

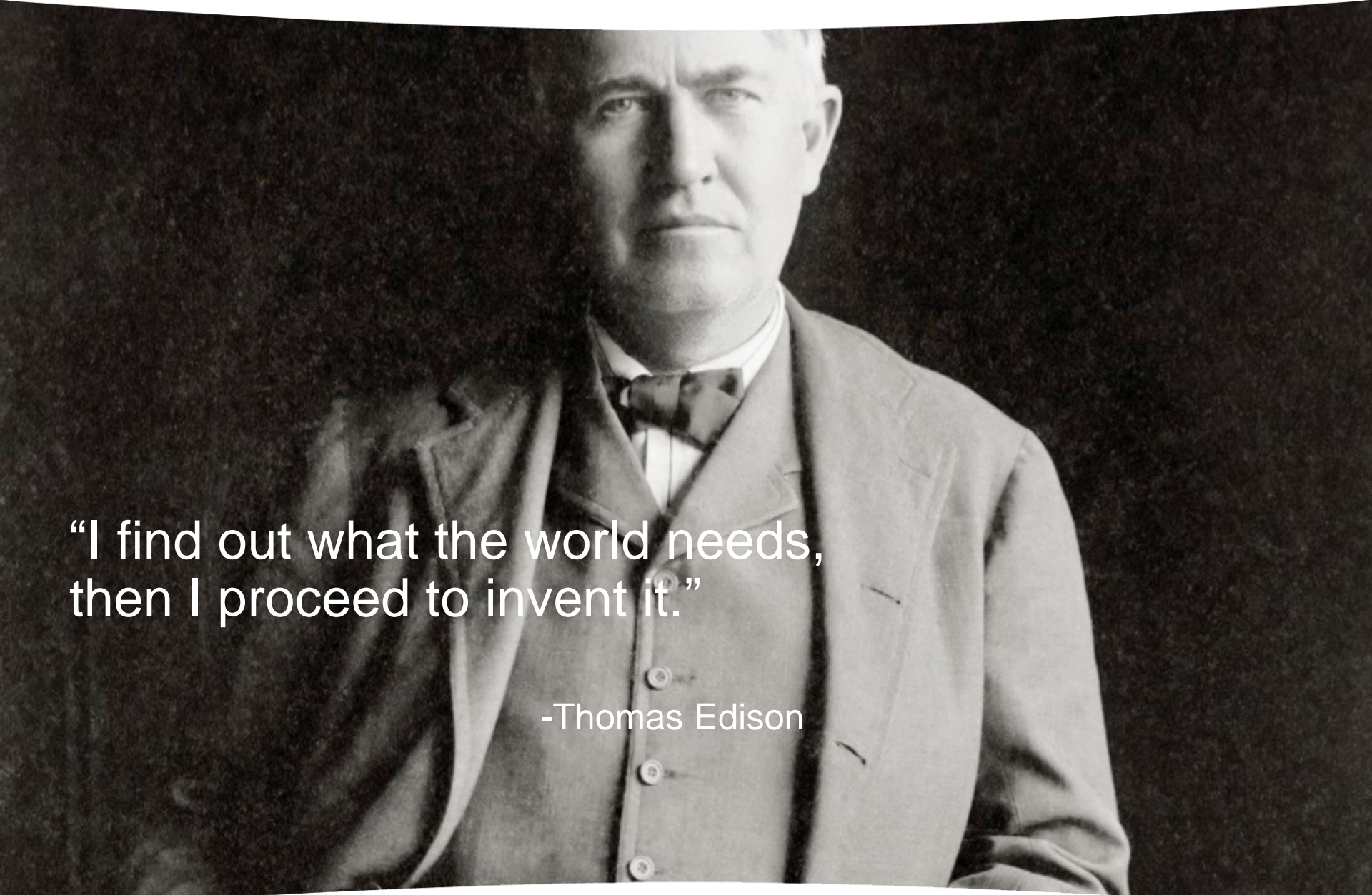


Unconventional Resources & The State of R&D

C. Michael Ming
General Manager, GE Oil and Gas Technology Center

2014 NAE-AAES Convocation
Washington DC
April 28, 2014

Imagination at work.

