2-26-09
Work Session: Comprehensive Energy Plan Resources

<target><bill></bill><subject>2-26-09 Work Session
Comprehensive Energy Plan
Resources</subject><comm>SENE26</comm></target>

Alaska State Legislature
Senate Special Committee on Energy

Cambridge Energy Research Associates Qualifications

February 26, 2009 • Juneau, Alaska

David Hobbs, Managing Director

Michael Marinovic, Vice President, Consulting

James R. Meitl, Senior Director, Business Development

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The CERA Mission

To provide insight into the energy future...

- Provide comprehensive, **integrated** research and thought leadership on market fundamentals, industry dynamics, and strategy in the energy sector
- Offer unique **insights**, often well ahead of conventional wisdom, into the most pressing challenges—economic, geopolitical, financial, technological, regulatory, environmental, and managerial
- Help clients **anticipate** the energy future and make informed strategic, investment, and market decisions
- Foster a **community** of senior-level decision makers

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Source: Cambridge Energy Research Associates.

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CERA Strategic Consulting and Advisory Services

- **Our Perspective.** Concerns over climate change, energy security and economic development are reshaping the competitive landscape of the global energy business. Through our unique integrated global energy scenarios and outlooks, we analyze markets in a global context while bringing quantitative results at the local level.

- **Our Approach.** Few consulting firms can match CERA's unique blend of profound energy industry knowledge, leading research, and hands-on experience. In working with our clients on strategy engagements, we leverage our deep knowledge and market leading research from all parts of the energy industry.

- **Our Experience.** CERA has provided the energy industry with advice and critical insight for more than 20 years. We have a diverse clientele of more than 400 leading governments, energy firms, and non-governmental organizations worldwide providing CERA with unparalleled breadth and depth of experience.

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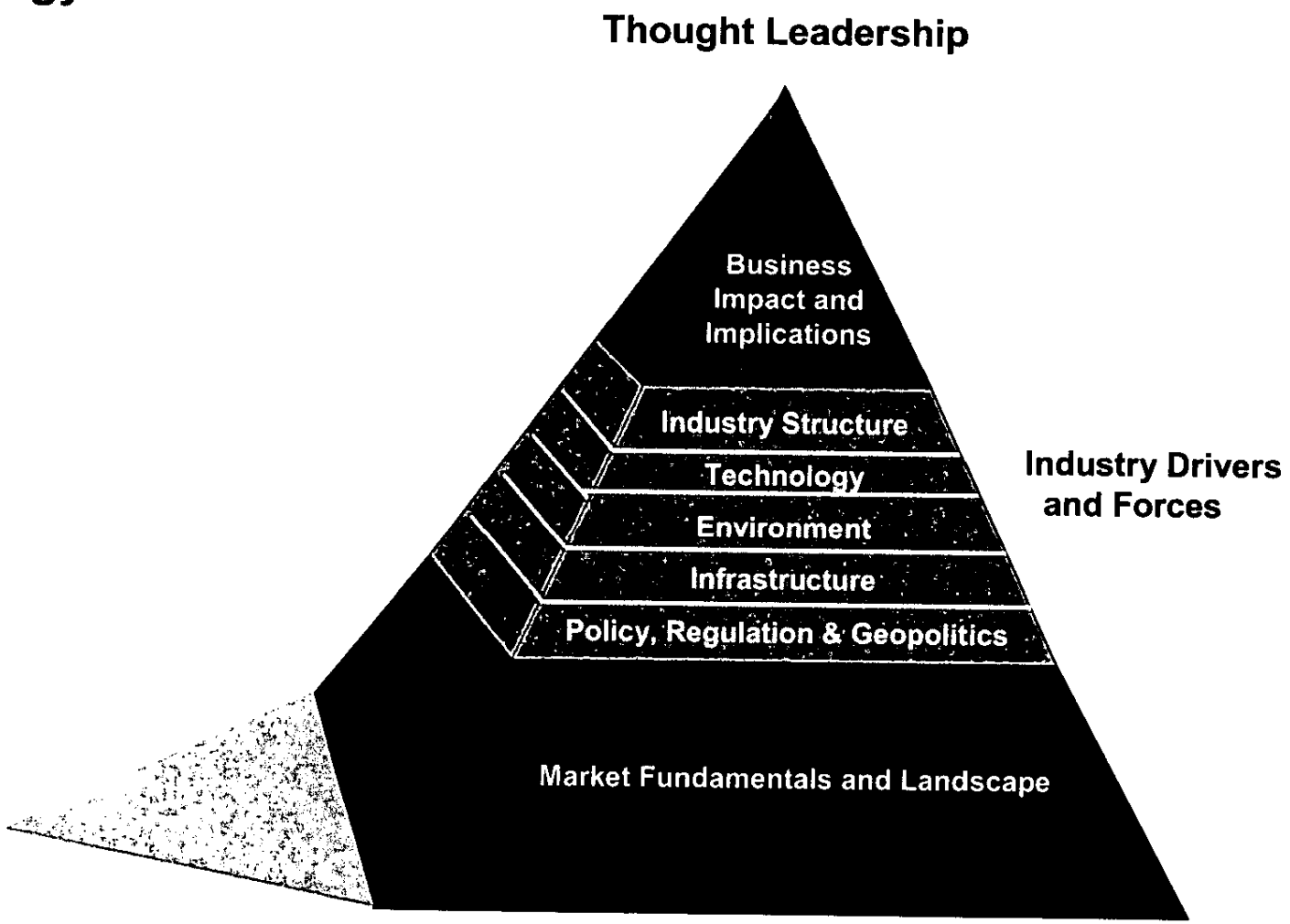
CERA Advisory and Consulting Services

Insight delivered through analysis of fundamentals, industry drivers, and strategy



Source: Cambridge Energy Research Associates.

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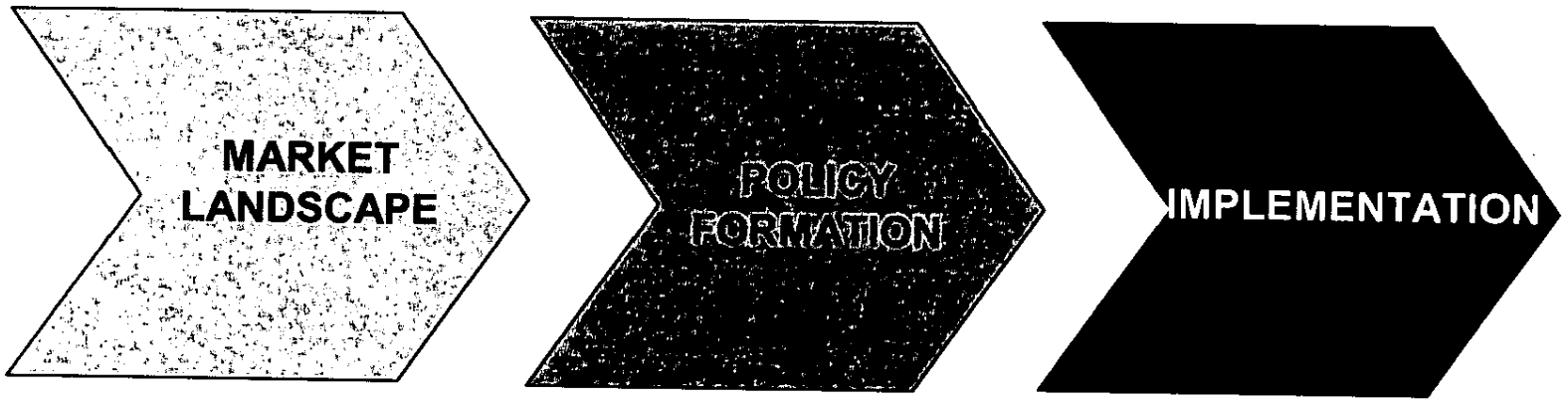
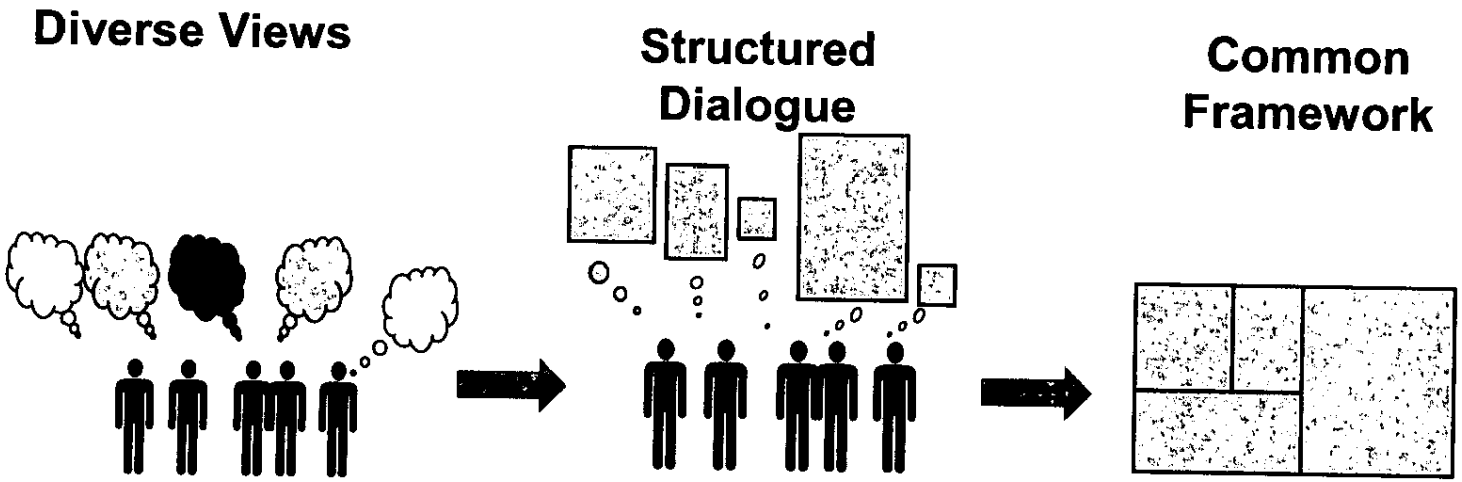
Policy Methodology and Selected Previous Engagements

Energy Policy Roadmap Components





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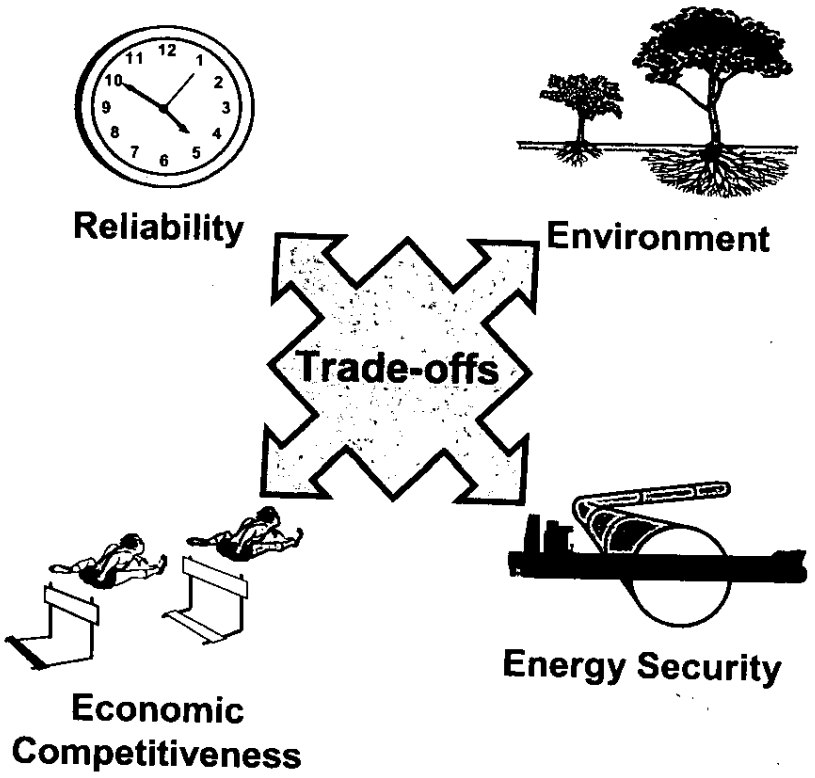
Role of the Market Landscape in Developing an Energy Roadmap

Defining the Landscape → *Defining the Policy Choices*

- Growth objectives
- Social, environmental and planning constraints & commitments
- Outside Linkages
- Geopolitical, economic, fuel and technology outlooks
- Supply and demand projections regionally and Globally
- Current Institutional Structures



Source: Cambridge Energy Research Associates.

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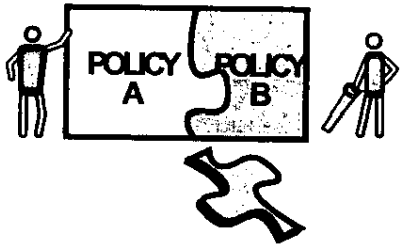
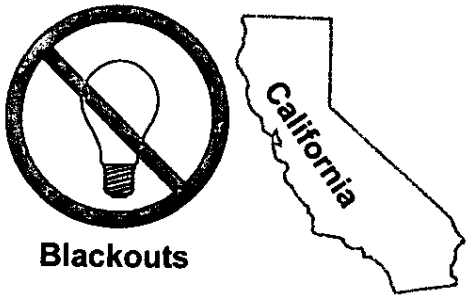
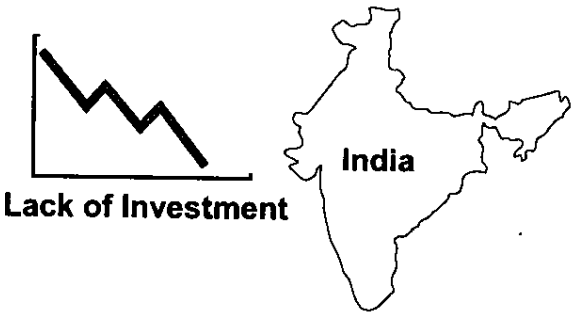
Policy trade-offs Must be Recognized and Resolved Early on



Or Face the Consequences...



Blackouts



Lack of Investment

Environmental Consequences

China

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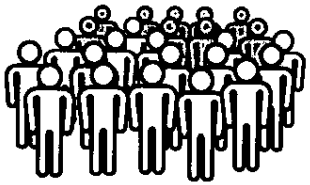
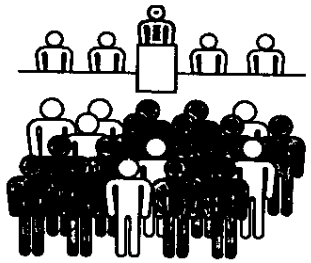
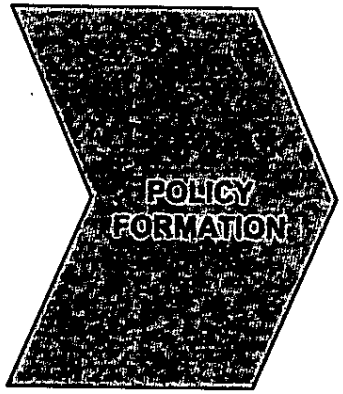
Four Key Policy Formulation Questions

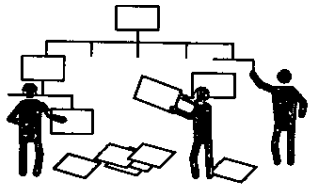


Who Decides?

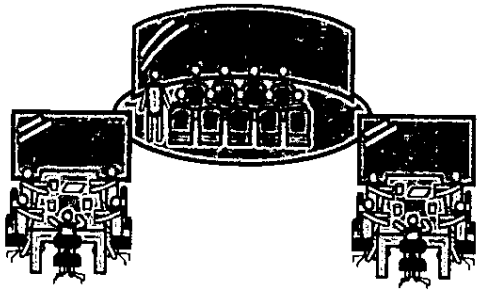


Who is consulted?





Which Topics?



What Institutions?

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We have assisted oil and gas clients in developing a broad range of strategies across the world.

