HONEYWELL UOP INTEGRATED PATHWAYS FOR DECARBONIZATION

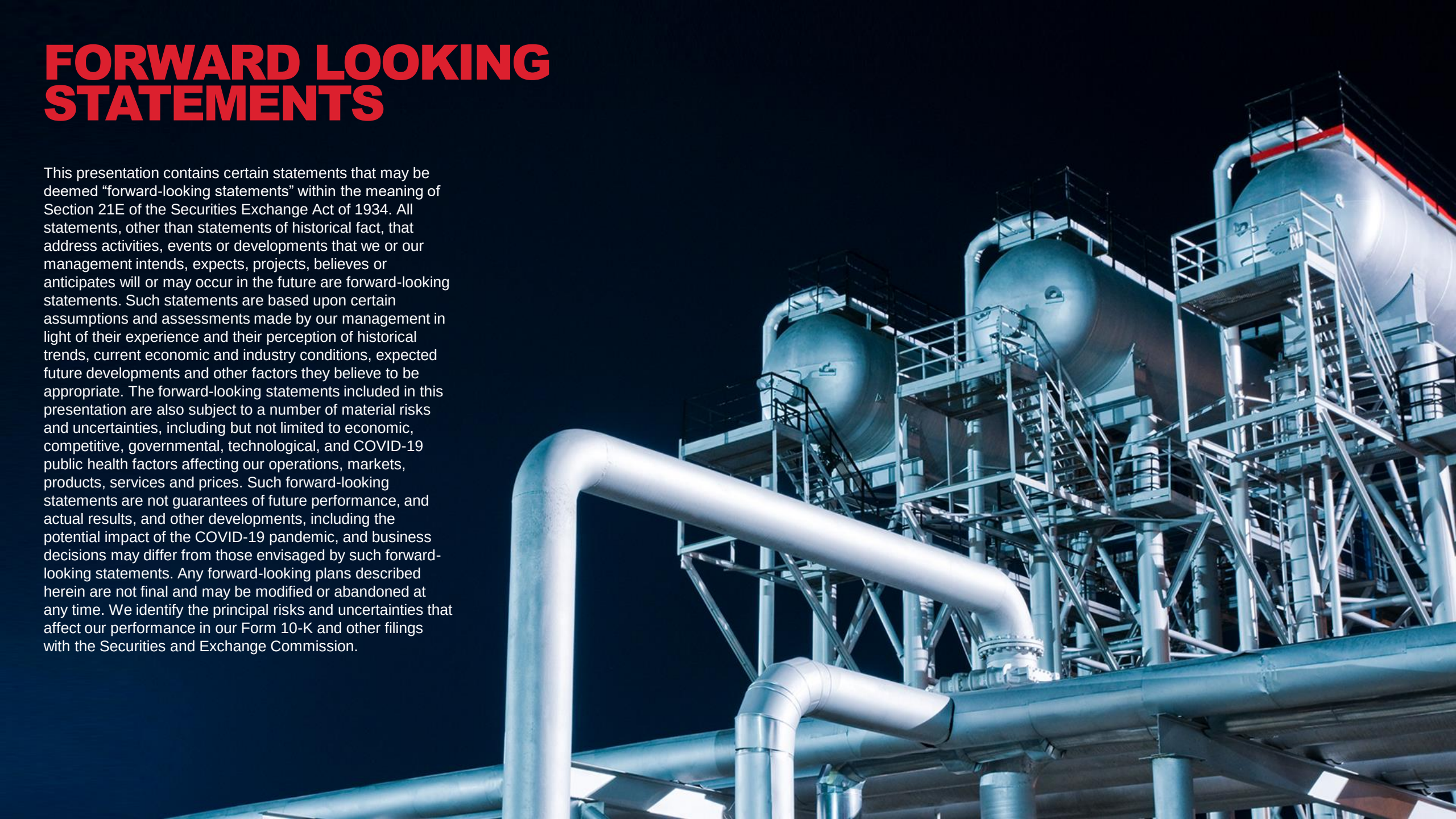
ZHIHAO FEI, PHD
R&D DIRECTOR

May 21, 2025

Honeywell
UOP

FORWARD LOOKING STATEMENTS

This presentation contains certain statements that may be deemed “forward-looking statements” within the meaning of Section 21E of the Securities Exchange Act of 1934. All statements, other than statements of historical fact, that address activities, events or developments that we or our management intends, expects, projects, believes or anticipates will or may occur in the future are forward-looking statements. Such statements are based upon certain assumptions and assessments made by our management in light of their experience and their perception of historical trends, current economic and industry conditions, expected future developments and other factors they believe to be appropriate. The forward-looking statements included in this presentation are also subject to a number of material risks and uncertainties, including but not limited to economic, competitive, governmental, technological, and COVID-19 public health factors affecting our operations, markets, products, services and prices. Such forward-looking statements are not guarantees of future performance, and actual results, and other developments, including the potential impact of the COVID-19 pandemic, and business decisions may differ from those envisaged by such forward-looking statements. Any forward-looking plans described herein are not final and may be modified or abandoned at any time. We identify the principal risks and uncertainties that affect our performance in our Form 10-K and other filings with the Securities and Exchange Commission.



HONEYWELL

UOP AT A GLANCE

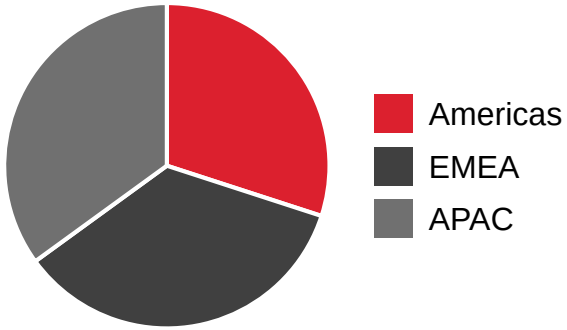
100+ Years of Global Expertise and Leading Technology Development

UOP TECHNOLOGY POWERS

- **90%** of biodegradable detergents
- **70%** of the world's polyester
- **60%** of the world's gasoline
- **60%** of the world's on-purpose propylene
- **60%** of the world's paraxylene
- **50%** of the world's renewable fuels
- **40%** of LNG processed
- **>30** Mtons of captured CO_2

GLOBAL REACH

Diversified regional presence that can effectively react to changes in demand



NEW TECHNOLOGIES

Honeywell UOP creates new technologies that convert oil, natural gas, and renewable feeds into transportation fuels, energy, and petrochemicals

EXPERTISE

Broadest range of downstream refining and petrochemical technologies; leading process technology licensor

2,000
Engineers and scientists

4,900
Active patents and applications

LARGEST
process licensing organization
in the world

31 out of **36**
refining technologies in use today were developed by
UOP

OUR PORTFOLIO
SOLUTIONS FOR THE ENERGY TRANSITION

UOP Process Technologies

Process technologies, engineering, and equipment for the refining, petrochemicals, and gas processing industries

- Chemical feedstocks
- Transportation fuels
- Hydrogen recovery and purification
- Burners and flares
- Natural gas purification

Sustainable Technology Solutions

Ready-now technologies for renewable low-GHG fuels, targeted solutions for a majority of the world's GHG emitters, H_2, and plastic waste recycling

- Renewable fuels, Ecofining™, SAF
- Blue and Green hydrogen
- Carbon capture
- Plastics recycling – UpCycle technology
- Energy storage – Flow battery