A black and white portrait of Thomas Edison, an elderly man with white hair, wearing a suit and a bow tie. He is looking directly at the camera with a serious expression. The background is dark and textured.

“I find out what the world needs,
then I proceed to invent it.”

-Thomas Edison

GE Oil & Gas Technology Center

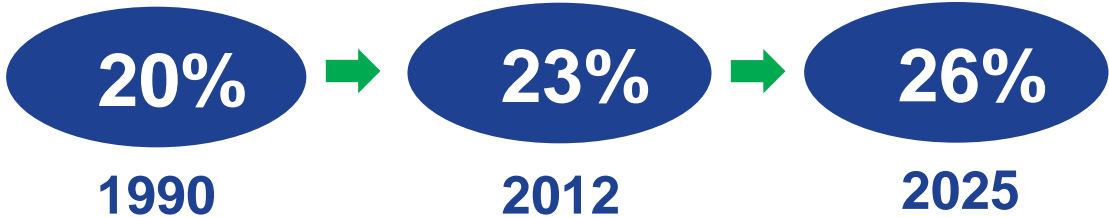
- Established in 2013
- Will create 130 high-tech jobs
- Customer-focused, collaborative research environment
- Accelerate key Oil & Gas tech solutions to market

GE Global Research

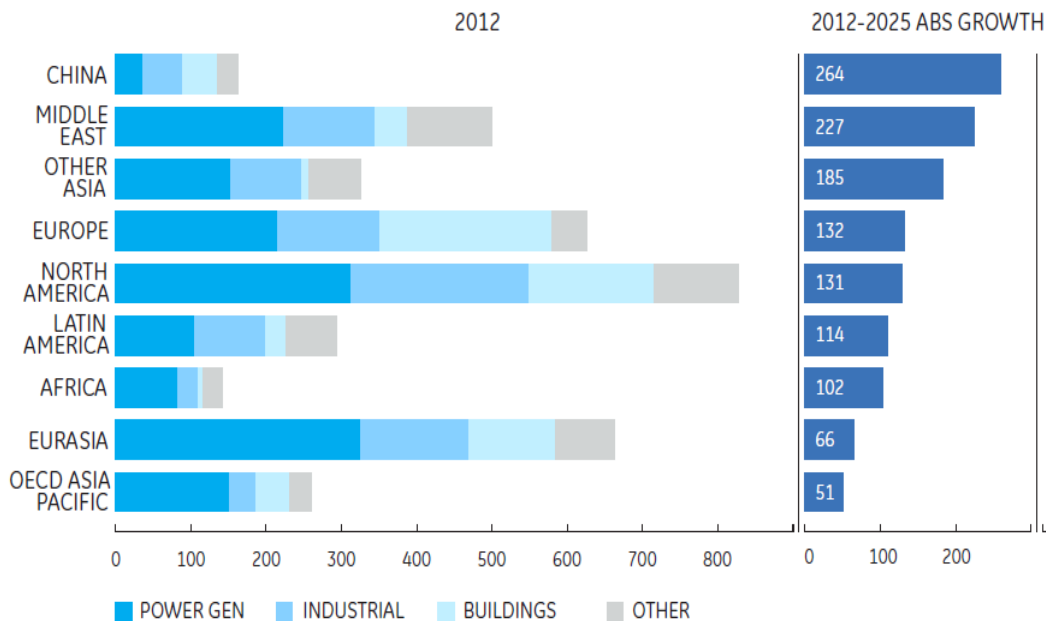
The “Age of Gas”

Natural gas is taking a larger role in global energy mix

Percent of
Primary Global
Energy
Production



“Age of Gas” Outlook ‘12 –’25 (Bcm per year)



Global growth 36% ‘12 to ‘25
~3,500 Bcm → ~4,700 Bcm

Key drivers

- Unlocking new gas supply sources
- Need for environmental mitigation
- Price competitiveness ... Asia & EU
- Gas network growth

