



Illuminating the Pathways to a Clean Energy Economy

2016 Annual Meeting

March 31, 2016

Doug Arent

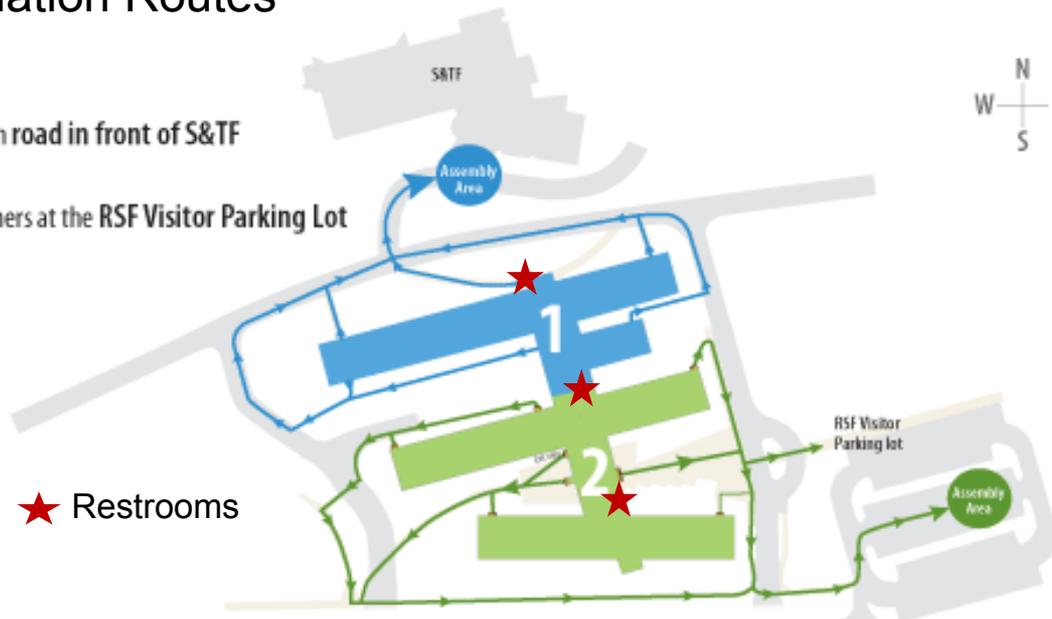


LOGISTICS AND SAFETY

RSF Building Evacuation Routes

1 WING A evacuates north and gathers on road in front of S&TF

2 WING B AND C evacuates east and gathers at the RSF Visitor Parking Lot



Recycling/Compost/Trash

Blue Bin – Recycling	Green Bin – Compost	Gray/Tan Bin - Trash
<ul style="list-style-type: none"> • Plastics 1-7 • Glass • Cans • Paper 	<ul style="list-style-type: none"> • Any food product • Paper Plates • Napkins, Paper towels, Kleenex • Compostable cups, plates, utensils • Tea bags 	<ul style="list-style-type: none"> • Foil and cellophane wrappers • Plastic bags • Styrofoam

JISEA's MISSION

JISEA research focuses on the intersections of energy, finance, and society. JISEA provides critical clarity and insights to inform decision making through leading-edge interdisciplinary research and objective, credible, cross-functional analysis.



PATHWAYS TO DECARBONIZATION

- *Natural Gas*
- *Renewables*
- *Nuclear*
- *Efficiency*
- *Energy Services*
- *Human-System Optimization*

- *Synergies*
- *Competition*
- *Integrated Systems*

MRS ENERGY 
SUSTAINABILITY

JISEA Joint Institute for
Strategic Energy Analysis



**Controlling Methane Emissions in
the Natural Gas Sector:
A Review of Federal & State Regulatory
Frameworks Governing Production,
Gathering, Processing, Transmission,**

