

Impact des grandes infrastructures

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on behalf of members of Labos 1point5

Réunion référents DD IN2P3
26 mars 2024



Labos 1.5

◆ Groupement de Recherche

- Understand and reduce the C footprint of research
- CNRS, INRIA (computing), INRAE (agriculture), ADEME (environment agency)

◆ Develop tools to estimate C footprint for labs <https://apps.labos1point5.org/ges-1point5>

The screenshot shows a web-based application for conducting a GHG inventory. The left sidebar has a blue header 'GHG 2022' and sections for 'DOCUMENTATION' (Methodology, Help, Data protection, The team GES 1point5), 'DATA' (Introduction, Boundaries, Buildings, Purchases, Digital devices, Vehicles, Travels, Commutes, Foods, Research activities), and 'RESULTS' (GHG Protocol, Regulatory inventory, Carbon footprint & submission). The 'Boundaries' section is currently active, indicated by a grey background and a green circular icon with a white question mark. The main content area displays the 'Calendar year of the GHG inventory and budget of the laboratory' form, which includes fields for the calendar year (set to 2022) and annual budget (€ 1576000). Below this is the 'Headcount of the laboratory' section, which asks for the number of researchers, professors, engineers, PhD or post-docs, and a total headcount. A table shows the following data:

# Researchers	# Professors	# Engineers	# PhD or Post-Docs	# Total
19	50	54	21	144

At the bottom of the main content area is a 'Description / internal notes' section with a rich text editor toolbar.

Récentes additions à GES 1point5

Labos 1.5

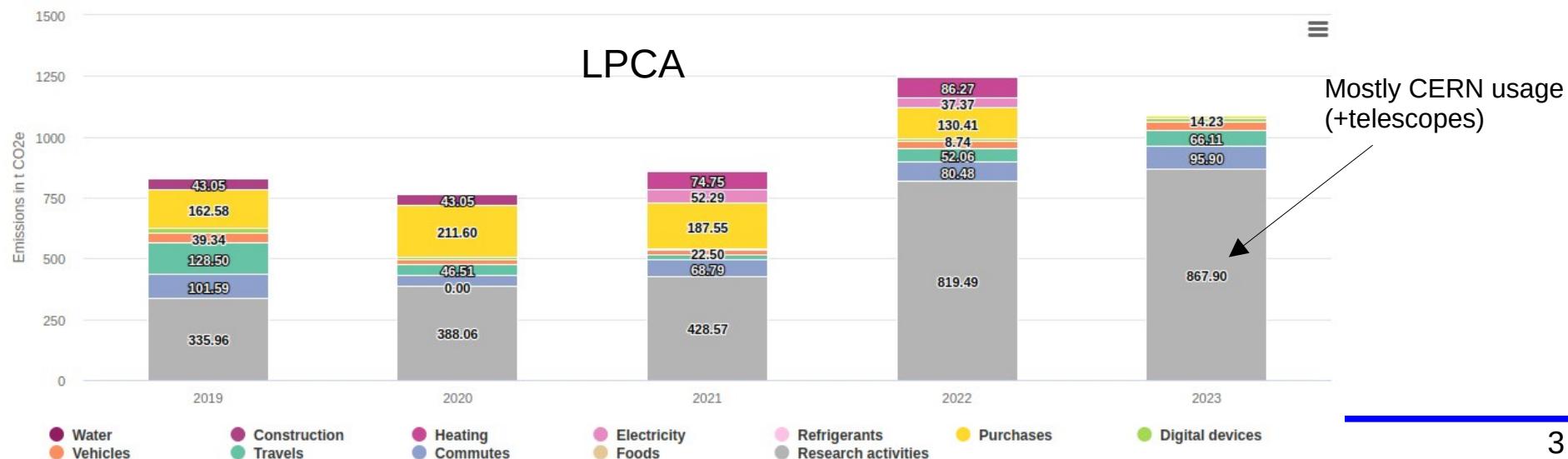
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Include plane contrails in GES 1point5 calculations.

