

March 22, 2017

JISEA Annual Meeting

# The 21st Century Energy Landscape

## Three Basic Approaches to Strategy

- Structural (Porter, Harvard)
  - Look at industry profitability first then company
  - Originally a “static” view, but now some dynamics
- Resource Theory (Edith Penrose, LSE/INSEAD)
  - Focus on the right people and other resources
  - Technologies, machines, distribution networks
- Simple Rules (Eisenhardt, Stanford)
  - Takes too long to build and use big models
  - Adopt well thought out “rules of thumb” to guide strategy
- Combinations (My preferred approach)

# The Simple Rules Approach to Strategy

“When the business environment was simple, companies could afford to have complex strategies. But now that business is so complex, they need to simplify. Smart companies have done just that with a new approach: a few straightforward, hard and fast rules that define direction without confining it.”

Eisenhardt and Sull, Harvard  
Business Review, January 2001

# Possible Simple Rules for Energy Sector Planning

- Maximize use of demand side options
  - Digital demand management technologies rapidly improving
  - Behavioral research bearing fruit
  - New business models emerging
- Lock up as much low cost natural gas as possible
  - It is clean
  - It may be plentiful
  - It may be safe
- Follow rapid improvements in renewable technologies
  - Wind & solar & smart grid to integrate with micro-grids as an alternative
  - Advanced biofuels more challenging – water/land/sustainability issues
- Electrify where possible, especially in transport applications
  - Mass transit
  - Plug in hybrids/electric cars

# Possible Simple Rules for Energy Sector Planning (2)

- Nuclear, coal w/CCS&U, and shale could all make major contributions, but need more development and face challenges.
- Technological challenges, possible show stoppers and required business plan innovations require a well designed RD&D portfolio to balance risks and rewards.
- So actively engage in RD&D in:
  - Electricity storage technologies
  - Smart grid technologies & smartgrid analytics
  - Wireless charging
  - Advanced nuclear technologies
  - Advanced bio-energy technologies
  - Carbon capture and sequestration
  - Direct air capture

# Colorado School of Mines Faculty Senate

## Climate Change Statement

(adopted, Feb. 14, 2017)

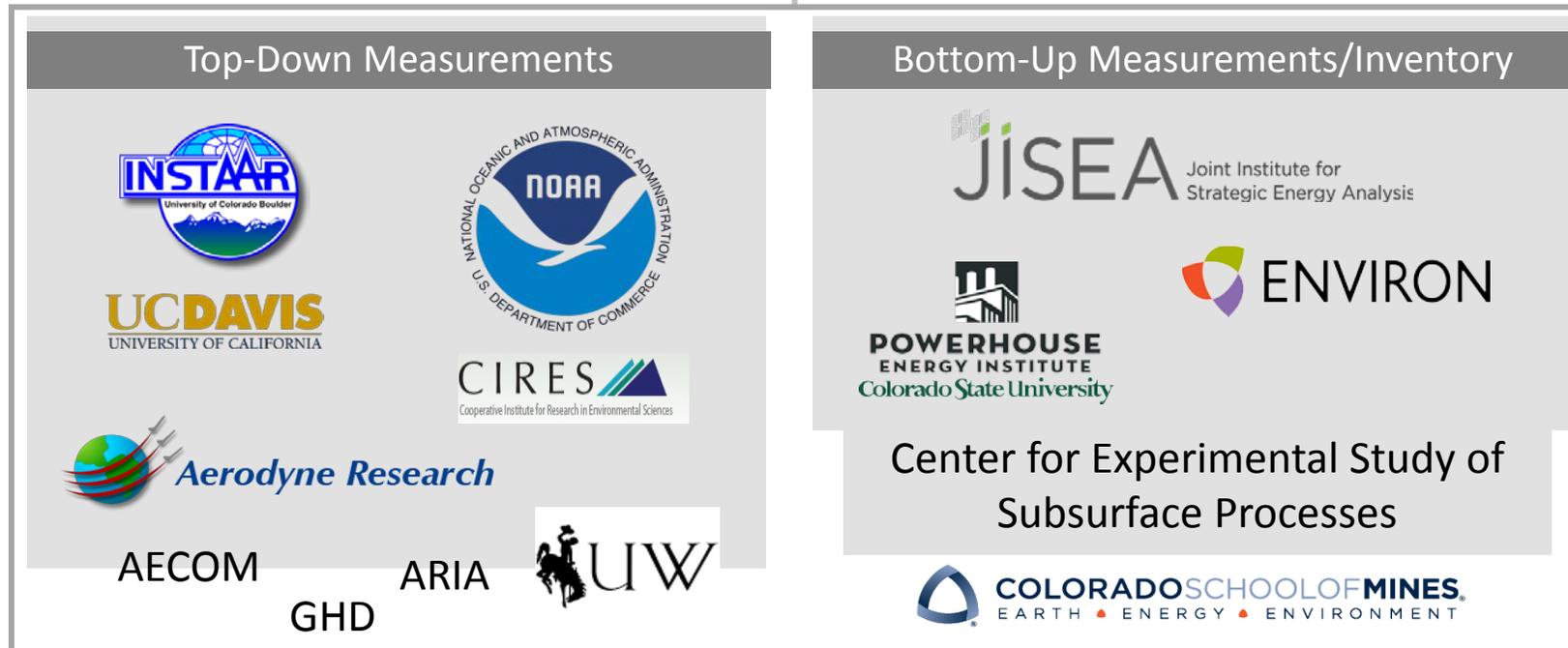
- We, the faculty at Colorado School of Mines agree with the consensus of 97% of the climate science community that climate change is occurring, and it is extremely likely that human activities are responsible. As a result, most scientific organizations have recommended that public policy should be formulated to limit future human impacts on the climate. At this historic juncture, this public policy could be fashioned so that we seize business and energy development opportunities to promote jobs and economic growth.
- Adopted by the Mines Faculty Senate, Feb 14, 2017.

