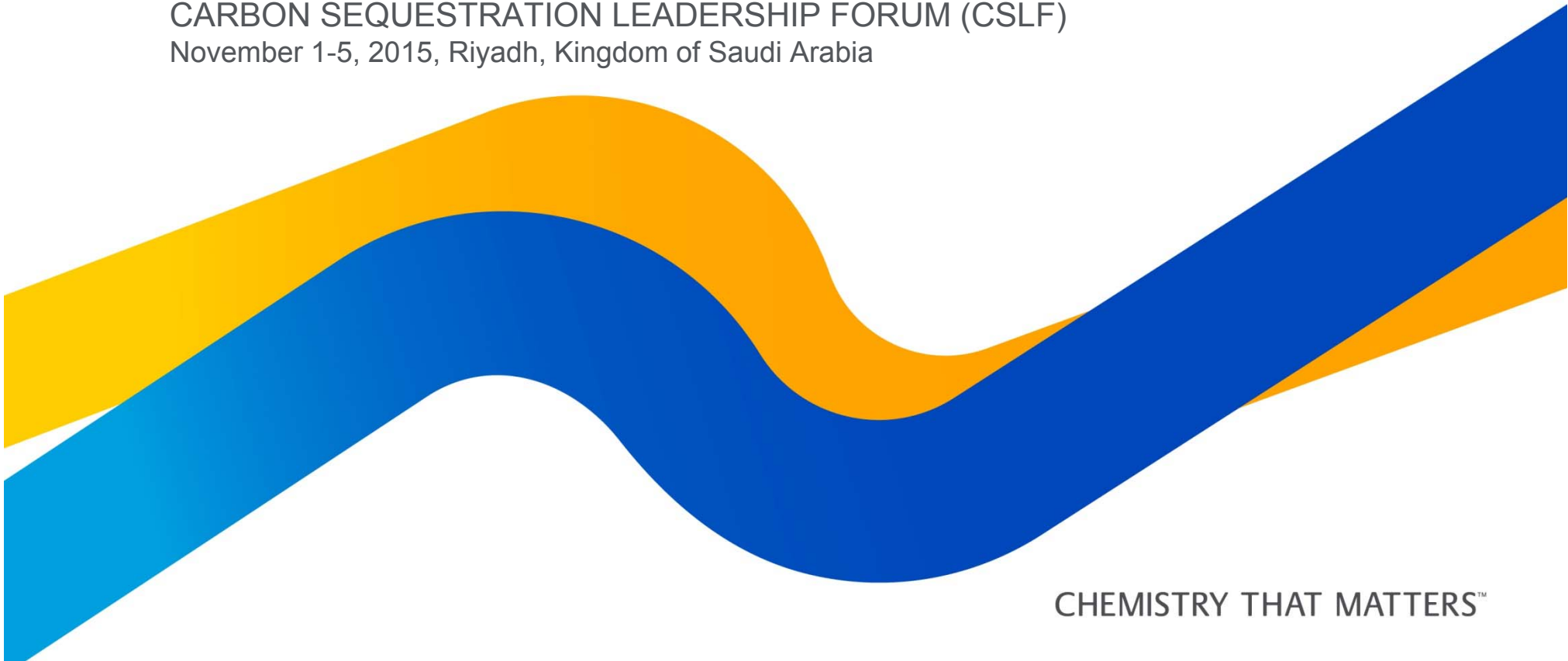




# SABIC CO<sub>2</sub> INITIATIVES

DR. ATIEH ABU RAQABAH, GENERAL MANAGER, SABIC CORPORATE SUSTAINABILITY

CARBON SEQUESTRATION LEADERSHIP FORUM (CSLF)  
November 1-5, 2015, Riyadh, Kingdom of Saudi Arabia