Lifecycle Solutions and Technologies

Serving customers in the operational phase with catalysts, adsorbents, aftermarket equipment, and services

- Catalysts for refineries and petrochemical plants
- Adsorbents for separations and purification
- Field services
- Equipment aftermarket
- Software-enabled services to advance project execution and improve plant operations

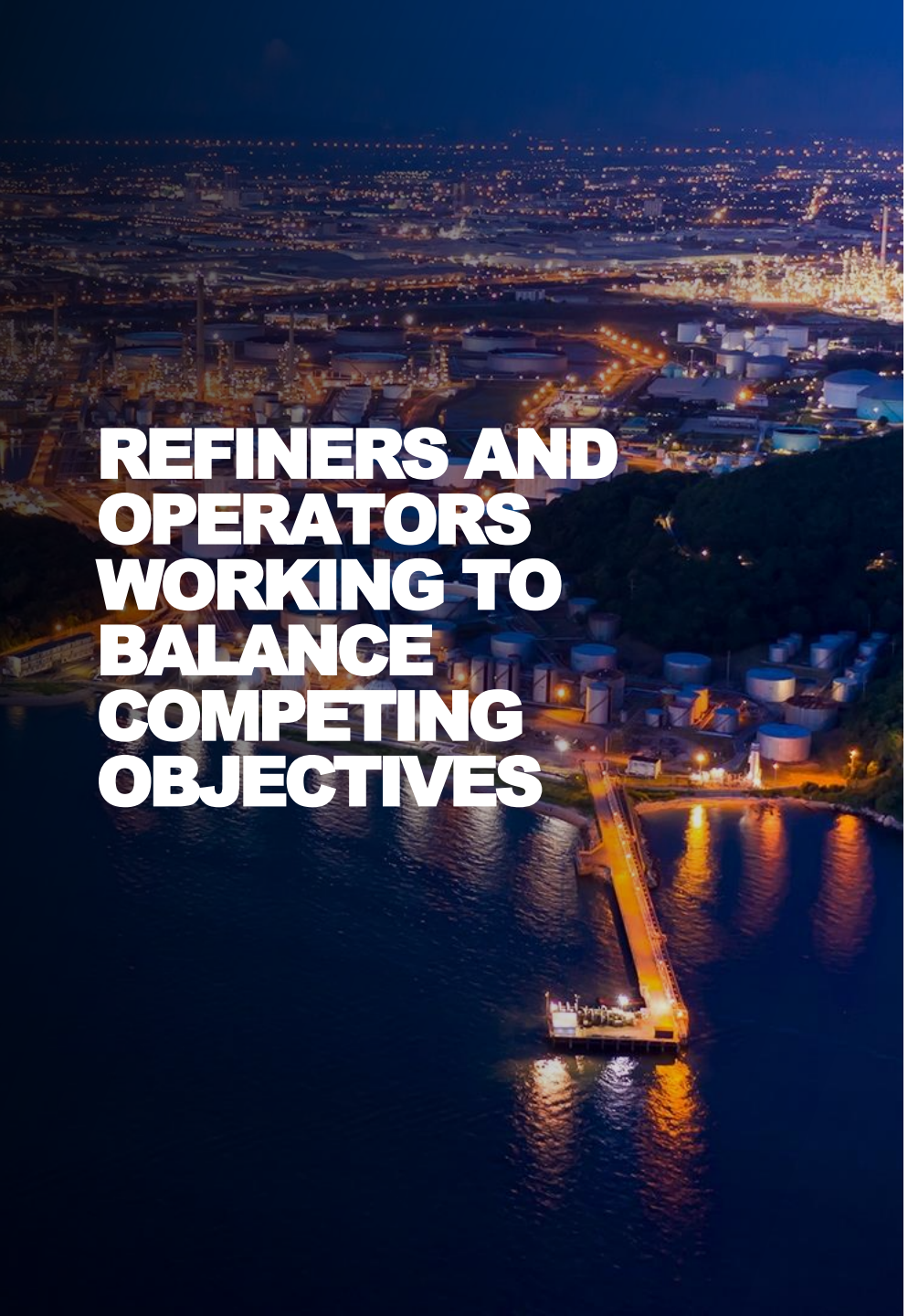
A CENTURY OF INNOVATION

FOR OVER 100 YEARS, UOP HAS DEVELOPED TECHNOLOGIES FOR THE WORLD'S LEADING OIL AND GAS COMPANIES – TODAY; WE ARE DEVELOPING NEW SOLUTIONS IN THE SUSTAINABILITY SPACE

1914: Dubbs Cracking Process
1938: High Octane Aviation Gasoline
1949: Platforming™ Process
1953: Synthetic Zeolites
1957: Zeolites for Catalytic Cracking
1960s: Technologies for Unleaded Gasoline
1968: Biodegradable Detergents
1970s: Automotive Catalytic Converter
1970s: Parex™ Process
1990: Oleflex™ Process
2008: MTO, Uniflex™ commercialized
2016: Connected Performance Services

2006: **Renewable Diesel** Technology
2008: **Renewable Jet™ Fuel**
2008: **Envergent JV** for biomass pyrolysis
2013: FCC py-oil co-processing demonstrated
2016: **ISOALKY™** ionic liquids alkylation
2022: **ASCC** carbon capture technology announced
2022: **Green H_2 CCM** technology announced
2022: **UpCycle™** Technology announced
2023: **MTJ** and **ETJ** technologies announced

Over 70 processes and 300 catalyst / products



REFINERS AND OPERATORS WORKING TO BALANCE COMPETING OBJECTIVES

Invest to Maintain Assets / Maximize Output ⟷ **Decarbonize**

+1.1 MM BPD conversion to biorefineries majorly in NA and EU

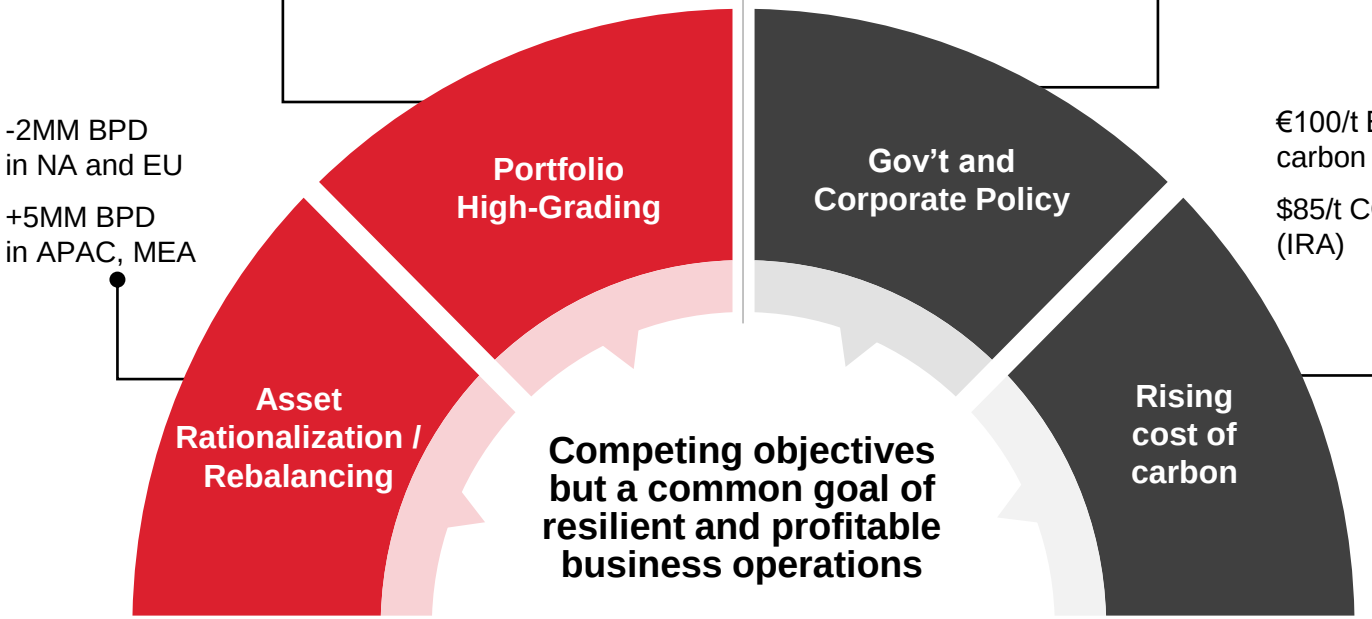
63 countries with laws or policies on the books

