

Case-Studies and projects from Geneva, Switzerland

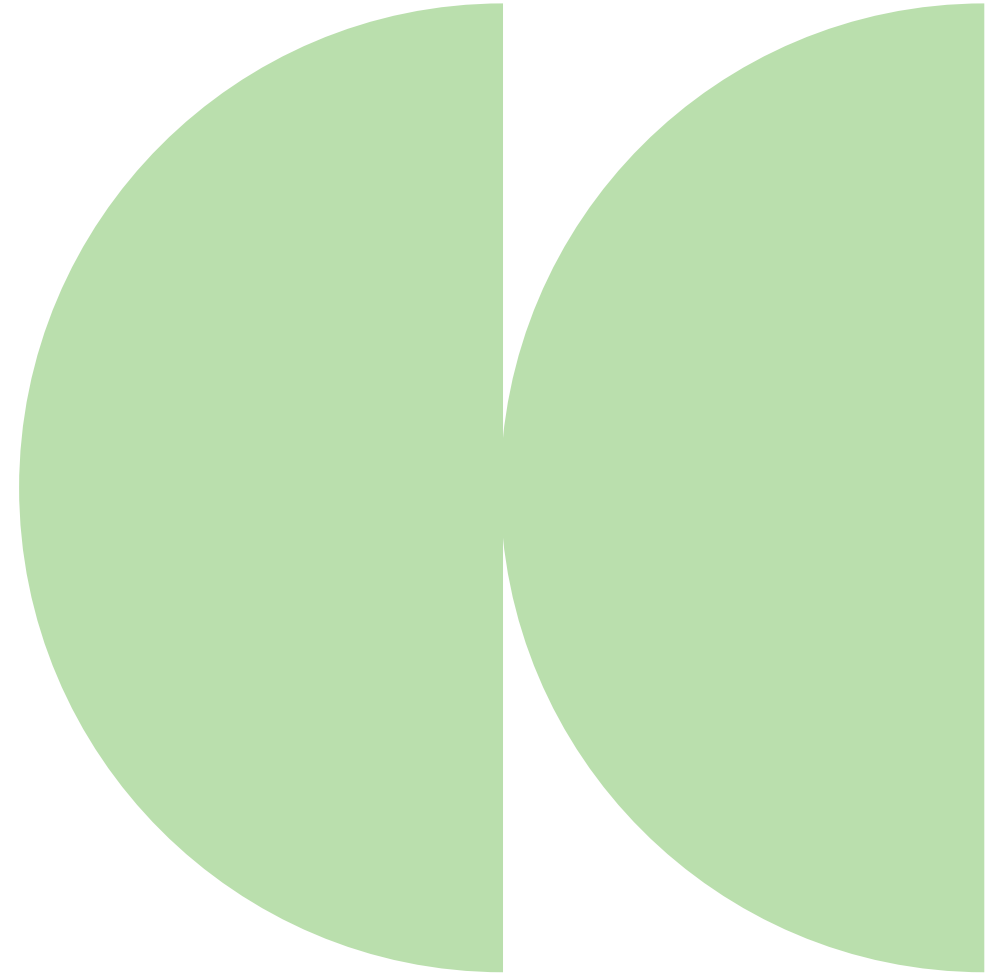
Annex 50 “Heat Pumps in Multi-Family Buildings for Space Heating and DHW”

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Services Industriels de Genève

13.06.2023



- 1 Context
- 2 Case studies
- 3 HP in large buildings - activities



Context



Act

→ Switzerland

○ Energy strategy 2050

→ Geneva

○ Cantonal Climate Plan (PCC)

Environ
5'141'000
tCO₂e
émis par le
canton de Genève
en 2012

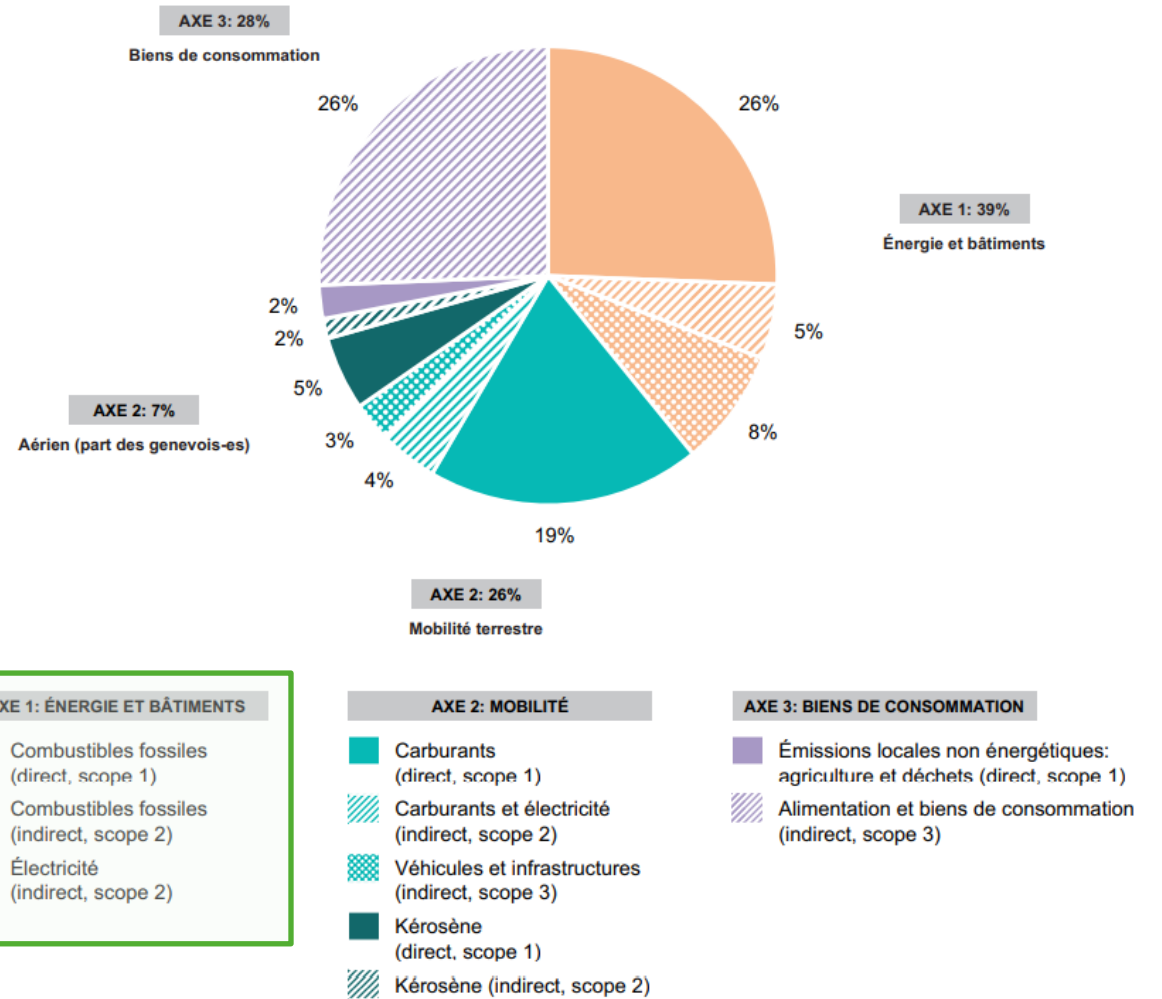
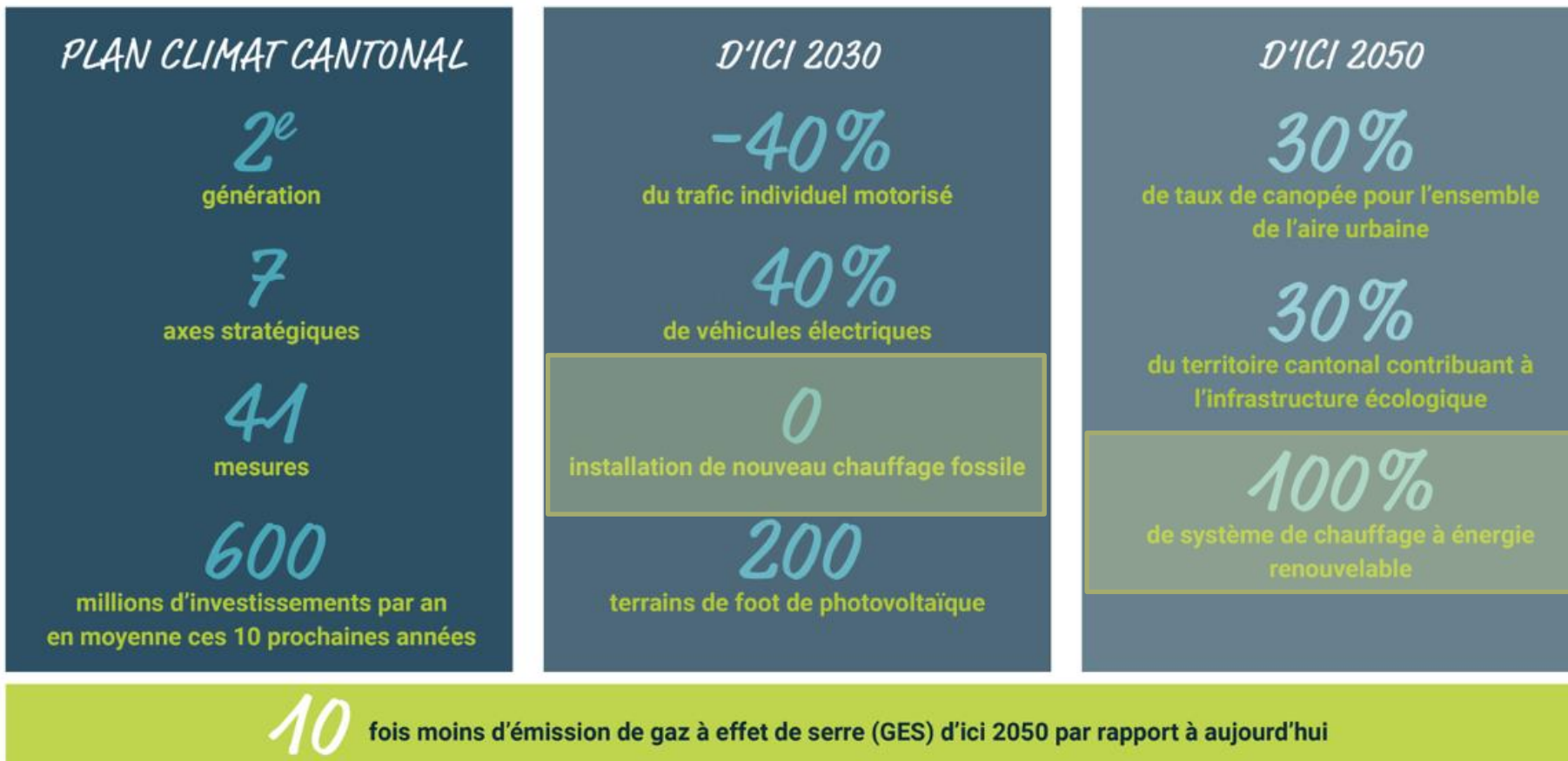


