Carbon Dioxide Enhanced Oil Recovery Road Map (CERM)

Collaboration for Efficiency, Resourcefulness, and Mastery

The CERM Project is the innovative collaboration between academic institutions, The University of the West Indies (UWI) and The University of Trinidad and Tobago (UTT), and Government Energy Institutions- the Ministry of Energy and Energy Industries (MEEI), PETROTRIN and the National Gas Company (NGC)- toward sustainable development of known oil reserves using Carbon Dioxide Enhanced Oil Recovery (CO_2EOR)

CERM = INNOVATION IN ACTION!

The CERM project is innovative in its collaborative, comprehensive and systematic approach to developing CO_2EOR in Trinidad and Tobago. The CERM Project Team is carrying out detailed analysis on technical, environmental, commercial, legal and socio-economic issues to underpin recommendations for the capital investments needed for supporting a carbon dioxide (CO_2) transportation network.

The technical data gleaned from previous CO_2 floods and generalized geological descriptions are not sufficient to address the inherent risks of investing more than TT 2 billion dollars in CO_2 transport, injection and processing infrastructure.

SPEED BUMPS	MITIGATION STRATEGY
Technical Capacity	Collaborative effort Training Engagement with experts
Cost of CO_2 delivered to field	Negotiation with suppliers Design Innovation
Timely approval for pilot project	Early engagement with regulatory bodies
Project Buy-In	Engagement with all stakeholders
Limitations associated with cross-institutional collaboration	Stakeholders sign a Memorandum of Understanding

In the middle of difficulty lies opportunity -Albert Einstein

For many years local and foreign experts have extolled the potential for CO_2EOR- the CERM project is a significant step toward realizing this potential. The mandate of the Working Groups (identified on page 3) is to 1) give data-based estimates for oil production and, 2) to decrease financial, environmental and technical risk of CO_2EOR. To this end the CERM Project will be planning and designing a CO_2EOR Pilot Project.

The CERM Project Team will answer four main questions in the next 3 months:

1. For the given reservoir and fluid characteristics, can CO_2 recover incremental oil?
2. If so, what rates and volumes can be recovered?
3. What are the estimated investment and operating costs?
4. Will incremental oil justify costs?

These questions will be answered by considering the case of the CO_2EOR Pilot Project. In addition to these techno-commercial issues there are also socio-economic, environmental, legal and regulatory matters that the CERM Project will consider with the key stakeholders: Ministry of Energy and Energy Industries, PETROTRIN, UWI, UTT, the National Energy Corporation (NEC) and the Environmental Management Agency (EMA). The CERM Project will make recommendations to carry out the national objective of increasing oil production using CO_2 emissions.

Unlike other enhanced oil recovery (EOR) methods, CO_2EOR is in alignment with the climate change policy of Trinidad and Tobago with the potential to reduce CO_2 emissions.

The CO_2EOR Pilot Project will be implemented by September 2018 through PETROTRIN or its selected Joint Venture partner or Lease Operator. Subsequent monitoring and data collection from this Pilot Project will reduce risk and uncertainty by providing data for future CO_2EOR projects.

To date we have determined screening criteria for the selection of reservoirs and sands for the pilot project; MEEI has begun a review of the current process for CO_2EOR approval in collaboration with the Environmental Management Agency and; a cross institutional team is considering the design and cost of transportation options and facilities needed for CO_2 injection.

CERM Steering Committee

The CERM Project is managed and coordinated by a Steering Committee comprising representatives of the key stakeholders, chaired by UWI and UTT representatives. Steering Committee Members provide directives for the Project and are responsible for mobilising personnel and resources within their respective organisations to achieve the CERM objectives.

Co-Chairs

Mr. Wayne Bertrand	Honorary Fellow, UWI
Dr. David Alexander	Assistant Professor, UTT

Project Coordinator

Dr. Lorraine Sobers	Lecturer, UWI

Members

Mrs. Penelope Bradshaw- Niles	Deputy Permanent Secretary, MEEI
Mr. Craig Boodoo	Senior Petroleum Engineer, MEEI
Mr. Stephen Awah	Vice President E&P, PETROTRIN
Mr. Richard McCarthy	Senior Reservoir Engineer, PETROTRIN
Mr. Ernest Esdelle	Manger, Engineering Services, NGC
Mr. Ramesh Chansingh	Manager, Strategic Projects, NGC
Dr. Donnie Boodlal	Assistant Professor, UTT

TOGETHER WE ASPIRE, TOGETHER WE ACHIEVE

Project Objectives

The CERM Project addresses the urgent need to implement sustainable measures to increase Trinidad and Tobago's oil production using CO_2 emissions. The major driver of this project is to increase the nation's oil revenue, using enhanced oil recovery (EOR) for reserves which have been already discovered. The approach of the project team will provide data-based recommendations for the CO_2EOR pilot project while building local technical expertise.

