RYSTAD ENERGY

HVA LIGGER I POTTEN?

OG21 FORUM

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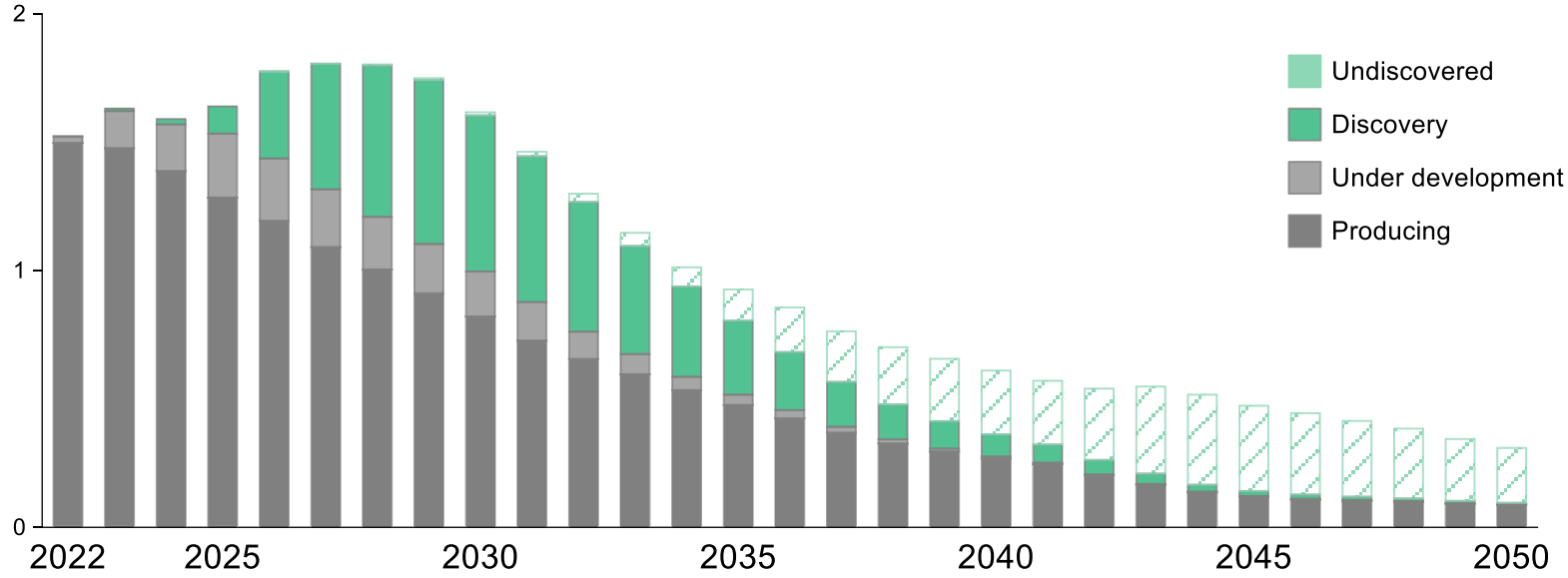
What is at stake?

NCS outlook 2022-2050
Production (million boe/d)



2022 - 2050

~28
billion boe in produced oil and gas volumes

~3000
billion NOK real in supplier purchases

~5000
billion NOK real in government take
(excluding SDØE and Equinor shares)

~190
million tonnes of CO2 emitted without further actions
(scope 1 – upstream emissions)

Successful transition and use of competence into new industries

Given a 2030 price at 50 USD/bbl real and 2040 price and 40 USD/bbl real
Source: Rystad Energy UCube

Two value levers: retain NCS competiveness and fight for a position in new energy markets

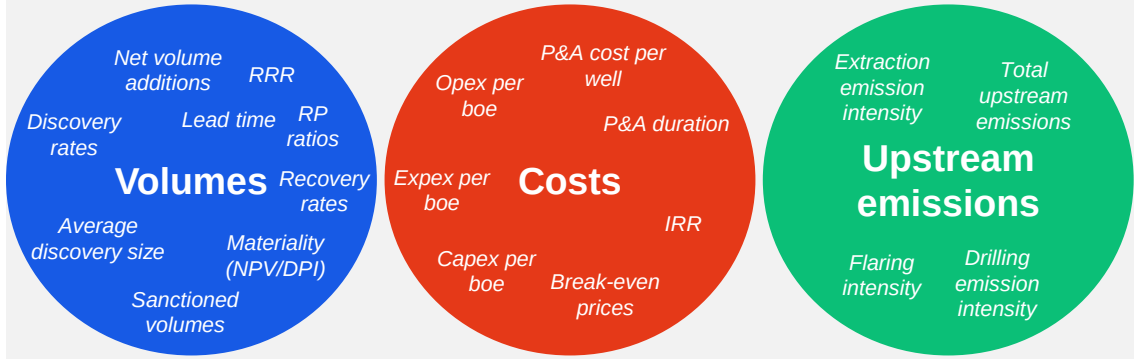
Retain competitiveness in an increasingly competitive landscape with less demand for fossil fuels

Based on the remaining resources/future activity the following technologies should be prioritized:

- *Technologies to target existing fields and topside infrastructure*
- *Technologies to target tie-backs*

An accelerated energy transition also implies that the following technologies should be prioritized:

- *Technologies that can be adopted quickly (demand projections decline rapidly post 2030)*
- *Technologies that reduce scope 1 emissions (will increase in importance with increased CO_2 costs)*

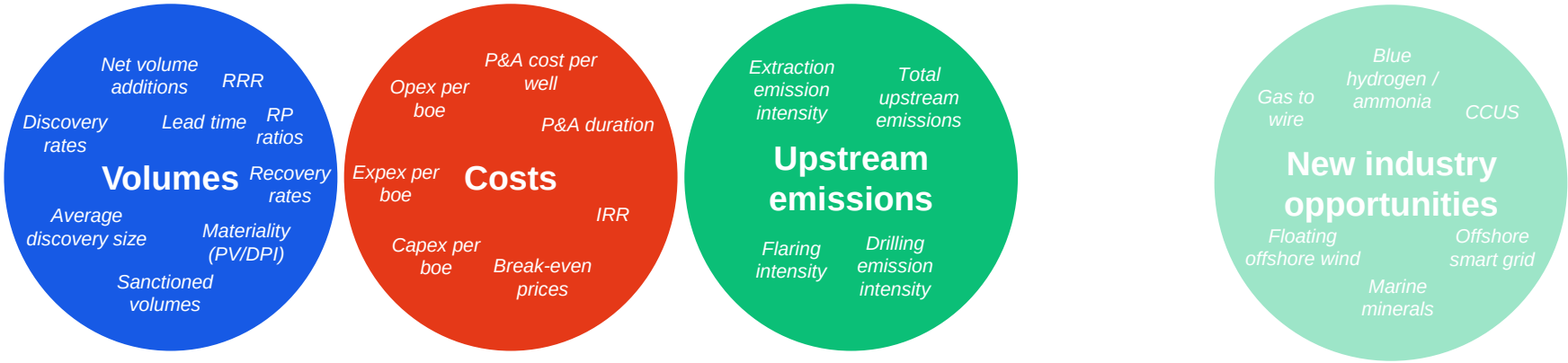


Position NCS for new energy markets by leveraging current capabilities

- *Oil and gas competences are highly complementary to several of the new energy markets*
- *Fit for Norway is not necessarily Fit for 55 (EU) as they have competing solutions for the energy transition.*
- *Brexit implies losing an energy voice similar to Norway in EU foras (blue hydrogen, CCUS , floating wind).*
- *Longer distance to market (transportation costs and losses) may prove a disadvantage if we do not utilize existing infrastructure*

