



# Digital Pathways for De-carbonisation of Process Industry

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# AspenTech® At-a-Glance

WORLD LEADER IN INDUSTRIAL SOFTWARE FOR ASSET-INTENSIVE INDUSTRIES

*Optimizing assets to run safer, greener, longer and faster*

**3000+** CUSTOMERS  
WORLDWIDE

ENERGY – CHEMICALS – EPC – POWER –  
PHARMA – METALS & MINING – FOOD &  
BEV – PULP & PAPER



**3700+** EMPLOYEES



**41** COUNTRIES

**62** OFFICES

**40** YEARS OF INNOVATION

A RECORD OF FIRSTS

- Flowsheet Simulator
- 360° Subsurface Images Voxel Visualization
- Ensemble-based Reservoir Simulations
- **monarch™** Common Real-time Platform for Utilities & Industries
- Adaptive Control Technology
- Concurrent Engineering Workflows
- Unified Environment for Planning, Scheduling & Operations
- Industrial AI - Hybrid Models and AIoT Hub



**170** ESTABLISHED  
PARTNERSHIPS

ADVISORY, TECHNOLOGY, VAR, ISP

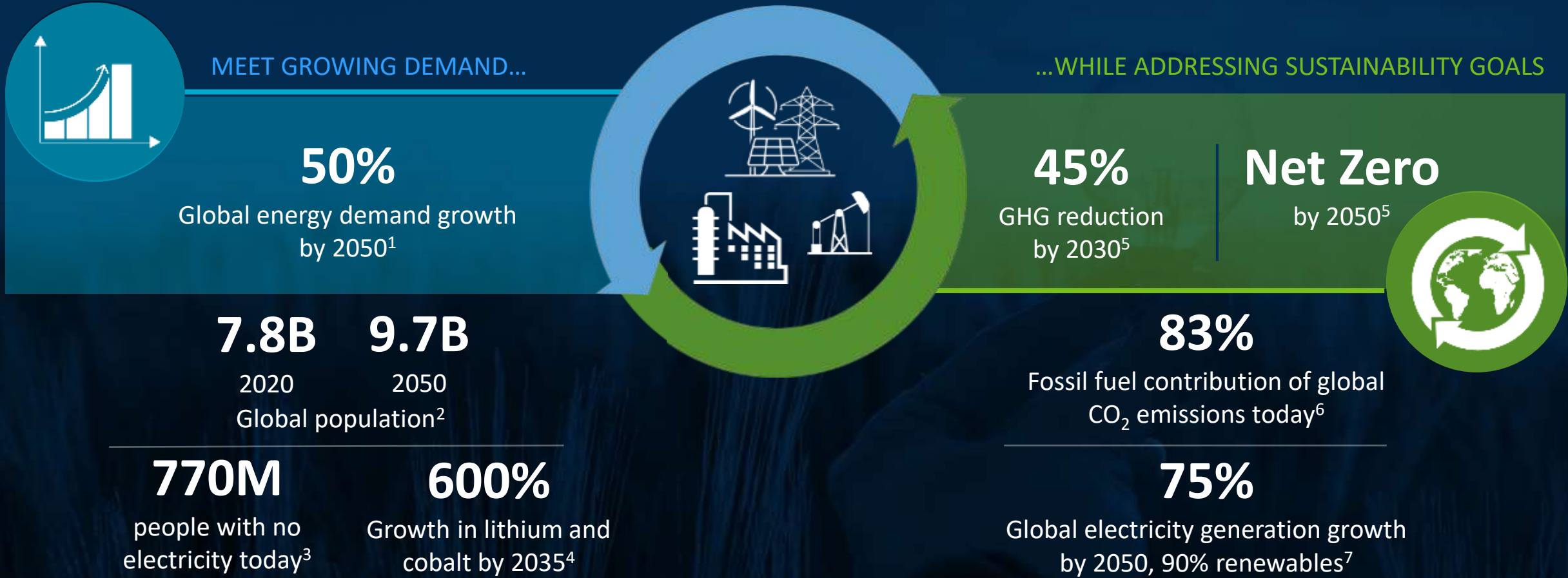


**\$59B** ANNUAL PROFIT CREATION

**16Mt\*** ANNUAL CO<sub>2</sub>e EMISSIONS REDUCTION  
\*IN GLOBAL REFINING

Mt = million metric tons | CO<sub>2</sub>e = CO<sub>2</sub> equivalent of various GHG

# Challenges in Energy



1. EIA projects nearly 50% increase in world energy usage by 2050, International Energy Outlook 2021,  
2. International Institute for Sustainable Development, SDG Knowledge Hub, Aug 2020  
3. EIA "access to energy 2022

4. Benchmark Mineral Intelligence

5. GHG emissions reduction by 2030 from 2010 level - COP 26 Nov 2022  
6. The net-zero challenge: Accelerating decarbonization worldwide, McKinsey and Company, Jan 2022  
7. World Energy Outlook Report 2021 – IEA Rev Dec 21

