2/26/09 WORK SESSION: COMPRE-HENSIVE ENERGY PLAN

ALASKA STATE LEGISLATURE

SENATOR LESIL McGUIRE
Chair, Senate Special Committee on Energy

MEMORANDUM

Date: February 19, 2009

To: Kirsten Waid, Senate Secretary

From: Senator Lesil McGuire, Chair
Senate Special Committee on Energy

Re: Senate Special Committee on Energy Schedule

Committee Schedule
Senate Special Committee on Energy
For the week of February 23-27

Thursday, February 26th @ 3:00 p.m. Senate Finance Room 532

Joint Senate and House Energy Committee

Work Session: Comprehensive Energy Plan

Presenters:
Gwen Holdman, Director, Alaska Center for Energy and Power
David Hobbs and Jim Meitl, Cambridge Energy Research Associates
Darrell Smith, Black Lion Energae

Friday, February 27th @ 11:00 a.m. Beltz Room 211

+ = SB 31: GEOTHERMAL ELEC. PROD. TAX CREDIT
+ HCR 2: IN-STATE GAS PIPELINE
+ HCR 3: IN-STATE GAS PIPELINE
+ HCR 4: IN-STATE GAS PIPELINE
+ HCR 5: IN-STATE GAS PIPELINE

* First Hearing in First Committee of Referral
\+ Teleconferenced
= Bill was Previously Heard/Scheduled

Developing Energy Policy: A Balanced Approach

ACEP
Alaska Center for Energy and Power

Gwen Holdmann, Director
Alaska Center for Energy and Power

Joint Senate-House Energy Committee Meeting
Juneau, Alaska
February 26th, 2009

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Alaska Center for Energy and Power

ACEP RESEARCH MISSION: To meet state and local need for applied energy research by working towards developing, refining, demonstrating, and ultimately helping commercialize marketable technologies that provide practical solutions to real-world problems.

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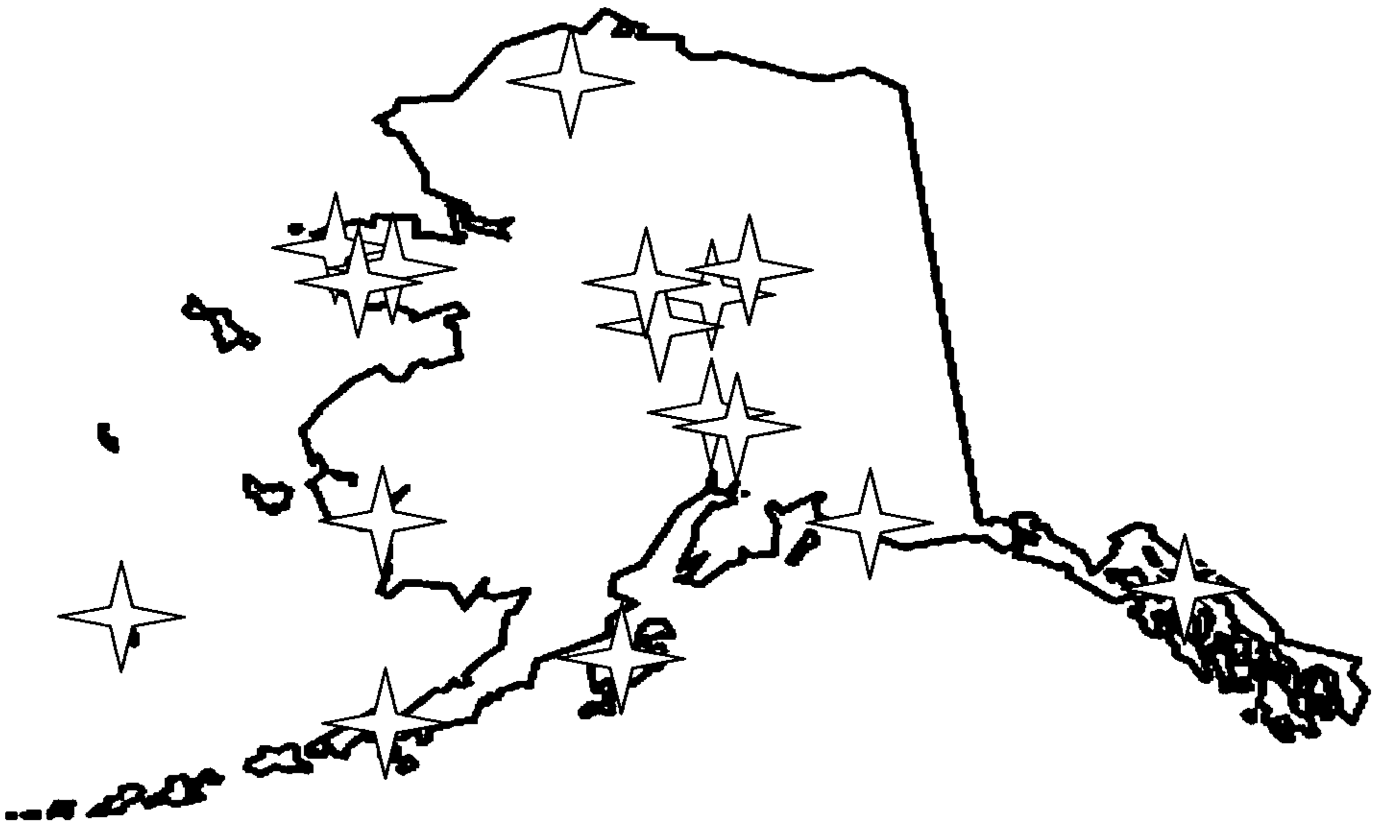
ACEP Current Projects



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ACEP Projects

- Waste heat capture (INE)
- Energy storage (INE, working with SNL)
- Geothermal (GI, INE, ISER)
- Tidal and In-stream hydro (SFOS, INE, UAA)
- Wind/diesel (working with NREL and AEA)
- Climate change impacts on hydro projects (GI, IARC, INE)
- Hydrogen Fuels (INE, ISER)
- Biogenic methane as an energy source (IARC, INE)
- Short-rotation woody biomass crops (AFES)
- Education and outreach (Coop. Ext)

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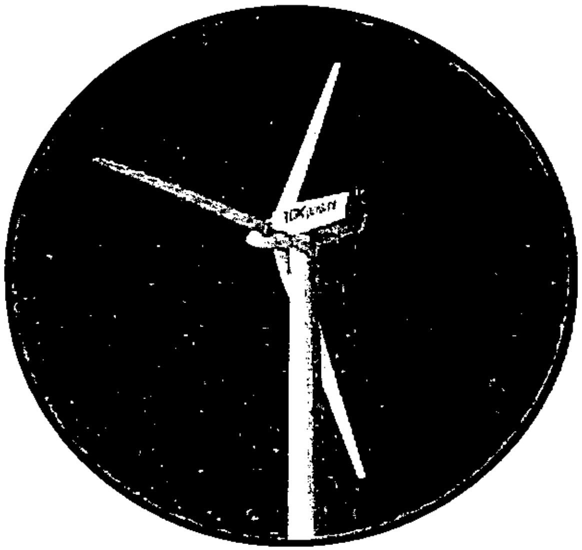
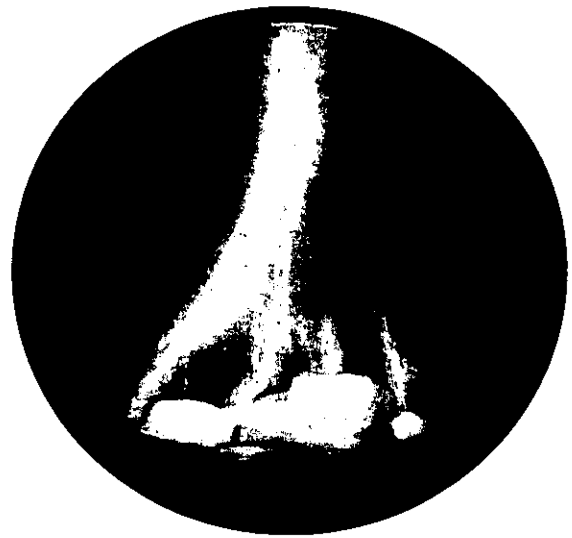
ACEP Focus Areas



Community
Energy Solutions

Powering the
Economy



The EnergyField
of the Future

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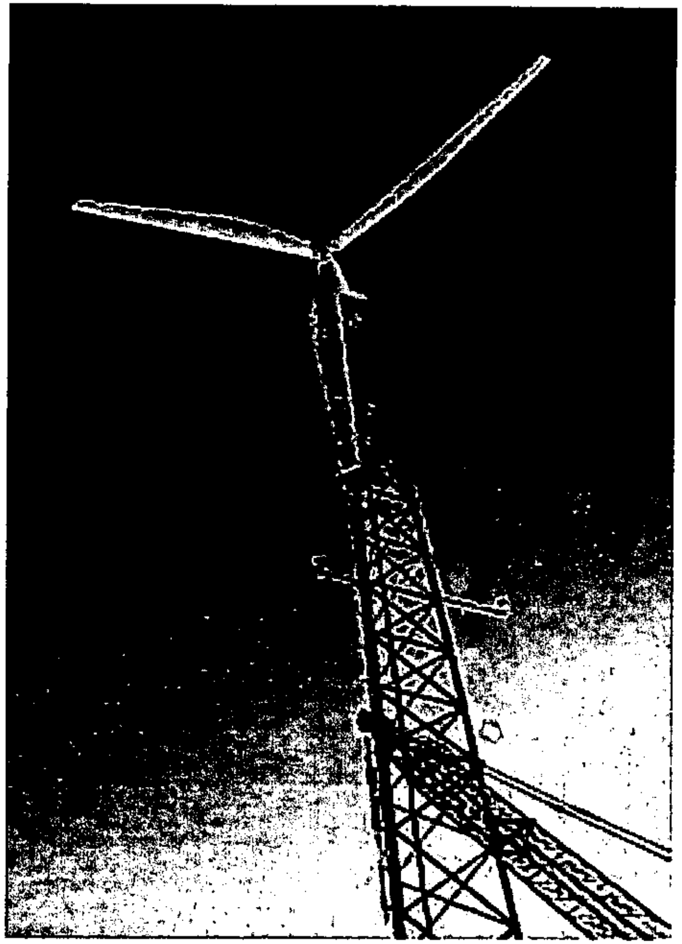
Community Energy Solutions



Diesel Efficiency
Energy Economics
Energy Storage
Geothermal
Biomass
Coal Bed Methane
Fuels
In-River Hydro
Tidal Energy
Wind Power

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Powering the Economy

Geothermal in the Aleutians
Susitna/Chakachamna
Mt Spurr
Power for Remote Mines
Etc.

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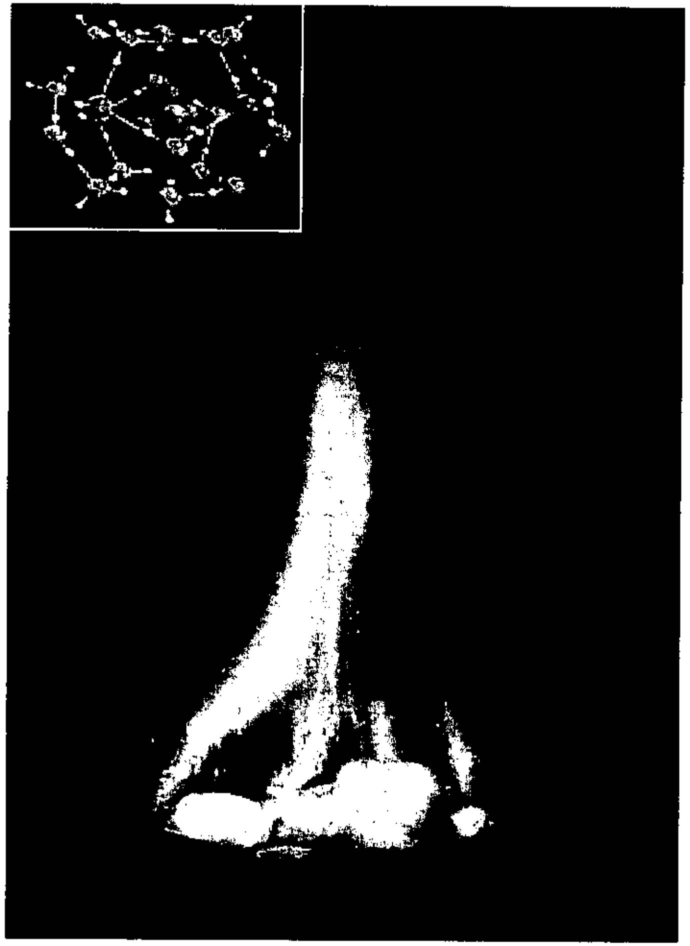
The 'Energyfield' of the Future



Methane hydrates
Gas pipeline
Heavy oil
Carbon Sequestration
Advanced Coal Technologies
Infrastructure
Etc.

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What are our Goals?

- Lower the cost of energy? For whom?
- Stabilize the cost of energy?
- Community self-sufficiency?
- Build/boost local economies?
- Create jobs?
- Develop wealth?
- Reduce greenhouse gas emissions?

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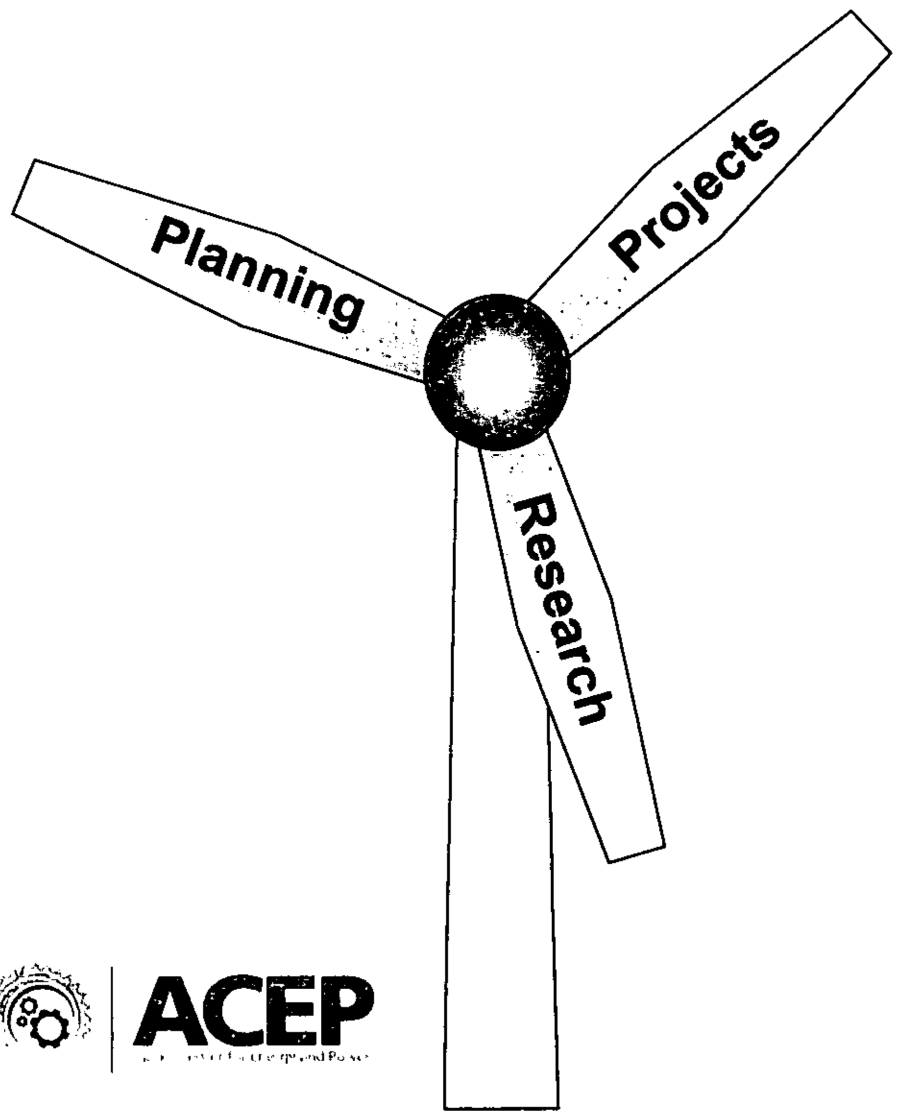
How do we get there?

- Make smart investments
- Take calculated risks
- Start with low-hanging fruit

How do we get there?



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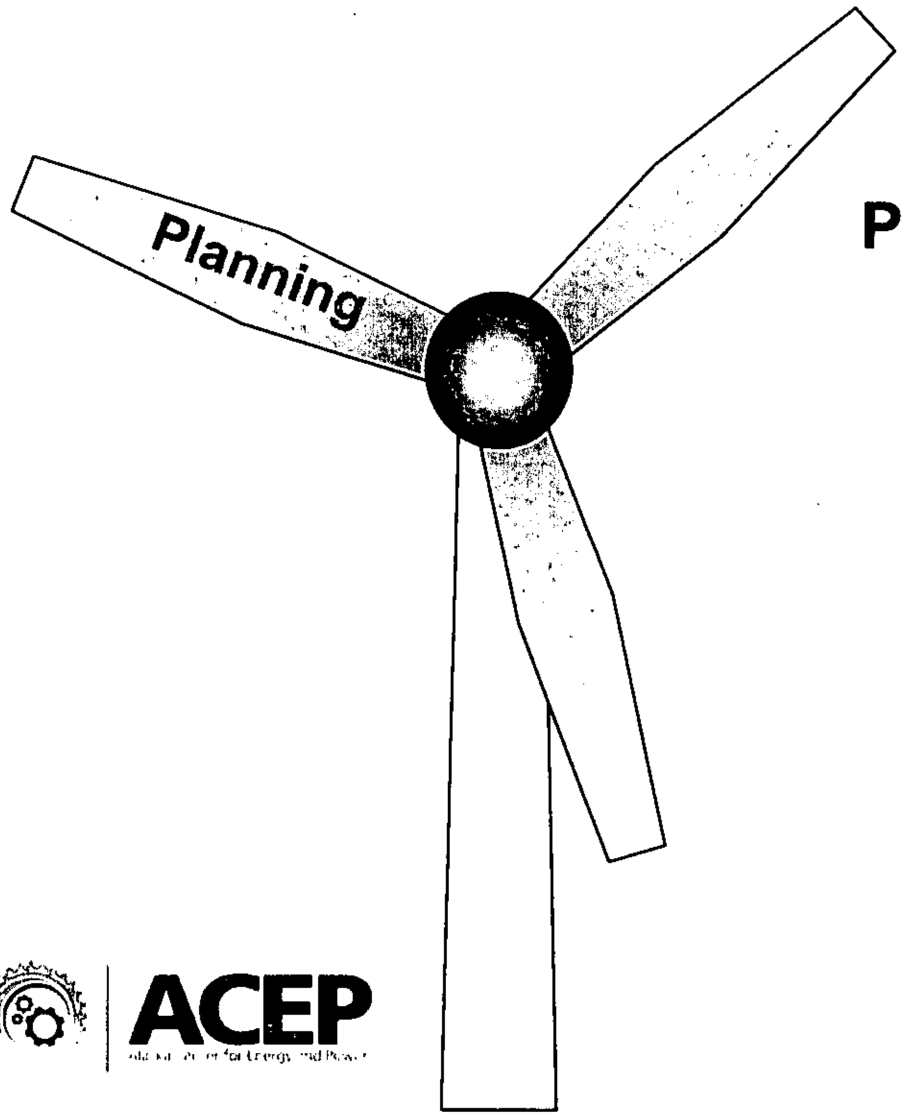
How do we get there?



Planning:

- ➢ Community level
- ➢ Regional
- ➢ Statewide

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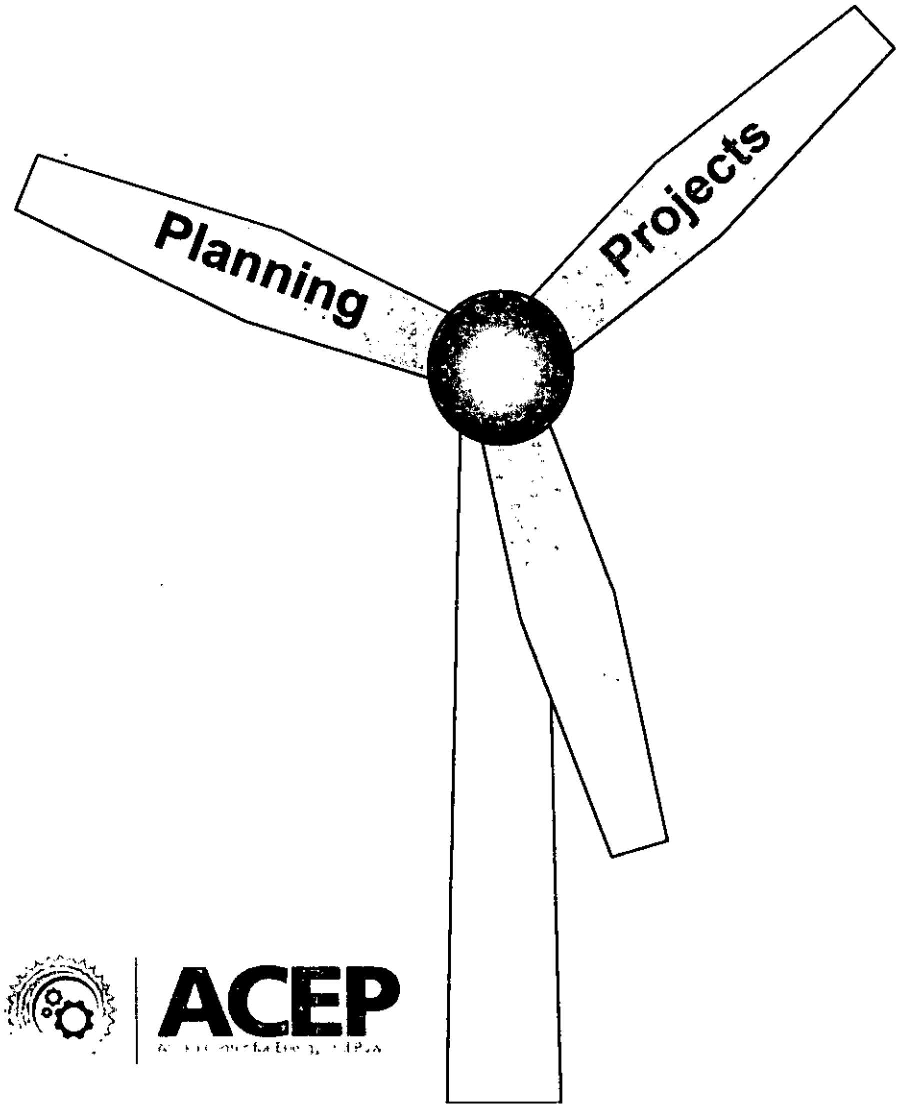
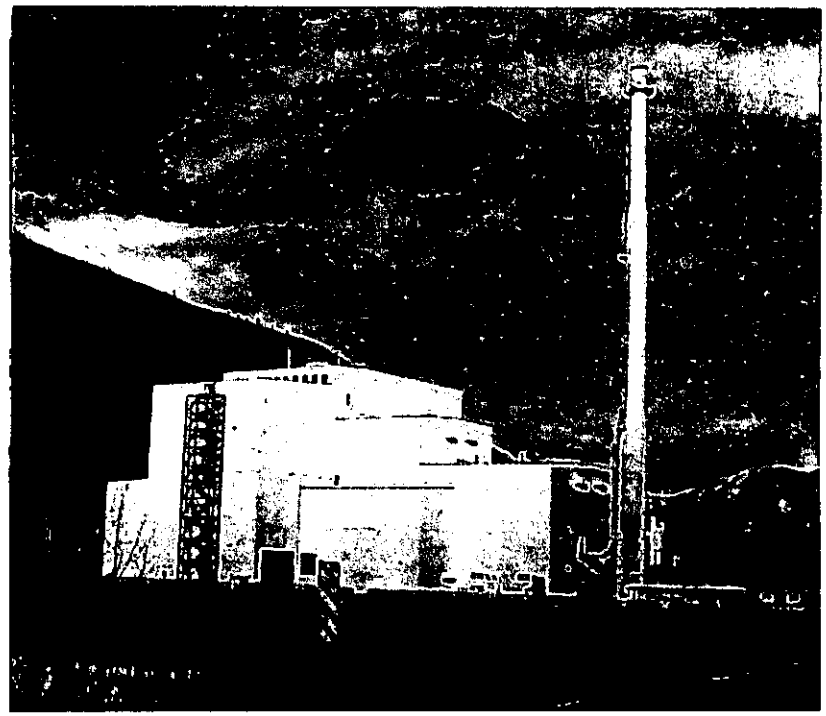
How do we get there: Projects





