

OIL & GAS

Gas transported to market on keel as LNG or in pipelines

What is better?

IBC Energy Committee Meeting 11th Nov 2016, Oslo

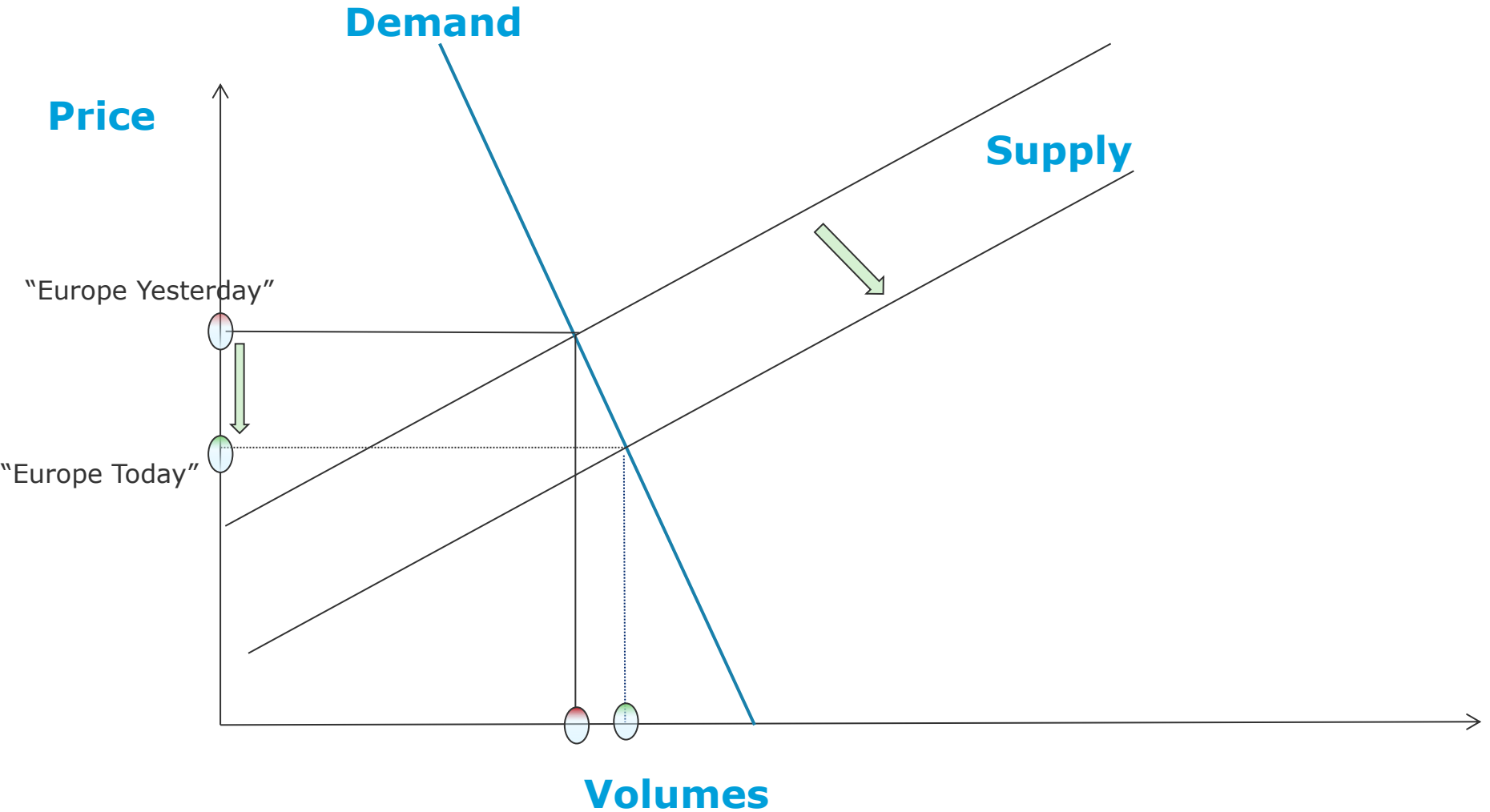
Nils Andreas Masvie

11 November 2016

DISCLAIMER

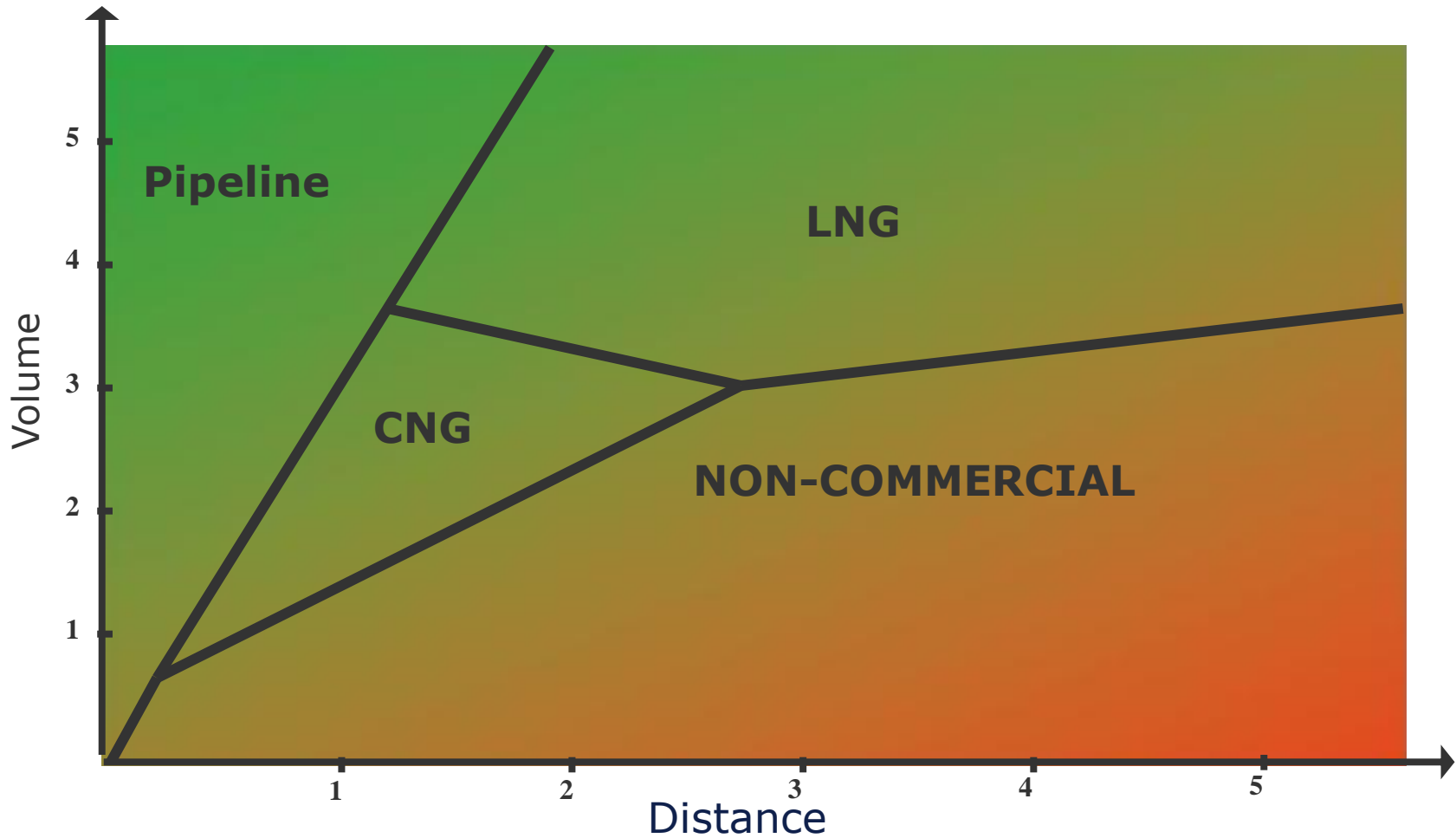
