UIC Asset Management Global Conference 2015

# Improved management of drinking water networks: the long-term OPTIMEAU model for forecasting renewal, application on the Water Services of Paris Area (SEDIF) and on Lausanne

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## Session III: Data, tools and models

Putting your assets on the right track

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II. Main issues of long-term planning models

III. Past decision-making process in Lausanne

IV. Overview of OPTIMEAU model

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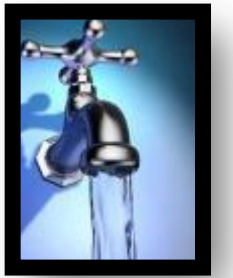
2. “I1P”: number of leaks
3. “I3P”: risk of traffic disruption

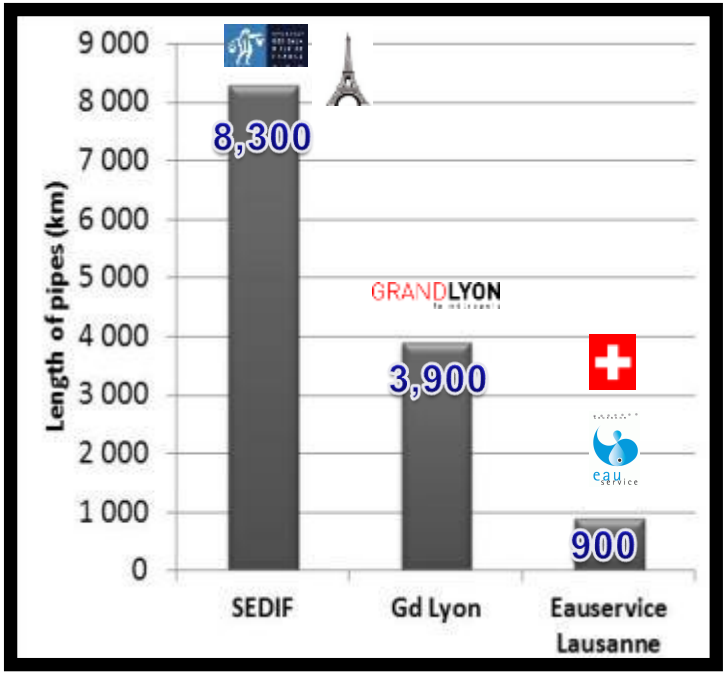
VI. Conclusion



# I. Main issues of the 3 water utilities

| | Inhabitants | Length of pipes (km) |
|---|---|---|
| SEDIF | 4,300,000 | 8,300 |
| Gd Lyon | 1,300,000 | 3,900 |
| Eauservice Lausanne | 330,000 | 900 |

The renewal of a **fraction** of the network is needed, **each year**, because of **poor condition**, but also for **coordination**.




- **Different histories** (materials, installation years)
- **Different practices**
- **High cost of pipes** **530 € / m**

⇒ **How much length should be replaced each year?**

⇒ **Balance between cost and performance?**

# II. Main issues with long-term planning models

Putting your assets on the right track

# Main issues with models at 3 planning scales

3

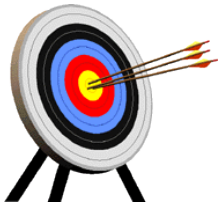
**Optimization of work**

2

**Budget consistent with the chosen strategy**

1

**Optimization of water utility objectives**



**Short-term** | **Mid-term** | **Long-term**

< 5 years

5 to 20 years

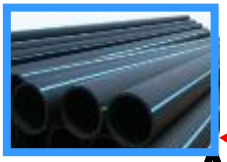
> 20 years

# Example of issues of long-term planning models

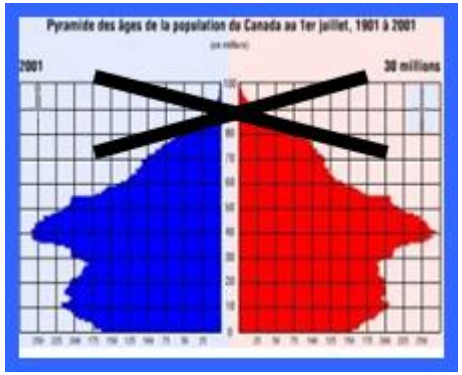
- **Steering strategy: Threshold renewal age by material**







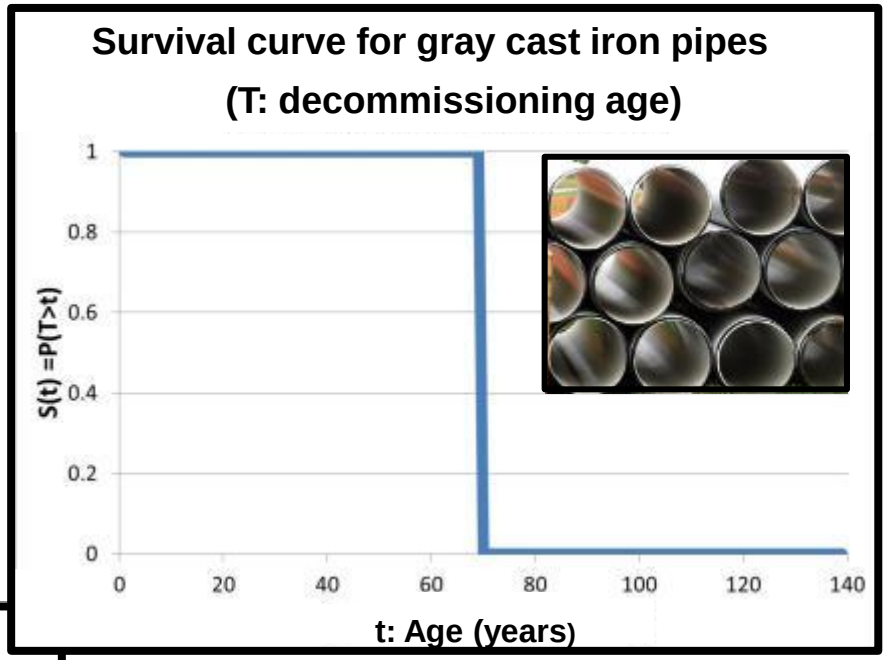
| Material | Renewal Age (years) |
|---|---|
| Steel | 60 |
| Concrete | 120 |
| Ductile Cast Iron | 120 |
| Gray Cast Iron | 70 |
| PEHD | 100 |

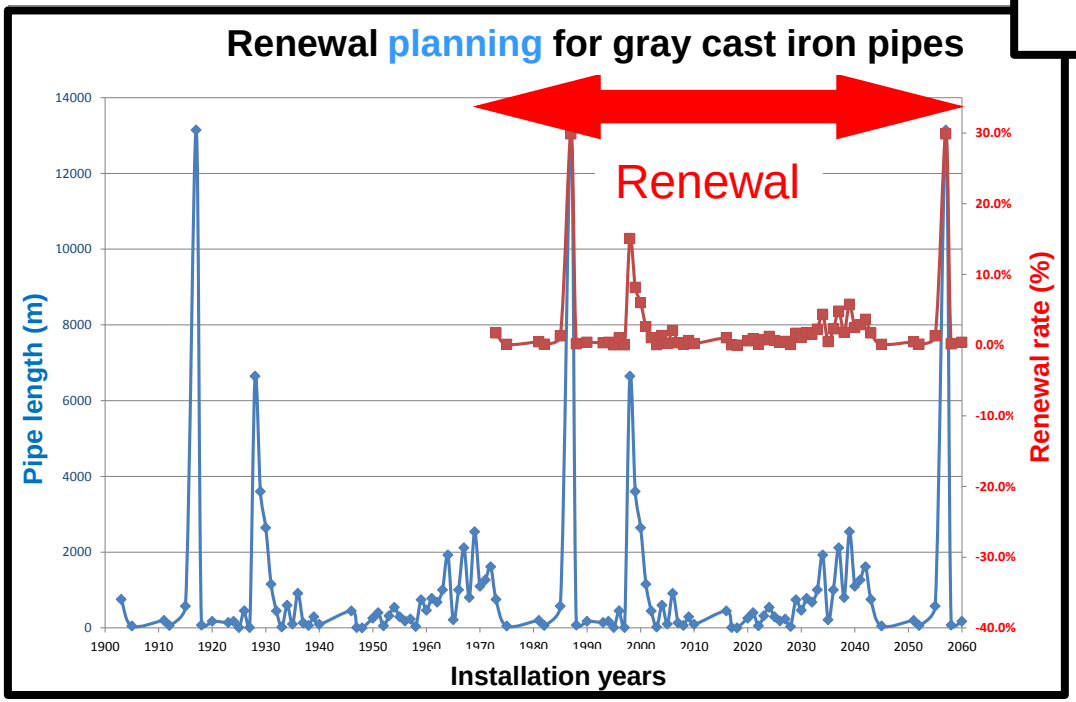



- **Action: Only renewal**

# Example of issues of long-term planning models

- Representing the strategy in a survival curve
- Long-term planning:

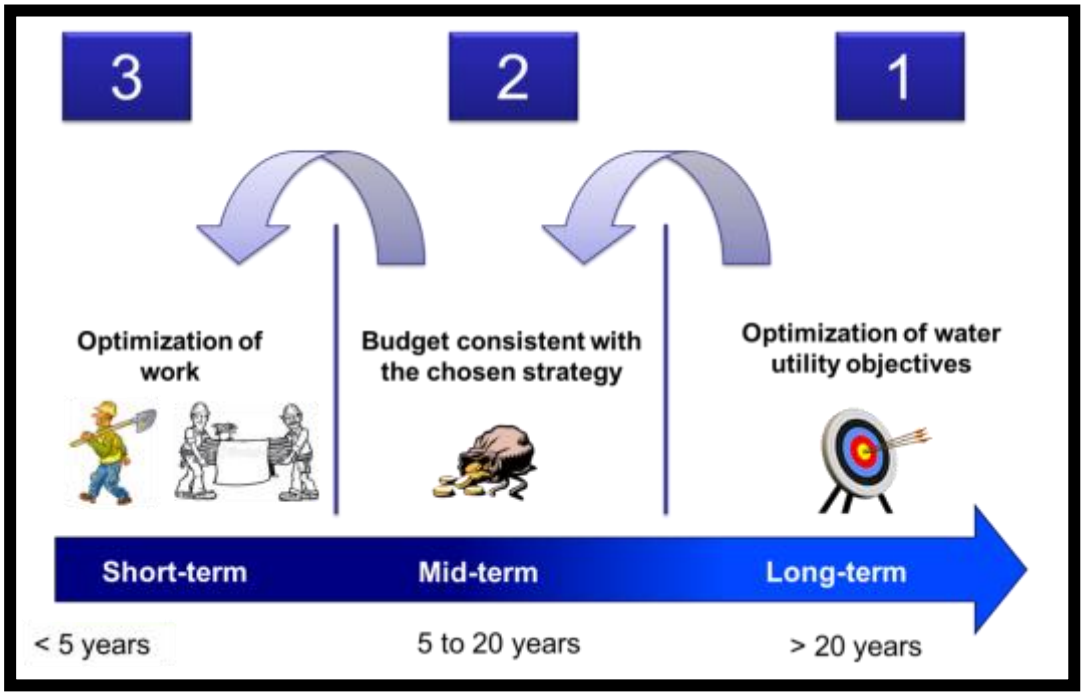


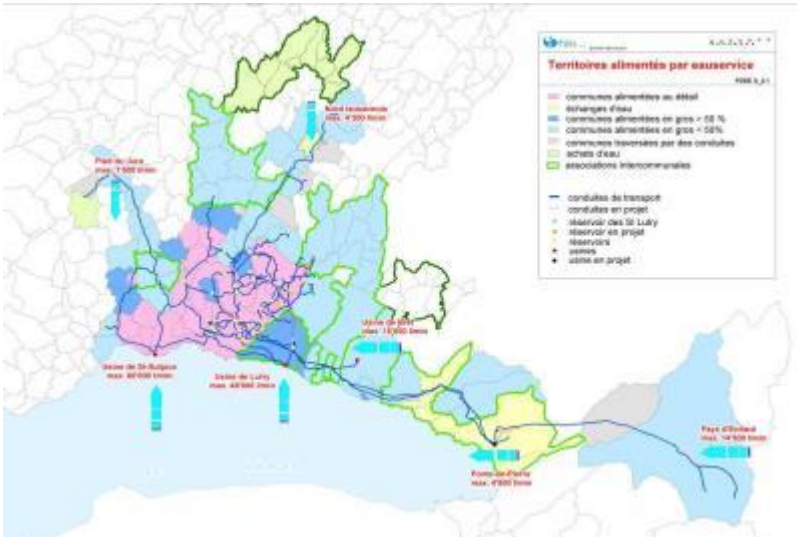

The Cador method, widely used (biblio and case studies), is not satisfactory!

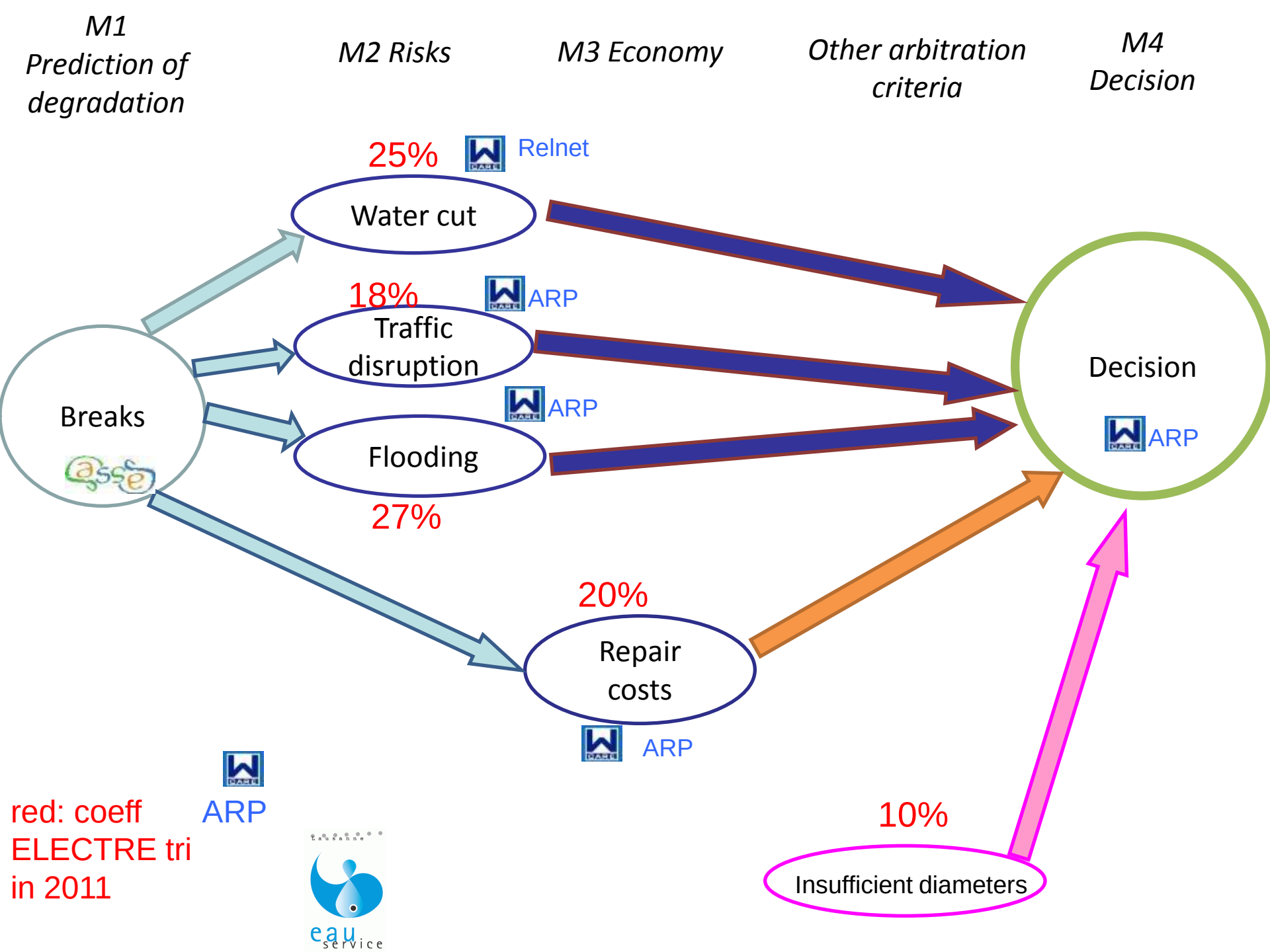
- **Objective of OPTIMEAU project:**

**Build a long-term planning model to help water managers optimize their future objectives by taking into account the past decision-making process.**




# III. Past decision making process in Lausanne


M1
Prediction of degradation
M2 Risks
M3 Economy
Other arbitration criteria
M4
Decision
25%
Relnet
Water cut
18%
ARP
Traffic disruption
ARP
Flooding
27%
Breaks
Decision
ARP
20%
Repair costs
ARP
ARP
red: coeff ELECTRE tri in 2011
10%
Insufficient diameters

# Output of decision model (M4)

ARP map

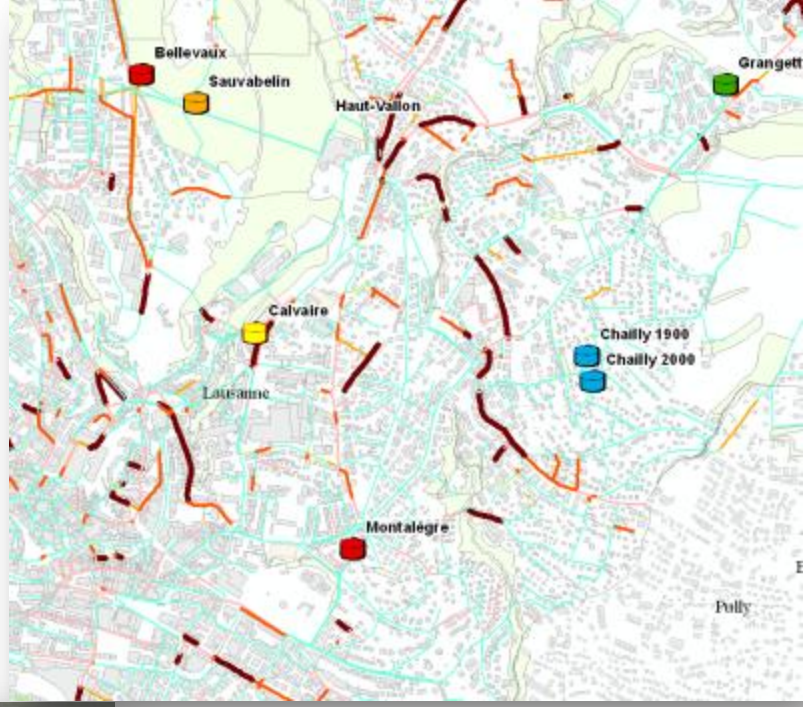
ARP

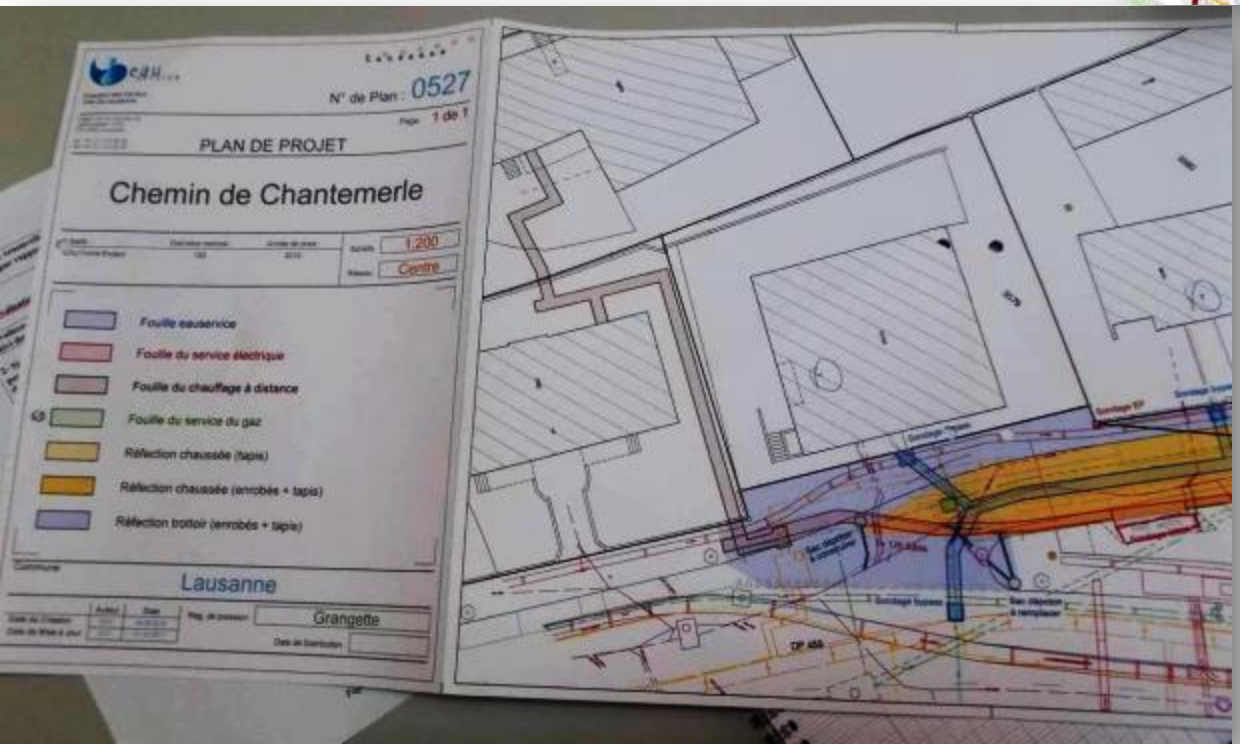
Résultat ARP analyse multicritère Electre tri

