



BIPV: Balancing Building Requirements and Human Comfort

SPHINX Final Event



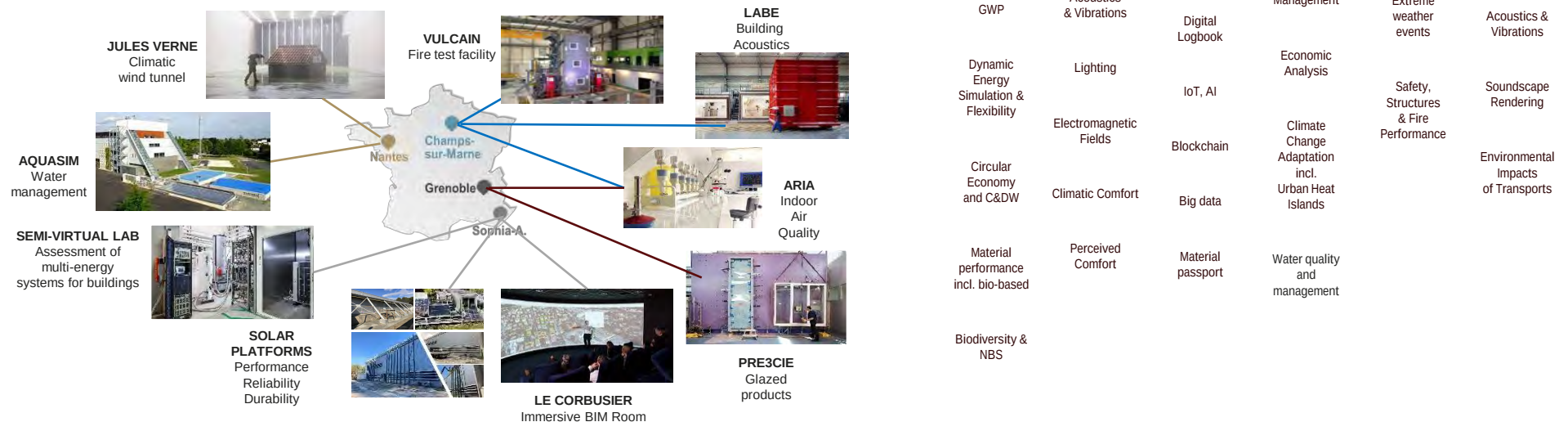
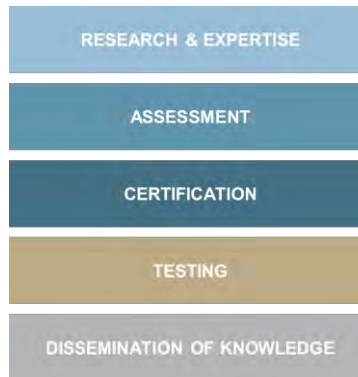
CSTB
le futur en construction

14/10/2026 – Simon BODDAERT



As of December 31, 2023 (excluding subsidiaries)

+ 50 PhD Students



✓ Building integrated Photovoltaic solutions today ...

- ✓ Meet the Building requirements for safety and durability
- ✓ Reliable and sustainable solutions
- ✓ BIPV is definitively a building product with a large range of application
- ✓ Contributes to energy and environmental goals
- ✓ Social contribution
- ✓ Patrimonial added value

✓ CSTB contribution enabling BIPV development

- ✓ Research Projects
- ✓ Indicators and guides to support efficiency
- ✓ People centric consideration
- ✓ Standard, certification activity and regulation ...

