

The background features a large, solid yellow circle in the upper left quadrant. To its right and extending across the lower right portion of the image are several thick, grey, irregular lines that resemble a stylized map or abstract drawing. These lines form a complex, interconnected shape that could be interpreted as a geographical outline or a network diagram.

Meet the Specifier

Deep Dive Session #1 – CO₂ Compressors

*The Heath, Conference Centre, Runcorn, UK
8th June 2022*

- *The meeting is being recorded*
- *Phones off, or on silent – kindly leave room if required*
- *Presentation will be limited solely on technical requirements – commercial requirements are outside the scope*
- *Welcome questions – please raise your hand, or wait until the Q&A session*
- *A scribe is available*
- *Provide your details on the register in circulation – clear handwriting please*
- *Fire exits – no drills planned*

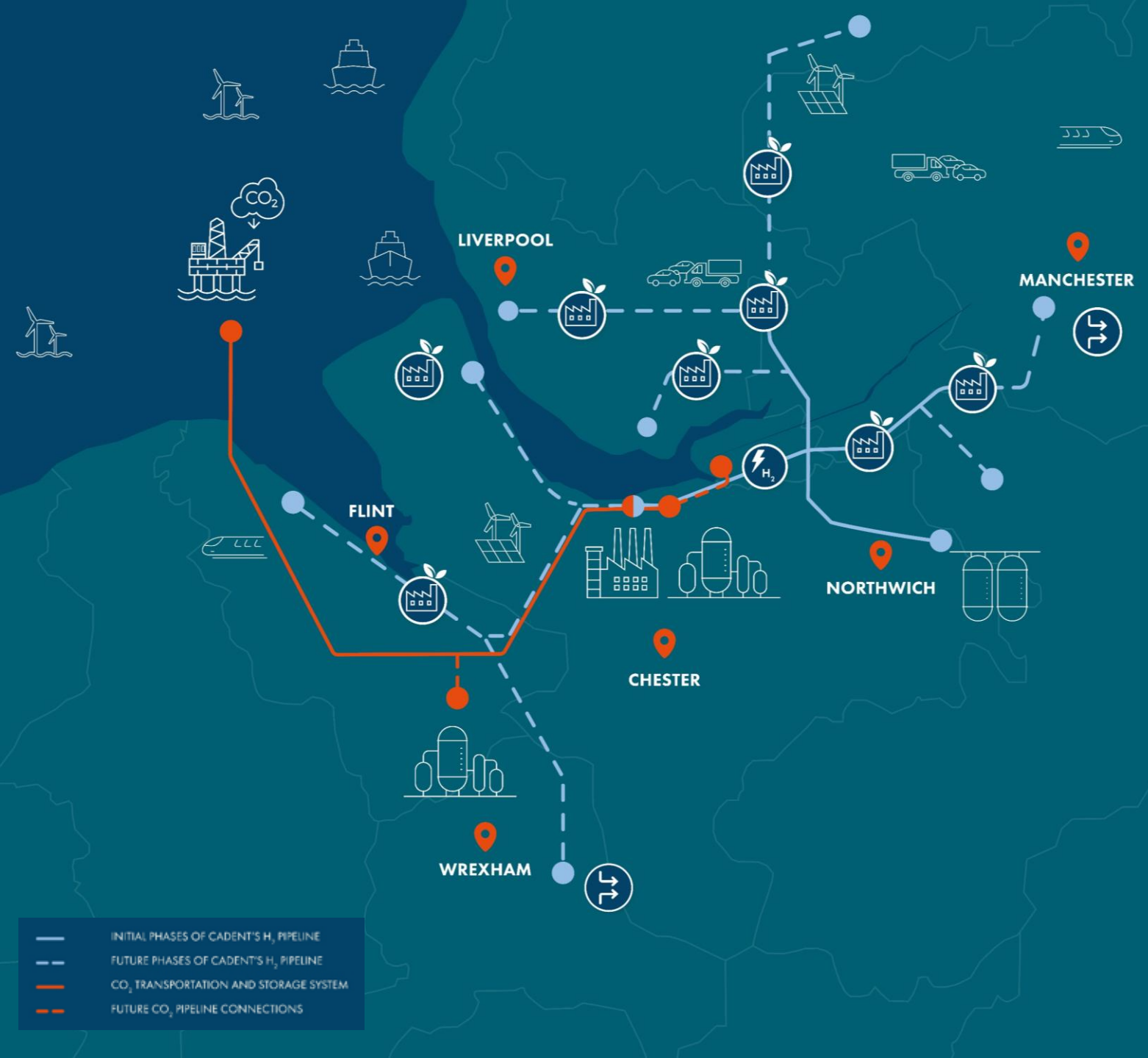
- *High level Project Overview – Location & Process*
- *Duty requirements*
- *Compressor configuration & Driver selection*
- *Scope of Supply*
- *Scope of Services*
- *Legislation, Codes & Standards*
- *Project specific objectives of Compressors*
- *Areas of interest to Project*
- *Q&A session*

