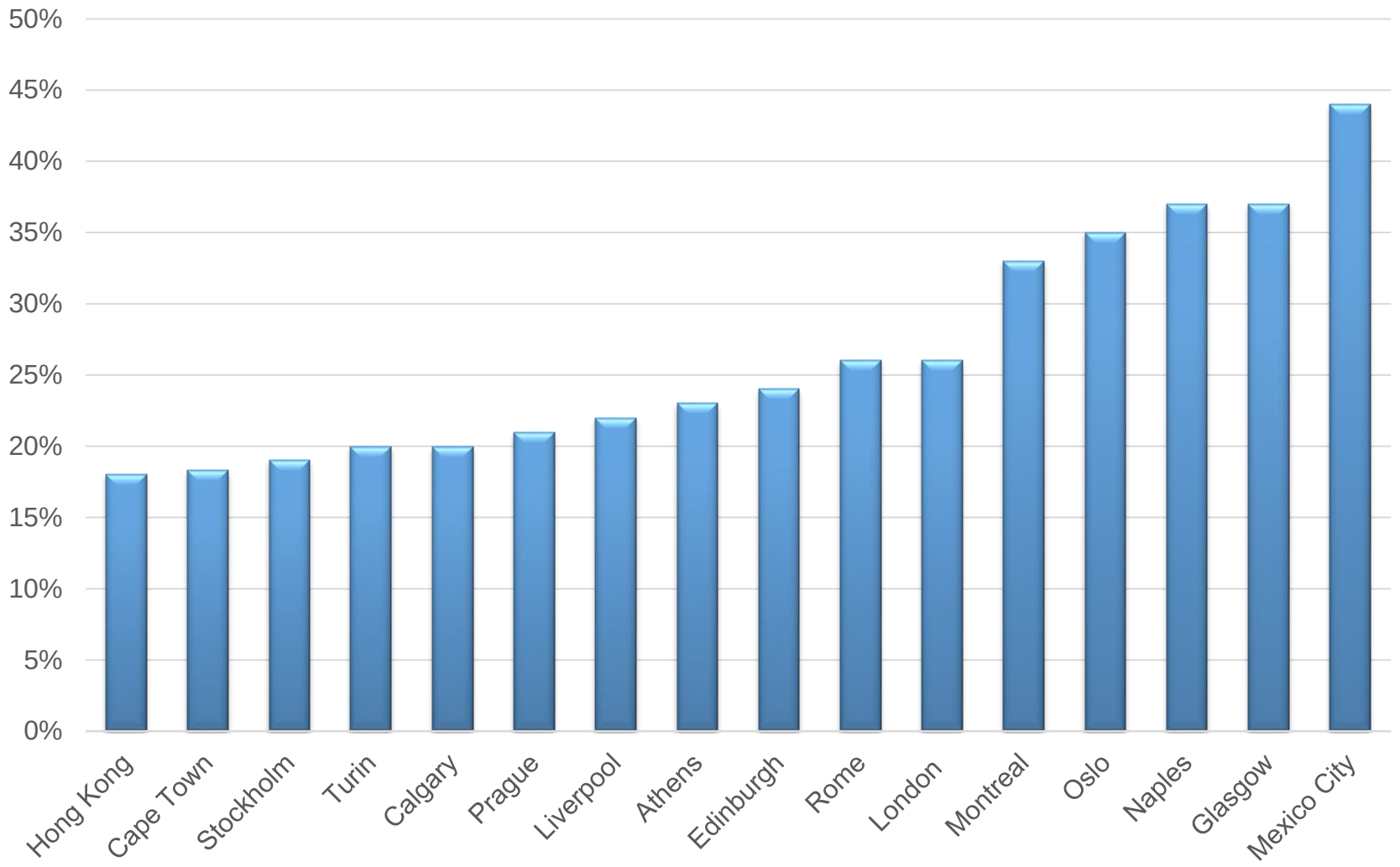

A Workable, Lasting Solution
for Water Losses through
Leaking Water Pipes

Introduction

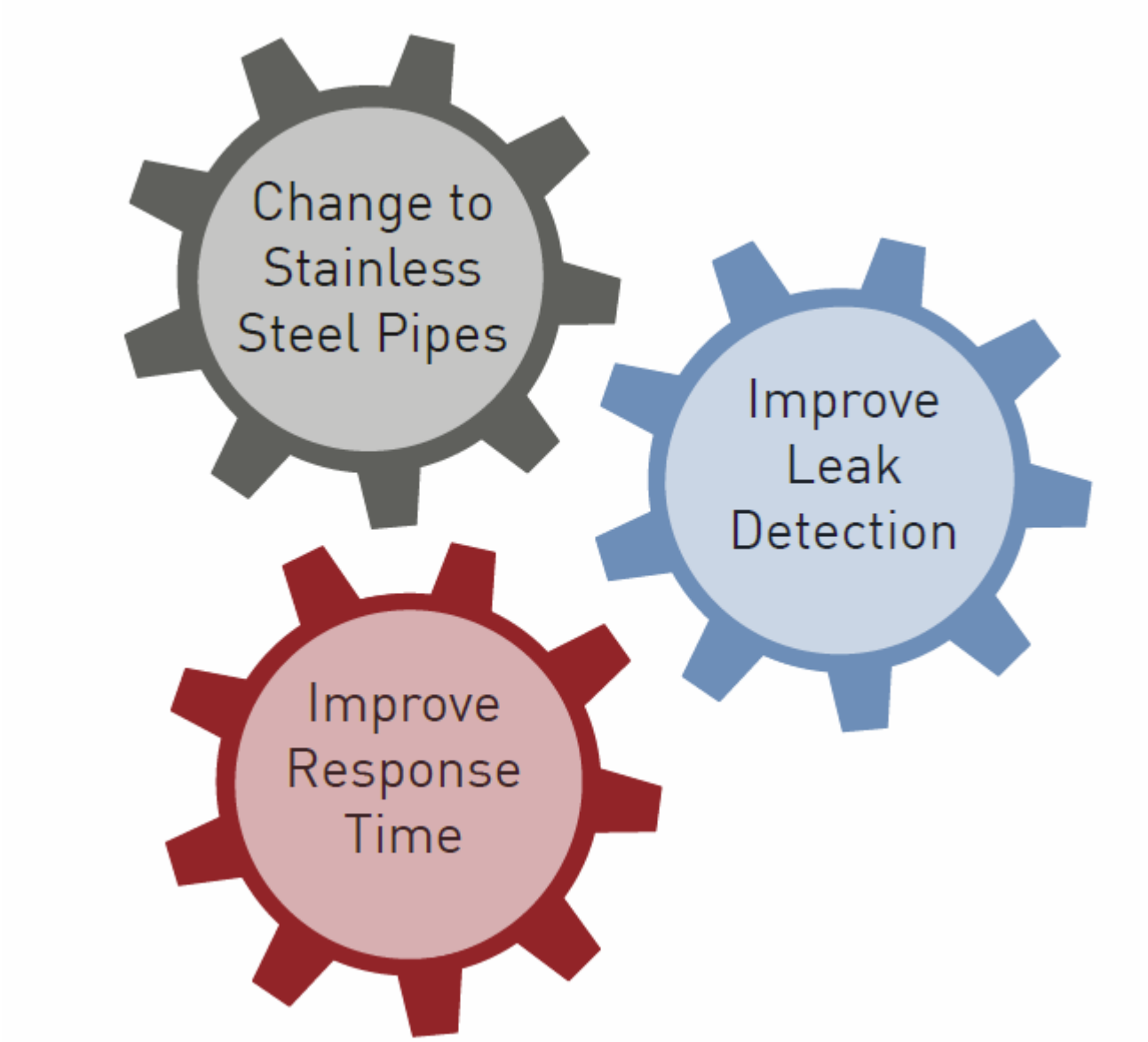
- Water is a valuable resource
- Leaking water pipes are a serious problem
- Together with the Nickel and Molybdenum industries, the ISSF has developed a Real-Life Case Study with a long term solution.
- The start-up costs are higher than for alternative solutions, but the extended useful life gives a lower Life Cycle Cost
- The longer useful life means fewer road works and fewer traffic disruptions

Leakage Rates in Major Cities



* Source : OECD (Water Governance In Cities, 2014)

