

# Facilitating Geothermal Development Through Policy Implementation

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# Presentation Outline

## Geothermal Resources

## Geothermal Utilization

- Electrical Generation
- Direct Use

## Development Potential

## Providing Access

- Defining Geothermal
- Leasing Terms and Conditions

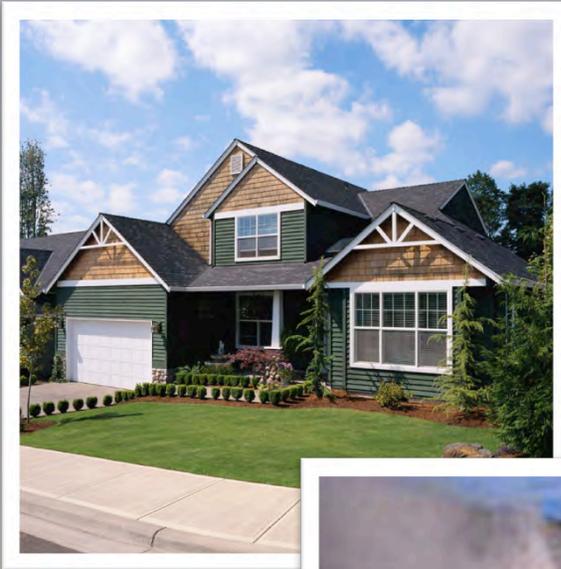
## Incentives for Development

- General
- Project Facility/  
Exploration