HEALTH, SAFETY AND ENVIRONMENT

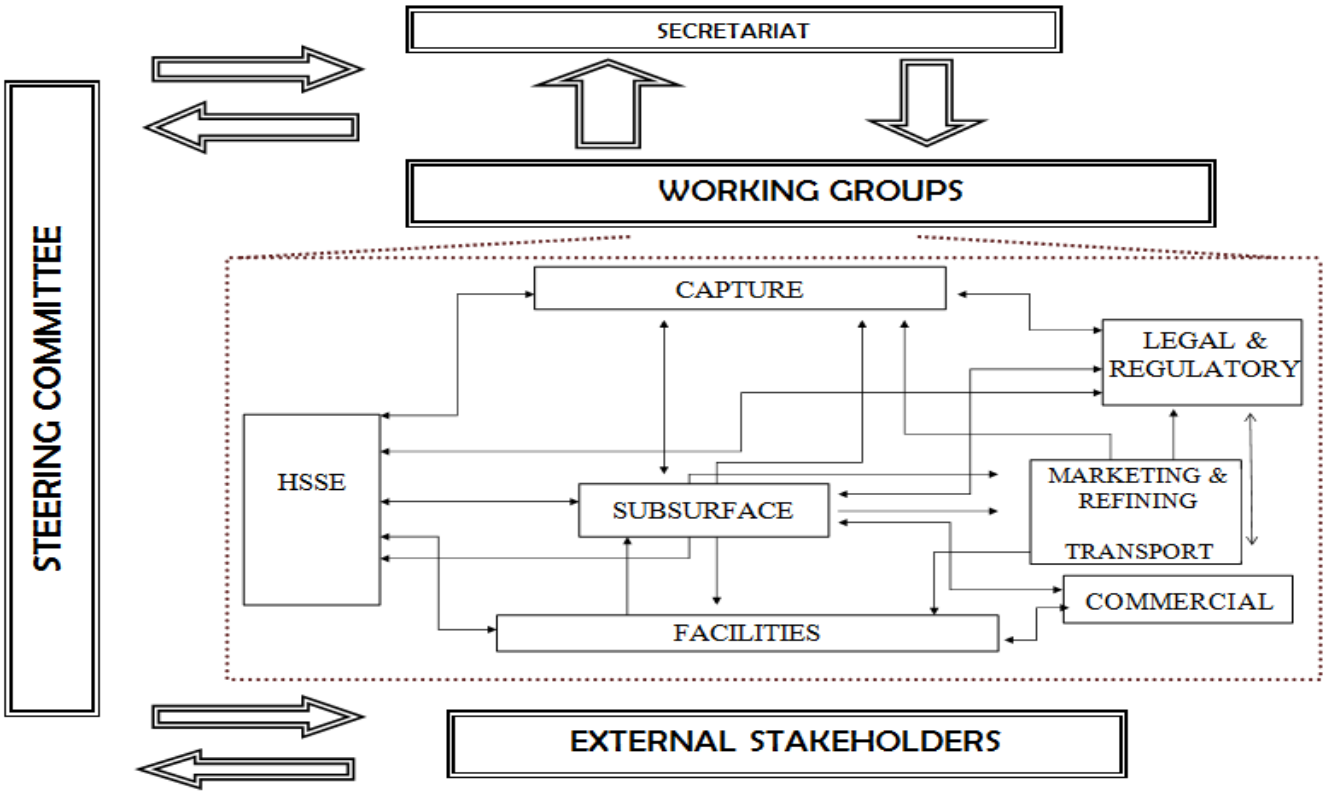
The health and safety of everyone connected to the implementation of CO_2EOR is a major consideration from the outset of the project. Every stage of planning will address the need to make decisions that balance the social, environmental and economic needs of the nation.