Figure 5 : Répartition par axe et par scope des émissions de GES du canton de Genève en 2012 avec prise en considération du trafic aérien (part des genevois-es uniquement)

LES CHIFFRES CLÉS



<https://www.ge.ch/teaser/plan-climat-cantonal-geneve-2030/plan-climat>

Geneva building stock

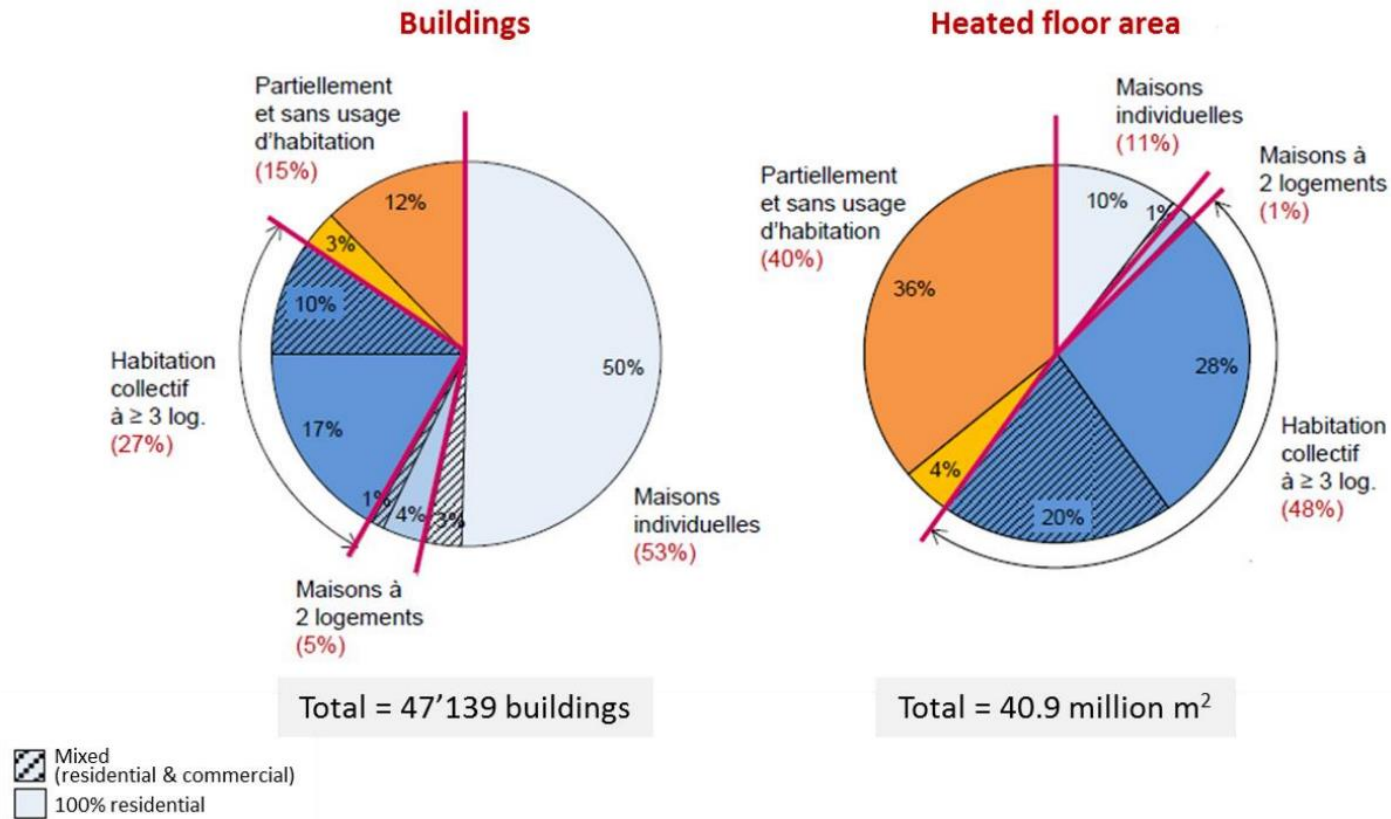


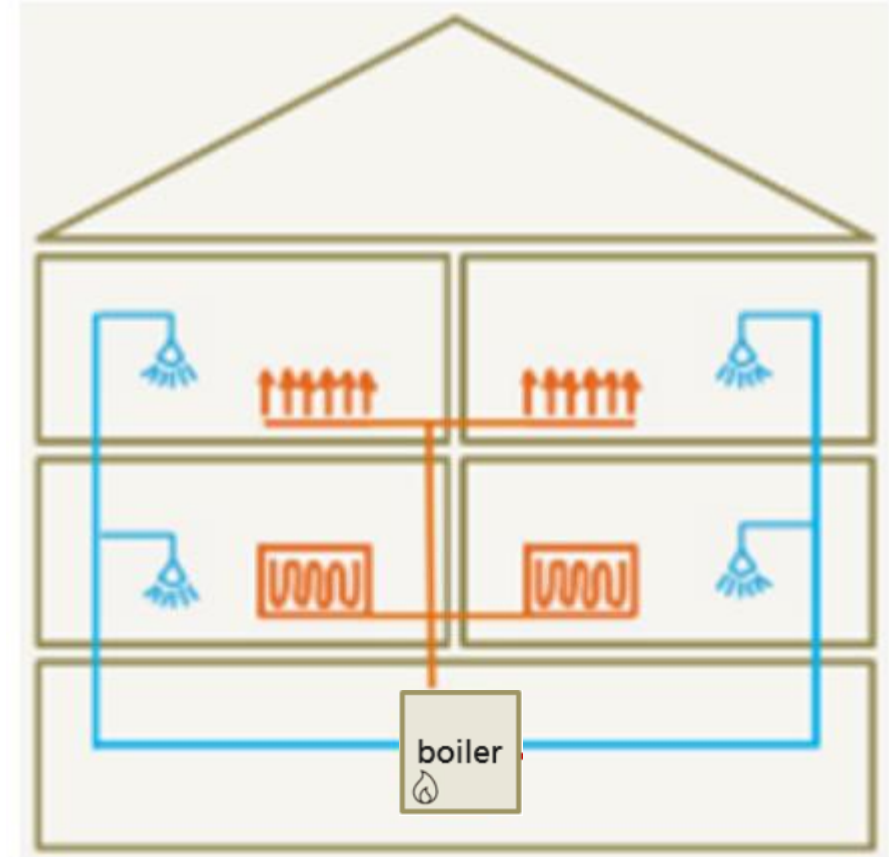
Figure 1:2 Geneva building stock, in 2010. Left: Number of buildings; Right: Heated surface (SRE). (source: Khoury, 2014)

Typical MFB heating system

EXISTING BUILDINGS

WHY?

- Cheaper upfront investment
- Owner/tenant issues
- Technological mistrust
- Risks associated with the unknown/non-mastery of the technology for these sizes of installations



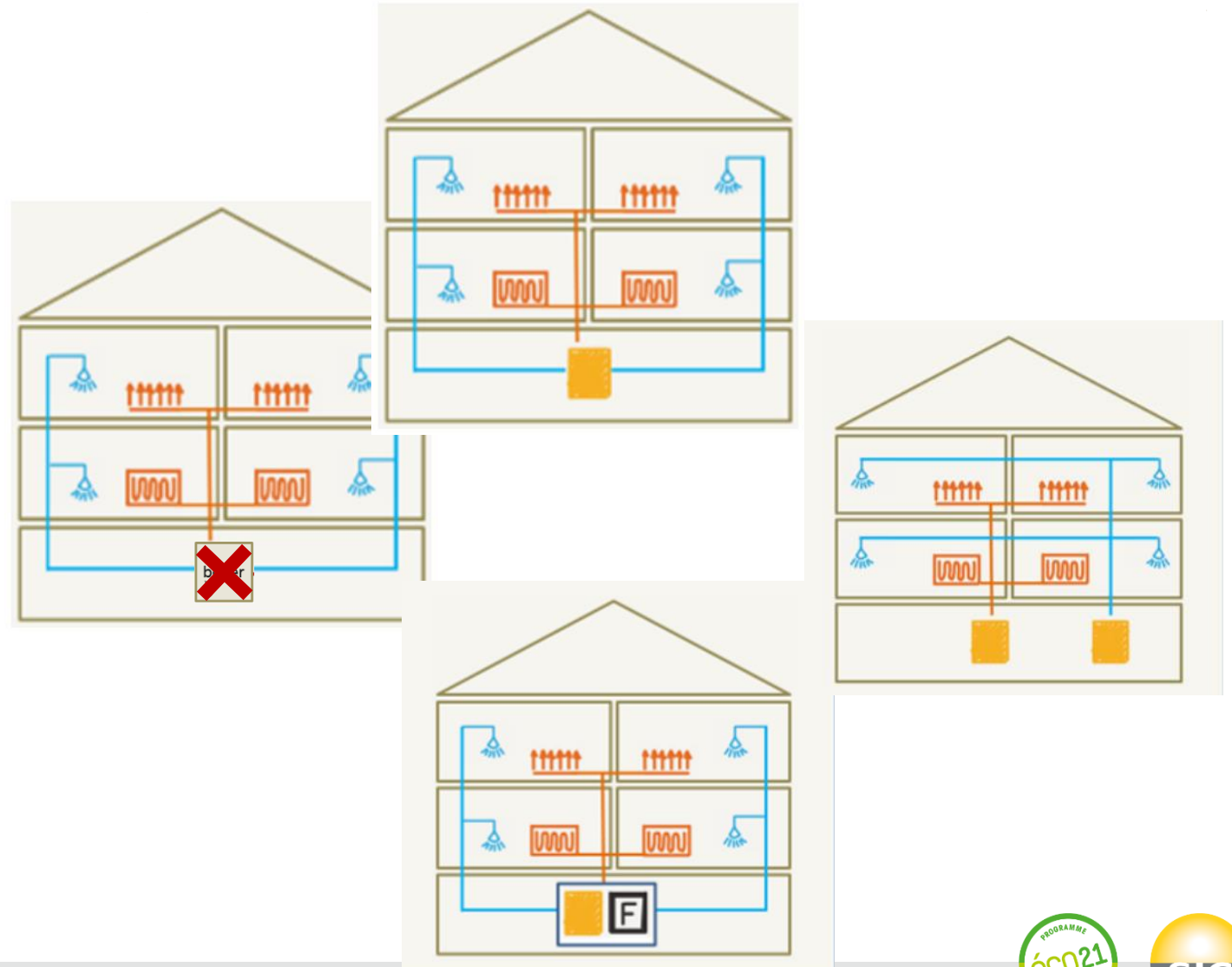
Energy contracting

