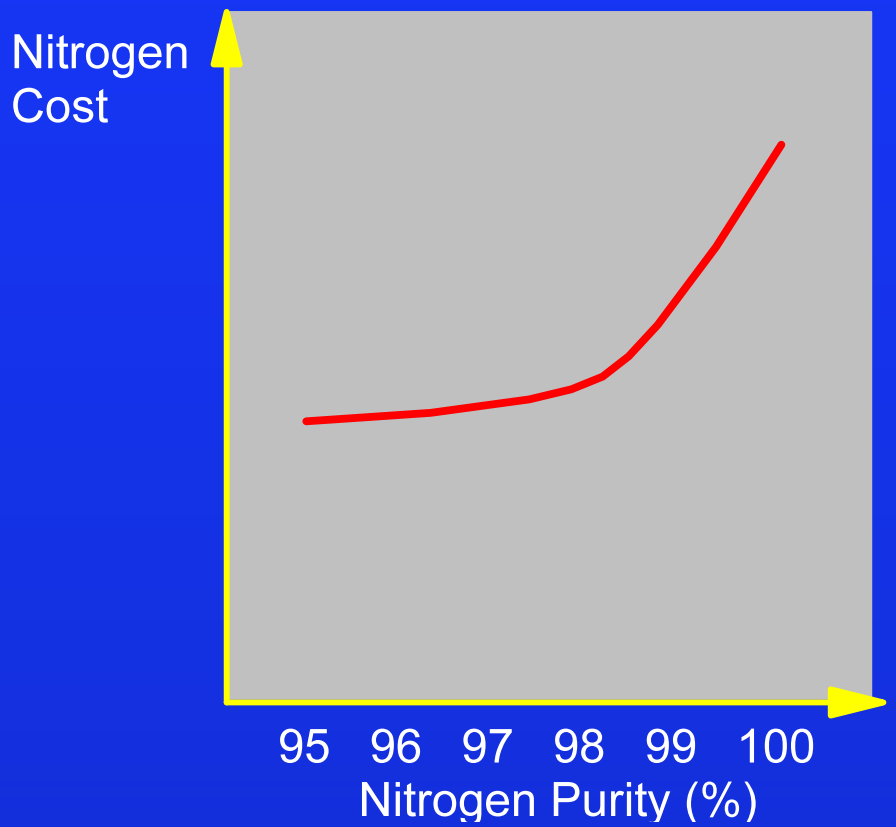
FUNDALMENTALS of ON-SITE NON-CRYOGENIC NITROGEN GENERATION

Why Non-Cryo Vs. Liquid?

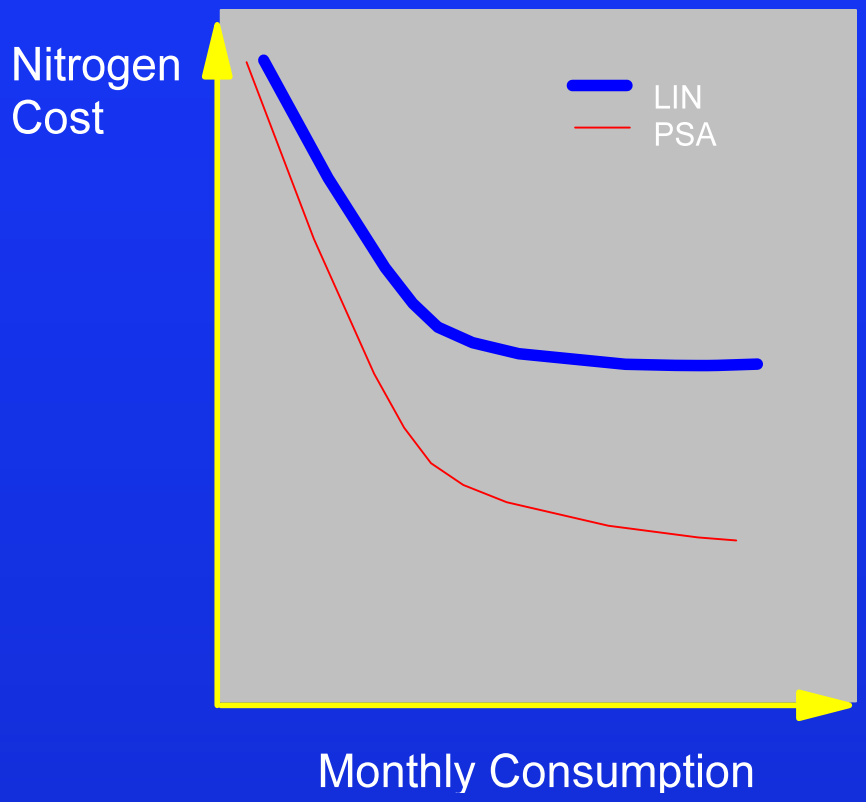
- Units are Re-locatable and Flexible
- Short Delivery Time-Gas in pipeline 3 months or less
- Customer preference for onsite N2 Generation
- Units are skid-mounted and compact
- Least expensive Gas Cost solution