For air travel, the French regulation advocates to take into account the emissions linked to fuel combustion and upstream, with the option of including or excluding emissions from **condensation trails**.

The **radiative forcing** of these contrails is **significant** even if its **magnitude is still uncertain**. Therefore, GES 1point5 allows to take these contrails into account or not in the calculation.



Labos 1.5

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 - Understand and reduce the C footprint of research
 - CNRS, INRIA (computing), INRAE (agriculture), ADEME (environment agency)
- ◆ Develop tools to estimate C footprint for labs
 - ... evaluate policies to reduce it

The image shows a software interface for managing laboratory energy consumption. On the left, a sidebar lists categories: Bâtiments, Isoler les bâtiments, Réduire le chauffage, Autoproduction d'énergie, Achats, Matériel informatique, Véhicules, Missions, and Dpts domicile / travail. A blue arrow points from the 'Isoler les bâtiments' button to a modal window titled 'Isoler les bâtiments'. This window contains the text 'Modifier la classe énergétique des différents bâtiments dans lesquels le laboratoire est hébergé.' and '(bâtiment: Tous)'. It features a horizontal slider with ticks at A, B, C, D, E, F, and G, where A is red and B is white. Another blue arrow points from the 'Réduire le chauffage' button to another modal window titled 'Réduire le chauffage'. This window contains the text 'Réduire la température de consigne de chauffe des bâtiments occupés par le laboratoire.' and '(bâtiment: Tous)'. It features a horizontal slider with ticks at 0°C and -5°C, where 0°C is red and -5°C is white. To the right, a large bar chart titled 'RÉDUCTION 6.3 %' shows emissions in t eCO2 from 2019 to 2030. The chart has five stacked bars: yellow (bottom), pink, light blue, orange, and green (top). The y-axis ranges from 0 to 1000. The x-axis shows years 2019 and 2030. Below the chart, four team members are identified: J. Mariette (INRAE), O. Aumont (IRD), L. Pagani (CNRS), and S. Calvet (CNRS). A legend indicates that the yellow bar represents the main reduction, while the other colors represent secondary components.

J. Mariette
(INRAE)

O. Aumont
(IRD)

L. Pagani
(CNRS)

S. Calvet
(CNRS)

- 11 labos testeurs
- L'équipe de construction des scénarios
- L'équipe technique

