



23rd World Gas Conference

Strategic Panel R&D

**Gas R&D – Avoidable Cost or
Essential Investment ?**



Question to the audience

In the context of competing priorities and limited resources, in order to ensure natural gas remains competitive, should the industry focus technology development primarily on

- 1) Upstream (reducing the cost of finding and producing gas)?*
- 2) Midstream (reducing the costs of building and maintaining the infrastructure needed to deliver gas to market)?*
- 3) Downstream (improving utility and efficiency in use and reducing greenhouse gas and pollutant emissions)?*

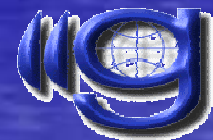
To vote please use the remote control in your voting system and press button 1 , 2, or 3 when the green light is on.

IGU Task Force R&D

Report on work undertaken 2003-2006

23rd World Gas Conference
Amsterdam
June 2006

Dr. Bob Harris



Task Force R&D

Presentation Summary

- **Rationale for the TF and its remit**
- **Membership**
- **Work Programme**
- **Findings**
- **Technology Questionnaire**
- **Conclusions**
- **Recommendations**



Task Force R&D

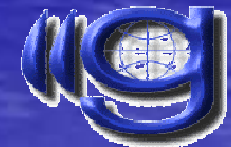
- ***Rationale*** - concerns arising from perception of decline in R&D by and for Gas Companies
- ***Remit*** -
 - confirm recent trends in conduct and financing of R&D
 - identify reasons behind changes
 - recommend any actions for IGU



Task Force R&D

Members

- Dr R M Bilbe – *TF Chair 2003/2004 (The Netherlands)*
- Dr R J Harris – *TF Chair 2005/2006 (UK)*
- Mr J Gomi – *(Japan)*
- Mr G Tenley – *(USA)*
- Mr P I Hinstrup – *(Denmark)*
- Prof C Beckervordersandforth - *(Germany)*
- Mr M Florette – *(France)*
- Dr R Stokes – *(USA)*
- Prof A Fronski – *(Poland)*
- Mr W Faber – *(The Netherlands)*
- Dr E Jurdik – *TF Secretary - (The Netherlands)*
- Dr P Crha – *(Czech Republic)*
- Mr W Rahman – *(Canada)*



Task Force R&D

Work Programme

- Review of recent trends - position surveys
 - invited presentations
 - literature
 - TF input
- Survey of IGU members' views on technology needs (Technology Questionnaire)
- Organisation of Strategic Panel Debate



Task Force R&D –Findings

Recent Trends in gas R&D expenditure

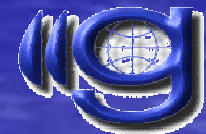
- Clear evidence of decline
- Gas/utility sector reduced from 1%(average) to 0.4%
- Decline most pronounced where markets 'liberalised'
- Greatest decline in utilisation and longer term R&D
- Evidence of more recent increase in E&P



Task Force R&D –Findings

Factors affecting investment in gas R&D

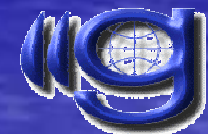
- Culture
- Liberalisation
- Commodity Pricing
- Regulatory Regime
- Business model
- New drivers



Task Force R&D –Findings

Specific impact of Liberalisation

- R&D irrelevant for firms competing on commodity pricing
- Focus on short term
- Longer term left to public funding
- Appropriation and preventing 'free-loading'



Task Force R&D –Findings

Impact of Changes

- Reduction in internal R&D
- Loss of industry knowledge
- Retention of 'informed buyer' capability
- Collaboration v Competition
- Changing trends in focus of projects



Task Force R&D –Findings

Private v public financing of R&D

- The balance of responsibility
- Who pays ?
- Market prospects
- Do 'levy' models work ?
- Collaboration