NON-CRYOGENIC SYSTEM ECONOMICS

N2 COST VS. N2 PURITY



LOWEST COST MODE OF SUPPLY
LIQUID NITROGEN (LIN) VS. PSA NITROGEN



ON-SITE SOURCE OF NITROGEN

- Supplies Steady Stream of 95% to 99.999% Pure Nitrogen
- Enhanced Customer Convenience and Control
- Can Be Located Indoors or Outdoors
- Requires Less Space Than Bulk Liquid Nitrogen Storage Tanks and Vaporizers

NONCRYOGENIC NITROGEN PRODUCTS

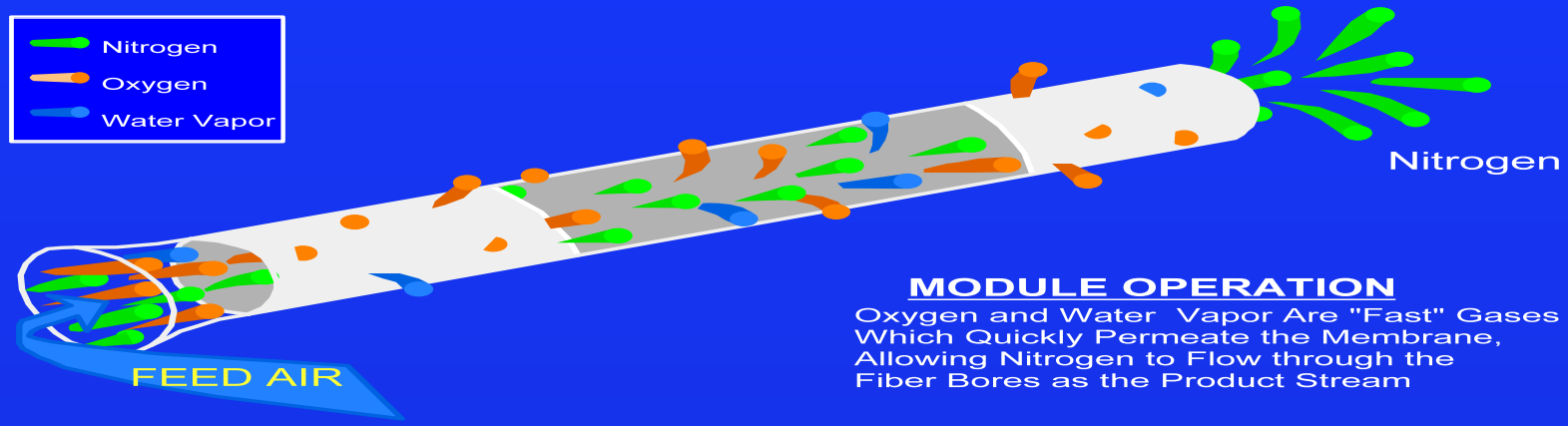
- Two distinct Technologies
  - Membrane Air Separation
  - Pressure Swing Adsorption (PSA) Air Separation

MEMBRANE AIR SEPARATION TECHNOLOGY

WHAT IS MEMBRANE AIR SEPARATION TECHNOLOGY?

