Removing Barriers to Private-Sector Development of Geothermal Resources

Presented Under the Auspices of the Organization of American States by:

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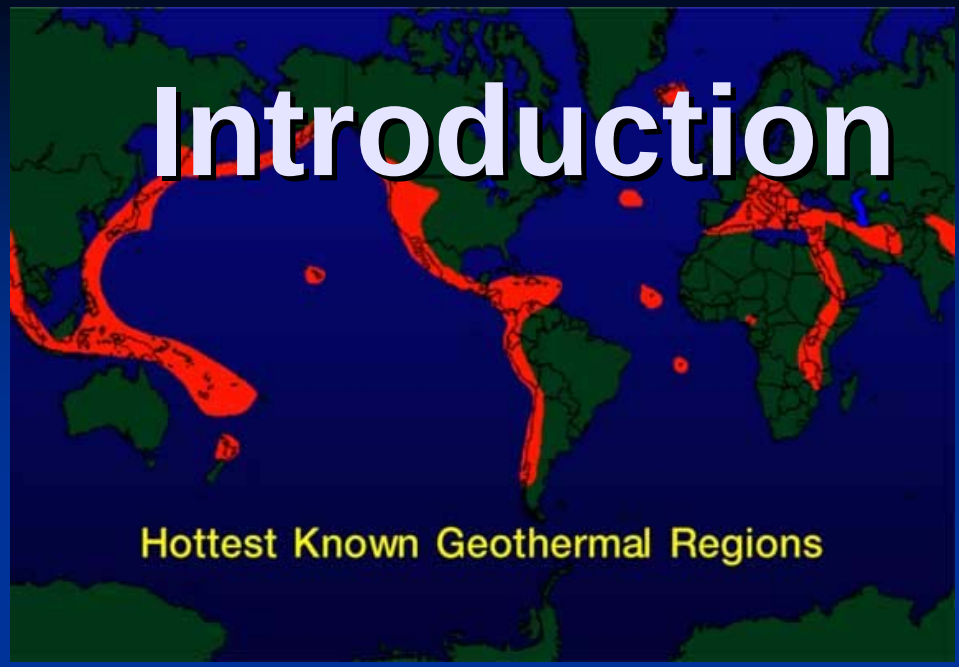
Introduction



- **Thesis:** Any country with geothermal resources can develop those resources.
- **Consideration of Policy Requirements**
  - At what price?
  - Does this goal compromise competing goals?

The Issue

- Energy Crisis
- Climate Change Crisis
- Latin American Issues

Global competition for energy resources

2005:
800 Million Cars

Growth of consumer economies in Asian sub-continent

Latin America

Turkey

China & India

Energy Self-reliance

Latin America Electricity generation predominantly:

1. **Hydrocarbon-based generation**

highly sensitive to oil & gas price fluctuation

2. **Hydroelectricity**

highly sensitive to droughts & silting

The Challenge

- Need to resort to alternative energy source in context of increasing demand
- Need to become self-reliant in energy generation
- Need to preserve the environment
- Need to take action in the near future

The Opportunity

Execute a **Geo-Green Strategy**

- Domestic Energy Security
- Regional as well as National capacity markets

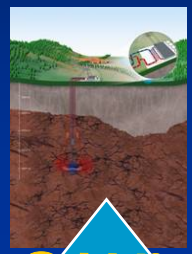
- Geothermal-energy based electricity generation as element of Geo-Green Strategy
  - **Vast untapped energy source**
  - **Renewable & environmentally friendly**
  - **Increasingly cost effective & commercially viable**
  - **Insensitive to external shocks** (drought and oil & gas price fluctuations)

The Goal

Create conditions for "best case" commercial development of geothermal energy

- "best case"
  - Maximum Power
  - Low Cost Electricity
  - Safe Conditions
  - Environmental Protection