JISEA Joint Institute for
Strategic Energy Analysis



**Quantification of the Potential
Gross Economic Impacts of Five
Methane Reduction Scenarios**

JISEA Joint Institute for
Strategic Energy Analysis



**Estimating U.S. Methane
Emissions from the Natural Gas
Supply Chain: Approaches,
Uncertainties, Current
Estimates, and Future Studies**

and Ethan Warner
ble Energy Laboratory
iversity

JISEA Joint Institute for
Strategic Energy Analysis



**Potential Cost-Effective
Opportunities for Methane
Emission Abatement**

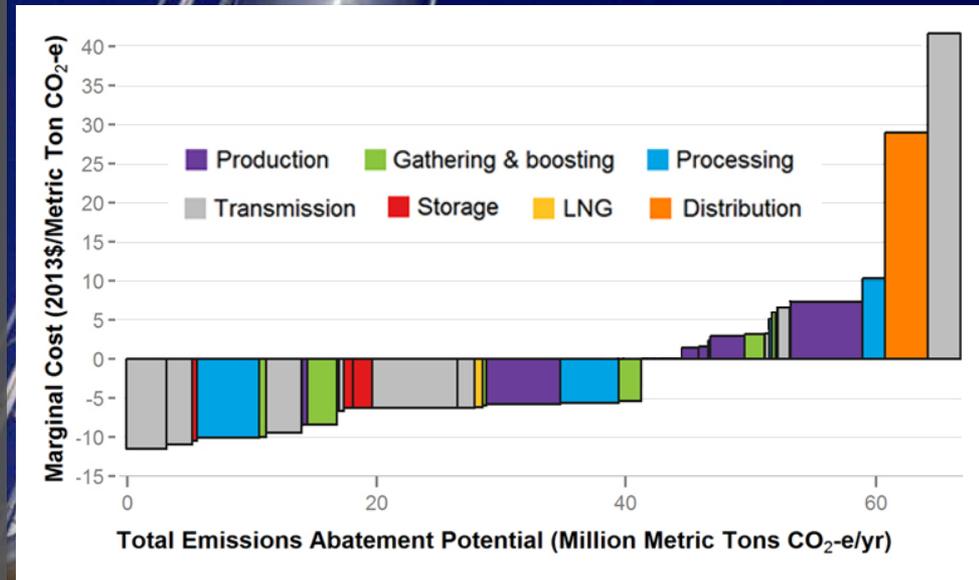
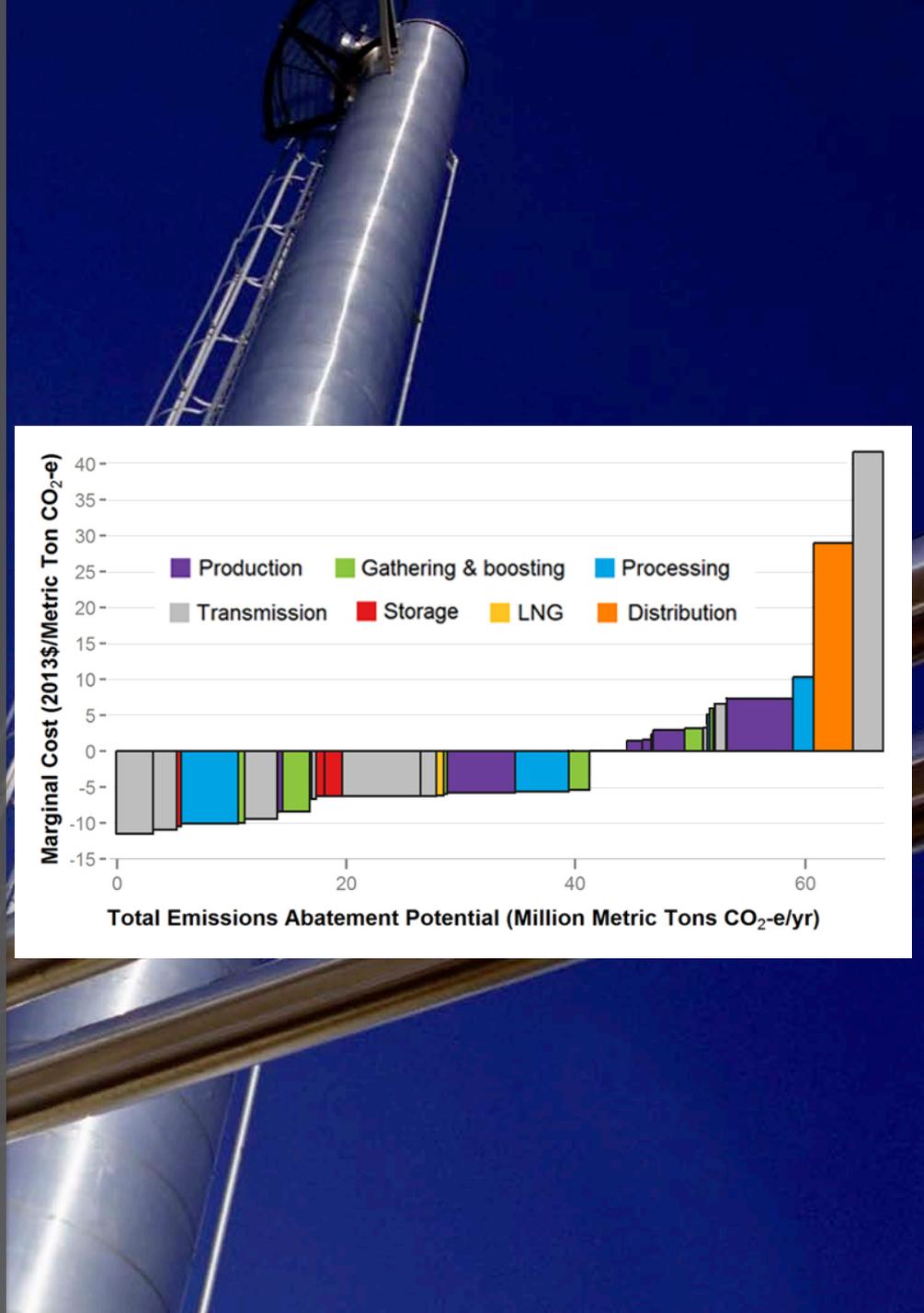
Ethan Warner¹, Daniel Steinberg¹,
Elke Hodson², and Garvin Heath¹