- A Technology Used to Generate Non-cryogenic (Gaseous) Nitrogen on-site
- A Polymeric Hollow Fiber Selectively Permeates Oxygen, Water Vapor, and Other Impurities Out of Its Sides while Allowing Nitrogen to Flow through Its Center and Emerge as Product
- Millions of Hollow Fibers Are Bundled and Encased to Form a High Performance Module
- One or More Modules Are Skid-Mounted and Operated in Parallel to Supply up to 100,000 SCFH of Continuous Nitrogen Product

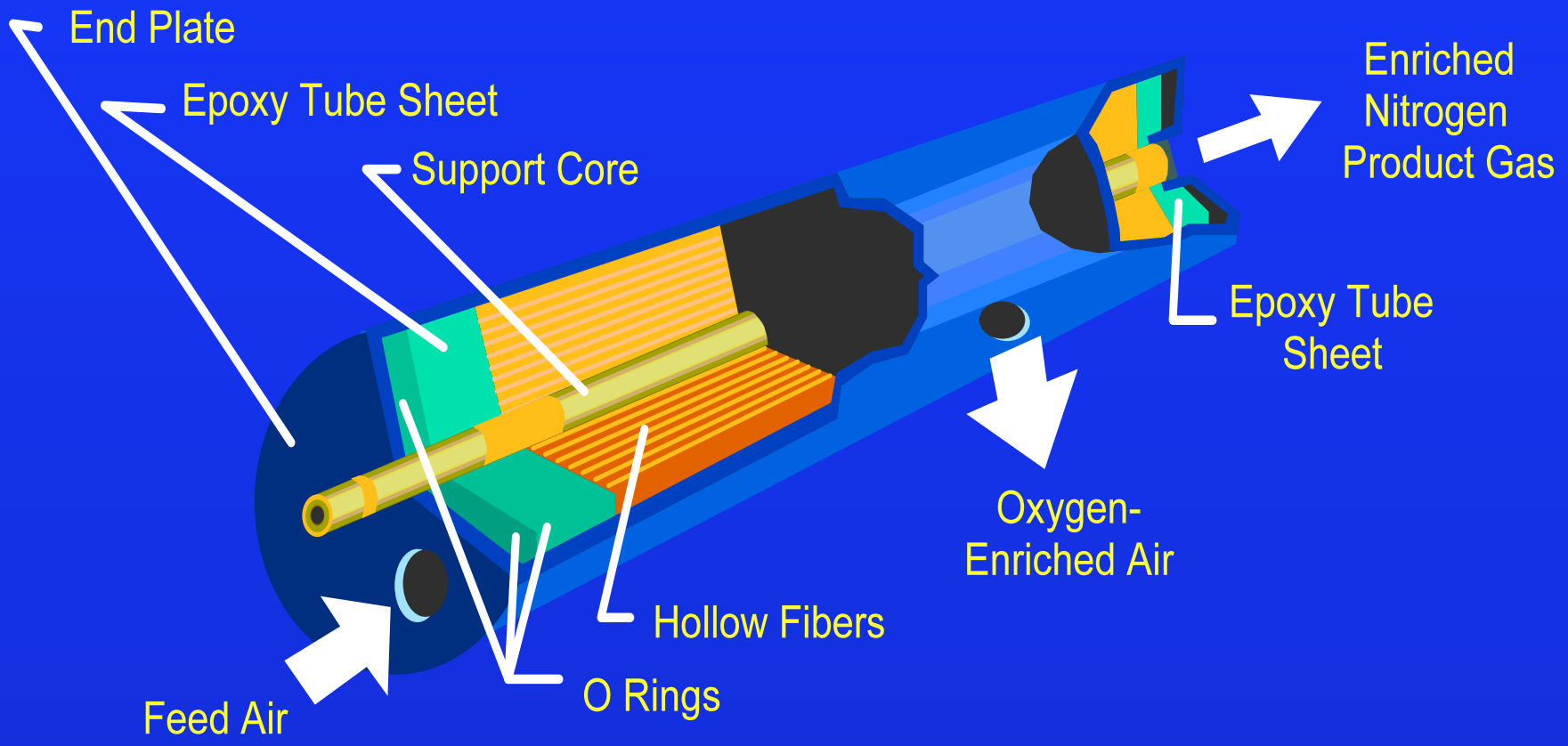
THE MEMBRANE PHENOMENOM



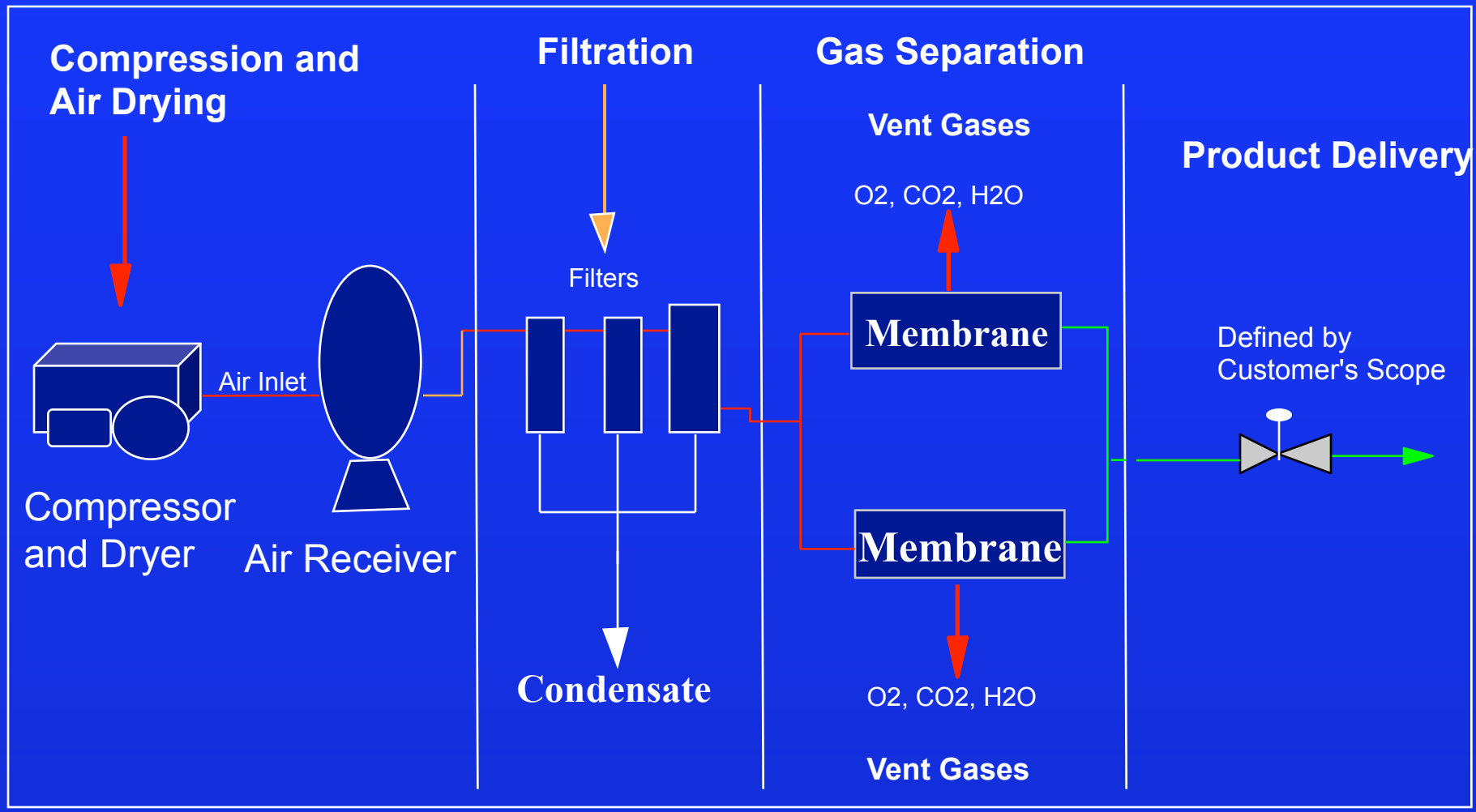
MODULE OPERATION

Oxygen and Water Vapor Are "Fast" Gases Which Quickly Permeate the Membrane, Allowing Nitrogen to Flow through the Fiber Bores as the Product Stream