Cornerstones of Geothermal Development



Resources

Finance

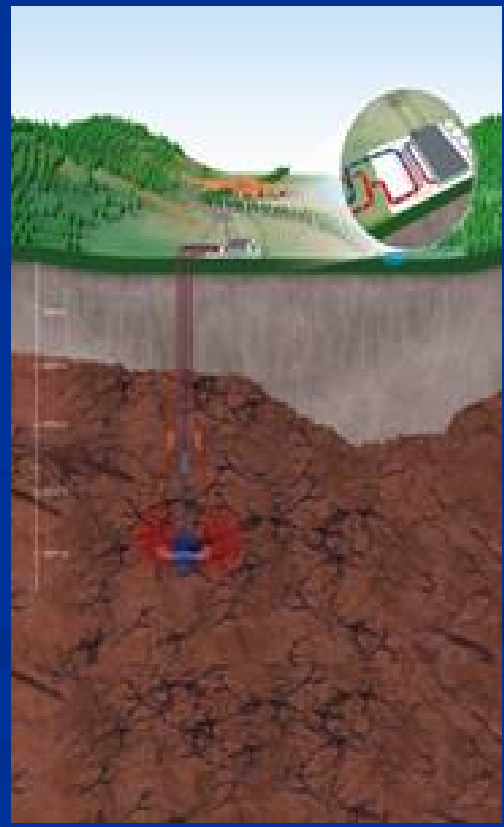
Market

Policy

Cornerstone 1 Resources

Barriers: What is there to develop?

- Limited identification of resource potential
  (beyond initial inventory / surface studies)
- No commercial-quality resource identification
  (geology, geochemistry mapping, geophysics)
- No confirmation of potential energy supply
  (drilling of shallow wells or deeper wells)



Resources

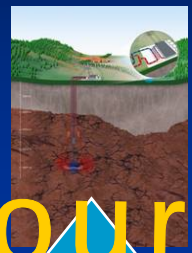
Barriers: What's the risk cost?

The Risk Mark-up Equation

Unproven Resource =
Development Uncertainty =
Up-front Investment =
Risk Mark-up

- **Results** of high risk mark-up
  - Little / no competition when geothermal development is tendered
  - Reliable developers limited (or no investor interest)
  - high tariffs in resulting PPAs

Cornerstones of Development: Examples



Resources

- Bolivia
- Chile
- Colombia
- Costa Rica
- Ecuador
- El Salvador
- Guatemala
- Honduras
- Mexico
- Nicaragua
- Panama
- **Peru**

Removal of Resource Barriers

- **Policy: Reduce Up-front Risks** by establishing greater certainty of
- **Action:**
  - **Initiate commerc** geochemistry, ma
  - **Confirm potentia** /deeper wells
- **Tools:**
  - **Risk guara**
  - **Regional netwo**
  - **International res**

Risk guarantee fund – Sustainable fund mitigating investor drilling risk at exploration, appraisal, production drilling stage

Regional network -- pool technical equipment, experts, & geothermal-development related documents

International resources *(more later)*

Cornerstone 2 Financing:
Threshold Issues

Geothermal development cost is

- "front-end loaded",

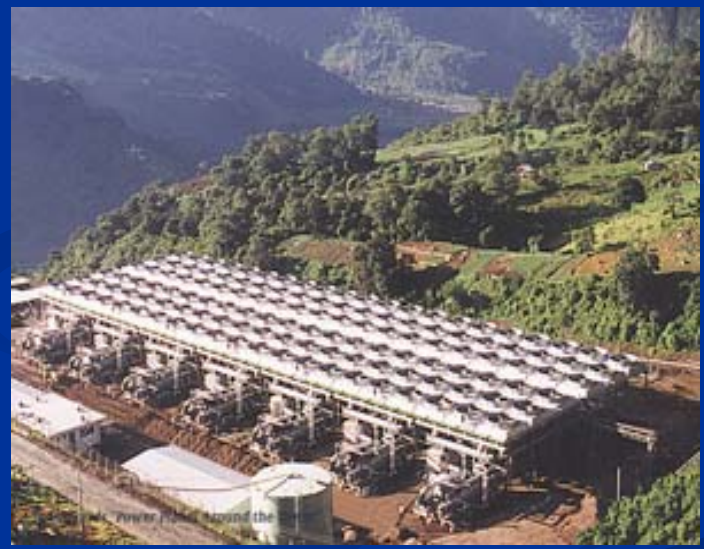
consequently, Private-sector development depends on

- "project financing"

Bank
Santiago, Chile

Financing : Threshold Issues "Front-end-loaded Costs"

- Bulk of the **cost** of a geothermal facility **is in the technology** effort exerted **at the outset** of project.
- Project total lifetime cost represented by initial capital cost, & will be incurred before project ever comes on line.



