Statistical analysis of spills from Western European cross-country oil pipelines 1971-2020

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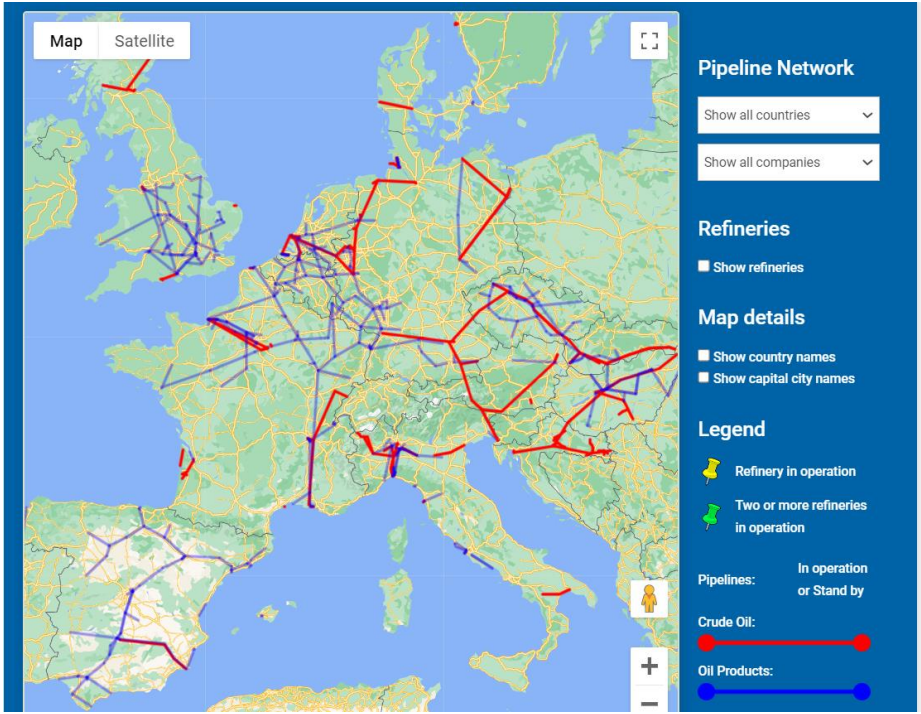
Content

01 The “Concawe” Network

An interactive map of the network is available on the Concawe website

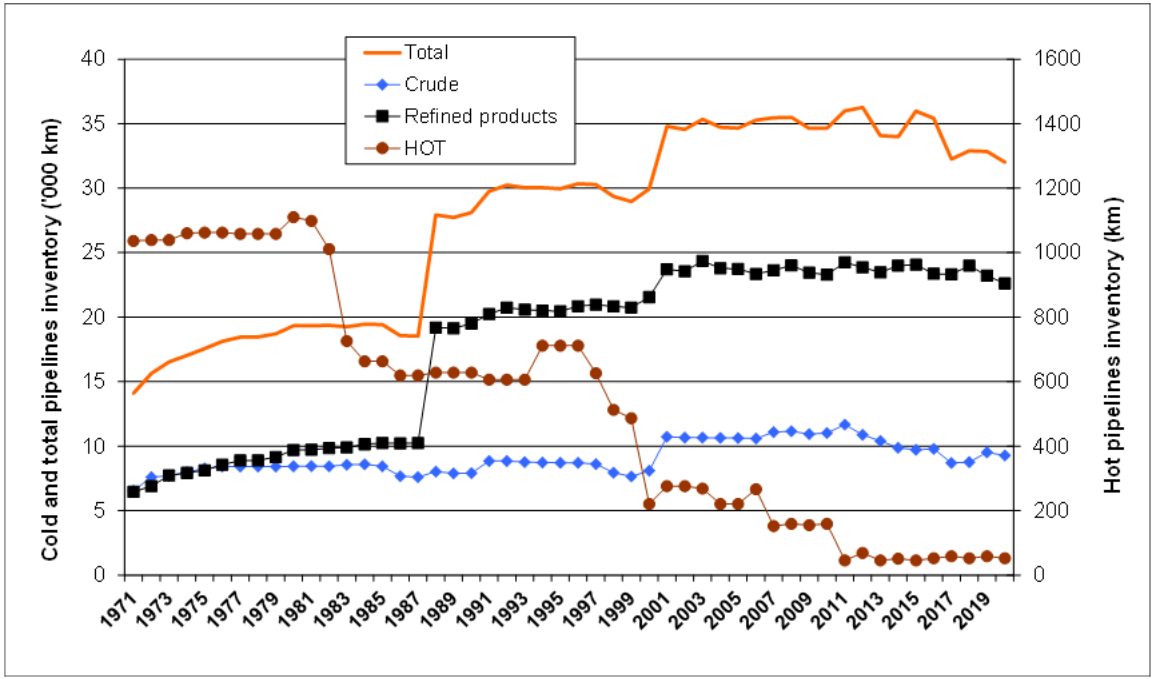


The “Concawe” network by service and over time

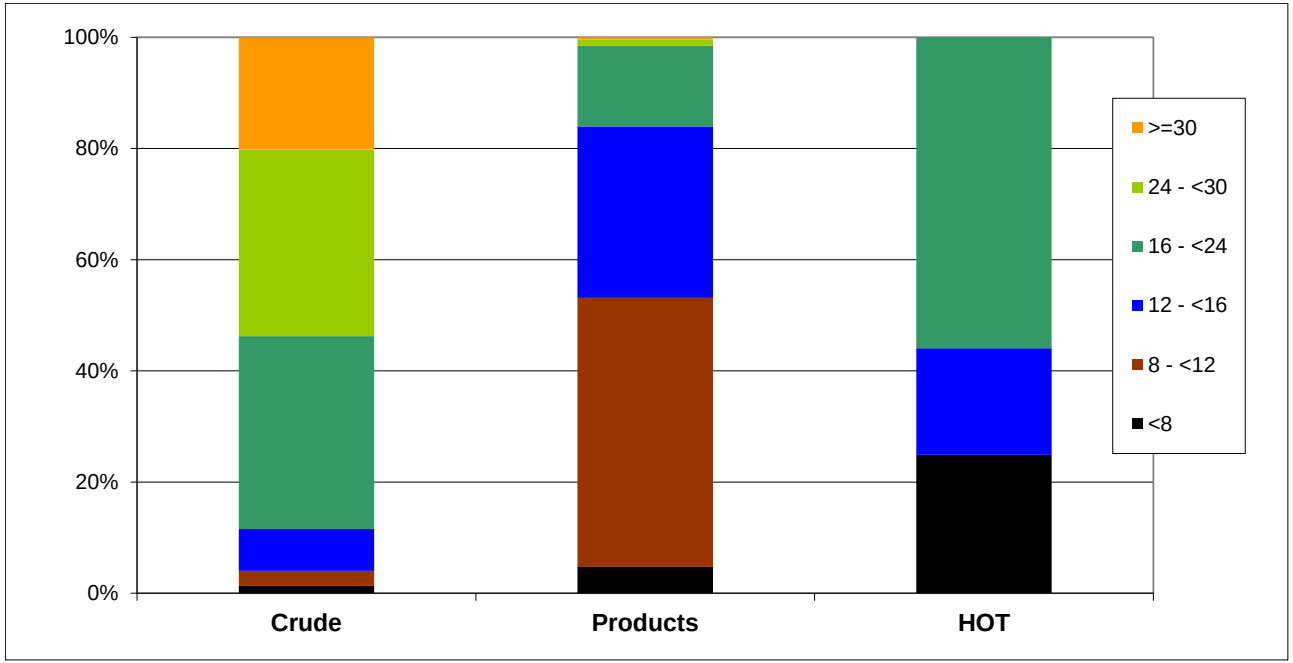
- The inventory has increased over the years (mostly product lines) as more operators joined (NATO, former Eastern bloc)
- The vast majority of pipelines are “cold” (unheated)
- “Hot” pipelines have virtually all been retired

Today:

- 72 operators
- Over 35,000 km
- 162 pipeline systems split into 674 active sections
- Over 300 m^3 of both crude and product transported annually