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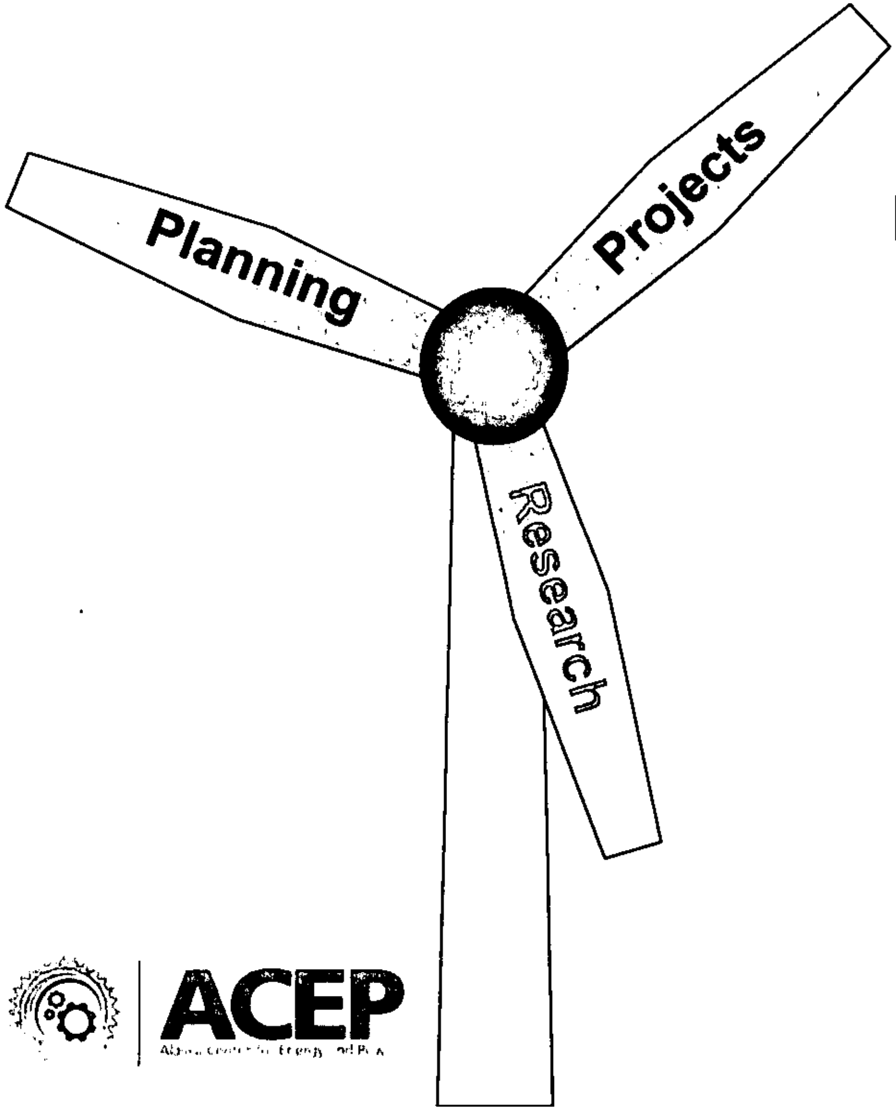
How do we get there: Research



Research:

- ‘Peering over the horizon’
- Needed for long-term success
- A good investment

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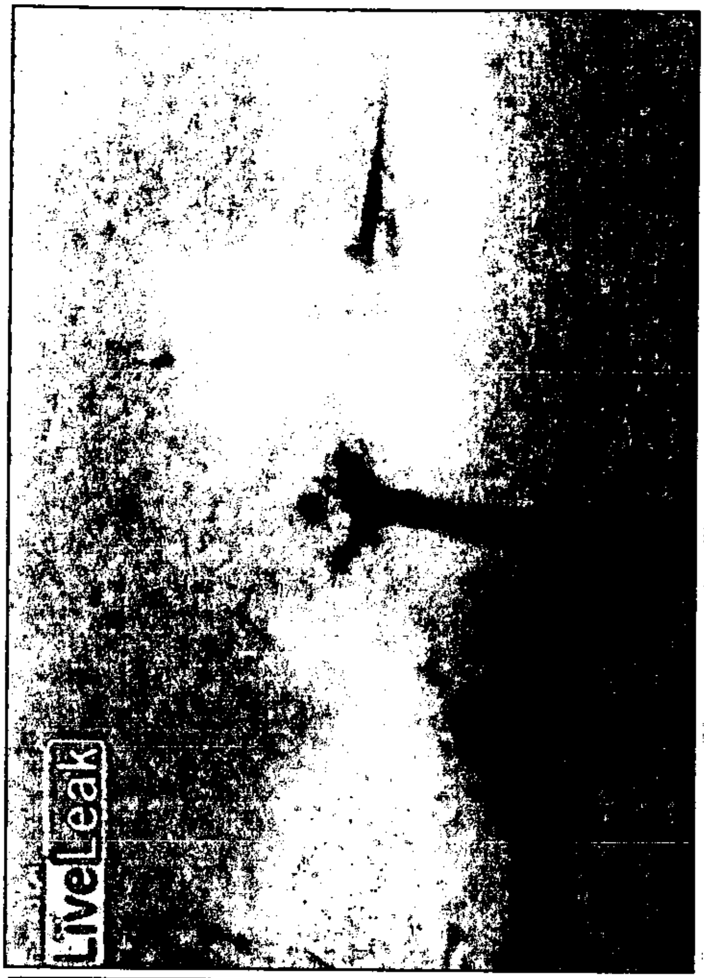
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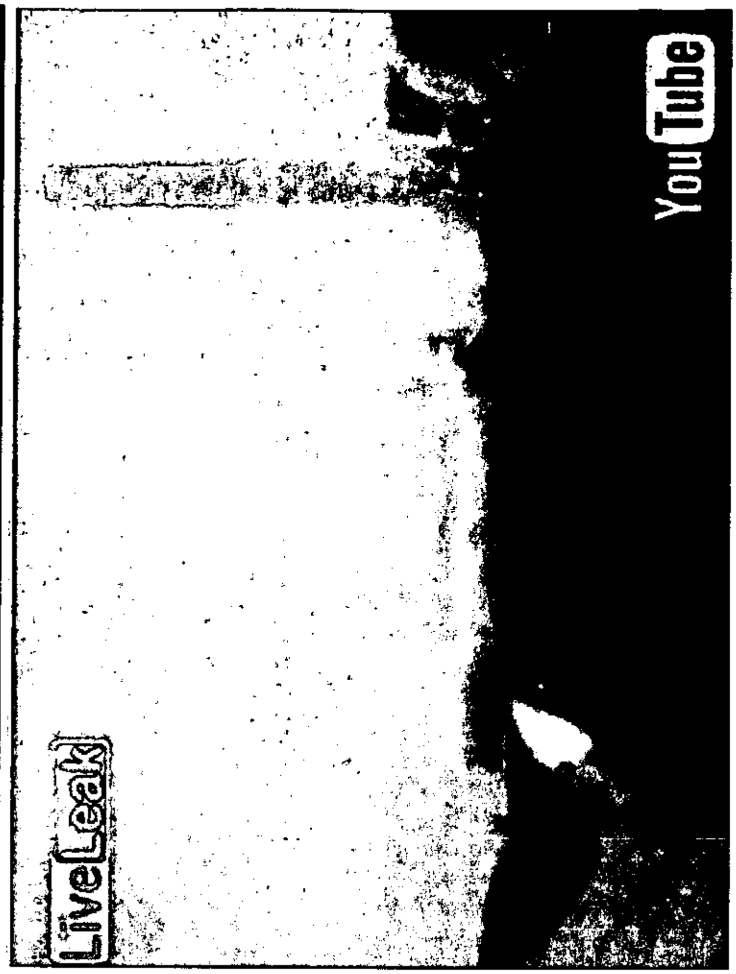
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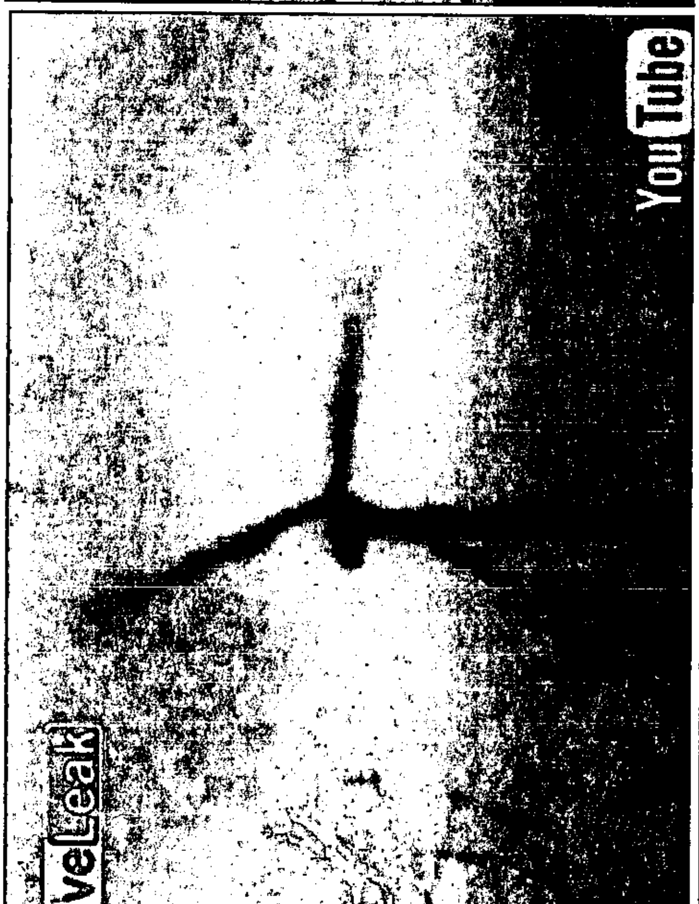
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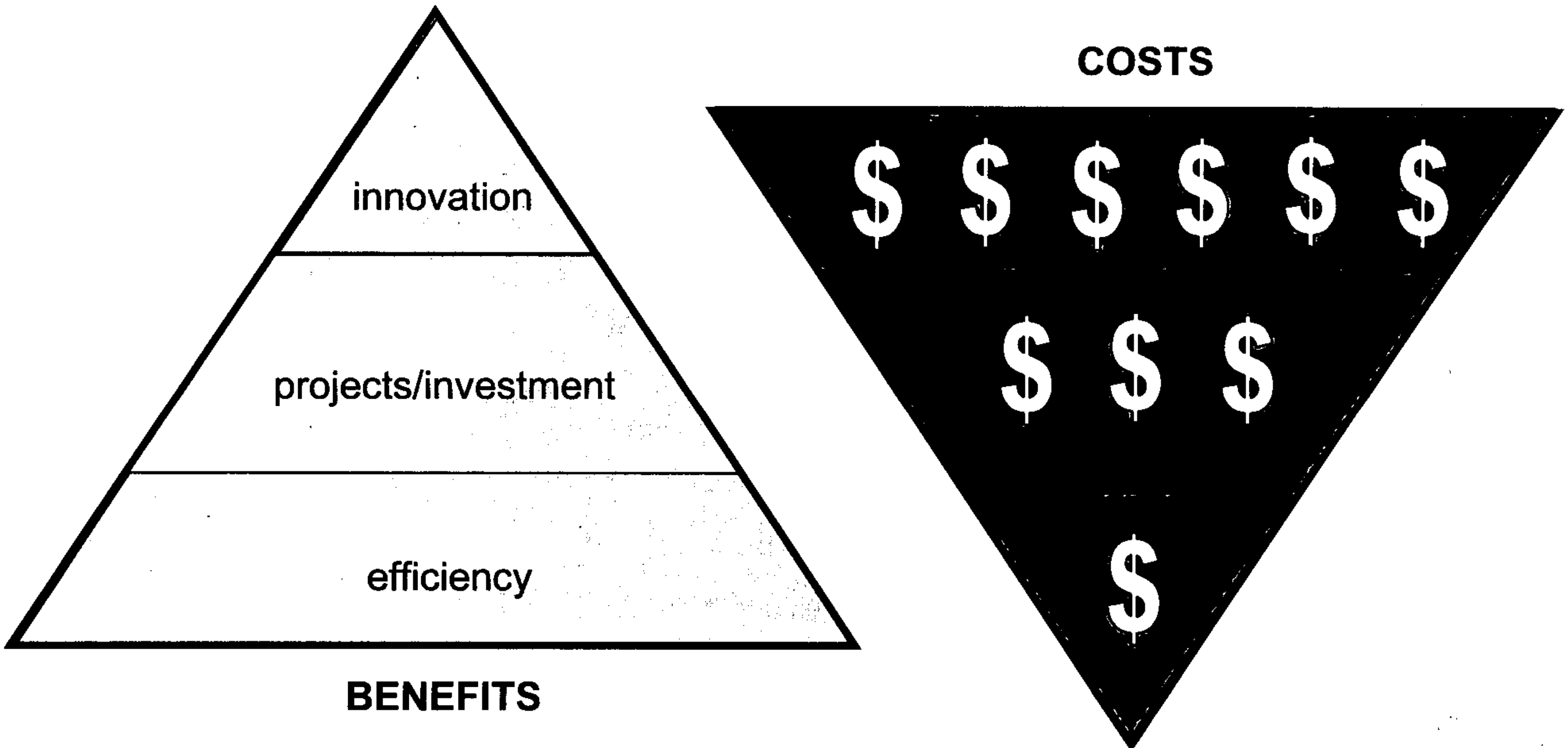
How do we get there?



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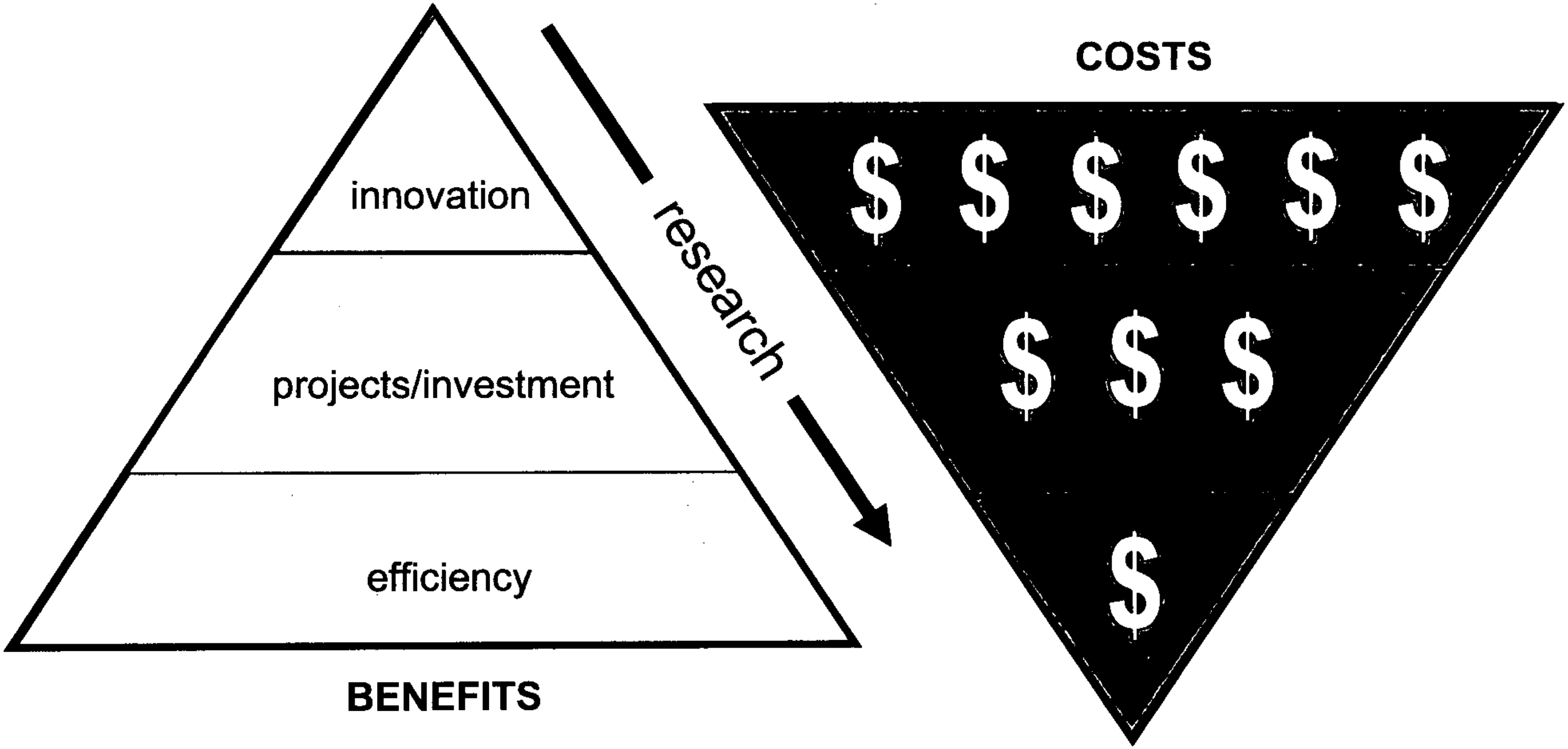
How do we get there?



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Role of ACEP

- Verify performance and reliability of equipment
- Assess technical and economic feasibility
- Test emissions
- Integration with existing power systems
- Resource assessment
- Procurement experiments
- Work with manufacturers to improve products for use in Alaska

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Role of ACEP

Serve as an impartial agent on behalf of Alaskan communities and agencies to ensure we are investing wisely in energy projects that make sense and that contribute to the long-term benefit of our residents

Help leverage external resources to address Alaska's energy challenges (funding, businesses, national laboratories, other universities, etc)

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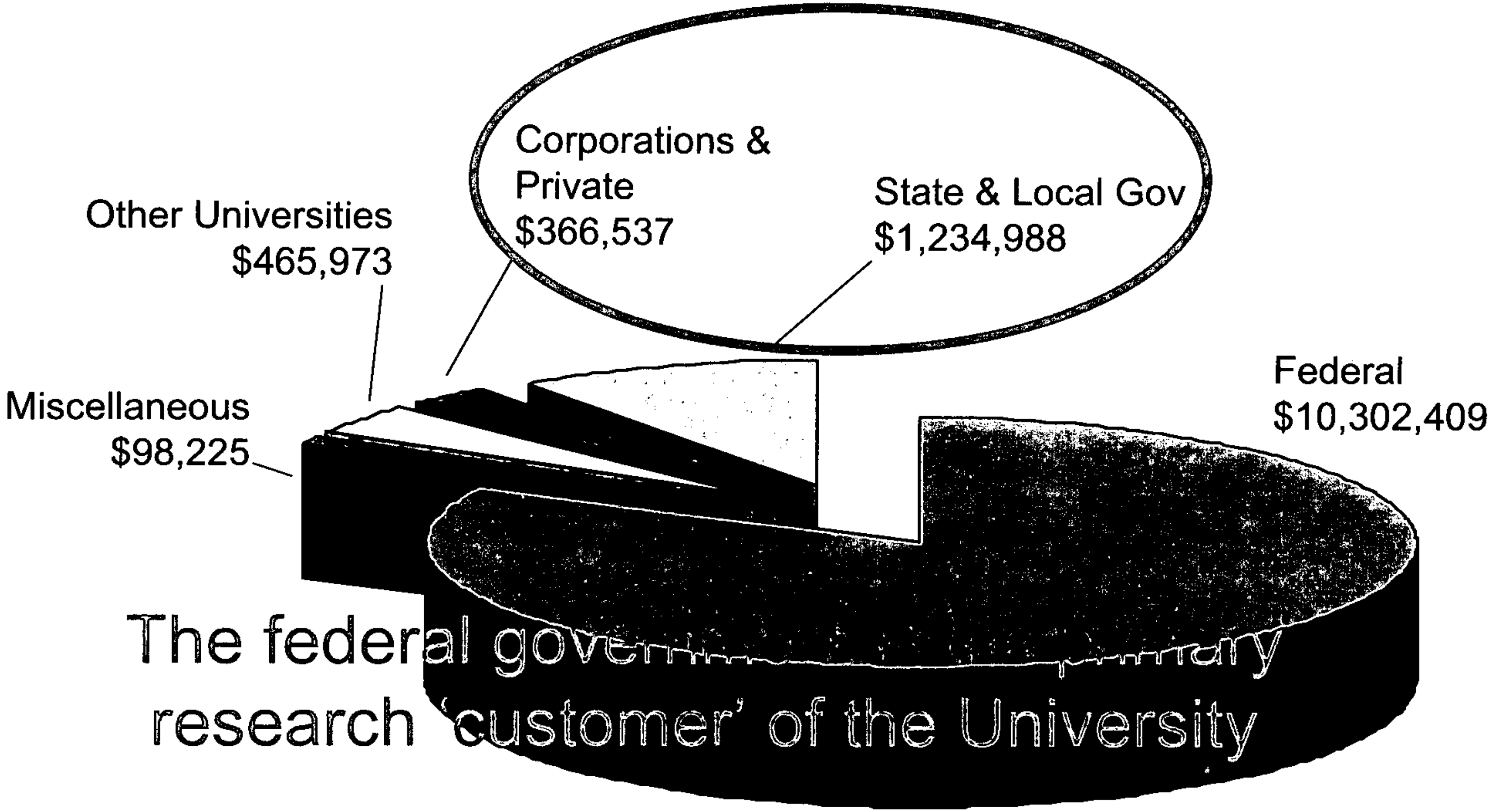
Funding Energy Research



The federal gove[illegible] primary research 'customer' of the University

INE 2006 Annual Report

ALASKA CENTER FOR ENERGY & POWER

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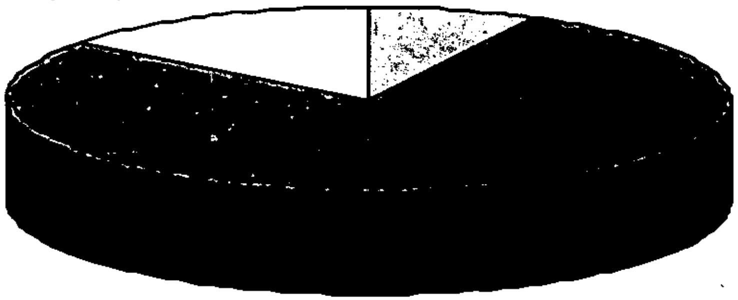
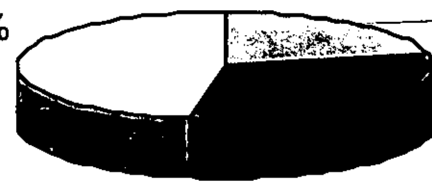
ACEP Funding to Date

Funding Requested
(via competitive proposals submitted)