Zunil
Location: Guatemala
Operator: Orzunil de Electricidad Ltd
Configuration: 24 MW binary

Financing: Threshold Issues
"Project Financing"

- Consequently, the majority of new generation facilities are funded through Project Financing, whereby the principal and interest (and profit) are paid from the proceeds of the project.

- Project financing is secured by Power Purchase Agreements (PPAs) – multi-year commitments between generators and distributors (or a major end user) that guarantee the purchase of capacity & electricity at a predictable price.

Financing

Barriers

- **Multi-year PPA**
  laws
- Focus on **short**
  insufficient long-te
  enables generatio
- Few **incentives**
  facilities
- **Project not a c**
  geoth
- **Econom**
  construction, $
  units & remote loc

Large plants >30 MW. Direct Costs US $/kW installed capacity (per World Ban):

High quality reso
$1150-1750/kW

Medium quality reso
$1350-2200/kW

Small plants<5MW, resource/location dependant, $1600-3000/kW

Per National Renewable Energy Lab

Cost
= 5-8c/kWh 2002
= 3-5c/kWh 2007

Cornerstones of Development: Examples

Financial Feasibility

- Bolivia
- **Chile**
- Colombia
- Costa Rica
- Ecuador
- El Salvador
- Guatemala
- Honduras
- Mexico
- Nicaragua
- Panama
- **Peru**

Removal of Financial Barriers through Policy Initiatives

- **Policy:** Establish tariff structure conducive to promoting geothermal development
- **Action:**
  - Set tariffs sufficiently high to allow for cost recovery & appropriate return on equity
  - Provide conditions for appropriate recovery rate -- Ensure multi-year PPAs

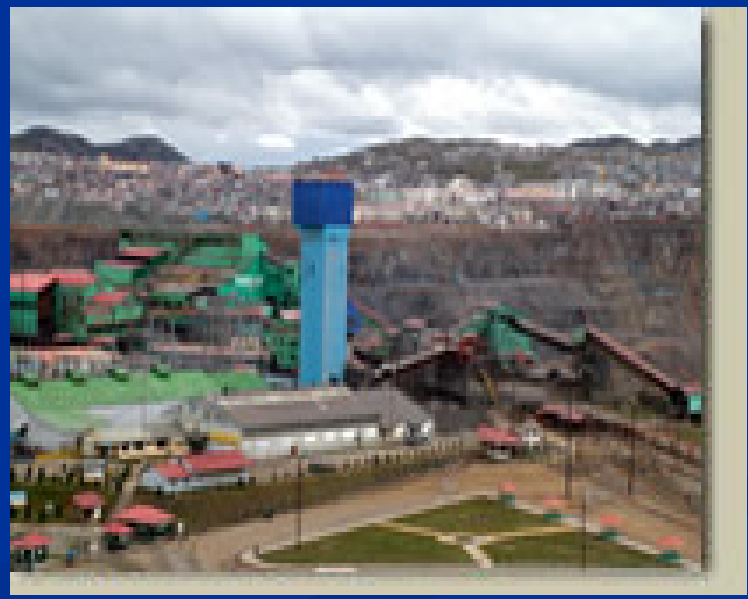
Removal of Financial Barriers through Policy Initiatives

- Policy: Institute Development Drivers
- Action (Domestic):
  - Incentives (Tax Credits, etc.)
  - Renewable Portfolio Standard
  - Small Power Grid Solutions
  - Green Pricing programs
- Action (International Incentive programs)
  - Kyoto Protocol
    - Clean Development Mechanism
    - Joint Implementation
  - Carbon Financing Mechanisms
  - Global Environmental Fund

Cornerstone 3 Markets

Barriers

- Location, location, location
  - Access to population or manufacturing centers
  - Access to reliable transmission lines
  - Grid Connectivity
  - Proximity to developers
  - Access to area for heavy equipment & generators
  - Terrain
  - Infrastructure
  - Ports



Cerro de Pasco Mine Peru

Cornerstones of Development: Examples

- **Bolivia**
- Chile
- Colombia
- Costa Rica
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- Guatemala
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- Mexico
- Nicaragua
- Panama
- **Peru**