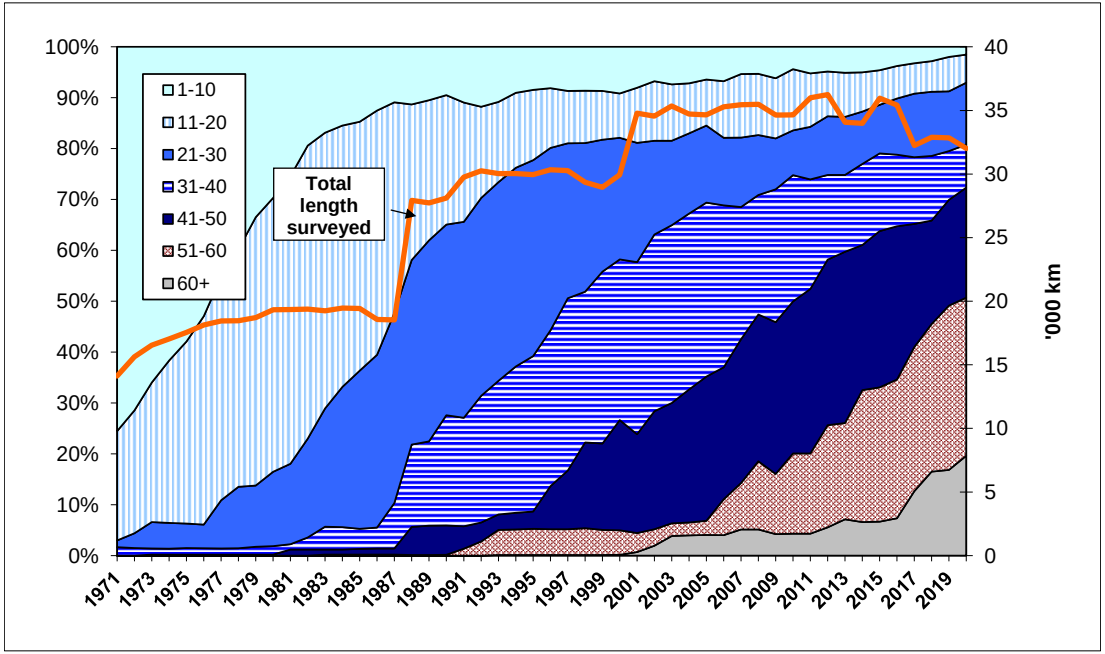


The “Concawe” network: Diameter distribution



- Crude lines tend to be larger than product lines

The “Concawe” network: Age distribution



- **The average age of the inventory has steadily increased over the years**
  - In 1971 nearly all pipelines were 20 years old or less
  - In 2020 nearly 80% of all pipelines were 40 years old or more

02 Safety record

Safety record (in relation to spillage incidents)

- No fatality, injury or fire reported since COPEX 2016
- 3 injuries reported since 1971
  - Last recorded injury was in 2006
- 14 fatalities in 46 years, none involving members of the public
  - Last recorded fatality was in 1999 (1 fatality)
- 9 fires in 46 years
  - Last fire in 1999

03 Spillage statistics

Criteria for inclusion in the statistics

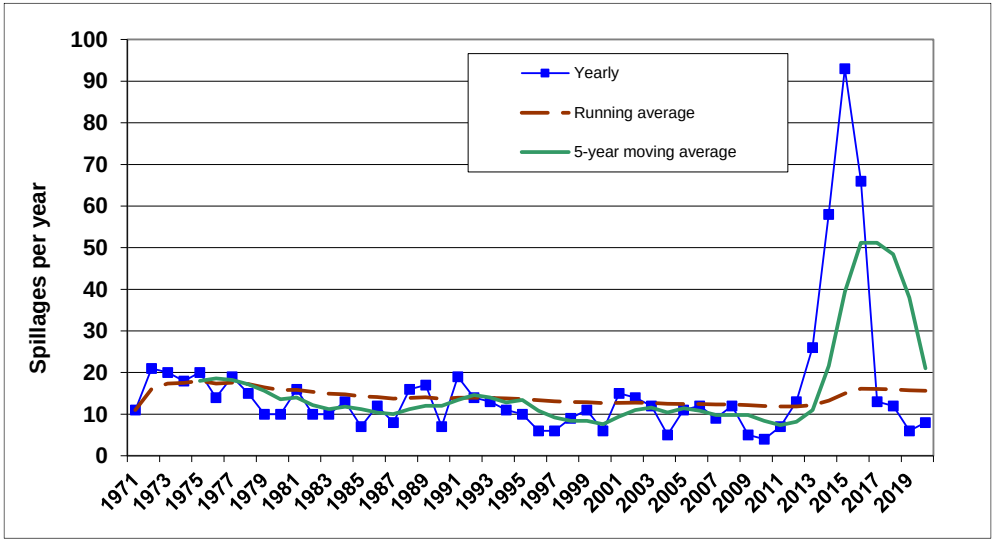
- Used for transporting crude oil or petroleum products
- >= 2 km in the public domain
- Running cross-country
  - including short estuary or river crossings
  - excluding under-sea and offshore systems
- Including pump stations, intermediate above-ground installations and intermediate storage facilities
- excluding origin and destination terminal facilities and tank farms

- Spill > 1 m^3 (unless in cases of exceptional safety or environmental consequences)

Spillage events

Since the beginning of the last decade, the game changer has been the very rapid increase of the number of product theft (successful or attempted), often resulting in a spill

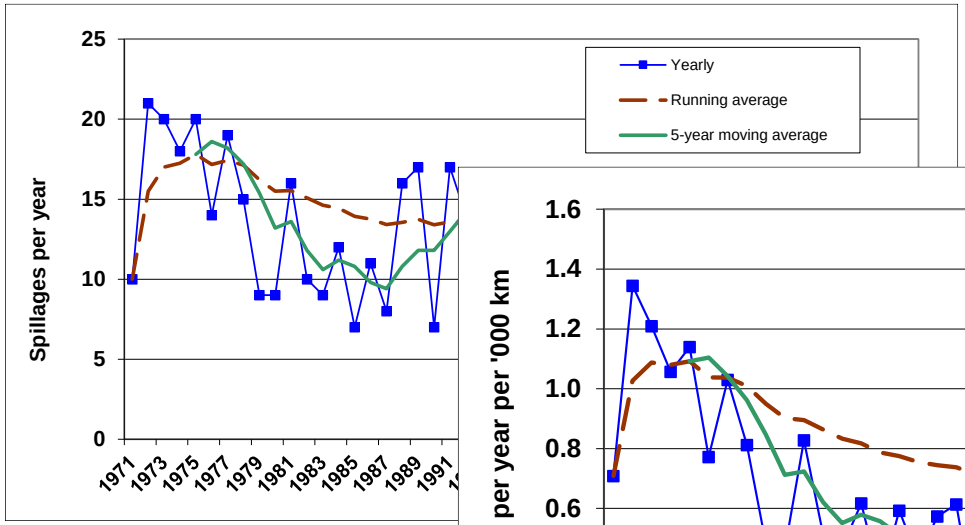
Number of spillages
Inc. theft



- **By 2020, out of a total of 780 spillage events, 272 were caused by theft or attempted theft of product**

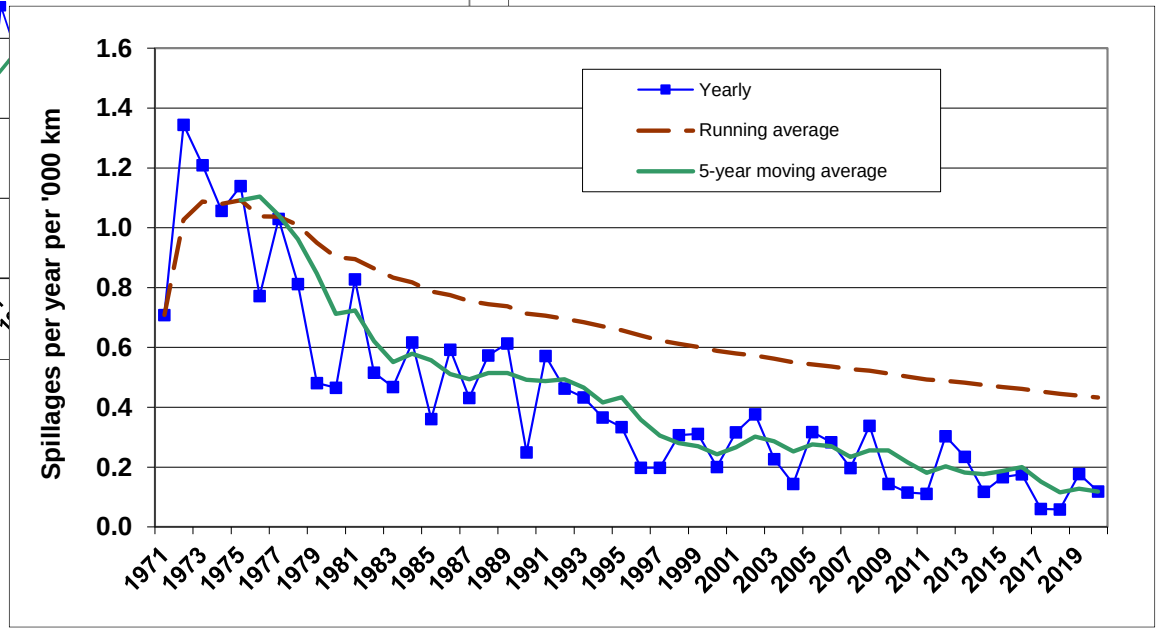
In order not to distort the long-term statistics
we account for these theft-related events separately