# Sustainability Pathways to Address the Dual Challenge

## TODAY



Energy Efficiency



Emissions Management



Electrification



Water Conservation



Waste Reduction



Bio based Feedstocks



Hydrogen Economy



Renewable Energy



Carbon Capture & Storage

## TOMORROW



Plastics Circularity



New Materials



CO2 as Feedstock



# Energy Efficiency



# Energy Efficiency

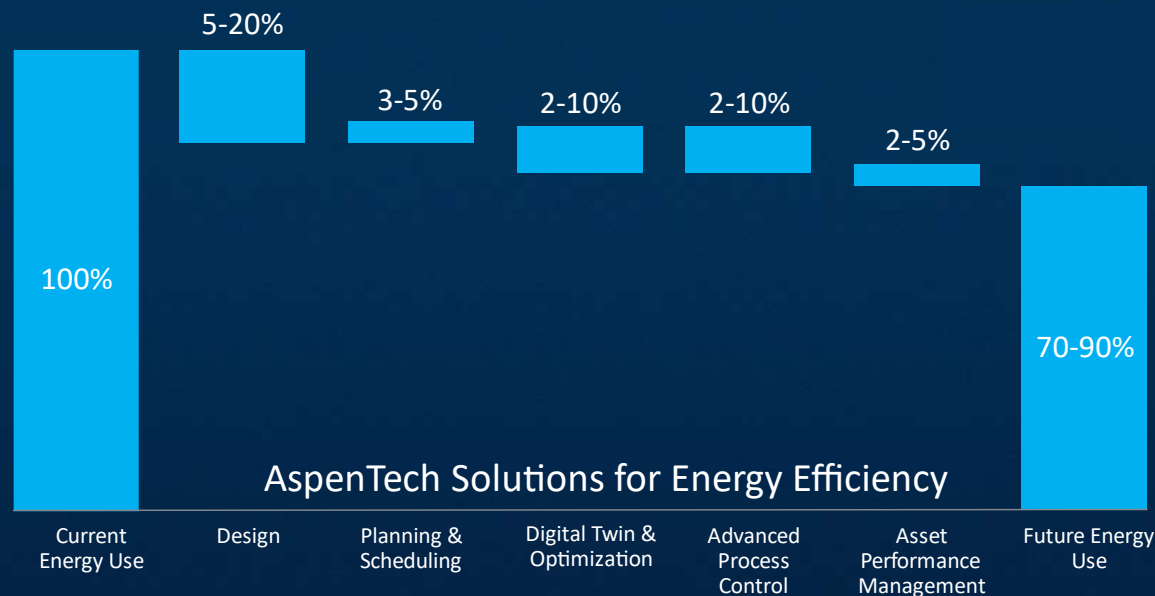
## Challenges

- High energy intensity and utilities spend
- Complex site-wide energy & utilities management
- Energy wasted from unplanned equipment outages
- Inefficient heat integration in complex processes

## Benefits of Digital Solutions

- Reduce energy consumption per unit of product produced
- Develop optimal plans for site-wide energy management
- Avoid losses by predicting & mitigating equipment outages
- Reconfigure process designs for optimal energy use

## Typical Energy Savings\*



# 30%

improvement in energy efficiency\*\*

\* Typical savings based on 26 energy efficiency case studies

\*\* Total savings depends on overlap & synergies

# AspenTech Sustainability Pathway: Energy Efficiency

## Track and Manage Energy Use

### Measure, Estimate & Benchmark Energy Use

- Gain visibility on key energy demand, sources and trends
- Benchmark unit and site performance

## Plan & Optimize through Value Chain

### Control & Optimize Energy Targets

- Optimize operations to minimize energy use
- Employ digital twins for accurate insights

## Enterprise Energy & Emissions Management

### Drive Enterprise Insights & Decision Support

- Report and control energy use
- Track and analyze asset wide energy use and renewables content

### Plan Operations & Predict Energy Use

- Operate to optimize energy use, CO<sub>2</sub> and profit
- Optimize utilities to minimize carbon footprint

### Avoid Disruptions

- Prevent unplanned events and maintain consistent operations to improve energy efficiency

### Optimize Process Re-design

- Reconfigure processes with process intensification
- Enable better heat integration



# Refinery-wide Project to Improve Energy Efficiency



- Identified “quick win” opportunities that saved 57,890 TPY of CO<sub>2</sub>, EII of 3.2 & \$16M/Yr.
- All improvement opportunities identified was estimated to save over 260 M BTU/HR , EII of 6 & \$77M/Yr.
- Insights from project encouraged operations team reorganization to continually improve energy efficiency

**Saved**  
**57,890 TPY**  
**of CO<sub>2</sub>**

## CHALLENGE

- Identify opportunities across the refinery to reduce energy consumption
  - Quick win opportunities that require no investment
  - Minor & major investment project opportunities to reduce energy consumption

## SOLUTION

- Rigorously simulated multiple units of the refinery using Aspen HYSYS & used in-built pinch technology to identify energy improvement opportunities.
- Aspen EDR used to rigorously simulate HX operations, including fired heaters
- Refinery-wide utilities system analyzed and optimized using Aspen Utilities Planner

**Product(s):**

*Aspen HYSYS®, Aspen Exchanger Design & Rating™, Aspen Utilities*



# Enterprise-wide Energy Optimization for Upstream Assets



- Seven Aspen HYSYS Models created feed to Excel to support the integrated model
- Energy reduction opportunities identified
- Estimated USD \$60-80 million savings realized

**Reduced  
Energy Use By  
3-5%**

## CHALLENGE

- Develop model based solution for both enterprise-wide and plant-wide optimization
- Size of the system in terms of model size, large surface networks and multiple process models
- Complex model integration challenges across multiple departments

## SOLUTION

- Aspen HYSYS for robust process models to solve heat and mass balance
- An integrated model is created to balance model accuracy and solution times
- Aspen HYSYS models and Aspen PIMS™ models integrate operations and planning

**Product(s):**

*Aspen HYSYS, Aspen PIMS*

# Emissions Management



# Emissions Management

## Challenges

- Insufficient measurements at emissions sources
- Manual processes to roll-up data globally cause delays which prevent proactive management
- Limited capital investment available

## Benefits of Digital Solutions

- Automate emissions reduction with powerful tools
- Empower staff to proactively reduce emissions
- Report with transparency across the enterprise
- Prevent unplanned shutdowns to minimize flaring emissions and environmental impact





# Emissions Decision Support

## Achieve Better CO<sub>2</sub> Decision Support

*Situational Awareness View of Emissions, Margins, Alternatives & CAPEX Opportunities*

### Bird's Eye View of Enterprise Emissions Situation

*Empower all stakeholders to make informed decisions & take required actions to optimize between emissions and profit with easy visibility to multi-site insights by aggregating data, models, carbon calculations*

#### AspenTech Solution

- At enterprise or plantwide level:
  - Current CO<sub>2</sub> emission performance
  - Trends, benchmarks
  - Potential actions
- View of abatement options
  - Through Planning, Digital Twin, and Utilities models
  - Comparing actual emissions vs. planned & possible
- Calculated emissions & CO<sub>2</sub> Tax, capital and operating cost tradeoffs for mitigation options



