

OIL & GAS

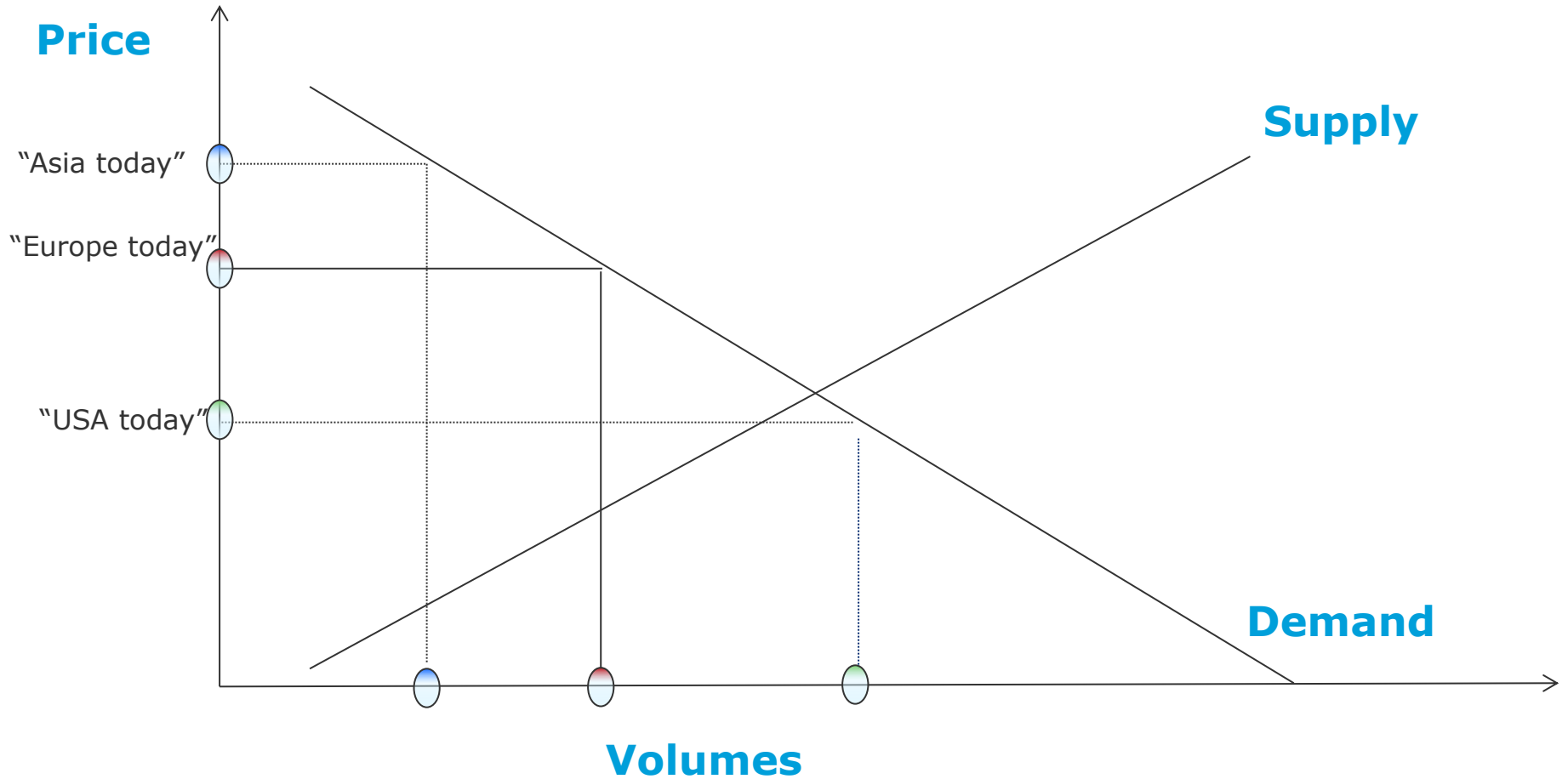
Pipelines vs LNG transport

Competing or complementing transport solutions in tomorrow's energy markets?"

Nils Andreas Masvie, VP DNV GL AS

Annual Regional Natural Gas Forum, 23.Sept 2014

Regional Gas markets (only illustrative)



The Golden Future of Gas?