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Illustrative gas prices in Europe



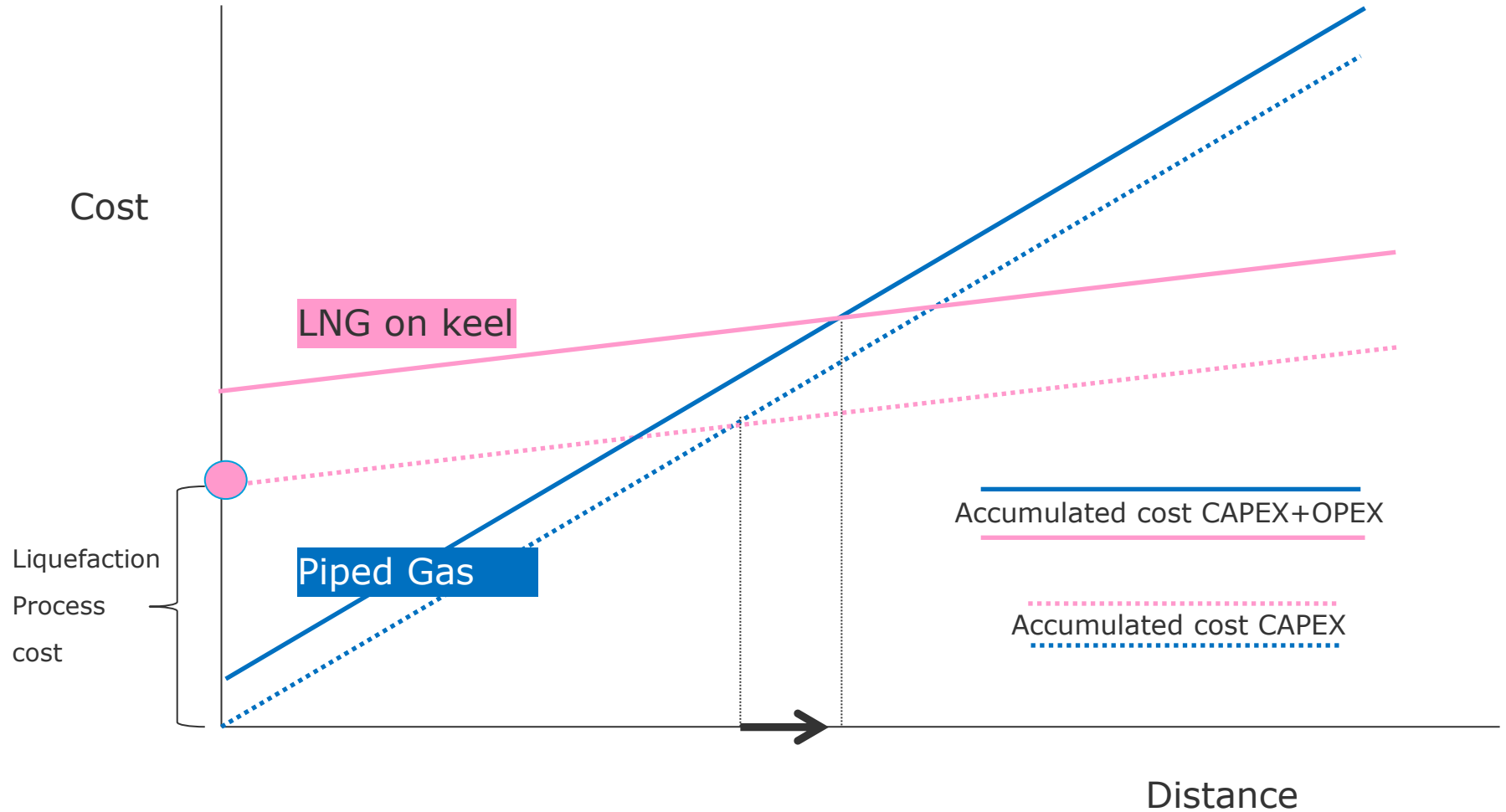
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Pipelines, CNG and LNG; distance and volume matrix