-2MM BPD in NA and EU

+5MM BPD in APAC, MEA

€100/t EU ETS carbon price soars

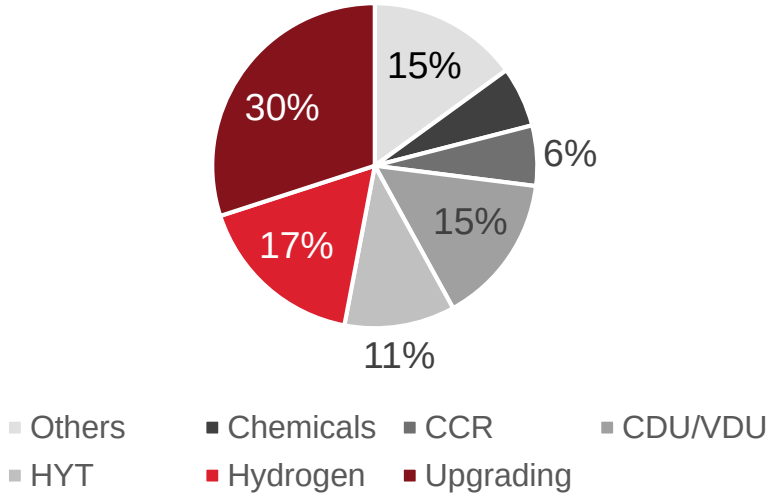
$85/t CO_2 credit (IRA)

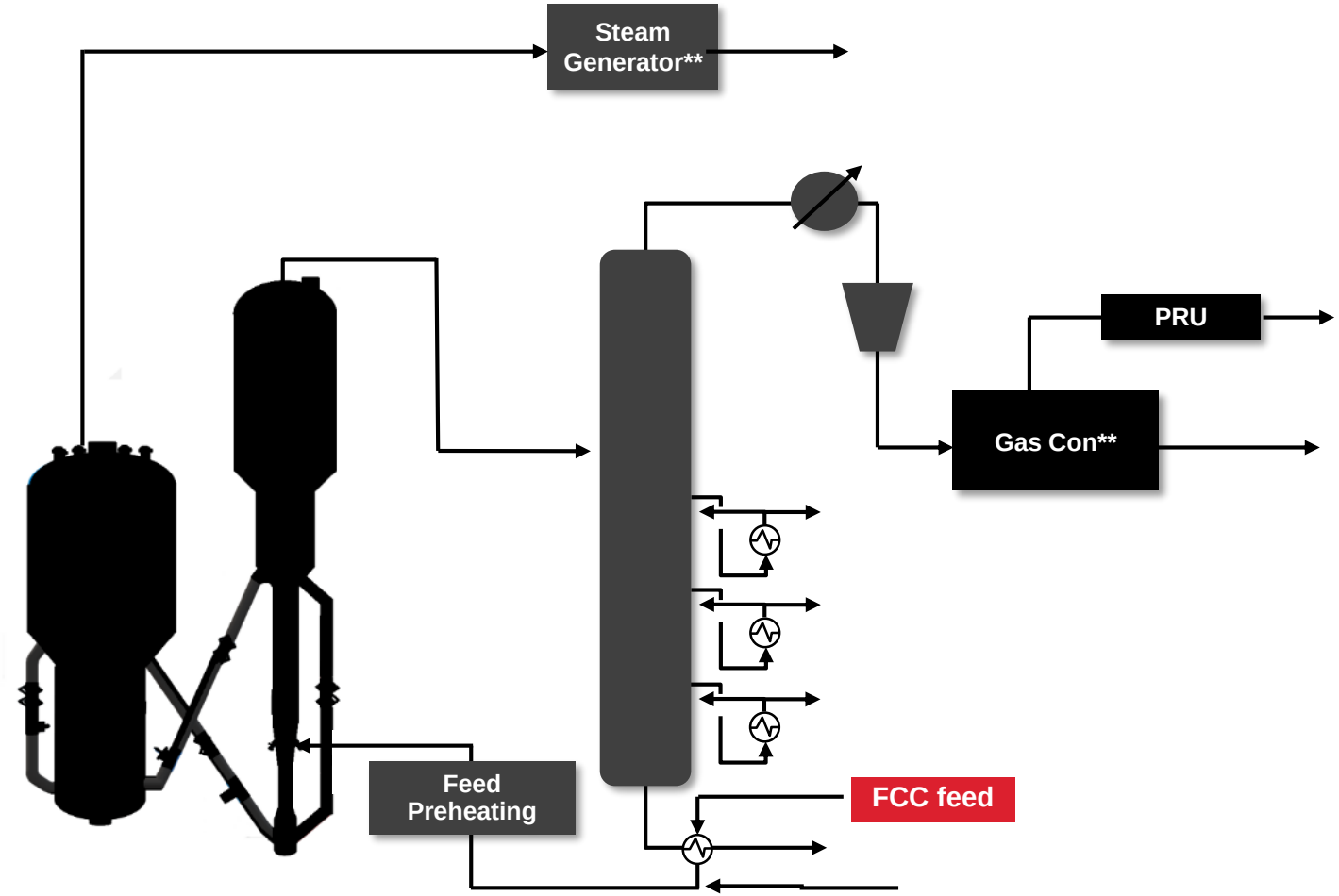


FCC SCOPE 1, 2 & 3 EMISSIONS REDUCTION

FCC UNITS:

- **Generally used for gasoline production**
- **Significant point source of GHG**
- **Present in most refineries**





