OG21

OPEN INDUSTRY INPUT MEETINGS

February 3-4, 2021

Industry economic support 2021:

equinor vår energi Lundin Norway OMV ConocoPhillips NEPTUNE ENERGY

Date & time	Theme/challenge	Discussion facilitator
Feb.3., 09:00-11:00	Reduction of climate gas emissions: • In production • Throughout value chain	Luke Purse, TG1
Feb.3., 13:00-15:00	Safety and working environment: • Major accident prevention • Working environment	Espen Forsberg Holmstrøm, TG5
Feb. 4, 09:00-11:00	Cost-efficient exploration and operations: • Drilling, wells and P&A • Subsurface understanding	Jan Roger Berg, TG3
Feb.4, 13:00-15:00	Digitalization and automation: • Remote operations • Unmanned / low-manned • Autonomy	Kjetil Skaugset, TG4

Agenda:

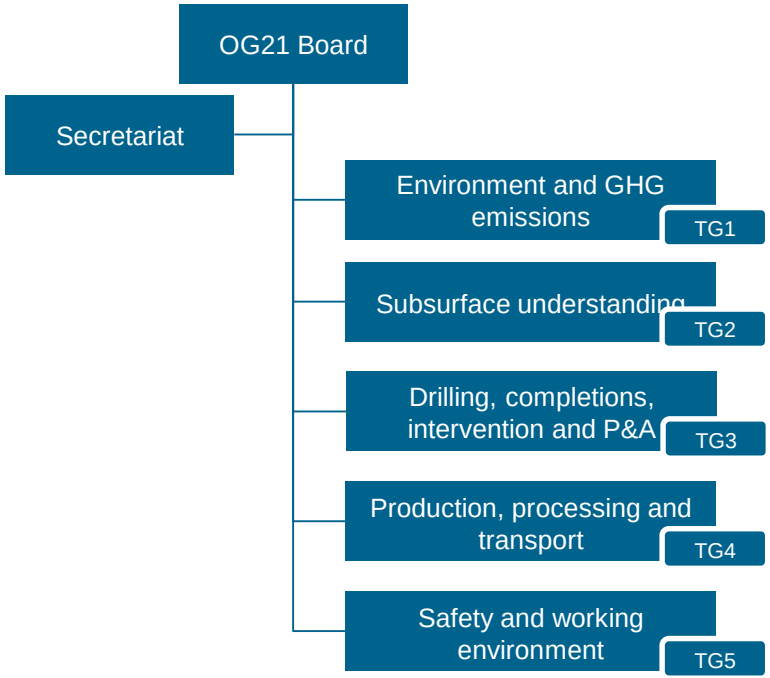
- Welcome. 5 mins.
- Strategy revision scope and timeline. 10 min.
- Introduction to theme. 15 min.
- Facilitated discussion, 75 min.
- Summary and next steps. 15 mins.

HOUSERULES FOR DISCUSSIONS

Chat – New suggestion / opportunity

Hand – Comment, clarification to on-going discussion

OG21 – AN INDUSTRY R&D COLLABORATION



OG21 SEEKS INPUT TO STRATEGY REVISION

Input opportunities:

Input form
Dec.2020-Feb. 2021

Input meetings
February 2021

Commenting round
Aug-Sept. 2021

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STRATEGY REVISION TIMELINE

Preparations
- 2020

Open industry meetings
- Feb.3-4

OG21 workshops
- March - May

Comments
- Aug.-Sept.

Final strategy document
- OG21-forum
- Nov.11, 2021

OG21 vision: Technology enabling the future of petroleum

Secure attractiveness and competitiveness

Robustness to fluctuations in oil and gas prices

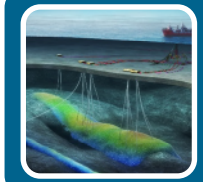
World class safety and environmental performance

Low CO2-emissions in production and value chains.

Shorter lead-times to attract investments.

Strategic objectives:

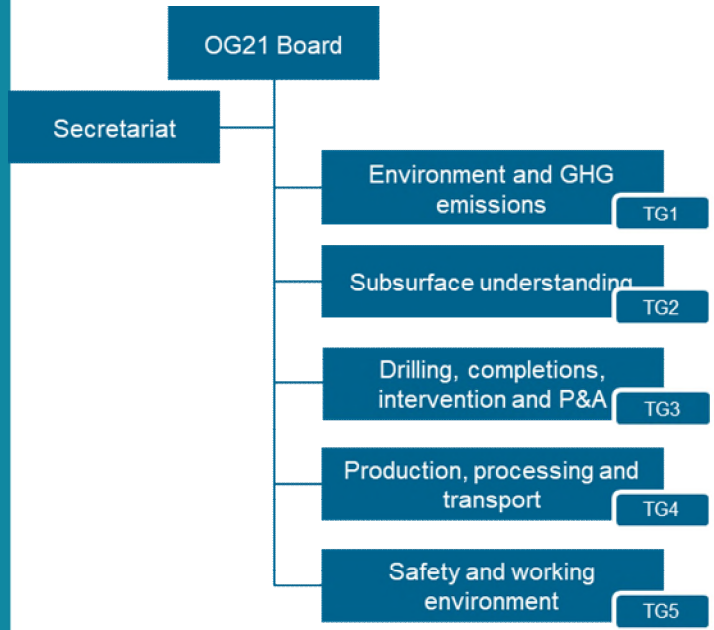
Safe operations with minimized environmental impact



Efficient resource utilization and reduced costs

Internationally competitive competence and technology suppliers

STRATEGY REVISION SCOPE



Scenario based

Ideas to broad implementation

Energy system perspective

Upstream + value chains

Value driven – maintain competitiveness

Technology opportunities

Knowledge opportunities

Drivers and hurdles

Identify cross-industry opportunities

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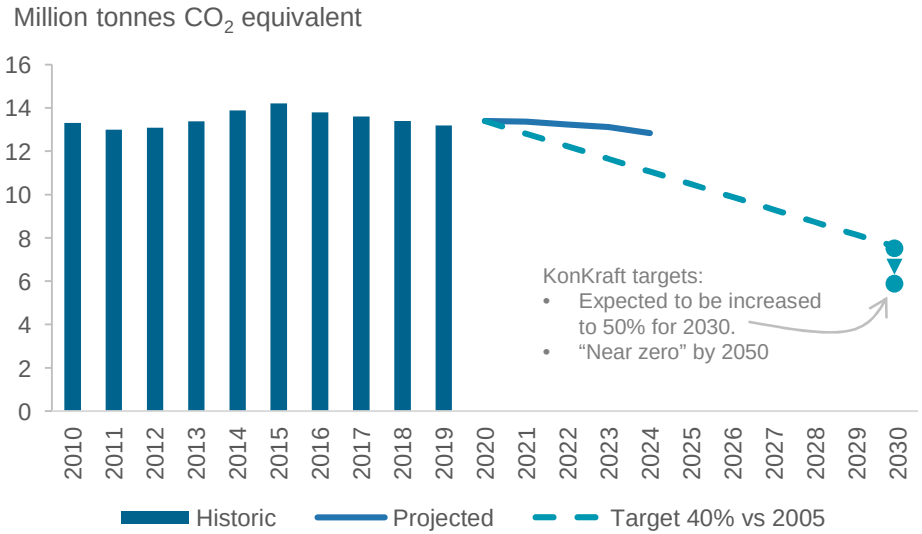
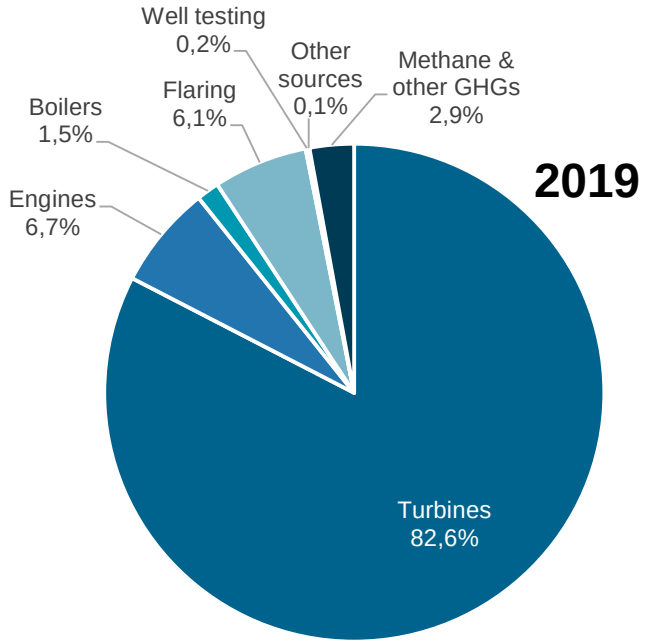
INTRODUCTION
REDUCTION OF GHG EMISSIONS

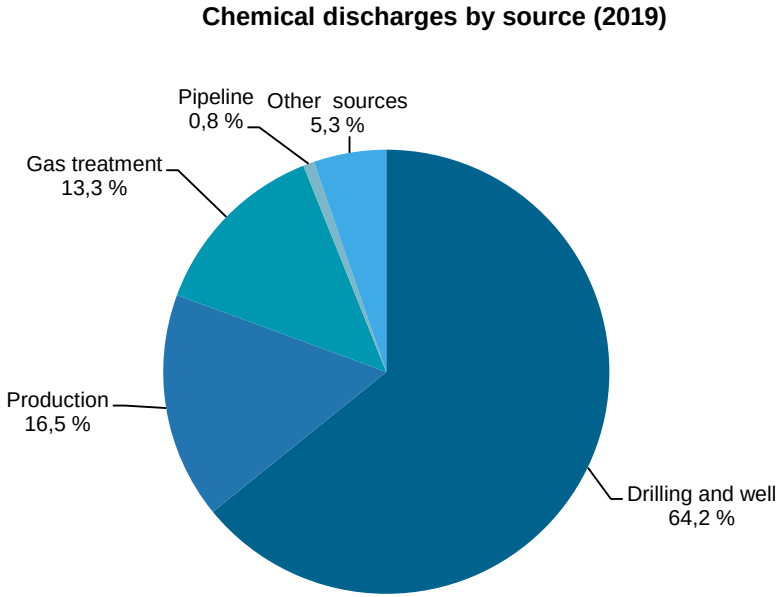
GREENHOUSE GAS EMISSIONS FROM THE NORWEGIAN PETROLEUM SECTOR

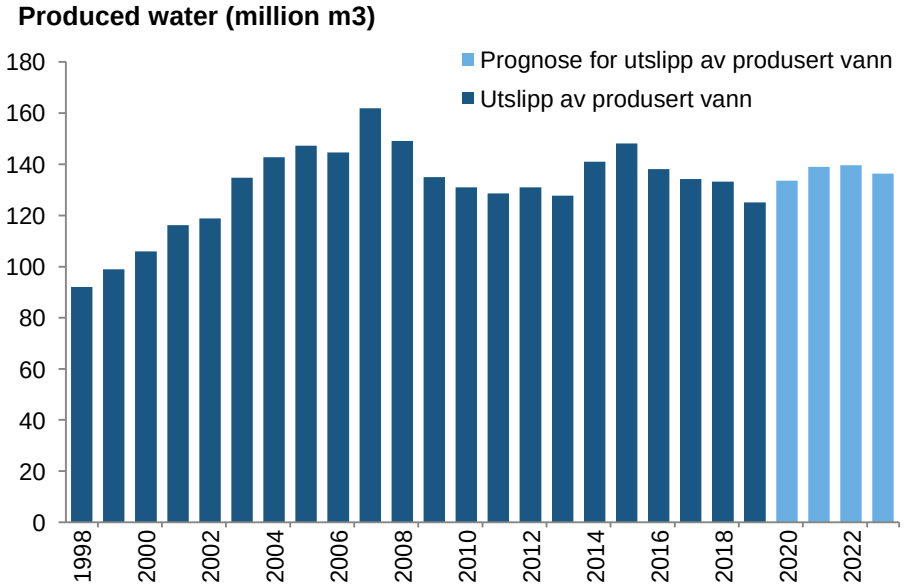




Source: https://www.norskpetroleum.no/en/environment-and-technology/emissions-to-air/

