

Energy, Environment and Petrochemical Research: To Serve the Circular Carbon Economy

Presented by

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)06/03/2022 (03/08/1443



Content

This Talk aims to Provide a **brief overview** about:

- **Circular Carbon Economy (CCE)**
- **KSU Priorities Supporting CCE**
- **Examples of Research on these priorities, namely Energy, Petrochemicals and Water and Environment.**



Circular Carbon Economy (CEE)

Linear vs. Circular Economy



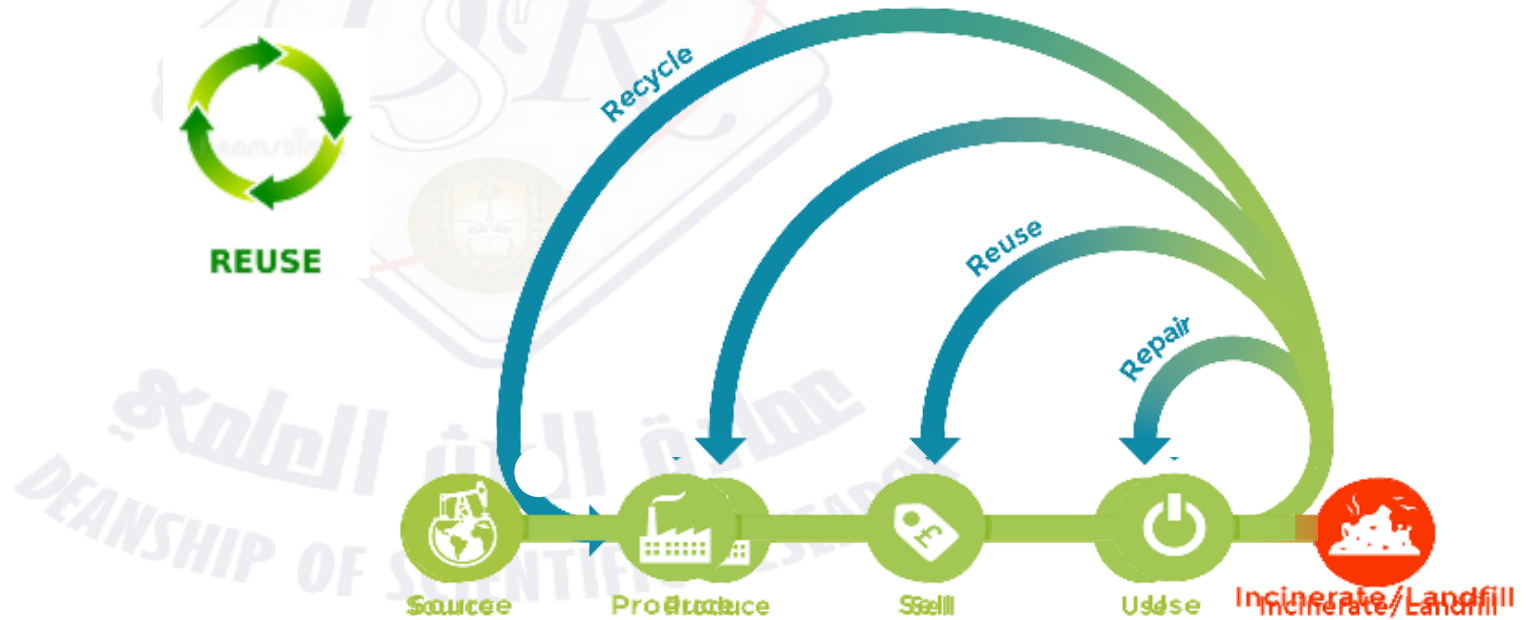
REDUCE



RECYCLE



REUSE



Source: <https://woodpeck.org/circular-economy/>

Circular Carbon Economy (CEE)



REDUCE



REUSE



RECYCLE



Remove

?