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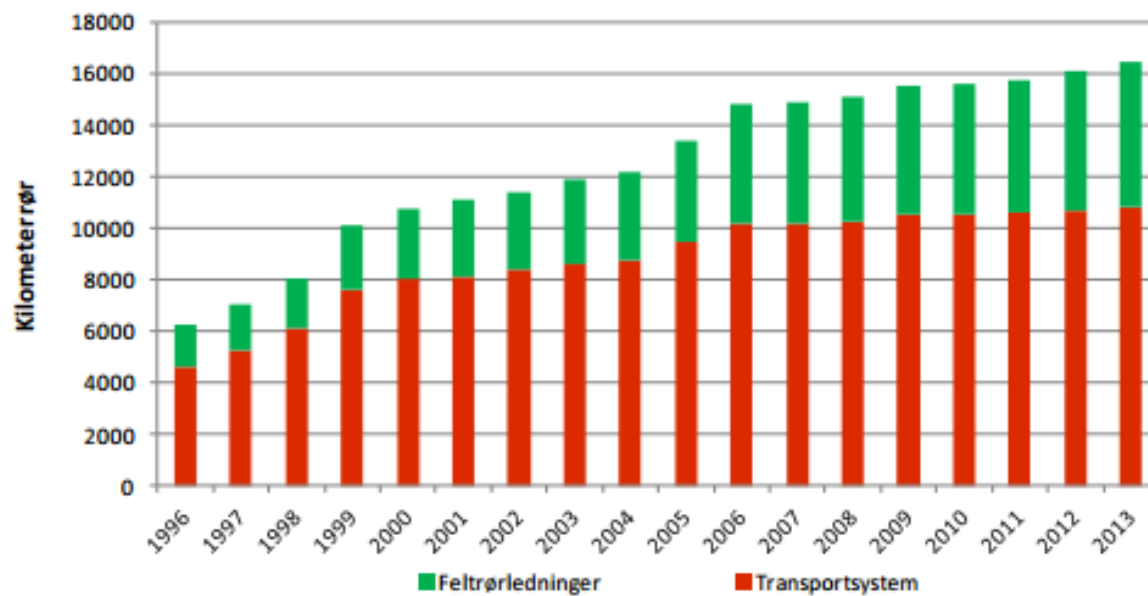
Illustrative only: Transportation matrix with fixed field size – including operations



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Main Report – Petroleum Safety Authority – Offshore Norway

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



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

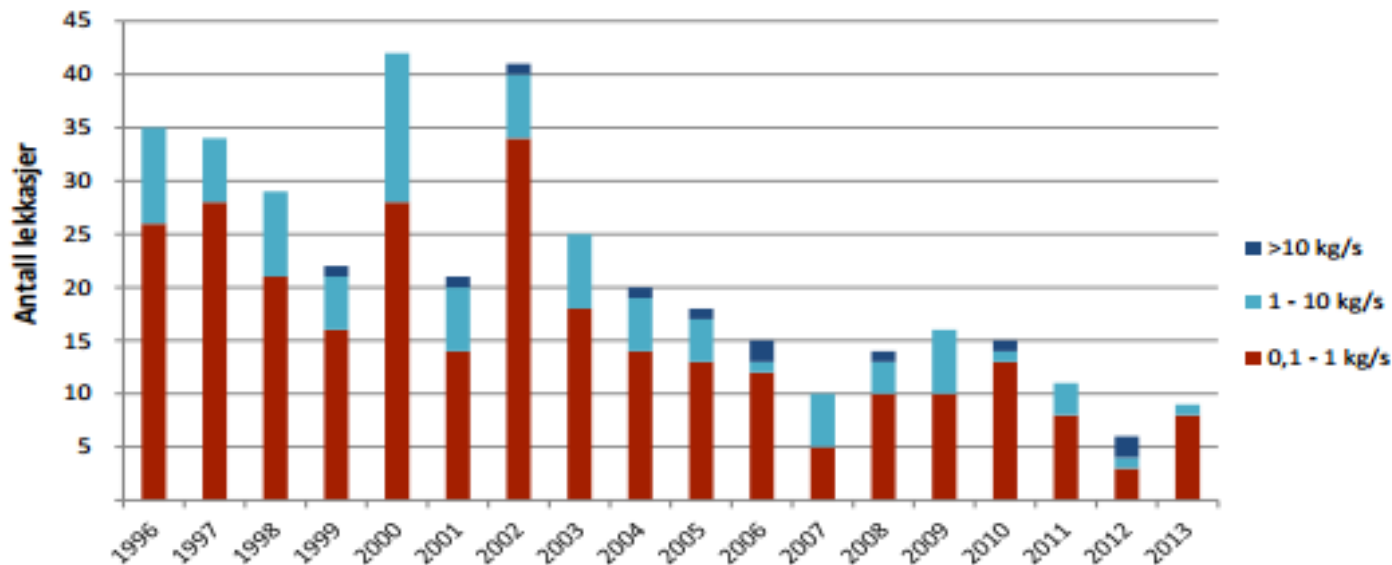
Report facsimile, page 20: Figure 2

X axis : Time – 1996-2013

Y axis: Annual, accumulated number of pipeline kilometres (green: infield lines, red: export lines)
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Main Report – Petroleum Safety Authority – Offshore Norway