Managing Leaking Pipes



Managing Leaking Pipes

The Advantage of Stainless Steel

Material Benefits

- Corrosion resistance
- Hygienic
- Long Life

Environmental Benefits

- 100% recyclable
- Lower CO_2 emissions

Economic Benefits

- Lower life cycle cost

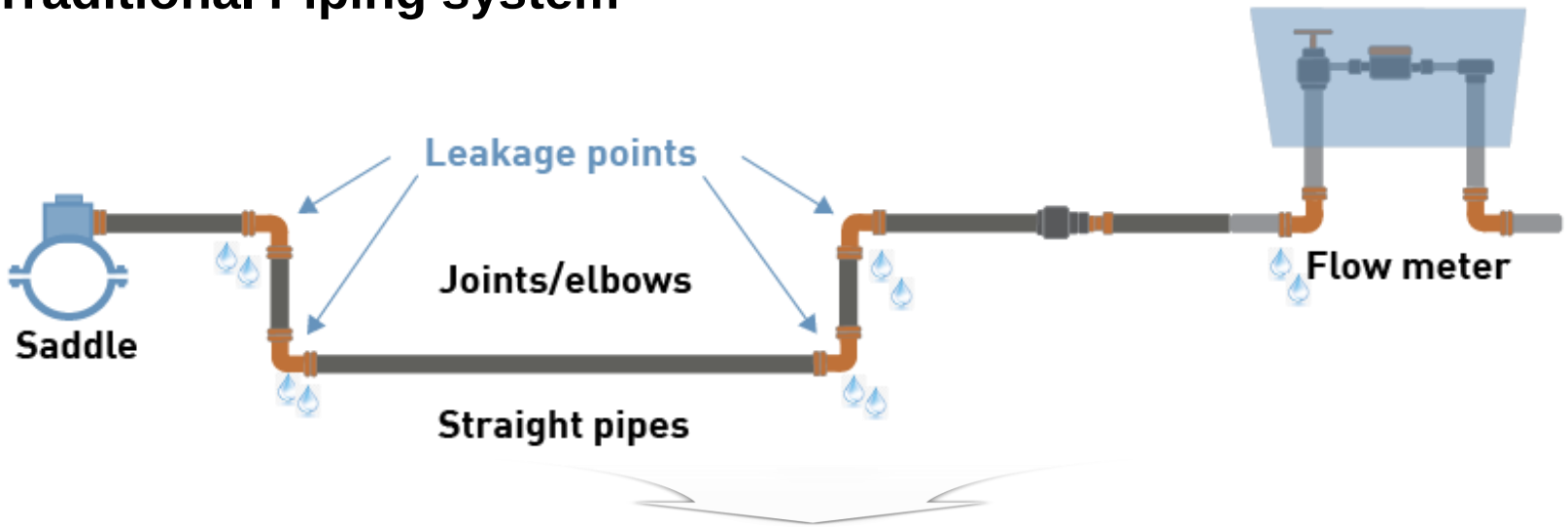
	Life Cycle Cost
Stainless Steel	$1,932
Competing Material	$3,321
Competing Material	$3,279