Pace of energy transition shifts focus to the right

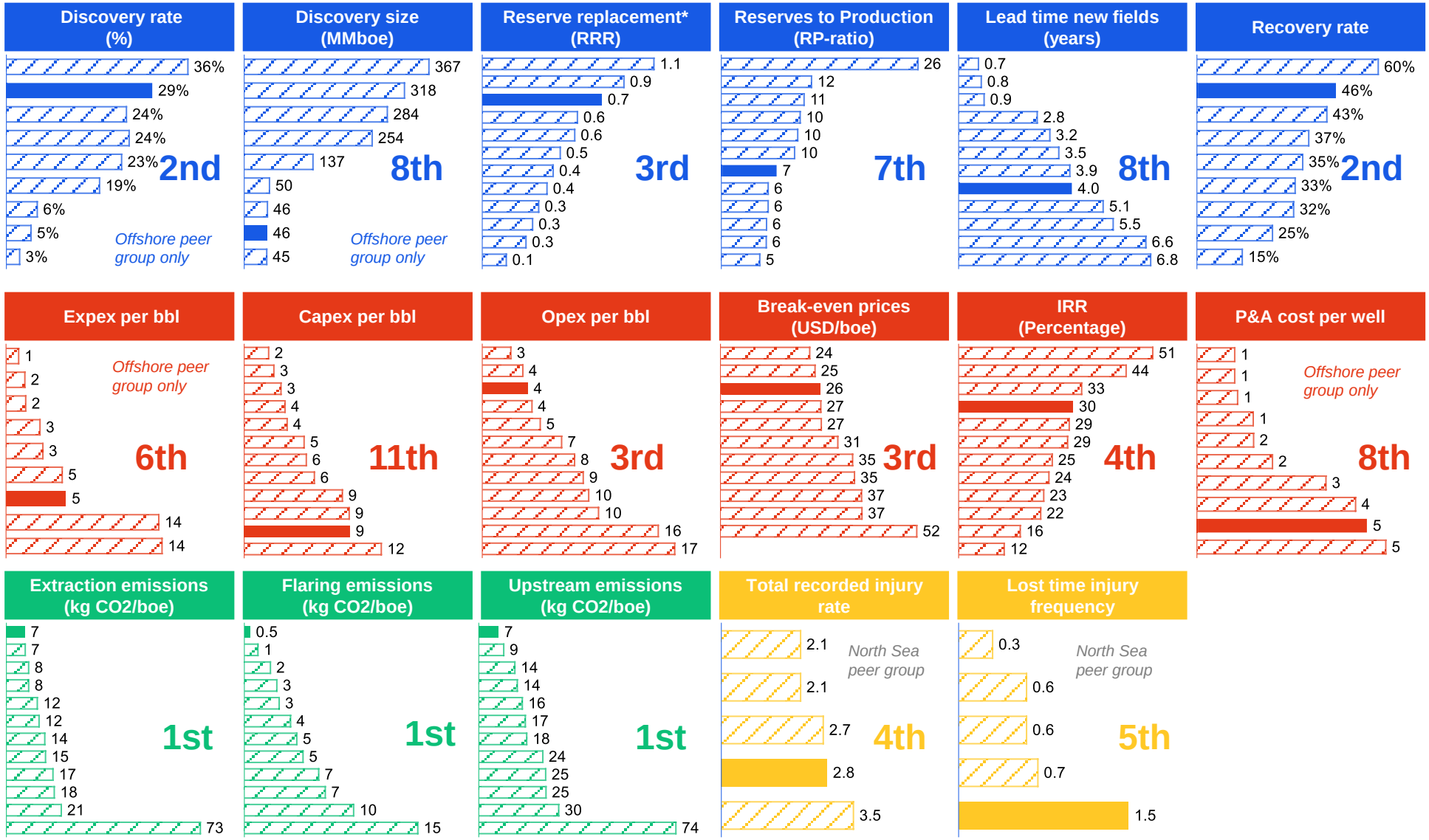
The pace of the energy transition implies change in competitiveness



NCS competitiveness metrics

Pace of energy transition shifts focus to the right

NCS is currently very competitive on many metrics, especially on emissions and lifting costs



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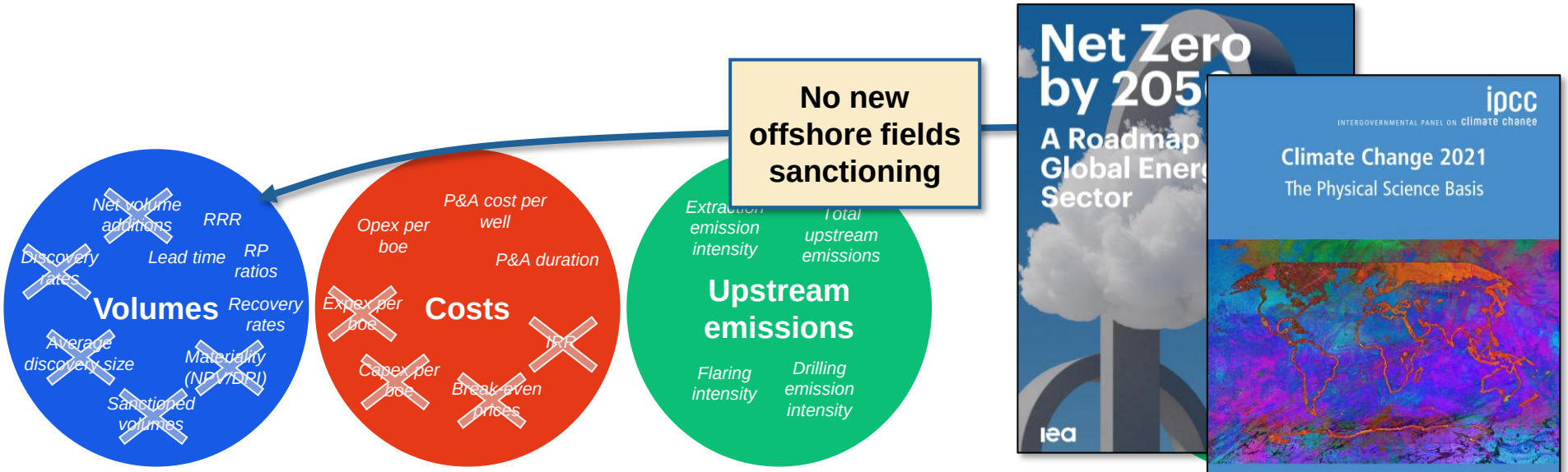
New publications call for extensive change in modus operandi



