Accelerating Technology Commercialization

Through Public Private Partnership Collaboration

July 17, 2019

Will Johnson, President

VisageEnergy

Public Private Partnerships Outline

- **Visage Energy Backgrounder**
- **Tested Approach to Accelerated Commercialization**
  - Public-Private Innovation Network
  - Frame Setters and Enablers
  - **Example 1: Macro Level –Frame Setters and Enablers**
  - CCUS Public Private Partnership Stakeholders' Collaborative Initiative
  - **Example 2: Micro Level–Project level implementation**
  - Benchtop to Full Scale Deployment of PBI Membrane
- **Example 3: Applicability to other Carbon Management technologies**
  - California Energy System for the 21st Century Collaborative

Visage Energy Snapshot

25+ years of experience

1. Technology Commercialization
2. Technology Assessment advisory services
3. Financial and Business advisory services

Technology Focus areas:

- Distributed Energy Resources: Energy Storage, Demand Response, Energy Efficiency and Renewable Energy
- Carbon Capture, Utilization, & Storage (CCUS)
- Water reclamation in Hydraulic Fracturing
- Applying High Performance Computing to grid modeling

Brief list of current and past clients:

PG&E, SCE, Exergonix, ThermoEnergy, Terrajoule, SRI International, National Energy Technology Laboratory, Lawrence Livermore National Laboratory, California Energy Commission, & SoCal Gas.

CMTC 2019, Houston TX

VisageEnergy

A Proven Approach to Commercialization

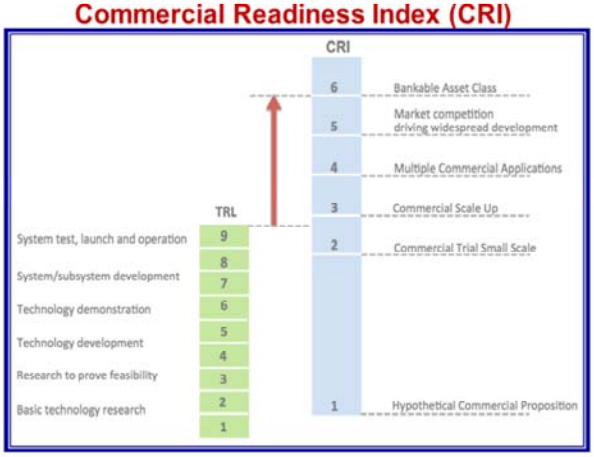
Traditional Method

- Technologists focus ONLY on technologies
- Business considerations introduced at late stage development
- End users and stakeholders engaged only at deployment
- Limited coordination between Federal, State, and Private development efforts

Collaborative Approach

- Technologist focuses on match between technology and CUSTOMER NEEDS
- Inject business perspective and acumen EARLY into technology RD&D effort
- Engage end-users and stakeholders EARLY
- Complete coordination of language and processes across Federal, state, and private efforts through a PUBLIC-PRIVATE PARTNERSHIP NETWORK
- Establishes COMMON language to decrease deployment time

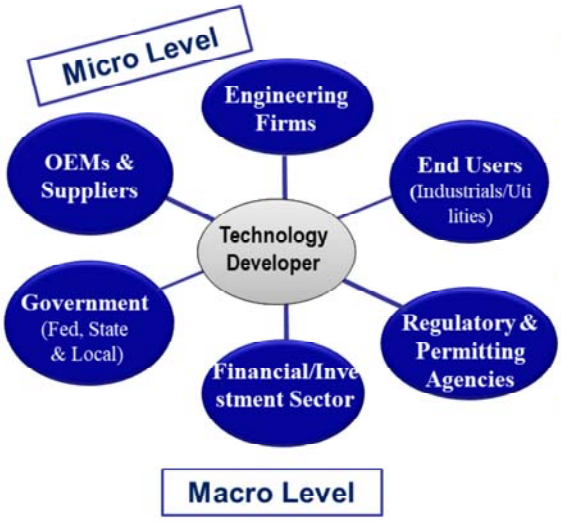
Commercial Readiness Index (CRI)