Task Force R&D Technology Questionnaire

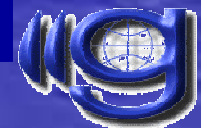
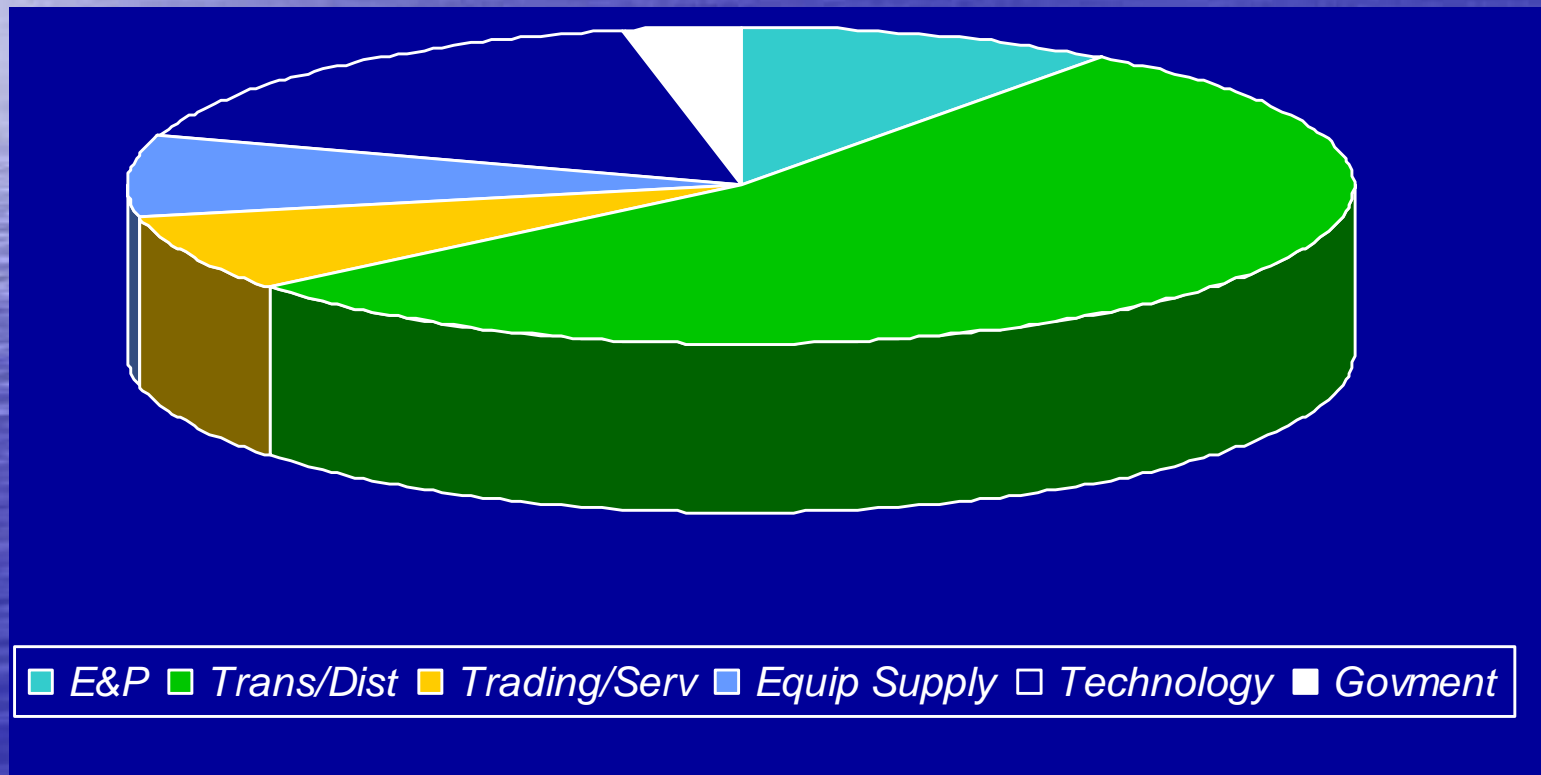
- Seeking the views of IGU members
- Development – supported by University of Groningen
- Ranking of technologies within and between gas chain sectors and geography
- 182 returns (26%)