FCC SCOPE 1, 2 & 3 EMISSIONS REDUCTION

SCOPE 1

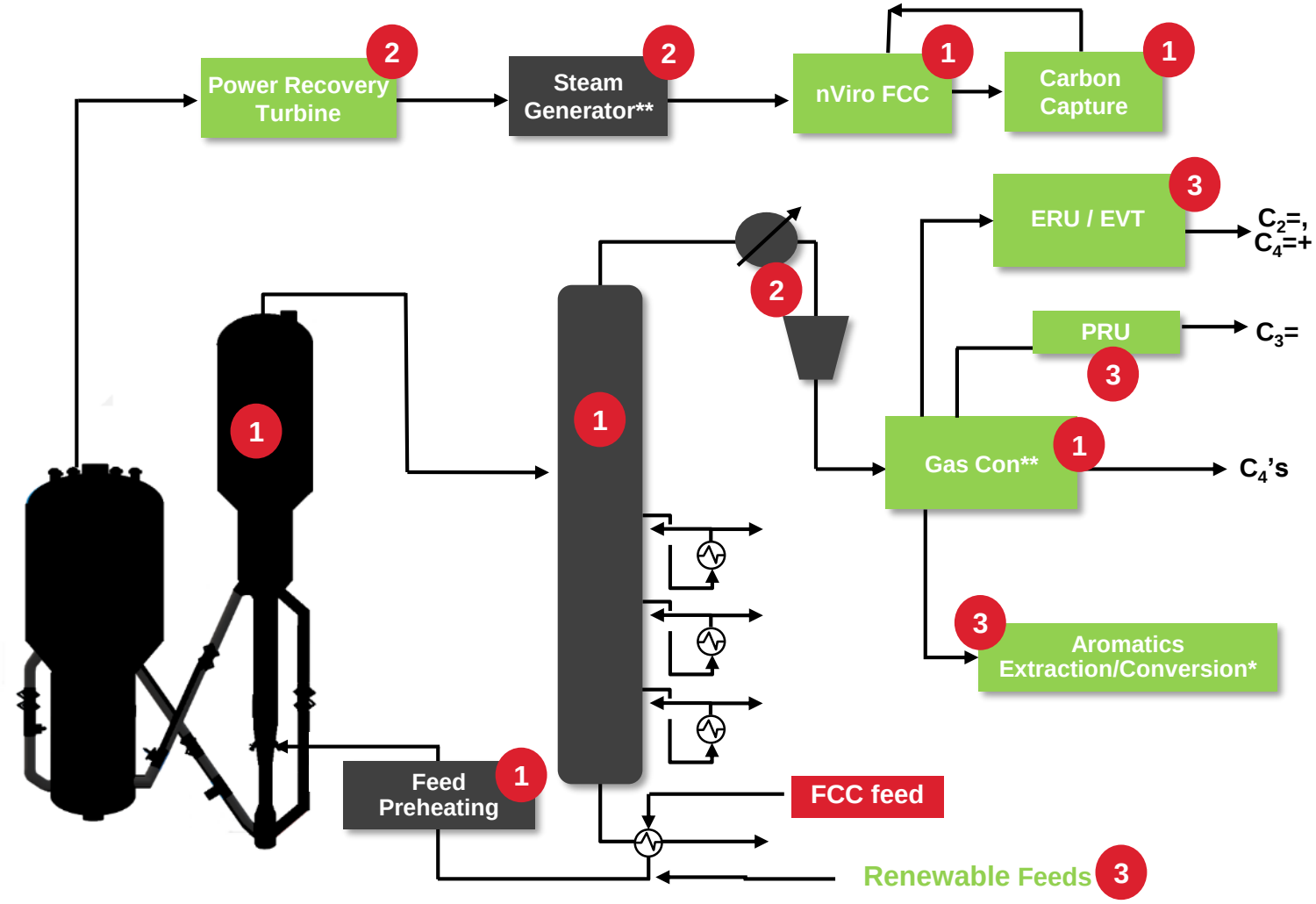
- Flue gas carbon capture
- nViro™ FCC
- Other efficiency Solutions

SCOPE 2

- Power Recovery Turbine
- Flue gas Steam Generation
- Thermal energy harvesting MC OVHD

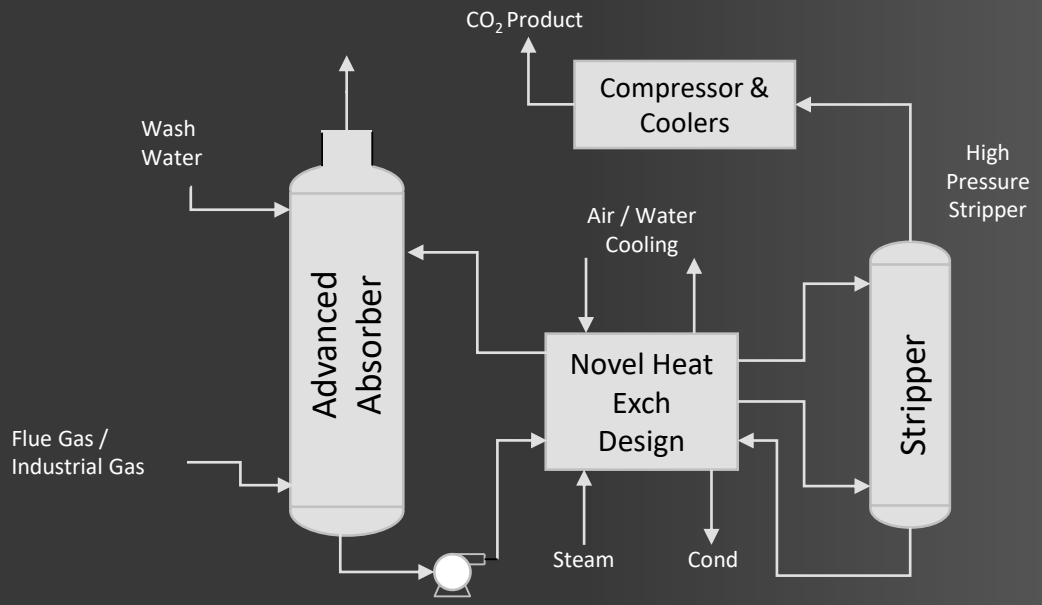
SCOPE 3

- Renewable Feed Integration
- Increased petchem production (C_3=,
- Ethylene utilization



Holistic approach to emissions reduction

NEW Technology - Advanced Solvent for Carbon Capture



Applications Include: Refining, Hydrogen Plants, Power, Steel, Cement, Natural Gas

Patented Solvent with Optimal Properties

- High mass transfer rate – smaller absorber
- Low heat of regeneration
- High stability
  - Enables higher pressure stripper & lower solvent makeup rates

Process & Equipment Design

- Advanced absorber with proprietary internals
- Novel heat exchange tailored to solvent
- Reduced solvent regeneration heat duty and lean solvent cooling
- High stripper pressure ➡ reduced CO_2 compression

Development Status

- Technology demonstrated for more than 2000 hours at NCCC with piloting at SRP
- Ready Commercially available technology
- Modular Options up to 150kMTa of CO_2 Captured
- License, Engineering & Solvent Supply for larger capture units

SUSTAINABILITY FOCUS AREAS

With a century of innovation behind us, we are eagerly looking to the next opportunities to shape the future with novel UOP materials, catalysts, membranes, and processes.

New Membranes

Utilizing our expertise and infrastructure, UOP is inventing new polymers, electrolytes, and membranes for electrochemical reactions such as for energy storage, CO_2 reduction/conversion, and green H_2 production.

.

Biomass to Fuels/Chemicals

Untangling the complexity of lignocellulosic biomass can result in maximum carbon conversion to the fuels and chemicals on which the world has come to rely. We are studying multiple routes to convert whole biomass via thermal and physical and chemical methods.

