An exploratory societal CBA

The management of PFAS contamination in soil and groundwater in Flanders

A study by UAntwerp and Arcadis

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Introduction

- Since 2016, we are working on solutions for PFAS in soil & groundwater
  - → Inventory of contaminated sites is going on
  - → Guidelines on how to investigate and to measure PFAS
  - → Remediation projects are starting & co-financing mechanisms are developed
- Total costs of tackling the problem will be very high
  - → Budgets are available for R&D, for co-financing, orphan sites, …

Questions: **What do we do first? How to spend budgets effectively and efficiently?**

→ **Instrument 'Social Cost Benefit Analysis'**

- Project 'SCBA for PFAS in soil & groundwater in Flanders' – including excavated soils
- Methodology development + gaps in data & knowledge + cases
- Goals: formulate **policy recommendations** & **prioritize measures and actions**

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Overview of today's presentation

- **Method**
- **Problem analysis**
- **Effects**
- **An application to cases**
- **Recommendations**
- **Conclusion**

Given the limited presentation time, we will focus on highlighting **what can be found** in **the final report**.

Method

- **Societal CBA**
- **But: exploratory - mapping possibilities, knowledge gaps, and methodological challenges**
  1. Problem analysis of PFAS contamination in soil, based on available data
  2. Inventory of relevant economic, social, environmental, and health effects
  3. Description, quantification and—where possible—monetization of these effects
  4. Application to cases, comparing a zero-alternative with various policy alternatives

Problem analysis

- **Inventory of available PFAS data in soil and groundwater in Flanders**
- **Goal → propose realistic cases:**
  - What's the volume of a "typical PFAS" contamination? Concentration range? Depth? Land use?
  - What do we know of (diffuse) soil contamination with PFAS – affecting the reuse of excavated soil
- **Initial cautious estimate of the scale of the problem in Flanders: how many sites might be involved?**

Data are limited or not uniformly structured: assumptions, simplifications, and extrapolations were used.

Economic effects €

	Management-related effects	PFAS-presence effects	Unit
Costs for remediation and/or soil relocation works	X		€
Costs for drinking water treatment		X	€
Costs due to restrictions on future developments		X	€
Property value		X	€
Employment	X	X	€
Agriculture	X	X	€

Note: every effect in **bold** is applied in the cases

Health effects

	Management-related effects	PFAS-presence effects	Unit
Health effects linked to the PFAS contamination in soil: • Prostate cancer • **Kidney cancer** • Testicular cancers • Reduced immune response • Liver damage **(Liver cancer)** • Colitis • Asthma • Hypertension (during pregnancy) • Preeclampsia • Early menopause • Fever days in children		X	€ or DALYs
Risk factors linked to the PFAS contamination in soil: • Reduced fertility • Hypertension (during pregnancy) • Low birth weight • Hormonal disruption • Increased cholesterol • Thyroid disruption		X	€ or DALYs
Health effects linked to remediation and/or soil relocation works (emissions, (temporary) exposure to PFAS, etc.)	X		€ or DALYs

Environmental effects

	Management-related effects	PFAS-presence effects	Unit
Emissions linked to remediation and/or soil relocation (CO_2 **emissions**, NOx, **particulate matter**, etc.**)**	X		€ or kg CO_2-eq
Ecosystem effects	X	X	e.g. species loss or €
Land use for landfills	X		m^2
Groundwater quality	X	X	mg PFAS/m^3

Social effects

	Management-related effects	PFAS-presence effects	Unit
Experienced nuisance	X		e.g. # of disturbed persons, complaints
Psychosocial well-being		X	e.g. # of concerned residents, cortisol levels, or €
Trust in government	X		e.g. # of protests
Socio-economic vulnerability	X	X	e.g. % of vulnerable groups in contaminated areas
Liveability (including recreational opportunities)		X	

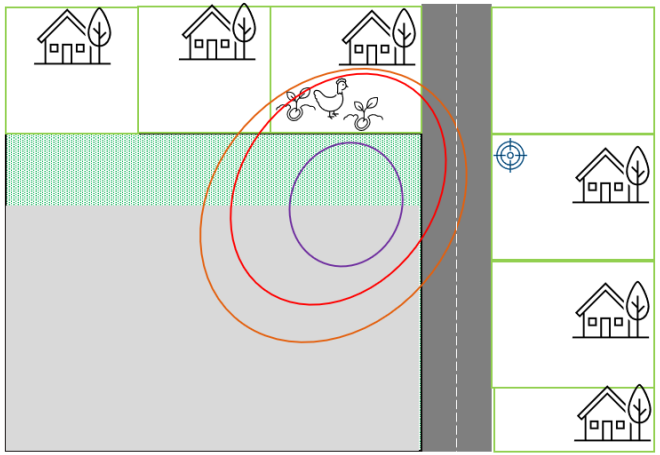
All the effects (economic, health, environmental, and social) are discussed in the report, and appropriate assessment methods are proposed.