Sources: History -BP Stat report, EIA, IEA. Outlook-GE Fuel COE Jul '13

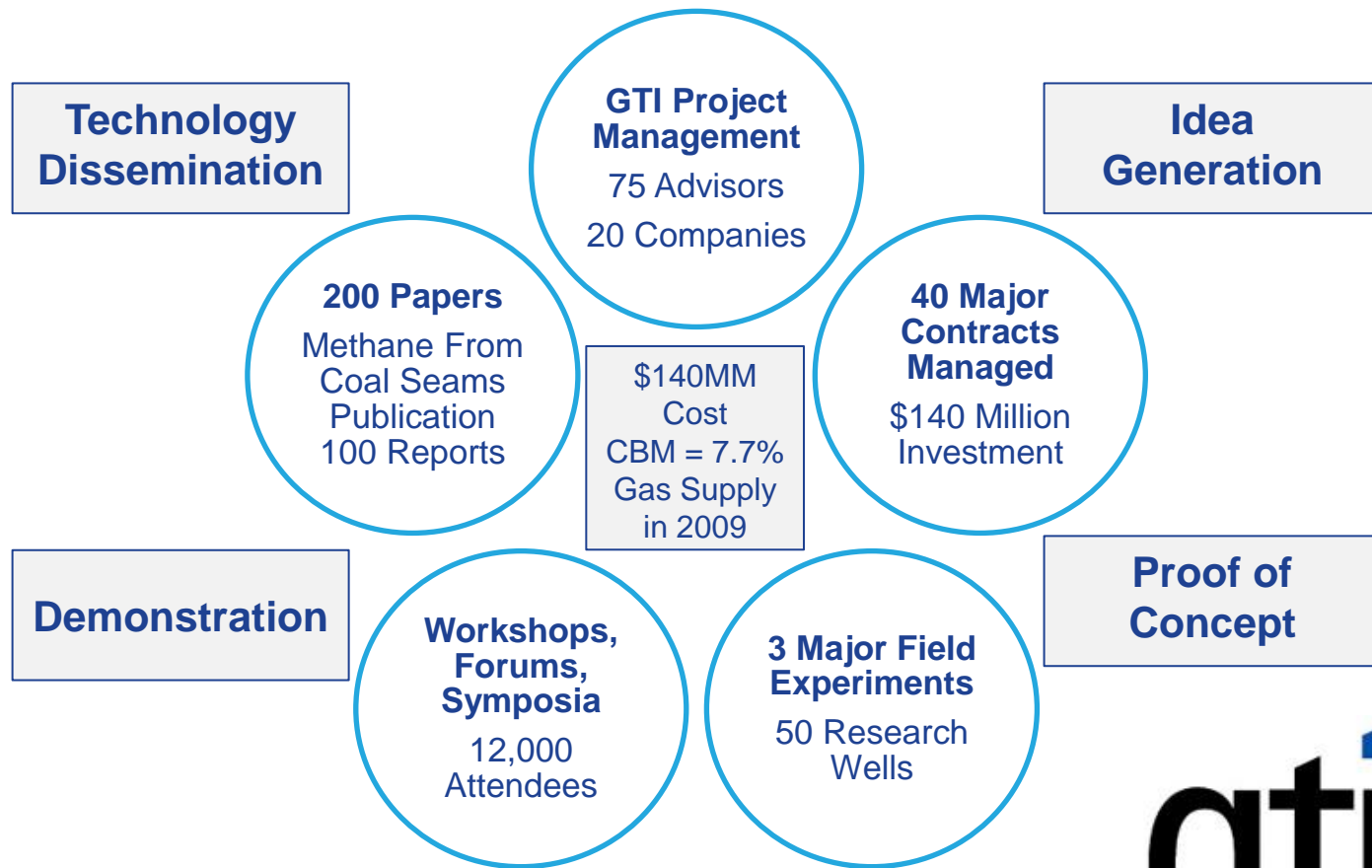


Available for download at:
http://www.ge.com/sites/default/files/GE_Age_of_Gas_Whitepaper_20131014v2.pdf

“If we did all the things we are capable of, we would literally astound ourselves.”

