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BIM2BEMLCA

An integrated tool coupling building energy modelling (INTEMA) with life-cycle assessment (VERIFY) for sustainable buildings

INTEMA
Building Energy Model

+

VERIFY
LCA / LCC engine

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What is BIM2BEMLCA?

One pipeline instead of two disconnected tools — from BIM geometry to whole-life environmental & economic assessment

BIM / IFC
Geometry & materials imported automatically

▼

INTEMA — BEM
Dynamic hourly energy demand & system behaviour

▼

VERIFY — LCA/LCC
Whole-life carbon, primary energy & cost KPIs

Because both engines share one data model, results flow automatically — no manual re-entry between an energy tool and a separate LCA tool.

One integrated tool vs. two separate tools

Dynamic, not static — Hourly, IoT- and simulation-fed updates replace a fixed-period, steady-state snapshot

Cost + carbon together — Built-in LCC (NPV, IRR, payback, LCOE) lets environmental and financial trade-offs be optimised jointly

One model, many scales — A single framework spans building → district → city → industrial process

No data hand-off errors — Shared IFC/CSV inputs remove the mismatches that arise when piping an energy tool into a separate LCA tool

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Why couple energy modelling with LCA — and why now

A methodological shift driven by EU building-decarbonisation policy

EU policy is making whole-life carbon mandatory

Recast EPBD (EU 2024/1275): life-cycle GWP must be calculated and disclosed on the EPC — from 2028 for new buildings > 1 000 m², from 2030 for all new buildings.

Common method (Del. Reg. C/2025/8723) built on Level(s) and EN 15978; Member-State GWP limit-value roadmaps due by 2027.

Methodological advantages

- Operational reality: real hourly demand replaces assumed usage in the LCA use-phase
- Passive & active systems assessed together — envelope, HVAC, RES and storage
- A single feedback loop tests design/retrofit options for energy, carbon and cost at once

INTEMA answers this with standards-based hourly modelling

- ✓ **ISO 52016** — hourly, element-by-element thermal modelling (supersedes ISO 13790)
- ✓ **ISO 52010-1** — TMY solar/weather data from PVGIS
- ✓ **ISO 13789 / 13370 / 14683** — envelope conduction, ground & thermal bridges
- ✓ **ISO 52016 (solar storage)** — incoming radiation stored in internal elements
- ✓ **DIN EN 16798-1 / ISO 18523-1** — occupancy, ventilation, setpoints & schedules
- ✓ **EN 15265 & TRNSYS** — cross-validated — average error < 4%

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INTEMA — the building energy engine

Its role in BIM2BEMLCA and the physics & standards it accounts for

Role: the dynamic demand generator

INTEMA produces the **hourly energy performance** of the building — heating, cooling, electricity and on-site generation — that becomes the **operational-phase input to VERIFY's LCA/LCC.** It models the building as one or many thermal zones, resolving each element separately (ISO 52016).

What the engine accounts for

- Conduction, convection & radiation through opaque and transparent elements
- Stored incoming solar radiation in internal elements; shading from obstacles
- Occupancy, appliance & lighting gains split into convective/radiative loads
- Natural, mechanical & unintended ventilation, incl. heat recovery
- Thermostat setpoints by use category and thermal-comfort level

Compliance with international standards

✓ **ISO 52016** — thermal zoning & incoming-solar storage

✓ **ISO 52010-1:2017** — TMY weather data from PVGIS

✓ **ISO 13789 / 13370 / 14683 / 19467** — envelope heat transfer & thermal bridges

✓ **ISO 15099 / ISO 52022** — shading factors for obstructed surfaces

✓ **ISO 13798 / 9972 / DIN EN 16798-1** — ventilation & heat-recovery air-change rates

✓ **EN 15193-1** — internal heat gains (convective/radiative)

✓ **DIN EN 16798-1 / ISO 18523-1** — hourly schedules, loads & occupancy profiles

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VERIFY — the life-cycle engine