* For 100 years service life

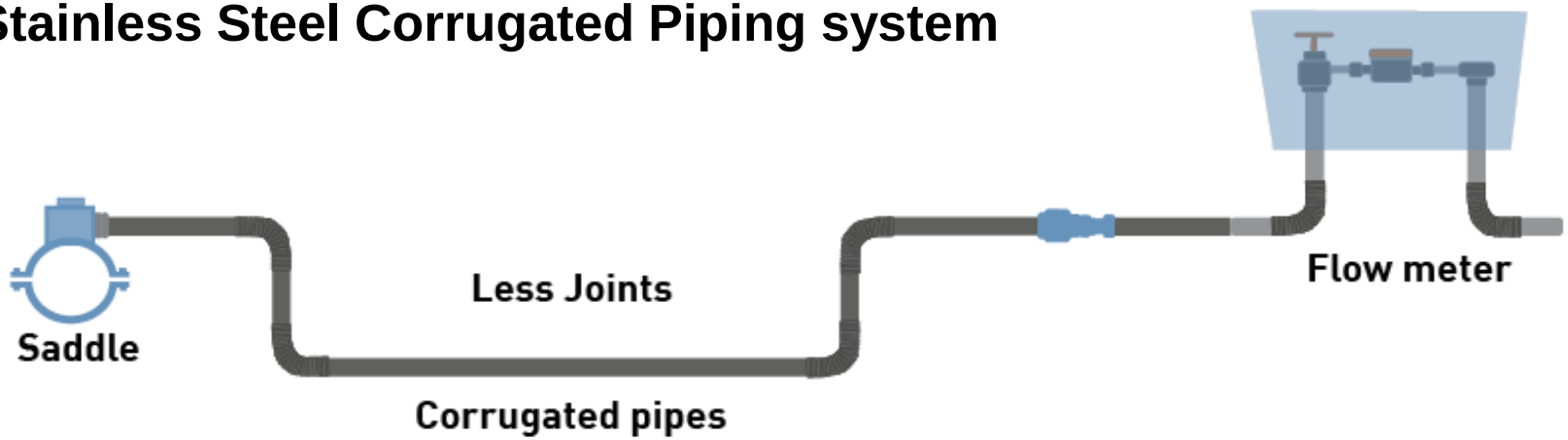
Managing Leaking Pipes

Fewer joints, improved workability and resistant to shocks

Traditional Piping system

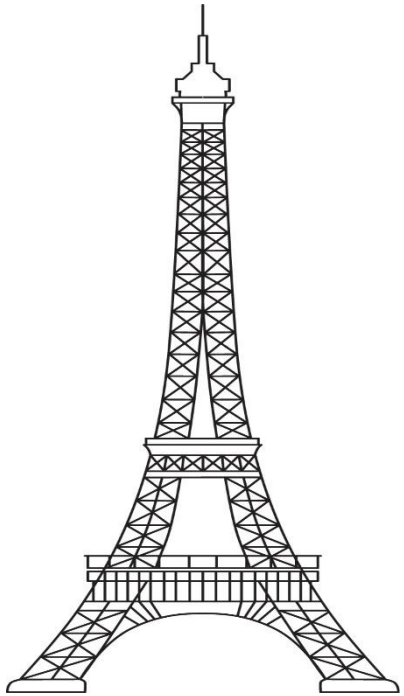


Stainless Steel Corrugated Piping system



Life Cycle Cost

The Eiffel Tower



- Built in 1889
- 7,300 tons of carbon steel
- Repainted every seven years.
- Repainting takes 18 months, 25 painters and 60 tons of paint
- If it had been built using stainless steel, the only maintenance would have been occasional cleaning with household cleaners.
- Observe the “as-new” condition of the stainless steel roof on the Chrysler Building in New York, in place for 88 years and cleaned only three times
- Despite the higher initial cost, stainless steel saves money by reducing repairs and maintenance and avoiding the road works which cause traffic disruptions

Life Cycle Cost Analysis

Formula

All Costs at Present Value Before Addition:											
Total Life Cycle cost		Initial Materials Acquisition Costs		Initial Materials Installation & Fabrication Costs		Operating & Maintenance Costs		Lost Production Costs during Downtime		Replacement Materials Costs	
LCC	=	**AC**	+	**IC**	+	$\sum_{n=1}^{N} \frac{OC}{(1+i)^n}$	+	$\sum_{n=1}^{N} \frac{LP}{(1+i)^n}$	+	$\sum_{n=1}^{N} \frac{RC}{(1+i)^n}$	