01

PROJECT REVIEW

02

PERFORMANCE IN OPERATION

03

STANDARD ACTIVITY

04

BUILD4PEOPLE

05

REGULATION



ADEME Canopy – Source CSTB – Simon BODDAERT 2026



01 - Project review

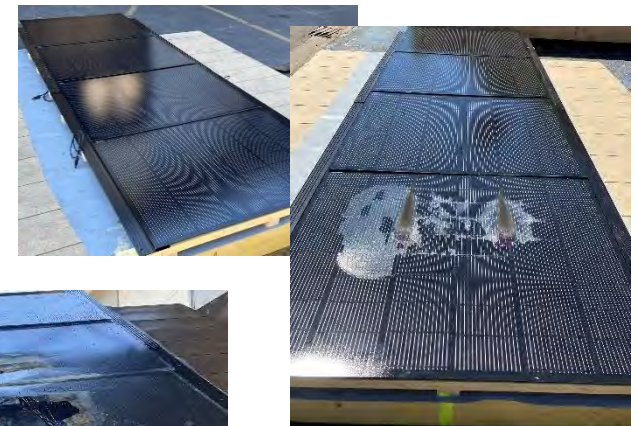
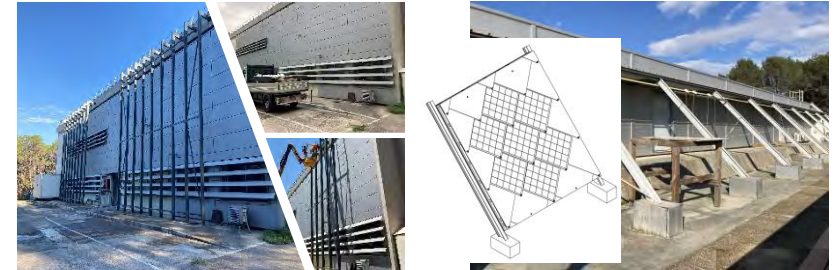


✓ Specific KPIs definition

- ✓ For BIPV and IIPV solution
- ✓ Pre-demo validation before demo-site implementation
- ✓ Monitoring / long term behavior

✓ Indoor/outdoor test plan

- ✓ Acoustic/thermal/fire
- ✓ Mechanical/reliability
- ✓ De-ice and self cleaning
- ✓ Color and glare management