Spillage incidents (exc. Theft, all pipelines)



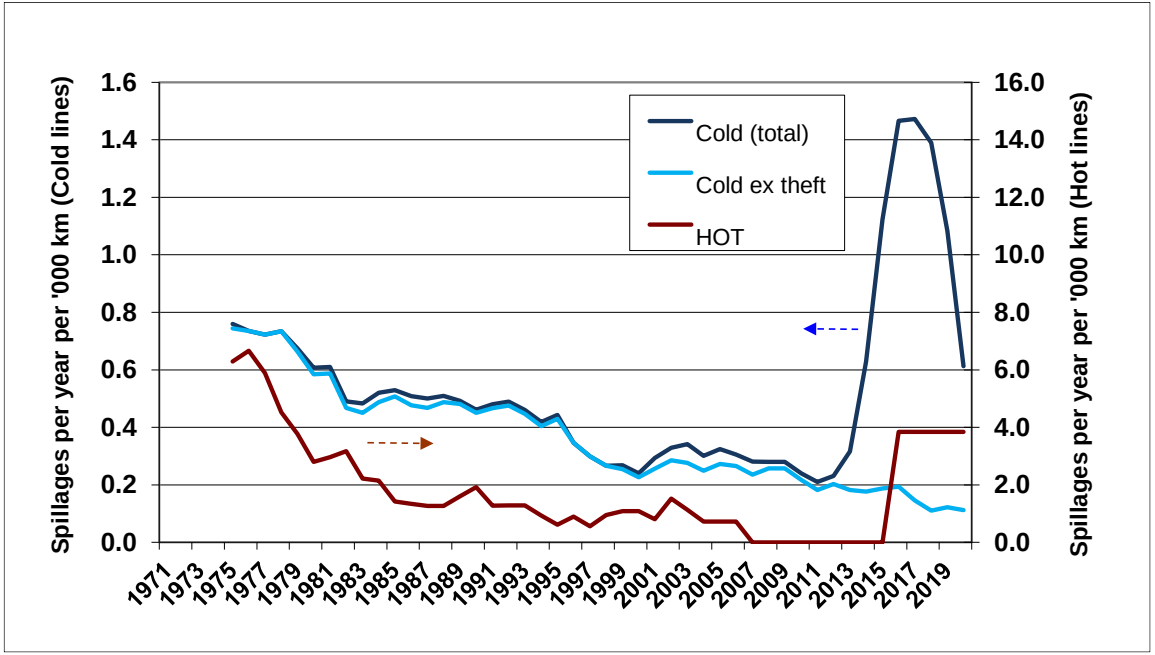
Number of spillages

Frequency



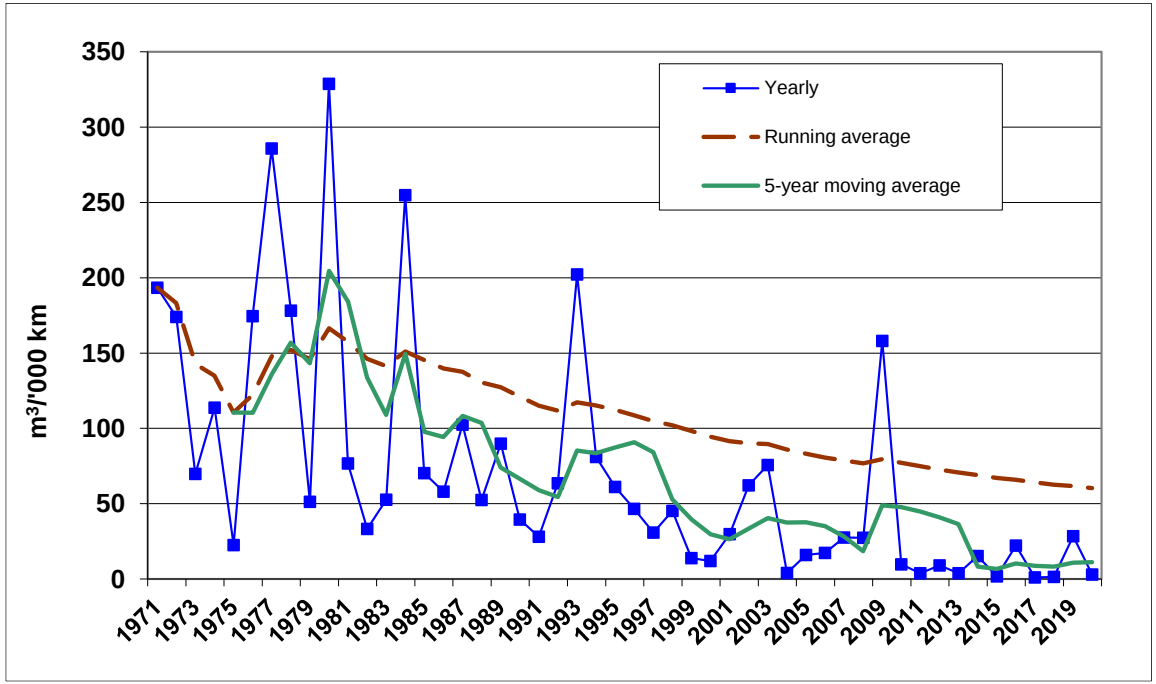
Because of the changes in the inventory over time, frequency is a more meaningful metric

Hot versus Cold pipelines



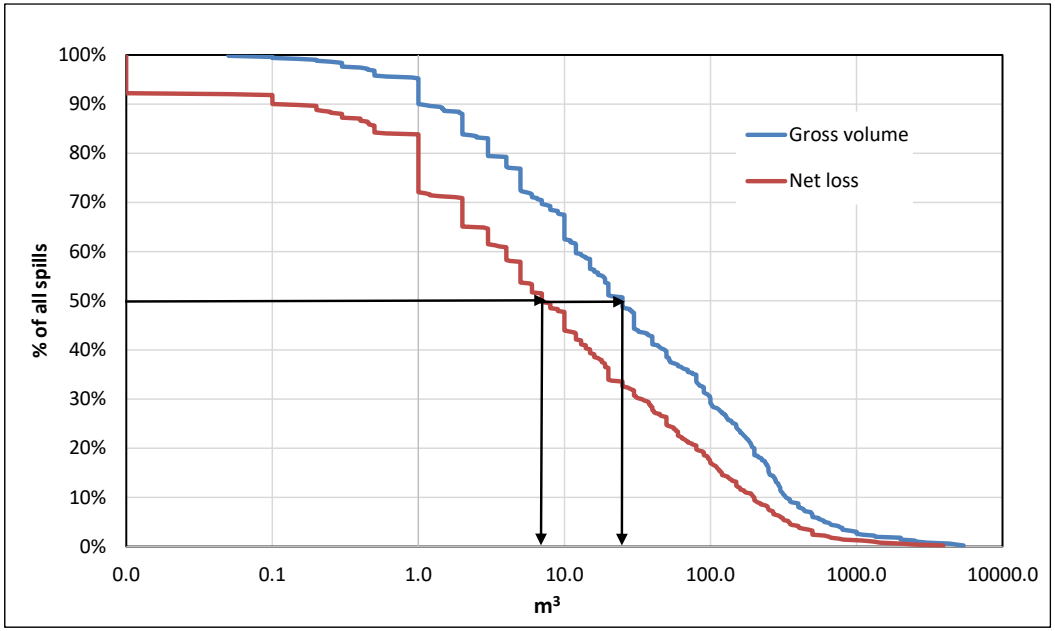
The frequency of failure in hot pipelines was an order of magnitude larger than for cold pipelines