Etape 2

- C11
- C21
- C22
- C31
- C32
- C33

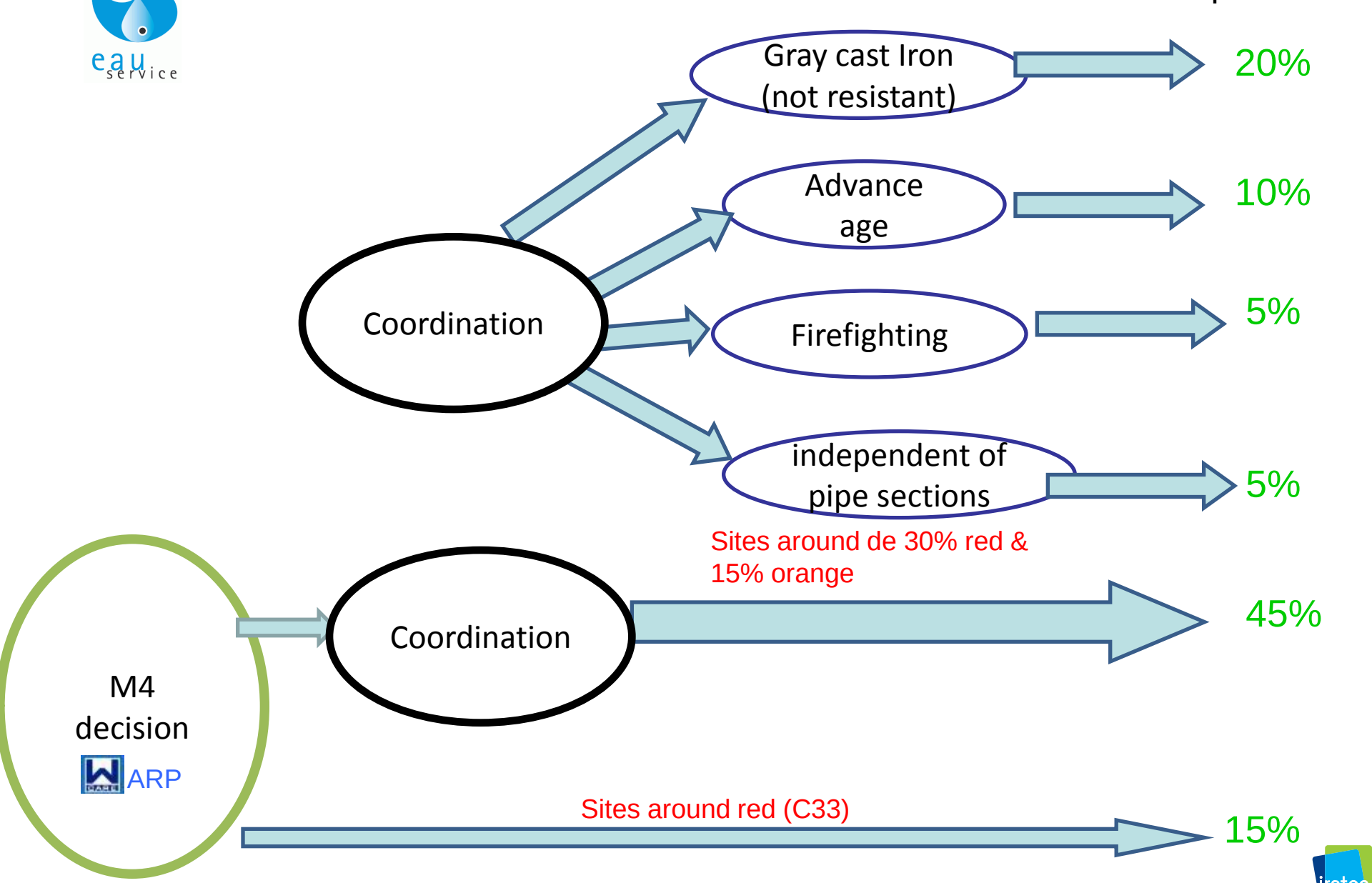
Source : eauservice



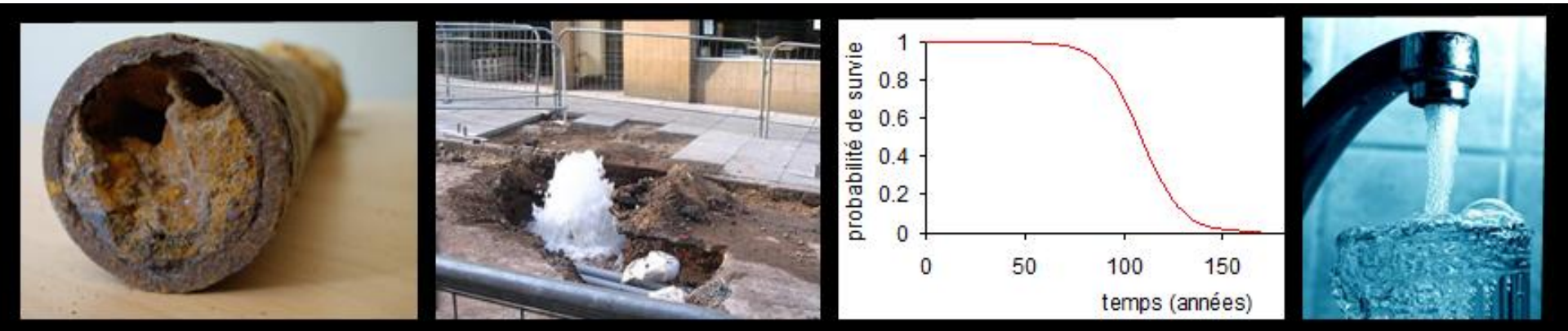




Renewal site selection: coordination + ARP

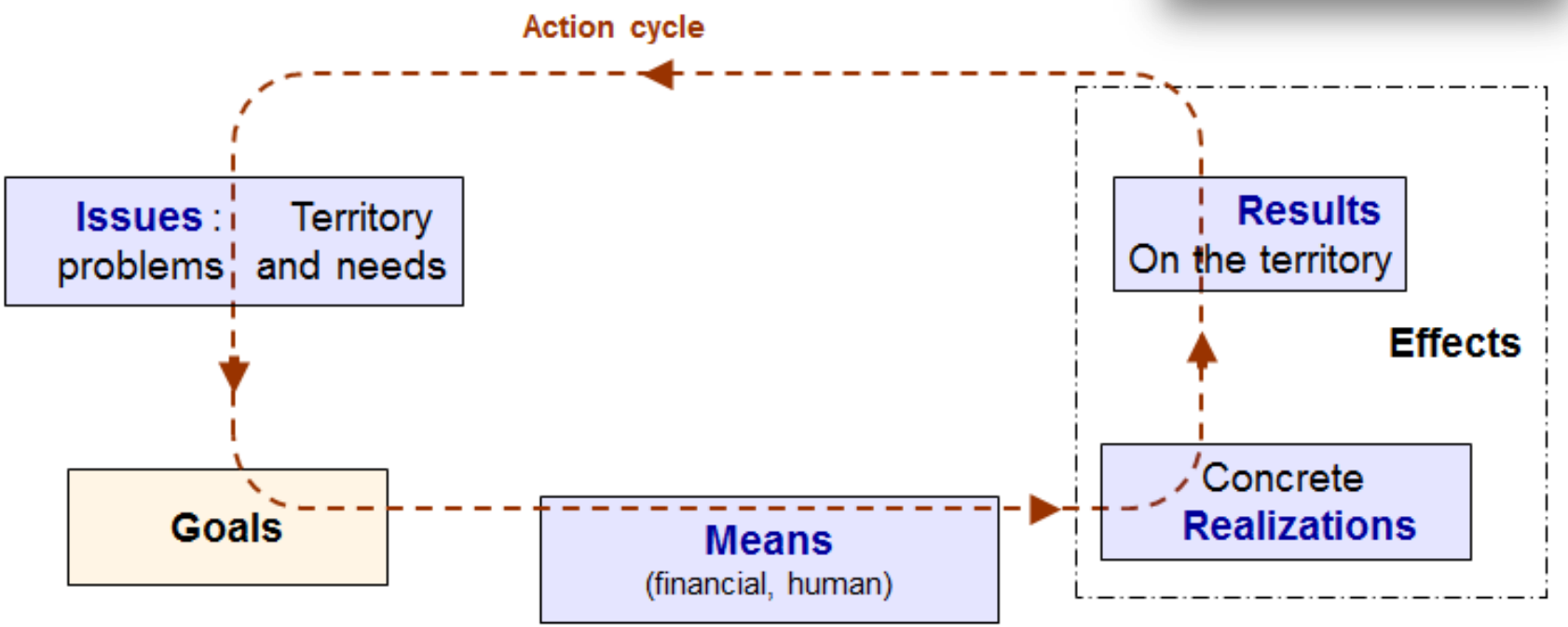
# *Other arbitration criteria*



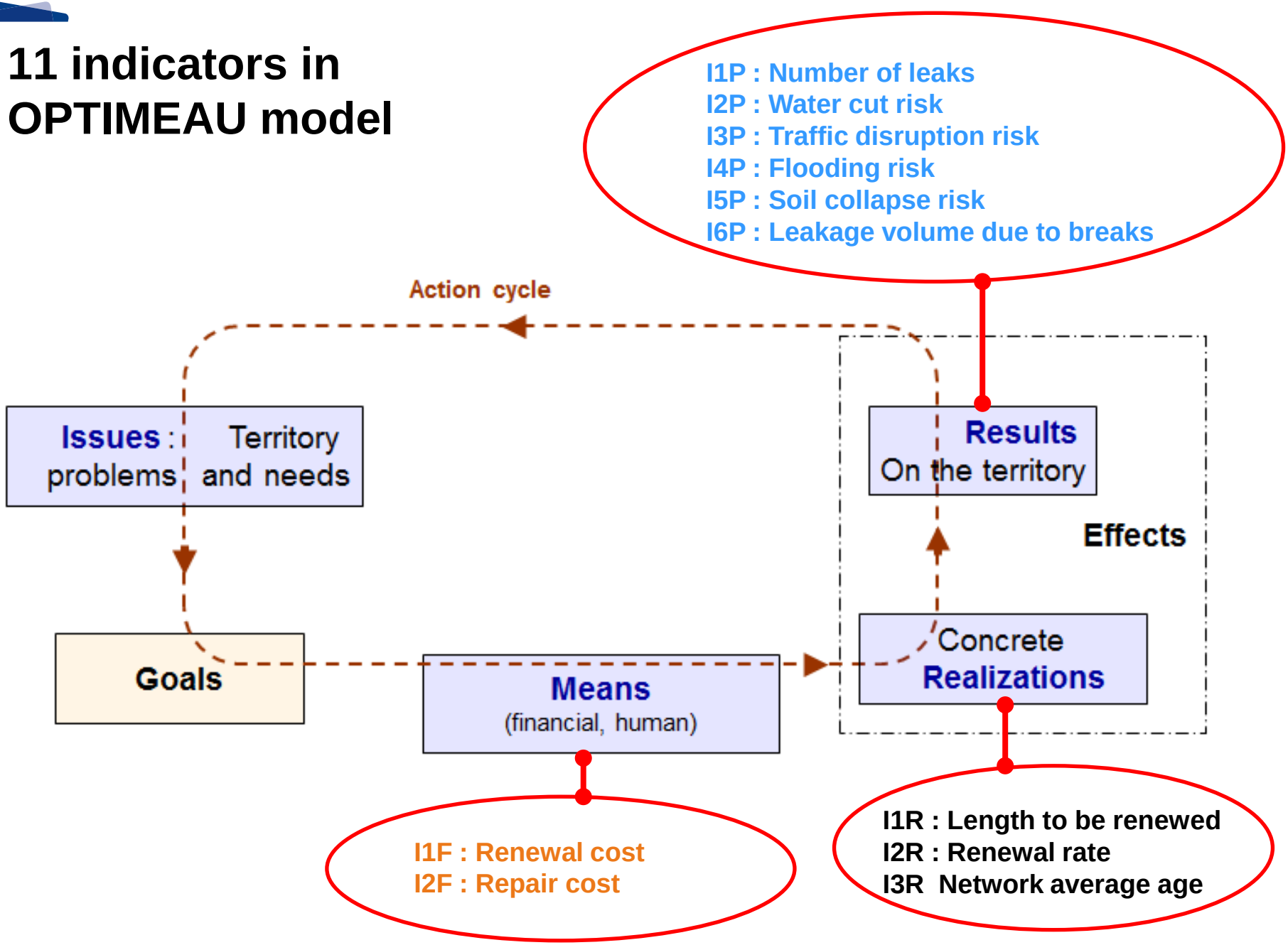