Funding Awarded to Date



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Example from North Dakota Energy and Environmental Research Center

'The EERC is a high-tech, nonprofit branch of the University of North Dakota. The EERC operates like a business; conducts research, development, demonstration, and commercialization activities; and is dedicated to moving promising technologies out of the laboratory and into the commercial marketplace.' (from the EERC website)

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Example from North Dakota Energy and Environmental Research Center

- 84% of contracts are with private sector
- Has generated 14 spin off companies
- 290 scientists, engineers and support personnel
- Total expenditures in FY07: $27 million
- Regional impact: $94.5 million
- Receives no base state funding today – instead serves as a funding SOURCE for UND
- Substantial investment at state and federal level to develop the program initially

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FY10 University capital budget request to fund ACEP and other energy research:

- AEA-ACEP Partnership ($2M per year for 5 years)
- Rural Power Projects ($350k per year for 5 years)
- Data Information Network (ISER) ($200k per year for 5 years)
- Transportation Fuels ($250k per year for 5 years)
- Coal Technologies ($200k per year for 5 years)
- Carbon Sequestration ($250k per year for 5 years)
- Sustainable Infrastructure ($200k per year for 5 years)
- Biomass Energy ($700k per year for 5 years)

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Emerging Energy Technology Development Fund

- ☆ Would create an Alaska Energy Trust to administer grants and loans for R & D and demonstration projects for renewable energy and energy efficiency
- ☆ Would coordinate workforce training and development
- ☆ Alaska could get "first mover" advantage in several technologies including:
  - Biomass gasification
  - Tidal and Wave power
  - Energy Storage

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What a good state R&D program can do:

- Attract investment to the state
- Reduce Failures
- Improve existing projects
- Provide focus to energy initiatives
- Assist with developing prudent policy and planning
- Create jobs and develop new/expanded industries

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For more information visit:

www.uaf.edu/acep

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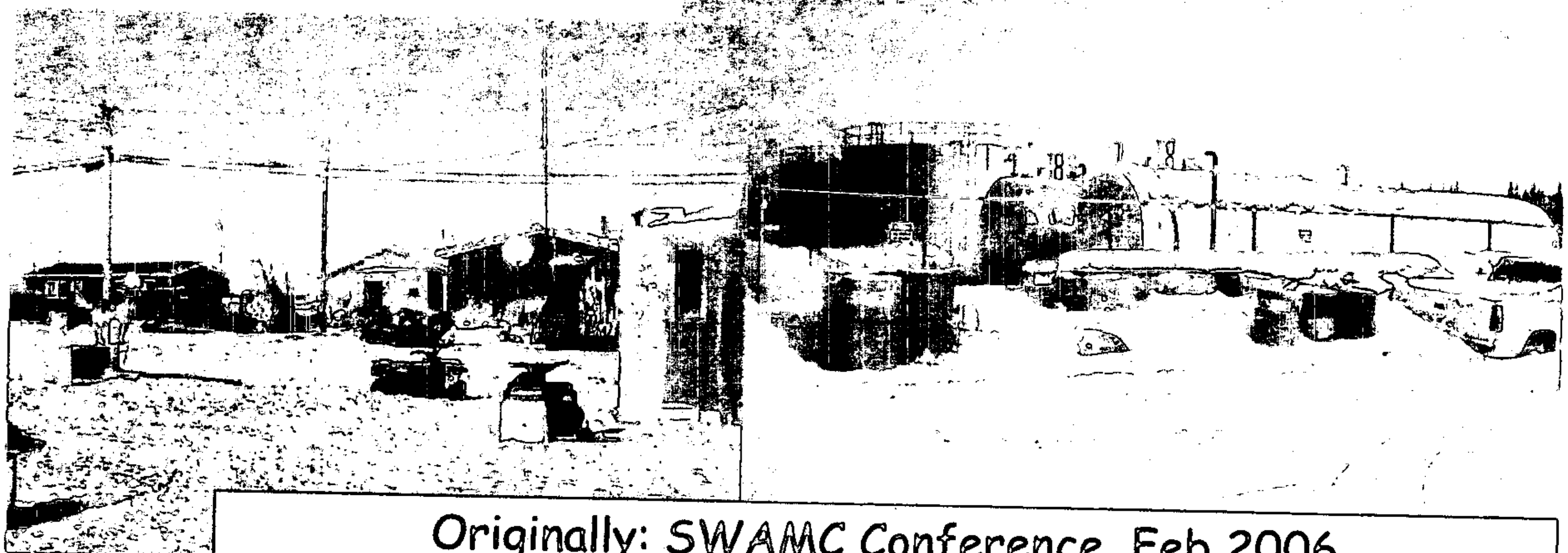
Five Almost-Practical Policies to address High Energy Costs in Remote Alaska



Originally: *SWAMC Conference*, Feb 2006

Revised Sep 2006

Steve Colt

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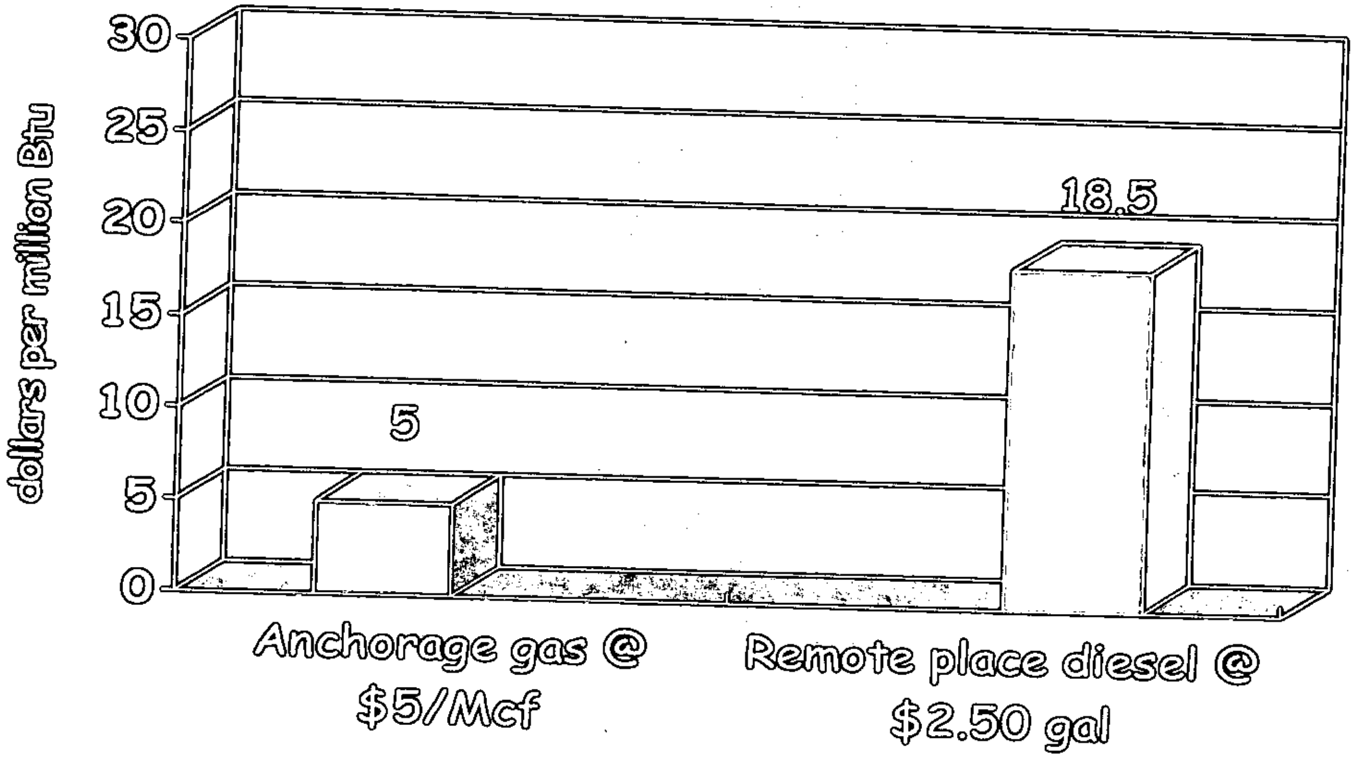
steve_colt@uaa.alaska.edu

The Problem:
High energy COST = High energy PRICE



However, Price is Not Cost

- Very easy to reduce the price of things in remote Alaska
  - rolled-in pricing (First-class mail)
  - subsidized services (bypass mail)
  - cost-shifting (Bill the School District!)
- Much harder to reduce the cost - the overall resources used to provide energy when, where, how people need it

Physics Reminder: Energy is converted from one form to another

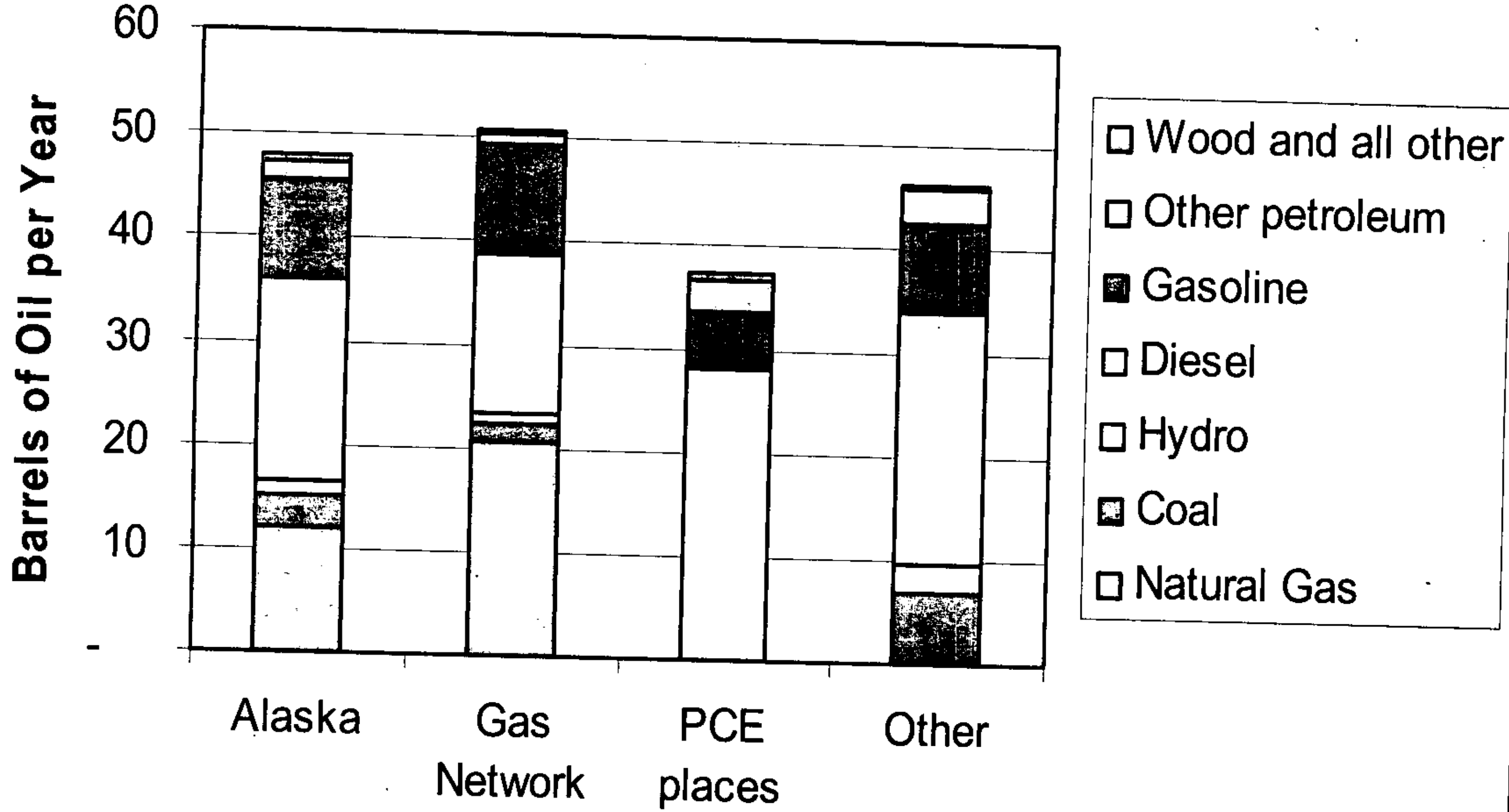
- Electricity is an energy "currency," not a primary energy source
- Hydrogen is an energy currency too!
- Example: Your Toaster

  Solar energy→ plants→Natural Gas→Electricity→Heat→

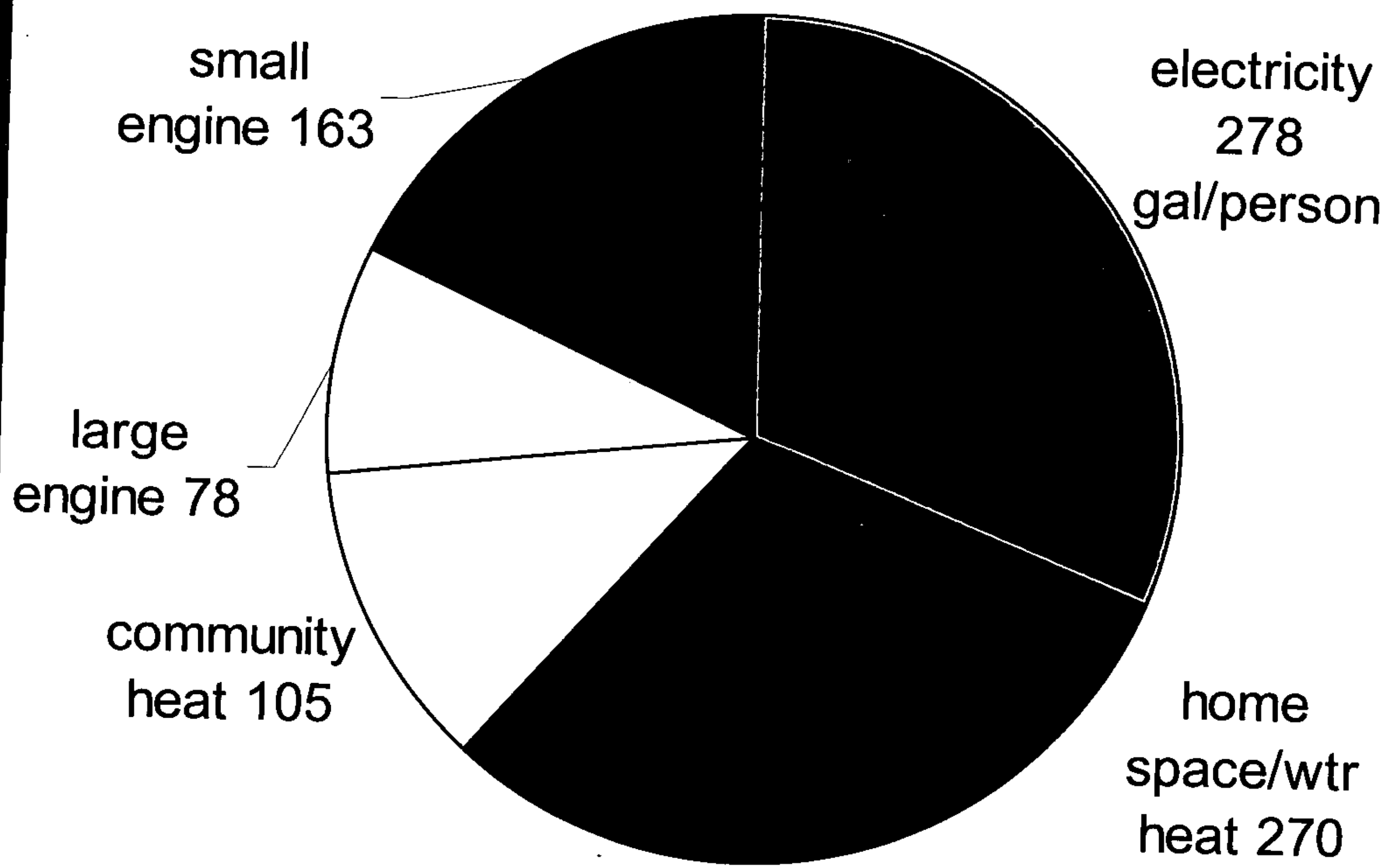
  (toast + low-grade heat)

Primary energy consumption per Alaskan

barrels oil per person per year



How we use it: about 900 gallons diesel/person/year in remote places

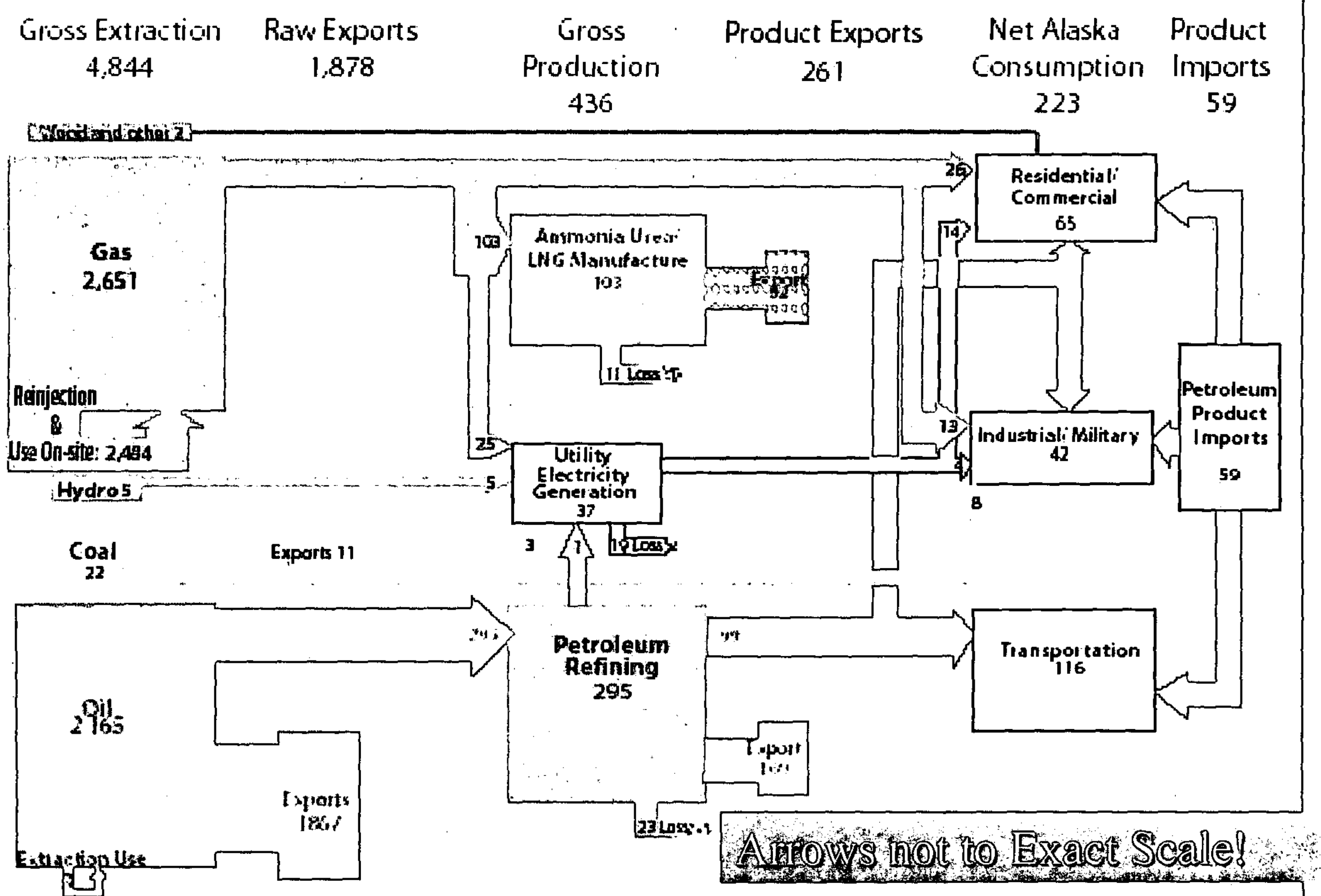


almost practical Policy #1: Share the wealth from high oil prices

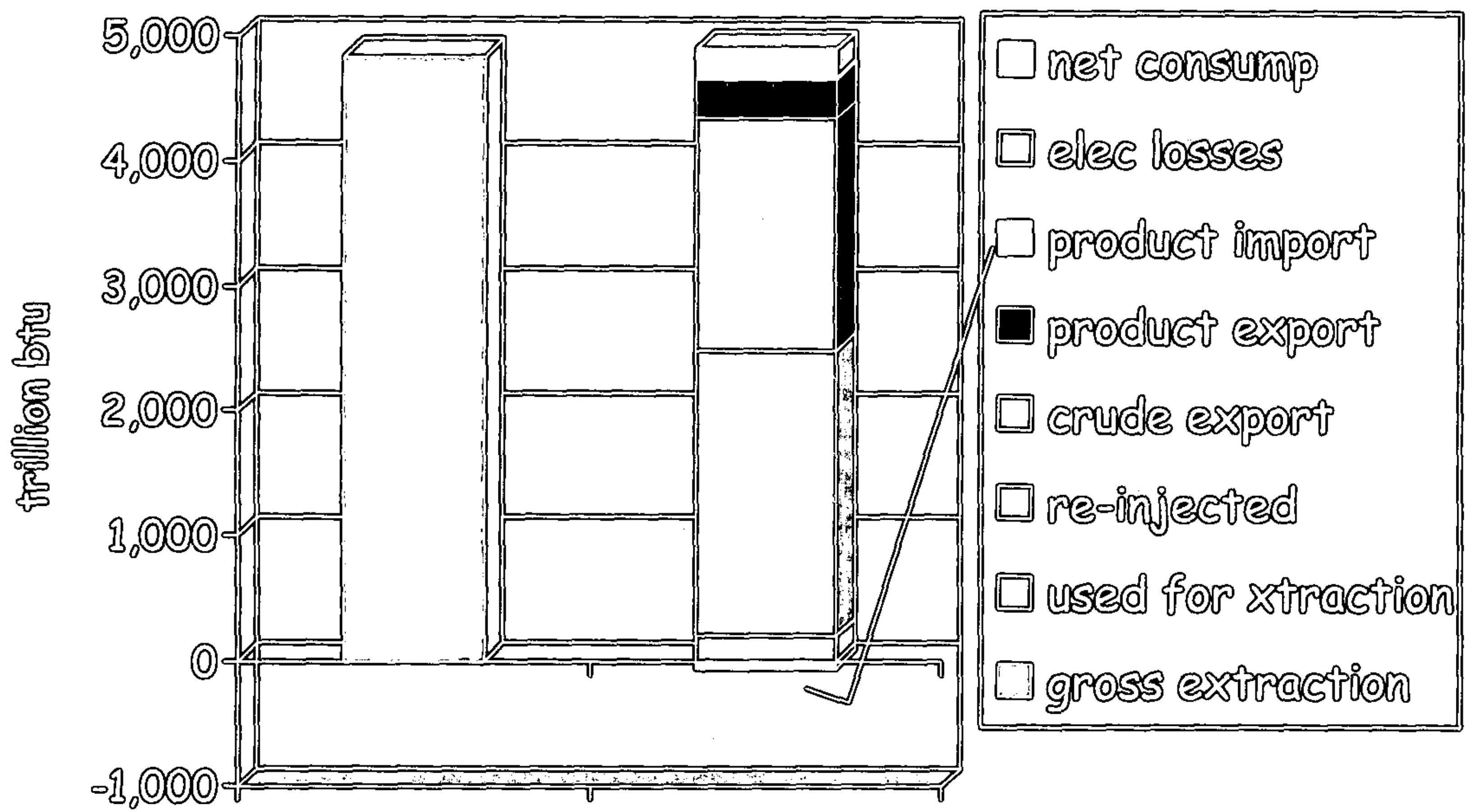
Practical because:

- *Alaska is overwhelmingly a Seller of Energy.*
- Therefore, we are in *GREAT FISCAL SHAPE*, overall, when oil prices rise.
- Short-term, do this with cash (revenue sharing) rather than fancy energy projects

2001 Alaska Energy Flow (Trillion BTUs)



Overall Disposition of Energy



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Reduce the Energy Bill: Details

- Fully fund PCE, with sliding funding when diesel prices are high
- Community energy assistance tied to rising and falling oil prices

almost practical policy #2: Make PCE a Lump-Sum Payment

Practical because:

- Relatively easy to create a fair formula using existing data and program delivery channels
- Might also REDUCE program admin costs

Make PCE Lump-sum: Details

- Reward utilities for efficiency improvements
- Reward entrepreneurs for new technologies
- Reward consumers for being frugal
  - Preserve the Price Signal!

almost practical policy #3: Pre-fund energy costs (with an endowment) as part of a capital project

Practical because:

- We spend a lot of money on the "capital" budget
- It provides powerful signals for efficient design
- It's a proven, prudent way to build sustainable infrastructure
  - Most private universities require this

Pre-Fund Energy Costs as Part of a Capital Project: Details

- Include an energy (and maintenance?) endowment in all appropriations
- Maintain endowments in escrow;
- Make payments partly as lump-sum amounts to further encourage efficient facility design

almost practical Policy #3A: Include Life-Cycle Energy Costs in Evaluation of the "Low Bid"

Practical because:

- Communities could do this on their own
- Rewards designers for efficient design rather than penalizing them for higher up-front costs

almost practical Policy #4: Focus State capital $$ on Energy-Saving infrastructure, Away from Energy-Using Infrastructure

Practical because:

- You save the most $$ with up-front efficient design

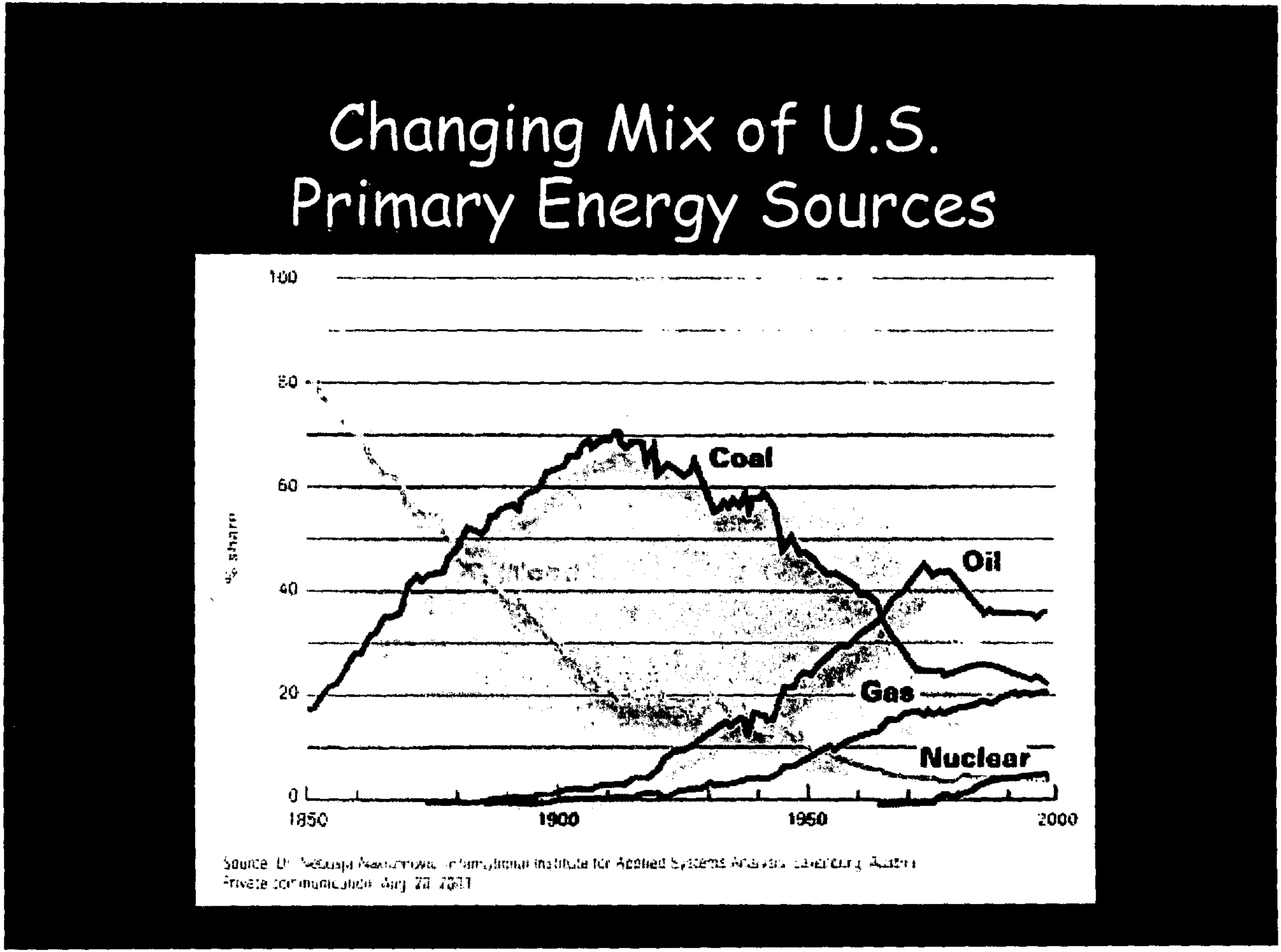
almost practical policy #5: Focus State R&D dollars on Adaptation of Emerging but existing Technologies

Practical because:

- Feds and private sector are conducting major efforts on "new" stuff
- Alaska is a unique market niche with harsh conditions, most technologies require adaptation

Focus on Adaptation: Details

- Continue support for wind technology, focus on shared O&M from regional nodes
- Pilot projects:
  - Direct Hydrogen combustion in vehicles
  - Small-scale coal gasification
  - Coal-bed methane
  - Biodiesel utilization


Changing Mix of U.S.
Primary Energy Sources
100
80
60
40
20
0
% share
Coal
Oil
Gas
Nuclear
1850
1900
1950
2000

1809

www.iser.uaa.alaska.edu

- Other references:
-

by Scott Goldsmith, November 2003.

Alaska State Energy Policy

Introduction

Alaskans utilize energy to light and heat their homes and businesses and power their cars, trucks, trains, four wheelers, skiffs, fishing boats, and snow machines. Industry develops, refines and transports oil and gas, mining, fishing and other natural resources products. Alaska's energy policies need to be as broad as our use and production of energy.

The average Alaska household energy budget is divided with roughly 40 %spent on space heating, 35 %t for electricity, and 25 % for transportation; this varies significantly depending on the location. Historically, Alaska's energy policy and investments have been disproportionately focused on electricity generation and oil and gas development, transportation and refining. It is important that Alaska's energy policy be directed at the full range of energy uses and sources.

Alaska state agencies who carry out policy related to energy would greatly benefit from a clear and sensible energy policy. Alaska's energy policy should recognize the difference between energy costs and energy prices. Alaska's energy policy should also recognize that trade-offs exist between a policy's efficiency and its fairness (i.e. a policy that maximizes savings may not be fair and a fair policy may not maximize savings).

Current Energy Policy in Alaska

The following three goals appear to be Alaska's de facto energy policy since the discovery and development of oil and gas in Prudhoe Bay in the 1970s. This energy policy is separated into three parts reflecting three distinct energy policy goals:

1) Alaska's primary energy goal is to reduce the total cost of energy by decreasing the cost of energy supply and increasing end use efficiency without sacrificing the quality of life of any Alaskans. The cost of energy supply could be decreased by supplying needed capital, through grants and loans and management to renewable projects.

2) Alaska's secondary energy goal is to redistribute resources, in the form of price subsidies and payments to consumers, to equalize the burden of energy costs for all Alaskans in a manner that preserves the effect of natural price signals.

3) Alaska's tertiary energy goal is to ensure that energy prices are low enough in some communities to ensure that high energy prices do not cause the destruction or irreversibly damage of rural lifestyles and Alaska Native cultures. The state is willing to artificially (and possibly unsustainably) manipulate energy prices to achieve this end.

Recommendations for Future Energy Policy in Alaska

General Recommendations:

Recognize that oil prices are volatile; establish a long-term oil price forecast on which to evaluate long-term capital investments in energy project to displace fossil fuels.
Tie crude oil and natural gas price assumptions to Alaska Department of Revenue or the U.S. Energy Information Administration long-term oil price forecasts to evaluation projects. The state should determine a reasonable price for carbon emissions to incorporate within the price forecast until a federal price is established

Recognize the importance of discount rates in the evaluation of energy policies.
The discount rate has a significant impact on the net present value and the benefit cost ratio of energy projects. The discount rate reflects not only the opportunity cost of an investment but also how much the investor values the future. The discount rate should not be considered just a value used in comparing competing projects, but instead it should be considered a primary part of state energy policy.

Support establishing national and global policies for capping and reducing carbon emissions.
This will provide a more efficient outcome than a defensive posture toward greenhouse gas legislation.

Develop a carbon emissions reduction plan.
Developing a plan and state goals will provide investment certainty and stimulate markets for renewable energy projects.

Retain a share of the renewable energy grant funding at the Alaska Energy Authority for development of viable energy projects.
The Alaska Energy Authority has experience in managing and developing renewable energy projects. The agency is able to identify renewable energy projects with high rates of return for which there are no grant applications. Retaining a portion of the state's renewable energy funding would allow AEA to identify, develop and manage good projects.

Provide a mechanism for funding applied energy research within the state.
At this time, there is no state funding allocated to energy research and development (R&D). If Alaska hopes to successfully develop a suite of alternative and renewable projects in the future, it will be necessary to address some specific research questions that are directly relevant to ensuring the success of those projects. By reducing failures, prudent investment in R&D can have an excellent return on investment.

Provide a mechanism for developing and maintaining baseline data needed for conducing applied energy research.
Currently there is insufficient data on community energy and fuel use to accurately evaluate the renewable energy and other capital projects.

Recommendations related to electric energy sector:

Development of an Alaska Renewable Energy Goal
Governor Palin recently announced a goal to meet 50 % of Alaska electric energy needs with renewable energy technologies by 2025. This is currently the most aggressive goal in the country; however, Alaska currently meets 25 % of electrical energy needs with renewable energy technologies. Given Alaska's abundant resources, reaching 50 % is well within reach. Additional components of this goal could include:

1) Meet the goal of 50 % renewable energy technologies while investing in technologies and projects at the lowest cost to ratepayers and the Alaska state budget energy.

2) Give priority to integrated renewable energy projects that displace both electric generation and space heating and have the lowest cost in relation to the cost of the non-renewable energy that they displace.

3) In urban Alaska, providing low interest loans rather than grants for energy projects may provide a "market test" for energy supply alternatives while grants may be necessary in rural communities.

Recommended adjustments to the Alaska Renewable Energy Fund
The Alaska Energy Authority should retain a share of the allocated Renewable Energy Grant funding. AEA has experience in managing and developing of renewable energy projects, and the agency is capable of identifying renewable energy projects with high rates of return that may fail to submit application for grant funding.

Develop policy that positions Alaska as the world's leading exporter of small-scale, off-grid integrated energy systems and the know-how needed to adapt them to local conditions.
About two billion people live off the grid or have no electricity at all. Alaska is currently importing the equipment and some of the technical know-how for renewable energy projects under development. Alaska can be a de facto world leader and test bed for small-scale, off-the-grid energy systems while solving our energy issues one village at a time. This will require establishing some funding mechanism for research and development and demonstration projects.

Set a conservation target for communities to offset 30 % of incremental resource needs through conservation by 2020.
This goal would reduce the growth in electricity demand so that by 2020 500 GWh per year of currently forecast Railbelt needs will be met through demand reduction measures. This may include energy efficiency, conservation, and other demand side solutions.

Encourage utilities to pursue cost effective and competitive demand side management opportunities.
Energy efficiency is a critical piece of utility resource plans. Through demand side management (DSM) technologies, combined with price incentives, energy utilities play a

vital role in promoting energy conservation with investments in energy efficient technologies and building designs. Reducing electric utility peak loads energy costs can be reduced energy by avoiding the construction of new capacity or operation of inefficient peaking plants.

Explore new utility rate structures that encourage energy efficiency and conservation.
A key demand side management tool is pricing structures to either discourage consumption overall, or shift demand to less costly periods. Smart meters and peak load pricing for electricity and natural gas have been shown to reduce consumption and shift demand to lower cost periods. In addition to electricity and space heat, establish solid waste utility rate structures that reward recycling and reduction of garbage to landfills.

Establish a competitive request for proposals for the use of sawmill residues, logging debris and beetle-killed timber for space heating and electricity generation to help mitigate impacts from bark beetle infestation.
The spruce bark beetle (Dendroctonus rufipennis) outbreak in Southcentral Alaska has affected 2 to 3 million acres in the past 10 years. In heavily affected stands, often all spruce trees greater than 10 cm are killed.[1] The area affected by tree death is one of the largest ever documented from an insect outbreak in North America.[2] Using this biomass for energy will reduce fire danger while restoring damaged forests and lowering energy costs.

Recommendations related to space heating:

Expand Energy Efficiency Standards for residential housing by 2010.
Expand the Alaska Housing Finance Corporation (AHFC) Building Energy Efficiency Standard (BEES) to all Alaska residential housing.

Implement Energy Efficiency Standards for commercial buildings by 2012.
Expand the Alaska Housing Finance Corporation (AHFC) Building Energy Efficiency Standard (BEES) to include commercial buildings by developing appropriate measures.

Implement an Energy Efficiency Labeling Program for buildings.
Energy performance labeling supports increased energy efficiency by making the efficiency of buildings observable, in much the same way that the Energy Star labels provide information for consumers on appliance energy use. Labeling also supports other policies and programs, such as energy-efficient mortgages, promotion of energy efficiency by realtors and property inspectors, and incentives to promote energy efficiency upgrades of houses and buildings. This program could use the AHFC AKWarm Energy Star rating system for new construction as well as the Weatherization program to rate retrofits.

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[1] Juday, Glenn P., Spruce Beetles, Budworms, and Climate Warming, Department of Forest Sciences, University of Alaska Fairbanks, no date. http://www.cgc.uaf.edu/Newsletter/gg6_1/beetles.html
[2] Werner, R.A., and Holsten, E.H. 1983. Mortality of white spruce during a spruce beetle outbreak on the Kenai Peninsula in Alaska. Canadian Journal of Forest Research 13(1):96-101.

Require new state public sector buildings to integrate environmental design to achieve the highest standards for greenhouse gas emission reductions, water conservation and other building performance measures.
Buildings have many environmental impacts, including energy demand, water consumption, waste water production, the embodied energy of building materials, solid waste production, and in some cases, disposal of toxic materials.

Continue to fund the home weatherization programs through the Alaska Housing Finance Corporation.
These programs are well structured to address the needs of homeowners throughout Alaska. Research indicates that the programs reduce energy use by 25 %. The program also attempts to train energy raters and weatherization crews living in the communities and regions where the work is occurring thus fostering local work skills and employment.

Fully fund the Low Income Energy Assistance Program (LIHEAP).
This program assists households with high energy costs when oil prices increase while maintaining market prices signals to encourage efficient use of energy. State revenues also increase when oil prices increase so the funding is more readily available to fund this "counter cyclical" program. The program has an administrative structure in place to readily respond to pressures on household budgets of rising energy prices and is available for all regions of Alaska.

Policy recommendations related to industrial energy use

Develop an Industrial Energy Efficiency Program for Alaska to address specific challenges faced by Alaska's industrial sector.
Establish an Industrial Energy Efficiency Program for Alaska to address challenges and issues faced by the industrial sector. The program will encourage industry driven investments in energy efficient technologies and processes; reduce emissions and greenhouse gases; promote self generation of power; and reduce funding barriers that prohibit energy efficiency in the industrial sector. Some specific strategies include developing a results-based pilot program with industry to improve energy efficiency and reduce overall power consumption and promote the generation of renewable energy within the industrial sector.

Eliminate routine flaring at oil and gas producing wells and production facilities by 2019 with an interim goal to reduce flaring by 50 percent by 2014.
Reducing flaring is an issue for many jurisdictions and the World Bank is leading a Global Gas Flaring Reduction Partnership. Routine associated gas flaring is considered gas that meets an economic threshold for conservation. Operators will be required to perform an economic analysis of all sources of continuous solution gas flaring and subsequently tie in any gas that shows a net present value greater than zero.

Explore opportunities and new technologies to develop underground disposal of carbon dioxide (sequestration or carbon capture and storage).
Geological carbon sequestration involves disposing of carbon dioxide safely and permanently in carefully selected underground locations. There are opportunities to

dispose of carbon dioxide into depleted gas reservoirs or specific formations with saline water, or to use the carbon dioxide to enhance oil recovery.

Establish policies and measures to reduce industrial greenhouse gas emissions. Alaska industries with the highest greenhouse gas emission estimates are those engaged in the energy production and energy delivery business accounting for approximately 36 % of greenhouse gas air emissions.

Policy recommendations related to transportation

Support the development of community transit systems and plans to provide alternatives to private passenger vehicles for transportation.
On-road vehicles account for approximately 18 % of Alaska transportation greenhouse gas emissions and a similar proportion of household energy budgets. Community transportation systems provide accessibility to underserved members of the public including senior citizens, low income workers, the physically handicapped and students and facilitate their ability to get to jobs, school, medical facilities, and purchasing food, clothing and other essentials. In Anchorage in 2008, the People Mover transported over 4.2 million riders an average of 4.52 miles per rider displacing approximately 1 million gallons of gasoline and 20 million pounds of CO_2 one gallon of gasoline creates 20 pounds of CO_2).[3]

Enhance transportation planning and decision-making criteria by adding CO_2 emissions as criteria in transportation decisions.
By adopting criteria that estimates a project's CO_2 emissions for regional and statewide transportation plans and state transportation improvement program projects (STIP), the public and decision makers can be informed on what projects' CO_2 emissions will be and can make decisions accordingly.

Make transportation investments where existing or planned development will encourage public transportation use, walking, and bicycling.
Use the statewide transportation and STIP criteria to support greenhouse gas (GHG) reducing programs and projects. Give greater emphasis to Plan and TIP criteria and projects that support sustainable land use and transit-oriented development; that promote transit, ridesharing, and travel demand management coordination; and that include bicycle and pedestrian improvements that will generate significant use of these modes.

Remove from law the limits on the percentage of Alaska Department of Transportation's State Transportation Improvement Program (STIP) that can be spent on enhancements.
Also remove any limits on the ability of communities to improve pedestrian, bicycle and trail projects and safety programs.

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[3] Anchorage People Mover rider ship statistics provided by Alton R. Staff, Planning Manager, Anchorage Public Transportation Department, February 24, 2009.

Encourage more compact communities and land use policies to reduce energy use from the dependence on single occupancy vehicles and reduce the cost of transportation to Alaska families by giving priority to projects in areas identified in local and regional plans as being suitable for concentrated development and/or redevelopment, support initiatives that increase sustainability.
According to John Horsley, Executive Director, American Association of State Highway Transportation Officials (AASHTO), one third of transportation's contribution to emission reductions will be shaped by transportation reauthorization investments, policies and improved fuel efficiency standards. The other two thirds will come from federal, state, and local energy policies, local land use policies, the effect of higher fuel prices, and new technologies.[4]

Support the acquisition of clean and fuel-efficient vehicles for public fleets.
State and regional agencies and urban municipalities should buy more efficient cars and trucks and increase the use of lower-carbon fuels. By doing this, agencies and municipalities will assemble a cleaner fleet and save money on energy.

Support legislation that encourages the expanded use of electric cars.
Electric cars have the potential to reduce energy costs in Alaska communities with excess electricity from renewable sources. These include small, Southeast Alaska communities off the highway system and remote communities developing wind generation facilities. Electric cars, and potentially electric four wheelers, are well suited for off-highway use and are a natural fit for these communities.

Support initiatives to eliminate unnecessary idling.
Consider developing an anti-idling regulation that prohibits idling the engine of any motor vehicle while the vehicle is stopped in excess of five minutes (with exceptions for activities such as maintenance and operating equipment such as delivery lifts). With technology that is now available, buses can be automatically switched off if left idling for over five minutes.

Consider environmental issues during transportation project selection.
In particular, air quality and the reduction of pollutants (CO, NOx, VOCs, particulates, and CO_2), the protection of water resources (soil and water contamination, stormwater management, and wetlands impacts), open space, and fish, wildlife and ecosystem preservation; and value those projects that reduce negative impacts.

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[4] Horsley, John, Executive Director, American Association of State Highway Transportation Officials (AASHTO), Reauthorization and Climate Change, presentation at the Transportation Research Board Annual Meeting, January 2008.

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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

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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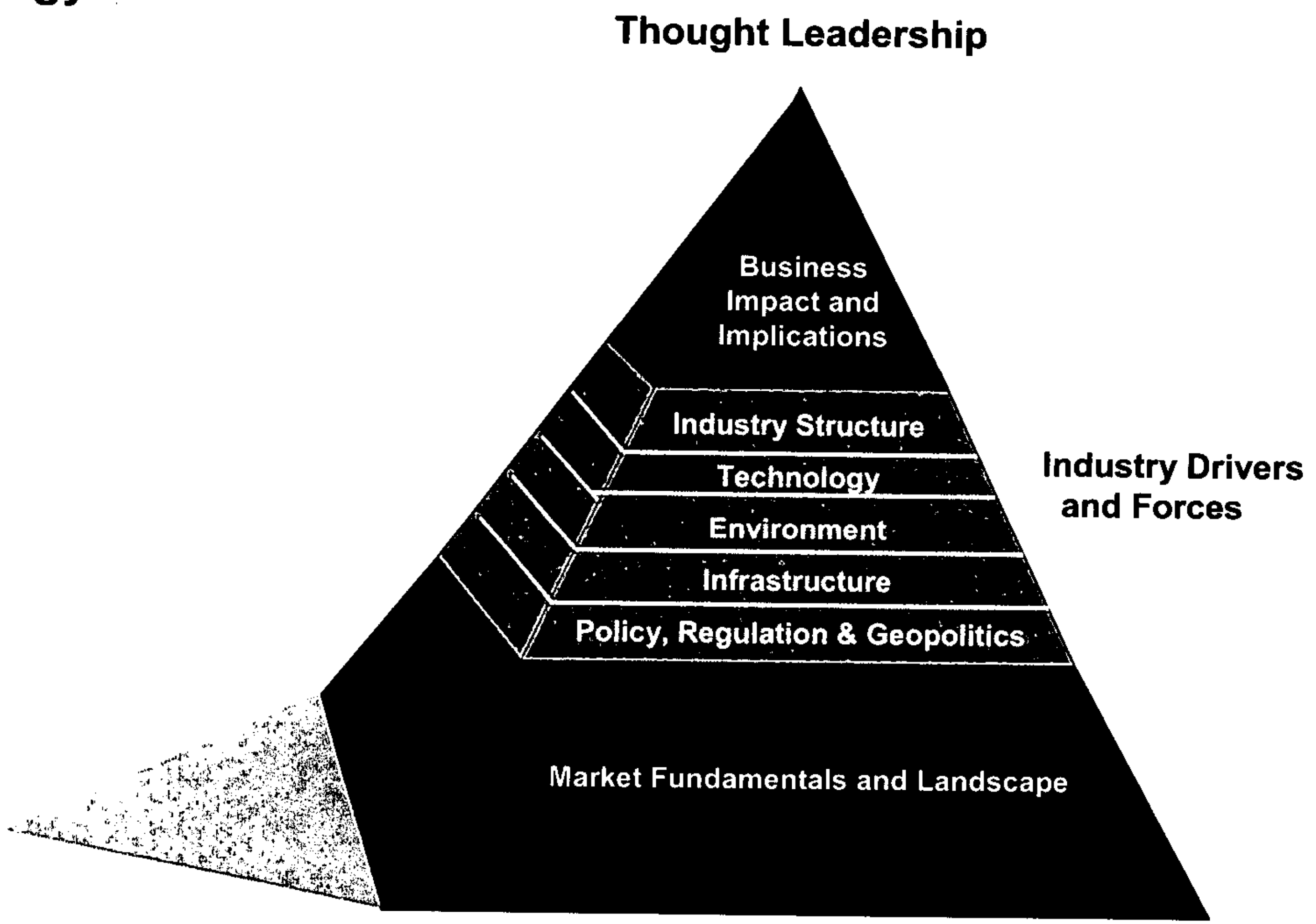
CERA Advisory and Consulting Services

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



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Source: Cambridge Energy Research Associates.

