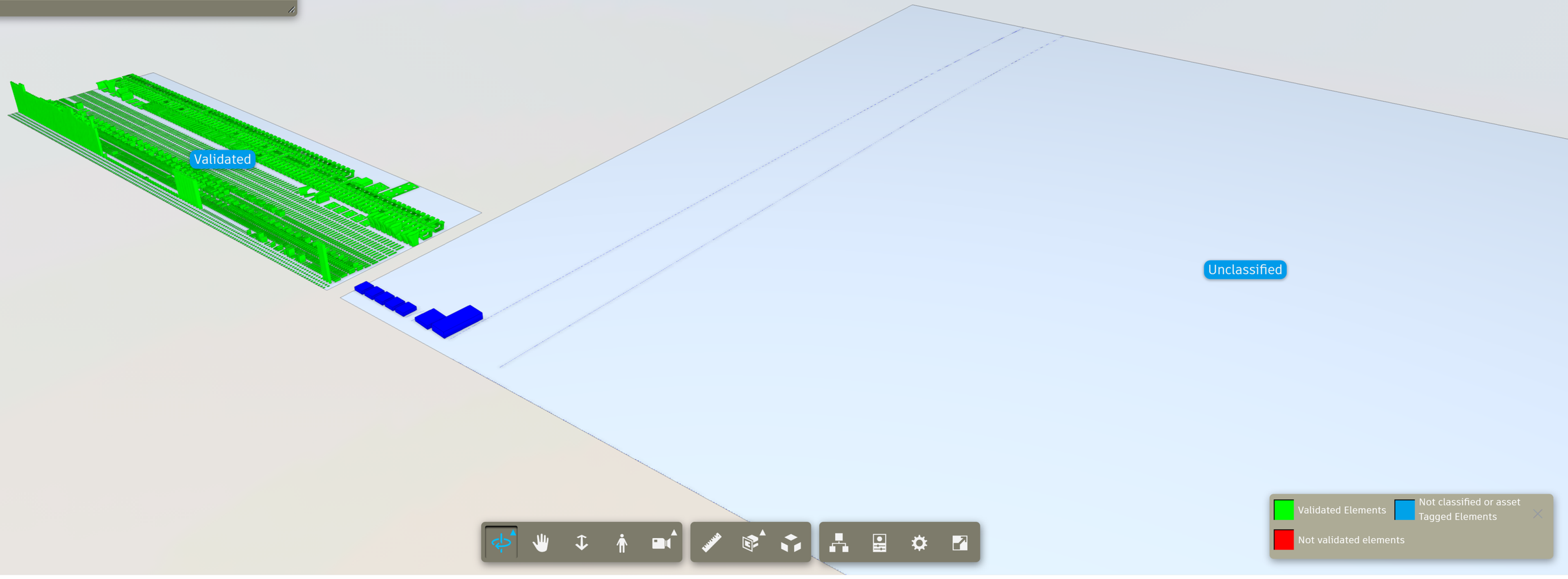

CARBONTRACKER by SYSTRA
Configuration
Input Data
Results
FR
EN
Project: ANZ Demo
Objects Error
2
Forge ID
2637
GET FROM SELECTION
APPLY
Property
Value
Rule
category
no value
Classification Code
UAID
FRP-000001259
AssetCode
Validated Elements
Not classified or asset Tagged Elements
Not validated elements