Removal of Market Barriers through Policy Initiatives

- **Policy:** Enable remote generation sites market access
- **Action:**
  - Facilitate reliable Transmission Lines & Grid Connectivity
  - Facilitate Regional Grid & multi-nation import / export market
  - Enable Mini-Grids in remote areas – consider generation /distribution / transmission /monopoly for universal electrification

Removal of Market Barriers through Policy Initiatives

- **Policy**: Engage developers
- **Action**:
  - **Familiarization Program.** If proximity to developers is barrier, institute outreach
  - **Due Diligence Guidelines.** Craft to pre-qualify developers
  - **Promotion Director.** Appoint (&Fund)
  - **One-stop Shop.** Time is money. Facilitate permit / Concession process.
  - **Prioritize**: Do not focus development promotion on areas inaccessible due to terrain / infrastructure –except for economic development reasons

Cornerstone 4 Policy
Private Investment Pre-requisites

- Pre-requisites for private investment are –
  - a stable political environment
  - a reliable legal environment
  - an effective regulatory framework
- Clear & reliable off-take rules stipulated in PPAs *crucial*

Cornerstones of Development: Examples

- Bolivia
- Chile
- Colombia
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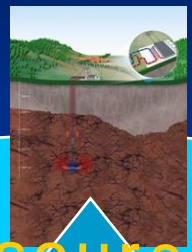
- Mexico
- Nicaragua
- Panama
- Peru

Policy Framework

8 Step Policy Process

- Step 1. Prioritize national economic, infrastructure & energy *goals*
- Step 2. Determine *objectives* in electricity sector
- Step 3. Establish role of geothermal resources in energy mix
- Step 4. Determine geothermal energy *objectives*
- Step 5. Identify existing & potential impediments
- Step 6. Identify available *mechanisms* to remove the barriers to achieving renewable energy policy objectives
- Step 7. Design a legal vehicle
- Step 8. Design a regulatory vehicle

Regional Development Approach



Resources

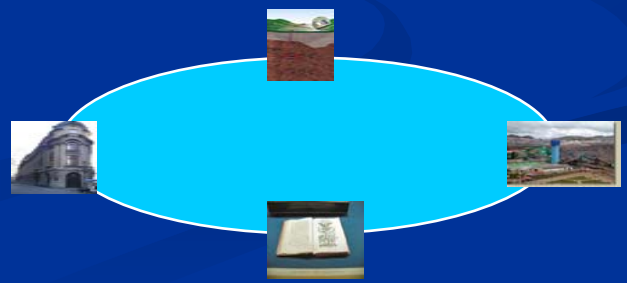
Financial Feasibility

Market Access

Policy Framework

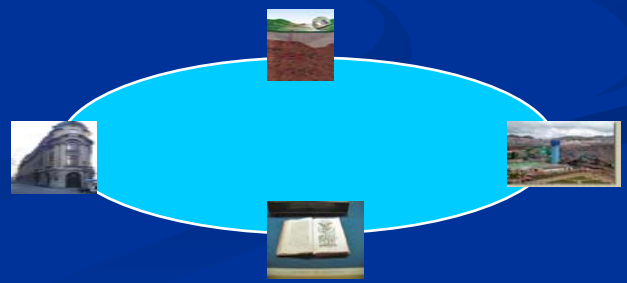
Regional Development Approach

- **Objective:**
  - **National development** - develop geothermal resources in every country in region
  - promote **regional economic development**
  - take advantage of **Economies of Scale**



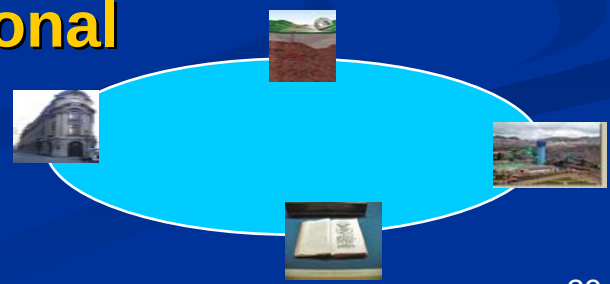
Regional Approaches: Central America

- **Integration** of electricity markets in Central America and southeastern Mexico is moving forward with implementation of two initiatives:
  - Sistema de Interconexión Eléctrica de los Países de América Central Central (SIEPAC)
  - Plan Puebla-Panamá



Regional Approaches:

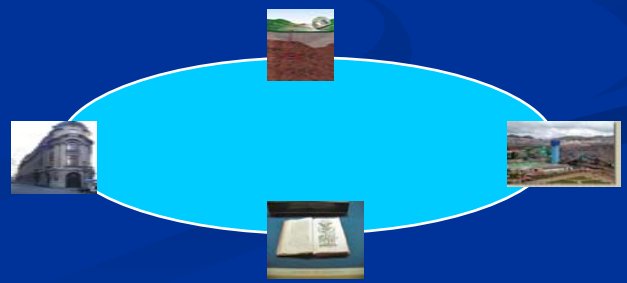
- **Andean Community** (1996) Bolivia, Colombia, Ecuador, Peru, & Venezuela
- Three major areas for action:
  - Construct **energy markets**
    - integrate **physical networks** &
    - harmonize **regulatory frameworks**
  - Promote **private entrepreneurial** development in energy clusters & in energy services
  - Position Sub Region in **international hydrocarbon markets**



Regional Concept Study: African Rift Valley & Geo-Caraïbes

Goal: overcome technical constraints & remove early-stage uncertainty of resource availability on a regional basis

- Risk Mitigation
- Capacity Building

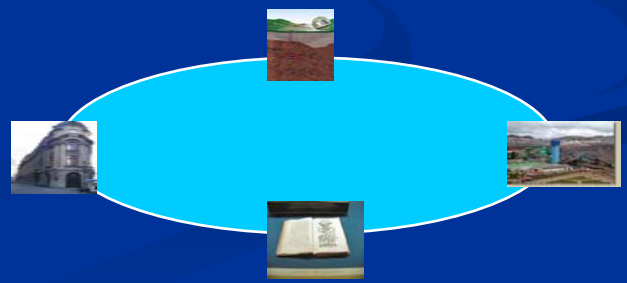


African Rift & GeoCaraibes
Risk Mitigation …

Endowed Fund

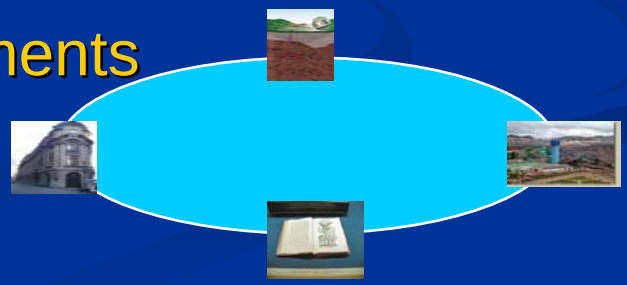
- Mitigates risk of resource availability for exploration
- Mitigates risk high-risk, early-stage drilling
- Covers loss of unproductive wells
- Provides successive investments into geothermal development

  in the region



African Rift & GeoCaraibes
Capacity Building …

- Facilitate transition of geothermal development from public to private responsibility
- Ensure sound & transparent tendering processes
- Ensure adequate PPAs
  - Base on sound bankable feasibility studies
  - Balance private investors' & public interest
- Establish **regional network**
  - **Data base** of experts & documents
  - **Pool** technical equipment

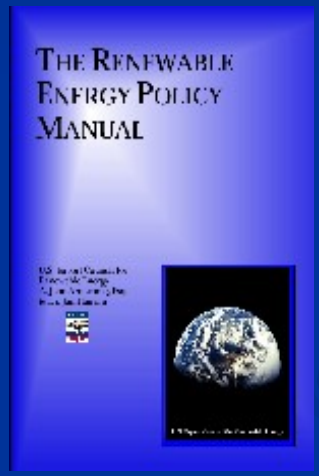


Removing Barriers to Private-Sector Development of Geothermal Resources: Conclusions

- Crisis
- Geothermal Development -- one solution
- Developmental Policy -- precondition
- Four Cornerstones
- Any country with geothermal resources can develop those resources.

Policy Resources

- The Renewable Energy Policy Manual



- http://www.oas.org/reia/english/Documents/RE_policy_manual.htm

Gracias

Preguntas?