NCS competitiveness metrics

Pace of energy transition shifts focus to the right

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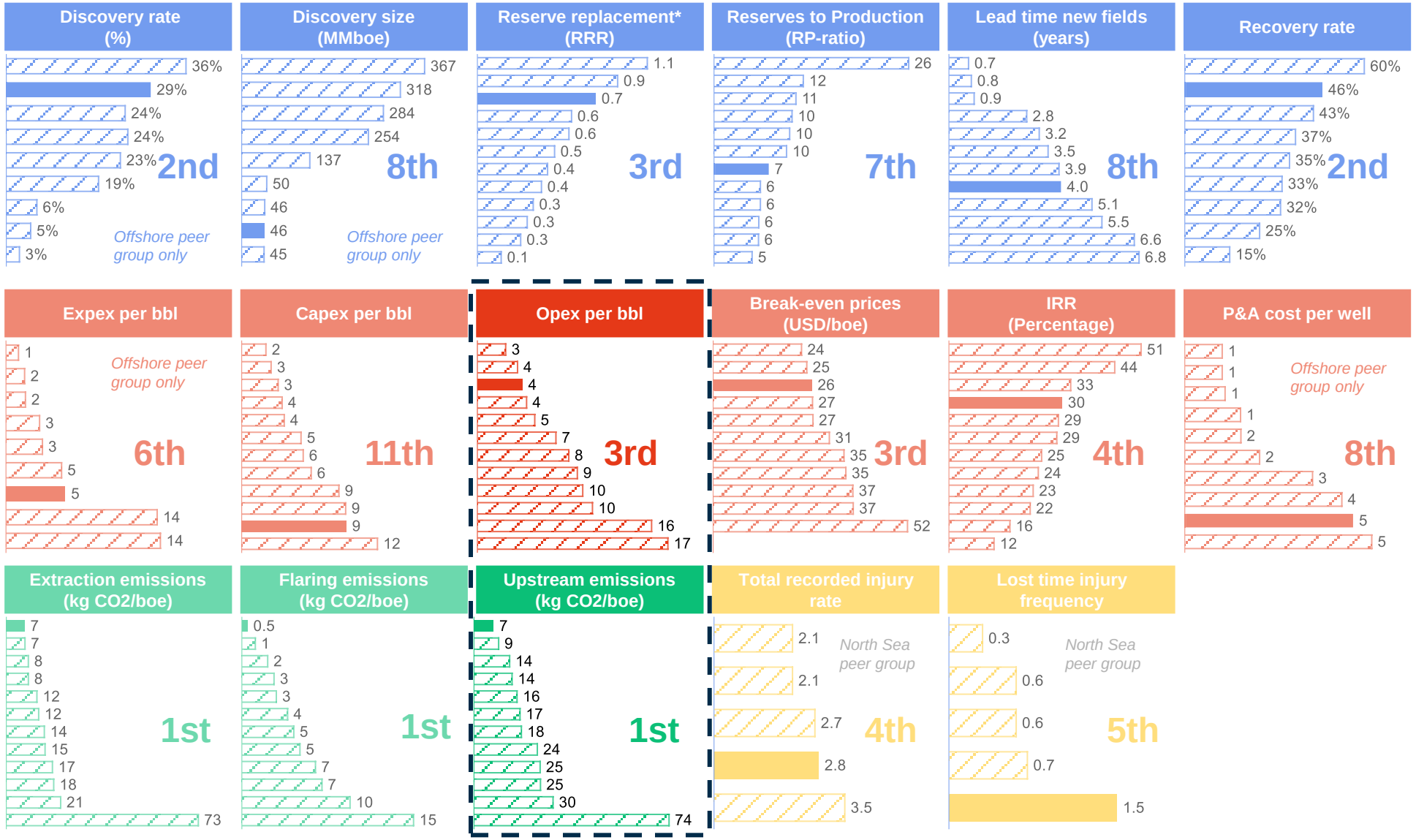
In an accelerated transition staying competitive on lifting costs and emission will be key to capture value



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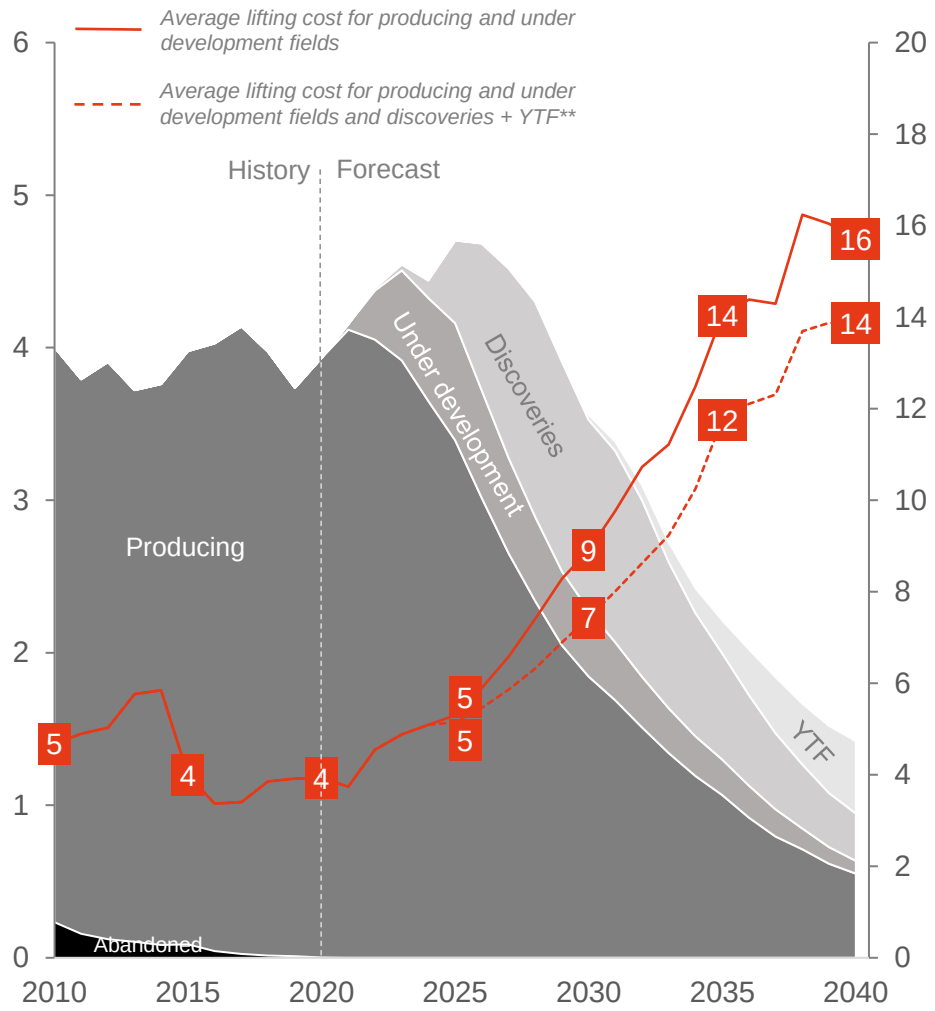
Competitiveness will not last without significant efforts