Visual Cluster

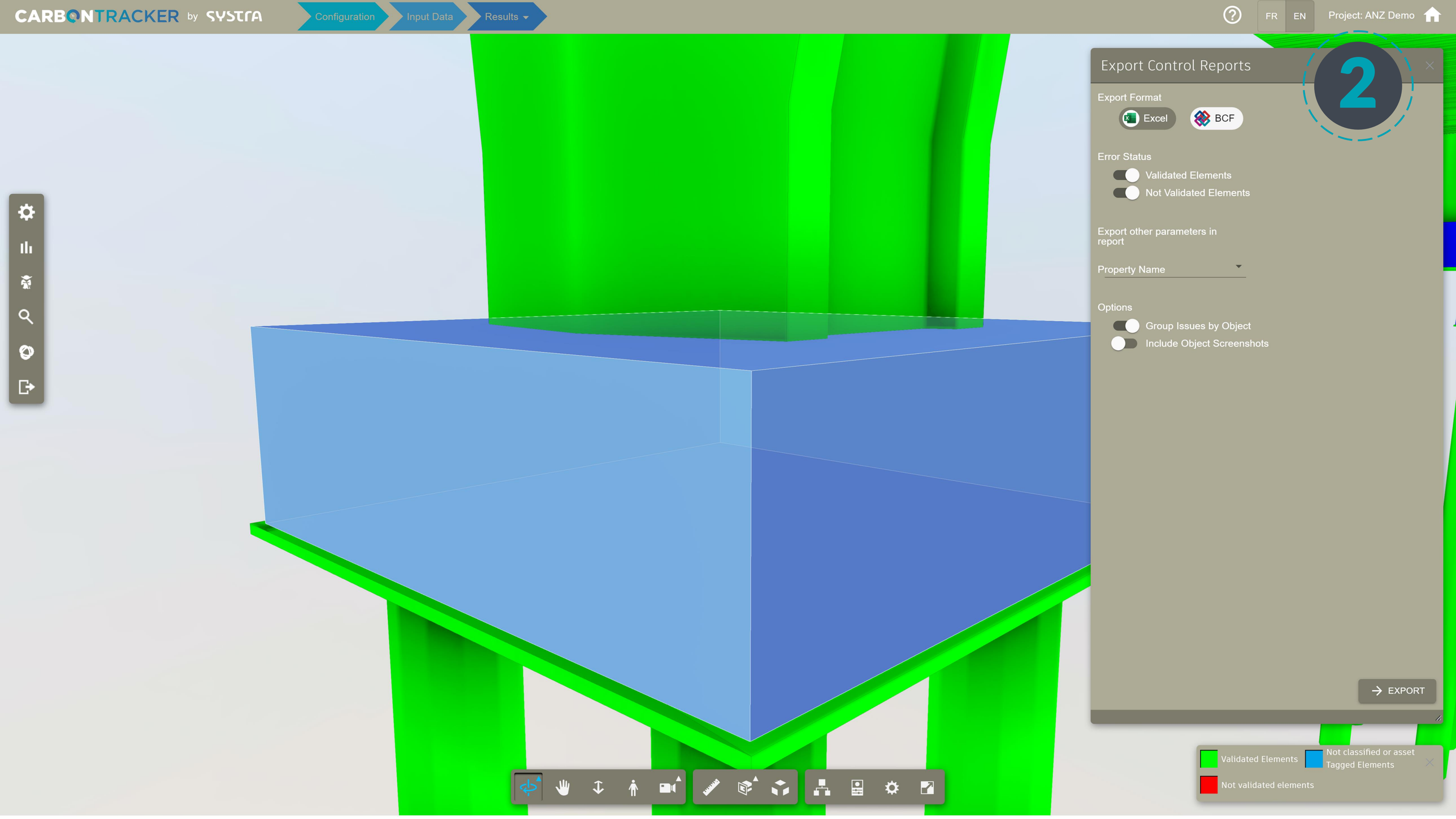
- (•) Checking Classification (Object Status)
- ( ) Project Classification (category)
- ( ) CarbonTracker Components
- ( ) Other Classification

