Hugo Carronnier

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Project manager – risk assessment emerging pollutants at VALGO

VALGO Canada Inc.

From Lubrizol (France) To Canada
Development of a global strategy for PFAS

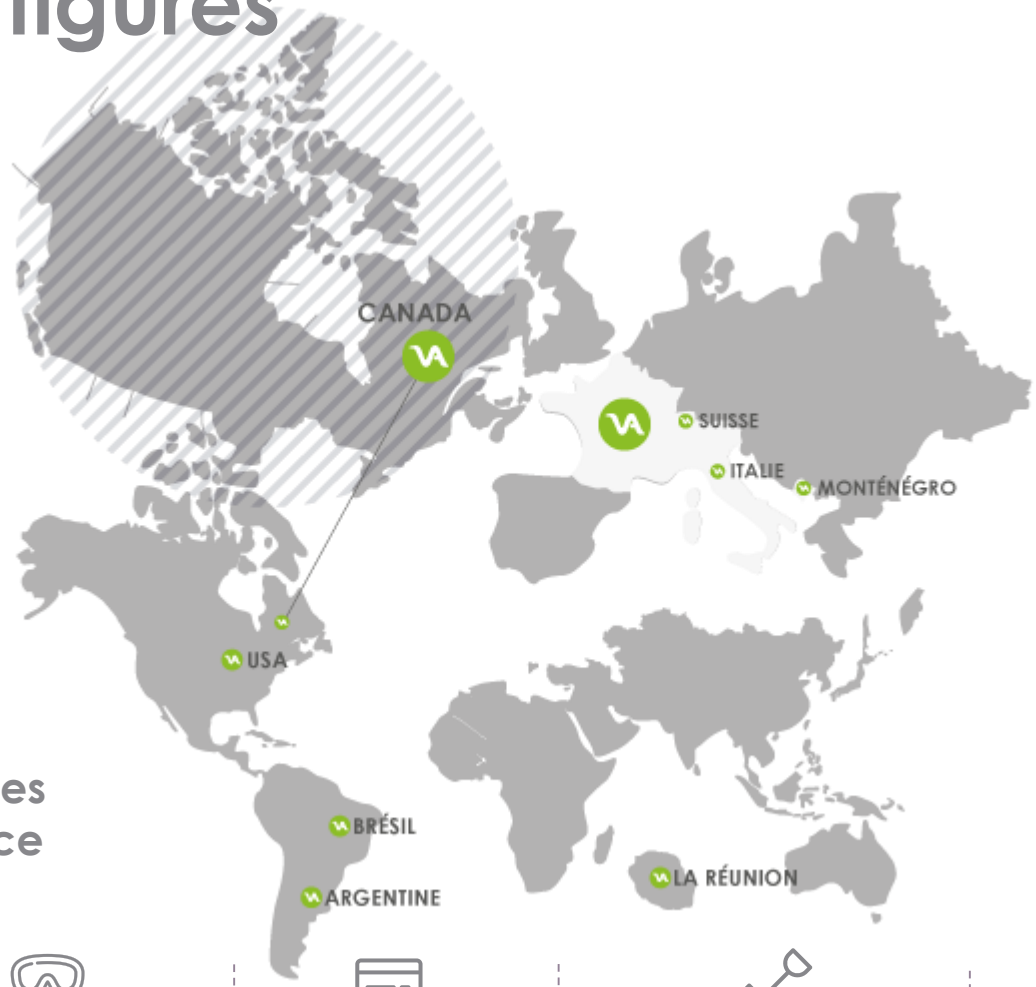
Key figures

VALGO Canada Inc.

+600
Employees around the world

6
Branches worldwide

12
Agencies in France



100
M€ revenue

Sept. 2021
New Shareholder

TIKEHAU CAPITAL

+650
Projects / year

+5000
Remediated sites

1008
Billed contracts

+1000
Ha recovered from our clients

+350
Proprietary Ha recovered

POSITIONING / MARKET: 360° approach

Our specificities – Our advantages – Your profit

GLOBAL DIAGNOSIS of the site

- Pre global diagnosis of a brownfield
- A real value appreciation for a land property

Building REMEDIATION (Asbestos, lead…)

- National coverage
- Capability to interfere in industrial and building construction

Soil and water REMEDIATION (phreatic zone)

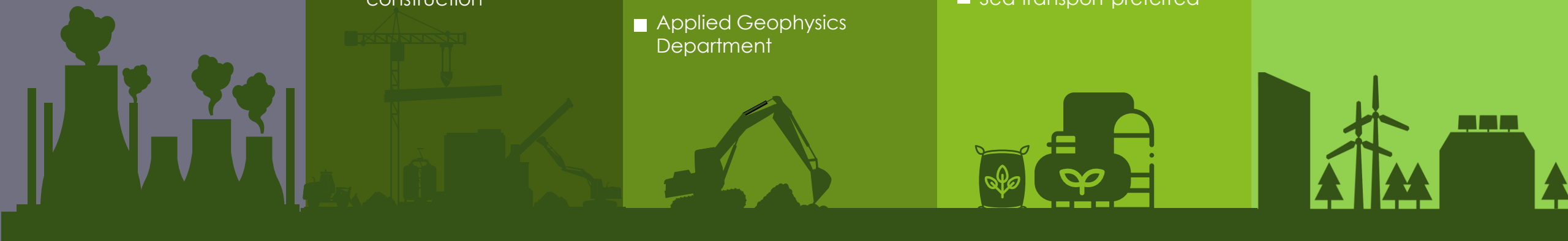
- Thermal desorption
- Physical-chemical treatment by Hydrosplit
- Laboratory and integrated R&D
- Applied Geophysics Department

VALORIZATION of raw products

- Advice and expertise on the transformation of waste into biogas
- Polluted soil recovery
- Sea transport preferred

SITE DEVELOPMENT & VALORIZATION.

- Transformation of an obsolete production tool into a higher value-added tool (energy, logistics, etc.)



- **More than 90 years** of petrochemical pollution
- **270 htrs** of polluted land and premises
- **Seveso classification -** high
- **Partial** asbestos diagnosis

- **270 ha** recovered
- **75,000 tons** metals and **400 000 tons** concrete recycled
- **400,000 t** concrete and **55 000 t** hydrocarbon waste recycled and recovered
- **62 htrs** land remediated
- **3000 future jobs** created

From Lubrizol (France) To Canada
Development of a global strategy for PFAS

The PFAS Issue

1. Context
2. The compounds
3. Exposure and toxicity

Diagnosis

1. Analytical complexity
2. Case study – Large Scale Diagnosis – Distribution study of PFAS in the Seine River

Treatments

1. Usual treatments
2. VALGO innovative treatments

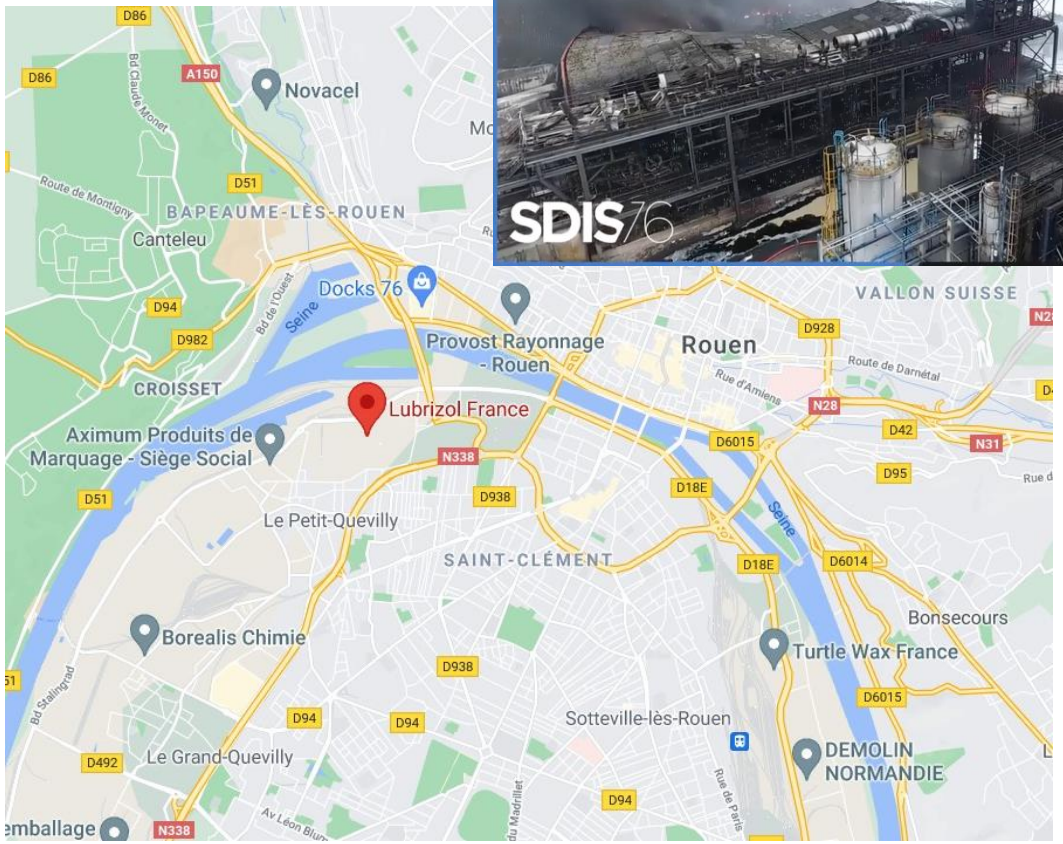
The PFAS Issue

Context : Lubrizol/Normandie Logistique Fire

Seveso 2 site
(High Risk)