### Benefits

- Enterprise visibility enables better and faster CO<sub>2</sub> mitigation, profit and production decision-making
- All CO<sub>2</sub> analysis done based on same data and assumptions
- Contextual alerts based on real-time data focuses operations and managers on carbon footprint
- Opportunity to reduce emissions by 10-50%
- Ease of implementation & support
- Incorporate existing tools

**Product(s):**

*Situational Awareness, AORA, Utilities, Unified*



### Emissions Management

Calculation of CO<sub>2</sub> emission and price

Carbon emission control in refinery using DMC3

Plant scheduling with CO<sub>2</sub> emissions projections using Aspen Plant Scheduler

Carbon emissions modeling for refinery planning (PIMS-AO)



# AspenTech Sustainability Pathway: Emissions Management

## Track and Manage Emissions

### Measure, Estimate & Prioritize Sources of Emissions

- Gain visibility on key emission sources
- Use consistent data for all sustainability work
- Target process, equipment and value chain inefficiencies

## Plan & Optimize through Value Chain

### Control & Optimize Emission Targets

- Stabilize operations to minimize emissions
- Model assets/processes to improve efficiencies

## Enterprise Energy & Emissions Management

### Drive Emissions Insights & Decision Support

- Report emissions across sites
- Monitor KPIs
- Make faster and better decisions

### Plan Operations & Predict Emissions

- Understand impact of potential feedstocks & other operational scenarios
- Plan operations to control emissions at the sources

### Avoid Disruptions

- Gain insights to prevent unplanned incidents
- Plan maintenance before failure

# Improved Refinery-Wide Emissions Management With Real-time Digital Twins



- Solution contributed to increase refinery margins by taking advantage of opportunity crudes and cost-effective fuel while meeting emission targets.
- Accurate site-wide emission estimates acceptable to regulators, saving HSE personnel significant time on computation & reporting

## Save Reporting Time & Meet CO<sub>2</sub> Targets

### CHALLENGE

- Meet emission requirements from increasingly stringent statutory emission limits
- Crude planners unable to leverage opportunity crudes as they could not estimate impact on emissions from new crude

### SOLUTION

- Online digital twin for emissions monitoring of refinery complex
- Intuitive graphical dashboards enable users of all skill levels to use solution
- Real-time KPIs and trends (e.g. CO<sub>2</sub> emission rates, Sox, excess O<sub>2</sub>, flue gas volume, etc.)

Product(s):

*Aspen HYSYS<sup>®</sup>, Aspen OnLine<sup>®</sup>, Aspen InfoPlus.21<sup>®</sup>, aspenONE*





- Reduced reconciliation and accounting process time >300%
- Fast tracked ISO 50001 compliance requirements
- Identified unaccounted losses of 1.5% and improved reservoir life
- Identified and reduced HP steam losses and incinerator and Sulphur emissions calculation and reporting

## Decreased Energy Use By 10%, Water By 5%

### CHALLENGE

- Provide actionable sustainability dashboard across Abu Dhabi's largest gas field (Shah Gas Field)
- Demonstrate value of digital twin, for broader adoption across all assets

### SOLUTION

- Actionable operator insights from intuitive visualization
- Online site-wide engineering model, calibrated every minute
  - Model incorporates utility demand profile, economic parameters, equipment and operational characteristics
- Identifies lift gas compressor operating issues for operator action

Product(s):

*Aspen HYSYS, Aspen Energy Analyzer, Aspen Utilities, AORA, Aspen IP.21*

# Hydrogen Economy





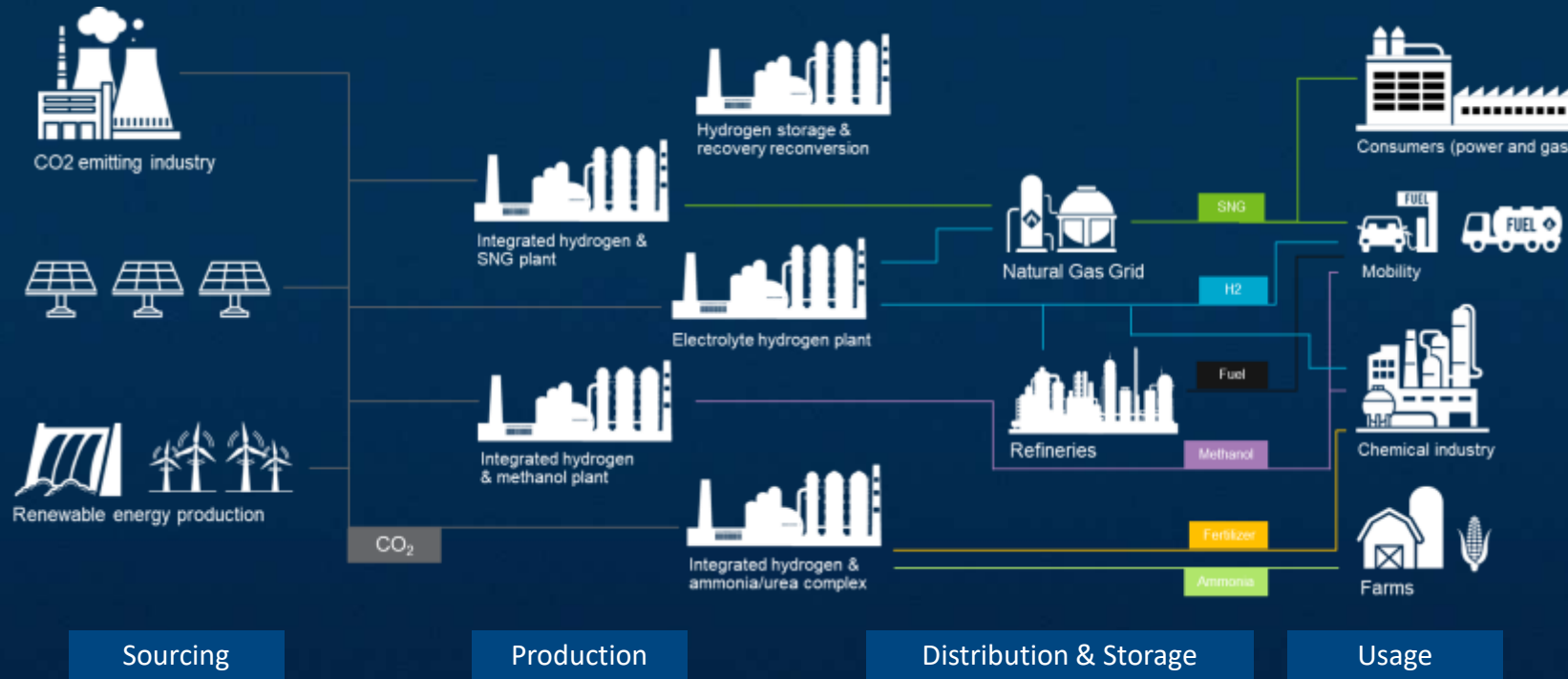
# Hydrogen Economy

## Challenges

- Improve time to market and scaling
- Optimize process, cost and load factor efficiencies
- Operate innovative processes effectively