Gross volume spilled



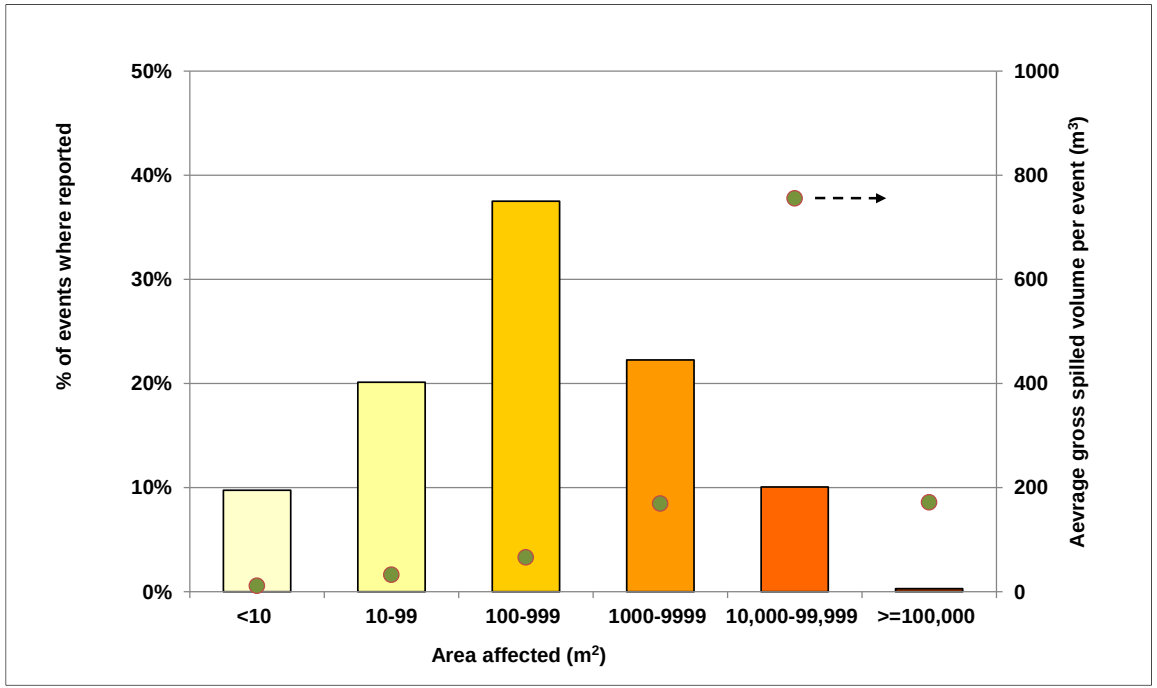
- The long term trend is downwards but single large spill events can distort yearly figures
  - These figures are not always accurate as for some events it can only be an estimate
- Typically 60 to 80% of the spilled volume is recovered

Spillage volume and net distribution



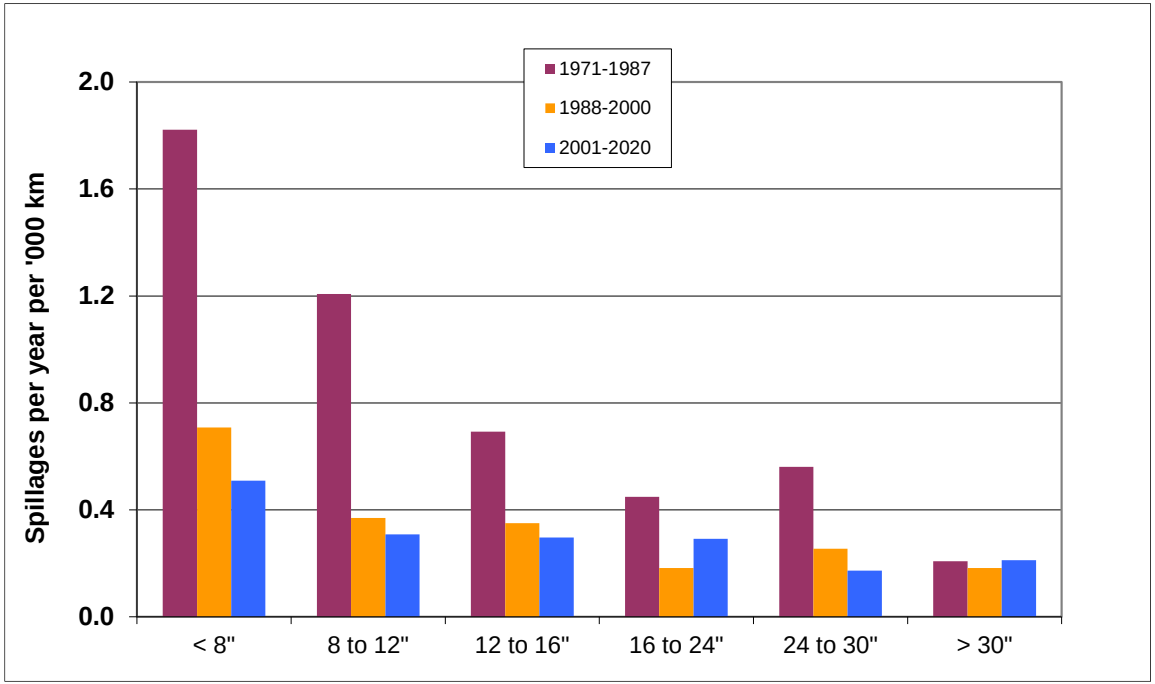
- In 50% of all events gross spillage was <25 m^3 and net loss <7 m^3
- 20% of events account for 80% of the gross spillage and 90% of the net loss
  - The picture has not changed much with time
- In about 5% of events spillage was less than the general 1 m^3 cut off value (special circumstances)

Ground area affected by spills



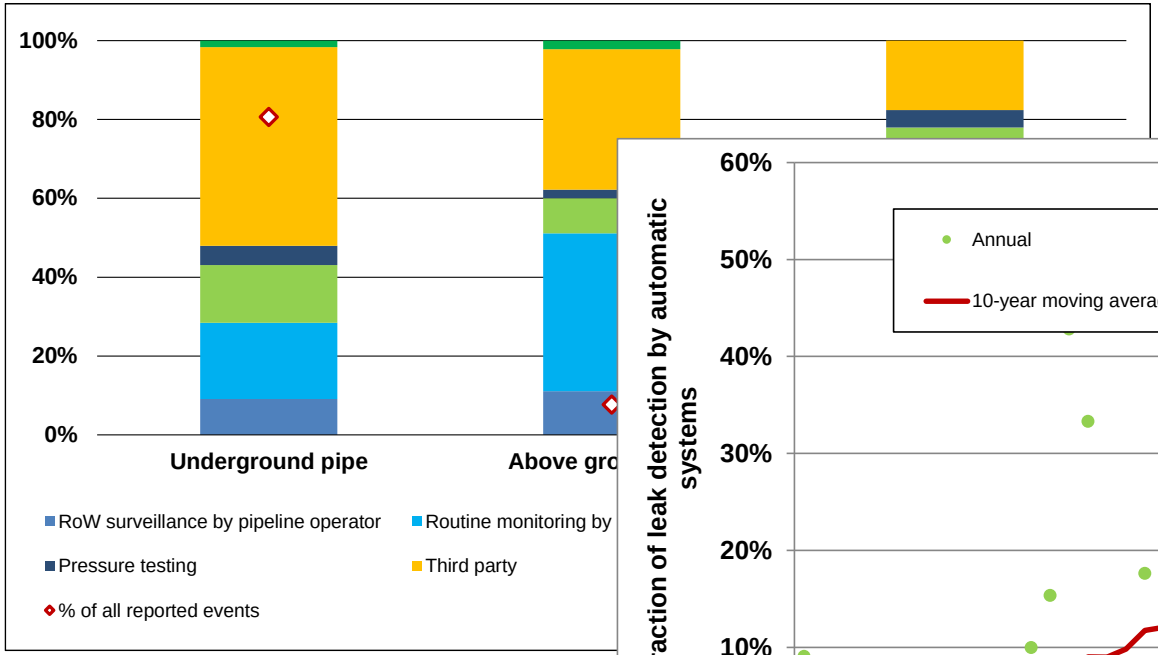
A relatively small spilled volume can contaminate a large area