April 2005

Latin American Resources

Costa Rica	2900	152.5				No specific Law for Geothermal (1999)
Ecuador	1700	0				
El Salvador	2210	160				No specific Law for Geothermal (1999)
Guatemala	3500	29				No specific Law for Geothermal (1999)
Honduras	990	0				No specific Law for Geothermal (1999)
Mexico	6510	960 (2003)				Geothermal undert Water Laws. Government (CFE) Controlled Commercial limited to build / operate (leased to CFE) or designated areas
Nicaragua	3340	77.5				Ley de Geothermia (2002) "fast-track" geothermal development program with significant support from the private sector.
Panama	450	0	El Valle de Anton			No specific Law for Geothermal (1999)
Peru	2900	0				Organic Law on Geothermal Resources(Ley

Additional Slides

What Investors Want !

- Renewable Projects which make money!
- Consistent Government Tax Policy, better yet, a national tax incentive
- “Real” equity investors want more tax investors
- Developers who are honest
- PPAs at fixed prices with healthy utilities
- More debt investors
- Adequate ROI (Project Returns 12%)

What Investors Avoid!

- "Merchant" geothermal projects
  - Projects without PPAs
- Market rate PPAs
  - Capital Cost vs. Fuels Cost Conundrum
- Technology risk
  - New or Scale-up Technology

Policy: Benefits of private investment in geothermal-energy development

- Geothermal-energy development implies **high investment costs**, incurred up-front in the context of resource exploration.
- Private investment enables the substitution of **scarce public funds** by private capital.
- Up-front investment = **risk** which can be better dealt with by geographically diversified private investors.
- **Complexity** of geothermal technology & development
- **Proven private investors** can be expected to cope professionally with challenge, thus ensuring state of the art technology

***Primary Geothermal Investment Issues

Ranked in order of priority

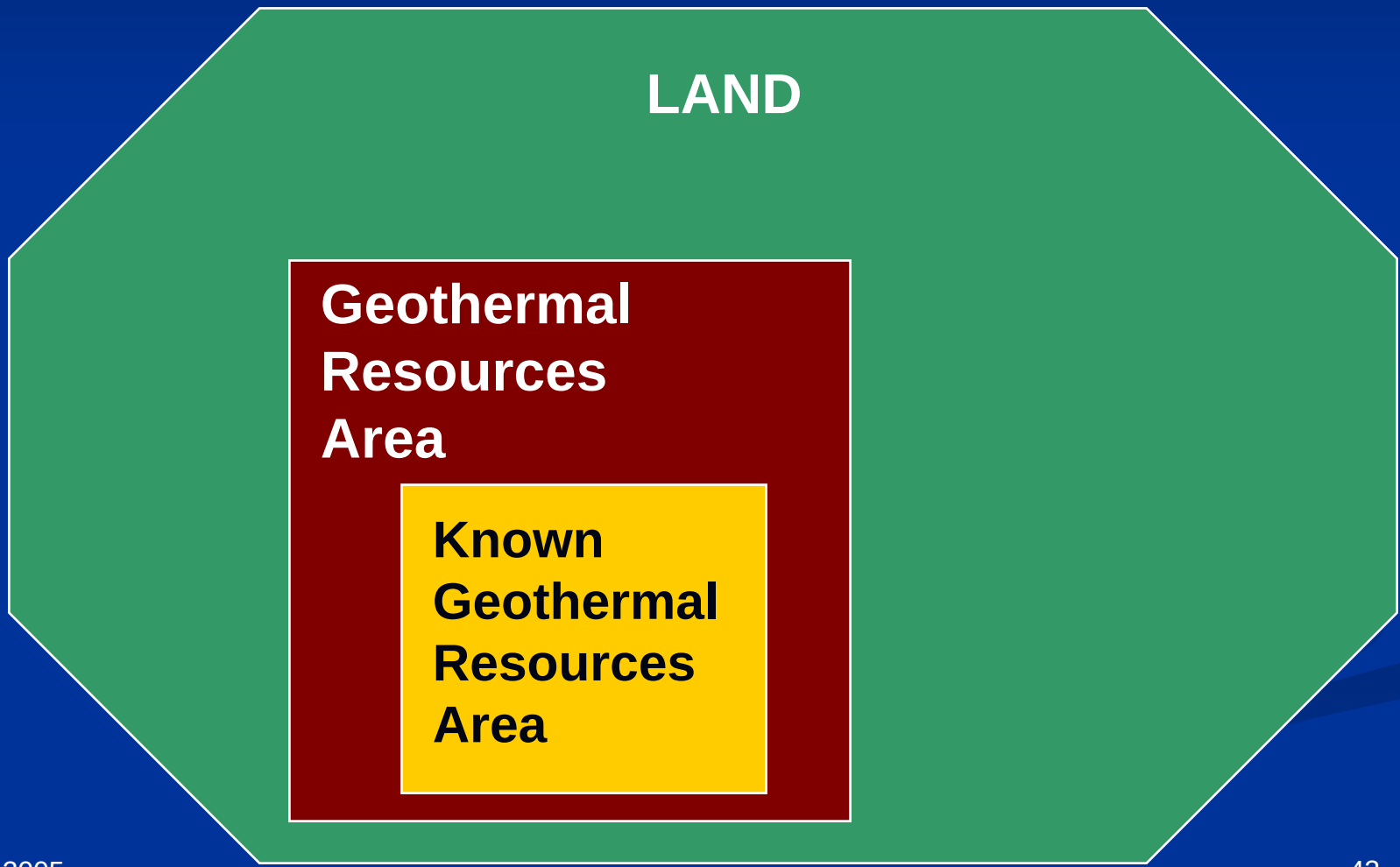
- Resource Risk
  - Temperature Decline
    - Overdraw of Reservoir (CA geysers)
    - Re-injection/Production well communication
  - Excess Dissolved Solids
    - Turbine/Heat Exchanger Fouling
    - Re-injection Well Fouling
- Off-taker Risk
  - Most Geothermal resources located in western U.S. where “troubled” electric utilities abound
    - PG&E, SCE, Sierra Pacific, Nevada Power