Real-time, IoT-driven LCA & LCC of buildings, districts and industrial processes

- Evaluates energy-system sustainability across the whole lifecycle, focused on the operational phase
- LCA per ISO 14040/14044 and LCC per ISO 15686-5; aligned with Level(s) indicators
- Consumes primary (IoT sensors, message broker) and secondary (APIs) data in real time
- Designed for the EU ETS2.0 (operational 2027); BIM2LCA-ready via IFC
- Green Brand Gold Award 2023 (R&D for Green Service)

Representative KPIs

- **Primary Energy Demand**
- **Global Warming Potential**
- **GHG emission savings**
- **LCC / NPV / IRR / ROI**
- **Payback & carbon payback**
- **LCOE**

Technical features that set it apart

Temporal LCA
hourly disaggregation & real-time updating

Interoperable
RESTful APIs, SAREF, big-data repository

Multi-scale & modular
Building / District / Industry modules

Scales seamlessly

VERIFY-Building · VERIFY-District · VERIFY-Industry — one methodology, portfolios of buildings, communities, islands and processes.

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How the two engines work together

Data sources feeding VERIFY — and how INTEMA fills the gaps

Static

Files with measurement time-series or fixed parameter values

Dynamic

Live data via network / IoT message broker

Estimated

Modelled operation supplied by INTEMA where sensors are absent

Hybrid

Annual / monthly data disaggregated into hourly series by INTEMA

The overall approach

- INTEMA supplies simulated & disaggregated series wherever measured data is missing
- VERIFY then runs a complete, hourly-resolved LCA / LCC on the combined dataset
- Supports data-driven and model-driven analysis, plus component-level and temporal LCA
- Result: whole-life KPIs even for buildings that are only partly instrumented

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Demonstration — the EVELIXIA project

Horizon Europe GA 101123238 · 36 partners · 12 countries · 7 pilots · buildings as active utility nodes

Buildings as Active Utility Nodes (BAUNs). EVELIXIA turns the EU building stock from passive endpoints into energy-efficient, connected, smart and flexible nodes in multi-vector energy networks, through predictive, autonomous control.

17%
GHG emissions ↓

13.5%
energy use ↓

+25%
flexibility ↑

≤100%
self-consumption

Five innovation pathways: B2G · G2B services · human-to-building interfaces · systems interoperability · HW flexibility enablers.

The role of VERIFY-B

Inside the Autonomous Building Digital Twin (ABDT), VERIFY-B is the Building Investment Planning Assistant, turning operational data into financial & environmental insight.

Awareness & Forecasting
iSCAN — energy modelling & simulation (IES)

Decision Support
VERIFY-B — investment planning assistant

Autonomous Control
BAUN flexibility & grid-balancing services

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EVELIXIA "proof of value" — the data

A 50-year cradle-to-grave, component-level analysis aggregated to building-level KPIs

static data · .ifc

Building definition & geometry from the BIM model

dynamic data · .csv

Measured operational time-series from the field

simulated data · .csv

Modelled series generated by iSCAN / INTEMA

Financial viability

- Lifecycle Costs (LCC)
- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Return on Investment (ROI)
- Payback Time (PBT) · LCOE

Environmental impact

- Lifetime Primary Energy Demand (PED)
- Lifetime Global Warming Potential (GWP)
- GHG emission savings
- Fossil-fuel consumption avoidance