MEMBRANE AIR SEPARATION MODULE



MEMBRANE PROCESS FOR AIR SEPARATION



PRESSURE SWING ADSORPTION

(PSA)

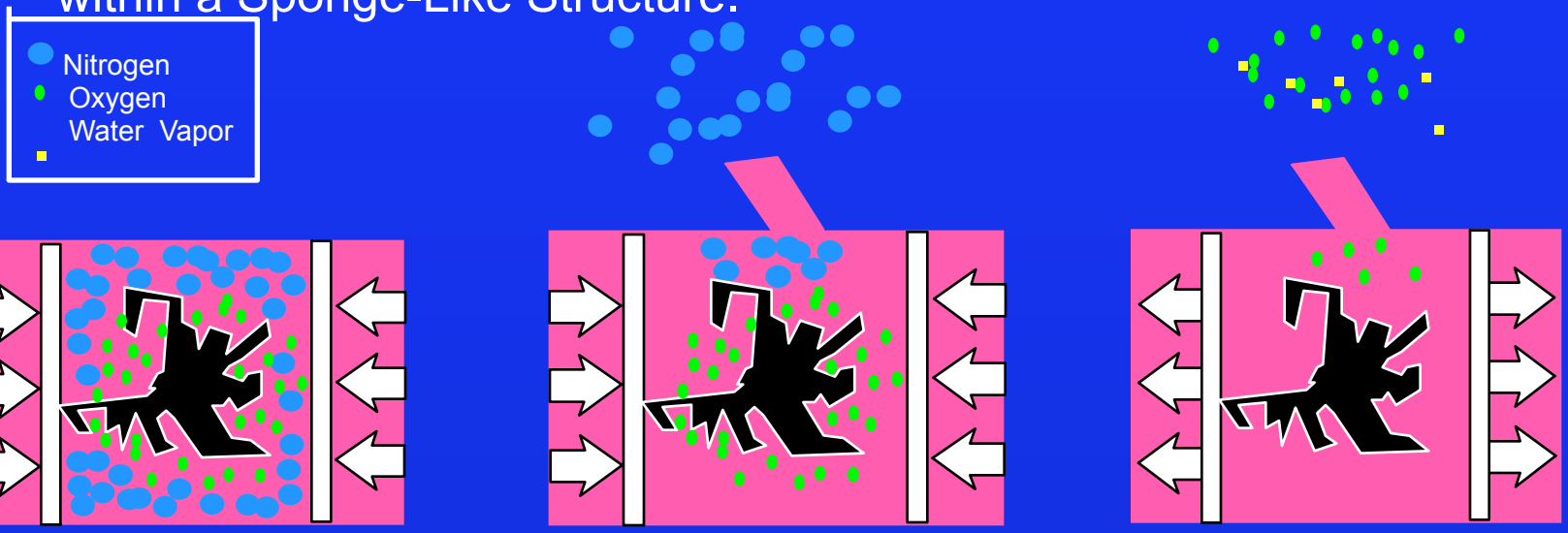
AIR SEPARATION TECHNOLOGY

WHAT IS PRESSURE SWING ADSORPTION?

- A Technology Used to Generate Non-cryogenic (Gaseous) Nitrogen On-Site
- A Proprietary Carbon Molecular Sieve (CMS) Preferentially Adsorbs Oxygen And Water Vapor Molecules under High Pressure - While Allowing Nitrogen to Pass through
- Skid-Mounted Units Can Supply up to 90,000 SCFH of Continuous Nitrogen Product
- Standard Units and Custom Designs to Meet Precise Flow, Pressure, and Purity Requirements

THE PSA PHENOMENON

Selected Porous Materials, Such as Carbon Molecular Sieve, Have the Ability to Preferentially Adsorb Gas Molecules within a Sponge-Like Structure.