***Primary Geothermal Investment Issues

Ranked in order of priority (continued)

- Environmental Risk
  - Well blowouts not uncommon
- Transmission Access
  - Due to remote locations of resource, TA can be a problem.

Geothermal Resources Areas



Stages of Geothermal Power Production

Phase I
Reconnaissance
minimal environmental impact

Permit I
< 2 years
1 year extensions

Phase II
Exploration
Drilling shallow temperature gradient wells

Permit II
< 2 years
1 year extensions

Stages of Geothermal Power Production

Phase III
production injection wells
injection wells

License
<5 years
2 year extensions

Phase IV
Resource Production
steam

License
<5 years
2 year extensions

Stages of Geothermal Power Production

Phase V
Electricity Production
electricity

Concession
30 Years
5 Year Extensions

Transmission

Bi-lateral Treaty

Classes of Geothermal Resources

- Class I Capable of being used to generate electrical energy

  - Class II Used other than to generate electrical energy = direct heating, agriculture, recreational bathing

    - Class II Grantee shall hold harmless Class I Grantees if development of Class I Geothermal Resources affects the Class II Geothermal Resources

Policy: Safety, Environment & Compliance

- **Acknowledging that the Region has limited resources:**
  - **Balance** government regulation & self-regulation
    - Identify public interest being fostered or protected
    - Identify tools that can accomplish this task with least disruption to the market & least cost to the public
  - **Focus** regulatory regime on …

… safety

… environment &

… avoid micro-management.

Policy: Economic & Financial

- Fees. **Balance** …
  - fees charged to cover Government's **cost** in issuing permits, licenses, concessions, & regulating for the public welfare, with
  - **enabling** projects to succeed
- Royalties. Resources belonging to State should return their value to the State
- Taxes. **Balance** …
  - **taxes owed** by a corporate citizen receiving State services, with
  - **facilitating** Geothermal Resource development with front-end-loaded financing

*** Financing :
Investor Concerns and Issues

- Investment Return and Exit Strategy
- What return over what time horizon?
- How is return earned? (cash, tax credits or both)
- Exit Strategy? (hold or turn over)
- Technology
- How many? How Long?
- Resource Risk
- How Much? How Long?

*** Economics: Investor Concerns and Issues (continued)

- Contractual Risk
- Who is obligated to do what for how long and at what price?
- PPA (Take or pay? Fixed or variable rates? Reg. Out?)
- O&M (Turnkey? Routine? Fixed or cost plus?)
- Land Lease (Term? Rent/Royalty based on gross or net?)
- EPC Contract (Turnkey? Fixed Price? LD's for time etc.?)
- Equipment Warranty (Term-what does it cover?)
- Environmental Risk
- Existing or potential damage to the environment?