HyNet North West

The HyNet North West cluster will deliver:

- Facilities to capture CO₂ emissions*
- Underground pipelines to transport CO₂ emissions to permanent safe storage*
- Low-carbon hydrogen production plants*
- A hydrogen pipeline network and salt caverns in which hydrogen can be stored ready for use*

Eni's scope is shown by the red line.

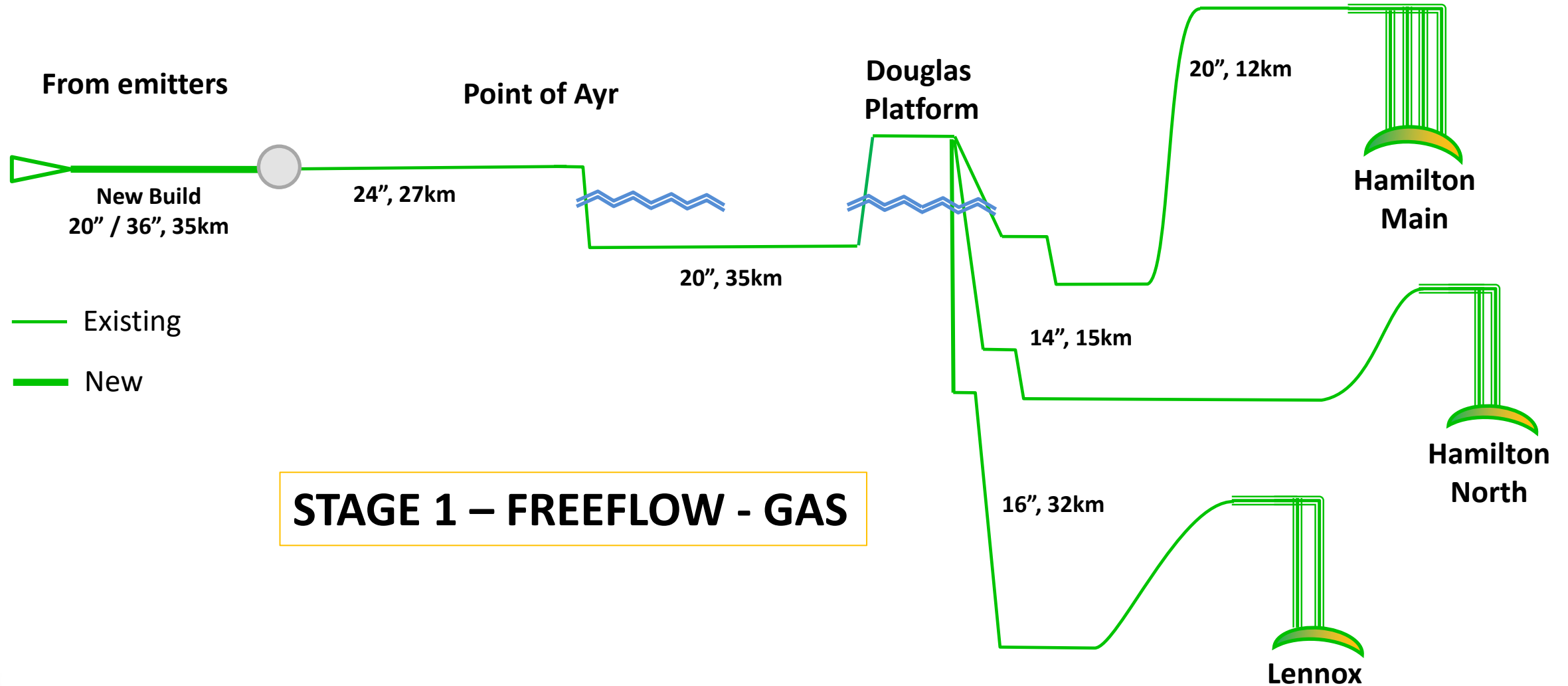