Corporate
- IOC's strategy for high-oil price environment
- Independent's corporate portfolio strategy
- Supermajor's CO2 strategy

National Energy and Resource Development
- National resource plan based on fundamental gas demand supply forecast
- Create national resource planning and dev't

Business Unit & Regional
- SE Asia regional upstream gas strategies
- North Sea regional and country strategies
- West Africa business unit strategies

Exploration & Country Entry
- Middle East country gas entry strategy
- Atlantic Margin exploration strategy
- Various other country entry strategies

Major Resource Development
- Caspian region mega investments
- GOM and West Africa DW developments
- Major new Siberian resource development

Operating Asset Strategies
- Arctic mega asset renewal strategy
- Mature offshore asset cluster strategies
- Steam and CO2 flooding investments

Unconventional Resources
- In-situ and mined oil sands
- Tight gas, CBM and shale gas developments
- New unconventional resource technologies

LNG and GtL
- LNG liquefaction investments
- Portfolio assessment of GtL opportunities
- IOC's LNG portfolio strategy

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Case Example

Oil & Gas Producing Country (2007)

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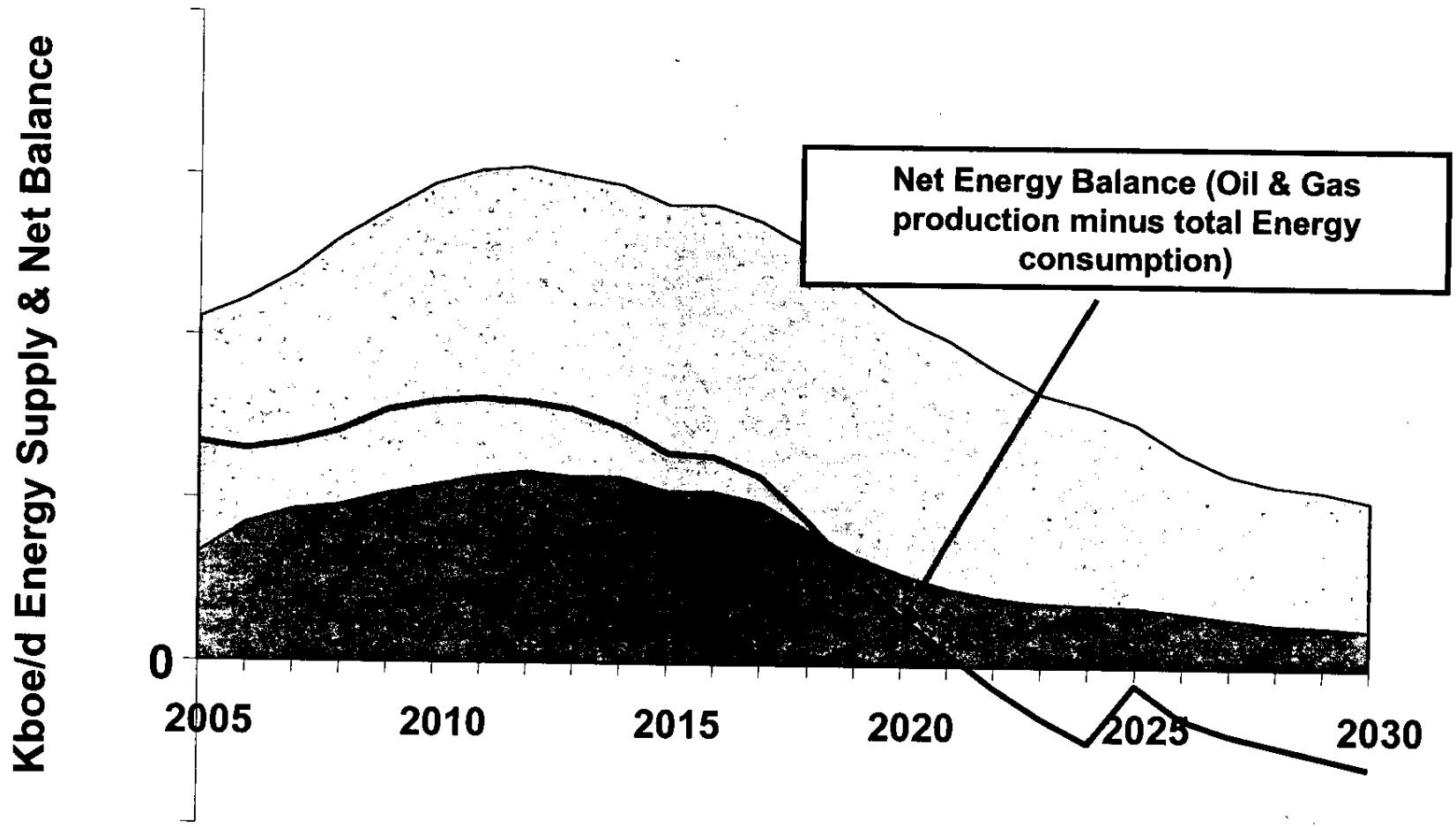
Emerging Energy Balance Shift Drove the Need for Policy Review



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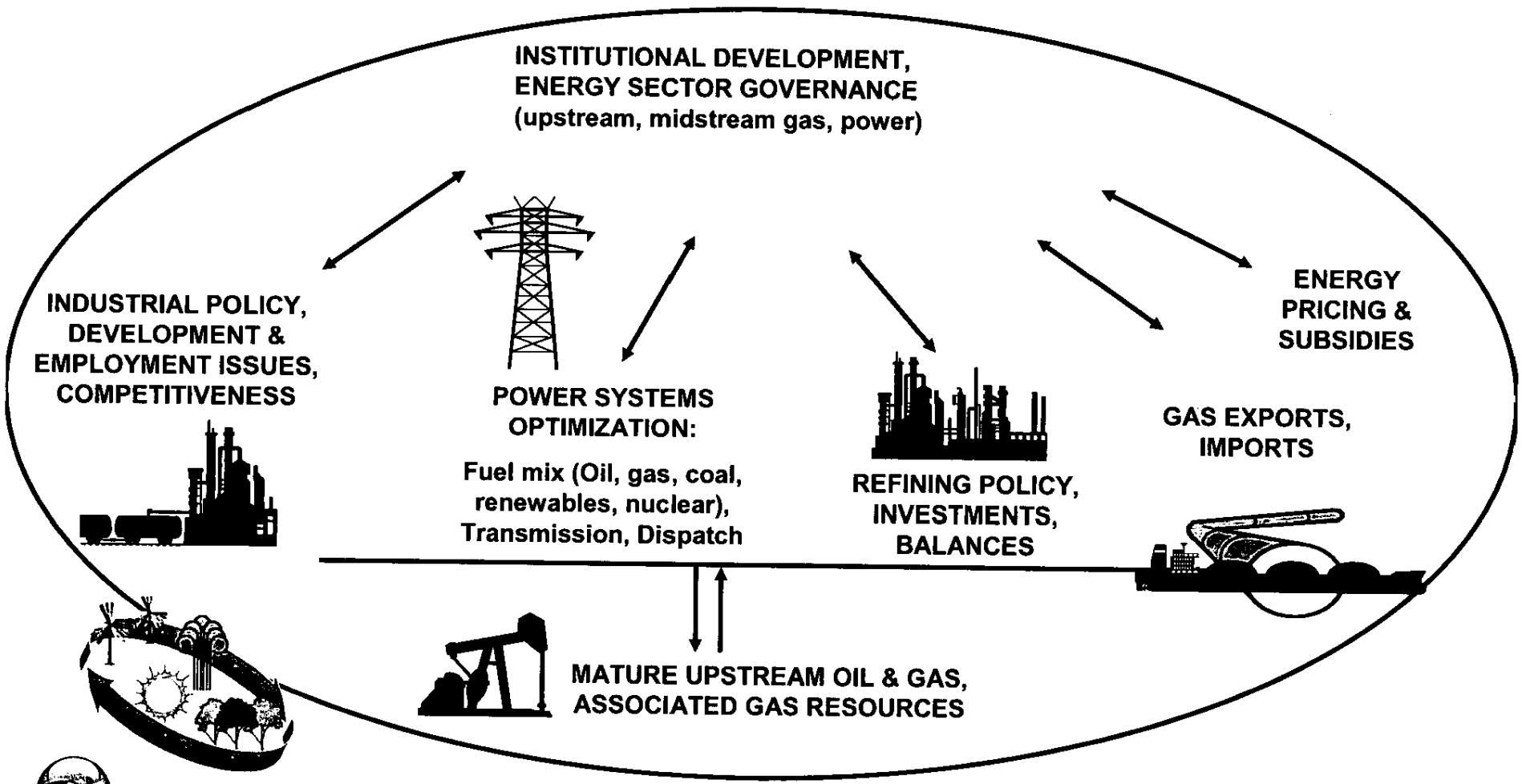
Source: CERA analysis, study data

Study Embraced the Entire Energy Spectrum



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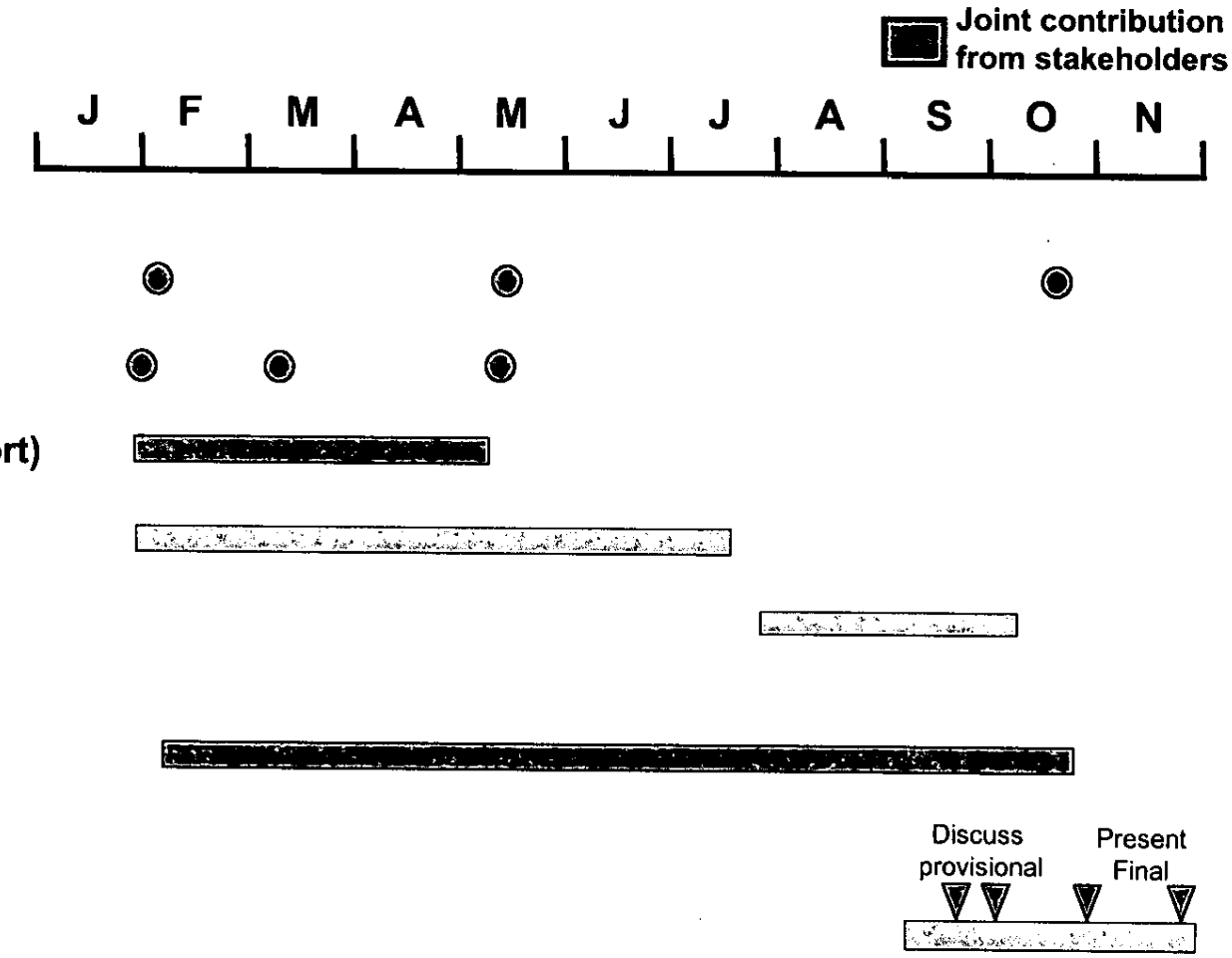
Case Example

Stakeholders were Engaged Throughout



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Case Example

Notional Country Energy Strategies were Developed to Test Stakeholder views

Notional Country Strategy

1. Policy Focus	Restrict / control demand across all sectors	Depend on neighbours for supplies	Give preference to upstream oil energy needs
2. Energy Supply Policies.			
3. Energy Demand Policies			
4. Energy Export Policy			
5. Fuel Mix Policy			
6. Industrialization / development policy			
7. Energy User contracts			
8. Employment			
9. Environm. Policy			
10. International Diplomacy			
11. Govt Regulatory Approach			
12. Foreign companies			

As part of the Stakeholder engagement process, CERA conducted a workshop to surface constraints / agendas affecting policy choices

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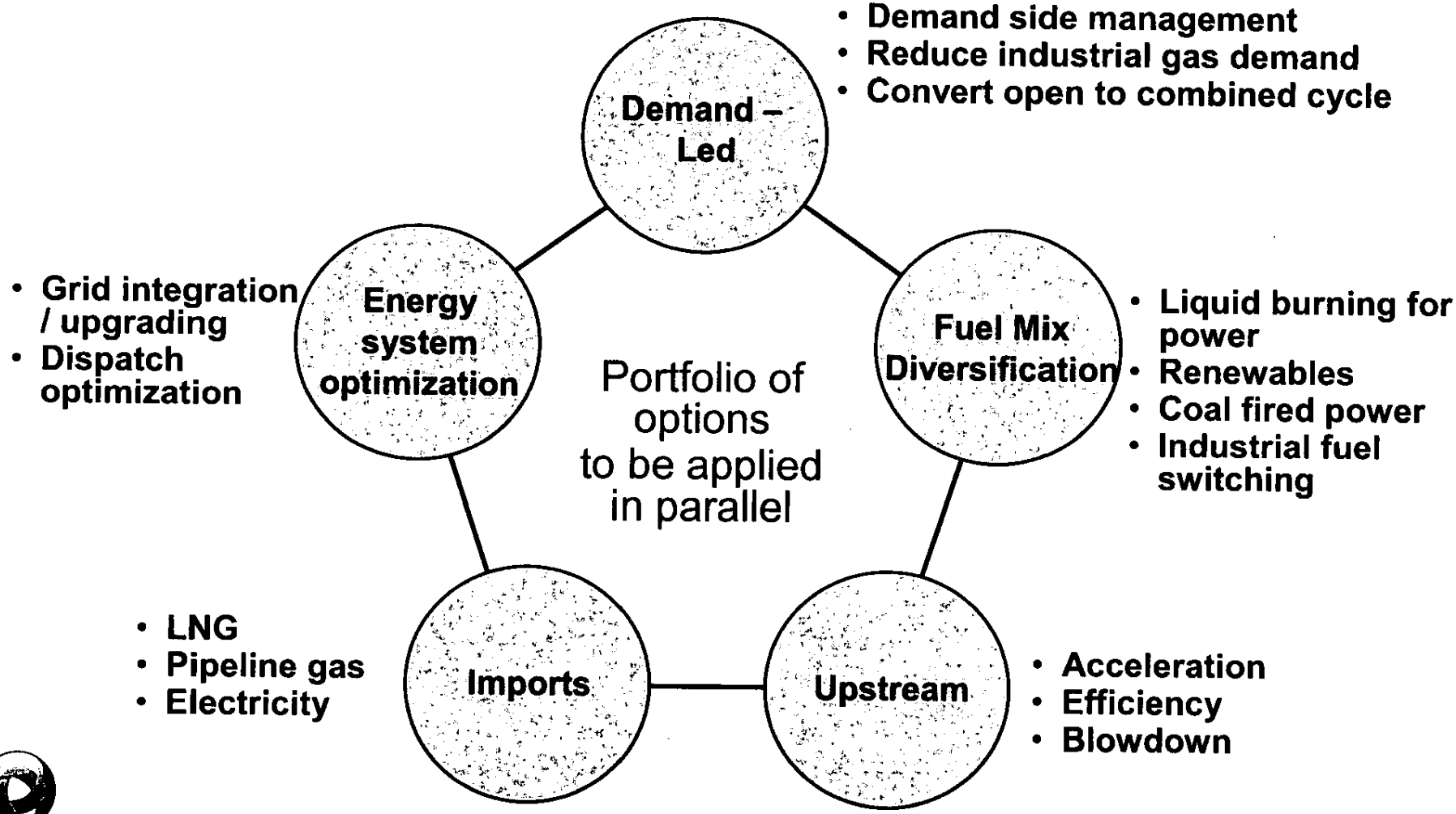
Case Example

The Study Analysed a Portfolio of Options to Optimize Future Energy Balance



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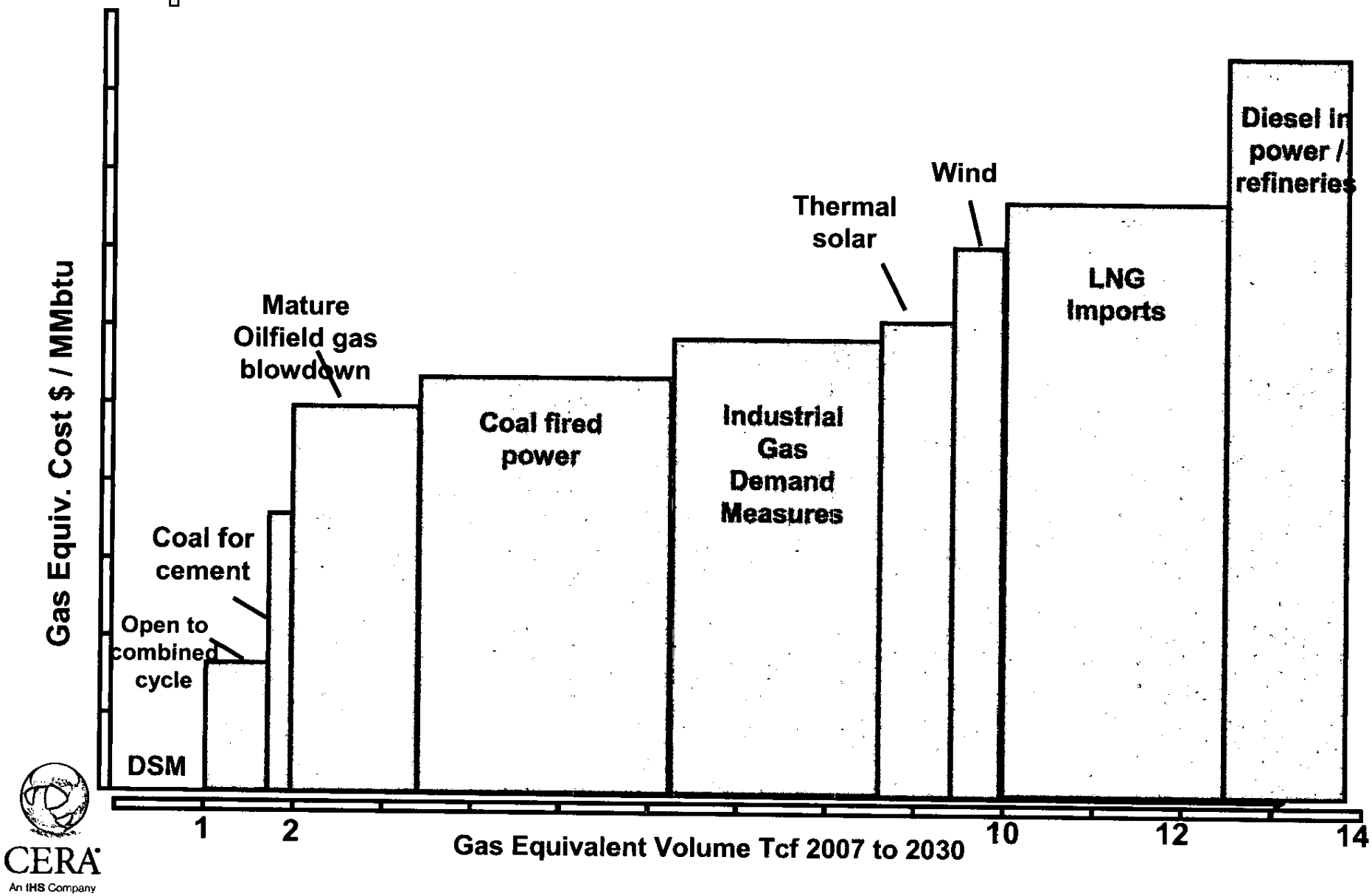
Costs of Energy Balance Options were Compared

Case Example



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Case Example

Qualitative Considerations were Critical in Developing Final Energy Policy Recommendations

Qualitative Factors to Consider	Key Questions
Strategic Fit	• Willingness to depend on neighbours ? • Attitude toward existing gas user contracts ? • What value does diversification have (gas or fuel sources) ? • Is there a strategic upside for certain options
Risks and Vulnerabilities	• What risks or uncertainties impact implementation ? • How robust is an approach to different global energy scenarios ? • How might institutional capability influence do-ability ?
Alternatives & Trade-offs	• Do more radical options exist ? • What- if certain options excluded ?