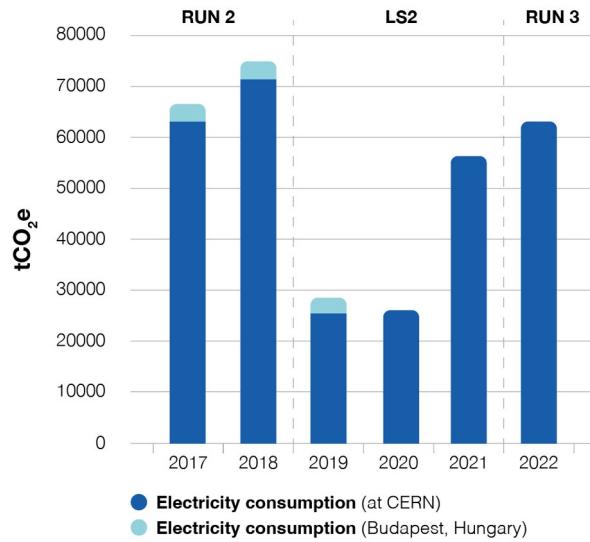
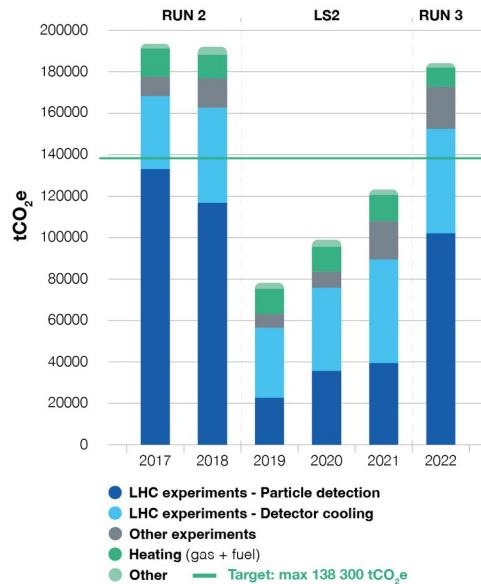
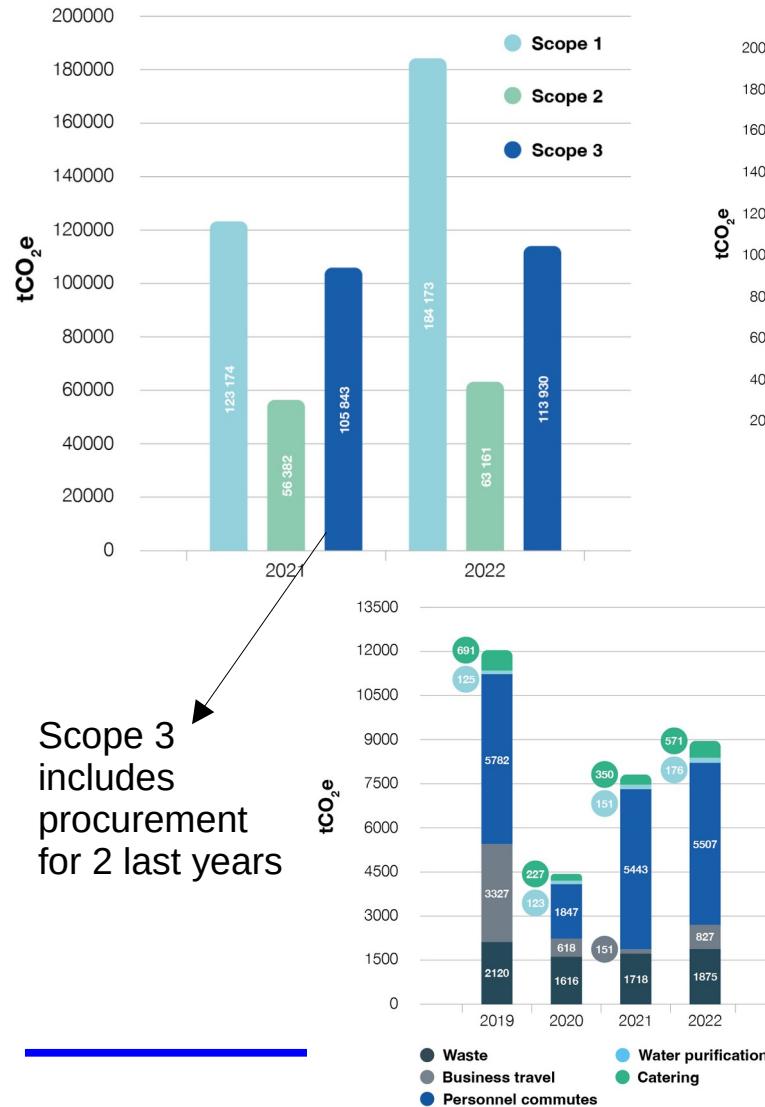
Labos 1.5

- ◆ Groupement de Recherche
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- ◆ Develop tools to estimate C footprint for labs
 - ... evaluate policies to reduce it
- ◆ On going task force to include the impact of infrastructures
 - Crucial task
 - Better awareness of the impacts by physicists → actions
 - Fairer discussion in the labs if everything is properly accounted for
 - CERN, telescopes and national computing center impacts released in 1st version of the module
 - More to come: biological and medical analysis platforms, animal facilities, ...
- ◆ Possibility to use outside of French research institutes (open source)
 - Discussions ongoing



Inputs, last CERN environmental report

- ◆ <https://hse.cern/environment-report-2021-2022/emissions>



Scope 1

Scope 3
(excluding procurement)

Scope 2
(previous years recomputed)

Strategy & Inputs (2)

◆ How to distribute the footprint?