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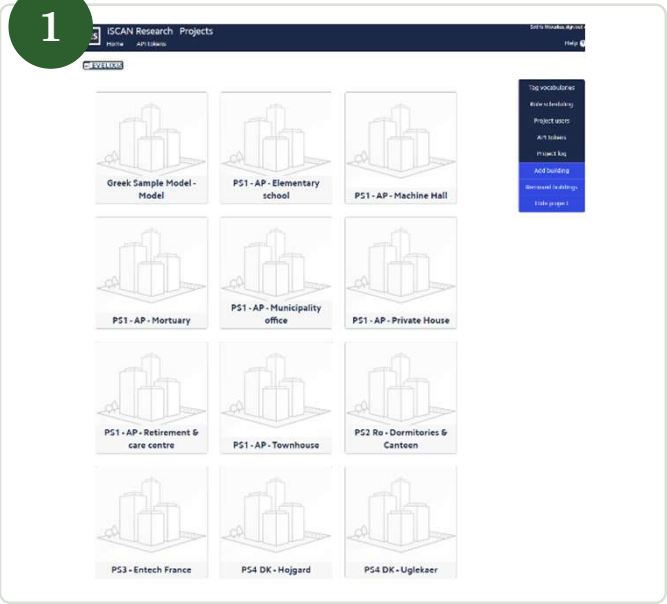
EVELIXIA example — Stage 1: export from iSCAN

Real workflow · PS3 – Entech France pilot · simulated operational data prepared in iSCAN

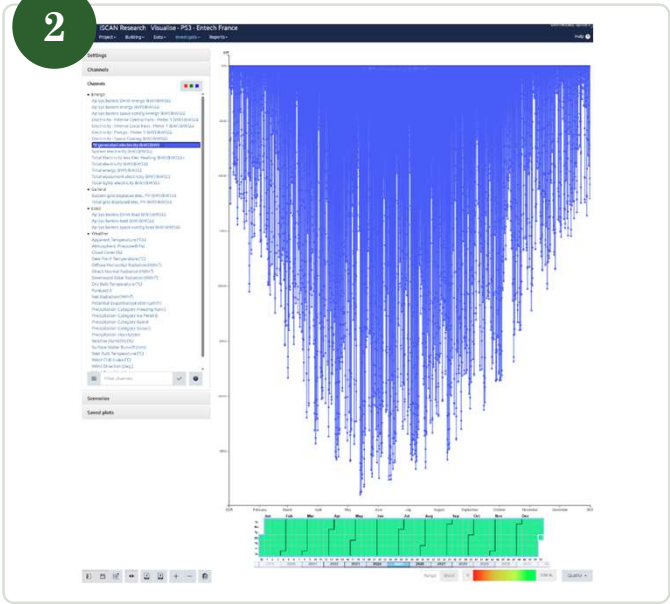
1



Select model in iSCAN

Pick the pilot building (PS3 – Entech France)

2



Select scenario, year & channels

Choose channels (e.g. PV-generated electricity) & year

3

Create the export log

Export the selected CSV channels for the date range

The building models correspond to the EVELIXIA pilots; iSCAN (IES) supplies the simulated hourly series that INTEMA-type modelling would otherwise provide.

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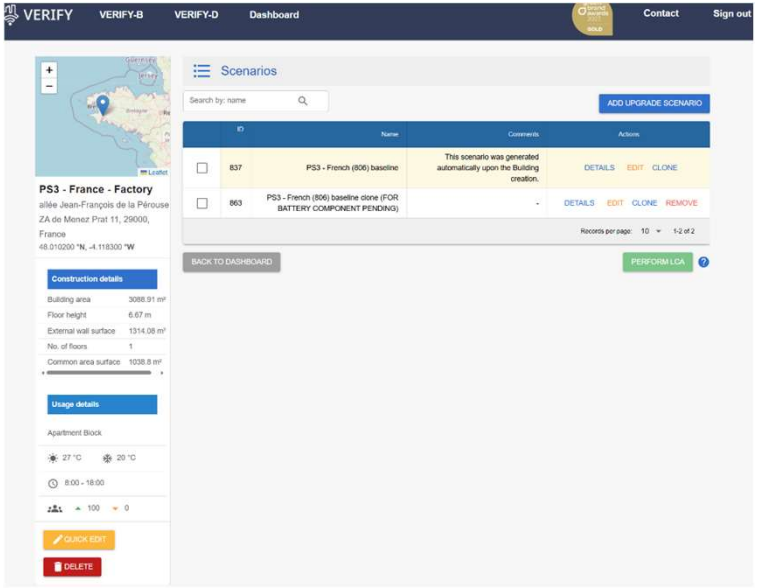
EVELIXIA example — Stage 2: bring data into VERIFY