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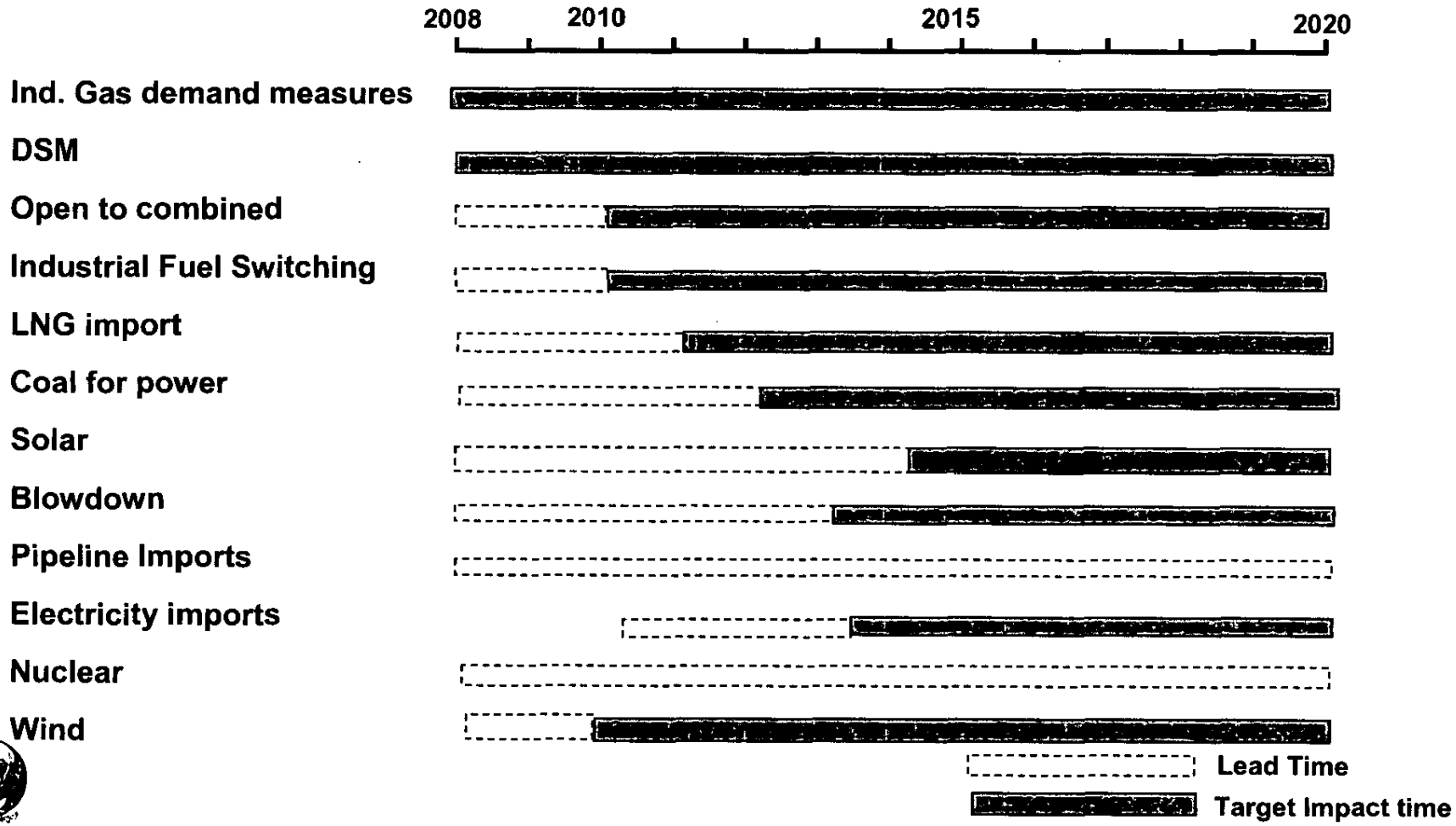
Case Example

Early Planning for Implementation was Recommended

Conservative / prudent planning assuming firm supply and no pipeline imports



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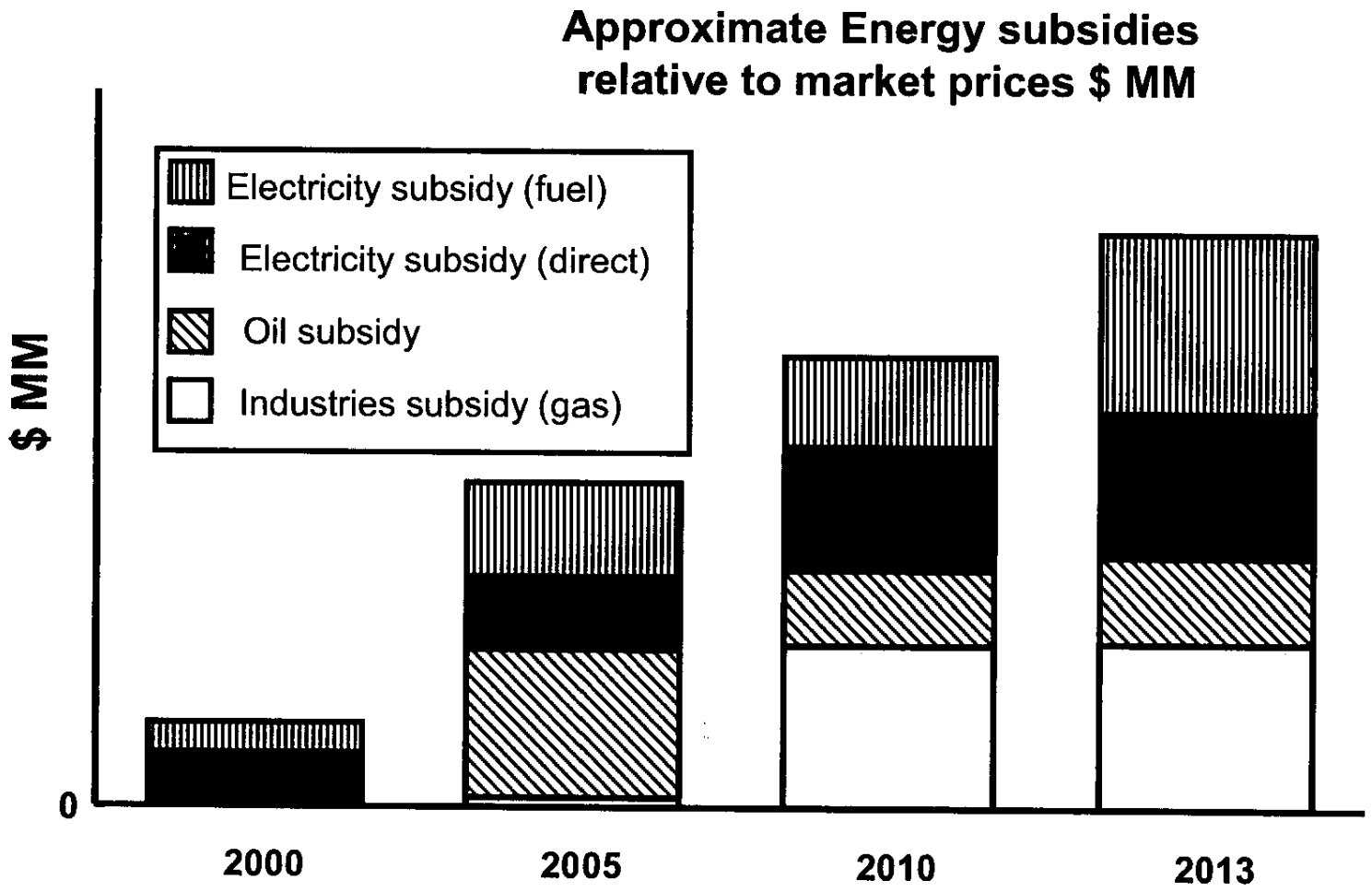
Identifying the Cost of Energy Subsidies Assisted Pricing Policy Thinking



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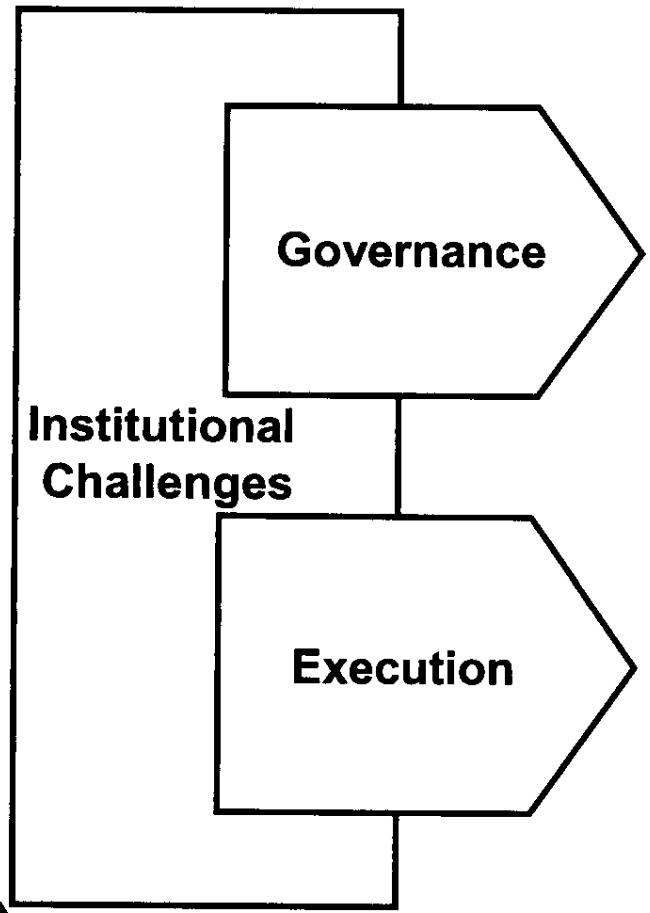
Case Example

Identification of Institutional Challenges and Solutions were Important When Recommending a Policy Roadmap



- Long term sector planning and data inventory
- Policy setting
- Designing and creating new institutional structures
- Allocating responsibilities and following-up
- Independent technical capability

- Co-ordinating wide range of policy actions (arising from this study)
- Individual actions are doable, but delivering all in parallel is a major challenge

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Learnings : Key Success Factors for Energy Policy Related Projects

- **Tailored, issue driven analysis**
  - — Identify critical issues to address early on
  - — Tailor model / analysis to focus on those issues
  - — Broad remit for recommendations : technical, economic, institutional, etc.
- **Build on existing knowledge**
  - — Review existing reports, work with local experts
- **Seek and build senior Stakeholder consensus**
  - — Early engagement with full range of stakeholders
  - — Continue to seek their views as project progresses
- **CERA's independence and objectivity**
  - — Flexibility to explore and deliver sometimes sensitive messages

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Selected Additional Energy Policy Experience

- World Bank – Yemen
- Ministry of Finance Economic Affairs – Barbados
- ExxonMobil – US
- Brazilian Petroleum Institute –Brazil
- Government Authority –Pakistan
- Ministry of Petroleum / Sonangol – Angola
- Bureau Of Minerals and Petroleum – Greenland
- Ministry of Energy – Kuwait
- Nigerian National Petroleum Corporation – Nigeria
- General Planning Council – Libya
- Confidential – Middle Eastern Country
- Directorate General of Hydrocarbons – Gabon
- Agencia Nacional de Hidrocarburos – Colombia
- JNOC / JOGMEC – Japan
- SOCAR – Azerbaijan
- Chinese NOC – China
- Government of Kazakhstan – Kazakhstan
- PetroEcuador – Ecuador
- ONAREP - Morocco

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Recent Strategic Consulting Experience Related to Climate Change and Clean Energy

- **Assessment of Voluntary Carbon Markets.** CERA developed a framework to assess the current and potential future demand for energy efficiency services, green power procurement and carbon offsets by businesses to achieve voluntary GHG emissions reductions.

- **GHG Policy Analysis.** CERA developed carbon abatement cost curves to inform the development of policy and business strategies related to the implementation of GHG policies.

- **GHG Policy and Market Strategies.** CERA has advised a variety of clients on the business risks and opportunities related to emerging GHG policies and markets.

- **Investment Strategies.** CERA has advised on investment and business strategies for technology providers and power generators by using a scenario framework to assess the potential risks and opportunities for various strategy options.

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CERA Scenarios – Testing Strategies against a Range of Different Futures

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CERA's Scenario Process

INPUTS

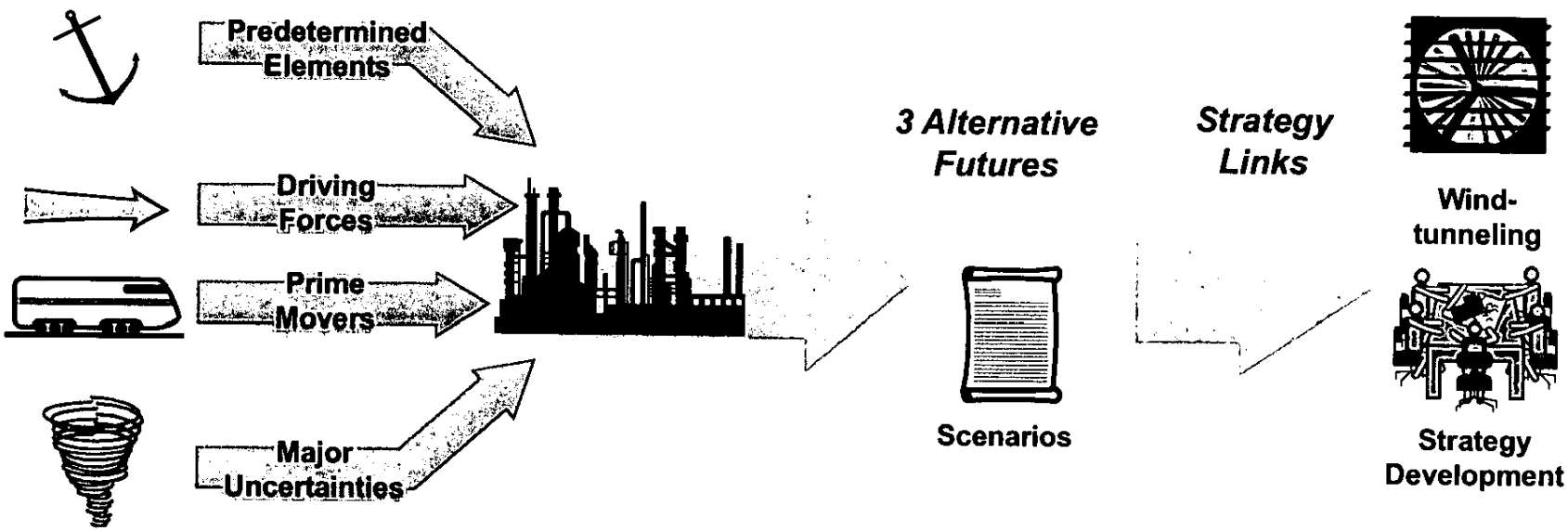
Factors that will shape the future

SCENARIOS

Combine inputs into alternative views of the energy future with signposts for each

STRATEGY

Apply scenarios to develop and test strategies



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Source: Cambridge Energy Research Associates.
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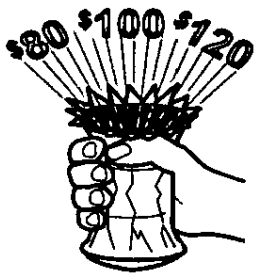
CERA's Global Energy Scenarios are the Backbone of Our Vision of the Future

ASIAN PHOENIX The center of global economic and political gravity shifts to Asia. Strong growth in China and India puts them on a path to eventually challenge the United States for global economic pre-eminence. Piecemeal international efforts to manage carbon emissions.



BREAK POINT Oil supply difficulties limit production growth. Average annual oil prices surpass $150 per barrel (nominal). Fear of peak oil encourages moves to enhance energy efficiency and accelerate growth of alternative fuels. Oil loses its monopoly on transportation. Strong, coordinated international focus on limiting CO_2 emissions drives carbon prices and research and investment in clean energy

GLOBAL FISSURES Widespread political backlash against free trade and globalization, combined with global trade and political disputes and growing security concerns over ongoing terrorist threats results in lower economic growth and weaker energy demand. Little to no effort to limit carbon emissions.

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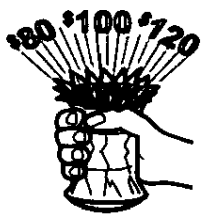
Source: Cambridge Energy Research Associates.

2008 US Scenarios Policy Drivers



RPS	Tax Incentives	Cap-and-Trade
❑ The 29 existing state standards remain in effect but increased compliance flexibility temper demand.	❑ Federal ITC and PTC peter out during the lead-up to federal cap-and-trade policy.	❑ RGGI continues, followed by WCI and a program in the Midwest. ❑ A federal program takes effect in 2015. ❑ Prices stay at $20-$35/ton.
❑ All existing, proposed and non-binding state goals are met.	❑ The PTC and ITC are extended through the start-up of federal cap-and-trade policy and are slowly phased out.	❑ A federal program starts up in 2012, requiring a 30% reduction below 2007 levels by 2030 leading to $100/ton prices by 2020. ❑ RGGI gets integrated into the federal program.
❑ A difficult economic environment saps the momentum behind state programs.	❑ The PTC fails to get extended past 2009 and the ITC reverts back to 10%.	❑ RGGI continues operating up until 2018 but prices remain at $2/ton. ❑ A federal program, as well as additional regional programs stall.