An application to cases

- **2 cases:**
  - Soil investigation and remediation
  - Soil excavation and relocation
- **Not all effects are calculated** (see previous slides)
- **Goal: map possibilities, data, and knowledge gaps**
  - What can we monetize?
  - Which data is missing or uncertain, and which assumptions need to be made?
  - What can we learn?

An application to cases – an example

- **Case: soil investigation and remediation**
  - Industrial zone with contamination affecting the surrounding **residential area**
  - What are the costs and benefits for society in…



Alt 0:
No investigation or remediation

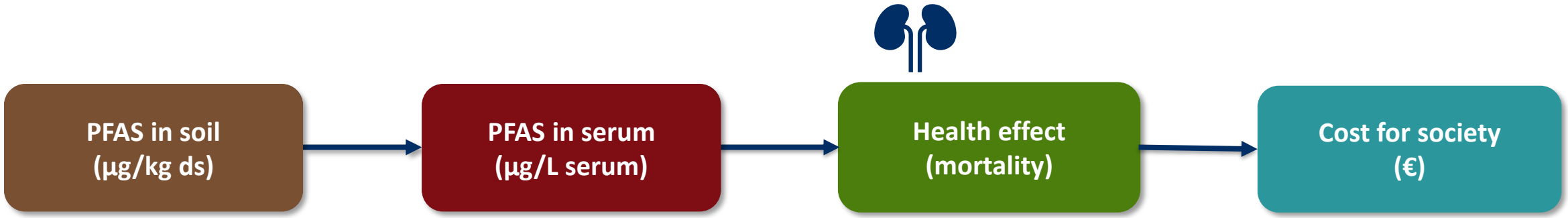
Alt 1 & 2:
Different levels of remediation

Alt 3:
Risk management

- **Case: soil excavation and relocation**
  - In the report – will not be presented today