CO_2 Conversion

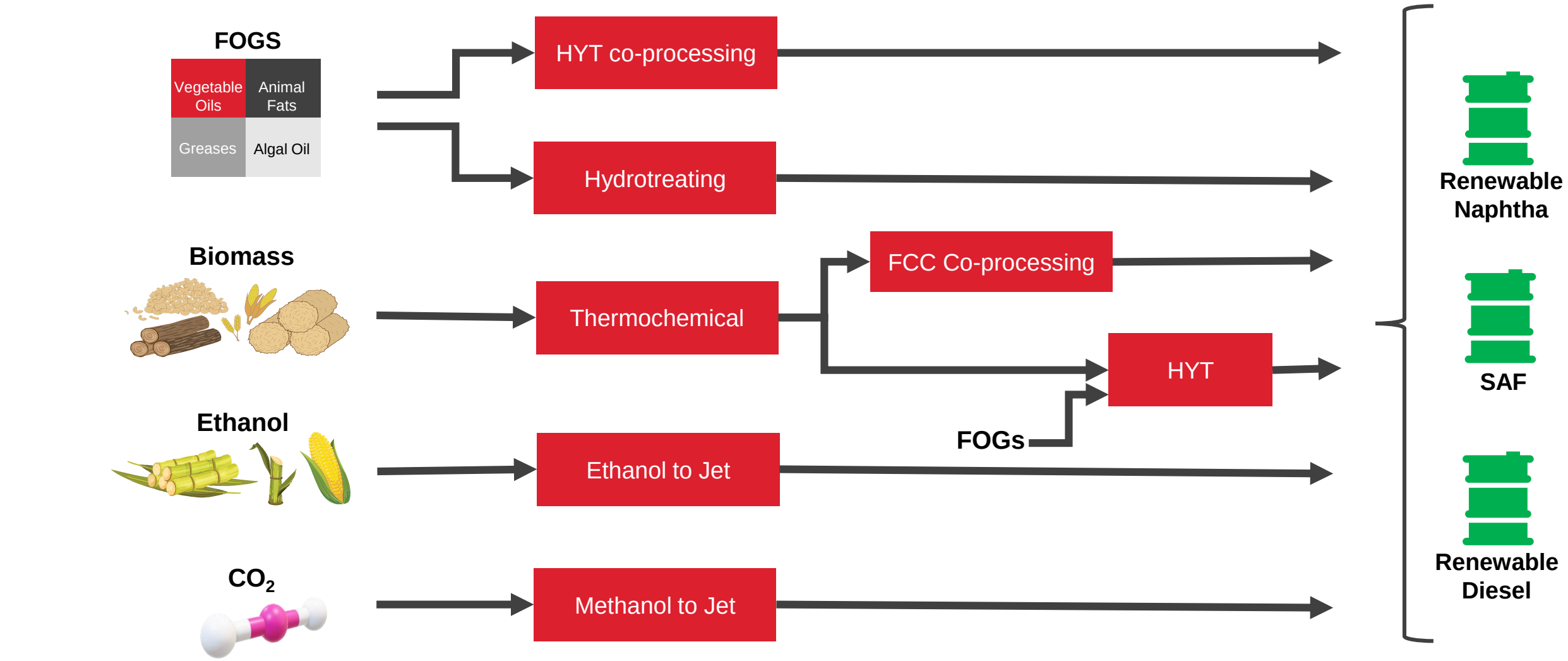
Carbon dioxide is a thermodynamically stable molecule that requires a reductant to be converted into value-added chemicals. Regulations in some parts of the world are encouraging the use of biogenic CO2 as a feedstock for fuels and chemicals. Novel catalysts will be required to enable this technology.

Separations and Purifications

As the demand for renewable electricity increases, so will a new stream of high value materials destined for landfills unless efficient, circular technology is developed. UOP is studying novel routes and materials for the extraction and recycling of critical minerals and other building blocks.

UOP is already discovering the next generation of technology breakthroughs

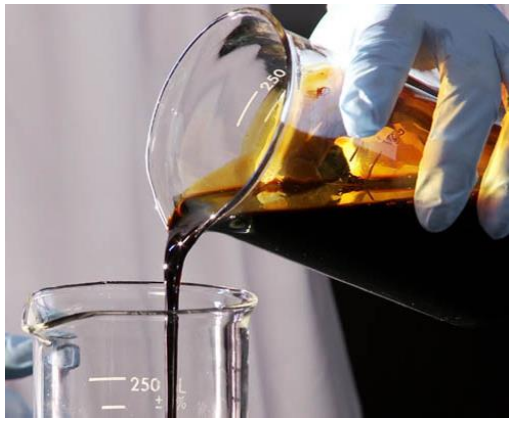
RENEWABLE FUELS SOLUTIONS



Several routes to renewable fuels

EXPANDING FEEDSTOCKS FOR SAF

- Finding alternative feedstocks is vital to producing Advanced Biofuels and SAF to meet global targets
- UOP understands the need for new technologies and is focusing on two pathways