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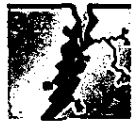
2008 US Scenarios Overview



	ASIAN PHOENIX	BREAK POINT	GLOBAL FISSURES
International Outlook	❑ Trend economic growth. ❑ Continued growth in world trade. ❑ India, China, FSU, and Middle East continue development of home markets.	❑ Productivity suffers from high commodity prices, reducing long run growth potential. ❑ Increased reliance on multilateral trading agreements and international solutions to regional conflicts.	❑ Economic growth slows as international trade declines. ❑ NA and European backlash against globalization. ❑ Focus shifts to national adjustment issues. ❑ Emergence of resource nationalism.
Technology Outlook	❑ Technology development dependent on government subsidies and demonstration projects.	❑ Rapid pace of technology development requires more public/private initiative and risk sharing. ❑ Domestic/foreign joint ventures develop.	❑ Technology development directed toward promoting energy security within North America.
Regulatory Environment	❑ Continuing experimentation with alternative regulatory solutions. ❑ State challenge federal initiatives.	❑ Enhanced commitment to competitive solutions at the federal and state levels. ❑ Move toward multi-state regional compacts.	❑ States successfully assert regulatory authority over resource adequacy planning and infrastructure siting issues.
Industry Structure	❑ Continuation of current hybrid environment with mix of competitive and regulated entities.	❑ Increasing reliance on private capital and market-determined returns on gas and power investments.	❑ Increasing reliance on traditional vertically-integrated utilities and command and control regulation and policies.

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Source: Cambridge Energy Research Associates.

2008 US Scenarios Overview (continued)

	ASIAN PHOENIX	BREAK POINT	GLOBAL FISSURES
Economic Growth	❑ Recession of 2008-09 is not severe. ❑ 2011: return to long-term trend growth. ❑ Slowing population/labor force growth after 2020 reduces trend growth.	❑ High energy prices make recession of 2008-09 worse. ❑ Productivity growth slows as capital is substituted for energy in production process.	❑ Recession delayed to 2009-10 but is severe as world trade shrinks. ❑ Productivity growth well below historic norms.
Growth in Power Demand	❑ 1.6% CAGR to 2020. ❑ Recession slows growth until 2013. ❑ 1.6% CAGR after 2020 even as population growth slows.	❑ 1.1% CAGR to 2020 due to rising real power prices and sharper recession. ❑ 1.0% CAGR after 2020 as real prices escalate and population growth slows.	❑ 1.1% CAGR to 2020. ❑ 1.4% CAGR after 2020 despite declining population growth rate.
Investment	❑ Near term drivers: demand growth and tighter reserve margins. ❑ Long term drivers: continued demand growth, aging plants and environmental programs.	❑ Aggressive push for renewables and GHG legislation. ❑ Early retirement of fossil fuel units and accelerated investment in transmission. ❑ Investment requirements similar to AP.	❑ Need for transmission and generation reduced. ❑ Lower demand growth and greater reliance on domestic coal and natural gas.
Policy and Regulation	❑ Rising nominal retail rates. ❑ Some states end retail choice and reduce renewables targets. ❑ Federal GHG legislation by 2015. ❑ Many states move to reassert control over resource adequacy.	❑ 2012: Federal GHG legislation begins. ❑ Aggressive state RPSs. ❑ Regional transmission planning initiatives. ❑ FERC asserts federal authority over transmission siting.	❑ Increasing emphasis on energy security and independence. ❑ Emphasis on local reliability. ❑ Regional climate change initiatives abandoned.
Technology	❑ Focused in generation, transmission, and distribution (metering). ❑ Reliance on government subsidies for commercial scale development.	❑ Strong push for renewables, GHG abatement, and efficiency accelerate smart grid development. ❑ Commercialization of CC&S, PHEV, and storage technologies accelerated.	❑ Low economic growth pressures government budgets to support new technologies. ❑ Funding for new initiatives delayed a decade.

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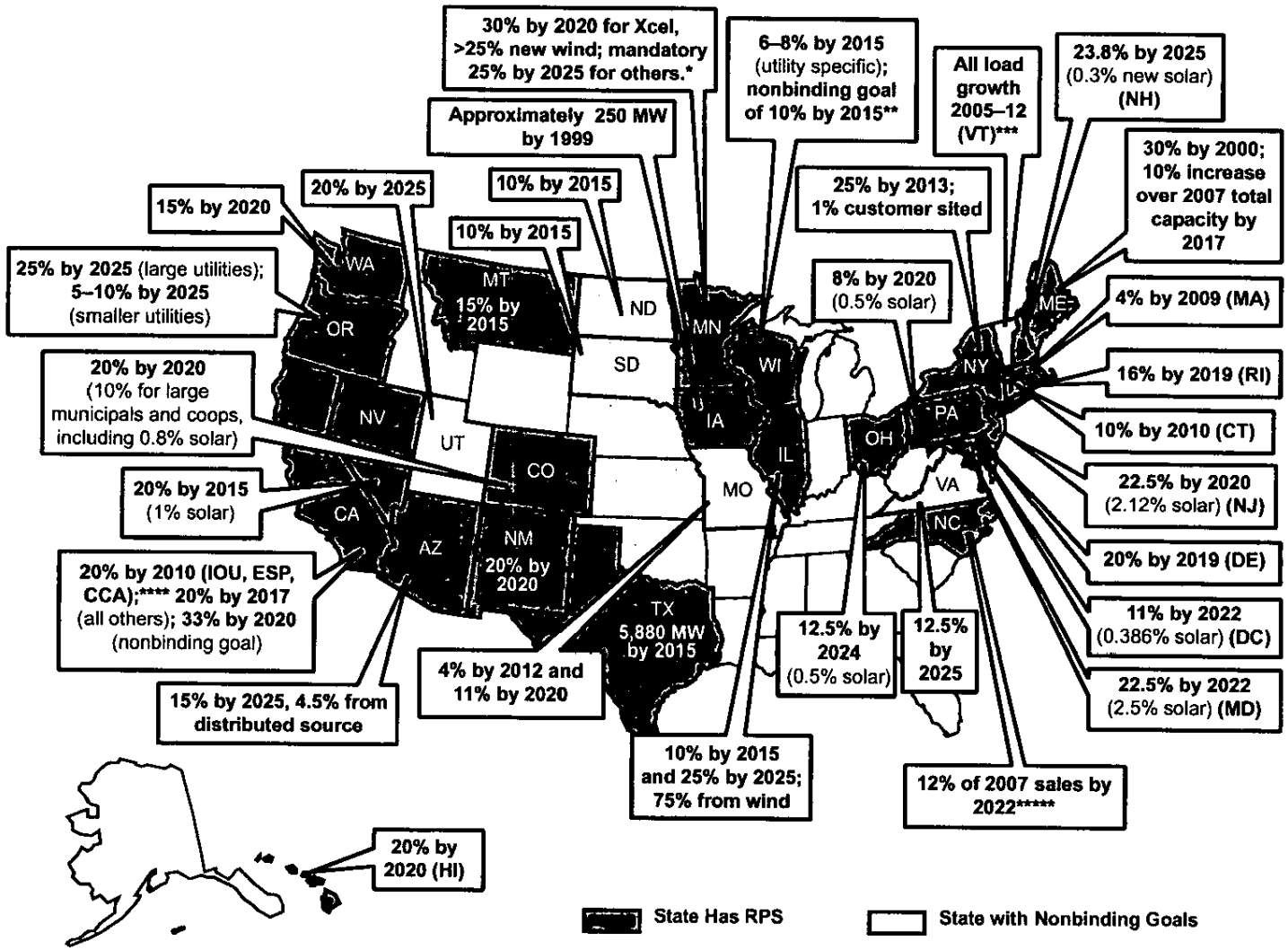
State Renewable Portfolio Standards Driving Renewable Investments



Source: Cambridge Energy Research Associates, Database of State Incentives for Renewable Energy (DSIRE).
*Previous Minnesota RPS was a nonbinding goal except for Xcel Energy.
**Vermont's voluntary standard becomes mandatory in 2013 if it is not met by 2012.
***California: IOU = investor-owned utility; ESP = energy service provider; CCA = community-choice aggregator).
****Wisconsin requires all utilities to increase renewables contributions by 6 percent over the 2001–03 average level by 2015and has a nonbinding goal of 10 percent by 2015.
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Selected CERA Studies

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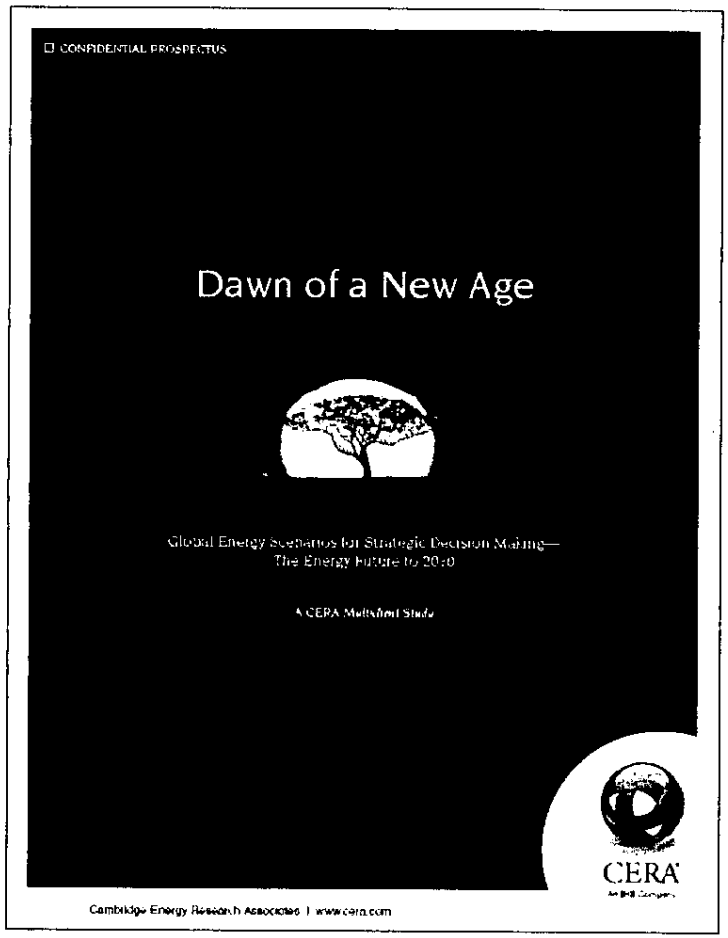
Global Energy Scenarios
Dawn of a New Age Multiclient Study



CERA's *Dawn of a New Age* study presents three long-term global energy scenarios to assess different paths for global energy supply and demand and to help define key risks and opportunities for a range of energy segments and geographic regions.

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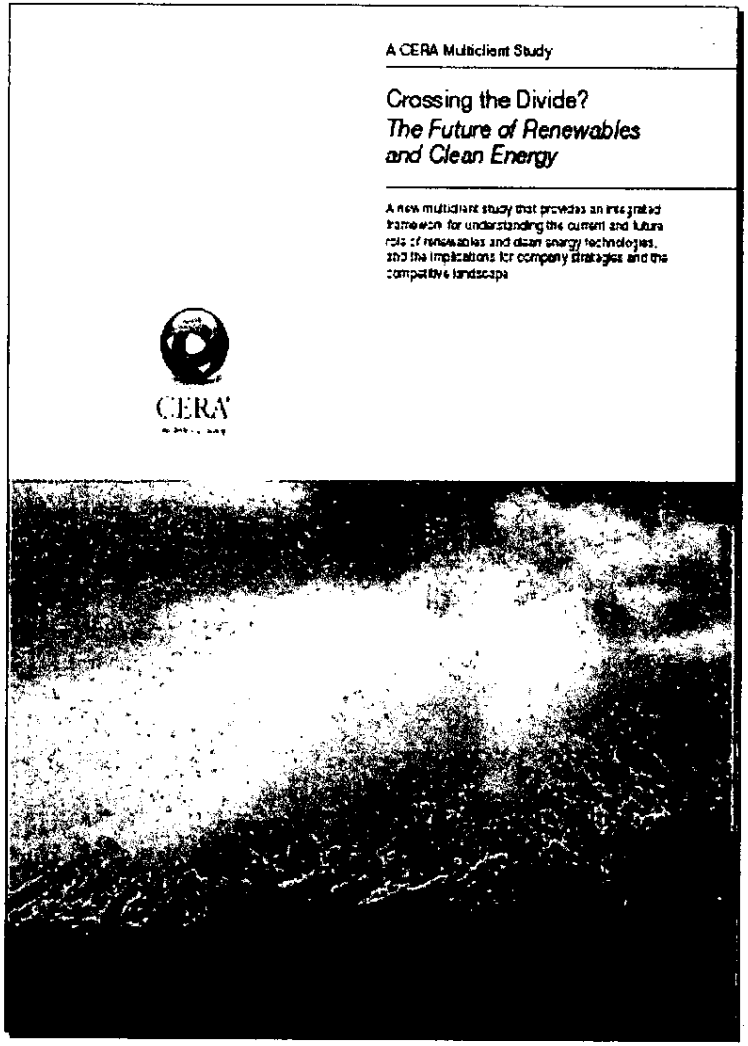
Clean Energy Technologies

Crossing the Divide Multiclient Study



CERA's *Crossing the Divide* study presents three long-term global energy scenarios to assess the winners and losers among various clean energy technologies and help define key risks and opportunities for a range of energy segments and geographic regions.

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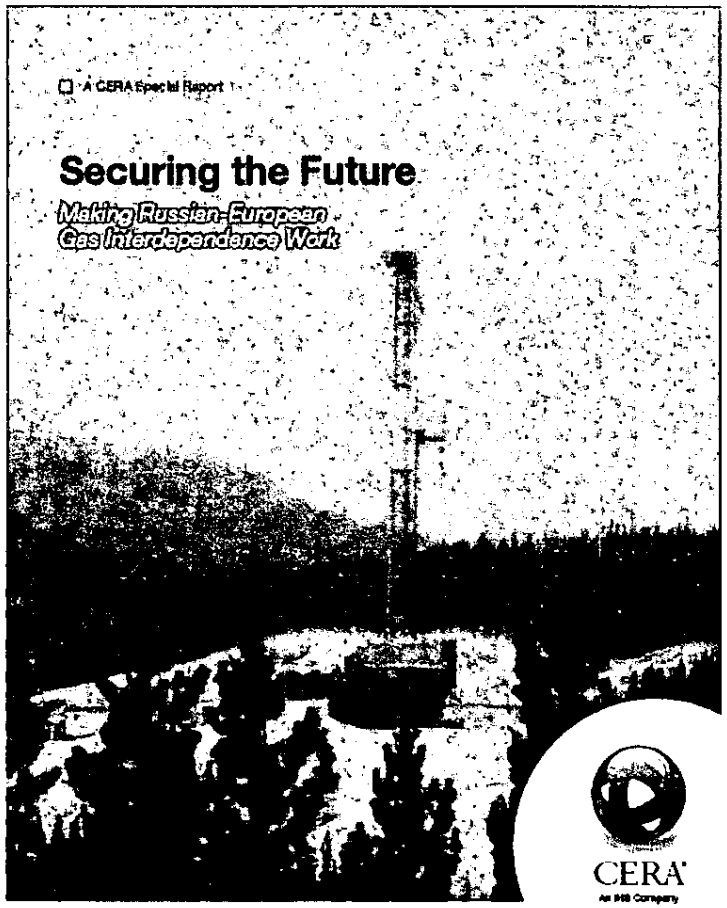
Multi Stakeholder Dialogue

Securing the Future Multiclient Study



CERA's *Securing the Future* study resulted from an extensive dialogue between multiple stakeholders to understand what was (and was not) achievable in securing the benefits of the gas trade between Europe and Russia. It identified the requirements to ensure mutual benefits and identified the risks to all parties from failing to nurture a trade that has benefited all parties for several decades.

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CERA is part of the IHS Group
The leading provider of insight and critical information in four key domains

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About CERA

- Leading international energy research and advisory firm
- Founded in 1983
- An IHS Company
- Global presence with offices in 14 countries.
- Staff of over 200 professionals including leading energy market, industry, and geopolitical experts covering all major sectors on a regional and global basis
- Extensive network of distinguished Senior Associates
- Diverse clientele of senior executives at leading energy industry corporations—an exceptional community of strategy and planning executives—and leading policymakers globally.