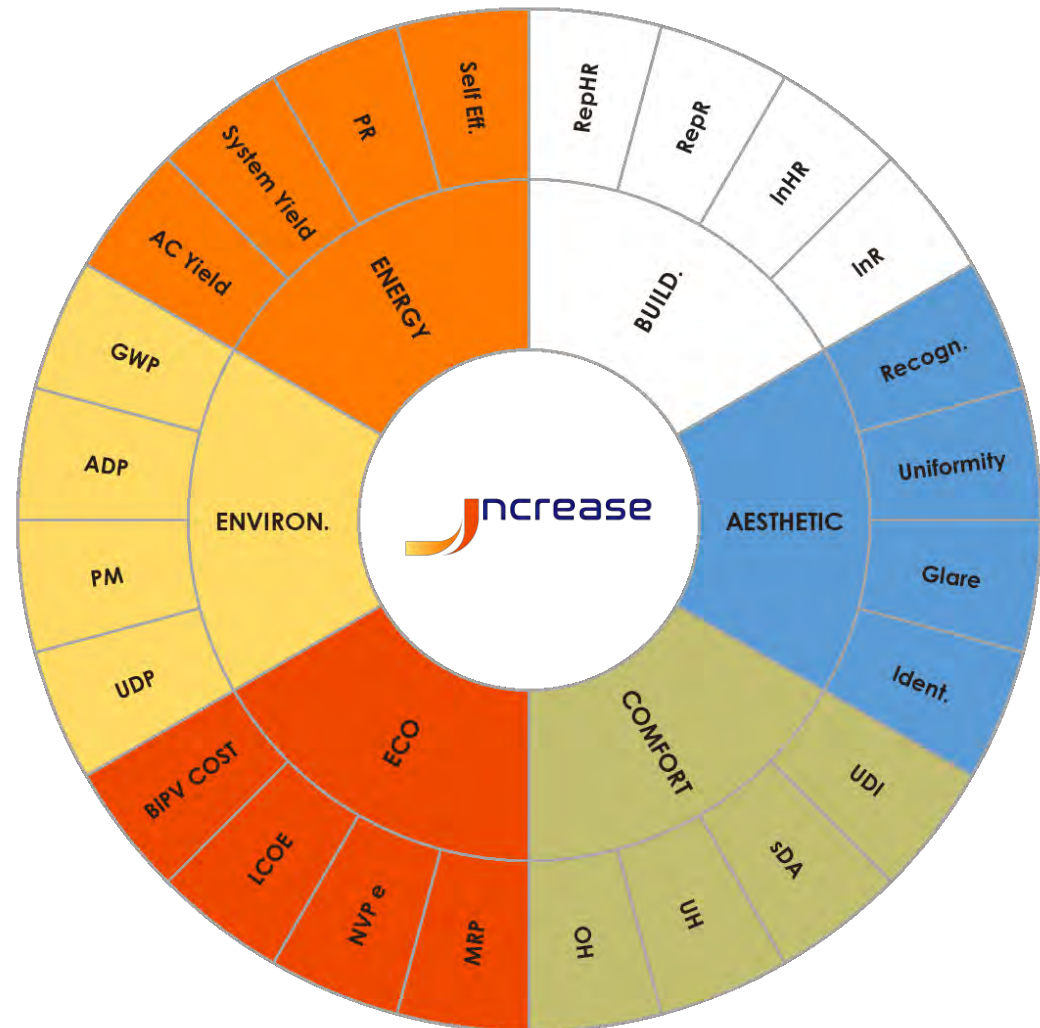


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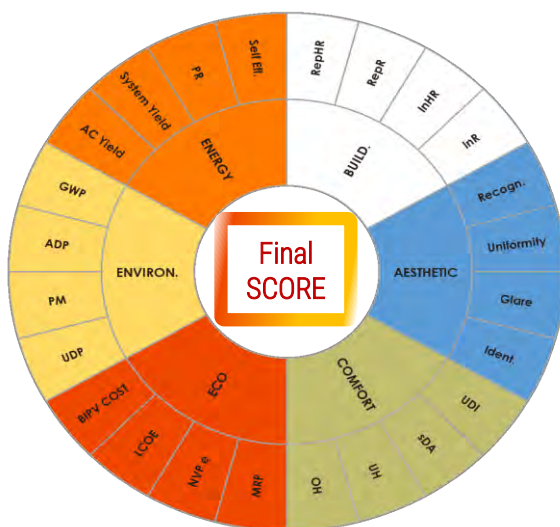
✓ Indoor/outdoor test plan

- ✓ Acoustic/thermal/fire
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Glare risk	Points
Base rating	3
Saturated or highly structured glass (no specular reflections visible)	-1
Flat glass (specular reflections highly visible)	-1
Facing only low traffic areas	+1
Facing high traffic areas	-1
Small, unconnected areas (module areas < 2 m ² and < 25 % coverage)	+1
Final rating	1-5



Based on this assessment, the degree of recognizability is rated from “clearly identifiable as PV” (1) through “not recognizable at first glance but relatively easily for experts” (3) to “difficult to recognize as PV even for experts” (5), or in reverse if the installation is meant to be identifiable as PV.

Aesthetical PIs	Ref.
Recognizability	Reco.
Colour	Unif.
Glare	Glare
RIPV identification	Ident.

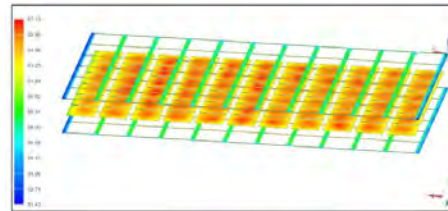
Main parameter	rating 1	rating 2	rating 3	rating 4	rating 5
Y/N					
Spatial $\Delta C(A)$ and angular $\Delta C(\theta)$ colour uniformity (validation needed)	$\Delta C(A) > 10 / --*$ $\Delta C(\theta) > 10 / --*$	$\Delta C(A) < 10 / --*$ $\Delta C(\theta) < 10 / --*$	$\Delta C(A) < 7 / --*$ $\Delta C(\theta) < 7 / --*$	$\Delta C(A) < 4 / --*$ $\Delta C(\theta) < 4 / --*$	$\Delta C(A) < 1 / --*$ $\Delta C(\theta) < 1 / --*$
	*if desired	*if desired	*if desired	*if desired	*if desired
Glare risk	Risk for	Risk for	Risk for	Risk for	Risk for
(example calculations and validation needed)	flash blindness >10 hours annually	flash blindness 1-10 hours	discomfort glare >10 hours annually	discomfort glare 1-10 hours annually	discomfort glare <1 hour annually
Y/N					