Where: N= Actual service life, i= Real interest rate, n= Year of the event

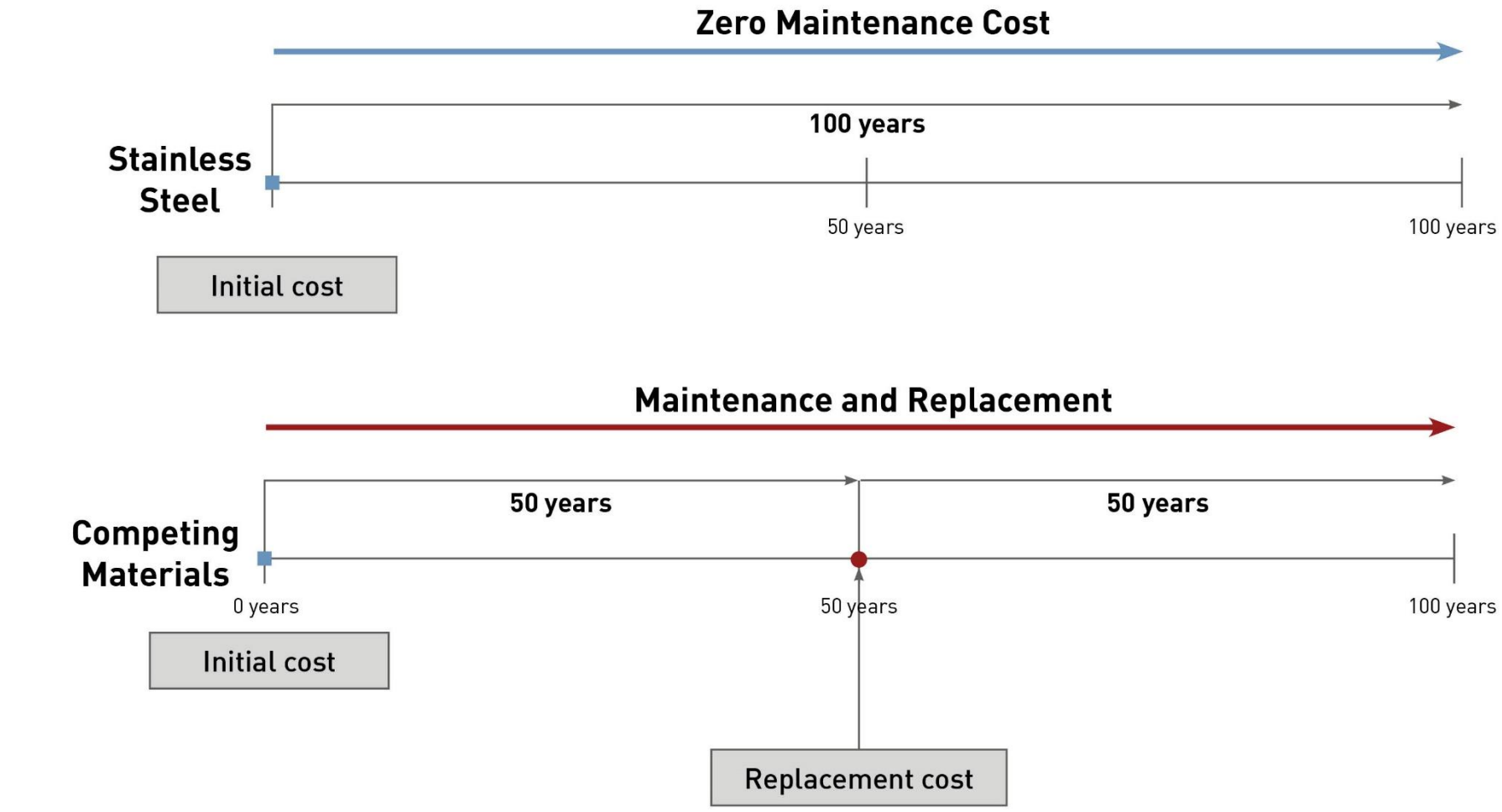
Assumptions

4 meter long (20ϕ) service pipes with 100 year life span
Service pipes connect water mains to consumer water meters, including joints, elbows, T-joints and valves.

Life Cycle Cost Analysis

Cost Diagram for each material

Cost diagram for each material

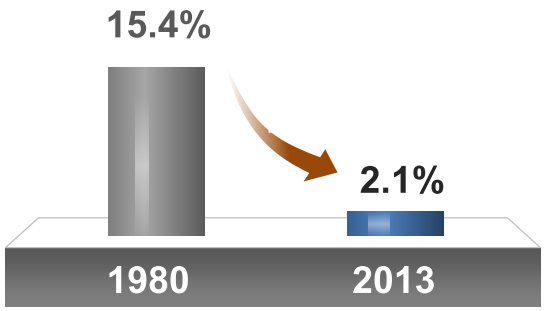


Previous Successes

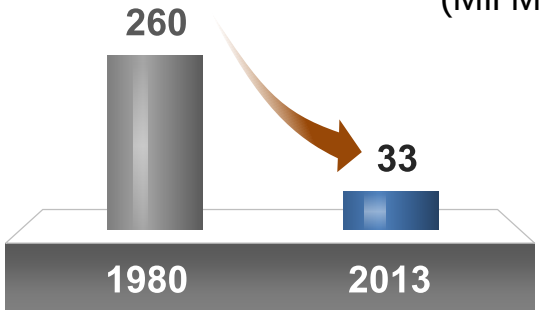
Leakage rate

Leakage Volume

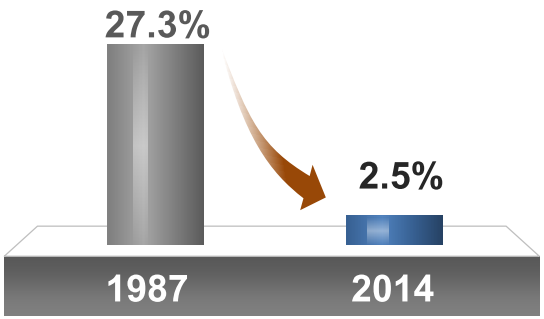
Tokyo



(Mil M^3)