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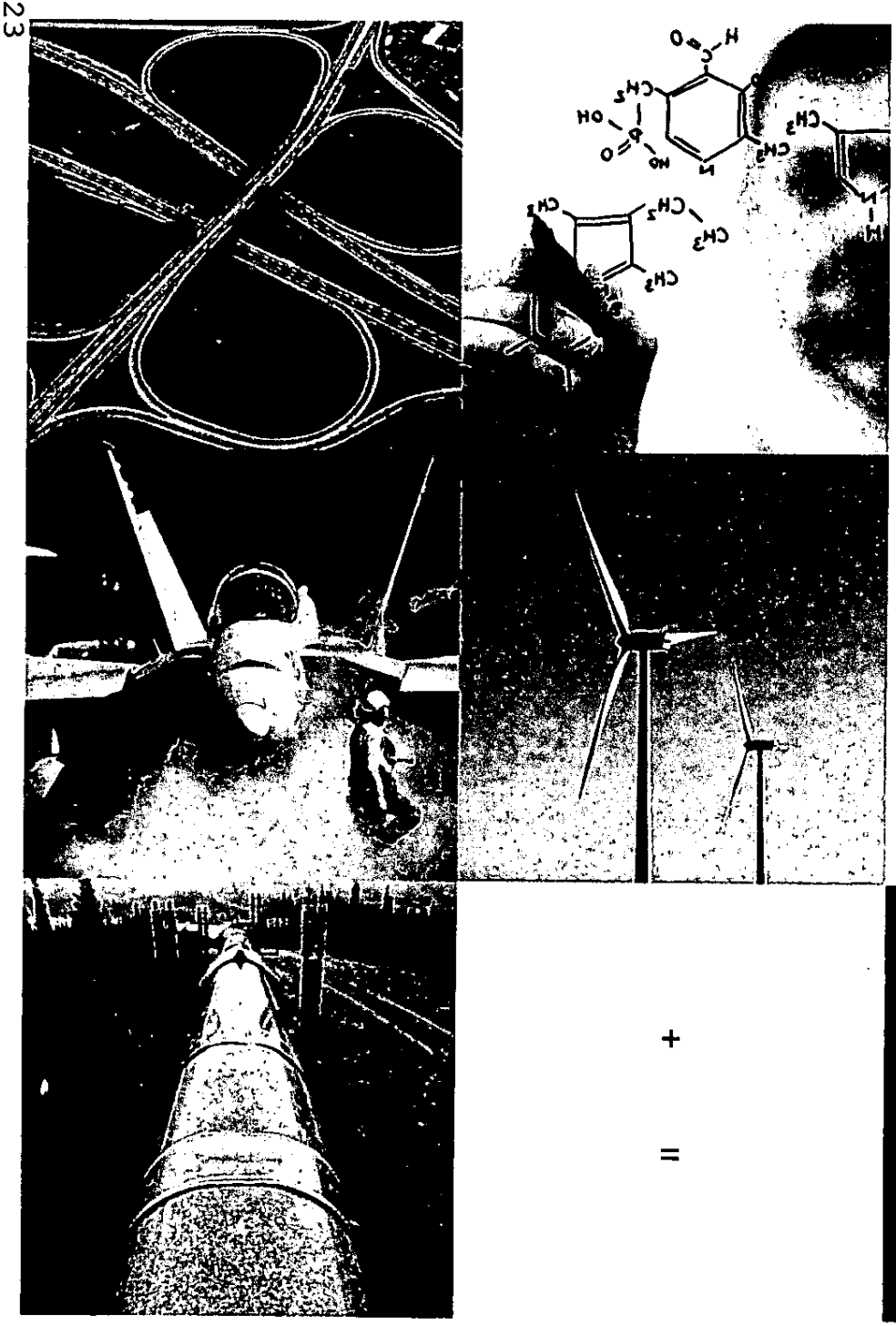

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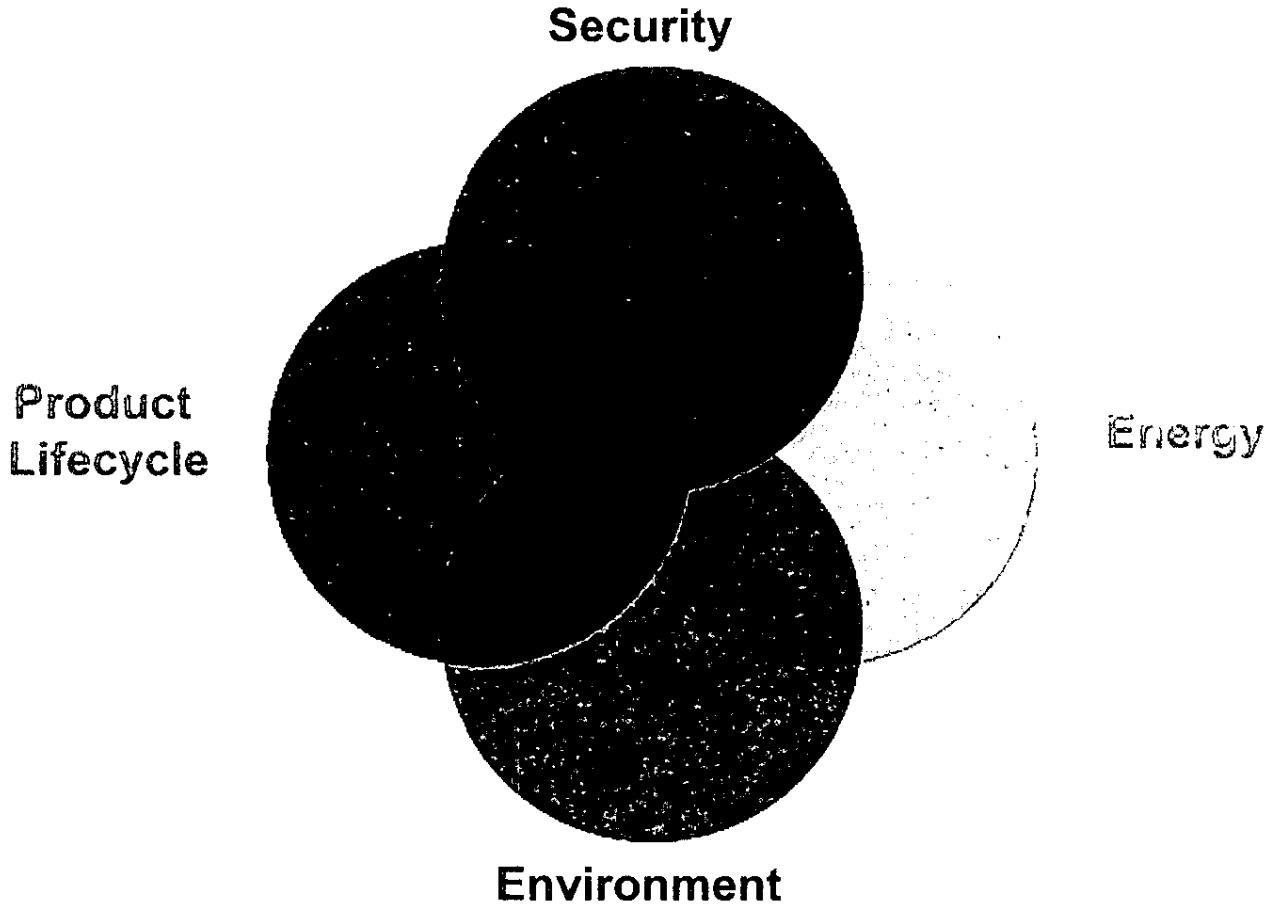

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If you have any questions about this presentation or CERA in general, please feel free to contact

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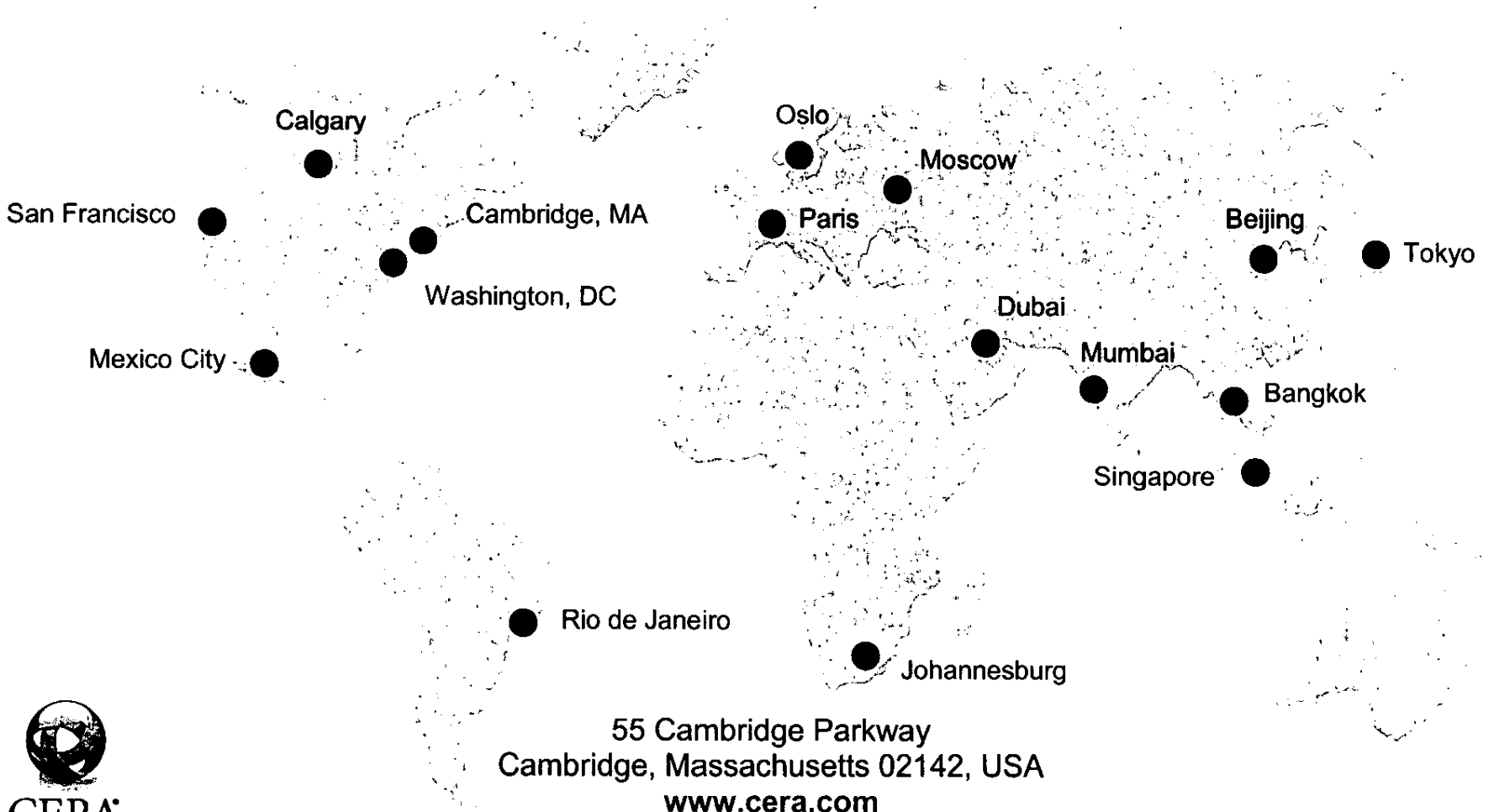

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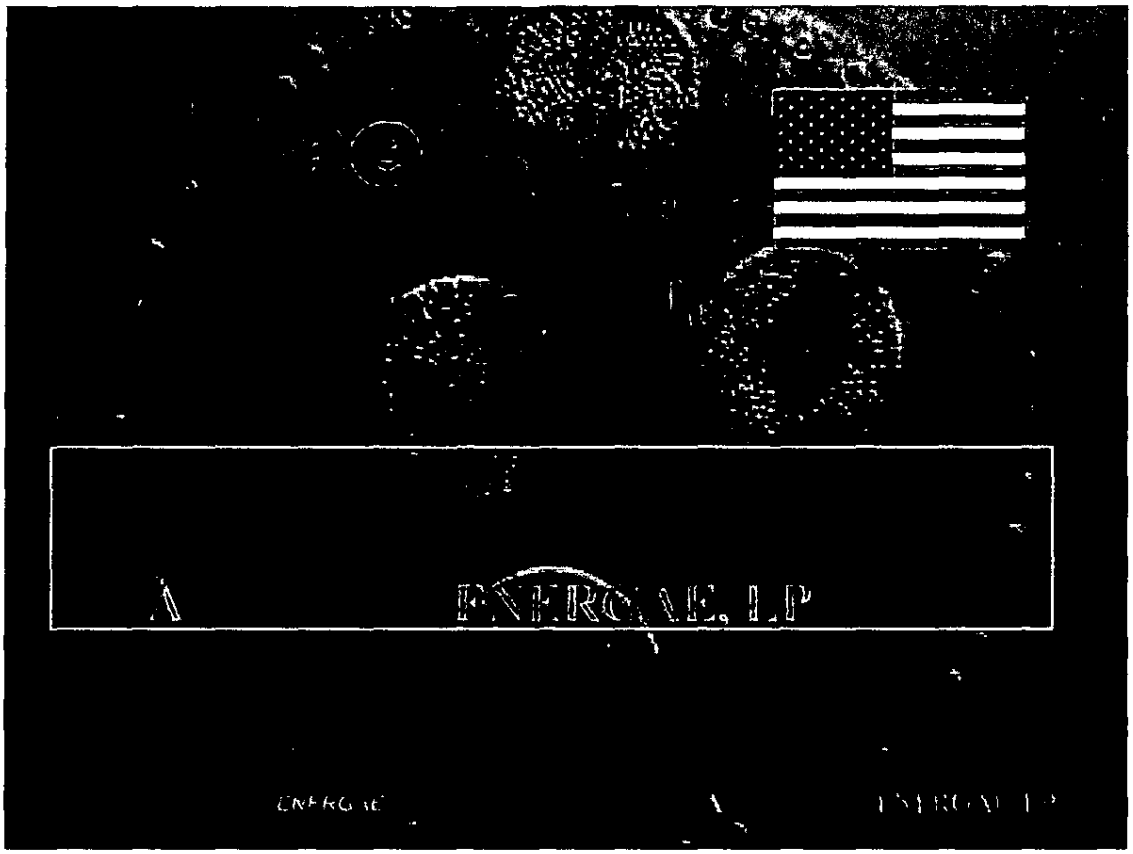

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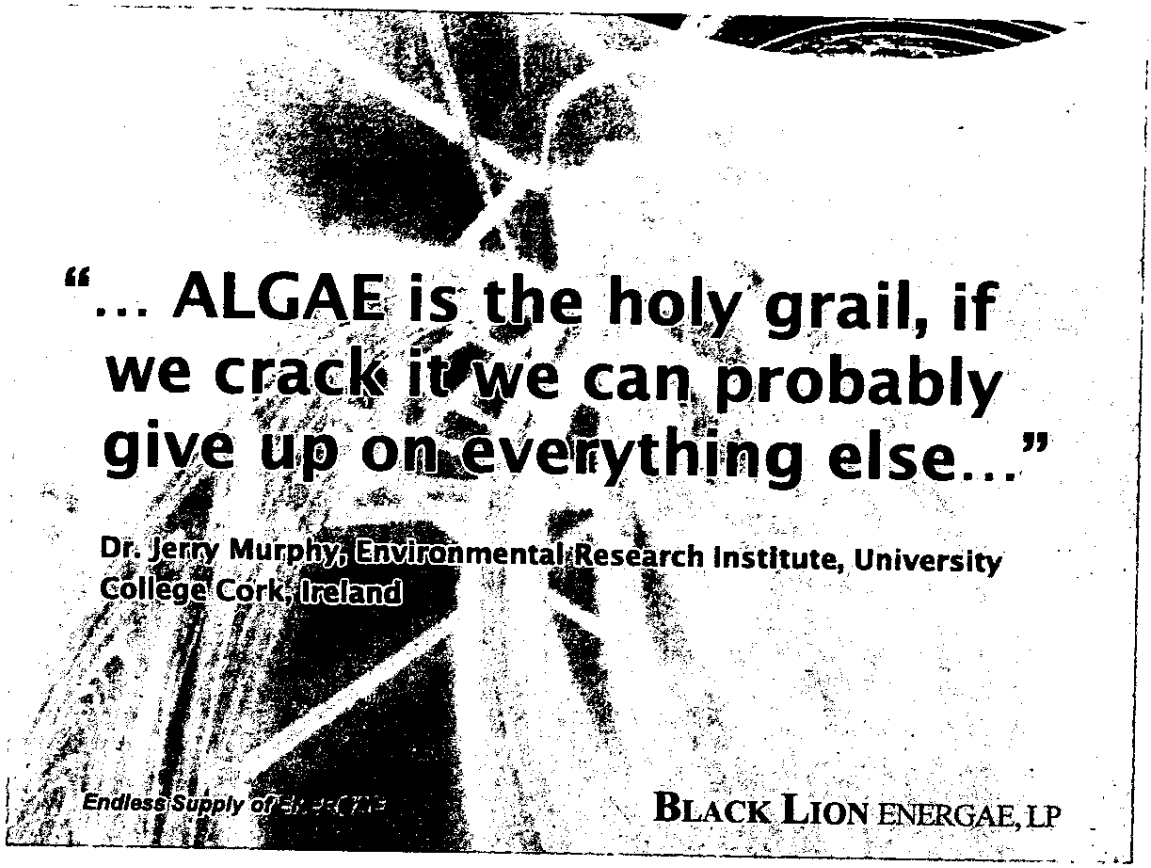
"... ALGAE is the holy grail, if we crack it we can probably give up on everything else..."
Dr. Jerry Murphy, Environmental Research Institute, University College Cork, Ireland
Endless Supply of
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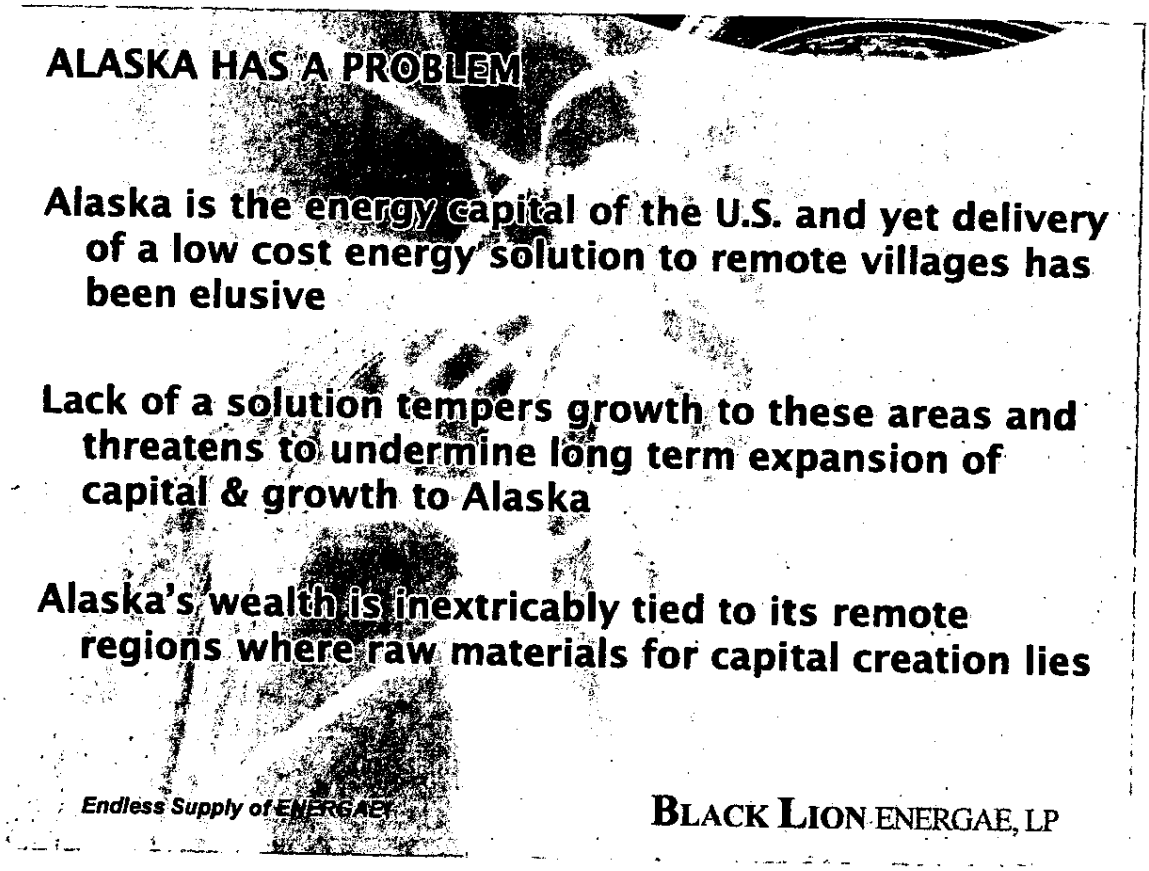
ALASKA HAS A PROBLEM
Alaska is the energy capital of the U.S. and yet delivery of a low cost energy solution to remote villages has been elusive
Lack of a solution tempers growth to these areas and threatens to undermine long term expansion of capital & growth to Alaska
Alaska's wealth is inextricably tied to its remote regions where raw materials for capital creation lies
Endless Supply of ENERGAE
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ALASKA HAS A PROBLEM