Spillages per diameter class

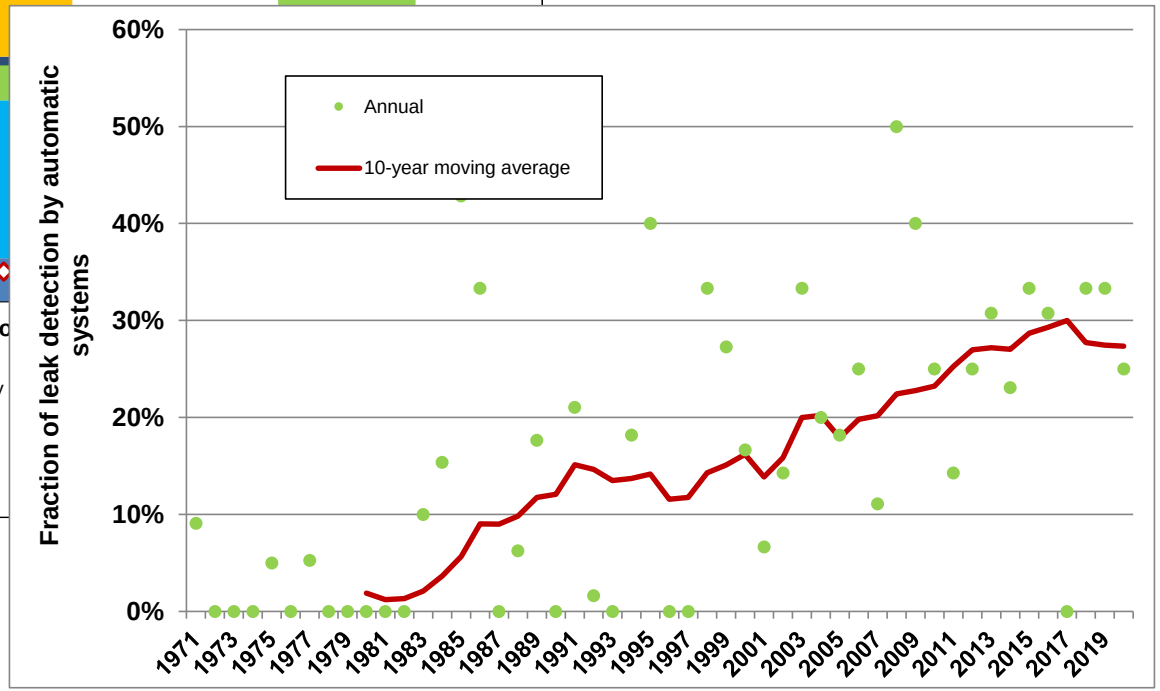


Spillages are more frequent in smaller pipelines

Leak / spillage detection



- Spills are often first detected by third parties

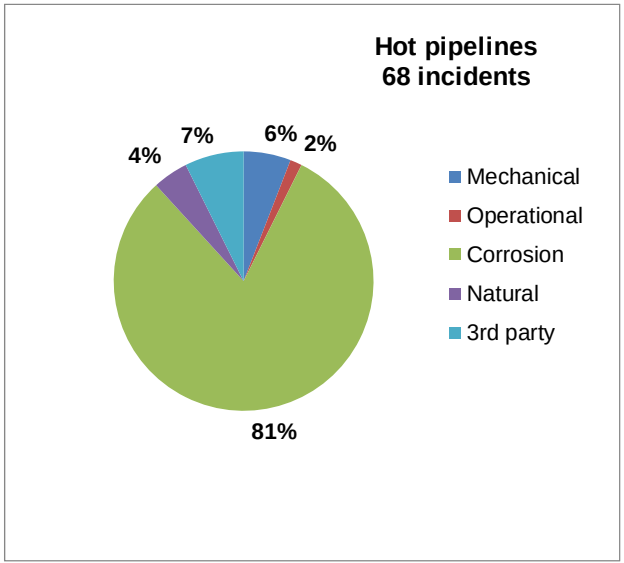


- Automatic Leak Detection systems are increasingly effective

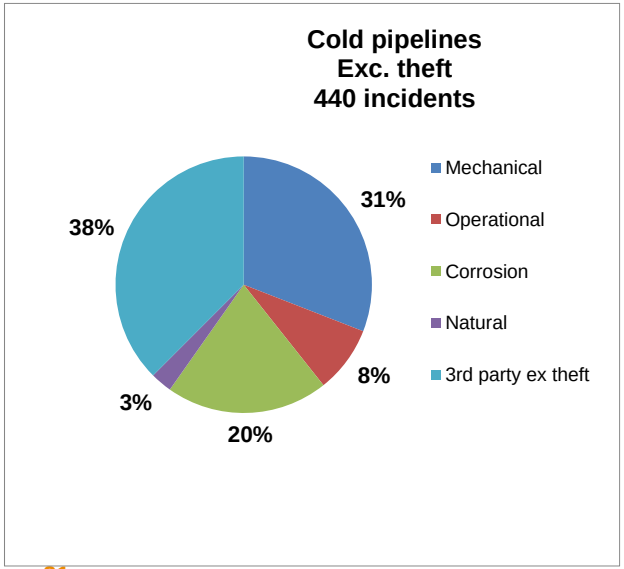
Causes of spills categories

Primary		*Secondary*		*Reason*	
A	Mechanical	Ab	Design and Materials	1	Incorrect design
				2	Faulty material
				3	Incorrect material specification
				4	Age or fatigue
		Aa	Construction	5	Faulty weld
				6	Construction damage
				7	Incorrect installation
B	Operational	Ba	System	8	Equipment
				9	Instrument & control systems
		Bb	Human	10	Not depressurised or drained
				11	Incorrect operation
				12	Incorrect maintenance or construction
				13	Incorrect procedure
C	Corrosion	Ca	External	14	Coating failure
				15	Cathodic protection failure
		Cb	Internal	16	Inhibitor failure
		Cc	Stress corrosion cracking		
D	Natural	Da	Ground movement	20	Landslide
				21	Subsidence
				22	Earthquake
				23	Flooding
		Db	Other		
E	3rd Party	Ea	Accidental	17	Construction
				18	Agricultural
				19	Underground infrastructure
		Ec	Incidental		
		Eb	Intentional	24	Terrorist activity
				25	Vandalism
				26	Theft (incl. attempted)

Causes of spills: all events

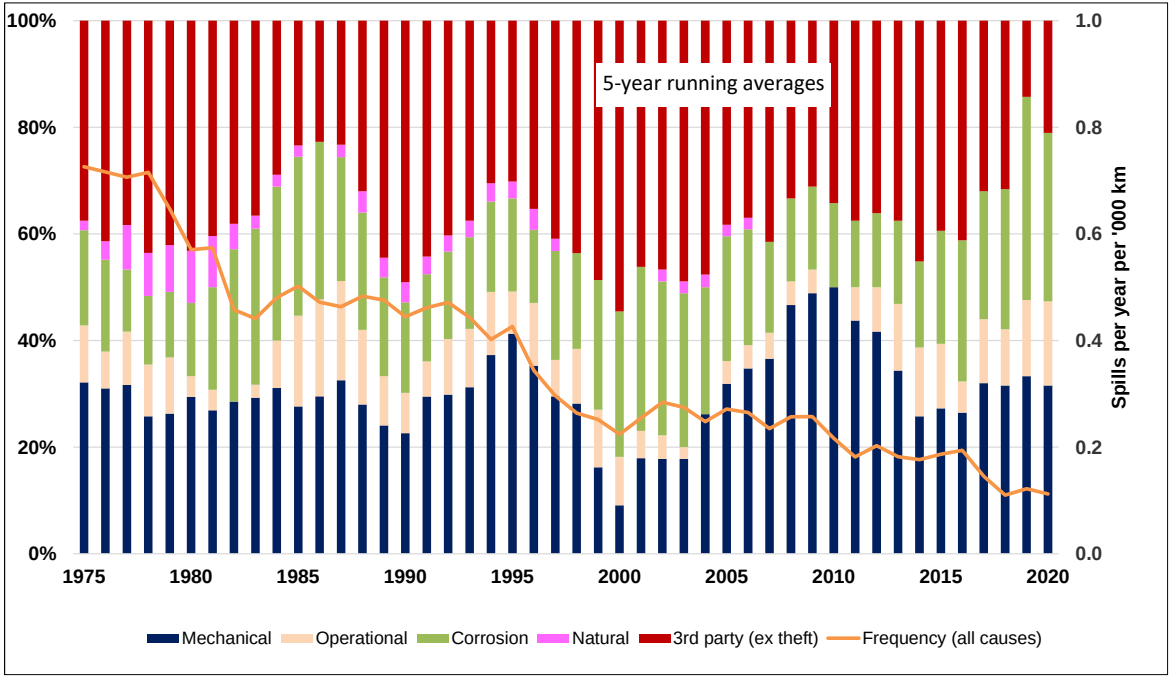


- Most spills on hot pipelines were corrosion-related
  - Hot lines have virtually all been shutdown