Seoul



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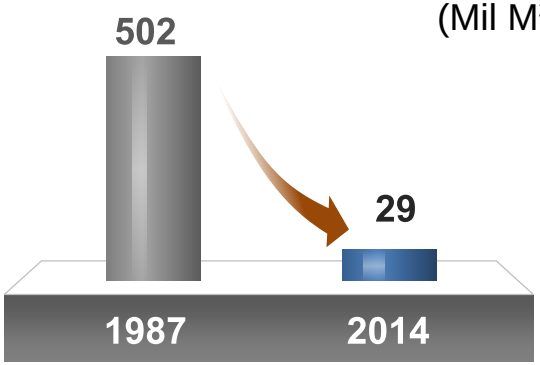


Tokyo

Underground Tests

- Tokyo tested carbon steel, copper, lead and grades 304 and 316 stainless steel, burying them at 10 sites, for 10 years
- Tokyo has high concentrations of Cl^- and SO_4^2, and requires a strong resistance to corrosion
- Stainless steel performed best for corrosion resistance and 316 outperformed 304

1. Kushiro city, test No. H; after acid pickling

2. Kuwana city, test No. P; after acid pickling

Tokyo

- Tested corrugated stainless steel pipes from 1991 to 1998 and introduced them from 1998
- They first used bronze fittings but discovered corrosion at the joints. They changed to stainless steel fittings
- Stainless steel pipes reduced the number of leaks; reduced maintenance; improved water quality; and demonstrated a resistance to seismic activity, thus assuring fewer injuries and continuous water supply
- No evidence of chemical residues inside the pipes

Tokyo

Corrugated Stainless Steel Pipes

- Most leaks were found at joints
- Corrugated pipes could be bent on-site thereby improving handling and reducing joints
- They could remain flexible after installation, providing resistance to seismic shocks

Tokyo

Proven Resistance to Seismic Shocks

Inspections after the 9.0 earthquake in 2011 revealed that less than 5% of the stainless steel water pipes had been damaged. That was one of the strongest earthquakes ever recorded.