## Benefits of Digital Solutions

- Accelerate techno-economic analysis
- Design and operate to optimize economics & CO<sub>2</sub>
- Maximize uptime and safety; minimize risk



# AspenTech Sustainability Pathway: Hydrogen Economy

## Hydrogen Production

### Research & Develop Hydrogen Innovation

- Enable electrolysis innovation
- Improve blue & green hydrogen processes
- Integrate renewables, electrolysis, and storage

### Design & Scale-up Production

- Improve time to market
- Analyze CAPEX & OPEX
- Evaluate feasible integration with industrial processes

## Storage, Transportation and Use

### Improve Storage, Transport & Conversion to Energy Carriers

- Ensure feasibility of liquefaction & conversion into energy carriers
- Enable safety analysis
- Reuse of pipelines

### De-risk Hydrogen Systems

- Prioritize investments
- Evaluate alternatives & pathways
- Enable system-wide analysis over hydrogen value chain

### Maximize Efficiency in Operations

- Improve energy efficiency with advanced process control
- Optimize integration of blue hydrogen with CCS

### Optimize Hydrogen Value Chain

- Integrate with existing operations, carbon capture & energy carriers
- Plan Hydrogen transportation

### Develop End-Use Solutions

- Pursue high value market opportunities
- Enable fuel cell innovation
- Optimize power system storage

# Hydrogen Economy: Key Digital Solutions

**To Advance the Hydrogen Economy, Innovation, Rapid Scale-up and Advanced Operating Strategies are Needed**

## Accelerate Hydrogen Production Innovation

(Aspen Plus, Aspen Hysys, ACM, APEA, EDR)

- Accelerate research-to-construction pipeline
- Improve conversion processes
- Exhaustively evaluate alternatives
- Improve fuel cell economics
- De-risk storage and transport

## De-risk and Optimize the Hydrogen Value Chain

(Aspen Fidelis, Aspen PIMS)

- Built the right value chain
- Optimize integration with natural gas networks



## Blue Hydrogen and Ammonia Asset Optimization

(Aspen Plus, Aspen Hysys, Aspen Energy Analyzer, AUP, APC)

- Optimize energy use
- Optimize production
- Carbon Capture

## Rapid repeatable design and operation

(Aspen Plus, Aspen Hysys, ABE)

- Need to scale
- Operate complex plants with minimum staff

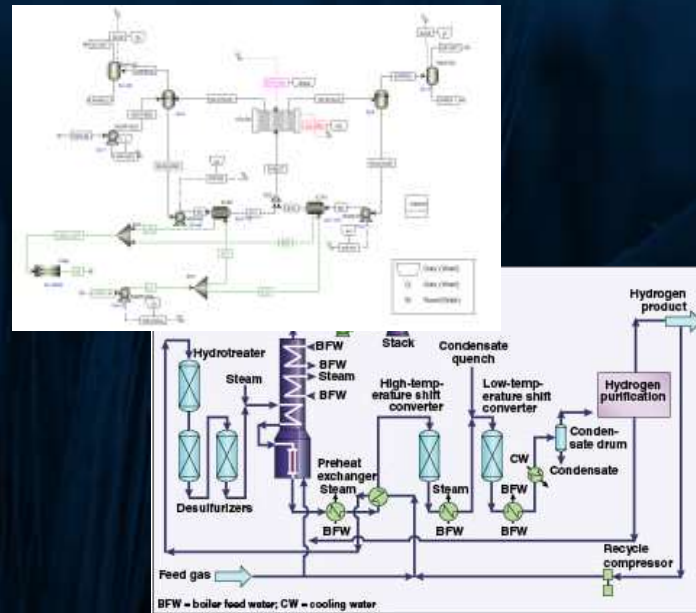
# R&D and Design for Hydrogen Production

## Develop Best New Technologies Faster

*Innovate and integrate across the energy sourcing, hydrogen production, CO<sub>2</sub> removal, and transport aspects of hydrogen economy*

### AspenTech Solution

- Detailed and accurate modeling of hydrogen synthesis processes
- Modeling between electrical and chemical systems
- Accurate modeling of CO<sub>2</sub> capture processes and entire blue hydrogen processes
- Concurrent engineering work-flow for rapid screening, scale-up, and repeatable design



### Benefits

- Accurately model chemical and electro-chemical processes
- Rapidly scale-up, size and cost without expensive test facilities
- Equally design components and entire system-level rigorously and for risk and safety analysis
- Digital twin from feasibility through operations
- Optimize OPEX and lifecycle cost

**Product(s):**

*Aspen Plus<sup>®</sup>, Aspen HYSYS<sup>®</sup>, ACM<sup>®</sup>, Economics<sup>™</sup>*



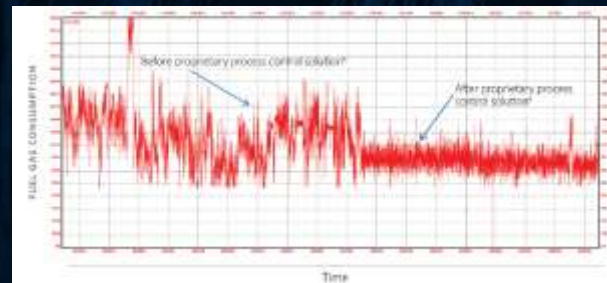
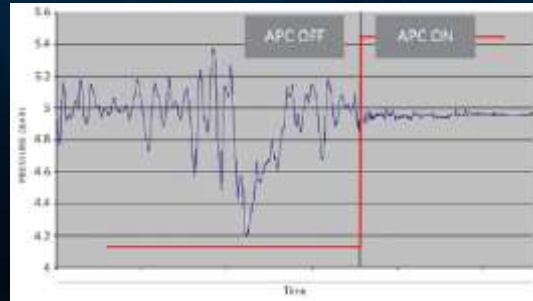
# Blue and Green Hydrogen Production Optimization

