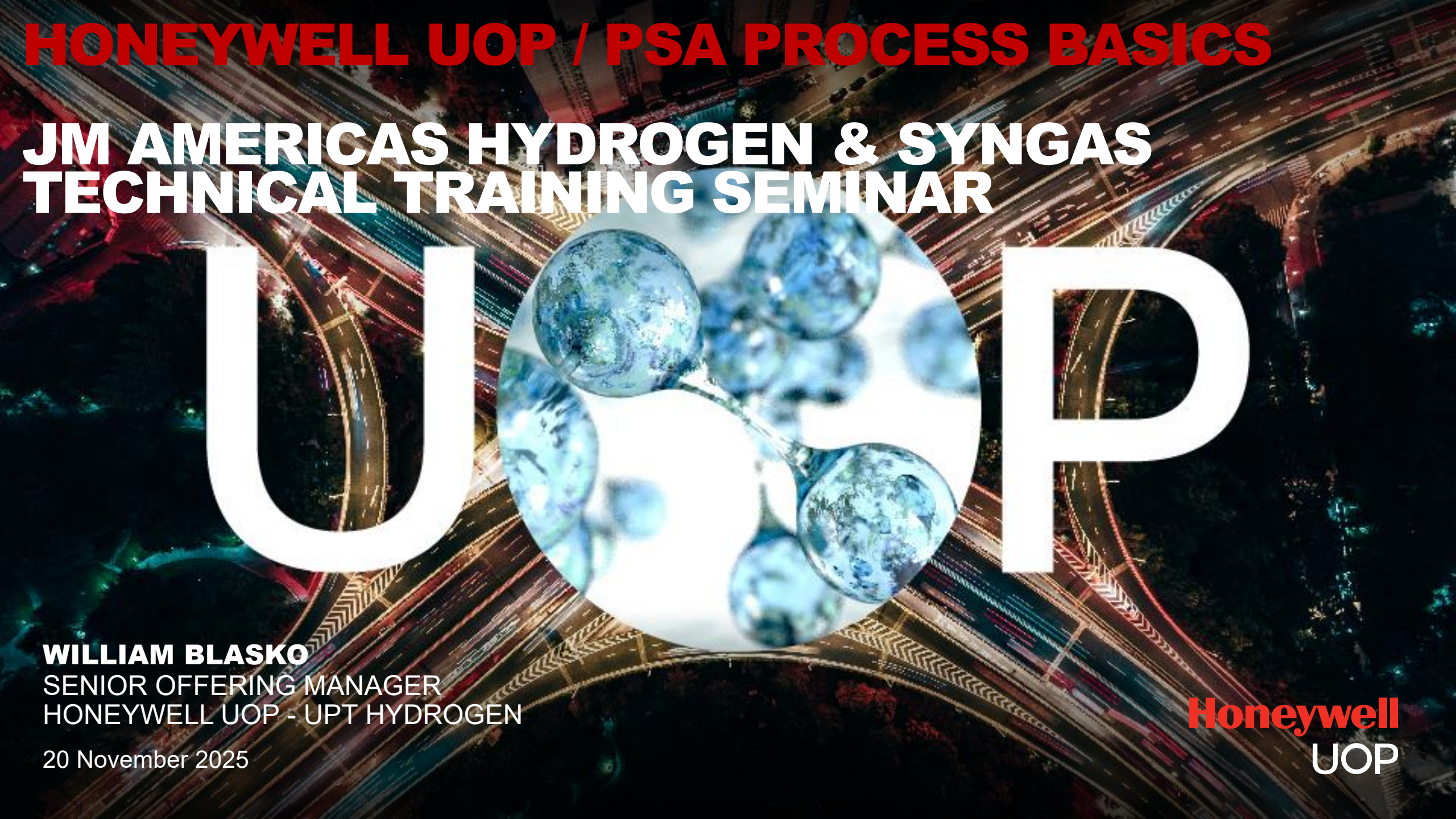
HONEYWELL UOP / PSA PROCESS BASICS

JM AMERICAS HYDROGEN & SYNGAS TECHNICAL TRAINING SEMINAR



WILLIAM BLASKO
SENIOR OFFERING MANAGER
HONEYWELL UOP - UPT HYDROGEN

20 November 2025

Honeywell
UOP

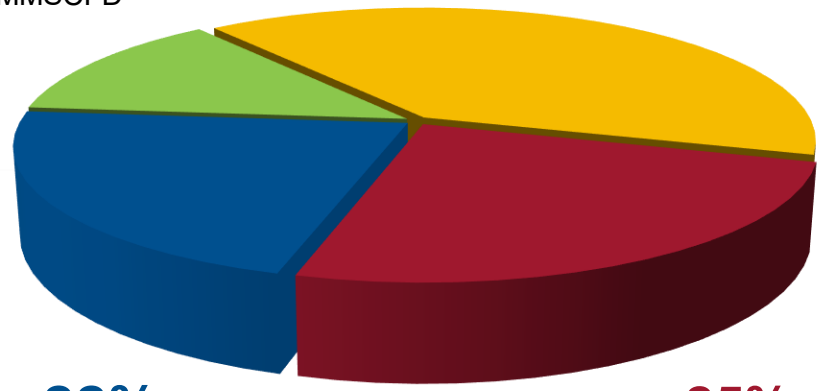
PSA APPLICATIONS / EXPERIENCE LIST

13%
Ethylene Off-Gas

No. of Units: 151
Feed Pressure: .4 – 640 psig
Feed Flow: 0.08 – 188,385 MMSCFD

40%
Steam Reformers

No. of Units: 465
Feed Pressure: 15 – 928 psig
Feed Flow: 0.12 – 344 MMSCFD

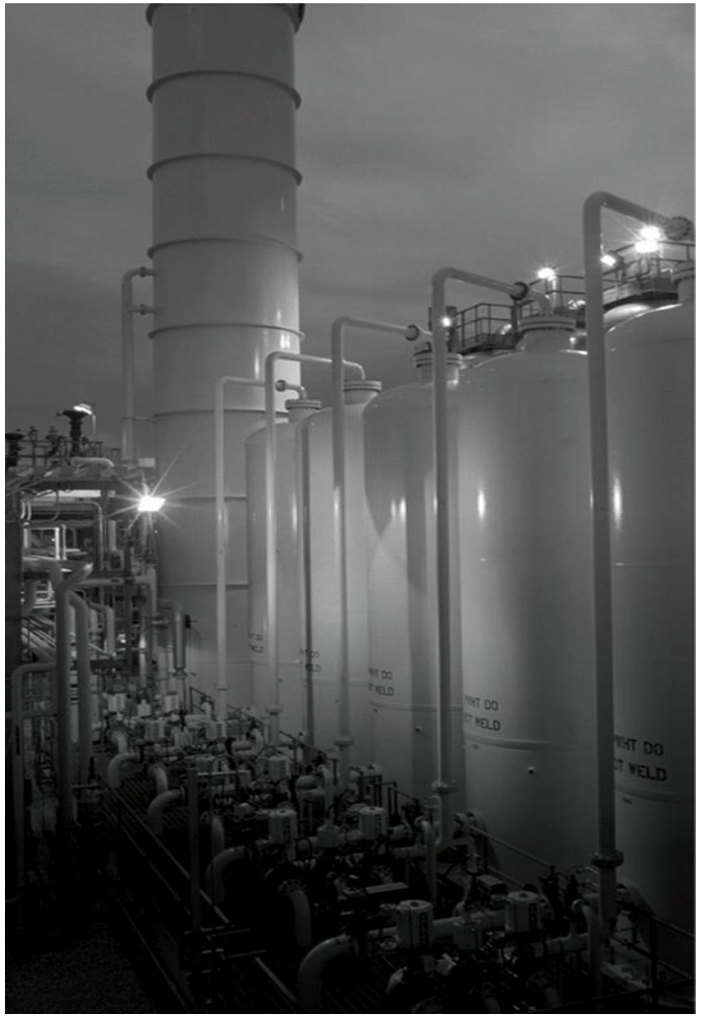


22%
Specialty Applications

No. of Units 255
Ammonia Plants
Coke Oven Gas
Gasification
Methanol Off-Gas
Misc Off-Gas
Partial Oxidation/Syngas