Combustion of more than **9000t** of various products

Intensive use of AFFF Foams (40 000 m^3)



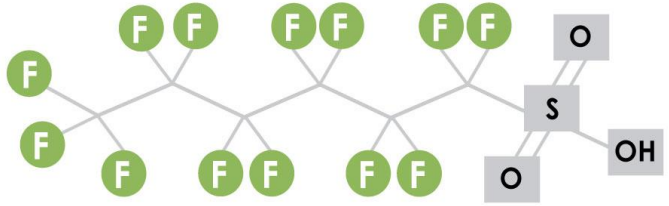
The compounds

- Complex family with more than 4000 Compounds
- **Defined by the C – F bound**
  → **long half life** (between 40 and 90 years)

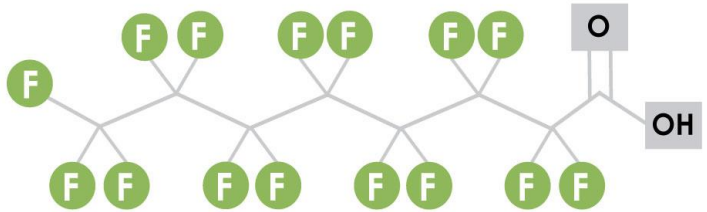
  → Virtually non biodegradable (ECHA), even if contradictory publication indicate that long chain PFAS degrades to short chain PFA

  → Very **bioaccumulative**
- Ubiquitous in the environnment

PFHxS



PFOA



Similar chemical properties **thought not identical**

➡ Analytical Difficulties

➡ Treatment difficulties

The compounds

Also Ubiquitous in consumer goods

Regulatory values:

	Matrices	PFOS ($ng.L^{-1}$)	PFOA ($ng.L^{-1}$)
E-U (2022-2027)	All waters	∑ 20 PFAS = 100	
GERMANY 2006		∑ PFOS + PFOA = 300	
UK 2009		1000	300
US-EPA 2016		**70**	**70**
NETHERLAND2011		530	-
SUÈDE 2014	Tap Water	90	90
ATSDR 2018		11	7
NETHERLAND (2011)	Groundwater	23	-
Health Canada (2018)	**Tap water**	**200**	**600**

Toxicity

- Multiple ways of exposure
- Multiple toxicity
  - Moderate hepatic toxicity
  - Immunological toxicity
  - Metabolic toxicity
  - Pre and postnatal development disorders
  - Endocrine disrupting effect
  - Promotes cancers

CONSEQUENCES ON HUMAN HEALTH

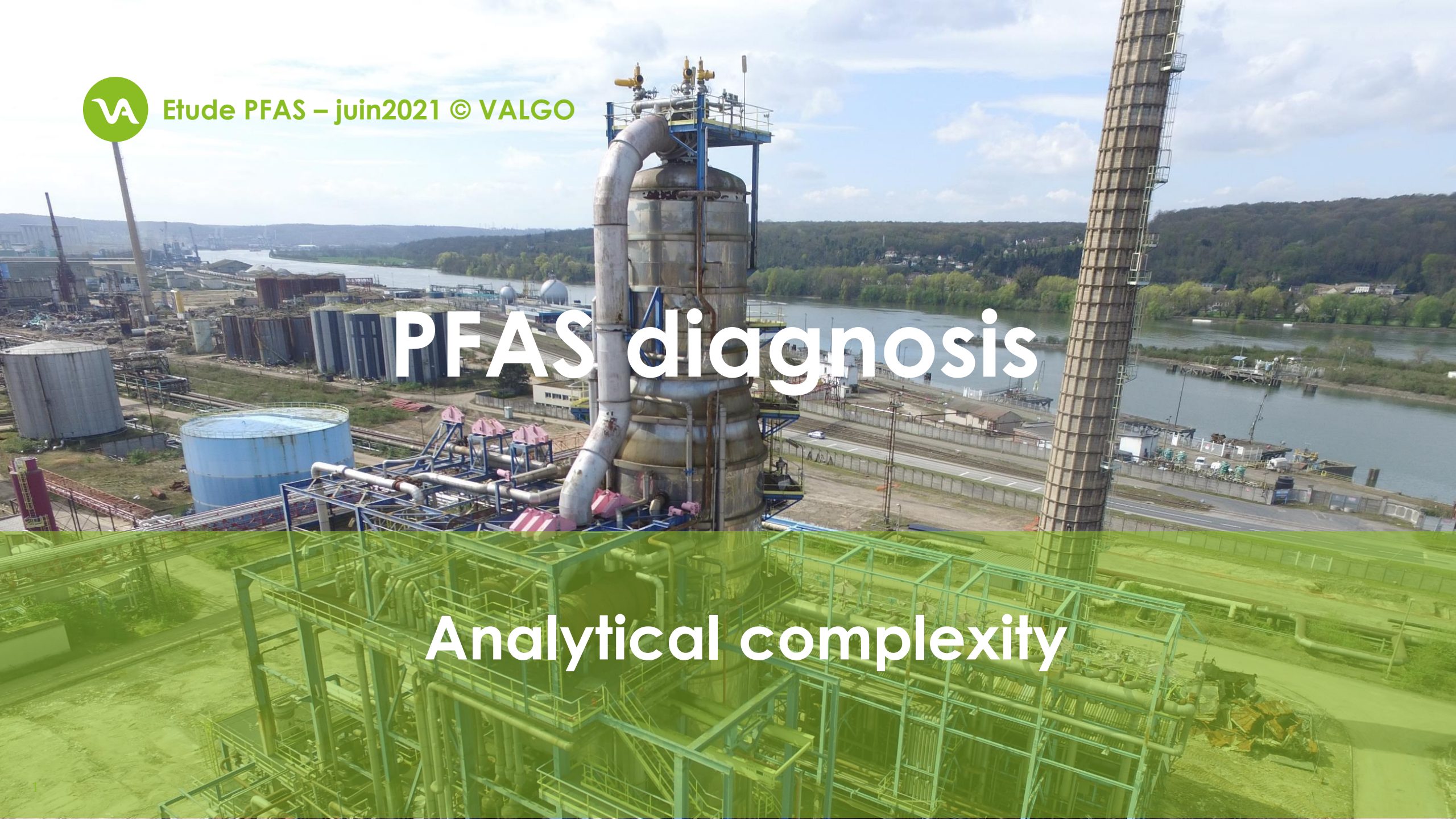
1NG/L

PFAS are reducing the mean concentration of vaccine antibody in children from 1ng/L

***Nanogram/liter**

Increase of x2 of the plasmatic concentration of PFAS is leading to a **decrease of 49%** of the plasmatic concentration of post vaccinal antibodies

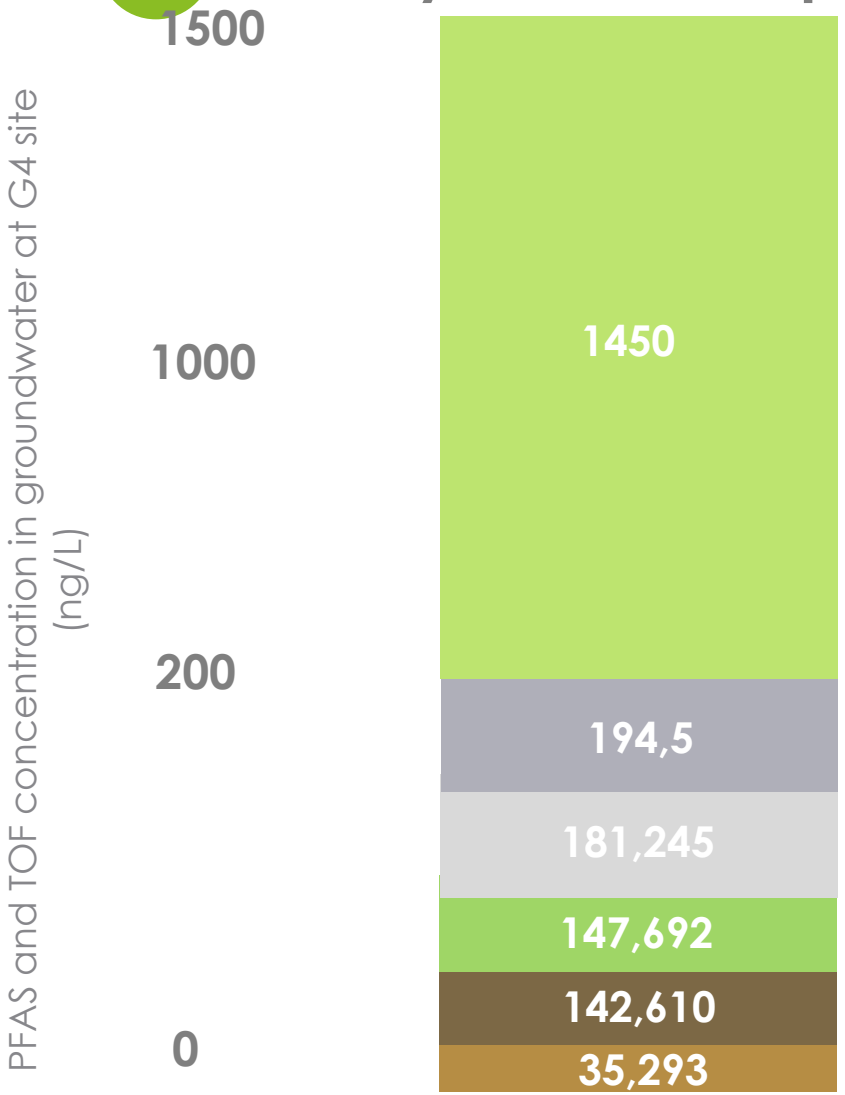
(Grandjean 2012) (Grandjean 2013)