Attaching the exported .csv to the existing VERIFY-B model (PS3 – France – Factory)

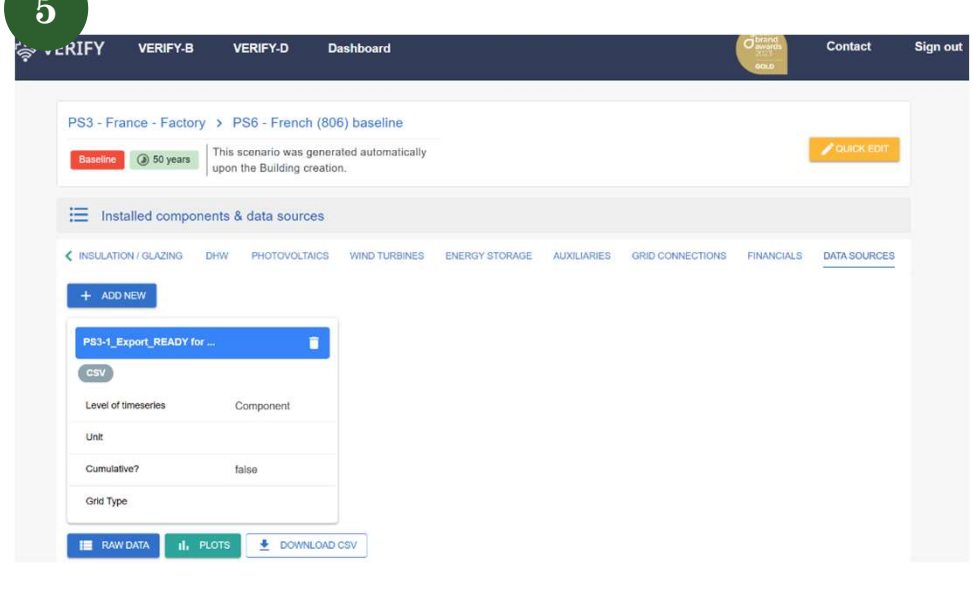
4



Select scenario in VERIFY

Open the PS3-French baseline and choose Perform LCA

5



Provide the .csv as data source

Add the exported CSV under the scenario's Data Sources

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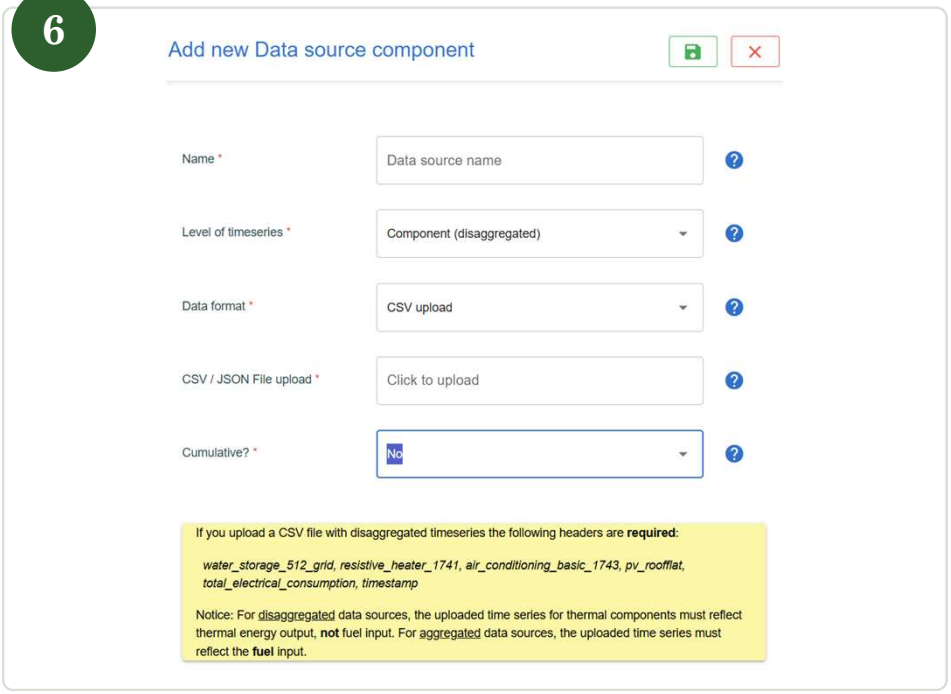
EVELIXIA example — Stage 3: match the data