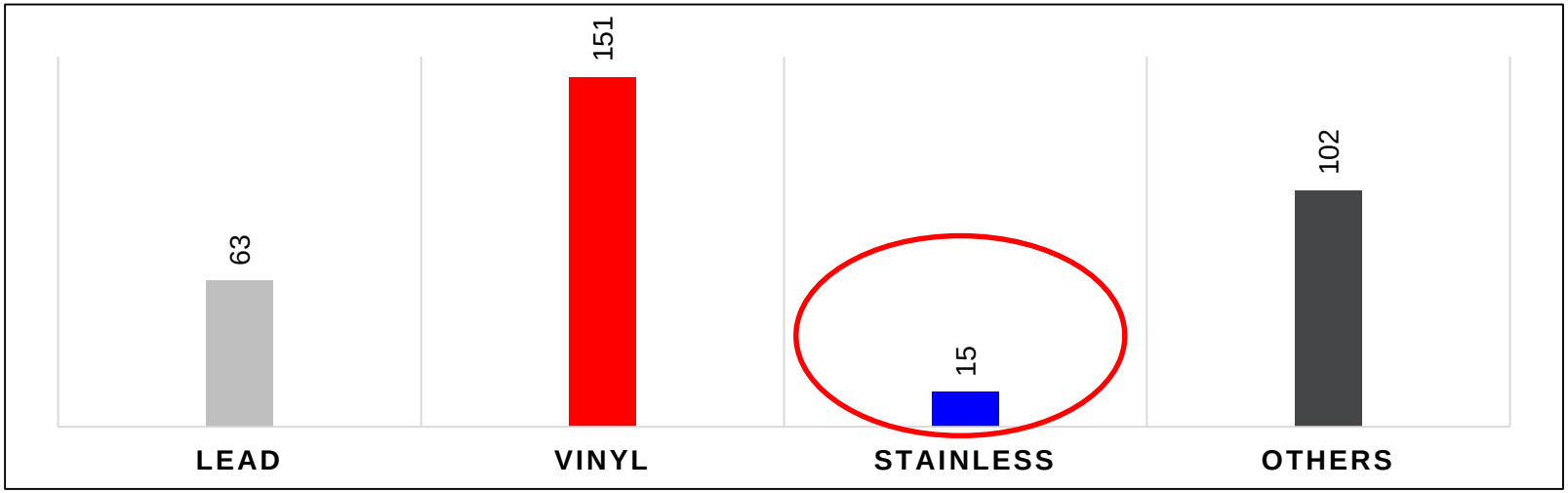
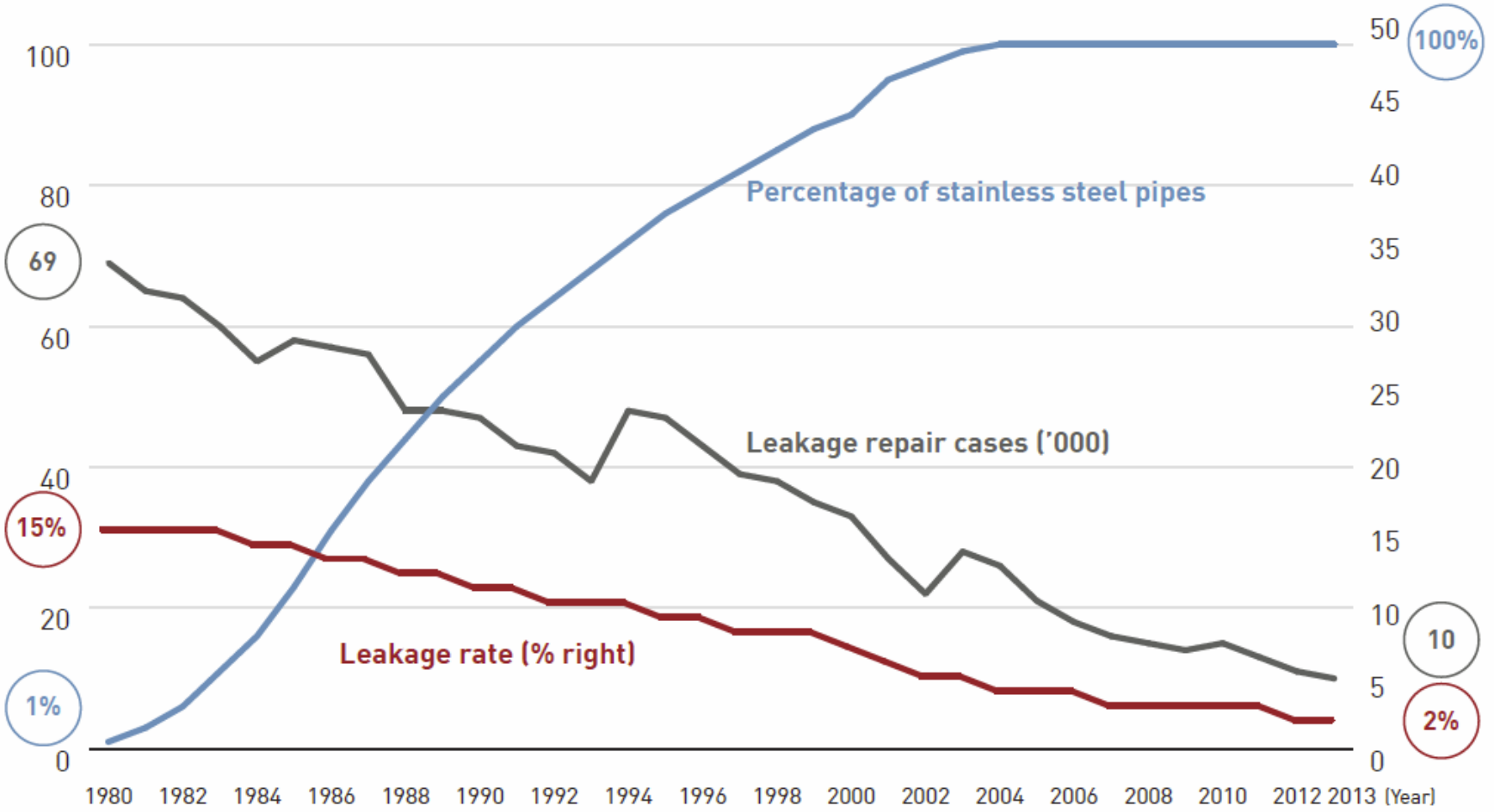


