

# NOV CCUS Product Offerings





# Contents

---

Summit Solution	<b>6-7</b>
Peak Solution	<b>8-9</b>
Ascent Solution	<b>10-11</b>
Approach Solution	<b>12-13</b>
Natural Gas Sweetening Solution	<b>14</b>





**NOV**

**NOV**

[pf-ccusmarketing@nov.com](mailto:pf-ccusmarketing@nov.com)

# Our CCUS offerings

**Summit Solution™ Offering** – customizable & optimized post-combustion carbon capture

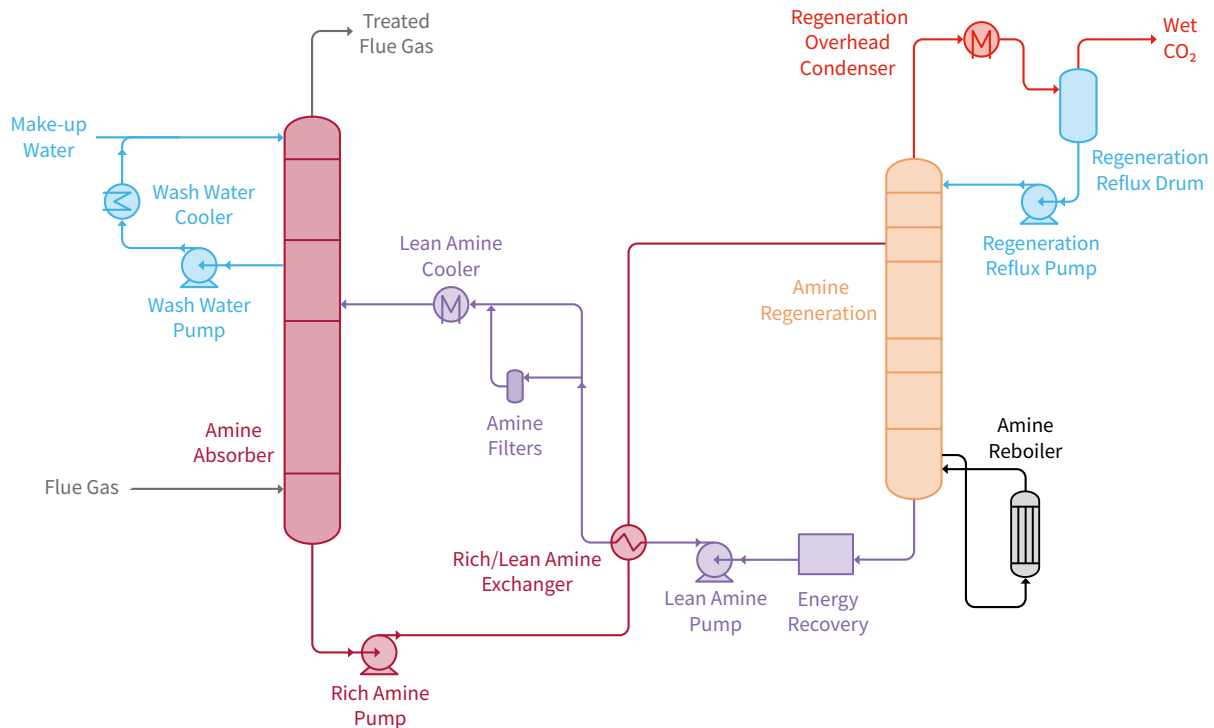
**Peak Solution™ Offering** – partly modularized & pre-engineered post-combustion carbon capture

**Ascent Solution™ Offering** – fully modularized & standardized post-combustion carbon capture

**Approach Solution™ Offering** – fully configurable solution with standardized modules as building blocks

**Natural Gas Sweetening Solutions** – customizable CO<sub>2</sub> removal by amine or membrane technology

## Post-Combustion Carbon Capture at a glance





## Summit Solution™ Offering

The Summit solution offering utilizes customization and technologies best deployable for client needs. We offer proprietary amine based solvent carbon capture technology for post-combustion applications. Other solvents can be assessed for use based on client needs. This built for purpose solution can be customized and scaled as required by the site needs to meet gas capacities below 1 mtpa CO<sub>2</sub> in a variety of applications.