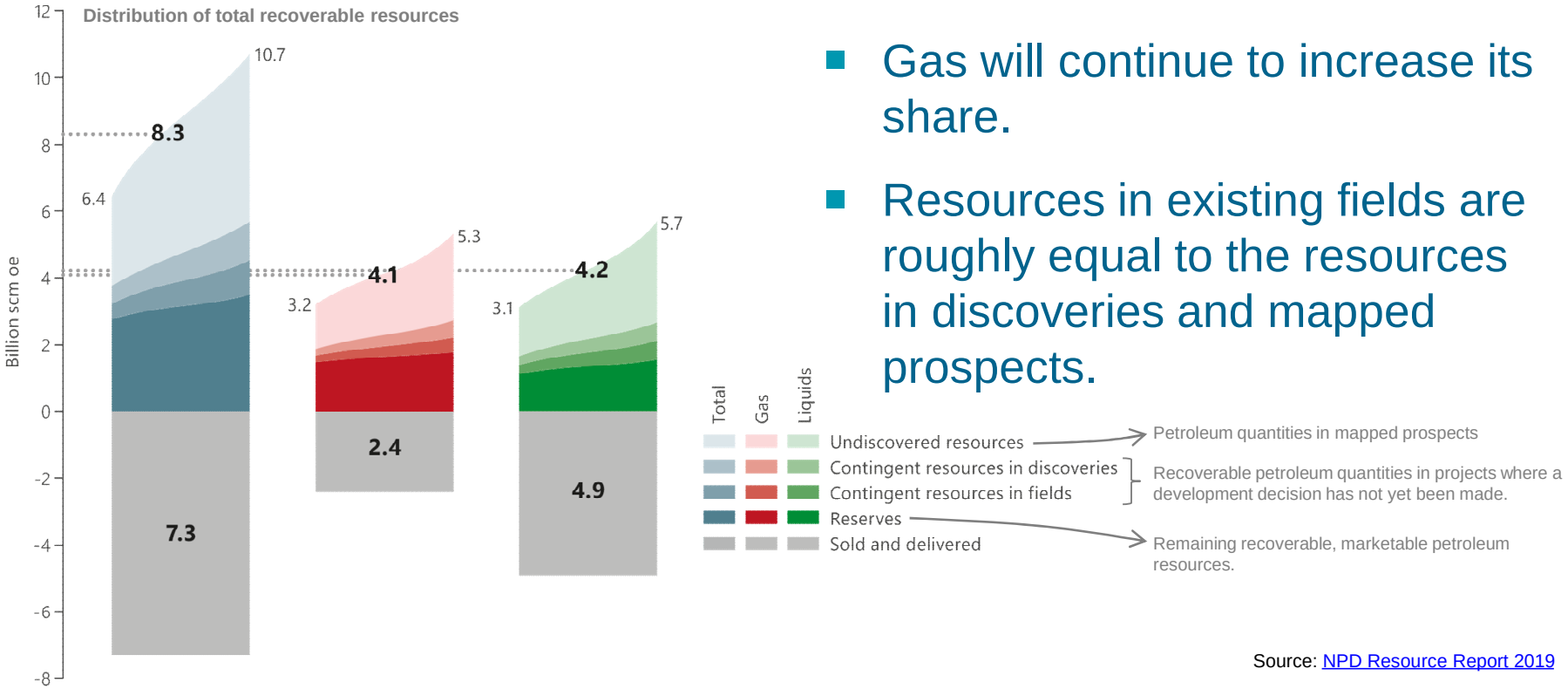
DISCHARGES TO SEA





Source: https://www.norskpetroleum.no/en/environment-and-technology/discharges-to-the-sea/

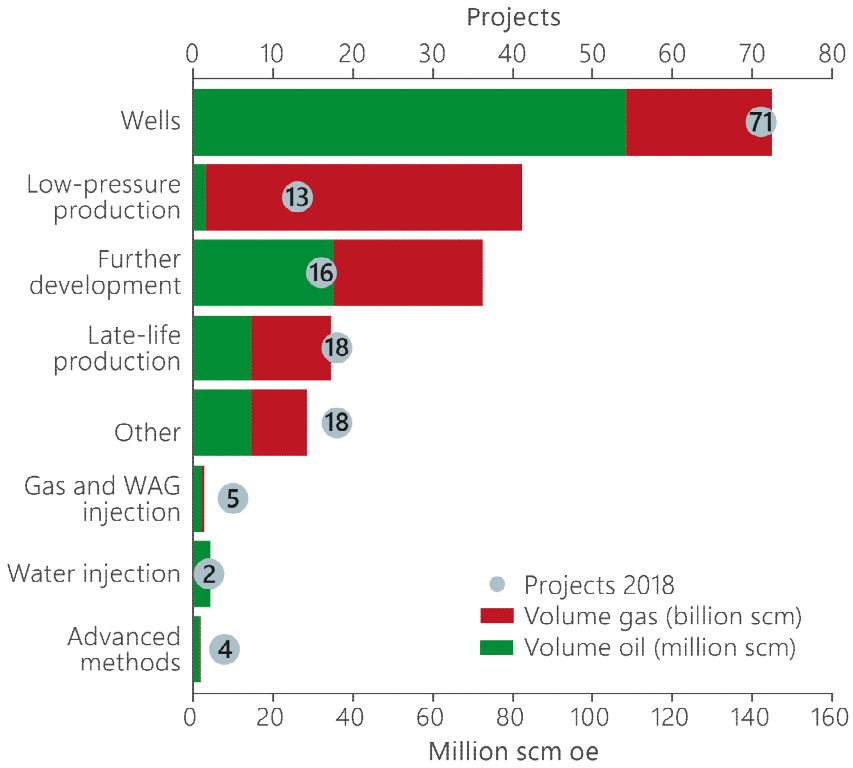
NCS TRENDS: RECOVERABLE RESOURCES



- Gas will continue to increase its share.
- Resources in existing fields are roughly equal to the resources in discoveries and mapped prospects.

Source: NPD Resource Report 2019

NCS TRENDS: EXISTING FIELDS

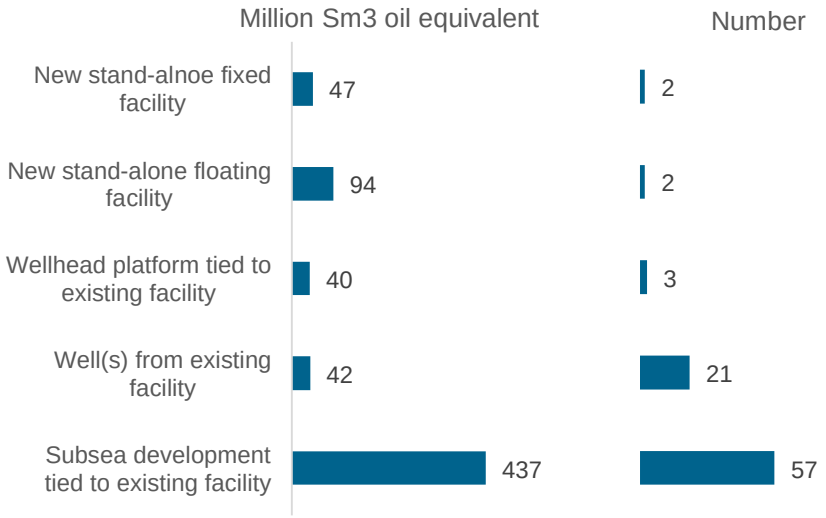


Specific but undecided projects for improving recovery from fields:

- Dominated by new wells.
- Low-pressure production likely to involve additional topside compression work.
- “Further developments” is predominantly subsea projects involving new templates tied back to existing facilities.