Policy Methodology and Selected Previous Engagements

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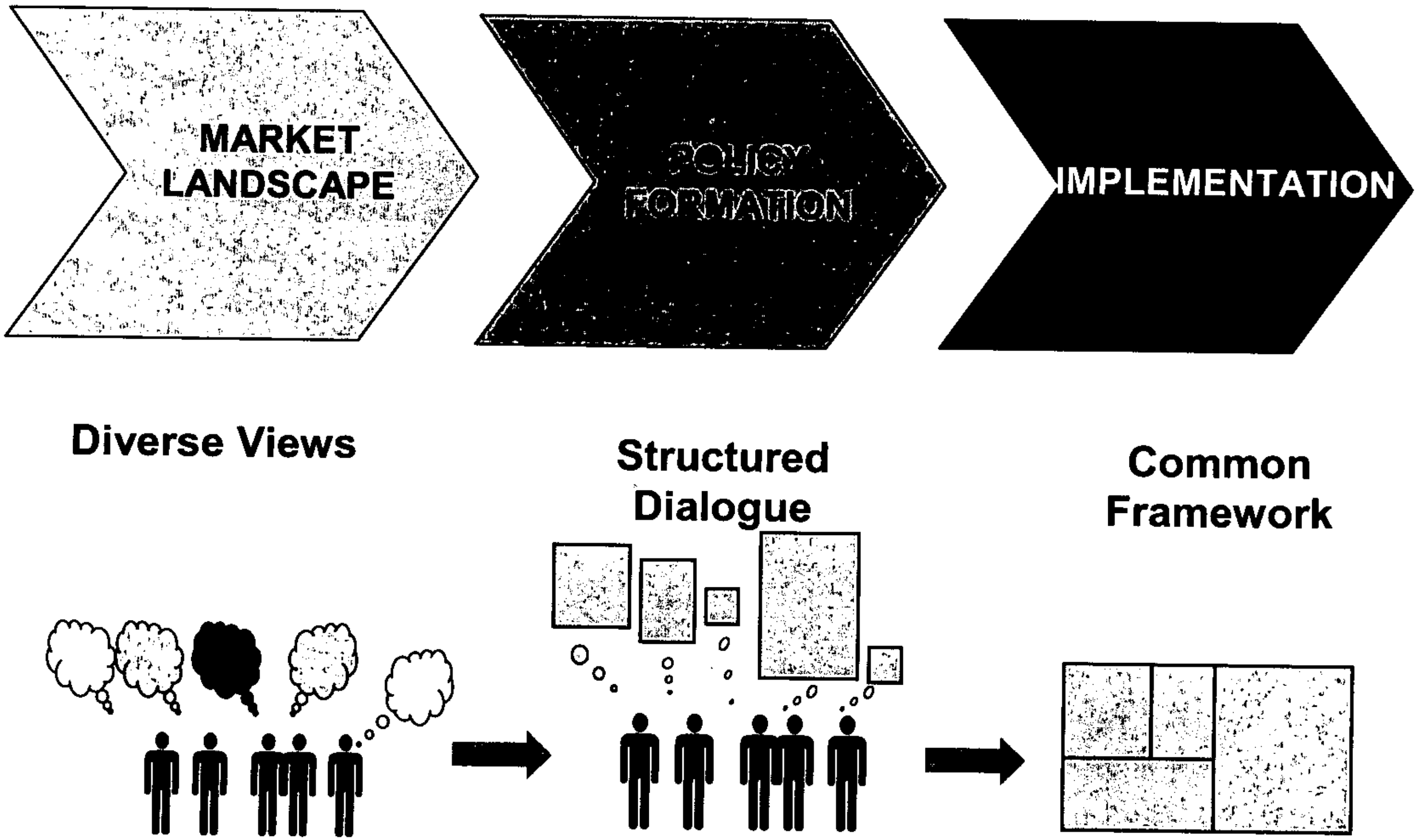
Energy Policy Roadmap Components



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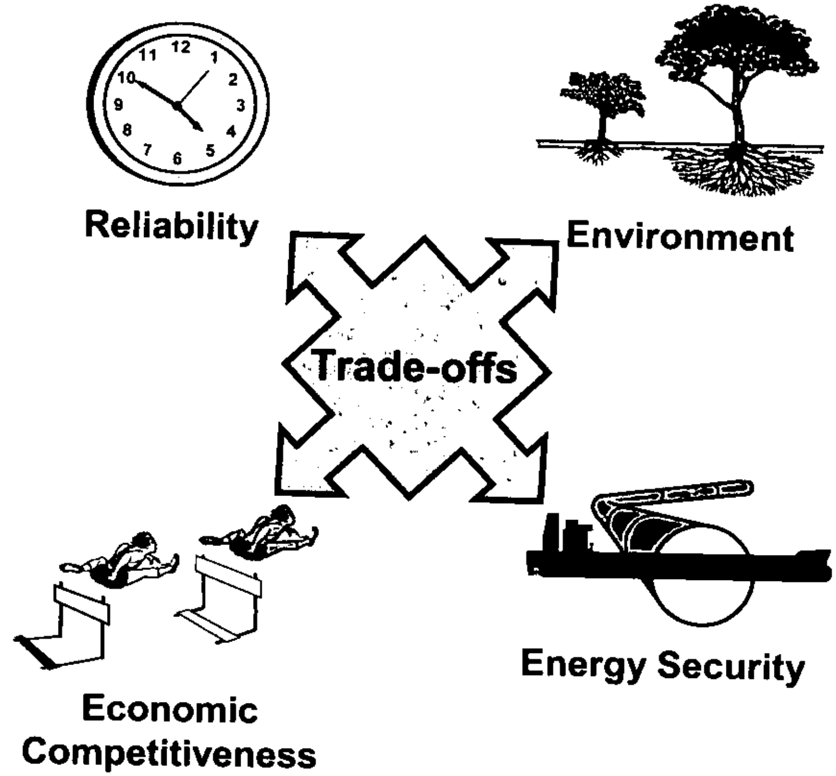
Role of the Market Landscape in Developing an Energy Roadmap

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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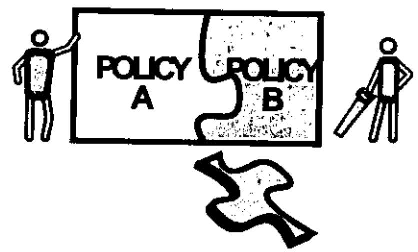
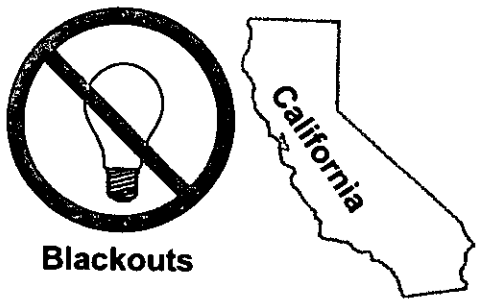
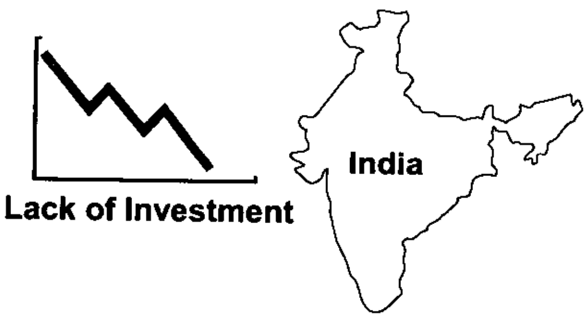
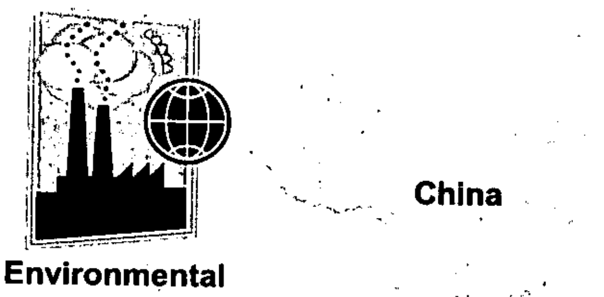
Policy trade-offs Must be Recognized and Resolved Early on



Or Face the Consequences…







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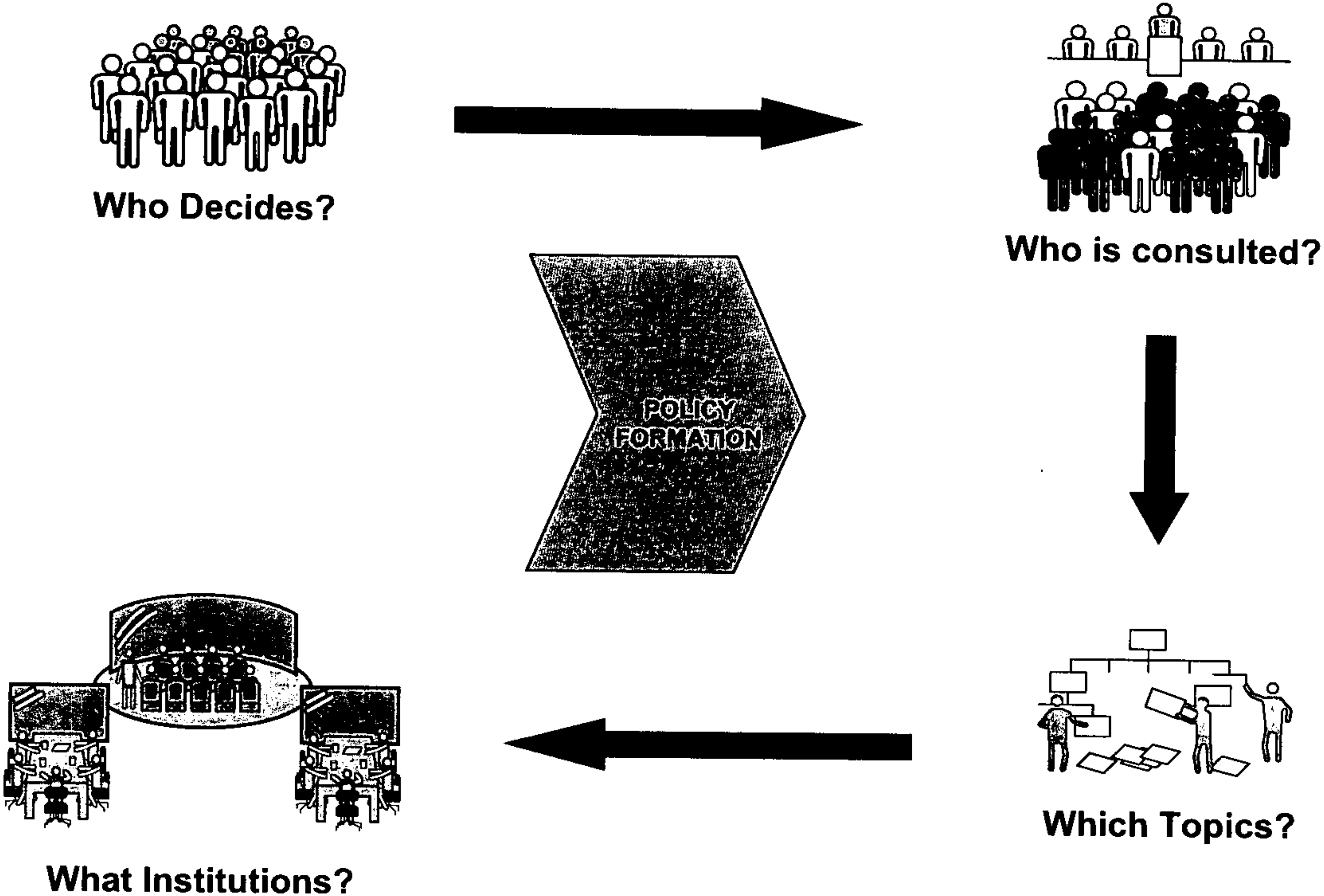
Four Key Policy Formulation Questions



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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 CO_2 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 CO_2 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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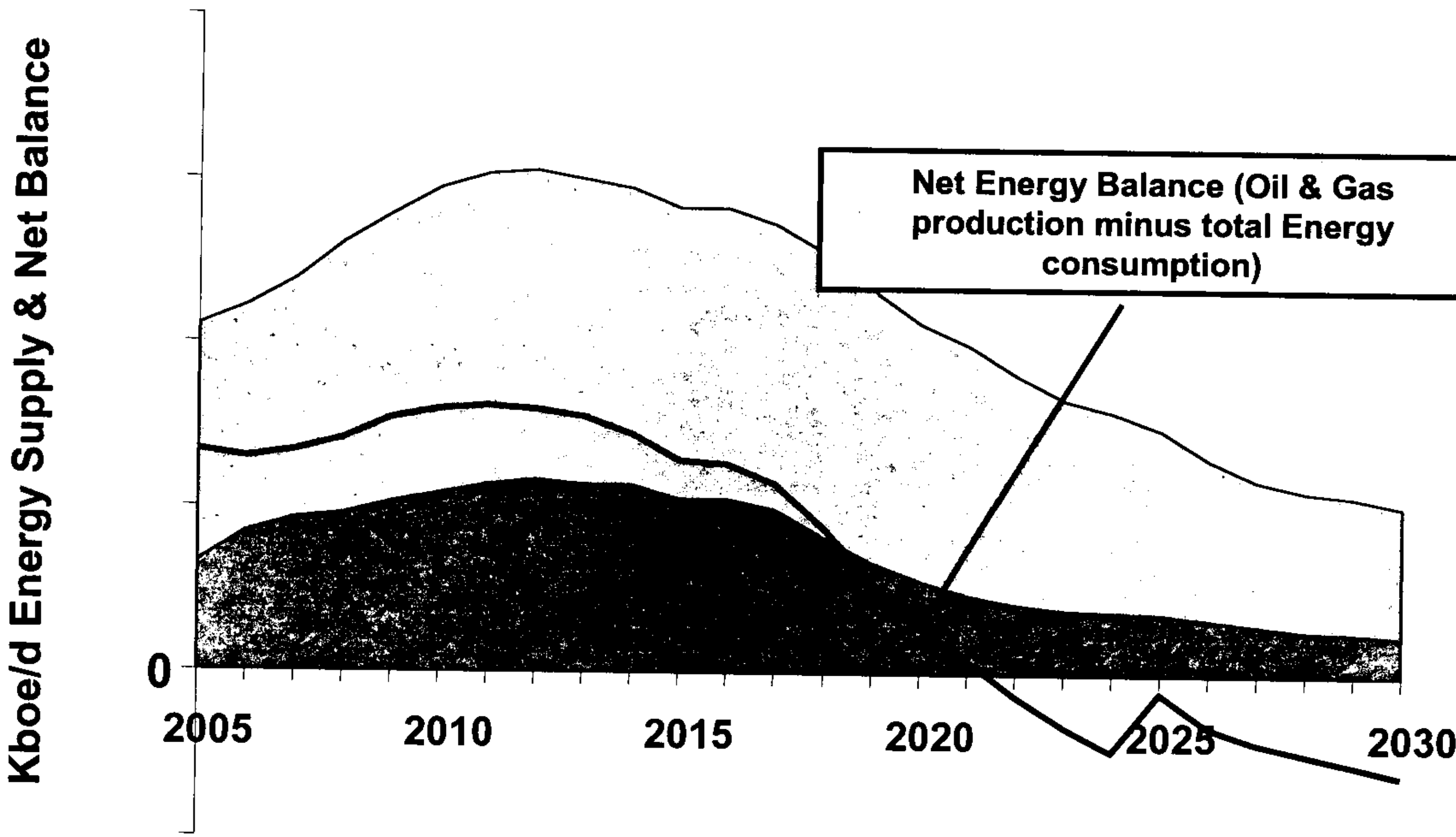
Case Example

Emerging Energy Balance Shift Drove the Need for Policy Review



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Source: CERA analysis, study data

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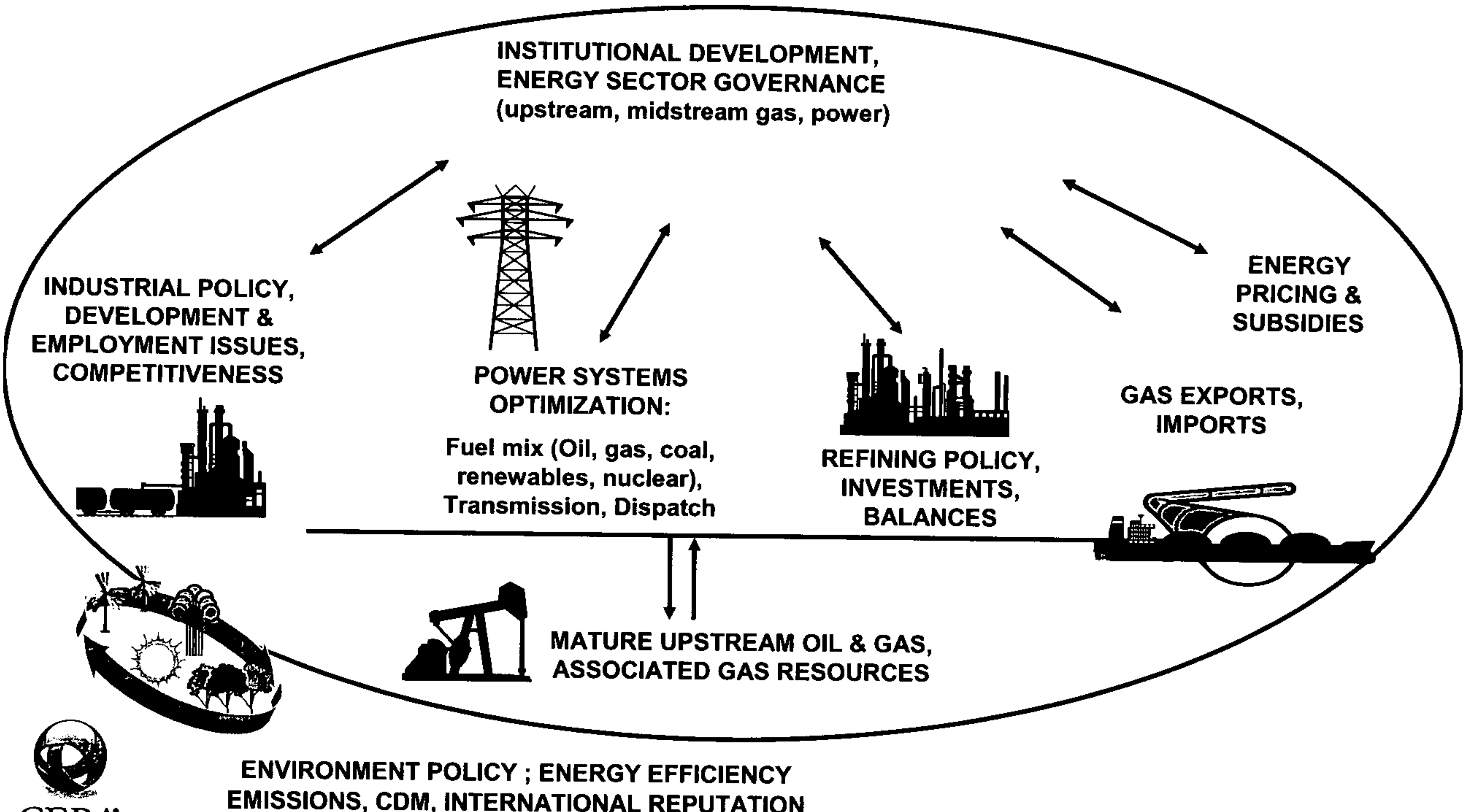
Case Example

Study Embraced the Entire Energy Spectrum



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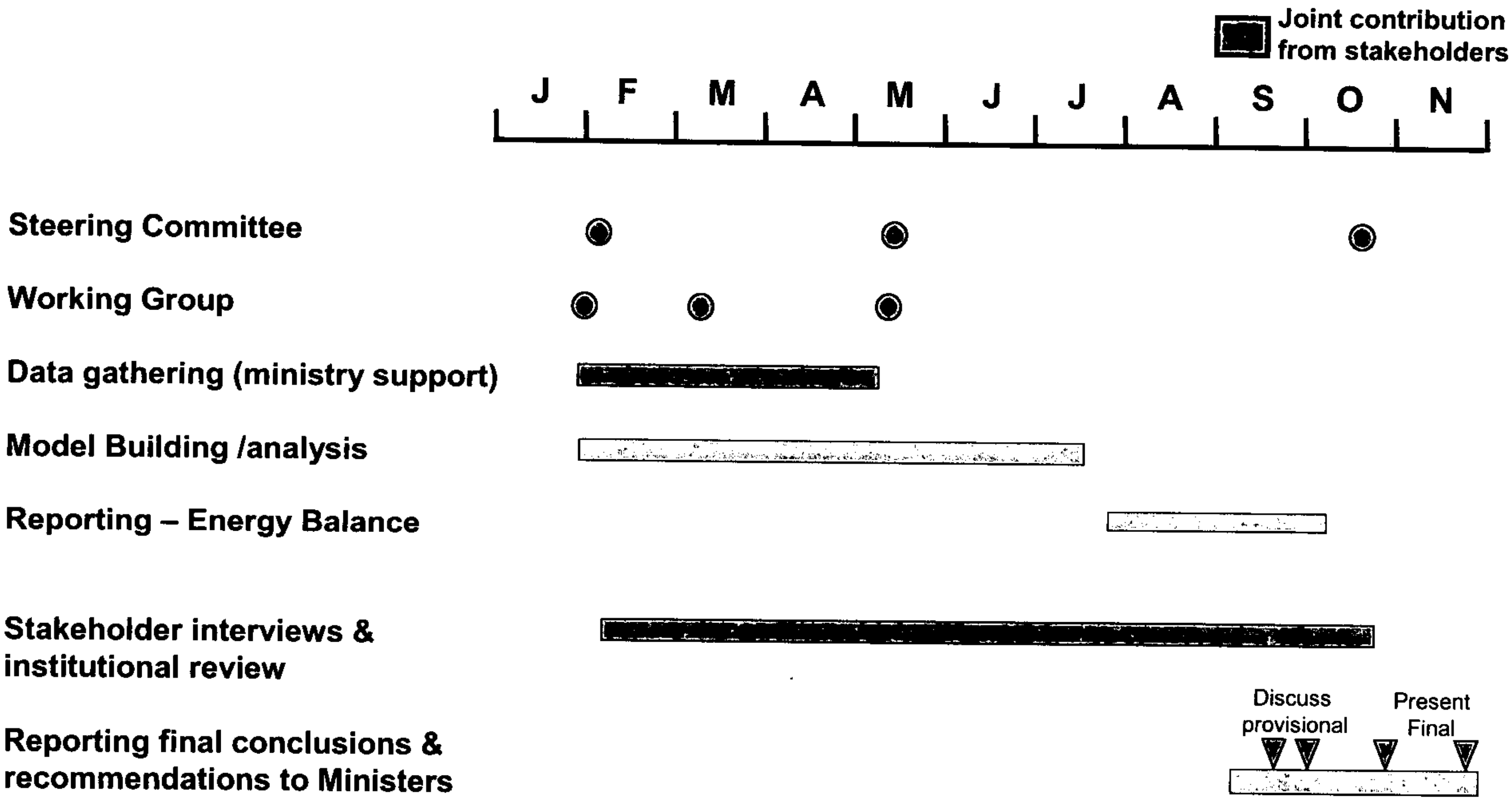
Case Example