PFAS diagnosis

Analytical complexity

Analytical complexity

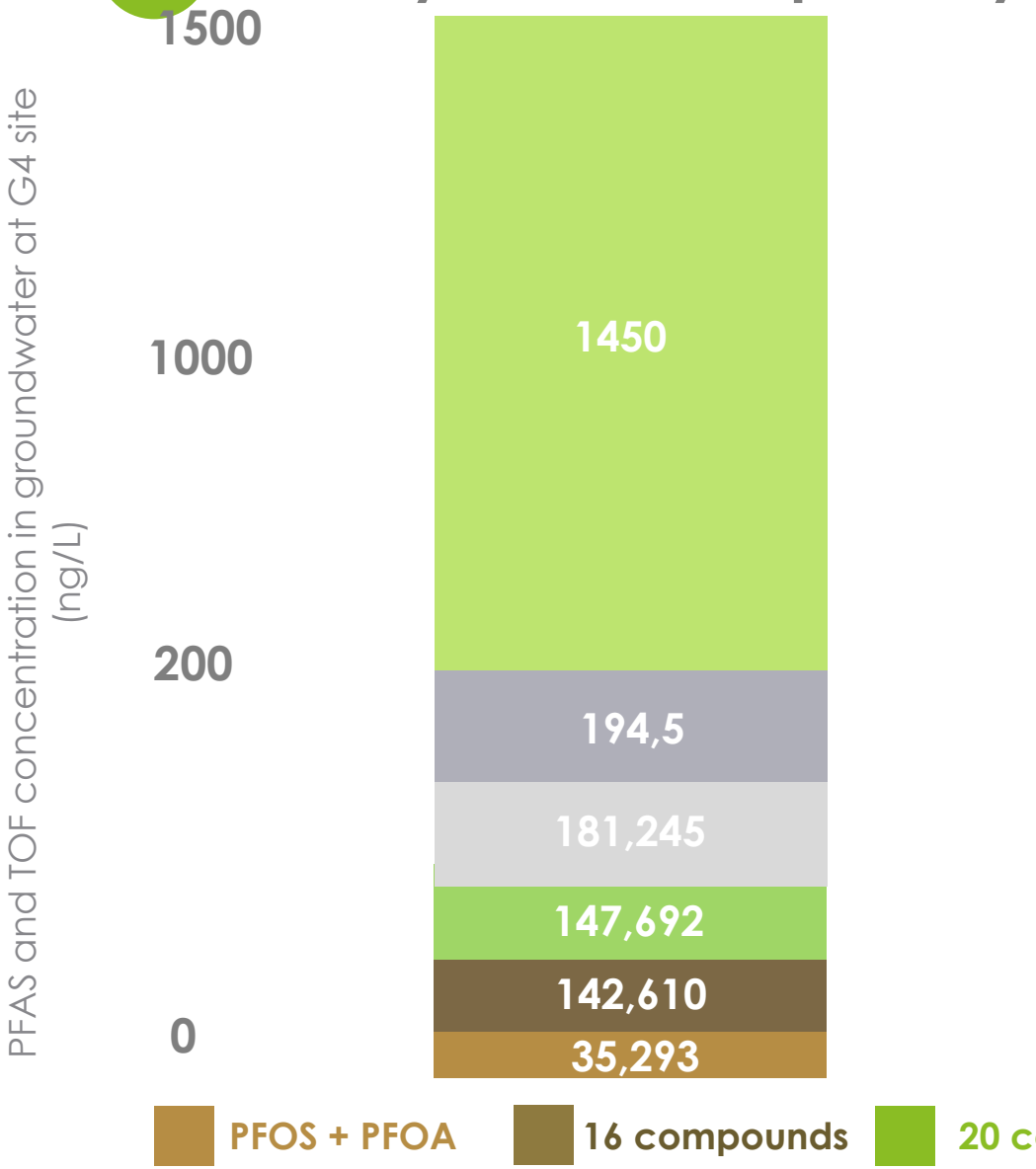


- **Cross contamination:**
- **Analytical blindness**
  - ➡ Which analysis?
  - ➡ Which compounds?

PFAS are easily undetected with inappropriate analysis or can be overestimated without a good methodology

PFOS + PFOA | 16 compounds | 20 compounds | 60 compounds | 200 compounds | TOF

Analytical complexity



Which analysis?

- **Quantitative mass spectrometry**
  - \+ Well known, efficient, low LQ
  - \- Limited list of PFAS (not suitable for atypical or industrial contamination)
- **"Fingerprint" mass spectrometry**
  - \+ Identification of the main contaminants, of new PFAS
  - \- Not quantitative, limited number of identified PFAS (not suitable for a contamination study)
- **Top Assay**
  - \+ Identification of precursors
  - \- Degradation of some PFAS, only measures a limited number of short chain PFAS (not suitable for a contamination study)
- **CIC**
  - \+ Total Organic Fluorine
  - \- Very High limit of quantification (not suitable on moderatly contaminated sites)

Solutions to deal with analytical complexity

- **Cross contamination:**

Strict protocol with :

- ➡ PFAS Free equipment (lab coat, gloves, containers, pumps…)
- ➡ Prohibition of some textile, cosmetics, inc…
- ➡ Blanc Strategy (LOQ 0,1ng/L)

- **Analytical blindness**

Working with the montreal University:

Université de Montréal

- ➡ LOQ < 0,1ng/L
- ➡ Thoughfull use of all analytical processes (**60 compound Mass spectrometry**, CIC, Fingerprint…)

Targeted analysis on 200 PFAS

1/ First quantified analysis on 60 PFAS → identification of main contaminants
2/ Semi quantification of 140 other PFAS **selected regarding the first results**

PFAS diagnosis

Case study – Distribution study of PFAS in the Seine River

Case study

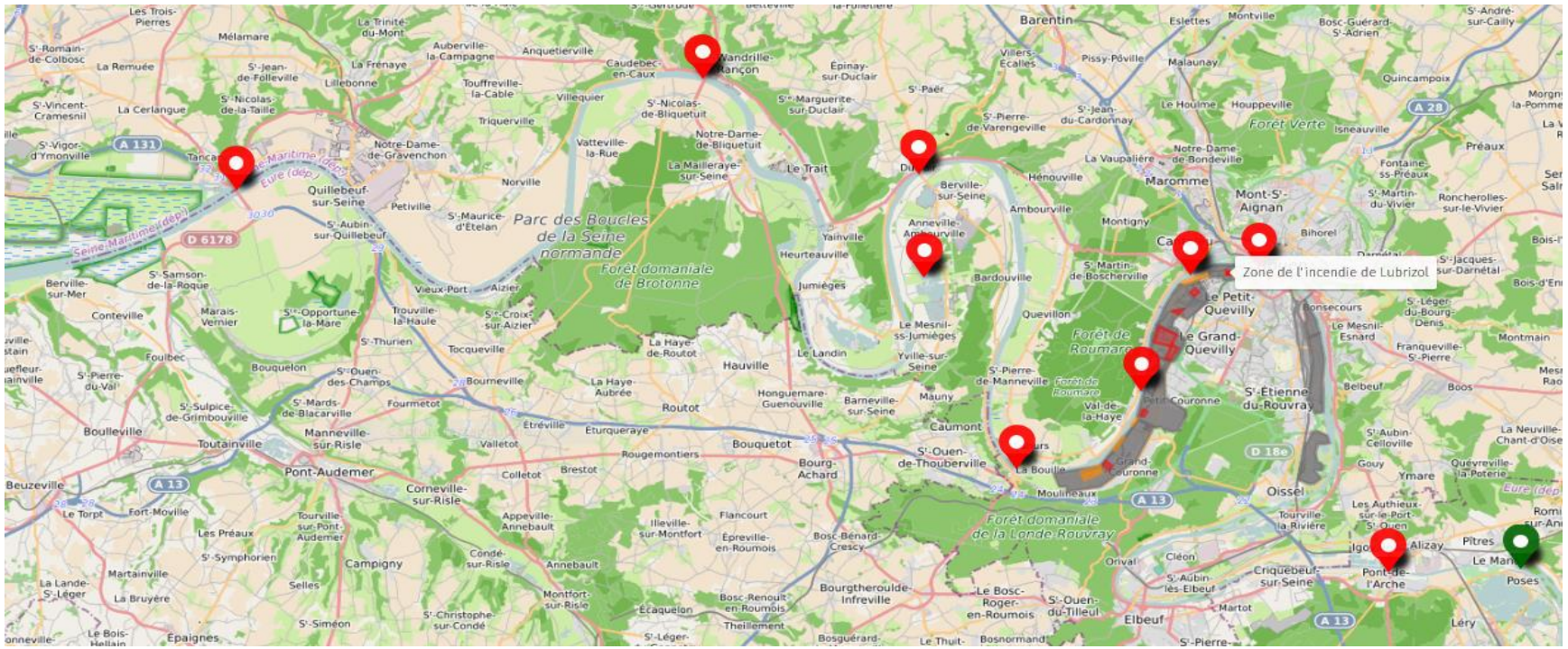
- **Surface water**
- Sediments
- Groundwater
- Biological samples

Largest study on PFAS on the Seine River :