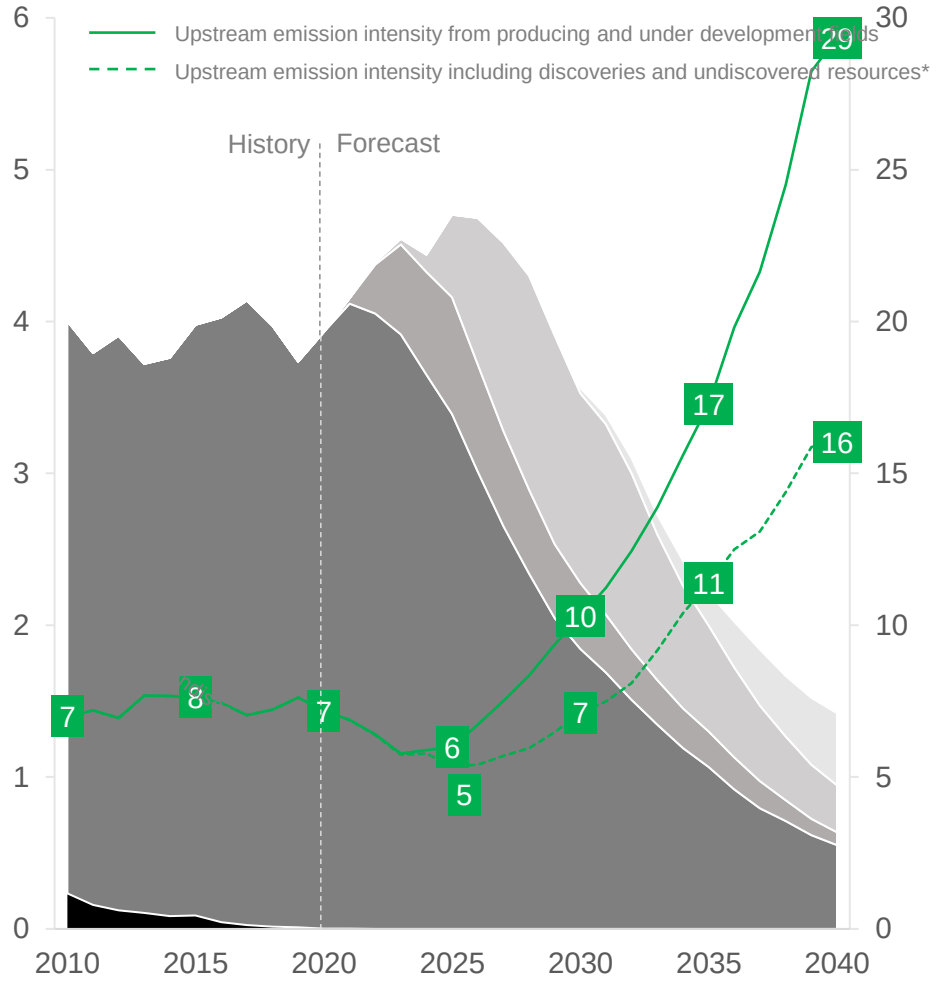
NCS Production
MMboe/d

Average lifting cost for NCS
Opex per boe produced*



NCS Production
MMboe/d

Upstream emission intensity for NCS**
kg CO2/boe



*Production opex only. SG&A and transportation tariffs not included; **only from opened areas
Source: Rystad Energy UCube

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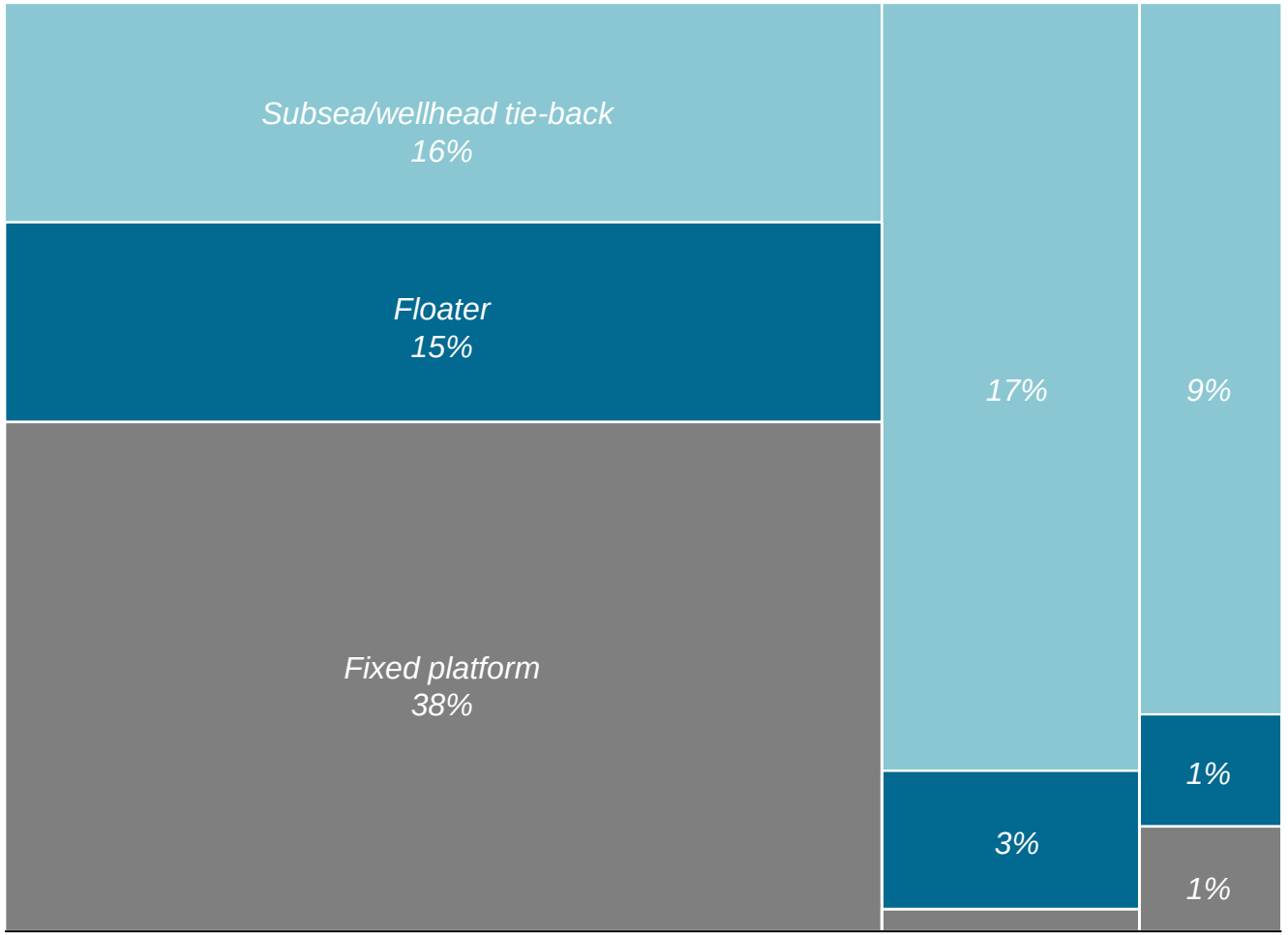
Almost 70% of 2021-2050 volume potential lie in sanctioned fields