EXISTING MF BUILDINGS

- Owner/tenant issues
- Technological mistrust
- Risks associated with the unknown/non-mastery of the technology for these sizes of installations



Energy contracting



Case Studies

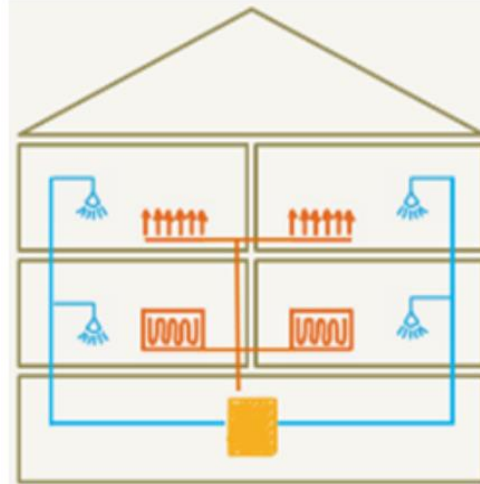


Pilot projects

HP in existing buildings (without envelope renovation)

→ St Julien

- Heated area : 4'049 m²
- Construction : 1972
- Enveloppe : non renovated
- Heat distribution : radiators



→ Before replacement

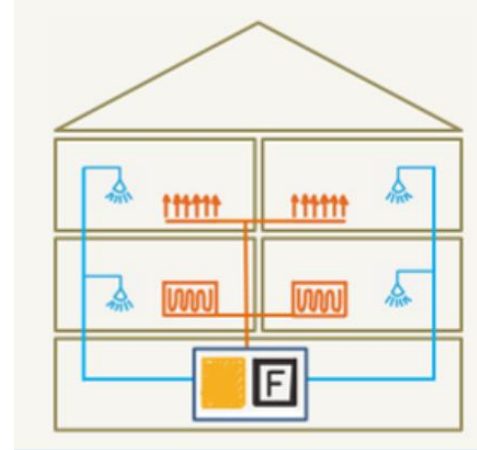
- 2 oil boilers of 320 kW
- Oil consumption : 640 MWh/yr
- CO₂ emissions : 48 kgCO₂/m².an

→ Current system :

- Monovalent → HP only
- 2 x 125 kW «industry» HP

→ Daru

- Heated area : 7'563 m²
- Construction : 1992
- Enveloppe : non renovated
- Heat distribution : radiators