✓ Specific New Test Procedures roof/façade

- ✓ Mechanical, Electrical safety
- ✓ Fire
- ✓ Durability
- ✓ Energy, Economy (U, G value, T max)

✓ CPR and building codes



EN 12467	EN 12467
EN 12467-1:2017	EN 12467-1:2017
EN 12467-2:2017	EN 12467-2:2017
EN 12467-3:2017	EN 12467-3:2017
EN 12467-4:2017	EN 12467-4:2017
EN 12467-5:2017	EN 12467-5:2017
EN 12467-6:2017	EN 12467-6:2017
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EN 12467-100:2017	EN 12467-100:2017



• From Fire point of view

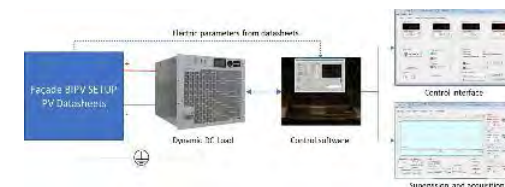
COLOR CODE		
	ENERGY	
	ELECTRICITY	
	MECHANICAL	
	FIRE	

	Av.(R0)	Av.load.(R1)	Std.dev.
FIGRA(0.2) W/s	1161.3	1017.3	-101
THR(600) M	21.3	14.7	-4.6
SMOGRA cm2/s2	27.1	18.4	-6.2
TSP(600) m2	61.5	35.8	-20,7

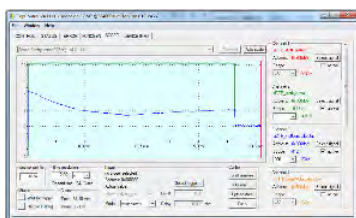
Potential classification	Av.	Av.load	Trend
Propagation time	Tp > 30 min	Tp > 30 min	=
External prop. time	TE = 30 min	TE = 30 min	=
Classification	B ROOF (t3)	B ROOF (t3)	=

Potential classification	Av.	Av.load	Trend
Class	E	E	=
Smoke production	s2	s1	^
Flaming droplet/particules	d2	d2	=

$$R_{fr} = \frac{R_1}{R_0} > 1$$



• From electric point of view



No discontinuity
No electric arc

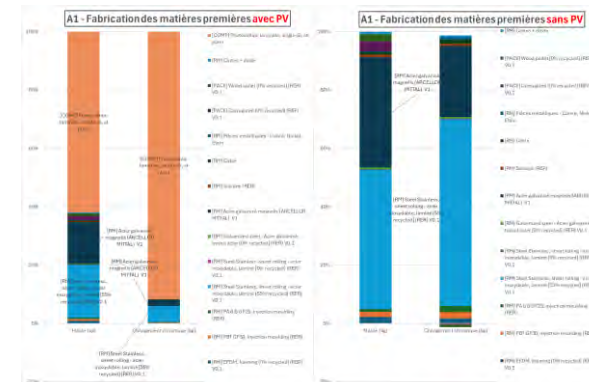
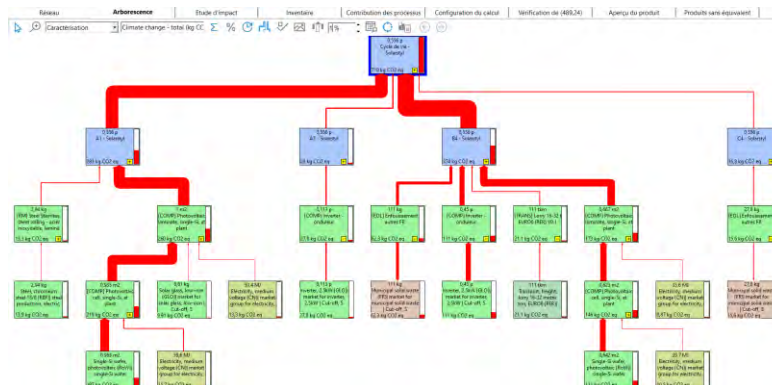
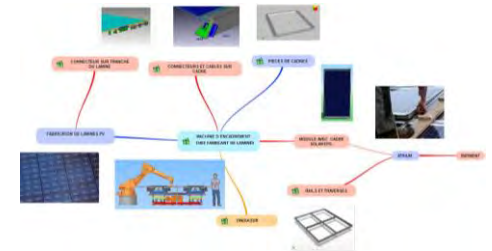
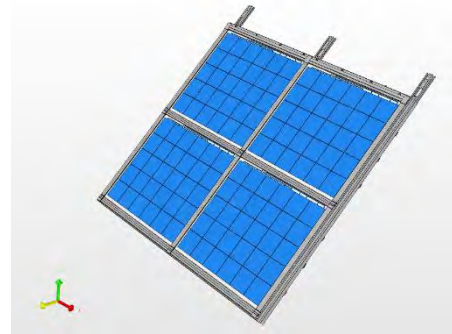
Passed test
Validated
methodology