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



Figur 34 Antall lekkasjer, alle innretninger, norsk sokkel

Report facsimile, page 78: Figure 34

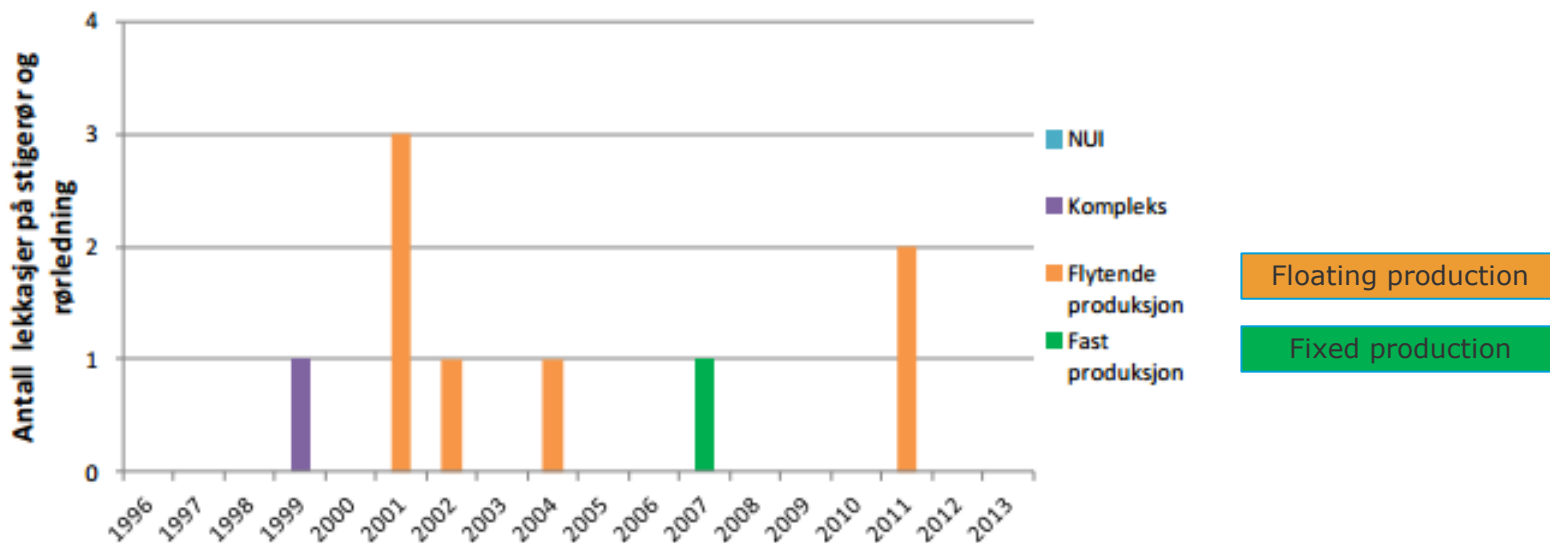
X axis : Time – 1996-2013

Y axis: Annual number of leakages – all installations

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Main