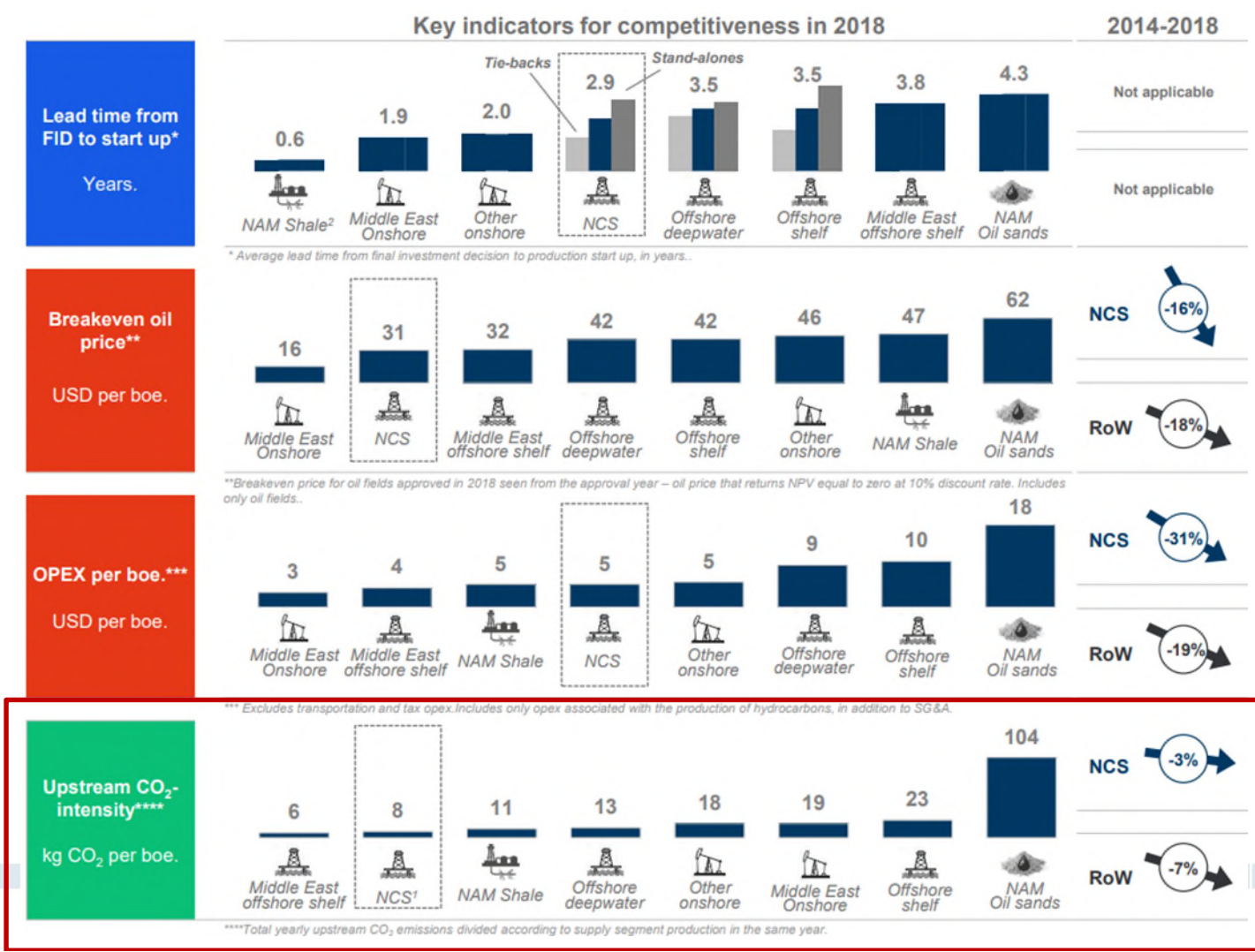
Source: NPD Resource Report 2019

NCS TRENDS: DISCOVERIES



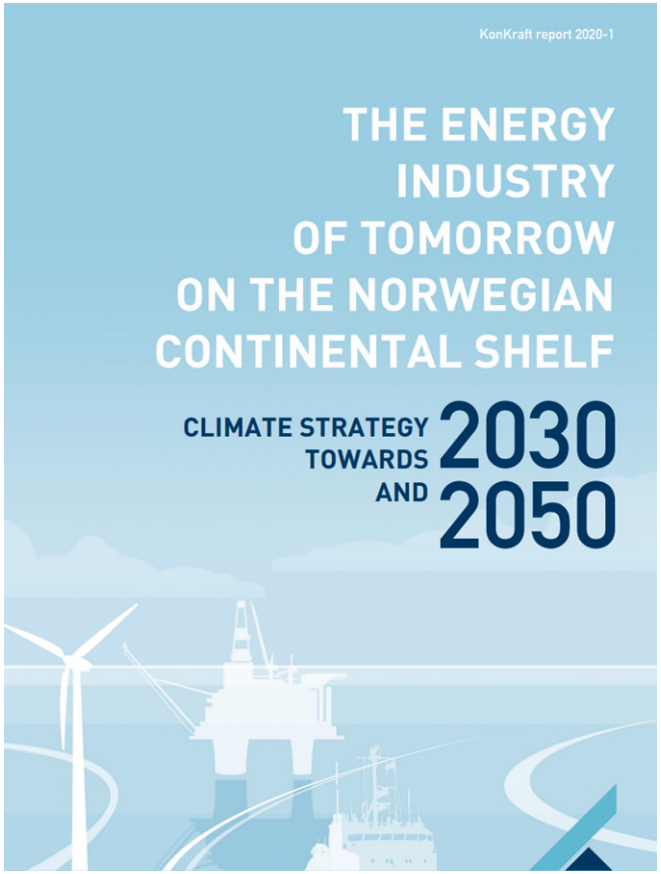
- Vast majority of discoveries will be tied-back to an existing facility.
- Existing infrastructure to be maintained and utilised.
- Unlikely able to rely on a gradual replacement of existing facilities to improve environmental performance.

Source: NPD Resource Report 2019



GHG emissions production among best in class, but…

Source: Rystad Energy



-40%
in 2030

Near zero
in 2050

Oslo Børs stengt Indeks 879,20 Oljepris 43,18 -0,37% USD 9,24 SEK 104,39 EUR 10,88 BTC 10883,90 Mer DN Investor

DN Dagens Næringsliv Meny D2 Magasinet Dagens avis Kjøp DN Logg inn

Koronaviruset Direktestudio Artikler Markedseffekt Næringslivseffekt Spørsmål og svar Tips oss

Bred enighet i oljeskattstriden: Slik blir den nye oljeskatten

Partiene på Stortinget er enige om ny oljeskatt. Partiene vil legge bort endringer i selskapsskatten, men øker friinntektene til 24 prosent.

2 min Publisert: 08.06.20 – 13.01 Oppdatert: 4 måneder siden

Det er løsning i det betente spørsmålet om oljeskatt på Stortinget. Her er Ap-leder Jonas Gahr Støre (fra venstre), Høyres parlamentariske leder Trond Helleland og Frp-leder Siv Jensen. (Foto: Vidar Ruud/NTB Scanpix)

50

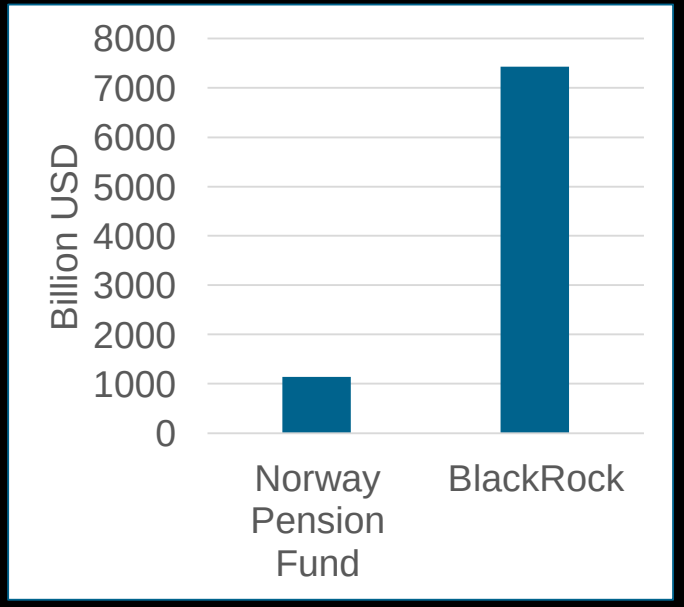
~~-40%~~

in 2030

Near zero in 2050

“Climate risk is finance risk”

“In the near future – and sooner than most anticipate – there will be a significant reallocation of capital”



SEEKING INPUT ON:

- Technology needs
- Knowledge gaps
- Challenges in development and implementation:
  - Industry capabilities
  - Innovation system
  - Data access
  - Competence
  - Etc.

Today:

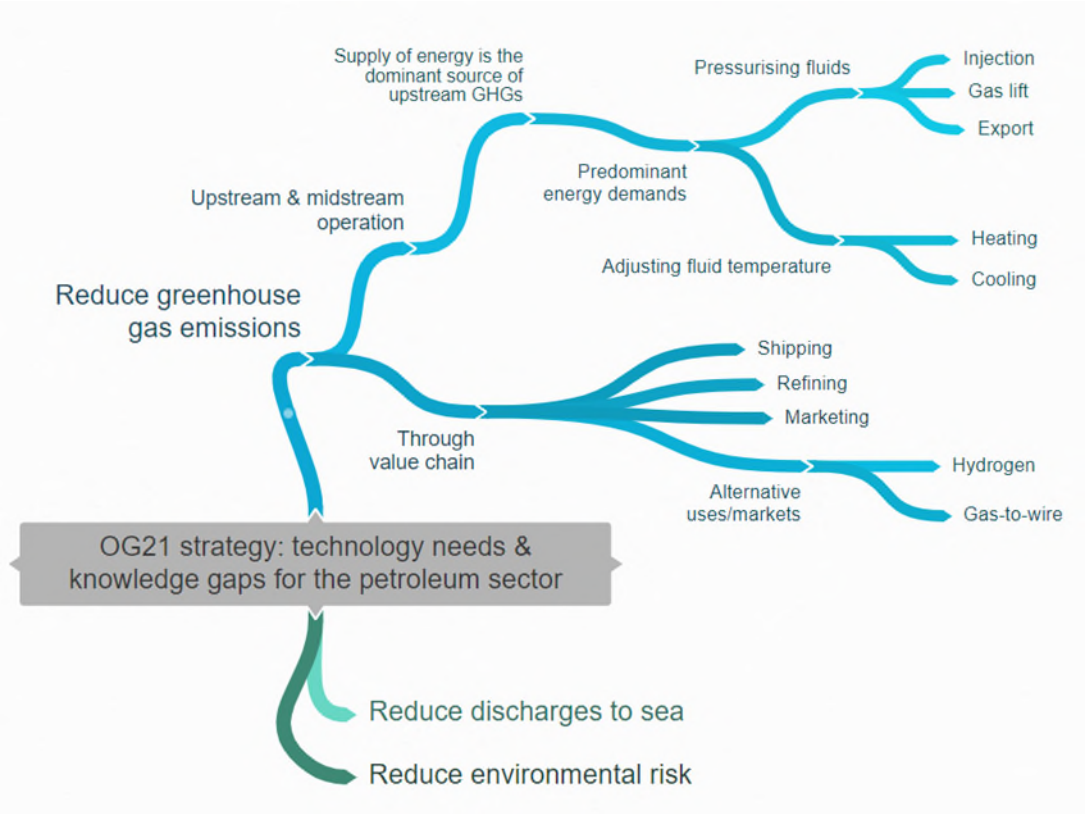
- Reduction of production GHG emissions
- Reductions of GHG emissions through value chain
- Reduction of discharges
- Reduction of environmental risks

HOUSERULES FOR DISCUSSIONS

Chat – New suggestion / opportunity

Hand – Comment, clarification to on-going discussion

SUMMARY



NCS trends:

- Gas will continue to increase its share.
- Resources in existing fields are roughly equal to the resources in discoveries and mapped prospects.
- Improving recovery from existing fields:
  - Dominated by new wells.
  - Low-pressure production likely to involve additional topside compression work.
  - “Further developments” is predominantly subsea projects involving new templates tied back to existing facilities.
- For discoveries:
  - Vast majority will be tied-back to an existing facility.
  - Existing infrastructure to be maintained and utilised.
  - Unlikely able to rely on a gradual replacement of existing facilities to improve environmental performance.

- Welcome. 5 mins.
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INTRODUCTION
SAFETY AND WORKING ENVIRONMENT

E24 AKSJELIVE BØRS E24+ TIPS OSS Søk MENY

Ptil slår alarm etter dramatisk utvikling: Rekordmange alvorlige hendelser i 2020

Antallet alvorlige hendelser i norsk petroleumsvirksomhet er firedoblet på to år. Tillitsvalgt i Equinor reagerer sterkt.

I slutten av september begynte det å brenne på Equinors gassanlegg på Melkøya utenfor Hammerfest. Saken granskes nå av Equinor, Petroleumstilsynet og politiet.

Ⓒ Bjarne Halvorsen

- RNNP 2019: "Good results, but no guarantees" ...