CHEMISTRY THAT MATTERS™

# SABIC IS ROOTED INTO SUSTAINABILITY

Jubail City 1976



On burning: 1 gm CH<sub>4</sub> releases 2.8 gm CO<sub>2</sub>

- Billions of Tons wasted gas
- Billions of Tons CO<sub>2</sub> emissions

Evolution of  
petrochemical industries  
in KSA

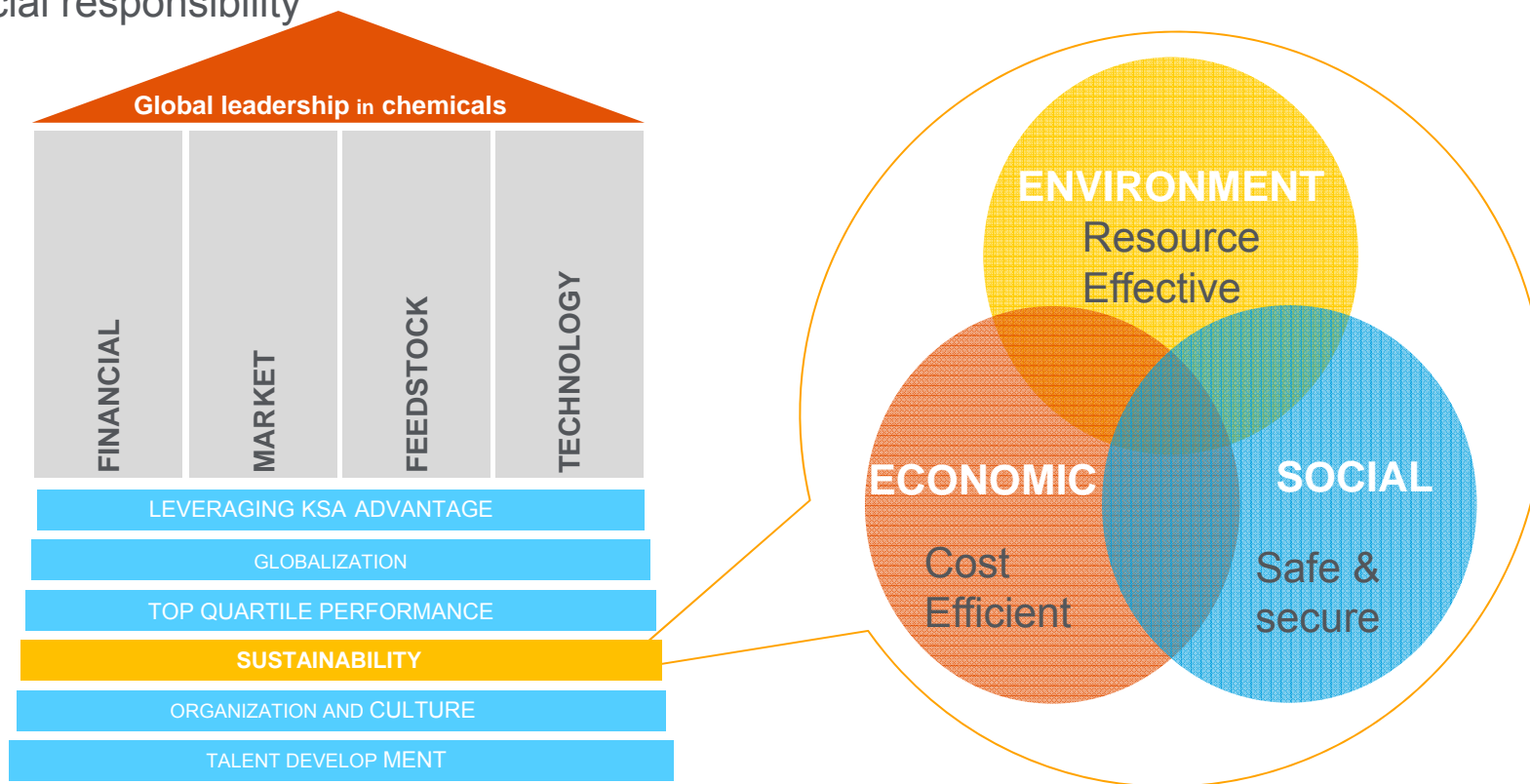
Jubail City now



- Millions of tons valuable materials
- Billions of tons avoided CO<sub>2</sub> emissions
- Over 35,000 direct jobs
- Over 280,000 indirect jobs
- Thousands of new related industries
- Billions of dollars revenue and dividends
- Over \$160 Billion total state of the art assets

# SUSTAINABILITY IS A KEY FOUNDATION OF SABIC 2025 STRATEGY

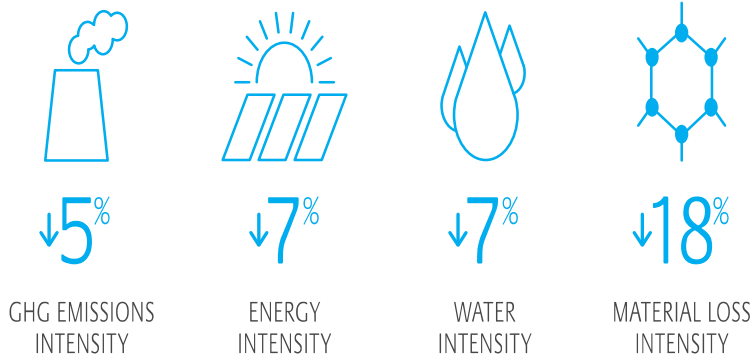
Sustainability is achieving long term economic success with environmental protection & social responsibility



- Minimize own environmental impact
- Provide solutions that help enable our customers to meet their sustainability goals
- Invest in local economies and communities