Alaska is perceived a big oil's big brother, yet fuel costs in remote villages are among the highest in the world – higher than Central America or other developing countries who have no access to oil finds.

the long term financial health of Alaska's Native Corporations and remote regions lies with delivery of a cost effective energy solution to its own: you can have all the wealth in the world, but if you can't provide for your own, you have a problem.

energy alternatives

diesel fuel – $.24 to $.25 per kwh

- efficient energy source – yet, even with Alaska's abundant oil resources, they can't supply remote areas inexpensively
- costly transportation
- environmentally challenged

solar – $.35 to $.45 per kwh

- too much land required for 1 megawatt of power
- heat value non-existent/limited in winter months

wind – $.25 to $.29 per kwh

- average efficiency rating on wind generators is 35%
- costly to install and maintain relative to energy return
- lack of energy grid to maximize return

natural gas – $.09 per kwh

- perfect source; too costly to install relative to total population
- costly conversion from current diesel energy platforms

geothermal – $.29 per kwh

- excellent source, but few areas have access
- costly conversion of current diesel energy platforms

coal – $.06 to $.08 per kwh

- lowest cost energy source, but infrastructure non-existent
- unwanted discharge – "true clean coal" solution elusive
- costly conversion of current diesel energy platforms

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Alaska needs an energy platform solution that provides the following:

• kwh	– low cost
• environment	– safe
• diesel platform	– combined with no interruption
• transportation	– current infrastructure
• scalable	– energy platform expanded as need dictates
• set-up time	– months, not years
• infrastructure	– reasonable costs
• maintenance/upkeep	– low
• renewable	– "green"
• operation	– ease of use

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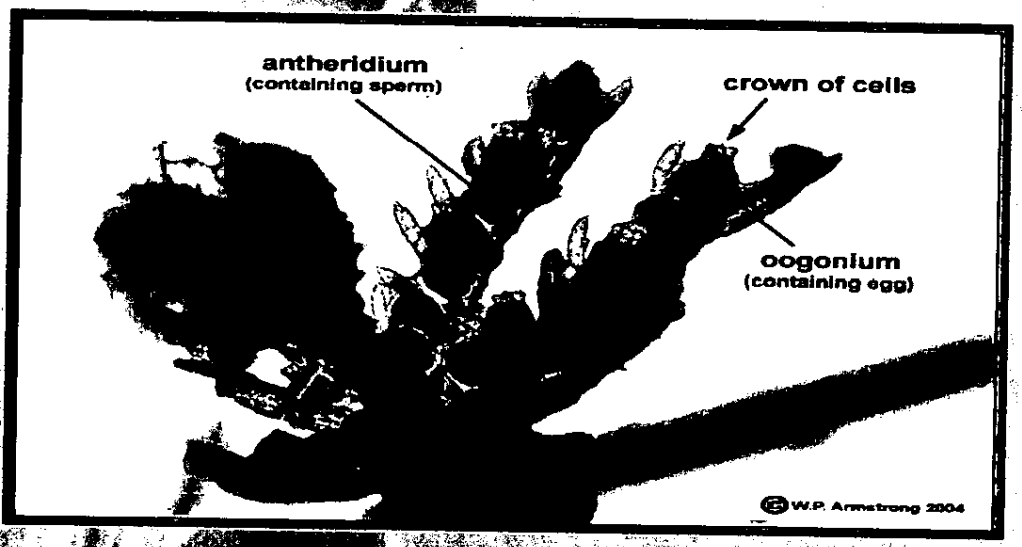
Alaska needs Algae



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ALGAE

$.15 per kwh

- current diesel system
- manufactred oil
- self-sustaining energy
- weather
- BTU quantity/quality
- maintenance
- turn-key systems
- ongoing operation

- retained, enhanced
- on site, at will
- does not require outside source to function
- operates in sub-zero under low cost greenhouse
- manipulate relative to need
- low cost
- RWE builds, maintains
- locals without Phds

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ALGAE history

National Research Energy Lab (NREL) spent $450 million studying alternative biofuels from 1977 through 1995, $25 million of which went to Algae research

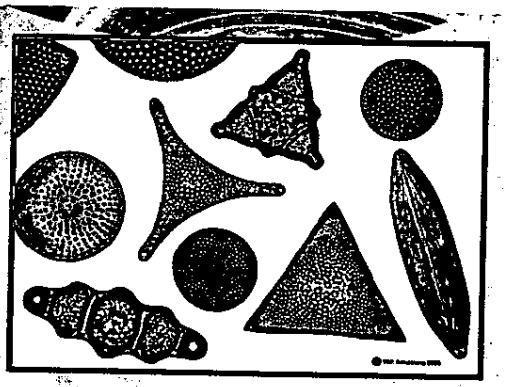
- qualified Algae strains relative to oil *quantity*
- qualified Algae strains relative to oil *quality*
- published Algae white paper in 1998 detailing findings

– **$12 oil - Clinton administration cut funding**

– **Algae research – shifted overseas due to Algae growth problems**

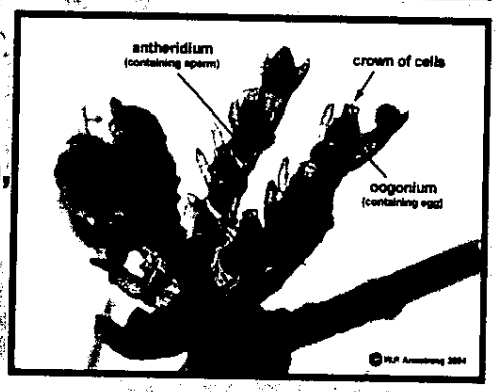
bad ALGAE - massive growth, **limited** energy value

dunaliella tertiolecta
dunilelia salina
butryoccocus braunii
cymbella
nitzschia
amphora
bacillariophytes



good ALGAE - massive growth, **much** energy value

green algae
dunilelia salina



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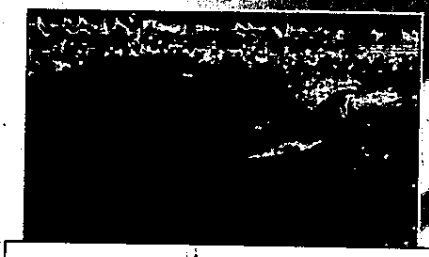
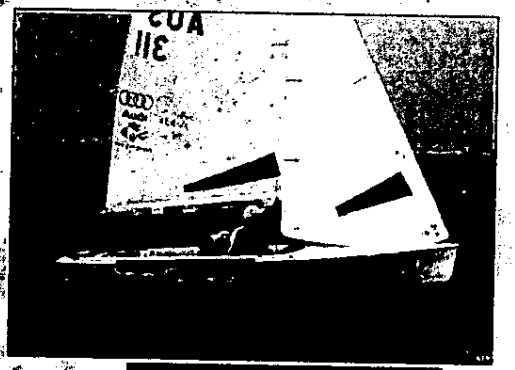
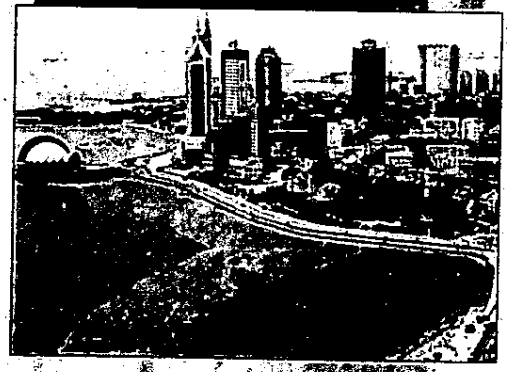
ALGAE growth worldwide - exploding





Indian Ocean, 2008



Shanghai, China - the world's most populous city, Pacific Ocean, 2008

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The Carolinas were hard hit with ALGAE problems

They turned to two men to find a solution: Richard Armstrong & Tim Tompkins

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Armstrong - physicist, electrical engineer, bio-systems & process systems specialist

Tompkins - chemical engineer, bio-engineer

together Armstrong & Tompkins built $7 billion in pulp, paper, & energy in the southern states - BF Goodrich, Duke Power, Bowater, Rhone Poulec, GE & others

Armstrong & Tompkins had worked to solve "bad" ALGAE growth problems for these companies. Armstrong & Tompkins never had to put out a resume to bid a job, word of mouth & reputation was enough

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Carolinas - "...get rid of it, or find a use for it..."

Armstrong & Tompkins visited ALGAE research centers worldwide

what they found... ALGAE was loaded with oil; firms were growing it

but, two major problems associated with ALGAE oil eluded solutions

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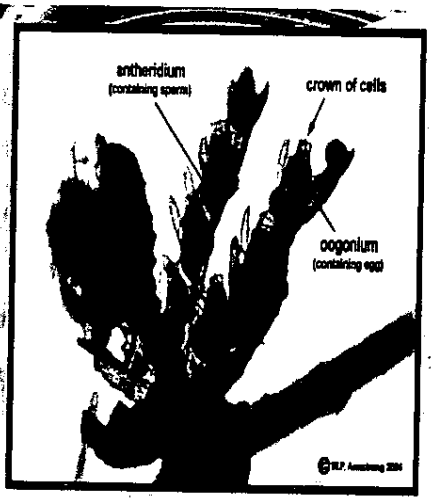
Problem 1 - Growth: starving the ALGAE increased the oil value, but it slowed the growth



Problem 2 - Oil Extraction: extracting energy from ALGAE's 'tight' cell walls was costly

After much research, personal capital & trial & error Armstrong & Tompkins invented solutions

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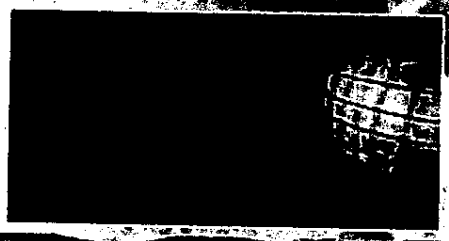
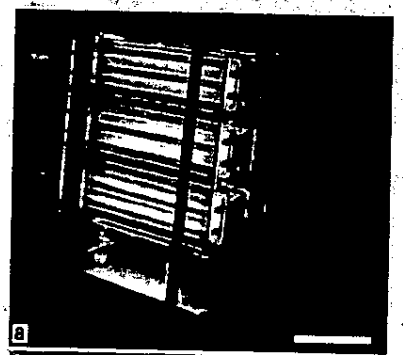
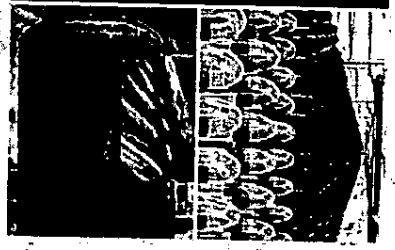
In developing their solutions, Armstrong & Tompkins' visited all known ALGAE bioreactors....

ALGAE bioreactor – a man-made incubation unit in which ALGAE is grown in order to produce oil & other ALGAE bi-products

many good ideas.....but most fell short...either too costly to build or they couldn't efficiently extract oil







Armstrong & Tompkins *A.T. Bioreactor* design principles

- Produce large quantities of high energy value Algae and bi-product
- Cost effectively produce the oil & bi-product
- Complete automation to manage input/ouput

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if you could build a customizable, fully automatic, computer controlled engine to grow massive amounts of oil, *what would it look like?*

the engine would need to be high tech, ultra durable, made of thermo-isolated materials to prevent energy loss. it would need to achieve optimal nutrient monitoring, optimal light exposure, optimal water flow, optimal CO2 & NOx intake & exchange, and optimal oil extraction.

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it would look like this...

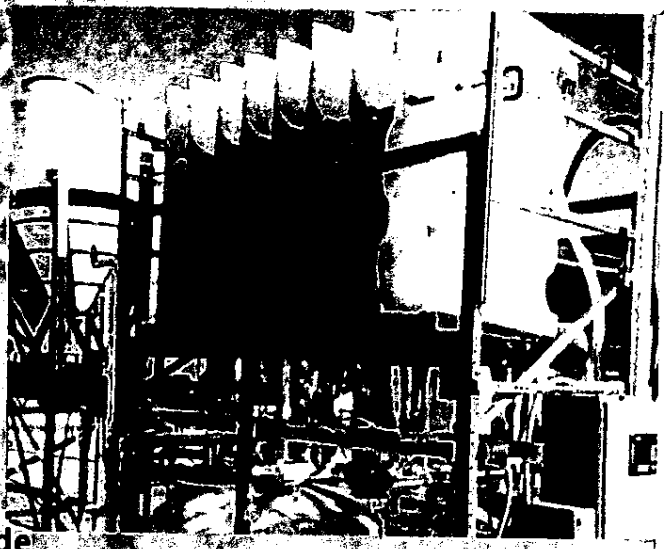
It would have

full automation

constant monitoring of
- nutrients
- light
- gas exchange/intake
- water flow
- PH level
- temperature controlled

continuous harvesting

self-sustaining - low quality oil burned to provide electricity for the entire unit



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ALGAE optimization & automation produce the following:

low cloud point

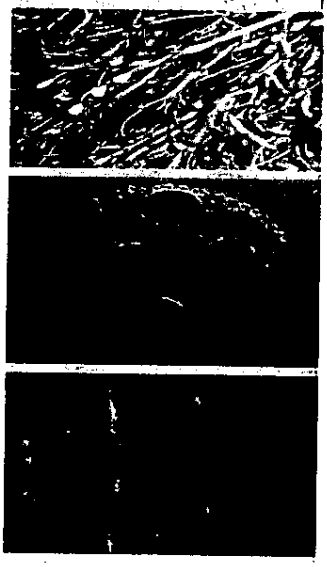
cleaner oil

low sulfur

fuel for vehicles - direct use

high quality oil & BTU value

sucks up nasty gases while growing



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ALGAE traits

35% to 80% of body weight in oil

fastest growing organism known to man

ALGAE oil combined with diesel fuel produces superior burn ratios & cleaner fuel

ALGAE can eat noxious gases produced by burning fuel - turns them into harmless organic carbons

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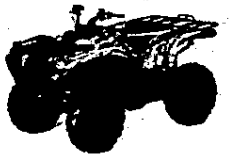
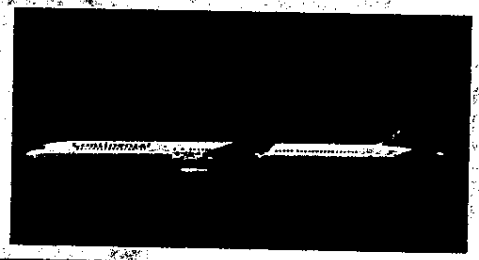
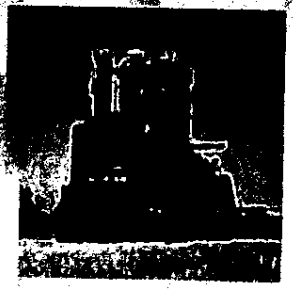
products derived from ALGAE oil

- jet fuel
- gasoline
- plastics
- hydrogen
- Ethanol







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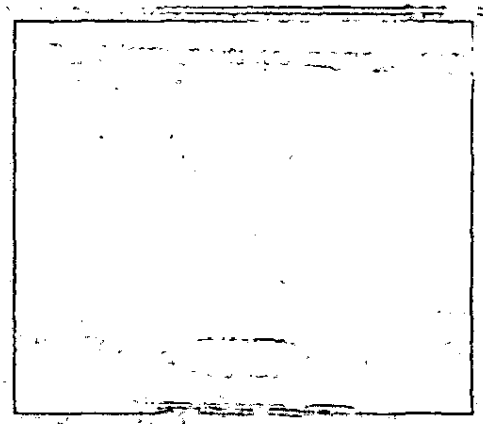
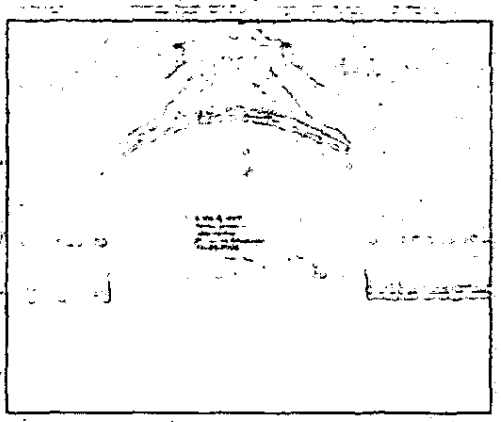
sample Algae growth rate