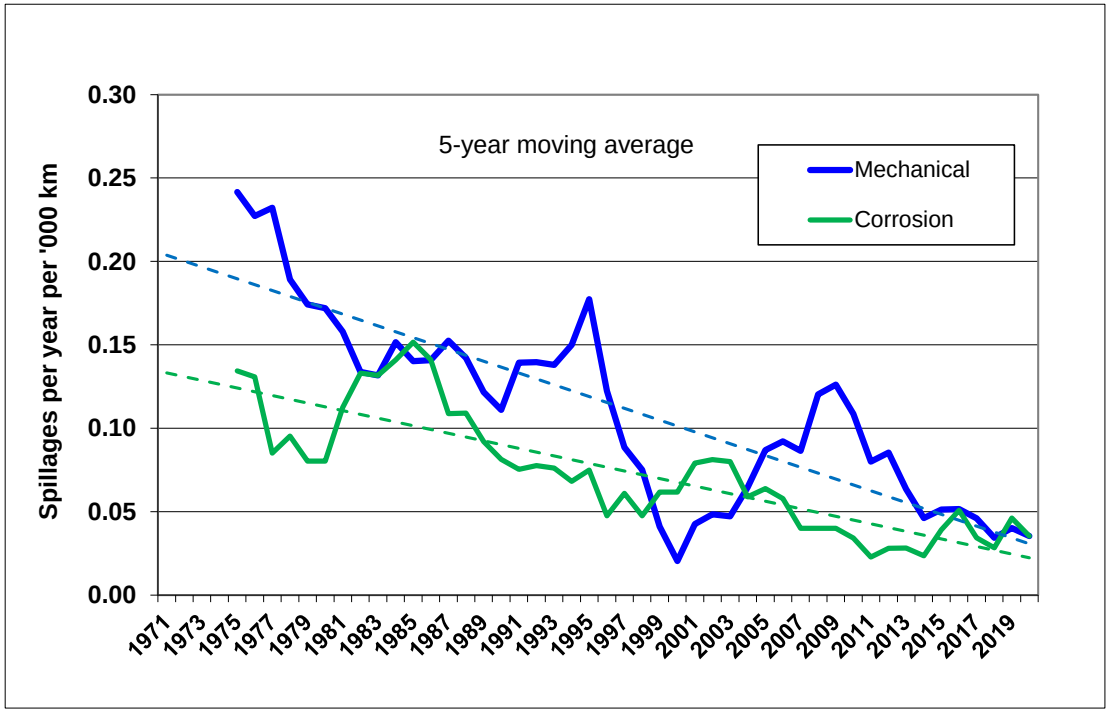
- On cold pipelines the main causes are mechanical and third party interference

Causes of spills in cold pipelines over time



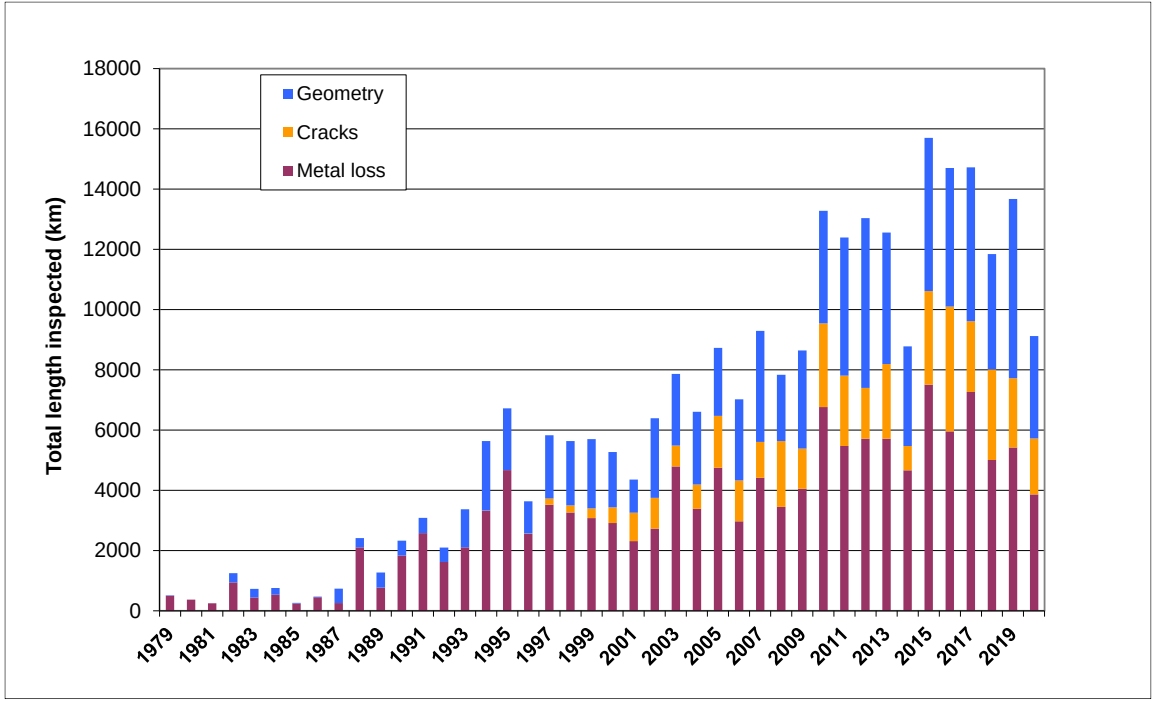
- The overall frequency has steadily decreased over time
- Third party interference remains an important cause
- After an increase in the last decade mechanical causes have returned to historical levels
- The proportion of corrosion-related failures has increased in recent years but…

Mechanical and Corrosion causes frequency (cold pipelines)



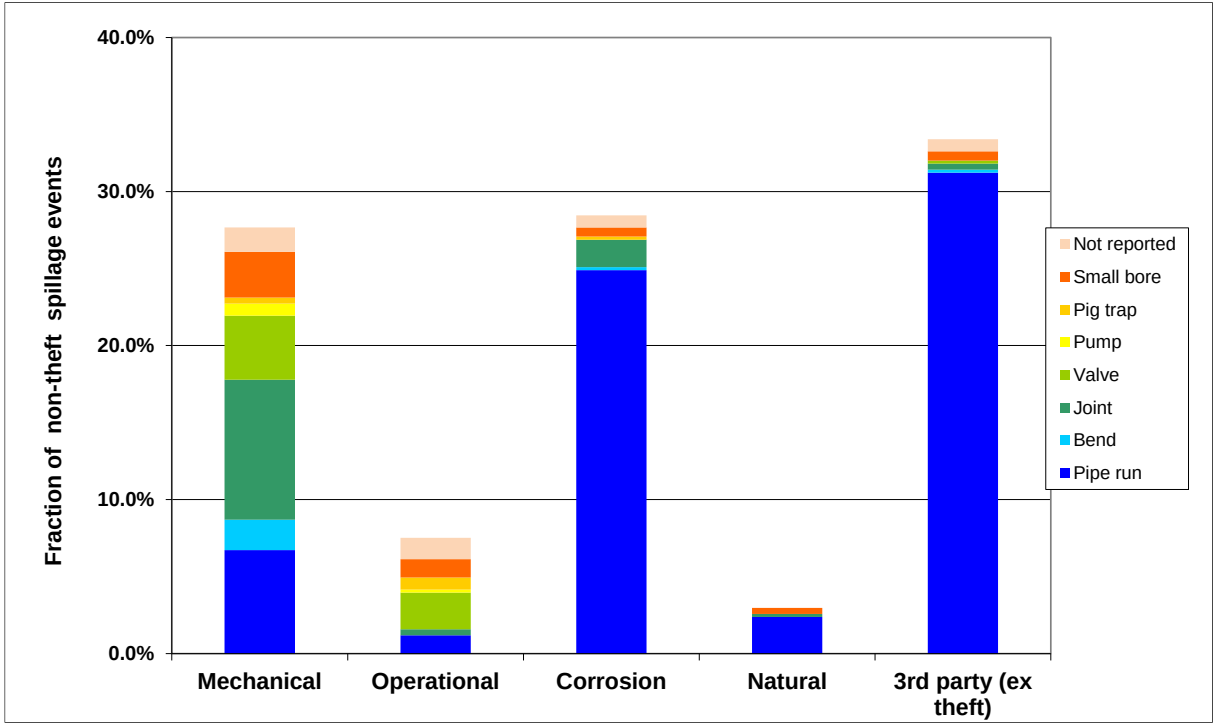
- The frequencies are still decreasing slowly over time
- Ageing-related issues appear to be under control