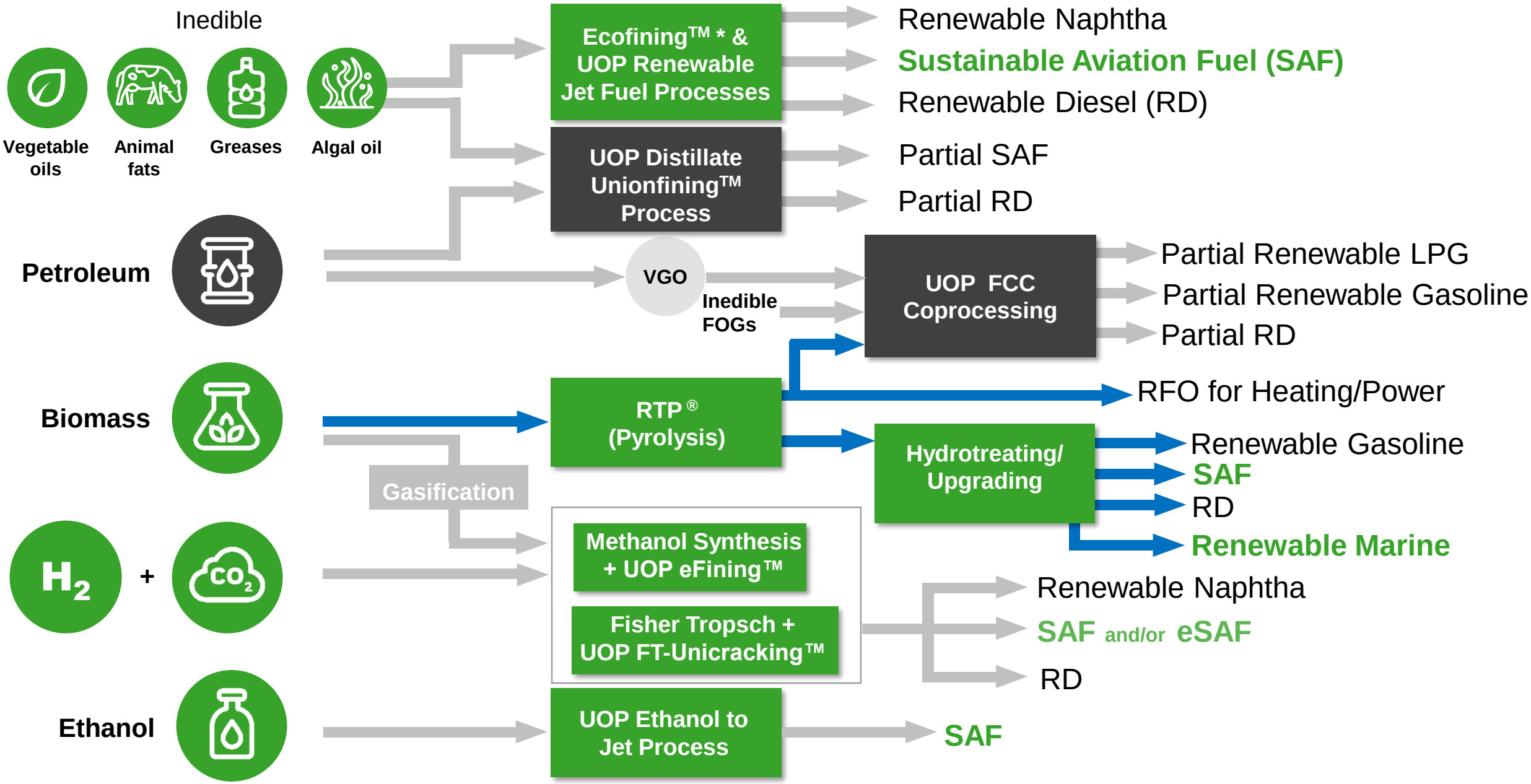


- Alcohol to jet fuel technology
- Using ethanol or other alcohols as the basis for multi-step conversion to Jet/Diesel Fuel
- Expands on prior work and is based on largely commercial technologies

- Announcement from Honeywell, United Airlines, and Alder Fuels
- New pathway in development for processing of 100% SAF originating with solid biomass materials

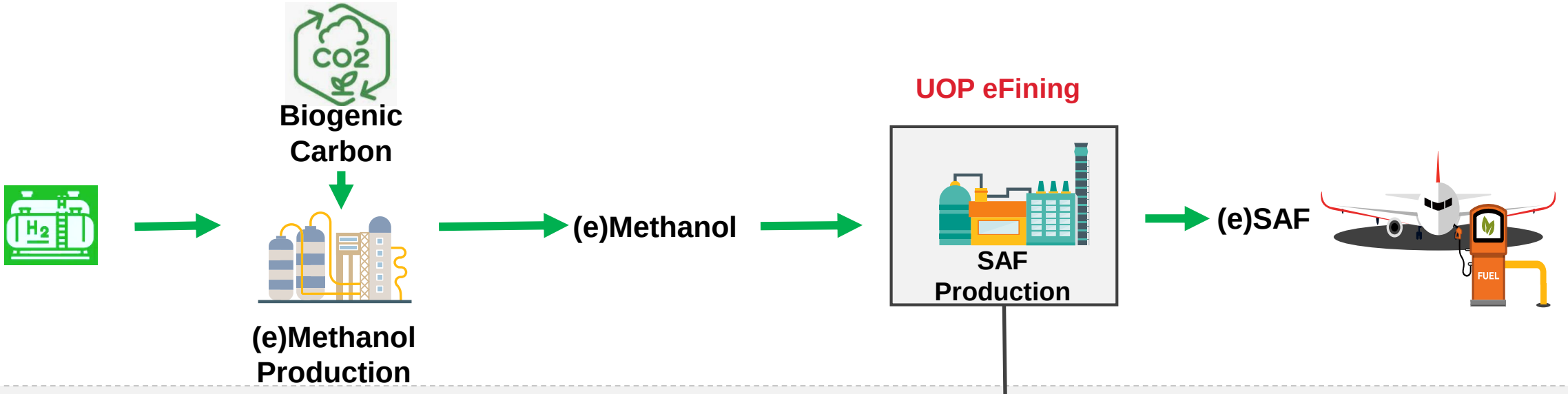
Expanding feedstock sources is vital to long-term decarbonization

PATHWAYS TO FUEL PRODUCTION



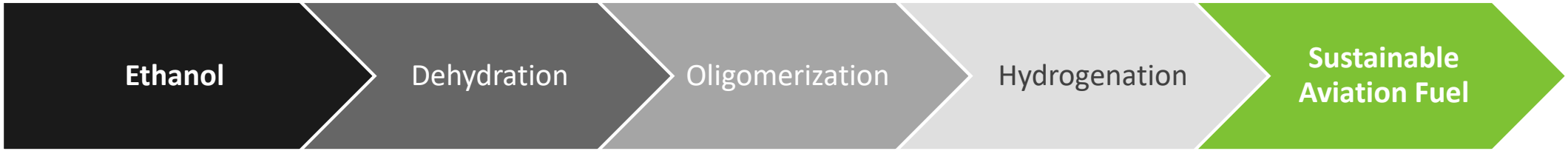
* Ecofining technology produces renewable diesel, SAF, and other renewable products from biogenic feed sources. The technology was developed and commercialized jointly by UOP in collaboration with ENI