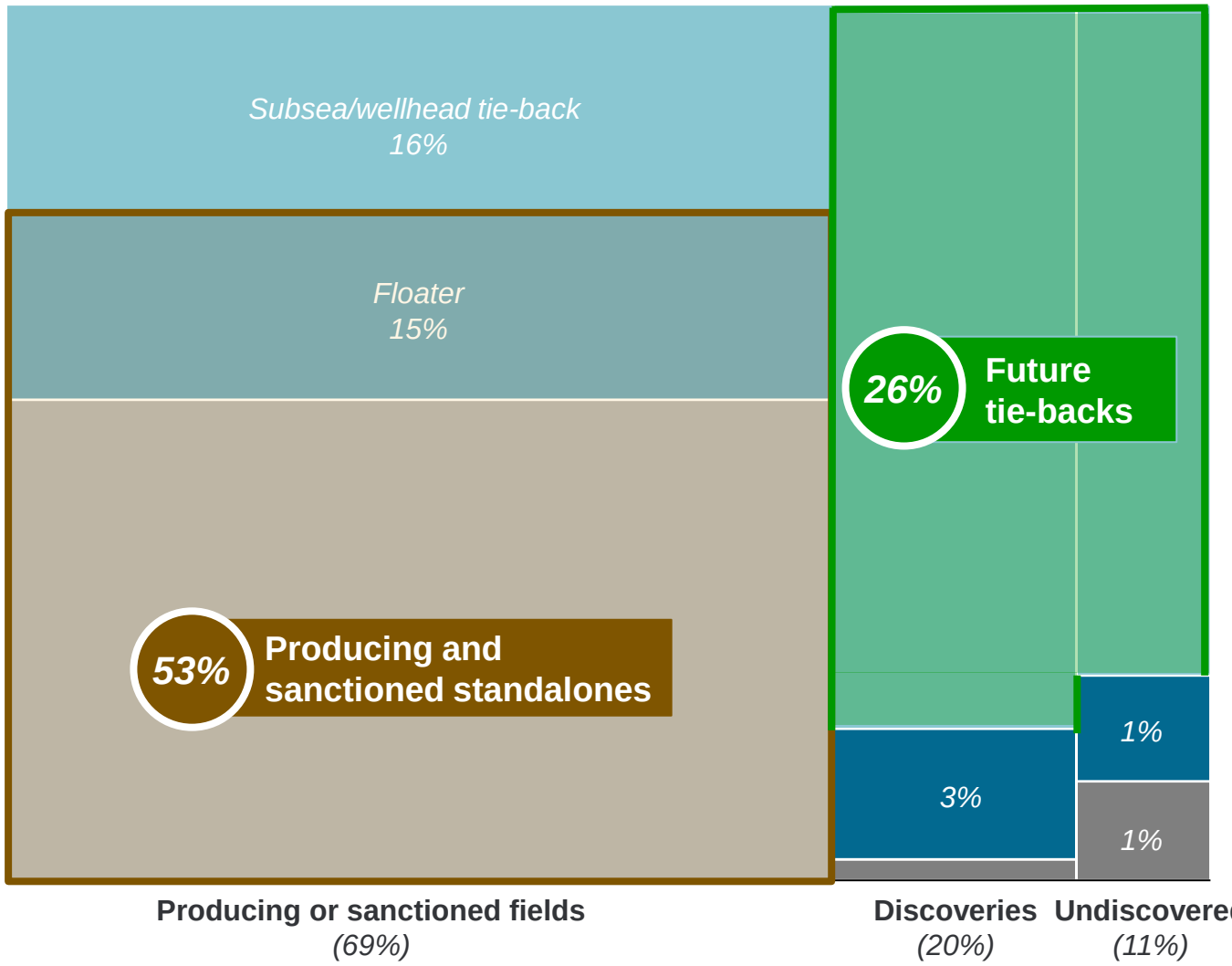
Future production on the NCS between 2021 and 2050



Source: Rystad Energy UCube

About one fourth of future production is expected from future tie-backs

Future production on the NCS between 2021 and 2050



A balance between these two buckets must see careful consideration:

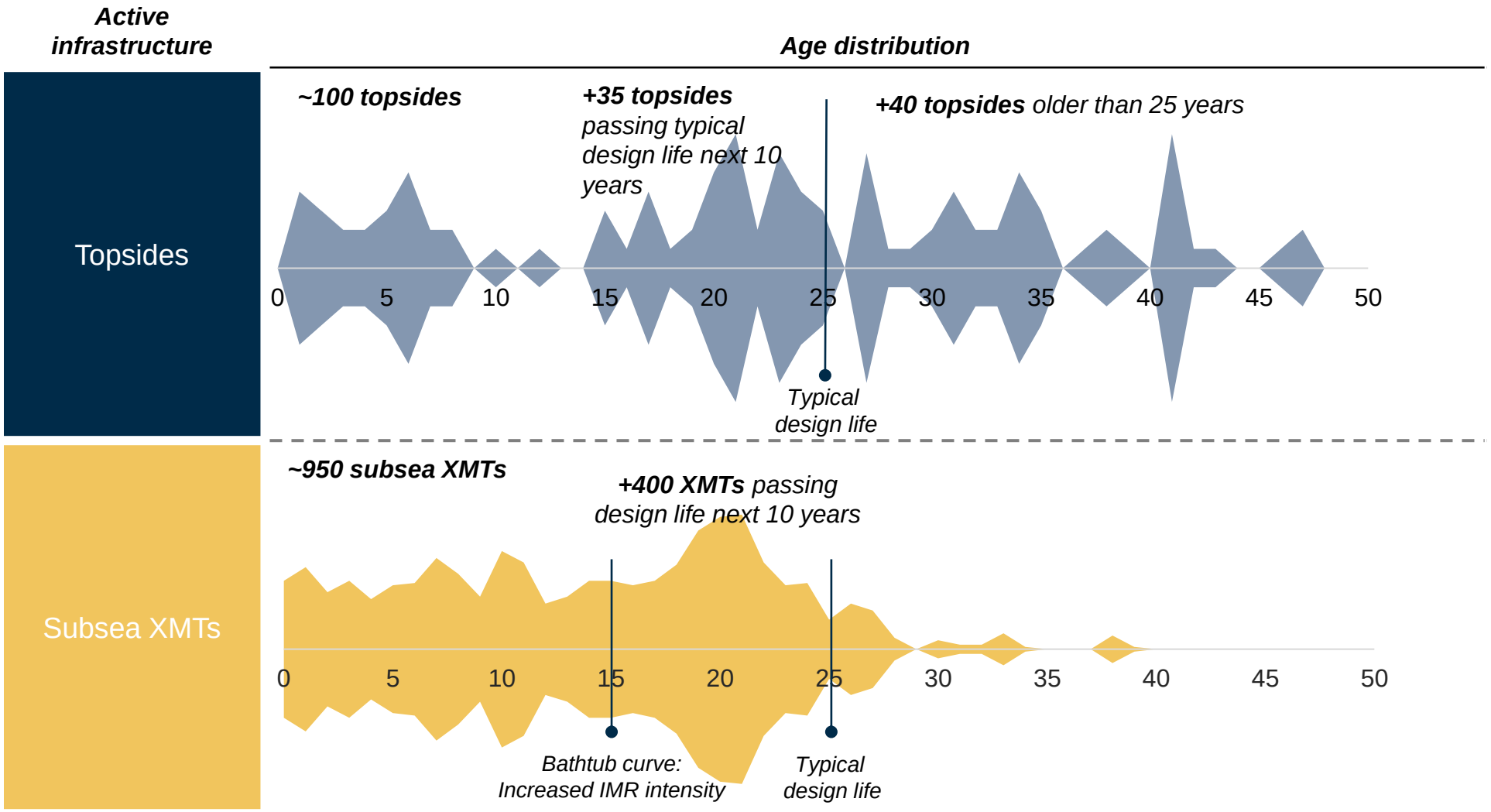
Maintain integrity on hosts to secure future tie-back volumes

Ensure electrification and improved energy efficiency on topsides to keep both buckets competitive

Rationalize hosts to retain operational efficiency advantage for the NCS – prioritize between volumes and rationalize hosts (later)