Report – Petroleum Safety Authority – Offshore Norway

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



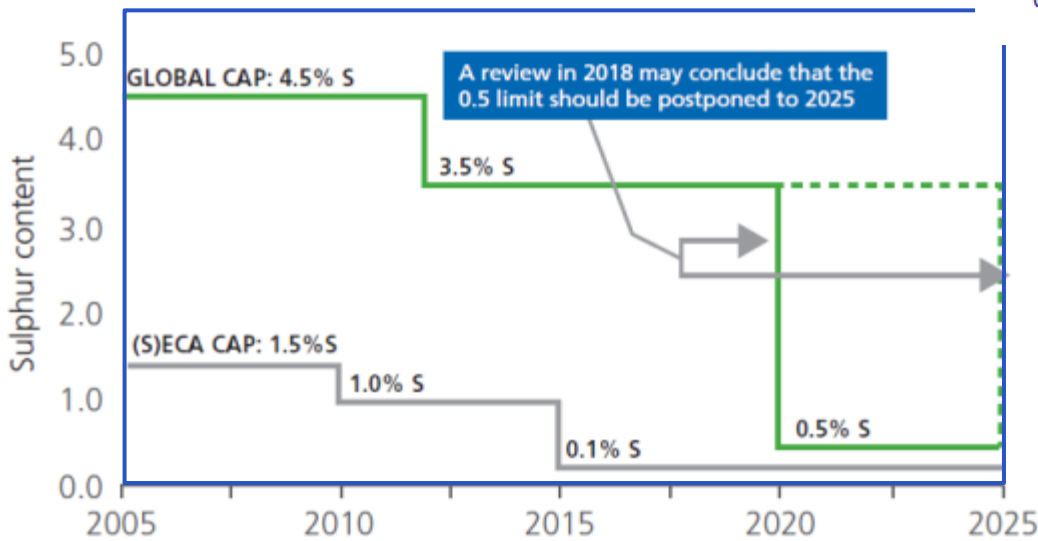
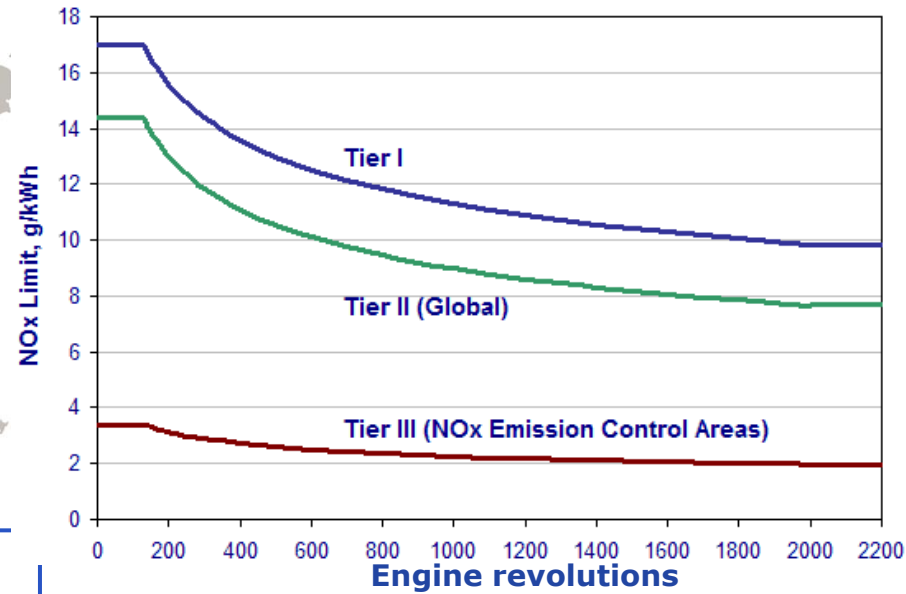
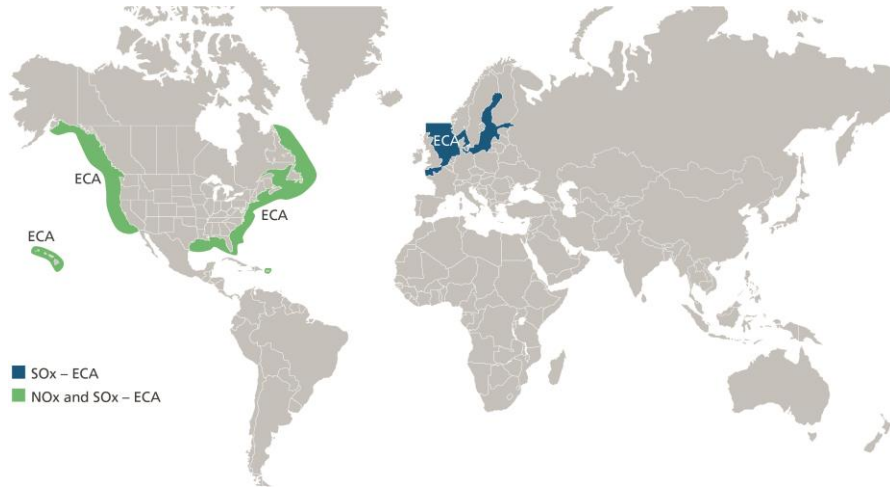
Figur 60 Antall lekkasjer fra stigerør og rørledninger innenfor sikkerhetssonen, 1996-2013