- Share it among the physicists using CERN
 - CERN's goal is to provide them data
 - Well known numbers, by CERN and labs

PhD student, post-doc, staff at Dec 31st

- <https://cds.cern.ch/collection/CERN%20Annual%20Personnel%20Statistics>

1	2017	2018	2019	2020	2021	2022
2 Runs	Run 2	Run 2	LS2	LS2	LS2	Run 3
3 Users CERN (31-déc.)	12236	12569	12428	11399	11175	11860
4 Atlas	3912	3971	3983	3699	3517	3580
5 CMS	3076	3092	3055	2862	2749	2940
6 Alice	1314	1320	1329	1180	1159	1208
7 LHCb	870	913	946	887	910	959
8 ->Exp LHC	9172	9296	9313	8628	8335	8687
9	74,96%	73,96%	74,94%	75,69%	74,59%	73,25%
10 LHC	78					
11 SPS	733	745	718	676	695	711
12 PS	219	229	204	179	177	221
13 -> Acc	1030	974	922	855	872	932
14	8,42%	7,75%	7,42%	7,50%	7,80%	7,86%
15 -> Autres Expe	2034	2299	2193	1916	1968	2241

LHC experiment users

Accelerator sector
→ not used for the sharing

Other-experiment users

Home > Articles & Preprints > CERN Notes > Human Resources (HR) > CERN Annual Personnel Statistics

HR Department

CERN Annual Personnel Statistics

Search 54 records for:

Add to Search + Search Tips Advanced Search

Latest additions:

2023-05-12 08:16 CERN Annual Personnel Statistics 2022 CERN-HR-STAFF-STAT-2022-2022 Fulltext: PDF; Detailed record - Similar records

2022-05-18 14:08 CERN Annual Personnel Statistics 2021 CERN-HR-STAFF-STAT-2021-2021 Fulltext: PDF; Detailed record - Similar records

2021-06-01 07:46 CERN Annual Personnel Statistics 2020 CERN-HR-STAFF-STAT-2020-2020 Fulltext: PDF; Detailed record - Similar records

2020-06-26 16:53 CERN Annual Personnel Statistics 2019 CERN-HR-STAFF-STAT-2019-2019 Fulltext: PDF; Detailed record - Similar records

2019-06-04 09:05 CERN Annual Personnel Statistics 2018 CERN-HR-STAFF-STAT-2018-2018 Fulltext: PDF; Detailed record - Similar records

2018-05-09 09:27 CERN Annual Personnel Statistics 2017 CERN-HR-STAFF-STAT-2017-2017 Fulltext: PDF; Detailed record - Similar records

Scope 1

		2017	2018	2019	2020	2021	2022	2023	
1		Run 2	Run 2	LS2	LS2	LS2	Run 3	Run 3	
2	Runs								
18	Emissions (tCO2eq)	374 119	380 943	220 270	231 057	285399	361264		
19	scope 1	193600	192100	78169	98997	123174	184173		
20	Exp-Detec LHC	133029	116690	22597	35537	39355	101850		LHC
21	Exp-Refr LHC	35312	46122	33665	40383	50171	50475		LHC
22	Autres Exp	9132	14068	6918	7846	18325	20430		horsLHC
23	Chauffage	13700	11300	12221	12000	12618	9012		any
24	autres	2130	3921	2768	3231	2704	2403		any
25	->LHC	168341	162812	56262	75920	89526	152325		
26	-> hors LHC	9132	14068	6918	7846	18325	20430		
27	-> anyexp	15830	15221	14989	15231	15322	11415		

38	scope 1 LHC/user	18,35	17,51	6,04	8,80	10,74	17,53
39	scope 1 horsLHC/user	4,49	6,12	3,15	4,09	9,31	9,12
40	scope 1 any	1,29	1,21	1,21	1,34	1,37	0,96

18.35t/phys (for LHC experiment users)

4.49t/phys (for non-LHC experiment users)