-Thomas Edison

A Research Success Story with CBM



Proven Research Models

1



DeepStar – Technology Development for Deepwater Research

Model: Private Consortium
Region: US
R&D: Deepwater

- Started in 1991
- 80+ member organizations
- 1,000+ subject matter experts
- \$100 million in projects founded in 23 year history

2



RPSEA - Research Partnership to Secure Energy for America

Model: Government-Private
Region: US
R&D: Ultra Deepwater, Unconventionals, Small Producers

- Energy Policy Act of 2005
- Unconventional program projected to add \$1.1 billion in additional federal royalty revenue at a cost of \$150 million
- Overall 10 year \$375 million

3



OG21

Model: Government-Private
Region: Norway
R&D: Norwegian petroleum industry & resource optimization on the NCS

- Started in 2001
- Petromaks – Basic R&D
- Demo2000 – Demonstration and testing
- Direct investment of ~\$470 million*; ~\$750 million* in partnership financing

4



ANP - Brazilian National Agency of Petroleum, Natural Gas, and Biofuels

Model: Government
Region: Brazil
R&D: O&G and Biofuels

- 1% of gross revenues from fields with extraordinary production applied to O&G R&D
- At least 50% to Universities or Research Institutes
- 2011-2020 R&D forecast = \$8.9 billion*