- **170 km (106 miles)** on the last segment of River
- **100 sampling** spots+ ***60 secondary*** *samples (second study)*
- Analysis of all environmental matrices

Case study

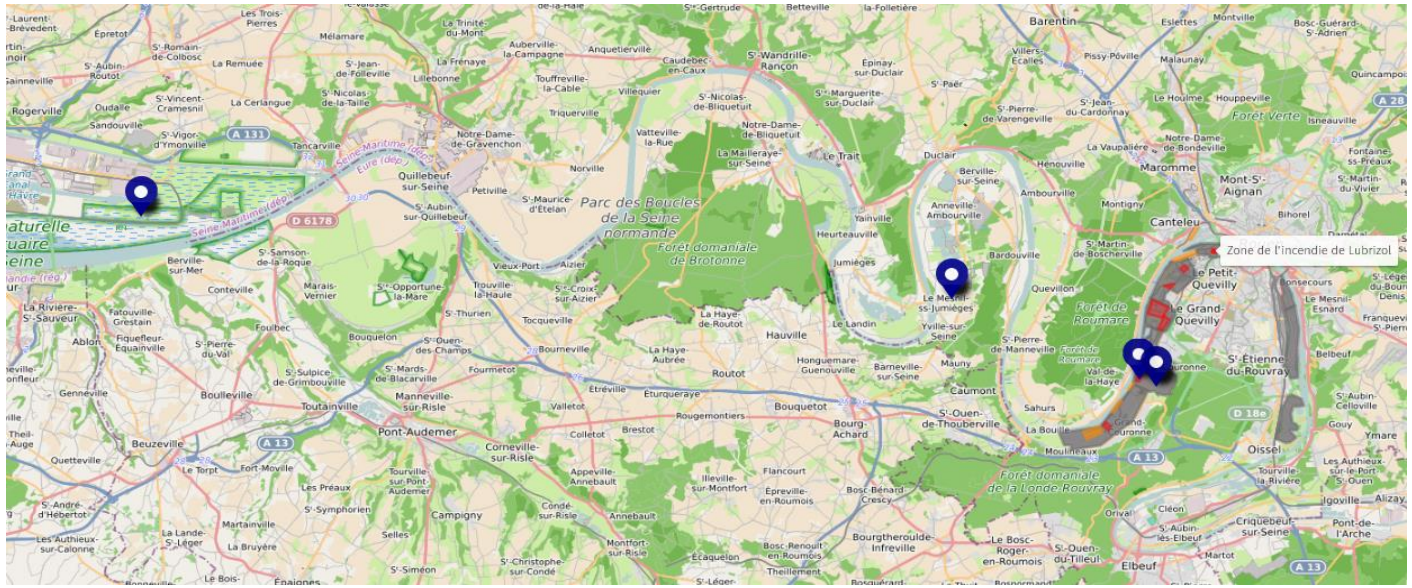
- **Surface water**
- **Sediments**
- Groundwater
- Biological samples



- **3 Sampling spots (on each bank and on riverbed)**

Case study

- Surface water
- Sediments
- **Groundwater**
- Biological samples



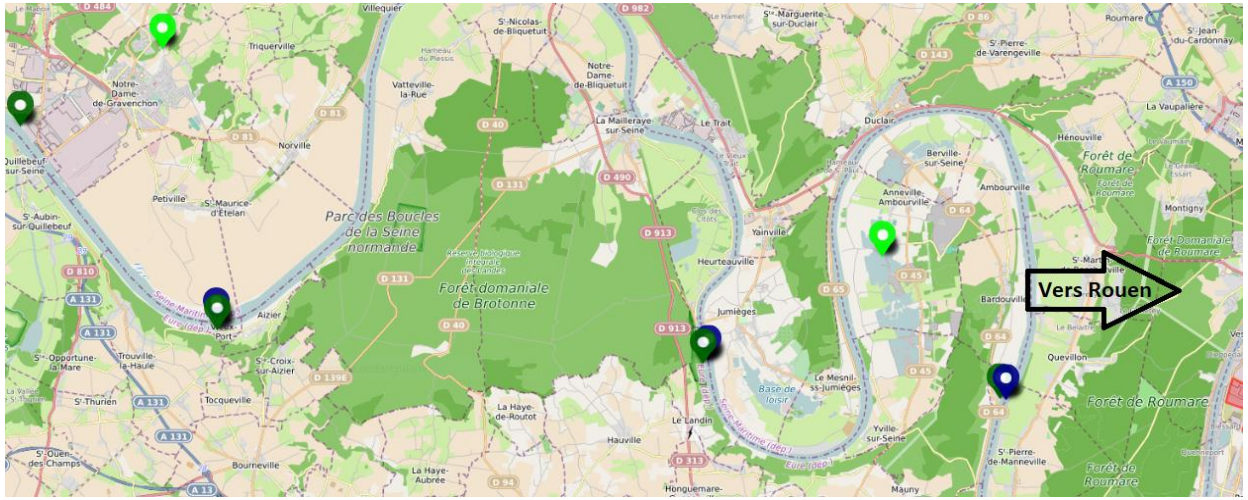
5 to 22 m deep

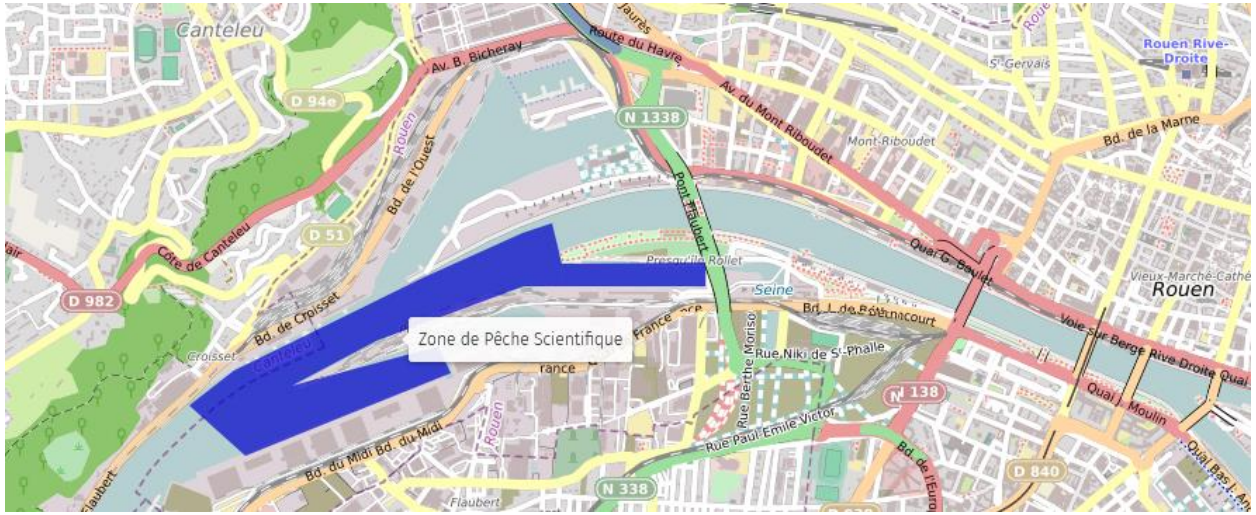
Case study

- Surface water
- Sediments
- Groundwater
- **Biological samples:**

- **Vegetals:** Butomus umbellatus sampled on the last part of the Seine river and before Paris
- Plankton: sampled on the last part of the Seine river and before Paris

- **Fishes**: Scientific angling fishing leading to the capture of Sander *(Sander lucioperca)* and Roach *(Rutilus rutilus)*
  *Control from the **OFB** Sample Library (2008-2010)*