Approach

Scope

Goal

Circular Economy

Sustainable Production and Consumption

Flows of Resources and Materials

Reduce Consumption and Disposal

Circular Carbon Economy

Climate Mitigation by All Means

Flows of Carbon and Energy

Manage GHG (e.g CO2) Emissions

Source: KAPSARC, The Circular Carbon Economy Index 2021 – Results.

Circular Carbon Economy (CEE)



REDUCE



REUSE



RECYCLE



The circular carbon economy (CCE) is a new concept, developed in detail by Saudi scholars and stakeholders since 2019 and promoted via Saudi Arabia's Group of Twenty (G20) presidency in 2020.

Source: KAPSARC, The Circular Carbon Economy Index 2021 – Results.

Circular Carbon Economy (CEE)



REDUCE



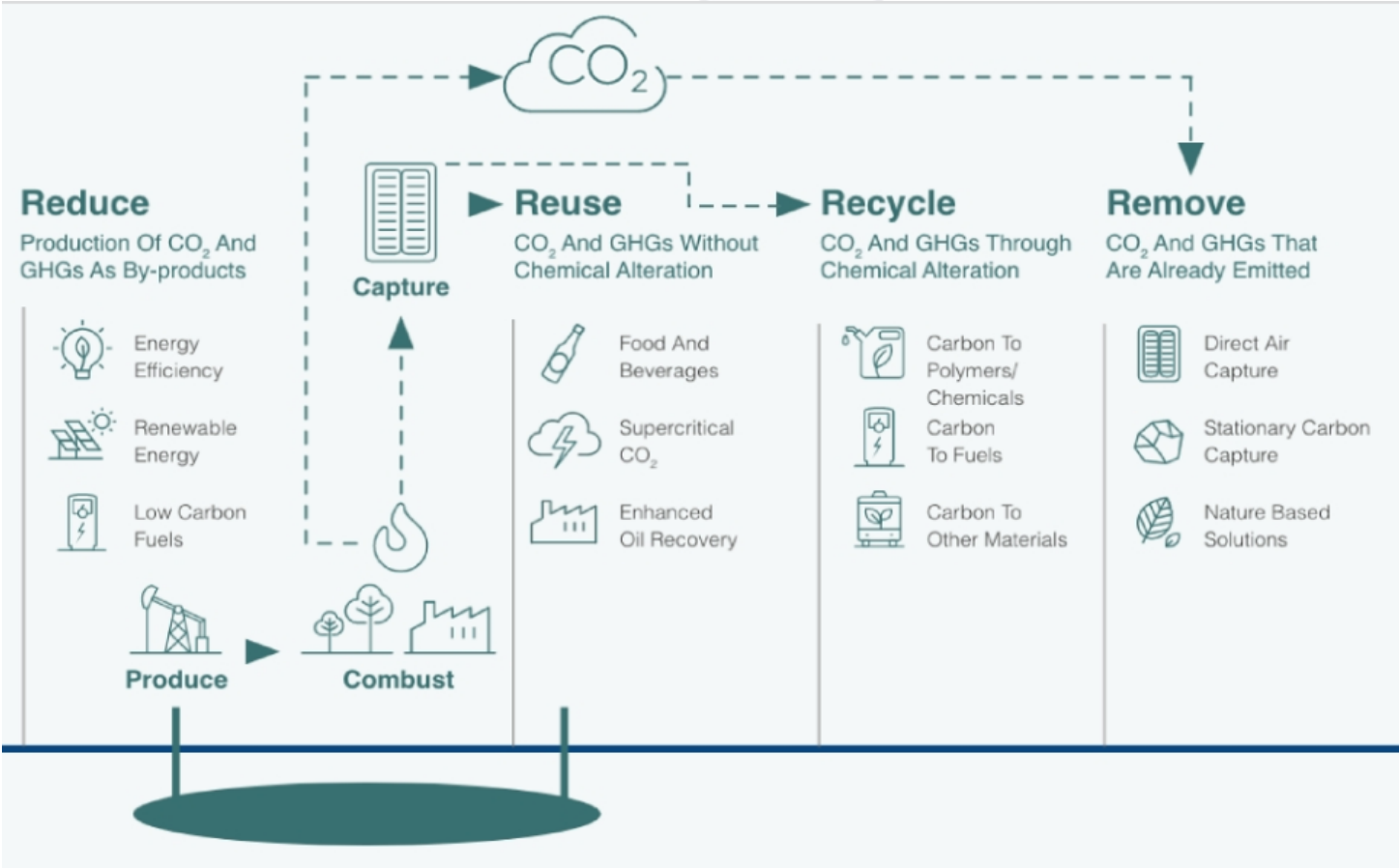
RECYCLE



REUSE



6



Source: Circular Carbon Economy National Program, <https://www.cce.org.sa/cce-framework.html>

?!Why Care

هُوَ أَنْشَأَكُمْ مِنَ الْأَرْضِ وَاسْتَعْمَرَكُمْ فِيهَا

هود 61

He (Allah) initiated you from the earth, and settled you in it

Hud 61

?!Why Care



"نحن جزء من هذا العالم، نعيش مشاكله والتحديات التي تواجهه ونشارك جميعا في هذه المسؤولية، وسنسهم بإذن الله بفاعلية في وضع الحلول للكثير من قضايا العالم الملحة، ومن ذلك قضايا البيئة وتعزيز التنمية المستدامة، وسنستمر في العمل على ذلك مع المنظمات والمؤسسات الدولية والشركاء الدوليين"

المملك الشرفين الحرمين خادم
عبدالعزيز
We are part of this world, we live with its problems and challenges and we all share this responsibility, and we will contribute effectively, God willing, to developing solutions to many urgent world issues, including environmental issues and the promotion of sustainable development, and we will continue to work with international organizations and institutions and international partners. King Salman Bin Abdulaziz