METHANE

EMISSIONS & ABATEMENT

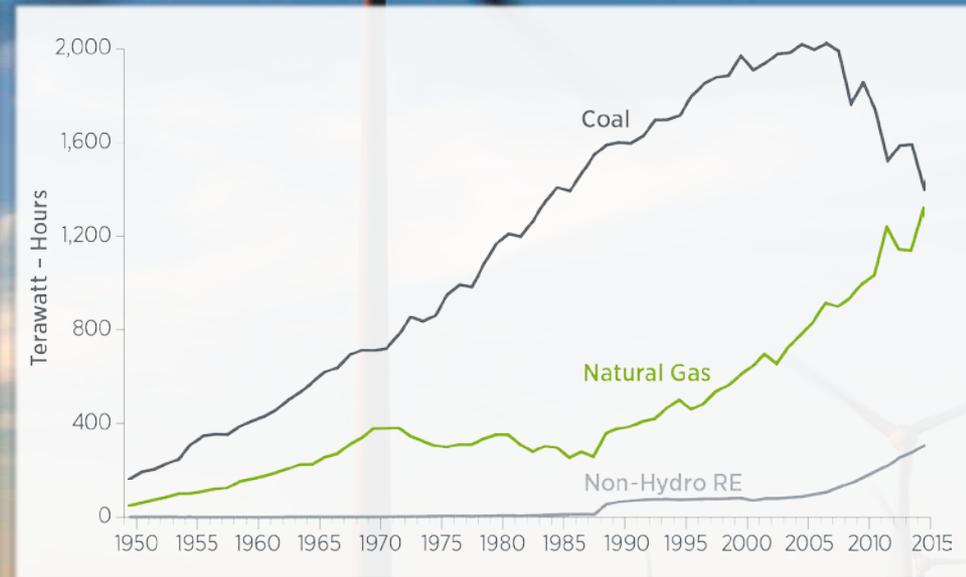
Key Issues:

- Federal Framework
- Economics
 - Corporate
 - Stakeholder & Local
 - State
 - Federal
 - United States.
- Environment
 - Water
 - Emissions
- Society
 - Social License...



THE EVOLVING POWER SECTOR

- *NG & RE*
- *Gas/Electric*
Coordination/Dependencies
- *State, CPP +...*
- *Flexibility*
- *PSOF: e.g. "Utility 2.0"*



21st Century
POWER PARTNERSHIP
*Accelerating the transformation
of power systems*

Illuminating pathways...