2020

- Significant increase in serious incidents raises concerns

WORKING ENVIRONMENT

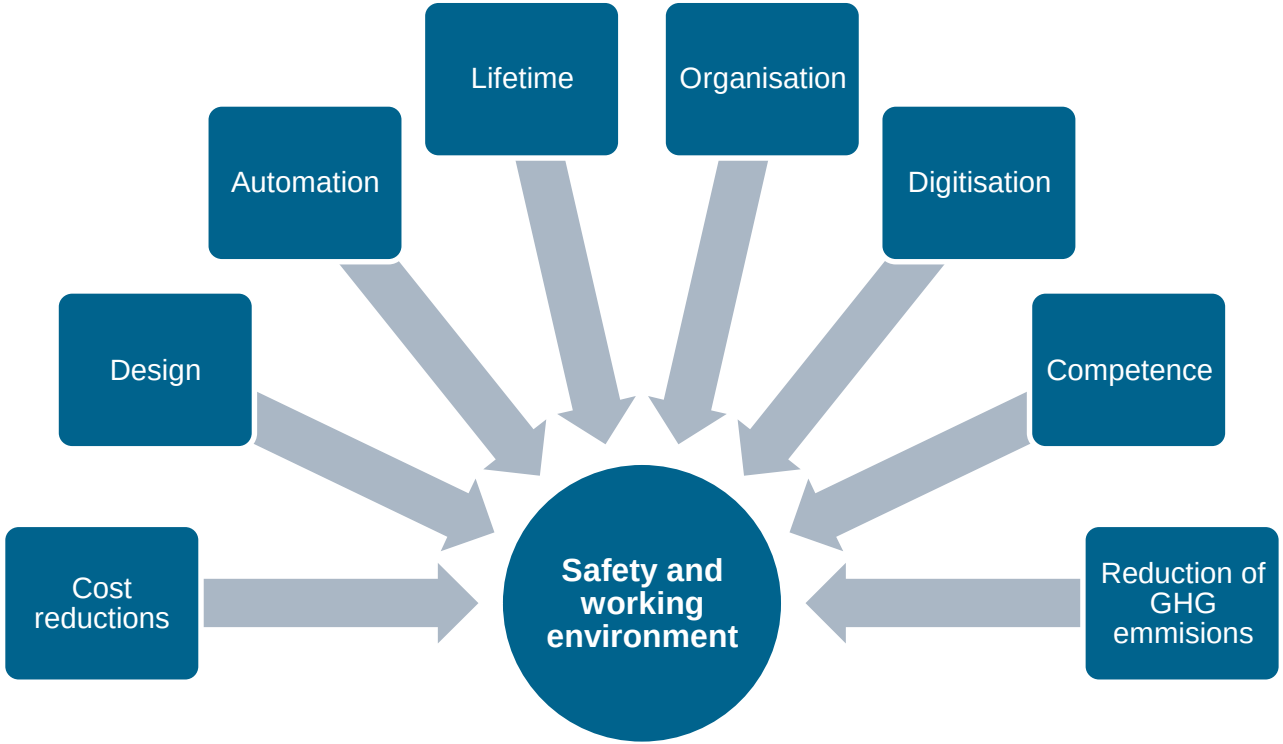
CYBER SECURITY

"ICT is used in all stages of petroleum activity, and if companies fail to protect cyber security, this can result in risks to health, safety and environment"…

Recommendations

…ensure that the PSA improves its follow-up on cyber security in petroleum activities

HSE INTEGRAL WITH CHANGES AND IMPROVEMENTS



SEEKING INPUT ON:

- Technology needs
- Knowledge gaps
- Challenges in development and implementation:
  - Industry capabilities
  - Innovation system
  - Data access
  - Competence
  - Etc.

Today:

- Working environment improvements
- Reduced occupational risks
- Reduction of major accident risks
- Improved cyber security

HOUSERULES FOR INPUT SESSIONS

Chat – New suggestion / opportunity

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Welcome. 5 mins.

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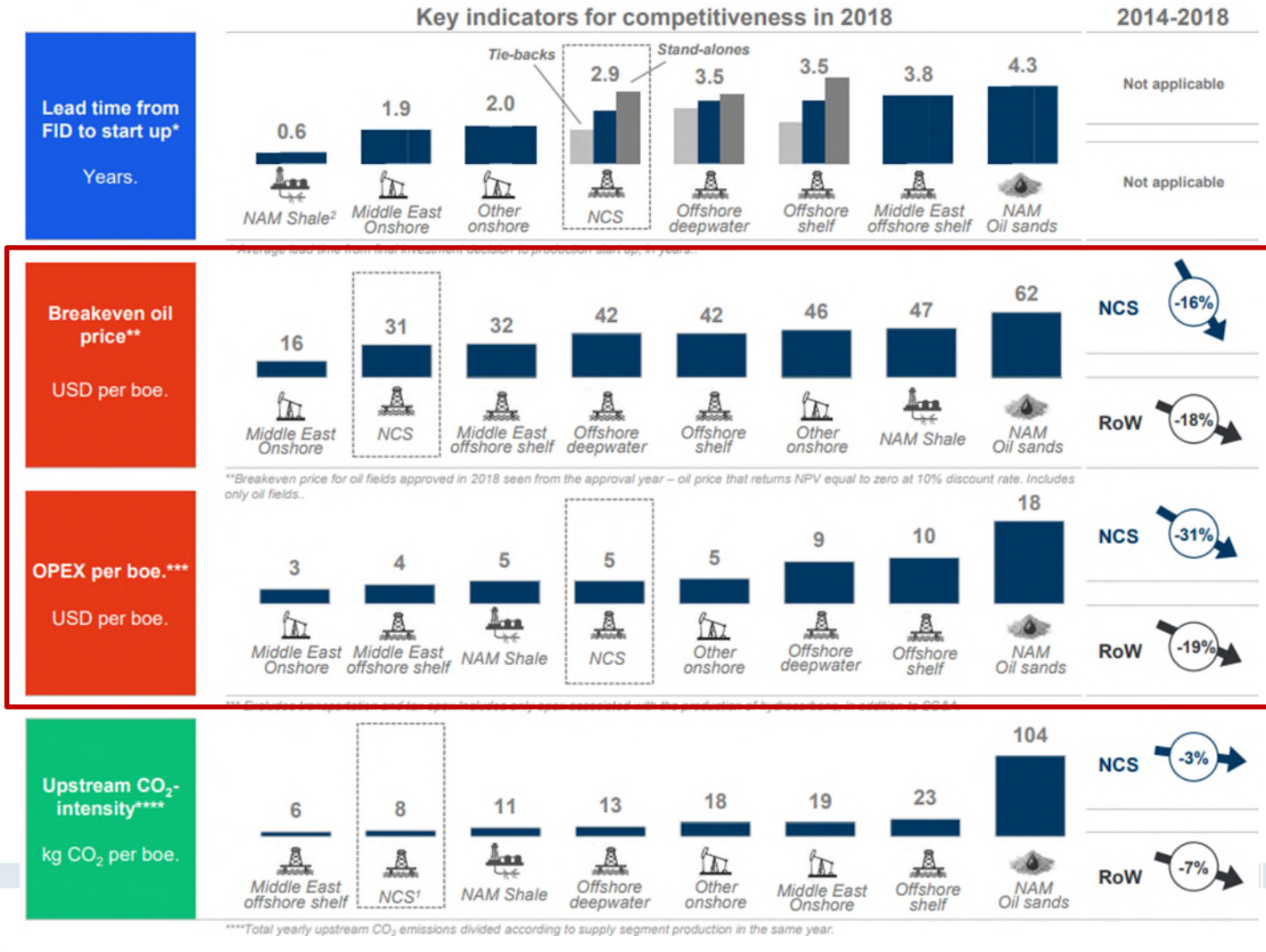
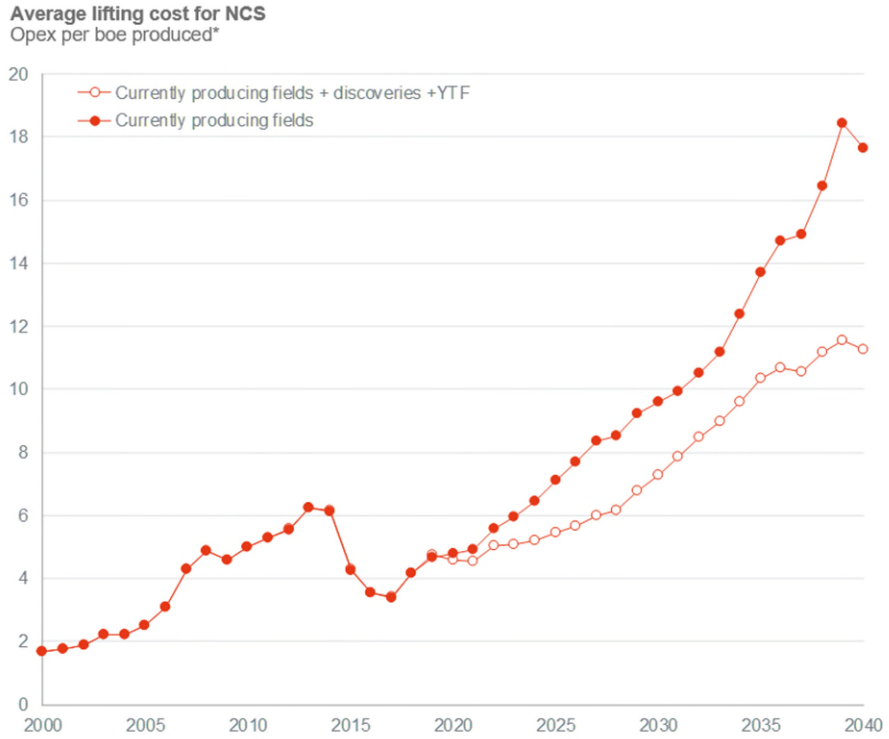
INTRODUCTION
COST-EFFICIENT EXPLORATION AND OPERATIONS



Competitive on costs today, but…

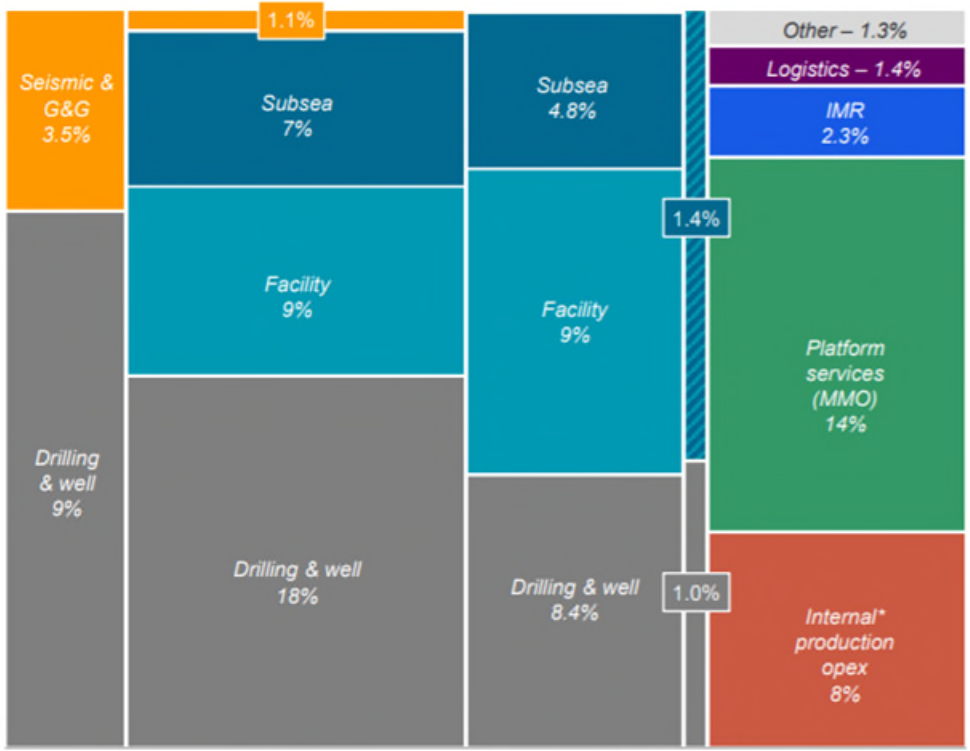
Source: Rystad Energy

COSTS INCREASE AS NCS MATURES



Kilder: Rystad Energy, OG21

Spend buckets on the NCS spend 2019-2040
Percentage of spending in MUSD real 2018