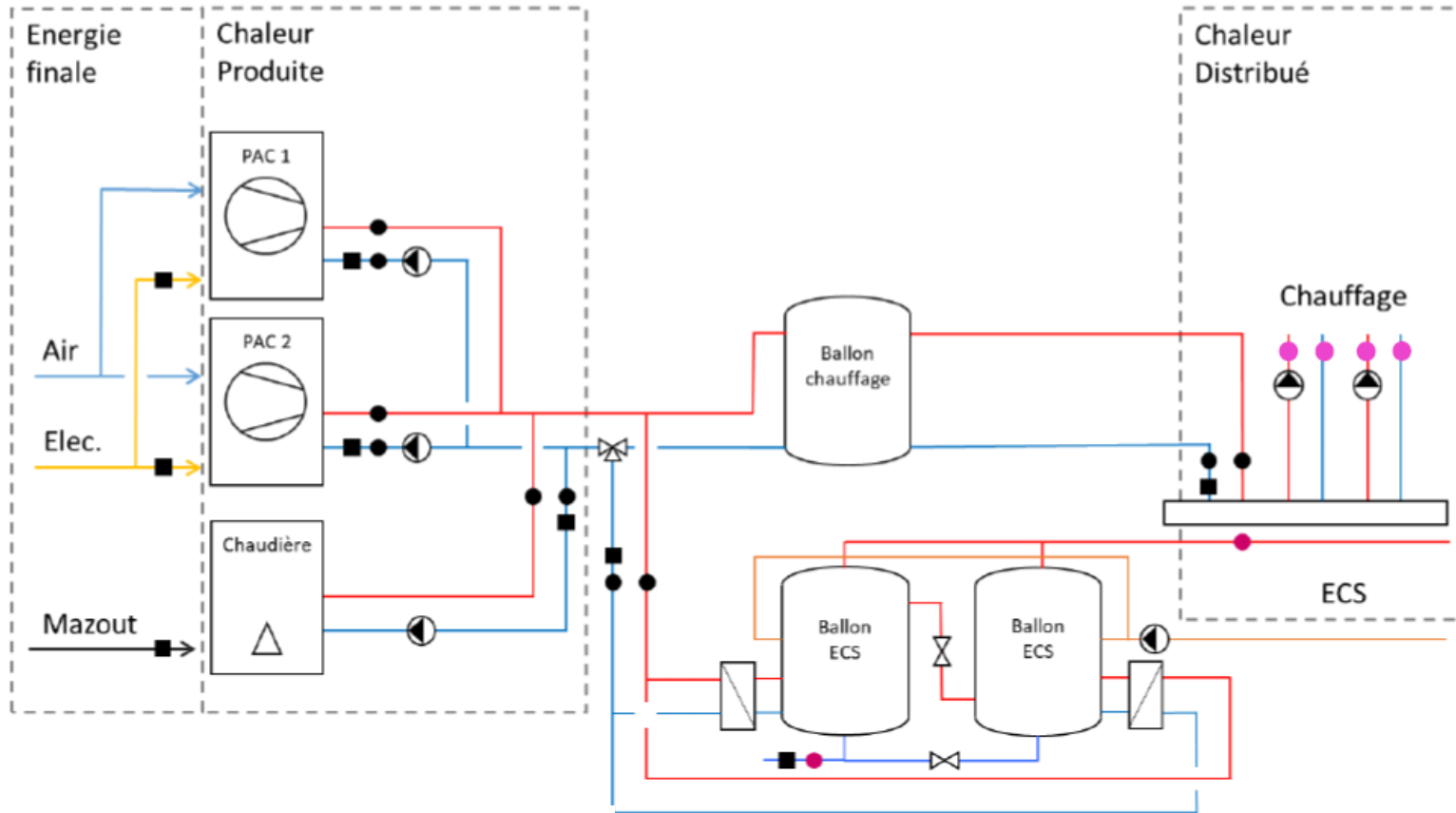


→ Before replacement


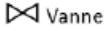
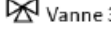





- 2 gas boilers of 240 kW
- Gas consumption : 1'080 MWh/yr
- CO₂ emissions : 36 kgCO₂/m².an

→ Current system :





- Bivalent → HP + gas boiler
- 6 x 30 kW «villa» HP & 210 kW gas boiler






Légende:

-  Pompe
-  Vanne
-  Vanne 3 voies
-  Automate (5 min.)
-  Débitmètre
-  Sonde température
-  UNIGE (5 min.)
-  Sonde température

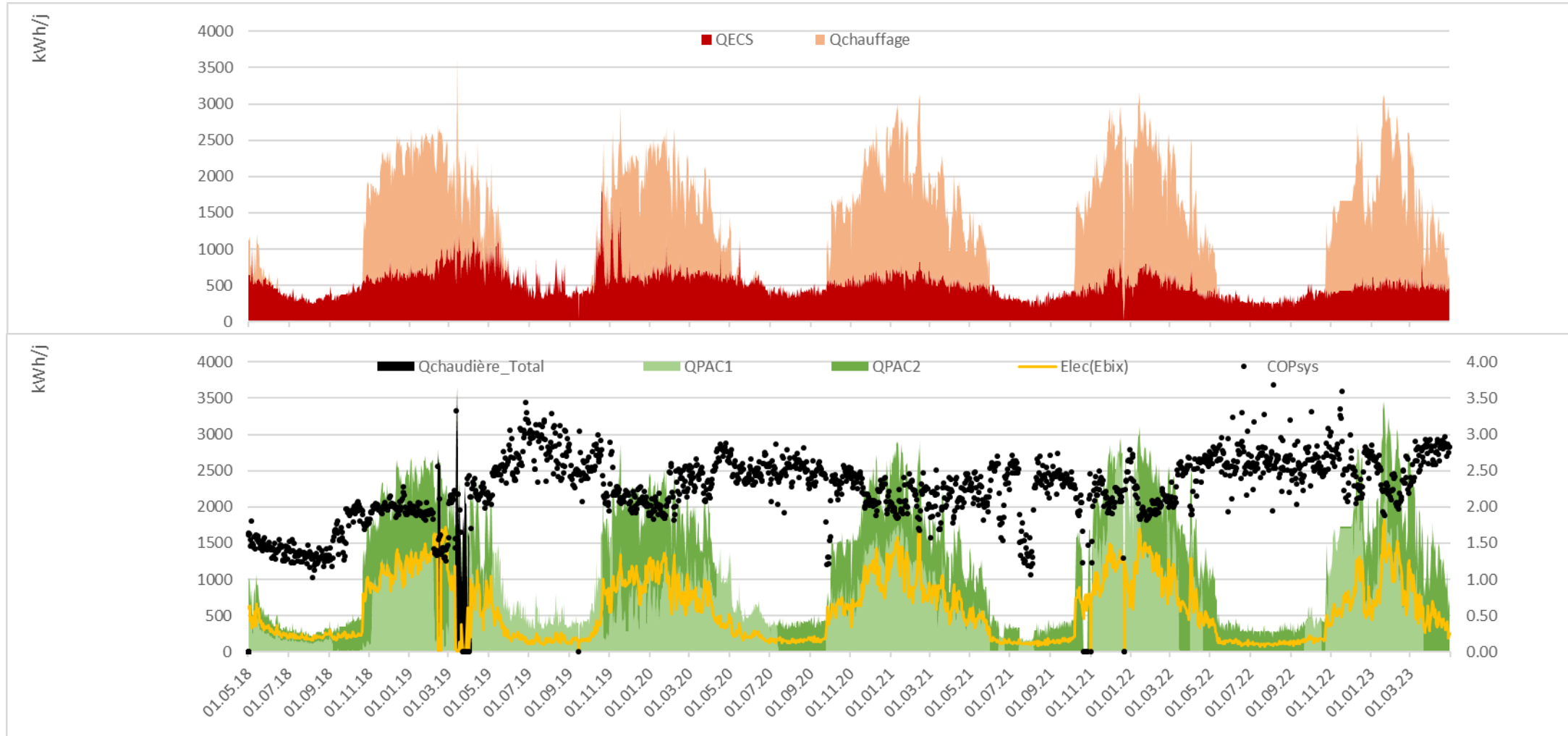
→ Components

-  2 x Aermec NRK 650 (125 kW à -7°C/65°C) 4 compressors each
-  Back up : old oil boiler 320 kW Dismantled in Nov. 2021
-  Heat storage : 1000 L
-  DHW storage : 2x 1000 L