*... to facilitate the global
transformation to a modern
power sector.*

Report on India's Renewable Electricity Roadmap 2030

Toward Accelerated Renewable Electricity Deployment

Executive Summary

Wheeling and Banking
Strategies for Optimal
Renewable Energy
Deployment: International
Experiences

Feed-in Tariffs: Good Practices and Design Considerations

A CLEAN ENERGY REGULATORS INITIATIVE REPORT

Leonardo
ENERGY

CLEAN ENERGY
SOLUTIONS CENTER
ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

CLEAN ENERGY
SOLUTIONS CENTER
ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

21st Century
POWER PARTNERSHIP
Accelerating the transformation
of power systems

Shivani Mathur
Laboratory

Renewable Electricity

Sadie Cox and Sean Esterly
National Renewable Energy Laboratory

21st Century
POWER PARTNERSHIP
Accelerating the transformation
of power systems

Designing Distributed Generation Policies and Tariffs Well in Mexico

Period of Performance:
December 2014–June 2015

Carl Linvill and Donna Brutkoski
Regulatory Assistance Project
Montpelier, Vermont

NREL Technical Monitor: Ricardo Bracho

Status Report on Power System Transformation

A 21st Century Power Partnership Report

Mackay Miller¹, Eric Martino², Sadie Cox¹, Bethany Speer¹,
Owen Zinaman¹, Sam Booth¹, Romain Zissler¹, Jaquelin Cochran¹,
S.K. Soonee¹, Pierre Audinet², Luis Munuera², and Doug Arent¹

POWER SECTOR TRANSFORMATION

Driving Change ...

Measuring Progress...

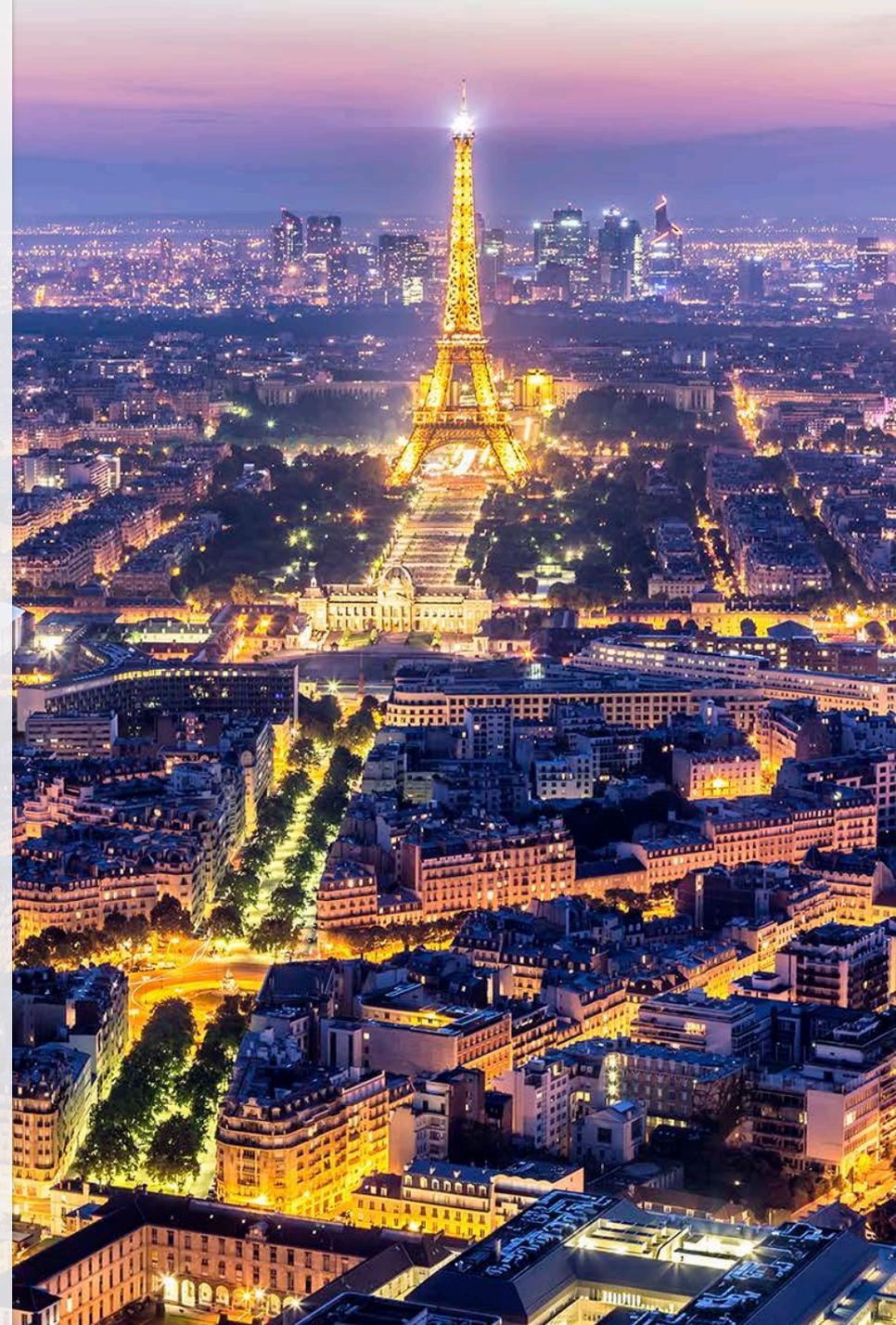
- Degree of innovation
- Engagement
- Impact