*IMR: inspection maintenance repair

Four main spend buckets identified

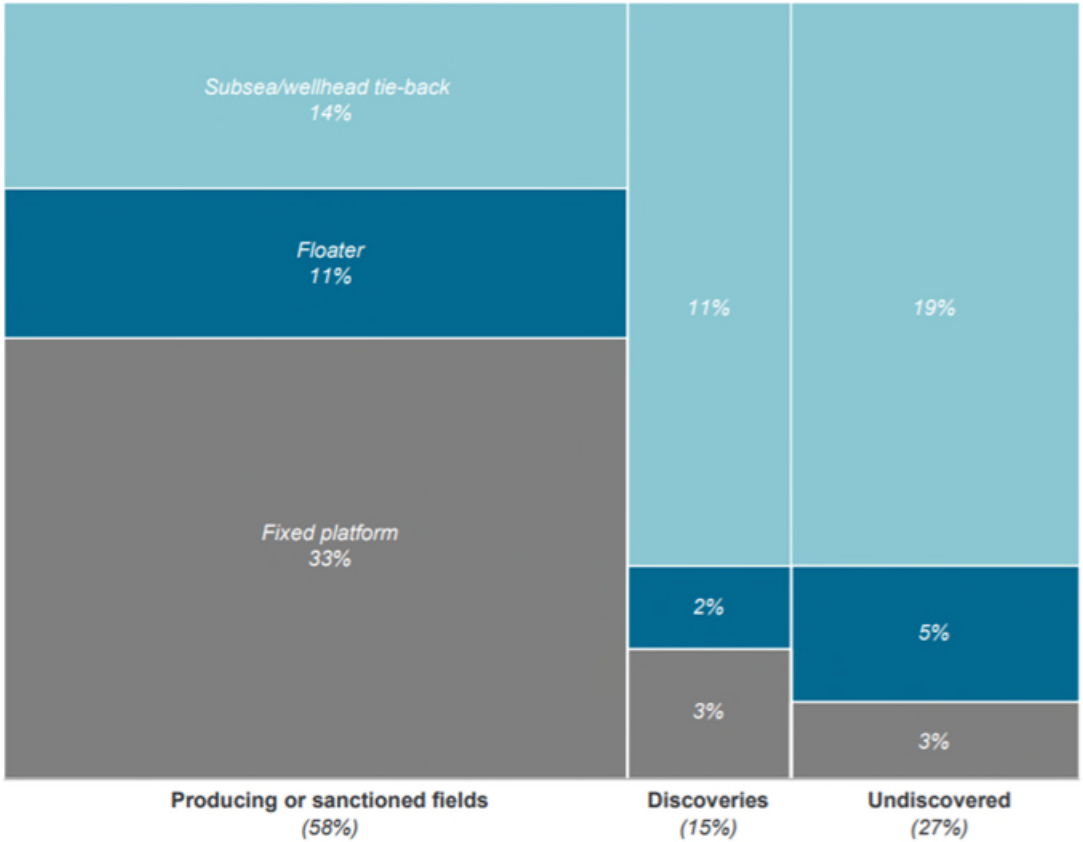
1. Drilling & well (37%)
2. Facility capex (18%)
3. Subsea capex (11%)
4. Platform service and maintenance (14%)

Other takeaways:

- More than 50% of the spend will target fields that are producing
- Capex is 60% of the spend across exploration, greenfield and brownfield
- IMR* is not significant
- Logistics is hidden in the other capex buckets (see next slide)

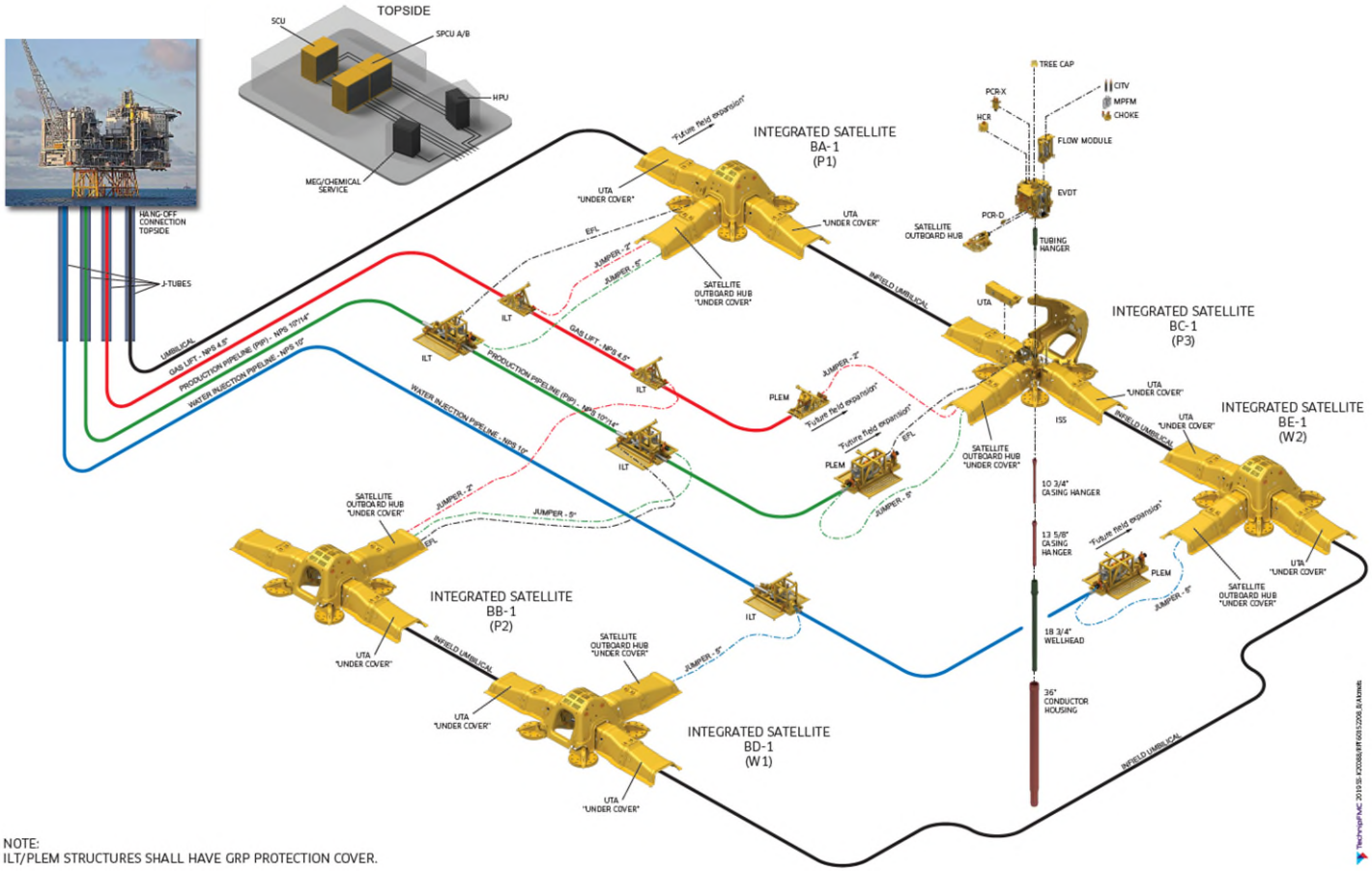
Source: Rystad Energy (2019)

Volume buckets on the NCS between 2019-2050
Percentage of expected barrels of oil equivalent produced



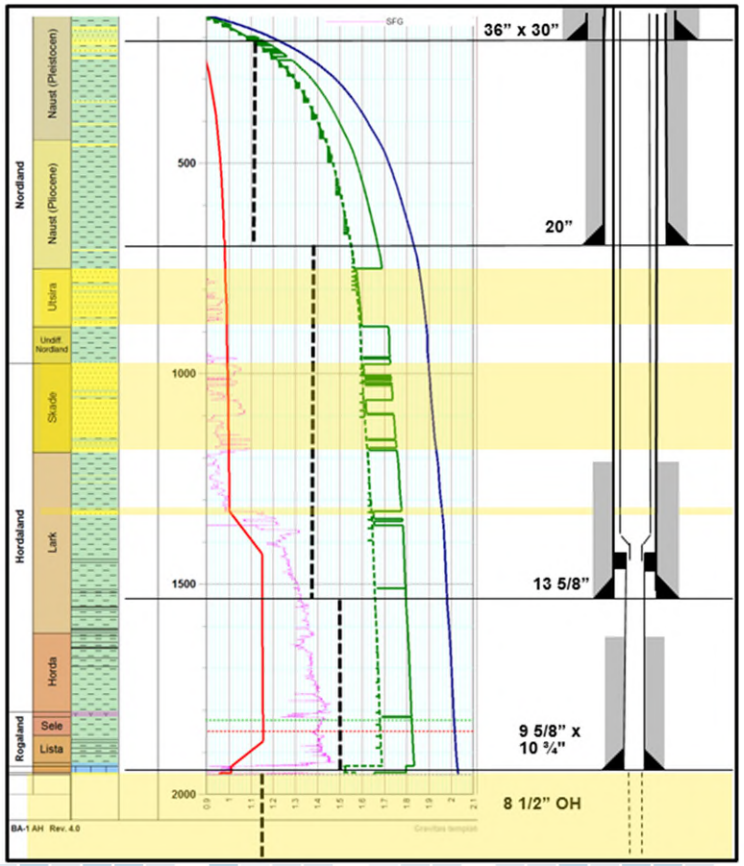
- The chart outlines production volumes on the NCS in the period 2019-2050 in terms of current status of the field and facility type.
- Fields that are yet to be sanctioned are expected to rely heavily on tie-back solutions, whereas currently producing fields (mostly in the North Sea) have been developed as stand-alones with fixed or floating production facility

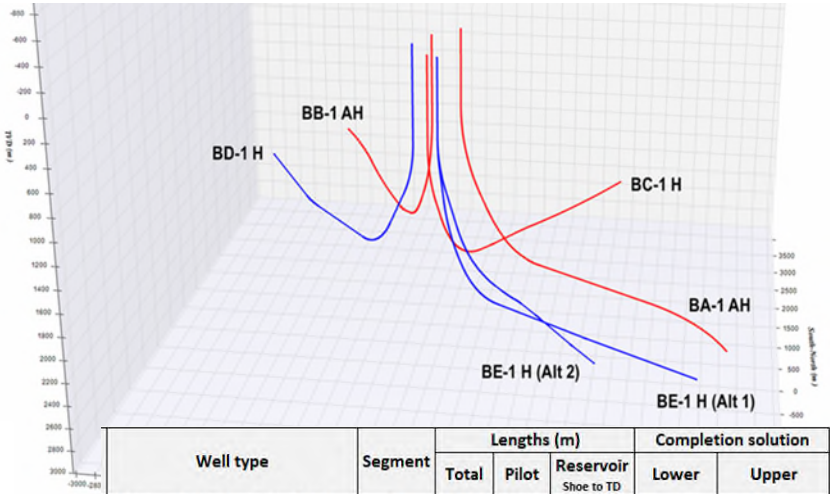
Source: Rystad Energy (2019)



NOTE:
ILT/PLEM STRUCTURES SHALL HAVE GRP PROTECTION COVER.

Simplify the design?