- Unlike oil, gas is primarily a transportation business; not a production business.
- There are abundant resources, and multiple export routes will secure better market liquidity.
- Russia's size and location, i.e. distance to markets, requires long transport routes.
- LNG and ship transport are not always an option.
- Three drivers for gas growth:
 - Economic and population growth
 - Switching from other energy carriers into gas
 - Creating a new market

New uses for gas – i.e. a new market



LNG used as fuel for power plants

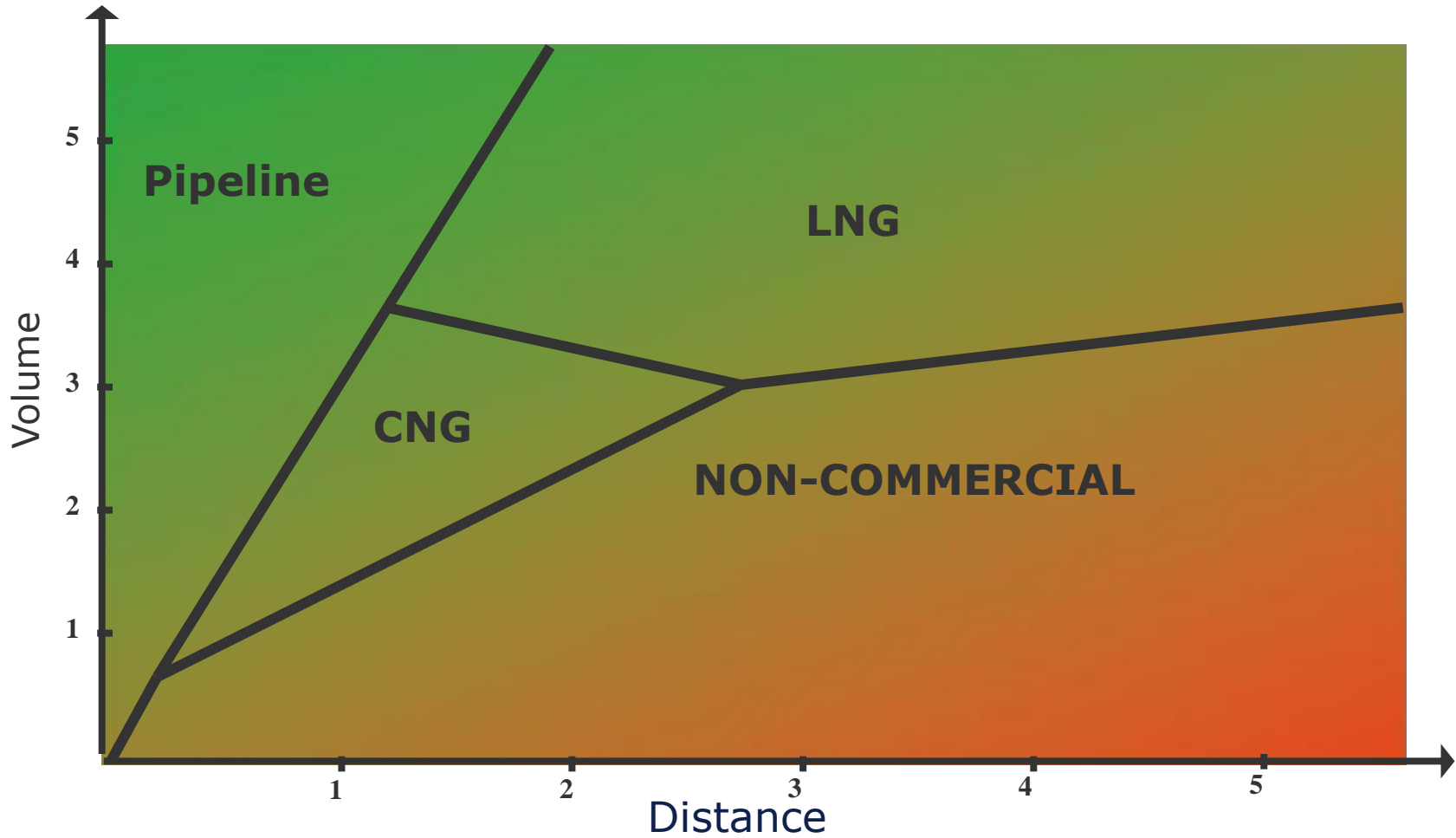


Break-bulk and small scale distribution

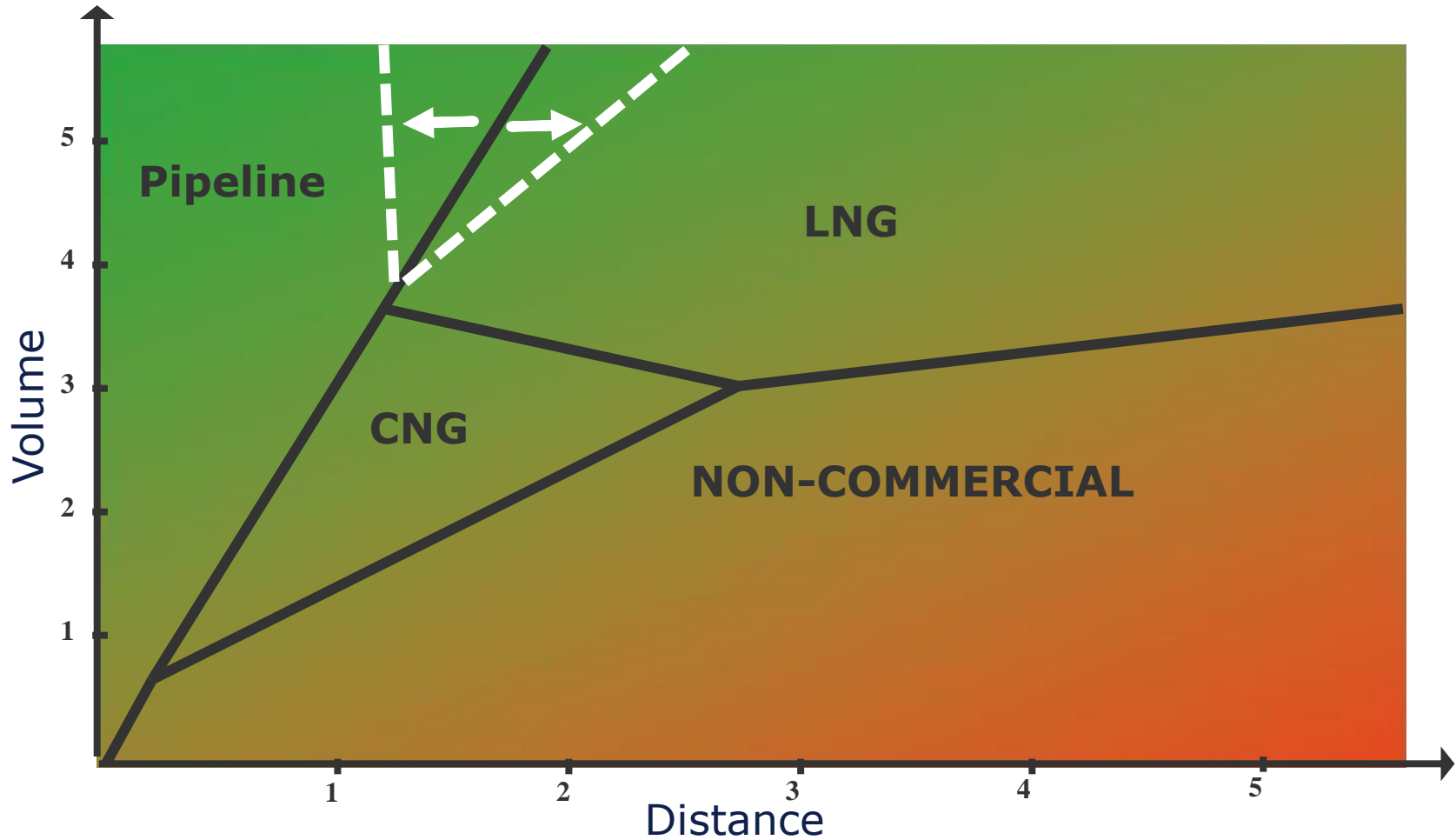


LNG used as a maritime fuel

Pipelines, CNG and LNG; distance and volume matrix



Technological advances are bringing more transport options