✓ Steel structure development

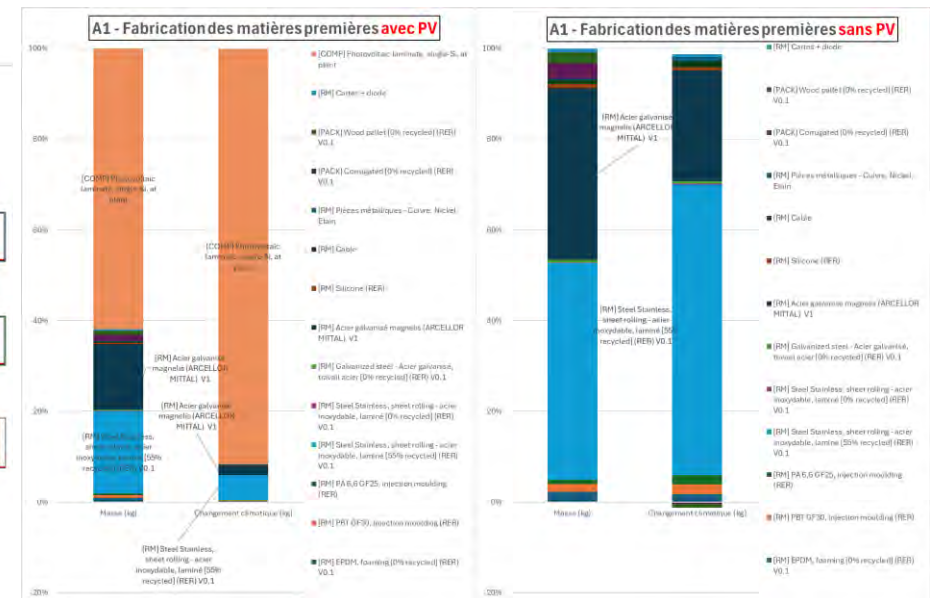
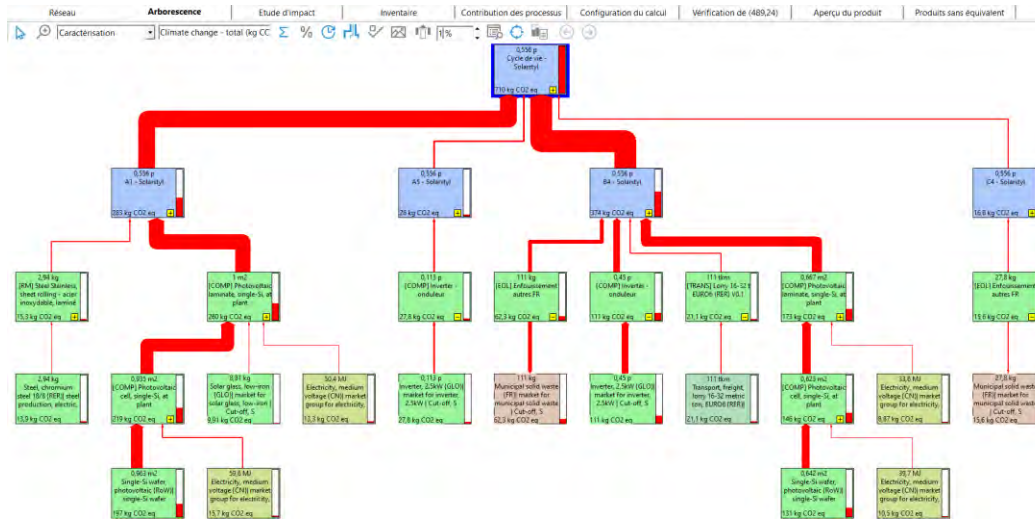
- ✓ Environmental contribution
- ✓ Mechanical added value
- ✓ Building completion and code requirements
- ✓ Reliability and durability
- ✓ Cost effectiveness