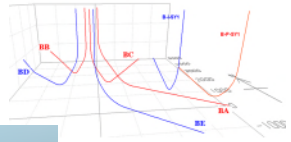


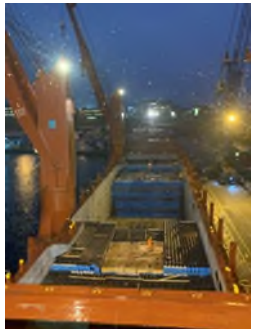


Well type	Segment	Lengths (m)			Completion solution	
		Total	Pilot	Reservoir Shoe to TD	Lower	Upper
Horizontal OP in Outer Wedge	B	5242	690	2889	Screens	Smart
Horizontal OP combining Outer Wedge and Synrift	B	4820		2488	Screens	Smart
Horizontal WI in Outer Wedge	B	4374		2165	Screens	Conventional
Horizontal OP combining Outer Wedge and Synrift	C	5272	370	2897	Screens	Smart
Horizontal WI in Outer Wedge	C	5346		3013	Screens	Conventional

Casing Size, Weight and Grade				Conn. Type	Setting Depth
Csg size	OD [in]	Weight [ppf]	Grade		
36" x 30" Conductor Housing w/extension joint					
Conductor	30	309.7	X-56	NOV Viper M-70 3ST	Standard conductor length
18 ¾" Wellhead Housing w/extension joint					
Surface Casing	20	133.0	N-80 Q	Tenaris BQS	~50 m above Utsira sand
Intermediate csg	13 5/8	88.2	P-110	Vam 21	In Lark Fm. and ~80 mTVD above Lower Hordaland
Tie-back csg (*)	10 3/4	60.7/65.7	SM-110XS / P-110	Vam 21	Tie-back inside top of 9 5/8" liner
	9 5/8	53.5	SM-110XS / P-110	Vam 21	
Liner (*)	9 5/8	53.5	SM-110XS / P-110	Vam 21	10 – 15 mMD into Shetland Gr. / Ekofisk Fm

EGTB 2020 – Equipment status and rig



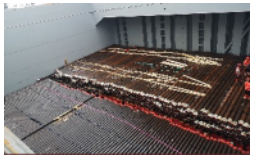


First batch of casing arrived Tananger

30» Conductors arrived from Batam, Indonesia

Production screens at Mongstad

Injection screens at Mongstad



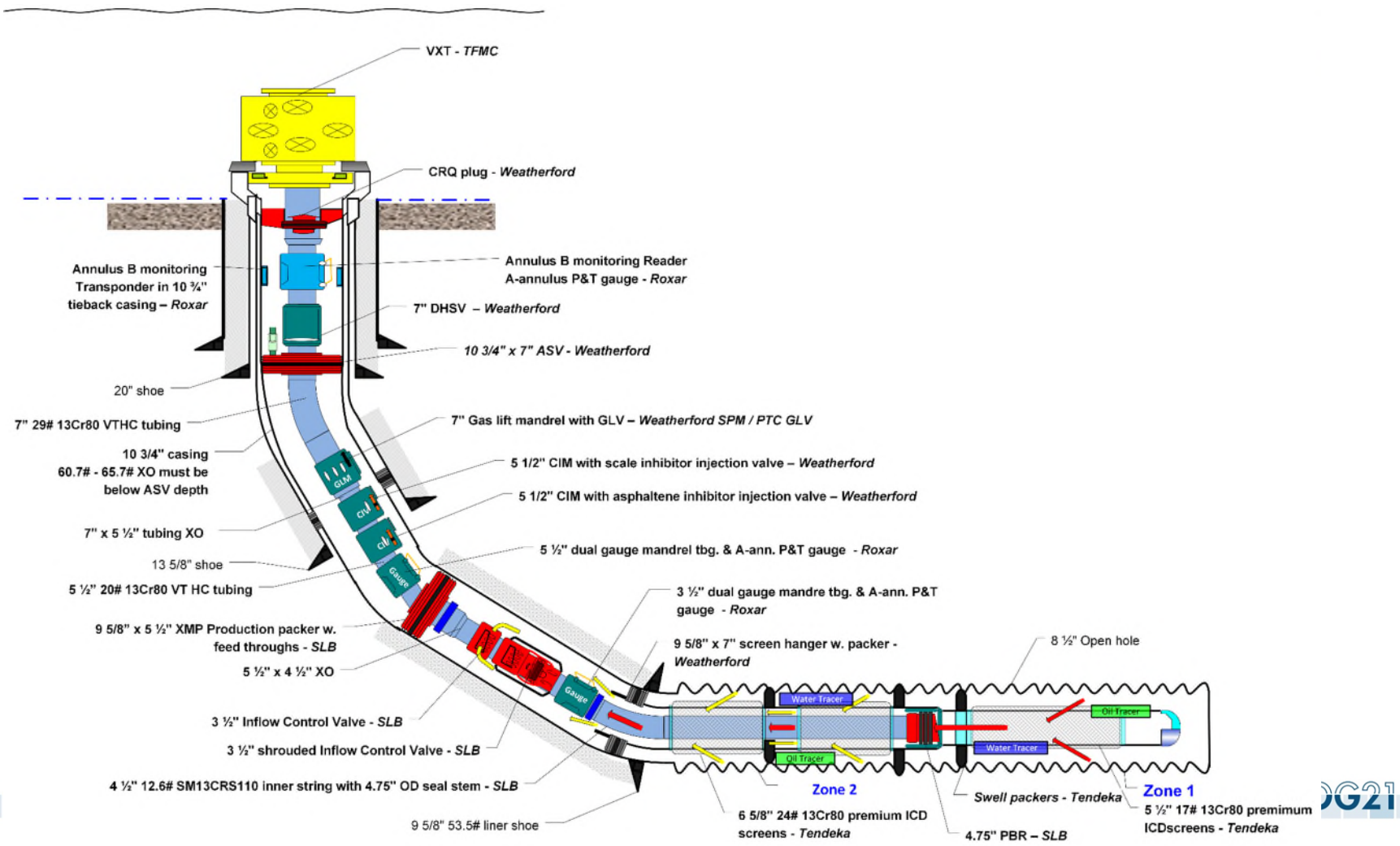
Last batch of csg & tbg

Jan | Feb | Mars | April | Mai | Juni | Juli | Aug | Sep | Okt | Nov | Des

Rig arrived Hanøytangen

Reactive Flex Joint installed on West Bollsta's BOP

BOP & RFJ launched


VXT - TFMC
CRQ plug - Weatherford
Annulus B monitoring Transponder in 10 ¾" tieback casing – Roxar
Annulus B monitoring Reader A-annulus P&T gauge - Roxar
7" DHSV – Weatherford
10 3/4" x 7" ASV - Weatherford
20" shoe
7" 29# 13Cr80 VTHC tubing
7" Gas lift mandrel with GLV – Weatherford SPM / PTC GLV
10 3/4" casing 60.7# - 65.7# XO must be below ASV depth
5 1/2" CIM with scale inhibitor injection valve – Weatherford
5 1/2" CIM with asphaltene inhibitor injection valve – Weatherford
7" x 5 ½" tubing XO
5 ½" dual gauge mandrel tbg. & A-ann. P&T gauge - Roxar
13 5/8" shoe
5 ½" 20# 13Cr80 VT HC tubing
3 ½" dual gauge mandre tbg. & A-ann. P&T gauge - Roxar
9 5/8" x 5 ½" XMP Production packer w. feed throughs - SLB
9 5/8" x 7" screen hanger w. packer - Weatherford
8 ½" Open hole
5 ½" x 4 ½" XO
3 ½" Inflow Control Valve - SLB
3 ½" shrouded Inflow Control Valve - SLB
4 ½" 12.6# SM13CRS110 inner string with 4.75" OD seal stem - SLB
9 5/8" 53.5# liner shoe
Zone 2
6 5/8" 24# 13Cr80 premium ICD screens - Tendeka
Swell packers - Tendeka
4.75" PBR – SLB
Zone 1
5 ½" 17# 13Cr80 premimum ICDscreens - Tendeka
GLM
CIM
CIM
Gauge
Gauge
Water Tracer
Oil Tracer
Water Tracer
Oil Tracer

SEEKING INPUT ON:

- Technology needs
- Knowledge gaps
- Challenges in development and implementation:
  - Industry capabilities
  - Innovation system
  - Data access
  - Competence
  - Etc.

Today:

- Cost-efficient exploration
- Cost-efficient drilling and operations
- Subsurface understanding
- Plugging and abandonment

HOUSERULES FOR INPUT SESSIONS

Chat – New suggestion / opportunity

Hand – Comment, clarification to on-going discussion

Welcome. 5 mins.

Strategy revision scope and timeline. 10 min.

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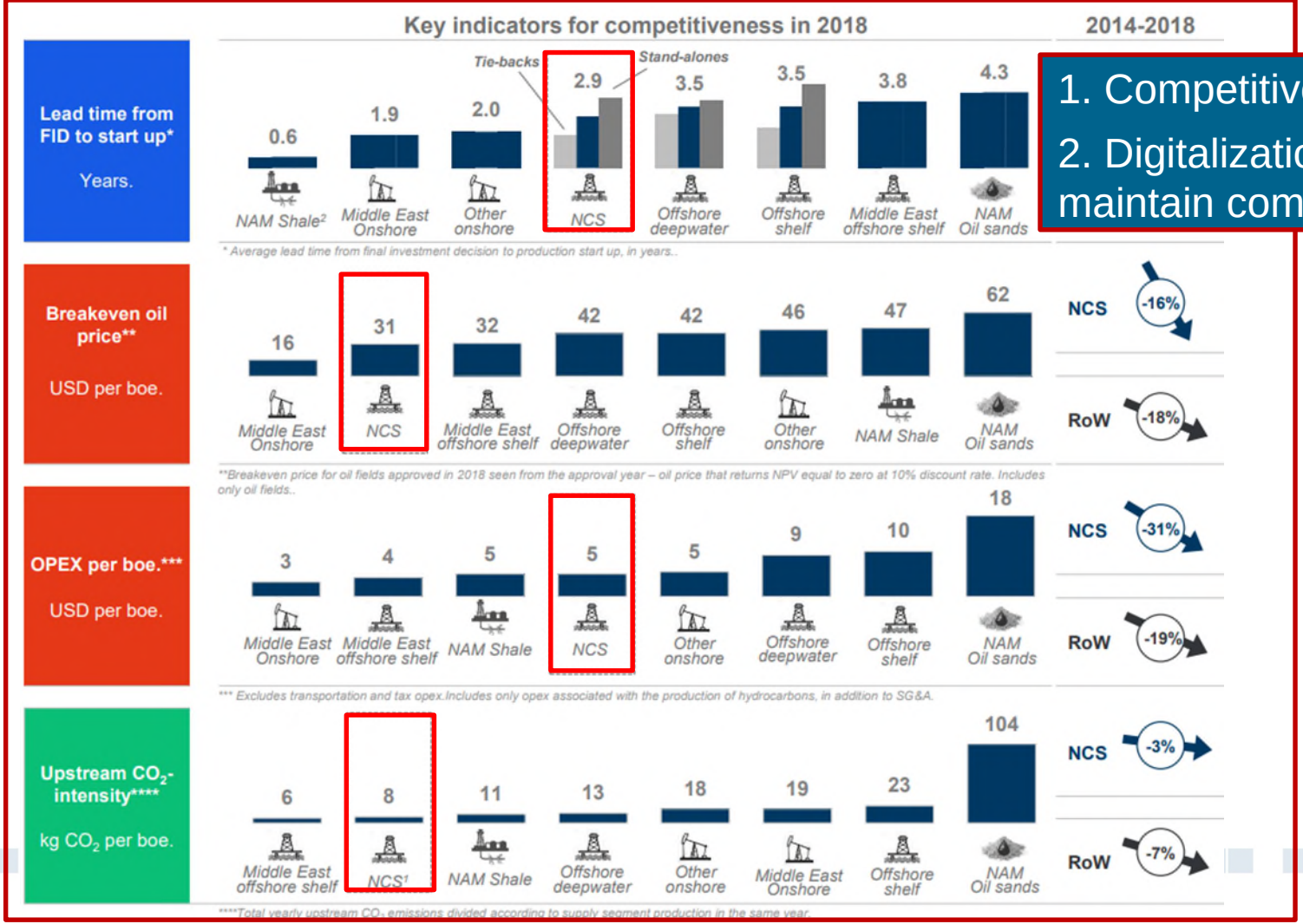
INTRODUCTION DIGITALIZATION AND AUTOMATION