High level Project Overview – Location & Process

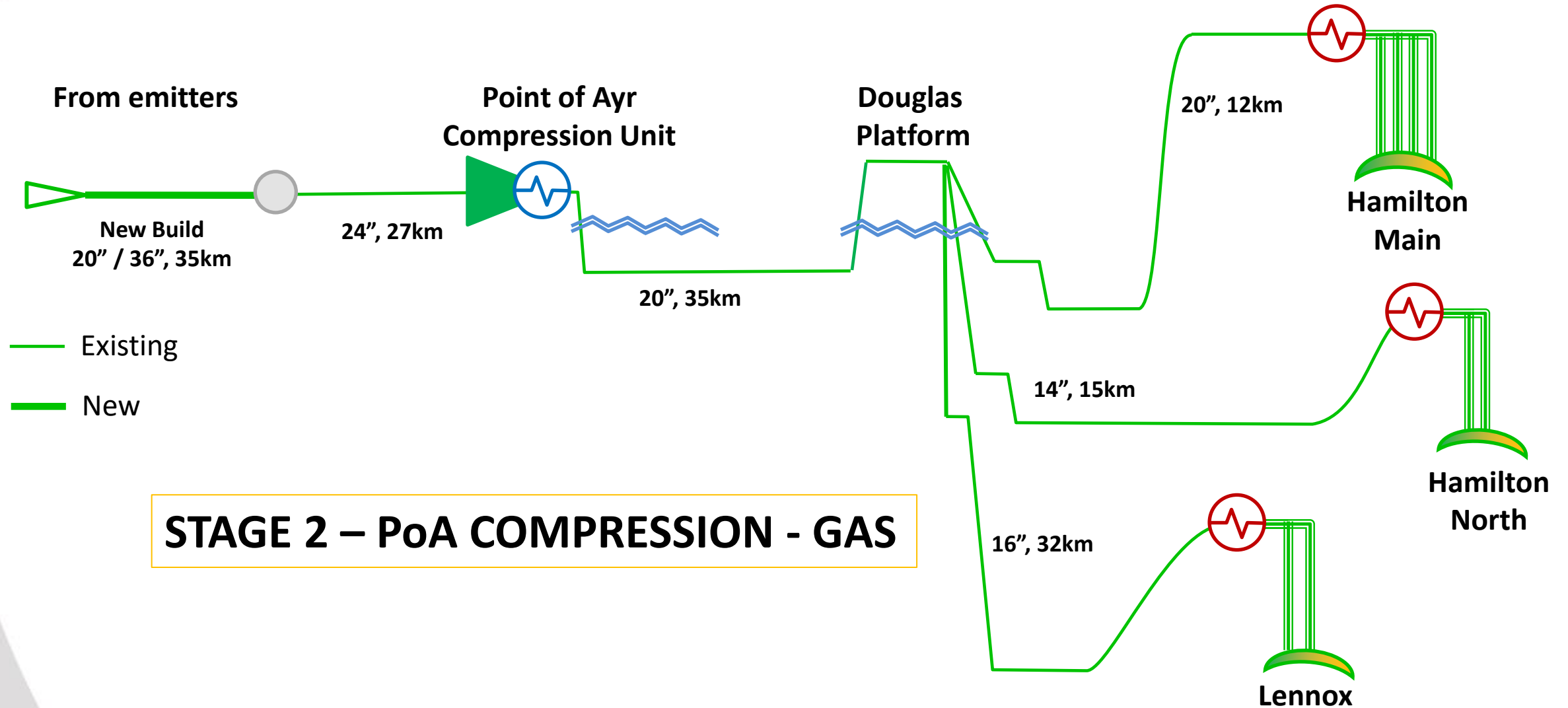


- **New-build onshore pipeline from emitters to Connah's Quay**
- **Repurpose existing onshore natural gas pipeline from Connah's Quay to Point of Ayr**
- **Redevelopment at Point of Ayr**
- **Repurposing and life extension of existing offshore structures and pipelines.**
- **Drilling**
- **Sub-surface studies to secure CO₂ storage permit**