Our Summit Solution offering provides a full range of design flexibility to meet demanding applications. This offering allows for full integration to maximize existing capacity of support systems and reduce the operating costs. Furthermore, footprint and orientation of equipment can be specifically designed to meet more challenging settings.

In addition to the carbon capture solution, pipeline and storage components can be incorporated into the project utilizing NOV's products in flue gas ducting, large composite piping, downstream pipeline transport/transfer of CO<sub>2</sub> as well as downhole coatings to support sequestration wells. A full solution from flue gas conditioning to CO<sub>2</sub> capture, transport and storage can be achieved in this solution.



### Our fully engineered Summit Solution Offering:

- Meet your needs in size and operation with the highest degree of customization at commercial scale
- Stick-built approach for cost effective and customized layout
- Provide you with the lowest OPEX solution for long term operation
- Adaptable configuration with heat integration possibilities with surrounding facilities and suited for diverse utilities
- Flexible capture efficiency design
- Incorporation of health, safety and environmental control

We offer efficient & optimized process design, all the way to fabrication and package delivery for full-service carbon capture systems. We are comfortable taking on full scope and split scope solutions to meet the project needs. We work with EPC, project developer and consortium arrangements to support a wide range of project requirements. We have direct relationships with key EPC companies, midstream/sequestration companies, and CCUS developers to offer a full turnkey solution together.



### Post-Combustion Carbon Capture

- Typical Flue gas capacity: ~50k to 950k Nm<sup>3</sup>/h (29k to 559k scfm)
- CO<sub>2</sub> inlet composition: ~4 to +25%v CO<sub>2</sub>
  - Flexible flue gas composition
- CO<sub>2</sub> capture capacity: ~150 to 1000 ktpa CO<sub>2</sub>
- Technology: Advanced amine-based solvent
- Constructability: Customizable stick-built approach
- Configuration: Flexible configuration to suit multiple flue gas sources & specific project restraints

### Full functional features can be included in the solution considering aspects of:

- Concept configuration
- Fluid hydraulics (CFD analysis, customized internals, pressure drop optimization)
- Gas pretreatment
- Solvent reclamation and handling
- CO<sub>2</sub> Conditioning (dehydration, deoxygenation, solvent emissions)
- CO<sub>2</sub> Compression
- Monitoring and controls



## Peak Solution™ Offering

The Peak Solution offering utilizes modularization and technologies best deployable for client needs. Peak Solution utilizes a proprietary amine based solvent carbon capture technology for post-combustion sectors. Other solvents can be assessed for use based on site needs. This set of pre-designed solutions can fit site needs to meet gas capacities between 50k and 200k ktpa CO<sub>2</sub> in a variety of applications.

Our Peak Solution offering provides a limited range of design flexibility to decrease project time and cost. This offering allows for product size ranges to pair with site requirements with flexibility to integrate with existing plant utilities and support systems. Additionally, footprint and orientation of equipment can be specifically designed to meet site requirements.

In addition to the carbon capture and conditioning solution, pipeline and storage components can be incorporated into the project utilizing NOV's products in flue gas ducting, large composite piping, downstream pipeline transport/transfer of CO<sub>2</sub> as well as downhole coatings to support sequestration wells. A full solution from flue gas conditioning to CO<sub>2</sub> capture, transport and storage can be achieved in this solution.