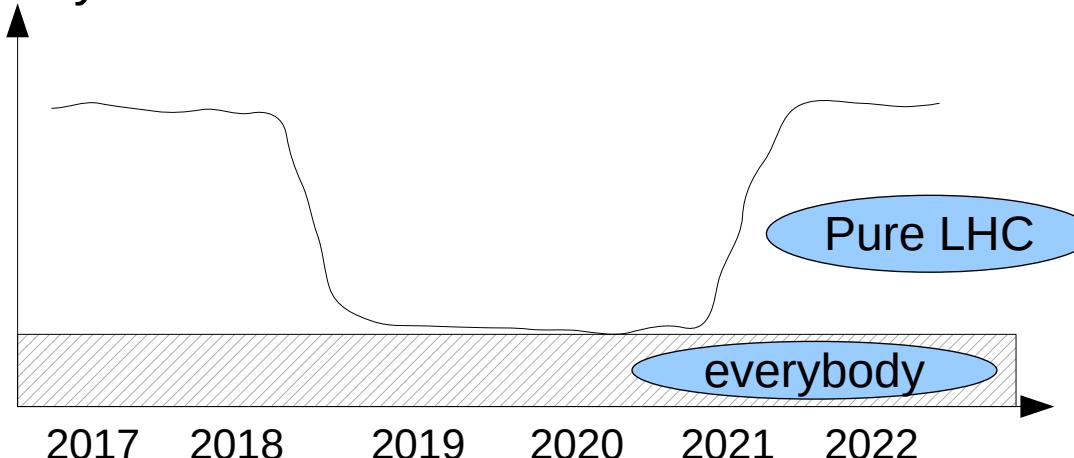
+ 1.29t/phys (LHC or non-LHC)

Actuellement dans l'outil GES1point5 (pre-rapport environnemental 2021-2022) :

37	scope 1 LHC/user	18,22	17,51	6,04	8,80	7,93	18,74
38	scope 1 horsLHC/user	4,61	6,12	3,15	4,09	3,75	6,28
39	scope 1 any	1,12	1,21	1,21	1,34	1,32	1,25

Scope 2 (mostly electricity)

- ◆ Global tendency:



Chiffres revus à la hausse rétroactivement (2017-2020) dans le nouveau rapport 2021-2022

Hypothèse: durant le shutdown la conso électrique/physicien pour une expérience hors LHC est similaire à celle du LHC/physicien

Cooling!
→ LS with high consumption

1		2017	2018	2019	2020	2021	2022	2023
2	Runs	Run 2	Run 2	LS2	LS2	LS2	Run 3	Run 3
30	scope 2	66589	74913	28554	26127	56382	63161	
31	scope 2 (any)	27340,5	27340,5	28554	26127	27340,5	27340,5	Ave (19', 20)
32	scope 2 (LHC)	39248,5	47572,5	0	0	29041,5	35820,5	27340,5

Scope 2 (mostly electricity) - Uncertainties

- ◆ Evaluate with another sharing:
 - LHC data production: largest part of scope 2 → give it to LHC users

1	2017	2018	2019	2020	2021	2022
2	Runs	Run 2	Run 2	LS2	LS2	Run 3
41	scope 2 pour LHC	7,26	8,06	3,07	3,03	6,76
42	scope 2 (any)	2,23	2,18	2,30	2,29	2,45
43	scope 2 (LHC)	4,28	5,12	0,00	0,00	3,48
						4,12

- Comparaison des 2 méthodes :
 - LHC: [15, 27%] → 30%
 - Non-LHC : [10,16%] → 20%

Actuellement dans l'outil GES1point5 (pre-rapport environnemental 2021-2022) :

40	scope 2 pour LHC	4,91	3,41	1,15	1,07	1,19	4,41
41	scope 2 (any)	0,81	0,79	0,86	0,81	0,89	0,84
42	scope 2 (LHC)	3,82	2,34	0,00	0,00	0,00	3,27