Report facsimile, page 99: Figure 60

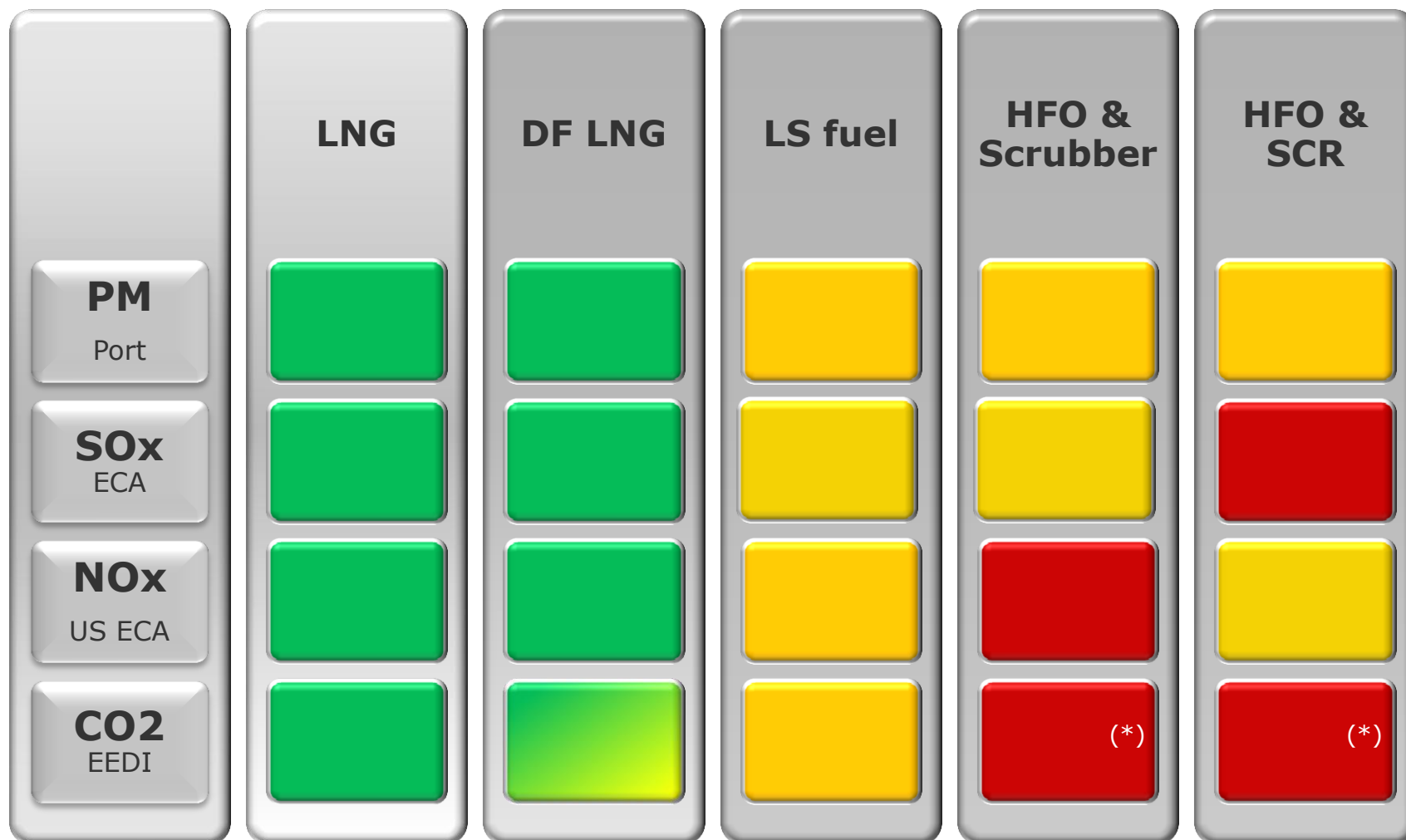
X axis : Time – 1996-2013

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



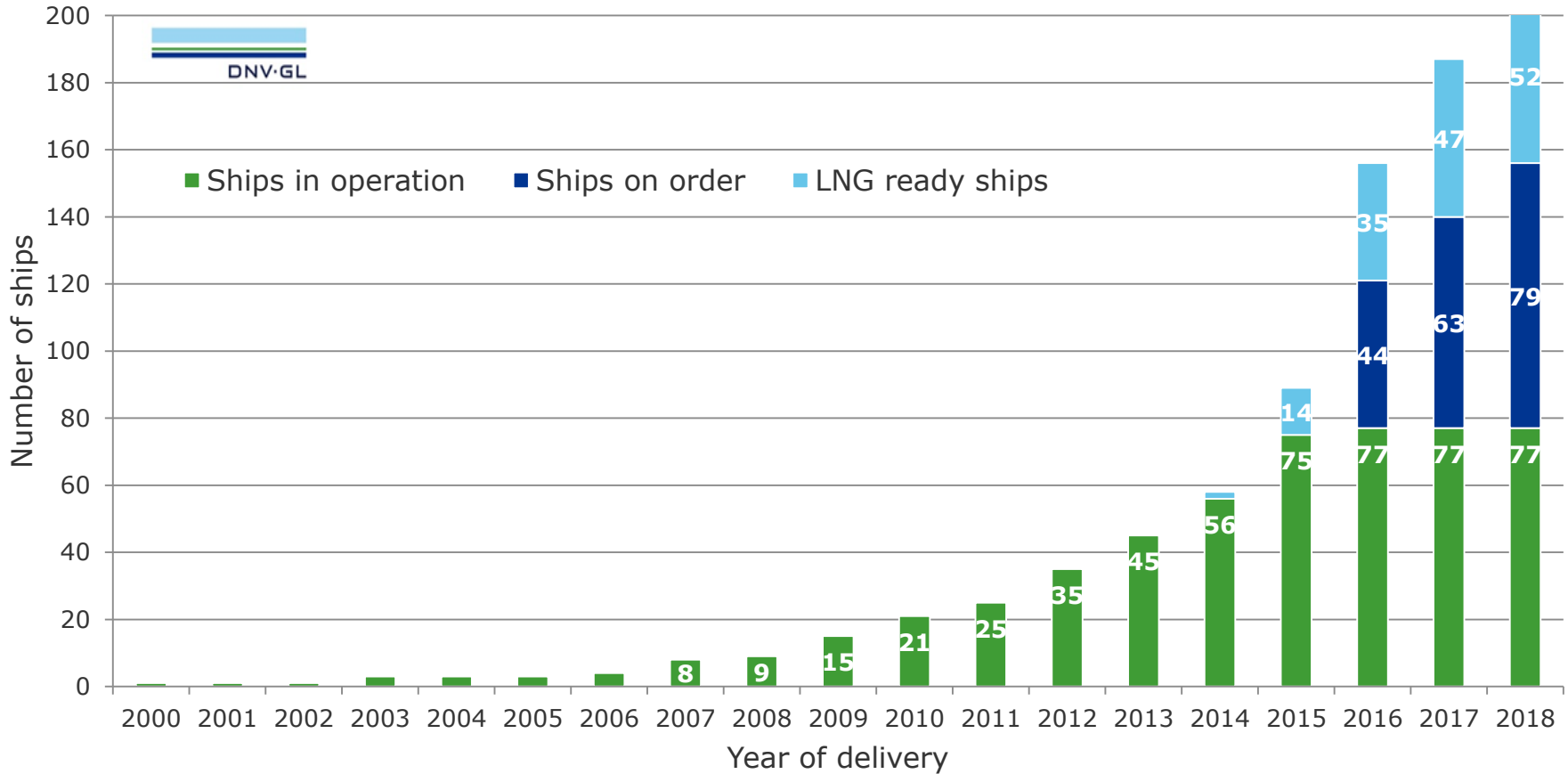
Emissions (4-stroke)



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(*) requires Energy

There are currently 162 confirmed LNG ship fuel projects



Additional orders beyond 2018 are confirmed

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Updated 21 March 2016

Excluding LNG carriers and inland waterway vessels

Energy efficiency comparisons

- Energy loss in transportation chain from well to consumer
 - CNG 5-8%
 - LNG 15%
 - Pipeline 3-5%
 - GTL 40%
 - LPG 5%