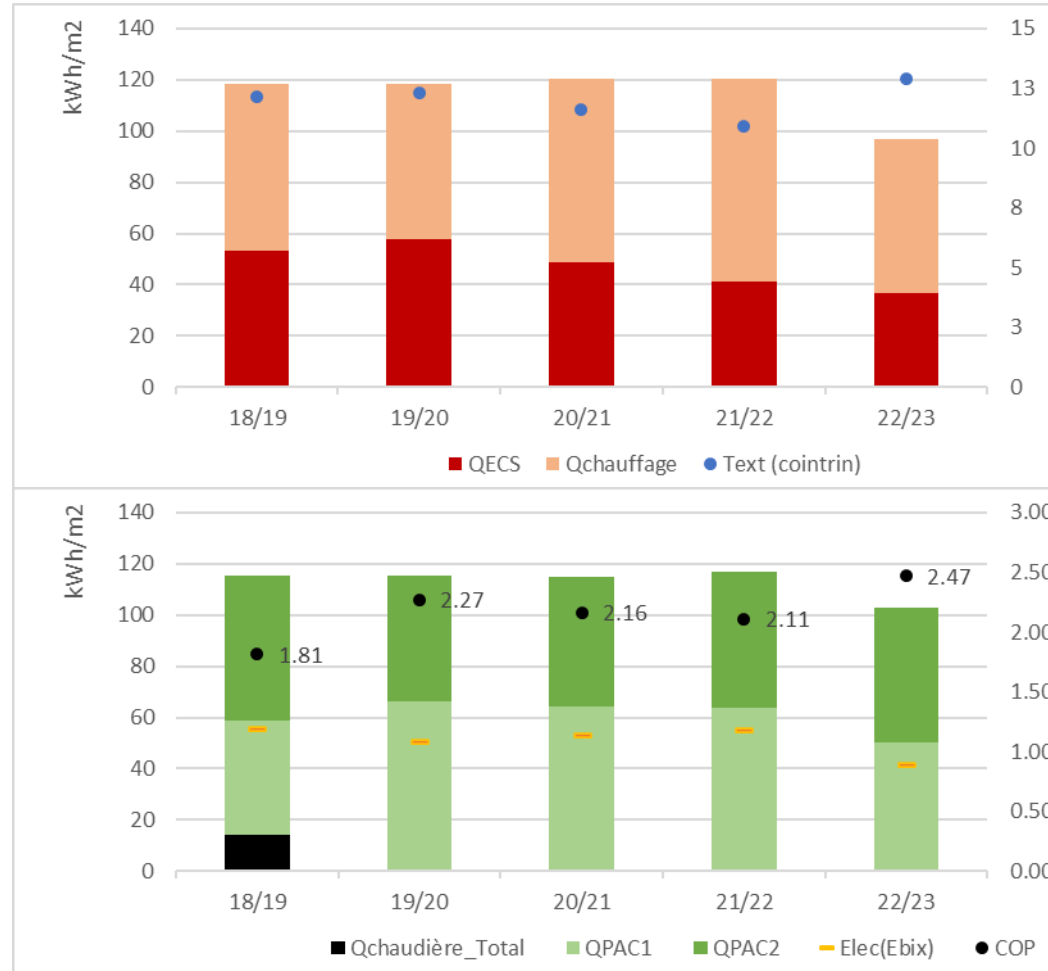
→ Control strategy

-  DHW priority
-  Master/slave HP control until Dec 19
-  MS regulation afterwards each HP controls its 4 compressors