From Bruce Adderley, Jeremy Carey, Jon Gibbins, Mathieu Lucquiaud and Richard Smith, "Post-Combustion Carbon Dioxide Capture Cost Reduction to 2030 and beyond", Faraday Discussion on CCS, July 2016. http://pubs.rsc.org/en/Content/ArticleLanding/2016/FD/c6fd00046e#!divAbstract

VisageEnergy

Benefits of Public-Private Innovation Network



MACRO LEVEL

- Decrease time to deployment by EARLY dialogue with ecosystem
- "Network" of developers, deployers, regulators, and stakeholders leverages Federal, State, Private efforts
- "Internet" of investors facilitates syndicated funding

MICRO LEVEL

- Common language enables dialogue between all members of network
- Ensures multi-institutional, multi-national teams remain on-track

VisageEnergy

Macro Level

Network Crafted to Engage Frame Setters and Enablers

Frame Setters

I. Federal Stakeholders – to provide federal policy commitments and funding vehicles to acceleration deployment of CCUS projects

II. Other Technology Sources – critical to CCUS technology development

III. State Stakeholders – to develop the regulatory framework and provide funding to create necessary incentives

IV. End users/Utilities & Industrials – to collaborate with Regulatory Agencies in the RD&D process

V. Environmental Groups – critical to gaining public acceptance of CCUS as a safe climate change mitigation tool

Enablers

VI. Insurance Companies –engaged in the process of risk based assessment

VII. Financial Institutions – with the alignment of groups I - VI, would provide funding to CCUS projects with Federal & State policies/funding support

Example 1: CCS Executive/Technical Stakeholders' Collaborative

VisageEnergy

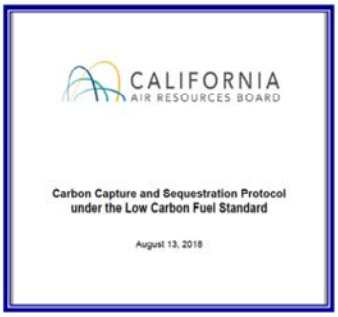
CCUS Stakeholder Collaborative Accomplishments

NGCC +CCUS Feasibility Study (2014)

- NETL funded and PG&E, & CEC supported assessment of cost effectiveness of CCUS deployment on CA's NGCC fleet

CCUS Protocol (2018)

- In 2014, CARB convened Blue Ribbon Panel Working group of experts to determine/address impediments to wide scale CCUS deployment in CA
- **Outcome**: CCUS protocol was adopted for use in Cap-and-Trade and LCFS



CMTC 2019, Houston TX

VisageEnergy

Example 2: Micro Level: PBI Membrane Technology

- Developed clear lines of communication for each of the technology's stakeholders
- Ensured alignment of PBI technology development with market needs
- Performed risk management analysis to uncover several system-level issues
- Developed and refined mitigation strategies using an iterative process

DOI Final Report • June 2008

Using the Disciplines of Innovation Approach to Fabrication and Scale-up of Polybenzimidazole (PBI) Membrane Based System for Pre-Combustion Based Capture of Carbon Dioxide

Summary Report Based on Meeting August 21-22, 2007 at SRI International, Menlo Park, California

Cooperative Agreement No.: DE-FC26-07NE43090

Prepared by:

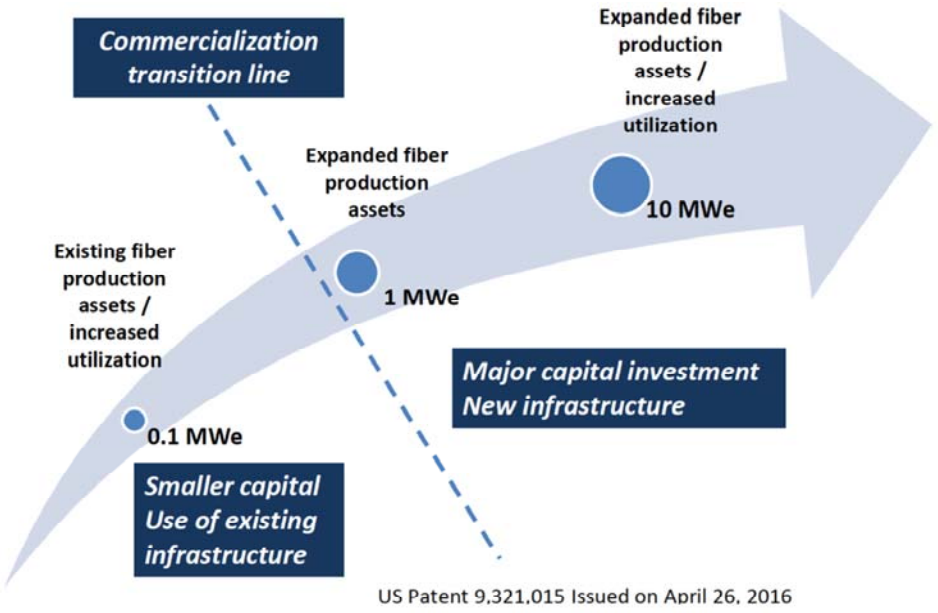
Kevin O'Brien
Brian Engleman
SRI International
333 Ravenswood Avenue
Menlo Park, CA 94025

Will Johnson
Daryl-Lynn Roberts
Visage Energy
6345 Green Valley Circle, Suite 216
Culver City, CA 90230

Prepared for:

U.S. Department of Energy
National Energy Technology Laboratory
626 Cochran Mill Road
Pittsburgh, PA 15236

The Road to Small and Large Pilots



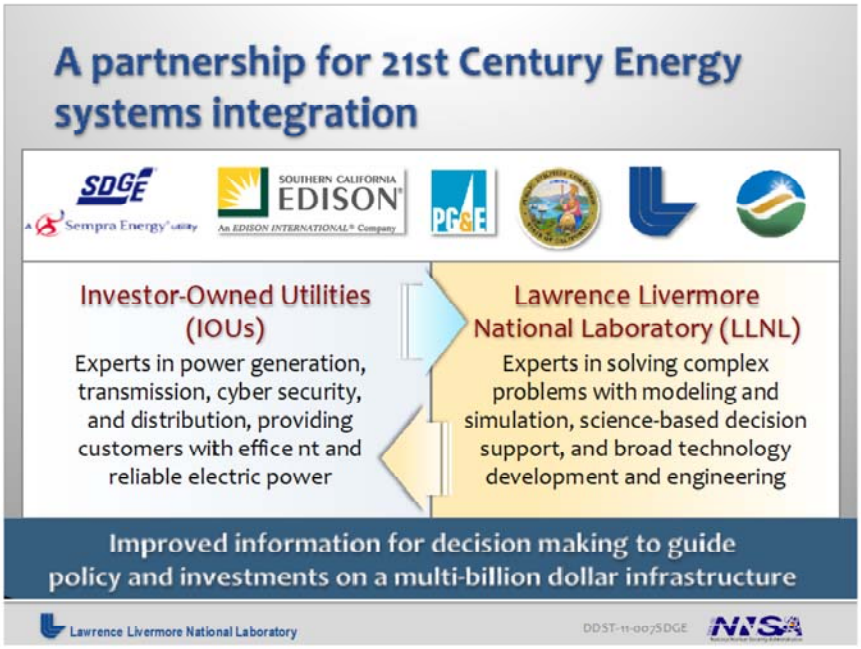
US Patent 9,321,015 Issued on April 26, 2016

Excerpt from: 2017 NETL CO_2 Capture Technology Project Review Meeting Presentation by Indira S. Jayaweera at SRI

CMTC 2019, Houston TX

VisageEnergy

Example 3: Macro & Micro Level: Deployment of HPC



CMTC 2019, Houston TX

VisageEnergy

CES-21 Collaborative Funding Outcome

CES-21 is a primarily a **cybersecurity research** and development program, directed by the California Public Utilities Commission (CPUC) and the California Legislature.

Collaborative effort between California-based investor-owned utilities (IOUs) and Lawrence Livermore National Laboratory.

$35M with **$33M dedicated to cybersecurity** activities over five years (2015-2019), enabled by California Senate Bill 96 and the CPUC Decision.

Q&A

Contact information:
Will Johnson
President
Email: will@visageenergy.com
Website: www.visageenergy.com

VisageEnergy