It took 30 hours for ALGAE to grow 20 fold in Armstrong & Tompkins bioreactor using their proprietary nutrient solution & automation

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Armstrong & Tompkins Bioreactor

A.T. Bioreactor	Others
closed System	· open pond system
full Automation	· partial automation
super strains	· local wild strains
98% of oil extracted using proprietary harvesting methods	· 45% of oil extracted using "pressing"
cleaner oil extraction	· less quality oil
low cost to produce	· high cost to produce
low cost to build	· high cost to build
optimal CO2 intake	· poor CO2 management

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some of RWE curent agreements

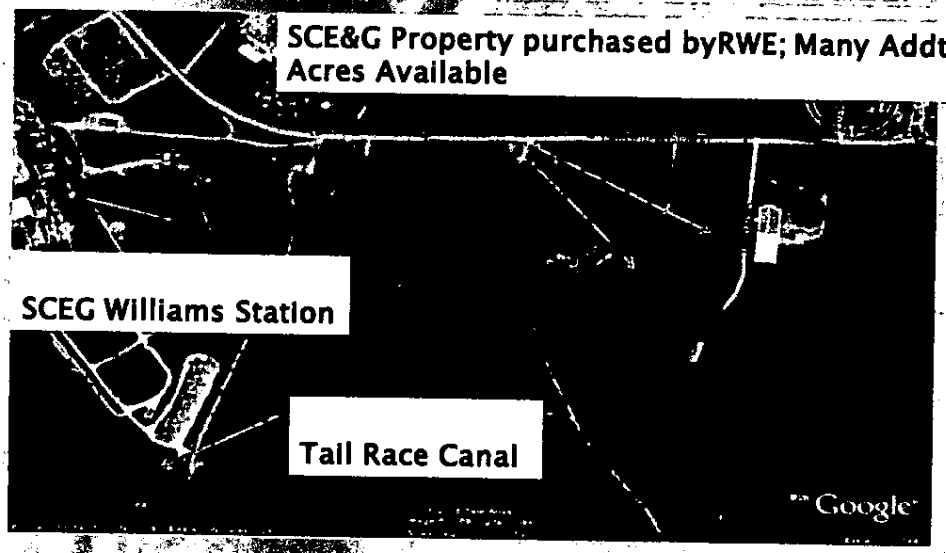
1. Universities – super Algae strains

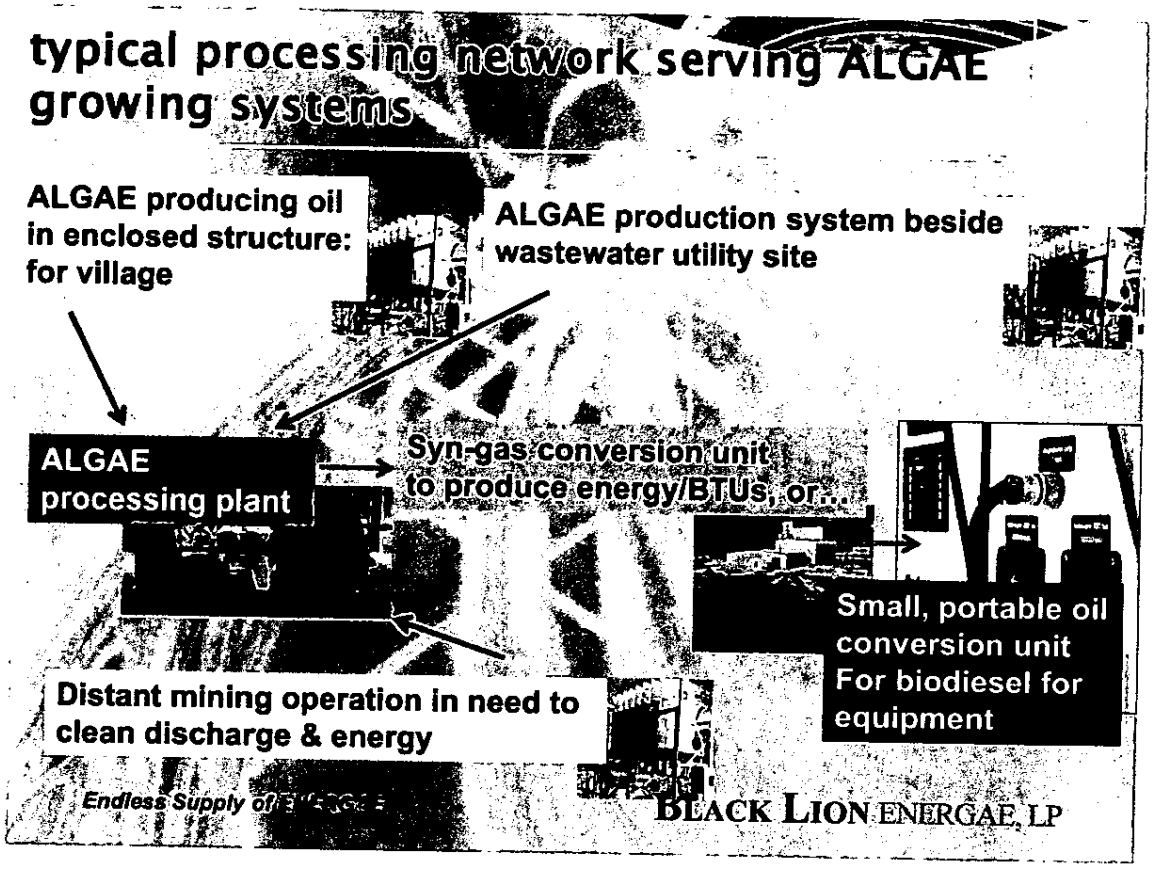
2. South Carolina Power & South Carolina Gas & Electric, the largest power production companies in the Carolinas
   - free CO2 and NOx

3. State of South Carolina –
   - $13 million in tax credits,
   - pays for all worker training,
   - 250,000 acres for $25 an acre

4. largest coal-fired power production company in the nation

S.C.EG & S.C. Power – RWE's owned site




typical processing network serving ALGAE growing systems
ALGAE producing oil in enclosed structure: for village
ALGAE production system beside wastewater utility site
ALGAE processing plant
Syn-gas conversion unit to produce energy/BTUs, or...
Small, portable oil conversion unit For biodiesel for equipment
Distant mining operation in need to clean discharge & energy
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BTU & system production
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our vision – U.S. native groups

Native owned lands in Alaska and the Southwest hold the keys to energy production in the U.S.

Southwest U.S. – perfect for growing Algae low cost, but they lack the capital

Alaska – can provide the capital

Together, the native groups can help provide the energy needs for the U.S., and in the process return an investment for their shareholders

ALGAE BTU value groups

oil

- bio-lubricants
- gasoline, ethanol additives, plastics

cake – natural drying, no drying agents

- synthetic gas
- omega 3s & other vitamins
- feed

oil & cake production & profit

1540 bioreactors per acre	≈	38,500 gallons of oil per annum
	+	285 tons of cake
Biodiesel spot price $1.90 per gallon	=	$73,150
Cake $120 a ton	=	$34,200
cost to produce $.85 per gallon	=	$32,725
		=======
Net profit (~acre)	=	$74,625

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Net profit	=	$74,625
shipping	=	$11,550
conversion @ modular biodiesel plant in Alaska	=	$13,475
distribution from southwest	=	$4,620
		=====
EBITDA		$44,980

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cost per gallon of ALGAE oil to Alaska

production	=	$0.85
shipping to port	=	$0.30
shipping to villages	=	$0.35
conversion at villages	=	$0.45
Misc.	=	$0.10
Middleware markup	=	$0.25
		====
Total		$2.30
offsetting cake revenue reduction	=	$0.90
Net cost per gallon	=	$1.40

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optional revenue source - CO2 & NOx

ALGAE eats CO2 & NOx

ALGAE chemically changes CO2 & NOx gases into organic carbons

organic carbons are harmless to the environment and can be consumed by animals as feed when dried

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EBITDA	=	$44,980
Optional revenue 38,500 gallons of ALGAE consumes 10,000 tons of CO2 while growing; CO2 producers will pay up to $2 per ton to rid CO2	=	$20,000
38,500 gallons of ALGAE consumes 50 tons of NOx & other gases while Growing; NOx producers will pay $350 a ton to rid NOx	=	$17,500 ======
EBITDA per 38,500 oil gallons with Optional	=	$119,980

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industries that need CO2/NOx gas management discharge solutions

Coal	Mining	Steel	Cement
CO2	CO2	CO2	CO2
NOx	NOx	NOx	NOx
SOx	SOx		

average 3 million ton Coal plant will spend

gas management	=	$60 million per year
installation of scrubbing equipment	=	$200 million

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ALGAE solution

800 acres of ALGAE beside a 3 million ton coal plant:

gas discharge reduction	=	$35 million
oil/cake net revenue	=	$39.58 million
		=====
combined annual savings	=	$74.58 million
		or $24.86 per ton
scrubbing cost		
installation reduction	=	$120 million
		or $4.50 per ton
		(amor. 15 yrs)

$24.86 + $4.50 = $29.36 per ton

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ALGAE systems allow for an environmentally safe expansion of the coal, petroleum and mining industries in Alaska and beyond

ALGAE sucks up the nasty discharges, turning them into organic carbons which are harmless

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Proposal: State of Alaska sponsored

ALGAE pilot project in Alaska, expected costs & installation

2.25 megawatt power system

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first step: perform low cost feasibility study to determine costs associated with creating 2.25 megawatts of power

second step: if viable cost-wise, install

- ALGAE bioreactors
- newest, small scale Florida Hydro wind design to provide electrical generation for dark winter months, growing ALGAE under artificial lighting
- covered enclosure
- optional oil processing & diesel production units

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expected system cost for first/single 5 megawatts of power

feasibility study	=	$0.250 million
3000 Algae bioreactors & set-up costs	=	$1.50
syn-gas processing station	=	$1.25
optional oil processing station	=	$1.75
enclosures	=	$2.00
wind	=	$2.00
		=====
Total		$8.75 million

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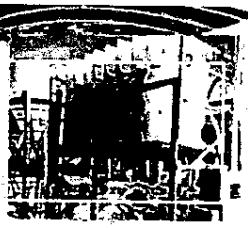
expected ALGAE BTU value



3000 units (system)	~	75,000 gallons of oil per system per year +
	+	540 tons of biomass
BTU value oil (syngas)	=	12,242 megawatts per annum
BTU value biomass	=	5,975 megawatts
wind	=	1,000 megawatt
		====
	=	19,217
combined syngas BTU value	~	2.25 megawatts per hour

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monitoring/maintenance, pilot project year 1

testing/monitoring costs - 1 fulltime employee to manage system & maintenance	= $150,000
- RWE manager for communication/ electrical distribution	= $75,000
RWE phase study	= $100,000
	=======
Total	= $325,000

expected revenue from energy production

2.25 megawatts & $.20kwh	= $3.94 million
10,000 gallons of oil not converted to BTU value for study and distribution @ $3.00 a gallon	= $0.03
	======
total	= $3.97 million


village prototype system can be profitable in first year of operation
produces 2.25 megawatts of energy
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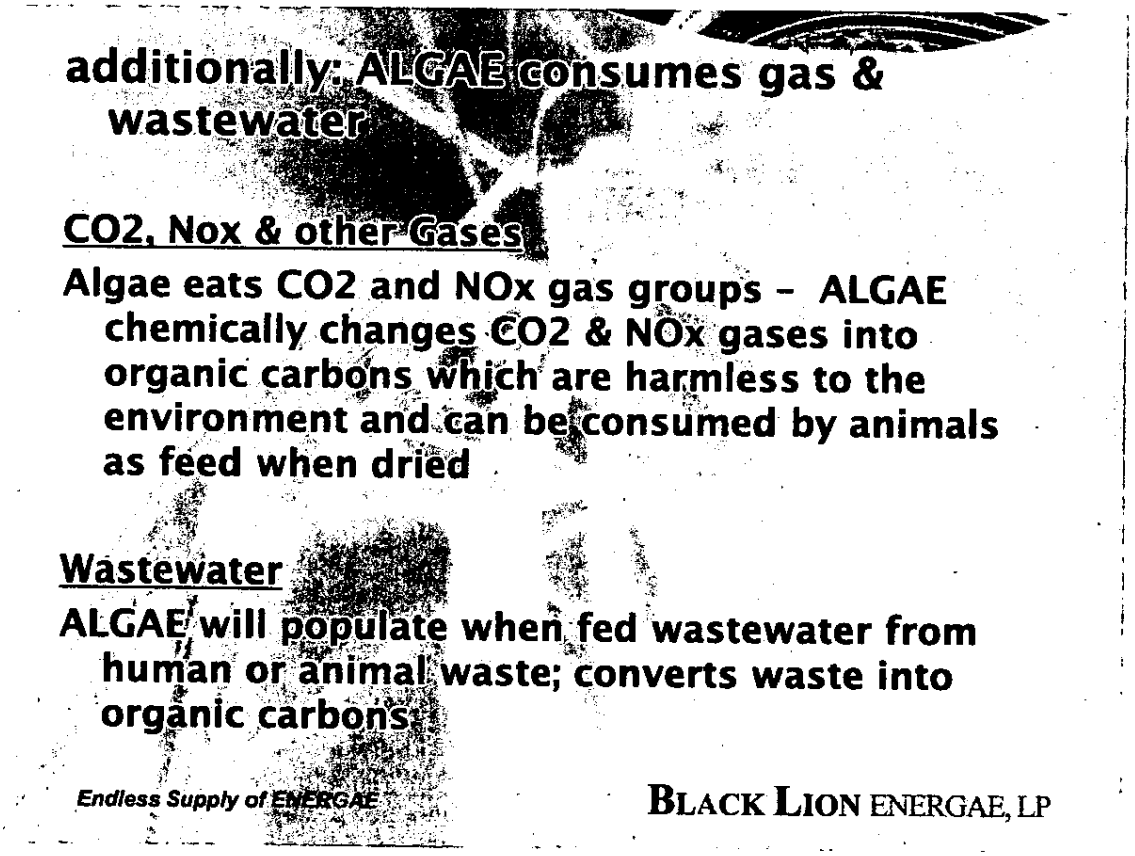
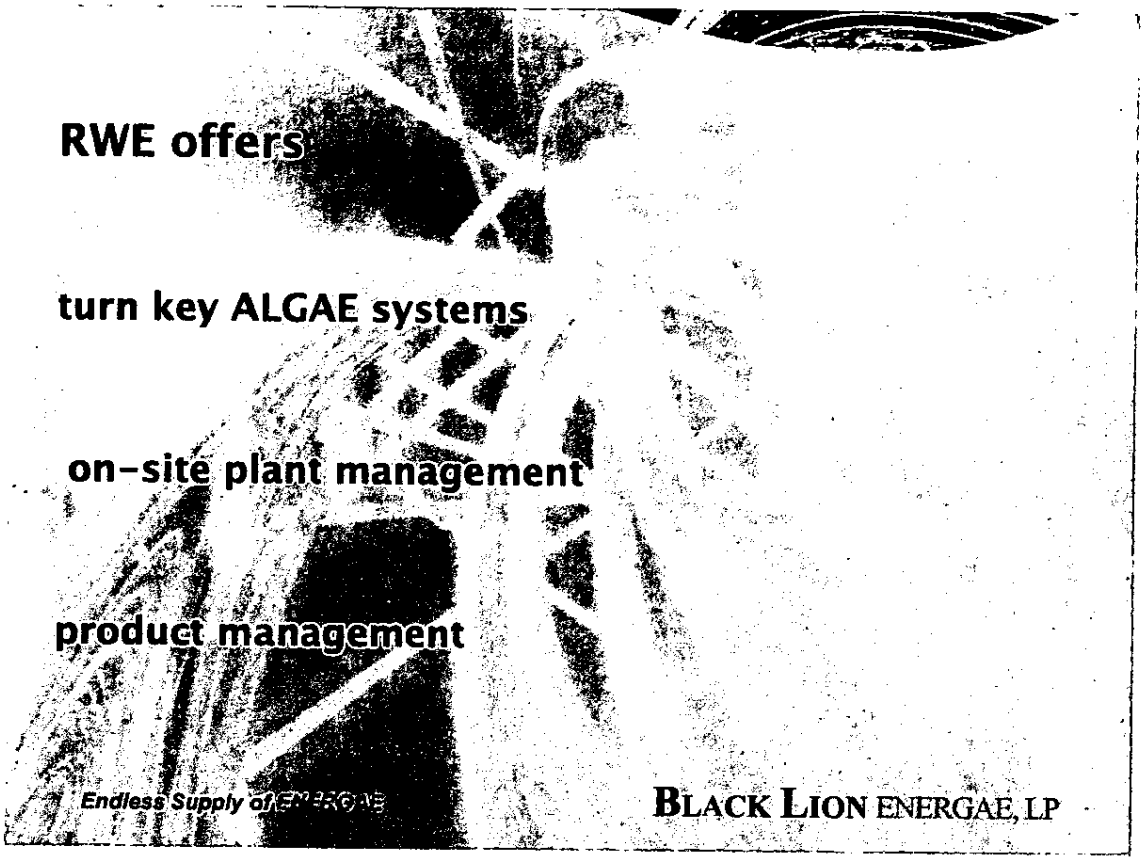

additionally: ALGAE consumes gas & wastewater
CO2, Nox & other Gases
Algae eats CO2 and NOx gas groups - ALGAE chemically changes CO2 & NOx gases into organic carbons which are harmless to the environment and can be consumed by animals as feed when dried
Wastewater
ALGAE will populate when fed wastewater from human or animal waste; converts waste into organic carbons.
Endless Supply of ENERGAE
BLACK LION ENERGAE, LP