Some relevant Variables to consider before choosing your transport solution

HAZARD – resulting from...	PL	PNG, CNG	LNG	Comment
CAPEX (relative)	HIGH	LOW	HIGH	Large volumes and long amortization periods needed for PL & LNG.
OPEX (relative)	LOW	MEDIUM	MEDIUM	Contributing: Energy loss
Increased cost of financing, more risk aversion.	+	+	–	PLs may more easily secure mutual commitments, speculative LNG projects may struggle
Less demand for gas/energy	–	+	+	LNG/CNG-ships can more easily find alternative markets
Well tested technology	++	0	+	(CNG is, however, ready to go)
Scale economies	++	-	+	PLs – capacity increase on the margin: cheap to add.
Break-even on small volumes, medium distance	-	+	-	CNG best solution for marginal fields, far from existing infrastructure.

What is the trend in *relative PL vs LNG costs**

- *Roughly* how many kilometers of installed offshore large diameter pipe – standard/typical project - did you get for the price of a large standard (160 000 m³) LNG vessel in:

1995: 73 km (\$1,65m pr km / \$120 mill pr vessel)

2010: 91 km (\$2,75m pr km / \$250 mill pr vessel)

**internal DNV GL calculations*

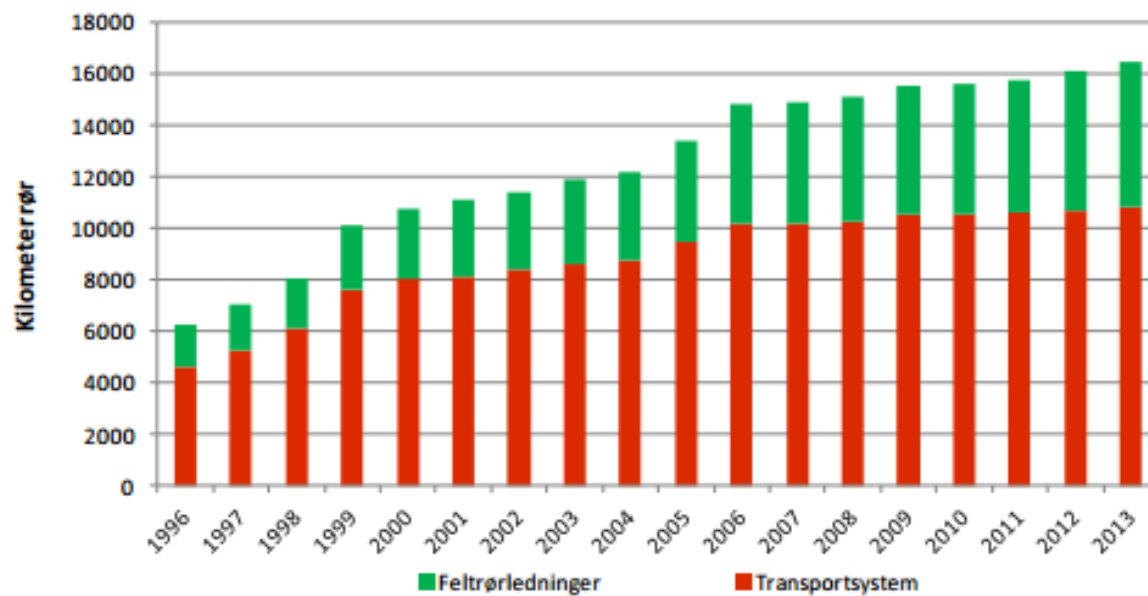
Regulatory Compliance – high on the agenda

Risk ranking	2013	2015
The risk of a health, safety or environmental incident, and in ensuring regulatory compliance	1	1
Price volatility; managing long-term investment with the potential for extreme price volatility	2	2
Access to reserves or markets	3	3
Cost escalation and inflation	4	6
Uncertain energy policy	5	5
Worsening fiscal terms	6	4

Ernst & Young; "Business Pulse – Exploring dual perspectives on the top 10 risks and opportunities in 2013 and beyond"