High level Project Overview – Location & Process

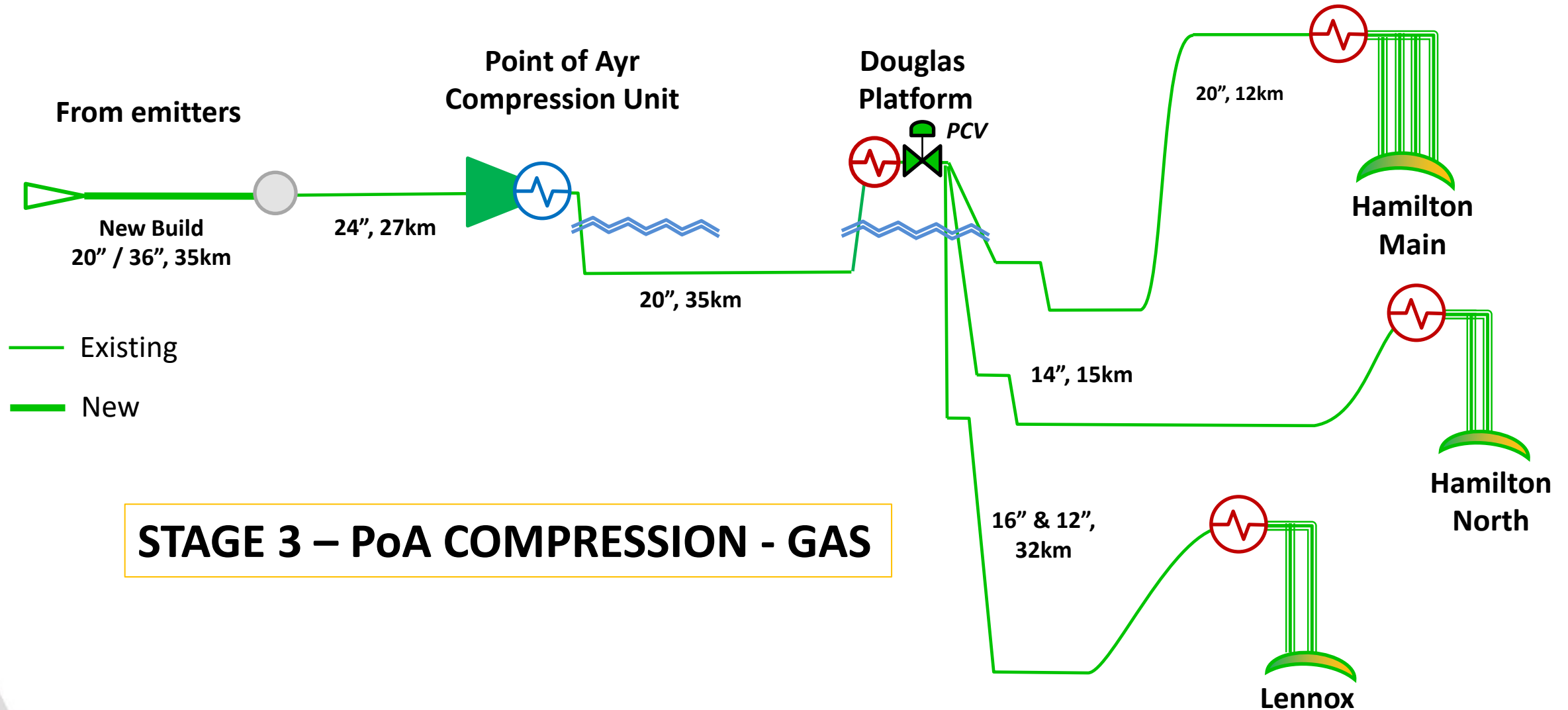


High level Project Overview – Location & Process

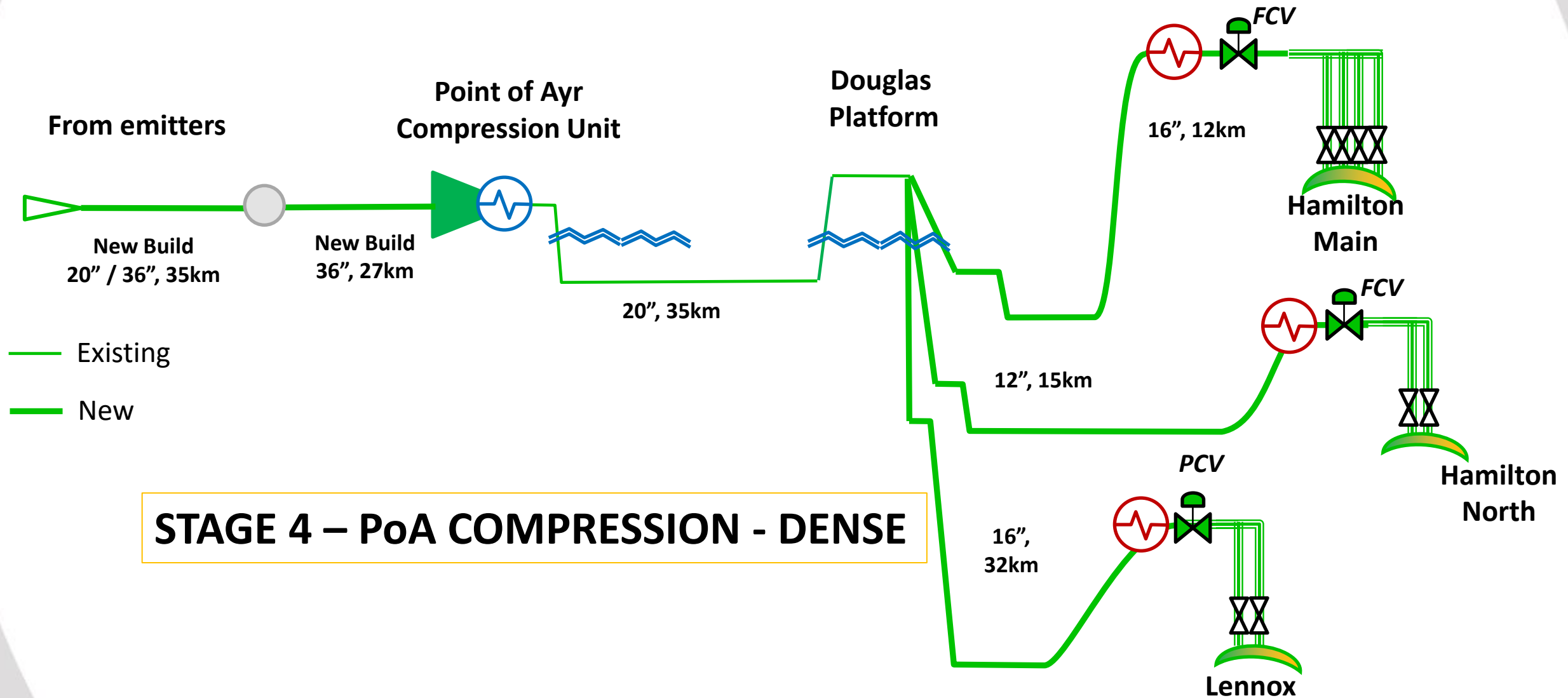


STAGE 2 – PoA COMPRESSION - GAS

High level Project Overview – Location & Process



High level Project Overview – Location & Process





■ *Why use a Compressor?*