RWE offers
turn key ALGAE systems
on-site plant management
product management
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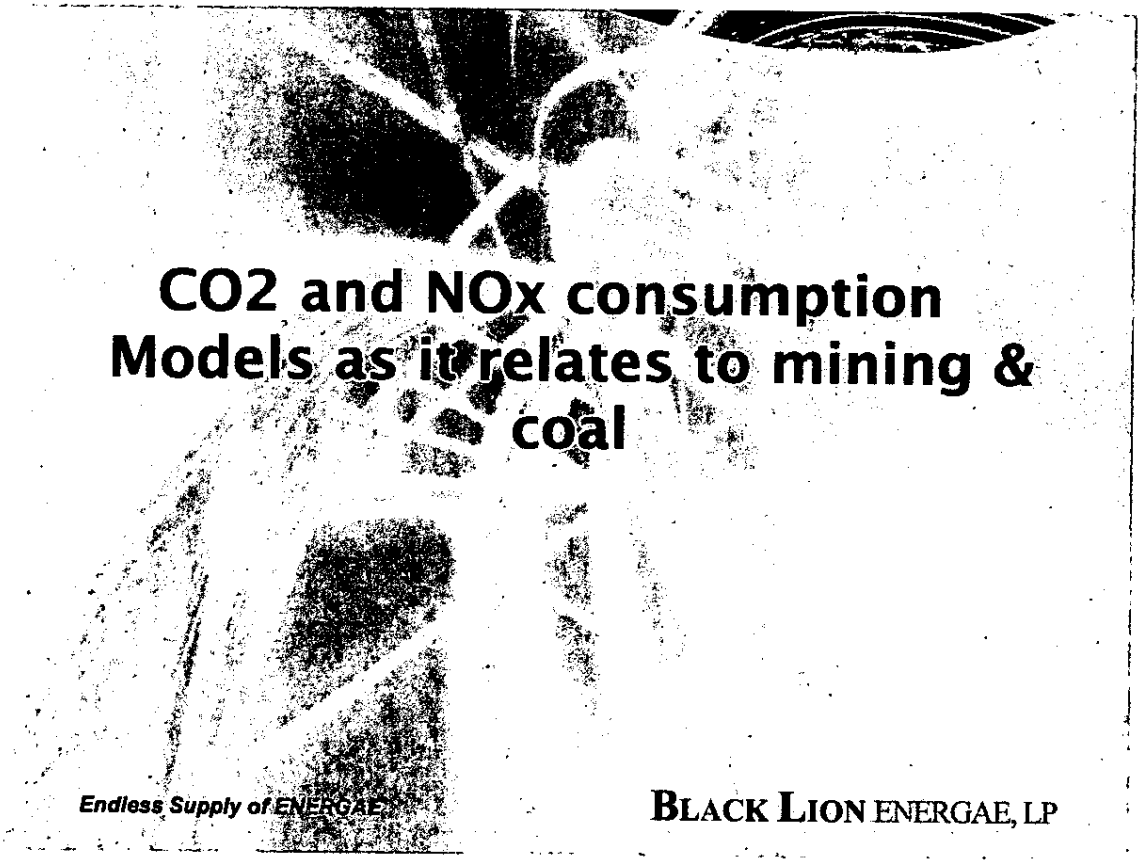
CO2 and NOx consumption Models as it relates to mining & coal
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In January 2009 the EPA fined Kentucky Utilities' largest coal-fired power plant $140 million in fines and equipment upgrades to clean-up NOx & Sulfur Oxide emissions. The plant had already spent $270 million

Both the EPA & the E.U. have a ZERO tolerance for NOx emissions

But, what of CO2?
- World currently operating under TWO CO2 models

E.U./Kyoto model: Each country/industry is allotted "x" CO2 emissions

All CO2 emissions are monitored

If you exceed CO2 emissions you must
1. purchase carbon "credits" or
2. be heavily fined

U.S. Model:
...voluntary...but...

ALL CO2 emissions are NOW recorded by the EPA

California is mandating a CO2 trading market

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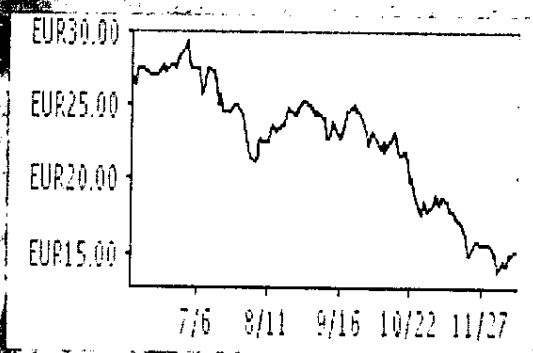
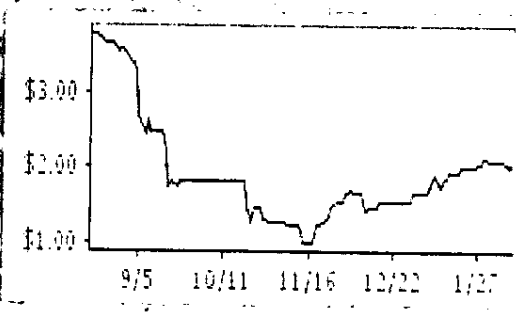
Mandatory Carbon Trading Market in Europe
($15 E.U. converts to $19 U.S.)



Voluntary Carbon Trading Market in the U.S.



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E.U. Problem: there are not enough carbon credits relative to demand – $30 billion traded in 2008

U.S Problem: The US Supreme Court gave the EPA the "right" to mandate all CO2 emissions

Coal Problem: coal plants must spend addtl $50 million per ton of coal produced per annum to clean-up CO2 emissions, not including NOx upgrades

Mining Problem: water and gas discharge from mining operations run into multiple millions of clean-up

minimal cost to clean CO2/NOx gases in Alaska

CO2 per coal ton	$3 to scrub/sequester $6 for equipment to scrub
NOx per coal ton (bound & thermal)	$5 to scrub $8 for equipment to scrub
	==== $22 per ton
small sized coal plant 1.5 million tons of coal per annum	1.5 X $22 = $33 million per

TVA TWO POWER "Lines" ~ 1000 Megawatt each – are SHUT DOWN, due to

- being "over limit" on CO2 & NOx
- annual revenue loss = $500 million per annum
- cost to correct: $200 million + $50 million per year operating costs

Increased EPA regulations on coal, mining, steel & cement now being set up for mandates

RWE Solution: ALGAE system

- consumes all CO2
- consumes all Nox & other nasty gases
- reduces need for costly scrubbing equipment
- puts people back to work
- produces additional revenue streams
- cleans up mining, cleans up coal

RWE's solution – half the corrective cost of using scrubbing – RWE's solution produces revenue

EPA's solution for EPA – $250 million COST not including ongoing $50 million per annum!

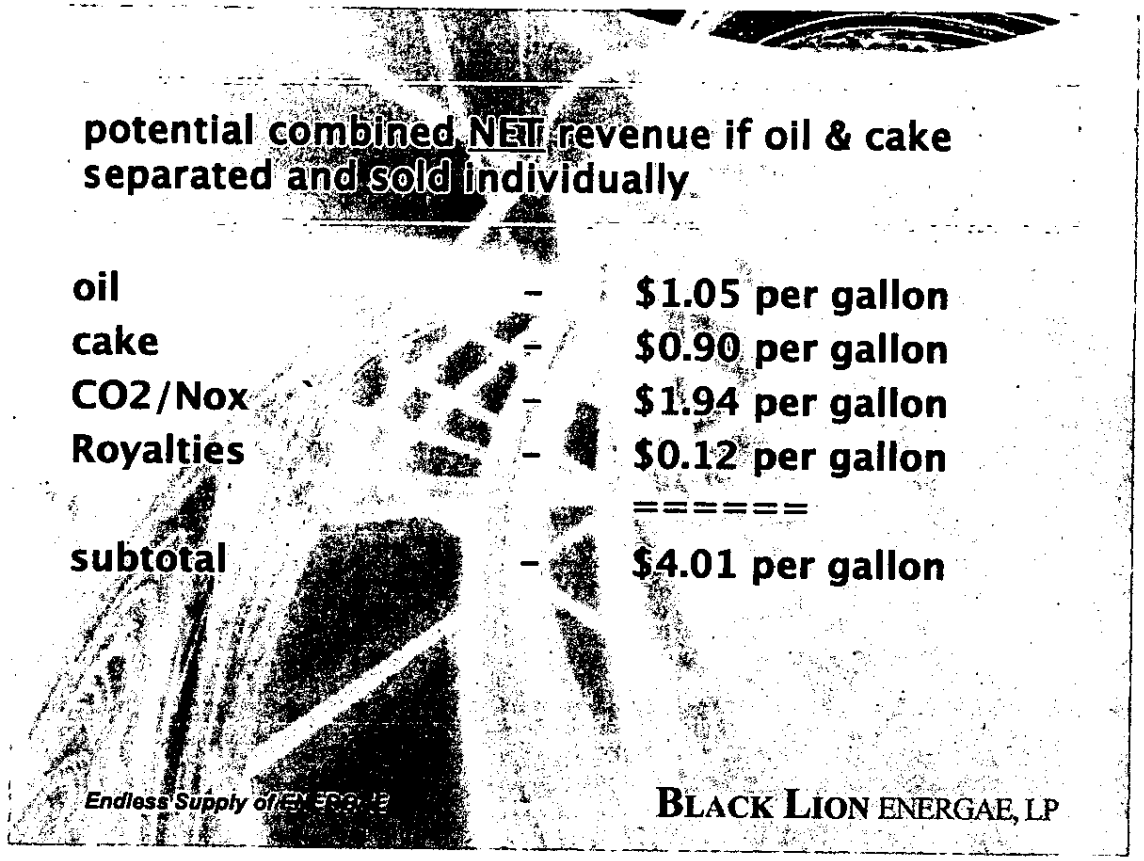
other revenue sources from algae cake & oil

- Plastics
- Fertilizers
- Cosmetics
- Enzymes
- amino-acids
- Antioxidants
- superoxide dismutase
- Phycocyanin
- carotenoids, etc.

mining

Algae can be programmed to suck up mining's "other" output, turns output into harmless organic carbons for fertilizer and animal feed

produces badly needed low-cost energy for remote mining locations


potential combined NET revenue if oil & cake separated and sold individually
oil - $1.05 per gallon
cake - $0.90 per gallon
CO2/Nox - $1.94 per gallon
Royalties - $0.12 per gallon
subtotal - $4.01 per gallon
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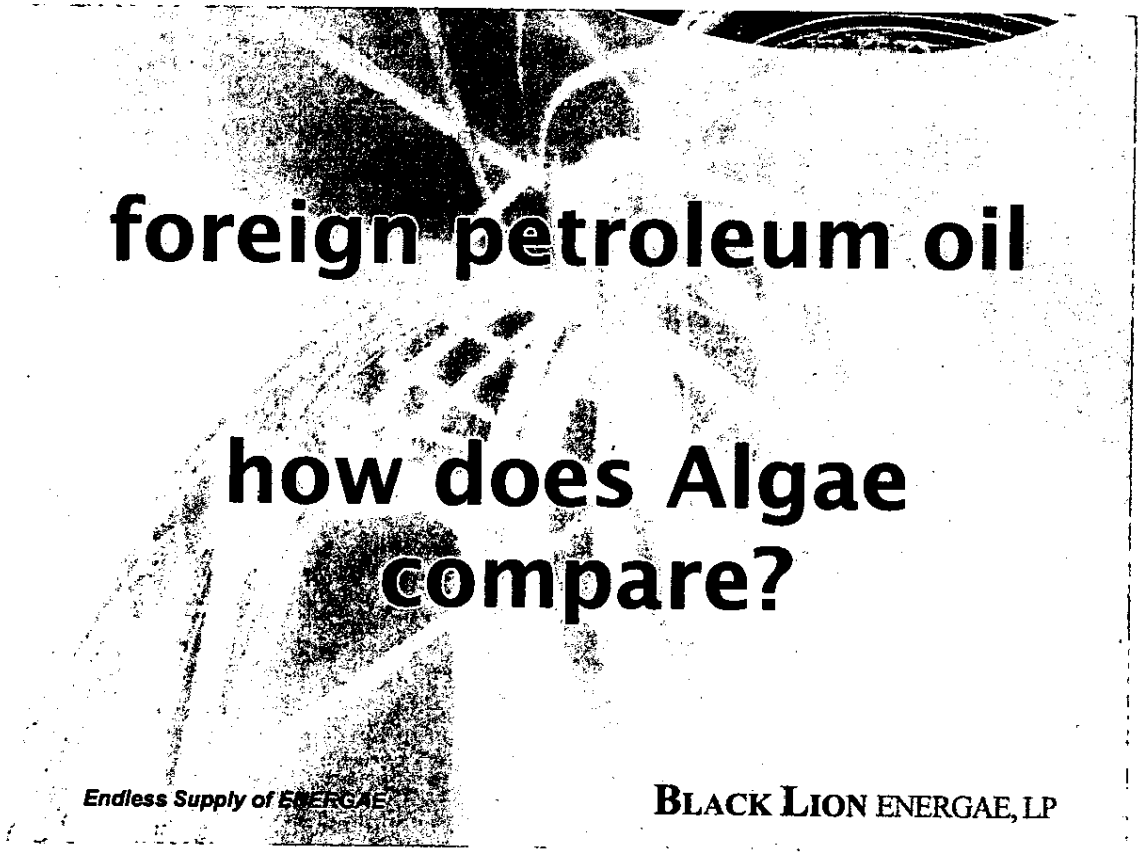
foreign petroleum oil
how does Algae compare?
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*D.O.E . Figures	No. 2 Diesel Fuel	Algae Oil
Cost per gallon:		
At $40 per barrel oil*	($.86)	N/A
At $10 Barrel oil = ($.22)		
Cost to Grow Oil or Convert Diesel Fuel	($0.93)	($0.85)
Convert Algae Oil to No. 2 Diesel Fuel	N/A	($0.45)
SG&A & Marketing	($0.25)	($0.25)
Shipping/Handling	($0.25)	($0.30)
Subtotal	($2.04)	($1.85)
Bi-Product Revenue Cake	NA	$0.90
Bi-Product Revenue Carbon Credits	N/A	$1.94
Bio-Diesel $1.00 per gallon credit	N/A	$1.00
Total	($2.04)	$1.99

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In January 2009, $17 billion left American pockets to purchase foreign oil - $381,000 per minute

the U.S. imports 67% of the oil it consumes

we have a solution

Canada - 2.028 million barrels per day
Saudi Arabia - 1.487 million barrels per day
Mexico - 1.296 million barrels per day
Venezuela - 1.071 million barrels per day
Nigeria - 0.775 million barrels per day
Iraq - 0.467 million barrels per day

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other oils vs. ALGAE oil

350 gallons – Palm Oil per acre per year

Fatty acid – HIGH Conversion to Diesel – LOW

303 gallons Canola/Rapeseed

Fatty acid – LOW Conversion to Diesel – HIGH

150 Soy Oil

Fatty acid – LOWER Conversion to Diesel – VERY HIGH

38,500 gallons & more Algae Oil

Fatty acid – Extremely Low Conversion to Diesel – 1 to 1

competitors

Valcent Products – No revenues, demonstration model, produces product called Vertigro – website claims similar gallons per acre but system is costly

Solazyme – The company utilizes proprietary genetic engineering methods to develop and optimize commercially relevant biochemical pathways ys production of hydrocarbons

LiveFuels – A national alliance of labs and scientists dedicated to transforming algae into biocrude by the year by the year 2010. Working on breeding various strains of algae, driving down the costs of harvesting algae and extracting fats and oils

Infinifuel Biodiesel - Nevada - home to a unique biodiesel project under development and is being touted as the world's first geothermal powered and heated biodiesel plant. Geothermal "wells" will be used as energy to grow ALGAE on 300 acres; still under development.

PetroAlgae - commercializing environmentally friendly ALGAE developed by a research team at Arizona State University that generates over two hundred times more oil per acre than crops like soybeans. Using a cost-effective, modular cultivation process that can be scaled. Working on converting ALGAE oil to plastics.

Sapphire - a developer scalable photo-bioreactors for the production of alternative oil products from algae oil. Sapphire's closed photo-bioreactors are expensive, but designed for high-end oil market products. Bill Gates dumped over $50 million into this project and they make oil for $2.50 a gallon and more

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production/value goals

	2009	2010	2011	2012	2013
RWE oil in MGPY	3	15	30	60	100
RWE Partner MGPY	0	15	40	60	100
	===	===	===	===	===
	3	30	70	120	200
Projected Value Per Unit	$1665	$2368	$3780	$6890	$11,450

Based on Profit per Unit current unit price $1000

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Richard Armstrong Resume

Richard Armstrong, President, Chairman

SUNY- Binghamton, Electrical and Chemical

Brome CC, Math and Physics Major

Senior member ISA, Instrumentation Society of America

Extensive experience in building large chemical plants. *Project design/manager on over 5 billion dollars in projects on pulp & paper & chemical processes including transesterification processes.* Experience includes project design, start-up and commissioning of pulp dryers, bleach plants, paper machines, scrubber systems, electrical distribution, emergency generators, plant automation, system networks, electronic primary and final control elements and programming/configuration of PLC's and distributive control systems for boiler houses, chemical batch reactors, conveyor systems, Pharmaceuticals, pulp and paper plants as well as petrochemical.

- **Has extensive experience in negotiating large equipment purchases. *Every project over the last 5 years has been on budget and on time.***
- **Partial list of clients: *Bowater Pulp & Paper, Rhone Poulenc Chem., BF Goodrich, Duke Power, Phillip-Morris, AMEX, GE***

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TIM TOMPKINS RESUME

Tim Tompkins, CTO

Technical Association for the Pulp and Paper Industry (TAPPI) – member since 1989

Carolinas Air Pollution Control Association (CAPCA) – member since 1996

B.S., Pulp and Paper Technology

N. C. State University

***Engineer on over 2 billion dollars in projects on boilers, Pulp & Paper & chemical processes and often managed these facilities.* Pulping and bleaching projects include a new 50 ton-per-day chlorine dioxide plant and storage tank system, bleach plant modifications, recycle and de-ink pulp facilities, pulp dryer system modifications, pulp mill studies, chilled water system modernization, and design of several cooling tower systems. Papermaking projects include white water system modifications, vacuum pump installations, cleaner modifications and additions, post consumer waste recycle system, and ground calcium carbonate system. Environmental projects include scrubber additions and modifications, storm water collection and treatment, and several Cluster Rule related jobs that included: studies, capital cost, design, and construction.**

Endless Supply of ENERGAE

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