Source: Rystad Energy UCube

An ageing NCS – Significant challenges for maintenance intensity and integrity



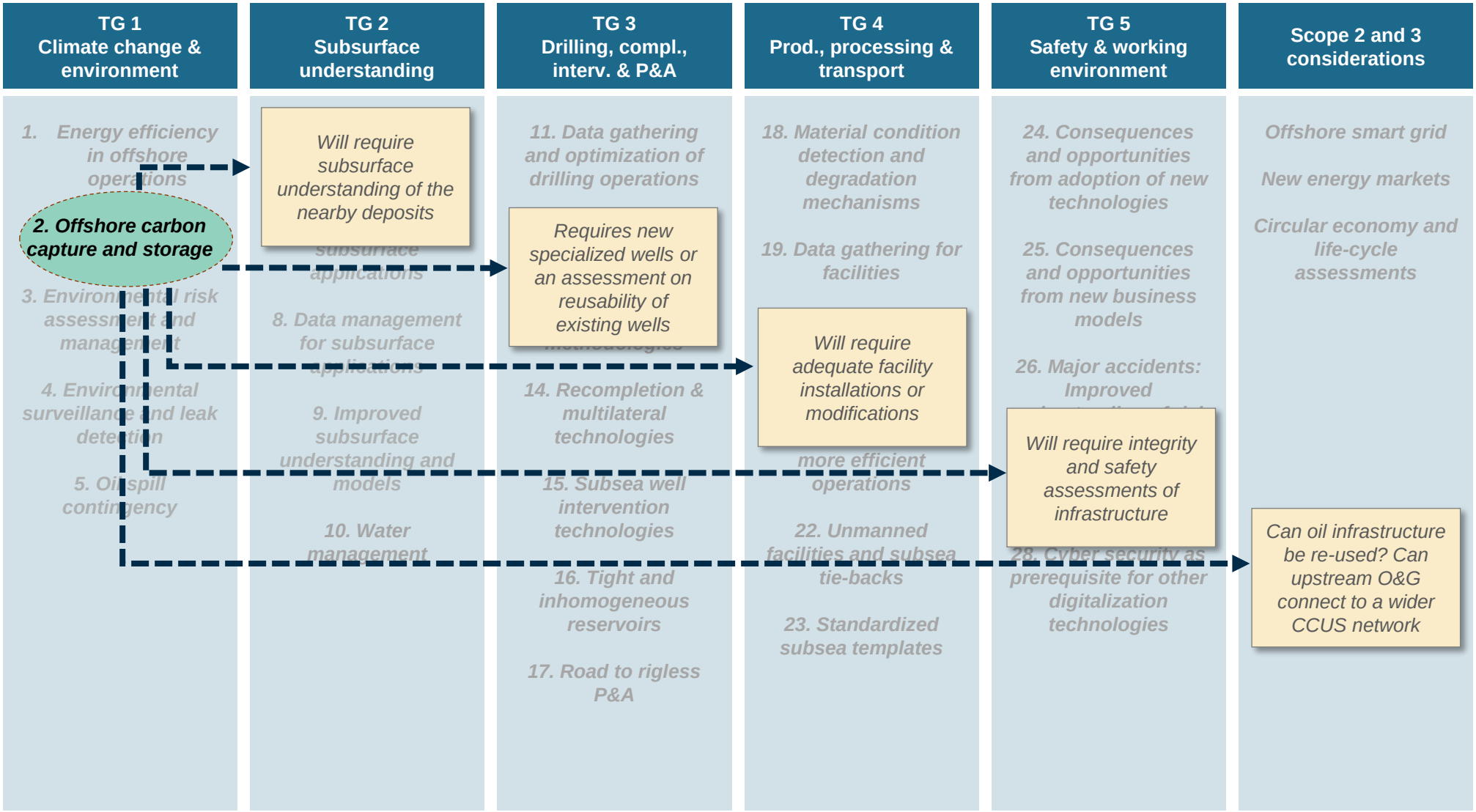
*Subsea XMT age based on age of main original wellbore - no replacements assumed only refurbishments
Source: NPD; Rystad Energy research and analysis

28 technology opportunities evaluated for their potential to secure NCs competitiveness

TG 1 Climate change & environment	TG 2 Subsurface understanding	TG 3 Drilling, compl., interv. & P&A	TG 4 Prod., processing & transport	TG 5 Safety & working environment	Scope 2 and 3 considerations
1. Energy efficiency in offshore operations	*7. Offshore CO2 storage and late-life deposits*	*11. Data gathering and optimization of drilling operations*	*18. Material condition detection and degradation mechanisms*	*24. Consequences and opportunities from adoption of new technologies*	*Offshore smart grid*
2. Offshore carbon capture and storage	*8. Data gathering for subsurface applications*	*12. Improved drilling equipment*	*19. Data gathering for facilities*	*25. Consequences and opportunities from new business models*	*New energy markets*
3. Environmental risk assessment and management	*8. Data management for subsurface applications*	*13. Advanced well construction and methodologies*	*20. Data management for facilities*	*26. Major accidents: Improved understanding of risk and uncertainty*	*Circular economy and life-cycle assessments*
4. Environmental surveillance and leak detection	*9. Improved subsurface understanding and models*	*14. Recompletion & multilateral technologies*	*21. Digital tools for improved maintenance and more efficient operations*	*27. Improved working environment*	
5. Oil spill contingency	*10. Water management*	*15. Subsea well intervention technologies*	*22. Unmanned facilities and subsea tie-backs*	*28. Cyber security as prerequisite for other digitalization technologies*	
		16. Tight and inhomogeneous reservoirs	*23. Standardized subsea templates*		
		17. Road to rigless P&A			

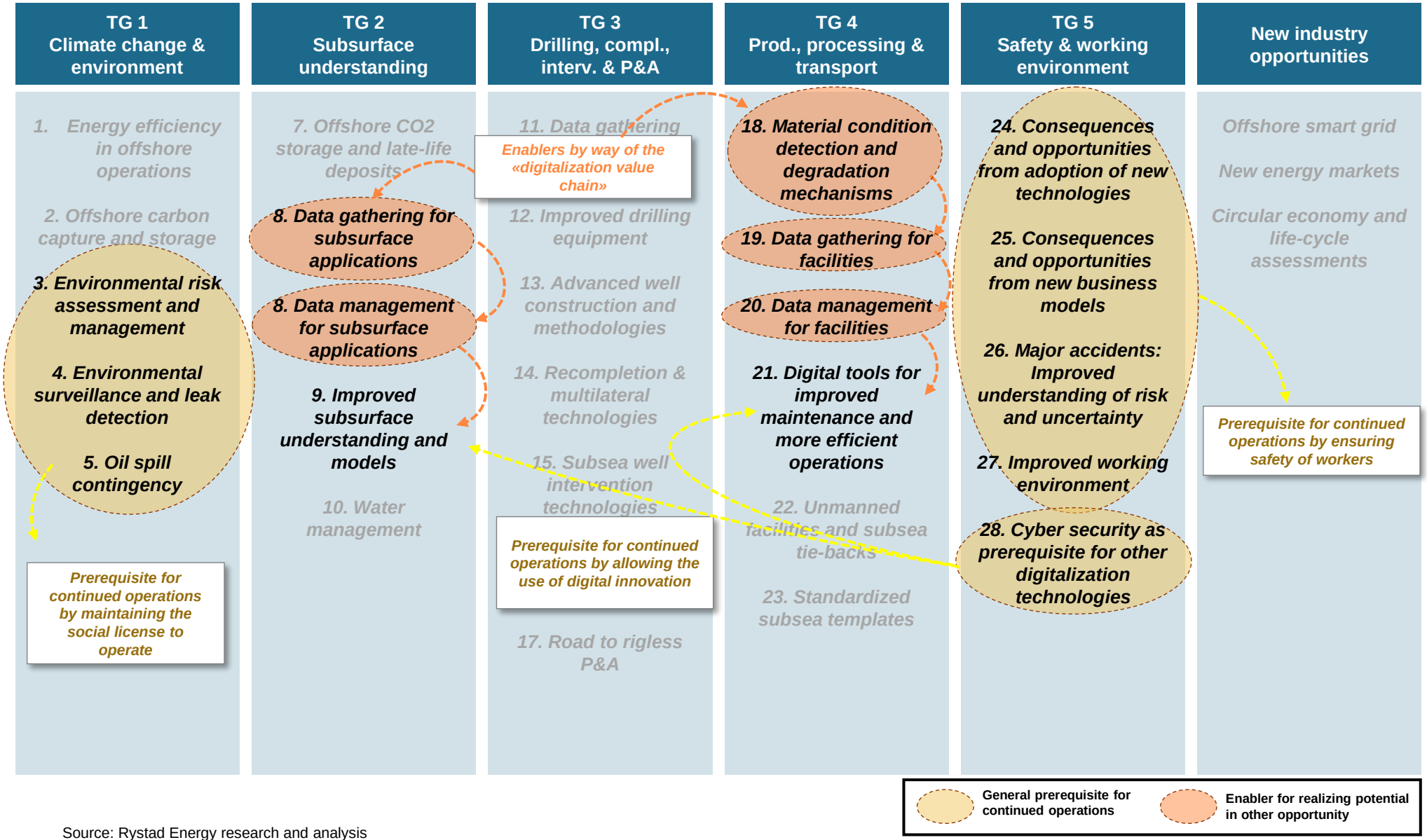
Source: Rystad Energy research and analysis