Scope 3

Some assumptions for early periods

	Run 2	Run 2	LS2	LS2	LS2	Run 3	
	2017	2018	2019	2020	2021	2022	
Waste	1875	1875	2120	1616	1718	1875	2017/8: use running condition (2022)
Business travel	3327	3327	3327	618	151	827	2017/8: use pre-covid condition (2019)
Commute	5782	5782	5782	1847	5443	5507	2017/8: use pre-covid condition (2019)
Water	176	176	125	123	151	176	2017/8: use running condition (2022)
Catering	691	691	691	227	350	571	2017/8: use pre-covid condition (2019)
Sub-total	11851	11851	12045	4431	7813	8956	
procurement	101502	101502	101502	101502	98030	104974	<2021: Average(21', 22')
Total	113353	113353	113547	105933	105843	113930	101502

Adding **procurement**, from recent years
(not available in reports before 2021)

Construction of LHC

- ◆ Not clear how to handle it
 - Tunnel already existing (LEP)
 - Amortisation period (how long?) or single shot at construction time?
 - How to take into account the upgrades ?

- ◆ Order of magnitude

	A	B	C	D	E	F
1	cout:	4,50E+09 euros		LHC+4 experiences (CHF=euros)		
2	annees:	2008	2040	32 ans		
3				1,41E+08 euros/an		
4	FE:	0,3 kg/euros				
5	Co2eq:	4,22E+04 tonnes				
6	physiciens:	8600				
7		4,91 t/phys				

→ Much smaller than yearly usage → choice to **ignore** it

Results & Uncertainties

◆ Uncertainties

● Methodology:

Comparaison btw 2 methods

LHC: [15, 27%] → 30%

non-LHC : [10,16] → 20%

1	2	Runs	2017	2018	2019	2020	2021	2022	2023
52	FE t/user (LHC)	Run 2	-0,15	-0,17	-0,27	-0,23	-0,24	-0,20	-> 30%
53	FE t/user (CERNuser)	LS2	0,16	0,15	0,09	0,10	0,10	0,14	->20%

● Emission factors: (from GES1.5)

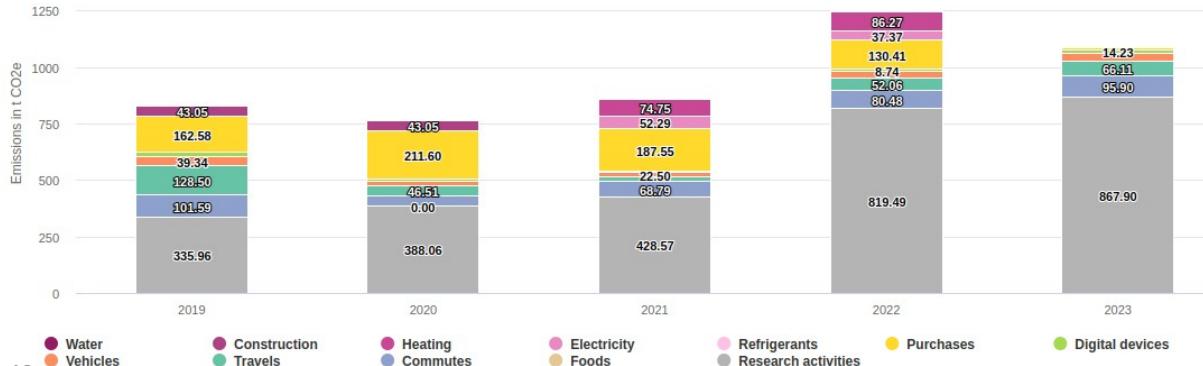
- Gaz : 30%

- Electricity (Fr): 10%

◆ Results: (computing still to be included...)