Task Force R&D

Technology Questionnaire

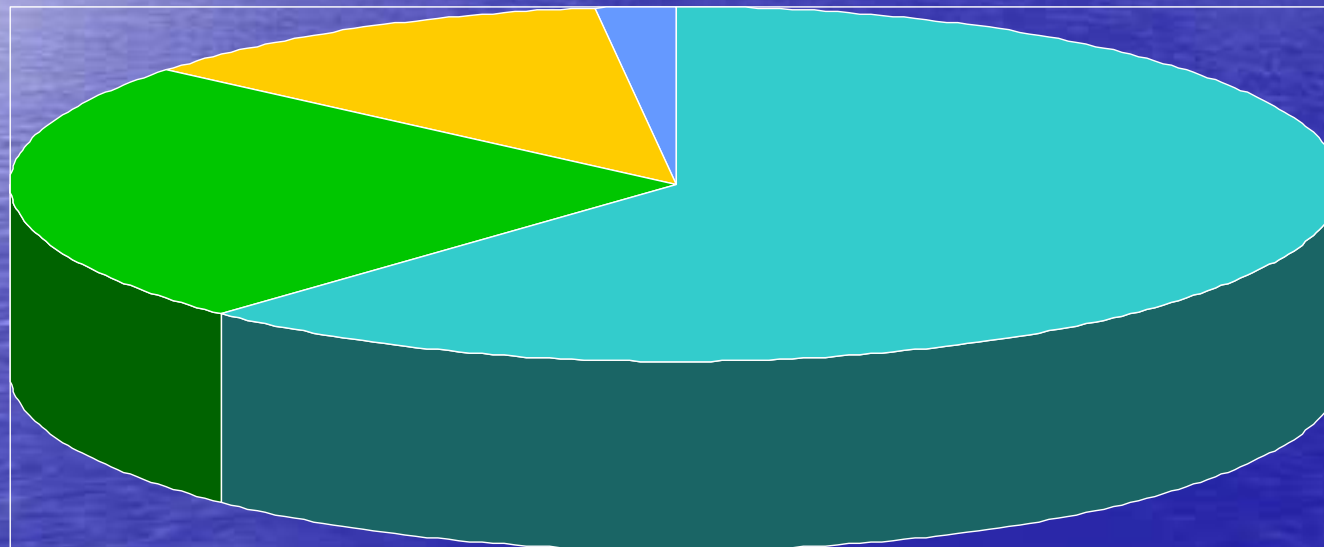
Respondents – Business Sector (%age)



Task Force R&D

Technology Questionnaire

Respondents – By Geographic Region (Percentage)



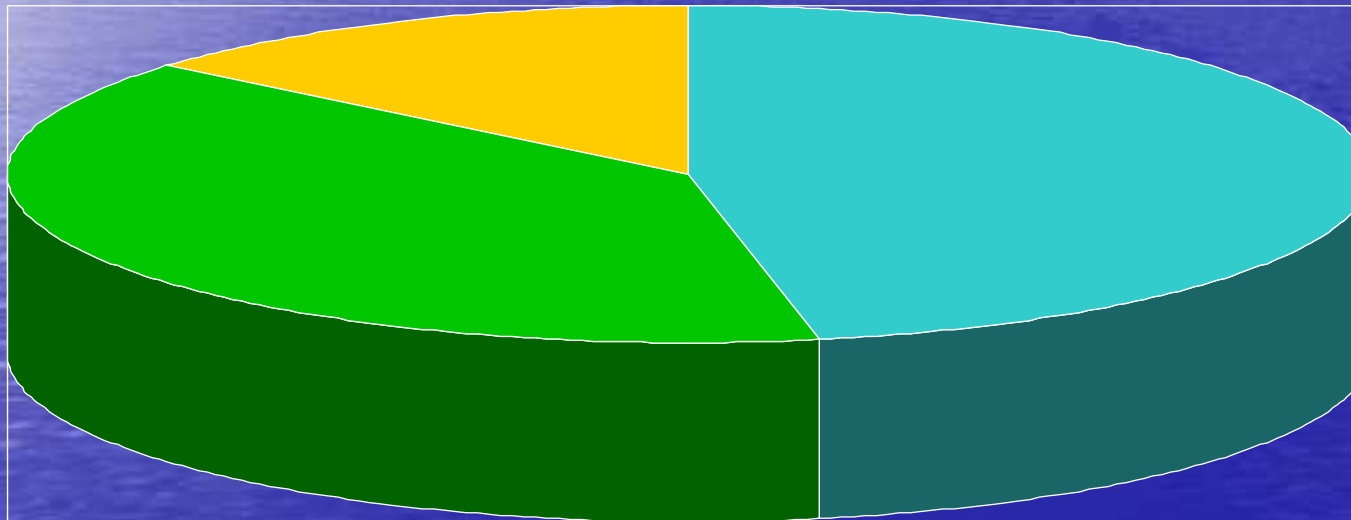
■ Europe ■ SE Asia ■ North America ■ Others