An opportunity allocated to a certain TG will most likely have some relevance to other TGs



Source: Rystad Energy research and analysis

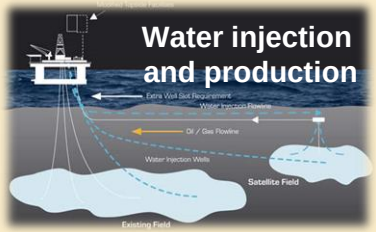
Some of the opportunities identified are enablers or prerequisites for those with direct effects



Source: Rystad Energy research and analysis

An opportunity allocated to a certain TG will most likely have some relevance to other TGs

TG 1 Climate change & environment	TG 2 Subsurface understanding	TG 3 Drilling, compl., interv. & P&A	TG 4 Prod., processing & transport	TG 5 Safety & working environment	Scope 2 and 3 considerations
1. Energy efficiency in offshore operations	*7. Offshore CO2 storage and late-life deposits*	*11. Data gathering and optimization of drilling operations*	*18. Material degradation*	*21. Competence*	*Offshore smart grid*
2. Offshore carbon capture and storage	*8. Data gathering for subsurface applications*	*12. Improved drilling equipment*	*19.*		*and*
3. Environmental risk assessment and management	*8. Data management for subsurface applications*	***13. Advanced well construction and methodologies***	*20.*		
4. Environmental surveillance and leak detection	*9. Improved subsurface understanding and models*	*14. Recompletion & multilateral technologies*	*22.*		
5. Oil spill contingency	***10. Water management***	*15. Subsea well intervention technologies*			
		16. Tight and inhomogeneous reservoirs	*23. Standardized subsea templates*	*technologies*	
		17. Road to rigless P&A			



- *Relevant to the topic of "Energy optimization" as a significant amount of turbine power is used on water pumps or water production*
- *Clearly relevant for the reservoir related topic of "Effective water injection and management"*
- *Also relevant for TG3 as water production can be partially addressed by improved well completion technology to avoid it reaching topsides in the first place.*

Source: Rystad Energy research and analysis

No silver bullet, a wide range of technologies needed to improve NCS competitiveness

TG	Opportunity name	Volume additions potential [mmboe 2020-2050]	Cost reduction potential [BUSD 2020-2050]	Upstream emissions reduction potential [mt CO2 2020-2050]
TG1 Climate change and environment	#1 Energy optimization offshore	*Neutral*	5.2	29.0
	#2 CCS for offshore oil and gas	*Neutral*	-9.0	35.0
	#3 Environmental surveillance and leak detection	*Prerequisite for continued operations and future technology adoption*		
	#4 Environmental risk assesment and management			
	#5 Oil spill contingency			
TG2 Subsurface under-standing	#6 CO2 for EOR and late life deposits	495	-13.0	*Very large, but scope 2&3*
	#7 Data gathering for subsurface understanding and models	*Enabler for technology opportunity #9*		
	#8 Data management for subsurface understanding and models			
	#9 Subsurface understanding and models	2560	10.0	1.5
	#10 Water management	1090	0.0	7.0
TG3 Drilling, completions, intervention and P&A	#11 Data gathering and optimization of drilling operations	1550	5.8	1.3
	#12 Improved drilling equipment	0	6.0	2.5
	#13 Advanced well construction and methodologies	840	4.4	0.9
	#14 Subsea well intervention technologies	1520	4.2	0.9
	#15 Recompletion & multilateral technologies	1350	7.0	0.6
	#16 Tight and inhomogenous reservoirs	970	-7.8	-1.9
	#17 More efficient P&A and road to rigless	*Neutral*	5.9	0.6
TG4 Production, processing and transport	#18 Material condition detection and degradation mechanisms	*Enabler for technology opportunity #21*		
	#19 Data gathering for facilties			
	#20 Data management for facilities			
	#21 Digital tools for improved maintenance and more efficient operations	970	20.0	16.5
	#22 Unmanned facilities and subsea tie-backs	800	11.0	1.5
	#23 Standardized subsea templates	710	14.6	*Neutral*
TG5 Safety and working environment	#24 Consequences and opportunites from adoption of new technologies	*Prerequisite for continued operations and future technology adoption*		
	#25 Consequences and opportunites from new business models			
	#26 Major accidents: Improved understanding of risk and uncertainty			
	#27 Improved work environment			
	#28 Cyber security as enabler of other digitalization technologies	*Prerequisite for digitalization technologies*		
New industry opportunities (scope 2 & 3)	Offshore smart grid	*See seperate evaluation*		
	Circular economy / life cycle assessments			
	New energy markets			

Source: Rystad Energy research and analysis

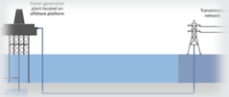
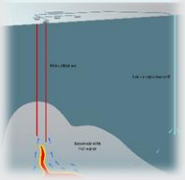
The pace of the energy transition implies change in competitiveness

NCS competitiveness metrics

Pace of energy transition shifts focus to the right

The potential for four out of seven new energy markets has been assessed

New energy markets

1 Hydrogen	2 CCS	3 Offshore wind	4 Marine minerals	5 Low-carbon fuels	6 Offshore gas to wire	7 Geothermal
						

Assessed

with the goal of determining potential to offset long term decline in oil and gas spending. Examples are synergized in a low carbon scenario.