- Project Development

## Recommendations

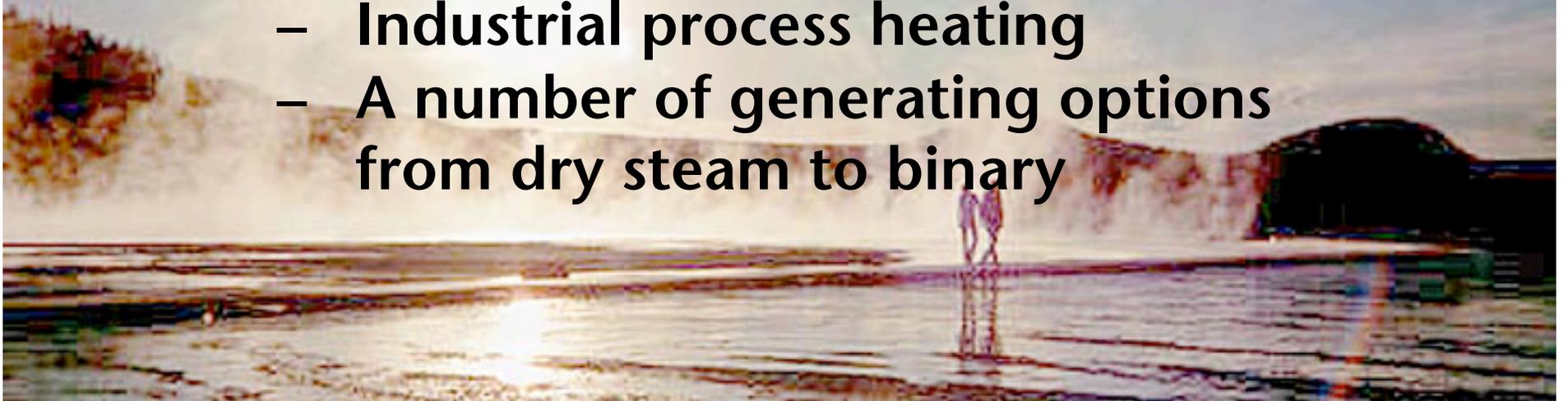


# Where are geothermal sources?



## Geothermal energy development covers a range of resource technologies:

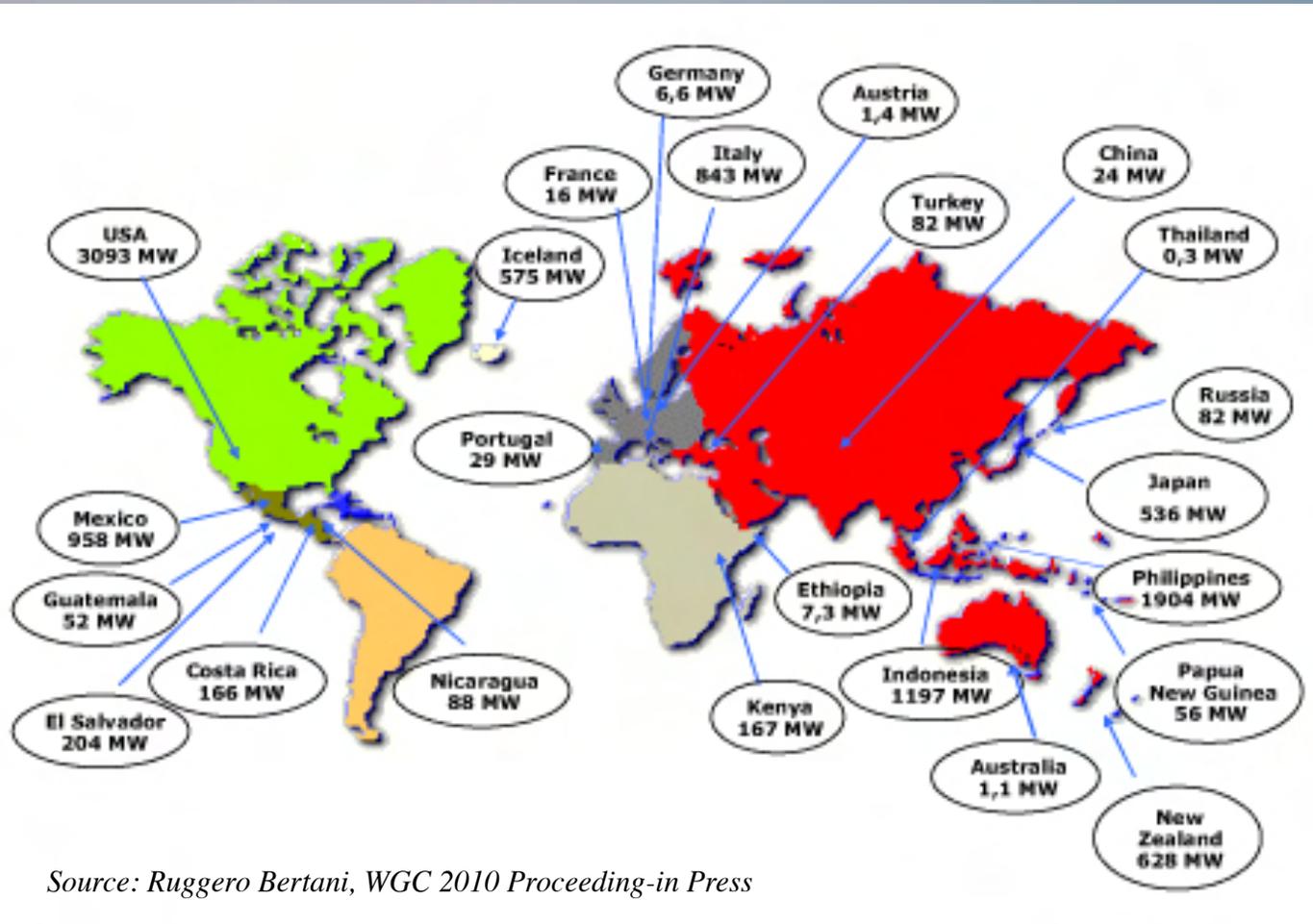
- A huge temperature range
- A host of alternative conversion technologies, including:
  - Space heating
  - District heating
  - Industrial process heating
  - A number of generating options from dry steam to binary