Calculation of effects – An example

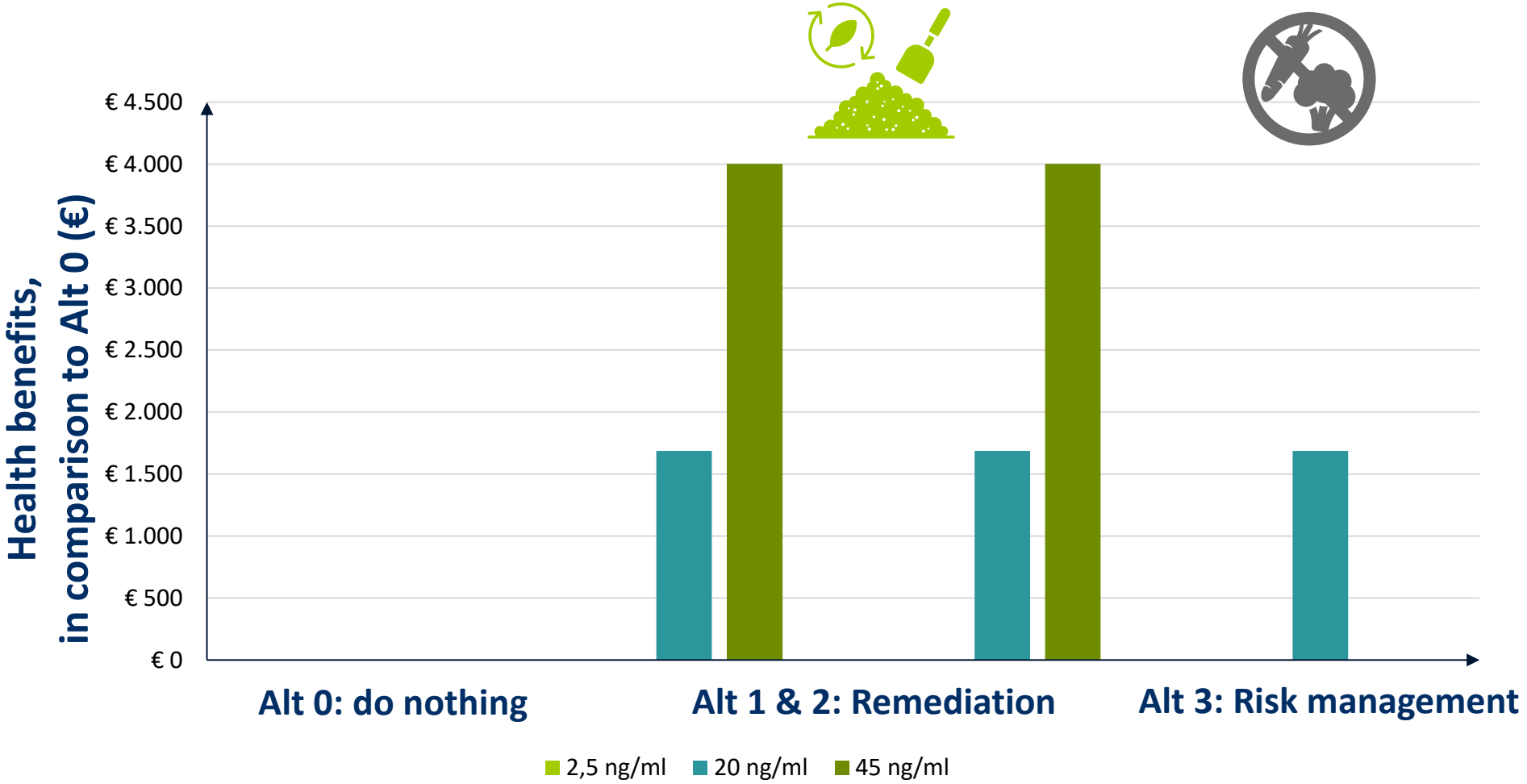
- **Health effects: kidney cancer**



- **PFOS**
- **Other health effects are not calculated (yet)**

Calculation of effects – An example

- One type of PFAS (PFOS)
- One health effect
- One generation
- Uncertainties
- Assumptions (e.g. Value of a Statistical Life)



Recommendations *(future research)*

Problem analysis

Update with **new data and results**, e.g. on leaching behaviour and short-chain PFAS

Economic effects

Further research needed on **innovative remediation techniques**;

Location- and PFAS-specific data are needed to calculate effects on treatment of drinking water and property values more accurately.

Health effects

Expand to include **other health effects**, **other PFAS components**, and **future generations**;

Strengthen **knowledge** of the **relationship** between PFAS-soil and PFAS-serum concentrations, and the resulting health effect.

Environmental effects

Conduct full **life cycle assessments**;

Research **ecosystem impacts** (biodiversity and soil health) and **valuation methods**.

Social effects

Context-specific data needed to quantify and monetize social effects

Mitigate social effects? enhance **transparent communication** and **realistic framing of risks**.

Recommendations *(policy)*

Case: soil investigation and remediation

Risk-based remediation, targeting the highest contamination load, is the most balanced approach, based on the calculated effects

Case: soil excavation and relocation

Conditions to reuse excavated soil are strict, with limited options to reuse soils that leach PFAS. An **area-based approach** and **project specific evaluation** can optimize costs and benefits.

Prioritise remediation…

… at or close to **drinking water catchments**

More cases are needed…

For a complete view of economic impacts, including effects on employment, agriculture, industry, and future development;

To include all environmental, health and social effects, but data/assessment method are still lacking

Is a societal CBA the right way to go?

- **Precautionary principle**
  - *"If there's a possibility of serious or irreversible harm, and scientific consensus is lacking, then preventative measures should be taken, even without full proof of cause and effect"*
- **Risk acceptance**
- **Multi-attribute analysis**

Conclusion

- PFAS contamination generates **substantial societal impacts**
  → **Prevention** – avoiding PFAS entering soil and groundwater remains key
- **Not all effects can be quantified or monetised**; where data existed, preliminary estimates were done.
- **Costs were easier to calculate than benefits**, especially with health effects, which may lead to underestimating long-term gains.
- **No aggregation or discounting** was applied in this study.
- **Social effects and perceptions** also deserve further attention.

The study is exploratory, and highlights the need for better data, broader effect assessment, and complementary approaches (precautionary principle, risk acceptance, multi-attribute analysis).

An exploratory societal CBA

The management of PFAS contamination in soil and groundwater in Flanders

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