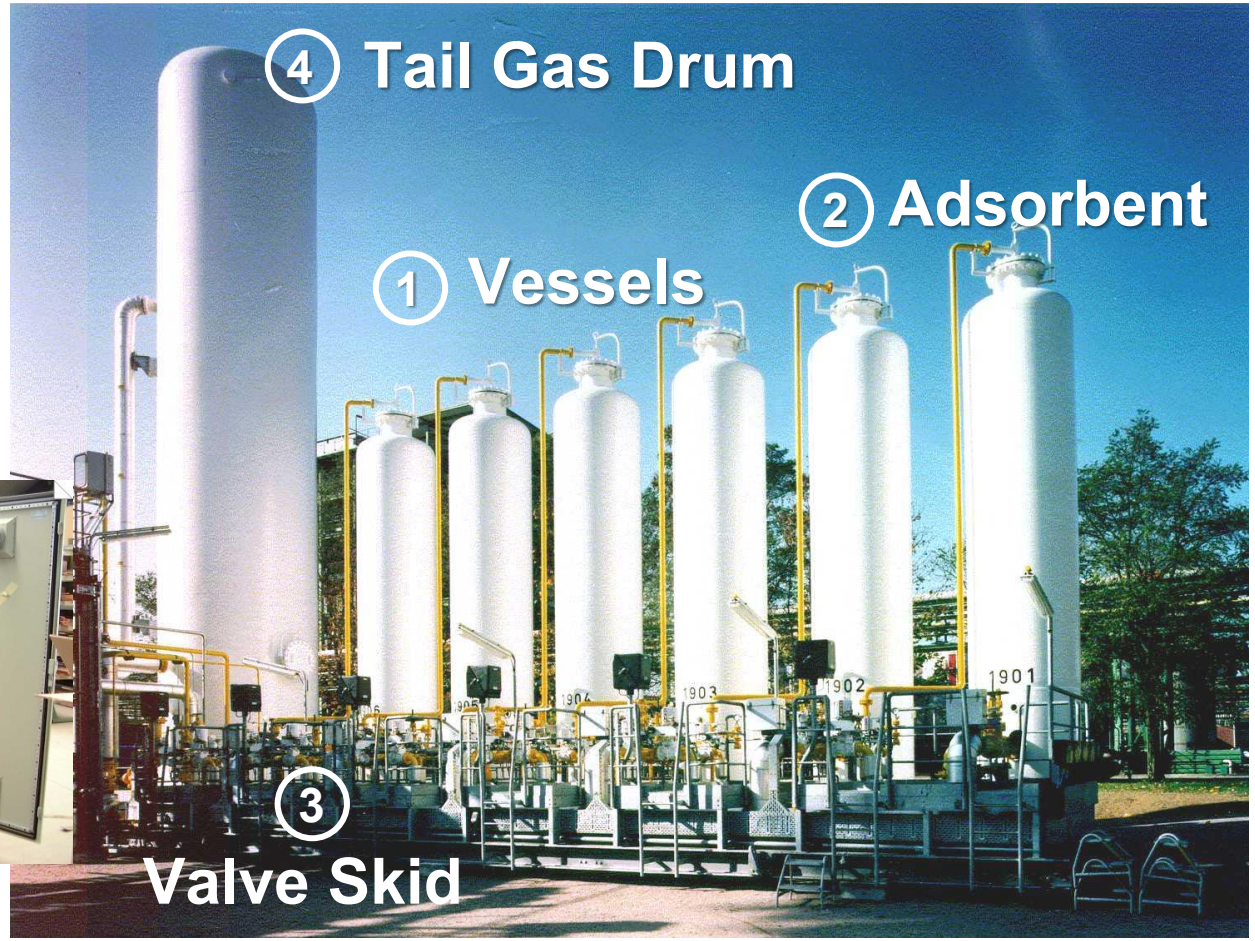
25%
Refinery Streams

No. of Units: 288
Feed Pressure: 20 – 670 psig
Feed Flow: 0.05 – 203 MMSCFD



> 1,180 Polybed PSA Units UOP Supplied Worldwide

COMPONENTS OF A PSA SYSTEM



5 Control System

6 UOP Service and Support

PSA Equipment / Modular Supply

AGENDA

I. Basics of Adsorption

II. Basics of PSA Process

III. PSA Process Animation / Process Steps

IV. Effect of Operating Conditions

BASICS OF ADSORPTION

CONCEPTS OF ADSORPTION

ADSORPTION

Preferential partitioning of substances from the gaseous or liquid phase onto the surface of a solid substrate

ADSORBENT

Solid substrate upon which the adsorption process takes place

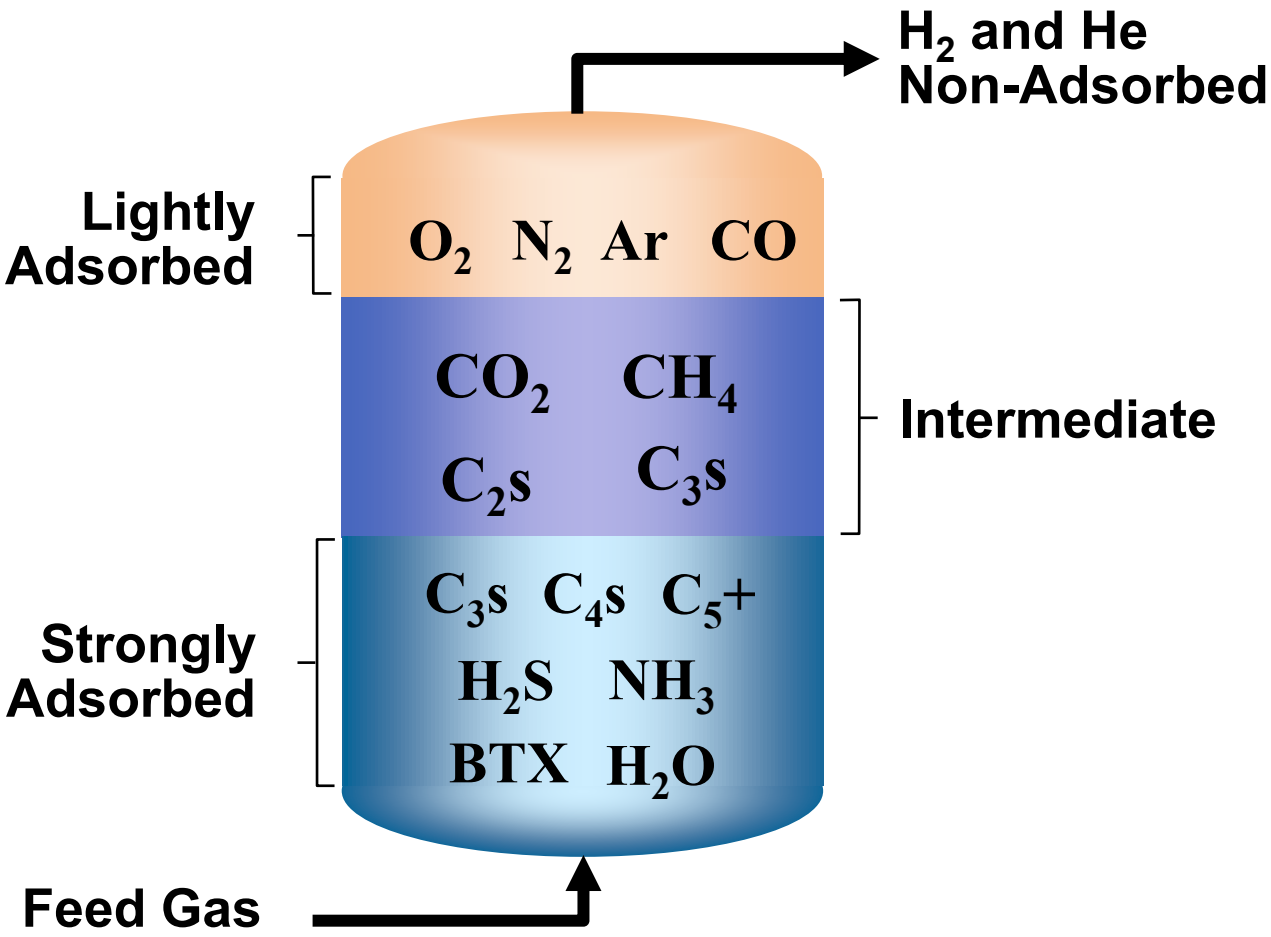
LOADING

Quantity of adsorbed material per mass unit of adsorbent

ISOTHERM

Quantity of adsorbed material per mass unit of adsorbent

ADSORPTION SELECTIVITY



Impurities are Removed Down to Any Level Required by the Customer

ADSORBENT PROTECTION

Avoid

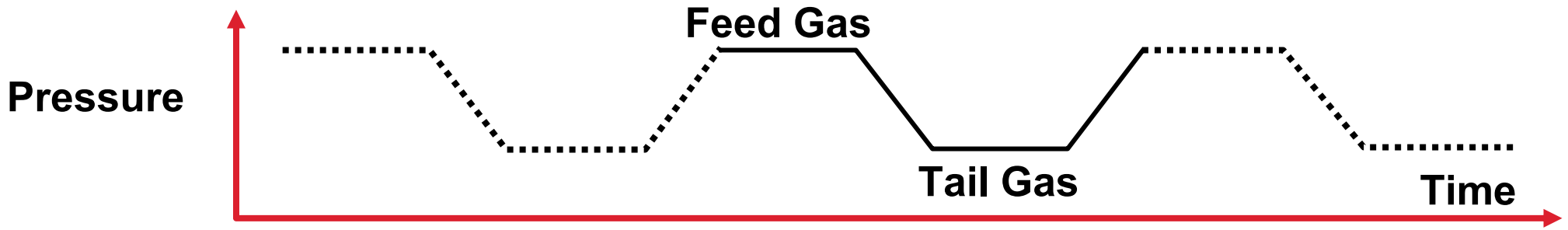
- ☒ Liquids
- ☒ Major feed changes
- ☒ New feed components
- ☒ Crushing / drilling
- ☒ Lifting