Case study: Results

- **River water**
- Sediments
- Groundwater
- Biological samples

Low but global contamination

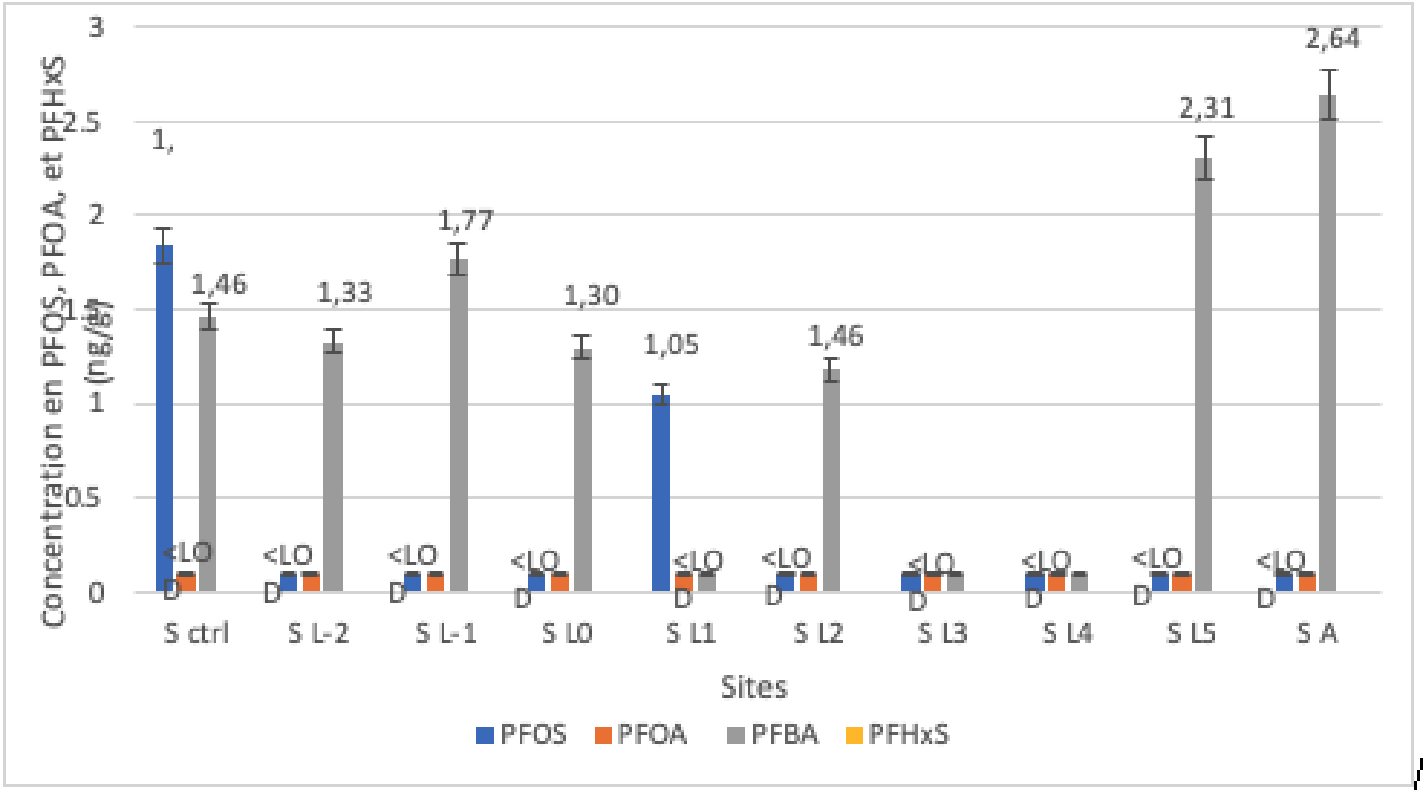
Close to the ANSES data from 2011, inferior to the ANSES data from 2009

Case study: Results

- River water
- **Sediments**
- Groundwater
- Biological samples

Higher than usual values in similar areas (0,2 – 0,5 ng/g)

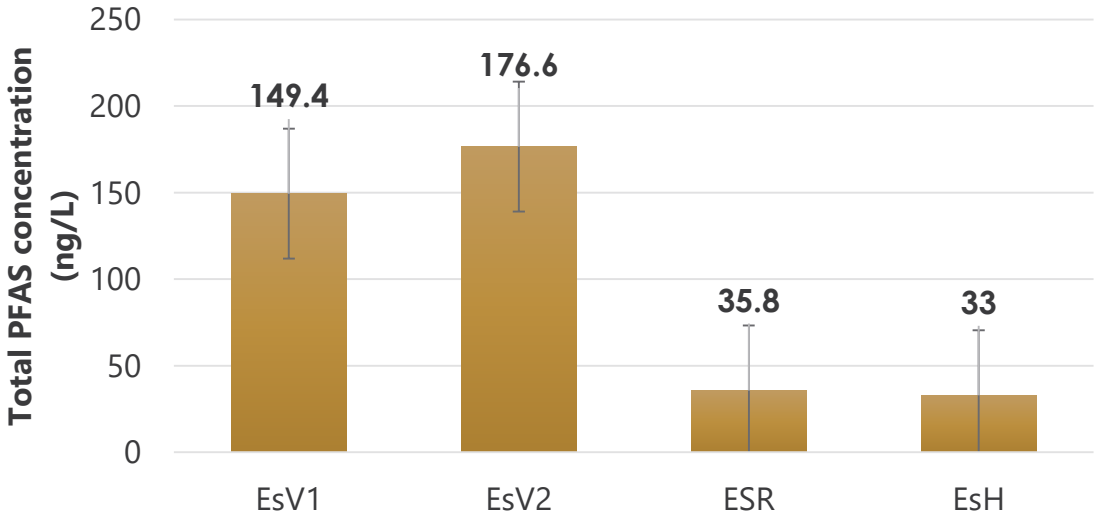
Global concentration of PFAS in sediments ($ng.g^{-1}$), *<LOD : Under the limit of detection*



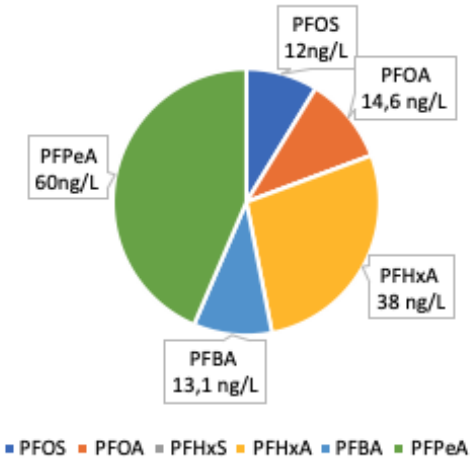
Case study: Results

- River water
- Sediments
- **Groundwater**
- Biological samples

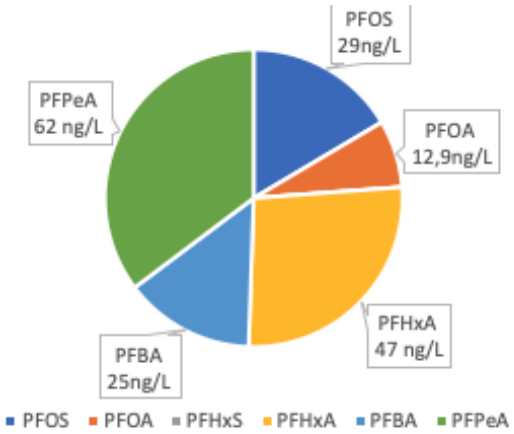
Superior to the expected results (ANSES 2011) : between 1 and 10 ng/L