## Optimization of Hydrogen Operations

Improve energy efficiency and overall process stability during hydrogen synthesis process, and carbon capture in blue hydrogen, without additional CAPEX

### AspenTech Solution

- Digital guidance for operational decision-making
  - Real-time process insights
  - Evaluation of multiple scenarios
- Multi-variable predictive process control for separation units
  - Improve energy efficiency
- AI-enabled adaptive process control for all major energy consuming units



### Benefits

- Make better decisions to improve operations
  - Insights into process conditions
  - Monitor performance
- Improve energy efficiency & reduce steam usage
  - Reduce operating costs
  - Minimize carbon footprint
- Improve electro-chemical integration
  - Minimize inefficiencies

Product(s):

Aspen DMC3™, GDOT™, Aspen HYSYS®/Aspen Plus®,

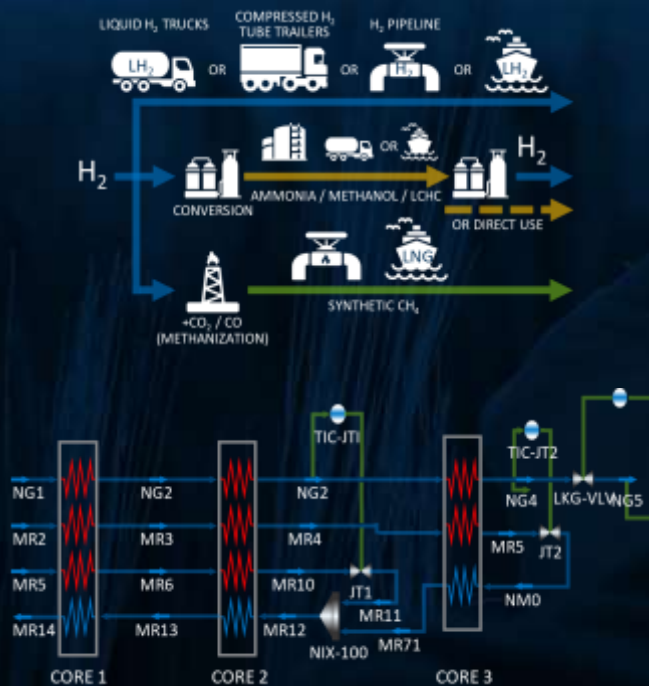
# Hydrogen Distribution and Storage

## Select the Best Transport Options

Evaluate all pathways and chose safest and most economic choices for transportation pathways, carrier materials, and integration with existing value chains

### AspenTech Solution

- Plan entire value chain with integrated planning and scheduling solutions
- Evaluate risks with system models
- Rigorously model technical, economic and safety risk of hydrogen and alternate carrier fluids across viable temperature and pressure ranges



### Benefits

- Optimized production and distribution through value chain
- Real time optimization of hydrogen conversion processes
- Safe operations with online digital twins

Product(s):

Aspen Plus®, Aspen HYSYS®, Unified PIMS™, Fidelis™



System and electrolyzer model provide guidance to optimize hydrogen production and accelerate commercialization of technology.

## Accelerate time to market for green hydrogen production

### CHALLENGE

- Undesired byproducts present in hydrogen production through electrolysis
- Require a model that can span the complete hydrogen production process

### SOLUTION

- Aspen Plus predictive model including electrolytic cell
- Electrolyte model easily integrated into Aspen Plus flowsheet
- Accurate model prediction of ions and undesired solids formation

Product(s):  
*Aspen Plus*



# Multilevel Optimization of a Hydrogen Production Enterprise



- Global hydrogen production enterprise has been optimized
- Solution possible after splitting into three optimization levels: equipment, plant, enterprise
- Optimal plant costs then used for Enterprise Optimization

**>1% Savings  
In Operating  
Costs**

## CHALLENGE

- Optimize the entire hydrogen enterprise, from stand-alone plants to large pipeline systems.
- Large scope means single optimization problem not tractable
- Need same approach and tools for all plants

## SOLUTION

- Single Aspen Plus® simulation used for all modes:
  - Data Reconciliation, Plant Optimization, MPC Analysis
- Plant-level optimization accomplished with:
  - Offline Optimization, Sequential-Modular modelling mode using SQP optimizer