# IV. Overview of OPTIMEAU model



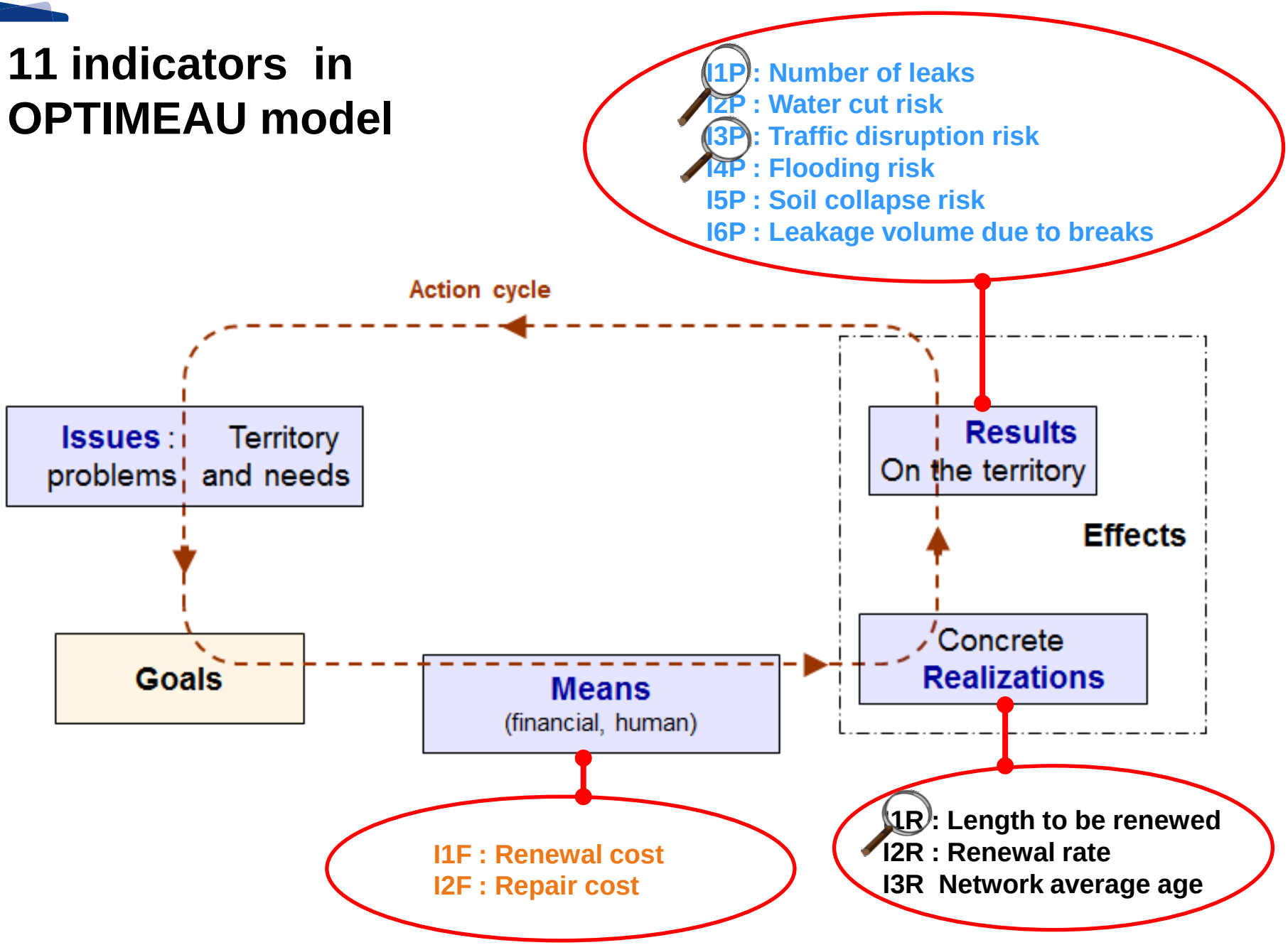
# Water utilities approach




# 11 indicators in OPTIMEAU model

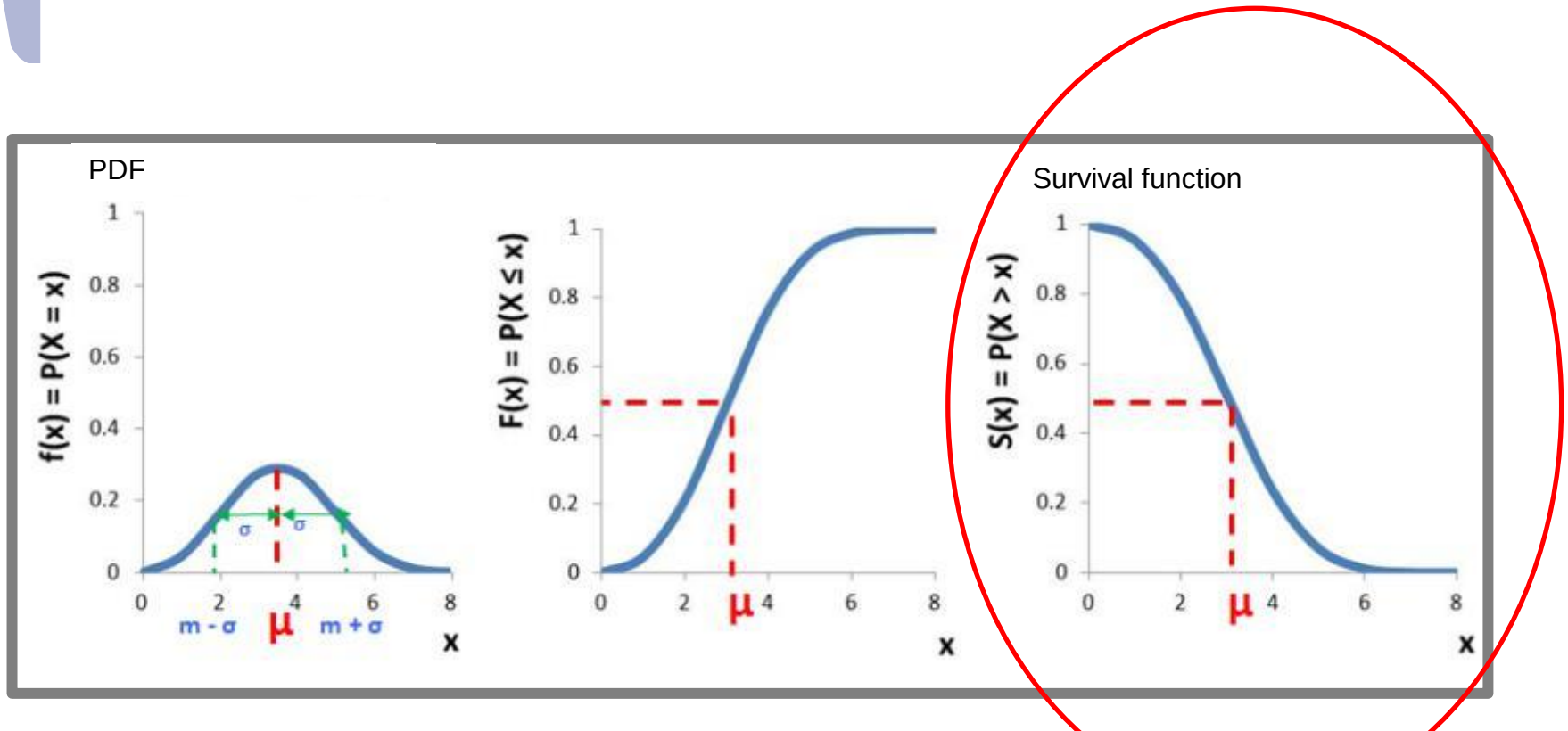


# 11 indicators in OPTIMEAU model



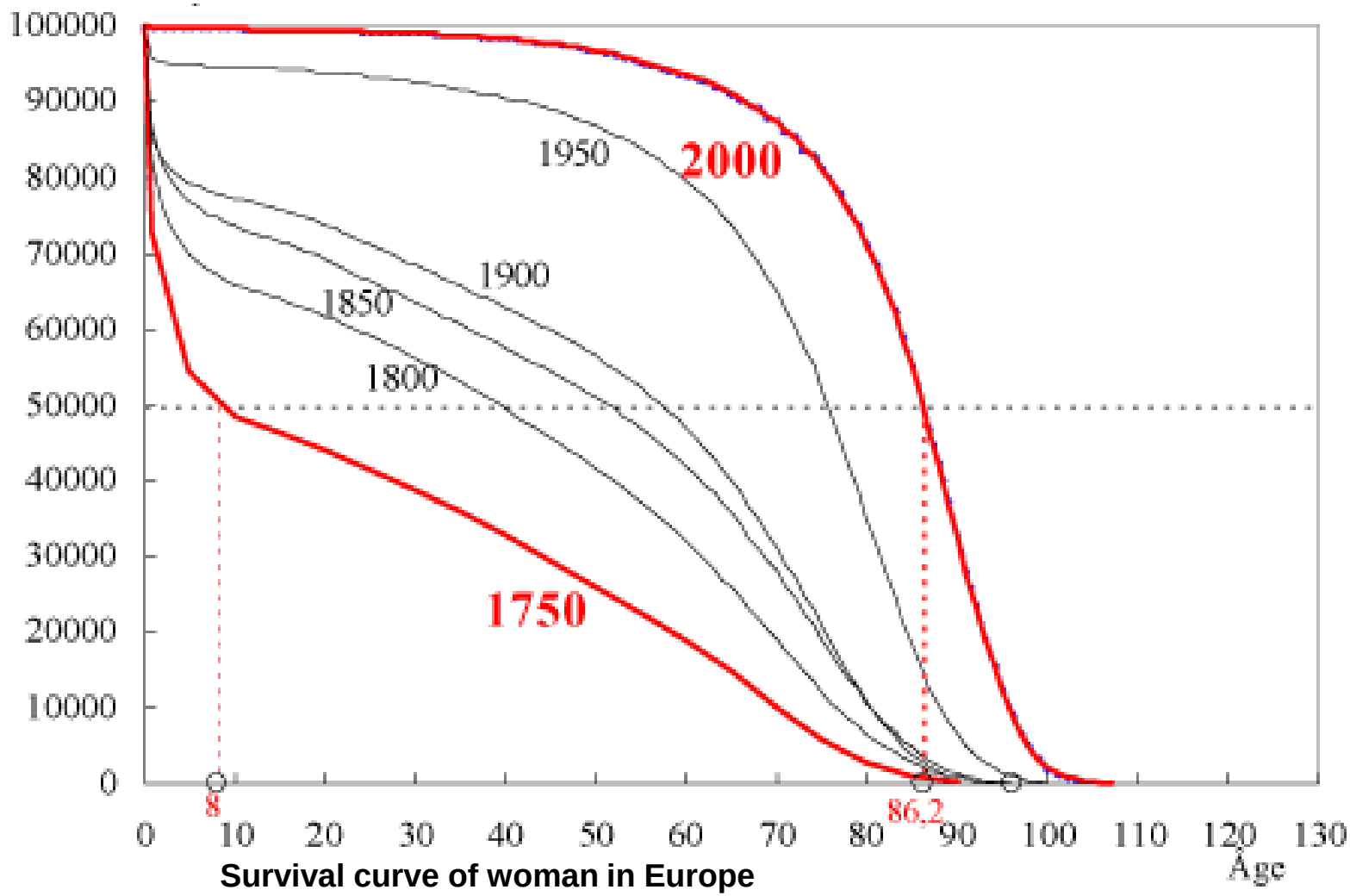
# T : Decommissioning age

## Survival function  connects all the indicators



# Example of survival