# SABIC'S OPERATIONAL SUSTAINABILITY PERFORMANCE AND 2025 ENERGY INTENSITY TARGET

## Operational KPI Reductions since Base Year 2010



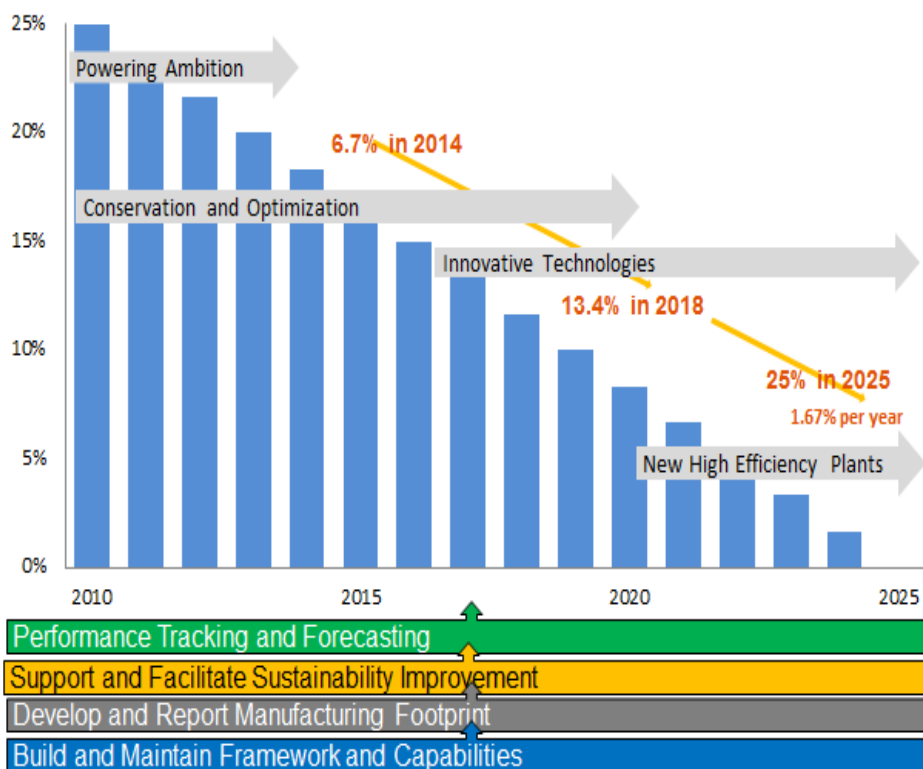
2,700,000<sup>MT</sup>

TOTAL CURRENT CO<sub>2</sub> UTILIZATION

49%

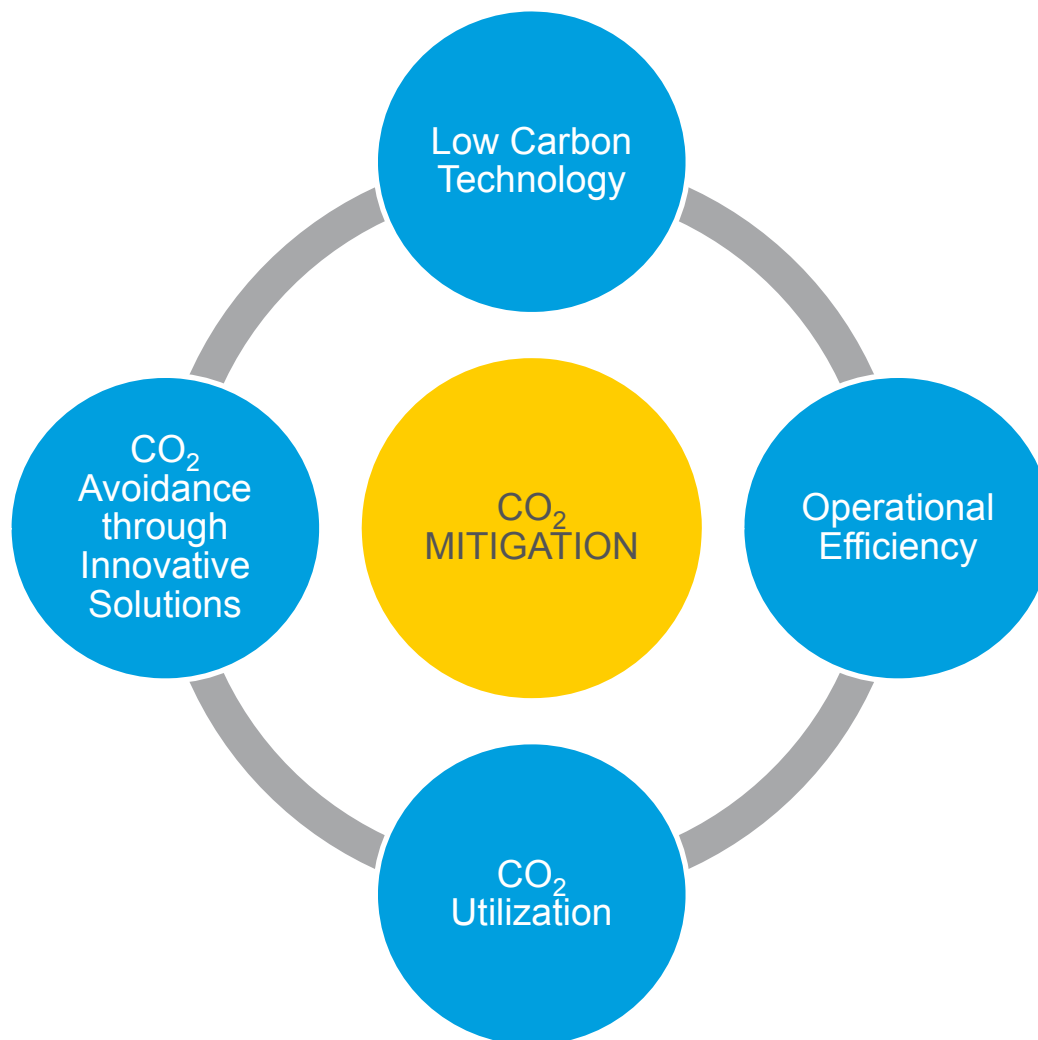
REDUCTION IN FLARING EMISSIONS

## 2025 Energy Intensity Target

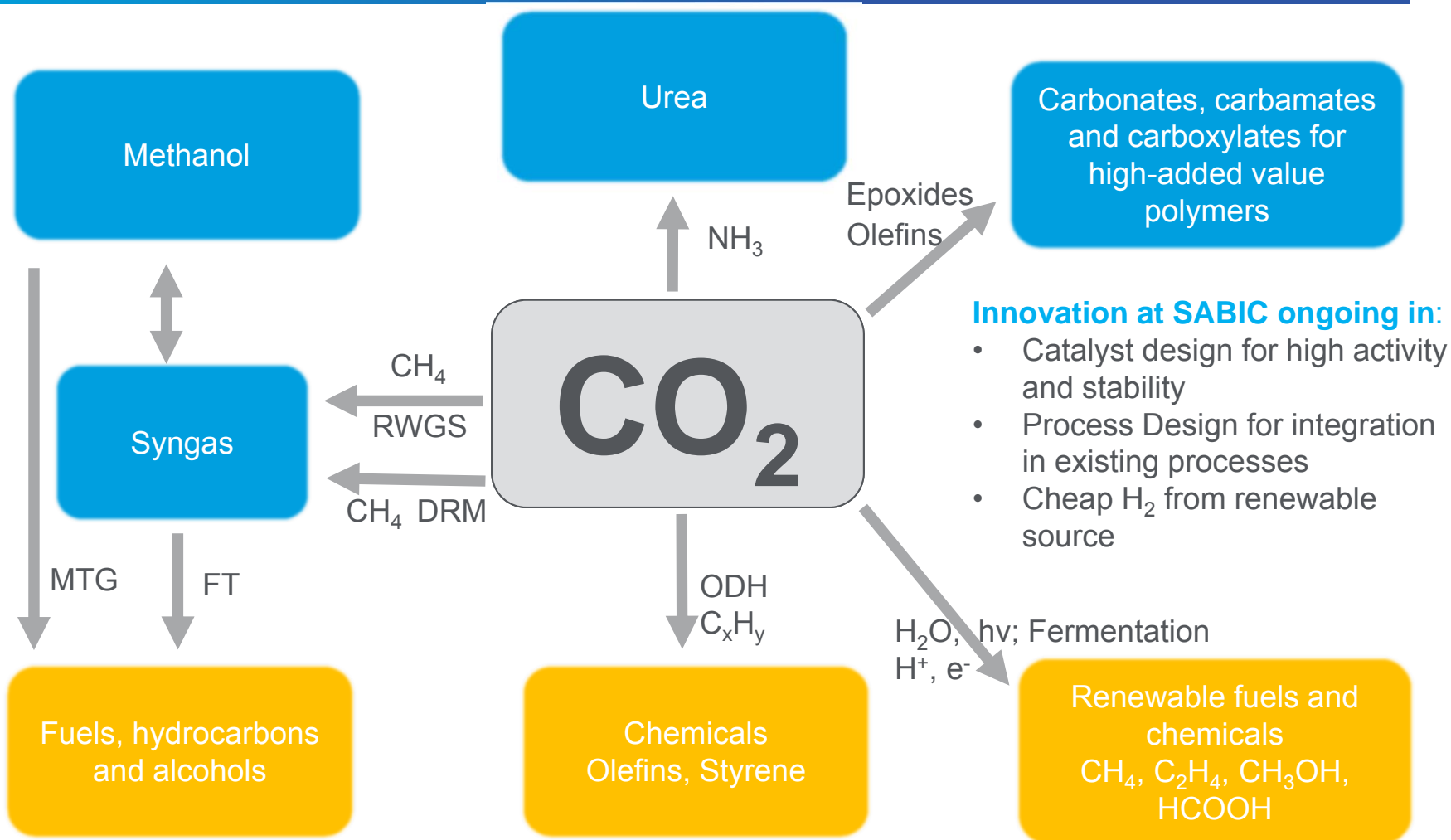


## OUR APPROACH TOWARDS CO<sub>2</sub> EMISSION

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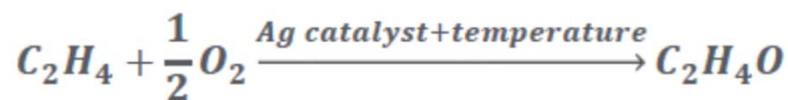


# CO<sub>2</sub> REACTION PATHWAYS FOR CHEMICAL INDUSTRY

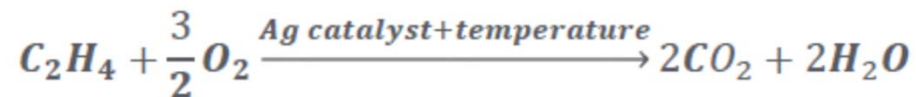