Product(s):  
*Aspen Plus*



# Carbon Capture, Utilization & Storage



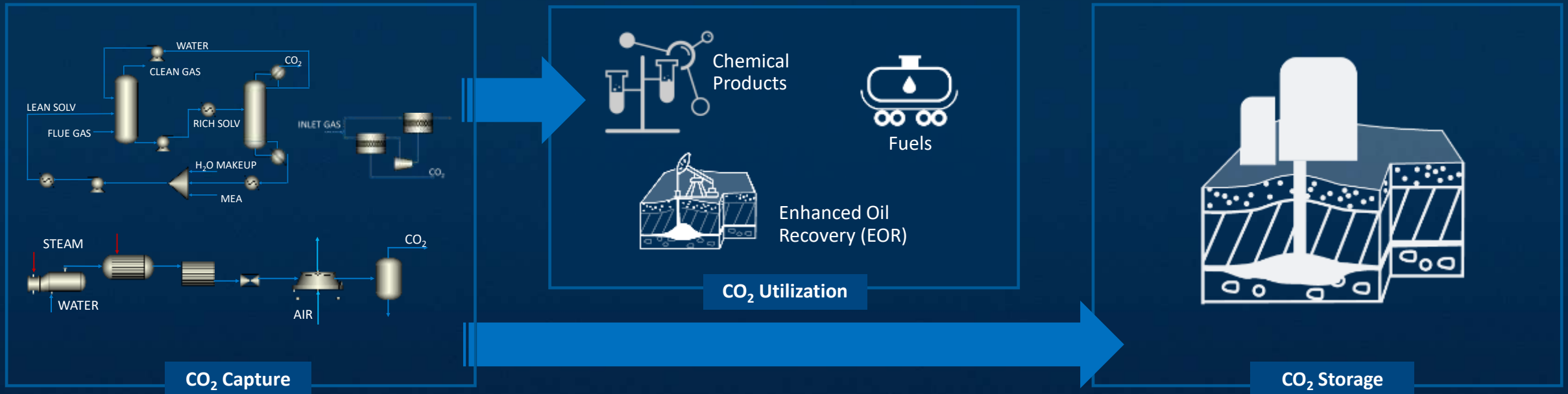
# CCS/CCUS

## Challenges

- Unfavorable economics & unproven scalability
- Dispersed assets & operations across value chain
- Limited commercial options to use CO<sub>2</sub>
- Uncertainty & risks around storage

## Benefits of Digital Solutions

- Identify options to reduce project lifecycle cost
- Make informed decisions and justify investment
- Accelerate innovation & improve processes for CO<sub>2</sub> utilization
- Ensure confidence in low-risk, long-term storage



# AspenTech Sustainability Pathway: CCS/CCUS

## Development & Project Execution

### Research & Develop New Processes

- Improve costs & performance
- Develop point source & direct air capture methods
- Select technology
- Develop CO<sub>2</sub> utilization technologies

### Scale-up & Execute Projects

- Develop end-to-end designs from capture to storage
- Analyze economics & risks
- Deliver & execute commercial-scale projects

## Optimization & Monitoring

### Optimize CO<sub>2</sub> Capture & Utilization

- Reduce energy use
- Leverage insights to improve efficiency
- Develop operating & start up strategies

### Optimize CO<sub>2</sub> Transport to Storage

- Control & monitor CO<sub>2</sub> pipelines
- Validate low temp, high pressure performance

### Characterize Geological Storage

- Evaluate storage candidates
- Assess capacity, containment
- Evaluate site ability for monitoring & injection

### Design Storage & Injection

- Identify well location & plan drilling
- Minimize energy & carbon footprint from design
- Ensure injectivity and containment integrity

### Optimize Storage Operations

- Optimize drilling
- Ensure proper injection
- Reduce energy use and risks across capture & injection

### Ensure Proper Storage & Site Closure

- Ensure containment
- Report CO<sub>2</sub> in storage
- Confirm appropriate storage site closure

# Technology Solutions for Carbon Capture Effectiveness & Economics

**Aspen Performance Engineering** helps to address carbon capture challenges for Energy & Chemical companies

## Solvent Innovation (Aspen Plus)

- Select adequate solvent for carbon capture
- Scale up processes from pilot plant data
- Technoeconomic evaluation and feasibility studies

## Support for Operating Decisions (Digital Twin: Aspen Plus, HYSYS, Hybrid Models, AEI)

- Monitor separation efficiency in operations
- Actionable improvements
- Measure trends
- CO<sub>2</sub> reporting and accountability

## Process Economics and Risk (Aspen Plus, HYSYS, EDR, ACCE)

- Design efficient capture process
- Optimize energy consumption
- Economic evaluation and feasibility studies
- Design column and heat exchangers
- Digital evaluation of scale-up economics and risk

## Control & Production Optimization (APC, GDOT)

- Apply advanced control to all energy consuming units
- Set control strategies to optimize energy use during carbon capture





# Advance Carbon Capture Effectiveness and Economics

*AspenTech Solutions Accelerate Innovation through Accuracy, Optionality & Collaboration*

## AspenTech Solutions

### Process Design:

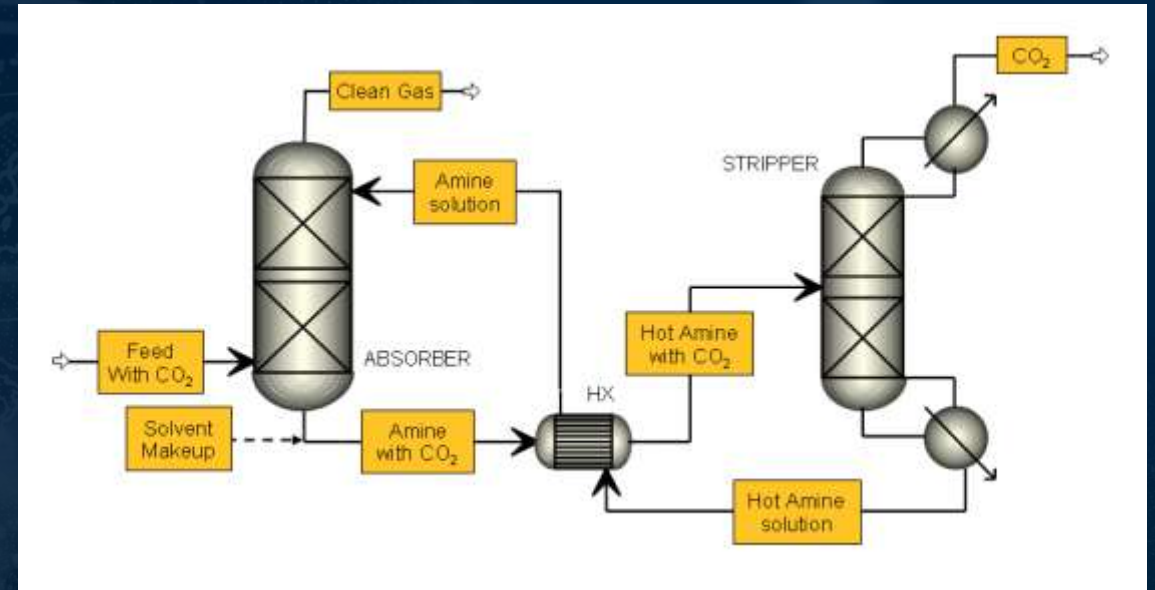
- Scale up processes from pilot plant data
- Design optimized processes for efficient carbon capture
- Optimize process operating conditions
- Select adequate solvent and column internals
- Column and exchanger design
- Economic Evaluation and feasibility studies