Fig. Number of Damages per pipe materials in 2011 Great Earthquake

Tokyo

Reducing Leaks

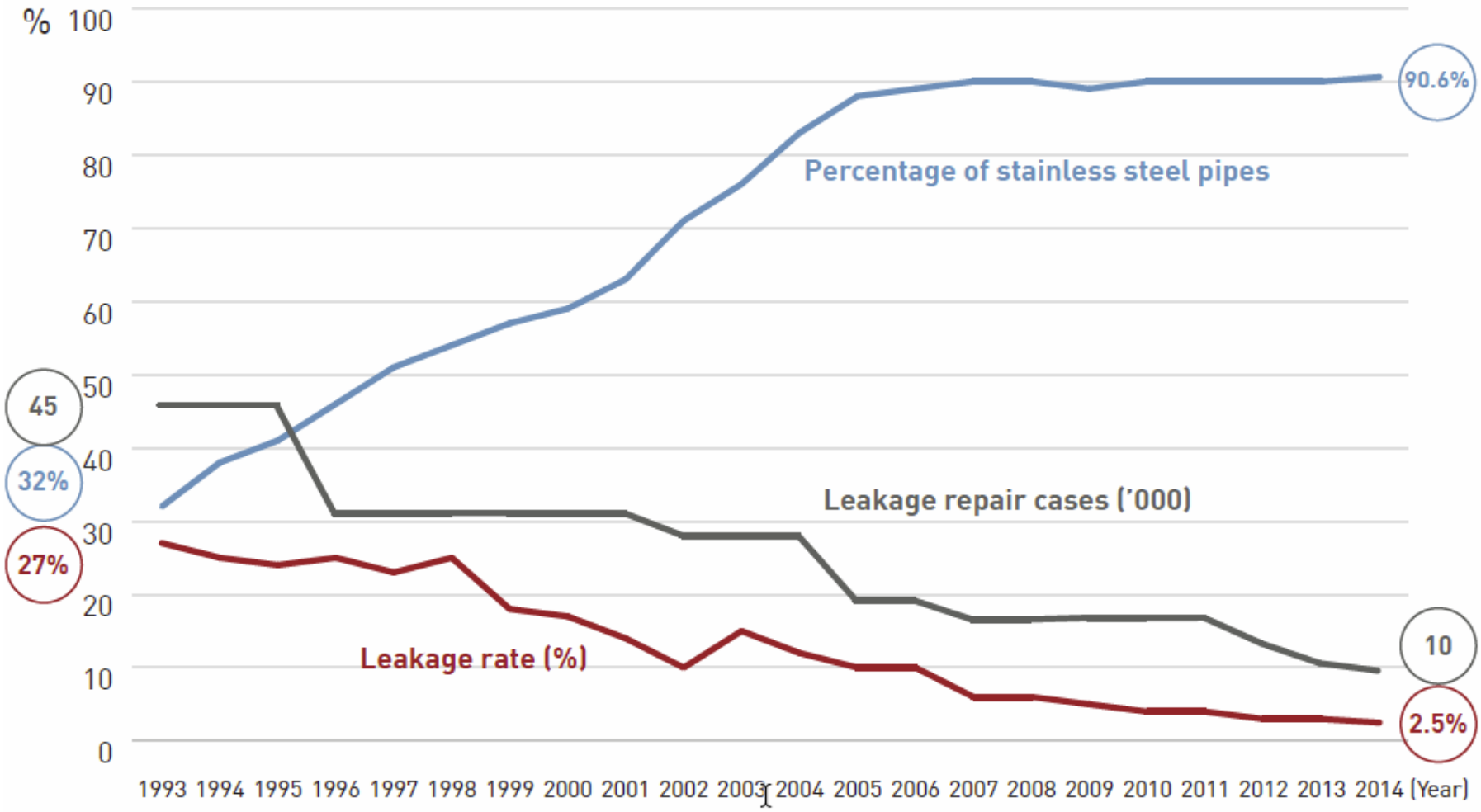


Seoul

- Seoul reduced water treatment by 40%, which provided a significant cost saving. The number of treatment plants was reduced from 10 to 6.
- Water losses fell from 27% to 2.5%
- Repairs reduced from 60,000 per year to 10,000
- Water treatment fell from 7.3 million cm3 per day to 4.5 million cm3
- Seoul considered alternative materials, but their tests showed that stainless steel provides a better solution
- They specified 304 stainless steel, because their soils are less aggressive than those in Tokyo

Seoul

Reduction of Leaks



Thank you for you attention!

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