### Our Peak Solution Offering:

- Meets your needs in sizes and capacity with certain degree of pre-engineered solutions which can be tailored to specific process and projects
- Pre-Assemble Units (PAU) for compact and minimal site work
- Provide you with reduced CAPEX through lower project engineering costs
- Adjusted to balance CAPEX requirements with OPEX expectations
- Flexible layout configuration to suit diverse surroundings
- Flexible capture efficiency design
- Incorporation of health, safety and environmental control

We offer efficient & optimized process design, all the way to fabrication and package delivery for full-service carbon capture systems. We are comfortable taking on full and split scope solutions to meet the project needs. We are comfortable working with EPC, project developer and consortium arrangements to support a wide range of project requirements. We have direct relationships with key EPC companies, midstream/sequestration companies, and CCUS developers to offer a full turnkey solution together.



### Post-Combustion

- Typical Flue gas capacity: ~20k to 265k Nm<sup>3</sup>/h (12k to 156k scfm)
- CO<sub>2</sub> inlet composition: ~4 to +25%v CO<sub>2</sub>
  - Flexible flue gas composition
- CO<sub>2</sub> capture capacity: ~50 to 200 ktpa CO<sub>2</sub>
- Technology: advanced amine-based solvent
- Constructability: Customizable modular approach
- Configuration: Flexible configuration to suit multiple flue gas sources & to match layout restraints

### Full functional features can be addressed in the solution spanning aspects of:

- Fluid hydraulics
- Gas pretreatment
- Solvent reclamation and handling
- CO<sub>2</sub> post treatment (dehydration, deoxygenation, solvent emissions)
- Compression
- Piping (fiberglass solutions)
- Monitoring and controls



## Ascent Solution™ Offering

The Ascent Solution offering utilizes standardization and technologies best deployable for client needs. The offering utilizes a proprietary amine-based solvent carbon capture technology for post-combustion applications to meet gas capacities between 25 and 70 ktpa CO<sub>2</sub>. Other solvents can be assessed for use based on site needs. This set of standardized solutions can fit site needs while decreasing project time and cost.

In addition to the carbon capture and conditioning solution, pipeline, downstream pipeline transport/transfer of CO<sub>2</sub> as well as downhole coatings to support sequestration wells. A full solution from flue gas conditioning to CO<sub>2</sub> capture, transport, and storage can be achieved in this solution.



### **Our standardized Ascent Solution Offering:**

- Meet your needs in sizes and capacity with standard solutions
- Provide you with the reduced CAPEX through lower engineering costs of project
- Can be standardized to balance CAPEX requirements with OPEX expectations
- Will be designed with long term operability in mind and fully supported for assurance of operation

We offer efficient & optimized process design, all the way to fabrication and package delivery for full-service carbon capture systems. We are comfortable taking on full and split scope solutions to meet the project needs. We are comfortable working with EPC, project developer and consortium arrangements to support a wide range of project requirements. We have direct relationships with key EPC companies, midstream/sequestration companies, and CCUS developers to offer a full turnkey solution together.