?!Why Care

"يعد حفاظنا على بيئتنا ومقدراتنا الطبيعية من واجبنا دينياً، وأخلاقياً وإنسانياً، ومن مسؤولياتنا تجاه الأجيال القادمة ومن المقومات الأساسية لجودة حياتنا. لذلك، سنعمل على الحد من التلوث برفع كفاءة إدارة المخلفات والحد من التلوث بمختلف أنواعه، كما سنقاوم ظاهرة التصحر، وسنعمل على الاستثمار الأمثل لثروتنا المائية عبر الترشيح واستخدام المياه المعالجة والمتجددة، وسنؤسس لمشروع متكامل لإعادة تدوير النفايات، وسنعمل على حماية الشواطئ والمحميات والجزر وتثبيتها، بما يمكن الجميع من الاستمتاع بها، وذلك من خلال مشروعات تمولها الصناديق الحكومية والقطاع



رؤية 2030 الخاص

By preserving our environment and natural resources, we fulfill our Islamic, human and moral duties. Preservation is also our responsibility to future generations and essential to the quality of our daily lives. We will seek to safeguard our environment by increasing the efficiency of waste management, establishing comprehensive recycling projects, reducing all types of pollution and fighting desertification. We will also promote the optimal use of our water resources by reducing consumption and utilizing treated and renewable water. We will direct our efforts towards protecting and rehabilitating our beautiful beaches, natural reserves and islands, making them open to everyone. We will seek the participation of the private sector and government funds in these efforts.