BASICS OF PSA PROCESS

PSA BASIC PRINCIPLES

Ability of adsorbents to adsorb more impurities at high pressure than at low pressure

‘Pressure Swing’ cycle



PSA BASIC FLOW DIAGRAM

H_2 + Impurities
High Pressure

FEED GAS

PRODUCT

H_2 @ High Purity
High Pressure

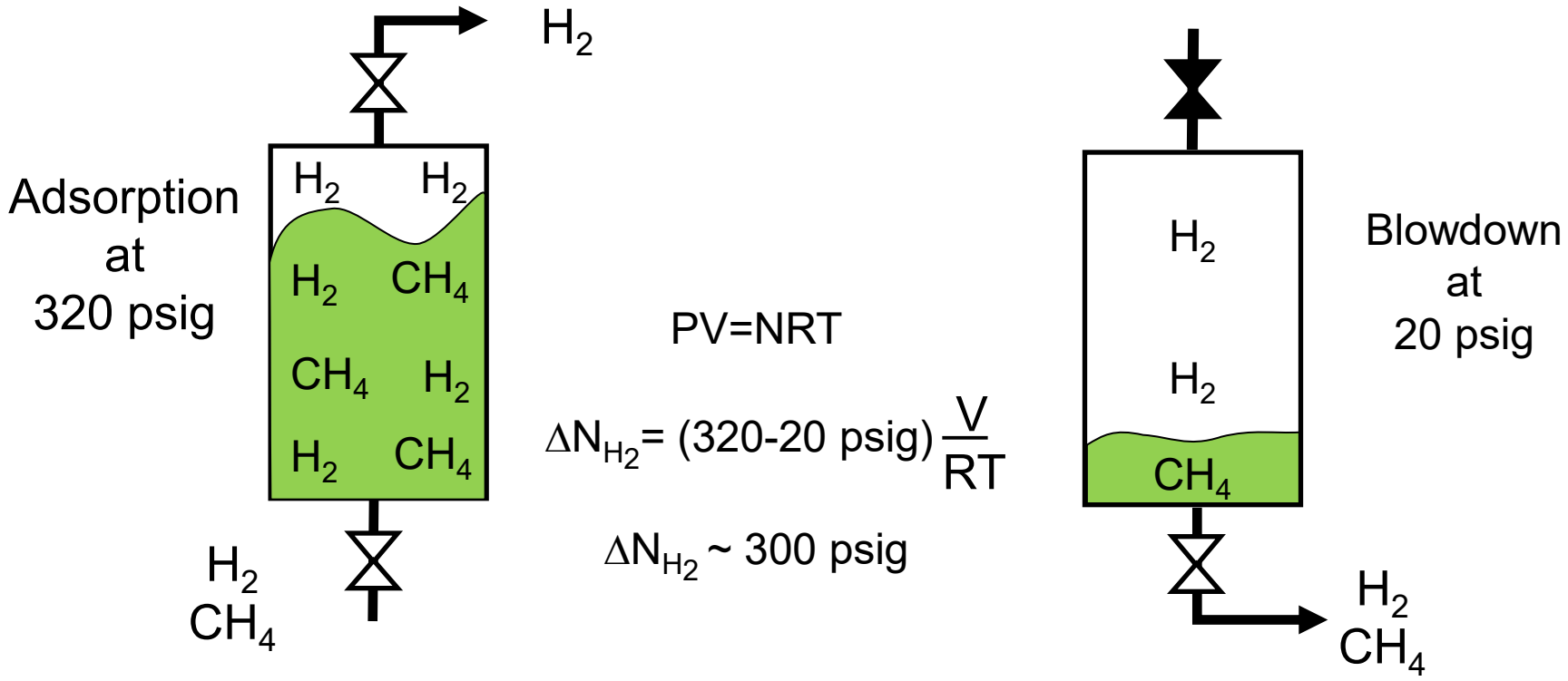
OFF GAS

Impurities (+H_2)
Low Pressure

- H_2 Purity 99.9 – 99.9999%
- H_2 Recovery 80 – 91+%
- H_2 Feed pressure 90 - 980 psig (6 – 67.5 barg)
- H_2 Product pressure 80 – 970 psig (5 – 67 barg)

PRESSURE EQUALIZATIONS

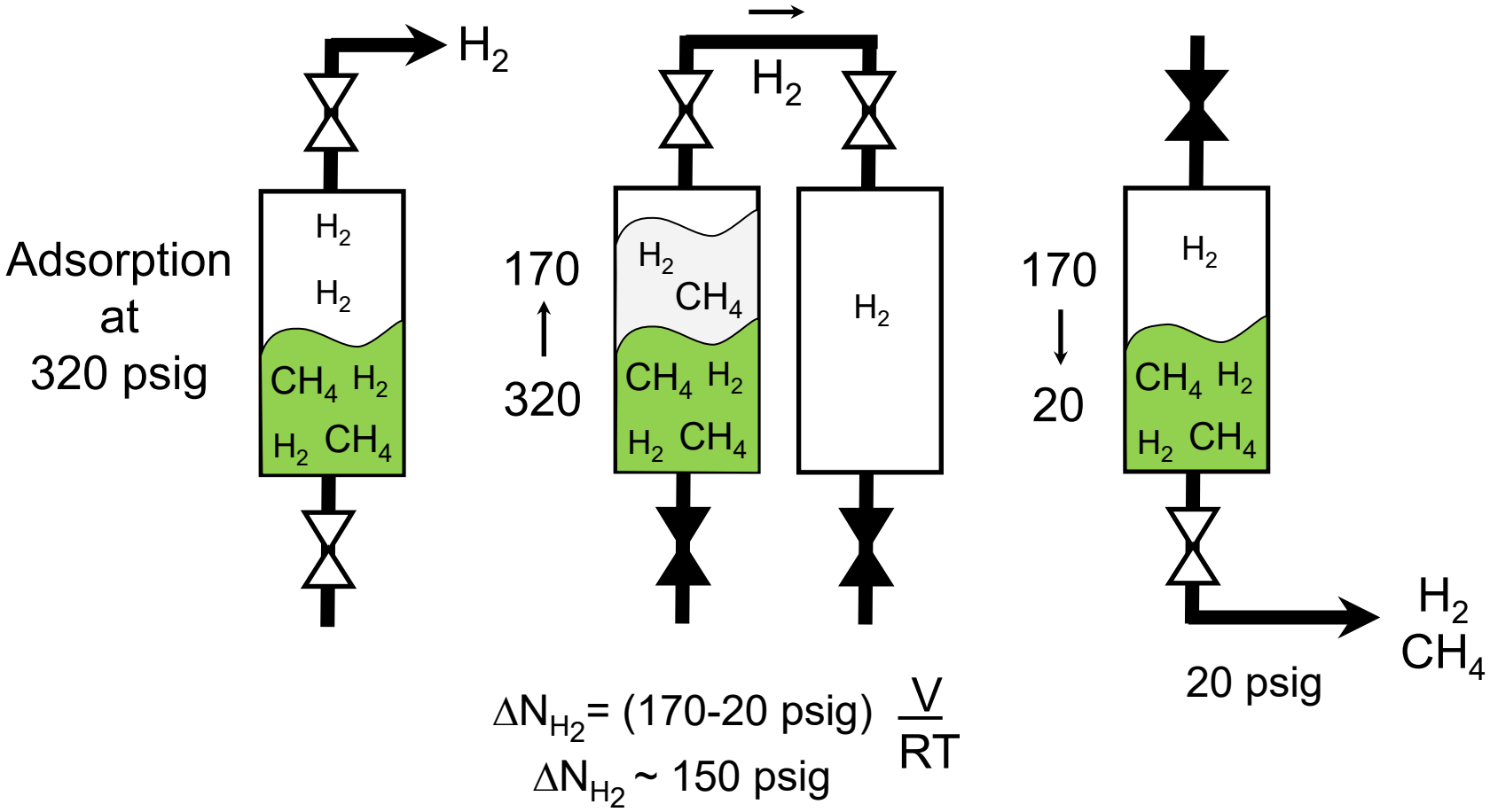
In its simplest form, the PSA process could consist of only two steps:
Adsorption and Blowdown