55	56	2017	2018	2019	2020	2021	2022		
57	58	Run 2	Run 2	LS2	LS2	LS2	Run 3		
FE t/user (LHC)	30%	35,43	35,04	18,68	21,72	27,51	34,53	divise les 3 scopes	
	30%	10,63	10,51	5,60	6,52	8,25	10,36	methodologie	
	10%	5,51	5,25	1,81	2,64	3,22	5,26	gaz	
		0,65	0,73	0,23	0,23	0,59	0,64	electricite	
Incertitude totale		11,99	11,77	5,89	7,03	8,88	11,64		
63	64	65	66	67	68	69	70	71	72
FE t/user (exp non-LHC)	20%	17,28	18,52	15,79	17,02	22,60	21,99		
	10%	3,46	3,70	3,16	3,40	4,52	4,40	methodologie	
Incertitude totale		3,46	3,71	3,17	3,41	4,53	4,40		

Results for LPCA



Just a single number to be provided by the users

Category	Type	Sub-type	Amount	Unit
Research facilities	CERN	LHC experiment	32	User(s)
Research facilities	Astronomy	STEREO, TESS, GAIA, GALEX, WISE...	Utilisation	10 persons
Research facilities	Astronomy	STEREO	0.1	% facility usage
Research facilities	Astronomy	TESS	0.01	% facility usage
Research facilities	Astronomy	GAIA	0.01	% facility usage
Research facilities	Astronomy	GALEX	0.02	% facility usage
Research facilities	Astronomy	WISE	0.01	% facility usage
Research facilities	Astronomy	HST	0.01	% facility usage
Research facilities	Astronomy	SWIFT	0.01	% facility usage
Research facilities	Astronomy	Fermi	0.04	% facility usage
Research facilities	Astronomy	Pic-du-Midi Observatory	2.74	% facility usage
Research facilities	Astronomy	Anglo-Australian Telescope	0.06	% facility usage
Research facilities	Astronomy	VLT (Paranal)	0.01	% facility usage
Research facilities	Astronomy	GTC	0.09	% facility usage
Research facilities	Astronomy	TAROT	2	% facility usage
Research facilities	Astronomy	VLA	0.01	% facility usage

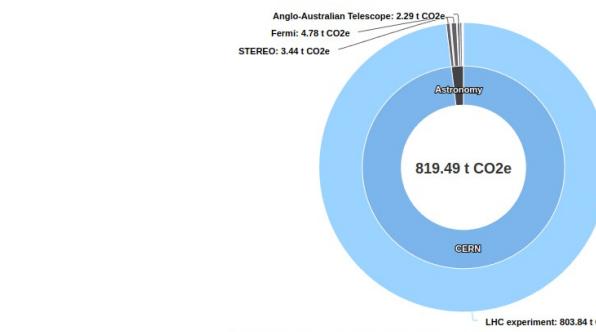


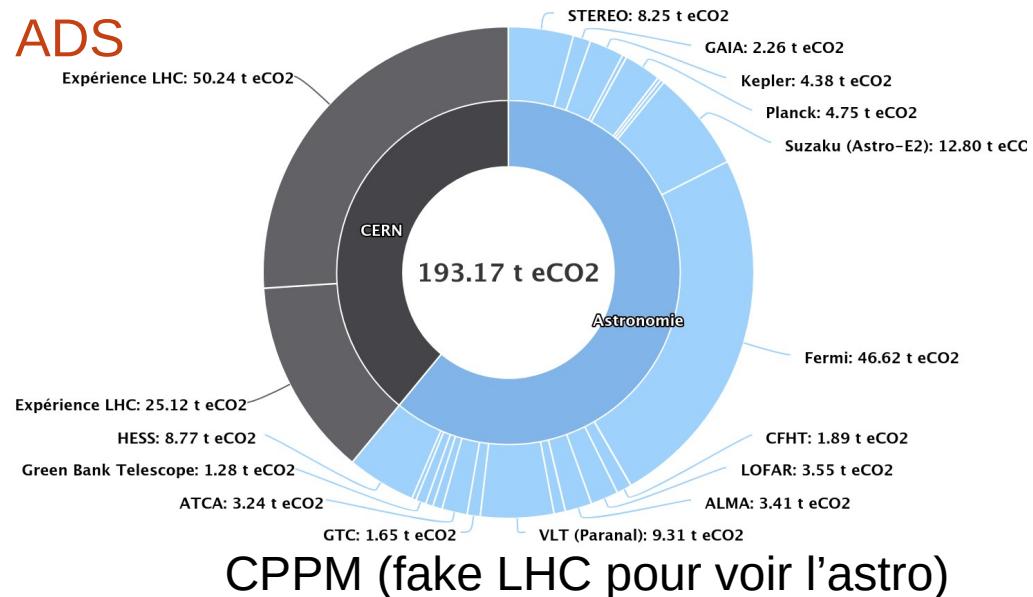
Figure : Carbon footprint of laboratory research activities separated by their types.