THE ROAD FROM PARIS

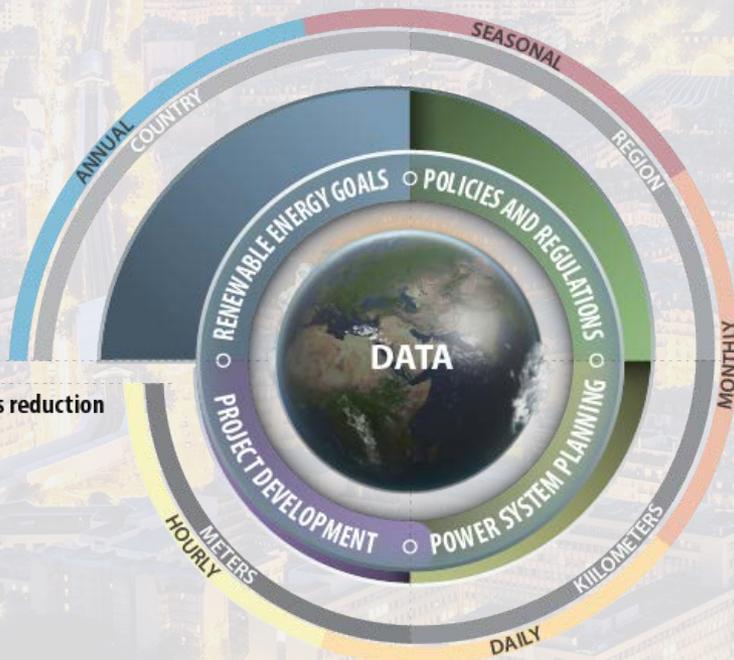
Aspirations...

Realization...



THE ROAD FROM PARIS

Science Informed Decisions...



Greenhouse gas reduction



GLOBAL COLLABORATIONS

- RE Integration
 - Technical, Institutional, Operational, Finance, Policy & Regulation
- EE, Smart Grid, & DER Policies
- Securitization: Mobilization of Capital



'Renewables-Friendly' Grid Development Strategies:



Advancing System Flexibility for High Penetration Renewable



Electricity Capacity Expansion Modeling, Analysis, and Visualization: A Summary of Selected High-Renewable Modeling Experiences

in Getman
ratory (NREL)

r Analysis

技术前沿 | [Energy Economics](#)



Historic Strateg Distrib

Travis Low
National Re
Douglas J.
Joint Institut

This work is a
Carbon Future
Foundation.

提高燃煤电厂弹性：从基荷电力到调峰电力

杰奎琳·科克兰 (Jaquelin Cochran), 美国国家可再生能源实验室 (National Renewable Energy Laboratory) 高级能源分析师
黛布拉·卢 (Debra Lew) 独立咨询师
尼基尔·库马尔 (Nikhil Kumar) 天祥集团 (Intertek) 能源及公共事业分析部总监

随着低碳能源、智能电网及其他新兴技术的不断涌现，21 世纪的电力系统倾向于边际成本低、能为系统提供“弹性 (Flexibility)”的能源资源，如图 1 所示。所谓“弹性”，是指既可以循环开停机 (Cycle On and Off) 运行，同时又能够实现最低负荷运行，调节发电量补足高渗透率可再生能源的输出变化，保持电力供应稳定。由于缺少总体运行经验，能源行业不仅对燃煤电厂在能源发展新格局下的走向存疑，而且对燃煤电厂在常规循环开停机下能否保持低成本运行感到担忧。