Main Report – Petroleum Safety Authority – Offshore Norway

“Hovedrapport – Sokkel – 2013 (Ptil)” www.psa.no



Figur 2 *Utvikling i akkumulert antall km rørledninger, 1996-2013*

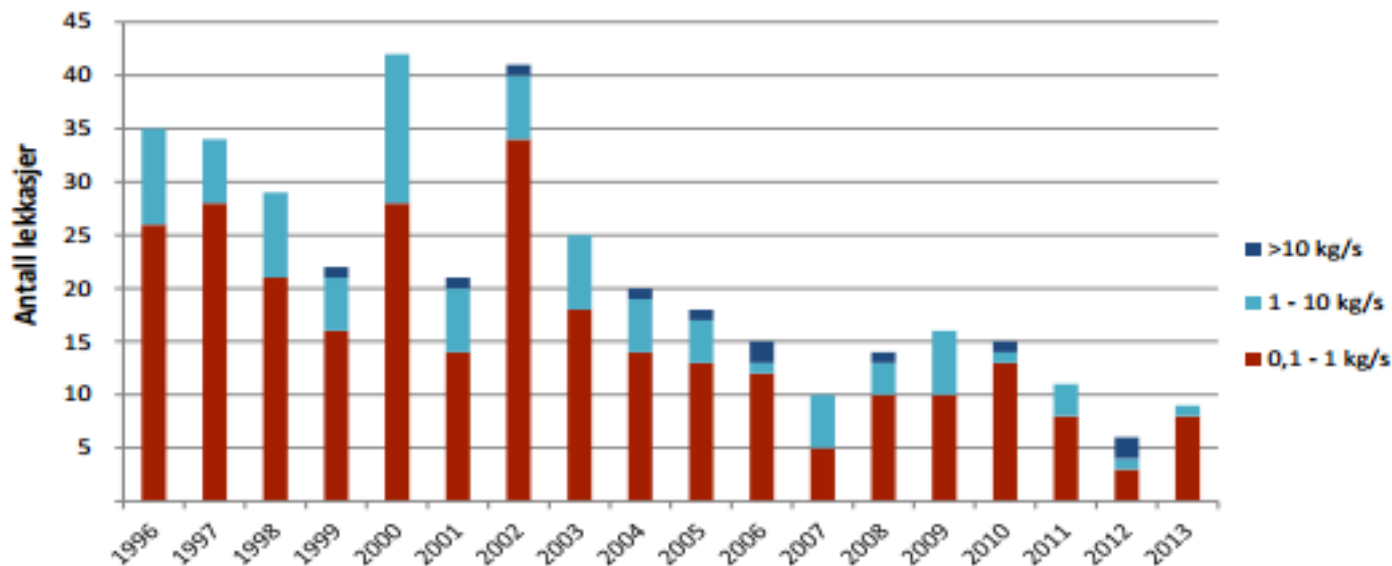
Report facsimile, page 20: Figure 2

X axis : Time – 1996-2013

Y axis: Annual, accumulated number of pipeline kilometres (green: infield lines, red: export lines)

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Figur 34 Antall lekkasjer, alle innretninger, norsk sokkel