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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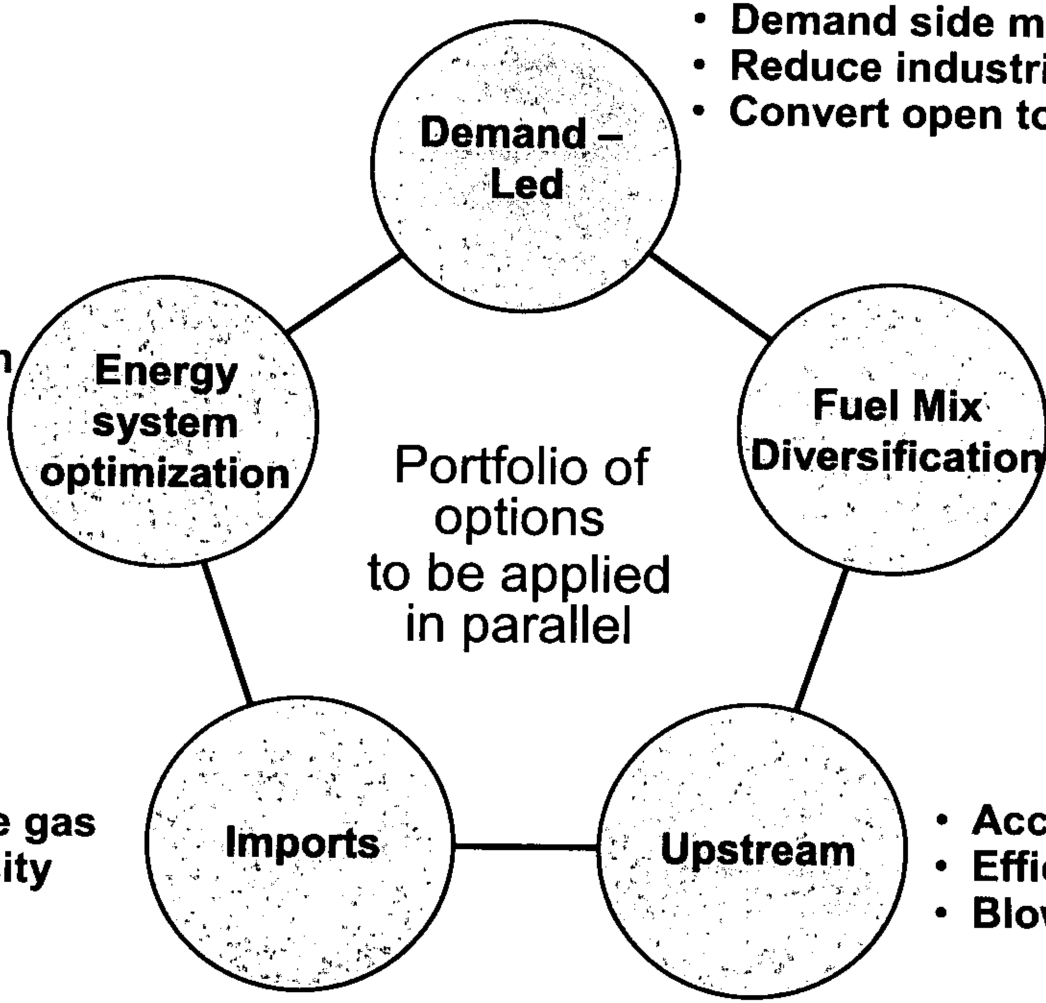
Case Example

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



Demand – Led
- Demand side management
- Reduce industrial gas demand
- Convert open to combined cycle

Fuel Mix Diversification
- Liquid burning for power
- Renewables
- Coal fired power
- Industrial fuel switching

Upstream
- Acceleration
- Efficiency
- Blowdown

Imports
- LNG
- Pipeline gas
- Electricity

Energy system optimization
- Grid integration / upgrading
- Dispatch optimization

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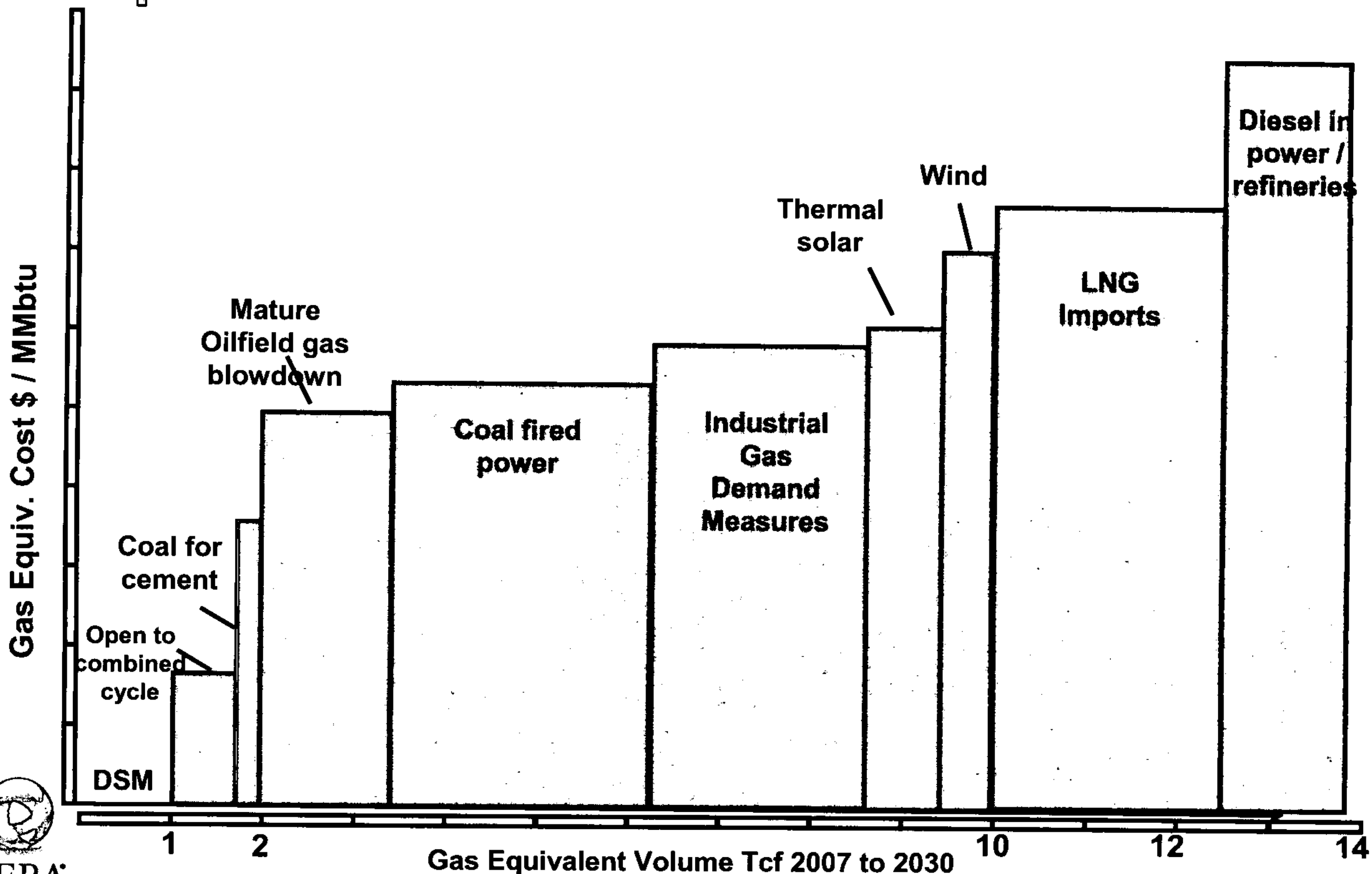
Costs of Energy Balance Options were Compared

Case Example



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Qualitative Considerations were Critical in Developing Final Energy Policy Recommendations

Case Example

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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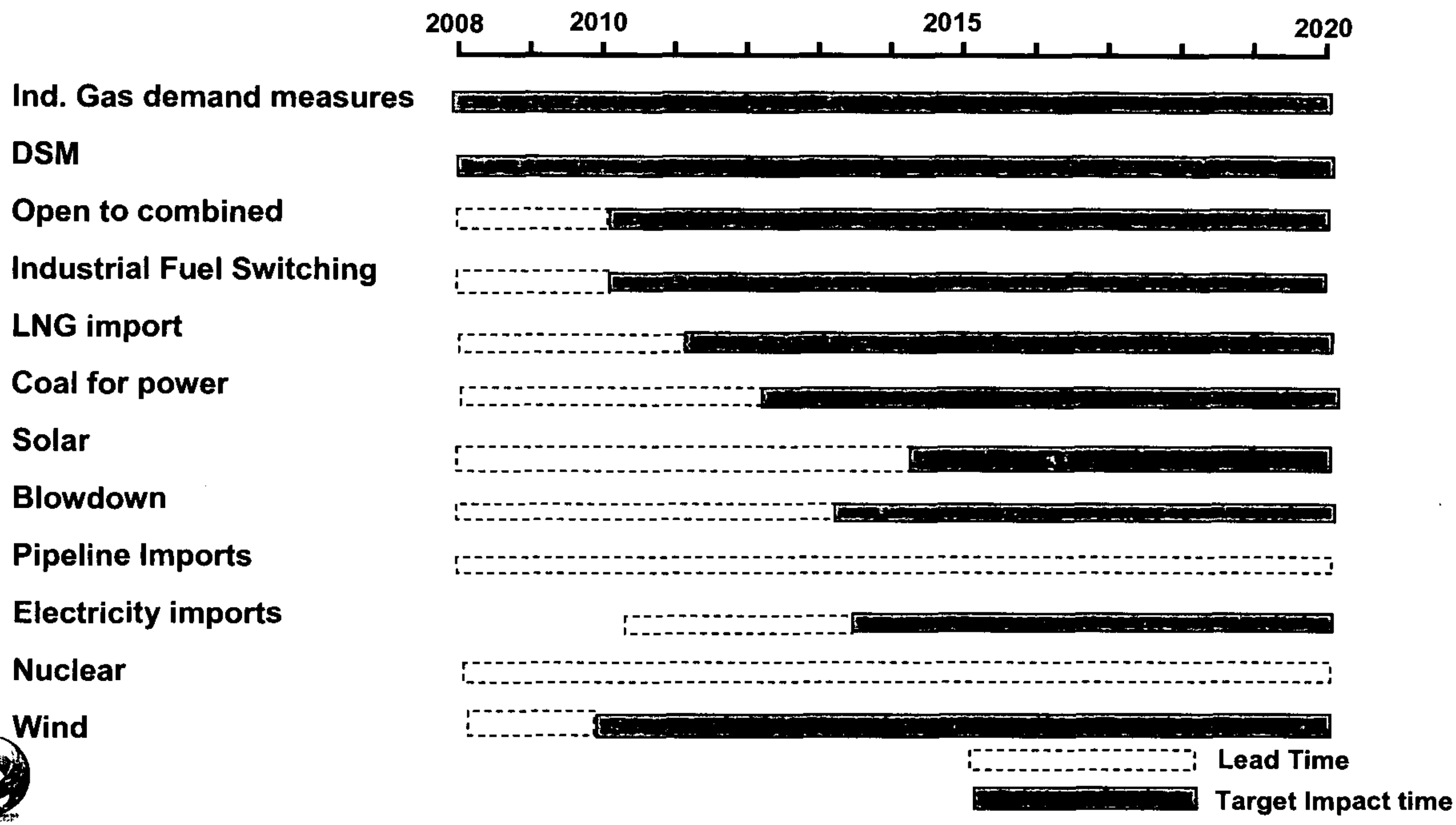
Case Example

Early Planning for Implementation was Recommended

Conservative / prudent planning assuming firm supply and no pipeline imports



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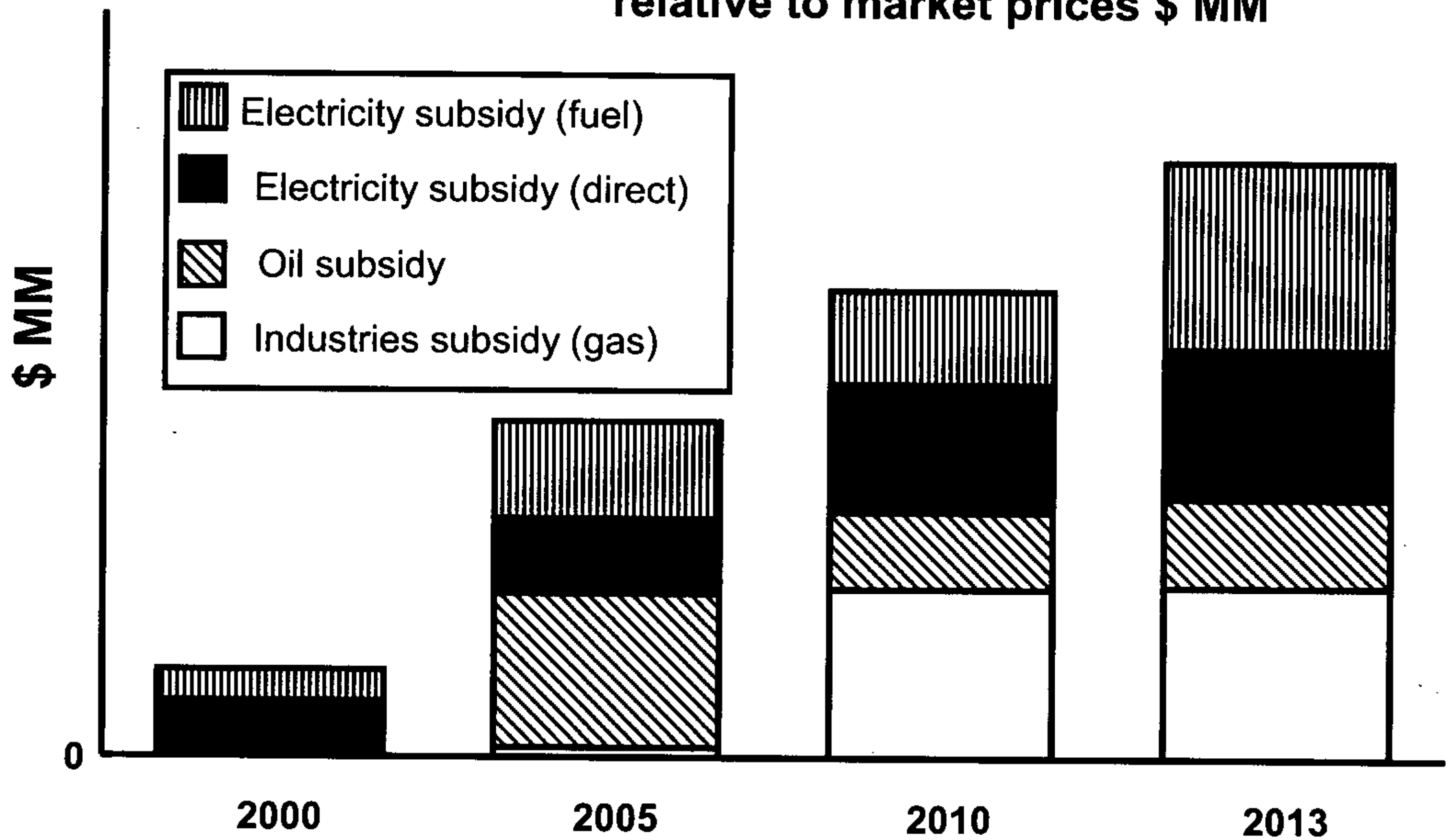
Case Example

Identifying the Cost of Energy Subsidies Assisted Pricing Policy Thinking

Approximate Energy subsidies relative to market prices $ MM



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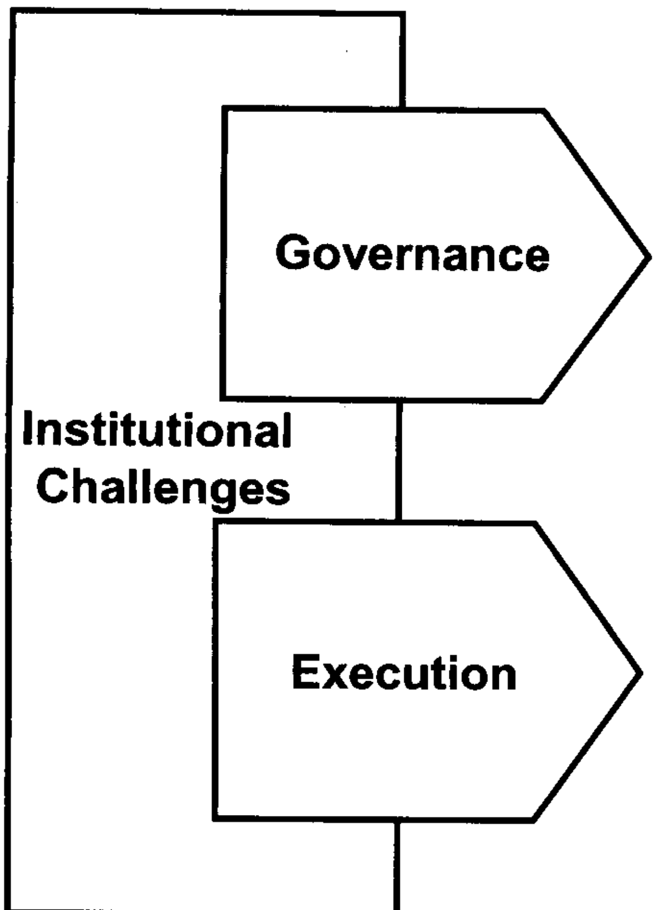
Identification of Institutional Challenges and Solutions were Important When Recommending a Policy Roadmap

Case Example



Governance

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

Execution

- 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

1840

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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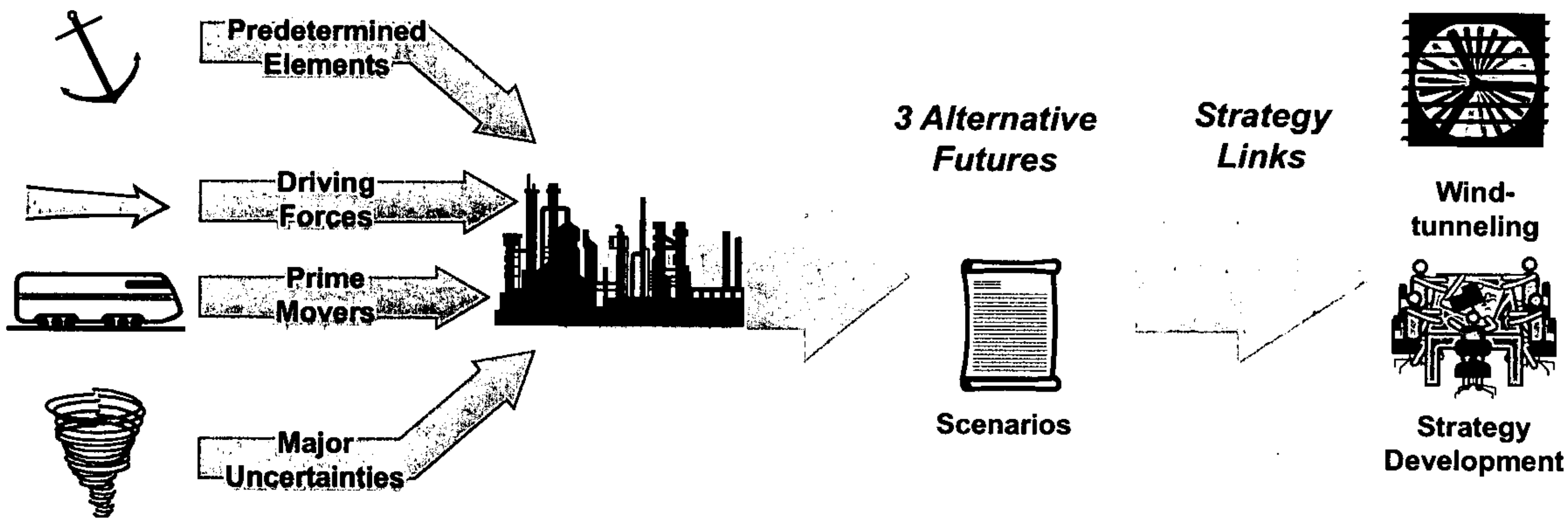
CERA's Scenario Process

INPUTS	*SCENARIOS*	*STRATEGY*
Factors that will shape the future	Combine inputs into alternative views of the energy future with signposts for each	Apply scenarios to develop and test strategies



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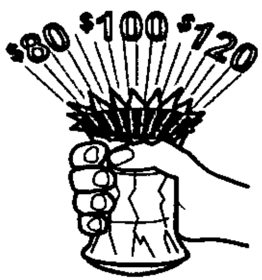
CERA's Global Energy Scenarios are the Backbone of Our Vision of the Future

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.

Source: Cambridge Energy Research Associates.

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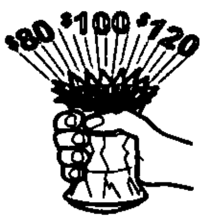
2008 US Scenarios Policy Drivers

	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.

Source: Cambridge Energy Research Associates.