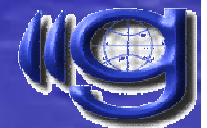
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Technology Questionnaire

Respondents – By Job Function (%age)



- Business/Operation M'ngment**
- Technology**
- Policy/Strategy**



Task Force R&D

Technology Questionnaire

Top Technologies by gas chain sector

- **Gas Resources**

LNG

Reduced Operational/Maintenance Costs

Gas from Hydrates

- **Transmission**

Extending operational life

Improved integrity management systems

Methods to increase pipeline capacity



Task Force R&D

Technology Questionnaire

Top Technologies by gas chain sector

- **Distribution**

Improved leak detection

New materials

Keyhole technologies

- **Utilisation**

Reduced NO_x

Capture of CO₂

Fuel cells using natural gas



Task Force R&D
Technology Questionnaire
Gas Resources - Regional Differences

	<i>SE Asia</i>	<i>N America</i>	<i>Europe</i>
LNG	Y	Y	Y
Reduce Costs		Y	Y
Increase Recovery			Y
CBM		Y	
GTL	Y		
Hydrates	Y		

Task Force R&D
Technology Questionnaire
Transmission-Regional Differences

	<i>SE Asia</i>	<i>N America</i>	<i>Europe</i>
Extend Operational Life	Y	Y	Y
Improve PIMS	Y	Y	Y
Increase Capacity		Y	Y
High Strength Steels	Y		

Task Force R&D Technology Questionnaire Distribution - *Regional Differences*

	<i>SE Asia</i>	<i>N America</i>	<i>Europe</i>
Improve Leakage Detection	Y	Y	Y
Live Inspection/ Maintenance	Y	Y	Y
S-Free Odorants	Y		
New Materials			Y
Keyhole Technology		Y	

Task Force R&D
Technology Questionnaire
Utilisation-Regional Differences

	<i>SE Asia</i>	<i>N America</i>	<i>Europe</i>
Fuel Cells	Y	Y	Y
CO2 Capture	Y	Y	
Reduce NOx		Y	Y
Lower Cost A/C			Y
i/c engines	Y		

Task Force R&D

Conclusions

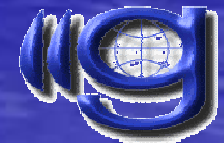
- Evidence of decline
- Effect of market liberalisation
- Greatest decline in utilisation and longer term R&D
- Anecdotal evidence of loss of specific industry knowledge
- Different drivers
- Public v private finance an issue
- Technology needs



Task Force R&D

Recommendations

- Continue the TF
- Widen representation
- Support IGRC
- Encourage collaboration





Christian Beckervordersandforth

- 1) *In entirely free markets there has been a dramatic decrease in gas R&D funding*
- 2) *Closer cooperation between manufacturers and the gas industry is essential*
- 3) *The role of government should remain restricted to long-term, fundamental gas R&D*



Hikaru Hirayama

- 1) *R&D is definitely essential for the gas industry*
- 2) *R&D should be promoted with a specific focus on promising projects*
- 3) *The role of government is essential in promoting basic and long-term projects and there is a need for greater international collaboration in addressing global environmental challenges*

Natural Gas Research Cost or Investment?

Given by Mary Jane McCartney
Senior VP, Con Edison of NY

WORLD GAS CONFERENCE
Amsterdam – June 8, 2006



Natural Gas Research: Cost or Investment?

- Who is Con Edison?
- Research needs
- Who's doing the research?
- Conclusions



Natural Gas Research: Cost or Investment?

- Who is Con Edison?