Report facsimile, page 78: Figure 34

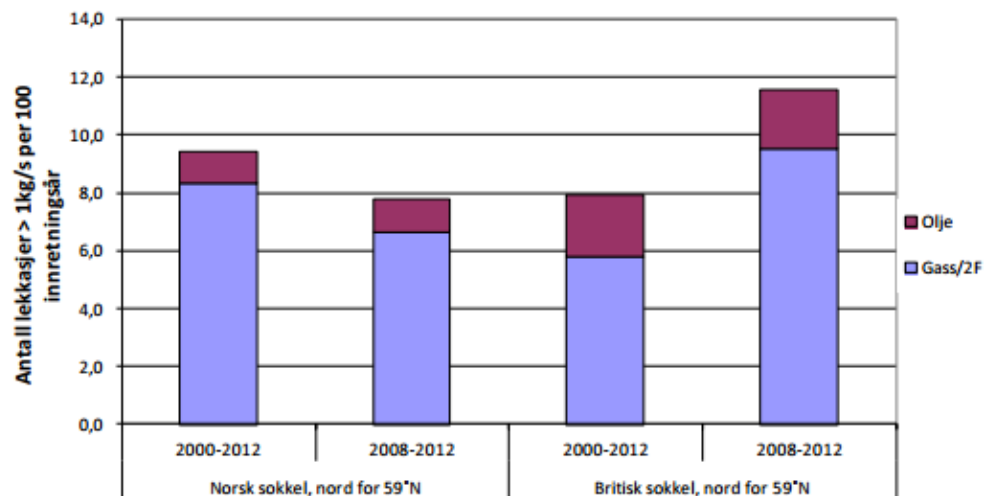
X axis : Time – 1996-2013

Y axis: Annual number of leakages – all installations

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Figur 46 viser sammenlikningen mellom gjennomsnittlig lekkasjefrekvens på norsk og britisk sokkel nord for 59°N, for periodene 2000-2012 og 2008-2012, begrenset til lekkasjer > 1 kg/s. Det framgår at det har vært en forbedring på norsk sokkel, mens britisk sokkel har høyere frekvens per innretningsår for perioden 2008-2012 enn 2000-2012.



Figur 46 Sammenlikning av gass/tofase- og oljelekkasjer på norsk og britisk sokkel per 100 innretningsår, gjennomsnitt 2000-2012 og 2008-2012

Report facsimile Page 88; Figure 46

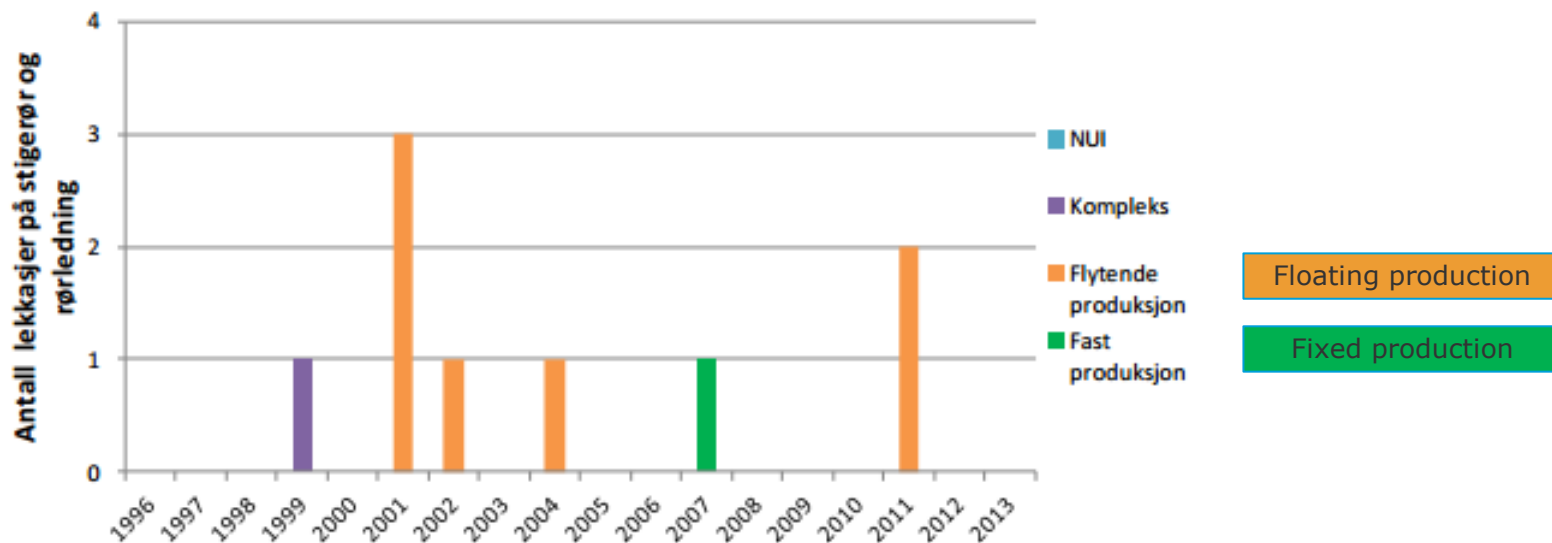
Comparison of leakage frequencies Norwegian vs British sectors; North of 59°N

Blue: Gas

Red: Oil

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Figur 60 Antall lekkasjer fra stigerør og rørledninger innenfor sikkerhetssonen, 1996-2013