Vision 2030

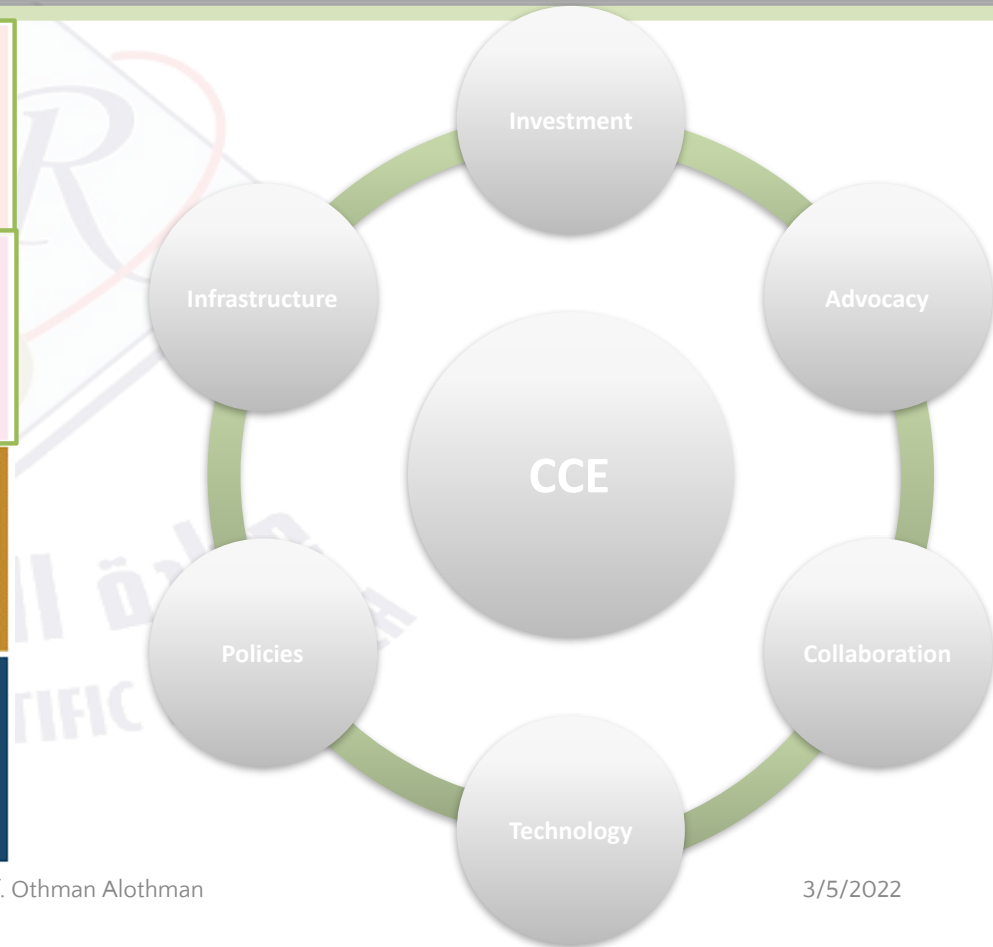
Part of ISPP Webinar, Prof. Othman Alothman

3/5/2022

?!Why Care



CCE Enabling





CLAEN AND SUSTAINABLE ENERGY SYSTEMS

- Integration of solar energy with desalination and petrochemical facilities
- Developing cost effective nano catalyst materials for fuel cells applications
- Development of Catalyst for production of Hydrogen
- polymer membranes for H₂/O₂ fuel cell application

PETROCHEMICALS

- Development of smart materials for biomimetic applications
- Optimization of phosphorescence emission in PP/strontium aluminate composites
- Development of polyolefins and polyester based polymer composites for various industrial applications

- Dual Membrane Systems for Water Desalination
- Utilization of Renewable Energy in Desalination
- Water Desalination with zero liquid discharge
- Photocatalytic electro spun polymer nanofiber membrane for water treatment
- Clean process for biodiesel production from biowaste
- The functionalization of nanocellulose extracted from date palms for various applications

- Development of fluidized-bed technology for wastewater treatment using activated carbon from local waste biomass
- Development of Bio polyester Nanocomposites
- Biowaste/Polymer composites for various applications
- Sustainable energy assisted Brine processing for Zero Brine Discharge (ZBD)
- **Recovery of terephthalic acid and ethylene glycol from post-consumer poly(ethylene terephthalate)**
- Utilization of Biomass Wastes

HUMAN WELBEING

- Predictive Approach of COVID-19 Propagation via Multiple-Terms Sigmoidal Transition Model
- Utilization of Green Solvents to Reduce CO₂ emissions to the atmosphere