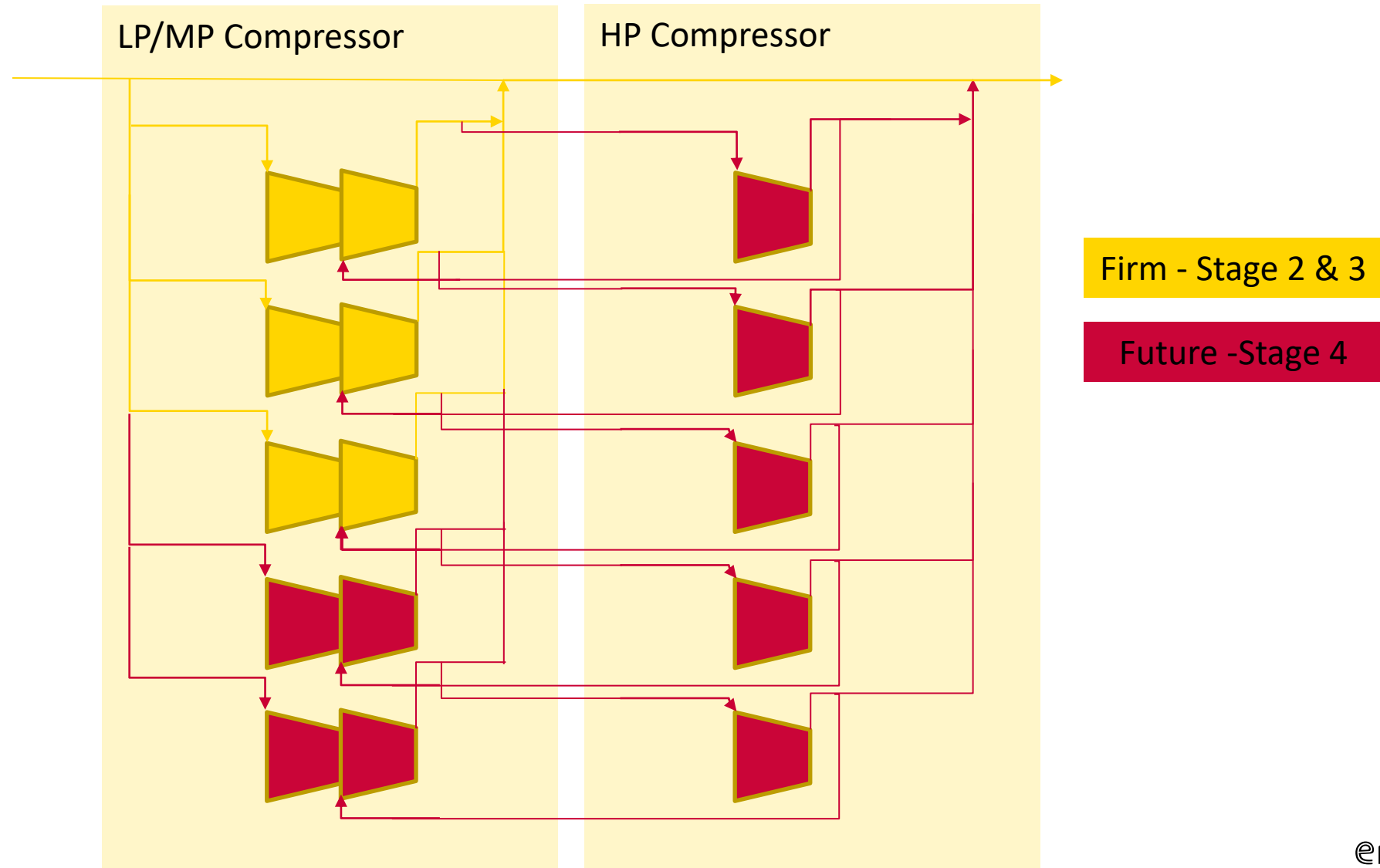
- *To transport a fluid (gaseous CO₂) from an onshore facility to an offshore reservoir and overcoming the reservoir pressure*
- *A mechanical means of providing the energy by increasing pressure and reducing the fluids volume*

Duty requirements



Stage		1	2	3	4
Strategy		Firm			Future
Operational Mode		Freeflow	Compression Required		
CO ₂ Phase		Vapor	Vapor	Vapor	Vapor & Supercritical
Nominal Flow	MTPA	4.5	4.5	4.5	10
Operating Flow	MTPA	N/A	2.32 – 3.6	4.74	2.75 – 10.53
Suction Pressure	Bara	N/A	22.9 – 29.5	13.8 – 15.8	12 – 31.4
Discharge Press.	Bara	N/A	35.8 – 63.9	66.6 – 73.4	101.2 – 137
Differential. Press.	Bar	N/A	6.3 – 40.9	51.4 – 59.6	86 – 125