Integrity Management: In-line inspections



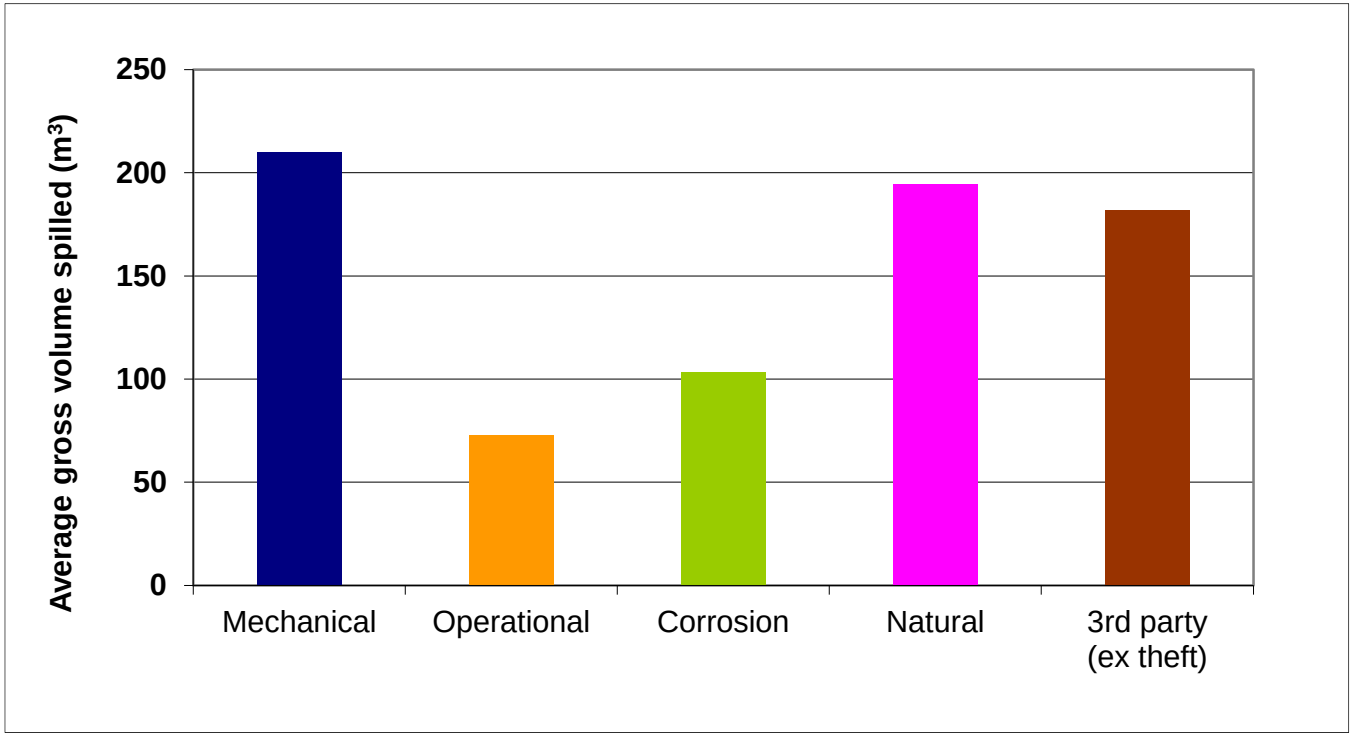
Sophisticated in-line inspections have become the norm over the years, contributing to more effective failure prevention in the ageing network

Failure location



Most incidents occur in pipe runs except for Mechanical and Operational causes

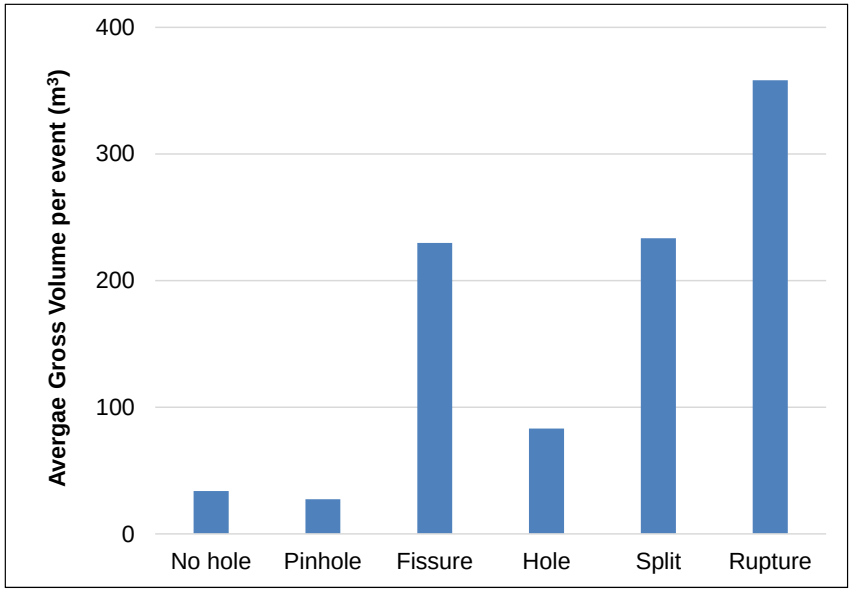
Gross volume spilled by cause



Operational and corrosion related causes result in lower spilled volumes

Hole size

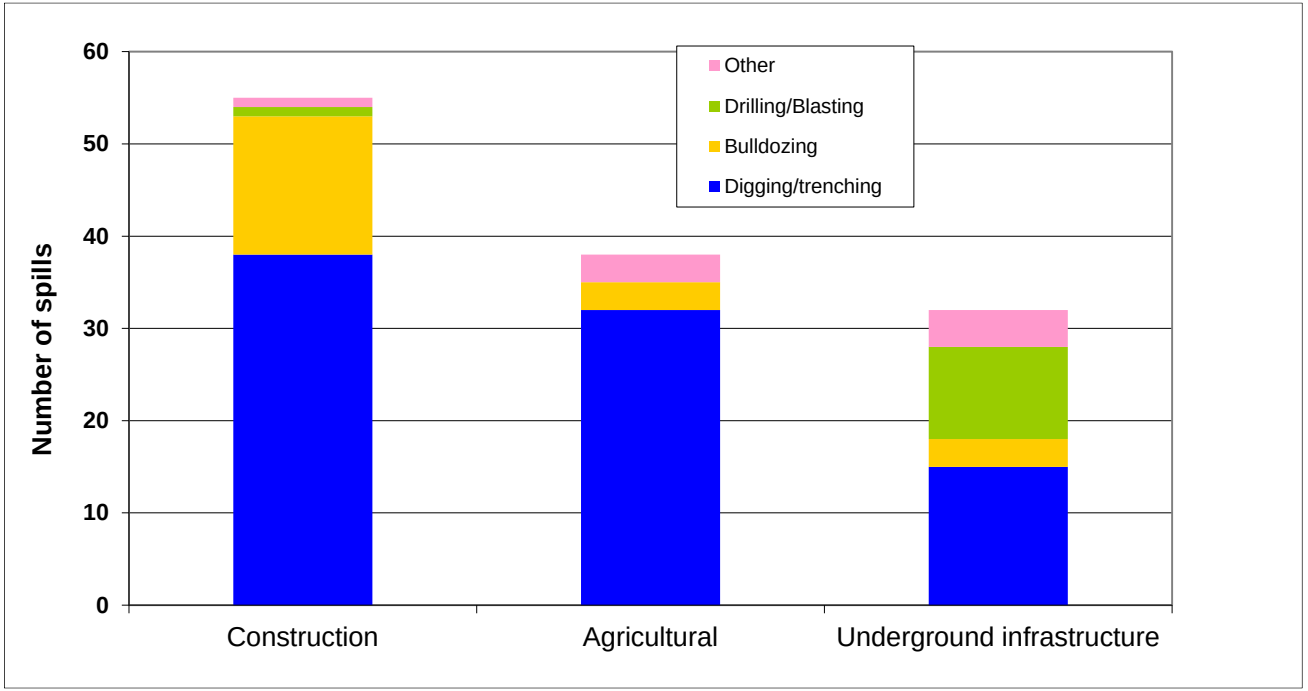
Pinhole	Less than 2 mm x 2 mm
Fissure	2 to 75 mm long x 10% max wide
Hole	2 to 75 mm long x 10% min wide
Split	75 to 1000 mm long x 10% max wide
Rupture	>75 mm long x 10% min wide