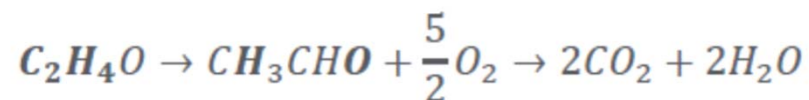


## CO<sub>2</sub> UTILIZATION, AN OPPORTUNITY FOR CO<sub>2</sub> FROM EO

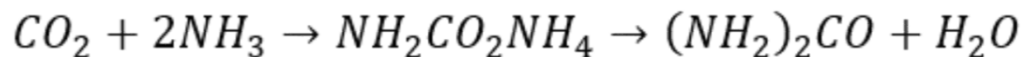
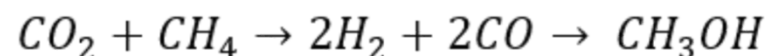
Ethylene oxide reaction:



Unwanted side reactions:

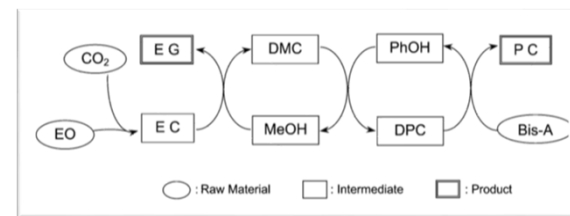


Converting waste CO<sub>2</sub> into valuable products:



**EG plants are a main contributor to CO<sub>2</sub> emissions in SABIC.**

**Large amounts can be utilized within SABIC to produce valuable products**



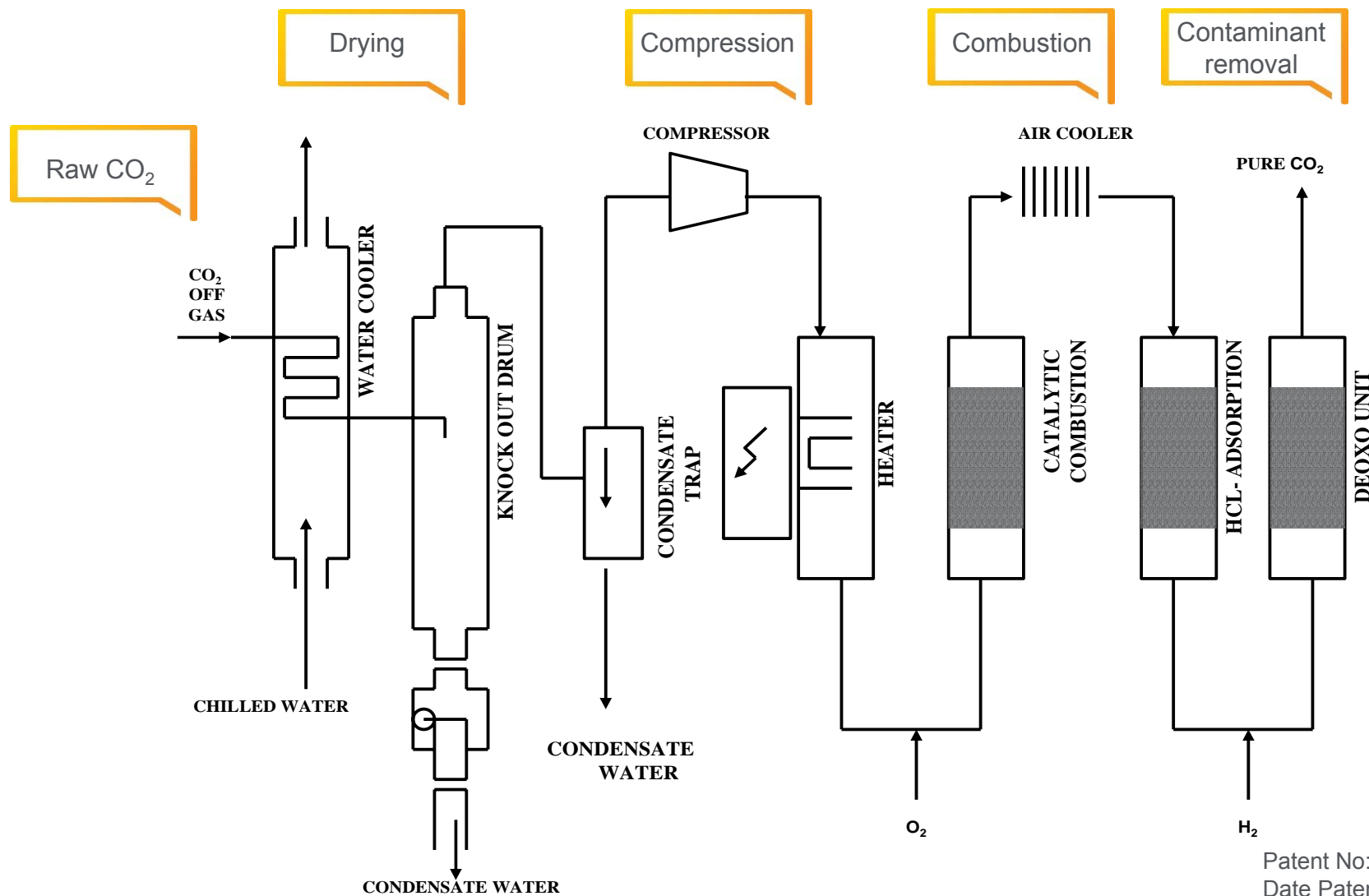
## SABIC CO<sub>2</sub> PURIFICATIONS REQUIRMENTS