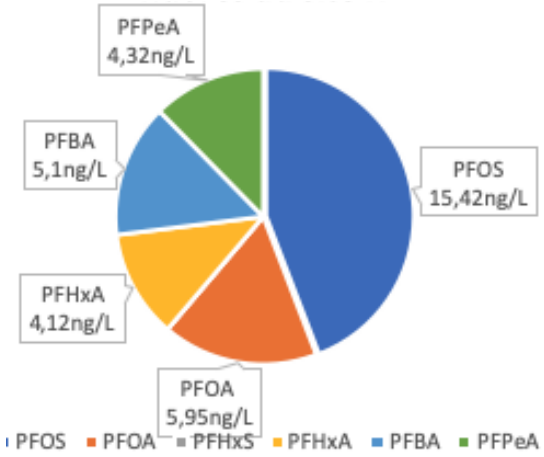
PFAS relative concentration at V1 site



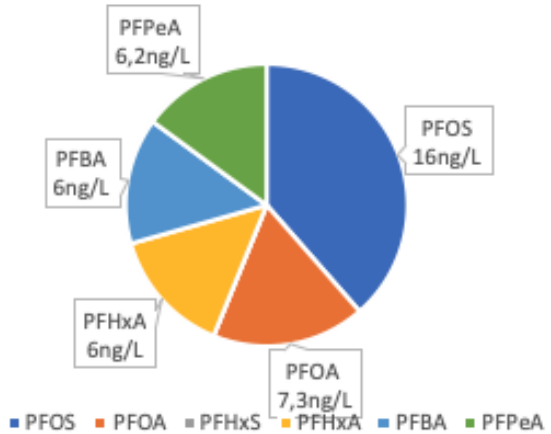
PFAS relative concentration at V2 site



PFAS relative concentration at R site



PFAS relative concentration at H site



Case study: Results

- Vegetals
- Plankton
- **Fishes**

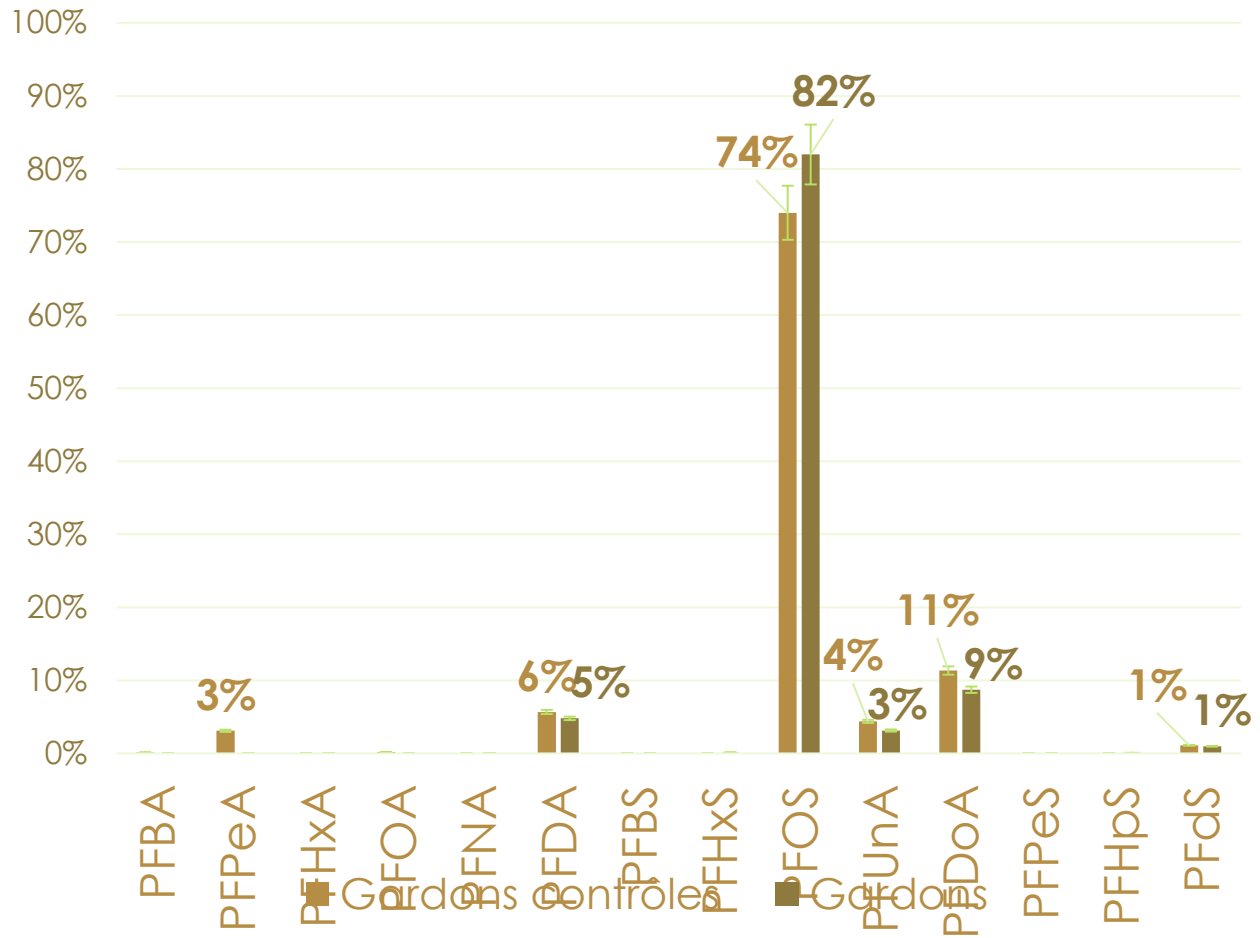
BMF S-G: 2.16

BMF S-P: 11.72 - 4.65

BMF: G-P: 5.4 - 2.16

High PFOS affinity to the blood leads to an Over-contamination by this specific PFAS

Roach



Conclusion

Ubiquitous contamination linked to the industrialization and urbanization of the Seine Valley

Higher concentration because of repeated use (Production, firefighter training…)

Lowering of the contamination of the aquatic fauna. Remain a good bio-indicator due to biomagnification

PFAS

A single Use of PFAS is not leading to an heavy contamination (dilutive effect)

High risk of exposure of general public in the area

Risk study related on the consumption of PFAS contaminated water in Rouen

Treatments

Usual treatments

Treatments

Exposure directly linked to the **consumption of contaminated water 75% of exposure (Hoffman 2011)**

Large experience on soil treatment (Petroplus rafinery)

- Treatment of contaminated water
  - ➡ Usual treatment work
  - ➡ **Innovant treatment are usefull to reduce costs**
- but soil is also important, because **PFAS contained in the soil can recharge groundwater**
  - ➡ Partneship with french academics and research institute to determine the comportment of PFAS in the soil : Project IPANEMA
  - ➡ Usuals treatment (thermal desorption, washing…)

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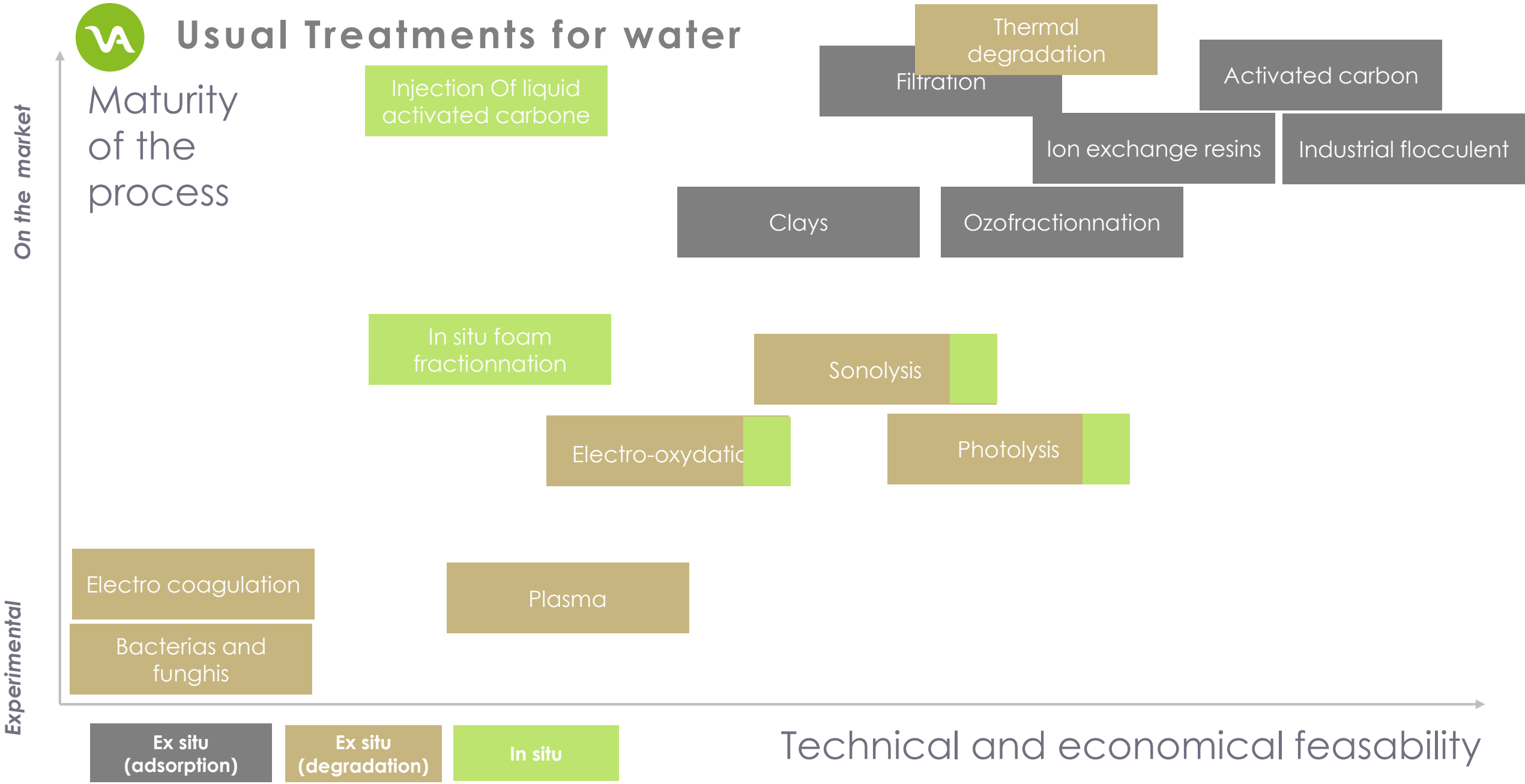
Usual Treatments for water



Usual Treatments

Activated carbon

\+ Efficient on long chain PFAS well known and easy to use

\- Low efficiency for short chain PFAS (0% on GenX) Higly dependent on co-contaminants
High quantity of wastes (difficult and expensive regeneration (>700°C))

Ion exchange resins

\+ Higher sorption capacity than GAC
Better efficiency on short chain PFAS than GAC
Can reach low concentrations (<70ng/L)

\- Fast chemical exchange saturation
Unefficient on positively charged PFAS
A large number of interraction with other contaminants
Difficult regeneration

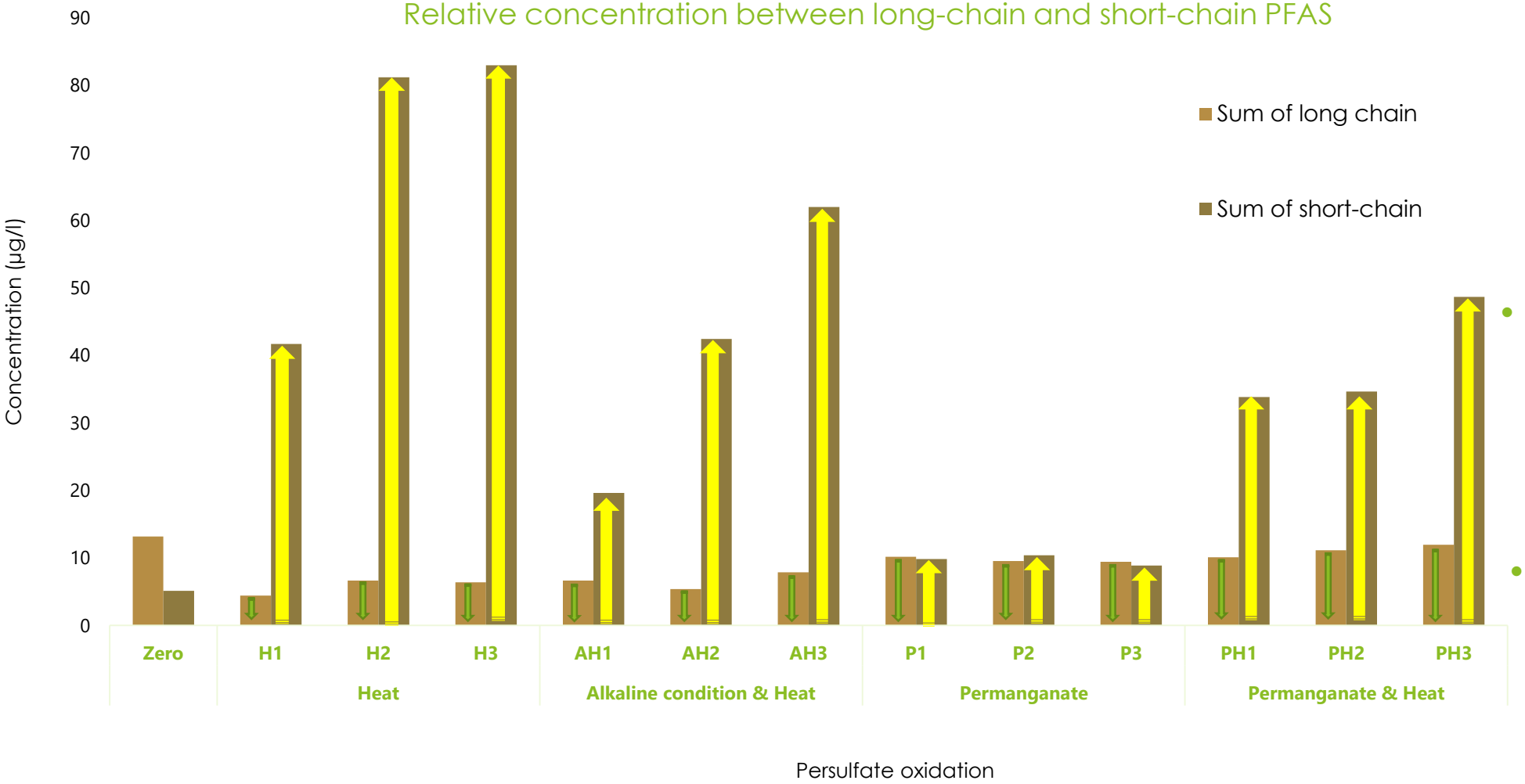
→Comprehensive use of remediation methods according to the contamination