Compressor configuration & Driver selection



- *Stage 2 & 3*
 - *LP/MP Compressor trains (3 x 50%)*
- *Stage 4*
 - *Additional LP/MP Compressor trains (5x25% anticipated, reutilising the Stage 2 & 3 installation)*
 - *HP Compressor trains (5x25% anticipated)*
- *Compression trains as follows:*
 - *Centrifugal Compressors (acc. API 617)*
 - *Electric Motor driven (variable speed type)*
 - *Capacity control achieved by:*
 - *Primarily speed control*
 - *Inlet guide vanes/ suction throttling (Supplier's to advise)*
 - *Cooled bypass*

Compressor configuration & Driver selection



■ LP/MP Compressor train duties

Oper. Case		Gas (Case 3.4A)		Gas (Case 2.3B)		Dense (Case 4.9B)	
Section		LP	MP	LP	MP	LP	MP
Flowrate	kg/h	270548		264360		270368	337960
MW		43.02		43.02		43.02	
Suct. Press.	Bara	13.8	(*)	29.5	(*)	13.8	(*)
Suct. Temp.	°C	8.4	26.8	5.4	26.8	8.4	15
Disc. Press.	Bara	(*)	73.4	(*)	35.8	(*)	65.5

(*) Inter-stage pressure to be confirmed by Supplier.

- *Stage 2 & 3 – Firm scope – 3x50% LP/MP Compressor trains, each comprising of:*
 - *Centrifugal Compressor (acc. API 617)*
 - *Seal Gas System c/w DGS', and panel inc. seal gas booster, KO drum/heater/tracing as required (acc. API 692)*
 - *Lubrication Oil System c/w freestanding air cooler (acc. API 614)*
 - *Electric Motor (variable speed type)*
 - *Anti-surge/capacity control valves, and hot gas bypass valves (if required)*
 - *Local Equipment Room*
 - *Variable speed controller (note: cooling water not available)*
 - *UCP*
 - *Auxiliary MCC & distribution*
 - *Auxiliary UPS & batteries*
 - *HVAC*
 - *Fire & gas detection*
 - *Clean agent active fire protection system (acc. NFPA 2001)*

- *Stage 4 – Future scope – further 2 LP/MP Compressor trains, and 5x25% HP Compressor trains anticipated, each comprising of:*
 - *Centrifugal Compressor (acc. API 617)*
 - *Seal Gas System c/w DGS', and panel inc. seal gas booster, KO drum/heater/tracing as required (acc. API 692)*
 - *Lubrication Oil System c/w freestanding air cooler (acc. API 614)*
 - *Electric Motor (variable speed type)*
 - *Anti-surge/capacity control valves, and hot gas bypass valves (if required)*
 - *Local Equipment Room*
 - *Variable speed controller (note: cooling water not available)*
 - *UCP*
 - *Auxiliary MCC & distribution*
 - *Auxiliary UPS & batteries*
 - *HVAC*
 - *Fire & gas detection*
 - *Clean agent active fire protection system (acc. NFPA 2001)*

- *Documentation*
- *Inspection & testing, notably*
 - *Integrated FAT of Control System with ICSS*
 - *Compressor Performance Test (acc. ASME PTC-10)*
 - *Complete Unit Test c/w job lubrication oil & sealing system, motor & local equipment room (acc. API 617)*
 - *Site Acceptance Test*
- *Engineering design review attendance at EPC Contractor offices – HAZOP/ SIL/ 3D model*
- *Dynamic simulation*
- *Packing & preservation*
- *Site supervision for installation, commissioning & start-up*
- *Training*
- *Remote condition monitoring*
- *Maintenance/service contract*

■ *Legislation*

- *UK directives for pressure equipment & machinery*

■ *Codes*

- *API 613, 614, 617, 661, 671, 684, 692 etc*
- *ANSI*
- *ASME VIII, PTC-10*
- *IEC*
- *NFPA 2001*

■ *Standards*

- *Eni Standards*
- *International Organisation of Oil & Gas Producers (IOGP) JIP-33 Specifications*

- *International Organisation of Oil & Gas Producers (IOGP) JIP-33 Specifications*
 - *Series of specifications which have been developed by 12 O&G majors*
 - *Endorsed by Supplier market through stakeholder management*