function for human beings

Survivors for 100 000 birth




**Survival curve of woman in Europe**

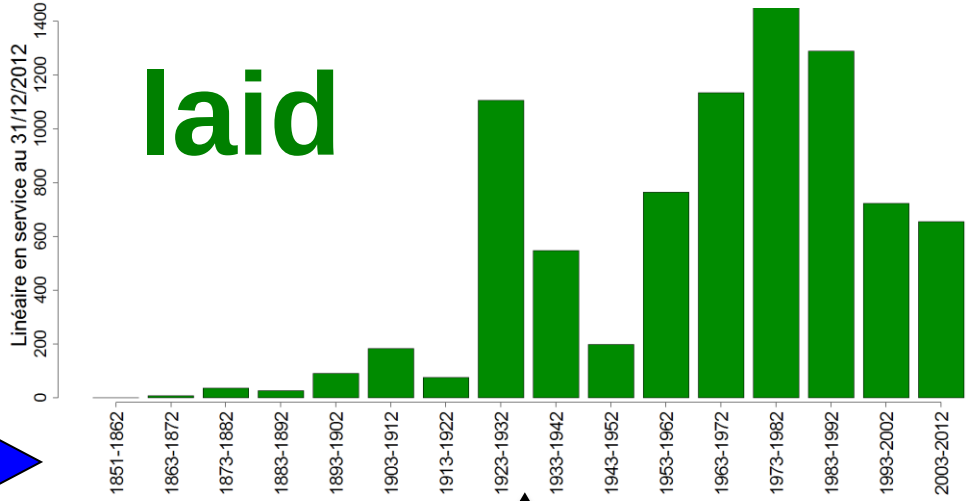
Source: Jacques Vallin, 2005

Input

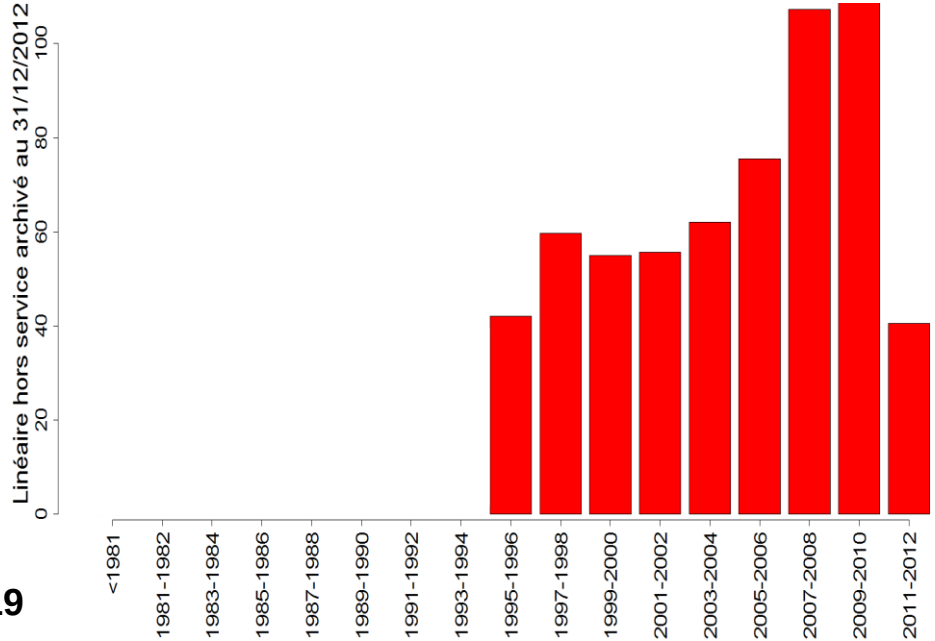
# SEDIF example

Length in service

Observation period of "decommissioning years" for the statistical model [1995, 2012]