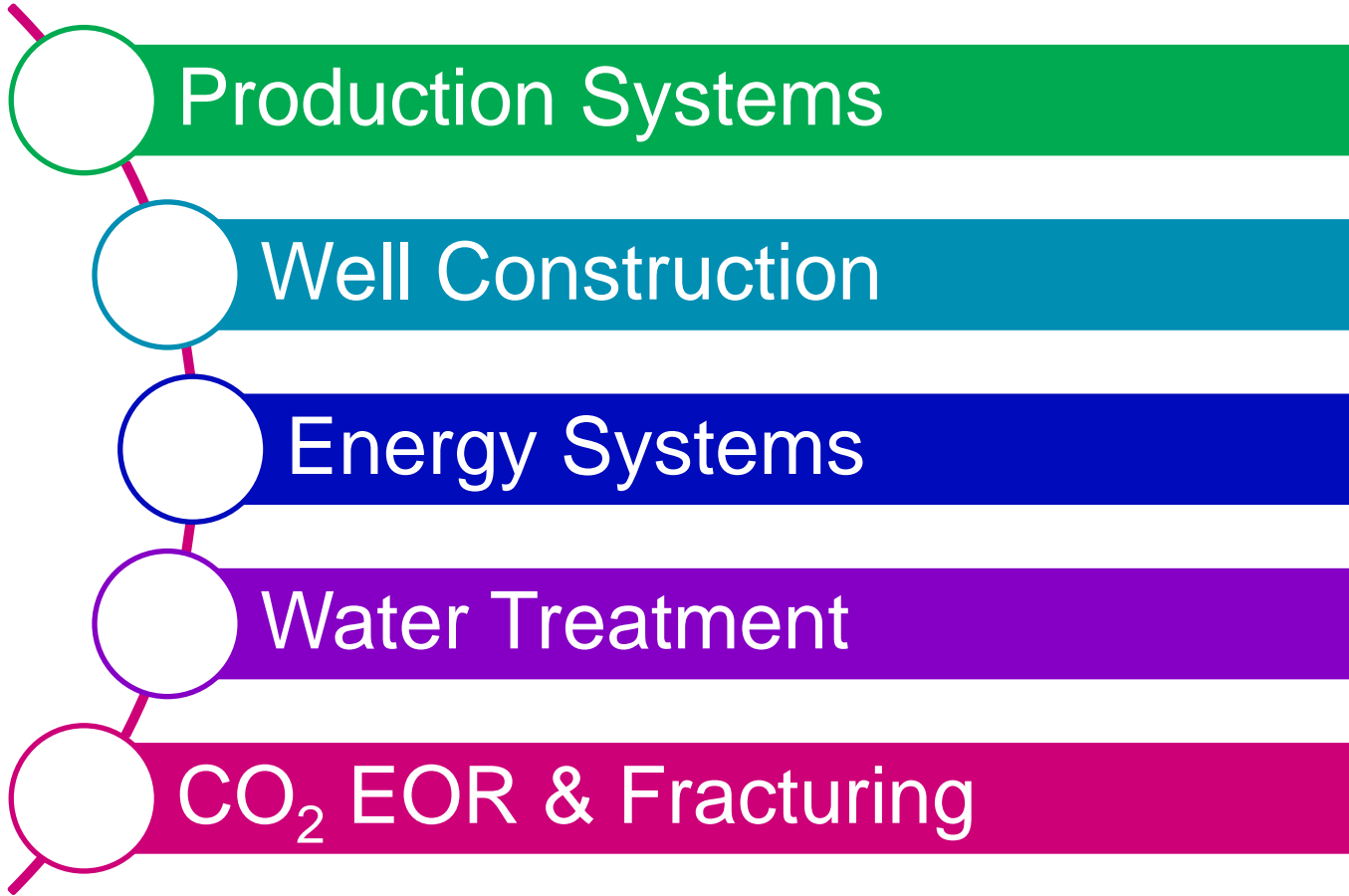
*based on current exchange rates

“There is far more opportunity than
ability”

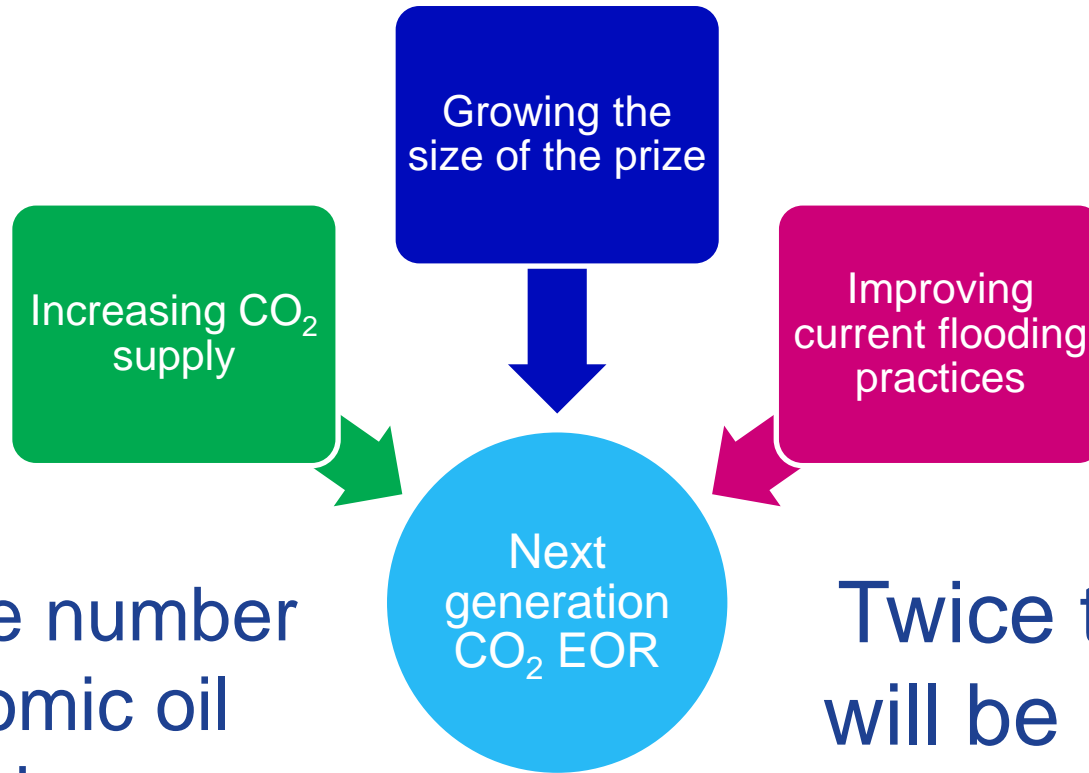
-Thomas Edison

Areas for R&D to optimize the system

Technologies that are better, cheaper, faster, safer, cleaner, smarter



CO₂ EOR... the potential is enormous



Double the number of economic oil fields

Twice the CO₂ will be required

Three times the amount of oil



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