St Julien – Daily data

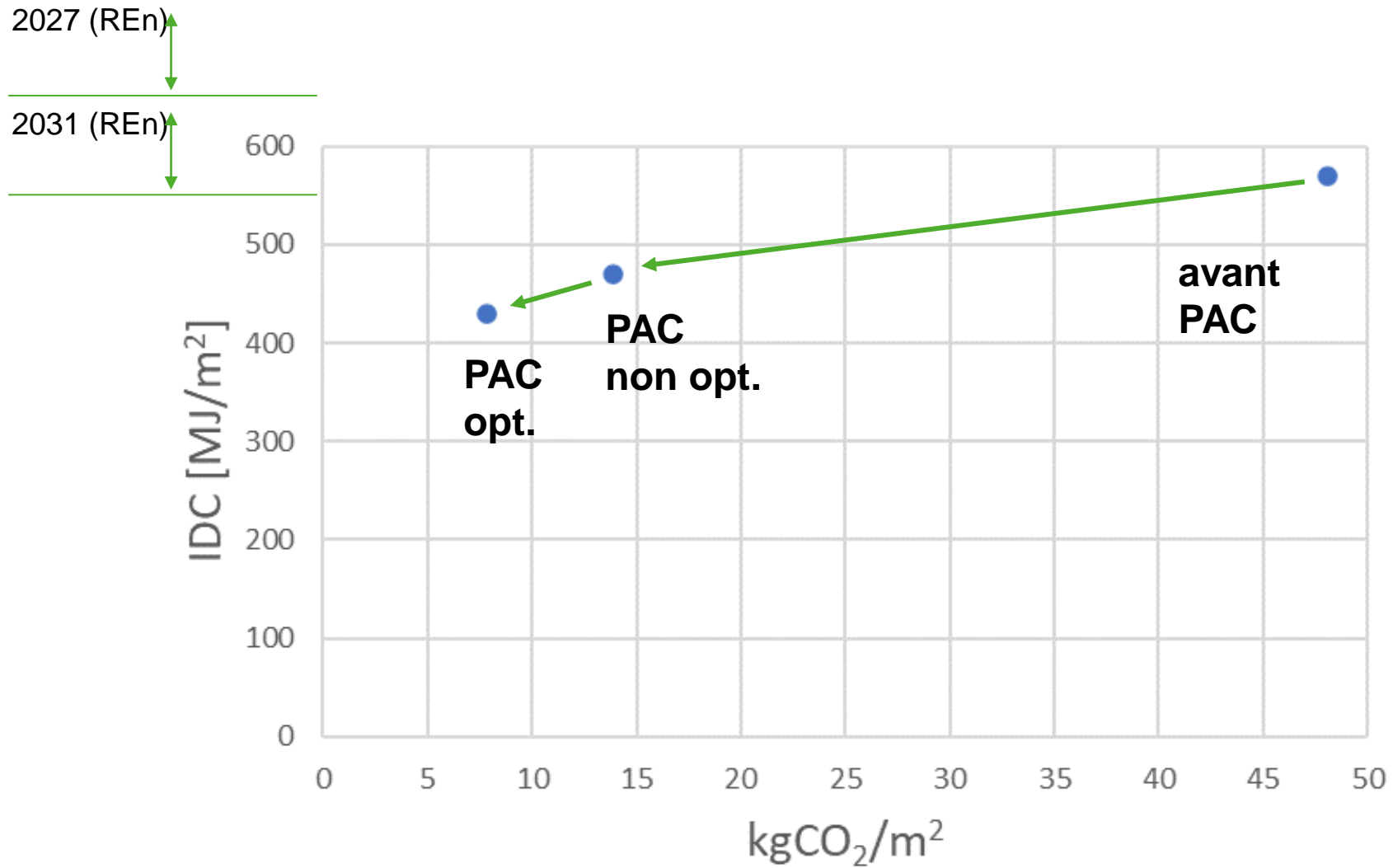


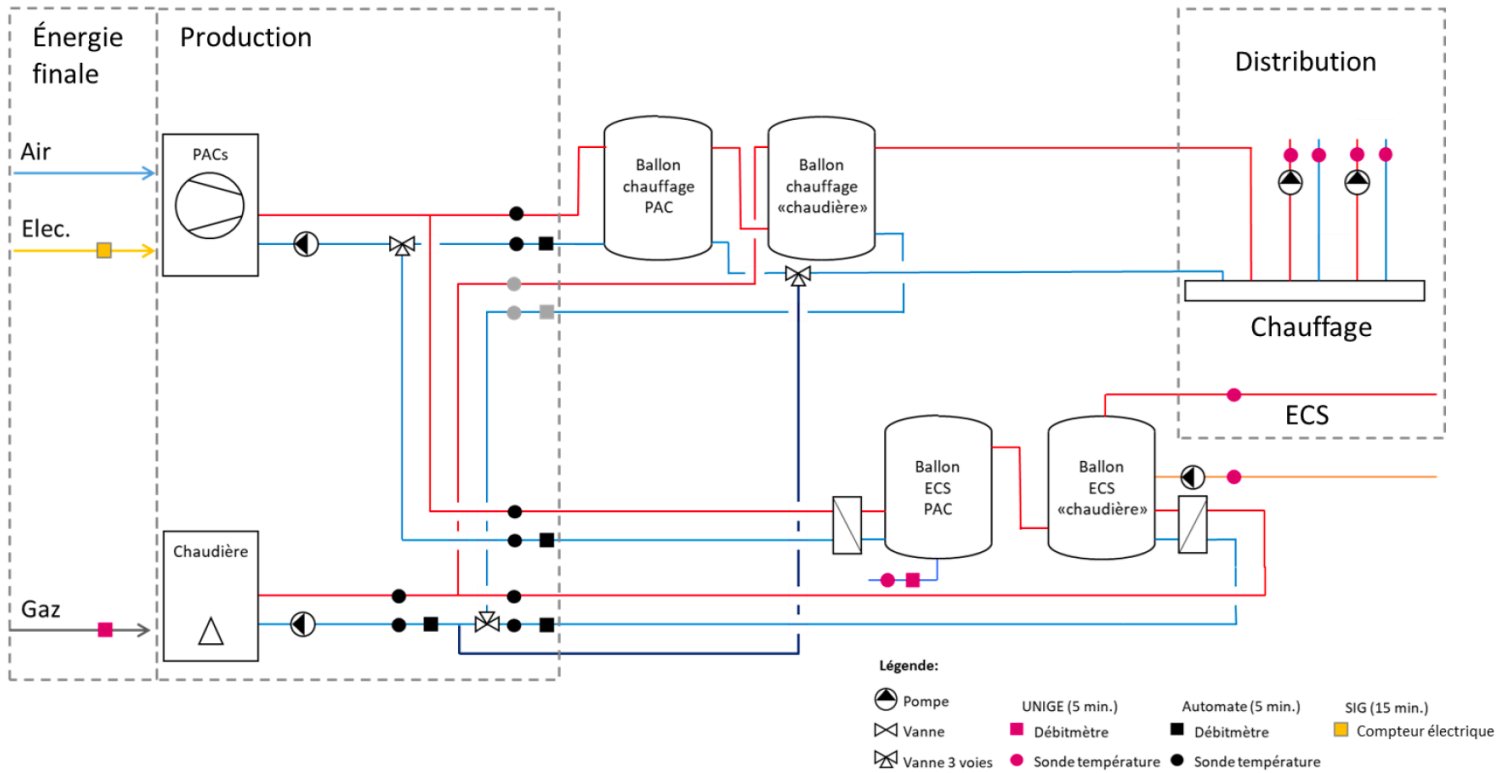
St Julien – Yearly data



Performance indicators

Final energy and CO₂ emissions





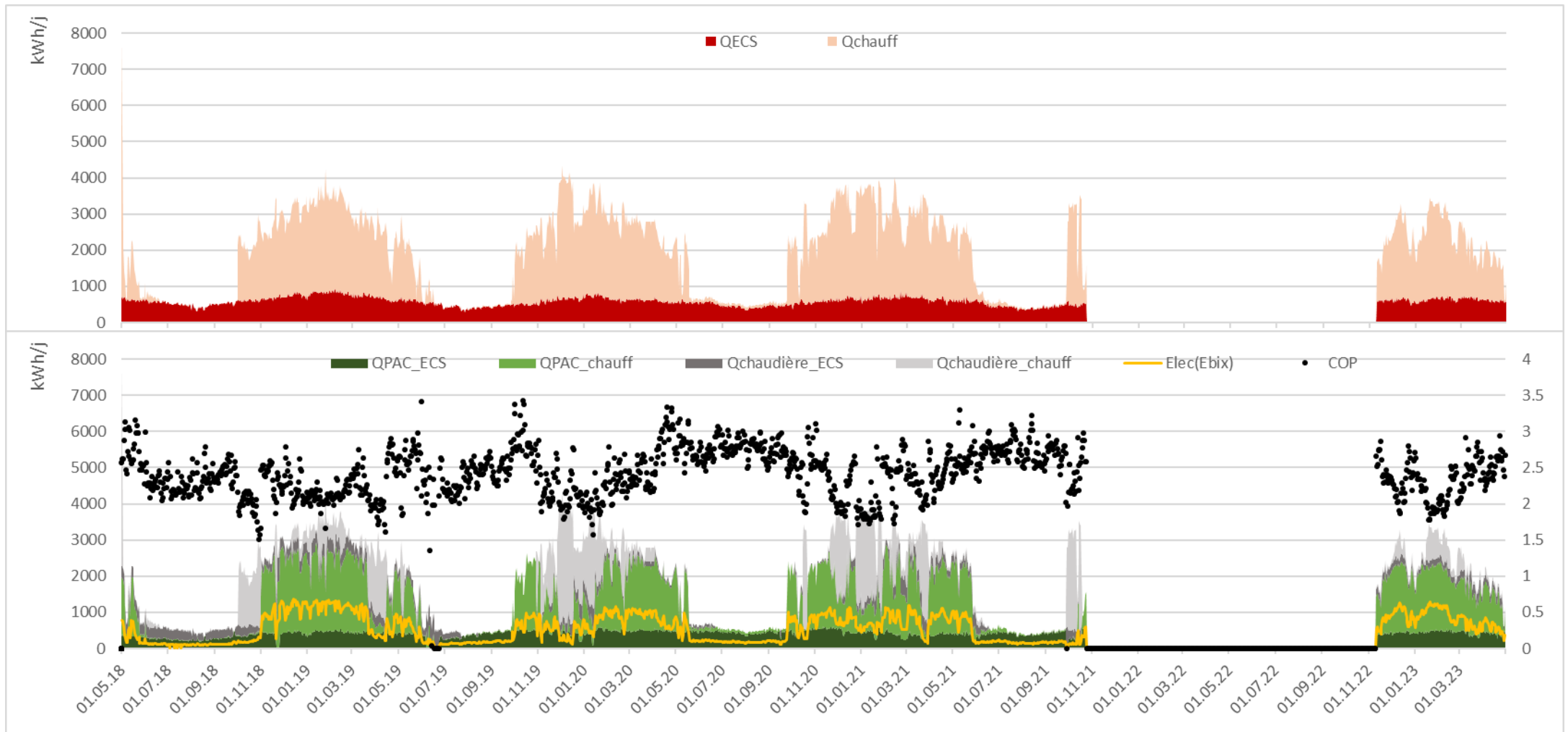
Components

- 6 x AIT (34 kW à 7°C/45°C)
2 compressors each
- Auxiliary old gas boiler 240 kW
Replaced by 210 kW in Nov. 2021
- Heat storage : 2x 1000 L
- DHW storage : 2x 1000 L