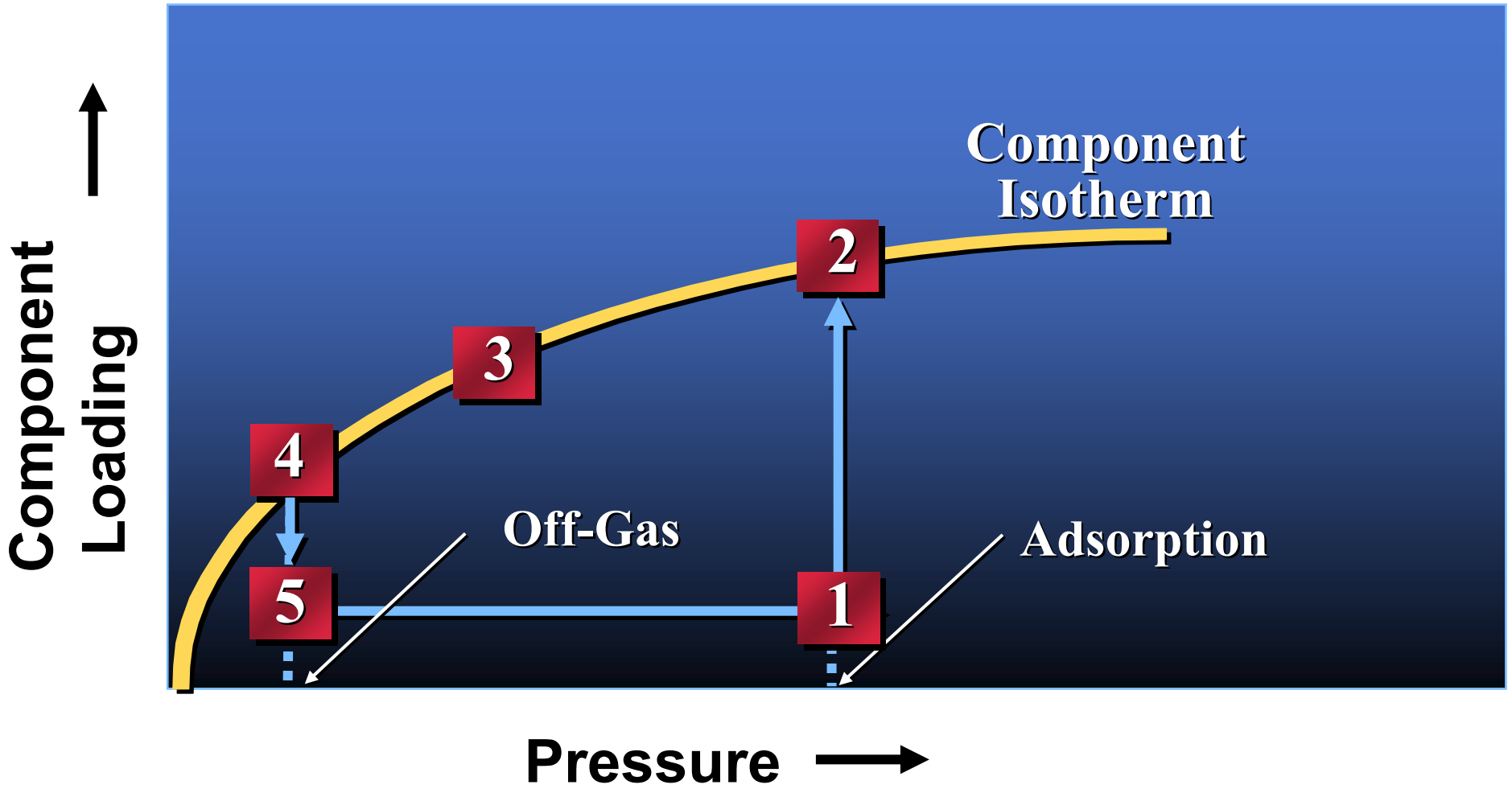
Hydrogen Lost Due to Large Pressure Fluctuations