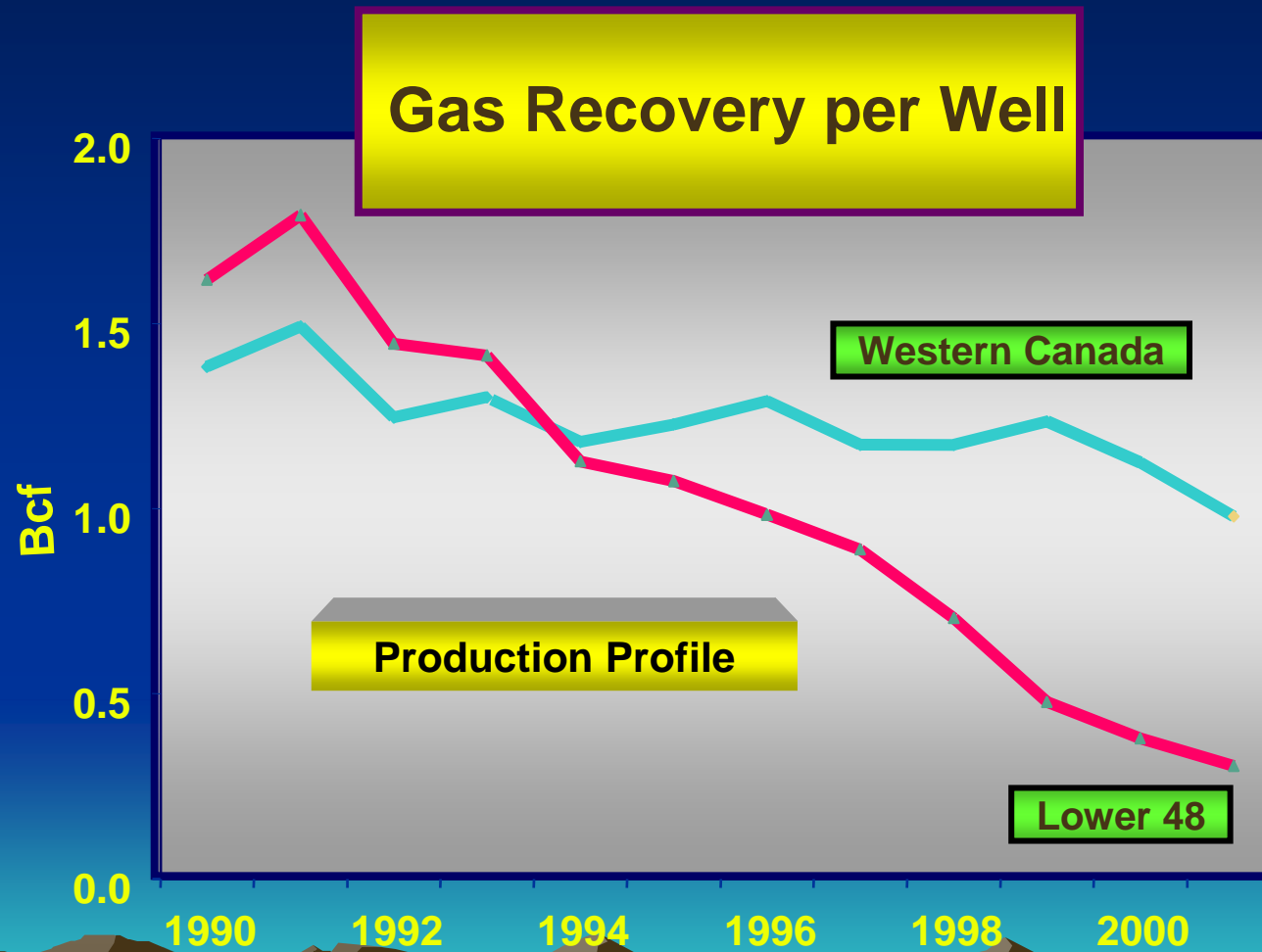


Natural Gas Research: Cost or Investment?