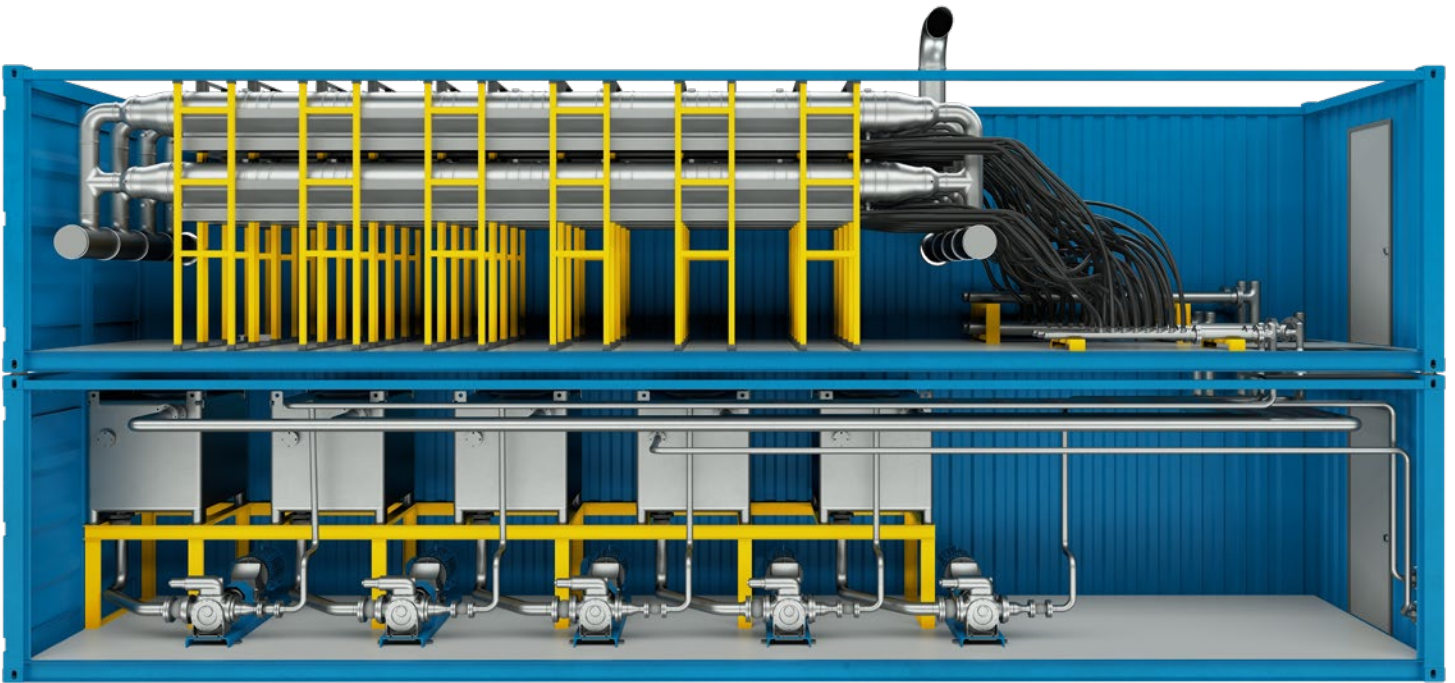


### **Post-Combustion Carbon Capture**

- Flue gas capacity: ~10k to 100k Nm<sup>3</sup>/h (6k to 59k scfm)
- CO<sub>2</sub> inlet composition: ~4 to +25%v
  - Flexible flue gas composition
- CO<sub>2</sub> capture capacity: ~25 to 70 ktpa CO<sub>2</sub>
- Technology: Advanced amine-based solvent
- Constructability: Standardized modular approach
- Configuration: Flexible configuration & adaptive to layout restraints

### **Full functional features can be addressed in the solution spanning aspects of:**

- Fluid hydraulics
- Gas pretreatment
- Solvent reclamation and handling
- CO<sub>2</sub> post treatment (dehydration deoxygenation, solvent emissions)
- Compression
- Monitoring and controls



## Approach Solution™ Offering

The Approach Solution utilizes a unique horizontally configured advanced amine-based solvent carbon capture technology for post-combustion flue gases. Solvents can be assessed for use based on site needs. This set of standardized solutions can fit client needs to meet gas capacities between 10 and 80 ktpa CO<sub>2</sub> in a variety of applications.

Our Approach Solution Offering provides a limited range of design flexibility to decrease project time and cost. This offering allows for product size ranges to pair with site requirements with flexibility to integrate with existing plant utilities and support systems. Additionally, footprint and orientation of equipment can be specifically designed to meet site requirements.