# Electrical Production, Dry Steam, Flash, Binary:



# World Installed Capacity – 2010: 10.7 GW



## Installed Capacity

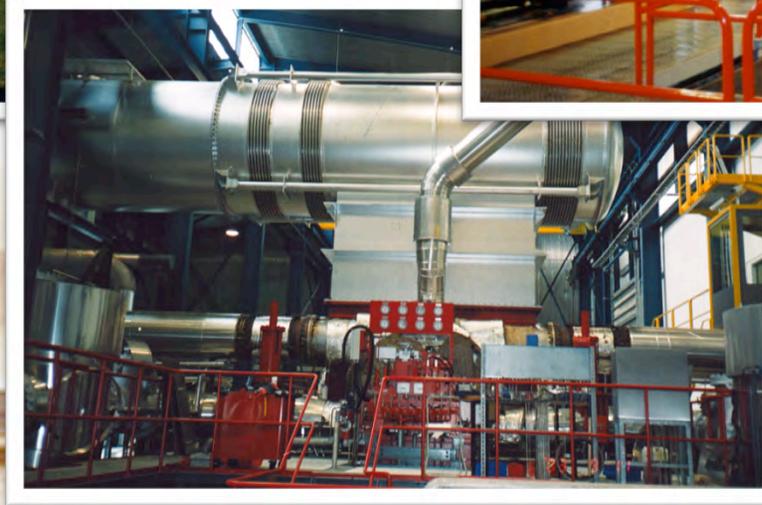
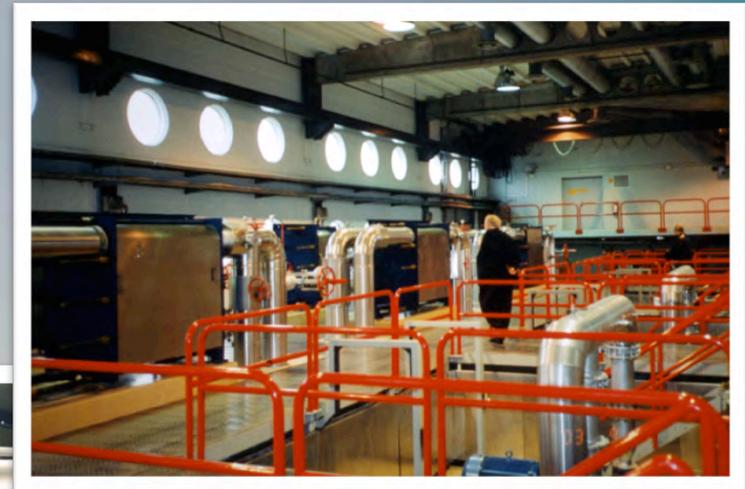
**25 countries report 10,000 MWe  
producing about 65,000 GWh in 2009.**

**Installed capacity expected to increase  
to 18,500 MWe by 2015.**

*Source: Bertani, 2010*