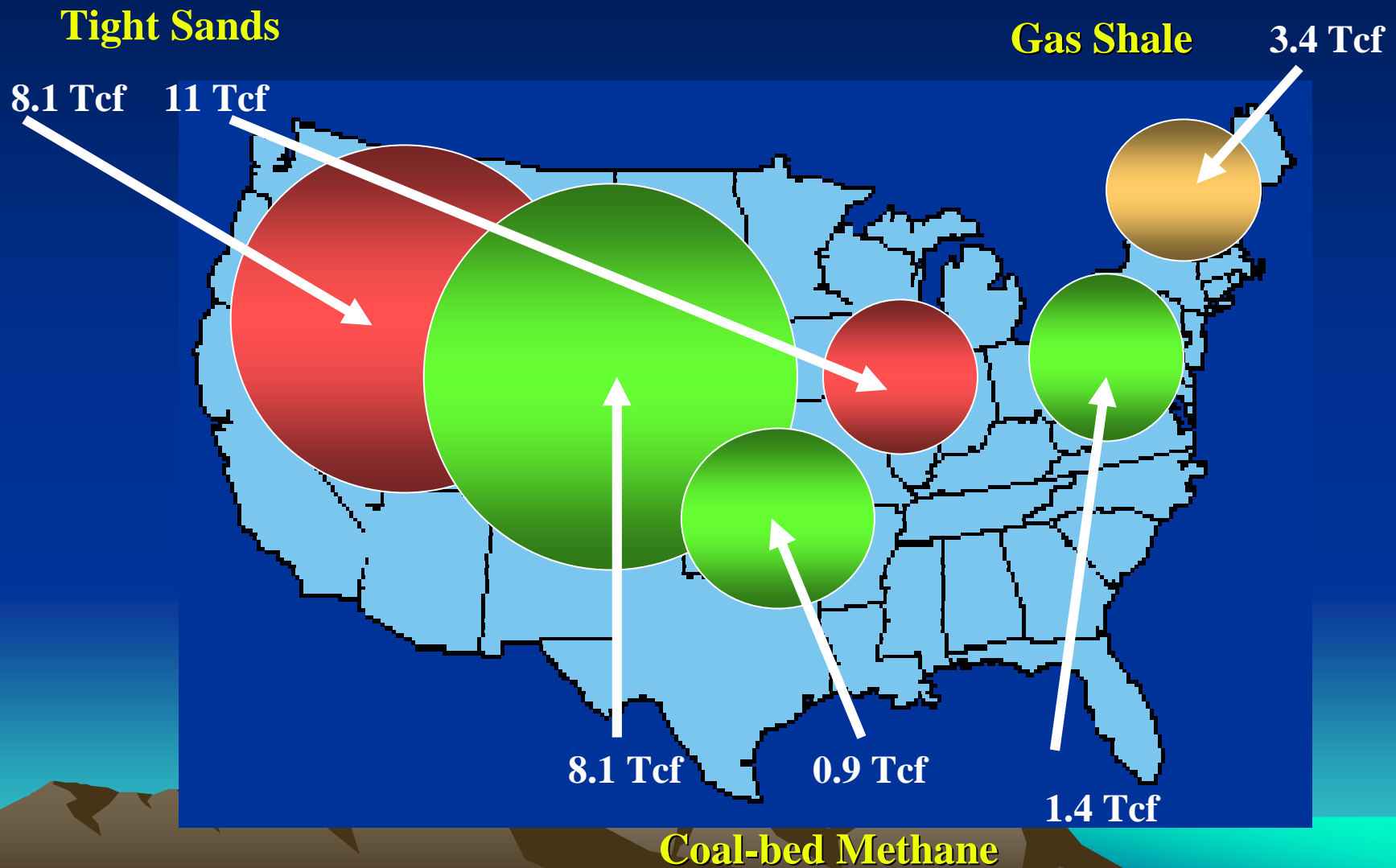
- Research needs
 - Energy supply
 - Pipeline safety
 - Damage prevention
 - Environmental remediation
 - Efficient energy utilization



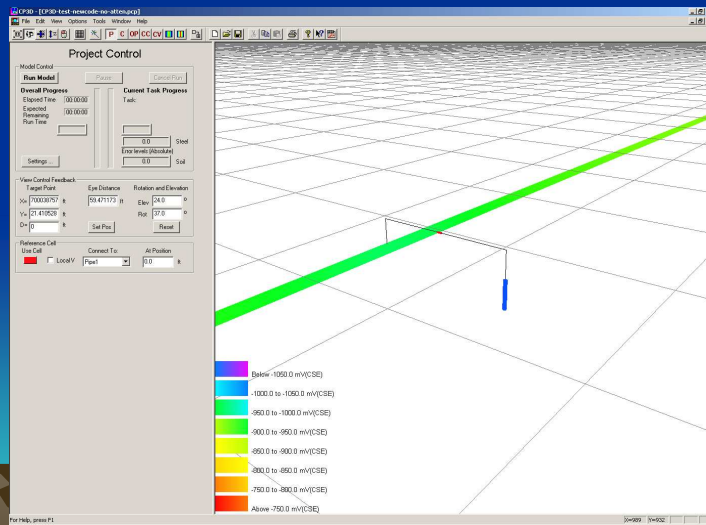
Natural Gas Research: Cost or Investment? Energy Supply