Upstream Members

BP
Chevron
ConocoPhillips
Eni
Equinor
ExxonMobil
Petrobras
Petronas
Saudi Aramco
Shell
Total
Woodside

IOGP Associate Members

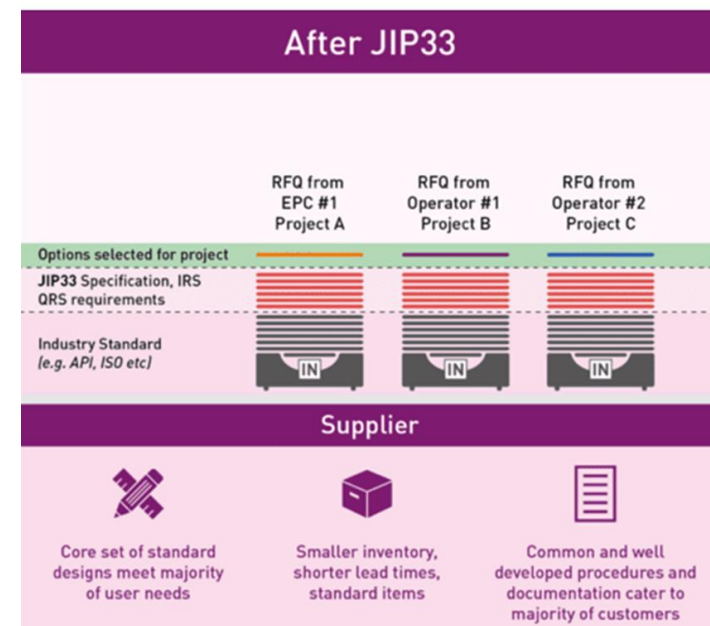
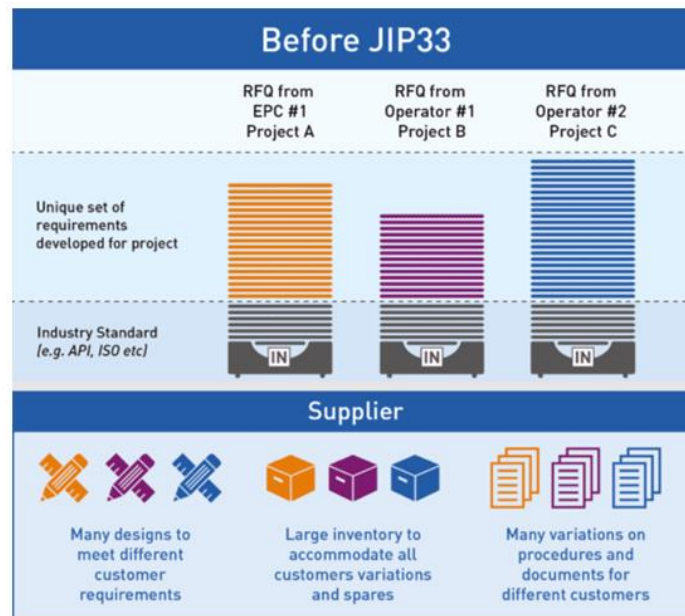
Aker Solutions
Baker Hughes
OPITO
Schlumberger
TechnipFMC plc

National and other associations

American Petroleum Institute (API)
Energy Institute (EI)
OEUK
Norwegian Oil & Gas Association



- *International Organisation of Oil & Gas Producers (IOGP) JIP-33 Specifications*
 - *Based on ‘minimum requirements’*
 - *As of May 2022 there are circa 50 active specifications for various commodities*



- *Pre-investment of Stage 2 & 3 (firm scope) to allow being reutilised for Stage 4 (future scope)*
 - *Consideration for duties, design temp/pressure, settle-out pressure, transient conditions*
 - *Control system provisions to allow seamless integration for future scope & operational flexibility*
- *Energy efficiency*
 - *Maintain a high overall & polytropic efficiency over the operational envelope (note: discharge cooling is limited by air cooling)*
 - *Minimise throttling & recycling to achieve the operational cases*
- *Carbon footprint*
 - *Minimise utility & electrical consumptions*
 - *Minimise emissions & effluents (e.g. venting)*

Deep Dive Session #1 – CO₂ Compressors



- *Q&A Session*