What's the trend in *relative PL vs LNG costs*

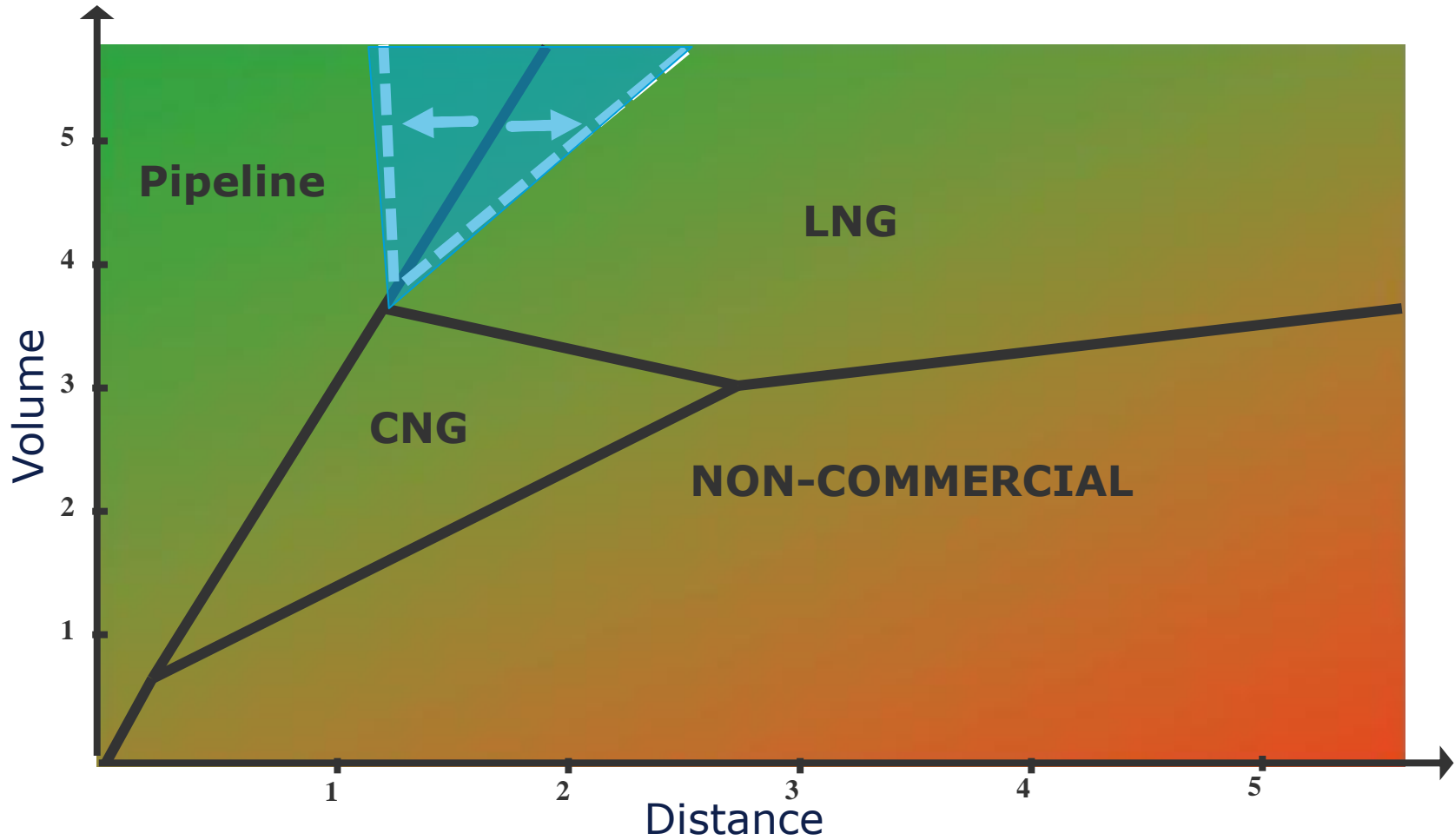
- **Roughly*** how many kilometres of installed offshore large diameter pipe – standard/typical project - did you get for the price of a large standard (160 000 m³) LNG vessel in:

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

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

(* "envelope" / non-verified, non-validated calculations)

Technological advances are bringing more transport options



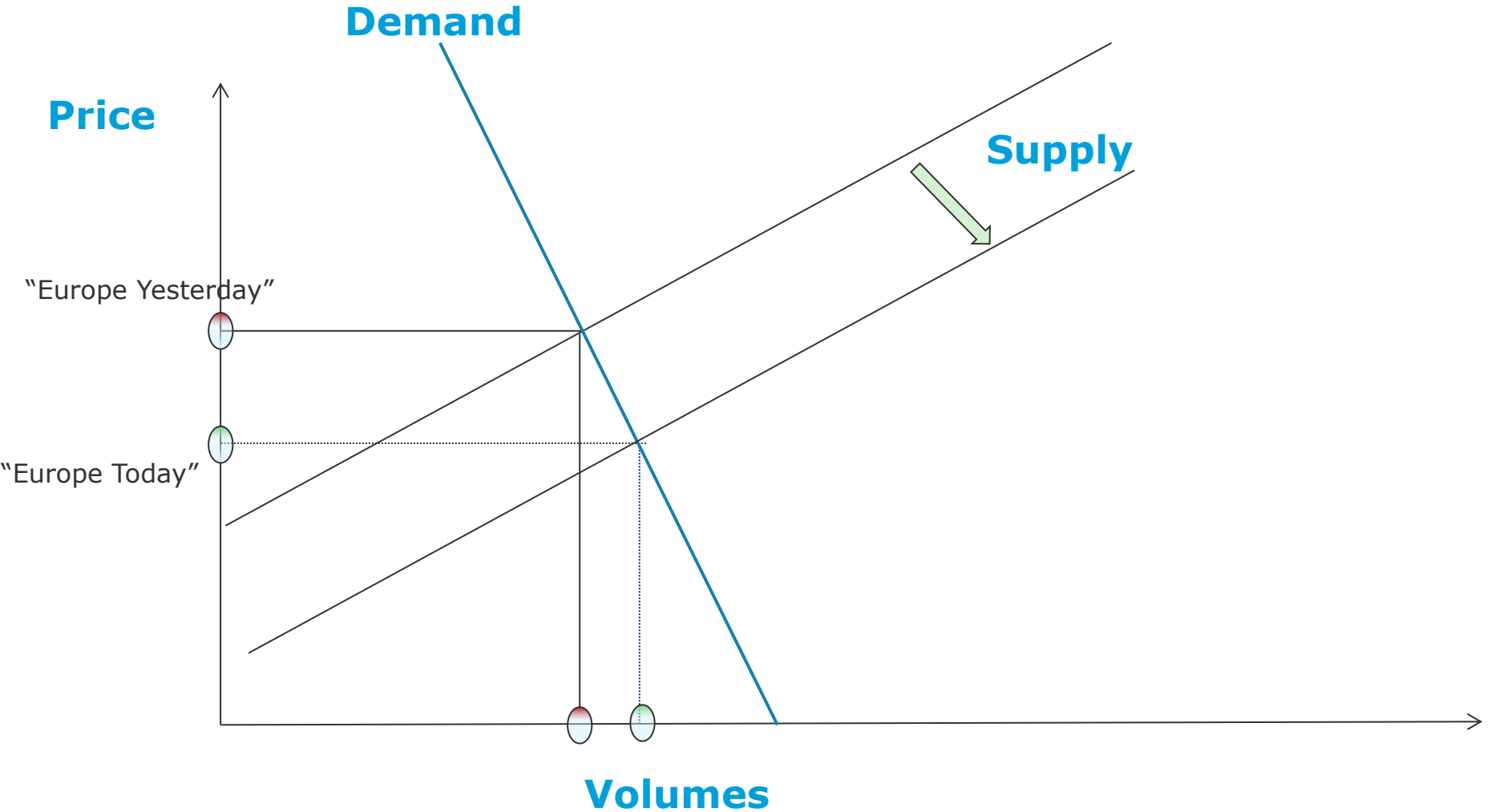
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Some relevant Variables to Consider