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- CO<sub>2</sub> from EO plants contains traces of contaminants (chlorides, hydrocarbons) that have to be removed for utilization
- No complete commercial scheme was available to obtain the desired CO<sub>2</sub> purification
- A process scheme was developed to tackle this challenge. SABIC T&I developed and built a pilot plant to test the assumption. The results were encouraging and assumption has been validated. 2 patents were granted
- Based on this, SABIC invested in building a commercial scale plant at UNITED affiliate



# CO<sub>2</sub> PURIFICATION PROCESS: GENERIC PROCESS FLOW DIAGRAM



Patent No: US 6,224,843 B1  
Date Patent: May 1, 2001

# LARGEST CO<sub>2</sub> CAPTURE AND PURIFICATION PLANT; CAPACITY OF 1500 TON CO<sub>2</sub>/DAY

Before

CO<sub>2</sub> capture plant

After

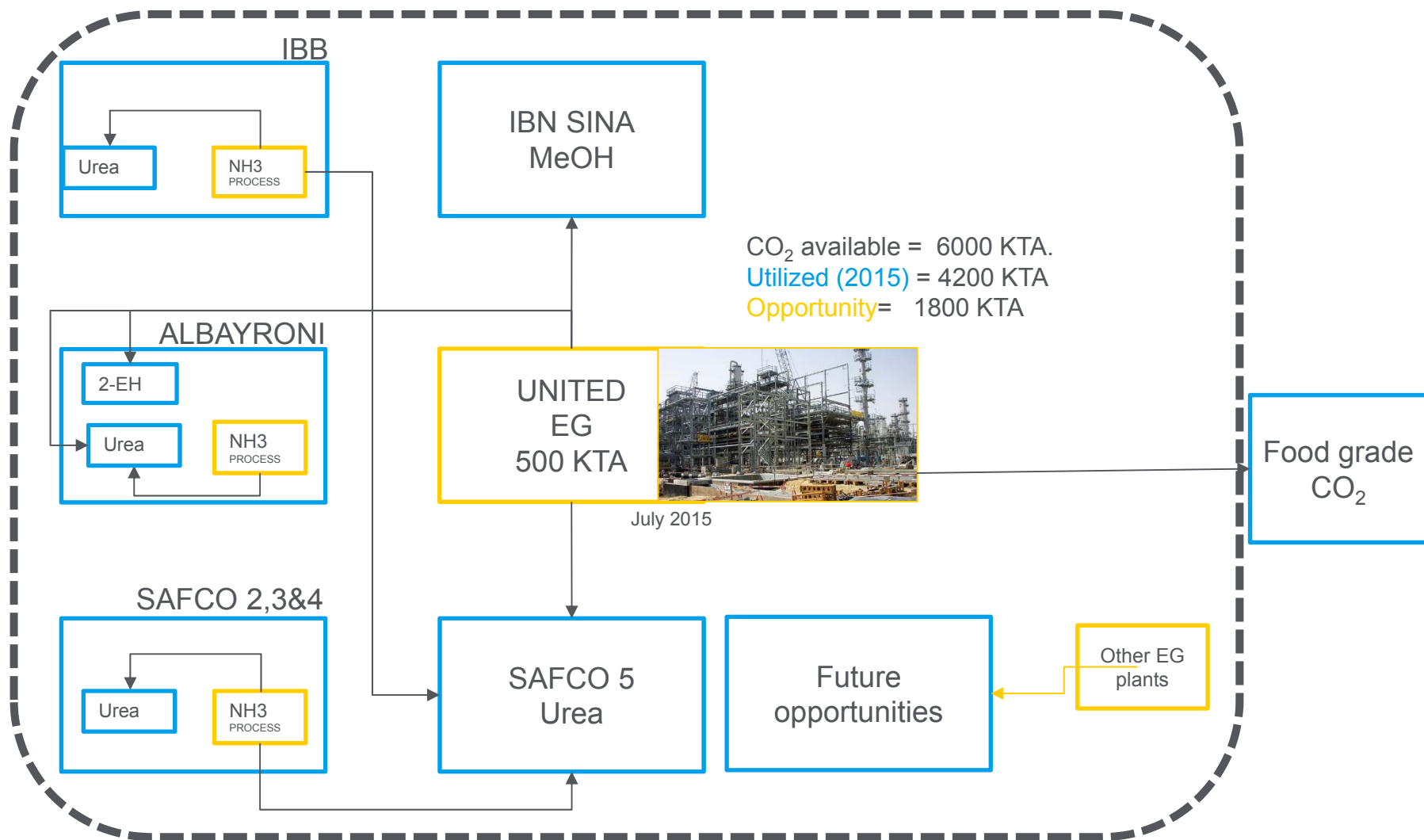
S. No		Unit	Values
1.	Total organic chloride (max)	PPMV	3
2.	Methane	PPMV	500
3.	Ethylene	PPMV	2000
4.	Ethane	PPMV	NIL
5.	Ethylene oxide	PPMV	16
6.	Carbon Di Oxide (CO <sub>2</sub> )	%	95
7.	water	%	4.75
<b>Process Parameters</b>			
8.	Temperature	Deg.C	60
9.	Pressure	Bar a	1.0