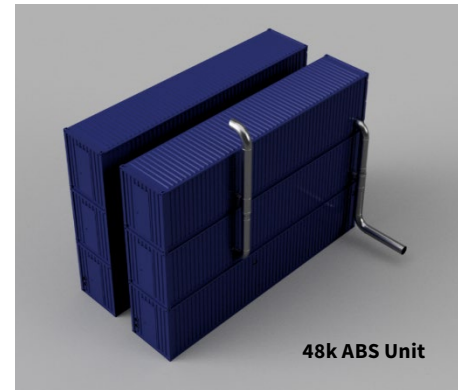
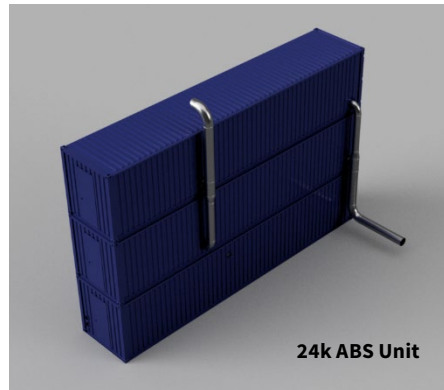
The solution can be packaged as a full turnkey carbon capture system to take flue gas to pipeline ready CO<sub>2</sub>. Partial capture systems with absorption units local to point sources can be deployed with connection to site centralized desorption infrastructure.

### Our standardized Approach Solution:

- Absorption modules can be deployed standalone to connect into existing centralized desorption to reduce large duct work that would otherwise be required to connect flue gases to centralized absorption units
- Can be a full carbon capture solution with absorption and desorption units combined
- Reduced site preparation
- Scalable for deployment at various sites
- Ability to push cash flow to the right in partial deployment followed by later addition through standard modules

Depending on gas composition various configurations of absorber units and desorber units can be paired for a full carbon capture unit. For higher or lower CO<sub>2</sub> concentrations, properly sized desorber units can be paired. The capture efficiency has a range of 60-90% depending on gas characteristics. Additional units can be placed in series to increase capture efficiency.

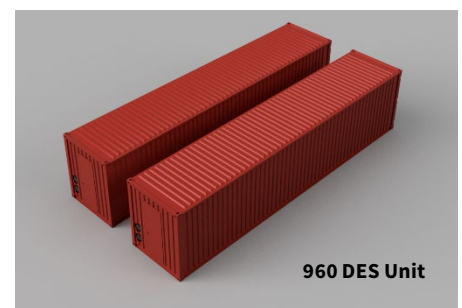
### Approach Solution Absorber (ABS) Units



Gas Flow - scfm (Nm <sup>3</sup> /h)	Size L x W x H ft (m)	Capture (ktpa) @ 4% / 8% CO <sub>2</sub>	DES Pairing
12 ABS - 12k* (20k)	40 x 8 x 17 (12.2 x 2.4 x 5.2)	10 / 20	240 DES / 480 DES
24 ABS - 24k (41k)	40 x 8 x 26 (12.2 x 2.4 x 7.9)	20 / 40	480 DES / 960 DES
48 ABS - 48k (82k)	40 x 20 x 26 (12.2 x 6.1 x 7.9)	40 / 80	960 DES / 2x 960 DES

\*4k and 8k options can be reviewed for special applications

### Approach Solution Desorber (DES) Units



Solvent Flow - gpm (m <sup>3</sup> /h)	Size L x W x H ft (m)	Capture (ktpa CO <sub>2</sub> )	ABS Pairing
240 DES - 240 (55)	20 x 8 x 8.5 (6.1 x 2.4 x 2.6)	10	4 ABS / 8 ABS / 12 ABS
480 DES - 480 (109)	40 x 8 x 8.5 (12.2 x 2.4 x 2.6)	20	12 ABS / 24 ABS
960 DES - 960 (218)	40 x 20 x 8.5 (12.2 x 6.1 x 2.6)	40	24 ABS / 48 ABS

Utilities can be provided by the site or adapted to the units. Cooling and heating media, fluids handling and power connections can be provided or tied into the units for a given sites quality and availability.

# Natural Gas Sweetening Solutions

We provide efficient, optimized, and custom-made solutions for CO<sub>2</sub> removal from natural gas. Depending on the inlet CO<sub>2</sub> concentration and treated gas specifications, we can offer amine-based solutions, membranes packages solutions or both (e.g. bulk CO<sub>2</sub> removal with the membranes and polishing with the amine to reach LNG specifications).