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	HIGH	Contributing: Energy loss
Increased cost of financing, more risk aversion.	0	–	–	PLs may more easily secure mutual commitments, and the more speculative LNG projects may struggle, but EU's 3rd Energy Directive decrease predictability for pipeline investors
Projects launched for political, rather economic reasons («stranded»)	–	+	+	The alternative/flexible market for LNG makes it more robust for possible over-capacity than pipelines.
Less local customer 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.

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Illustrative gas prices in Europe



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Combined transported solutions will add liquidity and volumes to gas markets, and may the thereby increase long term demand

Demand

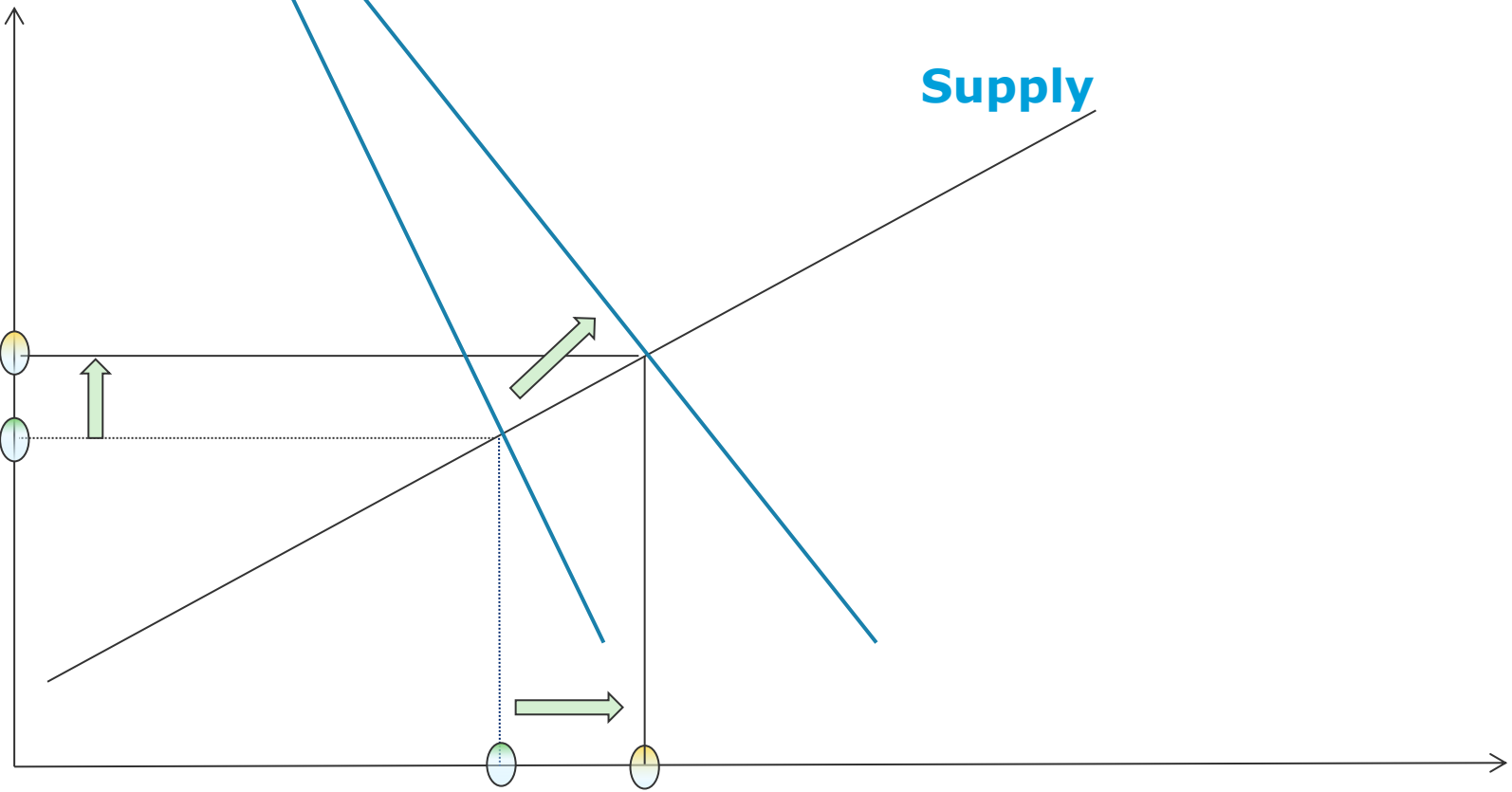
Price

Supply

"Europe Tomorrow"

"Europe Today"

Volumes



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Thank you

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SAFER, SMARTER, GREENER

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