Astronomie

- ◆ Prend en compte les **téléscopes (spatiaux et terrestres)** utilisés dans les publications du laboratoire
- ◆ Facile à utiliser : **juste fournir le nom du labo**
- ◆ Emissions attribuées au rapport entre *auteurs du labo ayant publié des articles citant l'infrastructure* et *ensemble des auteurs à l'échelle mondiale ayant également publié des articles citant cette même infrastructure*
- ◆ Amortissement : 38 ans pour les télescopes et 18 ans pour les satellites
- ◆ Données bibliométriques extraites de **ADS**
- ◆ N'inclut pas encore les infra récentes (Euclid, CTA, LSST, etc.)
- ◆ Ref : [arXiv: 2201.08748 \[astro-ph.IM\]](#)

$$EC_{\text{infra}} = \frac{GES_{\text{construction}}}{\text{amortissement}} + GES_{\text{opérations}}$$

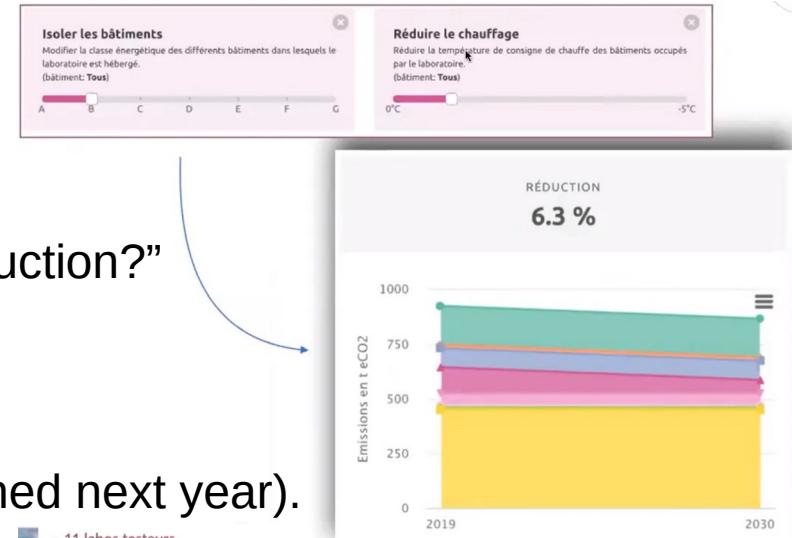
$$EC_{\text{labo}} = \sum_i (EC_{\text{infra}_i} \times \% \text{utilisation}_{\text{infra}_i}^{\text{labo}})$$



Implementing CERN reduction in Scenario1.5

That will ...

- Answer to
“our biggest GHG emission source is CERN,
and they're going to cut back on gas,
so we don't have much left to do for our 50% reduction?”
- Raise awareness of the long-term consequences
of our technological choices
(especially as the FCC proto-collab will be launched next year).



So ... What will the CERN footprint be in 2030 ?

- CERN plans to reduce Scope 1 by 28%
(wrt/ 2018) by 2025
→ Scope 1(2018) *28% / nb of phys = -5.8t
- To be applied only if the reference year is not a LS

Conclusion

- ◆ All French research areas involved in the labos1.5
 - Tools, methods, webinars, papers, ...
 - Encouraged by funding agencies
- ◆ Developed a tool to handle C-footprint of CERN and telescopes (and GENCI)
 - Rising awareness, decision-making support