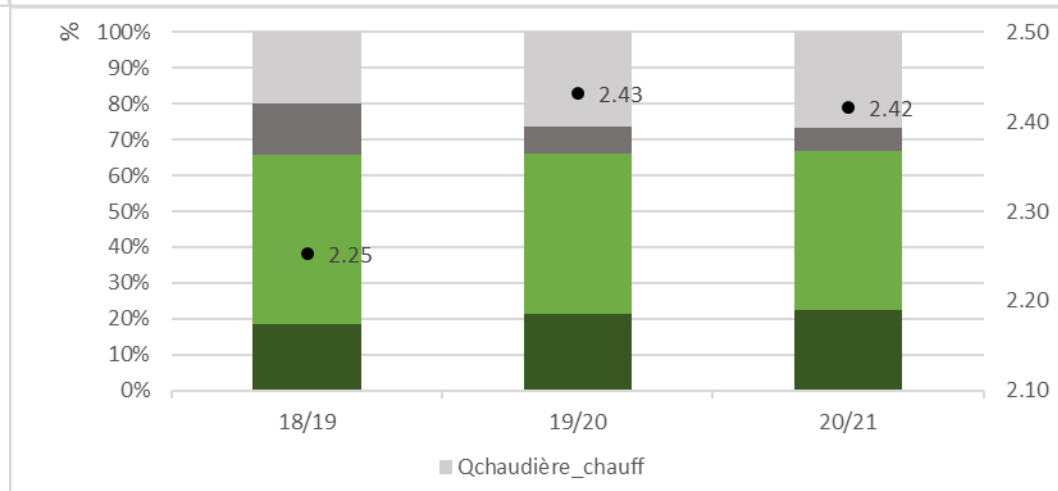
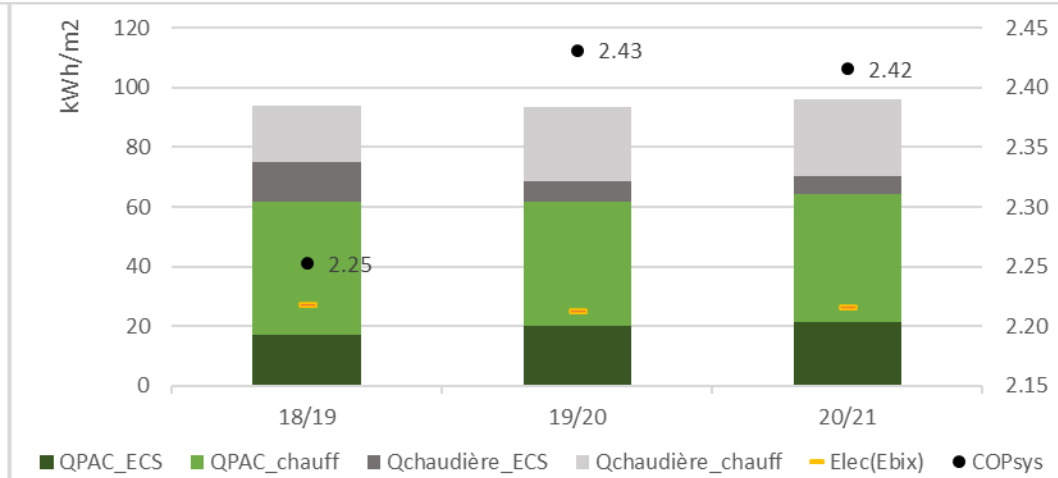
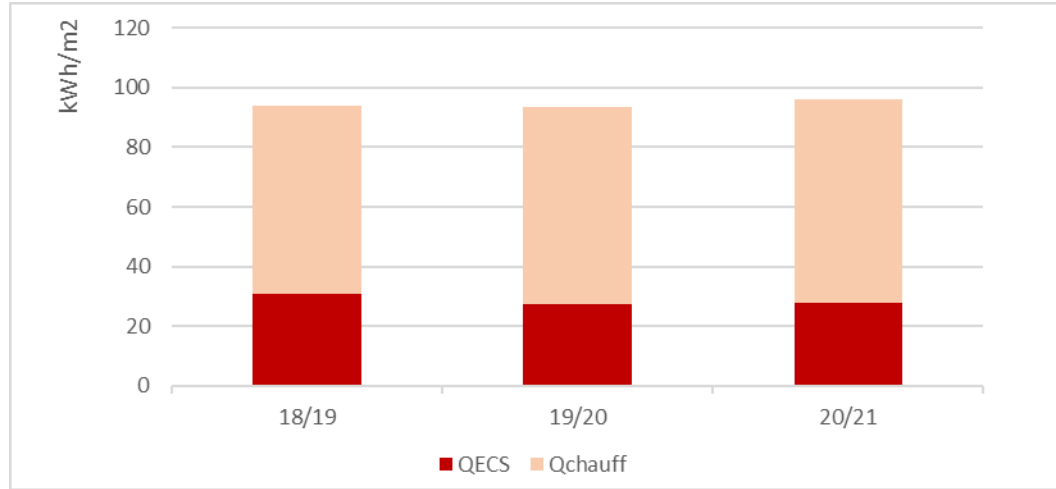
Control strategy

- DHW priority
- Master/slave HP control until Nov 21
- MS regulation afterwards
each HP controls its 2 compressors

Daru – Daily data



Daru – Yearly data



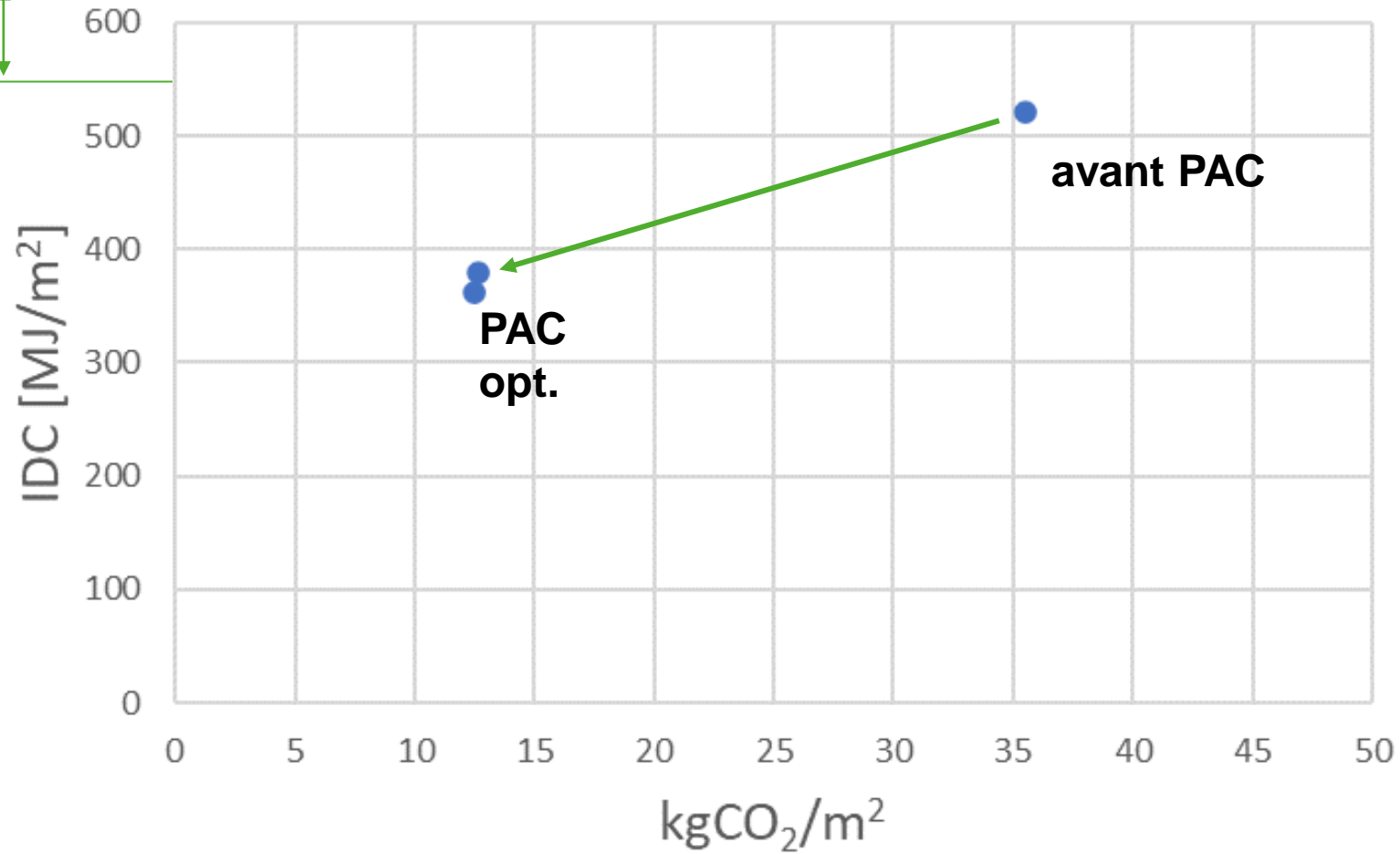
Performance indicators

Final energy and CO₂ emissions

2027 (REn)



2031 (REn)



Pilot projects

HP in existing buildings (without envelope renovation)

→ Positives

- It is possible!
Ensured tenant comfort in non-renovated buildings with radiator distribution with HP
- Significant reduction of CO2 emissions
- Knowledge
- Metering system in place → system optimization
- Less dependence on fossil fuels

→ Watch out for

- Communication between all those involved at all stages of the project
- Metering/optimising the installation using an appropriate metering system
- Bivalent heat pump/boiler
- Management of the HP cascade
- Extensive monitoring during the first few years of operation
- Guarantee an acceptable level of tenant charges

HP in large buildings

SIG éco21

HP in large buildings

→ Goal

- Efficient deployment of the air/water heat pump system to produce heat for large buildings

→ 4 pillars

- Energy contracting
- Mastering technical complexity
- Knowledge sharing
- Control and certification

Energy contracting

→ Solution to the following barriers :

- Technological mistrust, risks associated with the unknown/non-control of the technology for these sizes of systems
- High investment, owner/tenant issues
- **Knowledge to be shared with professionals**



Erneuerbare Wärme für Mehrfamilienhäuser

Mit sieben Luft-Wasser-Wärmepumpen, die 90 Prozent der Heizung und Warmwasserversorgung in einem Gebäude mit 260 Wohnungen gewährleisten, ist den Services Industriels de Genève (SIG) ein vorbildliches Projekt gelungen. Sie haben gezeigt, dass der Einsatz von Luft-Wasser-Wärmepumpen auch in grossen Mehrfamilienhäusern umsetzbar ist.