Report facsimile, page 99: Figure 60

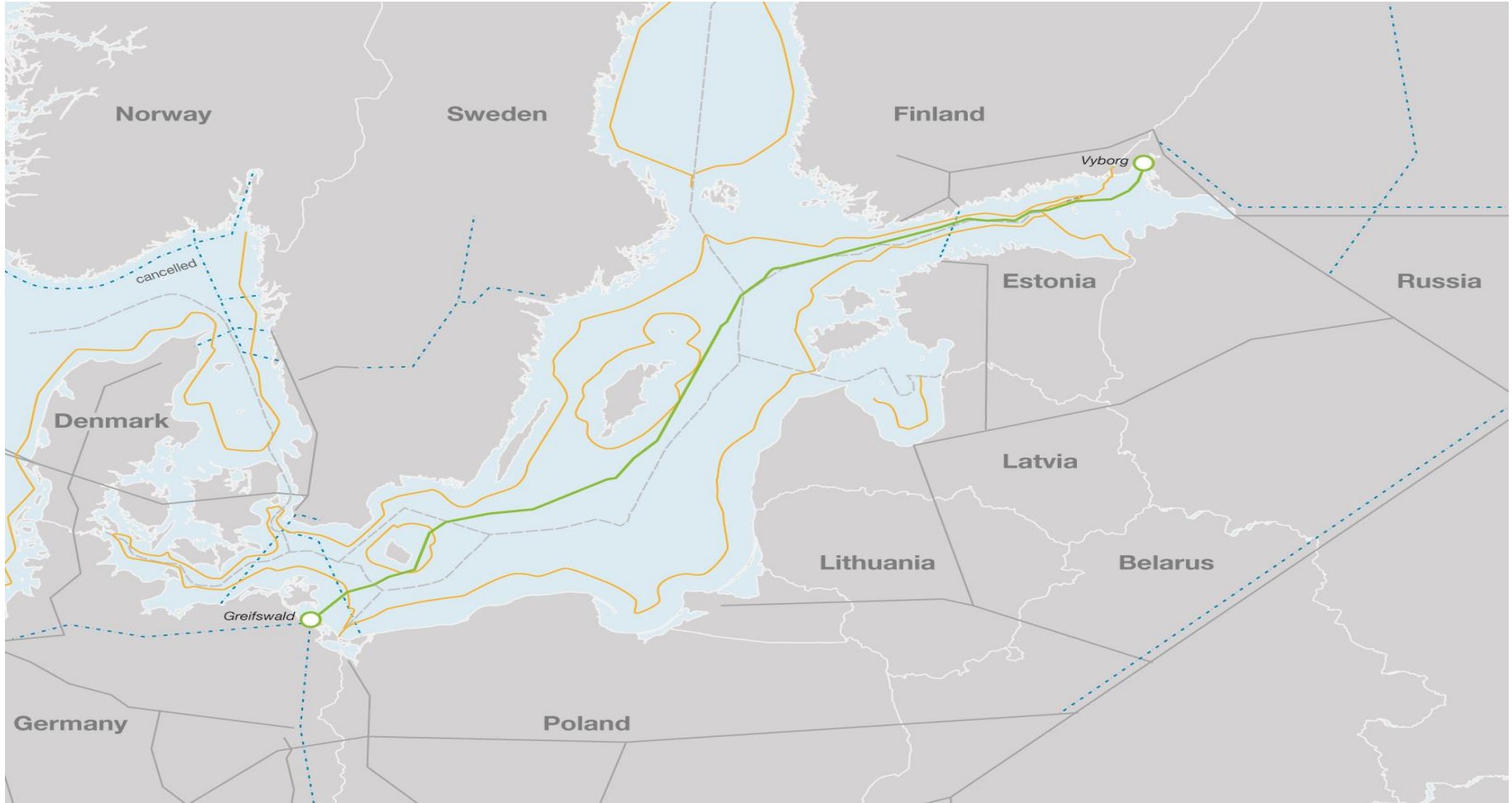
X axis : Time – 1996-2013

Y axis: Annual leakages inside the safety zone – risers and pipelines

Blue Stream 2*24" Gas Pipelines – Technical & Regulatory challenges



Nord Stream 2*48" Technology and Regulatory Challenges



South Stream Offshore Route 4*32" Technical and Regulatory Challenges



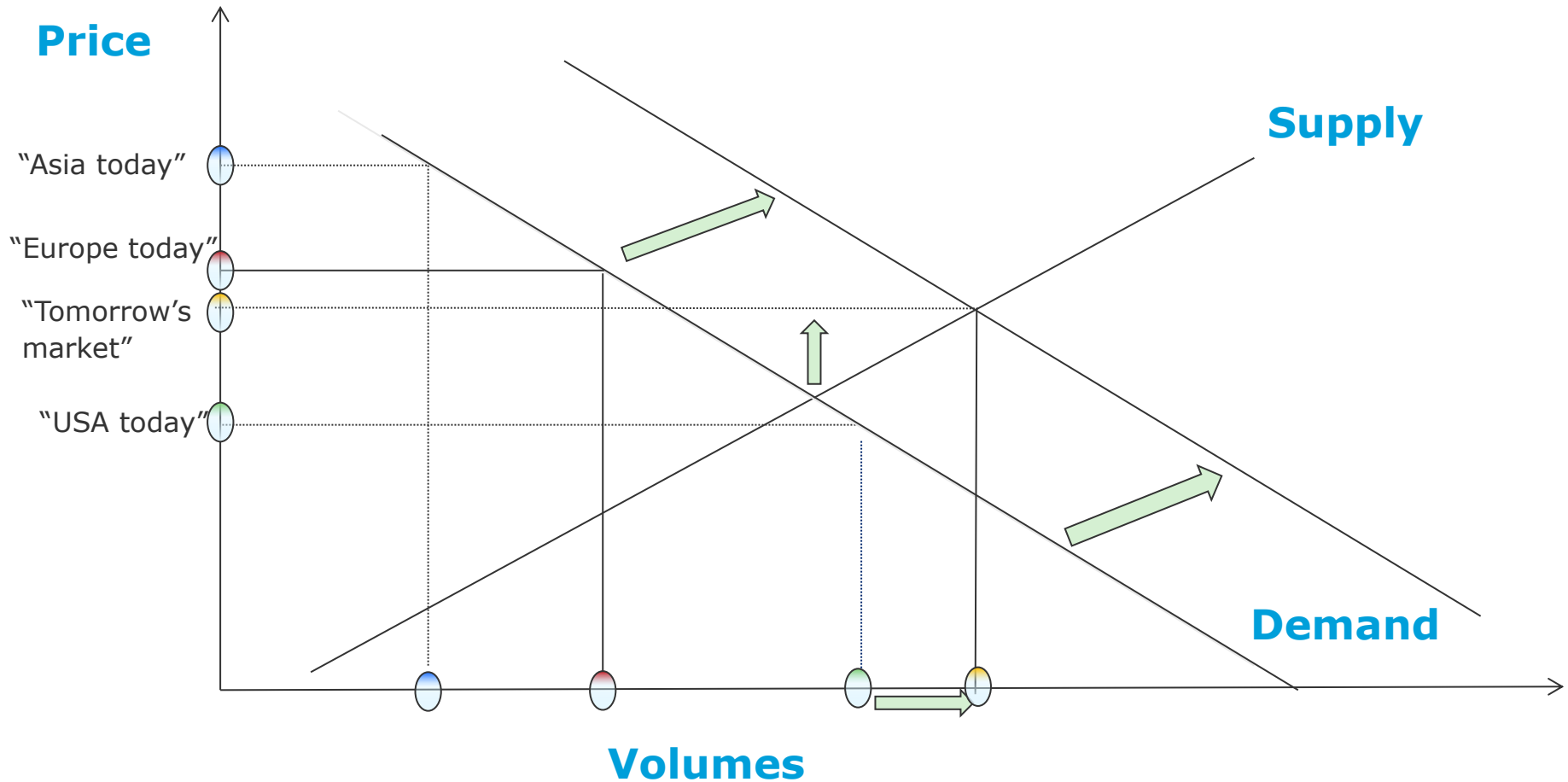
Blue Stream, Nord Stream and South Stream – same codes

		Main Design Code
Blue Stream	2*24"	DNV'96
Nord Stream	2*48"	DNV OS-F101
South Stream	4*32"	DNV OS-F101

DNV OS-F101 (DNV'96 is an earlier version) is used all over the world, and focuses on

Technical Integrity = Safety

New Gas supplies will add liquidity, volumes, reliability, and stability to gas markets (only illustrative)



Thank you

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