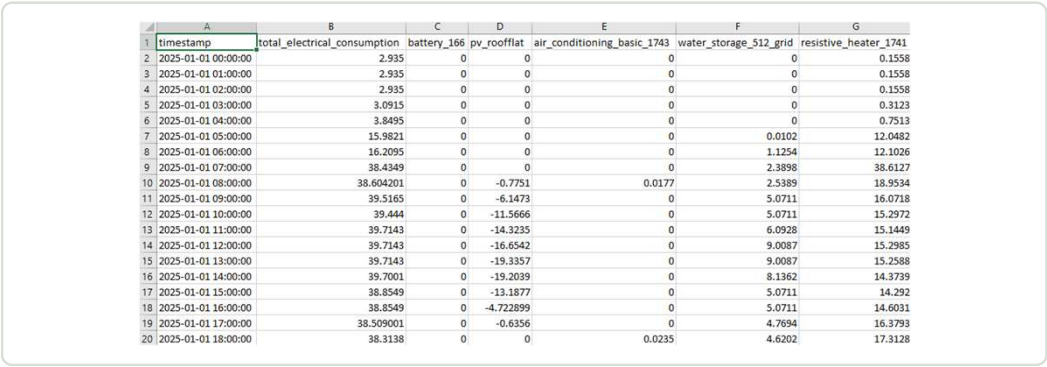
Column headers must map to component names / IDs for the disaggregated series

6



Define the data-source component

Required headers are listed for the disaggregated upload



	A	B	C	D	E	F	G
1	timestamp	total_electrical_consumption	battery_166	pv_roofflat	air_conditioning_basic_1743	water_storage_512_grid	resistive_heater_1741
2	2025-01-01 00:00:00	2.935	0	0	0	0	0.1558
3	2025-01-01 01:00:00	2.935	0	0	0	0	0.1558
4	2025-01-01 02:00:00	2.935	0	0	0	0	0.1558
5	2025-01-01 03:00:00	3.0915	0	0	0	0	0.3123
6	2025-01-01 04:00:00	3.8495	0	0	0	0	0.7513
7	2025-01-01 05:00:00	15.9821	0	0	0	0.0102	12.0482
8	2025-01-01 06:00:00	16.2095	0	0	0	1.1254	12.1026
9	2025-01-01 07:00:00	38.4349	0	0	0	2.3898	38.6127
10	2025-01-01 08:00:00	38.604201	0	-0.7751	0.0177	2.5389	18.9534
11	2025-01-01 09:00:00	39.5165	0	-6.1473	0	5.0711	16.0718
12	2025-01-01 10:00:00	39.444	0	-11.5666	0	5.0711	15.2972
13	2025-01-01 11:00:00	39.7143	0	-14.3235	0	6.0928	15.1449
14	2025-01-01 12:00:00	39.7143	0	-16.6542	0	9.0087	15.2985
15	2025-01-01 13:00:00	39.7143	0	-19.3357	0	9.0087	15.2588
16	2025-01-01 14:00:00	39.7001	0	-19.2039	0	8.1362	14.3739
17	2025-01-01 15:00:00	38.8549	0	-13.1877	0	5.0711	14.292
18	2025-01-01 16:00:00	38.8549	0	-4.722899	0	5.0711	14.6031
19	2025-01-01 17:00:00	38.509001	0	-0.6356	0	4.7694	16.3793
20	2025-01-01 18:00:00	38.3138	0	0	0.0235	4.6202	17.3128

The uploaded CSV

Hourly series whose column headers match each component name / ID

Why it matters: VERIFY maps each timeseries to a specific building component, so header names (component name / ID) must line up exactly. Disaggregated thermal series carry thermal-energy output, not fuel input.