Sr.No.		Unit	Gaseous	Liquid (Food Grade) *
1.	Total Organic Chloride	PPBV (Max)	< 50	< 50
2.	Oxygen (O <sub>2</sub> )	PPMV (Max)	< 10	< 10
3.	Ethylene (C <sub>2</sub> H <sub>4</sub> )	PPMV (Max)	< 5	< 5
4.	Methane (CH <sub>4</sub> )	PPMV (Max)	< 5	< 5
5.	Nitrogen (N <sub>2</sub> )	PPMV (Max)	<10	<10
6.	Carbon Dioxide (CO <sub>2</sub> )	% (Vol)	99.99	99.99
7.	Water (H <sub>2</sub> O)	PPMV	< 10	< 10
<b>Process parameters</b>				
8	Temperature (Min)	deg C	ambient	- 28
9	Temperature (Max)	deg C	50	
10	Pressure	bar A	40	16

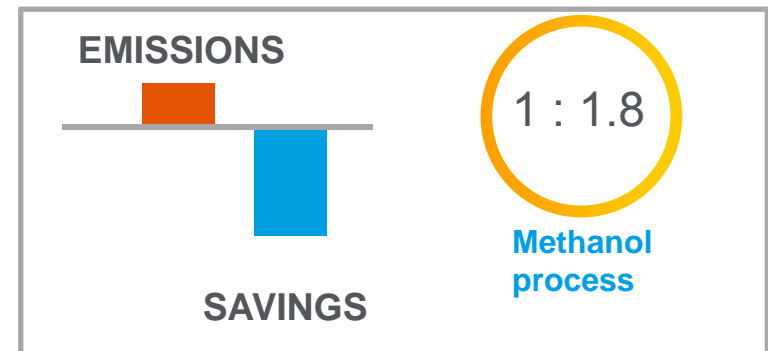
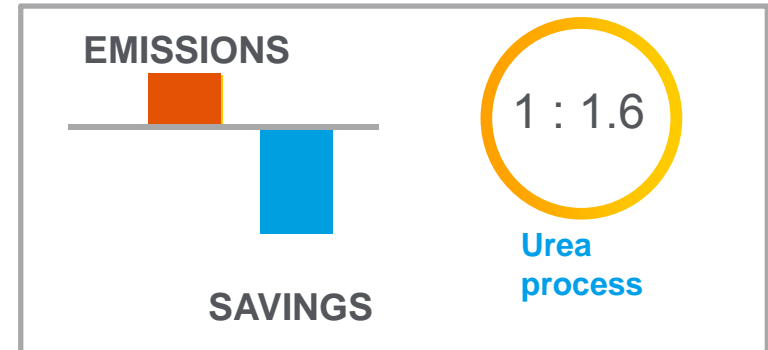
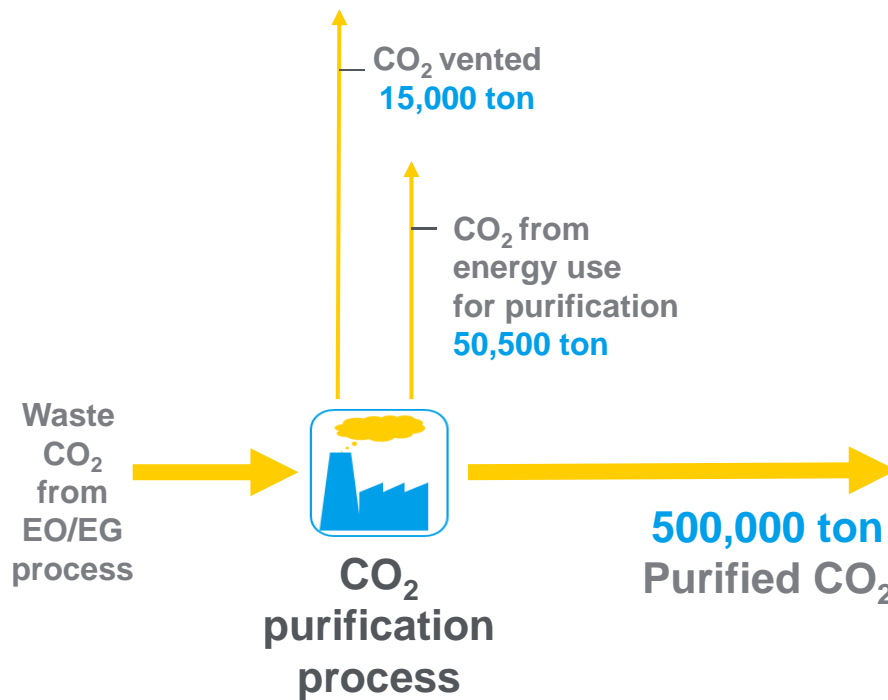
Drying  
Compression  
Combustion of hydrocarbons  
Contaminants removal  
Distribution to integrated CO<sub>2</sub> network or liquid storage