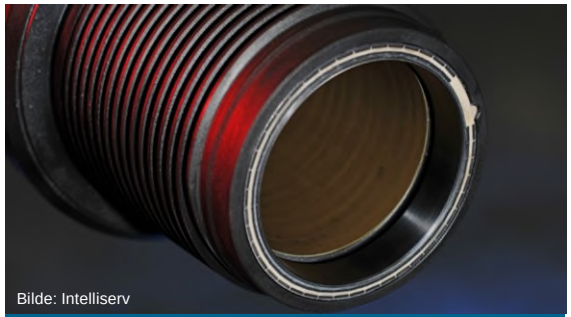
:



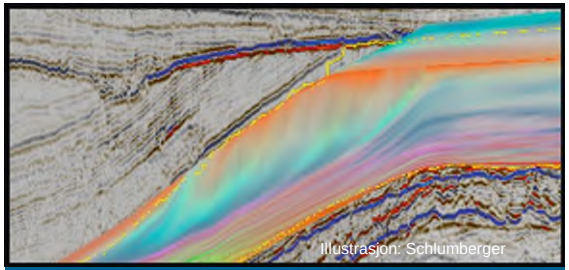
1. Competitive today
2. Digitalization key to maintain competitive position

Source: Rystad Energy

DIGITALIZATION: KEY TO UNLOCK POTENTIAL ACROSS VALUE CHAINS


Bilde: Intelliserv

Digitalization


Illustrasjon: Schlumberger

Increased subsurface understanding


Illustrasjon: DNV GL

Cost effective subsea

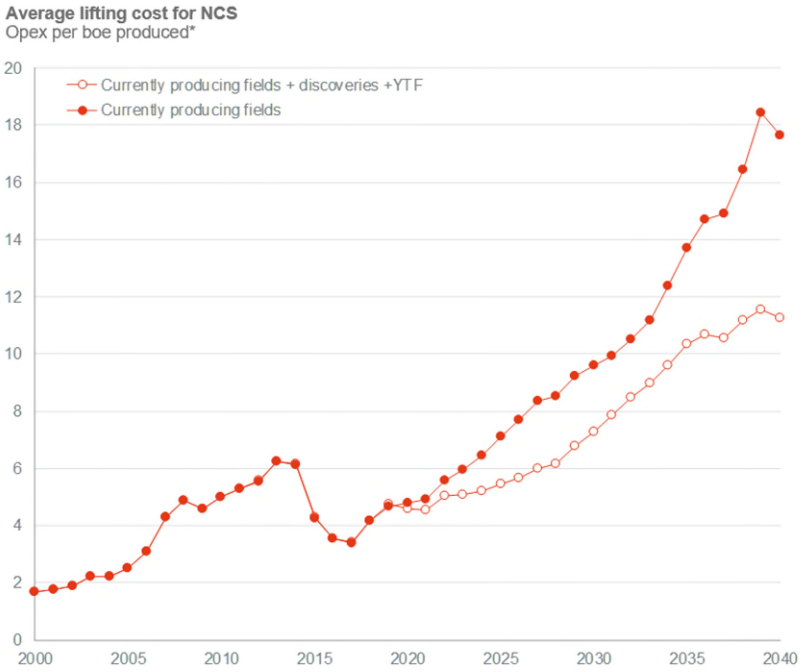

Bilde: Transocean

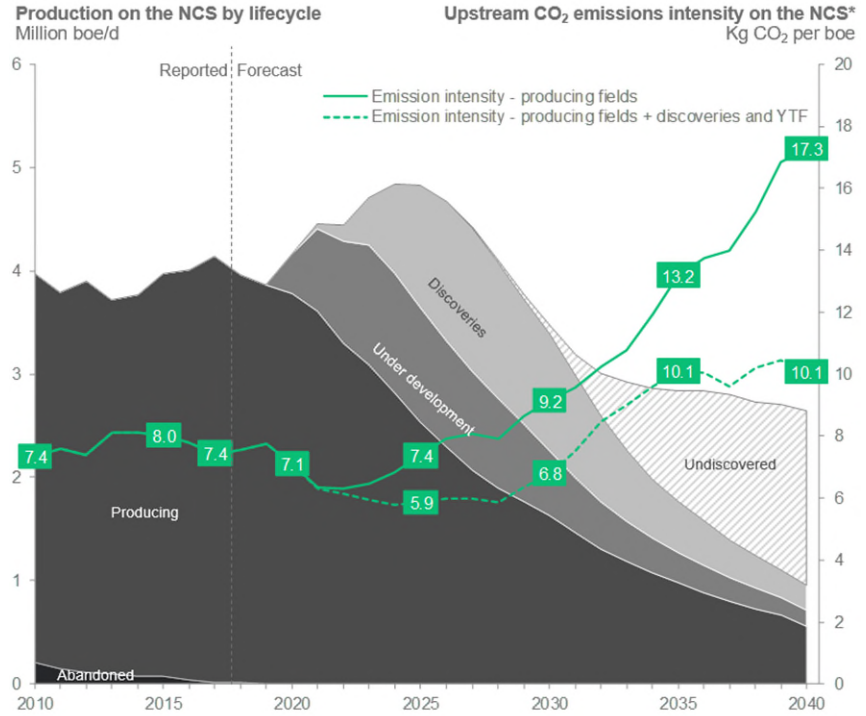
Efficient drilling


Bilde: Shutterstock

Reduced emissions

CHALLENGES AHEAD



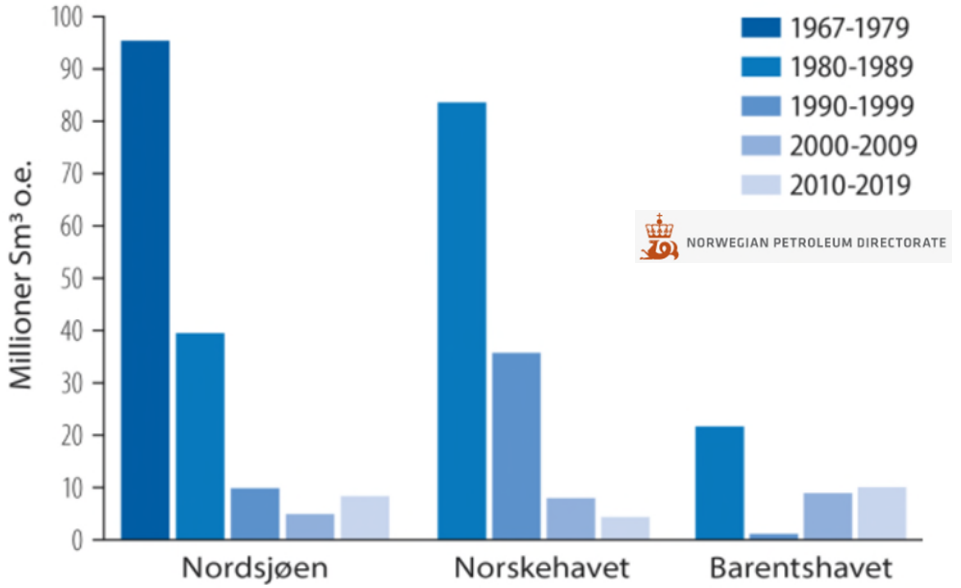


Kilder: Rystad Energy, OG21

SENSE OF URGENCY

Aging infrastructure on NCS

Smaller discoveries



Development of average discovery size by region

Inkl. RK6

UNMANNED FACILITIES – LEANER, CLEANER, GREENER

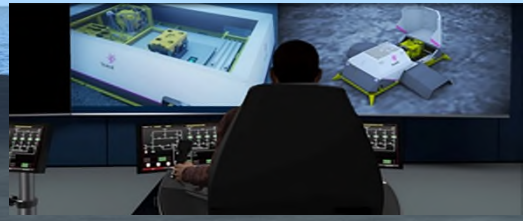
Host of technologies:

- Automation
- Robotics
- Drones
- Predictive maintenance
- Communication
- Analytics

Illustration: Ramboll

Remotely operated factory (ROF™)

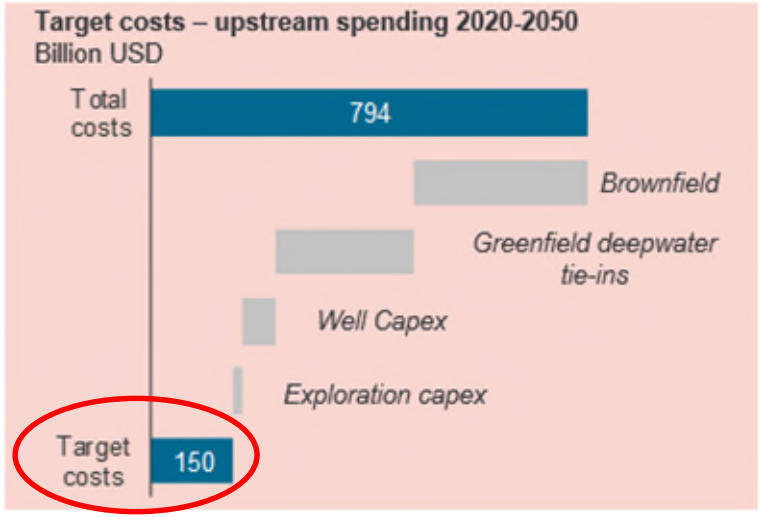
Automation and use of drones



UNMANNED FACILITIES OFFER GREAT OPPORTUNITIES

1

Cost reductions



OPEX -50%
CAPEX -30%

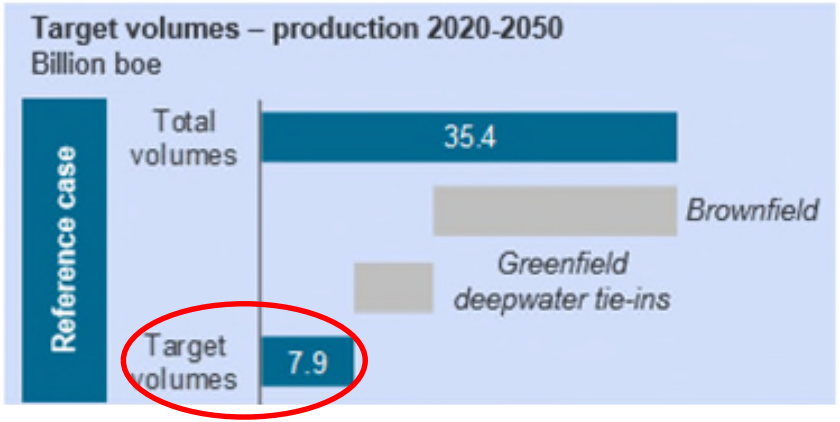
- 50 billion USD (->yr.2050)