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EVELIXIA example — Stage 4: validate & run

Confirming the input in tabular or graph form, then running the LCA / LCC

7a

- French (806) baseline

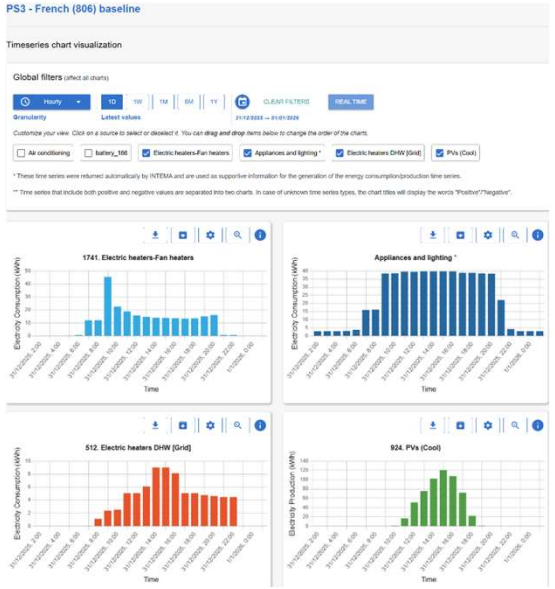
Series Table

Timestamp	air_conditioning_basic_1743	battery_166	pv_rooftat	resistive_heater_1741	total_electrical_consumption	water_storage_512_grid
2025-01-01 00:00:00	0.0000	0.0000	0.0000	0.1558	2.9350	0.0000
2025-01-01 01:00:00	0.0000	0.0000	0.0000	0.1558	2.9350	0.0000
2025-01-01 02:00:00	0.0000	0.0000	0.0000	0.1558	2.9350	0.0000
2025-01-01 03:00:00	0.0000	0.0000	0.0000	0.3123	3.0915	0.0000
2025-01-01 04:00:00	0.0000	0.0000	0.0000	0.7513	3.8495	0.0000
2025-01-01 05:00:00	0.0000	0.0000	0.0000	12.0482	15.9621	0.0102
2025-01-01 06:00:00	0.0000	0.0000	0.0000	12.1026	16.2095	1.1254
2025-01-01 07:00:00	0.0000	0.0000	0.0000	38.6127	38.4349	2.3898
2025-01-01 08:00:00	0.0177	0.0000	-0.7751	18.9534	38.6042	2.5389
2025-01-01 09:00:00	0.0000	0.0000	-6.1473	16.0718	39.5165	5.0711
2025-01-01 10:00:00	0.0000	0.0000	-11.5666	15.2972	39.4440	5.0711
2025-01-01 11:00:00	0.0000	0.0000	-14.3235	15.1449	39.7143	6.0928
Totals	1,940.29	0.00	-538,832.88	59,610.63	136,109.81	26,244.65
Averages	0.22	0.00	-61.51	6.80	15.54	3.00

Time-series table

Totals & averages per component channel

7b



Time-series charts

Hourly demand/production — returned automatically by INTEMA

Once validated, Perform LCA / LCC runs the 50-year, component-level analysis and aggregates it to building KPIs — financial viability and environmental impact, ready to export.