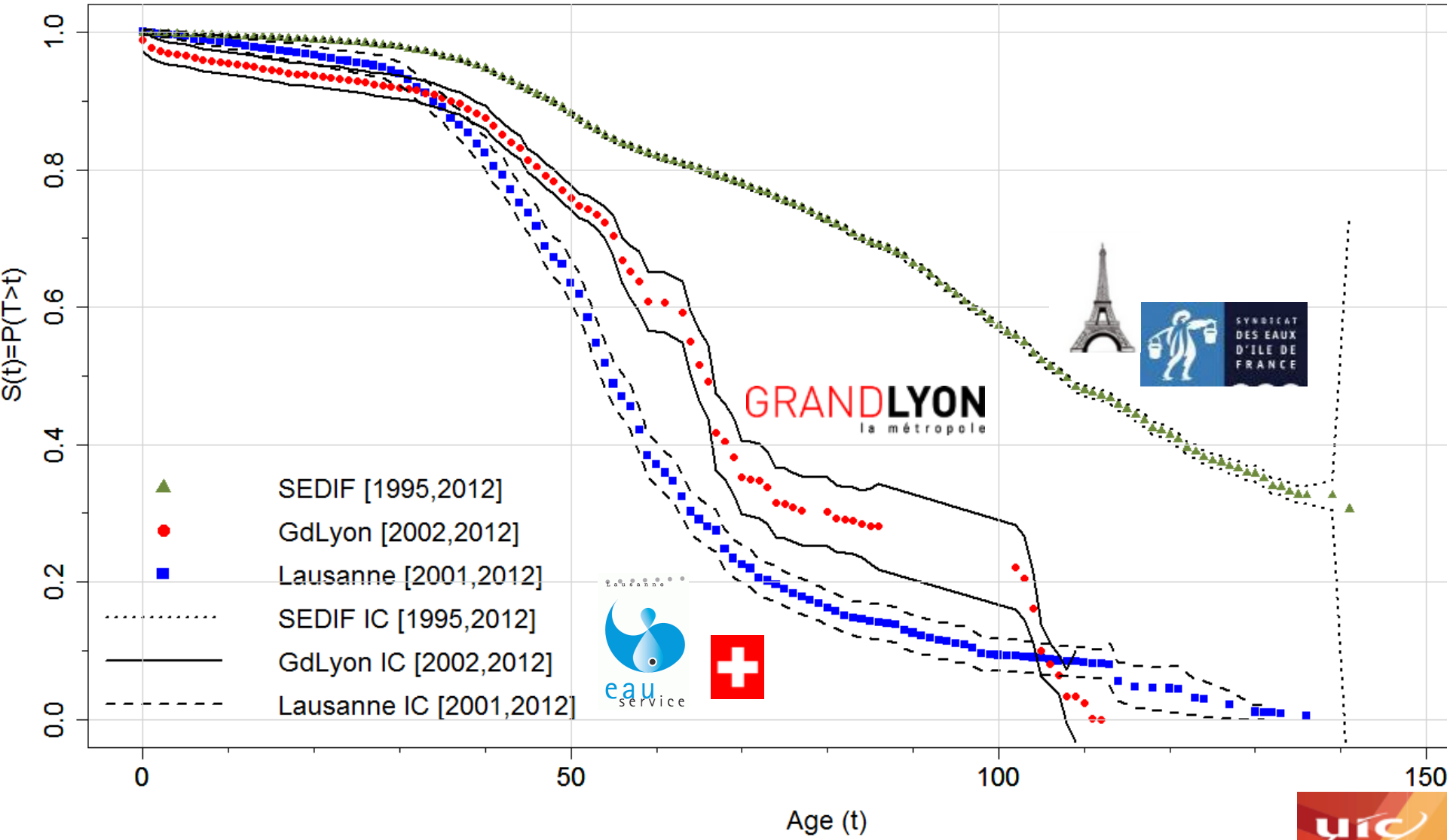

Decommissioned length



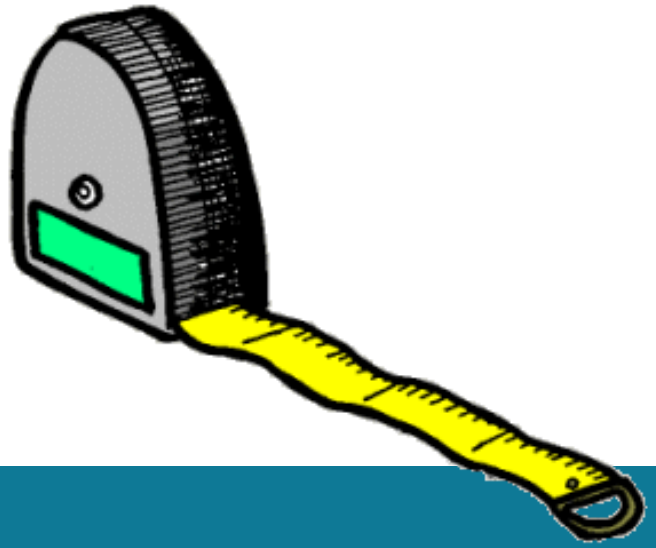

# Past real survival curves, in linear

Output

## T : decommissioning age

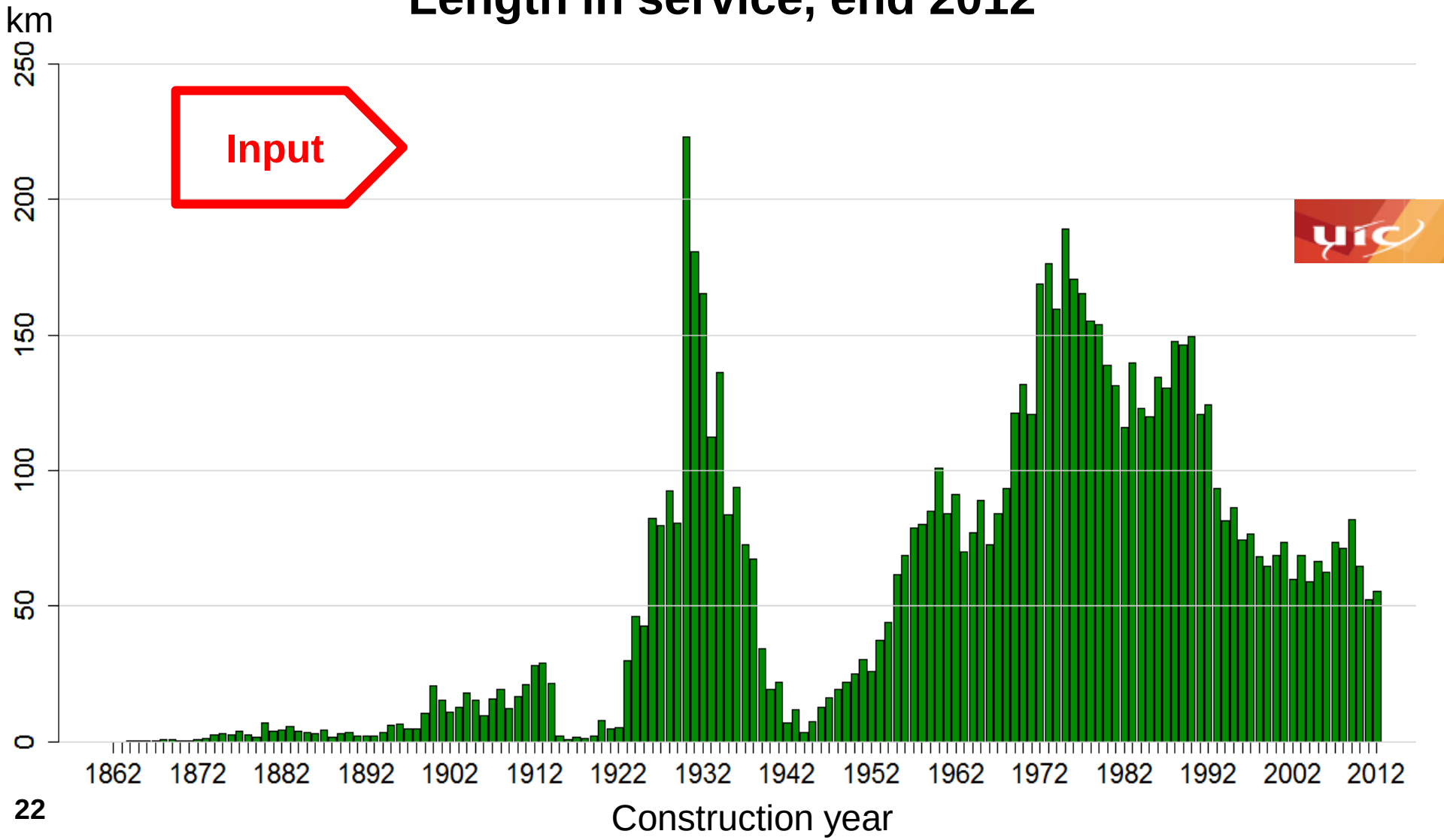


# V.1 Focus on indicator "I1R": length to be renewed

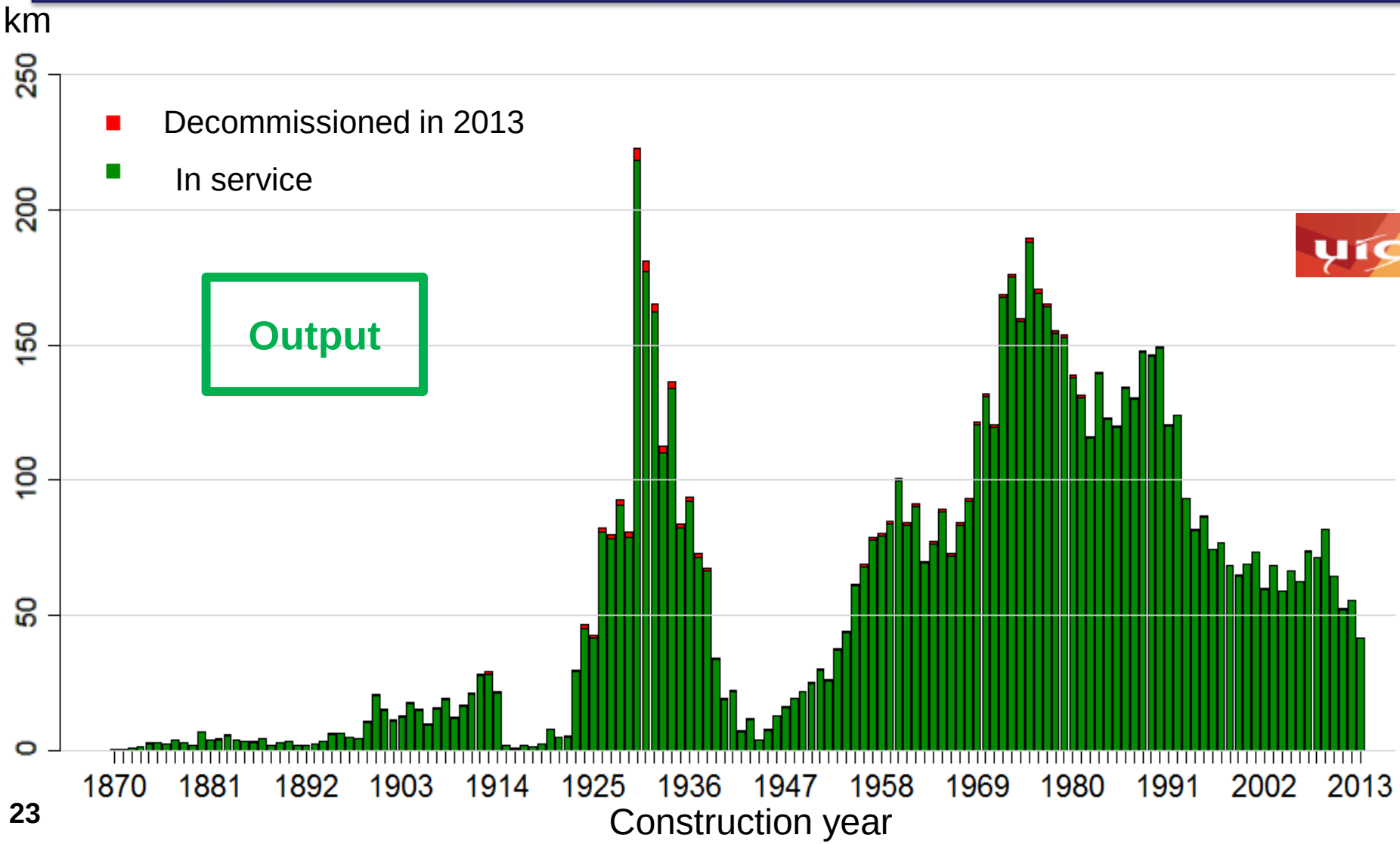
# Scenario 1: Status quo

## Length in service, end 2012



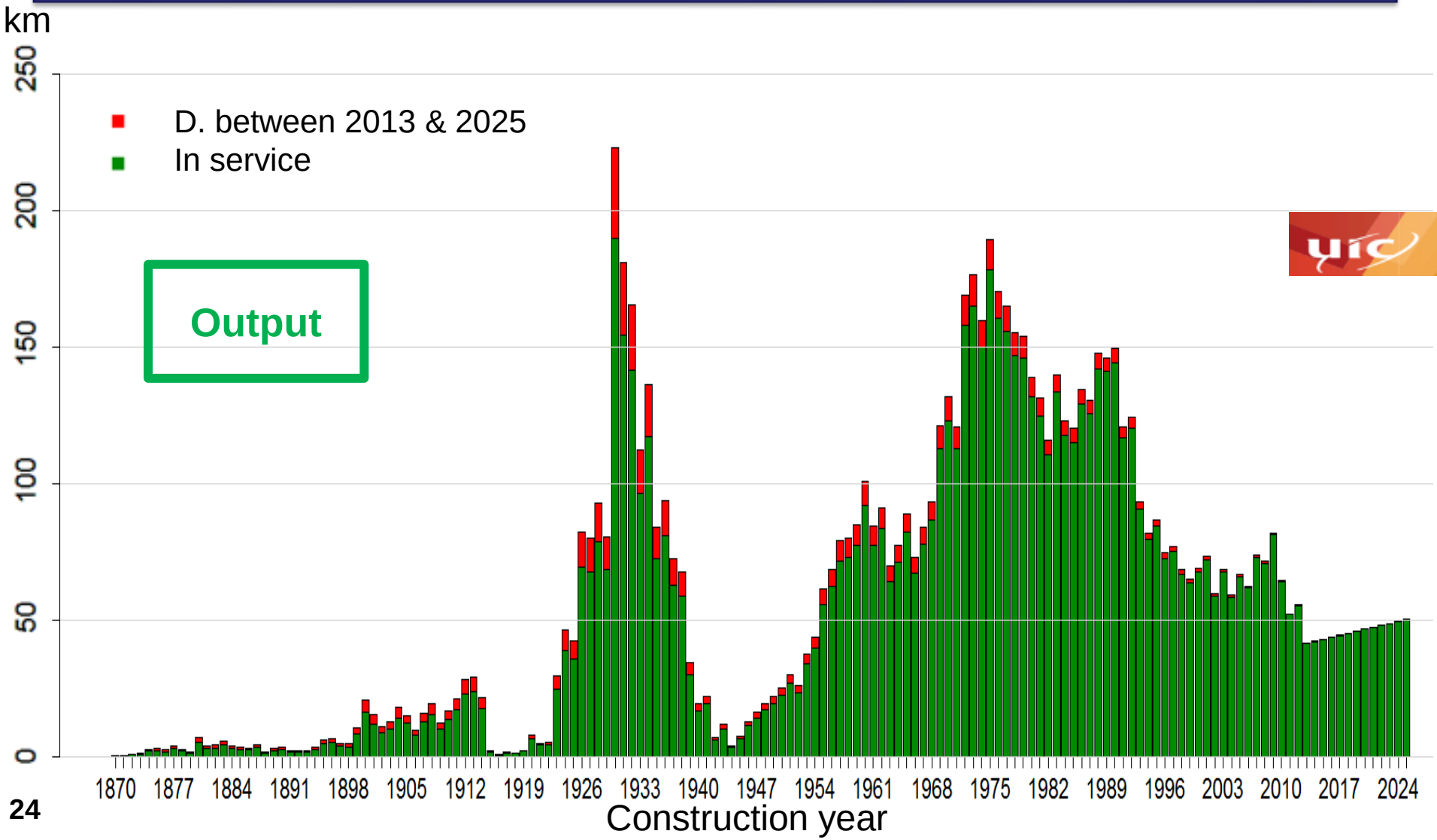