Synthesis of Cost-effective Nano-catalysts as Anode Materials for Fuel Cells Applications

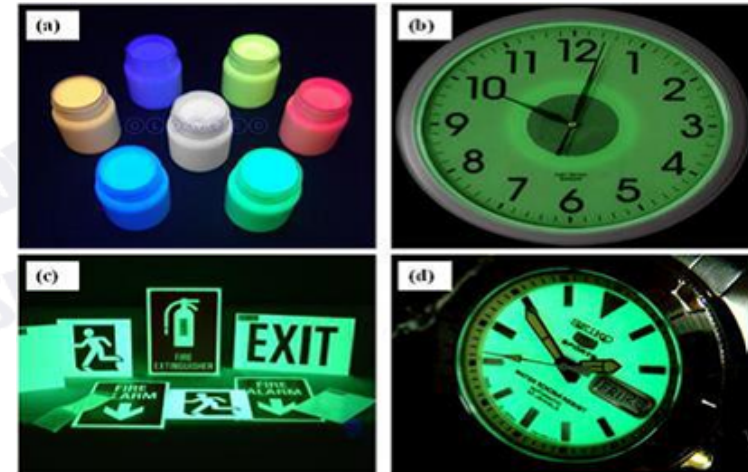
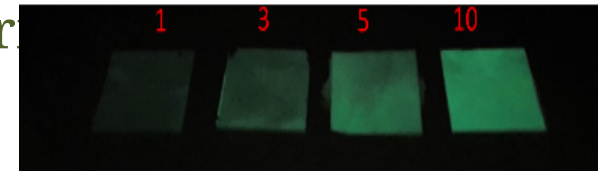
- A **fuel cell** is a device that **generates electricity** through an **electrochemical reaction**, not **combustion**.
- **hydrogen + oxygen** \rightarrow **electricity + heat + water**.
- Fuel cell systems: clean - efficient - reliable - quiet.
- **Continuous power** as long as a fuel source is provided.
- **Green hydrogen** will be produced in NEOM city (2025) using renewable energy sources such as **wind** and **solar**.
- **It is required to improve and develop the fuel cell technology to match the Saudi Arabia vision 2030 and the global trend.**

Optimization of phosphorescence emission in PP/strontium

Objective: a long life auto-glowing plastic composite, which can store solar in the forms of excitation energies and self-glow in multiple colors of visible light for hours to days in darkness without any electrical

Application Examples:

- Self-glowing decoration
- Safety warnings to direct traffic in the darkness
- Low light lighting source.