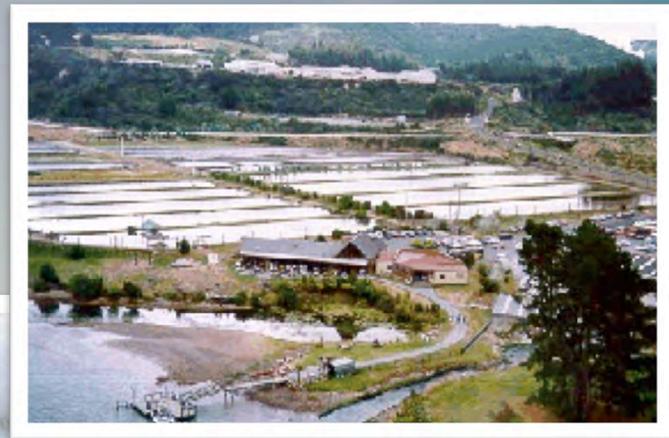


# Combined Heat and Power



## Direct Use

District heating, aquaculture, swimming pools, greenhouses, and heat pumps



**78 countries report about 50,000 MWt  
in 2009, an increase of 80% since 2005.**

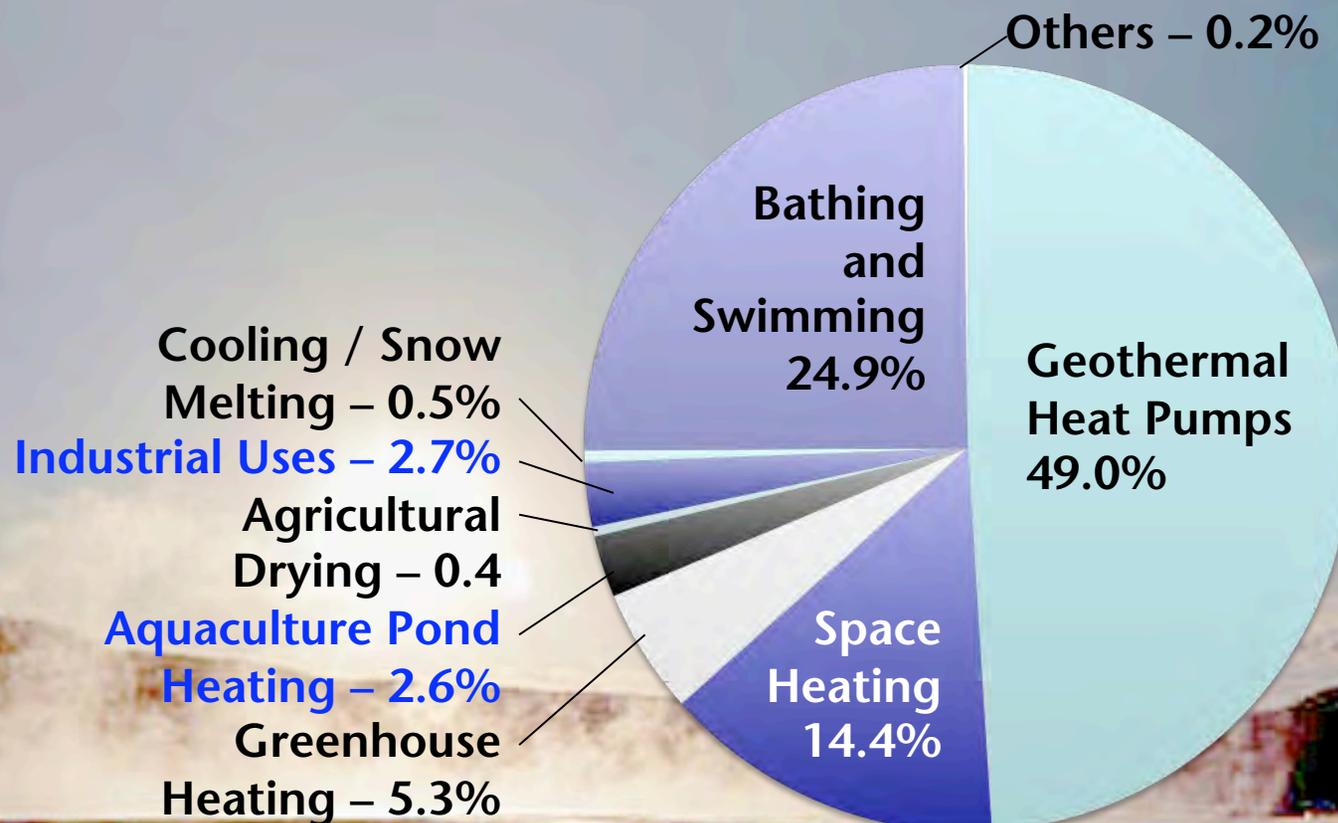
**This resulted in the production of about  
430,000 TJ/yr or 120,000 GWh/yr.**