(E)SAF PRODUCTION THROUGH UOP eFINING



Commercialized MTO combined with same oligomerization tech as ETJ

UOP'S APPROACH
ETHANOL CONVERSION TO JET



Produces ethylene from ethanol

Oligomerization of ethylene to heavy olefins

Hydrogenation of heavy olefins to Jet fuel

SAF produced is paraffinic, similar to HEFA SPK

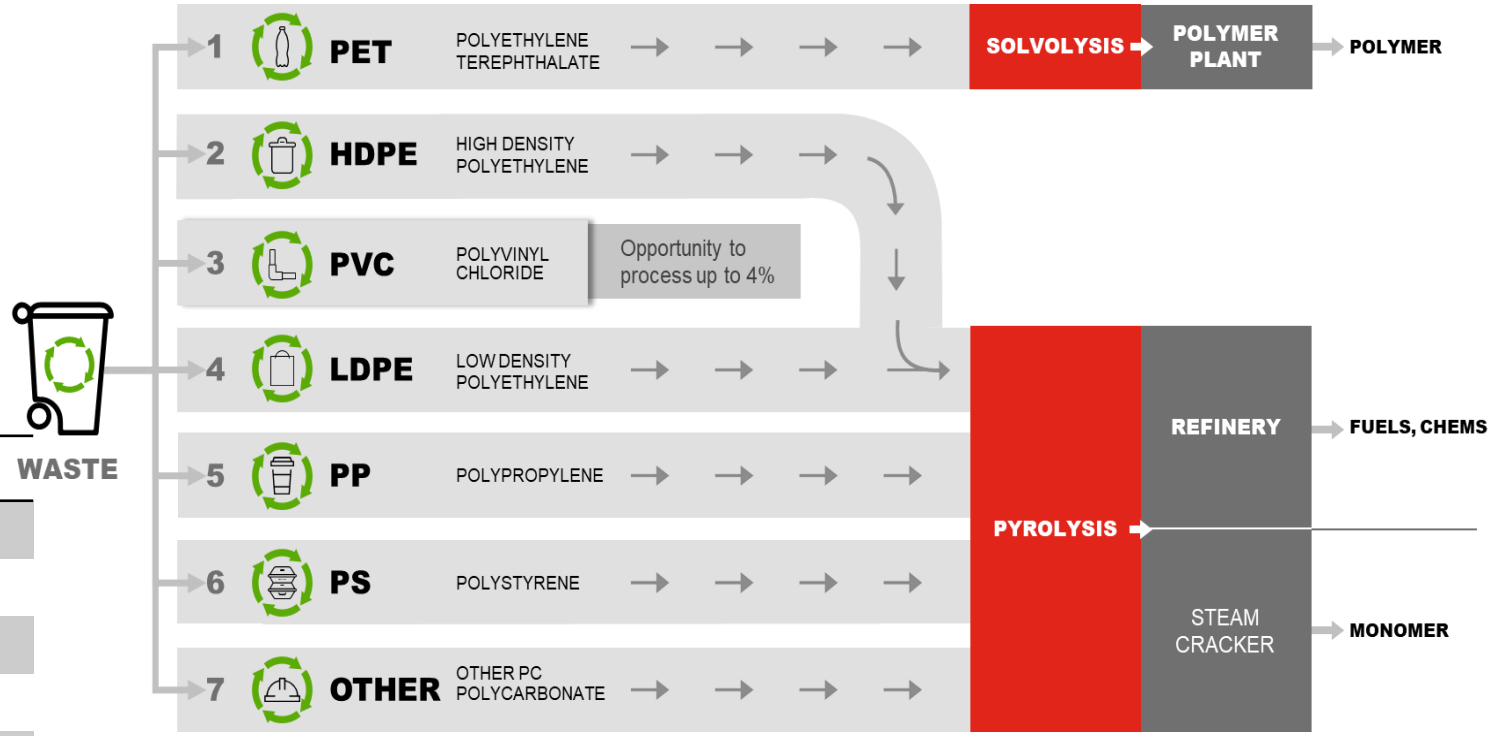
Key Features

- High yields to jet and diesel from UOP's ETJ process
- Reduce greenhouse gas (GHG) emissions by 80% on a total lifecycle basis[1]
- Compatible with hydrous or ASTM D4806 anhydrous ethanol
- Advanced heat integration for lower carbon intensity route
- Based on commercially demonstrated technologies – enables fast scale-up and quicker time to commercialization
- Option to purchase full scope catalyst and process design to provide a single point of guaranteed accountability

1- Based on the EPA's summary LCA of GHG emissions for sugarcane

HONEYWELL PLASTIC CIRCULARITY

- Honeywell's **UpCycle Process** Technology expands the types of plastics that can be recycled
- Targeting a **"drop-in"** intermediate **recycled polymer oil** (RPO) feedstock viable for Steam Crackers and downstream petrochemical producers
- Honeywell Advanced Recycling aspires to increase **waste plastic circularity from 9% to 90%**



Recycled Polymer Feedstock Properties	
Specific Gravity	0.77-0.83
Naphtha (wt%)	20-35%
Distillate (wt%)	45-60%
Gas Oil (wt%)	2-10%
Sulfur (ppmw)	<500 ppm
Nitrogen (ppmw)	<2000 ppm
Chloride (ppmw)	<15 ppm
Olefins (wt%)	25-50%

TO BIODEGRADE OR TO NOT BIODEGRADE

Bio-Based

Non-Biodegradable

Biodegradable

Fossil-Based

Bio-based, Non-biodegradable

Product
Bio-Polyolefin (bio-PE & bio-PP)
Bio-Polyethylene Terephthalate (bio-PET)
Poly(ethylene)furandicarboxylate (PEF)

Future Focus

Bio-based, Biodegradable

Product
Poly(lactide) (PLA)
Poly(hydroxyalkanoate) (PHA)

We are not focused on this area

Fossil-based, Non-biodegradable

Product
Polyethylene Terephthalate (PET)
Polyethylene (PE)

Traditional Area of Focus

Fossil-based, Biodegradable

Product
Poly(butylene)adipate terephthalate (PBAT)
Poly(butylene)succinate (PBS)

We are not focused on this area

PATHWAYS TO BIODERIVED CHEMICALS

1st Gen: Edible Biomass
- Sugar beet and cane
- Wheat
- Corn

2nd Gen: Lignocellulose
- Forestry
- Grasses
- Agricultural Waste

3rd/4th Gen
- Algae
- Waste Streams

1st Processing Step

- Biological Conversion
- Mechanical Pretreat
- Lignin Extraction
- C5/6 Sugar Extraction
- Direct HDO
- Gasification
- Pyrolysis
- Hydrothermal Liquefaction

Petrochemicals
- Light olefins
- Acrylonitrile
- Ethylene glycol
- Butadiene
- FDCA
- pX
- Phenol
- Linear Alkyl Benzene
- Lubricants

Current focus on 2nd generation feedstocks to chemicals

SUMMARY

1 Advancing the Core Technologies is a Must-Do

- Next Gen Ecofining SAF & Green Diesel , 2nd/3rd Gen Feedstocks for Renewable Fuels
- Refining -Petrochem Integration, NEP, Aromatics, Olefin Advances
- New HC Catalysts on Act/Yield , HDT Catalysts
- Materials and Catalysis which enable Decarbonization Solutions

2 R&D Pivoting to Sustainable Solutions & the ST&S Business is Central to this Strategy

- Energy Storage, Plastics Circularity, H2 Economy, Bio-Derived Monomers/Fuels, CCUS
- Leverage our core competencies in Materials, Catalysis, and Process Technology
- Investing in Capabilities required for new Growth areas