Source: Rystad Energy, OG21

UNMANNED FACILITIES OFFER GREAT OPPORTUNITIES

2

Improved recovery



Increased regularity 2-5%

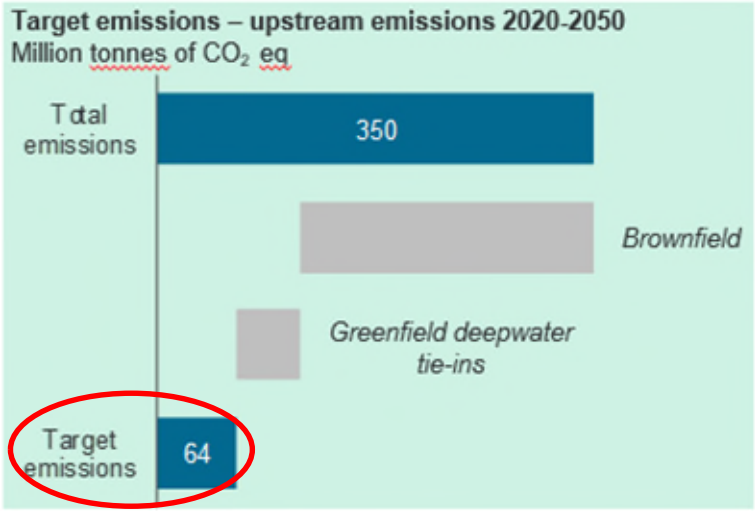
335 million boe (->yr.2050)

Sources: NPD

UNMANNED FACILITIES OFFER GREAT OPPORTUNITIES

3

Reduced emissions



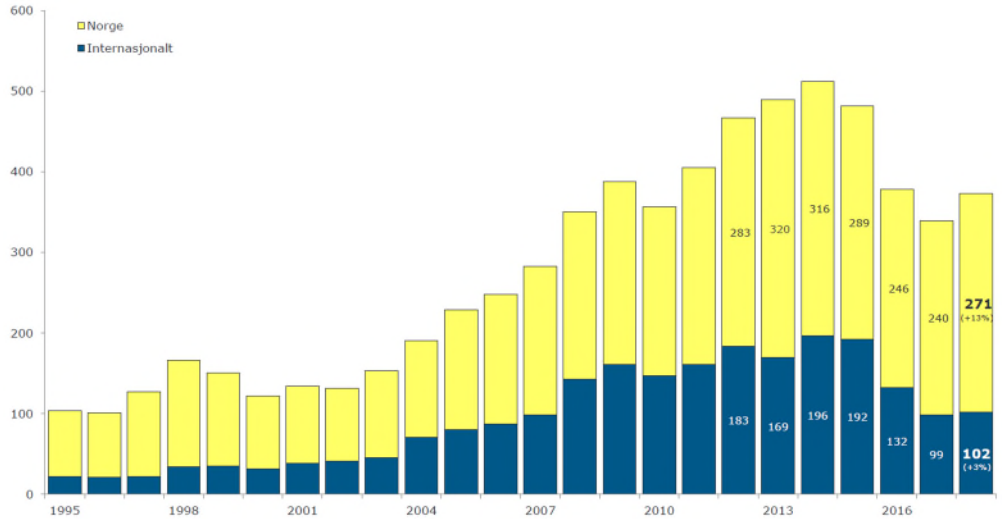
Reduced utility power demand 50% -> reduced power demand 7 %

- 5 million tons CO2 eq. (->yr.2050)

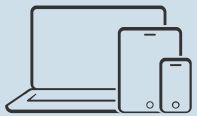
UNMANNED FACILITIES OFFER GREAT OPPORTUNITIES

4

New jobs



At Equinor, digital opportunity is driven by three technological enablers



Process digitalisation

Data science and analytics

Robotics and remote control

Digitalization success require maturity along three dimensions:

Organizational capability

- Culture and leadership
- Competence and skills at all levels
- Collaboration
- Changes to business models & work processes

Data

- Sufficient and relevant data
- Readable formats
- Without flaws and hidden assumptions
- Efficient data preparation and processing

Technology

- Sufficient computational power at reasonable cost
- Trusted algorithms / models
- IT platform and architecture that enable efficient scaling

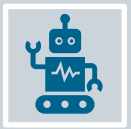
SEEKING INPUT ON:

- Technology needs
- Knowledge gaps
- Challenges in development and implementation:
  - Industry capabilities
  - Innovation system
  - Data access
  - Competence
  - Etc.

Today:

Remote operations

Unmanned/low-manned facilities



Automation and autonomy

HOUSERULES FOR INPUT SESSIONS

Chat – New suggestion / opportunity

Hand – Comment, clarification to on-going discussion

- Welcome. 5 mins.
- Strategy revision scope and timeline. 10 min.
- Introduction to theme. 15 min.
- Facilitated discussion, 75 min.
- Summary and next steps. 15 mins.

FACILITATED DISCUSSIONS

SUMMARY AND NEXT STEPS

- Welcome. 5 mins.
- Strategy revision scope and timeline. 10 min.
- Introduction to theme. 15 min.
- Facilitated discussion, 75 min.
- Summary and next steps. 15 mins.

SUMMARY

New OG21 strategy needs to address:

Reduce cost

Improve sub-surface understanding

Reduce lead times - accelerate production

Reduce operational and value chain GHG emissions

Reduce safety risks and environmental risks

Digitalization for lower costs, lower emissions and improved efficiency

Cost-efficient P&A

Global R&D attractiveness

Capabilities to leverage technology & competence

GHG EMISSIONS - NEW SUGGESTIONS IN MEETING

- Technology & competence:
  - Scope 3 engineering toolkit
  - Understand power system and integration w/onshore
  - CCS offshore
  - De-com
  - Standard structure for GHG emissions.
  - Flue gas heat recovery
  - Well stream heat recovery
  - Use of ammonia/hydrogen in turbines offshore
  - Subsea / down-hole separation
  - All-electric
  - Learning from other basins / international companies
  - Offshore wind power used for offshore operations
  - ..

- Drivers and challenges:
  - Utilize and mature existing technology
  - CO2-tax
  - Footprint and weight constraints
  - Leverage UK de-com experience and tools
  - Existing infrastructure have limitations for implementing new technology
  - ..

SAFETY AND WORKING ENVIRONMENT - NEW SUGGESTIONS IN MEETING

- Technology & competence:
  - Kunnskap om menneskelige faktorer
  - Granskning bør inneholde menneskelige faktorer
  - Not only cyber security, but also cyber safety
  - Erfaringsoverføring fra luftfart
  - Erfaringsoverføring fra fjernkontroll boring og røroperasjoner
  - HC-lekkasjer – forstå menneskelige feil
  - maintenance of digitalization systems: sensors, computers, need to re-tune control systems
  - Konsekvenser menneske/maskin av teknologiske endringer som skjer
  - Mangelfull poretrykksestimering og detektering – kan digitale tvillinger og wired pipe hjelpe?
  - Storulykker - fleksible stigerør. Kobling materiale, levetidsbetraktninger, risikoestimering
  - Risiko og barrierestyring – bade cyber-tankegang særlig ytre miljø
  - Er språk en problemstilling
  - Er barrieretesting god nok?
  - Forståelse samtidige hendelser
  - Ansvarforhold ulike personer, ulike selskap

- Drivers and challenges:
  - Robusthet for tekniske feil
  - Forståelse for kompleksitet – fremmedgjøring - usability
  - Digitalisering både muligheter for reduksjon av risiko og økning av risiko
  - Utfordring å ta I bruk erfaring fra granskning – hvor brukbare er granskningsrapporter
  - Vedlikhold digital systemer - Digitale tvillinger kan hjelpe oss - må finne ut hvordan vi kan bruke dem.
  - Hvorfor er det til dels dårlig etterlevelse av prosedyrer? For lange, for kompliserte.
  - Technical language processing (ML) kan ha potensiale i vedlikeholdsstyring

COST-EFFICIENT EXPLORATION AND OPERATIONS- NEW SUGGESTIONS

- Technology & competence:
  - P&A – cost reductions, manage risks
  - Electrification of BOPs
  - Marine riserless w/ electrical BOP
  - Increase in drilling rate - ADC, digital twilling, efficient well design
  - Parallell operations - Learn from others- 4000 m in 10 days
  - Better understanding of where to put wells - fluid flow in the reservoir, modelling, data acq, control/governance
  - Utilize the potential of wired pipe + develop more equipment for WDP applications
  - Retrofit multilateral system
  - MLT – scope for broader implementation
  - Reduce uncertainty in input data to reservoir models. New well testing methods.
  - Subsea RCD for reduced costs and control pressure
  - Consistent qualification process
  - Optimize drainage strategy w/digitalization
  - Coiled tubing drilling
  - Speed up R&D – data sharing etc.
  - How to bring scientific ideas into use/practice

- Drivers and challenges:
  - P&A – guaranteed scope
  - P&A – limited power, utilities
  - Electr. BOPs - Remove hydraulics, enable digitalization, reduce failures, vessels rather than rigs
  - Parallell operations - Learn from others- 4000 m in 10 days
  - WDP: Low reliability - low performance. Need to improve quality.
  - Established players put up barriers for new entrants.
  - Need to have operators on-board to get funding for piloting.
  - Qualification process/understanding is a problem
  - Topside weight and space constraints
  - Many people at different levels can veto new technology if it doesn't benefit them
  - Top management technology champions
  - Lack systems for knowledge transfer
  - Better dialogue industry <-> academia
  - More pressure on projects to test and use new technology

DIGITALIZATION AND AUTOMATION- NEW SUGGESTIONS

- Technology & competence:
  - Inkludere verdikjeder/manufacturing , stål etc., i CO2-utslipp
  - Hybrid modellering AI+fysiske modeler
  - Forbedre incentiver for teknologi som redusere OPEX
  - Automatisert boresystem som selv utfører tester og kalibrerer.
  - Brukersentrert utvikling av automatiserte systemer.
  - Standardisering i datamodeller, betydning og forståelse av data på tvers av alle disipliner. OSDU og READI er gode eksempler. Erfaringsoverføring fra andre land og bransjer. Modeller må være lesbare og flyttbare.
  - Automatisk vedlikehold av digitale tvillinger.
  - Villighet til å teste ut nye løsninger. Stimulere nye selskaper til å satse på bransjen.
  - Etablere digital innovasjonsplatform
  - Standardisering og digitale tvillinger innen drift bør utnytte synergier med prosessindustrien og verkstedsindustrien.
  - Konkurranser om innovasjon om utfordringer.
  - Implementere tilstandsbasert vedlikehold
  - Agile tilnærming. Stegvis tilnærming.
  - Dele læring om vellykka transformasjons-prosjekter.
  - Utnytte synergier med andre industrier innen digitalisering og standardisering
  - Utvikle digital engineering-prosess ved å bruke Industri 4.0 prinsipper og standarder

DIGITALIZATION AND AUTOMATION- NEW SUGGESTIONS

- Drivers and challenges:
  - Vanskelig å treffe på timing hos operatører
  - Svake drivere for å redusere OPEX
  - Må skille mellom IT og AI. Namur, (ISA?)
  - Få drivere for å redusere OPEX
  - Skepsis mot automatisering.
  - Motstand hos etablerte aktører.
  - Data management tar 80% av tida. Må standardisere.
  - Teste ut flere konsepter. Pilotere flere løsninger.
  - Klarifisere hva pilotering av SW er.
  - Vanskelig å hente finansiell støtte uten å ha med operatør.
  - Vanskelig å hente støtte hos IN for petroleumsprosjekter.
  - Byråkrati og formelle krav kan drepe innovasjon og initiativ
  - Lære fra industrier som har levd under kostnadspress lenge. Luftfart, maritime, petrokjemi.
  - Silo-tenkning
  - Sikkerhet kan gå på tvers av åpenhet og tilgang
  - Datakvalitet kan være en utfordring: dataformat, terminologi etc.

MORE OPPORTUNITIES TO PROVIDE INPUT

Input form
Dec.2020-Feb. 2021

Input meetings
February 2021

Commenting round
Aug-Sept. 2021

WWW.OG21.NO

Industry economic support 2021:

OG21