在基荷运行下如何发展以满足其他能源系统的需求。CGS 电厂的案例研究表明，CGS 电厂调整负荷率的方式可以适用于全球电力系统。CGS 电厂的实践对燃煤电厂具有局限性的传统观念提出了质疑，能够帮助政策制定者在限制碳排放的全球背景下，更好地理解制定电力系统转型过程中的政策和投资决策。

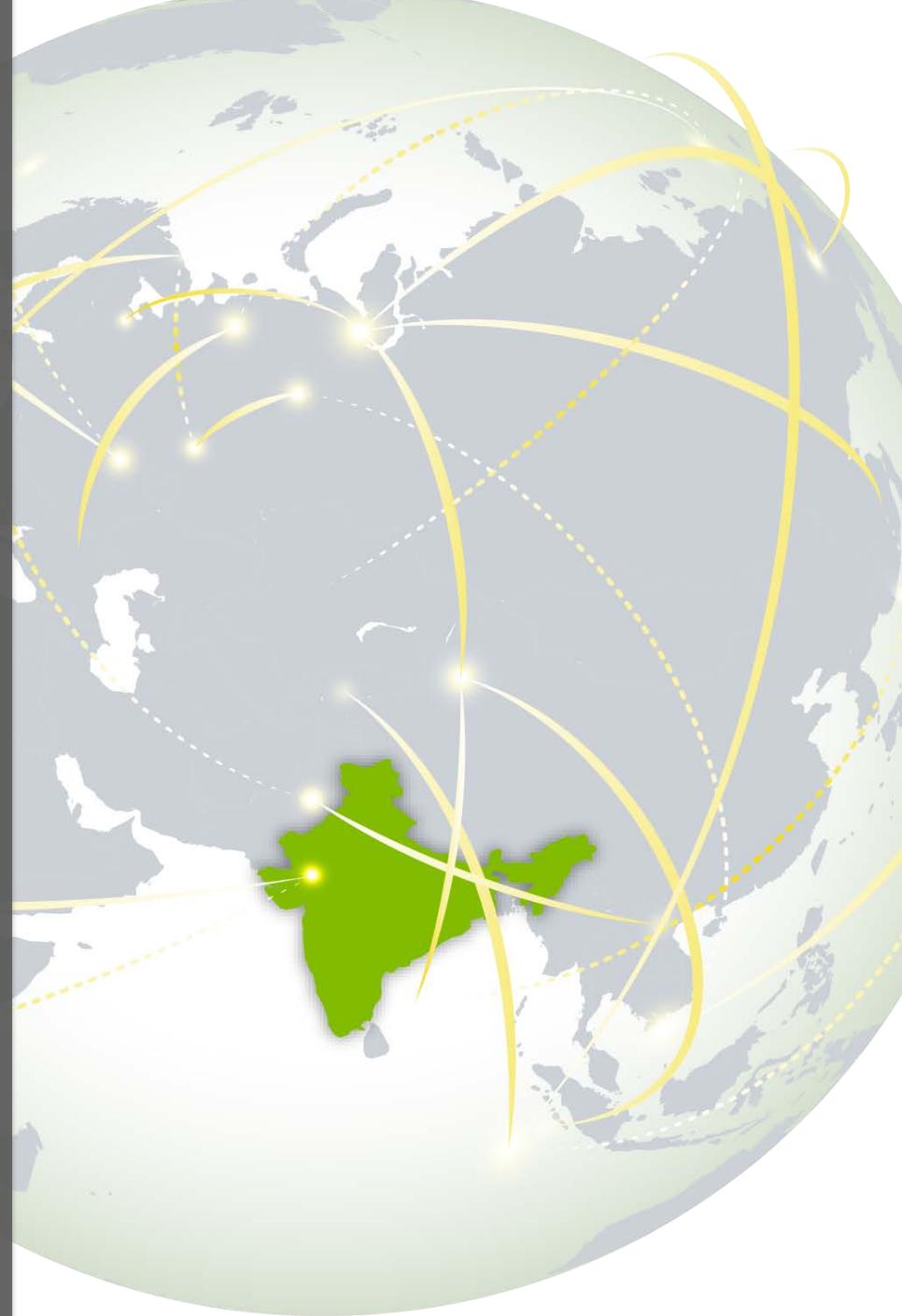
CGS 电厂概况

CGS 电厂于 20 世纪 70 年代并网运营，预期的年负荷率为 80%。然而，美国的核电“后来居上”，很快取代煤炭成为基荷发电的主要能源。因此，CGS 电厂在年负荷率仅为 50% 的状态下运行到 20 世纪 90 年代初。20 世纪 80 年代，为了解“峰谷转换” (Two-shifting)，即一天内循环开停机所带来的影响，美国开展了大量的研究。