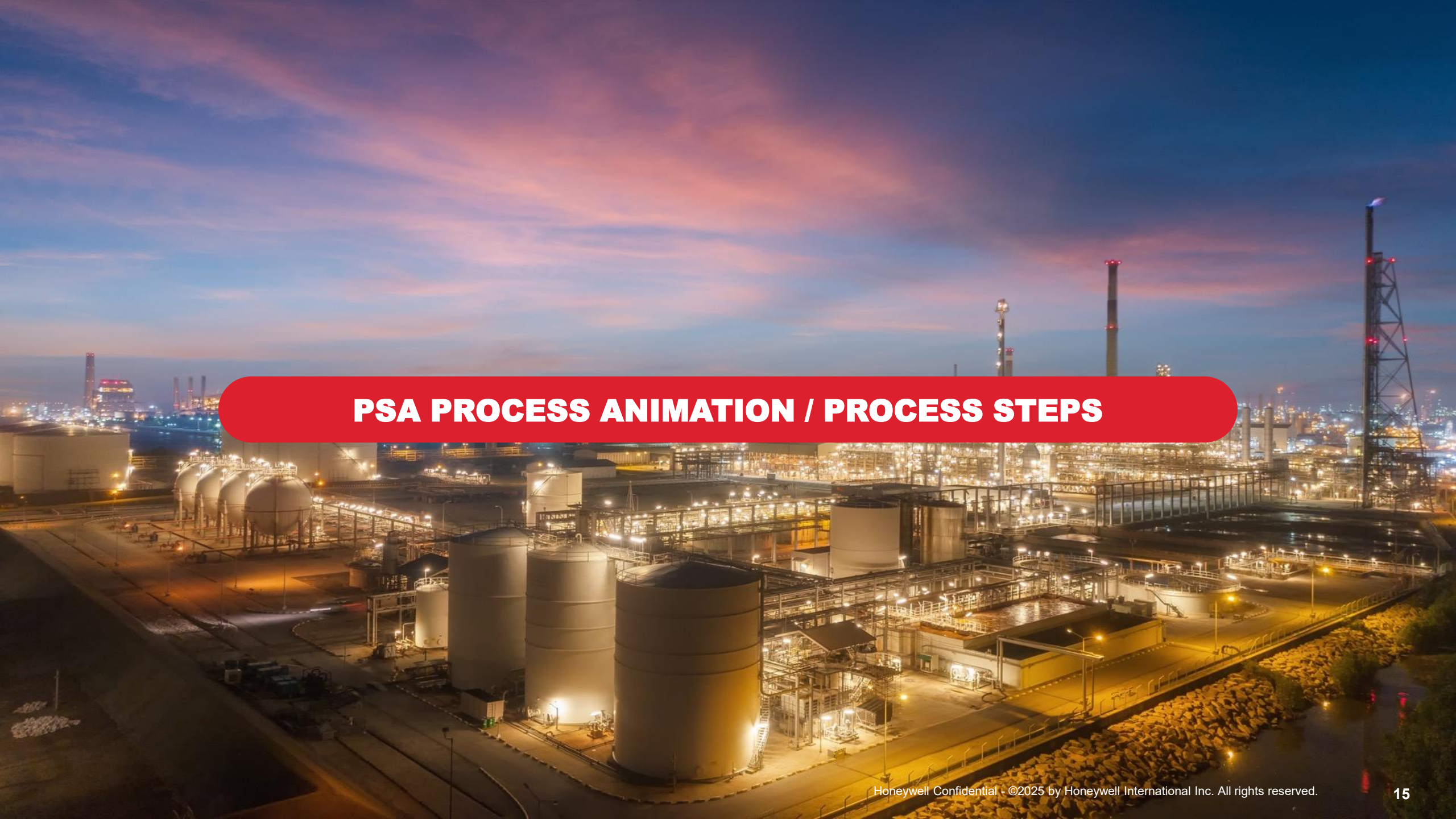
PRESSURE EQUALIZATIONS

Co-current depressurization increases hydrogen recovery



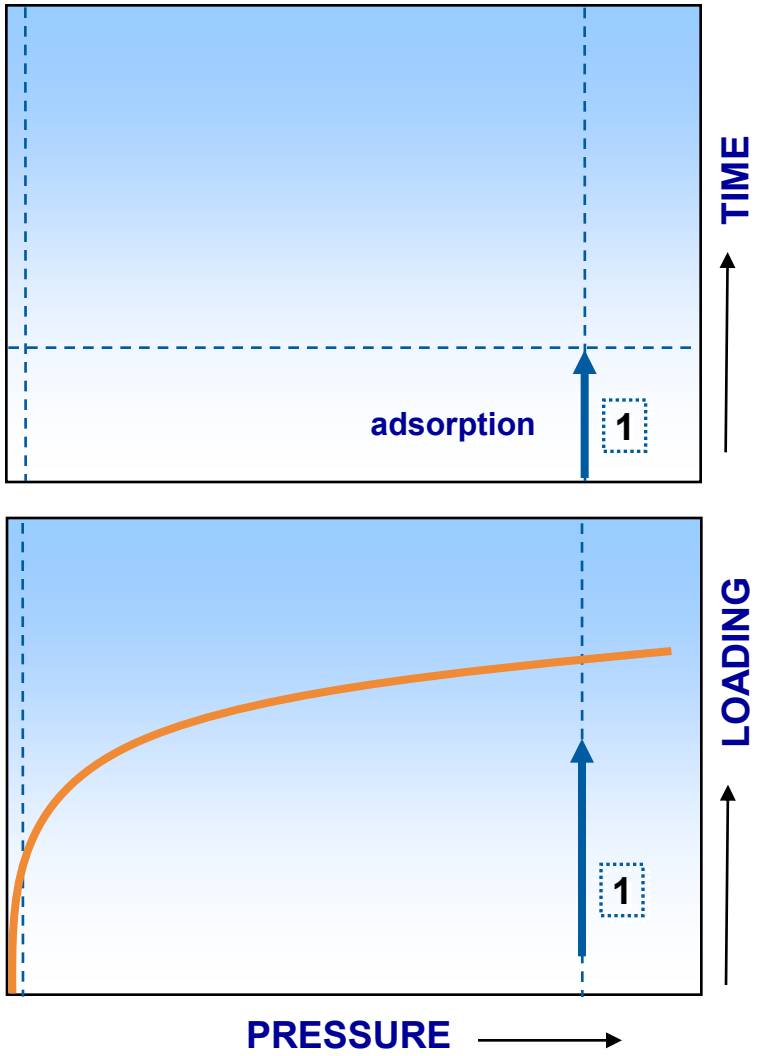
PSA CYCLE

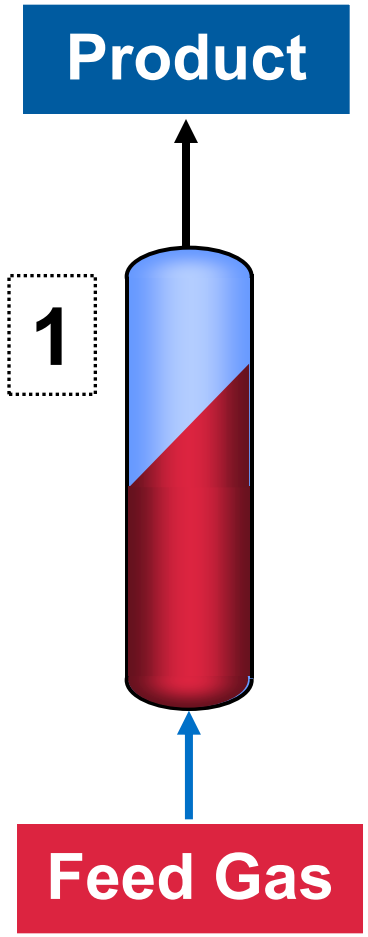




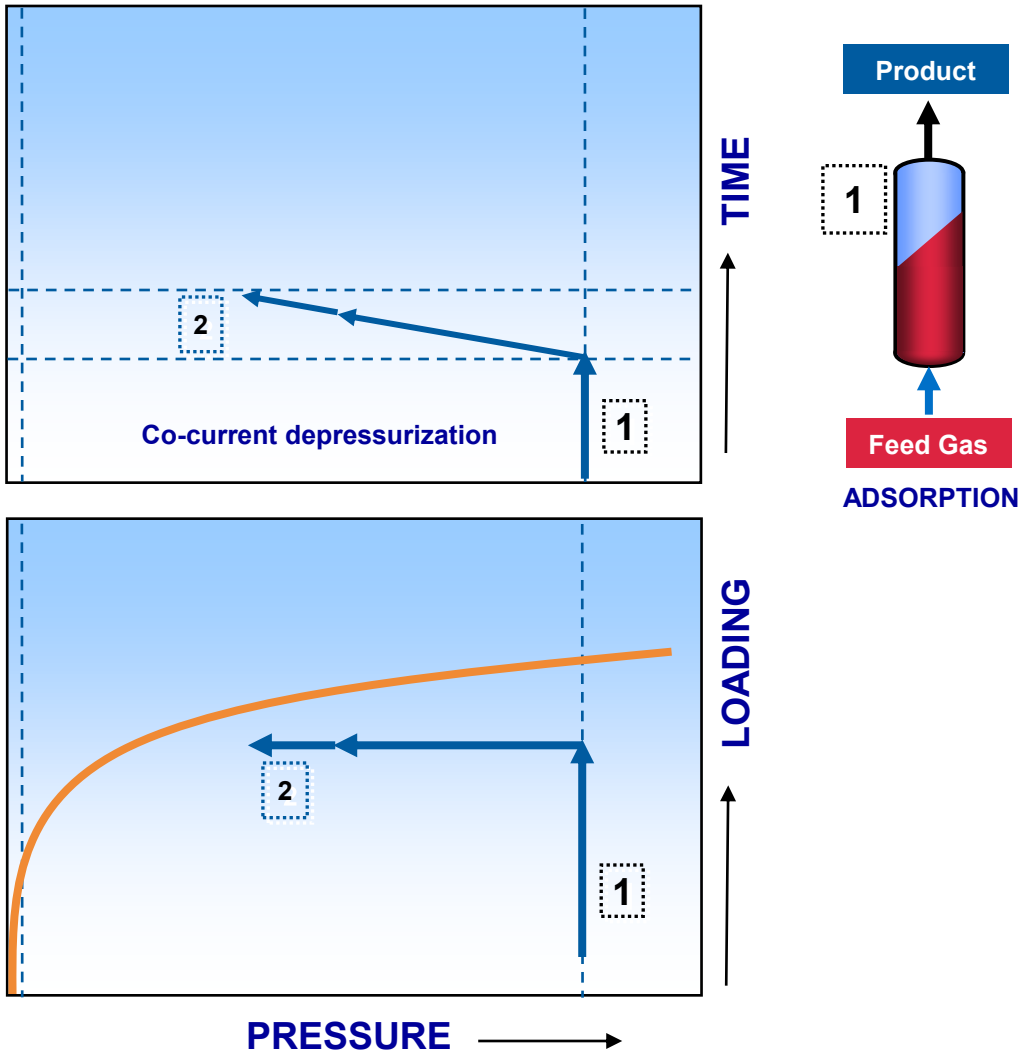
PSA PROCESS ANIMATION / PROCESS STEPS

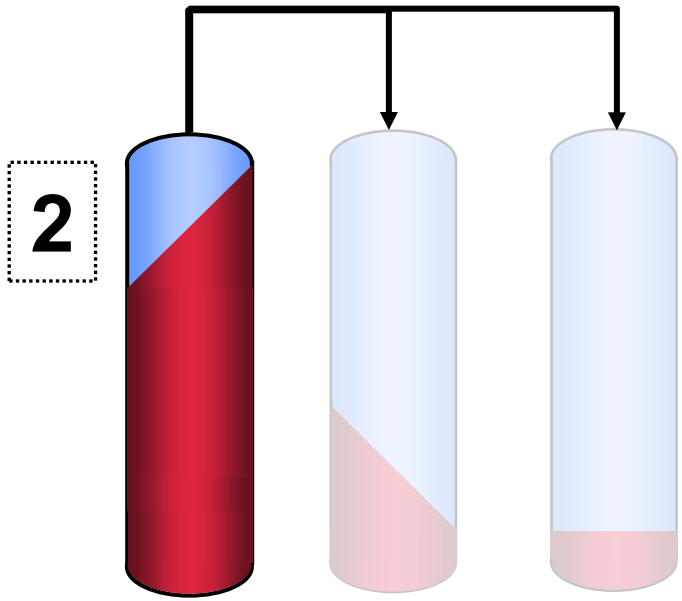
PSA PROCESS – STEP 1 (ADSORPTION)





PSA PROCESS – STEP 2 (CO-CURRENT DEPRESSURIZATION)

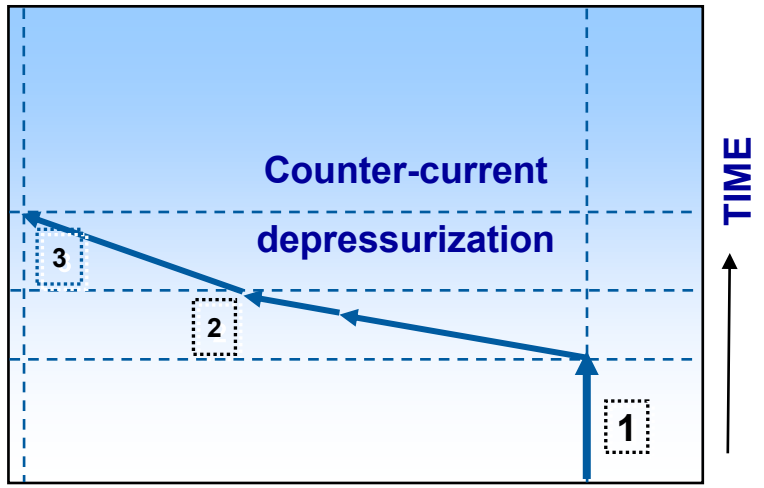


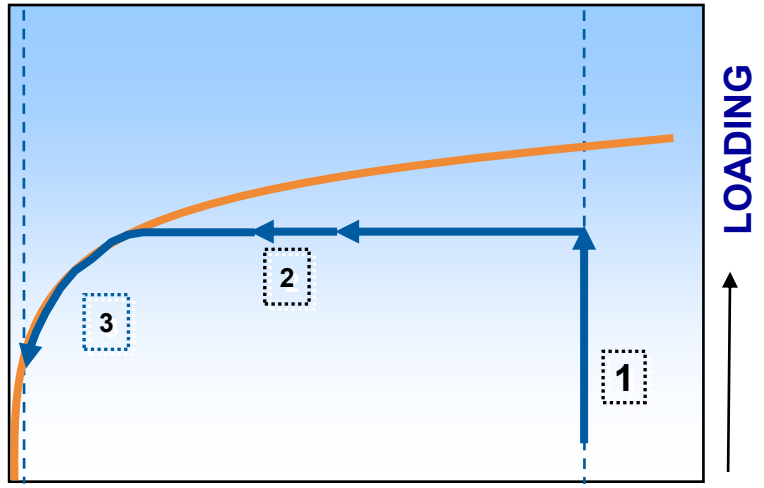


Pressure Equalization

Provide Purge

PSA PROCESS – STEP 3 (COUNTER-CURRENT DEPRESSURIZATION)