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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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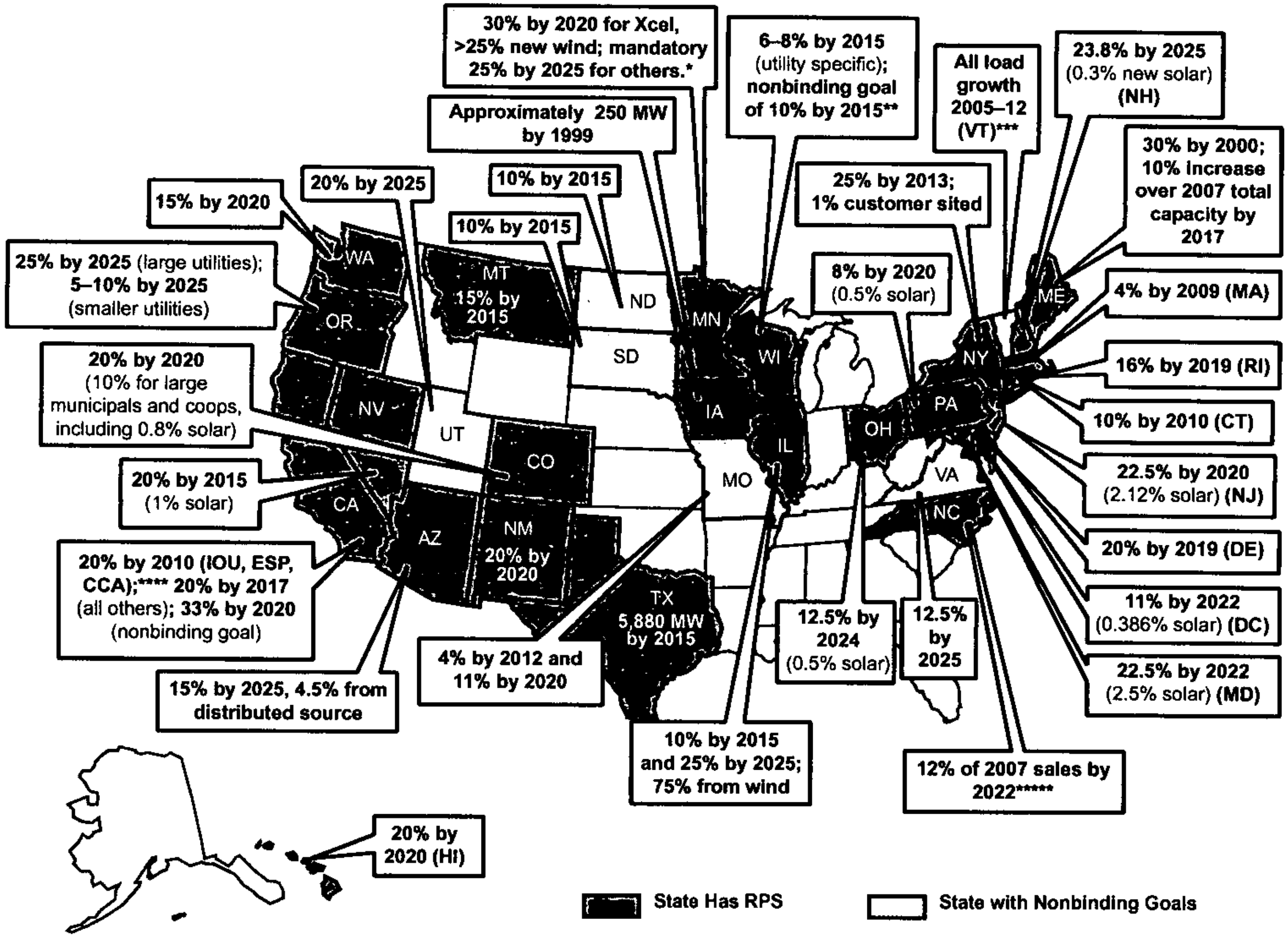
State Renewable Portfolio Standards Driving Renewable Investments



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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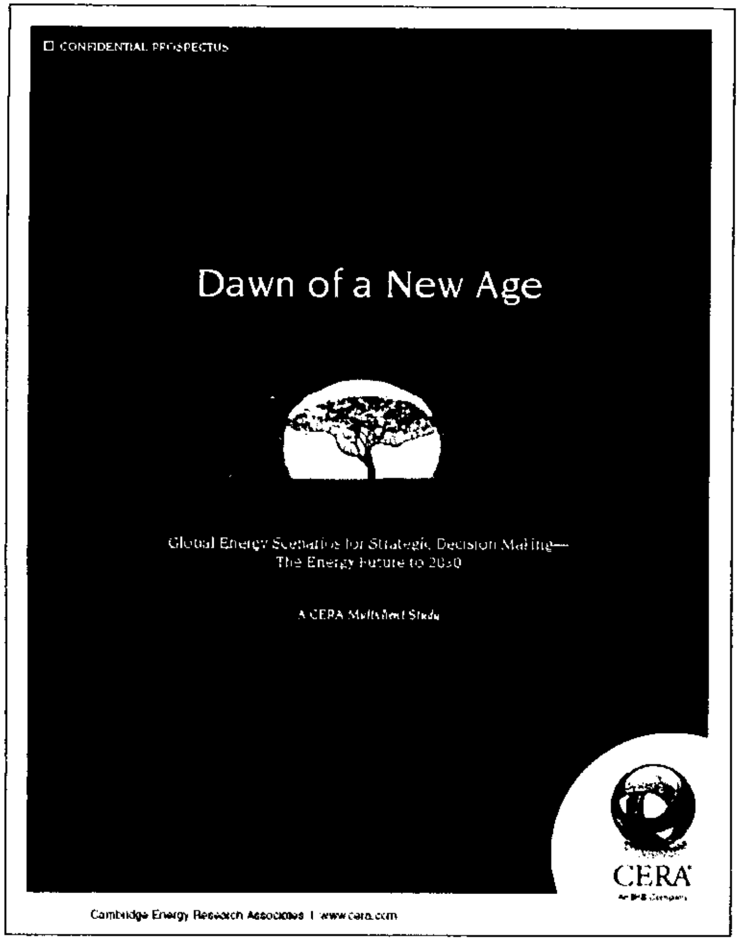
Global Energy Scenarios
Dawn of a New Age Multiclient Study



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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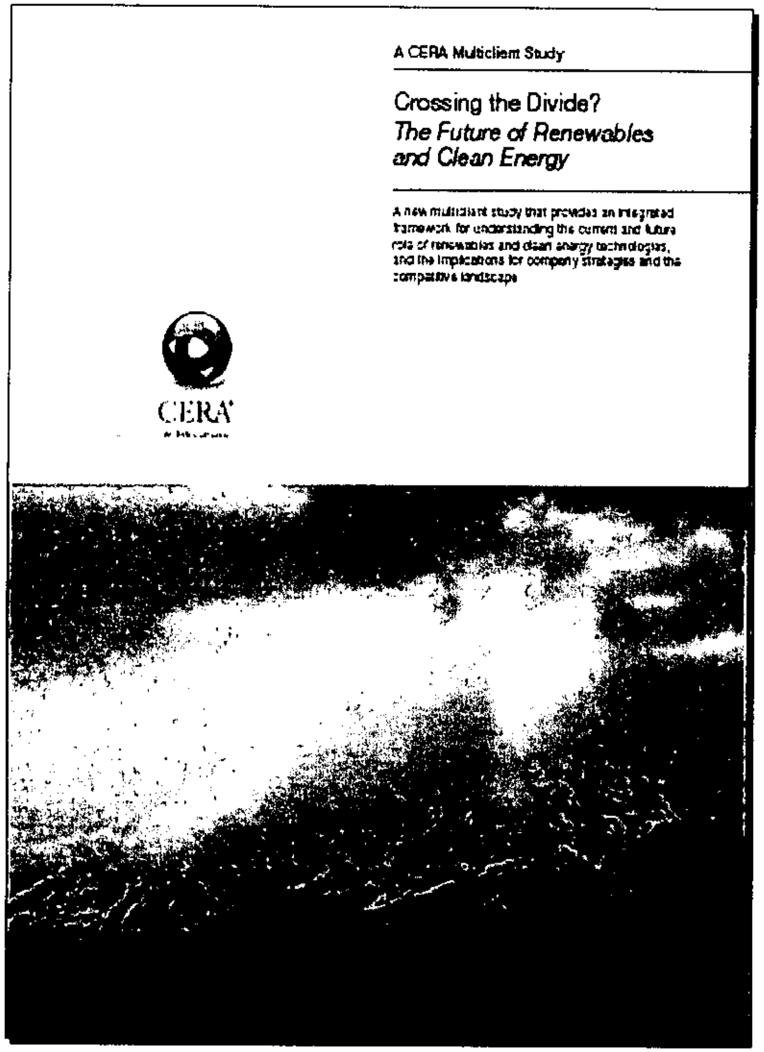
Clean Energy Technologies

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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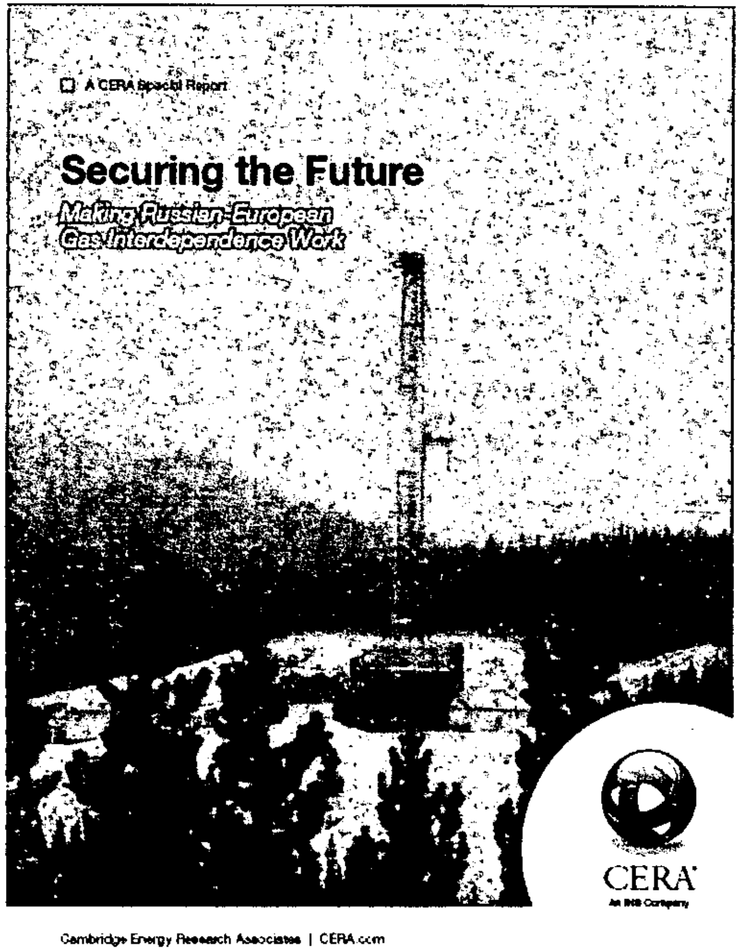
Multi Stakeholder Dialogue
Securing the Future Multiclient Study



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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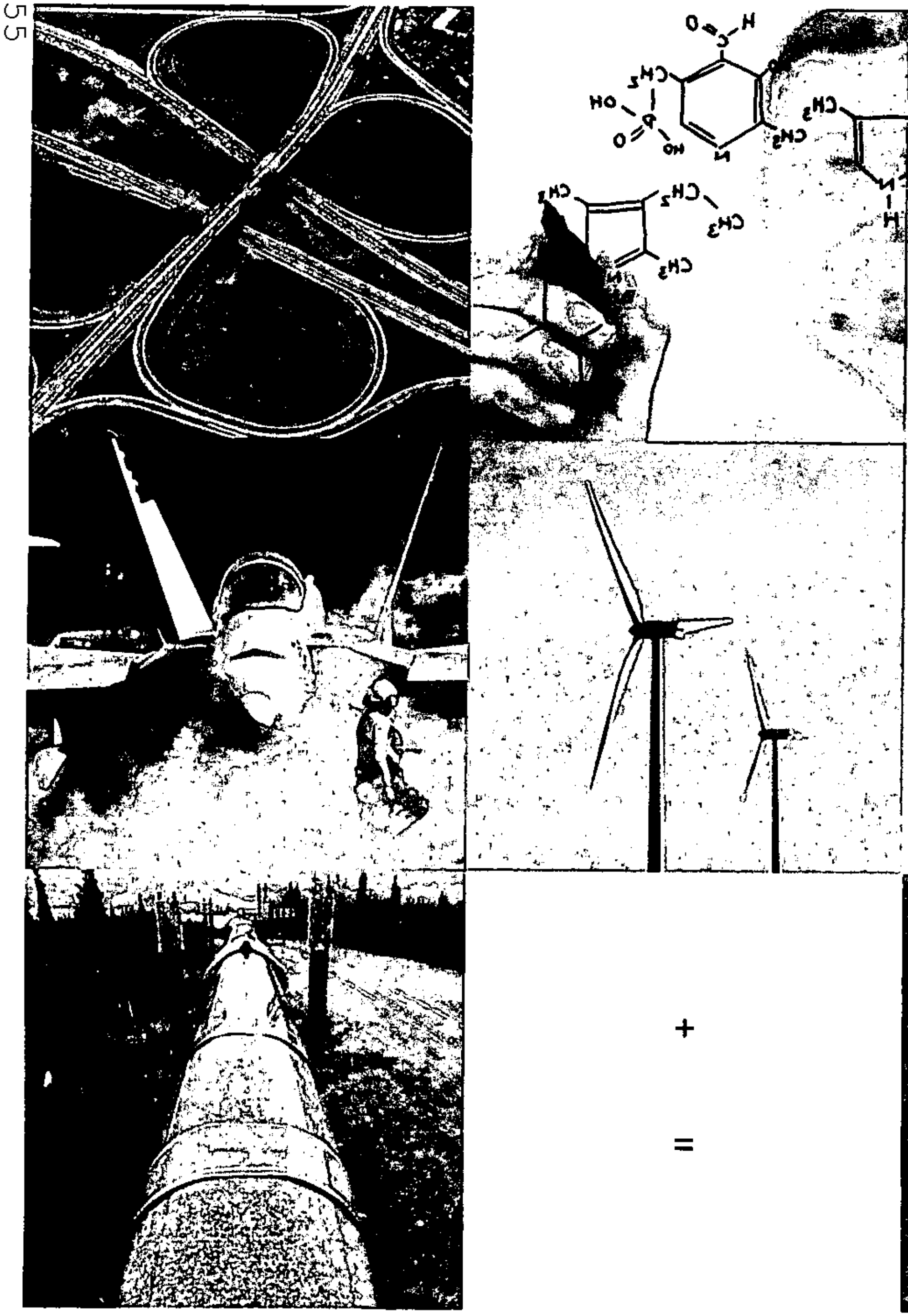

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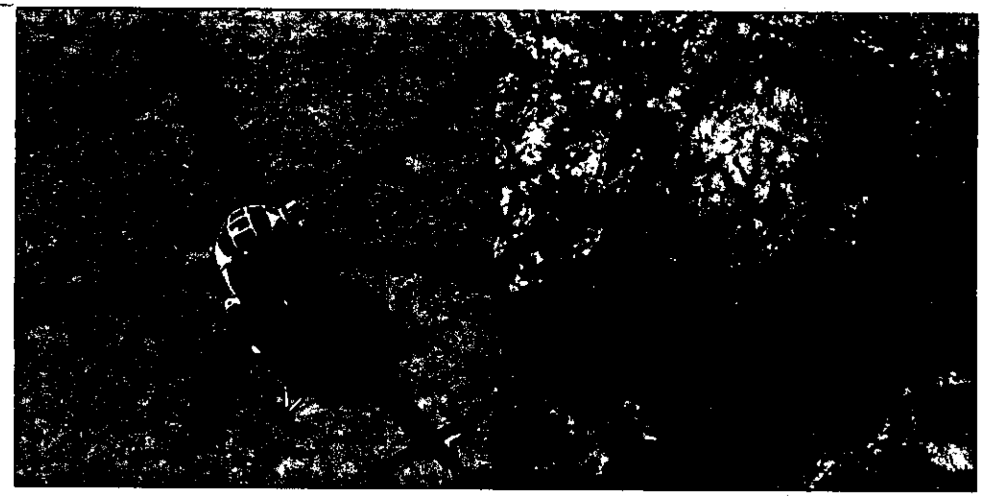

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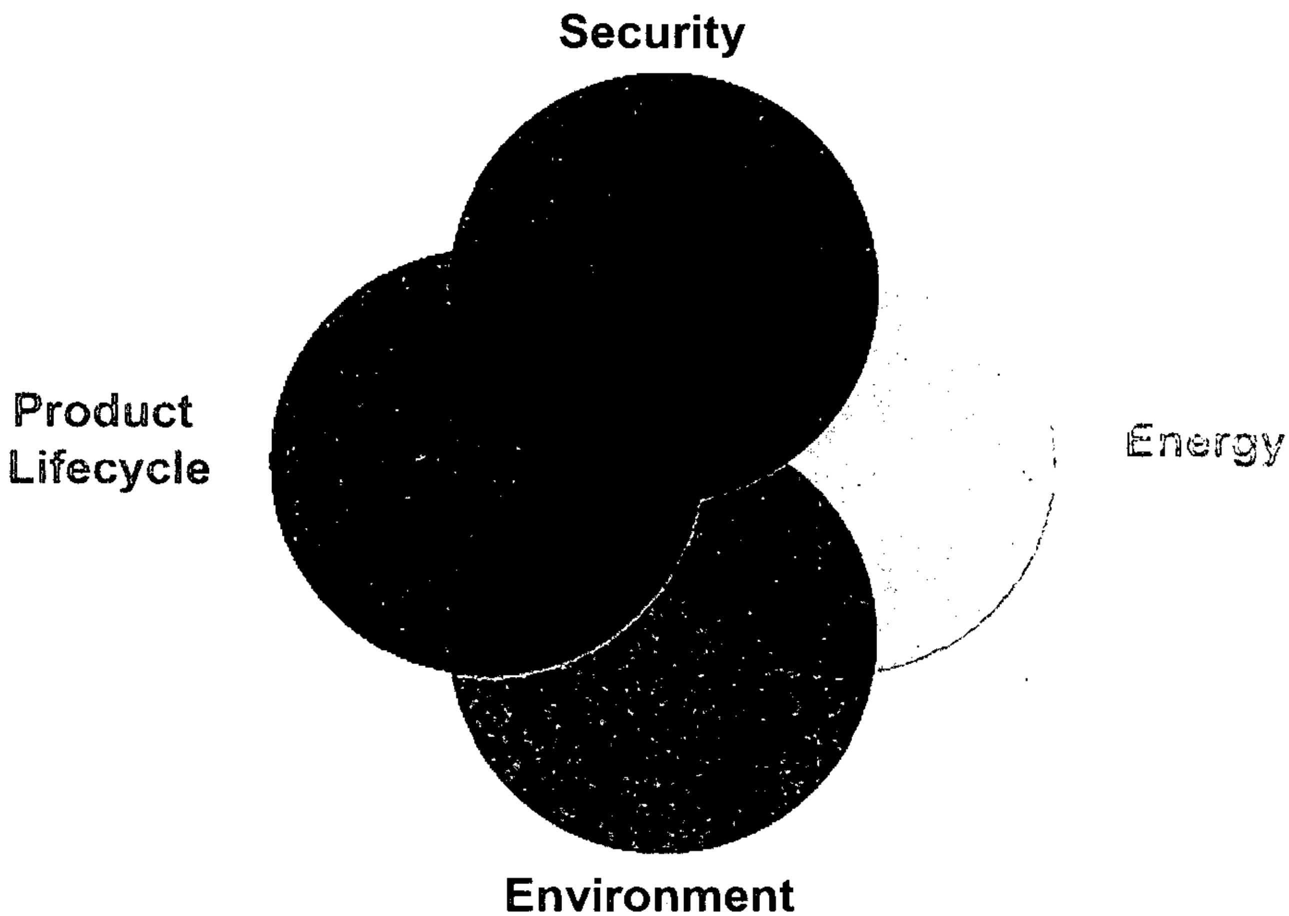
Four Domains of Insight and Critical Information



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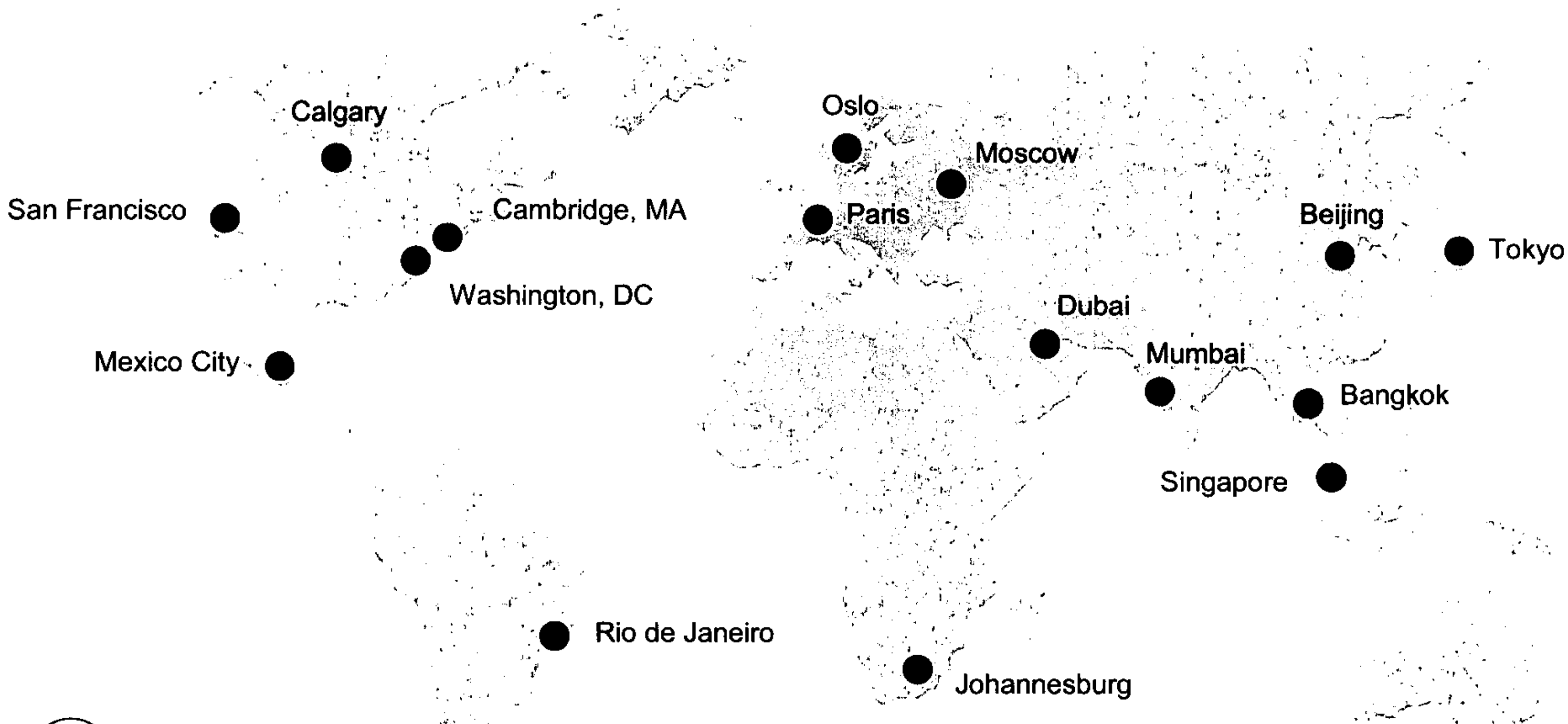

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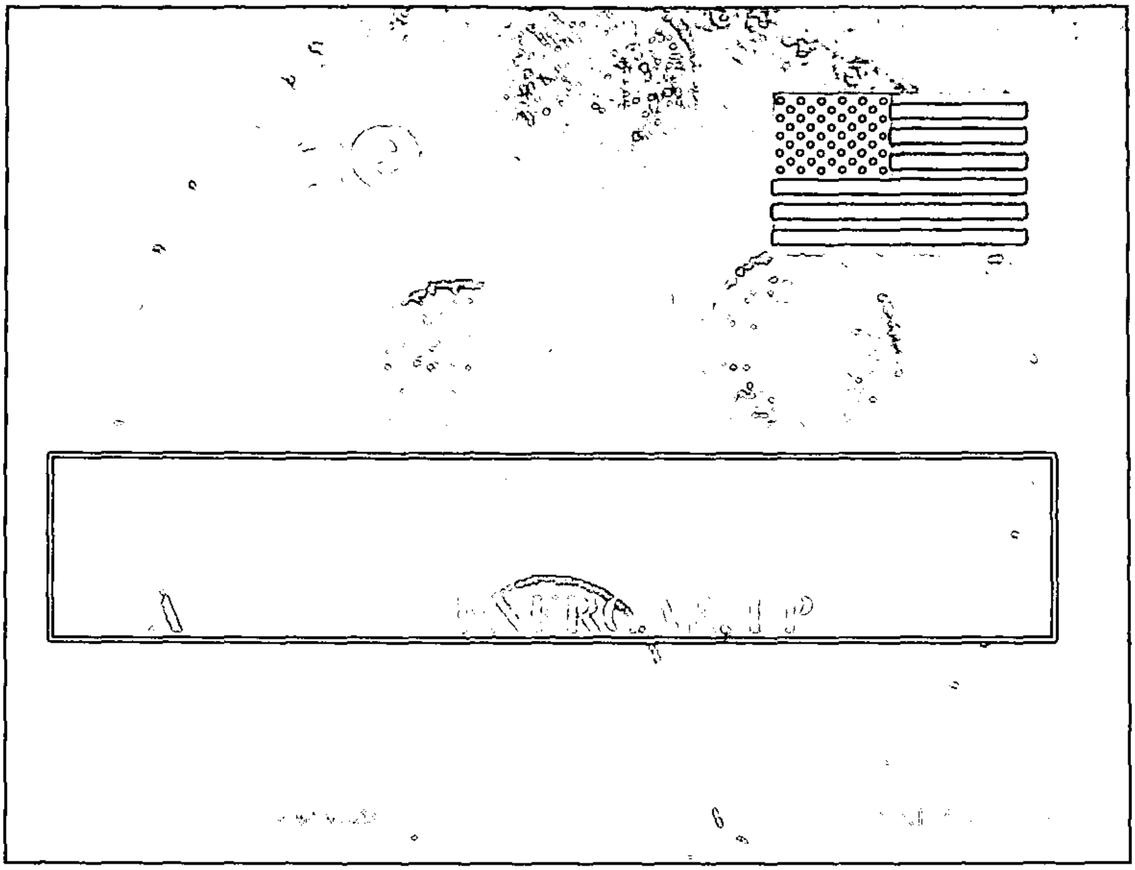

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"... ALGAE is the holy grail, if we crack it we can probably give up on everything else..."