✓ LCA analysis for industrial driving





✓ LCA analysis for industrial driving





02 – Performance in Operation



IEA
PVPS



✓ Methodology to assess BIPV performance in operation

- ✓ To secure all BIPV stakeholders
- ✓ Insurance scheme to support market access
- ✓ Tool to support reliability and durability of BIPV solutions

✓ On site audit to control health of BIPV solution

- ✓ Energy control
- ✓ Observation and measurement
- ✓ Forecast and numerical results assessed

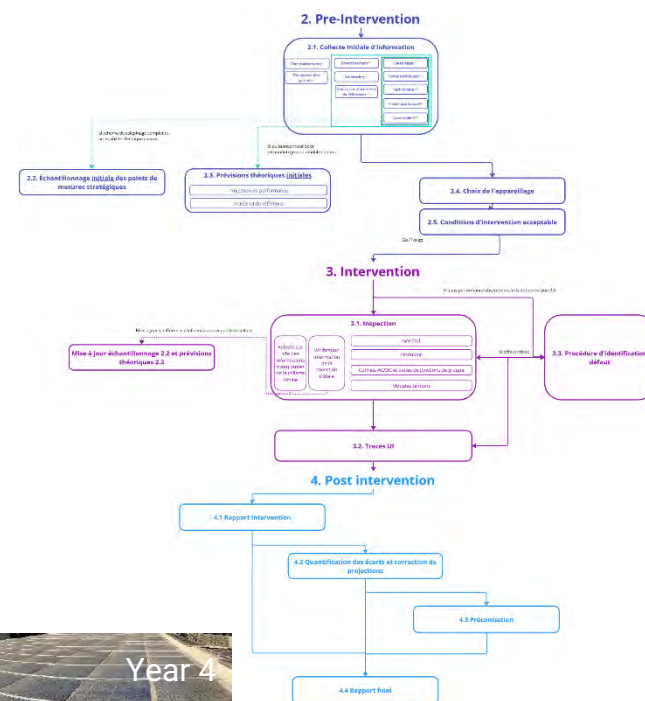
$$EPI = 91\%^{+2}$$



IEA
PVPS



- ✓ Validated on more than 30 BIPV solutions
- ✓ Explicit and clear protocol
- ✓ Step by step audit
- ✓ Track over the time behavior