### Control/Optimization

- Apply advanced control to all energy consuming units
- Set control strategies to optimize energy use during carbon capture

### Plant Digital Twin:

- Monitor separation efficiency in operations
- Actionable improvements
- Measure trends and report CO<sub>2</sub> capture for reporting and accountability



## Benefits

- Remove up to 90% CO<sub>2</sub> from emissions
  - Yielding up to 7% of total CO<sub>2</sub> load
- Avoid carbon tax

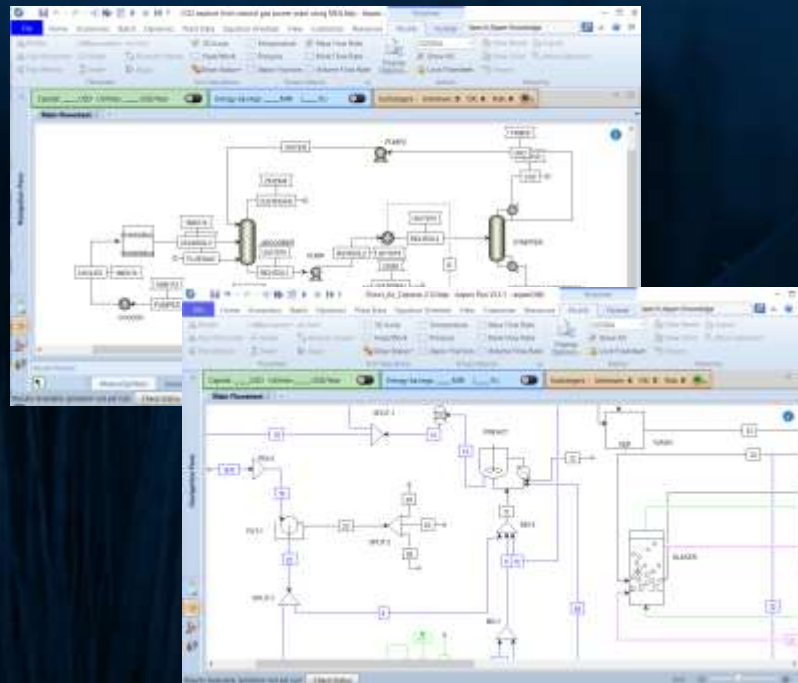
# R&D for Carbon Capture

## Development of New Technologies

*Innovate and design highly efficient carbon capture technologies for industry emissions and atmospheric CO<sub>2</sub>*

### AspenTech Solution

- State-of-the-art thermodynamics
  - Robust property estimation
  - Rigorous solids & electrolytes
- Property regression to match lab
- Accurate modeling of point source & direct air capture processes:
  - Absorption, adsorption, membrane separation, mineralization, etc.
- Unique rate-based distillation modeling for chemical separation



### Benefits

- Design & validate new solvents for conventional processes
- Select best solvents & solids for optimal capture performance
- Achieve confidence in designs of new processes
- Evaluate Direct Air Capture technologies
- Develop membranes & other new capture technologies

**Product(s):**

*Aspen Plus, Aspen HYSYS*

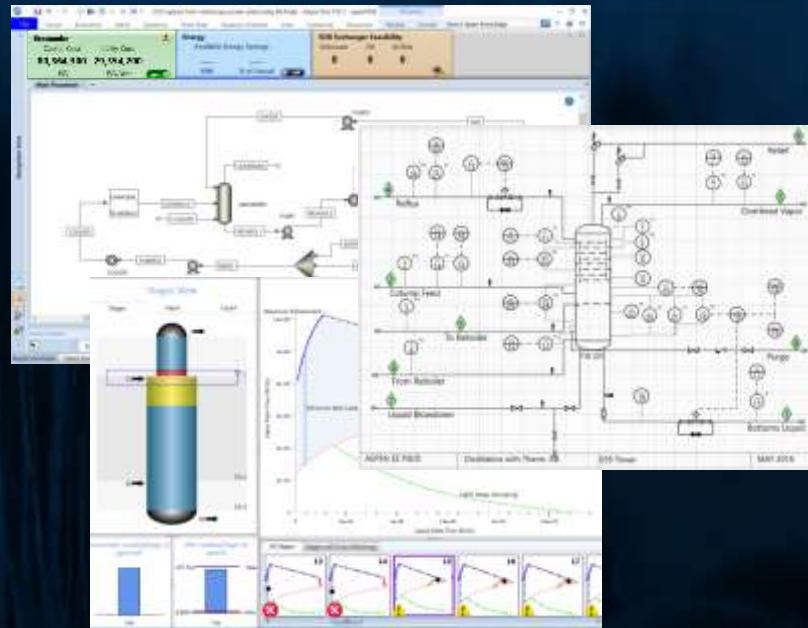
# CO<sub>2</sub> Capture Feasibility Studies and Scale-up

## Carbon Capture End-to-end Design

Rapid scale-up of complete process, from CO<sub>2</sub> capture to long-term storage & utilization. Optimize CAPEX, OPEX, % Capture and Longevity of Sequestration.

### AspenTech Solution

- State-of-the-art thermodynamics
  - Robust property estimation
  - Rigorous solids & electrolytes
- Unique rate-based distillation modeling for chemical separation
- Unique and highly accurate model-based cost estimation system
- Concurrent engineering workflow for rapid screening, scale-up & repeatable designs



### Benefits

- Ensure feasible performance
- Select most economic carbon capture technology
  - Point source & DAC
- Identify opportunities to reduce costs & ensure safety
- Design key equipment for carbon capture processing (HX, columns)
- Execute projects on time & on budget with high accuracy

**Product(s):**

Aspen HYSYS, Aspen Plus, ACCE, Aspen EDR Aspen Basic Engineering, Aspen OptiPlant





“ Rate-based distillation models are better than equilibrium models in simulating the CO<sub>2</sub> capture process.