Unconventional Gas: Proved Reserves

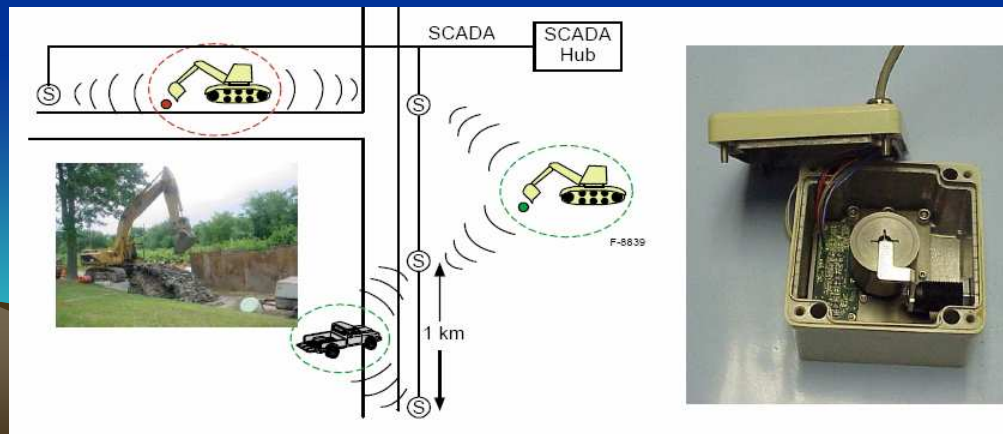


Pipeline Safety Direct Assessment



Natural Gas Research: Cost or Investment?

- Damage Prevention
 - Trenchless construction
 - Early warning



CISBOT

PIGPEN

MGP Site Remediation



Natural Gas Research: Cost or Investment?

End-Use

- Efficient energy utilization
 - Boiler technology
 - Fuel cells
 - Gasification
 - Gas interchangeability



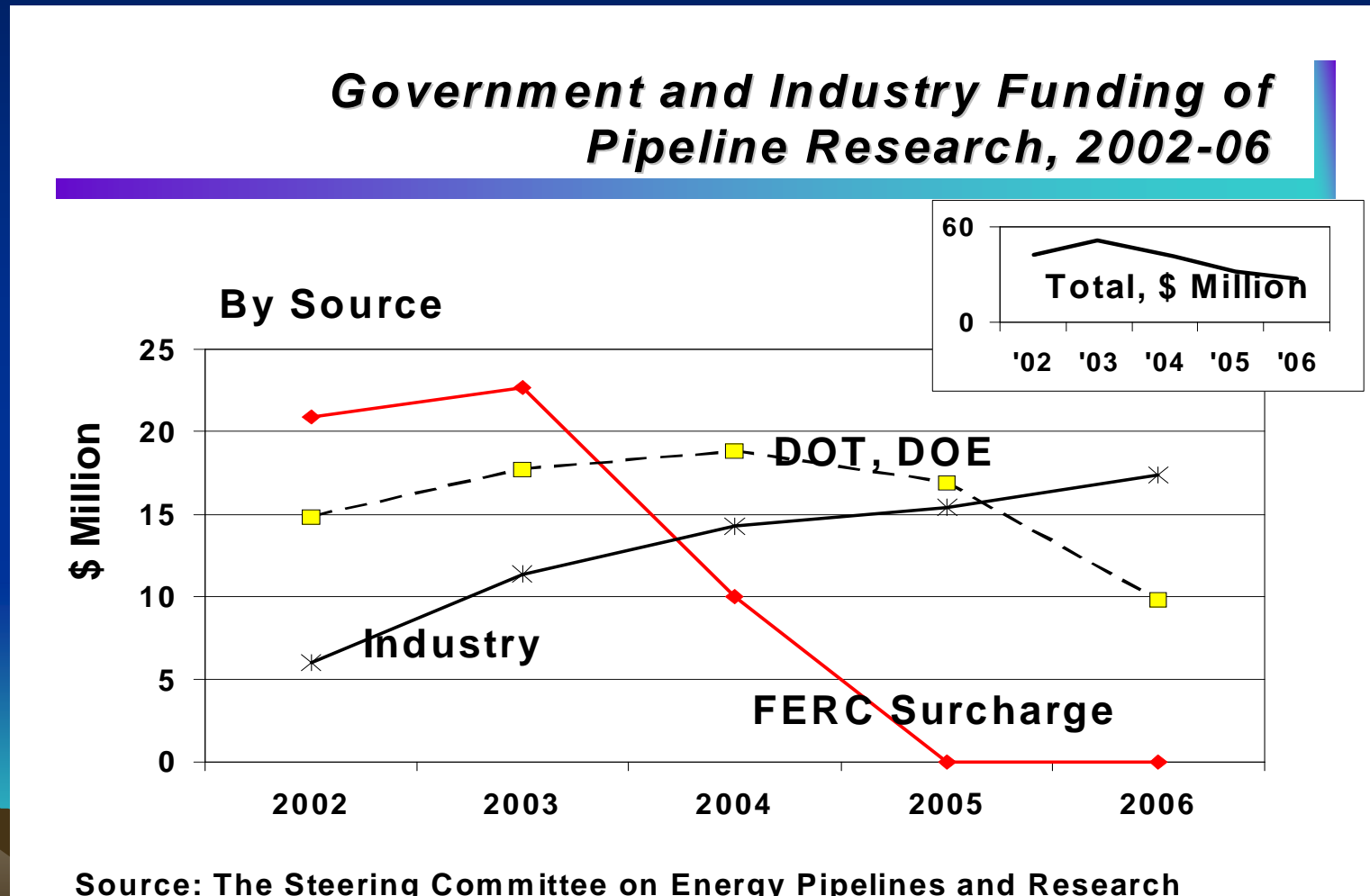
Natural Gas Research: Cost or Investment?