## **Example of Current O&G Industry Trends towards Decarbonization**

[http://digital.ogj.com/ogjournal/20170320?sub\\_id=tflcUmokZKzO&folio=22&pg=22#pg22](http://digital.ogj.com/ogjournal/20170320?sub_id=tflcUmokZKzO&folio=22&pg=22#pg22)

Shell to divest nearly all of its Canadian oil sands interests for \$7.25 billion. Oil and Gas Journal, March 20, p. 22, 2017.

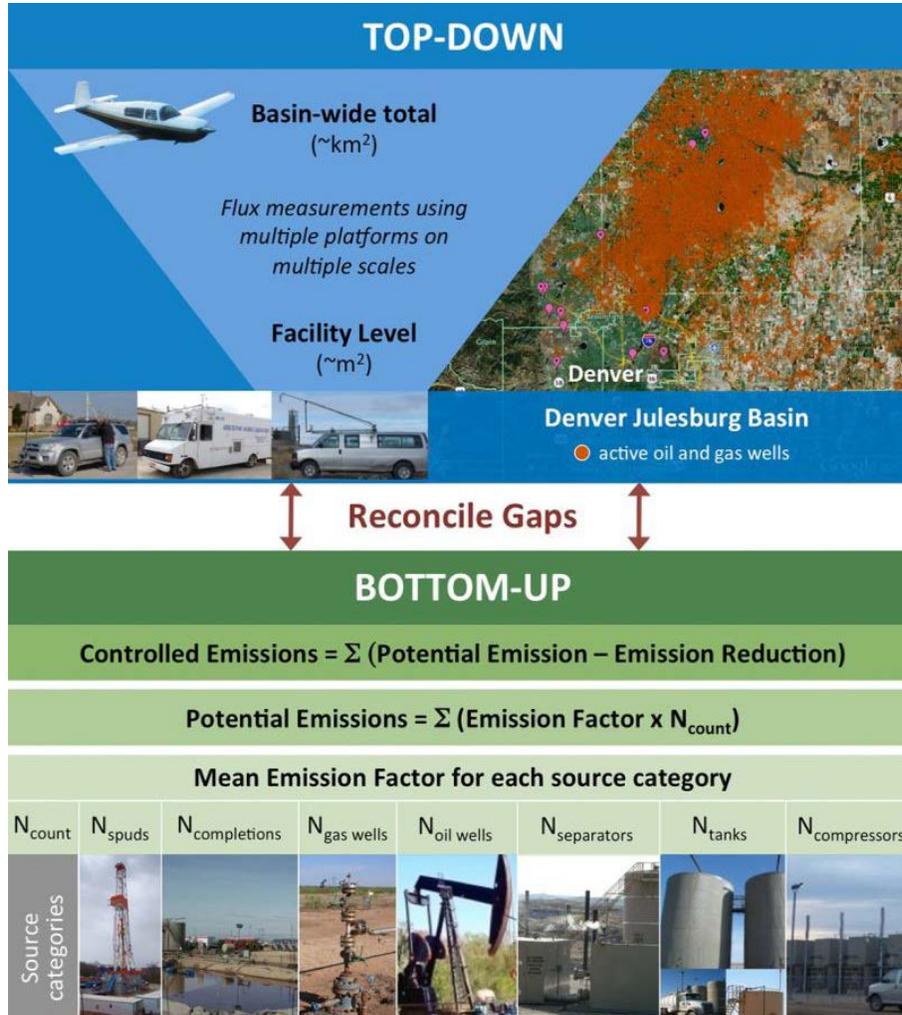
# Example of Multi-Institutional Colorado Project on Methane Emissions Reductions from Natural Gas



- NETL
- American Gas Association
- Four large oil and gas companies

- Colorado State University
- Colorado School of Mines
- Colorado Energy Research Collaboratory

# Top-down and Bottom-up Emissions Reconciliation



- **Top-down:**

- Source sector differentiation
- Representative sampling
- Accuracy
- Gas composition profiles
- Downscaling to sources

- **Bottom-up:**

- “Fat tails” emission distribution
- Missing sources
- Representative samples
- Activity data
- Uncertainty characterization

- **The challenge:**

- Reconcile Gaps. Current: close to a factor of ~ 2!

Graphics: Gaby Petron (NOAA/CIRES) and Garvin Heath (NREL)

# Extent and Density of Measurements