There is no significant correlation between cause and hole size

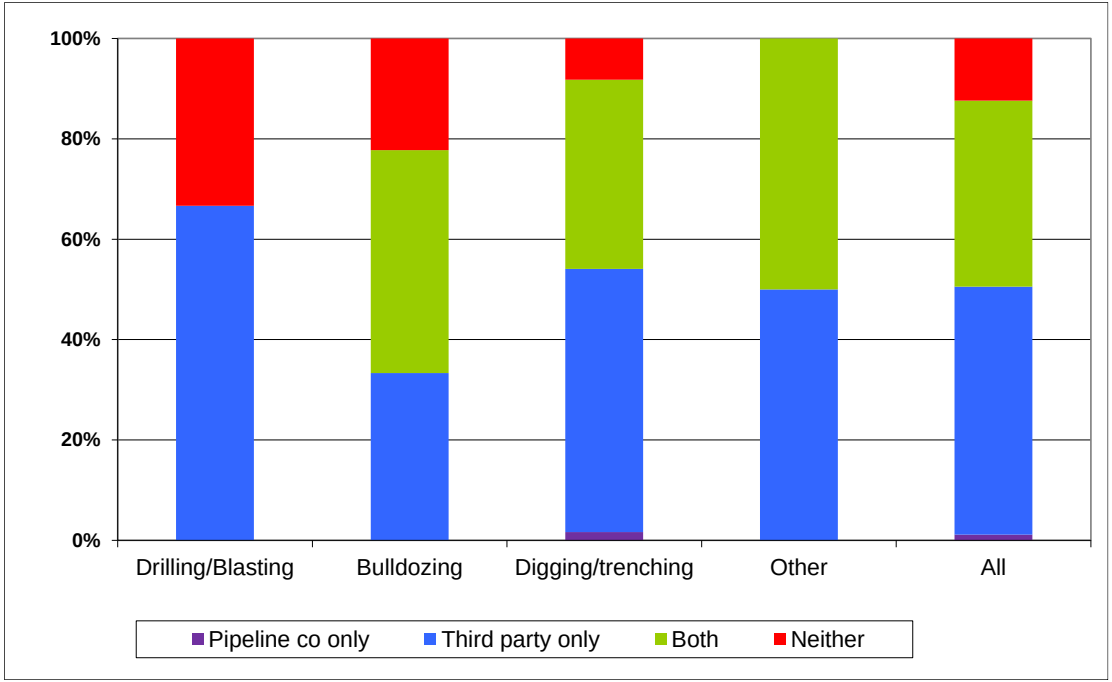
Larger holes lead to bigger spills?

Circumstances of third party spills



Most third party related spills occur during digging or trenching activities

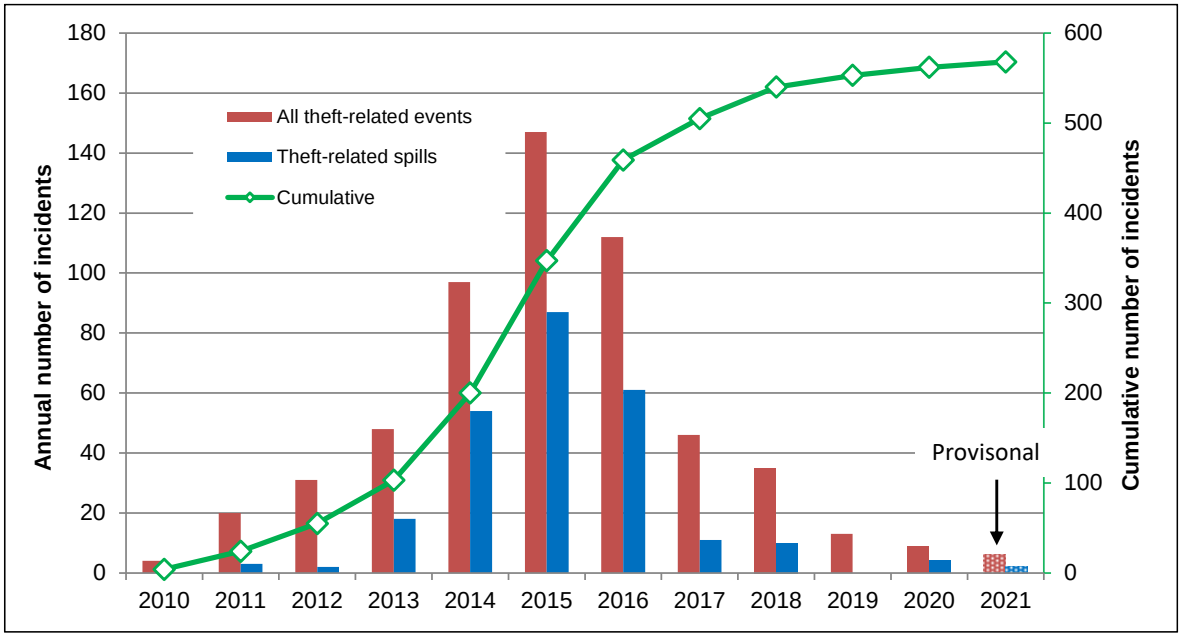
Mutual awareness of activities



- In nearly 50% of cases the third party is aware of the presence of a pipeline but the pipeline company is not informed of potentially hazardous activities near the pipeline
- Incidents occur even when both parties are mutually aware
- In some 12% of cases neither party is aware of the other

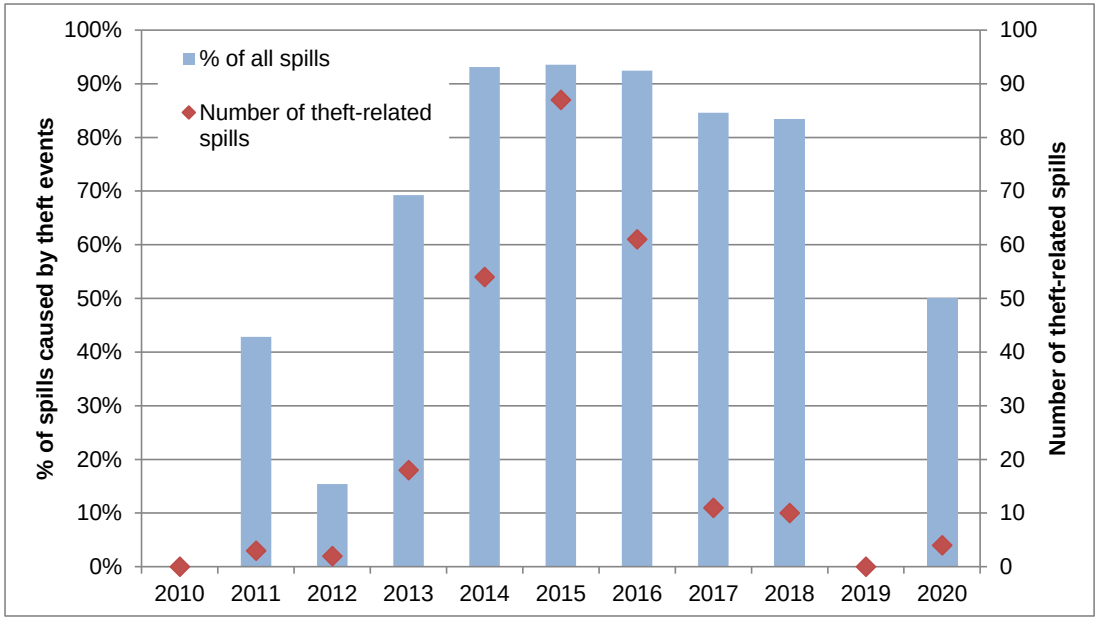
04 Product theft

Product theft



- The problem is not new, but the frequency is…
- Although a small number of countries were particularly affected, the geographic spread was wide

Theft-related spillages



- In the middle of the decade, theft accounted for over 90% of reported spillages
- Concerted efforts by operators and authorities have addressed the issue
  - We have passed the peak but…
  - The problem has not disappeared

Putting the report together

- This information is extracted from the data YOU supply
- The 2021 data is being collected... slowly

The report is used extensively in the Industry including pipeline risk assessment, support and/or challenge of regulations, operators to focus on high risk and high consequence events

Please respond promptly and ensure the data is filled as compeletely as possible

The quality of the report depends on the quality of your data

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Thank you for your attention

Jean-François Larivé