为了验证燃煤电厂可以具备弹性特征，笔者对一座位于北美的多机组燃煤电厂 (出于商业原因，名称保密，以下简称 CGS 电厂) 进行了研究¹⁾。弹性包括燃煤电厂可以循环开停机运行，最低运行负荷率低于 40%，仅对电厂硬件做有限改动，主要对操作运行实践做出较大改

GLOBAL COLLABORATION

- Contributing to the development of India's national Renewable Energy Roadmap



GLOBAL COLLABORATION

- Assisting Mexico with the implementation of its energy reform directives



GLOBAL COLLABORATION

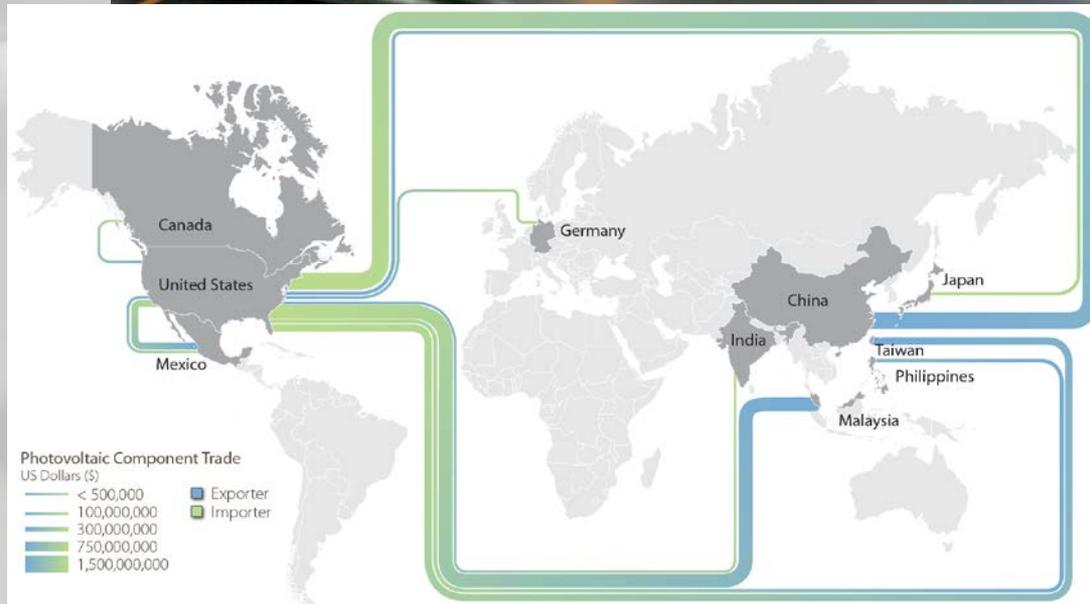
- Helping South Africa with near, medium and long term Power Transformation, RE integration, DG, and sustainable development challenges



CEMAC

Clean Energy Manufacturing
Analysis Center

*Credible, recurring global clean
energy manufacturing analysis &
insights*



INNOVATION STRATEGY FOR THE 21ST CENTURY

- *The Connected World*
- *Demographic Waves*
- *Rapid Globalization & Localization*
- *Social Expectations*





Coming together is a beginning; keeping together is progress; working together is success.

- Henry Ford

Upcoming JISEA Webinars

Pathways to Decarbonization Webinar Series

Wednesday, April 13 at 10 a.m. MST

Insights on Natural Gas, Renewable Energy, and the Evolving Power Sector

Wednesday, April 20 at 10 a.m. MST

Environmental, Economic, and Technological Effects of Methane Emissions and Abatement

Wednesday, May 4 at 10 a.m. MST

Considering Space and Time in Energy Decisions

Visit jisea.org/news.cfm to learn more and register