# Scenario 1: Status quo

- **Prediction until end 2013**



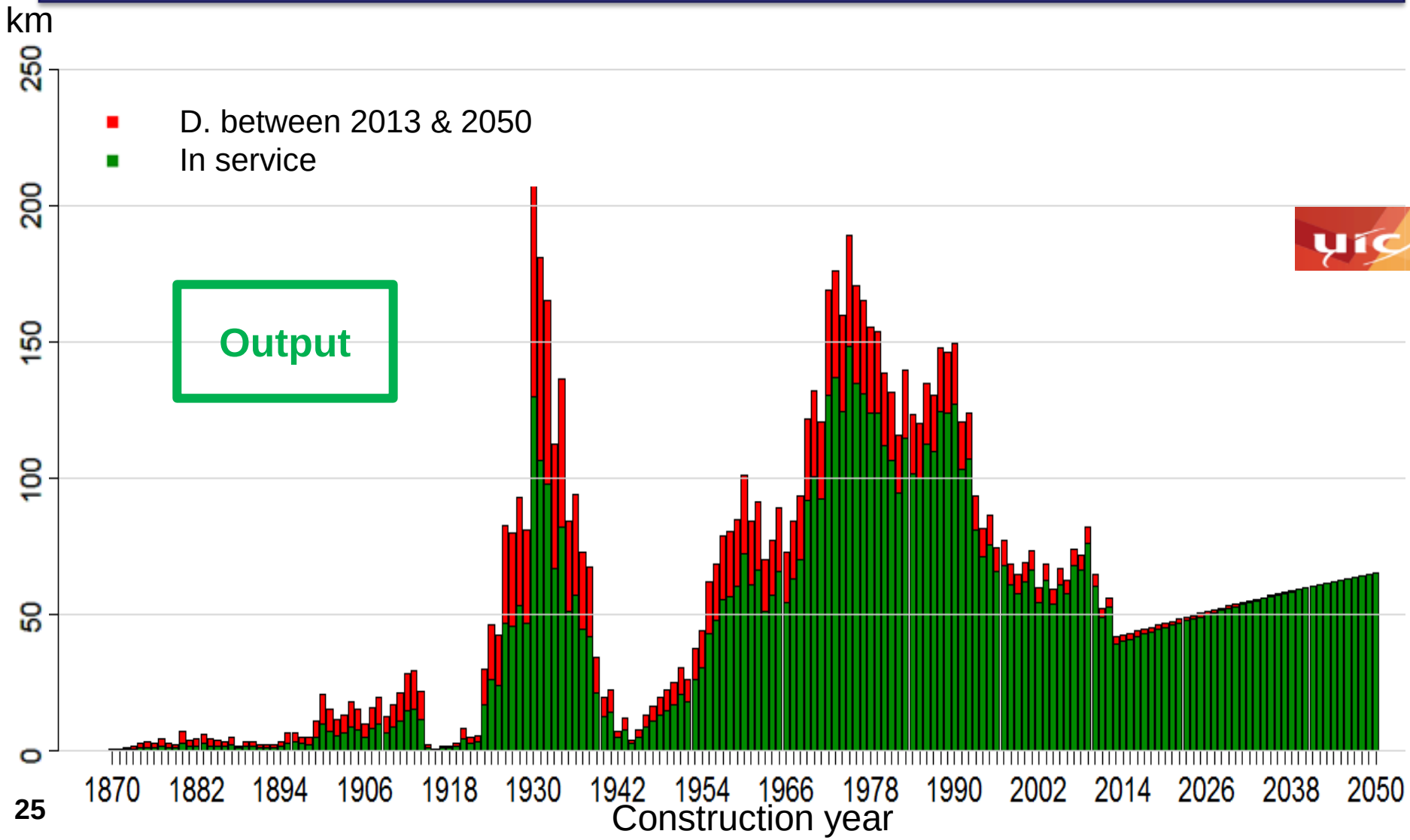
# Scenario 1: Status quo

- **Prediction until 2025**



# Scenario 1: Status quo

- **Prediction until 2050**



# V.2 Focus on indicator "I1P": number of breaks

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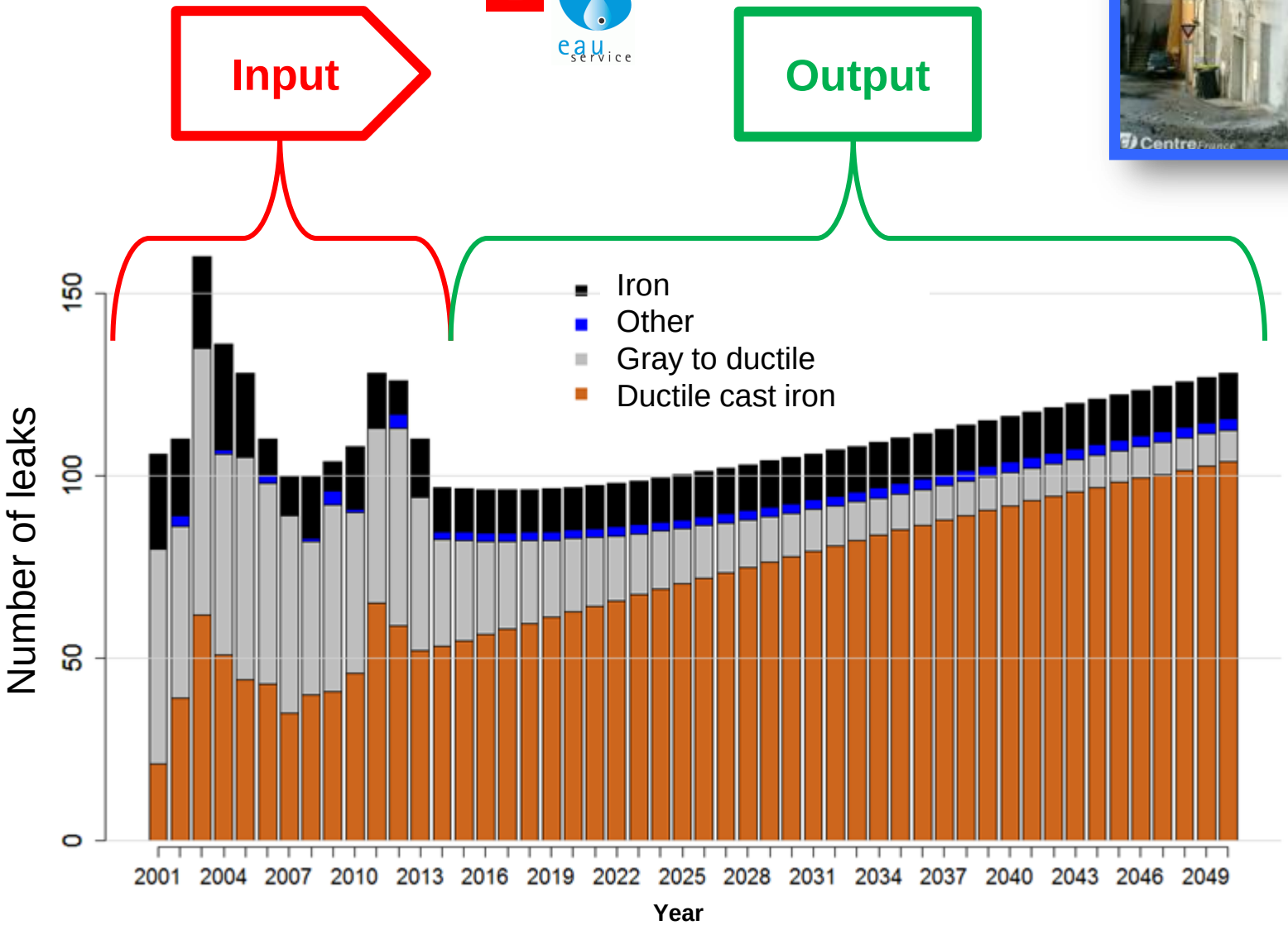
# I1P: Number of future leaks