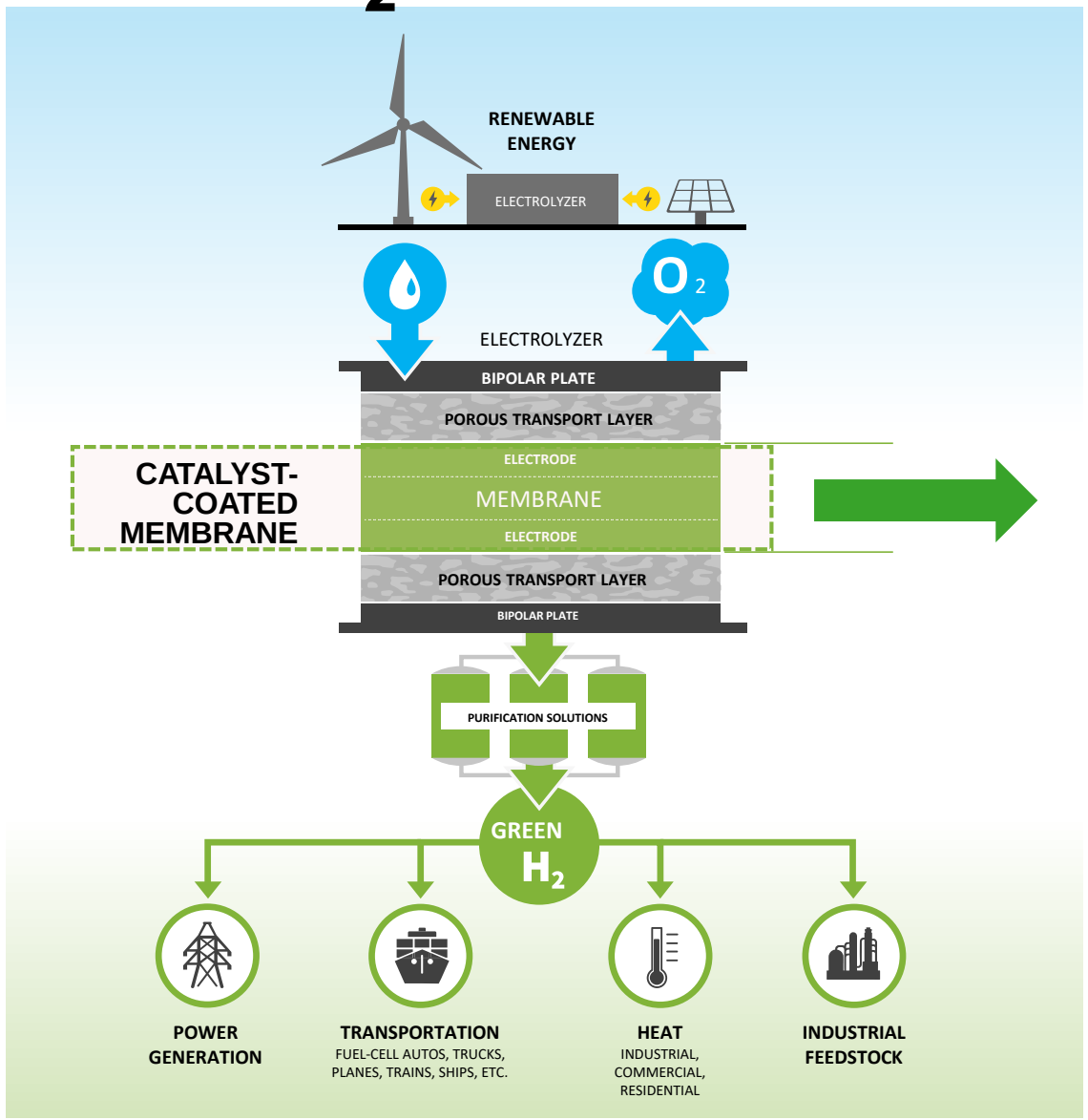
3 Capabilities and Tools for Speed

- High Throughput Material Testing including catalysts, metallurgy
- Rapid Prototyping , Model Based Experimentation
- Advanced Characterization

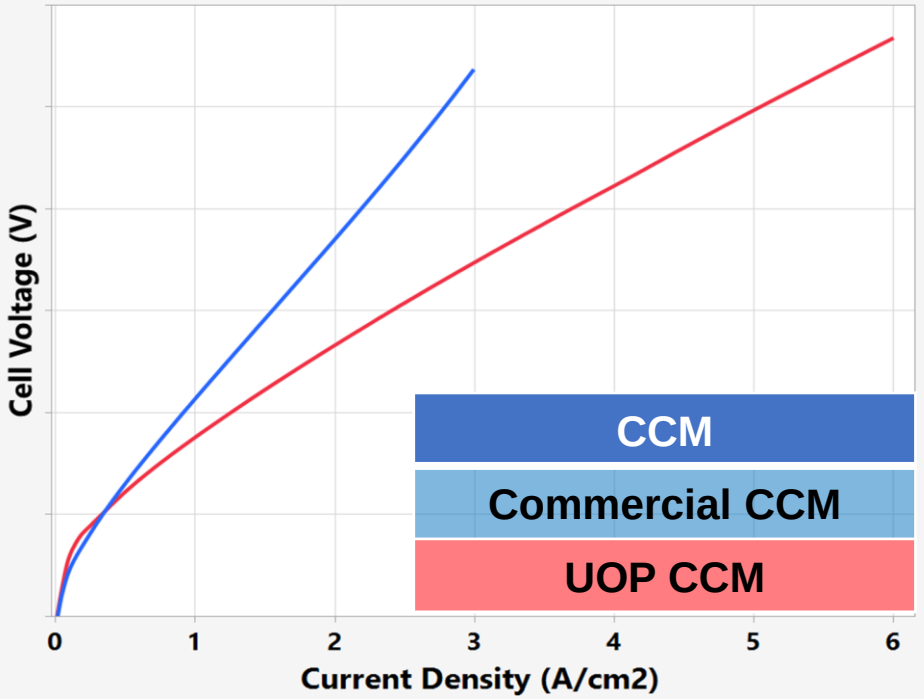

THANK YOU

BACKUP SLIDES

HONEYWELL'S CCM FOR GREEN H_2



CCM Drives the Performance



Reduced PEM CAPEX

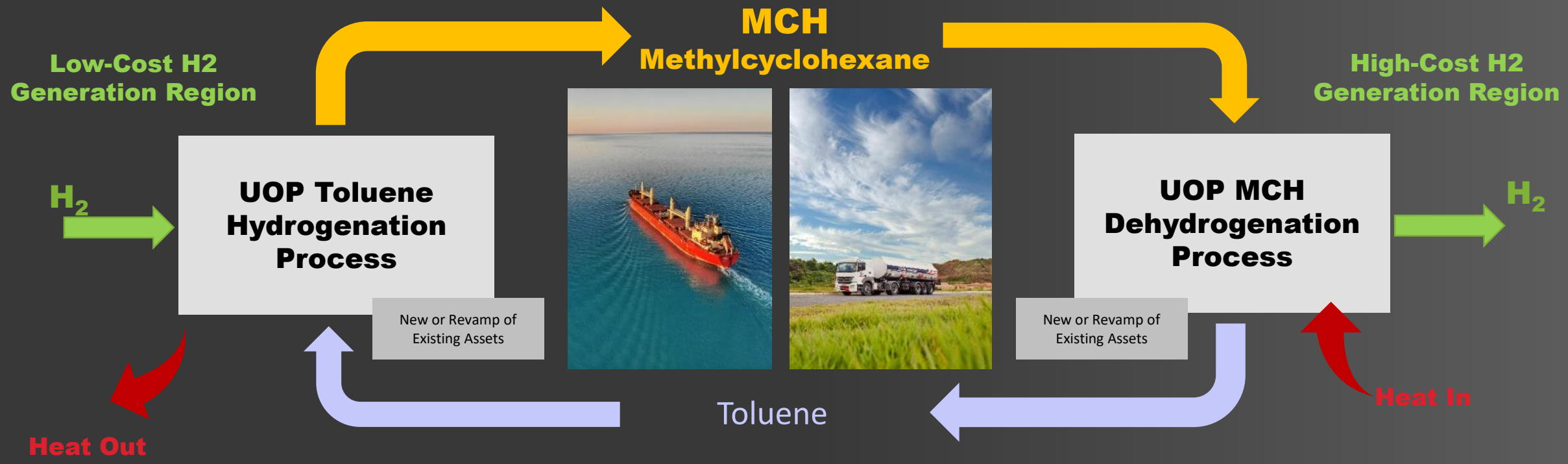
- Honeywell demonstrates **1.3X higher** Current Density at a similar voltage[1]
- Honeywell demonstrates **30% higher** hydrogen production per area[2]
- **Electrolyser OEMs have confirmed & validated HON CCM performance**

1 Higher current density and higher Faradaic efficiency when operated at the same cell voltage.
2. Based on a PEM water electrolysis system using renewable power to produce 2,300 MT H2/y with 5,000 operating hours/y.

HONEYWELL LOHC SOLUTION

COMMERCIALLY PROVEN TECHNOLOGY AND CATALYST

Honeywell UOP



UOP Toluene Hydrogenation
45+ commercial reference units on similar technology for Benzene/Aromatics processing

UOP MCH Dehydrogenation
1000+ commercial reference units on similar technology for heavy naphtha processing