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What sets the integrated approach apart

Versus standard, static LCA practice

Dynamic, real-time	Hourly IoT + simulated updates instead of a fixed-period, steady-state snapshot
Cost + carbon in one tool	Built-in LCC and investment metrics enable environmental / financial trade-offs
Multi-scale	One framework from building to district, city and industrial process
Real operational data	Measured and INTEMA-modelled inputs cut the uncertainty of assumed usage
Standards + augmentation	ISO 14040/44 & Level(s) methodology, augmented with monitoring and big data

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VERIFY key results — EVELIXIA example

LCA Results for the PS3 – French (806) baseline · 50-year, component-level analysis

Lifetime Primary Energy Demand

92,193,304 kWh

29,846.55 kWh/m² · 1,843,866 kWh/yr

Lifetime Global Warming Potential

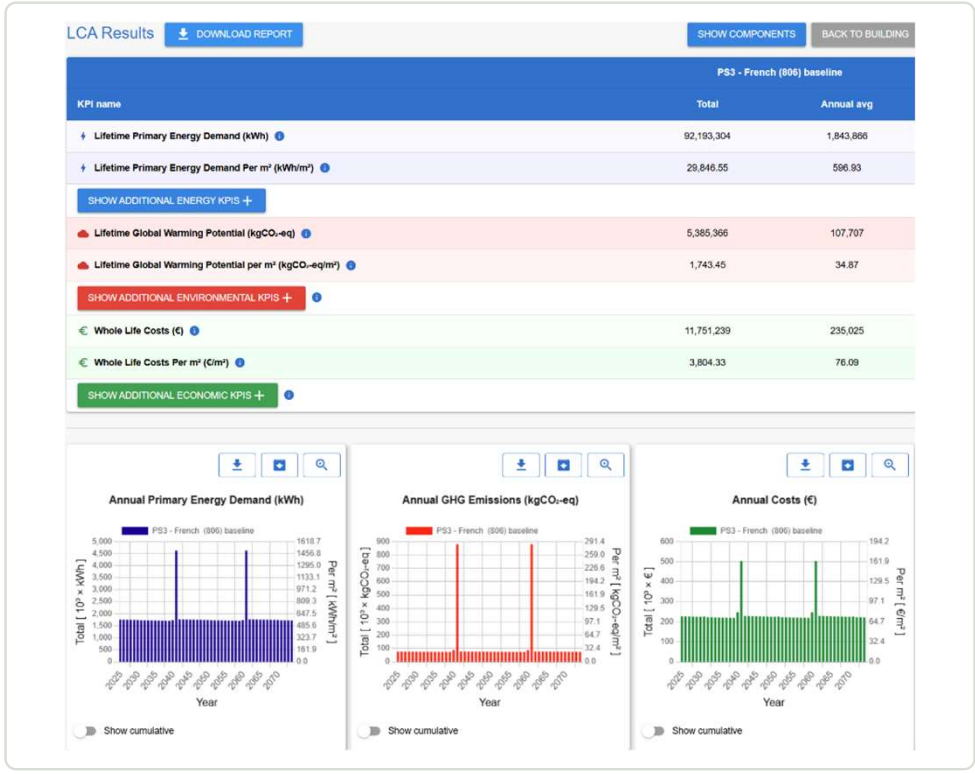
5,385,366 $kgCO_2$-eq

1,743.45 $kgCO_2$-eq/m² · 107,707 /yr

Whole Life Costs

€ 11,751,239

3,804.33 €/m² · 235,025 €/yr



VERIFY-B LCA Results dashboard — KPIs and annual trend charts, with report export

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Take-aways

BIM2BEMLCA turns a BIM model into decisions grounded in whole-life performance

Automated pipeline

BIM (IFC) → INTEMA energy model → VERIFY LCA/LCC, with minimal manual setup

Accurate performance

INTEMA supplies validated hourly demand (error < 4% vs EN 15265 / TRNSYS)

Whole-life view

VERIFY delivers carbon, primary-energy and cost KPIs over a 50-year horizon

Proven in EVELIXIA

Demonstrated as VERIFY-B inside the Autonomous Building Digital Twin

Policy-ready

ISO/EN- & Level(s)-aligned for EPBD whole-life-carbon reporting; API-connected, BIM-interoperable

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Thank you

BIM2BEMLCA — integrating INTEMA building energy modelling with VERIFY life-cycle assessment

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