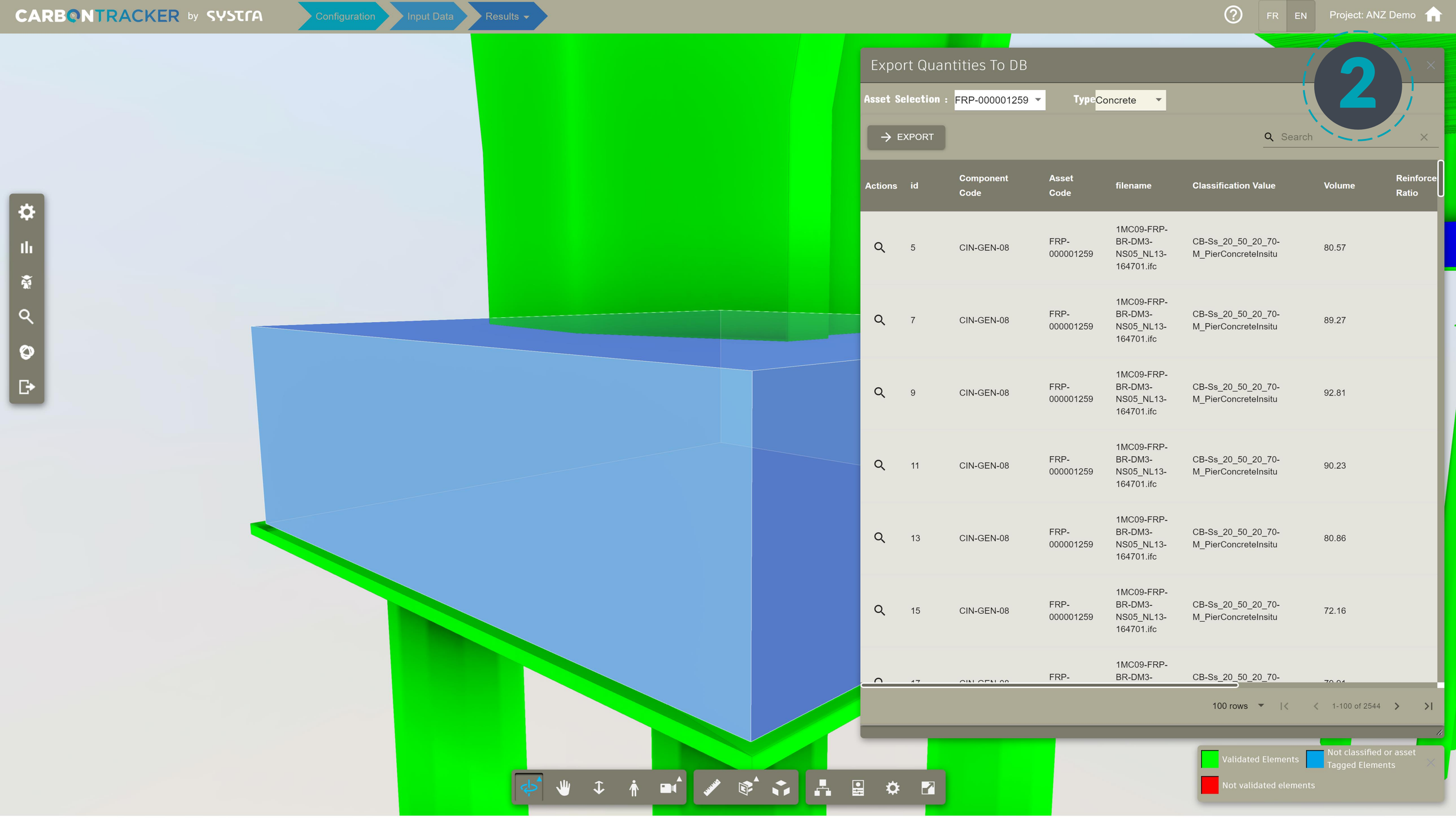
Property Name

APPLY

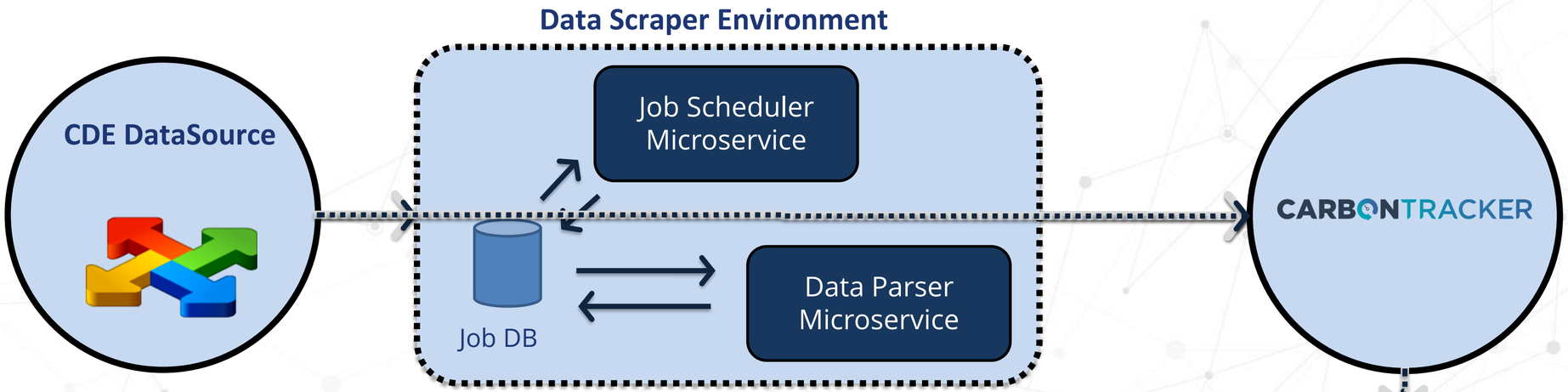


Validated Elements
Not classified or asset Tagged Elements
Not validated elements