Several overlaps in competence between O&G and new value chains for NCS OFS

NORWEGIAN COMPETENCE				COMMODITY INDUSTRY RELEVANCE					COMMENT
Norwegian geographical cluster	Field of industry competence	2019 Norwegian employment *[# employees]*	Examples of relevant players*	Oil and gas	Hydrogen 1	CCS 2	Offshore wind 3	Marine minerals 4	Competence relevance in potential alternate value chains
Eastern Norway	Seismic TG2	2,500	TGS, emgs, roxar, allton, PGS, magseis fairfield	●●●	●●●	●●●	○○○	●●●	Very compatible with hydrogen, CCS and Marine minerals. CCS for the purpose of finding and monitoring the appropriate reservoirs and marine minerals to assess resource densities.
	Geology TG2			●●●	●●●	●●●	●○○	●●●	Relevant for initial and life cycle geological studies and analysis of formations.
	Engineering TG4	9,500	OLAV OLSEN, moss maritime, GLOBAL MARITIME	●●●	●●●	●●○	●●○	●●○	All new energy markets are asset heavy, implying the need for engineering services. Pressure handling inherently makes O&G more complex than most the others.
	Subsea TG4	16,500	AkerSolutions, TechnipFMC, subsea 7	●●●	●●●	●●●	●●○	●●○	Most activity for new energy markets seen to happen in deeper-than-shelf waters. Analogues to risers, pipeline systems etc. likely to play a part.
West coast	Marine operations	9,000	DEEPOCEAN, DOF, Østensjø Rederi, SOLSTAD OFFSHORE	●●●	●●●	●●○	●●●	●●●	Marine operations essential for CCS and marine minerals for bringing or disposing of commodity in question. Also relevant for offshore wind, especially in installation phase.
	EPC- and shipyards TG4	15,000	aibel, VARD, KVÆRNER, KLEVEN, ULSTEIN	●●●	●●●	●●○	●●○	●●●	Similar to the Engineering segment, relevance is attributed to asset heavy nature of the new energy markets and the need to design and manufacture components.
	Drilling TG3	10,000	Transocean, Seadrill	●●●	●●●	●●○	○○○	●○○	Drilling operations not relevant for wind. Limited relevance for marine minerals given far smaller exposure to pressure as a complexity in commodity extraction.
South coast	Drilling rig- and topside equipment TG3	22,000	Schlumberger, ABB, mhwirth, NOV, WÄRTSILÄ	●●●	●●●	●●○	●○○	●●○	Drilling equipment relevant for well dependent hydrogen and CCS value chains. innovative equipment is needed in the case of marine minerals for the purpose of extracting wet bulk.
Country wide	Automation and digital technologies All	26,000	Sekal, Cognite, Eelume, KONGSBERG	●●●	●●●	●○○	●○○	●●●	Marine minerals set to be dependent on ROV-type solutions for subsea extraction of wet soil for processing.
	Other, incl. maintenance services TG4		DNV·GL, AXESS, I·K·M, JOTUN	●●●	●●●	●●●	●●●	●●●	High maintenance and integrity requirements for all new energy markets. Safety especially relevant for hydrogen, leak detection for CCS, integrity of rotation equipment for wind and subsea IMR for marine minerals.

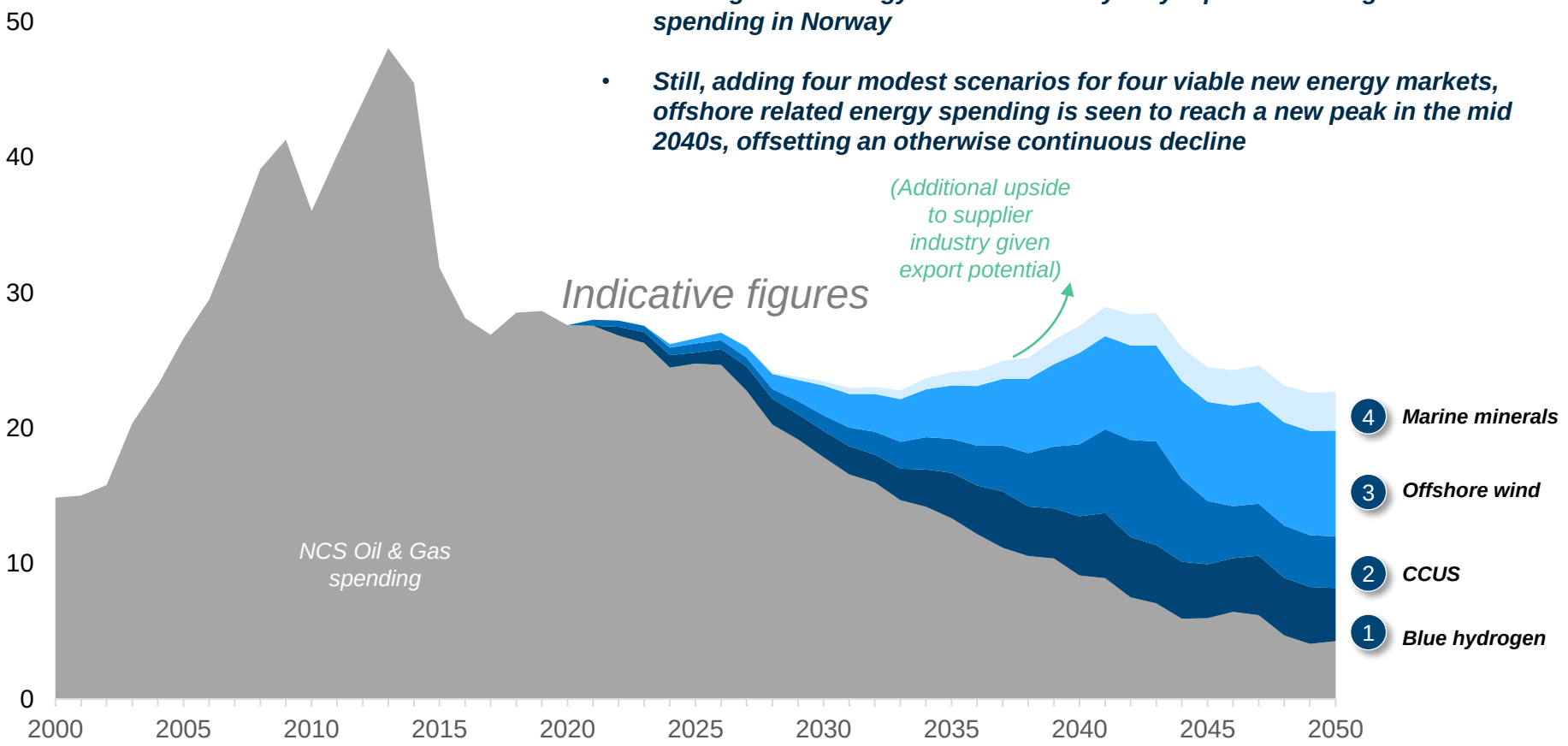
*Many of the listed oil field service companies perform work within several fields of competence, logos placed based on their main activities
Source: Rystad Energy research and analysis; Brønnøysundregistrene; Statistics Norway; Norwegian Petroleum

○○○ *Relevance degree - from high (3 filled) to low (1 filled)*

New value chains may compensate for a decreasing spend in oil and gas

Norwegian oil and gas spending from sanctioned fields* and parallel competence segments
USD billion

- ***No single new energy market will likely fully replace oil and gas in terms of spending in Norway***
- ***Still, adding four modest scenarios for four viable new energy markets, offshore related energy spending is seen to reach a new peak in the mid 2040s, offsetting an otherwise continuous decline***



*Includes both capital and operational expenditures, in addition to historical exploration costs and assumed future exploration costs
Source: Rystad Energy research and analysis; Rystad Energy UCube