→The right process on the right contamination

Treatments

VALGO Innovative treatments

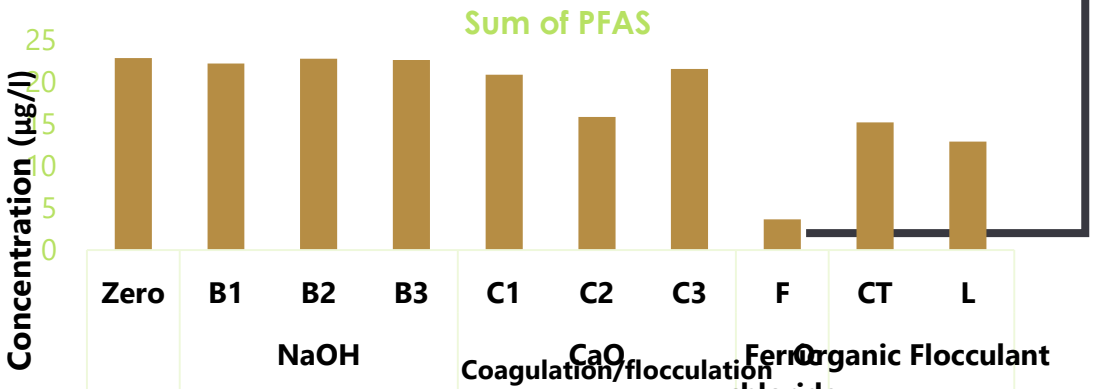
Advanced oxidation

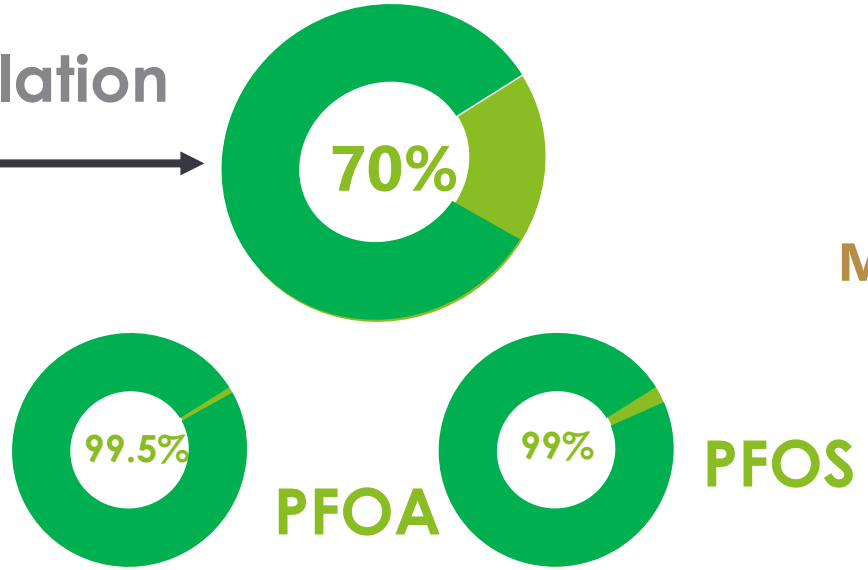


- Degradation of long-chain PFAS creates short-chain PFAS
- Challenge in quantification of destructed PFAS

Advanced Coagulation/Flocculation

- **Usual coagulation / Flocculation**

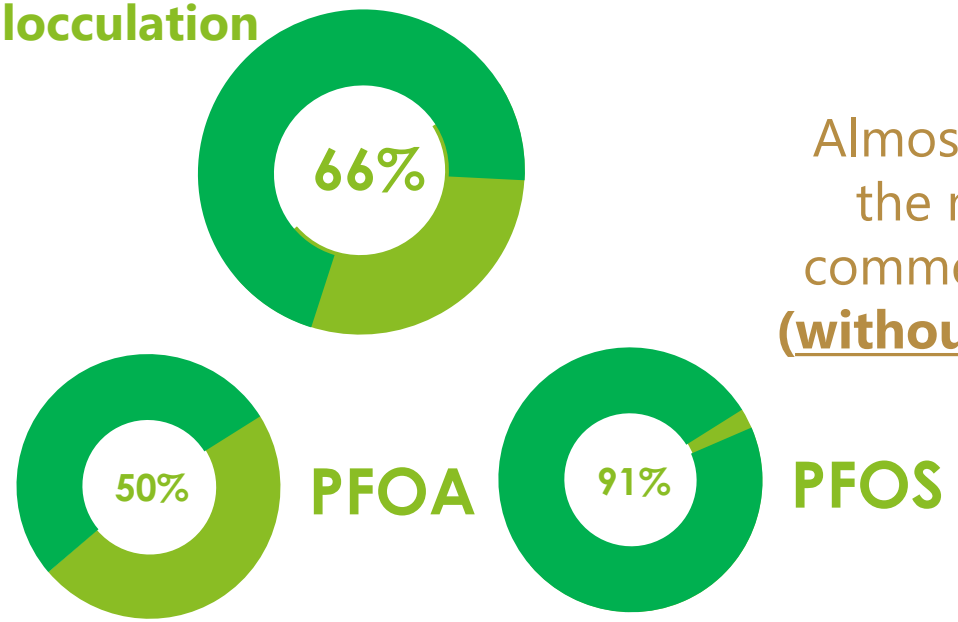




Most effective commercial flocculent

- **Valgo Biological innovant coagulation / Flocculation**

Patent in progress



Almost as efficient as the most efficient commercial flocculent **(<u>without optimization</u>)**

Treatment of contaminated site

Before treatment
Diagnosis is essential

- Adaptation to the site and the contaminants
- Considerate the whole contamination

Usual strategies work

- If they are used properly, but can be expensive

Innovant processes are developped
(patent in perspective)

- Biological like process: Organic Protein
- advanced oxydation

2022/2023: Pilote study of Valgo in Canada
Optimization usual treatments with a modular organization

- Adaptabily to the site and the contamination
- 2023/2024: Full scale study of our innovative treatment processes

- **The right diagnosis**
  - Correct concentration
  - Unique PFAS signature

- **The right treatment**
  - Adapted to the site
  - Adapted to the concentration
  - Adapted to PFAS

Each site should be correctly diagnosed and deserve an adapted treatment

VALGO Canada Inc.

Thank you
for your attention

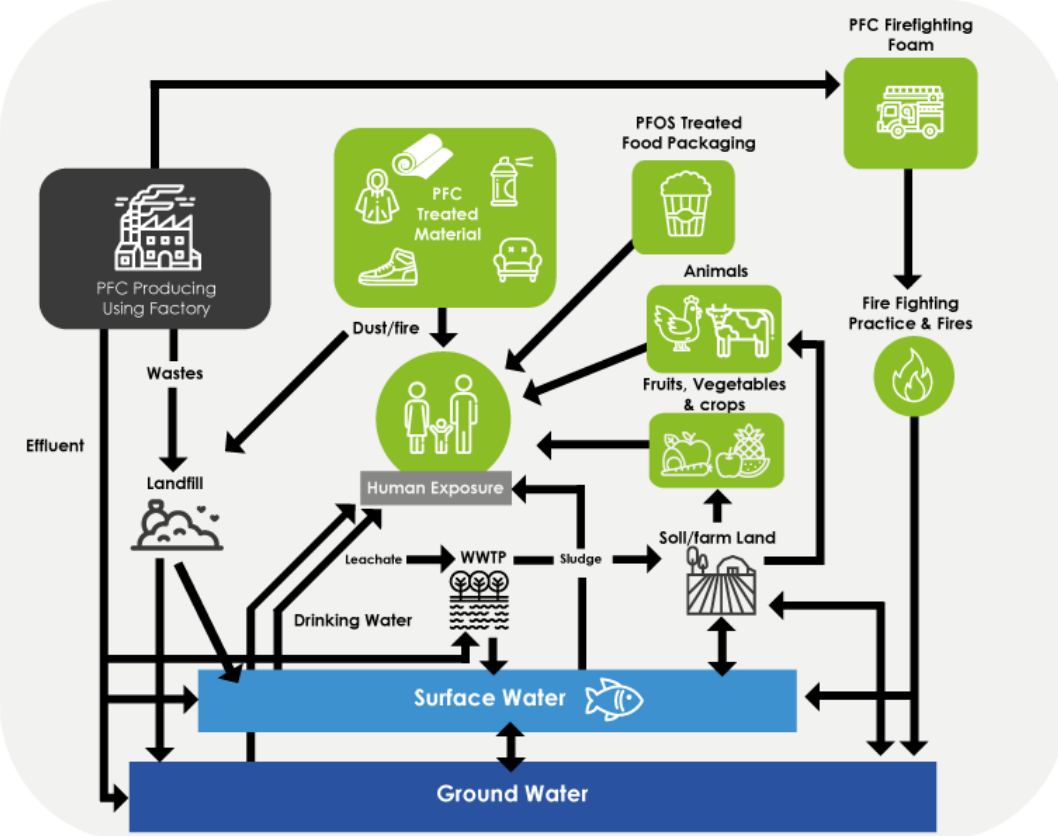
How are we exposed?