CARBONTRACKER by SYSTRA
Configuration
Input Data
Results
FR
EN
Project: ANZ Demo
Export Control Reports
2
Export Format
Excel
BCF
Error Status
Validated Elements
Not Validated Elements
Export other parameters in report
Property Name
Options
Group Issues by Object
Include Object Screenshots
EXPORT
Validated Elements
Not classified or asset Tagged Elements
Not validated elements


CARBONTRACKER by SYSTRA
Configuration
Input Data
Results
FR
EN
Project: ANZ Demo
Export Quantities To DB
2
Asset Selection : FRP-000001259
Type Concrete
EXPORT
Search
Actions
id
Component Code
Asset Code
filename
Classification Value
Volume
Reinforce Ratio
5 CIN-GEN-08 FRP-000001259 1MC09-FRP-BR-DM3-NS05_NL13-164701.ifc CB-Ss_20_50_20_70-M_PierConcreteInsitu 80.57
7 CIN-GEN-08 FRP-000001259 1MC09-FRP-BR-DM3-NS05_NL13-164701.ifc CB-Ss_20_50_20_70-M_PierConcreteInsitu 89.27
9 CIN-GEN-08 FRP-000001259 1MC09-FRP-BR-DM3-NS05_NL13-164701.ifc CB-Ss_20_50_20_70-M_PierConcreteInsitu 92.81
11 CIN-GEN-08 FRP-000001259 1MC09-FRP-BR-DM3-NS05_NL13-164701.ifc CB-Ss_20_50_20_70-M_PierConcreteInsitu 90.23
13 CIN-GEN-08 FRP-000001259 1MC09-FRP-BR-DM3-NS05_NL13-164701.ifc CB-Ss_20_50_20_70-M_PierConcreteInsitu 80.86
15 CIN-GEN-08 FRP-000001259 1MC09-FRP-BR-DM3-NS05_NL13-164701.ifc CB-Ss_20_50_20_70-M_PierConcreteInsitu 72.16
100 rows
1-100 of 2544
Validated Elements
Not classified or asset Tagged Elements
Not validated elements

Project Integration – Monitoring of Validated Design



Tracking the carbon footprint in 3 steps

Monitoring the Project's Carbon Performance from Concept Design to Infrastructure Delivery