UNITED, Jubail, Saudi Arabia

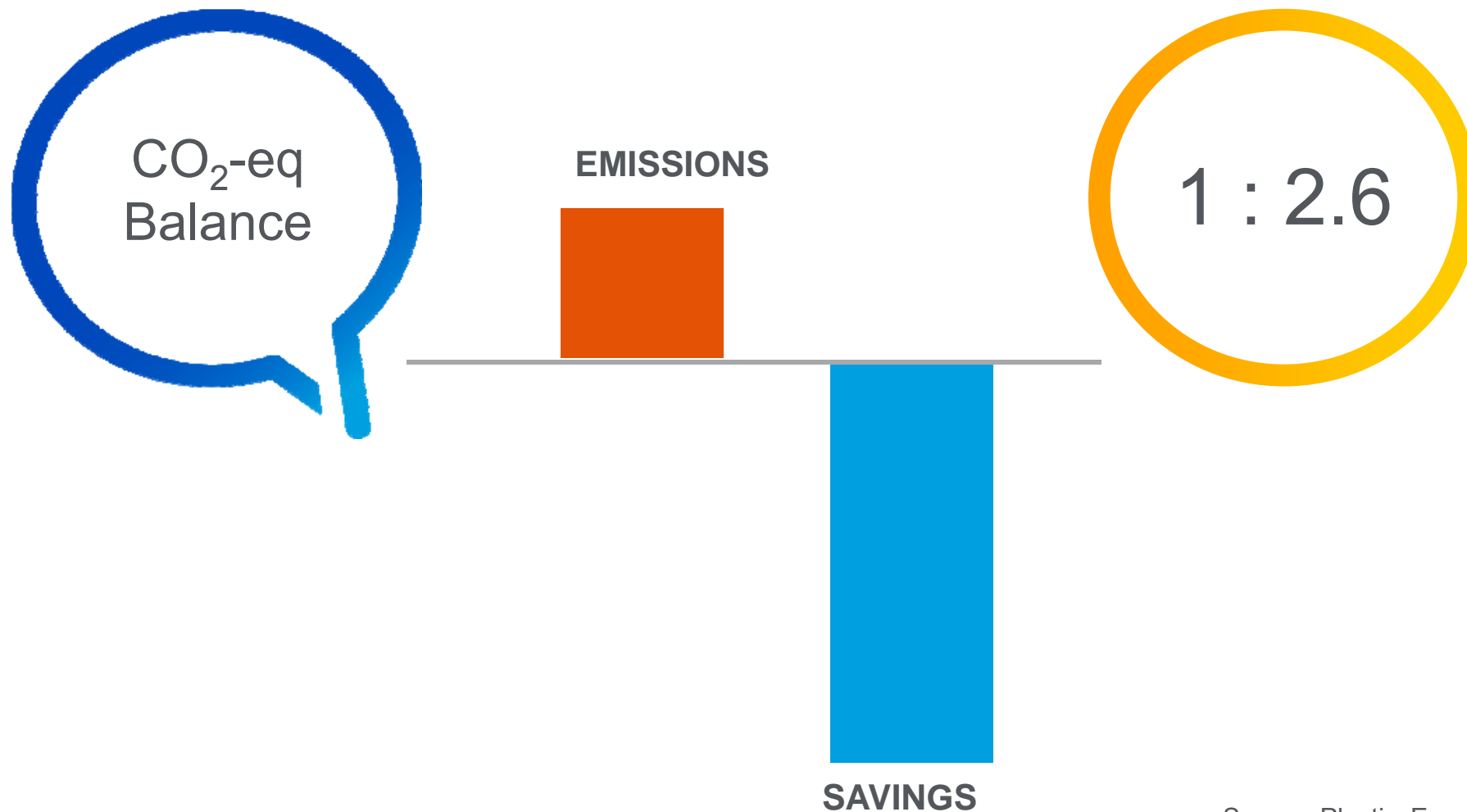
# CONVERTING CO<sub>2</sub> WASTE INTO VALUABLE PRODUCTS, VIA AN INTEGRATED NETWORK FOR CO<sub>2</sub> DISTRIBUTION



# NET CO<sub>2</sub> OFFSET POTENTIAL

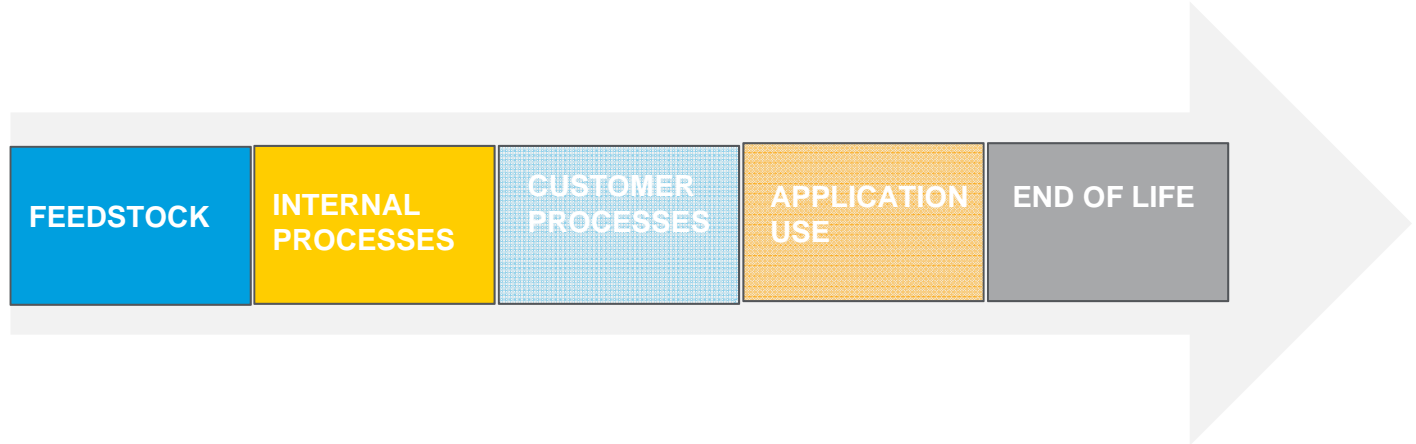


# AVOIDED EMISSIONS: BENEFITS PROVIDED BY THE CHEMICAL INDUSTRY



Source: PlasticsEurope

# HDPE BIMODAL PIPE FOR WATER TRANSPORTATION SOLUTION



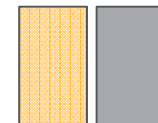
**Ductile Iron**



**HDPE Bimodal**

- ✓ Lighter
- ✓ Stronger
- ✓ More erosion resistance
- ✓ Energy reduction

71 % Avoided Emissions  
8.5 kg CO<sub>2</sub> avoided/kg resin



# SUSTAINABLE SOLUTIONS ENABLE AVOIDED EMISSIONS: LIGHT WEIGHT

SABIC innovations are reducing weight in nearly every interior area of the aircraft