Ultrafiltration Pretreatment in Seawater Reverse Osmosis Desalination



Ultrafiltration Pretreatment in Seawater Reverse Osmosis Desalination



NF/RO Membrane



UF Hollow fiber membranes

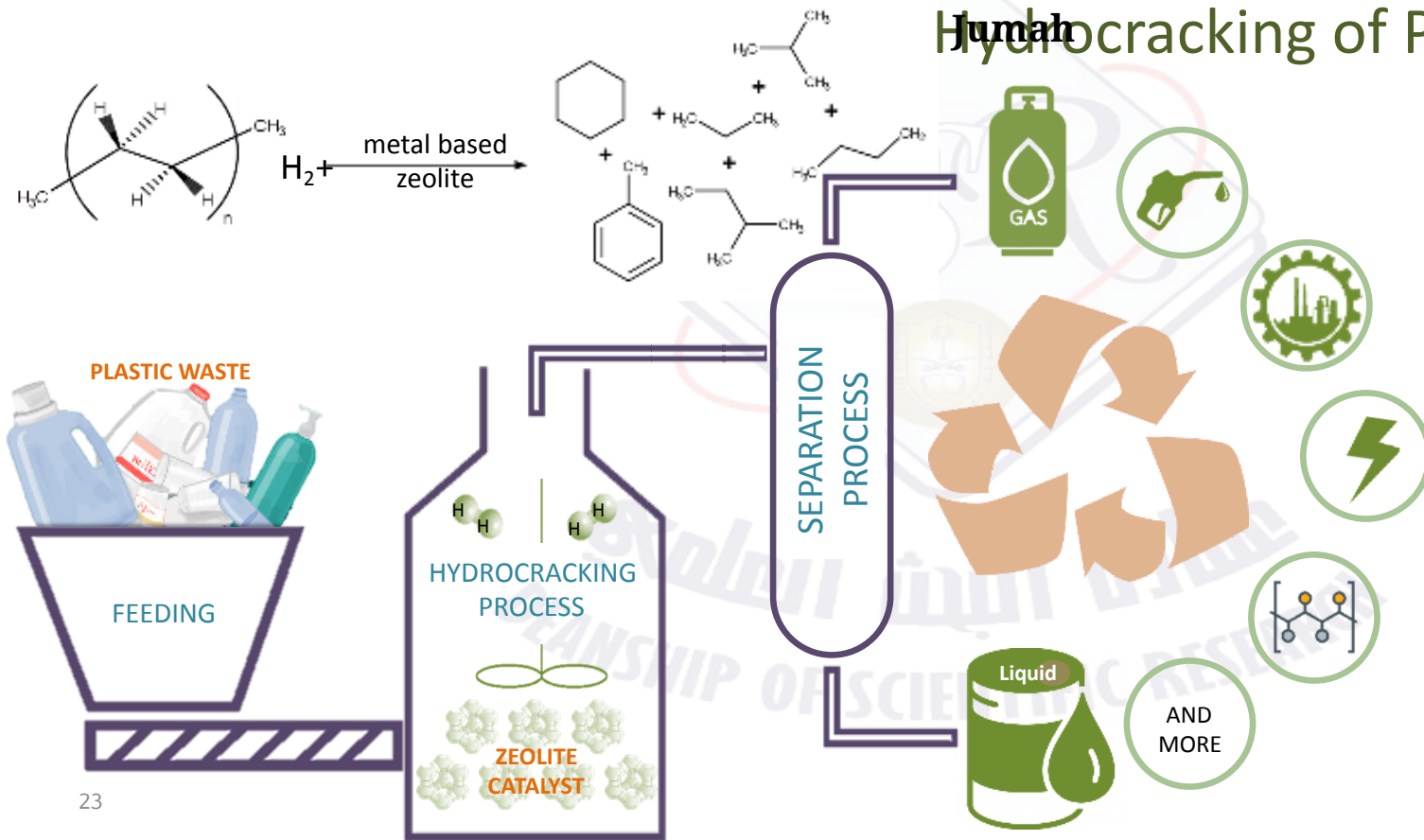


Dr. Abdulrahman Al-Rabiah
Dr. Abdulrahman Bin-Jumah

Hydrocracking of Polymer Waste

In comparison to thermal and catalytic cracking:

- Lower energy required (Exothermic reaction)
- Minimizes reaction time
- Better product quality (Saturated alkanes)
- Minimizes separation requirements
- Minimizes catalyst deactivation by coke



Closing Remarks

- You can be a Pioneer in Petrochemical and Respect Environment, Saudi Arabia as an Example!
- CCE is a framework concept for all countries to plan sensible contributions to the abatement of GHG emissions.
- KSU research priorities were aligned perfectly to fit into CCE framework.

شكراً لحضوركم



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References and Further Sources

- Saudi Vision 2030, <https://www.vision2030.gov.sa/v2030/overview/>
- Deanship of Scientific Research, King Saud University, <https://dsrs.ksu.edu.sa/en>
- Circular Carbon Economy National Program, <https://www.cce.org.sa/cce-framework.html>
- King Abdullah Petroleum Studies and Research Center, <https://www.kapsarc.org/>
- Department of Chemical Engineering, <https://engineering.ksu.edu.sa/en/CHE> .

شكراً لحضوركم

Thank
You

مطارة البحث العلمي
DEANSHIP OF SCIENTIFIC RESEARCH



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