3

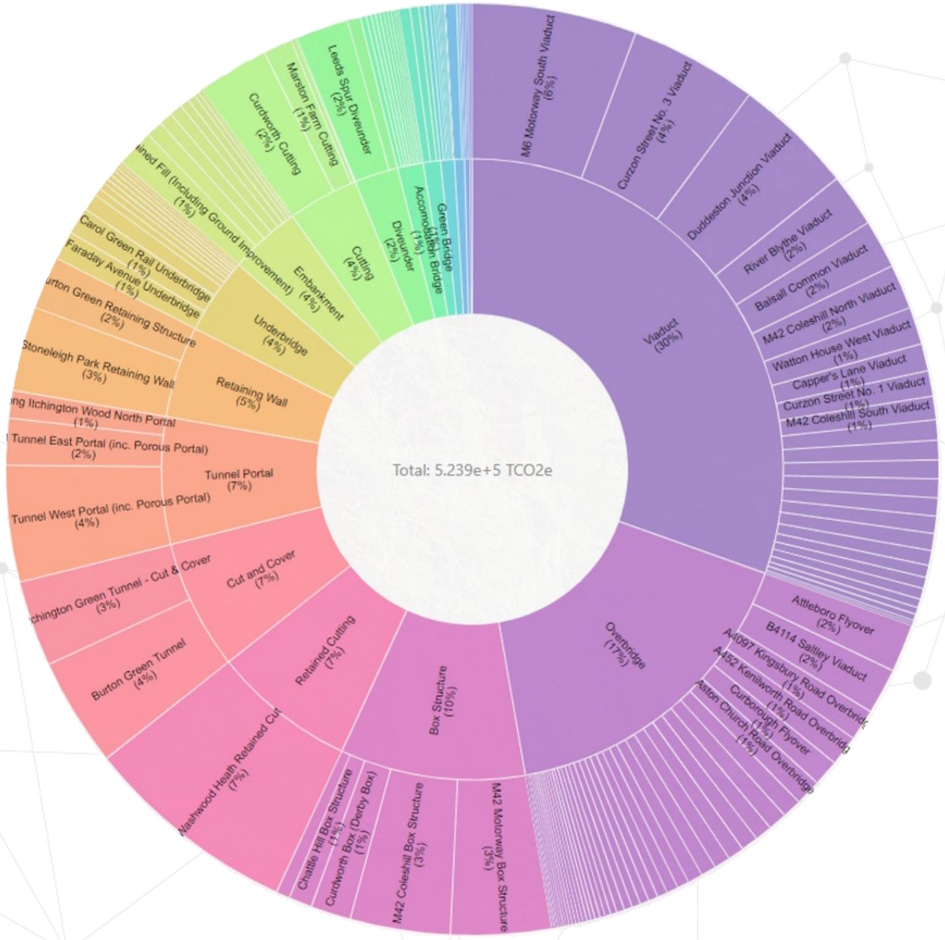
Visualising and managing the carbon footprint throughout design and delivery by:

- Calculating **the carbon footprint** in real time **with the design**
- **Analysing carbon emissions** per asset to identify alternative, lower carbon solutions and **assess avoided emissions**
- **Monitoring performance** towards achieving carbon reduction targets

Anticipate the impacts of your project and make the right decisions as early as possible in the design process

A multi-level analysis of emissions for a comprehensive and systematic review of carbon reduction opportunities

3



Compare the carbon footprint of different assets for any lifecycle stage to identify hotspots and optimise design

When to Use CARBONTRACKER ?

- **To define or review a baseline** against new assumptions and context
- **To compare** the **carbon impact** for alternative design options
- **To optimise the carbon performance** by identifying hotspots and testing alternative scenarios
- **To optimise as the design evolves** (early, preliminary, detailed)
- **To anticipate and assess the impacts of construction works** (incl. excavation materials management, transport, materials supply, …)

All Design stages (Early and beyond) → Design & Build process (tender phase included) → Call for proposals process → Construction stage to enforce the design choice

France, Paris, 2021

Technical assistance to the client for the East Line of metro 15, Grand Paris Express, France

- 10 Major Stations + 23 Ancillary Structures + 1 Maintenance Center + Tunnel (23 km)
- Use of BIM & non-BIM data
- *Mission description*
  - Carbon assessment to update and set the baseline for the Carbon reduction plan of the Project
  - Focus on major concrete/steel elements in civil engineering structures and traction systems (tracks, power supply)
  - Integration of transport of excavated materials

2 scenarios assessed : standard concrete and steel VS low carbon concrete and 100% recycled steel

25% reduction achieved for the carbon footprint and the baseline is defined as the optimised scenario

SYSTRA

Design for the Nagpur-Mumbai Super communication Expressway (Package II), India

India, 2022

- **58 km** long and a total of **155 major and minor structures** (bridges, interchanges, viaducts, Culverts, …)
- Penalty on any excess in overall project cost **OR** Bonus on any savings in design quantities
- Use of Bill of Quantities
- **Objective:** Achieve materials efficiency and assess the carbon footprint of the proposed material optimization solutions

9% cost savings compared to initial design via materials efficiency

Around 11% reduction in the carbon footprint for the detailed design compared to tender phase

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What comes next ?

- Integration of other KPIs such as water, reuse of materials, etc.
- Proof of concept to evaluate the distances, waste, etc, through GIS
- Mock-Up to manage the carbon emission for asset owners and project investments

Questions

Because sustainable design is **everyone's business,**

Because everything happens at the **design phase,**

Because project teams miss the **right information,**

Be **pro-active!**

Ensure **transparency of your commitments** to reduce CO2 emissions

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CONFIDENCE MOVES THE WORLD