- Who's doing the research?
 - Federal government
 - Supply -- RPSEA
 - DOD – fuel cells
 - DOE – gasification, hydrogen
 - Distribution company collaboration



Natural Gas Research: Cost or Investment?

- Federal Government



Natural Gas Research: Cost or Investment?

Who's doing the research?

- Federal Government: Energy Supply
 - Research Partnership to Secure Energy for America
 - Ten-year, \$50 million per year DOE program
 - New technologies to produce abundant, affordable domestic energy supplies.



LDC Focused Collaborative Programs are Growing



18 Members, \$7.4 Million Annual Dues
56 Projects since 2003



8 Members, over \$2 Million Annual Dues
24 Projects since 2004



18 Members, over \$1 Million Annual Dues
38 Projects since 2003, 47 Projects since 2000



Keyhole
Collaboration

26 Members, \$450k Annual Dues
since 2002

Natural Gas Research: Cost or Investment?

- Conclusions
 - Supply R&D greatest need
 - High energy prices = opportunity
 - States have supplanted FERC
 - Collaborative R&D is working



Natural Gas Research Cost or Investment?

Given by Mary Jane McCartney
Senior VP, Con Edison of NY

WORLD GAS CONFERENCE
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Mary Jane McCartney

- 1) *The greatest need for gas R&D is in the supply area*
- 2) *Federal funding of gas R&D through interstate pipeline surcharges has been replaced by state-by-state funding in US*
- 3) *Collaborative R&D among distribution companies focused on infrastructure integrity and cost reduction is growing*



Ton Hoff

- 1) Today's production and use of energy is not sustainable and the trends and projections in energy use indicate that sustainability will deteriorate***
- 2) The future energy system can become more sustainable but this requires significant changes. In the field of natural gas R&D, concerns are that too little is happening***
- 3) The gas sector has the responsibility to accept a large share of the R&D costs***



Mark J. Howard

- 1) *R&D is clearly needed to support the gas value chain, but priorities change as the Industry evolves and should drive further innovation*
- 2) *A wide range of organisations are now involved in these priorities, not just the more traditional gas monopolies and their successors*
- 3) *Today's R&D priorities include safety and reliability of supply, connecting distant resources with established and growing markets, and maximising exploitation and efficiency of use of both conventional and unconventional resources in established markets (e.g., N America, Europe, Japan)*