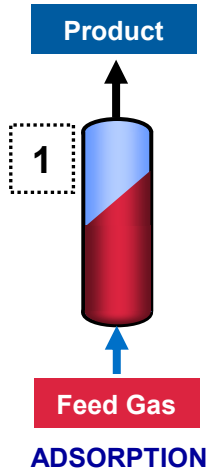




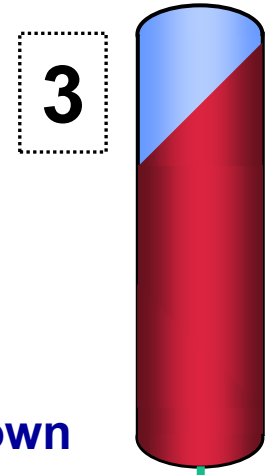
TIME

LOADING

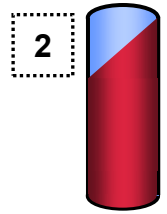
PRESSURE



ADSORPTION



Blowdown

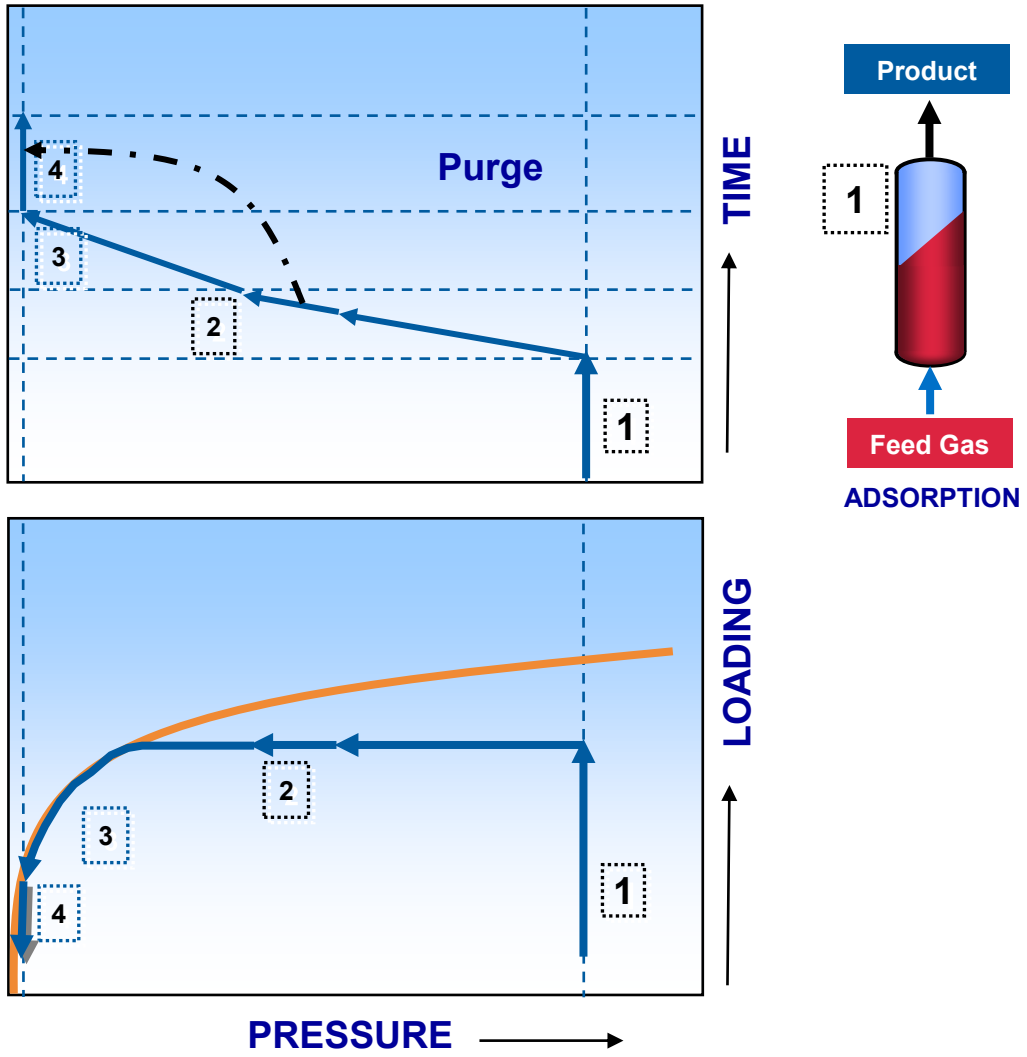


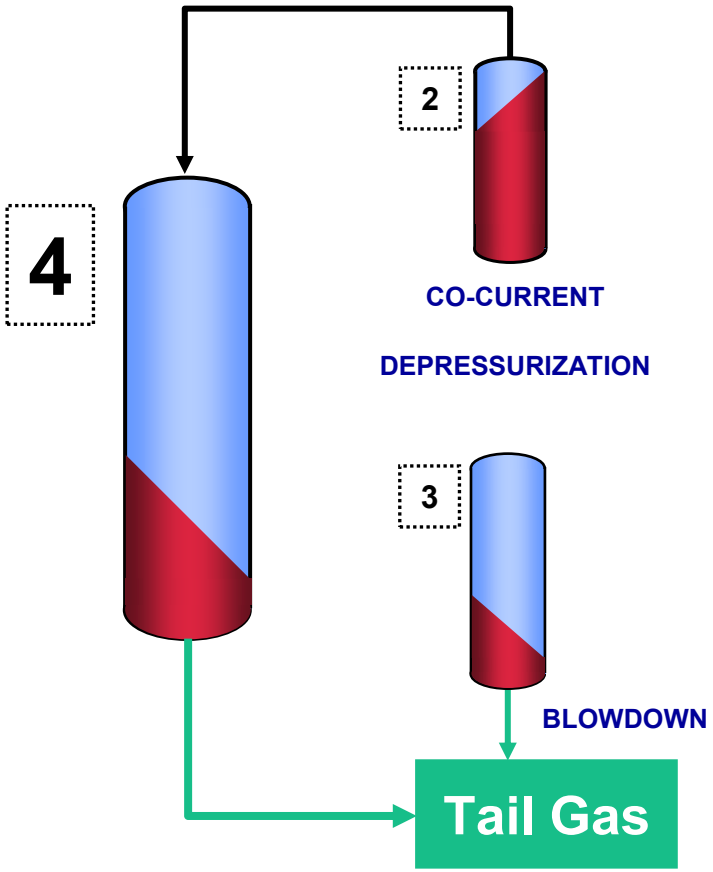
CO-CURRENT

DEPRESSURIZATION

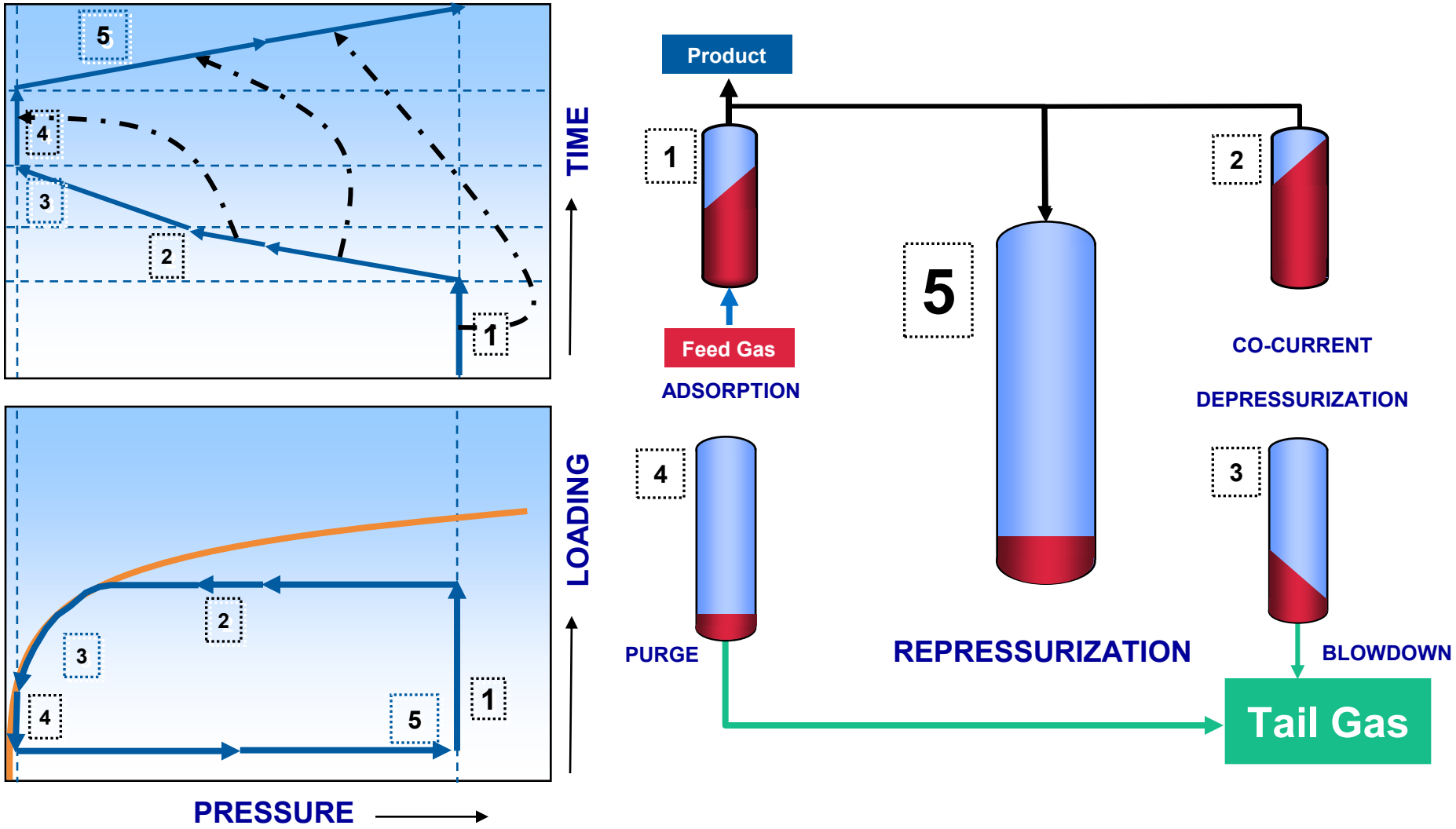
Tail Gas