Year 1



Year 2



Year 3



Year 4

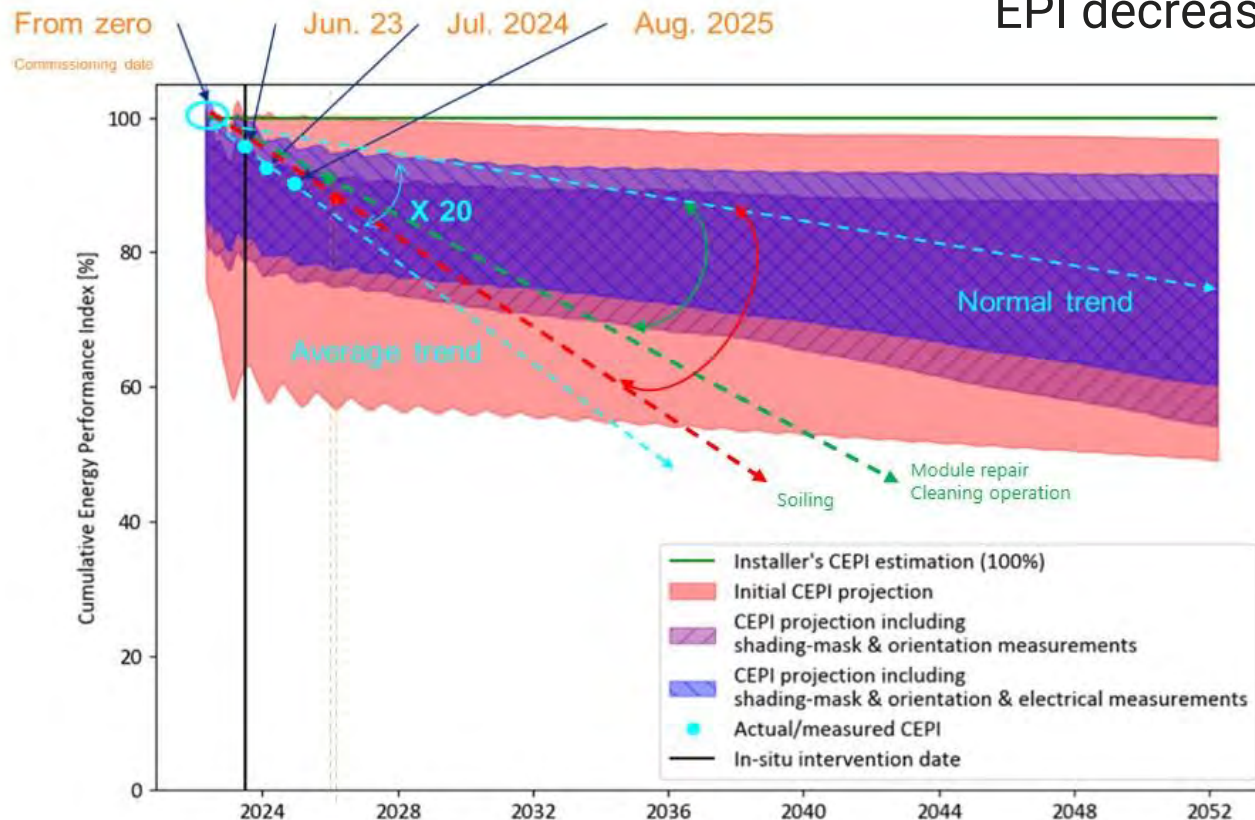


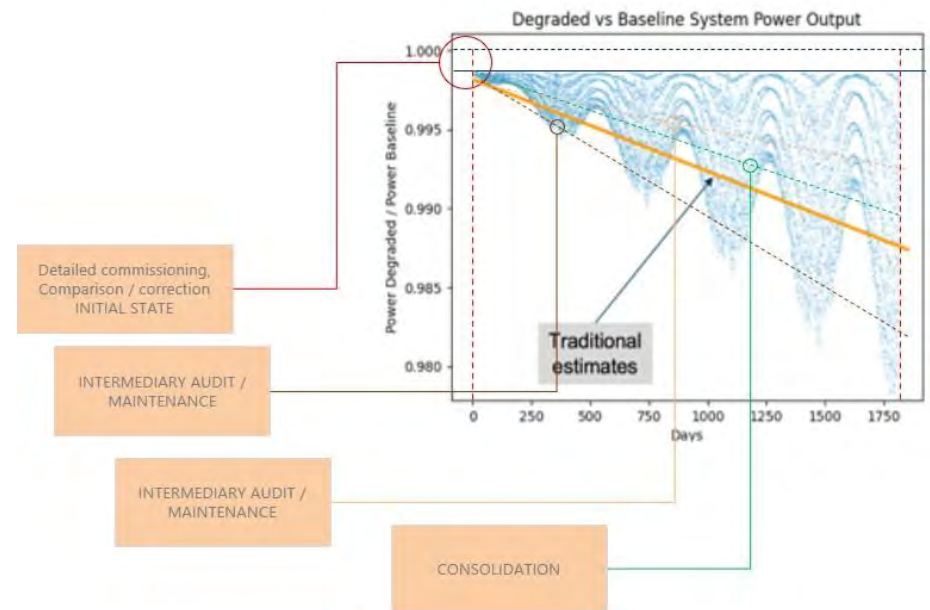
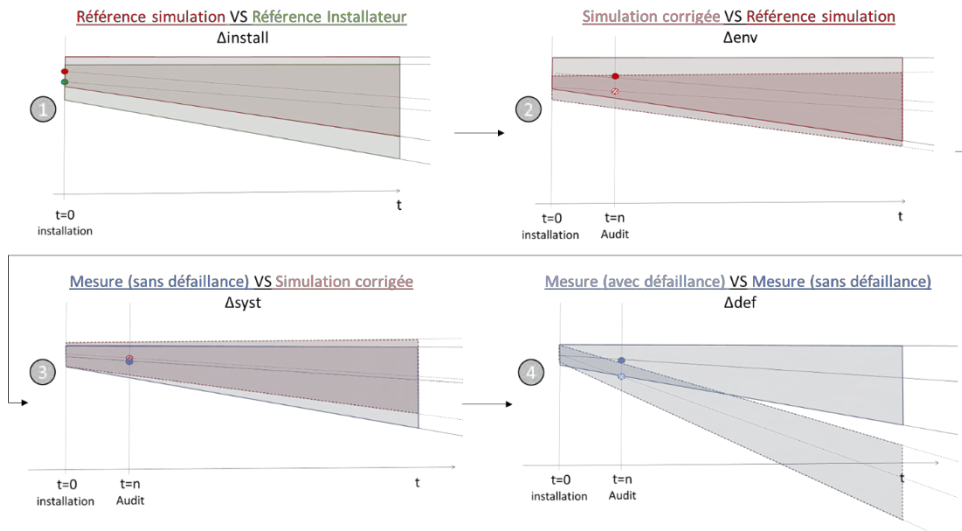
IEA
PVPS



$EPI = 91\%^{+2}$
EPI decrease $> 2\%/y$
Module repair
Cleaning operation

$EPI = 88\%^{-3}$
EPI decrease $> 3\%/y$
Soiling







03 – Standard Activity



✓ CSTB is Member of TC 82 / CENELEC

✓ WG1/WG2/WG3/**JWG11**/ PV600

✓ Contribution in advanced standard project

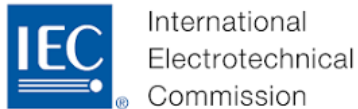
✓ CSTB is Member of UF 82

✓ Last contribution

✓ 61215 / 61730 / 63092 / Reuse / KV3000 / Floating

✓ CSTB is Member of TC 127

✓ Fire in building WG5 roof and WG10 façade



COST ACTION

P  A R L P V



SPARKPV



04 – Build4People



✓ CSTB is Board Member of Build4people

- ✓ Scientific and Technical Building Center > build for the future
- ✓ Users are at the center of CSTB consideration to ensure
 - ✓ Renovation and retrofitting in use
 - ✓ Disturbance minimization
 - ✓ Energy and environmental efficiency
 - ✓ Comfort requirement as drivers
 - ✓ Light comfort
 - ✓ Thermal comfort
 - ✓ Noise comfort



05 – Regulation

RE 2020 RÉGLEMENTATION ENVIRONNEMENTALE

- ✓ CSTB support development of national regulation
- ✓ Scientific base development
- ✓ In the field implementation and technical overview
- ✓ Comfort requirement integrated as a goal of efficiency DH



Thank you for your attention

Contact :

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