- Josh Stanislawski, EERC University of North Dakota

”

Saved  
\$23M/yr in  
solvent use

## Challenge

- Evaluate techno-economic feasibility of new power processes with integrated carbon capture

## Solution

- Aspen Plus & Rate-Based Distillation to simulate oxy-combustion & CO<sub>2</sub> capture
- Aspen Process Economic Analyzer to evaluate process operating & capital costs
- Identified parasitic energy loss & additional capital costs required

*Products:  
Aspen Plus, Aspen Rate-based Distillation. APEA*

# Optimize Carbon Capture Plant Operation at One of North America's Largest NGL Plant



- Discovered optimum operating strategy that maximized CO<sub>2</sub> capture while minimizing energy consumed
- Captured >99% of CO<sub>2</sub> in North America's largest NGL plant to produce ethane gas with very low CO<sub>2</sub>

Capture >99%  
of CO<sub>2</sub>

## CHALLENGE

- Remove >99% of CO<sub>2</sub> from Ethane gas produced by one of the largest NGL plant in North America.
- Optimize the carbon capture plant operation to minimize energy while maximizing CO<sub>2</sub> capture.

## SOLUTION

- Simulated the whole CO<sub>2</sub> capture plant in Aspen HYSYS.
- Used rigorous rate-based distillation method in Aspen HYSYS.
- Chose 50% DGA water mixture for primary amine using extensive amine property library in HYSYS.
- Analyzed CO<sub>2</sub> in ethane Vs
  - amine circulation rate &
  - reboiler duty

Product(s):  
Aspen HYSYS®



# Bio-Based Feedstock Processing





# Bio based Feedstock

## Challenges

- Operational instability due to less familiar feedstock properties
- Fluctuating product quality & hydrogen demand
- Difficult to quantify renewable content in the final product

## Benefits of Digital Solutions

- Design and implement new processes that consider economic & environmental impact
- Optimize production to ensure consistent product quality
- Track usage of biomass to capture rapidly developing market



Increased Demand



Government Policy



Renewable Alternatives

# Digital Technology Pathway: Bio based Feedstocks

## Techno-Economic Assessment

### Feedstock Replacement

- Evaluate integration of biomass in new & existing process
- Support design decisions regarding new processes or products

### Production Planning for Bio based Feedstocks

- Optimize feedstock selection
- Evaluate new feedstock economics

## Production Optimization

### Enterprise Optimization

- Improve system economics
- Optimize regional supply chains to maximize margins and minimize carbon intensity

### Process & Equipment Design

- Accelerate effective scale-up of new processes
- Optimize solids handling

### Process Optimization

- Optimize to ensure consistent production
- Hydrogen network optimization

### Incorporate new bio based feedstock

- Track biomass feedstock usage
- Prioritize end market opportunities

# Using Aspen HYSYS Molecule-Based Reactor to Optimize Hydroprocessing Units for Used Cooking Oil (UCO)



- The HYSYS model provided an economic way for the refinery to produce a high value product, by reusing existing units in the refinery and reduce the cost of construction of new plants.
- The effluent of the HDT (HDO) unit results in close molecular match to traditional petroleum feed
- Reuse 10% of used cooking oil produced in India

## Help Achieve 5% Green Diesel Blend

### CHALLENGE

- To transfer the knowledge of experimental studies into process design and scale up through simulation tools.
- Difficulty modelling used cooking oil (UCO), being an unconventional feed.
- Developing reaction pathways to convert UCO into green fuels, and calculate hydrogen consumption.
- Huge risks with incorrect design of reactors.

### SOLUTION

- All refining operations to handle and separate green fuels was modeled in Aspen HYSYS.
- Modeled HDO unit using the Molecule based (MB) reactor in Aspen HYSYS.
- MB fingerprint allowed to characterize the unconventional feedstock.
- Calibrated MB model to tune kinetic parameters for multiple data sets.

Product(s):  
Aspen HYSYS™



# Technology Pathways Towards Sustainability

## Sustainability Models to Accelerate Progress



**Emissions  
Management**

**Bio-Based  
Feedstock**

**Renewable  
Energy**

**Hydrogen  
Economy**

**Carbon  
Capture**

# SUSTAINABILITY

# Sustainability Models to Accelerate Progress

100+ Sample Models Showcase What's Possible Today *(select examples below)*

						
Emissions Management	Electrification	Bio-Based Feedstocks	Hydrogen Production & Usage	Hydrogen Transport	Carbon Capture	Materials Circularity
Calculation of CO <sub>2</sub> emission and price	Renewable electricity modeling: wind turbine model in ACM	Biomass feedstock characterization	Hydrogen production by alkaline electrolysis system	Single mixed refrigerant PRICO precooling process in hydrogen liquefaction plants	CO <sub>2</sub> capture from natural gas power plant using MEA	Transforming non-recyclable plastics to fuel oil using thermal pyrolysis
Carbon emission control in refinery using DMC3	Renewable electricity modeling: solar panel model in ACM	Integrating bio-based feedstocks into refinery planning	Integrated custom model of Proton Exchange Membranes (PEM) fuel cell	Hydrogen supply chain design with carbon emission reduction	Carbon capture and transport	Advanced recycling of High-Density Polyethylene (HDPE) via pyrolysis
Plant scheduling with CO <sub>2</sub> emissions projections using Aspen Plant Scheduler	Renewable electricity modeling: wind turbine with Aspen Utilities Planner	Production of 1,4-butanediol by aerobic fermentation	Hydrogen production from Steam Methane Reforming (SMR)	Integrated cryogenic process in hydrogen liquefaction plants	CO <sub>2</sub> capture from coal power plant using MEA	Advanced recycling of Polystyrene via pyrolysis
Carbon emissions modeling for refinery planning (PIMS-AO)	Li-ion battery recycling process	Production of aromatics with waste cooking oil	Hydrogen production by water electrolysis with polymer electrolyte membrane	Cascade mixed refrigerant + precooling process in hydrogen liquefaction plants	Direct air capture with calcium loop	Pyrolysis of waste tires

A person is silhouetted against a bright, glowing sun or light source, with their arms raised in a gesture of achievement or celebration. In the background, a large, glowing digital globe is composed of a network of white lines and dots, representing a global network or data system. The scene is set against a blue and orange sky. Various scientific and technological icons are scattered throughout the image, including a cloud, a factory, a hand holding a globe, a chemical flask, a laptop, a globe with leaves, a CO2 molecule, and a DNA helix.

**Thank you!**

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