## Pre-Combustion – Amine Based Technology

NOV Amine-based CO<sub>2</sub> removal packages are based on formulated amine for enhanced and optimized CO<sub>2</sub> removal. For these units, the design is either performed in-house or it comes from one of our preferred solvent vendor. For specific needs like Liquefied Natural Gas (LNG), we work closely with amine process licensors. Our extensive experience in the field of modularization is fully integrated with our process expertise to offer optimized solutions.

### Case study:

- **Gas capacity:** 202k Nm<sup>3</sup>/h (119k scfm)
- **CO<sub>2</sub> inlet composition:** 6.5%v CO<sub>2</sub>
  - Flexible gas composition
- **CO<sub>2</sub> capture capacity:** 221 ktpa CO<sub>2</sub>
- **Technology:** Advanced amine-based solvents
- **Constructability:** Customizable & modular approach
- **Configuration:** Flexible configuration & adaptive to layout restraints

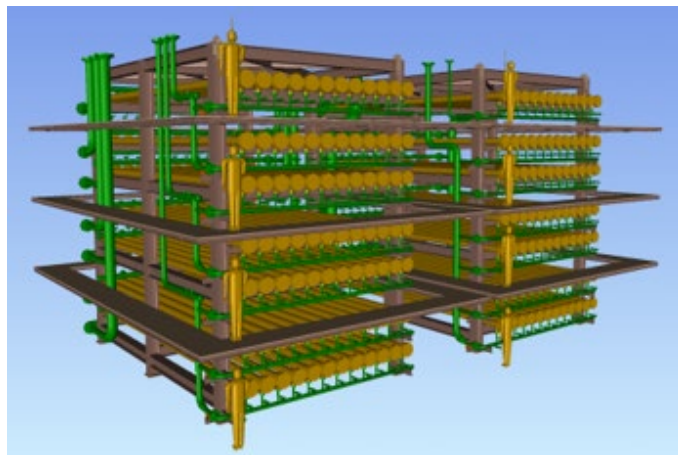


## Pre-Combustion – Membrane Based Technology

NOV CO<sub>2</sub> Removal Package is powered by EVONIK SEPURAN® NG MEMBRANES. Evonik developed SEPURAN® NG as an especially robust, hollow-fiber membrane, which is based on polyimide polymer that can withstand extreme pressure and temperatures. This enables particularly selective separation of the sour gases from the natural gas, excellent resistance to plasticization, high tolerance of the higher hydrocarbons contained in the natural gas, and consistently high performance of the membrane throughout its lifetime.

### Case study:

- **Gas capacity:** 237k Nm<sup>3</sup>/h (139k scfm)
- **CO<sub>2</sub> inlet composition:** 23 to 59%v CO<sub>2</sub>
  - Flexible gas composition
- **CO<sub>2</sub> capture capacity:** 900 to 1,575 ktpa CO<sub>2</sub>
- **Technology:** Hollow fiber polyimides membranes
- **Constructability:** Customizable & modular approach
- **Configuration:** Flexible configuration & adaptive to layout restraints





NOV Inc. has produced this brochure for general information only, and it is not intended for design purposes. Although every effort has been made to maintain the accuracy and reliability of its contents, NOV Inc. in no way assumes responsibility for liability for any loss, damage or injury resulting from the use of information and data herein. All applications for the material described are at the user's risk and are the user's responsibility.

**Corporate Headquarters**

10353 Richmond Ave.  
Houston, Texas 77042  
USA

© 2023 NOV Inc. All rights reserved.  
JIG 23-CAPS-PFT-LCS-0909



[pf-ccusmarketing@nov.com](mailto:pf-ccusmarketing@nov.com)

[www.nov.com/ccus](http://www.nov.com/ccus)