PSA PROCESS – STEP 4 (PURGE)



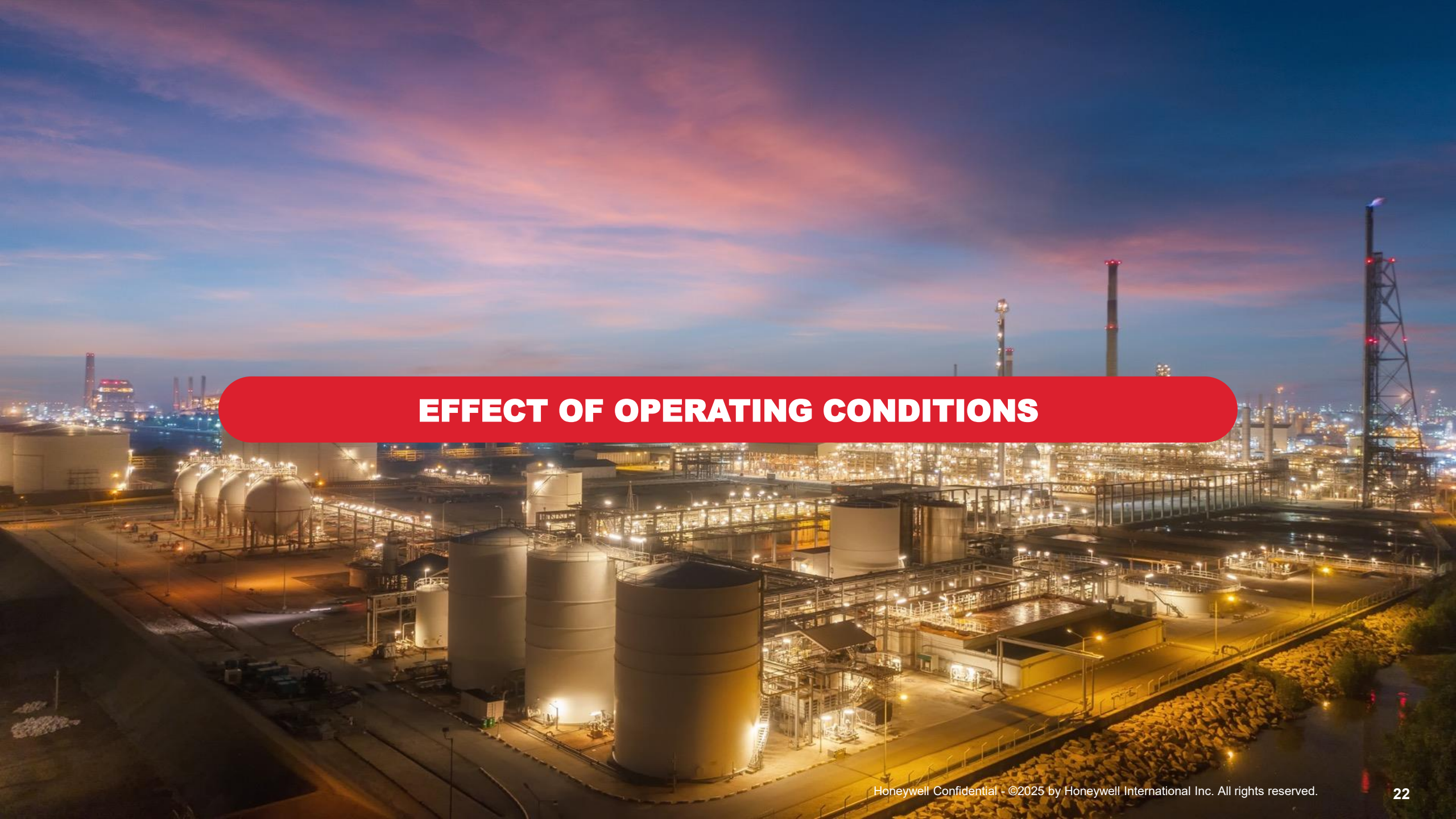


PSA PROCESS – STEP 5 (REPRESSURIZATION)



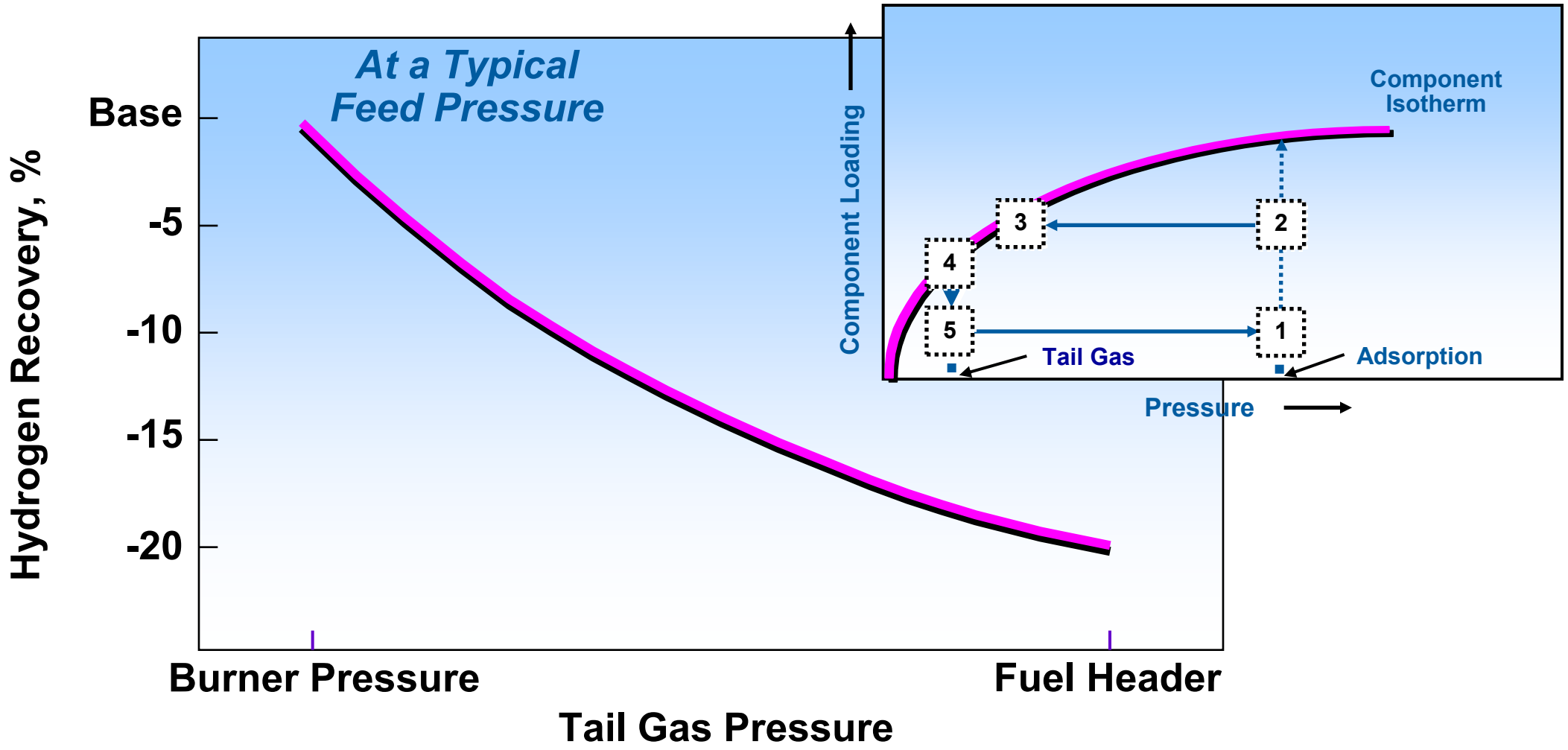
DESIGNED FOR RELIABILITY

- Over 99.95+% on-stream factor
- Component selection
- Back-up operating mode(s)
- No single component failure will shut the unit down
- Automation



