CO2 POTENTIAL IN THE METHANOL BUSINESS
Hans Vander Velpen, SABIC Corporate Sustainability Department

December 2, 2015
WELCOME TO

SABIC’S JOURNEY

SABIC’S JOURNEY ON SUSTAINABILITY
SABIC’S APPROACH TO CO2 MITIGATION
CO2 SAVING POTENTIAL OF METHANOL
CHEMISTRY THAT MATTERS™
SABIC IS ROOTED INTO SUSTAINABILITY

Jubail City now

60+ MMT valuable materials
40,000 jobs
$ 50 B revenue in 2014
$ 160 B total assets
SUSTAINABILITY IS A KEY FOUNDATION OF SABIC 2025 STRATEGY

Global leadership in chemicals

- Financial
- Market
- Feedstock
- Technology

LEVERAGING KSA ADVANTAGE
GLOBALIZATION
TOP QUARTILE PERFORMANCE

SUSTAINABILITY

ENVIRONMENT
Resource
Effective

ECONOMIC
Cost
Efficient

SOCIAL
Safe &
secure

ORGANIZATION AND CULTURE
TALENT DEVELOPMENT
“Sustainability is fundamental to our business strategy and we are continually looking for new ways to integrate it into our business.”

YOUSEF AL-BENYAN
VICE CHAIRMAN AND
CHIEF EXECUTIVE OFFICER

Sustainability value:
- provides solutions that enable our customers meet sustainability goals
- Identify trends and captures opportunities
- Increase business resilience
SABIC’S OPERATIONAL SUSTAINABILITY PERFORMANCE AND 2025 ENERGY INTENSITY TARGET

Operational KPI Reductions since Base Year 2010

- ▼ 5% GHG EMISSIONS INTENSITY
- ▼ 7% ENERGY INTENSITY
- ▼ 7% WATER INTENSITY
- ▼ 18% MATERIAL LOSS INTENSITY

2,700,000 MT
TOTAL CURRENT CO₂ UTILIZATION

49%
REDUCTION IN FLARING EMISSIONS

2025 Energy Intensity Target

- 6.7% in 2014
- 13.4% in 2018
- 25% in 2025

1.67% per year
SABIC’S APPROACH TO CO2 MITIGATION

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OUR APPROACH TOWARDS CO$_2$ EMISSION

- Low Carbon Technology
- CO$_2$ Utilization
- CO$_2$ Avoidance through Innovative Solutions
- Operational Efficiency
CO₂ REACTION PATHWAYS FOR CHEMICAL INDUSTRY

- Methanol
- Urea
- Carbonates, carbamates and carboxylates

Syngas

- Fuels, hydrocarbons and alcohols
- Chemicals: Olefins, Styrene
- Renewable fuels and chemicals: CH₄, C₂H₄, CH₃OH, HCOOH
CO2 UTILIZATION AT UNITED

Video Placeholder – UNITED CO2 utilization
CONVERTING CO₂ WASTE INTO VALUABLE PRODUCTS, LEVERAGING AN INTEGRATED NETWORK FOR CO₂ DISTRIBUTION

Government of the United Arab Emirates - Decarbonization Program

**CO₂ available**: 6,000 KTA

**Utilized (2015)**: 4,200 KTA

**Opportunity**: 1,800 KTA

**Future opportunities**

**IBB**
- Urea
- NH₃ PROCESS

**IBN SINA**
- MeOH
- Urea

**ALBAYRONI**
- 2-EH
- Urea
- NH₃ PROCESS

**SAFCO 2,3&4**
- Urea
- NH₃ PROCESS

**SAFCO 5**
- Urea

**UNITED EG**
- 500 KTA

**Future opportunities**

**Food grade CO₂**

Other EG plants
### METHANOL PRODUCTION FROM CO2 AND H2

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>2700 MTPD</td>
</tr>
<tr>
<td>H₂ Required</td>
<td>400 MTPD</td>
</tr>
<tr>
<td>Methanol Production</td>
<td>~ 1800 MTPD</td>
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- CO₂ injection to lower stoichiometric number of the makeup gas during reforming at IBN SINA affiliate.
- Increasing energy efficiency of the plant by 7-8%
- Lower footprint additional Methanol production
CO2 REFORMING OF METHANE FOR SYNGAS PRODUCTION

Utilize waste CO2 to generate feedstock for high-value chemicals like Methanol to reduce methane use by adopting CO2 reforming instead of steam reforming

\[ CO_2 + \text{CH}_4 = 2CO + \text{H}_2 \]

Technical challenges to overcome:
• Deactivation from catalyst sintering at high temperatures
• Deactivation from coke buildup
• Large energy requirements

Catalyst developments with thermally stable metal oxide support by tailoring crystal morphology and dispersing active metals in sub-Nano levels
CO2 SAVING POTENTIAL OF METHANOL

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CO2 SAVING POTENTIAL OF METHANOL

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BENEFITS PROVIDED BY THE PETROCHEMICAL INDUSTRY

CO₂-eq Balance

EMISSIONS

SAVINGS

1 : 2.1

Source: ICCA 2009 study
METHANOL VALUE CHAIN

UPSTREAM PRODUCTION
- Natural Gas
- Coal
- ...

SABIC
- Methanol

DERIVATIVES
- Formaldehyde
- Acetic Acid
- MTBE
- MMA
- DME
- ...

END USER
- Construction
- Automotive
- Insulation
- PET bottles
- Pharma
- ...

END OF USE
- Landfill
- Incineration
- Recycling
AVOIDED EMISSIONS OF METHANOL APPLICATIONS

Rigid Foam insulation in construction  MTBE, fuel additive

Currently methanol is already used extensively in net CO2 saving applications
Methanol is an environmental and financial answer for NOx and SOx legislations. Avoided Emission potential is high, but industry collaboration is needed to bring all benefits to the table and ensure no environmental trade-offs are made.

Source: http://www.walleniuslines.com/PageFiles/1472/Broschyr%20ZERO%20may%202010.pdf
DESIGN FOR SUSTAINABILITY EFFORTS AIM TOWARDS MORE EFFICIENT USE OF RESOURCES

- Alternative feedstocks
- Operational efficiency
- Recycle more
- Avoided CO₂ emissions through innovative solutions
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COLLABORATION & EXTERNAL RECOGNITION

Industry collaboration:
- Automotive
- Water Management
- Aviation
- Mass Transportation
- Packaging
- Electrical and Lighting
- …

International Council of chemical Associations (ICCA)
- Avoided Emissions Case Studies

World Business Council for Sustainable Development (WBCSD)
- Global Guidance
- Product Avoided Emissions
- LCA Metrics
- Social standards

Plastics Europe
Member, Life Cycle Task Force (LCTF), Plastics Europe
We are on a journey in sustainability, utilizing and expanding the potential of our plants and of our products. Together with the right people we make chemistry that matters™.
CHEMISTRY THAT MATTERS™
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