Project Deliverables

The CERM Project will conduct studies, analysis, simulations and produce innovative technical, commercial and administrative solutions to reduce the technical and financial risk associated with large scale CO_2EOR in Trinidad and Tobago. The collaborative and systematic approach of CERM will allow for synergy between stakeholders. To this end, Working Groups have been set up to gather information, analyze, review and design all aspects of the CO_2EOR Pilot Project. Working group members are staff members assigned to the project by the stakeholders: MEEI, PETROTRIN, NGC, UWI, UTT and NEC. The CERM Interaction Chart (page 3) shows how the Steering

Committee, Working Groups and Secretariat interface with each other and external stakeholders. In the next issue we will take a closer look at the Working Groups.

CERM INTERACTION CHART



Project Challenges

There are several challenges facing the CERM Project: 1) the energy sector is currently operating and developing plans in a low oil price environment, 2) the high CAPEX for enhanced oil recovery projects requires significant investment and can limit the economic viability of the project, 3) the source, quality and price of CO_2 delivered to the field and, 4) public awareness and public acceptance are critical to implementation of CO_2EOR. These challenges call for the CERM Project Team to develop strategies to reduce costs and uncertainty. The basic strategy for addressing these challenges is to reduce the cost and risks of CO_2 EOR in the form of innovative field development, facility designs and working closely with stakeholders.

I will strive in everything I do, to work together with my fellowmen of every creed and race for the greater happiness of all and the honour and the glory of my country

1st CERM Workshop May 2017

Petrotrin Learning Centre, Pointe A Pierre

On May 8th, 2017 twenty six participants met at the Petrotrin Learning Centre to 'jumpstart' the CERM Project. This first workshop was sponsored by PETROTRIN and facilitated by Dr. Graham King of the CR.T.CAL TH.NK.NG Institute of UWI. The workshop started promptly at 9am with Opening Remarks made by Mr. Ramish Boodoo, on behalf of Petrotrin President, Mr. Fitzroy Harewood.

In his opening remarks Mr. Boodoo emphasized the alignment of the CERM Project with the Petrotrin's plan to increase heavy oil production and the need for the personal commitment of each team member.

The Workshop provided the opportunity for team members, from the seven institutions, to gain an overview of the CERM project and appreciate the impact of their contribution to the overall output.

PARTICIPANTS	INSTITUTION	JOB TITLE
Wayne Bertrand**	UWI	Honorary Fellow
Dr. David Alexander**	UTT	Assistant Professor
Dr. Lorraine Sobers**	UWI	Lecturer
Penelope Bradshaw-Niles**	MEEI	Deputy Permanent Secretary
Richard McCarthy**	PETROTRIN	Reservoir Engineer
Dr. Donnie Boodlal**	UTT	Assistant Professor
Sheldon Butcher*	MEEI	Senior Chemical Engineer
Jasmine Medina*	UTT	Lecturer
Ayasha Nickie*	MEEI	Petroleum Engineer I/II
Shivan Sitahal*	PETROTRIN	Planning Engineer
Dr. Mohammad Soroush*	UTT	Assistant Professor
Candace Subero-Bailey*	NGC	Planning Engineer III
Tanuja Balkeran	MEEI	Geoscientist, Service Provider
Sophia Carter	MEEI	Petroleum Engineer, Service Provider
Stephon Jimenez	NEC	Analyst
Sophia Jones	UTT	Research Assistant
Reiann Jones	MEEI	Petroleum Engineer, Service Provider
McCaster Julien	PETROTRIN	General Counsel - Exploration & Production
Amanda Kissoon	MEEI	Mechanical Engineer II (Ag.)
Giselle Landeau Birmingham	EMA	Corporate Secretary/ Legal Officer III
Shivani Maharaj	MEEI	Geophysicist, Service Provider
Sally Maharaj	EMA	Environmental Programme Officer II
Shakola Mc Lean	MEEI	Chemical Engineer, Service Provider
Kiran Nandlal	MEEI	Reservoir Engineer, Service Provider
Steffan Ramlogan	MEEI	Chemical Engineer, Service Provider
Shivani Rambarack	MEEI	Chemical Engineer, Service Provider

**** Steering Committee Members**
*** Working Group Leaders**

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