There are multiple ways of contamination in the general population:

- **Drinking water (75% (Hoffman et al., 2011))**
- Food
- Textile (mainly on children)

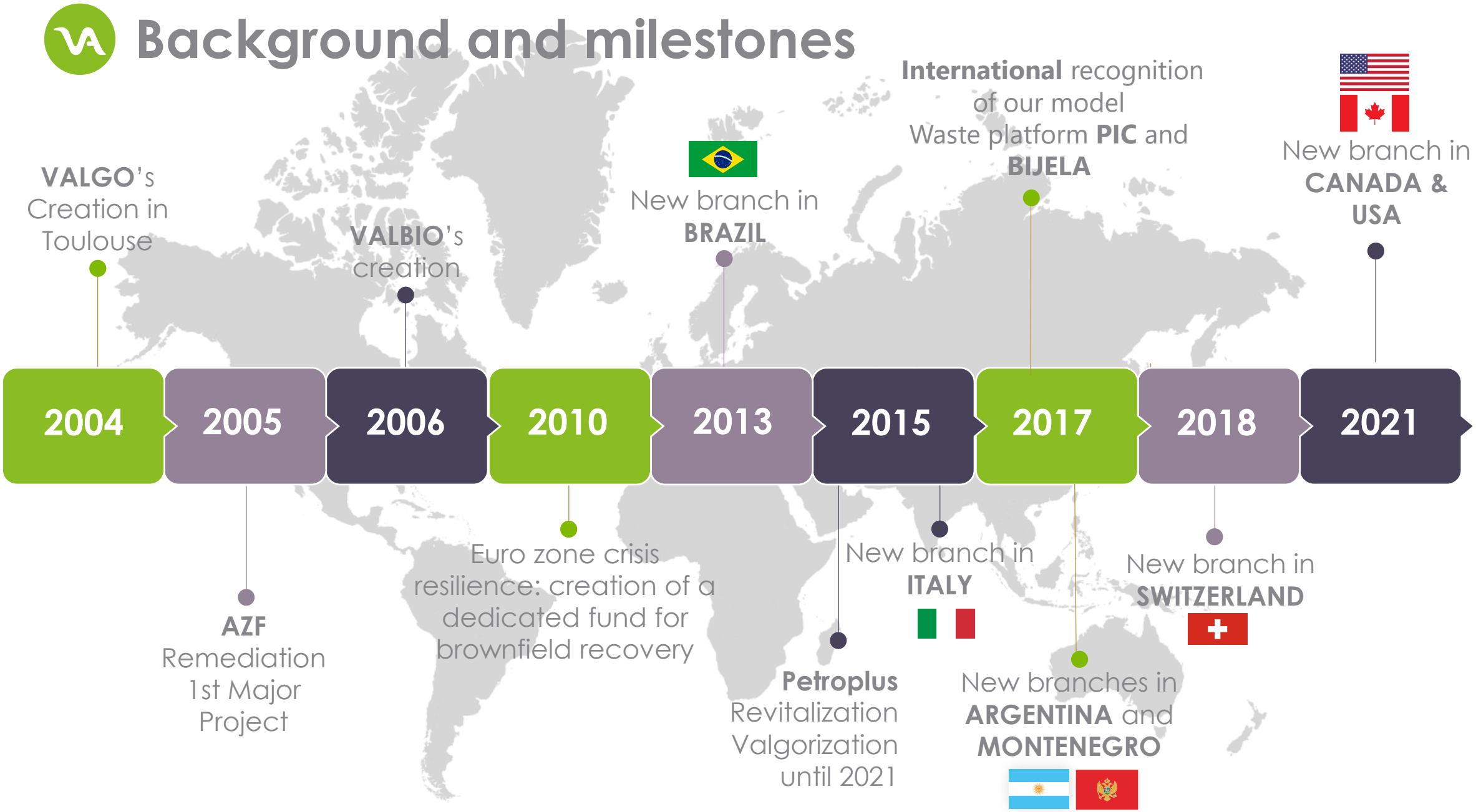
➡ In Developped countries, the plasmatic concentration of PFAS varies between **5 and 50 µg/L**

➡ Variable according to the geographical location and the professionnal occupation

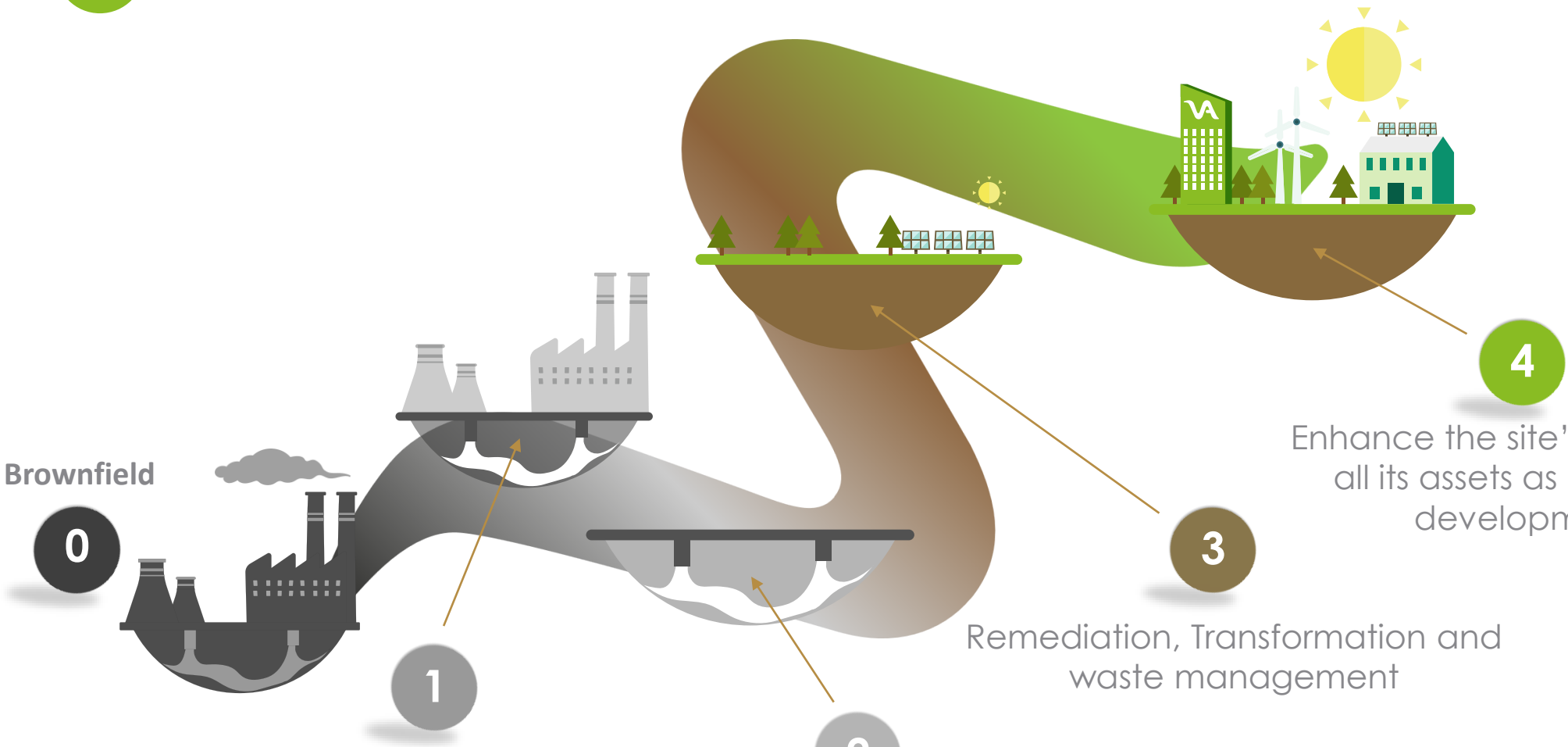


Ollileai 2013

Background and milestones



VALGOrization



Brownfield

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1

VALGO SCAN

Assessment, Design and risk analysis

2

Deconstruction and decontamination

3

Remediation, Transformation and waste management

4

Enhance the site's value and all its assets as part of its development