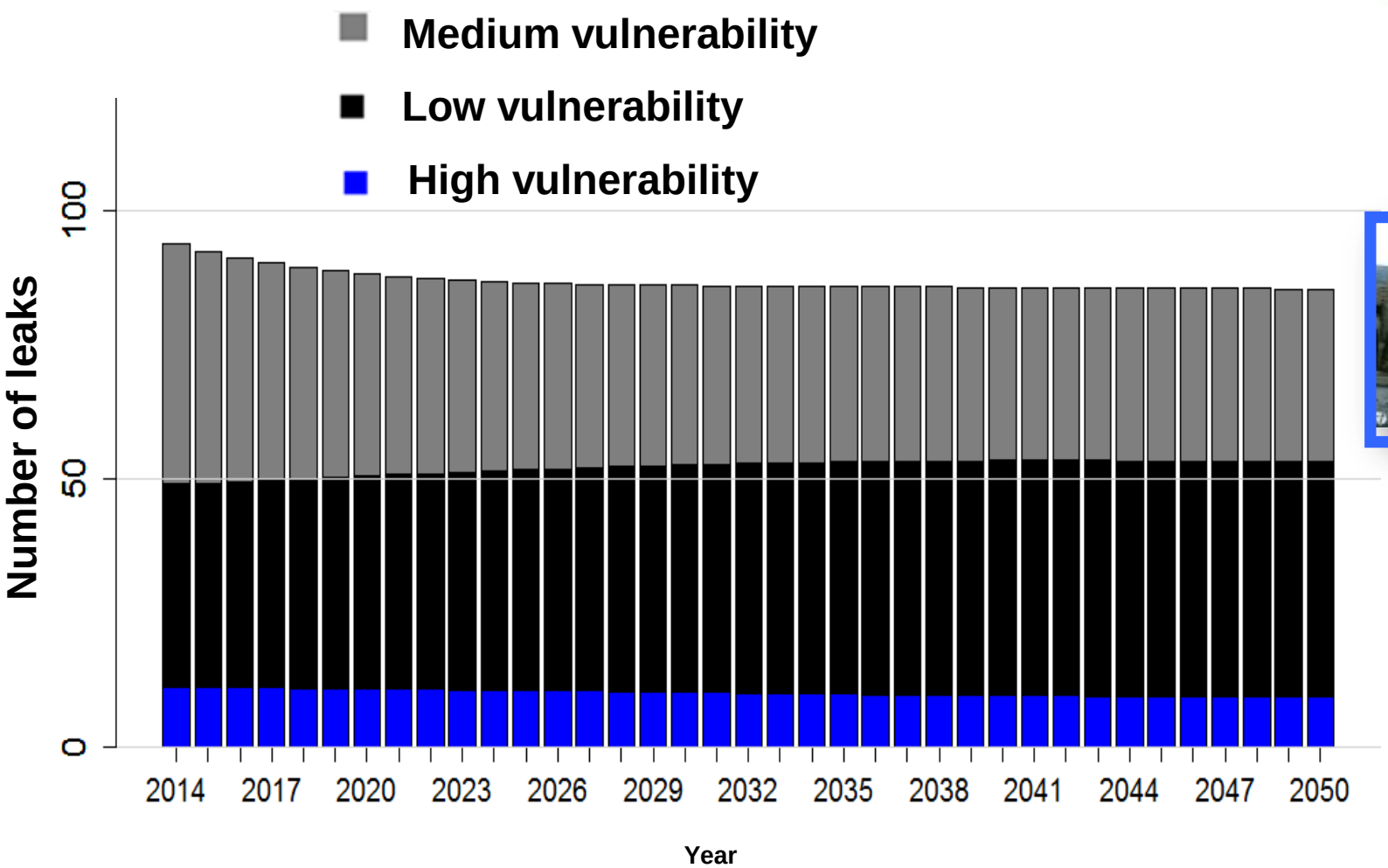



Scenario A : Status quo

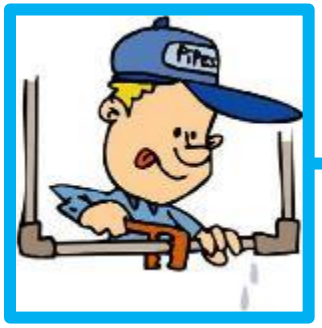
# I1P Lausanne

**Output**

## Scenario B : More drastic around vulnerable clients




# V.3 Focus on I3P: Risk of traffic disruption induced by a leak




Putting your assets on the right track

# I3P: Risk of traffic disruption induced by a leak

**Hazard**  **x** **Vulnerable element**  **=** **Damage** 

Probability ?

Intensity ?

Quantity ?

Sensitivity ?

Value ?

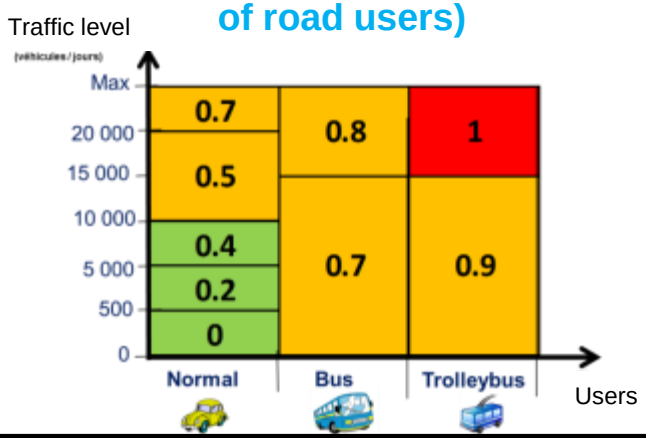
Probability ?

Gravity ?


$$Nb\ leaks \times Rt \times S = traffic\ risk$$

| ***Rt*** *(repair time)* | | |
|---|---|---|
| *Rt* (hours) | Materials | Diameter (mm) |
| 3 | Ductile cast iron, Plastic | $\phi < 250$ |
| 4 | Ductile cast iron, Plastic | $\phi \geq 250$ |
| 6 | Grey cast iron, Asbestos | $\phi < 250$ |
| 8 | Grey cast iron, Asbestos | $\phi \geq 250$ |

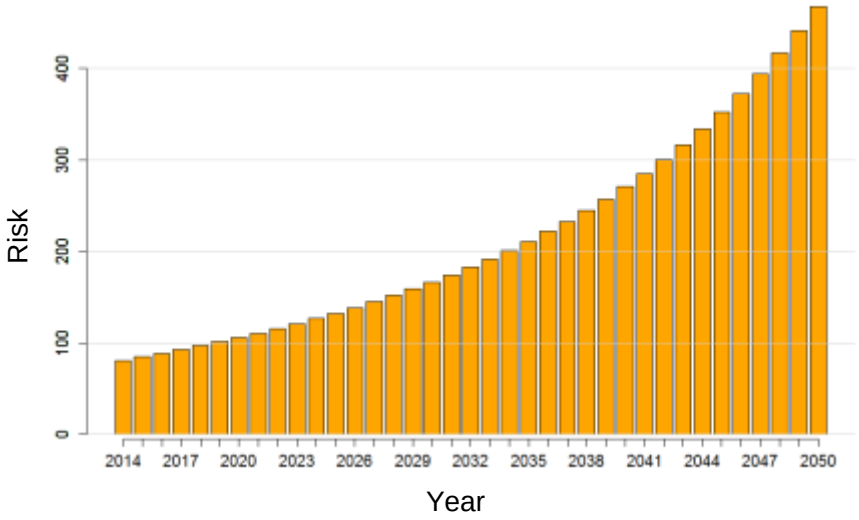
***S*** **(Sensibility of road users)**



Output

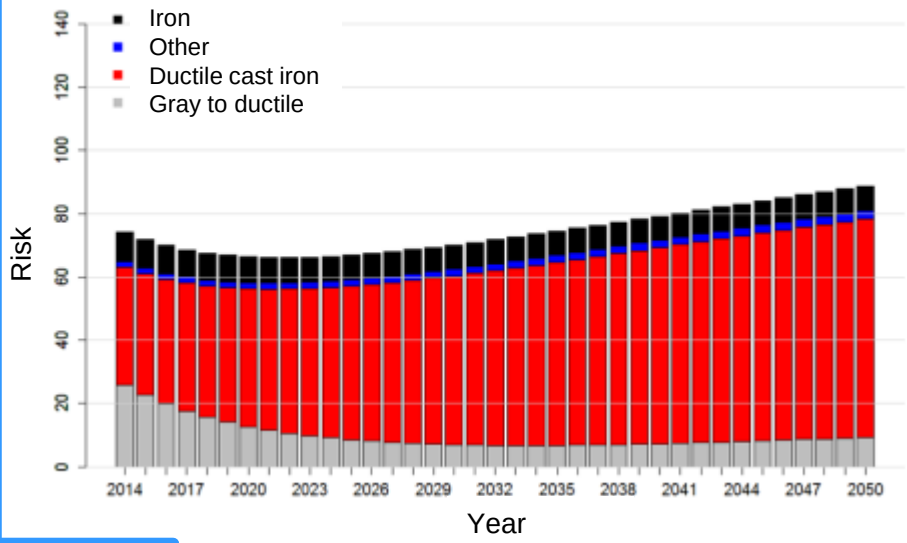
# I3P: Evolution of traffic disruption risk

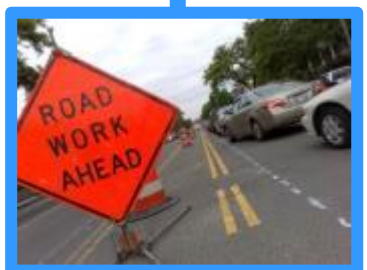
## Scenario 1: We stop renewing the network




All network, no stratification

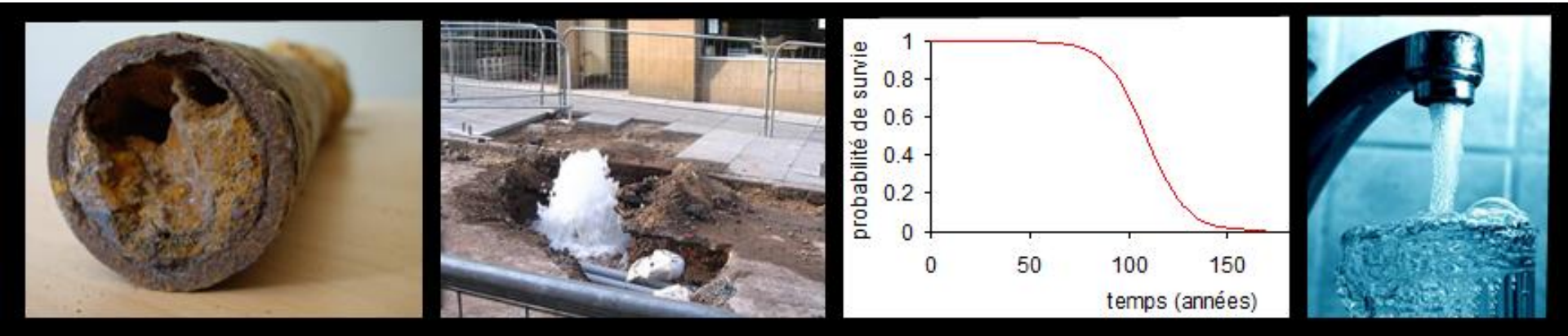
## Scenario 2 : We renew grey cast iron earlier in the future than in the past




Stratification of the network by materials

# VI. Conclusion



# Conclusion

- **Advantages and innovations in the OPTIMEAU model**
  - **Using the survival curve, long-term planning indicators can be linked together and connected to past decisions.**
  - **Perfomance indicators (risk, failures) are based on reliable statistico-probabilistic models**

- **Perspectives**
  - **Currently in the scenario with changes : empirical “trial and error” method => future mathematical optimization**


Thank you for your attention!