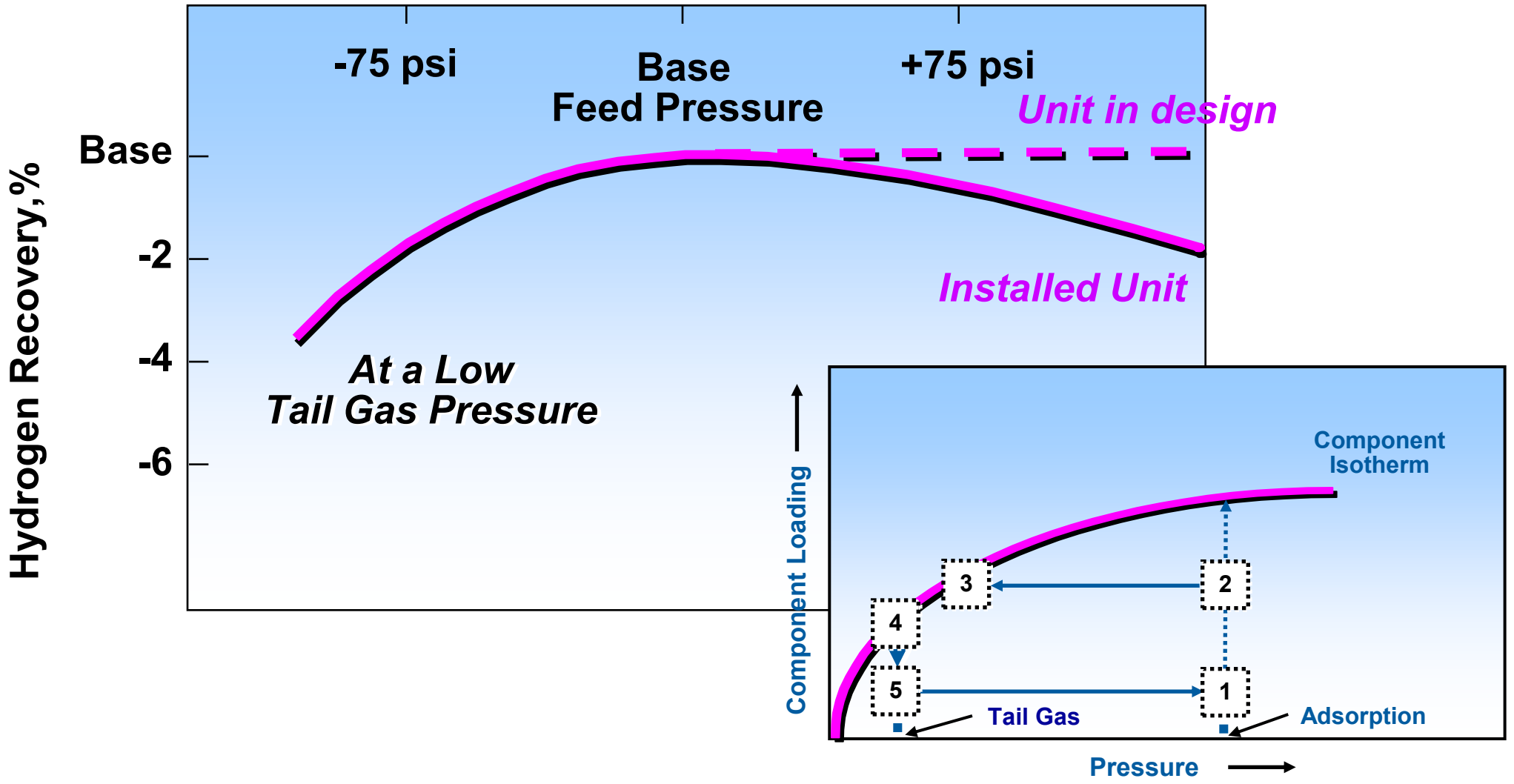
EFFECT OF OPERATING CONDITIONS

EFFECT OF TAIL GAS PRESSURE

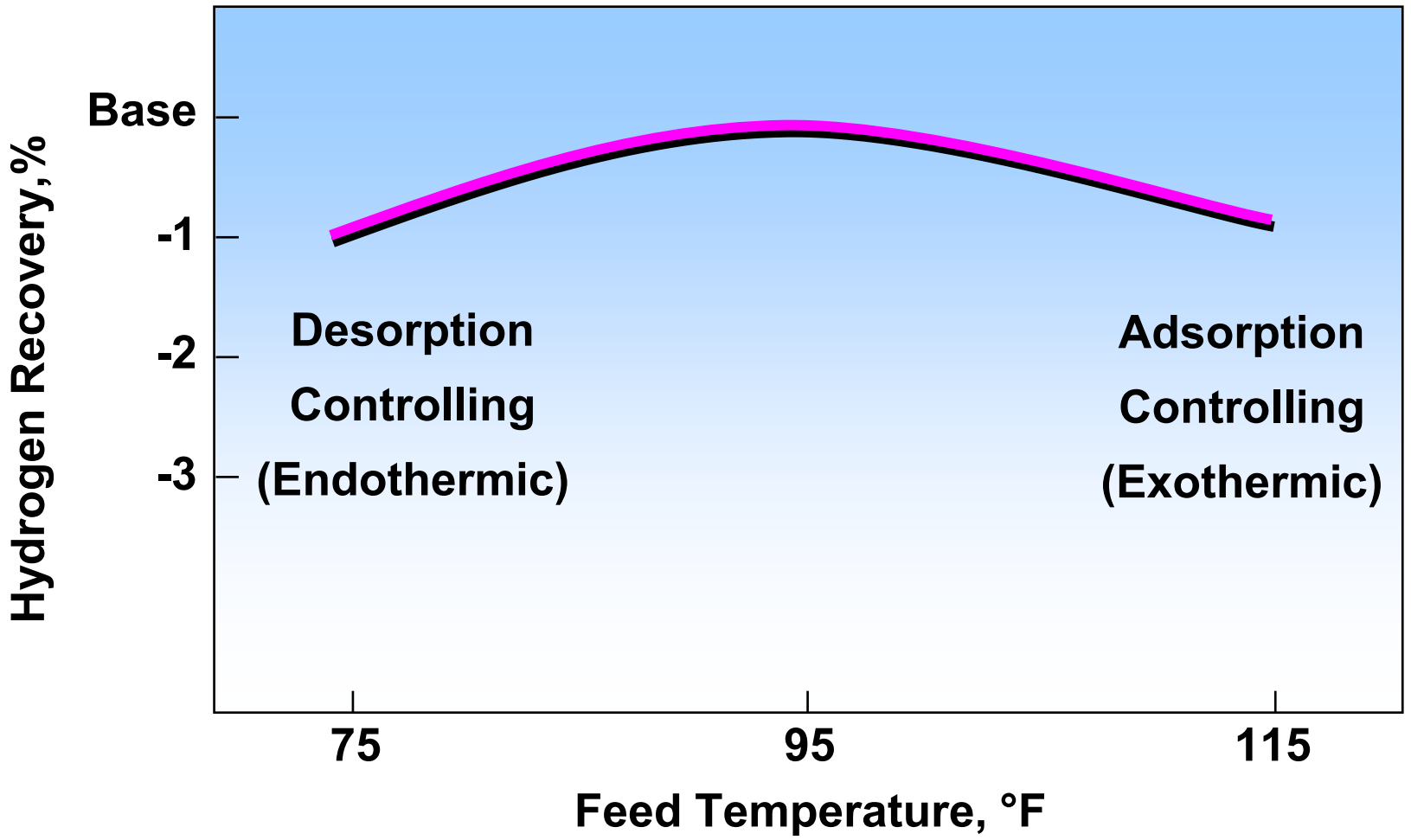


Tail Gas Pressure had the Greatest Impact on Product Recovery

EFFECT OF FEED GAS PRESSURE



EFFECT OF FEED GAS TEMPERATURE



GENERAL POLYBED™ PSA RELATIONSHIPS

Increase In:	Unit Size	H_2 Recovery
Tail Gas Pressure	↑	↓
Feed Pressure	↓	↑↓
Product Purity (99% to 99.9%)	↑	↓
Feed Temperature	↑↓	↑↓
Feed Purity (75% to 80%)	↓	↑
Cycle Time	↑	—
Feed Flow	↑	—

SUMMARY: THE PSA ADVANTAGE

- Approaches 100% Impurity Rejection
- Minimal Pre-treatment Required
- High Purity Hydrogen Product
- Low Pressure Drop to Hydrogen Product
- Avoids Downstream Catalyst Poisoning
- High Reliability (>99.95% On-Stream)
- Attractive Economies of Scale

THANK YOU

Honeywell
UOP

QUESTIONS? PLEASE CONTACT ME VIA THE QR CODE BELOW