*Source: John Lund, et. al., WGC 2010 Proceeding-in Press*



# Geothermal Applications

*Percentage of total energy use: 2010*



*Source: Lund, et. al., 2010*

# Electrical Generation Development Potential

**10,000 MWe in 2010**

**18,000 MWe in 2015**

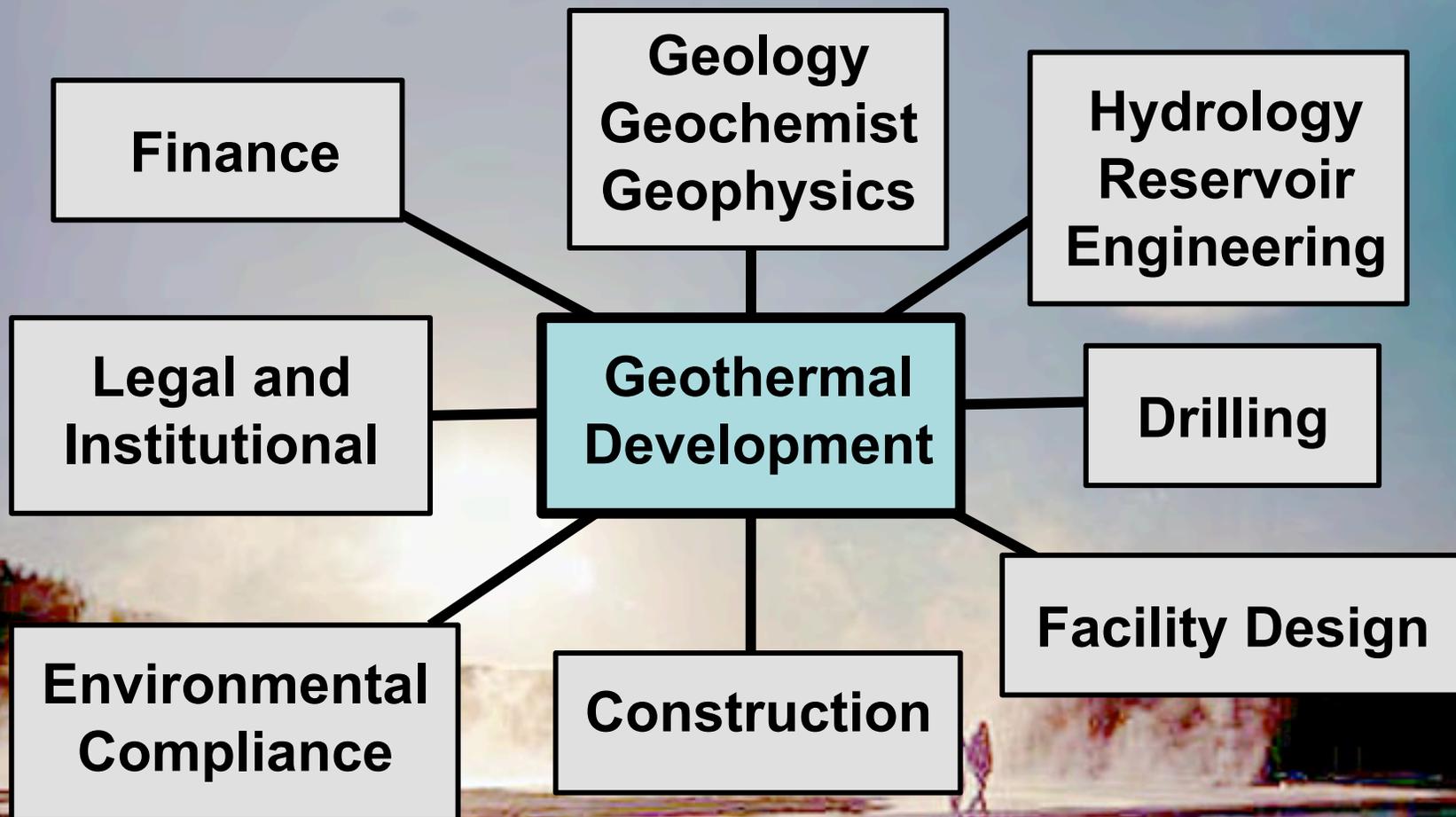
**148,000 MWe in 2027**



The ultimate potential could be in the tens of TW's and would result in tens and possibly hundreds of billions of dollars in investment in exploration, well field development and facility construction.



# How do we achieve such lofty goals?



## Developer Needs:

- Access to the resource
- Financing for exploration, well field development and construction
- A robust market
- A fair price



**Providing Access**

**Leasing**

**But what is geothermal relative to leasing?**

**Is it water?**

**Is it mineral?**

**Is it Sui Generis (unique unto itself)?**



**The first task is to define “Geothermal” and place it into the context of existing water, mineral and land rights.**

**The second is to determine who owns that resource. Is it the holder of the:**

- Surface estate?**
- Mineral estate?**
- Water rights?**



## Access can be provided through:

- **Exploration permits**
  - Exclusive or non-exclusive
  - Convertible or non-convertible to a lease
- **Non-competitive leases**
- **Competitive leases**
  - Cash bonus bids
  - Royalty bids



## Leasing Terms

- **Duration of primary exploration permit or lease and whether or not extendable and with what leasing terms**
- **Fees: Rentals and royalties**
- **Work requirements**
- **Environmental compliance**



## General Incentives:

- **Renewable Portfolio Standards**  
*(Helps create market)*
- **Production Tax Credits**  
*(Rewards for success)*
- **Feed in Tariffs**  
*(Establishes economic sales price)*



## Incentives for Exploration

- **Government grants**
- **Cost share grants (50-85%)**
- **Loan guarantees**
- **Repayable grants**
- **Contingent grants**  
*(Risk mitigation insurance)*



# Incentives for Project Development

- **Investment tax credits**  
*(Possibly as upfront grant)*
- **Guaranteed loans**



## Recommendation

**1. Establish a clear and proactive access policy taking into account the nature of the resource and requirements of the projects – electrical generation, direct use, and heat pumps.**



## **Recommendation – *Continued***

- 2. Establish aggressive goals for renewable development (RPS).**
- 3. Establish incentive programs that meet the needs of each phase of the development process.**
- 4. Use reward for success rather than cash handouts – for example, production tax credits.**

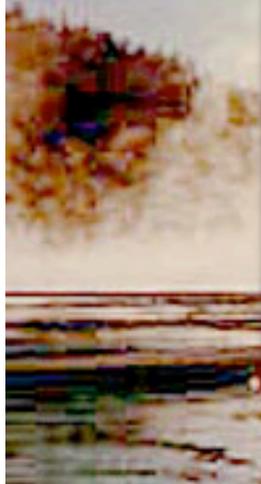
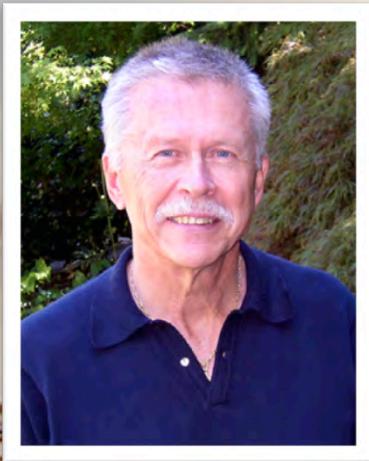


**Questions?**

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*The End*