**1 KG REDUCTION PER FLIGHT**  
= 1700 tons of fuel = 5400 tons of CO2

**1% = 0.75%**  
REDUCTION IN AIRCRAFT WEIGHT      REDUCTION IN FUEL CONSUMPTION



**-12%**  
versus PPMA/PVC



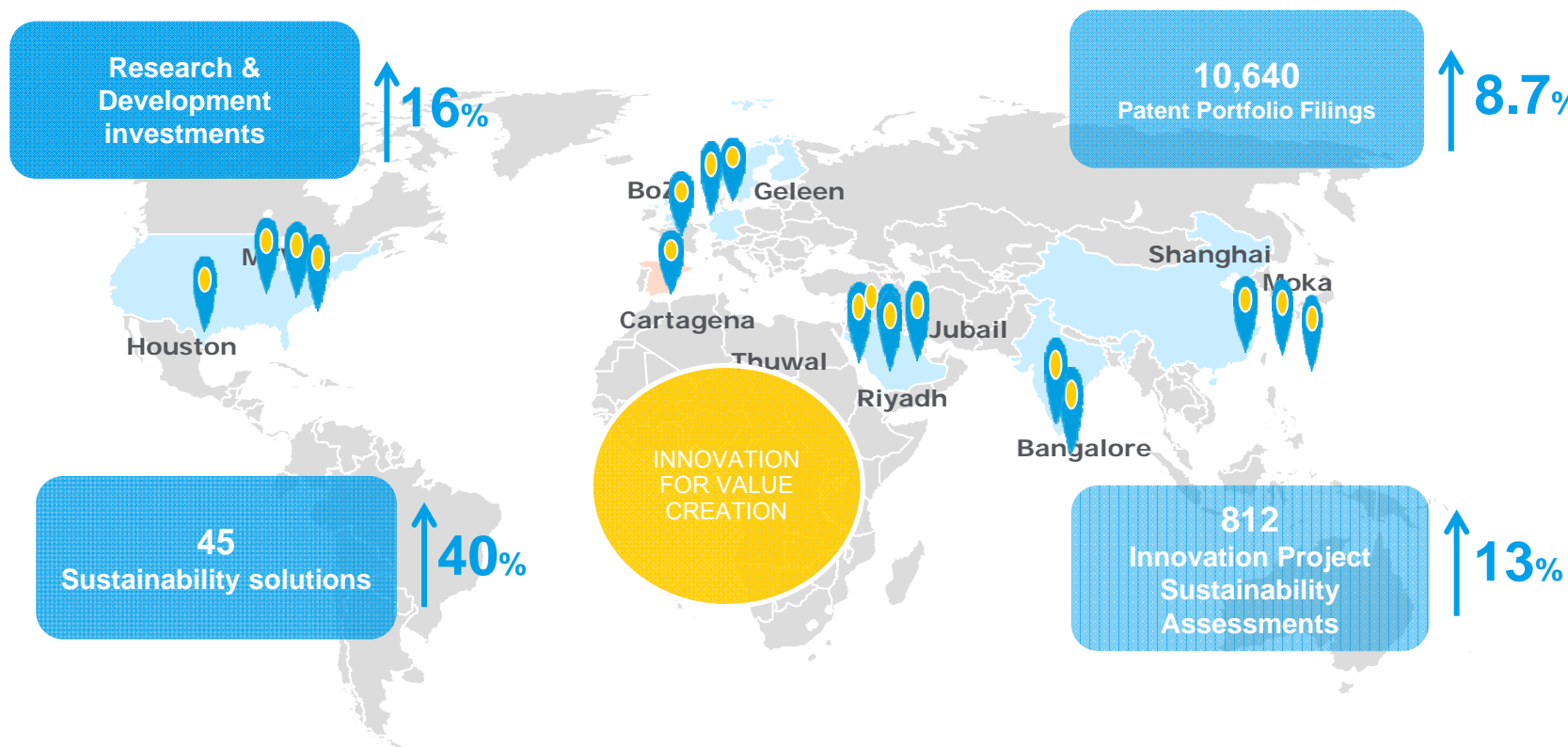
**-40%**  
versus Metal



**-25%**  
versus solid



# SABIC'S COMMITMENT FOR INNOVATION AND SUSTAINABILITY



➤ **SABIC has 19 Innovation and Technology Centers across the globe**



# SHARING OUR JOURNEY WITH THE WORLD



**2011**  
Goals, Life Cycle



**2012**  
Transparency,  
Performance Metrics



**2013**  
Value Creation



**2014**  
Foundation  
for the Future

# Acknowledgment

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## UNITED TEAM:

- Engineer Abdulaziz Al-Omari
- Engineer Ahmad Hasanain

## R&D Team

- Dr. Abdulaziz Al-Jodai
- Dr. Ijaz Ahmad

## Sustainability Team

- Pieter Smeets
- Abdullah Maghrabi
- Hans Vandervelpen
- Ananda Sekar

# Thank You



## APPROXIMATE UTILITIES CONSUMPTION & EFFLUENT GENERATION FOR STANDARD CO<sub>2</sub> PURIFICATION PROCESS UNIT

Utility Consumption	Unit	Value
Energy	KW	7400
Cooling Water	Cu.m/hr	1650
Steam Consumption	Kg/hr	400
Instrument Air	Nm <sup>3</sup> /hr	250
Oxygen (O <sub>2</sub> )	Nm <sup>3</sup> /hr	220
Effluent Generation		
Process Condensate	Kg/hr	6200
Emission to atmosphere	Nm <sup>3</sup> /hr	1027

## COULD THIS BE PASSING ON THE BURDENS DOWNSTREAM?