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

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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

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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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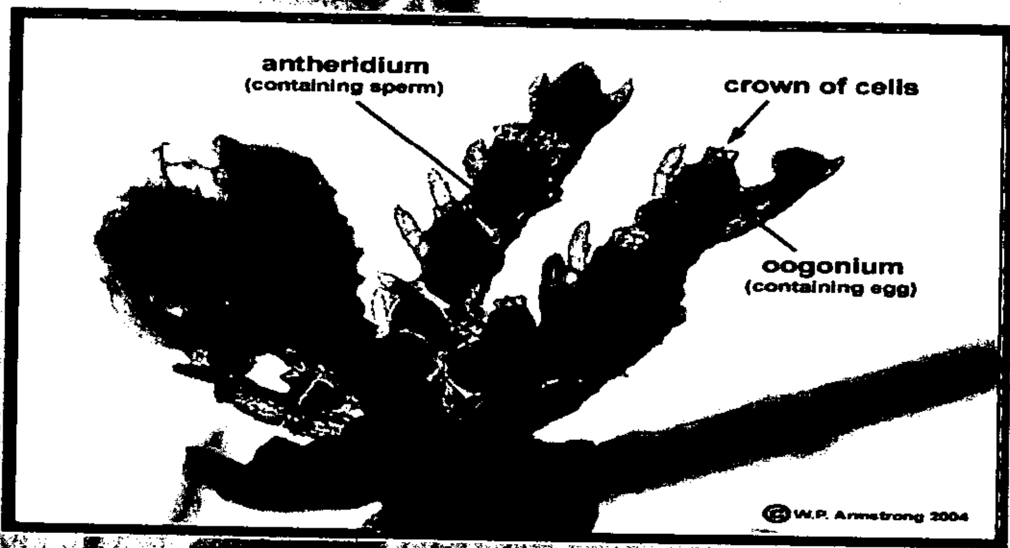
Alaska needs Algae



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ALGAE $.15 per kwh

- current diesel system – retained, enhanced
- manufactred oil – on site, at will
- self-sustaining energy – does not require outside source to function
- weather – operates in sub-zero under low cost greenhouse
- BTU quantity/quality – manipulate relative to need
- maintenance – low cost
- turn-key systems – RWE builds, maintains
- ongoing operation – locals without Phds

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ALGAE history

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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

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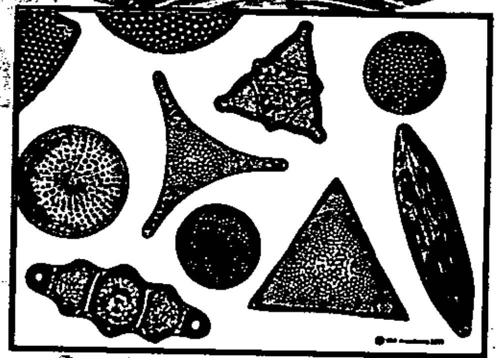
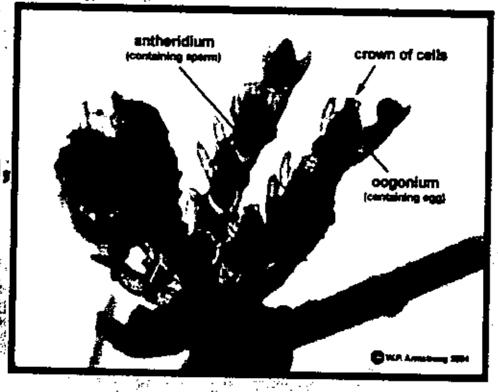
bad ALGAE - massive growth, limited energy value

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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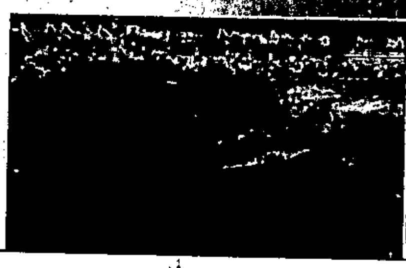
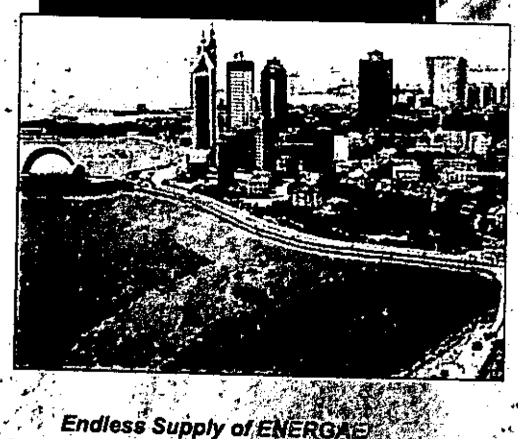
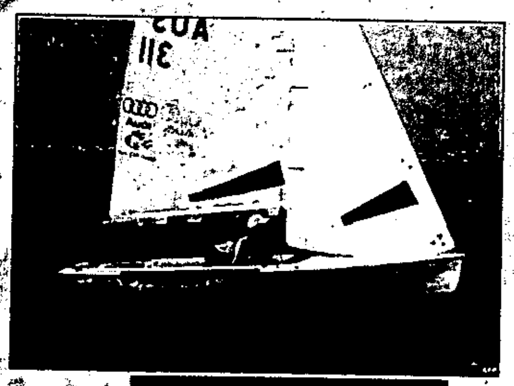
ALGAE growth worldwide - exploding







Indian Ocean, 2008

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

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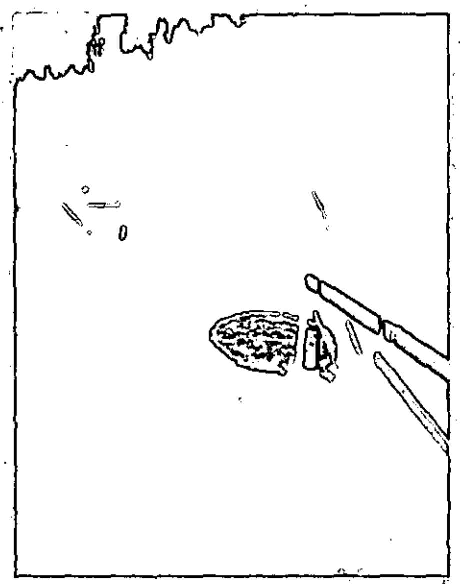
The Carolinas were hard hit with ALGAE problems

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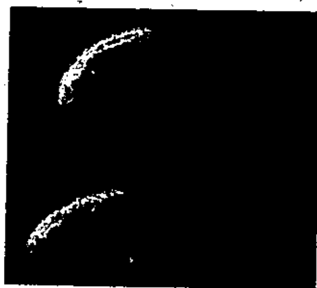
Carolinas - "...get rid of it, or find a use for it..."

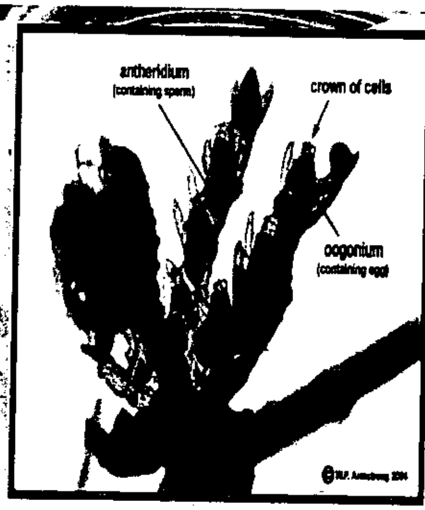
Armstrong & Tompkins visited ALGAE research centers worldwide



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

but, two major problems associated with ALGAE oil eluded solutions

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

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

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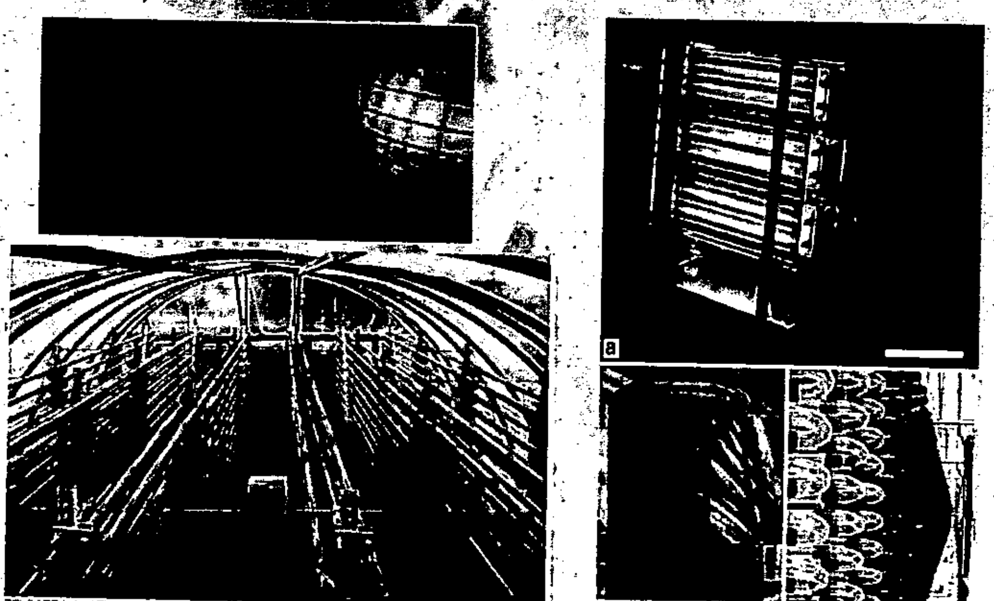
many good ideas.........but most fell short...either too costly to build or they couldn't efficiently extract oil



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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 CO_2 & NO_x 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

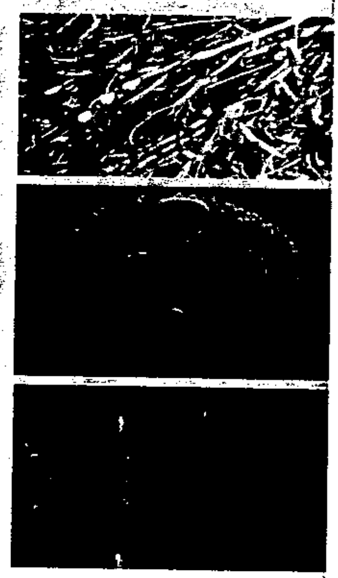
cleaner oil

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

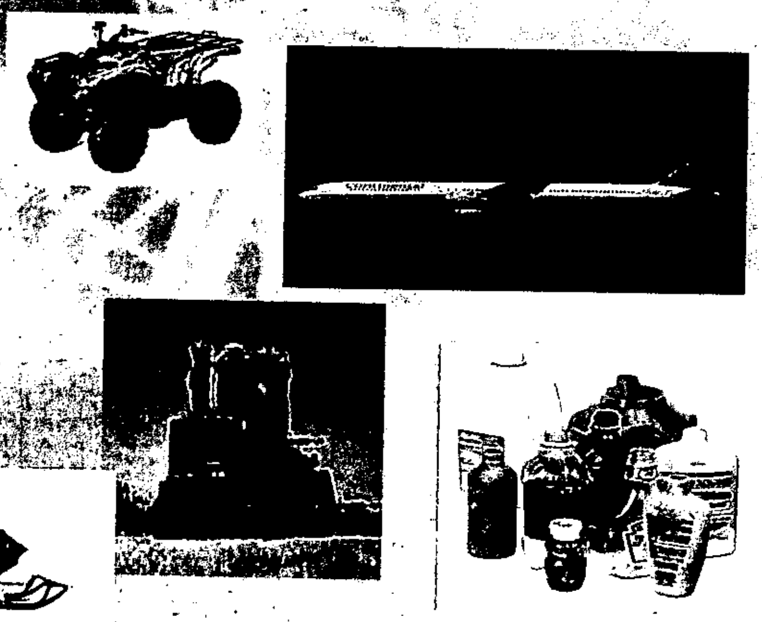
fastest growing organism known to man

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

products derived from ALGAE oil

- jet fuel
- gasoline
- plastics
- hydrogen
- Ethanol



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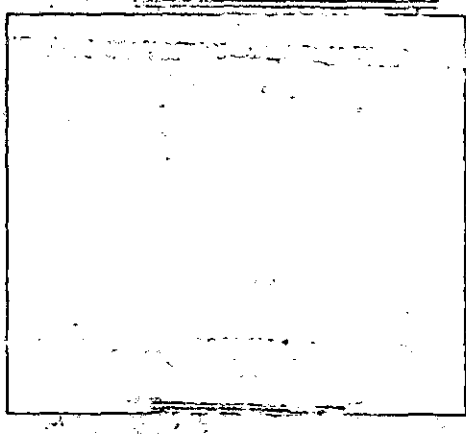
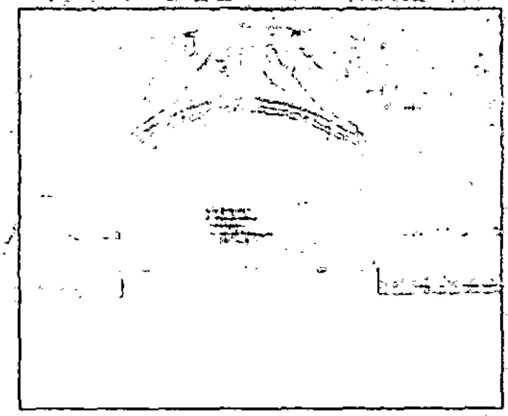
sample Algae growth rate





It took <u>30 hours for ALGAE to grow 20 fold</u> 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
<u>98% of oil extracted using proprietary harvesting methods</u>	<u>45% of oil extracted using "pressing"</u>
cleaner oil extraction	less quality oil
low cost to produce	high cost to produce
low cost to build	high cost to build
optimal CO_2 intake	poor CO_2 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 CO_2 and NO_x

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

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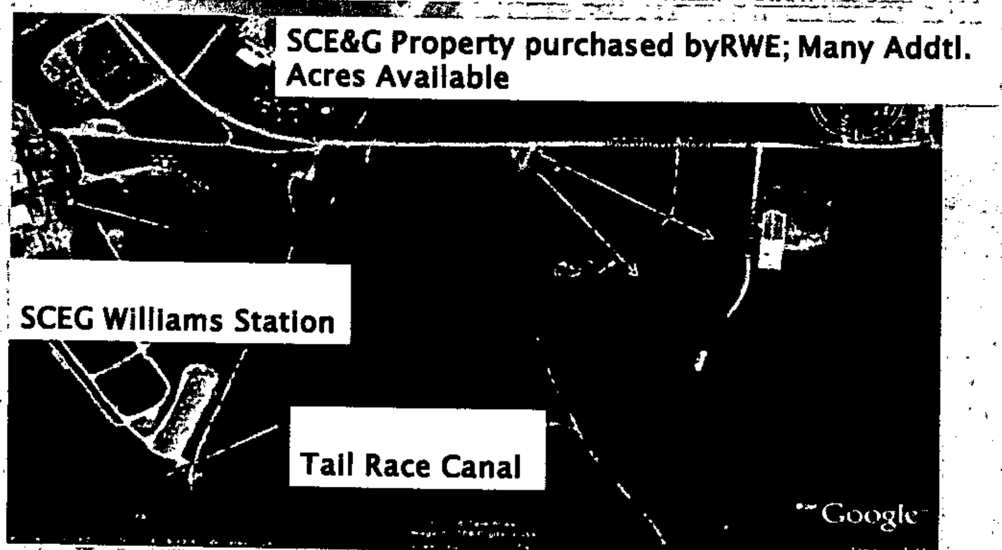
S.C.EG & S.C. Power - RWE's owned site



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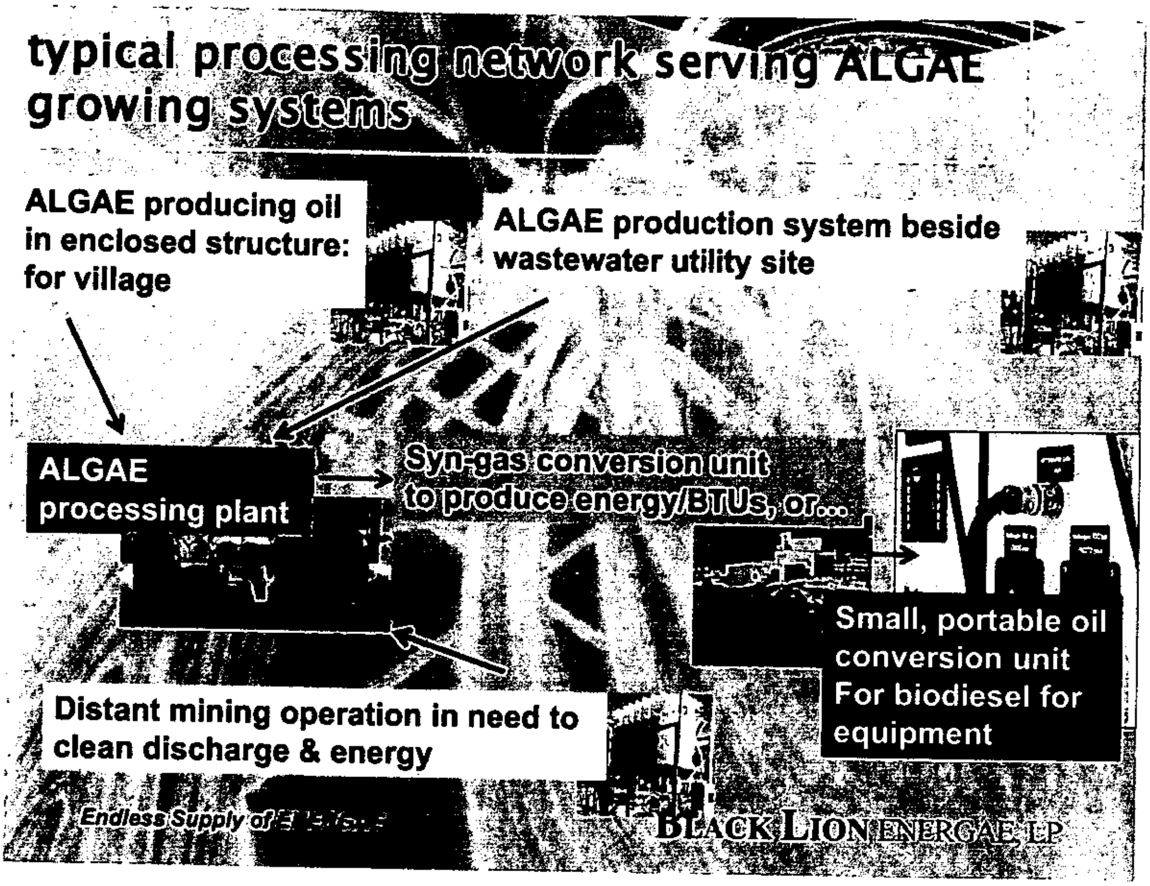
typical processing network serving ALGAE growing systems
ALGAE producing oil in enclosed structure: for village
ALGAE production system beside wastewater utility site
ALGAE processing plant
Syn-gas conversion unit to produce energy/BTUs, or...
Small, portable oil conversion unit For biodiesel for equipment
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

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ALGAE BTU value groups

oil

- bio-lubricants
- gasoline, ethanol additives, plastics

cake – natural drying, no drying agents

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

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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 prod[illegible] $.85 per g[illegible]	=	$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 CO_2 & NO_x

ALGAE chemically changes CO_2 & NO_x 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 CO_2 while growing;** **CO_2 producers will pay up to** **$2 per ton to rid CO_2**	=	**$20,000**
38,500 gallons of ALGAE consumes **50 tons of NO_x & other gases while** **Growing;** **NO_x producers will pay $350** **a ton to rid NO_x**	=	**$17,500** ======
EBITDA per 38,500 oil gallons with Optional	=	**$119,980**

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industries that need CO_2/NO_x gas management discharge solutions

Coal	**Mining**	**Steel**	**Cement**
CO_2	CO_2	CO_2	CO_2
NO_x	NO_x	NO_x	NO_x
SO_x	SO_x		

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

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

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
<u>optional</u> oil processing station	=	$1.75
enclosures	=	$2.00
wind	=	$2.00
		=====
Total		$8.75 million

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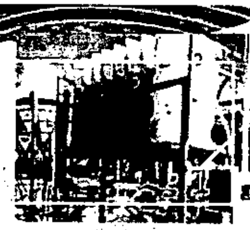
expected ALGAE BTU value



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 = $150,000
- 1 fulltime employee to manage system & maintenance
- RWE manager for communication/ electrical distribution = $75,000

RWE phase study = $100,000

=======

Total = $325,000

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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

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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 CO_2 and NO_x gas groups - ALGAE chemically changes CO_2 & NO_x 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

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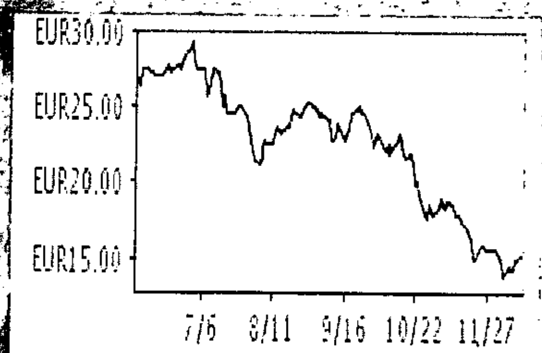
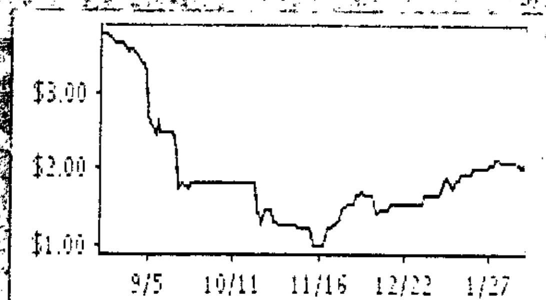
Mandatory Carbon Trading Market in Europe
($15 E.U. converts to $19 U.S.)



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

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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	$5 to scrub
(bound & thermal)	$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

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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 [illegible]es on coal, mining, steel & cement now being set [illegible] mandates

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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 TVA - $250 million COST not including ongoing $50 million per annum!

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other revenue sources from algae cake & oil

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

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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

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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** *At $10 Barrel oil = ($.22)*	($.86)	N/A
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 - 1.4[illegible] million barrels per day
Mexico - 1.296 million barrels per day
Venezuela - 1.07[illegible] 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

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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

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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 === 3	15 === 30	40 === 70	60 === 120	100 === 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 [illegible] last [illegible] 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***

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.**