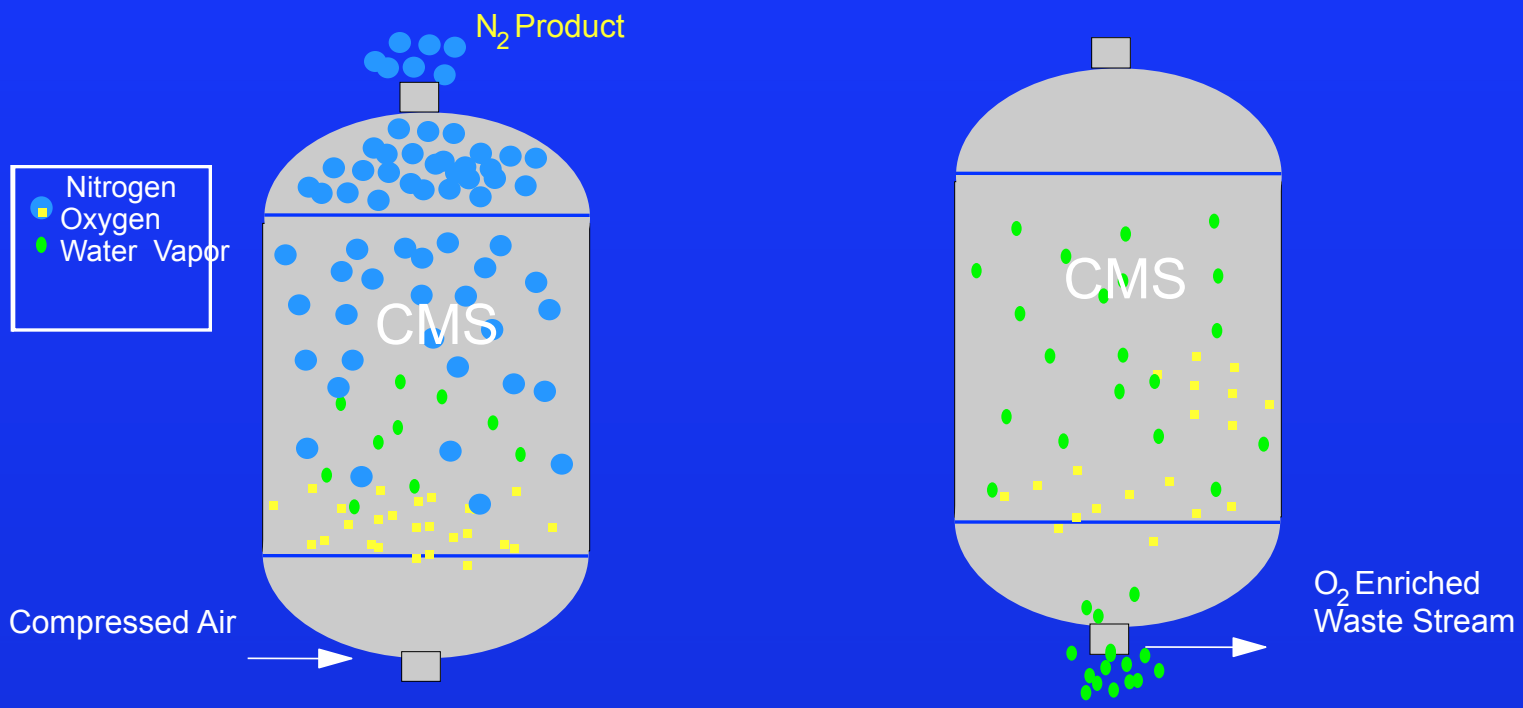


ADSORPTION
Oxygen and Other Impurities Are Adsorbed While the Nitrogen Molecules Pass By.

PRODUCTION
High Purity Nitrogen is withdrawn.

REGENERATION
Depressurization Releases All the Adsorbed Molecules, Allowing for Sieve Regeneration.