Text: Jean-Luc Renck, Fotos: David Schweizer / BFE

Das Vorzeigeprojekt liegt in Chêne-Bougeries und bietet neben einer schönen Aussicht auch beeindruckende Technikinstallationen.

WÄRMEPUMPEN



1 Die Wärmeerzeugung wird zu 90 Prozent durch sieben auf dem Dach installierte 75-kW-Wärmepumpen gewährleistet.

2 Luft-Wasser-Wärmepumpen können bei gleichem Wärme komfort und zu gleichen Kosten einen Gas- oder Ölkessel ganz oder auch teilweise ersetzen.

Mastering technical complexity



→ Research projects (with several partners)

- [AirBiVal](#) – Development and optimisation of hybrid air-source heat pump concepts for collective residential buildings (sept2021)
- [Cascade](#) - Optimum management of heat pump cascades (T1 2023)

Titre	Contributeurs/trices	Année	Publié dans
Monovalent and Hybrid Air-source Heat Pump Concepts for Existing Multifamily Buildings – Energy Performance and CO ₂ Savings	Montero Dominguez, Omar; Brischoux, Pauline; Fraga, Carolina; Rüetschi, Matthias; ...Hollmuller, Pierre	2023	
Gestion en cascade de pompes à chaleur air/eau pour immeubles résidentiels collectifs existants : Retours d'expérience sur sites pilotes et étude de sensibilité par simulation numérique	Montero Dominguez, Omar; Brischoux, Pauline; Hollmuller, Pierre	2023	
Large Air-to-Water Heat Pumps for Fuel-Boiler Substitution in Non-Retrofitted Multi-Family Buildings: Energy Performance, CO ₂ Savings, and Lessons Learned in Actual Conditions of Use	Montero Dominguez, Omar; Brischoux, Pauline; Callegari, Simon Augustin; De Sousa Fraga, Carolina; ...Hollmuller, Pierre	2022	Energies
AirBiVal: Développement et optimisation de concepts hybrides de pompes à chaleur sur l'air pour des immeubles résidentiels collectifs	Calame, Nicole; Cuvillier, Guillaume; Rognon, Fabrice; Montero Dominguez, Omar; ...Rüetschi, Matthias	2021	
Air-to-water heat pumps as a substitution of oil-boiler in a non-retrofitted multi-family building of the 70's. In-situ monitoring, actual energy balance and performance	Montero Dominguez, Omar; De Sousa Fraga, Carolina; Callegari, Simon Augustin; Hollmuller, Pierre	2020	13th IEA Heat Pump Conference 2020
Pompes à chaleur air-eau en remplacement d'une chaudière dans un immeuble résidentiel collectif non rénové	Montero Dominguez, Omar; De Sousa Fraga, Carolina; Callegari, Simon Augustin; Hollmuller, Pierre	2020	26. Tagung des BFE-Forschungsprogramms «Wärmepumpe...

https://archive-ouverte.unige.ch/home/search?view=list&search=heat%2520pump&advanced-search=0_researchGroupId%3D659



Mastering technical complexity



UNIVERSITÉ
DE GENÈVE

CSD INGENIEURS+
INGÉNIEUX PAR NATURE

Avec le soutien de



suisseénergie

→ Research projects (with several partners)

- [AirBiVal](#) – Development and optimisation of hybrid air-source heat pump concepts for collective residential buildings (sept2021)
- [Cascade](#) - Optimum management of heat pump cascades (T1 2023)

→ Projets in development

- Integrating heat pumps into Geneva's architecture
- COE PAC – Energy optimization contracts, application to a HP heat production system
- T drop
- Flexi-renove / Renowave
- ...

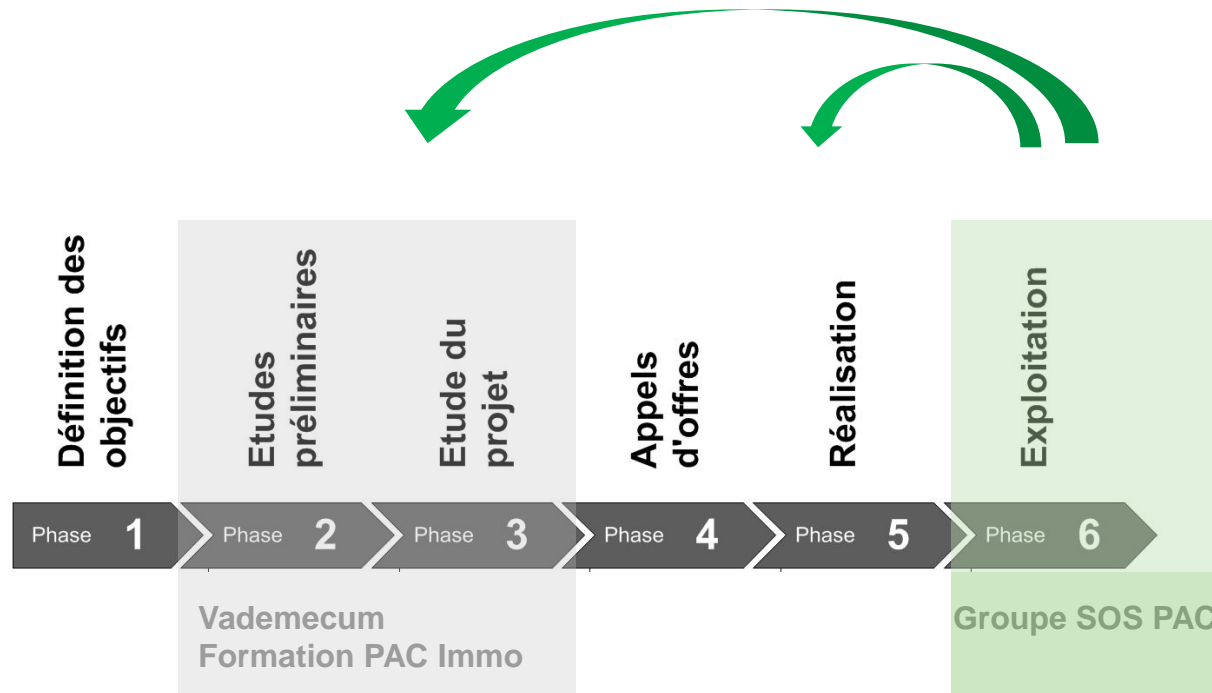


Knowledge sharing


- Vademecum (1st edition)
- HP in MFB course for engineers and heat technicians **CSDINGENIEURS+**
INGÉNIEUX PAR NATURE
- Monitoring and Optimisation of Heat Pump Systems – Sharing group

VademecumPAC air-eau en toiture

Guide pratique pour l'implémentation de pompes à chaleur air-eau en toiture dans les immeubles résidentiels de petite et moyenne taille.



OFEN – Services Industriels de Genève – CSD

 Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra



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INGÉNIEUX PAR NATURE



Control and labelling

with several partners

- **Noise label on low-power heat pumps (villa)**
- **Labelling HP SYSTEMS, for systems with Power > villa**

It is possible!

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13.06.2023