THE PSA PHENOMENON



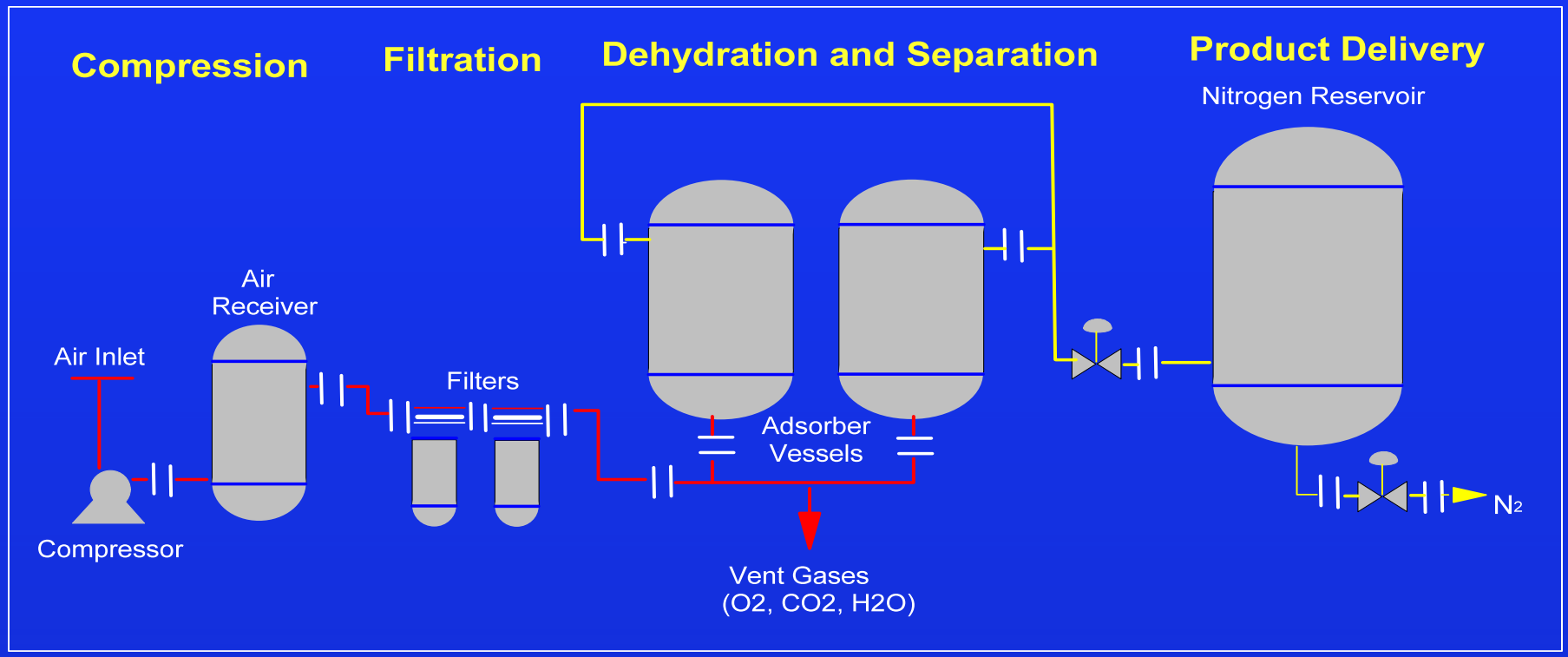
PRODUCTION

Under Pressure, the Carbon Molecular Sieve (CMS) Adsorps Oxygen and Other Impurities, Allowing Nitrogen to Pass Through as Product

REGENERATION

Depressurization Releases All of the Adsorped Molecules, Allowing for CMS Regeneration

THE PSA PROCESS FOR AIR SEPARATION



THE BENEFITS OF GSC'S PSA TECHNOLOGY

- On-Site Source of Nitrogen
- Lowest Cost Mode of Supply
- Proprietary Sieve Material
- Superior Design Features

PROPRIETARY SIEVE MATERIAL

- Exclusive Carbon Molecular Sieve (CMS) - Most Efficient in the World
- Reduced Feed Air Requirements - Smaller Compressor Needed
- Lower Power Costs - 10% to 30% Below Other Competitive CMS
- Does not Crush or Dust - Extremely High Compression Strength
- Retains Separation Efficiency - Years of Trouble Free Operation

SUPERIOR DESIGN FEATURES

- PLC-Based Controls
- Maximum Nitrogen Production at Specified Purity
- Unattended Operation
- Adjustable Set-Point Capability
- Flow, Purity, and Pressure Indication
- Capable of Sending Signals to Remote Areas for Monitoring Purposes

PSA Verses Membrane

	PSA	MEMBRANE
Power Cost	X	
Efficiency/Air Recovery	X	
Robustness (Can Take Abuse)	X	
Longivity	X	
Noise		X
Footprint/Size		X
Overall Cost	Varies	Varies